WESTERN SOLUTIONS

Campus Sustainability Planning Studio

Stephen Harvey
Brian Maskal
Courtney Rondel

03 June 2012

1.1 PROBLEM

Western Washington University has a Climate Action Plan which requires the university to reach climate neutrality by 2050. In order to reach that goal, Western needs to find efficient sources of renewable energy to phase away from using natural gas to reduce greenhouse gas emissions. The current water heating system for the Wade King Recreation Center (WKRC) is powered by natural gas and has a 25 percent energy loss, 15 percent is lost in the transition from natural gas to steam and 10 percent is lost travelling from the steam plant located near Red Square to the rec center. Annually, 274,733 pounds of carbon dioxide are emitted to heat the swimming pool with natural gas and 14,453 pounds of carbon dioxide are emitted to heat the domestic hot water.

1.2 SOLUTION

By integrating a solar thermal system to heat the Wade King Recreation Center's hot water system, carbon emissions can be greatly reduced. Western can use this project to become a living laboratory for solar thermal energy; this is an opportunity to educate and influence WWU students, alumni and the community on the importance of sustainable energy production. Our current proposed solution is to heat the domestic hot water with solar thermal system and transfer excess heat to the pool. By investing in enough panels to produce near 100 percent solar thermal energy during the optimal months, April-November, the recreation center can reduce their carbon emissions by an estimated 65 percent. This investment is calculated to need 45 solar collectors, two solar storage tanks (solar heat exchangers), temperature control units, two expansion tanks as well as installation, engineering, plumbing and permitting. This package, tailored for Pacific North West climate, has a ten year warranty and life expectancy of 20 years, the replacement cost is $500 per collector which can be covered by the savings from the project. An extended warranty is also available through the solar thermal provider.

1.3 FUNDING REQUIREMENTS

Funding has yet to be determined and is still pending. Three feasible funding options are available for the project; the Wade King Recreation Center, the Student Green Energy Fee Program and additional grants or incentives. Currently, the project is in the application process for the Student Green Energy Fee, this project among three other projects will be chosen to receive an allotment of the $300,000 available. Depending on the amount allotted to fund this project, the Wade King Recreation Center has shown interest in investing in the project as long as the amount in within their preferred 5-8 year payback period. After the payback period, the rec center would experience a reduction in natural gas costs on a yearly basis; these savings could be used to cover maintenance fees if necessary. Additional funds and incentives can potentially supplement the rec center and or green energy fee.

1.4 CASE STUDIES

<u>Colorado at Colorado Springs Recreation Center Solar Thermal Site</u>

- Colorado at Colorado Springs; solar thermal on campus recreation center, installed fall 2008. Colorado, a peer institute to Western and has a goal of reducing the universities greenhouse gas emissions 80 percent by 2050.
    - Purpose of project was to reduce fossil fuel usage, push towards carbon neutrality, and to create a living laboratory for sustainability. This project was part of the initial rec center construction and added LEED points for the building. The price of the project was around $300,000.
    - 68 evacuated tube solar thermal collectors were installed to heat two thirds of the pool.
    - Stakeholders were the Rec Center and Novan Solar Inc, the contracted company to install the collectors.

- With a pool cover the collectors currently heat near 90 percent of the pool annually, and the system has now been tied to heat domestic hot water, without additional collectors added. This tie into the domestic hot water would have been more cost efficient if done in the original installation.
- In August 2011 28,899lbs of CO2 were saved from being emitted.[1]
- "There are minimal ongoing costs."[2] Since the system has been installed there have been no major breakdowns.

Everett Naval Station

- The Naval Station in Everett, Washington recently partnered with Western Solar to install 120 flat plate solar thermal collectors to heat their 365,000 gallon swimming pool and showers. This project has not broken ground yet, once it does this case will be further studied to help guide the installation of the solar thermal system at the WKRC.

2.0 STATEMENT OF NEED

The WKRC will need 45 solar collectors to heat both the domestic hot water and swimming pool. To be cost efficient, it will be best to install the domestic hot water and swimming pool to the solar thermal system because it is less expensive to include all hot water systems with the same permit, plumbing, engineering, and installation process versus treating each system separately. Additional collectors could be added in the future which would reduce more carbon dioxide emissions.

3.0 PROJECT DESCRIPTION

This pilot project proposes that the recreation centers swimming pool will use 45 8X4 ft. Flat Plate Solar Thermal Collectors and two storage tanks (solar heat exchangers). The system runs off a food grade nontoxic glycol closed loop which prevents freezing in winter months. A heat expansion tank used in the system prevents overheating during summer months; this expansion tank captures boiling glycol when in the gas phase, containing it until cooled back into a liquid. Automated temperature controls program the supply of solar thermal heat to the pool, which can either bypass or be supplemented by the steam heat exchanger.

3.1 METHODS

To determine if the recreation center would be a prime location to install solar thermal collectors, a tool called the Solar Pathfinder was used to collect data in two locations on the roof. The collected data included areas of available sun proving the rec center is an optimal location for solar collection. The pool heat exchanger has an estimated 90 gallon per minute flow rate, which is the maximum flow rate. All of the natural gas prices and CO2 emissions are based off this flow rate. For implementation of this project, the Wade King Recreation Center will need to give approval and following this approval; an application for the Student Green Energy Fee will be submitted. After funding is figured out, a solar company will be contracted to supply and potentially install the collectors. After the installation, once every six months the collectors will have to be hosed down to clear dust and every two to three years a solar technician will have to check the glycol levels.

