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Research Institute for Environment, Energy and Economics

Annual Report, 2010 - 2011

August 15, 2011

Formed in November 2008, the Mission of the Research Institute for Environment, Energy and Economics (RIEEE) is to build internationally recognized competitive multi-disciplinary research initiatives that enhances Appalachian State University’s academic programs, institutional services, our region and fosters interdisciplinary discovery, creative activities, and research that addresses environment, energy and economic issues. We believe that by integrating environmental, energy and economic research initiatives with academic, outreach, operational, and co-curricula programs involving faculty, students, staff and the public we will create a broader understanding and appreciation of the inter-dependence of natural, social, economic, constructed and technological systems.

Because of its setting, Appalachian State University has drawn faculty and students who have a strong commitment and interest in environmental issues, our use of energy and public policy. This interest is expressed in many forms from energy conservation and innovative technologies to environmental economic policies. The RIEEE provides a means for integrating research initiatives from diverse academic, operational, and student units and enhancing ASU’s reputation of strong academic programs, community outreach and interdisciplinary research initiatives. The RIEEE thus allows faculty, students and staff members across colleges and multiple disciplines to focus on research at the intersection of energy, the environment and economic policy.

New Faculty

The RIEEE welcomes Dr. Gregg Marland as a Research Professor. He joins the RIEEE from the Oak Ridge National Laboratory where he served for over 35 years and since 2000 as Distinguished Research and Development Staff. He has served as a member of the National Research Council Committee on Methods for Estimating Greenhouse Gas Emissions, co-chair of the United State Interagency Carbon Cycle Science Working Group, and National Research Council Committee on Global Change Research. He recently served the Intergovernmental Panel on Climate Change (IPCC) where he was lead author of Guidelines for National Emissions Inventories (2006), lead on for the Special Report on Carbon Capture and Storage, contributing author on Radiative Forcing of Climate Change for the First Assessment Report, lead author on Energy Primer for the Second Assessment Report, lead author on Land-Use Change and Forestry for the Third Assessment Report, and lead author on Special Report on Land-Use, Land-Use
Change and Forestry. He currently serves on the editorial board of the *Environmental Science and Policy Journal* and editorial advisory board for the *Mitigation and Adaptation Strategies for Global Change Journal*.

Research Priorities and Activities

The 2010 - 2011 academic year has been an opportunity to stress the following research priorities and activities.

1. Foster interdisciplinary research that examines the linkages between our natural, constructed, economic, technological and human systems and supports inter-disciplinary research collaborations in the preparation and submission of multi-year proposals to funding agencies.
   a. U.S. Department of Agriculture (USDA) multi-year proposal through CERPA in collaboration with Texas A & M University and Dartmouth. Dr. Mike McKee led the ASU faculty team in “Climate Change and Southern Forest Management: Landowner Decisions and Valuing Ecosystem Services” with Todd Cherry, Todd Hartman, Dave McEvoy, Ash Morgan and John Whitehead representing the Department of Economics and the Department of Government and Justice Studies – (Amount: $994,852). Although this proposal was not funded, it reflects our efforts to foster multi-disciplinary multi-year research projects.
   b. Dr. Susan Doll (Department of Technology) submitted a proposal to Housing and Urban Development (HUD) through the Appalachian Energy Center titled: The Healthy Homes Technical Studies Grant Program: What Are People Breathing? Establishing Baselines Before and After Home (Amount: $999,725). The two-year project included staff from the ASU Energy Center (Bruce Davis and Kellie Stokes). The proposal was denied but received excellent reviews by HUD and the research team was encouraged by HUD to resubmit. A follow-up proposal was resubmitted and is currently under review by HUD.
   c. A proposal to the Golden LEAF Foundation, Inc. was submitted through the Appalachian Energy Center in the amount of $749,917 (STEM Initiative: STEMulating Appalachia). This project was led by Dr. Brian Raichle along with CO-PI’s Carla Ramsdell (Physics & Astronomy), Jerianne Taylor & Dennis Scanlin (Technology & Environmental Design), and Laura England (Biology). This multi-disciplinary effort reflected a targeted submission in the area of environmental education. Although this proposal was not funded, further proposals have been submitted to the U.S. EPA and NOAA.
   d. Dr. Eric Marland (Mathematical Sciences) led a multi-institutional team through SAREC with a submission to the National Science Foundation (Amount: $10,000,000) titled: Science, Technology, Engineering, and Mathematics Talent Expansion Centers (STEP Centers)” The National Institute for Climate Science Education (NICSE). The proposed center was in
collaboration with the City University of New York – Hunter College, University of Minnesota Duluth, and Chico State University California. The proposal represented a broad based group of ASU faculty and engagement with three universities similar to ASU. This faculty team will continue to look for opportunities to establish a national focus in collaboration with other university partners.

e. Dr. Todd Cherry (CERPA) has led a proposal titled: CICS: Monitoring and Assessing Weather and Climate Events from a Socio-economic Perspective through the National Climatic Data Center, NOAA Cooperative Institute (N.C. State University). This proposal ($1,418,131) is currently under review. The proposal was in collaboration with John Pine, Ash Morgan (Economics), Chris Badurek (Geography & Planning) and Jason Hoyle (Energy Center).

f. A multi-disciplinary proposal was funded by the National Renewable Energy Laboratory (Department of Energy) for the 2011 Solar Decathlon in the amount of $100,000 and led by Jamie Russell and Chad Everhart (Technology & Environmental Design). Additional support for this project was provided by Lowe's Inc. in the amount of $350,000. Students and faculty from throughout the campus have participated in this Appalachian Energy Center project over the past year.

g. Dr. Marie Hopefl (Technology and Environmental Design) received a grant through the Appalachian Energy Center from the U.S. DOE for the Appalachian Energy Internship Program ($485,857). ASU current and former students from throughout the campus received support under this project to work with units on the ASU campus and our private sector and government entities.

h. Dr. Jeff Tiller (Technology & Environmental Design) was awarded a grant in the amount of $2,550,000 (through the Appalachian Energy Center) from the Department of Energy through the N.C. State Energy Office. The title of the project: North Carolina Energy Efficiency Marketing Development and Implementation Program. This multi-year project will bring innovative sustainable building technologies and designs to residential housing in N.C. Energy efficiency programs of the Energy Center are expected to save more than $5 million in savings over the lifetime of the projects.

2. Extend collaborative initiatives with off-campus partners. ASU faculty through our three research centers have continued to partner with off-campus entities in initiating or enhancing collaborations in our research and outreach activities. Key collaborations include:
   a. A proposal submitted by Dr. Brett Taubman (Chemistry) in collaboration with Discovery Place, Inc. in Charlotte, N.C. This proposal titled: Environmental Education Regional Grants Climate Action Network through Direct Observations and Outreach (CAN-DOO) in the amount of $99,797 in under review by EPA.
b. Dr. Mike Gangloff (Biology) was awarded several grants from the U.S. Fish and Wildlife Service and the N.S. Wildlife Resources Commission. Dr. Gabrielle Katz has research that is supported by the U.S. Department of Interior, USGS.

c. Ms. Laura England and Ms. Carla Ramsdell hosted a ASU faculty campus presentation by the Director of Research for the N.C. Natural Science Museum Dr. Meg Lowman. We expect on-going collaborations between the Natural Science Museum and our faculty.

d. The National Committee for the New River (NCNR) led a collaboration with ASU and Radford University in a proposal to the National Science Foundation. Although this proposal was not funded by NSF, this research collaboration will be the first of many that will team ASU faculty with the NCNR examining land-use, water quality and forest resources and conservation issues.

e. The Catawba County EcoComplex Biodiesel Research Development and Production Facility was completed in the Spring of 2011 and will open in August 2011. This collaboration between the ASU Energy Center and Catawba County reflects a strong commitment to sustainable energy sources. The Appalachian Energy Center bio-diesel research is supported by a grant from the Golden LEAF Foundation ($750,000) awarded in 2008.

f. The Appalachian Energy Center community based landfill gas development program has partnered with 24 N.C. counties in obtaining DOE grants for implementing landfill gas projects. This effort has stimulated investment in excess of $8 million in economically distressed communities across the state.

g. CAEREC collaborated with the N.C. Rural Center on a rural economic opportunity project and the University of North Carolina System on the impact of UNC System research on the North Carolina economy.

3. Extend Appalachian State University’s research collaborations internationally.
   a. The Appalachian Energy Center extended its local landfill gas project with counties in N.C. to Brazil with additional funding from the EPA.
   b. The CAN-DOO faculty team has extended its environmental monitoring internationally by teaming with faculty from the University of the Free State in South Africa and St. Michael’s School. Students will be making atmospheric observations in collaboration with the CAD-DOO team at ASU.

4. External Funding.
   a. External funding awarded during the first three years, has grown from $370,638 in FY 2009 to $1,238,862 in FY 2010 and $3,941,109 in FY 2011. Submissions to external agencies (but not funded) have grown from $392,156 in FY 2009 to $4,134,556 in FY 2010 and $15,382,951 in FY 2011. The RIEEE has proposals currently under review in the amount of $2,297,895
as compared to 999,881 for FY 2010. There were no proposal under review at the close of FY 2009.
b. Continuing funding from grants and contracts awarded in one fiscal year but continuing to the next fiscal is a reflection of growing fiscal resources to ASU. External multi-year funding including an appropriation from the N.C. Department of Commerce (State Energy Office) is noted as continuing funding. Continuing funding awarded prior to the creation of the RIEEE in FY 2009 amounted to $2,016,159. Continuing funding from previously awarded contracts and the state appropriation grew to $2,320,910 in FY 2010 and $2,230,503 in FY 2011.

5. Student Engagement
   a. Graduate and undergraduate students are engaged with faculty research projects funded through the Energy Center, SAEREC, and CERPA. Students experience first hand the value and impact of focused research.
   b. The Energy Center funded ten peer reviewed research awards in FY 2011. The results of these projects will be made available through departmental and center web sites to the public in the Fall of 2011.

The following report provides a detailed description of the programs of the centers, the current status of their facilities, people engaged in the operations of the centers, major accomplishments including external funding, publications and presentations and public engagement, center development efforts and finally problems and needs for each center.

The RIEEE through its centers, associated faculty, students and community partners are committed to:

- The highest quality research initiatives that acknowledge the value of the natural environment, our cultural heritage, mutual respect and diversity.
- Applying our research resources to promote sustainable economies, natural systems, cultural prosperity and quality of life throughout our region and state.
- Fostering critical analysis through the interface of multiple disciplines in an open setting.
- Extending research outcomes to our community, region and state in support of economic development needs.
- Engagement in the local, regional, national and international community by extending our research beyond our boarders.
- Sustain Appalachian, where we will support our university in exploring and adopting policies, practices and programs that address our present needs without compromising our ability to meet long term needs and those of future generations.

We acknowledge that our university has well-qualified, committed, and available faculty, students, and off-campus partners. We have research laboratories, campus facilities, a comprehensive library, museums and off campus natural and constructed areas that provide a sound base for our research initiatives. Academic undergraduate and graduate programs associated with the environment, energy and economics bring talented students to the ASU campus and are critical in our research initiatives. Appalachian has outstanding institutional
sponsored program resources that support the proposal solicitation and fiscal management. Further, we have broad-based collaborations with public, private and non-profit entities that support and are actively engaged in our research initiatives.

