2009 – 2010 Annual Report

Prepared on June 9, 2010

By: Matthew Anthony & Matthew Parsons

Edited and Published on June 28, 2010

By: Matthew Anthony, Heather Kinsey, & Jon Ruth

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Introduction to the REI

Mission Statement

Reduce the environmental impact of Appalachian State University by replacing the University's existing sources of energy with cleaner forms of renewable energy technology on campus and serve as a resource for students and faculty by identifying and investing in the most appropriate renewable energy projects.

Previous Projects

Biodiesel Collaborative Solar Thermal System (Fall 2005)

The REI allocated $7,000 to the Biodiesel Collaborative which was used to purchase two 4x10 and two 4x8 solar thermal collectors. Theses collectors produce 100% of the heat required to produce biodiesel at the University's biodiesel research facility.

ASU & AppalCART Biodiesel Tank (Fall 2005 – Fall 2006)

The REI, in partnership with AppalCART, purchased a 10,000 gallon fuel tank; The REI allocated $60,000 and AppalCART provided the remaining $40,000. This tank is used to store B-20 biodiesel which is used by both University and AppalCART fleet vehicles. The REI also allocated $2,500 for bumper sticker to promote the progressive and collaborative efforts to reduce emissions. This project has helped to reduce the University's annual motor vehicle emissions by 10 to 20 percent.

Biodiesel Collaborative Photovoltaic Array (Fall 2006 – Spring 2008)

The REI allocated $17,500 to construct a ten panel, 1.7 kW pole mounted photovoltaic array. The array is the first grid-tied system for both the University and the local utility, New River Light and Power. This 1.7 kW system was sized to meet 100% of the electrical needs of the University Biodiesel Collaborative project and produces over 2,000 kWh annually.

Kerr Scott Hall Photovoltaic Array (Spring 2007 – Spring 2008)

In an effort to provide additional hands-on learning opportunity for students in the Appropriate Technology program, the Department of Technology and the REI partnered to construct a 1.5 kW direct grid-tied PV system on Kerr Scott Hall. The REI funded $5,000 dollars towards this project while the remaining $7,000 was donated by the Technology Department.

REI Informational Kiosk (Fall 2007 – Spring 2008)

In order to inform the campus community about the REI's projects, an informational kiosk was designed and constructed by students in the Department of Technology. The Kiosk is housed in the Plemmons Student Union and presents information regarding the REI activities.

Raley Photovoltaic Array (Spring 2007 - Fall 2008)

The Raley 4 kW PV array was designed to reflect the mountain landscape in which Appalachian State University is located. The installed price of the system was over $65,000. During the systems first year of operation it produced over 4,000 kWh of electricity and offset over 4 tons of CO_2.

Academic Year 2009 – 2010

Meeting Dates, Times & Locations

September 3, 2009; 6:37 – 8:07 pm, Plemmons Student Union, Attic Window Room #137C
September 17, 2009; 6:42 – 8:41 pm, Katherine Harper Hall, room 30
October 1, 2009; 6:32 – 8:02 pm, Katherine Harper Hall, room 30
October 22, 2009; 6:35 – 8:00 pm, Katherine Harper Hall, room 30
November 5, 2009; 6:35 – 8:05 pm, Katherine Harper Hall, room 30
November 19, 2009; 6:30 – 7:55 pm, Katherine Harper Hall, room 30
December 3, 2009; 6:35 – 8:00 pm, Katherine Harper Hall, room 30
January 26, 2010; 7:00 – 8:30 pm, Katherine Harper Hall, room 30
February 9, 2010; 7:06 – 8:30 pm, Katherine Harper Hall, room 30
February 23, 2010; 7:00 – 8:38 pm, Katherine Harper Hall, room 30
March 16, 2010; 7:10 – 9:03 pm, Katherine Harper Hall, room 30

March 30, 2010; 7:00 – 9:00 pm, Katherine Harper Hall, room 30
April 13, 2010; 7:00 – 9:00 pm, Katherine Harper Hall, room 30
April 27, 2010; 7:00 – 9:00 pm, Katherine Harper Hall, room 30
May 4, 2010; 7:00-9:00pm, Dr. Badurek's house
The minutes from these and all previous meetings can be found at www.rei.appstate.edu.

REI Members – Fall 2009

Student Members
- Clary Franko – Chair
- Matthew Parsons – Vice-Chair
- Matthew Anthony – Treasurer / Grant Master
- William Bales – Secretary (Non-Voting)
- Rio Tazewell – Public Relations Officer
- Morgan Bosse – Public Relations Officer
- Brooks Camp – Grant Master
- Andrew Edmonds – SGA Director of Environmental Affairs
- Christopher Robinson – (Non-voting)

Faculty/Staff Advisors
- Dr. Brian Raichle – Department of Technology
- Dr. Jeanne Mercer-Ballard – Department of Technology
- Dr. Chris Badurek – Geography and Planning
- Patrick Beville – Design and Construction
- Jerry Marshall – Physical Plant
- Ged Moody – Office of Sustainability

REI Members – Spring 2010

Student Members
- Rio Tazewell – Chair
- Matthew Anthony – Vice-Chair
- Britt Bales – Treasurer
- Heather Kinsey – Secretary (Deputy (aka non-voting))
- Morgan Bosse – Public Relations Officer
- Clary Franko – Grant Master
- Brooks Camp – Grant Master
- Sara Gallivan – SGA Director of Environmental Affairs
- Christopher Robin – (Deputy (aka non-voting))
- Jon Ruth – (Deputy (aka non-voting))
- Sean Hayes – (Deputy (aka non-voting))

Faculty/Staff Advisors
- Dr. Jamie Russell – Department of Technology
- Dr. Jeanne Mercer-Ballard – Department of Technology
- Dr. Chris Badurek – Geography and Planning

- David Sweet – Design and Construction
- Jerry Marshall – Physical Plant
- Ged Moody – Office of Sustainability

Project Managers

- Broyhill Wind – Morgan Bosse
- Plemmons Solar Thermal – Matthew Anthony
- Ivory Tower Brewery – Rio Tazewell / Jon Ruth
- E3 House – Brooks Camp
- System Monitoring – Clary Franko
- Policy – Matthew Parsons

Renewable Energy Projects

Broyhill Wind Turbine

Description

On June 15, 2009 (coincidently the first annual Global wind day), Alteris Renewables began constructing the Northwind 100 Northern Power Systems wind generator, a 100 kW wind turbine located at the Broyhill Inn and Conference Center. At this specific location and wind regime, the turbine is expected to generate over 147,000 kWh annually, enough energy to power approximately 10-15 southeastern US homes, and offset over 200 metric tons of carbon dioxide. This is currently North Carolina's largest wind turbine. The REI partnered with New River Light and Power (NRLP) to purchase the turbine which approximately cost $522,000; REI paid $304,000 of the project cost while NRLP contributed the remaining $218,000 and the senior class of 2009 donated their class gift of $1,000 towards the project.

History

Since the REI was formed in 2004, it has been a major goal of the organization to install a wind turbine on the University campus, bringing wind back to Boone. In the spring of 2005, the REI began conducting due diligence in the forms of site assessments, contacting local authorities and

discussing funding opportunities. Innovative partnerships were formed between industry and community stakeholders. Meetings were held with key stake holders such as the Watauga County Commissioners, Doug Uzelak – manager of the Broyhill Inn and Conference Center, Rick Presnell – New River Light and Power general manager, and Greg Lovins – vice chancellor of the University business affairs. By the fall of 2008 the Request for Proposal was complete and all zoning permits had been approved. A public, educational forum was held at the Broyhill Inn for community members to learn about the project and become aware of potential changes. In December of 2008, the REI Committee voted 6 to 1 in favor of moving forward with the project. In March 2009, the foundation was poured and by the end of June 2009, construction was complete and the turbine was completely erected. A special thanks to Brent Summerville, Joe Smith, Ged Moody, Patrick Beville, Jonathan Pierson, and Crystal Simmons for their dedication and hard work, for which without the project would not have been possible. Synthesis of an interview with Crystal on the history of the project and a project timeline are included in Appendix A.

Actions

In October 2009, loud squeaking noises were reported to be coming from the Turbine.

In November 2009, Matthew Anthony was able to get Pam Bunch from the local public supported radio station WNCW 88.7 cover a story of the turbine and air it on her morning news segment; Crystal Simmons, Clary Franko, and Morgan Bosse acted as REI representatives for the interview. A ribbon cutting ceremony was held at the Broyhill Inn and Conference Center on November 12, 2009 where community members from the University and Town of Boone were invited. Representatives from the REI, ASU Administration, Town of Boone, Northern Power Systems and Alteris Renewable gave short speeches about the significant of this project.

In February 2010, Alteris made several attempts to address the noise issue. A technician from Alteris was dispatched to service the generator and potentially solve the problem. Matthew Parsons was able to assist the technician in attempting to resolve problem. The initial thought was the problem originated from where the power cable was suspended from a u-bolt; a gasket was fashioned and applied, but the noise persisted. It was then assumed that the noise was coming from the brake assembly in the yaw system; brake pads were replaced with new one, but the noise continued. Because Alteris was unable to solve the problem, in March 2010 Northern Power System engineers were required to analyze the situation and conclude what mitigation would be necessary to solve the problem. It was determined that the noise was in fact coming from the brake assembly in the yaw system, but from washers housed in the assembly. A short term solution to the noise was to use a highly viscous lubricant on the washers.

Through the repair issue and a series of distinguished visitors to the University, it was determined that a stair case needs to be installed to access the turbine safely. The REI committee voted to dedicate funds $2,500 to construct the stair case.

Status

As of May 3, 2010 the turbine has produced 101,534 kWh of electricity! The turbine was serviced with a short-term fix by lubricating the source of the noise, washers in the yaw brake housing, and is currently awaiting a custom replacement part from Northern Power System engineers.

The REI is negotiating a power purchase agreement with NRL&P to split the revenue generated by selling Renewable Energy Credits (RECs).

The stair case is pending a quote from the University physical plant and is expected to be installed over the summer of 2010.

Plemmons Student Union Solar Thermal System

Description

The Plemmons Student Union (PSU) domestic hot water (DHW) solar thermal system consist of 42 flat plate collector, seven of which have experimental glazing technology, three-400 gallon EPDM rubber lined storage tanks, nine stainless steel perforated heat exchangers, and 200 plus feet of copper pipe. The total cost of the system was $153,000 and was contracted out to Sunqest. The solar heated water produced by the system will be utilized on site, reducing the emissions and a cost associated with the use of the central steam system and is estimated to generate annual energy savings of approximately $11,000 to $14,000.

History

The PSU solar thermal system is the longest running and most logistically complex of all REI projects to date, serving as a pilot commercial scale DHW solar thermal system to the area and the University. Initial system design was contracted out to ELM Engineering but later required the expertise of both Dr. Brian Raichle of the Technology Department and Patrick Beville of the University's office of Design and Construction to craft the design into a realistic and functional system. A series of challenges arose throughout the projects planning phase including the sighting of the system, the unsatisfactory feasibility analysis and system design by ELM engineering, contract personal turnover, insufficient budget estimates and the securing of additional funds, modifications of system design, and malfunctions of manufactured parts by

Trendsetter. An extended history of the project and these issues can be found in previous annual reports located on the REI web site at www.rei.appstate.edu.

Actions

By September 2009 the system was installed and in the process of testing functionality and efficiency. At that time it was discovered that there were problems with the equalization among the tanks and pin-hole leaks, from the circulation loop into the DHW tanks, in three of the nine heat exchangers. The equalization issue was causing the first tank in the loop to overflow and flood the mechanical room where they were housed. This issue was determined to be a result of negligence, the lack of engineering and design on the part of the tank manufacturer: Trendsetter, who proved to be extremely difficult to work with to resolve the issue. A solution was devised by the collaboration between Patrick Beville and Greg Baer of Sunqest to install an equalization / sight gauge linked to all tanks. This solution compromised the warranty of the tanks, but was seen as a necessary action considering the manufactures' lack of action and the consequential indefinite stall of the project in litigation limbo. The pin-hole leaks in the heat exchangers were also determined to be the fault of the manufacturer, Trendsetter, and were to be replaced by them.

At the end of 2009, Patrick Beville decided to leave the University to pursue his own business. This posed a major change for the REI, considering his integrated involvement in all projects and strategic position in the office of Design and Construction. Although Patrick left the University, he pledged to continue his involvement with the PSU solar thermal system until the project was completed.

By January 2010, the equalization / sight gauge was installed and the system was at a half operational status, generating a greater than expected output. By March 2010, the heat exchangers had yet to arrive and a meeting was once again arranged between project stakeholders to determine required action needed to complete the project and involved: Dave Roberson and Tom Elliot of the PSU, REI project manager Matthew Anthony, prospective REI project manager Jon Ruth, Patrick Beville of IONCON, Ged Moody of the Office of Sustainability, Jerry Marshal of the Physical Plant, and David Sweet of the Office of Design and Construction. It was determined that no legal recourse would be taken against Trendsetter due to the complex situation and possibility of the project not being completed. It was determined to prevent any other pressure related issues that contributed to the leaking heat exchangers by installing water hammer aerators, to relieving any pressure spikes that might occur. A virtual tour of the system was documented and published via a Picasa web album.

It was agreed by all stakeholders that Trendsetter was a negligent manufacturer and was to never be used again by the University, State, or any other affiliated parties.

Status

As of May 2010, the water hammer aerators, pressure relief valves, and replacement heat exchangers have been installed. The system is now fully operational and expected to supply more than the expected DHW needs of the PSU and any new additions to the building. In an

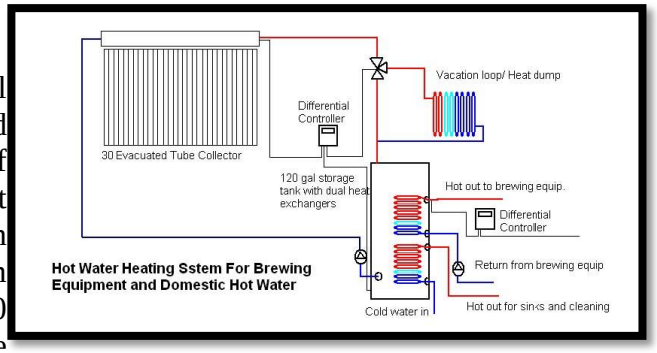
effort to fully utilize the efficiency of the system, the dishwashers of Cascades Café and McAlister's Deli will be directly piped into the system before temperatures are lowered to the point of end use.