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[1] *Energy Monitoring*. University of Colorado at Colorado Springs. Web. 14 May 2012. <http://www.uccs.edu/~kiosk/reccenter/energy/index.html>.

[2] Gilford, Kevin. "Insider Interview with UCCS Assistant Sustainability Director." Telephone interview. Feb. 2012.

3.2 STAFFING/ADMINISTRATION

Western Solar, Facilities Management, the Green Energy Fee, Wade King Recreation Center faculty and staff as well as Western's Faculty and Staff were key resources for developing this project.

- Brad Johnson, the Chairman of the WWU Physics department is sponsoring this project to apply for the Student Green Energy Fee.
- Facilities Management has provided information on the current heating system of the pool including flow rates, BTU's for the heat exchangers, steam and gas.
- Western Solar explained the solar thermal system, engineering and costs.
- Kathryn Freeman, the director of the Green Energy Fund Grant Program provided potential funding routes.
- Sandy Fugami, Facilities Management Mechanical Engineer, explained the mechanical engineering of the current system in regards to implementing a solar thermal system.
- Stephen Morrow, campus plumber, provided information regarding the flow rate of heat exchangers

3.3 EVALUATION

This project is for the students, faculty and staff of Western as well as the general public. WWU's rec center has been used at least once by 91 percent of all students and averages around 2,200 people per day during the school year. This high visibility can provide an excellent educational tool for promoting sustainability through renewable energy, especially since the rec center is a starting point for campus tours. Through the use of new and existing signage and informational boards, we can both inform and educate students, faculty and community. Multiple majors including energy, material science, economics, environmental studies and science can use this project as a learning site and even incorporate it into their curriculum.

3.4 SUSTAINABILITY

Solar thermal energy can be used to create a living laboratory. By tying this project into related curriculum and clubs on campus such as the Advanced Materials Science and Engineering Center, this project can be used for related studies on renewable energy and research. In order to change the unsustainable energy sources around Western, Western must first learn to change the energy sources within it. By harnessing heat from the sun, through this project, Western can take an important step to becoming a leader in reducing and hopefully eliminating anthropogenic negative impacts to earth. Natural gas has a nonrenewable supply, eventually this source can run out. By implementing solar thermal, long term energy security and resource conservation can be achieved.

4.0 BUDGET

This project will need 45 8X4ft. flat plate collectors. According to a local solar thermal company in downtown Bellingham, Western Solar*;* these collectors can be purchased at a commercial rate of $3500 each which makes this investment $157,500. Additional grants and incentives can supplement the funder(s) of this investment, either the rec center and or the green energy fee.

5.0 FUTURE WORKS

The amount of collectors calculated is based from the information that was available. A proper solar company is needed to justify the correct amount of collectors this project would need. To calculate the exact number of panels needed, a panametrix flow meter will be used to determine the flow rate of the domestic heat exchanger and if available, the swimming pool as well. If the solar thermal system is installed to heat the domestic hot water and pool at the rec center, additional solar collectors can be added to provide a greater percentage of annual solar collection. If this project proves successful it could be expanded to existing buildings on campus such as Carver Gym, dormitories and other buildings that use large amounts of hot water.

6.0 CONCLUSION

In conclusion this project will reduce carbon dioxide emitted from natural gas, and lower the amount of natural gas burned to heat water at the rec center. Investing in solar thermal will save the rec center money spent on annual utility bills. The returned savings from this project could be implemented towards other alternative energy projects at the recreation center that will educate and influence students about sustainability. The solar collectors will produce near 100 percent solar thermal energy for the domestic hot water and pool during the optimal months.

APPENDIX

1.0A ADDITIONAL CASE STUDIES

These following case studies helped us jump-start our research on solar thermal installations.

Case Study #1: Point Loma Nazarene University Solar Thermal Hot Water System

Point Loma Nazarene University is a small Christian Liberal Arts school with just 3,500 students. However small, PLNU is projected to save over $1.6 million dollars in the next twenty years with a new Photovoltaic (PV) system and solar thermal hot water system. Granted this school is located in San Diego, California, installing a 54 kW solar water heating system, can heat up to 940 gallons of hot water a day and save the university $5,000 annually in utility bills. PLNU is dedicated to implementing renewable energy throughout the university in a way in which it teaches the students about its sustainable choices through forums and sustainability classes. The heating system was financed by the students at PLNU by their contribution to the university's Green Fund of $5 every semester, which raises $25,000 a year for sustainability projects and the students chose to save the money for 2.5 years to buy the system outright without financing. This particular water system was used for the student dorms.

Case Study #2: Western Kentucky University Preston Pool Solar Thermal Project

Western Kentucky University is the fastest growing university in Kentucky with over 21,000 students and is still expected to grow in the coming years. As a result, WKU is looking for ways to reduce energy costs. The solar thermal project, which is part of an Energy Savings Performance Contract completed by Johnson Controls, will sustainably heat the Preston Center Pool for approximately ten months out of the year, and save the University around $11,000 annually. The array will keep the pool heated at a constant 80-83 degrees Fahrenheit when in operation. The system consists of an eighty-eight panel solar thermal array that initially cost $96,410 and will pay for itself in a little under 9 years.

Case Study #3: Solar Photovoltaic installation at James Madison University

JMU installed a 255 solar panel array on top of their ETEC building in 2003. The project cost 120,000 dollars, which was funded primarily through the university but also received a grant from the Virginia Alliance of Solar Energy. The current system provides approximately 10k watts of electricity to the building. While it does not power the entire building, the current system is set-up so that several dozen more panels can be added. The panels are set to last 20 years given proper maintenance. Other then being a source of electricity, it serves as an important teaching tool to students at the university.