It should be noted that faculty and staff have been successful in obtaining external research funding and conducting research projects even when they carry heavy teaching loads. Their productivity reflects their extensive commitment, talents and determination to make a difference on and off our campus, and to our professions. Without the engagement and support from our faculty and academic units, our ability to compete for external funding and support would be marginalized.

We believe that we have had a productive year especially in extending the nature of our centers, faculty engagement in research proposals and projects, as well as pulling together resources on and off our campus that support our research initiatives. Despite the challenges presented by state, national and international economic conditions, we anticipate that our research initiatives will continue to produce positive results in terms of external funding support, representation of faculty in our center research areas, and engagement of students in our projects.

Sincerely,

John C. Pine
Director
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<th>Center for Funding</th>
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<th>Continuing</th>
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* Annual Report FY 2009 (Office of Research & Graduate Studies
1 North Carolina State Energy Office - State Appropriation
2 Collaborations with Counties - Landfill Gas ARRA $8,175,657
(3) Walker College of Business

**Figure #1: RIEEEE External Funding for Fiscal Years 2009 through 2011**
Appalachian Energy Center

MISSION

Appalachian Energy Center (AEC) is committed to research, development, policy analysis, and demonstrations in all areas of energy, with a stated mission to facilitate the work of faculty and students engaged in teaching, research and outreach activities associated with energy technologies, conservation, and policy.

HISTORY

Appalachian Energy Center at Appalachian State University was established in 2001 to conduct energy research and applied program activities in a multi-disciplinary environment. It focuses on energy efficiency, renewables, policy analysis, forecasting, and economic development. The Center ties together faculty and staff from many different programs, departments, and colleges of the University including: Building Science, Appropriate Technology, Geography and Planning, Economics, Biology, Chemistry, Physics, and Political Science. The AEC also facilitates partnerships with the private sector as well as local, state, regional and federal governments.

AEC operates under the umbrella of Appalachian’s Research Institute for Environment, Energy, and Economics (RIEEE) which was established in November 2008 to enhance research opportunities for faculty and students whose interests are associated with environmental science, renewable energy and economics.

Appalachian State University has long been a home for renewable energy, sustainable development and an environmentally aware campus community. Appalachian State is home to one of the nation’s first degree programs in renewable energy technology, and remains one of a handful of schools in the world that offers a Masters-level degree in renewable energy engineering.

Because of its expertise and setting, Appalachian has drawn faculty and students who have a strong commitment and interest in environmental issues as expressed in many forms from energy conservation and innovative technologies to environmental economic policies. The University has built a reputation from its strong academic programs, community outreach and interdisciplinary research initiatives. Today, many faculty members across colleges and multiple disciplines focus on research at the intersection of energy, the environment and economic policy.
PROGRAMS

Appalachian Energy Center represented by a broad range of staff, ASU faculty, graduate students, and partners has pursued a diverse mix of over 30 activities during the 2010-2011 fiscal year. As a Center within the Research Institute for Environment, Energy, and Economics, AEC will continue to involve more disciplines and interested parties as we pursue our interdisciplinary outreach and research efforts. Our current work is collected within the four general categories of Building Energy Efficiency, Renewable Energy, Alternative Fuels, and Policy, Markets, and Economic Analysis. Our core funding has been provided by an Appropriation from the North Carolina Legislature with a large amount of additional funding provided by Federal, State, and private sources. For the 2010-2011 year we operated under a 20-percent reduction in our state appropriated funds.

Building Energy Efficiency
Focus topics within this section include Low Income Housing, High Performance Residences, High Efficiency Existing Homes, Commercial Buildings, and Policy Analysis.

The Energy Center worked with the NC State Energy Office to promote the state-wide Energy Star Plus program for manufactured housing through meetings with retailers and manufacturing facilities, e-mail campaigns, site visits, and phone calls. Group retailer educational meetings were held concerning the program and its benefits to their customers in terms of energy use and financial incentives. The program’s $500.00 rebate to the homebuyer failed to provide enough incentive for retailer participation. The program currently provides $1500.00 as an incentive to homebuyers. This is slowing getting the attention of North Carolina retailers. The NC manufactured home industry has experienced a substantial drop in units sold over the last 10 years. In 2000 there were 27,000 NC units sold but that dropped to only 3000 units by 2009.

An energy study was completed for four individual duplexes in a Watauga County low-income development. This study was completed in order to better understand the actual real-time performance of typical heat pumps of this size and to gain a set of examples of how some families operate their space conditioning equipment. Heat pump energy use; including separate data for the compressor, blower unit, and strip heat; indoor temperature and relative humidity; air handler coil temperature; and outdoor temperature were recorded for a 12-month period. This research provides data that support policies that provide better ongoing maintenance oversight to secure improved ongoing performance and efficiency of heat pumps.

A previously completed Radiant Barrier case study continues to be of interest, including at the national level as requests for electronic copies of the study have occasionally been received with the latest being in July 2010 which is a year and a half following it completion and publication.

Several Energy Center activities blend well into the growing national interest to establish a robust national energy efficiency effort for existing buildings. One item is the preliminary
exploration into a Micro Injection Technique that would air seal the top of stud cavities from inside the home with limited cosmetic impact. With regard to practical air sealing techniques to improve a home’s energy efficiency, air sealing the ceiling plane is of primary importance [second only behind duct system air sealing]. A central element in this air sealing is to seal from the attic side both edges and all penetrations in stud wall cavity top plates. For existing homes this can be a challenge [floored attics, storage of goods, low attics, lots of ducts and equipment, existing ceiling insulation, and it is very hot during the summer]. This challenge is both costly to address and access for application is often limited. Air sealing at the ceiling plane has been measured and often equals 25% of the original building air leakage.

A second related activity is the development of Quality Indoor Environment Protocols for assessing the impacts of energy efficiency measures. A team of Appalachian Energy Center researchers is now actively exploring the impacts on Quality Indoor Environments when buildings have energy efficiency measures applied to them. A study completed in 2010-2011 monitored multiple indoor environmental conditions in homes with real time equipment for a week prior to and a week post installation of energy conservation measures. Data from this initial study was used to support proposals submitted to HUD for a larger long-term study. While an initial HUD proposal was not funded, it did receive very positive reviews. We have now submitted a second HUD proposal that is pending. The importance of this work lies in avoiding improving energy efficiency at the expense of human health.

We are growing our remote monitoring capabilities in our Building Energy Efficiency, Renewable Energy, and Alternative Fuels program areas. In the Building Energy Efficiency area we are currently conducting a remote monitoring study of two Energy Star homes. Collected data will be used to compare actual performance of the homes to their REM rate scores. A total of 12 months of data will be collected for each home, including total electricity consumption, HVAC air handler (incl. strip heat) energy use, HVAC compressor energy use, range, dryer, refrigerator, and water heater electricity use, HVAC supply and return temperature and relative humidity, room temperature and relative humidity, and total VOC and CO₂ levels. The ability to remote monitor homes will be very useful to benchmark energy savings in the improved NC Energy Code and to document energy efficiency improvements in a variety of other standards.

A third related activity is Behavior Facilitated Efficiency studies. When we understand the barriers to and encouragements for individual property owners to actually participate in purchasing efficiency upgrades we have “buyers.” With buyers we can begin to significantly reduce the number of inefficient properties. This can reduce the overall growth in demand for energy and also reduce the size of the demand at peak. Substantial economic development and jobs creation would grow out of the business development necessary to provide a significant number of properties with efficiency upgrades. Current year activity included attendance at the Behavior, Energy, and Climate Change conference with a focus on developing the skills of Community-Based Social Marketing.

Structural Energy Panels is a new effort. The primary objective of this project is to carry out experimental work that could allow solar energy technologies to be integrated with structural
insulating panels. These panels will be referred to as structural energy panels or SEPs. The aesthetic integration of renewable energy technologies into new and existing building “skins” is an attractive option from the standpoint of energy independence, carbon foot-print reduction, and the development and/or enhancement of renewable energy manufacturing in the State. Any technologically successful and economically viable results of this work can be used to improve current renewable energy product development and develop new products.

With regard to commercial buildings we continue our effort to revise SB 668 presentations and provide related training. The General Assembly of North Carolina implemented Senate Bill 668 and other legislation, which became State Law in 2007. The legislation requires that new state buildings improve efficiency by at least 30% above the ASHRAE 90.1-2004 requirements. The PowerPoint presentations show designers and building owners and operators how to comply with the state requirements. They also provide recommendations for achieving increased efficiency. The benefits will be to improve compliance with the state law and improved efficiency of our state’s buildings. In the 2010-2011 year workshops were held in Charlotte and Raleigh for the North Carolina Chapter of the American Institute of Architects. In addition, commissioning activities for the Watauga County High School are nearing completion. This effort has proven the value of commissioning by uncovering and correcting many operational issues. These issues would not have otherwise been known, leading to much greater energy use.

Finally in our energy efficiency activities section is our work in Policy Analysis to look at the Impacts of High Performance Buildings. The ACEEE report submitted to the Energy Policy Council includes results of analysis prepared by Appalachian State over the past several years, with updated information from this year’s efforts. The ACEEE report also includes up-to-date information on energy code development in the state. The report will serve as the basis for policy recommendations by the Energy Policy Council, which will establish a portion of the agenda for future energy policy in the state. The energy code policy analysis has resulted in successful integration of recommendations into the energy code, which was approved by the state’s Building Codes Council at its December 2010 meeting.

**Renewable Energy**

Focus topics within this section include Solar Thermal and Photovoltaics, Wind Energy, and Renewable Energy Resources.

Construction of our Solar Training and Research Facility on the Appalachian campus is near complete, greatly enhancing our solar research program. Testing and reporting on performance of available solar equipment will allow homeowners and businesses to adopt these technologies with confidence. In addition, the facility is providing educational opportunities for future employees of the regional Green Economy. This facility will be used for real world performance testing of solar thermal and photovoltaic panels and systems. Currently, the data acquisition system is fully functioning, all meteorological instrumentation is installed and fully functioning, two of the three planned grid-connected PV systems are installed, three of the four planned solar thermal systems are installed, and available data is being logged. Students are involved in all aspects of laboratory development and component testing. Students are
developing expertise with the design, installation, and testing of solar thermal and photovoltaic systems. During this fiscal year, five students gained valuable experience in solar system design, installation, and testing; skills that will contribute to the maturation of the solar industry in North Carolina. It is anticipated that results generated from this facility will contribute to maximized energy savings and minimized environmental impact.

We continue to collaborate with the Department of Physics and Astronomy in their development of an extensive photovoltaic materials and device characterization facility which will provide the tools and training for ASU students and faculty to develop, fabricate and characterize PV devices. These facilities will serve as a user facility where PV researchers, fabricators, and users can have their PV materials and devices fabricated and tested. It is hoped and expected that the results of this work will serve as a resource for others who will need to use the tools we are developing to aid in their pursuit of fabrication and/or characterization of PV materials and devices. Appalachian can provide critical PV device measurements and characterizations at little or no cost to NC based companies and researchers.