Appropriate Technology graduate student Nicholas Hurst will tentatively conduct a quality assurance test on the efficiency of the system design to monitor efficiency beginning Fall semester 2010.

At the end of the Spring 2010 semester the system manual was emailed from Patrick; the manual (not including appendixes) is available in the appendix (see Appendix B) and an electronic version has been posted to the Google Group files section. Additional information on the document can be found on the webpage at: http://rei.appstate.edu/.

Ivory Tower Brewing Solar Thermal System

Description



The Ivory Tower Brewing Solar Thermal System will be located at the Broyhill Inn and Conference Center. For both reasons of diversifying the REI portfolio of different technologies and providing all of the high heat requirements of the Brewery, the system was initially designed with a set of 30 evacuated tubes and a 120 gallon storage tank. This design was drafted with the consideration of the brewery expanding its operations. The Total cost of this project was estimated to be at least $20,000.

History

The REI was approached by both Brett Taudman and Shea Turbety about a potential partnership to help make their non-profit brewery, Ivory Tower Brewery located in the Btoyhill Inn and Conference Center, to become more environmentally responsible and reduce its carbon footprint. Over the summer of 2009, several REI members met to discuss possibilities and began a feasibility analysis, which is included in the appendix (see Appendix C). By Fall 2009, the REI voted to pursue the project with the understanding that the REI would provide matching funds to a North Carolina State Energy Office (NCSEO) grant; total projected project cost of $20,000, with REI allocating $10,000 and the remaining $10,000 from NCSEO grant.

Ivory Tower is a non-profit organization, which is owned and operated by several University professors, that has initiated a brewer located at the Broyhill Inn and Conference Center for educational purposes. The brewery is associated with a brew class and will soon become part of the viticulture curriculum at the University. In order to lower the brewery's carbon foot print,

Ivory Tower has approached the REI to partner on a solar thermal system to supply all heating needs for the brewing process.

Ivory Tower is currently applying for a business license in the hopes of becoming a supplier to local establishments in the near future. REI has been in discussion with Ivory Tower since summer of 2009 about this project. The REI is excited to engage in this unique partnership and the opportunities that it will provide to incorporate various aspects of sustainability in supporting local business and diversifying the uses of renewable energy.

Actions

In fall 2009, the REI voted to allocate $10,000 towards the project as matching funds to a NCSEO grant for $10,000. However, due to an extensive delay in getting a response from the NCSEO, the committee is awaiting new quotes for a down-sized system. In essence, the REI has decided to solely fund the project with a smaller scale system. The committee has yet to allocate additional funds; the anticipated cost of the smaller design is approximately $12,000.

Status

The project is currently awaiting cost estimates for a smaller system. The committee has determined to not rely on the NCSEO grant, rather solely funding the entire solar thermal project costs. The REI has voted to purse the project; allocated costs to the project still remain at the original costs of $10,000.

E3 House Photovoltaic Array

Description

The Energy, Environment, and Economic House (E3 House) is an innovative approach in design to replace FEMA disaster relief trailer homes. The house is designed to be completely self sufficient; battery backed, the grid tied system provides the capability of selling excess power to the grid. System design includes: energy efficiency technology, rain water collection, and both solar thermal and PV systems. The REI funded the 3 kW PV array with $30,000.

History

The E3 House was designed by Chad Everhart, Director of the Building Science program. Back in Fall 2009, Nick Hurst approached the REI and proposed that the REI fund the PV array on the house that was built by students in the Department of Technology. Sundance, the contractor, provided design, material, and supervision.

Actions

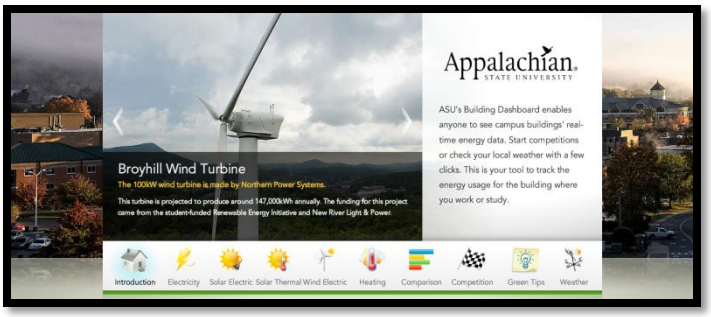
In Fall 2009, the REI voted to allocate $30,000 to fund the 3kW PV system of the E3 House **.** Nick Hurst, the E3 project manager, handled the contract with Sundance Power Systems in Asheville, NC. In early April 2010, students from PV class worked to install the system.

Status

The system is currently producing power and is hooked up to the grid. Jerry Marshall is currently working with Pepco to get the system tied into the Building Dashboard monitoring System. Brooks is currently working to register the system with the utility commission in order to sell power through the Green Power program as RECs.

System Monitoring

Description



The Campus Building Dashboard is another collaborative project that is in partnership with the University Physical Plant. The Campus Building Dashboard is an online monitoring system that will allow anyone to access it and visualize the energy statistics of selected locations and REI project on campus.

History

The energy monitoring system is being installed in select locations on campus as one part of a $5.3 million Energy Savings Performance Contract (ESPC) issued by the ASU Physical Plant. The ESPC contract, when completed, will save the University $600,000 in energy costs annually. This savings amount is guaranteed by the Energy Services Company (ESCO) responsible for completing the work.

Pepco Energy Services is the ESCO that was awarded the ESPC Contract.

Lucid Design Group is the sub-contractor hired by Pepco to install the energy monitoring system that we requested be made a part of the ESPC project.

Building Dashboard is the brand name of the monitoring system that Lucid is installing.

The original plan was to monitor energy use in buildings that are being impacted by the ESPC project, however during the negotiation phase, the ASUREI requested the Physical Plant include the then existing REI projects in the ESPC contract and that request was granted by Physical Plant Director Michael O'Connor at no cost to the REI (see Appendix D).

Actions

We cannot add any additional monitoring to the current ESPC contract as North Carolina does not allow change orders on this type of contract. However, we *can* contract directly with Lucid Design Group under a separate contract to add additional monitoring services at other buildings or locations. We (we being the Physical Plant Administration) decided we did not want to enter into any additional contracts with Lucid until we have seen if their system actually proves to produce everything we have come to expect and until we know how much additional monitoring we need or want.

Status

The system monitoring by Building Dashboard and in collaboration with the ASU Physical Plant was supposed to become active during the Spring 2010 semester but has yet to go live. Hopefully this will happen very soon. The site is currently available to ASU but doesn't have a live feed coming from our projects. The REI is very excited for this new education and outreach tool and is very thankful for all the help of the ASU Physical Plant.

If the Building Dashboard system performs as well as expected to, then we will begin to investigate what additional systems, buildings and locations we would like to monitor and where we might obtain funds to complete such a project.

Other REI Activities

Awards

During the 2009/2010 academic year the REI received two leadership awards. The first was the State Leadership Award which was presented at the 6th Annual Sustainable Energy Conference by the State Energy Office of North Carolina. The award is currently on display in the REI Kiosk located in the Student Union.

The second award received by the REI was the Sustainable Energy Award which was presented at the ribbon cutting ceremony for the Broyhill Wind Turbine. A representative from the North Carolina Sustainable Business Council presented the award to the REI during the ceremony.

Green Smart Festival

During the Summer of 2009, Brian Crutchfield, the Sustainability Director of Blue Ridge Electric Membership Corporation (BREMCO), held a festival in Hardin Park to promote awareness of energy efficiency and renewable energy and local energy related businesses. The REI participated in the event by tabling, provided information about the REI's mission and projects through interactive conversation and promotional pamphlets. There was no cost or registration fee for the REI to participate in this event; only the time and efforts of committee members. To learn more about BREMCO's Green Smart events, check out the following web address: http://www.blueridgeemc.com/greensmart/.

Music on the Mountaintop

During the Summer of 2009, Yellow Dog Entertainment LLC held its second annual environmental music festival to promote awareness or environmental issues and benefited the Appalachian Institute for Renewable Energy (AIRE). The REI participated in the event by tabling, provided information through conversation and pamphlets. There was no cost or registration fee for the REI to participate in this event; only the time and efforts of committee members. To learn more about the Music on the Mountaintop festival check out the following web address: http://www.musiconthemountaintop.com/.

Policy

The policy document (see Appendix E) was drafted in the spring of 2009 by former Chair Crystal Simmons, and was then approved by the REI committee at the beginning of the fall 2009 semester. The intention on the policy document was to create the REI opinion about how to manage revenue created by the sell of Renewable Energy Credits (RECs) generated by REI's systems. Several of the REI's projects, such as the Broyhill Wind Turbine, were co-funded by the University; therefore the REI felt the revenue should be split in direct proportion to the amount invested. The REI wishes to use the revenue generated by the sale of RECs as discretionary funds, in order to create promotional/educational material and diversify its portfolio. The policy document was sent to Cindy Wallace, Vice Chancellor of Student Development, and Tommy Wright for review. However, due to a change in the relationship and organizational structure between the REI and Appalachian State University (the transformation of the REI into a University Funded Organization (UFO)), the policy issue was postponed. This process, however, served as an important exercise for the REI to utilize when given the opportunity to redevelop its policy as a UFO.

High Country Brew Fest

During early Fall 2009, Ivory Tower Brewery held the first annual festival at the Broyhill Conference Center and Inn. The REI attended the event and participated in promoting the collaborative partnership with Ivory Tower to implement the solar thermal system project to power all of the brewery's hot water needs. The REI participated in the event by tabling, provided information through conversation and pamphlets. There was no cost or registration fee for the REI to participate in this event; only the time and efforts of committee members. To learn more about the High Country Brew Fest check out the following web address: http://www.hcbeerfest.com/.

Freshman Seminar Classes

At the beginning of the Fall 2009 semester, the REI contacted the coordinator of the freshmen seminar program and asked if there were any professors which would be willing to let the REI make a short presentation in their class. Between 10 and 15 professors agreed to let the REI speak in their classes. The public relations officer created a PowerPoint presentation summarizing the REI's history. The committee members then divided up the classes and presented the presentation at the appropriate class.

The purpose of this is to inform the incoming freshmen about the REI "green fee", encourage their involvement with the organization and build support with new students.

Broyhill Wind Turbine Ribbon Cutting

In order to celebrate the achievement of installing North Carolinas largest wind turbine, the REI held a ribbon cutting ceremony at the Broyhill Inn and conference Center on November 12, 2009. The event was free of charge, and open to the public. Announcements were made in the University's website, local papers, and even a highlighted story on the local public supported radio station, WNCW 88.7.

Representatives from the REI, Appalachian State University, the Town of Boone, Alteris Renewables and Northern Power Systems were invited to the event and asked to give a short speech about the significance of this project, in terms of student development, promoting wind energy in western North Carolina and sustainability.

At the ribbon cutting ceremony, the REI received the 2009 Sustainable Energy Award, from the North Carolina Sustainable Business Council, for its leadership role in promoting renewable energy.

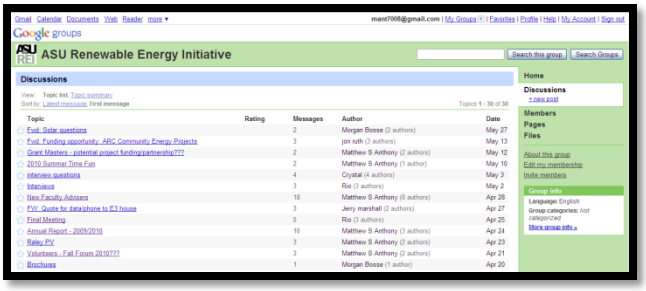
Fall Forum

The 2009 fall forum was held in the Plemmons Student Union on November 12, 2009 at 5:00pm. The purpose of this event is to inform the student body about the REI, make project updates, solicit new project ideas, and recruit new members.

A PowerPoint presentation was given highlighting the REI's current and completed projects, describing the board members positions and associated responsibilities, and presenting information regarding emissions offsets. During the forum the REI announced that one position would be opening in the spring semester and that applications would be accepted until November 25, 2009. After the presentation, the movie The Lorax was shown and pizza was provided.

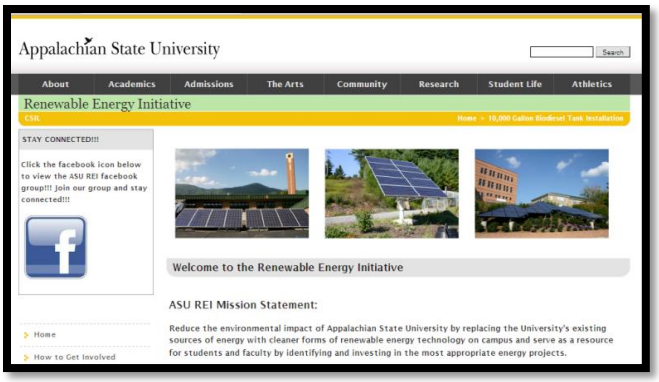
Google Group

In an effort to have improved communication among the committee and sub-committees, a Google Group for the REI was created. This action serves as a powerful tool for the REI to increase its efficiency and effectiveness by using threads for informally continuing discussions, sharing documents, project management, and keeping connected outside of meetings.



Website

During the Spring 2010 semester the REI website went through a re-organization, updates, and extensive overhaul. A series of data management techniques and aesthetic improvements were applied in an effort to make the webpage more intuitive to both administrators and users. The webpage was linked to the REI facebook account and is intended to increase student interaction with and awareness of the REI.



Carbon Offset Audit

During the Spring 2010 semester, new member Jon Ruth developed a carbon offset audit of all REI projects (see Appendix F). In an effort to better monitor and understand the true cost of the REI projects, Jon generated a excel spreadsheet that breaks down the carbon footprint of each REI project.