2.0A INSIDER INTERVIEWS

From these contacts, we were able to collect valuable information relating to Western's current energy use and heating system and information to conduct a solar site assessment for the demonstration site.

Interviewer: Courtney Rondel

Interviewee: Josh Miller
Position: Project Manager at Western Solar
Contact: (360) 393-1288 josh@westernsolarinc.com
Date: February 3, 2012

Josh helped us understand solar energy, through efficiency measures such as *solar flux* and *air mass data.* These measures will help us calculate the conversion efficiency of WWU's present recreation center heating system with the potential solar heating system. Josh will also help the project by providing a solar site assessment, which will help us narrow down the best location on campus for solar thermal. The size and cost of this project is TBD, however if WWU were to implement solar thermal, a package will be purchased at a commercial rate of $3500 per collector which includes; at least one heat exchanger/storage tank ranging from 300-1000 gallons, an expansion tank, controlling unit, and solar station (containing the pumps and valves.) Funding is still being calculated and therefore an estimate is currently unavailable. Currently, Josh and Western Solar are skeptical about being involved in this project since funding is not yet determined, as well as acceptance of the final result of this project. As a pilot project, Western Solar is weary about helping us build a design due to the chance that if we release an R.F.P; another firm could take their design and partner with WWU at a lower cost. The biggest challenges we currently face are; funding, conversion efficiency and engineering technicalities. We know that solar thermal can work for Western, however we do not know if solar thermal is the most efficient to use for just the swimming pool.

Interviewer: Chris Armstrong (team member during winter quarter)
Interviewee: Sandy Fugami
Position: Mechanical Engineer 3
Contact: (360) 650-2230
Date: February 3, 2012

Sandy and I met to discuss the Facilities Improvement Measures (FIMs) that McKinstry had proposed. She didn't have any information on any solar thermal projects, but she did have some leads that will help us move ahead with the project. While we were discussing the FIMs she explained to me that the main reason why Facilities Management decided not to go with any solar thermal improvements is because of the long payback period. They chose not to include any because the return on investment was more than 10 years.

We also talked about possible alternative places to put up a solar thermal display. The two most likely candidates as an alternative to the rec center that we thought of were the Campus Services building or at the Physical Plant because they are not connected to the steam heating system, they have their own boilers. While those two choices are good for a small system, they aren't highly visible. Both are a little out of the way and couldn't be used effectively as an educational tool.

Interviewer: Brian Maskal
Interviewee: Adam Leonard
Position: Associate director of Wade King Recreation Center
Contact: (360) 650-4972
Date: February 3, 2012

Adam Leonard expressed his openness to a clean sustainable source of energy such as solar thermal being instituted in the recreation center. He was adamantly clear that it would require a lot of research into cost and effectiveness to convince him and Director Marie Saylor that this was the best thing for the recreation center. Also, we would need to thoroughly and clearly represent our data and findings to the director of the recreation facility in order to persuade them.

Interviewer: Stephen Harvey
Interviewee: Kevin Gilford

Position: Office of Sustainability Assistant Director
Date: February 3, 2012

The project has been a huge success at the University of Colorado at Colorado Springs Rec Center with the solar thermal system supplying "near 100%" of the energy to heat the pool water. There is excess heat that is dissipated and now engineers are looking to hook this extra heat into the shower/faucet system. There was never in depth analytical data analysis done with the cost benefits and electricity saved by the solar thermal system. Originally the system was expected to pay off two to three times within its 30+ year life, but now that payback times has decreased.

3.0A STUDENT GREEN ENERGY FEE APPLICATION

Green Energy Fee Program

GEF Grant Program – Conceptual Stage Project Application

COMPLETED PROPOSAL APPLICATION MUST BE RECEIVED BY

MAY 3, 2012 AT NOON

Please submit a hardcopy of the completed Conceptual Stage Project Application to Kathryn Freeman, the Green Energy Fee Grant Program Coordinator, in Viking Commons 24. You will be sent a confirmation email verifying the proposal was received.

Date: 05/13/2012

1. Project Title: _Western ***SOL***utions

2. Applicant Information

Name: Stephen Harvey

Campus ID #: **W**00924738

Phone: 360-561-2240

Email: harveys2@students.wwu.edu

Major: Sustainable Practices, Huxley Designed Major

Expected Qtr./Year of Graduation: Spring 2013

3. Project Advisor Information

Name: Brad Johnson

Department: Physics

Phone: 360-650-3659

Email: brad.johnson@wwu.edu

4. Proposal Details

A) Proposal Description

This project proposes the Wade King Recreation Center (WKRC) will use solar thermal collectors to heat the domestic water and pool. The closed loop solar collectors will primarily heat the incoming 50°F domestic water to 120°F. Once the solar domestic water tank is fully heated or can no longer accept heat, excess heat will be sent to the pool which needs a continuous heat supply from 86°F to 95°F. When solar thermal is unavailable or cannot provide all the heat, the existing steam source will be used. The solar thermal system should tie into both the domestic hot water and pool water because this leaves an outlet for extra energy. Depending on funding, the collectors can offset 60 percent of natural gas for annual domestic hot water needs; more funding/collectors will offset the pool's natural gas needs. We propose a 60 percent offset because with this amount of collectors during peak production months there will be no excess collectors. Peak production months are April through November; these are the months solar thermal would be utilized the most. Collectors will not often be idle, therefore maximizing the investment per dollar for energy production. This project will decrease Western's CO2 emissions and will serve as a learning model and awareness tool for solar thermal energy.