Our wind energy public outreach, technical assistance, survey and small wind turbine testing activities have continued throughout the fiscal year. We have established a “Wind Application Center” which serves as a hub of the wind related activities. The center is located in an office in Katherine Harper Hall on the Appalachian campus with four work stations staffed by graduate students and Appalachian staff. The state appropriation funding has been leveraged to enable us to receive other grants, contracts and donated equipment. Appropriation support has enabled us to purchase equipment needed to establish a small wind turbine testing program on Beech Mountain. This, in turn, has allowed us to: negotiate a preliminary contract to test two wind turbines for NewWind of Nashville, Tennessee; establish a research project to examine wind shear on Beech Mt, which will provide useful information for determining proper tower heights when there are obstructions nearby; provide a Florida based vertical axis wind turbine manufacturer a spot to conduct testing on their new turbine; set up a live video stream of activity on the Beech Mt site; and conduct beta testing of four turbines for Southwest Windpower.

This past year we have secured a three year contract to develop and implement a state wide “Wind for Schools” program funded by the US DOE. Work has included the identification of 177 schools in the state with average winds on their campus of 10 mph or higher. We have identified all schools and invited them to participate in the program, organized, advertised and conducted a workshop for teachers, raised $200,000 to support the purchase and construction of small wind turbines at 8 – 10 schools in the state and begun the process of identifying the schools where the turbines will be constructed, siting the turbines, and working with the appropriate authorities to obtain needed permits.

We continue to provide technical assistance and wind resource assessment for property owners interested in learning more about wind energy and their wind resources. This involves producing wind maps, performing site visits, setting up met towers, collecting and analyzing data collected, producing reports, mailing information out and answering questions. We have set up three 20 meter met towers this past year and one 34 meter met tower. We are also
working with counties and state officials to assist them in developing ordinances which would provide for orderly and appropriate wind energy development. We have shared this ordinance with all of the 24 western NC counties and many others. Substantial economic development and jobs creation would grow out of the business development necessary to construct wind turbines in the state. We have also provided technical information and feedback to state legislators involved in developing a wind permitting bill, which was introduced this past session. We are also working with the Albermarle RC&D and workforce development programs to develop a training program for the College of the Albermarle focused on wind energy. We have participated in several Wind Working Group meetings and worked with the NC Solar Center to facilitate the meetings and provide relevant information about wind energy issues to the group.

Most of the wind turbines being installed in western NC and throughout the state have come about after significant consultation with Appalachian State’s Wind Application Center. We routinely provide wind maps and wind measurement equipment and analysis to individuals who subsequently install wind turbines. We also assist in connecting those interested in installing a wind turbine with companies who can install a turbine. There is now more than 200 KW of wind power being harnessed in the state with over 30 wind turbines installed. Many of these turbine owners have contacted us during their decision making process and we have provided wind resource assessment and wind turbine information.

We have reworked our wind.appstate.edu website and developed a new interactive map of all wind turbines in the state with information about them and their installers and owners and have installed a live video cam of the Beech Mt. site

Microhydro is of great interest to the state’s renewable energy community as it is listed as a viable renewable energy resource eligible for renewable energy financial incentives. However, there is limited research on microhydro resources at the national and state level. The only prior research on microhydro resources in western North Carolina was done in 1983 with collaborators from Appalachian State. Our current project will update this study by using higher quality data and more advanced GIS methods to provide information on microhydro as a viable renewable energy source. This project will also provide information on microhydro resources that can be directly mailed to residents of North Carolina. This project will therefore help to better inform North Carolina residents on microhydro resources as well as potentially increase the number of residents using it as a renewable energy source. In addition, the technical report will be one of the very few research reports available nationally and the first on small scale systems at a state level. This makes this report a valuable contribution to citizens, energy policy researchers, and policy makers in North Carolina as well as other states.

Our NC Microhydro Analysis for Residential Energy (NC-MARE) Project is using geographic information systems (GIS) to identify residential properties containing or adjacent to streams that may be suitable for installation of microhydro systems within a four county region within northwestern North Carolina (Ashe, Avery, Watauga, Wilkes). A database of property owners’ addresses and their microhydro potential is being created to assist in mailing information about installing microhydro systems at their property. They will also be directed to the project website for further information on microhydroelectric power and its installation.
The final technical report and website for the current microhydro project are ready for release. The database of input data has been completed for a pilot area within four counties in northwest North Carolina and the “GIS for Renewable Energy Workshop” was held in September 2010 to train Energy Center staff and research assistants on GIS. Conference presentations were delivered by PI and research assistants and abstracts have been submitted for upcoming conferences.

**Alternative Fuels**

Focus topics within this section include NIR Monitoring of Biodiesel, Appalachian Biofuels and Biomass Initiative, Emissions Analysis for Different Biodiesel Feedstocks, Algae Oil Production, Harvest, & Extraction, Microwave-Assisted Synthesis of Biodiesel, and Landfill Gas Research and Development.

Dr. Eric Allain’s lab in the Department of Chemistry has been focusing efforts on NIR monitoring of biodiesel production. We are also collaborating with Dr. Nicole Bennett’s lab on a project studying the potential for microwave enhancement of enzymatic biodiesel production. The purpose of the NIR Monitoring project is to develop a secondary analytical method and chemometric model to allow for online monitoring of the biodiesel production process. This will facilitate optimization and greater understanding of key parameters for maximizing efficiency and quality of the biodiesel production process. We have developed a secondary sampling and analysis procedure based on NMR spectroscopy. So far this method is only reliable for measuring methyl ester (biodiesel product). We hope to develop other secondary analysis methods for measuring glycerol, methanol, acyl glycerols and phospholipids, and possibly free fatty acids. The NIR spectrometer is now ready to be installed on site at the Biodiesel Research, Development and Production Facility in Catawba County. Greater understanding of key parameters for high quality and efficient biodiesel production should help other small-scale NC biodiesel producers get started and optimize their process. This should expand and strengthen renewable energy production in the state.

Appalachian Biofuels and Biomass Initiative is an effort to encourage and support economic expansion of biofuels and biomass sectors in North Carolina through outreach activities and dissemination of applied and fundamental research. Our current efforts include expanding the planting area and familiarity of alternative oilseed crops agronomics in Catawba Valley. Additionally, we are developing a system for B20 usage in off-road equipment at Blackburn Landfill in Catawba County. Emissions work that is being pursued will benefit the state by improving the understanding of combustion properties and life cycle analysis from alternative feedstocks grown and processed in NC. This work will become increasingly important with the trend towards quantifying carbon intensity of fuels. The Biofuels Center of North Carolina’s *Strategic Plan for Biofuels Leadership* states that by 2017, 10% of *liquid fuels sold in North Carolina will come from biofuels locally grown and produced*. The Biofuels Center also states that currently 5.6 billion gallons of fuel are consumed annually by the state. Not accounting for growth, by 2017 it will be expected that North Carolina will produce and consume approximately 560 million gallons of biofuel. Our current combustion emissions analysis research will allow a better understanding of the potential climate and health impacts of...
biofuels manufactured from different alternative feedstocks. With the amount of biofuels already consumed in the state as well as the estimated future consumption, it is important that we make informed decisions regarding not only which biofuels are most efficient economically and energetically, but also those with the least environmental and health impacts.

The Appalachian Biodiesel Research and Testing Facility is now partially operational, with final completion scheduled for December, 2011. As the building was completed we began to install equipment. The dynamometer for emissions testing was installed last year and is now operational. This Dynamometer was funded by our grant from the U.S. Department of Energy (DOE). Much of our lab equipment has been installed and is already being used for feedstock oil testing. We are in the process of installing our process equipment. We plan to process our first batch of fuel by September 2011 and complete all of the process equipment installation by the end of November 2011. The heat recovery system from the County’s GE Jenbacher landfill gas engines that will provide us with process heat is planned to be complete by the end of October 2011. Catawba County is holding an opening event for the facility on August 15, 2011. See photos of facility below.
As part of our collaboration with Dr. Brett Taubman’s lab (Chemistry) we are designing an additional analytical system that will allow for the quantification of particulate matter produced during the combustion of biodiesel fuels. With this addition, emissions will be further analyzed to quantify the mass concentration of absorbing species (i.e. black carbon and organic particulate matter) using a 7-wavelength aethalometer and/or a one-wavelength micro aethalometer. If the 7-wavelength aethalometer is used, the spectral dependence of the absorbing species will allow us to determine the contribution from black carbon and organic carbon. With these additional data estimates of the potential climatic impacts from the use of different biodiesel sources will be possible. We will also able to estimate the potential for health impacts from the emissions based on the mass contribution of the absorbing particles.

There is widespread interest in growing algae for Algae Oil Production, Harvest, and Extraction and ultimately biofuel production. This has not yet become an industrial reality because of inefficiencies in the process. First, algae do not reliably make large amounts of oil. By understanding the process better we hope to be able to better control their metabolism and increase yield. Second, algae are a microscopic crop grown in water. Harvesting methods are both expensive and energy intensive. Through work by Dr. Mark Venable’s laboratory (Biology) we hope that by growing algae on a solid substrate that we can efficiently harvest them at low cost. Third, oil extraction is somewhat inefficient. Dr. Venable’s lab has designed an extraction process that we feel will increase yield by 10-20%. With these improvements we hope to discover a system that will make the overall process both productive and efficient. This may lay the groundwork for a new component of biofuel industry for the state.

Another Appalachian State initiative in the Biofuels arena is Microwave-Assisted Synthesis of Biodiesel & Materials for Making Solar Cells. Once completed, the biodiesel research could be expanded into a collaborative effort with state wide biodiesel production facilities. The catalysts developed could be used with both industrial scale microwave reactors and standard industrial-scale batch reactors that use conventional heating. The prophyrin work is basic research that will be used by scientist in the field of photoconductivity to develop more robust solar cells.
Our final area of activity in the alternative fuels section is Landfill Gas Research and Development. This activity is to assist counties, especially rural economically challenged communities with smaller landfills, to develop landfill gas projects for community-based development, renewable energy implementation, and reduction of greenhouse gas emissions. Some results and benefits derived from our work include the following items:

- Assisted eight counties in applying for ARRA funding for landfill gas projects.
- Eleven counties applied for and were awarded ARRA grants for landfill gas projects totaling $5 million. This ARRA funding is expected to leverage at least $5 million more in other funds.
- Thus far over 4 megawatts of electricity generation capacity has been installed on these projects with approximately 1.5 more megawatts planned for installation before March 2012.
- An estimated three permanent full-time jobs and 10 man-years of temporary positions in planning, engineering, and construction have been created. Many more permanent jobs are expected in the next two years.
- Approximately 190,000 tons of CO₂ emissions avoided.
- Approximately 112,700 mmBtu of energy used from landfill gas to generate energy replacing the equivalent of 19,430 barrels of oil.

During the past fiscal year, progress was made on our EPA sponsored landfill gas project in Brazil. During 2010-2011 a second phase grant was applied for and received from the Global Methane Initiative for $125,000. A conceptual design and cost estimate for the landfill gas system at the Maracanau Landfill was completed. A large contingent of students from the Walker School of Business accompanied Brazil LFG team members Jeremy Ferrell and Marty Meznar to Maracanau for a formal signing of a Letter of Intent by Mayor Pessao. This letter was later signed by Dr. John Pine of the Research Institute for Energy, Environment, and Economics. We also identified technologies applicable to the establishment of value-added processing for the Energy Park at the Maracanau Landfill and began work on the conceptual design for this facility. In addition, we applied for a US AID Brazil grant which could pay for about 50% of the cost of a landfill gas collection system at the maracanau site.