Spring Forum

The Spring forum was held in collaboration with the Office of Sustainability film series on Tuesday April 20, 2010 at 7pm in the I.G. Greer Auditorium. The film being shown that night was 'No Impact Man'; before the film Jon Ruth addresses the audience by informing them of the REI, its projects and took an informal survey – the results of which were very poor.

The Spring forum was considered both a failure and disappointment by the committee; a learning experience and motivation to never let happen again. The committee came to an agreement that the students deserve a better effort and product from the REI; the committee pledged to never let the 'ball drop' like it did at this poorly planned and executed event. The committee determined that from now on the event needs to be its own, and follow the objectives of informing the student body about the REI, make project updates, solicit new project ideas, and recruit new members.

Budget Increase Proposal

As an advantage of being assumed into the University as a University Funded Organization (UFO), the REI was able to request up to a 15% increase in its budget. Over the Spring 2010 semester, the REI worked towards identifying what they wanted to increase. By the end of the Spring 2010 semester the REI was able to present its request for a budget increase to the fees committee. The majority of increases were allocated towards further renewable energy projects and the addition of education and outreach as something the committee could expend funds (see appendix G).

Sustainability Symposium

In an effort to celebrate Earth Week on campus, on April 21, 2010, the Appalachian State University Sustainable Energy Society in collaboration with the Net Impact club hosted the Sustainable Symposium at the Broyhill Inn and Conference Center. The REI participated in the event by tabling, provided information about the REI's mission and projects through interactive conversation and promotional pamphlets. There was no cost or registration fee for the REI to participate in this event; only the time and efforts of committee members.

Newsletter

In Spring semester 2010, new member Heather Kinsey choose to contribute to the REI by creating a semester Newsletter. The newsletter is intended to keep students, faculty, local community members and alumni abreast of REI projects and activities. The Spring 2010 newsletter has been through its final editing and is currently awaiting the conquering of formatting issues for distribution. The newsletter is intended to be distributed via the REI 'tux' (University mass email system) account and posted on the webpage.

Grants

Clary Franko and Dr. Badurek submitted a grant proposal to the Appalachian Parents Association (APA) this semester. The grant was submitted on the February 25, 2010 and was requesting funding for outreach and education handouts. We requested a ranging amount of brochures, flyers, and bookmarks to educate students and visitors about the REI. At the end of the Spring 2010 semester the REI received word that it was awarded the grant of $288.78 towards the production of bookmarks.

Spring 2010 Final Meeting

Dr. Badurek hosted the Cinco de Mayo themed final Spring 2010 meeting at his house on Tuesday, May 4, 2010. The event served as both as social function for REI members to induct new members and advisors, celebrate leaving members and advisors, and informally discuss current and future projects and duties. Good times were had by all!!!

Outlook for REI

UFO (University Funded Organization)

At the end of the 2009 year the REI received word that it was going to be assumed into the University as a University Funded Organization (UFO). Initially, due to issues related with recovering revenues from projects, the REI was uncertain as to how this would affect the committee. In hard economic times with uncertainty of reductions and cuts in budgets the University acted in interest of continuing its dedication to sustainable efforts by absorbing the REI from a bottom line organization to an above the line organization; this action essentially protected the REI from any budget cuts and ensured the continuing efforts of the committee.

This major change to the REI had some very important implications. The change of the REI to a UFO meant that the referendum was no longer required; the REI fee was now a permanent addition to the student fee and no longer required a vote every three years by the SGA and student body to renew the fee. This poses as both an amazing advantage and disadvantage. The REI is now a permanent part of the University and demonstrates the Universities' efforts and goals of implementing renewable energy technologies on campus. This is seen as a threat in the sense of potentially losing touch with the grass root efforts of the student body which brought about the REI and continue to be the underlying theme behind appropriate technologies. The REI's change to a UFO also means that every three years (instead of fighting for the right to exists) the committee can request an increase to the budget from the fee committee.

Another important aspect of the REI becoming a UFO is the opportunity to adjust or rewrite the policy. This serves as an opportunity for the REI to address some key issues that have been troubling the REI since its conception such as education and outreach, energy and water conservation efforts, and managing revenue streams from renewable energy projects. What was initially viewed as a treating transformation for the REI has turned into an opportunity for the committee to reorganize and mold an improved policy towards desired goals.

New Member Search

New members for both Fall 2009 and Spring 2010 (see appendix H) proved to be a difficult issue and resulted in a strategic process. Because of the high amount of committee member turnover in upcoming semesters and the transition to a UFO, the committee decided to take on additional members.

During the Fall 2009 semester it was publicized that the REI would be accepting applications for one new member. This new member was intended to replace the vacancy left by Matt Parsons' graduation. One of the two non-voting members (Britt Bales and Christopher Robinson) was to become a voting member, and the new member assume the role of a non-voting (or later dubbed – deputy member) position and transition into a voting position. Upon interviewing all of the amazing applicants it was decided that three were specifically impressive and recognized to be important assets to the committee; the new deputy members that were chosen: Jon Ruth, Heather Kinsey, and Sean Hayes.

At the end of the Fall 2009 semester the REI lost two very important advisors: Patrick Beville and Dr. Brian Raichle. Patrick was the longest standing advisor for the REI (since its conception) and served as a crucial liaison between the Office of Design and Construction. Dr. Raichle served as a critical technical consultant for many of the REI projects and helped to initiate several feasibility reports and analysis. In order to replace these vacancies within the REI, the Office of Sustainability was invited to provide a representative as a staff advisor and Dr. Jamie Russell was invited to sit as a faculty advisor.

During the Spring 2010 semester it was publicized that the REI would be accepting applications for one new member. This new member was intended to replace the vacancy left by Matthew Anthony, Clary Franko, and Rio Tazewell. Three of the four deputy members would assume voting member status (current deputy Christopher Robinson was graduating). It was realized that a new position was being added, Data Management, and that it is beneficial to have two grant masters. To address these issues the committee decided to again take on three of the amazing applicants as deputy members; the new deputy members that were chosen: Katie Cavert, Katharine Lea, and Caitlin Stepp.

It was however noted by the committee that these are special circumstances and that the committee does not want to water down the responsibilities of members by taking on too many members.

At the end of the Spring 2010 semester the REI yet again lost two more very special people to the committee: Dr. Christopher Badurek and Dr. Jeanne Mercer-Ballard. Dr. Badurek has helped to guide the REI with several grant proposals and provided expertise with feasibility analysis; Dr. Mercer-Ballard has provided countless insights and opened access to a variety of design-related avenues. In order to replace these vacancies within the REI, the committee invited Lee Ball and Dr. Joe Cazier to join the REI as faculty advisers.

New Project Ideas

The REI is always excited and looking forward to beginning new projects. Projects that are in the REI's horizon include: REI project contest, mobile renewable energy display trailer, Kidd Brewer stadium scoreboard PV array, micro-hydro system, and a bio-digester.

REI Project Contest

The possibility of the REI holding a contest for students to submit their ideas for renewable energy projects they would like to see around campus has been an idea discussed several times throughout the past year as a way to raise awareness of the REI among students and engage interaction between the committee and the student body.

REI Mobile Display

Another idea that has been floating around discussions is the possibility of the REI funding a mobile renewable energy display trailer. The trailer would be fashioned in a similar fashion to that of DAISEE, but on a larger scale. It is envisioned that the display would be created out of a tractor trailer and could be hauled around to various events in the region, state, and nation to provide power needs and educate on renewable energy.

Kidd Brewer Stadium Scoreboard PV Array

An innovative idea from Jon Ruth has been to reach out to a broader audience by implementing another PV system in the form of the University's iconic 'A', fixed on the Kidd Bewer stadium scoreboard. This project would not only grow the REI portfolio, but develop an established partnership with the Athletic Department.

Micro-Hydro System

The long standing REI challenge of implementing a micro-hydro system onto the University's campus might finally have an innovative solution. Patrick Beville believes that the potential energy stored in the University's water tank can be harnessed by a micro-hydro system attached to the tanks outlet – as the University uses water, energy is generated from the pull of gravity. In order to maintain a truly renewable system the loop is proposed to be closed by implementing a PV panel to power the pump water into the tanks inlet. At the final Spring 2010 meeting, there

were several members that expressed interest in crunching numbers and determining the feasibility of this project.

Bio-Digester

An interesting concept the REI has been playing around with for a while potentially has the opportunity to be manifested through existing research. Katie Cavert is involved with bio-digester research and is excited to bring the idea to the REI's table. Katie has planned to submit a proposal to the EPA E3 competition, another potential innovative collaboration for the REI. The tentative project proposal would be a pilot-sized bio-digester to treat food waste leaving the new cafeteria, a size proportional to the demonstration biodiesel facility. The biogas could be used to heat the bio-digester itself. If the committee decides to scale up the project, food waste from the all cafeterias could produce biogas and be used to power campus cafeteria cooking needs.

Appendixes

Appendix A: Broyhill Turbine History and Project Timeline

Synthesized notes from March 19, 2010 interview of Crystal Simmons: Installation of the ASU REI Northwind 100 turbine

Oddly enough the turbine was the shortest of REI projects to be implemented. This was due to the fact that several different forces were invested in the successful erection of the turbine.

The conception of the Broyhill turbine had been a long time coming; ever since the MOD-1 on Howards Knob, it has been a common goal of university and industry stakeholders to bring wind back to Boone. With the establishment of the REI, the means for implementing this goal was now possible.

In 2005 Brent Summerville took the initiative as project manager to conduct the initial due diligence of performing a site suitability analysis of the ASU campus and other necessary preliminary studies. As time passed, so did the project change hands without much progress. In early 2008 co-project managers Crystal Simmons and Jonathan Pierson began the second stages of due diligence by continuing to build on Brent's research. Data analysis necessary to determine turbine design selection were produced and helped to estimate projected power curves and in turn the annual energy output (AEO) based on GIS data from AWS truewind resource estimates.

As Crystal assumed the role of project manager, she determined that focusing on prioritizing goals was needed to complete the project. Both Patrick Beville and Joe Smith were instrumental in determining the projects next steps. As an engineer in the Universities office Design and Construction, Patrick played an action role to making sure the Universities end of things ran smoothly. Joe a conceptual role and proved to be a crucial link between University and Industry partnerships. At wind trade conferences Joe connected with Wind Energy Consulting and Contracting (WECC) out of Charlotte, developers who helped the REI stay abreast of industry standards and updates and who helped to provide project estimates. By utilizing industry knowledge, Joe made the case for the Northwind 100 based on the fact that it looks like a familiar utility scale machine with a low cut-in speed of 3.4 m/sec, conducive to the area; additional design benefits of the Northwind 100 included the monopole which mitigated avian issues from guidelines and lattice structures, and the blades upwind from the generator.

Within the first month of determining the design and model, the steps began to buckshot and become nonlinear. Once the Northwind 100 was chosen, the AEO could be estimated, which led to the ability to produce visualizations (photo montages, fly arounds, flicker affects, and noise analysis) and site analysis to determine setbacks from the Broyhill Inn and Conference Center and telecom towers. Joe performed these preliminary technical analyses.

The next step was to determine who was the first stakeholder? It is understood throughout the industry that community buy-in is achieved through performing due diligence. Of course the first sell was to be the manager of the site where the turbine was to be located; Doug Uzelac was the manager of the Broyhill Inn and Conference Center and subsequently the first stakeholder to gain support from since it would be in his backyard. Crystal, Joe, Patrick and Ged Moody met with Doug to present the idea of the project to gain support. Doug, rightfully so, had reservations and concerns as to what his customers were going to think. Understanding his reservations, the REI members had an open and transparent conversation that addressed all of Doug's concerns. To Doug, the proof would be in the pudding and his concerns could not be confirmed until after he made a decision and the turbine was up. In the western North Carolina region, wind is a controversial issue. Watauga County, however, is one of the most receptive counties as a community base open to wind energy deployment. At the end of the REI presentation to Doug, Patrick closed the deal by asking if the REI could count on Doug to support the project: Doug agreed.

From that point, the pieces fell into place and the process became that much easier. Every step informally and qualitatively verified that the community was receptive to wind energy and allowed the project to slowly be publicized and leaked to media outlets. At some point the County Commissioners were informed of the prospectus project and relayed their support, 100%.

A partnership was fostered between the REI and local power provider New River Light and Power (NRLP). The partnership was not solidified before the discussion with Greg Lovins, but presented to NRLP and understood that they were open to the idea in order to meet the requirements of the state mandated Senate Bill 3. There was therefore the notion that they would participate, but unclear as to what degree financially. The REI was aware that it would take years to wait for the funds to accumulate, which meant there would be a lull and a continued process of the project dragging out. Patrick and Ged closed the deal of NRLP becoming a partner and convinced them to pledge $225K towards the project. The REI then re-committed a little more than previously, roughly $304K. Regardless of the renewable energy project, there needs to be good relations with utilities when putting power back onto the grid. Utilities are required to pay energy producers and avoid cost by putting power onto the grid per the Public Utility Regulatory Policies Act (PURPA) of 1978 – an initiative to decentralize energy production and conservation effort; in conjunction with the movement of people giving back to the land and an increasing interest in becoming self sufficient. Today having good relations with utilities goes a long way. We are still not at the end result of the relations; the idea now is to determine how all parties can benefit. With mandates that are coming down the line, such as the NC renewable energy portfolio standard and Senate Bill 3 it is a good idea to talk to utility companies and determine how it can benefit them, how both sides benefit?

The project was then pitched to ASU administration's vice chancellor of business affairs, Greg Lovins. Greg cared less about the technical analysis and more about the economic analysis. Greg wanted to know where the money was coming from and didn't care about payback; part of the presentation included the idea that payback was of no concern to the REI, it was purely of educational value – primarily in consideration of the institutions higher education curriculum in specialized knowledge in the field. An aspect of the financial underpinnings was to mimic real world experience of a growing commodity and industry situations. This included getting paid by utility companies for the power that was being put onto the grid, as well as selling the renewable energy credits (REC's) as a growing commodity in the market. The financial aspect was not about recovering the cost invested in the project, but rather the process of establishing a closed loop system. A major component of the project was the educational experience and to go through the motions, verify that the utility company are willing and able to buy the power that is generated.