B) Need for Proposal.

The current water heating system for the Wade King Recreation Center is powered by natural gas and has a 25 percent energy loss, 15 percent is lost in the transition from natural gas to steam and 10 percent is lost travelling from the steam plant located near Red Square to the rec center.[3] Western Washington University has a Climate Action Plan which requires the university to reach climate neutrality by 2050. One route to climate neutrality from the Climate Action Plan is to "investigate emerging solar technologies."[4] Solar thermal will be an investment of renewable energy sources on campus. Annually, 274,733 pounds of carbon dioxide are emitted from burning natural gas to heat the rec center's swimming pool (this includes the 25% energy loss.) This proposal will offset the energy that cannot be purchased by RECs because the current water infrastructure is designed to be heated by steam. Recs only offset electricity. The WKRC has expressed the need for economically viable projects that will lower their environmental impact.[5] In teaching the effects of greenhouse gases the university has expressed the need for nonpolluting energy sources.

5. Project Goals and Desired Outcomes

A) Alignment with GEF Mission

Every student that showers, washes their hands, or uses the swimming pool at the rec center will be directly participating in this project. Western's rec center is used at least once annually by 91 percent of all students; this high visibility can provide an excellent educational and promotional tool.[6] This project will increase student involvement and education through posters and a whiteboard that will educate how the system works and showcase carbon emission reductions. Possible locations of these signs are locker rooms, the pool room, and front lobby of the rec center. Faculty will be approached in the following

[3] Hadley, Chris/ Facilities Engineer 3. "Rec Center Solar Thermal." Personal interview. February. 2012.
[4] Vidana, Seth, and Irene Hinkle. *Western Washington University Climate Action Plan*. pg.16. Bellingham
[5] Sather, Marie. Leonard, Adam. "Presentation Recap Meeting." Personal Interview. March. 2012
[6] Leonard, Adam. Personal Interview. February. 2012

programs to incorporate this solar thermal project into their curriculum; energy policy, engineering, environmental science/studies, economics, physics and material science.

The carbon emissions saved by using solar thermal will reduce the universities environmental impact. Approximate gallons per day of domestic hot water are currently being collected by an ultrasonic flow meter. Once collected the natural gas input and carbon savings can be calculated.

This project will create an aware and engaged campus community by using existing rec center and campus signage, such as scrolling banners and televisions to promote the installation. After installation, a grand opening event will be held to showcase the system. Campus tours visit the rec center, on this stop solar thermal can be mentioned. The collectors will be placed on the rec center roof where they will be visible from certain vantage points; seeing the collectors will create visual awareness.

B) Relationship with the Larger Context

Solar thermal is one of the most productive and cost efficient sources of renewable energy for Bellingham's physical climate. Solar thermal collects diffused and direct sunlight whereas photovoltaic collects direct sunlight, making solar thermal "more than three times as efficient at collecting solar energy than solar electric systems" for the Pacific Northwest.[7] Additional collectors can easily be installed to the initial rec center array. If funding is granted from the Green Energy Fee the rec center is willing to invest in this project assuming they receive their preferred five to eight year payback period on their investment.[8] Solar thermal will create a living laboratory for sustainable energy production where students, faculty, and staff can observe, learn from, and replicate the system across campus and in their own lives.

[7] *Western Solar*. Web. 13 May 2012. <http://www.westernsolarinc.com/hot-water-systems.html>.
[8] Sather, Marie. Leonard, Adam. "Presentation Recap Meeting." Personal Interview. March. 2012

6. Team

Team Member #1

Name: Courtney Rondel Role: Team Member

Phone: 425 269 4855 Email: rondelc@students.wwu.edu

Major/Minor: General Studies/Sustainable Design, Environmental Studies Expected Qtr./Year of Graduation: Spring 2012

Relevant experience or knowledge for this project:

I started this project in Campus Sustainability Planning Studio winter quarter 2012 and have indulged in all aspects of research and potential implementation of a solar thermal system on the recreation center. This includes some engineering and plumbing aspects, specifically how the solar thermal system will tie into the current steam heating system. I have developed relationships with a few members from Facilities Management, the recreation center and Western Solar to work collaboratively on this project. I have acquired a strong knowledge of solar thermal energy and its production abilities for the Pacific Northwest.

How will this team member ensure they have enough time to work on this project if it is selected? Please be specific. (For example, a student may choose to take fewer classes or participate in fewer extracurricular activities.)

By retaking CSPS this quarter with my team, allotted class time each week is dedicated to working on this project.

Will this team member work on this project for its entire duration? Unfortunately because I graduate this quarter I won't physically be able to work on it through the school year, but I hope very much to be a part of the process as much as possible.

Signature indicating agreement to the role and time commitment noted above:

____ Date: _________________

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Team Member #2

Name: Stephen Harvey Role: Project Leader

Phone: 360-561-2240 Email: harveys2@students.wwu.edu

Major/Minor: Sustainable Practices/ Environmental Science Expected Qtr./Year of Graduation: Spring Quarter/2013

Relevant experience or knowledge for this project:

For the past quarter in Campus Sustainability Planning Studio I have gained a concrete knowledge of how solar thermal works and its benefits. In doing so I have approximately estimated the rec center pools baseline natural gas costs and carbon emissions, then used these numbers to calculate the carbon and

financial savings associated with solar thermal. I have also been working collaboratively with facilities management and the rec center to gain their approval and learn how the solar thermal system would tie into the current rec center infrastructure.