Policy, Markets, and Economic Development

Our first activity was to Assess Carbon Market Opportunities in North Carolina. Activities under this Task include: monitoring developments in national carbon-emissions policies and market development for potential impacts on North Carolina’s economy; examining characteristics of the current market for voluntary carbon offsets; Researching climate change and carbon policy options as they relate to stakeholders in North Carolina; examining NC GHG emissions supply and demand; and examining threats and opportunities to local and regional economies presented by the national GHG regulation program, identifying strategies to maintain or
improve economic competitiveness. The purpose of this work is to understand how carbon market development may impact (positively or negatively) NC’s economy. The voluntary market report is complete and the Carbon Market Activity report is nearing completion.

We also assisted in registering more than 3,760 (53.75%) of forest acres in the state in the Climate Action Reserve and in developing 200,000+ tons of CO₂ offsets earned by county-owned landfill gas projects. Counties have received millions of dollars in additional income and conservation land (and non-profit it supports) have received millions of dollars from voluntary carbon markets.

Revisions to the State Energy Plan have been completed. This work, caught in the transitions from the previous Governor’s administration to our current Governor’s administration, has been renamed the State Energy Report and submitted to the State Energy Office. There were extensive revisions involved in this effort. The total length of the report was reduced by about 60%, and the recommendations from a lengthy series of meetings with three Task Forces and the Energy Policy Council were removed. The State Energy Report shows the current energy situation in North Carolina regarding energy supplies and energy demand from the residential, commercial, industrial, transportation, and electrical generation sectors. The plan will serve to inform policy makers and others about the state’s energy situation. It includes analysis of the potential contribution of energy efficiency and renewable energy in reducing the state’s need for fossil fuel and nuclear resources.

Economic Development Analysis and Outreach has involved multiple efforts, including preliminary work on Volume 5 of the Economic Developer’s Guide to the Renewable Energy Industries, scheduled to be published on-line in the fall of 2011. Additional benefits to the state from our focused expertise include: increased awareness and understanding of opportunities and strategies for capitalizing on the economic growth potential in the green economy; access to analysis and unbiased third-party financial reviews for local governments seeking to tap into the value of new markets for renewable energy and carbon offsets; and through stakeholder interactions the state benefits from increased economic activity, more productive economic development investments, and lower transaction costs resulting from stakeholder progress along the experience curve.

The purpose of our examination of strategic development indicators for the green economy in NC is to provide insight into decision making for local economies based on competitive and comparative advantage as pertains to focusing investment of limited resources into opportunities which provide the intended balance between risk and return. Current work sponsored by Z. Smith Reynolds includes the development of a web-based information/decision support system that will lead to increased effectiveness and efficiency of public investments in green economy areas. The Green Economic Asset Mapping project will provide a web-based tool for use in identifying and prioritizing key opportunities for local and regional economies to capitalize on economic growth related to green energy. This tool will indicate economic
development opportunities where local economic assets are related to green energy markets and technologies, quantify each opportunity’s potential impact, and provide insight into the tradeoffs between opportunities. With the information provided in this tool, local leaders will be able to evaluate potential green economic development programs in the context of local priorities and local capabilities. In doing so, these leaders will thus be more effective in allocating their limited resources by targeting opportunities which leverage local assets such as natural resources, labor skills, existing idle infrastructure, or training programs. Specifically, the asset map tool will include opportunities in three broad categories: producing green energy products/components/materials for sale outside the local area, improving local energy efficiency, and utilizing natural resources for their green energy potential. Participating in the project are the Energy Center, students and recent graduates from the Computer Science Department, Technology Department, College of Business, and Geography ad Planning Department.

Our work on Hydrogen & Fuel Cell Industry Development & Commercialization reaches beyond the state and national arenas and onto the international stage. The Sixth International Hydrail Conference was held in Istanbul, Turkey on 1-2 July 2010. The conference is funded by the United Nations, through Istanbul-based International Centre for Hydrogen Energy Technologies (UNIDO-ICHET). Representatives from over a dozen countries were in attendance and a special information session for the Director of the Turkish State Railways was included. Of specific interest within North Carolina is that Charlotte has incorporated hydrogen-fueled mass transit technologies into their infrastructure planning and cost-benefit analyses. A manufacturer of hydrogen vehicles, Proterra LLC, engaged the state in an attempt to locate 1,000+ jobs in the Charlotte area (though eventually decided on the Greenville, SC area). North Carolina benefits from these activities through increased international recognition as a globally engaged state and source of high-technology innovation. These activities have brought new green transportation technology OEM’s to the doorstep, and will likely result in growth in supplier industry jobs in batteries, textiles, plastics, and reinforced composite materials production. Furthermore, these activities bring attention to a resource that will be vital to future energy systems, hydrogen. Recently, President Obama visited a Hydrail Conference recruit’s manufacturing facilities (Proterra) in SC. We are currently involved in the planning of the next conference that will be held at the University of Birmingham, UK.

The Energy Center worked with Watauga County to evaluate the financial benefits of the ongoing electricity generation project using landfill gas at the closed County landfill. This work started by examining the potential for electricity bill savings from aggregating multiple electricity service accounts at the landfill, and determined that the County’s electricity bills at the landfill could be reduced by as much as 10% per year from aggregating these accounts. The study then looked at the potential value of savings from generating electricity for use on-site and selling the excess to the power grid and determined the project would reduce electricity costs at the landfill by nearly 80% from the business-as-usual scenario. For the sale off excess
electricity, the Energy Center negotiated what is believed to be a first-of-its kind arrangement in the state where the County will sell its excess electricity directly to Duke Power for a fixed-rate schedule via a transaction structure described by the Federal Energy Regulatory Commission (FERC) in its order implementing the Public Utilities Regulatory Policy Act (PURPA), a deal expected to bring in as much as $47,750 per year in new revenue to the County. The Energy Center also prepared a bid for the sale of renewable energy certificates, or green power, to N.C. Green Power which is expected to bring in an additional $8,650. Before the project the County spent about $38,000 per year on electricity at the landfill facility, and as a result of the project the County is projected to receive a net income (after expenses) of more than $64,300 per year.

The final initiative in our review is the Student Energy Research Development program. In it we assist students at Appalachian State University to complete energy related research by providing seed funds to be used to carry out research activities mentored by an advisor. The program will help significant and important research to be completed within the state and provide students within the state an opportunity to significantly improve their research skills that they will carry with them into the workplace. This year’s program awarded grants of approximately $500 to six Appalachian students for their energy related research.

**FACILITIES**

**Solar Training and Research Facility** is in development at the University’s State Farm Road location, with construction nearing completion. This facility provides a site for testing and research on performance of available solar equipment. This work will allow homeowners and businesses to adopt these technologies with confidence and make the best decisions about what technology to adopt. The facility provides educational opportunities for future employees of the regional Green Economy.

**Small Wind Testing & Demonstration Facility** on Beech Mt provides a site for the testing small wind turbines. Most of the wind turbines being installed in western NC and throughout the state have come about after significant consultation with Appalachian State’s Wind Application Center. We routinely provide wind maps and wind measurement equipment and analysis to individuals who subsequently install wind turbines.

**Appalachian Biodiesel Research and Testing Facility** at the Catawba County EcoComplex provides valuable feedstock, fuel quality, and emissions data to the biodiesel industry in the State of North Carolina. The modular nature of our facility allows substitution of specific equipment in the production line to determine optimal engineering design for conversion of different feedstocks to biofuels while maximizing positive fuel properties and minimizing impact on air and water quality. The facility also allows experimentation with different processing elements to determine which components work together to provide the best overall production performance, fuel quality, and combustion emissions. Fuel quality and combustion
emissions are analyzed well beyond ASTM and EPA standards, using advanced chemical analysis techniques.

**Alternative Fuels Research Labs** on campus include Biodiesel Education and Research Laboratory (BEReL), Cell-Free Ethanol Production & NIR Monitoring of Biodiesel Lab (Chemistry), Algae Oil Production, Harvest, & Extraction Laboratory (Biology), Microwave-Assisted Synthesis of Biodiesel (Chemistry), and Landfill Gas Research and Development Labs.

**Photovoltaic Materials and Device Characterization Facility** in the Department of Physics and Astronomy is under development. This site will provide the tools and training for ASU students and faculty to develop, fabricate and characterize PV devices. This facility serves as a user facility where PV researchers, fabricators, and users can have their PV materials and devices fabricated and tested. It is hoped and expected that the results of this work will serve as a resource for others who will need to use the tools we are developing to aid in their pursuit of fabrication and/or characterization of PV materials and devices. We can provide critical PV device measurements and characterizations at little or no cost to NC based companies and researchers.

**Landfill Gas Research and Development Labs** (Hickory, Boone, and local sites throughout North Carolina). This initiative develops landfill gas projects for community development, renewable energy implementation, and reduction of greenhouse gas emissions.

**PEOPLE**

**Director**
Jeff Ramsdell

**Staff**
Amanda Perry
Stan Steury
Jeremy Ferrell
Kellie Stokes
Quint David
Chuck Perry
Landon Williams
Lawrence Lippard
Bruce Davis
Jason Hoyle
John Lehman
Joey Mosteller
Brian Witmer
Nick Hurst
Sean Gray

**Associated Faculty**
Jeff Tiller
Brian Raichle
Joe Crocker
Mark Venable
Brett Taubman
Chris Badurek
Dennis Scanlin
Marie Hoepfl
Lee Ball
Nicole Bennett
Eric Allain
David Domermuth
I. MAJOR ACCOMPLISHMENTS

1. External Funding Activity

SUMMARY
Appalachian Energy Center receives core funding through an Appropriation from the North Carolina Legislature. In addition, AEC supported ___ proposals that have remained active over the past year. Two submitted proposals are currently under review and ___ additional were rejected. Of the ___ active funded projects, at least ___ provide indirect funds to the university. The total funds secured exceed $___. AEC staff have worked with 11 county governments to develop Landfill Gas proposals and all 11 have been funded with total funds secured equaling $8,175,657.