There was about a 5 month lull after the funds were committed by REI and NRLP and both Doug of Broyhill and Greg of Administration supported the project during which the request for proposal (RFP) was being drafted. Joe submitted a draft that Crystal and Jonathan edited. Over the next 4 months it sat with the office of D&C where Patrick brought it up to snuff per NC mandates of RFP's. It is important to note in NC that RFP's under $500K are considered to be informal contracts and require far less dedication and headache. Fortunately, the estimates from WECC were under $500K, which turned out to be a great thing. In the RFP, Patrick included all proper paper work: NC contract lingo, a physical contract that would be signed, including a vetted 5-year maintenance warranty contract required by the public institution – the RFP was essentially the contract. The RFP was released to the public in November 2008 and the REI wanted bids in by mid December in order to avoid price increases of Northwind 100's by the beginning of the New Year. The RFP was sent to 7 different bidders, all of which requested an extension to the requested deadline: they needed to visit the proposed site, crunch numbers and generate estimates, and provide stamped drawings of the foundation. An important lesson was learned on behalf of the REI as the deadline was extended to account for technical needs on the ends of the bidders. Only 2 bids were submitted out of the 7 – had the deadline been of an appropriate timeline it was believed that all 7 developers would have submitted bids. The lowest bid came back at $522K and was awarded to Windwrights; the bid included

everything except electrical tie-in by ASU physical plant and NRLP electricians. The contract was awarded in early 2009 and logistics were negotiated by Patrick and Windwrights (later to become Alteris).

The last part of the technical analysis was to conduct an environmental impact analysis (EIA). Despite the possibility of receiving an undesirable conclusion, Crystal and the REI felt comfortable with the environmental impact of the project due to the existing infrastructure of the water tanks and telecom towers. Brent was called to perform an environmental assessment and Curtis Smalling of the regional Audubon Society representative to conduct the avian assessment, desktop studies of ecological sensitive zones and migratory flight paths. Within a couple of days a response letter was received by both parties verifying that the project was in the clear and not violating any ecological, migratory or historical/cultural zones.

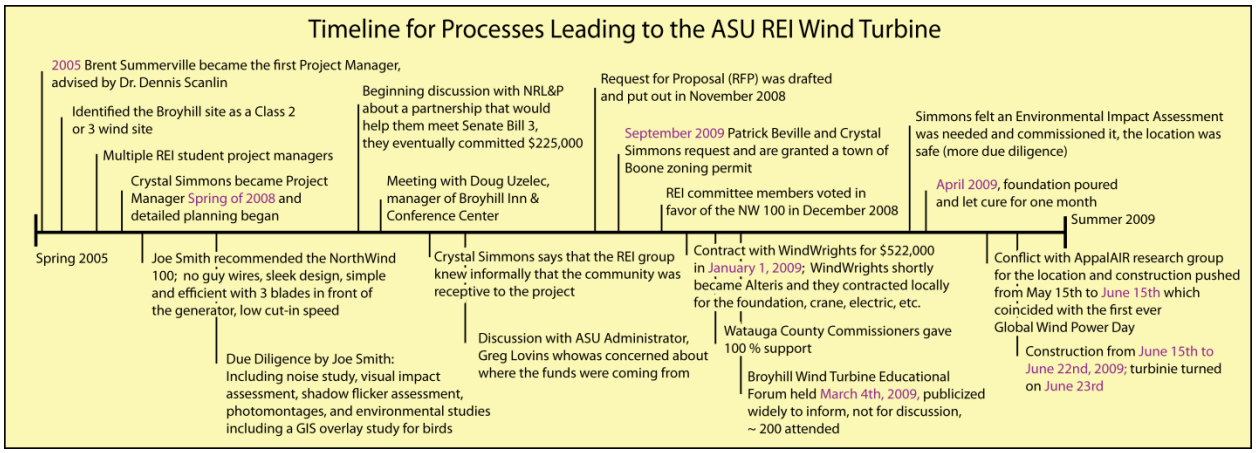
From the time of awarding the contract and the public forum, the location of the turbine changed from near the Northern end of the water tanks to the East of the Water tanks. In order to stay consistent with due diligence, the technical analysis was to be redone, regardless of the minimal change. At that time Joe was no longer with ASU, but rather moved on to work for the National Renewable Energy Laboratories (NREL). In the matter of 2 weeks Andrew Makee with the help of Dr. Brian Raichle recreated the entire technical analysis to coincide with the new location.

As far as due diligence and community buy-in goes, the next step was to host an informational forum. The REI was very explicit to note that the forum was not to seek approval or permission, but to address public concerns and educate the community on wind energy, allowing the community to become aware of the project and prepare for shock – to let everyone how the project might impact the community – what it will look and sound like, in an attempt to allow for the adjustment period and ease the shock after impacting the landscape – effects people in a variety of ways (emotionally and physiologically). The REI wanted to be responsible and alert the public.

The public was very receptive and provided great feedback at the forum, held on 3/4/10. The event was widely publicized throughout ASU campus and the community. Considering the state of wind in NC, the REI knew this innovative project would shatter the glass ceiling of wind issues in NC by providing a functional model that allowed people to experience firsthand wind energy and shift the paradigm of perspectives. A large majority of people had never experienced wind before… Watauga likes wind and wants more of it. 200 plus people from the community attended the event to support the project including mayor Clawson, Jeff Deal of Appalachian Voices and Steve Owen of AIRE. The question and answer session afterwards consisted of nothing but supportive responses. The continuum of support only grew.

There was a 2 month lull from March to May until the ground breaking of the project. The ground breaking was to start on May 15th, but was delayed for an additional month to account for logistical debates with the AppleAir climatological research project in close proximity to the turbine. The serendipitous rescheduling put the project starting date on June 15th, the first ever global wind day celebration – not planned, just happened. The REI and ASU administration learned from the AppleAir situation and better understand each other and function smoother because of the learning experience. The breakdown was traced to the office of Design and Construction failing to understand how the projects would impact each other. This experience served as a great example of how inclusive planning and communication only helps the development of projects.

The foundation was poured in April and set by May. The erection began on June 15th and was completed by the 22nd. Everyone on the job site was very excited about the project and thought it was the coolest thing to happen to Boone since the MOD-1; in fact the crane operator's father was the crane operator that installed the MOD-1. On June 23rd, the turbine was commissioned by NorthenPower and turned on. As of 3/19/10, the turbine has generated over 85K kWh of electricity.


Timeline for Processes Leading to the ASU REI Wind Turbine
2005 Brent Summerville became the first Project Manager, advised by Dr. Dennis Scanlin
Identified the Broyhill site as a Class 2 or 3 wind site
Multiple REI student project managers
Crystal Simmons became Project Manager Spring of 2008 and detailed planning began
Beginning discussion with NRL&P about a partnership that would help them meet Senate Bill 3, they eventually committed $225,000
Meeting with Doug Uzelec, manager of Broyhill Inn & Conference Center
Request for Proposal (RFP) was drafted and put out in November 2008
September 2009 Patrick Beville and Crystal Simmons request and are granted a town of Boone zoning permit
REI committee members voted in favor of the NW 100 in December 2008
Simmons felt an Environmental Impact Assessment was needed and commissioned it, the location was safe (more due diligence)
April 2009, foundation poured and let cure for one month
Summer 2009
Spring 2005
Joe Smith recommended the NorthWind 100; no guy wires, sleek design, simple and efficient with 3 blades in front of the generator, low cut-in speed
Due Diligence by Joe Smith: Including noise study, visual impact assessment, shadow flicker assessment, photomontages, and environmental studies including a GIS overlay study for birds
Crystal Simmons says that the REI group knew informally that the community was receptive to the project
Discussion with ASU Administrator, Greg Lovins whowas concerned about where the funds were coming from
Contract with WindWrights for $522,000 in January 1, 2009; WindWrights shortly became Alteris and they contracted locally for the foundation, crane, electric, etc.
Watauga County Commissioners gave 100 % support
Broyhill Wind Turbine Educational Forum held March 4th, 2009, publicized widely to inform, not for discussion, ~ 200 attended
Conflict with AppalAIR research group for the location and construction pushed from May 15th to June 15th which coincided with the first ever Global Wind Power Day
Construction from June 15th to June 22nd, 2009; turbinie turned on June 23rd

Appendix B: PSU Solar Thermal Owner's Manual

SYSTEM MANUAL

System description, operation and maintenance manual for:

ASU Plemmons Student Union Solar Water Heating System

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OVERVIEW: The Plemmons Student Union hot water service has been supplied by conventional steam-powered indirect water heaters. The University's steam boiler supplies the water heaters through insulated piping. The condensing steam is a very powerful energy source to the water heaters and hot water supply to the facility has been proven significant. The boiler is fed by either fuel oil or natural gas, a decision made based on current pricing and availability.

REI funded the Engineering design, purchase and installation of a solar thermal collector system to preheat the indirect water heaters thereby reducing boiler fuel consumption. The design called for "drain back" solar configuration so that the collectors drain when not in use. This eliminates freeze potential as well as high temperatures and pressures common in "closed-loop" solar configurations operating at low, or no loads.

The system includes (42) solar collectors, (3) 400 gallon storage tanks with internal heat exchangers, and the associated pumping, piping and controls. Performance to date has been impressive with storage tank temperatures often reaching 140^{o} F. This Manual will summarize the system design, components, operation and maintenance.

SYSTEM DESIGN: (42) solar collectors were installed on the Student Union's flat roof. The 4' x 10'collectors were divided into two rows of (21). Collectors were further grouped in (7) parallel-flow banks with common 1" inlet/outlet piping.

(5) 7-collector banks utilize conventional glass-glazed Solar Development Inc. (SDI) "SD-8" collectors with the remaining bank consisting of prototype SunQest lightweight collectors. The latter utilizes a spring-loaded Tefzel^{tm} glazing system that reduces weight and provides excellent transmittance performance, durability and long-term weather ability.

The solar collectors circulate with the (3) Trendsetter 400-gallon storage tanks located in the building's main mechanical room on the lower level. When the system is off, the collectors drain into the storage tanks. A 3-phase, 1 HP Grundfos pump pulls water from the bottom of the tanks and pumps it to the inlet (bottom left corner) of each collector bank. Collector banks were plumbed in "reverse-return" fashion to provide even flow to each bank. Insulated 2 ½" copper was used as the common supply and return piping between the roof array and the storage tanks. Flow is returned to the (3) storage tanks below water level to reduce noise.

An IMC "Differential Controller" controls the system operation by activating the pump based on the temperature difference between the collectors and the lower part of the tanks where the temperature is the coolest. The controller has a built-in digital display to observe the real time collector and storage tank temperatures as well as recent highs and lows. Two added "Aux" sensors were included for informative purposes having nothing to do with the Differential Controller operation. One Aux sensor allows the output temperatures between a 7-collector glass-glazed bank and that of the 7-collector prototype collectors. The other Aux sensor measures the temperature of the hot water being delivered to the school. Additionally, the controller has a serial port connection for long-term data logging of all four sensors.

Heat exchangers are submerged in the upper half of the storage tanks to exchange the heat from the hot solar drain-back water and the clean pressurized water feeding the steam-fired

indirect water heaters. (3) ¾" diameter, 50' long coils of thin-wall stainless steel corrugated tubing serve as the heat exchangers for each tank. The (9) total heat exchangers are again plumbed in reverse-return fashion to provide even flow through each.

We encountered a number of problems with the Trendsetter tank heat exchangers including failure due to pressure spikes within the schools potable water distribution and perhaps fatigue cracking in the thin-wall SS heat exchanger piping. The latter has not been substantiated. The heat exchangers have been reworked with damaged areas being cut out and new compression fittings installed. There have been no failures recently.

To minimize the flood issues upon heat exchanger failure, we added an overflow port and plumbed it to the nearby floor drain. It is hoped that if there is another failure, the maintenance crew will see the evidence without having to pump out the mechanical area.

There are two indirect water heaters; one next to the storage tanks and the other in the remote mechanical area. The cold supply water to the adjacent indirect water heater was rerouted through the submerged heat exchangers thus picking up the storage tank heat prior to feeding the indirect heater. Insulated 1 ½" copper piping reroutes the remote heater's supply water through the tank heat exchangers to again preheat that indirect water heater. A circulation pump was installed to keep the long piping run hot improving solar contribution.

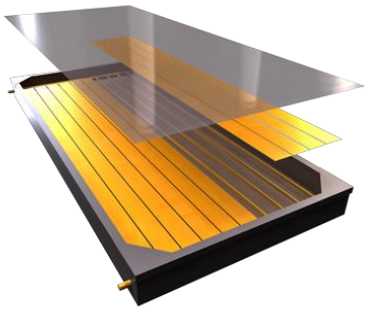
System drawings are included in Attachment 5.

COLLECTOR COMPONENT: All collectors utilize welded copper absorber plates, closed-cell isocyanurate insulation, aluminum extrusion sides and aluminum back sheet. Ultrasonic welding joins the 4 5/8" wide fin to the 3/8" nominal "riser" tube to comprise one of (10) fintube assemblies. The fintubes are brazed into common 1" headers to make the absorber plate. The copper fin material was pre-coated "black chrome" to lower the emissivity and associated radiant heat loss.

Glass-glazed collectors utilize a conventional "C" shaped side extrusion. The gasketed glass sets on top of the extrusion and a smaller 1" aluminum angle extrusion holds the glass in place. The glass is heavy and has some transmission losses, but is time-proven and durable.

The prototype lightweight collectors utilize a custom side extrusion that provides a rounded top for the dynamically-tensioned Tefzel[tm] glazing material and a receptacle for the associated tensioning springs. A 1" loop is heat sealed around the Tefzel[tm] perimeter where an aluminum rod is inserted. Stainless steel springs puncture the Tefzel and snap over the rod. The other end of the spring clips into the extruded receptacle below. As wind and impacts from foreign objects load the glazing, the springs extend and compress accordingly providing even tension across the surface.