How will this team member ensure they have enough time to work on this project if it is selected? Please be specific. (For example, a student may choose to take fewer classes or participate in fewer extracurricular activities.)

After fall quarter of 2012 my current job will end leaving me more free time. I would like to possibly get Huxley credits for working on the project. This quarter in Campus Sustainability Planning Studio we will get as much work done as possible leaving less to be done in the future. This is an important project to me and I will make time for it.

Will this team member work on this project for its entire duration? Yes

Signature indicating agreement to the role and time commitment noted above:

_____ Date: _____

Team Member #3

Name: Brian Maskal Role: Successor

Phone: (253)-232-4342 Email: maskalb@students.wwu.edu

Major/Minor: Environmental Science Expected Qtr./Year of Graduation: Fall 2013

Relevant experience or knowledge for this project:

Last quarter, I participated heavily within this project along with my other teammates. I gained an intimate understanding of solar thermal and how it works as well as the process of bringing a project such as this from a simple idea to a reality. Doing so has afforded many possibilities with the work that we have done clearly demonstrating that this project has the opportunity of becoming a reality. .

How will this team member ensure they have enough time to work on this project if it is selected? Please be specific. (For example, a student may choose to take fewer classes or participate in fewer extracurricular activities.)

Due to a conflicted course schedule, I will be able to go throughout the next couple of quarters in Western Washington University with limited credits thereby giving me extra time. I partake in a few extracurricular activities but they do not compose a vast amount of time and can be scheduled over if need be.

Will this team member work on this project for its entire duration? Yes

Signature indicating agreement to the role and time commitment noted above:

_____ Date: _____

7. Case Studies

- Colorado at Colorado Springs; solar thermal on campus recreation center, installed fall 2008. Colorado, a peer institute to Western and has a goal of reducing the universities greenhouse gas emissions 80 percent by 2050.
    - Purpose of project was to reduce fossil fuel usage, push towards carbon neutrality, and to create a living laboratory for sustainability. This project was part of the initial rec center construction and added LEED points for the building. The price of the project was around $300,000.
    - 68 evacuated tube solar thermal collectors were installed to heat two thirds of the pool.
    - Stakeholders were the Rec Center and Novan Solar Inc, the contracted company to install the collectors.
    - With a pool cover the collectors currently heat near 90 percent of the pool annually, and the system has now been tied to heat domestic hot water, without additional collectors added. This tie into the domestic hot water would have been more cost efficient if done in the original installation.
    - In August 2011 28,899lbs of CO2 were saved from being emitted.[9]
    - "There are minimal ongoing costs."[10] Since the system has been installed there have been no major breakdowns.

The Everett Naval Station in Washington State recently partnered with Western Solar to install 120 flat plate solar thermal collectors to heat their 365,000 gallon swimming pool and showers.

8. Stakeholders

Primary

- Wade King Recreation Center; need approval for project implementation, potential funder.
- Facilities Management and Facilities Development and Capital Budget; will be involved with planning, installation, and cost of project.

9. Additional Supporting Documentation

If you would like to see the in-depth analysis from last quarter which mainly focused on the pool, please see the attached document (it should be noted that throughout the document, specific numbers are merely tentative and do not represent actual costs, quantities, or carbon savings. The systems inability to produce energy at night was not calculated into the initial numbers; this reduces the carbon savings and doubles the payback period if implemented just for the pool.) Currently we are collecting data for the domestic hot water usage rates. Once this information is obtained a questionnaire will be sent to Schuco Energy, a solar company in Germany that will determine how many collectors are needed to heat the domestic hot water and pool during peak months (April-Nov)

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[9] *Energy Monitoring*. University of Colorado at Colorado Springs. Web. 14 May 2012. <http://www.uccs.edu/~kiosk/reccenter/energy/index.html>.

[10] Gilford, Kevin. "Insider Interview with UCCS Assistant Sustainability Director." Telephone interview. Feb. 2012.

Figure 1:

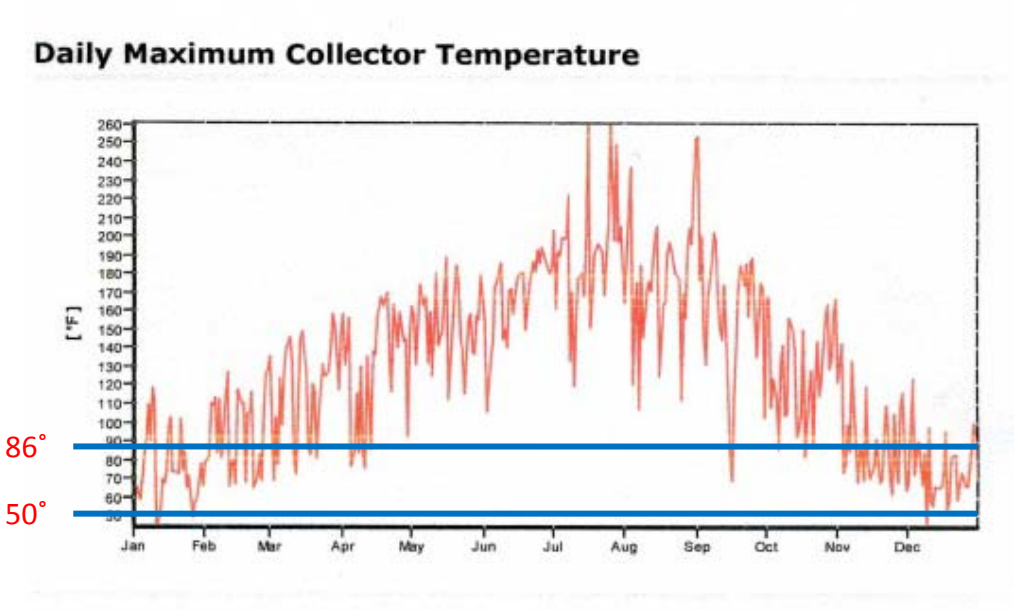


Figure 1: Daily maximum collection temperature for the Seattle Area. Any temperature collected above 50°F can be used to heat the domestic water and any temperature collected higher than 86°F can be used to heat the pool. – Philippe Gregoire. *Solar Domestic Hot Water Simulation*. Philippe Gregoire, 2008. Print.

Figure 2:

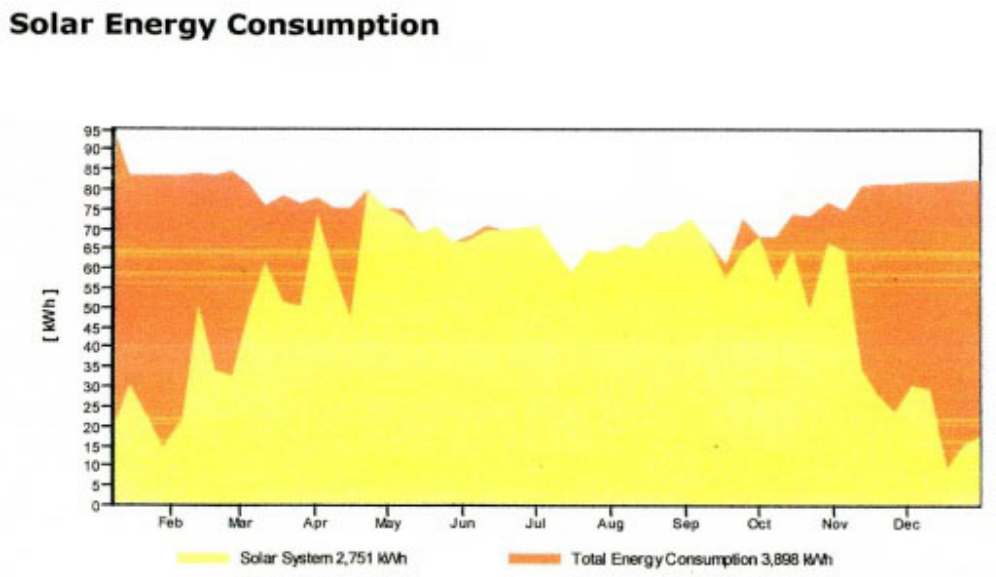


Figure 2: Percentage of solar energy used for electricity annually, shows peak months of solar energy production-– Philippe Gregoire. *Solar Domestic Hot Water Simulation*. Philippe Gregoire, 2008. Print.

Figure 3:

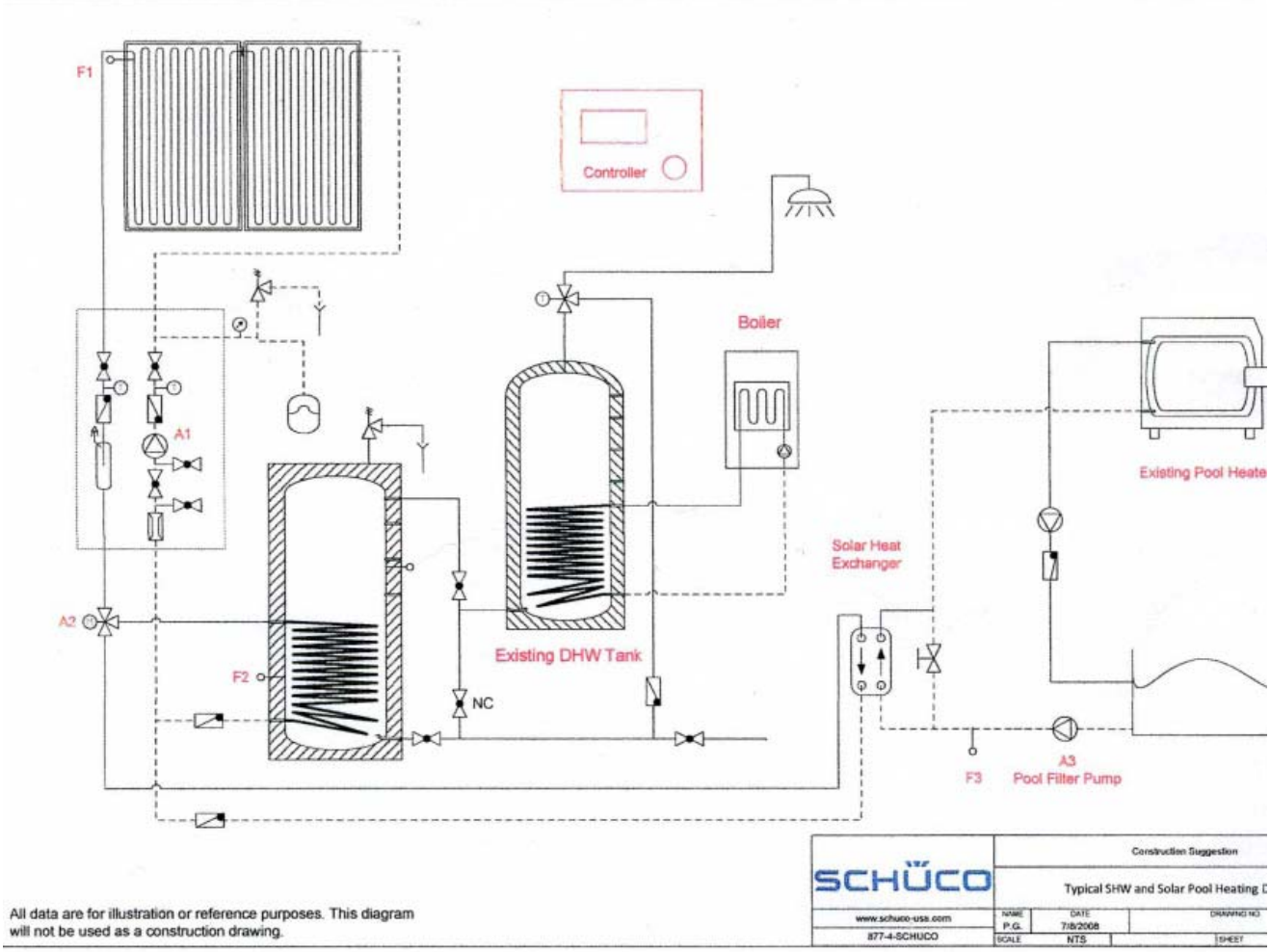


Figure 3: Diagram of how solar thermal collectors will tie into existing water heating system. Collected solar energy can either bypass existing steam heat exchanger or be supplemented by existing steam heat exchanger. - Solar Thermal System Diagram. Digital image. Western Solar. Winter 2012

Figure 4:

Figure 4: Solar Pathfinder tool used to collect available sunlight locations on the recreation center's roof. The yellow line represents the East side of the building; the green line represents the west side of the building. Any area inside the lines is available sunlight.

Figure 5:

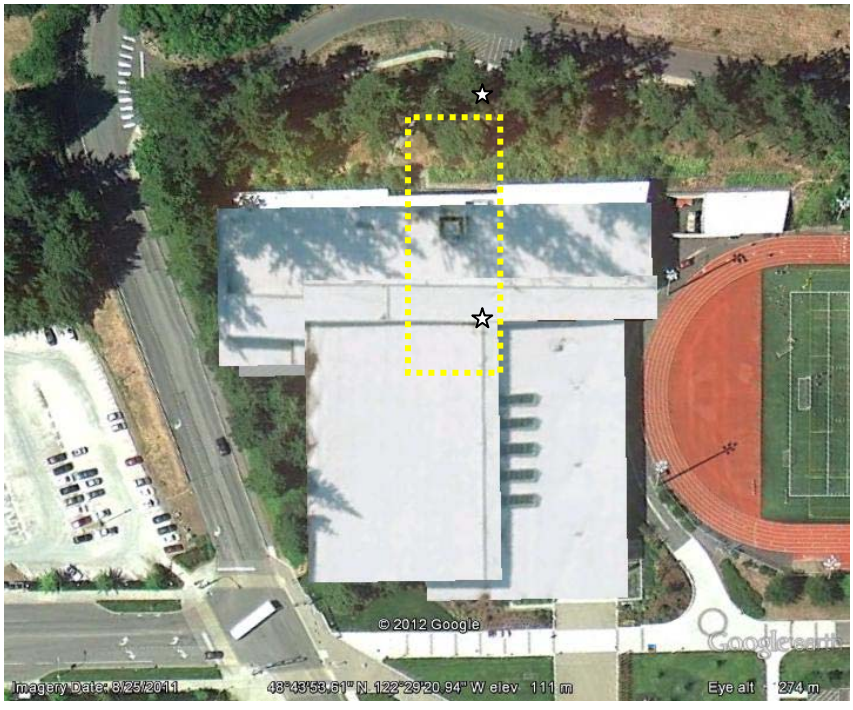


Figure 5: The two stars represent the locations where the pathfinder was used to collect solar availability. The dashed box represents the optimal location for the installation of solar collectors.

4.0A STUDENT GREEN ENERGY FEE COMMITTEE QUESTIONS

Date: 5/23/12
Project Proposal Title: Western SOLutions
Reviewer's Name: Rick Benner Dept.: Facilities Development & Capital Budget
Reviewer's Phone: x3550 Email: Rick.Benner@wwu.edu

1. From your perspective, what are the strengths of this proposed project?
   The project uses technologies that have been around for a while so the data and cost benefits should be fairly easy to determine.

2. From your perspective, what are the weaknesses/challenges of this proposed project? Are any of the challenges insurmountable? Please explain.
   It is unclear from the proposal beyond mounting the panels on the roof, where the remainder of the new system would be located? Is there space within the building?

3. How will the implementation and installation of this proposed project impact your department?
   Similar to last year's ES solar panels, this project will likely be completed as a Public Works Project. It will require a Project Manager from Facilities Development and the financing will need to be worked through Capital Budget. Additionally, the design will need to be approved to assure it fits within the campus character and doesn't look like and add-on to the Rec Center. Will probably take about as long as the ES solar panel project.