<table>
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<tr>
<th>AEC Proposals</th>
<th>Total Number</th>
<th>Number w/ Indirect</th>
<th>Total $</th>
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<td>Total Funding 2010-2011</td>
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Proposals With Counties (AEC provided assistance and is a subcontractor for some)

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<tr>
<th>County Landfill Gas Proposals</th>
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<td>Additional leveraged funds from other sources</td>
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<td>Total Funded</td>
<td></td>
<td></td>
<td>$8,175,657</td>
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PROPOSALS AWARDED

1. Green Economic Asset Mapping
Researchers: Jason Hoyle
Funding Agency: Z. Smith Reynolds Foundation, Inc.
Amount: $34,602
Dates: 7/1/2010 – 9/30/2011
Indirect: NO
2. Student Energy Internship and Fellowship Program
Researchers: Marie Hoepfl, Jeff Ramsdell, Jeff Tiller, Dennis Scanlin
Funding Agency: ARRA – US DOE thru NC State Energy Office
Amount: $485,857
Dates: 7/30/2010 – 6/30/2012
Indirect: Yes

3. NC Home Energy Efficiency Marketing Development and Implementation Program
Researchers: Jeff Tiller, Jamie Russell, Lee Ball, and Bruce Davis
Funding Agency: ARRA – US DOE thru NC State Energy Office
Amount: $2,550,000
Dates: 7/1/2010 – 4/20/2012
Indirect: Yes

*4. 2011 Solar Decathlon *
Researchers: Jamie Russell and Chad Everhart
Primary Funding Agency: National Renewable Energy Laboratory
Amount: $100,000
Secondary Funding Agency: Lowes
Amount: $350,000 (Cash and Equipment and Materials)
*(Not included in summary statements and counts - the Energy Center is providing financial management support for funds provided for this project by Lowes)*

5. Appalachian State University Wind Application Center – APPWAC
Researcher: Dennis Scanlin
Funding Agency: National Renewable Energy Laboratory
Amount: $59,951
Indirect: Yes

6. Watauga County Energy Analysis Project
Researcher: Jason Hoyle
Funding Agency: Watauga County
Amount: $1,975
Dates: 9/1/2010 – 10/31/2010
Indirect: No

*7. Community-based Landfill Gas Utilization In Brazil - Phase I
Researchers: Jeff Ramsdell and Stan Steury
Funding Agency: U.S. Environmental Protection Agency
Amount: $120,000
Indirect: Yes

8. Community-based Landfill Gas Utilization in Brazil - Phase II and Extension
Researchers: Stan Steury, Jeff Ramsdell, Jeremy Ferrell, Patricia Cornette
Funding Agency: U.S. Environmental Protection Agency
Amount: $120,000
Dates: TBD
*9. ASU Western North Carolina Wind Energy Initiative, NC Solar Center
Researcher: Dennis Scanlin
Funding Agency: US Dept of Energy
Amount: $25,870

*10. NSF Planning Grant: Sustainable Integrated Buildings and Sites (SIBS)
Researcher: Jeff Ramsdell
Funding Agency: NSF- Industry/University Collaborative Research Centers
Amount: $10,000
Dates: 2/1/2010 – 1/31/2011 Indirect: Yes

*11. Wind Powering America – NC Mountain Outreach
Researcher: Dennis Scanlin
Funding Agency: US DOE Wind Powering America – National Renewable Energy Lab
Amount: $75,321
Dates: 3/19/2008 – 11/30/2010 Indirect: Yes

*12. Improved Energy Code for NC
Researcher: Jeff Tiller
Funding Agency: US Dept of Energy thru NC State Energy Office
Amount: $254,546

*13. Extraction & Refinement of Oils from Biodiesel Feedstocks
Researcher: Nicole Bennett
Funding Agency: Biofuels Center of NC
Amount: $129,133

*14. Watauga County Green Business Certification Program
Researcher: Laurel Elam
Funding Agency: Watauga County Economic Development Commission
Amount: $58,093

16. Optimization of North Carolina Biodiesel Production through Data Regulated Processing of Variable Alternative Feedstocks – Biodiesel Car and Analysis Equipment
[Not included in summary statements and counts – included for historical reference]
Researcher: Jeff Ramsdell, Nicole Bennett, Eric Allain
Funding Agency: The University of North Carolina Research Competitiveness Fund
Amount: $275,000
Dates: 3/1/2008 – 8/30/2008 Indirect: No
*17. Modular Biodiesel Testing Facility – Combustion Analysis – Dynamometer at Test Facility
Researcher: Jeff Ramsdell
Funding Agency: U.S. Department of Energy
Amount: $295,200
Dates: 5/1/2008 – 9/30/2010 Indirect: Yes

*18. Biodiesel Testing Facility
Researcher: Jeff Ramsdell
Funding Agency: Golden Leaf Foundation
Amount: $750,000

19. Landfill Gas Utilization for Columbus County
Researcher: Stan Steury
Funding Agency: Cape Fear Resource Conservation and Development
Amount: $6,000

20. Project Support Request Landfill Gas for Community Development - Construction Phase
Researcher: Stan Steury
Funding Agency: Z. Smith Reynolds Foundation, Inc.
Amount: $25,000
Dates: 5/01/2011 – 4/30/2012 Indirect: Yes

PROPOSALS AWARDED to COUNTIES with AEC Assistance

Landfill Gas Proposals for Counties Supported by AEC
Researcher: Stan Steury, Jason Hoyle, Joey Mosteller
Funding Agency: ARRA – thru NC State Energy Office
The following grants were recently approved for our cooperating counties in response to proposals we helped develop.
• Columbus County -- $544,500 to install landfill gas generators to produce electricity and to develop on-site greenhouses to use waste heat from the generators - Total cost of the project is $951,500
• Edgecombe County -- $325,000 to install generators to produce electricity and develop uses for the waste heat from the generators - Total cost of the project is $825,000
• Robeson County -- $1 million to capture, condition, and compress methane gas and use it to produce thermal energy for adjacent business use - Total cost of the project is $1,549,900
• Rockingham County -- $814,300 to install and operate a methane collection system carbon credit verification equipment and electricity generators and electricity interconnect upgrades - Total cost of the project is $1.9 million
• Scotland County -- $250,000 to build a gas collection system and use the methane to run an engine/generator for electricity generation - Total cost of the project is $336,045
• Wilkes County -- $358,635 to complete a gas collection system and use the gas for electricity generation and thermal heat for a greenhouse project
• Gaston County -- $200,000 to install landfill gas generators – Total project cost is $446,200
• Caldwell County -- $326,515 to install landfill gas generators to produce electricity
• Rutherford County -- $400,000 to install landfill gas collection system and generators and greenhouses heated with waste heat from the generators
• Haywood County -- $1 million to capture methane gas
• Watauga County -- $40,931 - Total cost of the project is $81,862

PROPOSALS UNDER REVIEW

1. The Healthy Homes Technical Studies Grant Program: What Are People Breathing? Establishing Baselines Before and After Home Weatherization
   Researcher: Susan Doll, Bruce Davis, and Kellie Stokes
   Funding Agency: Department of Housing and Urban Development (HUD)
   Amount: $649,993
   Date: Indirect: Yes

2. Center for Sustainable Technology Innovation
   Researcher: Jason Hoyle
   Funding Agency: DOC Economic Development Administration
   Amount: $15,010
   Date: Indirect: Yes

3. Valuing Biochar Management Practices for Sequestering Carbon in Soil to Develop a Role for Farmers in the Carbon Credits Market
   Researcher: Jason Hoyle
   Funding Agency: NC Farm Center for Innovation & Sustainability – Conservation Innovation Grants
   Amount: $25,200
   Date: Indirect: Yes

PROPOSALS REJECTED

1. Energy Code Training
   Researcher: Jeff Tiller
   Funding Agency: ARRA – US DOE thru NC State Energy Office
   Amount: $998,236
   Date: 8/2/2010
   Not Funded

2. Appalachian State University - Testing of Small Wind Turbines at Regional Test Center - Small Wind Test Center
   Researcher: Dennis Scanlin
   Funding Agency: National Renewable Energy Laboratory
   Amount: $636,458
   Not Funded
3. Bio-char Cost-Benefit Analysis
Researcher: Jason Hoyle
Funding Agency: NC Farm Center for Innovation and Sustainability
Amount: $34,717  Not Funded

4. STEMulating Appalachia
Researchers: Brian Raichle, Jerianne Taylor, Laura England, & Carla Ramsdell
Funding Agency: Golden LEAF Foundation, Inc.  Amount: $749,917  Not Funded

5. What Are People Breathing? Establishing Baselines Before and After Home Weatherization Measures
Researchers: Susan Doll and Bruce Davis
Funding Agency: US HUD – Healthy Homes Technical Studies
Amount: $999,881  Date: 11/8/2010  Not Funded

6. Economic Innovation Grants, seed grant: Community-based Economic Developments and Landfill Energy Parks
Researcher: Stan Steury
Funding Agency: Rural Economic Development Center  Amount: $197,000  Not Funded

2. FACULTY PARTICIPATION

AEC staff and associated faculty developed a multiple discipline initiative plan through which to apply funding from the North Carolina Legislature Energy Centers Appropriation and received a MOU to proceed from the NC Energy Office. Work has been being pursued by 15 Center staff, more than 35 project staff, and 16 faculty.

AEC competed for additional externally funded projects which involved 6 additional faculty.

<table>
<thead>
<tr>
<th>Campus Researchers</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>22</td>
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<td>Department/College</td>
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<tr>
<td>Technology/FAA</td>
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<td>Chemistry/CAS</td>
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<td>Geography &amp; Planning/CAS</td>
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<tr>
<td>Biology/CAS</td>
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<tr>
<td>Economics/COB</td>
<td>1</td>
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<tr>
<td>ORSP/Grad School</td>
<td>1</td>
</tr>
<tr>
<td>Computer Science</td>
<td>1</td>
</tr>
</tbody>
</table>

AEC’s efforts entailed collaborations with many other research institutions (e.g., subcontracts, co-PIs, etc.)
Off-Campus Collaborations

University of North Carolina Charlotte
Carnegie Mellon University
North Carolina Solar Center at NCSU
Catawba County EcoComplex
Southern Energy Management
Center for Energy Research & Technology at NC A&T
City College of New York
NC Fuel Cell Alliance
Advanced Energy Corporation
County Governments – Multiple for Landfill Gas Initiatives

3. RESEARCH REPORTS and PUBLICATIONS

Taylor, Marcus, 2010, Public Opinion of Wind Turbines in Watauga County, North Carolina

Scanlin, Taylor & Kersey, 2010, Public Opinion of Wind Development in Western North Carolina

Scanlin, Taylor & Flynt, 2010, Wind Resources of Western North Carolina

Scanlin, Taylor & Flynt, 2010, Potential Economic Impacts of wind energy development in Western North Carolina


Tiller, Jeff. 2011 “Issues Report for the Watauga High School Commissioning effort”


Steury, Stan W. and Ramsdell J. Community-based Landfill Gas Development in Brazil. WasteLand movie premier, Farthing Auditorium, Boone, NC. November 2010


Steury, Stan W. Community-based Landfill Gas Development in Ceara Brazil. ASU Office of Research and Sponsored Programs, First Friday Presentations, Boone, NC. April 2011


Lehman, John and Joey Mosteller. 2010. The Hurricane Threat for North Carolina Offshore Wind Development. Policy Brief for Appalachian Energy Center and CERPA.

Lehman, John and Quint David. 2010. Choosing a Wind Site. Working paper for Appalachian Energy Center and CERPA.


4. **RESEARCH PRESENTATIONS**


Raichle, B. W. (, How Tall is Too Tall?: Maximizing the Return on Your Wind System Home Power, 126, 84-89. Article, Magazine


Scanlin, D. M., Conference on Renewable Energy in Mexico, "Introduction to Photovoltaics," Appalachian State University, Mexico. (March 7, 2011).


Scanlin, D. M., Buncombe County Planning Board Meeting Presentation, "The North Carolina Model Wind Ordinance," Buncombe County Planning Board, Boone, NC. (September 2, 2010).


5. PUBLIC ENGAGEMENT

Biofuels
We have also continued our education and outreach efforts in many areas. These efforts include workshops and conference presentations for a diverse list of groups across the state. Refer to the table below for a list of oilseed pressing workshops our team held in the fall of 2010. Outreach and workshops have been well received and have helped to reach new farmers, provide hands-on opportunities for interested parties, and encourage farm to fuel initiatives throughout our service area.