The manufacturer's collector information and warranty statements are included in Attachment 2.



TANK COMPONENT: The storage tanks were manufactured by Trendsetter. Each tank is about 3' wide, 5' long and 5' tall with a capacity of approximately 400 gallons. The walls, floor and lid of the tanks are what's often called "stress skin panels" consisting of thin embossed aluminum skins separated by 3" of polystyrene foam. Several aluminum extrusion profiles were used to form the frame to hold the panels in place and to support the water weight. An EPDM rubber liner was installed inside the formed tank to provide a long-lasting, waterproof seal.

The heat exchanger and collector connections are provided on top between the removable lid panel sections. Initially there were no equalizing lines between the tanks creating problems with maintaining proper tank levels over time. That was corrected by installing through-wall fittings and interconnect 1 ½" piping so that water can flow between tanks to equalize levels. After the update, the tank levels remain nearly equal.

A tank site level tube was also added as an easy reference for periodic tank water adage to compensate for evaporation. A ½" ball valve turns on the water fill when required. Float valves in each tank will turn the water off when that tank is full.

Tank level adjustment must only be done when the system is off and the collectors fully drained back. If "topped off" when the system is running, the 70 gallons or so of drain-back water will overflow the tanks. We consider this to be an oversight on Trendsetter's part but has been rectified with the site level gauge, the ½" shutoff valve, and instructions for the maintenance crew.

The manufacturer's tank information and warranty statement are included in Attachment 3.

COLLECTOR PUMP: A high head, high flow pump was used to circulate the tank water with the collectors approximately 35' above. The Grundfos 1 HP pump sucks water from a level about 8" off the tank bottom. Due to the manufacturer's unwillingness to provide through-wall fittings, the piping extends vertically from the tank top before extending horizontally and then down below water level. The pump was located approximately 12" above floor level to provide good suction supply head pressure once the pump and associated piping are primed. A hose bib was placed conveniently above the pump to allow quick priming with a water hose.

The pump is 3 phase, is controlled by the Differential Controller, and has a labeled disconnect in the adjacent electrical switchgear.

The manufacturer's pump information and warranty statement are included in Attachment 4.

DIFFERENTIAL CONTROLLER COMPONENT: IMC was selected as the controller supplier. Temperature sensors are located on the output header of the collectors and in the lower section of the storage tanks. The differential is adjustable but preset to 14^{o} meaning that the controller won't turn the pump on until the collectors reach a temperature 14^{o} higher than the lower part of the storage tanks. To prevent wasting pump power when minimal solar gain, the controller turns the pump off when the temperatures are with 4^{o} of each other.

Two "Auxiliary" sensor inputs are available for monitoring. They have nothing to do with the controller operation. One auxiliary sensor monitors the temperature of the tank upper level and the other monitors the output temperature supplying the indirect water heaters.

The controller was equipped with a serial port to allow long term data collection. With the University's assistance, a laptop computer was connected to tally the information and if desired, make it available over the internet.

The manufacturer's pump information and warranty statement are included in Attachment 1.

SYSTEM MAINTENANCE: The required solar system maintenance is limited to:

Checking storage tank levels and adding water if required.

The site level tube shows the water level and should be checked first thing in the morning before the system turns on.

If water needs to be added, open the labeled "Cold Fill Valve" above the left-most tank. Although the internal float valves will shut the water off once the tank is full, the Cold Fill Valve must be turned off as soon as the tanks are full. Otherwise, the internal float valves will refill the tanks when the system turns on and the level drops as the collectors and associated piping are filled.

Checking the rooftop collector array for possible storm and other damage.

Checking temperature display on the Differential Controller to compare collector and storage tank temperatures.

The two should be within 15^{o} if the system is pumping correctly.

Higher differentials indicate a flow problem.

CONTRACTOR WARRANTY: The solar system is warranted against workmanship issues for a period of 1 year from the time of "substantial completion" noted as 11/25/2009. Component manufactures also have warranties that typically extend much beyond the 1 year.

If a component fails within the 1 year Contractor Warranty term, we will, provide the associated diagnostic and installation labor. Typical response time will be within 24 hours although weather can be a factor in the Boone area.

Appendix C: Ivory Tower Project Proposal

State of North Carolina, RFP# 200900845, Renewable Energy Projects

This proposal will install a solar thermal system on the campus of Appalachian State University (ASU). The system will provide hot water to the newly created Ivory Tower Brewery located in the _royhill Inn and _onference _enter on !SU's campus. The brewery was established as a research/teaching laboratory to support both interdisciplinary coursework and a proposed Fermentation Science concentration in the Department of Chemistry. It is the only non-profit, university-based research brewery in the country, and the only one that is committed to zero-carbon brewing. The matching funds will be provided by !SU's Renewable Energy Initiative (REI), a student led organization that implements renewable energy projects on campus. The total project cost is $20,000.

1. Corporate Background and Experience

Appalachian State University is one of the 17 constituent campuses of the University of North Carolina System. The university currently enrolls approximately 15,000 students and has an annual budget of 249 million dollars. The University has a building inventory of over 100 buildings consisting of over 2.5 million square feet on a 65 acre main campus area. As such the University has a complete Physical Plant and an office of Design and Construction to handle renovations and construction of facilities and infrastructure. The University has housed an Appropriate Technology Academic unit for more than 25 years. This academic unit has provided research and education regarding renewable energy technologies and installation. Appalachian State University also has the Renewable Energy Initiative, an award winning student group that has installed renewable energy systems directly on campus including solar PV, solar thermal, biodiesel and the largest wind turbine in the State of North Carolina (see attached). Each project is assigned a student project manager who works closely with the contractor and !SU's Office of Design and Construction. Appalachian State University is the clear leader in the University of North Carolina system regarding renewable energy initiatives and uses.

2. Project Staffing and Organization

The University will utilize one of its project managers from the Office of Design and Construction to manage the project. Patrick A. Beville, PE, LEED AP, will serve as the project manager (see attached). He has served as a project manager for the University for over 8 years and has 19 years of project management experience. Mr. Beville has overseen $100M in construction projects including over $60M for Appalachian State University in the past 8 years (including over $1M in renewable energy projects).

The Renewable Energy Initiative will assign a student to serve as a student project manager in conjunction with the primary project manager. As this is a project on state property, a final system design will be submitted to the State Construction Office for approval and an informal bidding process will be utilized to choose a contractor for installation of the system. The lowest responsive bidder will be chosen for the project.

3. **Technical Approach** This proposal will install a solar domestic water heating system at the Broyhill Inn and _onference _enter on !ppalachian State University's campus. This system will provide a significant fraction of the brewery's hot water energy requirements.

Location

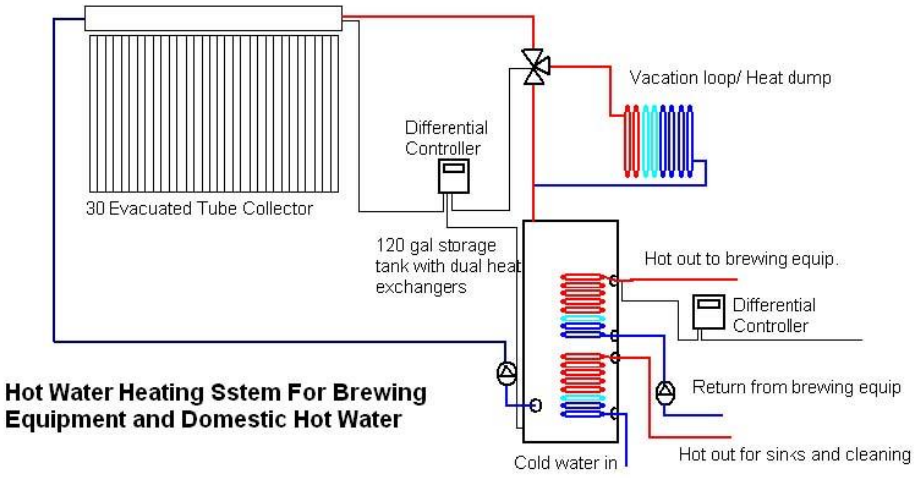
The proposed solar thermal system will be located in the Broyhill Inn and Conference Center on !ppalachian State University's campus Watauga County. "The Broyhill" hosts events that attract both on- and off-campus clientele, and is also the location of the REI's newly commissioned Northwind 100, the largest wind turbine
in North Carolina.

The Broyhill houses Ivory Tower Inc., an educational brewery owned and managed by the president, Dr. Brett Taubman, an assistant professor in the Chemistry Department at Appalachian State University. The brewery will educate students at Appalachian State University in the production of high quality, fresh beer for the Broyhill Inn and Conference Center. The brewery will offer an educational opportunity for students in an industry that continues to show strong growth in a weak economy (5% by volume and 9% by dollars in the first half of 2009). Students will be trained in the daily operations of a commercial brewery, gaining experience in the technical aspects of brewing as well as in running a small business.

Description

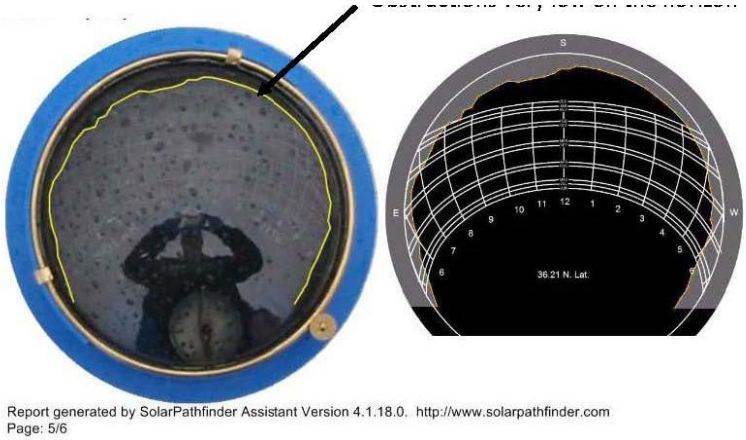
The first step toward developing a sustainable brewery is to provide the required hot water needs by a solar thermal system. The necessary temperatures, between 160°F and 180°F suggest that heat pipe evacuated tube collectors be used. A 120 gallon tank will store the collected energy. Operation will in effect be as a drainback system, with storage water circulating directly through the collectors. Useful energy will be extracted from the tank via an upper internal heat exchanger. Energy recovered from cooling the hot wort will be transferred to the tank via a lower heat exchanger. Because the solar system may operate for several days without a load, a heat dump is provided to dissipate excess energy.

A local renewable energy design and installation company (High Country Energy Solutions), in consultation with REI members, has provided a cost estimate and parts list. Specifically, a Thermomax Mazdon 30 tube collector array is speced, coupled with a Heat Transfer Products SSC119SB storage tank with dual heat exchangers. The Mazdon collector is not domestically manufactured; there are no domestic high temperature solar thermal collectors manufactured in the US. These major components and the balance of system will be commercially available components.



Site assessment

REI members have performed a site assessment of the _royhill's solar resource using Solar Pathfinder, the output of which is included in the Appendix. There are no obstructions to the proposed location of the collectors, as shown in the following figure.



Obstructions very low on the horizon

Energy Saved

Each gallon of beer brewed requires around five gallons of water at ground water temperature (55°F) to be heated to and maintained at 170°F for several hours. It is estimated that the brewery will process two 20 gallon batches (each requiring 100 gallons of hot water) per week, with future expansion in the planning stages. Therefore the energy requirement per week is 190,000 Btu, or around 9.5 MBtu annually. It is estimated that the solar thermal system will provide around ½ of the energy needed to raise the temperature of the water, since the tank (initially at the desired final temperature) and the brew (at ground water temperature) are of the same volume and will thermalize at around the average temperature. This is likely an underestimate of the solar fraction, since the brewing will likely be conducted during hours of solar gain, and residual heat in the tank will be utilized for washing. Therefore, this solar system will save an estimated 5 MBtu annually.

Monitoring and Data Acquisition

In addition to satisfying the reporting requirements of the funding agency, as a research facility monitoring of system performance is an important indicator of success. A data acquisition system will be implemented using a Campbell Scientific CR1000 data logger using LoggerNet software.. Operating temperatures will be measured using Campbell Scientific 108-L temperature sensors, and flows measured with SeaMetrics SEB turbine flow meters, thus allowing the calculation of energy harvested and energy delivered to the brewery. In addition, a LI-COR 200x pyranometer will measure solar irradiance. These data will be analyzed and results made publically available online and at the REI Campus Dashboard energy information kiosk, the clearinghouse for campus energy consumption

and generation information.

Educational Aspects

The primary mission of Ivory Tower Brewery and the REI is education, which makes this partnership so attractive.

The brewery will be a truly interdisciplinary endeavor. Student from the Chemistry, Biology, and Technology departments will assist in all areas related to the daily operation of the brewery. Research students will gain experience in: 1) Chemistry – separations, quantitative analysis, and instrumental techniques that can translate to any discipline; 2) Biology – yeast propagation and strain development, onsite hop production; and 3) Technology – novel, energy efficient and carbon-neutral brewing system designs. Students in the Walker College of Business will be responsible for advertising, promotions, purchasing, inventory control, and the management of retail sales associated with the brewery.

A novel Junior Seminar course HON 3515: The Science, History, and Business of Brewing, is being designed around the Ivory Tower Brewery and will be offered in Spring 2010.
The course will be collaboratively taught by Drs. Taubman (Chemistry), Shea Tuberty (Biology) and Ben Sibley (Health Leisure and Exercise Science). The course will provide a rigorous coverage of the chemical, biological, and physical processes that go into brewing malted beverages, the history of the production and consumption of fermented beverages and their cultural context, and the financial, managerial, and marketing considerations that are required to run a small brewery. A Chemistry concentration in Fermentation Science is under development.

Additionally, research in brewing science will be conducted as part of the Heltzer Honors Program and Chemistry curricula, offering further opportunities for students to gain valuable hands-on, real-world experience.