4. Are there any significant changes and/or suggestions you would make to strengthen this proposed project?
   No changes

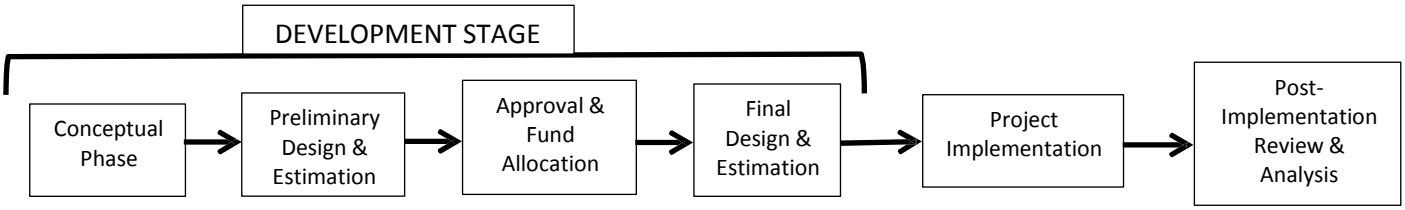
5. Any other comments you would like to make that were not addressed in the above questions.
   No additional comments

Green Energy Fee Grant Program

GEF Grant Program – Technical Feedback

The Green Energy Fee (GEF) Grant Program is funded by a student-initiated, quarterly fee paid by all Western students. It provides grant funding for sustainability projects that reduce the campus' environmental impact and engage the campus community in environmental awareness. It is a highly collaborative program paid for by students, managed by the Office of Sustainability, and includes Facilities Development & Capital Budget, Facilities Management and the Associated Students as the primary partners.

The GEF Grant Program involves several steps in order to make these projects a reality. The GEF Committee has not yet selected projects for this grant cycle, and your input is requested in order to assist them in making their decisions.



At this point, we are currently in the Conceptual Phase of the Development Stage for this round of new project proposals. We are looking for your feedback on the concept only of these proposed projects from a "50,000 foot viewpoint." The Development Stage entails three more phases, two of which are Preliminary Design & Estimation and Final Design & Estimation. These two phases involve the project team participating in internships that focus on finalizing the highly technical details of the selected projects. If the project is selected to continue to the next phase of development, you will have the opportunity to provide more detailed feedback.

You are a key stakeholder in relation to the proposed project(s) you were sent. Please have you or the staff person you identify review and provide feedback for each proposal. Your input is invaluable to the selection process. Please address each of the below questions based upon the scope of your departmental expertise, and email your type-written response to Kathryn Freeman, the GEF Grant Program Coordinator, at kathryn.freeman@wwu.edu by **May 24, 2012 at 5 pm.**

You can reach her at 360.650.4501 for any assistance you may need.

Date: 5/23/12
Project Proposal Title: Western Solutions
Reviewer's Name: Adam Leonard/Marie Sather Dept.: Campus Recreation Services
Reviewer's Phone: 4972/3402 Email: adam.leonard@wwu.edu marie.sather@wwu.edu

1. **From your perspective, what are the strengths of this proposed project?**
   The strengths of this proposed project are obviously the energy and financial savings with regards to steam consumption.

2. **From your perspective, what are the weaknesses/challenges of this proposed project? Are any of the challenges insurmountable? Please explain.**
   Some of the challenges/concerns of this project are the initial costs of the panel installation as well as the concern of when the panels become outdated and newer technology becomes available.

3. **How will the implementation and installation of this proposed project impact your department?**
   As long as there is no financial burden on the students/recreation center budget, it appears to be a worthwhile project.

4. **Are there any significant changes and/or suggestions you would make to strengthen this proposed project?**
   To strengthen this proposal it would be nice to have clear expectations of the life cycle of the panels. Furthermore, it would also be wise to know the cost to recycle the panels once they become obsolete and replaced with better technology.

5. **Any other comments you would like to make that were not addressed in the above questions.**
   We would like to have architectural review/approval with regards to the aesthetic nature of the panels. We are concerned with how their appearance will tie into the existing architectural design of the recreation center and its roof.

Date: 5/24/12
Project Proposal Title: Western SOLutions **Reviewer's Name:** John Furman
Dept.: FM
Reviewer's Phone: 3496 **Email:** John.Furman@wwu.edu

1. **From your perspective, what are the strengths of this proposed project?**
   A great educational opportunity – but not sure there's a true business case from the steam plant perspective.

2. **From your perspective, what are the weaknesses/challenges of this proposed project? Are any of the challenges insurmountable? Please explain.**
   I have no confidence that the estimated cost for purchase and installation is anywhere near what the true costs might be. I believe the solar array installed last year cost over $160K, and that was without interior plumbing modifications.
   How much additional mechanical equipment has to be added to accommodate the heat transfer equipment? Recall we cannot eliminate the steam system.

3. **How will the implementation and installation of this proposed project impact your department?**
   Assuming the savings estimate are correct, what impact would the demand reduction have on the overall efficiency of the boilers in the steam plant? The assumption is that the steam plant would immediately stop burning gas and producing steam upon switching to solar – which can't happen. The boiler takes a minimum amount of fuel simply to operate at minimum capacity – maximum efficiency is attained by balancing load demand to boiler capacity. There is not necessarily a direct correlation between reduced demand at the rec center and reduced consumption at the plant.

4. **Are there any significant changes and/or suggestions you would make to strengthen this proposed project?**

5. **Any other comments you would like to make that were not addressed in the above questions.**
   I was unable to reconcile the fact that the most effective solar heating opportunity periods are those when we need the steam heat the least.
   I think the project has potential, but would like to see a full financial analysis before concurring. If the financial analysis doesn't pan out, the model may need AS subsidies to make it viable.