Oilseed Pressing Workshops

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Date (2010)</th>
<th>Location</th>
<th>Participants</th>
<th>Counties Represented</th>
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<tbody>
<tr>
<td>Western North Carolina Renewable Energy Series</td>
<td>09/10 and 11</td>
<td>Boone</td>
<td>14</td>
<td>Watauga</td>
</tr>
<tr>
<td>Unifour Cooperative Extension Advisory Council</td>
<td>16-Sep</td>
<td>Newton</td>
<td>40</td>
<td>Catawba, Alexander, Burke, and Caldwell</td>
</tr>
<tr>
<td>Organic Growers School</td>
<td>09/25 and 26</td>
<td>Barnardsville</td>
<td>14</td>
<td>Buncombe, Jackson, Haywood</td>
</tr>
<tr>
<td>NC Rural Center</td>
<td>4-Nov</td>
<td>Raleigh</td>
<td>61</td>
<td>State-wide representation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Total:</strong> 182</td>
</tr>
</tbody>
</table>
Unifour Cooperative Extension Advisory Council Workshop with the mobile crushing facility; Jeremy Ferrell (center, left).

We have had multiple successful workshops on oil extraction with press demonstrations. The first workshop was part of the Western North Carolina Renewable Energy Series and demonstrated the technology to 14 participants including community members, and students. The second workshop was for the Unifour Cooperative Extension Advisory Council. This group consisted of 40 participants from Catawba, Alexander, Burke, and Caldwell Counties.

**Hydrail Conference**
The Sixth International Hydrail Conference was held in Istanbul, Turkey on 1-2 July 2010. The conference is funded by the United Nations, through Istanbul-based International Centre for Hydrogen Energy Technologies (UNIDO-ICHET). Representatives from over a dozen countries attended and a special information session by the Director of the Turkish State Railways was included in the schedule.

**Wind Initiatives**
Approximately 1000 people have attended our wind energy workshops over the last 7 years. Participants have come from more than 30 US states and 10 different countries. Many more have visited the small wind turbine site at Beech Mountain, which is open to the public.

- **Public Policy Polling, 2010, Wind Energy Survey Results report**, completed and placed on wind.appstate.edu website
- Produced a map of 174 schools in North Carolina with average annual wind speeds greater than 10 mph at 30 meters and a data base of contact information
- 1 small wind workshop developed, advertised and conducted
- 10 presentations given at conferences and meetings
- Developed an updated factsheet on wind energy
- Developed a new informational kiosk on Wind Energy for the Beech Mt test facility
6. DEVELOPMENT

Major development items for the Appalachian Energy Center for this period include facility enhancements and expansions, organizational structure improvements, and expansion of internal and external collaborations.

1. FACILITY ENHANCEMENTS AND EXPANSIONS

As discussed in more detail in the facilities section above, the Appalachian Energy Center has continues to expand and enhance our facilities both on campus and off. Major expansions and additions include: the Solar Training and Research Facility at the University’s State Farm Road site, the Appalachian Biodiesel Research and Testing Facility at the Catawba County EcoComplex, and Landfill Gas Research and Development Lab at the Watauga County Landfill. While these facilities are currently operating on a limited basis and offering some data, all three will be complete and fully operational by the end of 2011.

2. ORGANIZATION STRUCTURE IMPROVEMENTS

Ongoing improvements in the organizational structure of the Appalachian Energy Center include the formalization of our program areas, staff titles and reporting hierarchy, and development of titles and responsibilities of associated faculty. These efforts are being completed in collaboration with the other two centers of the Research Institute for Environment, Energy, and Economics (RIEEE).

3. EXPANSION OF COLLABORATIONS

Both internal and external collaborations have greatly expanded in the current reporting period. Significant additional collaborations include the development of an NSF I/UCRC with UNC Charlotte, Carnegie Mellon University, and City College of New York (part of the CUNY system), the development of renewable energy engineering programs with UDLAP in Puebla, Mexico and The University of the Free State in Bloemfontein, South Africa. Internal collaborations have expanded greatly as shown in the faculty participation section above.

II. PROBLEMS/NEEDS

Important needs include proper salaries for permanent staff, research space on campus, and an increase in the number of full-time technical staff.

1. PROPER STAFF SALARIES

Salaries of a few Appalachian Energy Center staff are currently well below market rate. Even with the current state budget crisis these salaries should be increased to market rate in order to retain these important employees and continue our current success. These employees have performed exceptionally well and are experts in their field.
2. ON-CAMPUS RESEARCH SPACE

The Appalachian Energy Center continues to operate with no real research space on campus other than that of a few collaborating faculty. This lack of space greatly reduces our ability to expand important research programs, especially in the area of high performance buildings. We are currently turning away external funding opportunities due to this lack of on-campus space.

3. FULL-TIME TECHNICAL EMPLOYEES

The Appalachian Energy Center is also in great need of further full-time technical researchers. This need is most apparent in the lack of any full-time staff dedicated to renewable energy technologies. This deficiency greatly reduces our ability to apply for large external grants.
Center for Economic Research and Policy Analysis

MISSION

The Center for Economic Research & Policy Analysis (CERPA) is a multidisciplinary unit at Appalachian State University. The mission of CERPA is to improve policy- and decision-making by producing rigorous research and disseminating relevant information on current economic and policy issues. To that end, CERPA maintains research programs in the specific areas of economic development, environment & energy, and experimental & survey research.

PROGRAMS

The Experimental Economics Program applies the laboratory method of inquiry to better understand how society and policy work. Experiments, in the lab and the field, allow for a more precise investigation of how individual, social and institutional characteristics influence individual behavior and aggregate outcomes. Consequently, the lab can serve as a wind tunnel for policy analysis to better predict the responses and outcomes of competing policies. Such policy simulation increases the power of economic inquiry and policy analysis. The program is centered on 6 experimental economists that constitute one of the largest and strongest experimental groups in the country. A recent ranking placed Appalachian’s Experimental Economics group among the top 20 in the country.

The experimental program was extremely active during 2009-2010. CERPA’s experimental lab supported eight research projects funded by the National Science Foundation, Internal Revenue Service, Office of Naval Research, World Resources Institute, among others. Over 1000 subjects participated in the sessions. Over $20,000 in funds were paid to student subjects.

The Economic Development Program facilitates research and policy analysis that promotes higher standards of living and improved economic and social conditions. The program addresses a wide range of economic and social issues, such as the urban-rural divide, workforce development, health care, income and job growth. The program maintains an area of work that focuses on Western North Carolina economic and social issues. WNC initiatives attempt to improve conditions in the region by providing relevant, time and accurate information to people in the private and public sectors.

For eight years, CERPA personnel have produced the WNC Economic Index and Report, a monthly report that measures and tracks regional economic conditions. The report provided substantial visibility to CERPA and the university on a regular basis, while being an effective facilitator of engagement at the local, regional and state levels. Unfortunately, this project was suspended due to changes in the university’s budget priorities.

The Survey Research Program is a newly formed program that provides critical capacity to conduct research and analyses on current social and economic issues. The program has already
contributed to projects such as assessing the disparities in economic and social conditions across different segments of North Carolina, investigating the benefits of marine wildlife conservation, and estimating the impact of off-shore wind turbines on NC coastal tourism.

The new survey research program hit the ground running. With just an investment of $1300, the new survey lab supported four research projects in the first year that entailed 2,427 hours of interviews and 1,833 completed surveys. The cost per completed interview continues to be low relative to outside providers.

Environment & Energy Program promotes research and policy analysis on critical environmental and energy issues, such as conservation and land-use policy, benefit-cost analysis of renewable energy, invasive species management, non-market valuation of green energy programs, and the impact of climate change on the NC coast. CERPA researchers employ a diverse set of approaches with a comprehensive perspective that considers the interdependence of economics, energy and the environment.

FACILITIES

The Appalachian Experimental Economics Laboratory (AppEEL) supports experimental research that tests the validity of economic theories, examines the emerging questions of behavioral economics, and test-best new policies and mechanisms. AppEEL can improve predictions of policy outcomes by serving as a wind tunnel that reveals the response and outcomes associated with alternative policies. AppEEL is directed by Michael McKee.

The Appalachian Survey Research Laboratory (AppSRL) supports survey research and survey services to Appalachian faculty, staff and students; researchers at other institutions; local, state and federal agencies; and other working in the public interest. AppSRL facilitates a better understanding of how people view current social and economic issues and alternative public policies. The lab is equipped to use multi-modes (telephone, internet and mail) to conduct local, state, regional and national surveys, and can undertake all phases of a survey project. AppSRL is directed by Todd Hartman.

In the past year, the survey research lab received a software upgrade that will improve efficiency and effectiveness.

PEOPLE

Director  Todd L. Cherry (Economics)

Program Directors (ASU Faculty leading Research Clusters)
    Richard Crepeau, Economic Development Program
        (Geography & Planning)
    Brian Ellison, Environmental and Energy Program
(Government and Justice Studies)
Todd Hartman, Director of Survey Research Program
(Government and Justice Studies)
Michael McKee, Director of Experimental Economics Program

Research Fellows  (ASU Faculty serving in other leadership roles)
Ash Morgan (Economics)
John Whitehead (Economics)
Chris Badurek (Geography & Planning)
David Dickinson (Economics)

Research Associates  (ASU FACULTY on Center Research Projects)
Jamie Price (Sociology)
David McEvoy (Economics)
Tanga McDaniel (Economics)
Jeff Colby (Geography & Planning)
Michael Madrich
Saskia Gevel (Geography & Planning)
Mike Denslow (Geography & Planning)
Tatyana Ruseva (Government and Justice Studies)

Research Affiliates  (OFF CAMPUS COLLABORATIONS)
Calvin Blackwell, College of Charleston
Michael Jones, Bridgewater State University
Gary McElroy

I. MAJOR ACCOMPLISHMENTS

1. EXTERNAL FUNDING ACTIVITY

Summary
CERPA supported 9 externally funded proposals, with 6 of them being funded during the past year and 2 of them being revised in the past year after being rejected. One major proposal is currently under review at NOAA. Performance is very strong number for an economics and public policy unit, particularly one without a budget or staff.