The REI has successfully installed several renewable energy projects on campus, including PV, solar thermal, biodiesel, and most recently the largest wind turbine in North Carolina. All REI projects include an educational component to educate the campus and community about renewable energy, as well as providing valuable project management experience for the REI student project managers. If awarded, the facility will be available for tours upon request.

Greenhouse Reduction

Backup heat will be provided by propane burners. It is estimated that the solar thermal system will displace around 5 MBtu of energy annually. With an energy density of 95,000 Btu/gallon and 70% efficient burners, around 76 gallons of propane will be displaced annually. Carbon emission from the combustion of propane is 63 kg CO2/MBtu, so this will displace the production of 0.5 metric tons of CO2 annually.

Jobs Created

Because of its small size, the project will provide a unique opportunity for a start-up installation company with little commercial experience to work on a state project.

Ivory Tower and the related courses are designed to stimulate regional economic growth in Western NC through agricultural development by growing hops as a conversion crop from tobacco, the use of agricultural products such as hops, barley, and adjuncts in beers, and by providing the spent grains as feed for local livestock. In addition, Ivory Tower will stimulate revenue for the Broyhill and local businesses by attracting tourism, regional research support for the craft-brewing industry, and training for the next generation of brewing scientists, brewmasters, and business owners.

Warrantee, Maintenance, etc.

The RFQ issued for this project will require a maintenance contract.

Schedule

This project can be completed rapidly. The system design is nearly fully developed and the space is not currently used for other purposes. When funded, the bidding process will begin immediately, with installation to begin immediately after. A February 2010 completion date is anticipated.

Bidding Process	Nov 09 – Dec 09

Step	**Duration**
Construction	Jan 10 – Feb 10
Commissioning	Feb 10
Monitoring & reporting	Feb 10 – Feb 11

Outsourcing No work associated with this project will be performed by workers located outside the United States. Further, American-made components will be selected whenever possible. **Cost Proposal**

The estimated total cost of the proposed solar thermal system is $20,000, of which $10,000 will be provided as matching funds by !SU's Renewable Energy Initiative. !n itemized estimate from High Country Energy Solutions, a local renewable energy installer and potential bidder for the contract (see attached). In summary,

Item	Cost
Personnel costs (170 Hrs @ $20/hr)	$3,400
Equipment costs	$15,400
Maintenance plan	$1,200
Total	$20,000

Site Report

Report Name	Broyhill Solar Thermal
Report Date	9/17/2009 3:46:42 PM
Declination	-6d 50m
Location	Lat/Long specified
Lat/Long	36.21 / -81.69
Weather Station	Hickory Rgnl AP, NC, Elevation: 1,142 Feet, (35.733/-81.383)
Site distance	37 Miles
Report Type	Thermal
Array Type	Fixed
Tilt Angle	36.21 deg
Ideal Tilt Angle	36.21 deg
Azimuth	180.00 deg
Ideal Azimuth	180.00 deg
Collector Make	Thermomax Ind
Collector Model	Solamax AST20
Collector Area	26.9 Sq. Feet
Collector Count	5
Total Collector Area	134.3 Sq. Feet
Solar Fraction	0.95
Annual Production	13.20 Million BTU
Electricity Saved	4,205.4 KWH
Annual Savings	$378.49
Collector Fluid	Water
Layout Configuration	SinglePicture
Layout Point Count	1

Notes: Site assessment for the sustainable brewery.

Report generated by SolarPathfinder Assistant Version 4.1.18.0. http://www.solarpathfinder.com

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System Picture Layout

Layout Type Single Picture
Layout Point Count 1

Report generated by SolarPathfinder Assistant Version 4.1.18.0. http://www.solarpathfinder.com
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Thermal Energy Cost Savings

Energy Source Used to Heat Water

Energy Source	Electricity
Energy Efficiency	100.0 %
Energy Cost	$0.0900 per KWH
Total Electricity Saved	4,205.4 KWH

Estimated Monthly Savings

January	$30.12
February	$24.48
March	$31.74
April	$32.88
May	$33.97
June	$32.88
July	$33.97
August	$33.97
September	$32.34
October	$33.97
November	$27.64
December	$30.53
Annual Savings	$378.49

Notes: Site assessment for the sustainable brewery.
Report generated by SolarPathfinder Assistant Version 4.1.18.0. http://www.solarpathfinder.com
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Thermal Data Input Assumptions

Estimated Average Daily Hot Water Usage (gallons/day)

January	50.0
February	50.0
March	50.0
April	50.0
May	50.0
June	50.0
July	50.0
August	50.0
September	50.0
October	50.0
November	50.0
December	50.0

Other Assumptions

Tank Temperature	135.0 °F
Water Supply Temperature	55.0 °F
Main Tank Volume	120.0 Gallons
Secondary Tank Volume	0.0 Gallons
Heat Exchanger Efficiency	70.00 %

Notes: Site assessment for the sustainable brewery.

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Solar Site Analysis Report

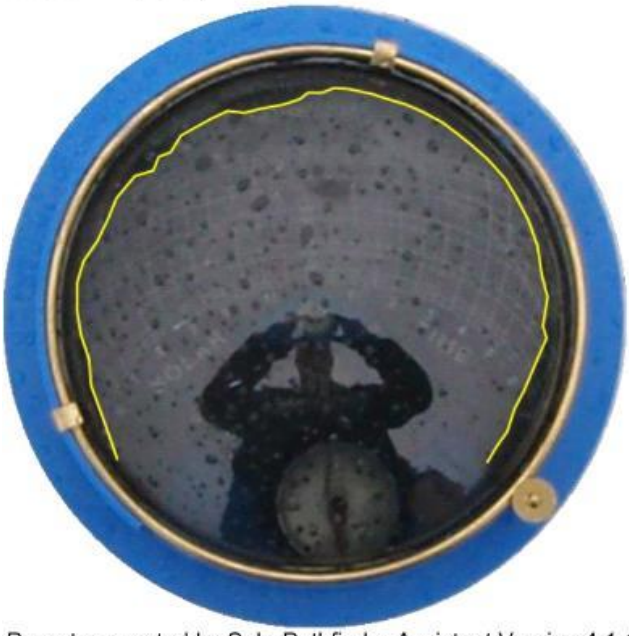
1

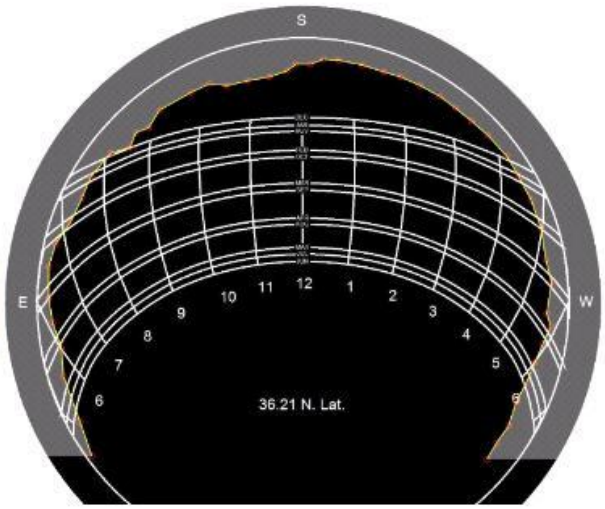
Image File P9173491.JPG

Solar Obstruction Data

Month	Unshaded % of Ideal Site Azimuth=180 Tilt=36.21	Actual Solar Rad w/ Shading Azimuth=180.0 Tilt=36.21 KWH/m^2 /day	Solar Hot Water Actual Cost Savings Electricity $0.09/KWH	Solar Hot Water Solar Fraction Azimuth=180.0 Tilt=36.21	Solar Hot Water Produced Azimuth=180.0 Tilt=36.21 MMBTU	Solar Hot Water Demand Azimuth=180.0 Tilt=36.21 MMBTU
January	97.36%	4.18	$30.12	0.89	1.05	1.19
February	98.31%	3.64	$24.48	0.80	0.85	1.07
March	98.71%	4.37	$31.74	0.93	1.11	1.19
April	99.33%	5.38	$32.88	1.00	1.15	1.15
May	99.20%	5.58	$33.97	1.00	1.19	1.19
June	99.08%	5.87	$32.88	1.00	1.15	1.15
July	98.89%	5.03	$33.97	1.00	1.19	1.19
August	99.10%	5.35	$33.97	1.00	1.19	1.19
September	99.09%	4.55	$32.34	0.98	1.13	1.15
October	99.40%	5.87	$33.97	1.00	1.19	1.19
November	98.01%	3.77	$27.64	0.84	0.96	1.15
December	97.13%	4.20	$30.53	0.90	1.07	1.19
Totals	**98.63%**	**57.78**	**$378.49**	**0.95**	**13.20**	**13.95**
	Unweighted Yearly Avg	**Effect: 98.44% Sun Hrs: 4.82**				

Notes: [None]





Report generated by SolarPathfinder Assistant Version 4.1.18.0. http://www.solarpathfinder.com
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Summary Report

Solar Obstruction Data

Month	Unshaded % of Ideal Site Azimuth=180 Tilt=36.21	Actual Solar Rad w/ Shading Azimuth=180.0 Tilt=36.21 KWH/m^2 /day	Solar Hot Water Actual Cost Savings Electricity $0.09/KWH	Solar Hot Water Solar Fraction Azimuth=180.0 Tilt=36.21	Solar Hot Water Produced Azimuth=180.0 Tilt=36.21 MMBTU	Solar Hot Water Demand Azimuth=180.0 Tilt=36.21 MMBTU
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March	98.71%	4.37	$31.74	0.93	1.11	1.19
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Totals	**98.63%**	**57.78**	**$378.49**	**0.95**	**13.20**	**13.95**
	Unweighted Yearly Avg	**Effect: 98.44% Sun Hrs: 4.82**				

Notes: Site assessment for the sustainable brewery.

Report generated by SolarPathfinder Assistant Version 4.1.18.0. http://www.solarpathfinder.com

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HIGH COUNTRY
ENERGY SOLUTIONS
INC
828.265.2683 | PO Box 103 | Sugar Grove, NC | 28679 | HighCountryEnergySolutions.com

For: ASU REI Regarding: Solar Thermal Hot Water Heating System For Brewery at Broyhill 9/16/09

Materials:

Thermomax Mazdon 30 Evacuated Tube Collector

System……..…….…

…..$6,000.00 Heat Transfer Products Model SSC119SB 119 gal

Storage Tank

w/ Dual Heat

Exchangers……..…….……$2,500.00

Differential Controllers and

Pumps…..……....$1,900.00 Other

materials

(insulation, Copper, Fittings, Valves, and hardware,

etc.)..……..…..$1,700.00 Heat Dump

Radiator……...$800.0

0 Monitoring

System……...$2,500.0

0 Labor

…….……..……..…….$3,

400.00 10 Year Maintenance

Plan…….$1,200.00

Total System

Cost……$20,000.00

NOTE: 1. All solar equipment is SRCC rated (OG-100)
2. All electrical components are UL listed.

Maintenance Plan: This estimate includes a ten year maintenance plan that includes yearly service, which will need to be scheduled with the operations manager.

Warranty: High Country Energy Solutions, Inc. warranties the installation for a period of five years on new parts and ten years on labor not covered by the manufacturer.

Exclusions/maintenance: High Country Energy Solutions, Inc. warranty does not cover catastrophic acts of nature or damage caused by operator negligence.

Please feel free to contact us with any questions.

Thank You, Kent Hively

H.C.E.S.

Panel size 1,000 Watts per meter sq BTUs collected per sun hour BTUs per panel per day (4 sun hour BTUs per deg-pound Delta T (assuming 55deg H2O is

heated to 115deg F) #gallons of H2O per week total BTUs required per day Number of panels required mmBTUs collected per day mmBTUs collected per week mmBTUs collected per year lbs of CO2 emitted per mmBTU of

Nat. Gas* lbs CO2 eliminated per day lbs CO2 eliminated per year tons of CO2 eliminated over 20 year Brewery CO2 reduction

length ft width ft area (meter sq.) 4 10 3.72 3720.93

Watts 12688.37 BTUs 50753.49 BTUs per day

8.33 BTUs

60 degrees 200 gallons 14280 BTUs

0.3 panels

0.0143 mmBTUs

0.10 mmBTUs

5.212 mmBTUs

117.08 lbs CO2

1.67 lbs CO2

610.24 lbs CO2 6 tons CO2

*Source of lbs of CO2 per mmBTU http://www.eia.doe.gov/oiaf/1605/coefficients.html

From: Tommy Wright [mailto:wrighttf@appstate.edu]Sent: Friday, September 18, 2009 10:33 AMTo: Patrick A. Beville Cc: Erica Tate Subject: REI Fund(s) Availability

Patrick,

As the individual that provides oversight to the REI fund, Iacknowledge the availability of funds for the expenditure of$10,000 to be used in conjunction with a $10,000 matching grantfrom the State Energy Office for a solar thermal project that isprojected to not exceed a total cost of $20,000.

Thanks

Dr. Tommy WrightAppalachian State UniversityDirector of Administrative Support ServicesOffice of Student DevelopmentDougherty Administration BuildingBoone, NC 28608-2117828.262.2060 (t)828.262.2615 (f)

REI Projects and Respective Maintenance/Revenue Reports

1. Biodiesel B20 Tank *Dale Street*

This renewable energy system provides a blend of B20 biodiesel to ASU. This project was co-funded by the REI and ASU. This tank is integrated into the physical plant's refueling facilities, and the University receives all benefit from this system. All funding parties agree that maintenance associated with this system will be the sole responsibility of ASU. This agreement was reached with Mr. Mike O'Connor, Physical Plant Director on June 9, 2009.

2. Biodiesel Solar Thermal *Ayers Lane*

This renewable energy, hot water-generating system provides hot water needs for the biodiesel research facility. The project was co-funded by the REI and the student grant money awarded to this project from the EPA's P3: People, Prosperity and the Planet Student Design Competition for Sustainability. This system is highly integrated into the biodiesel production capabilities of the research center. The energy provided by this system greatly reduces the need for purchased energy to heat the oil for biodiesel production. All funding parties agree maintenance associated with this system will be solely the responsibility of the biodiesel facility. This agreement was reached with Dr. Jeffrey Ramsdell on Friday 20 March 2009.

3. Biodiesel Photovoltaic Array *Ayers Lane*

This renewable energy, electricity-generating system provides electrical energy to the grid. This project was funded solely by the REI. The REI assumes all responsibility for maintenance and receives all monetary benefit associated with this facility.

4. Katherine Harper Hall Photovoltaic Array *Rivers Street*

This renewable energy, electricity-generating system provides electrical energy into Harper Hall, reducing the building's need for purchased electricity. This project was co-funded by the REI and Department of Technology. The majority of the cost of this project was funded by the Department of Technology. All funding parties agree maintenance associated with this system will be the responsibility of the Department of Technology. This agreement was reached with Dr. Dennis Scanlin in April 2009.

5. Raley Photovoltaic Array *Howard Street*

This renewable energy, electricity-generating system provides electrical energy to the grid. This project was funded solely through the REI. The REI assumes all responsibility for maintenance and receives all monetary benefit associated with this facility.

6. Plemmons Student Union Solar Thermal *Plemmons Student Union*

This renewable energy, hot water-generating system provides hot water needs for the Plemmons Student Union (PSU). This system was fully funded by the REI. This system is highly integrated into the hot water supply system of the student union. The energy produced by the system greatly reduces the student union's need for purchased electricity to provide hot water. All maintenance for this system will be the responsibility PSU. This agreement was reached with Dave Robertson on in 2008.

7. Broyhill Wind Turbine *Bodenheimer Drive*

This renewable energy, electricity-generating system provides electrical energy to the grid. This project was co-funded by the REI and ASU through New River Light & Power Co. At an installation cost of $533,000, the overall equitable value split based on the proportion of capital investment made by REI is 58%, and NRL&P is 42%.

All maintenance for this system will be the responsibility of REI. The revenue streams from this facility will be split according to proportion of capital investment contributed by each investor, REI (58%), NRL&P (42%).

Appendix D: System Monitoring Memo

Memo of Understanding between the ASUREI and the ASU Physical Plant on the terms of the purchase and use of Building Dashboard Monitoring Systems

The ASU Physical Plant is installing Building Dashboard for its own purposes and has offered to include REI's completed and in-progress renewable energy projects listed below in the initial installation. The REI is appreciative of this offer and would like to accept with the understandings laid out below.

In the year 2009, the physical plant will cover the initial $2,500 per location setup fee, the $950 fee per additional meter at each location, and the first twelve years' annual service fee per location (currently $500 per location) for the following completed projects:

- Biodiesel Cooperative Facility – 1 Photovoltaic and 1 Solar Thermal
- Harper Hall – 1 Photovoltaic
- Raley Hall – 1 Photovoltaic
- Plemmons Student Union - 1 Solar Thermal
- Broyhill Inn – 1 Wind Turbine

After the first twelve years of fees the REI may be required to cover any further annual service fees if the Physical Plant does not choose to continue this monitoring service.

Any future setup or monitoring fees associated with and future REI projects not included in the above list will be the responsibility of the REI. The current setup and monitoring fees for such additional projects are quoted by Richard Hermansson with Pepco Energy Services in March of 2009 as being as follows:

- $2,500 setup fee per building or point of service (fee includes one meter)
- $950 setup fee for each additional meter at an already metered location
- $500 per location annual service fee for tech support, transmitting and maintaining our data and website on the monitoring company's servers *(this annual service fee is not applicable for locations already monitored under the current agreement).*

The REI can end this agreement if the committee members feel it is necessary and in the event of such termination the REI will be under no further contractual obligation to pay annual fees thereafter.

The REI will have access to all data coming from the system monitoring for educational and research purposes.

Approved by:

_____	_____
Mike O'Connor	Crystal Simmons
ASU Physical Plant Director	ASUREI Chairperson

Appendix E: Proposed Policy

Table of Contents

Prepared

by **ASU REI**

on **May 2009**

Published

on **October 2009**

ASU Renewable Energy Initiative

Revenue, Expenses and Maintenance Account Policy

ARTICLE I Revenue Streams

Section 1 Student Fees

A. The REI's operating budget includes a dollar amount contributed per student per semester. This student fee can only be used according to a specific referendum. This referendum is presented before the student body during Student Government Elections every three years. REI student committee members negotiate the referendum language and decide the dollar amount of the fee. This referendum is voted on and approved of by the student body. Approval from the student body happens at majority-in-favor.

Section 2 Project-generated revenue

A. The REI's philosophy is that revenue and value derived from student–funded REI projects should remain the property of the REI. In some cases, the REI partners with the university to complete these projects. In this case, the REI's philosophy is that revenues and values should be shared in direct proportion to the investments made by each contributing party. This, we believe in principle, is the most logical and fair method for distributing revenue generated by REI projects.

B. Monetary value generated by REI projects through the sale of electricity (utility payment of averted cost), Renewable Energy Credits (RECs), or any other means will be shared between investors based on the proportion of capital investment made by each investor. The REI committee will negotiate the terms and conditions of these sales. Project-specific, negotiated terms and conditions shall be stated in Appendix A per project for clarification purposes.

C. New River Light & Power (NRL&P) maintains right of first refusal on the purchase of RECs generated from all REI renewable energy projects.

D. In some cases, the university and NRL&P may have more desire for the RECs than they do the monetary value of the energy. Should this be the case, the REI would work with the university to see that the university receives their proportion of the overall value in RECs to an extent determined by the university. However, this instance should not allow for the overall value split between the REI and the university to become skewed outside of the aforementioned pro-rated investment proportions. Should the university's desire for the RECs and their associated value exceed the aforementioned pro-rated proportions from a value standpoint, the university will compensate the REI in accordance with the aforementioned pro-rated proportion. This type of compensation could come in the form of cash payment or an increased percentage of profit drawn from the electricity sold on the grid.

E. The monetary values associated with averted energy costs and the value of the RECs will be determined by the current, customary, regional rates.

F. Every project shall have a specific clarified policy statement regarding revenue streams. When agreement between all parties is reached of a project's policy statement, this statement shall become permanently placed into Appendix A.

Section 3 Non-electricity Generating Projects

A. Value sharing of non-revenue generating renewable energy projects will be determined on a project-by-project basis. The REI's philosophy is to maintain an overall equitable value split based on the proportion of capital investment made by each investor, should there be more than one investor.

B. There will be some instances when a completed project is not able to generate revenue (e.g., solar thermal technology). If and when the market changes to reflect a means to generate revenue from a previous non-revenue generating project, the REI can adapt to industry standard and reserves the right to solicit revenue from the project.

Section 4 Donations

A. Private donations to the REI can be made through the Appalachian Foundation. The number for this account is 992894.

Section 5 Miscellaneous

A. Fundraisers, grants, selling of advertising materials, etc, can help obtain additional revenue.

ARTICLE II Expenditures

Section 1 Student Fees

A. Spending of student fees on renewable energy projects requires a number of actions. After voting within the committee to allocate funds to a project, and the project receiving majority favor, the project manager must fill out a project funding request form. This project funding request form must be signed by the chair of the REI and taken to the Director of Administrative Support Services, Office of Student Development.

B. See *Appendix C* for Project Funding Request Form.

Section 2 Renewable Energy Projects

A. Income generated by renewable energy projects through the sale of electricity (utility payment of averted cost), RECs or other means can be used outside the purview of the referendum so long as it falls within the spirit of the REI mission. Examples of this would be maintenance, energy conservation, energy efficiency, other renewable energy technologies, promotion, education, etc.

B. After voting within the committee to allocate revenue funds from a renewable energy project, and the allocation receives majority favor, a funding request form must be filled out and delivered to the Director of Administrative Support Services, Office of Student Development.

C. See *Appendix C* for Project Funding Request Form.

Section 3 Maintenance

A. The REI will maintain a General Maintenance Account. On each project, the REI, in consultation with appropriate parties (faculty/staff advisor[s], company on contract, etc), will determine a Project Maintenance Budget (PMB). All project maintenance funds will be held in the General Maintenance Account.

B. PMB funds will be accrued into a general maintenance account until such time that funds available is equal to 2.5 times the anticipated maintenance costs for the next academic year. This maintenance reserve will remain in place as long as REI systems are operational. Each project's PMB will be reevaluated at the first fall REI meeting. Once 2.5 times the associated maintenance costs are met, the REI will maintain this maintenance reserve at all times.

C. Once the PMB is satisfied, additional revenue will be treated as Discretionary Funds.

D. Maintenance costs associated with projects where there is more than one investor will be shared between investors based on the proportion of capital investment, unless the investors agree to an alternative proportion. If an agreement is made regarding maintenance where an alternative pro-rated proportion is derived, the details will become an addendum to Appendix A.

E. Every project shall have a specific clarified policy statement regarding maintenance. This statement shall be permanently placed in Appendix A.

F. Expenditures from the General Maintenance Account will be treated like a project funding request. A committee vote is required. The allocation of maintenance funds must receive majority favor, at which time a funding request form must be filled out and delivered to the Director of Administrative Support Services, Office of Student Development.

G. See *Appendix C* for Project Funding Request Form.

Section 4 Discretionary Funds

A. The REI may spend, without the approval of the Director of Administrative Support Services, Office of Student Development, 0.5% of the annual student fee revenue.

Section 5 Miscellaneous

A. Donations, fundraisers, grants, etc can obtain miscellaneous funds. This money can be used outside the purview of the referendum so long as it falls within the spirit of the REI mission. Examples of this would be maintenance, energy conservation, energy efficiency, other renewable energy technologies, promotion, education, etc.

B. After voting within the committee to allocate funds, and the allocation receives majority favor, a funding request form must be filled out and delivered to the Director of Administrative Support Services, Office of Student Development.

C. See *Appendix D* for Miscellaneous Fund Allocation Form.

Appendix I

Project-specific Maintenance/Revenue Report

This appendix is a comprehensive, project-specific outline indicative of revenue streams and maintenance agreements.

[Outline: List the Project name and the street name and town of the project. Description of project, project funding and percentages of overall contribution, allocation of benefits {monetary or otherwise} and maintenance agreement, person with whom the agreement was worked and date]

1. Biodiesel B20 Tank Dale Street

This renewable energy system provides a blend of B20 biodiesel to ASU. This project was co-funded by the REI and ASU. This tank is integrated into the physical plant's refueling facilities, and the University receives all benefit from this system.

All funding parties agree that maintenance associated with this system will be the sole responsibility of ASU. This agreement was reached with Mr. Mike O'Connor, Physical Plant Director on June 9, 2009.

2. Biodiesel Solar Thermal Ayers Lane

This renewable energy, hot water-generating system provides hot water needs for the biodiesel research facility. The project was co-funded by the REI and the student grant money awarded to this project from the EPA's P3: People, Prosperity and the Planet Student Design Competition for Sustainability. This system is highly integrated into the biodiesel production capabilities of the research center. The energy provided by this system greatly reduces the need for purchased energy to heat the oil for biodiesel production.

All funding parties agree maintenance associated with this system will be solely the responsibility of the biodiesel facility. This agreement was reached with Dr. Jeffrey Ramsdell on Friday 20 March 2009.

3. Biodiesel Photovoltaic Array Ayers Lane

This renewable energy, electricity-generating system provides electrical energy to the grid. This project was funded solely by the REI.

The REI assumes all responsibility for maintenance and receives all monetary benefit associated with this facility.

4. Katherine Harper Hall Photovoltaic Array Rivers Street

This renewable energy, electricity-generating system provides electrical energy into Harper Hall, reducing the building's need for purchased electricity. This project was co-funded by the REI and Department of Technology. The majority of the cost of this project was funded by the Department of Technology.

All funding parties agree maintenance associated with this system will be the responsibility of the Department of Technology. This agreement was reached with Dr. Dennis Scanlin in April 2009.

5. Raley Photovoltaic Array Howard Street

This renewable energy, electricity-generating system provides electrical energy to the grid. This project was funded solely through the REI.

The REI assumes all responsibility for maintenance and receives all monetary benefit associated with this facility.

6. Plemmons Student Union Solar Thermal Plemmons Student Union roof

This renewable energy, hot water-generating system provides hot water needs for the Plemmons Student Union (PSU). This system was fully funded by the REI. This system is highly integrated into the hot water supply system of the student union. The energy produced by the system greatly reduces the student union's need for purchased electricity to provide hot water.

All maintenance for this system will be the responsibility PSU. This agreement was reached with Dave Robertson on _____.

7. Broyhill Wind Turbine Bodenheimer Drive

This renewable energy, electricity-generating system provides electrical energy to the grid. This project was co-funded by the REI and ASU through New River Light & Power

Co. At an installation cost of $533,000, the overall equitable value split based on the proportion of capital investment made by REI is 58%, and NRL&P is 42%.

All maintenance for this system will be the responsibility of REI. The revenue streams from this facility will be split according to proportion of capital investment contributed by each investor, REI (58%), NRL&P (42%).

Appendix II

Recommendation for Project Funding

Project Name:

Project Manager:

Staff/Faculty Advisor:

Project Description:

Areas Consulted and Comments:

Recommended Funding Amount:

REI Committee Vote Tally: unanimous (6 of 6)

Method of Fund Distribution:

_____ _____

REI Chairperson Date

Approval:

_____ _____

Vice Chancellor Student Development Date

Appendix III

Recommendation for Miscellaneous Fund Expenditure

Project Name:

Project Manager:

Staff/Faculty Advisor:

Expenditure Description:

Recommended Funding Amount:

REI Committee Vote Tally:

Method of Fund Distribution:

_____ _____

REI Chairperson Date

Approval:

_____ _____

Vice Chancellor Student Development Date

Appendix F: Carbon Offset Audit

Totals

Costs/Production/Offsets		
Total $ Spent on RE	$547,000.00	
Total Yearly Carbon Offset	314,626.29	lbs CO2
Lifetime Carbon Offset	6,341,408.91	lbs CO2
lbs CO2 Offset/$ Spent on RE	11.59	lbs CO2
Total Yearly Energy Produced	234,795.74	kWh/yr
Total Liftime Energy Produced	4,732,394.71	kWh/Lifetime
Lifetime cost of energy	$0.12	/kWh

Maintenance Costs			
Preventative Cost	$1,000.00	/yr	
Repair Cost	$3,585.00	/yr	
Other Cost	$330.00	/yr	<---Grounds maintenance or other maintenance outside of the maintenance schedule
Total Maintenance Costs	$4,915.00	/yr	
Lifetime Maintenance Costs	$100,300.00		

Total Revenue		
Energy Sales/Avoided Cost	$7,781.83	/yr
RECs-Voluntary/RPS	$22,374.37	/yr
Total Revenue	$30,156.21	/yr
Lifetime Revenue	$610,055.37	

Assumptions

CO2 Emissions		
CO2 Coal	2.095	lbs/kWh generated
CO2 Average	1.340	lbs/kWh generated

Price paid for electricity				
Photovoltaics	$0.04	/kWh	<-------	Unknown if this will be actual rate.
Wind	$0.04	/kWh	<-------	Unknown if this will be actual rate.