<table>
<thead>
<tr>
<th>Proposals</th>
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43
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<tr>
<th>Total Submitted</th>
<th>7</th>
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<tbody>
<tr>
<td>Not Funded</td>
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<tr>
<td>Rejected</td>
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<td>$1,507,895</td>
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<tr>
<td>Under Review</td>
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Proposals Awarded in Fiscal 2010-2011 (July 1, 2010 to June 30, 2011)

**Title: Rural Economic Opportunity**
Researchers: Todd Cherry (PI), Todd Hartman (co-PI), Jammie Price (co-PI), Richard Crepeau (co-PI) and Mike McKee (co-PI)
Funding Agency: North Carolina Rural Economic Development Center
Amount: $10,000
Dates: Summer 2010-Fall 2010

**Title: Rural Economic Opportunity**
Researchers: Todd Cherry (PI), Todd Hartman (co-PI), Jammie Price (co-PI), Richard Crepeau (co-PI) and Mike McKee (co-PI); subcontract with UNC School of Government
Funding Agency: North Carolina Rural Economic Development Center
Amount: $90,000
Dates: July 2009-January 2010 (extended September 2010)

**Title: Multi-mode Chesapeake Bay Menhaden Survey**
Researchers: John Whitehead (PI), Todd Hartman (co-PI) and Tanga McDaniel (co-PI)
Funding Agency: Virginia Marine Resources Commission
Amount: $51,415
Dates: April 2010-December 2010

**Title: Land Parcel GIS Database Development**
Researchers: Chris Badurek
Funding Agency: Highland Mapping
Amount: $4,033
Dates: May 2010-August 2010

**Title: GIS Analysis and Mapping for Watauga County Tourism Authority**
Researchers: Chris Badurek (PI) and Richard Crepeau (co-PI)
Funding Agency: Watauga County TDA
Amount: $3013
Dates: June 2009-August 2010

**Title: The Total Economic Impact of Mission Health on the Regional Economy**
Researchers: Todd Cherry (PI), Ash Morgan (co-PI) and Mike McKee (co-PI)
Funding Agency: Mission Health
Amount: $39,000
Dates: May 2010-August 2010
Title: Promoting Strategic Coastal Retreat Policies

Proposal No: 10-0321
Researchers: John Whitehead (PI); Ash Morgan (Co-PI)
Academic Affiliation: Economics
Amount: $8,000
Sponsor: Western Carolina University

PROPOSALS UNDER REVIEW

Title: CICS: Monitoring and Assessing Weather and Climate Events from a Socio-economic Perspective
Researchers: Todd Cherry (PI), Ash Morgan (co-PI) and John Pine (co-PI)
Funding Agency: NOAA
Amount: $1,418,472
Dates: January 2012-January 2015

Title: Circadian mismatch and fatigue effects on decision-making
Proposal No. 11-0206 PI: David Dickinson
Academic Affiliation: Economics Amount: $24,290
Sponsor: SHRM- Society for Human Resource Management Foundation
CO-PI: Gary McElroy

Title: CI-TEAM Implementation Project: Innovative Multi-disciplinary Earth Science Education through GeoBrain
Project No. 110241 PI: Chris Badurek
Academic Affiliation: Geography & Planning Amount: $37,999
Sponsor: George Mason University
CO-PI: Jeff Colby

Title: Interdisciplinary Course Proposal: Land Cover Change Science
Project No. 11-0172
PI: Chris Badurek; CO-PI’s: Michael Madrich, Saskia Gevel and Mike Denslow
Academic Affiliation: Geography & Planning Amount: $7,250
Sponsor: N.C. Space Grant Consortium

Title: DCRC New River Flood Hazard Mitigation
Project No. 110203
PI: Chris Bedurek, CO-PI’s: Todd Hartman, Tatyana Ruseva and John Pine
Academic Affiliation: Geography & Planning
Amount: $193,029
Sponsor: National Science Foundation

**Title: Economic Values of Coastal Erosion Management**
Proposal No. 11-268    PI: John Whitehead; David Dickinson (PI) and Todd McEroy (co-PI)
Academic Affiliation: Economics
Amount $19,884
Sponsor: N.C. Sea Grant (East Carolina University)

**PROPOSALS NOT FUNDED**

**Title: Climate Change and Southern Forest Management: Landowner Decisions and Valuing Ecosystem Services**
Researchers: Mike McKee (PI), Todd Cherry (co-PI), Todd Hartman (co-PI), Dave McEvoy (co-PI), Ash Morgan (co-PI) and John Whitehead (Co-PI)
Sponsor: USDA (Collaborating Universities: Texas A & M (Lead) and Dartmouth)
Amount: $994,852

**Title: The Effects of Voluntary Sleep Loss and Cicadian Mismatch on Controlled versus Automatic Thought Processes**
Researchers: David Dickinson (PI) and Todd McEroy (Co-PI)
Funding Agency:
Amount: $353,110

2. FACULTY PARTICIPATION

CERPA externally funded efforts involved 18 researchers across campus, representing 5 different departments. Half of the proposals involved multi-disciplinary teams of researchers, and CERPA was instrumental in developing these opportunities.

<table>
<thead>
<tr>
<th>Campus Researchers</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
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<td>Department/College</td>
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<td>Economics/COB</td>
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<td>Government Studies/CAS</td>
<td>3</td>
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<tr>
<td>Geography &amp; Planning/CAS</td>
<td>5</td>
</tr>
<tr>
<td>Sociology/CAS</td>
<td>1</td>
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<tr>
<td>Psychology/CAS</td>
<td>1</td>
</tr>
<tr>
<td>Biology</td>
<td>1</td>
</tr>
</tbody>
</table>
CERPA’s efforts entailed collaborations with many other research institutions (e.g., subcontracts, co-PIs, etc.)

**Off-Campus Collaborations**
- UNC School of Government
- Texas A&M
- Dartmouth College
- CICERO-University of Oslo
- Bridgewater State University
- NC Rural Center
- University of Houston Clear Lake
- University of Wyoming

### 3. RESEARCH REPORTS (selected)


**Cherry, T.L.** and Cotton, S. “Sleeping with the Enemy: The Economic Cost of Internal Environmental Conflicts” *Economic Inquiry*, in press. (Journal Article, Academic Journal)


“Taxpayer Information Assistance Services and Tax Compliance Behavior” (with J. Alm, M. Jones and **M. McKee**) *Journal of Economic Psychology*, Volume 31, Number 4, August 2010. (Journal Article, Academic Journal)


Huang (Eds.), *Preference Data for Environmental Valuation* Routledge Taylor and Francis Group. (Book, Chapter in Non-Scholarly Book-New)


Rural Economic Opportunity, submitted to the NC Rural Economic Development Center

Collaboration with Center for Entrepreneurship entailing a survey of local businesses and a series of accompanying reports

WNC Economic Index and Report (7 reports)

**4. RESEARCH PRESENTATIONS** (selected)


Cherry, T.L. “Indicators of socio-economic impacts from climate change” National Climatic Data Center, NOAA, March 2011

Cherry, T.L. “The impact of trial runs on the acceptability of environmental taxes” College of Charleston, Charleston SC, February 2011

Cherry, T.L. “The impact of trial runs on the acceptability of environmental taxes” American Economic Science Association, Tucson AZ, November 2010


Dickinson, D. L., Les Journees de l'economie, "Effects of sleep deprivation on emotional decision making," Research Foundation of Lyon (France), Lyon, France. (November 2010).

Dickinson, D. L., "Sleep deprivation, sleep choice, and time-of-day effects on high-level decision making," University of Rennes, Rennes, France. (November 2010).

Dickinson, D. L. (Presenter & Author), Drummond, S. P.A. (Presenter & Author), NSF Human and Social Dynamics Awardees conference, "Impact of sleep deprivation on decision making.
Behavior and Brain Impact.,” National Science Foundation, Washington, D.C.. (September 2010).


5. PUBLIC ENGAGEMENT

CERPA Public Lecture on Transportation and Sustainability: David Green, Oak Ridge National Laboratory, IPCC Lead Author
Member (Todd Cherry), TAC Mountain Resource Legislative Commission, NC General Assembly, monthly meetings throughout WNC, since December 2010

Cherry, T.L. Presentation on Regional Economy, Cherokee County Chamber of Commerce, Murphy NC, October 2010

Cherry, T.L. Contributor, WNC Sustainability Report Card (economic indicators), June 2011 to December 2011

Cherry, T.L. Multiple Media Appearances

6. DEVELOPMENT

A New Research Working Group
We developed a new research working group on campus: experimental social science. The intent of the initiative is to generate new ideas and collaborations by bringing together social science researchers that employ experimental research methods. A group of psychologists, economists and political scientist began meeting on a regular basis in the winter 2010. Each meeting entailed a presentation and discussion on research ideas and methods. The faculty will dictate future development, but discussions include creating a seminar series and external speakers. CERPA envisions, if the group develops further, this group will transform the Experimental Economics Program to a more broad Social Science Experimental Program.

A New Survey Research Lab
We developed a new survey research lab based on interest and talent of faculty. CERPA provided initial funds for the facility. Todd Hartman provided the faculty expertise. The Appalachian Survey Research Lab (AppSRL) has provided valuable new capacity for research. It has been a vital element in securing two externally funded projects, and interest is growing.

Addition of a new program: Survey Research Program
We developed a new CERPA research program: Survey Research Program. This new program coincides with the new capacity (AppSRL) and interest (faculty and external agencies). Todd Hartman, Department of Government Studies, has been designated the director.

Updates for Survey Research Lab: Software
The Survey Research Lab received support from CAS and COB to purchases survey management software. Previously, the lab operated on an ad hoc created system and the new software will substantially enhance the capabilities and efficiencies of the lab.

Updates for Experimental Economics Lab: Database Management
The Experimental Economics Research Program depends on a sizable database of students that participate in the experimental sessions. This database must be updated on a regular basis to
keep up with the departure of graduating students. This was done begun this past Spring and will be completed this Fall.

**Discontinued: WNC Index and Report**

Due to a shift in priorities, support for the WCN Index and Report was eliminated. This is an enormous loss for CERPA and the university. This 8-year long program, which began as a collaboration with AdvantageWest and the WCOB, has served the region and state with invaluable information while also highlighting the social and economic challenges in the region—challenges that receive little attention elsewhere. The project also provided CERPA and the university invaluable and regular visibility among residents, businesses and elected officials in the community. For instance, officials from the Governor’s office took note of this engagement effort and asked to be included on the monthly distribution list. But maybe more importantly, the index was a facilitator of opportunities for Appalachian. The index caused those in the community to think of CERPA and Appalachian when they had a question or need related to economic and policy issues. For instance, Mission Health contacted us to conduct an impact study only because they knew of us via the visibility of the WNC Index. The network and relationships that CERPA and Appalachian has built in the region will suffer due to the elimination of this program.

**Website**

The website is regularly updated and improved.

**II. PROBLEMS/NEEDS**

CERPA’s development was a faculty-driven process and continues to not receive any support beyond reassigned time. This past year the reassigned time was cut by 50 percent. Such a dramatic cut in resources has already harmed what was an over-achieving research and engagement unit. Considering the level of investment and output, CERPA has been an incredible success. Last year, I argued the success justified additional investment, but unfortunately, resources were cut by 50 percent. The obvious result will be a significantly lower level of external funding efforts and economic engagement activities.

The biggest problem is the need for support. The most effective support would be reassigned time, and fortunately, this is the least costly form of support. Actually, reassigned time can be zero because many CERPA-related faculty teach multiple sections of the same course. To illustrate, the reassigned time for the WNC Index and Report could have been achieved by allowing one large section to replace two small sections. Therefore, with this in mind, the elimination of the WNC Index and Report actually offered no savings while imposing substantial losses to CERPA and the university. Such flexibility and efficient use of resources can extends to other opportunities to increase the research activities in CERPA.
Environmental Programs

Proposed: Southern Appalachian Environmental Research and Education Center (SAEREC)

MISSION
The mission of the proposed Southern Appalachian Environmental Research and Education Center (SAEREC) is to promote interdisciplinary environmental research and educational outreach in the southern Appalachian region. Through these efforts SAEREC will contribute to an increased understanding of the critical challenges facing natural ecosystems in this region due to human activities.