Avoided cost				
Solar Thermal	$0.02	/kWh	<-------	Need to know the cost of steam.

NCGreenPower/RECs				
Photovoltaics	$0.15	/kWh	<-------	This is the current price for systems less than 10kW in size.
Wind	$0.09	/kWh	<-------	This is a baseline price for small wind. Need to find out actual.

Voluntary Market or RPS RECs				
Solar Thermal	$0.10	/kWh	<-------	This will Vary depending on the

			market.

Cost of Maintenance Labor done by physical plant.			
Hourly Rate	$50.00	<-------	Unknown if this will be actual rate.
Day Rate	$400.00	<-------	Unknown if this will be actual rate.

Broyhill Wind

Project Type:	Wind	
Project Location:	Broyhill Inn	
Project Size:	57.35849057	kW
Project Est Life:	20	years
Project Description:	Northwind 100 Northern Power Systems wind generator. The REI paid for 57.36% of the cost which is figured into the size.	

Costs/Production/Offsets		
Project Cost	$304,000	
Est Production/yr	147,000.00	kWh/yr
Est Lifetime Production	2,940,000.00	kWh/lifetime
CO2 Offset (Coal)	2.10	lbs offset/kWh
Yearly CO2 Offset	307,965.00	lbs offset
Lifetime Offset	6,159,300.00	lbs offset
CO2 Offset (Average)	1.34	lbs offset/kWh
Yearly CO2 Offset	196,980.00	lbs offset
Lifetime Offset	3,939,600.00	lbs offset
lbs CO2 Offset/$ on RE	12.96	lbs offset
kWh lifetime Cost	$0.10	/kWh

Maintenance					
Preventative Cost	$1,000.00	/yr	<-------	$20,000.00	over the life of the project.
Repair Cost	$2,500.00	/yr	<-------	$50,000.00	over the life of the project.
Other Cost	$250.00	/yr	<-------	$5,000.00	over the life of the project.
Total Mainteance Cost	$3,750.00	/yr			
Lifetime Maintenance	$75,000.00				

Revenue Generated		
Energy Sales	$5,880.00	/yr
RECs-	$13,230.00	/yr

NCGreenPower		
Total Revenue	$19,110.00	/yr
Lifetime Revenue	$382,200.00	

BERL PV

Project Type:	Photovoltaic	
Project Location:	Biodiesel Education and Research Labrotory	
Project Size:	1.5	kW
Project Est Life:	25	years
Project Description:	10-150W photovoltaic panels. This is a grid tied system which was purchased by the REI and installed by students.	

Costs/Production/Offsets		
Project Cost	$15,000	
Est Production/yr	1,785.00	kWh/yr
Est Lifetime Production	44,625.00	kWh/lifetime
CO2 Offset (Coal)	2.10	lbs offset/kWh
Yearly CO2 Offset	3,739.58	lbs offset
Lifetime Offset	93,489.38	lbs offset
CO2 Offset (Average)	1.34	lbs offset/kWh
Yearly CO2 Offset	2,391.90	lbs offset
Lifetime Offset	59,797.50	lbs offset
lbs CO2 Offset/$ on RE	3.99	lbs offset
kWh lifetime Cost	$0.34	/kWh

Maintenance		
Preventative Cost	0	/yr
Repair Cost	0	/yr
Other Cost	0	/yr
Total Mainteance Cost	0	/yr
Lifetime Maintenance	0	

<------ This system is maintained with Biodiesel Collaborative and Sustainable Transportation Club funds.

Revenue Generated		
Energy Sales	$71.40	/yr
RECs-NCGreenPower	$267.75	/yr
Total Revenue	$339.15	/yr
Lifetime Revenue	$8,478.75	

KH PV

Project Type:	Photovoltaic	
Project Location:	Katherine Harper Building	
Project Size:	0.625	kW
Project Est Life:	25	years
Project Description:	10-150W photovoltaic panels. A grid tied system which was purchased by the REI in partnership with the Dept of Technology and installed by students. The portion REI paid is factored in.	

Costs/Production/Offsets		
Project Cost	$5,000	
Est Production/yr	750.00	kWh/yr
Est Lifetime Production	18,750.00	kWh/lifetime
CO2 Offset (Coal)	2.10	lbs offset/kWh
Yearly CO2 Offset	1,571.25	lbs offset
Lifetime Offset	39,281.25	lbs offset
CO2 Offset (Average)	1.34	lbs offset/kWh
Yearly CO2 Offset	1,005.00	lbs offset
Lifetime Offset	25,125.00	lbs offset
lbs CO2 Offset/$ on RE	5.03	lbs offset
kWh lifetime Cost	$0	/kWh

Maintenance					
Preventative Cost		/yr			
Repair Cost	$80.00	/yr	<-------	$2,000.00	over the life of the project.
Other Cost		/yr			
Total Mainteance Cost	$80.00	/yr			
Lifetime Maintenance	$2,000.00				

Revenue Generated		
Energy Sales	$30.00	/yr
RECs-NCGreenPower	$112.50	/yr
Total Revenue	$142.50	/yr
Lifetime Revenue	$3,562.50	

Raley PV

Project Type:	Photovoltaic

Project Location:	Raley Hall	
Project Size:	4	kW
Project Est Life:	25	years
Project Description:	Sharp photovoltaic panels. This is a grid tied system which was purchased by the REI. This system was installed by Southern Energy Management by former students.	

Costs/Production/Offsets		
Project Cost	$63,000	
Est Production/yr	4,761.00	kWh/yr
Est Lifetime Production	119,025.00	kWh/lifetime
CO2 Offset (Coal)	2.10	lbs offset/kWh
Yearly CO2 Offset	9,974.30	lbs offset
Lifetime Offset	249,357.38	lbs offset
CO2 Offset (Average)	1.34	lbs offset/kWh
Yearly CO2 Offset	6,379.74	lbs offset
Lifetime Offset	159,493.50	lbs offset
lbs CO2 Offset/$ on RE	2.53	lbs offset
kWh lifetime Cost	$1	/kWh

Maintenance					
Preventative Cost		/yr			
Repair Cost	$240.00	/yr	<-------	$6,000.00	over the life of the project.
Other Cost	$80.00	/yr	<-------	5	Days of labor
Total Mainteance Cost	$320.00	/yr		$2,000.00	over the life of the project.
Lifetime Maintenance	$8,000.00				

Revenue Generated		
Energy Sales	$190.44	/yr
RECs-NCGreenPower	$714.15	/yr
Total Revenue	$904.59	/yr
Lifetime Revenue	$22,614.75	

PSU Solar Thermal

Project Type:	Solar Thermal	
Project Location:	Plemmons Student Union	
Project Size:	1680	sq. ft. Collector
Project Est Life:	20	years
Project Description:	42-4'x10' solar collectors. Installed by Suntech Inc.	

Costs/Production/Offsets		
Project Cost	$153,000	
Est Production/yr	77,586.58	kWh/yr
Est Lifetime Production	1,551,731.60	kWh/lifetime
CO2 Offset (Coal)	2.10	lbs offset/kWh
Yearly CO2 Offset	162,543.89	lbs offset
Lifetime Offset	3,250,877.70	lbs offset
CO2 Offset (Average)	1.34	lbs offset/kWh
Yearly CO2 Offset	103,966.02	lbs offset
Lifetime Offset	2,079,320.34	lbs offset
lbs CO2 Offset/$ on RE	13.59	lbs offset
kWh lifetime Cost	$0	/kWh

Maintenance		
Preventative Cost		/yr
Repair Cost	$765.00	/yr
Other Cost		/yr
Total Mainteance Cost	$765.00	/yr
Lifetime Maintenance	$15,300.00	

<------- $15,300.00 over the life of the project.

Revenue Generated		
Avoided Cost	$1,551.73	/yr
RECs-Voluntary/RPS	$7,758.66	/yr
Total Revenue	$9,310.39	/yr
Lifetime Revenue	$186,207.79	

BERL Thermal

Project Type:	Solar Thermal	
Project Location:	Biodiesel Education and Research Labrotory	
Project Size:	144	sq. ft. Collector
Project Est Life:	20	years
Project Description:	2-4'x8' and 2-4'x10' Solar Thermal Panels. These panels are used to provide heat which is used in the production of biodiesel.	

Costs/Production/Offsets		
Project Cost	$7,000	
Est Production/yr	2,913.16	kWh/yr
Est Lifetime Production	58,263.11	kWh/lifetime

CO2 Offset (Coal)	2.10	lbs offset/kWh
Yearly CO2 Offset	6,103.06	lbs offset
Lifetime Offset	122,061.22	lbs offset
CO2 Offset (Average)	1.34	lbs offset/kWh
Yearly CO2 Offset	3,903.63	lbs offset
Lifetime Offset	78,072.57	lbs offset
lbs CO2 Offset/$ on RE	11.15	lbs offset
kWh lifetime Cost	0.12	/kWh

Maintenance		
Preventative Cost	0	/yr
Repair Cost	0	/yr
Other Cost	0	/yr
Total Mainteance Cost	0	/yr
Lifetime Maintenance	0	

<------

This system is maintained with Biodiesel Collaborative and Sustainable Transportation Club funds.

Revenue Generated		
Avoided Cost	$58.26	/yr
RECs-Voluntary/RPS	$291.32	/yr
Total Revenue	$349.58	/yr
Lifetime Revenue	$6,991.57	

Appendix G: Budget Increase Proposal

Product / Expense and Provider	Quantity	Unit	Unit Price	Total Price / yr
Project Signage				
Information Placards	5		$ 300.00	$ 1,500.00
Newspaper Ads				
Appalachian (by-weekly)				
Half Page	4	issue	$ 299.25	$ 1,197.00
Quarter Page	4	issue	$ 149.63	$ 598.52
Website Ads				
Facebook	180	day	$ 3.00	$ 540.00
Google	180	day	$ 3.00	$ 540.00
Radio Ads				
WASU Rocks 90.5 (9, 30 second ads per day)	3	4 weeks	$ 375.00	$ 1,125.00
Appalachian ISP Sports Network				
Kidd Brewer Stadium Video Board (1, 30 second ad per game)	1	season	$ 4,000.00	$ 4,000.00
Athletic Program				
Half Page	1	season	$ 2,000.00	$ 2,000.00
Brochures				
PrintForLess.com color brochures	3	1000	$ 296.00	$ 888.00
Color Copies - 8.5x11				
Docucopies.com	1000	per copy	$ 0.07	$ 70.00
Tri-Fold Laminated Display Board				
theGreenOffice.com	1		$ 239.19	$ 239.19
Letterhead				
Overnight Prints	1	100	$ 39.95	$ 39.95

Doe Valley Printing				
T-Shirts w/ 2 color screen print	180	each	$ 8.90	$ 1,602.00
Collared Shirt w/ left chest embroidery	30	each	$ 20.00	$ 600.00
6.25x3.125in removable bumper sticker	180	each	$ 1.84	$ 331.20
Baseball hat w/ logo	30	each	$ 5.00	$ 150.00
Recycled Content Pens w/ logo	180	each	$ 0.45	$ 81.00
Conference at Broyhill Inn				
Food & Beverage	1	event	$ 449.10	$ 449.10
Audio/Visual	1	event	$565.69	$ 565.69
Housing Stipend for Speakers	2	person	$75.43	$ 150.86
Food Stipend for Speakers	2	person	$40.00	$ 80.00
Travel for Speakers	2	person	$300.00	$ 600.00
Keynote Speaker	1	person	$ 5,000.00	$ 5,000.00
				$ 22,347.51

Appendix H: Fall 2009 Application

Student Committee Members

Application

The Renewable Energy Initiative (REI) is a student-initiated, student-funded, student-run committee. Student committee members design and manage the installation of renewable energy infrastructure on ASU's campus. The committee is comprised of seven voting students. The REI is soliciting applications for new members.

See www.rei.appstate.edu for more information.

Requirements:

- Passion to bring Renewable Energy to ASU.
- New committee members must be enrolled at ASU though Fall 2010; commit at least one year.
- Must be available for biweekly meetings.
- Must be willing to commit an appropriate amount of time outside of meetings to complete tasks, roughly 5hrs/wk.
- The REI committee needs many different skills: website management, research, advertising, public relations, grant writing, public speaking, group facilitation, and more.
- The REI needs representation from students in many different programs.

Applications must be delivered before **noon** on **Wednesday, 25 November 2009**.

Submit to any REI committee member, SGA offices on the second floor of Plemmons Student Union, PO Box 9030.

Interviews will be held in late November.

If selected, the first meeting will be in December, with tenure beginning before the spring semester.

Name:_____

Expected Date of Graduation:_____

Major/Minor:_____

Phone number:_____

E-mail:_____

Best day for interview:_____

Best time range for 1/2-hour interview (between 5-9pm):_____

Answers the following questions (guideline on length: total of 1-2 pages, double-spaced, typed):

1. **Why do you have an interest in joining the REI?**
2. **What skills/talents/experiences do you have to contribute to the REI Committee?**
3. **What do you wish to gain from your experience with the REI?**