**Objectives are to:**

1) support research in the southern Appalachian mountain region that has both regional and global implications
2) promote an understanding of increased human resource demands on ecosystems of the southern Appalachian mountain region
3) encourage interdisciplinary collaborations to solve environmental problems in the region, and
4) actively engage and mentor students in environmental research and educational outreach

This mission statement was approved by the SAEREC Board of Advisors on July 21, 2010.

**PROGRAMS**

Environmental Programs through the RIEEE operates under the proposed Southern Appalachian Environmental Research and Education Center (SAEREC). RIEEE’s Environmental Programs is now in its second year of existence with a growing array of research projects. The first organized group within SAEREC was AppalAIR, which is an interdisciplinary atmospheric research initiative. The Director of SAEREC, with the assistance of John Pine, RIEEE Director, is also working to organize several other research “clusters”, defined as groups of faculty who share particular interests in environmental research and who may work together to develop new research programs that address our mission and goals.

The approach being taken at these early stages is to create research clusters centered on atmospheric processes (AppalAIR), water resource issues (quality and quantity), earth systems (land, soil, hydrology, nutrient cycling, etc.), and conservation ecology (which would include biodiversity issues). A diagrammatic view of the interaction of these clusters, both within SAEREC, and among the other RIEEE Centers, is shown in Figure 1 below.
Atmospheric Issues

AppalAIR is the Appalachian Atmospheric Interdisciplinary Research Group formed within the College of Arts and Sciences in 2008. Its primary mission is to understand the role of atmospheric processes in the southern Appalachian Mountain region and their effects on natural ecosystems. The initial research focus is on aerosols, which can greatly affect radiative forcing and in turn, temperatures in this part of the country. A second goal is to educate the public about the importance of atmospheric research and climate change.

The members of AppalAIR have expanded and now include the following members:

- Howard Neufeld, Chair (BIO)
- Brett Taubman (CHE)
- Barkeley Sive (CHE)
- Jim Sherman (A&P)
- Baker Perry (G&P)

Figure 1. Tentative organizational structure of SAEREC as embedded within the larger framework of the RIEEE.
The Water Resource Planning Committee is a group of faculty that share interests in water quality issues. This highly diverse group is already addressing issues related to streams on campus, and hydrological issues in the region. Faculty have worked with graduate and undergraduate students to set up long term water resource research efforts. No proposals have been submitted by this group.

**Earth Systems**

Faculty from the Earth Systems Group have explored potential collaborations that would lead to proposals but have to date not led to submissions. The group will meet in the fall semester of 2011 to introduce faculty to each other, to determine if there is enough interest to make this a formal working group, and if so, to elect people to lead and manage this cluster. One goal of this meeting is to create a mission statement for this cluster, along with specific research objectives.

**Conservation Ecology**

This research cluster is not yet formed either, and as with the Earth Systems Group, a meeting will be held in the fall to formalize this research cluster.

It should be noted that SAEREC’s role in promoting research in these clusters is limited to facilitating faculty interactions, letting faculty know about specific RFPs, and acting to coordinate multi-institutional collaborations if so asked. It is not the role of SAEREC to “push” science onto any faculty as a top-down measure. Rather, it is the hope that SAEREC will facilitate faculty collaborations that arise from the bottom-up collaborations, both within ASU as well as with other institutions. A listing of prospective faculty in each cluster is provided at the end of this document. Note that some faculty may cross over several clusters, so this grouping should be viewed only as a preliminary classification and not something set in stone.

**FACILITIES**
The AppalAIR group has a research building and sampling tower located on the ASU campus behind the Broyhill Inn & Conference Center. The 16’ x 20’ building houses numerous instruments used to sample the air and to measure meteorological parameters. A second facility is being readied for occupancy some time in 2011 in a climate-controlled shed located behind the Top Shop at Grandfather Mountain; however, there have been delays in installing the instrumentation, and we are still trying to work these issues out at this time. A separate set of instruments are located on the roof of the Broyhill Inn for measuring various aspects of incoming solar radiation. Through funding from the College of Arts and Sciences a LIDAR was obtained and is now installed at the AppalAIR building behind the Broyhill Inn & Conference Center. A mobile sampling laboratory contained in a trailer, is now available for AppalAIR members, and was brought down from New Hampshire after the hiring of Dr. Barkeley Sive. In addition, Dr. Sive is able to contribute the following instruments to AppalAIR (Table 1):

Table 2: Summary of New AppalAIR Instrumentation from Dr. Sive.

<table>
<thead>
<tr>
<th>Expanded AppalAir Equipment List</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Chemical Ionization Mass Spectrometer (CIMS)</td>
</tr>
<tr>
<td>2 Proton Transfer Reaction-Mass Spectrometers (PTR-MS)</td>
</tr>
<tr>
<td>1 canister analytical system (2 GCs &amp; 2 GC-MSs)</td>
</tr>
<tr>
<td>1 cryogen-free in situ VOC GC</td>
</tr>
<tr>
<td>1 CH$_4$ GC</td>
</tr>
<tr>
<td>1 Green House Gas (GHG) GC – measures CO, CO$_2$, CH$_4$, N$_2$O and SF$_6$</td>
</tr>
<tr>
<td>1 in situ OVOC GC</td>
</tr>
<tr>
<td>1 in situ HCN &amp; CH$_3$CN GC</td>
</tr>
<tr>
<td>1 TDL system</td>
</tr>
<tr>
<td>1 PAN GC</td>
</tr>
<tr>
<td>1 Aerosol Mass Spectrometer (AMS)</td>
</tr>
<tr>
<td>1 Scanning Mobility Particle Sizer (SMPS)</td>
</tr>
<tr>
<td>500+ 2L SS whole air sample canisters</td>
</tr>
<tr>
<td>1 Strohl 8.5’ x 16’ instrument trailer</td>
</tr>
<tr>
<td>2 mini-O$_3$ sensors</td>
</tr>
<tr>
<td>3 LiCor 7000</td>
</tr>
<tr>
<td>2 CNCs</td>
</tr>
</tbody>
</table>

An NSF-EAR grant also allows AppalAIR to purchase a mobile sampling tower (100’) which is being outfitted with instruments at this time, and members hope to begin using it this fall to sample air at various levels through forest canopies. Biology provides an aquatic conservation laboratory to Dr. Mike Gangloff for his research while Chemistry provides an ion chromatograph and associated instrumentation for water quality work under the direction of Dr. Carol Babyak. SAEREC members also make use of the Biology Department Greenhouse and the College of Arts and Sciences Instrumentation facility and microscope laboratory.

PEOPLE
I. MAJOR ACCOMPLISHMENTS

1. EXTERNAL FUNDING ACTIVITY

SUMMARY

SAEREC is currently administering 15 active grants or contracts (Table 2). In the 2010-2011 fiscal year, a total of 11 new grants or contracts were submitted through SAEREC. Five of those contracts were obtained by Dr. Mike Gangloff for conservation work on endangered mussels. There was one new NSF-EAR grant to the AppalAIR group, which allows the purchase of a mobile sampling tower and affiliated instrumentation. The NASA CanDoo grant is now in its second year, under the direction of Drs. Taubman, Sherman and Baker. Dr. Gabrielle Katz, in Geography & Planning, has a total of three grants/contracts that are currently active. Her work focuses on invasive species (Russian Olive) and its effects on riparian systems in the southwestern United States as well as on the consequences of stream restoration for riparian forests here in North Carolina.

New funding for this past fiscal year totaled $391,964 (see Table 2). When you add in the currently active grants and contracts, the total funding being administered through SAEREC totals nearly one million dollars ($953,194). The amount of indirect available this fiscal year (resulting from grant activity the previous fiscal year) is $3,044. Of these sums, approximately 15% goes to SAEREC. These amounts show a continuing and strong research effort by faculty affiliated with SAEREC. Some of the indirect has been used to provide lightening protection for the AppalAIR facility.

Table 2. Number of Proposals Submitted, Awarded, Rejected with Total Funding Amounts
Beginning July 1, 2010 and ending June 30, 2011 and number of currently active
grants/contracts.

<table>
<thead>
<tr>
<th>Proposals</th>
<th>Total Number</th>
<th>Number with Indirect</th>
<th>Total Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Submitted</td>
<td>11</td>
<td>11</td>
<td>$10,632,560</td>
</tr>
<tr>
<td>Awarded</td>
<td>8</td>
<td>8</td>
<td>$442,263</td>
</tr>
</tbody>
</table>
Rejected*  2  2  $10,140,799
Under Review  1  1  $99,797
Active Grants**  4  4  $561,230
Total Active Grants  15  15  $953,194

*One grant rejected in preliminary phase was for $10,000,000.

**This is the number of grants still active but which were funded in the previous fiscal year;

**Proposals Awarded in Fiscal 2010-2011 (July 1, 2010 to June 30, 2011)**

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>PIs</th>
<th>Funder</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-0032</td>
<td>An assessment of low-head dam impacts on mollusk assemblages in North Carolina Piedmont and Coastal Plain streams</td>
<td>Michael Gangloff</td>
<td>NC Wildlife Resources Commission</td>
<td>$30,000</td>
<td>July 2011 to June 2012 (year 3 of an earlier award)</td>
</tr>
<tr>
<td>10-0237</td>
<td>Surveys for Candidate Freshwater Mussels on the Florida Panhandle</td>
<td>Michael Gangloff</td>
<td>United States Fish and Wildlife Services</td>
<td>$59,000</td>
<td>September 2010 to December 2011</td>
</tr>
<tr>
<td>10-0247</td>
<td>Distribution of Endangered Mussels in the East Fork Tombigbee River, Itawamba and Monroe Counties, Mississippi</td>
<td>Michael Gangloff</td>
<td>United States Fish and Wildlife Services</td>
<td>$52,753 (includes two supplements)</td>
<td>August 2010 to December 2011</td>
</tr>
<tr>
<td>10-0250</td>
<td>Effects of Russian olive control</td>
<td>Gabrielle Katz</td>
<td>Three Rivers Alliance</td>
<td>$6,000</td>
<td>August 2010</td>
</tr>
<tr>
<td>10-0284</td>
<td>Cooperative Agreement, Factors Influencing Proliferation and Control of the Invasive Tree Russian-Olive (Elaeagnus angustifolia) in the Western US</td>
<td>Gabrielle Katz</td>
<td>Three Rivers Alliance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funder</td>
<td>Amount</td>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USDOI-USGS</td>
<td>$32,000</td>
<td>August 2010 – September 2013</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Project No. 11-0119**

**Title:** Alabama Aquatic Invertebrate Inventory and Conservation Planning- Year V

**PIs:** Michael Gangloff

**Funder:** Auburn University

**Amount:** $30,331

**Duration:** October 2010 to September 2011 (year 5 of project 10-0069)

<table>
<thead>
<tr>
<th>Funder</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Fish and Wildlife Services</td>
<td>$104,000</td>
<td>September 2010 to December 2011</td>
</tr>
</tbody>
</table>

**Project No. 11-0130**

**Title:** Surveys for Candidate Freshwater Mussels on the Florida Panhandle - Supplemental Funds

**PIs:** Michael Gangloff

**Funder:** United States Fish and Wildlife Services

**Amount:** $104,000

**Duration:** September 2010 to December 2011

<table>
<thead>
<tr>
<th>Funder</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF-MRI</td>
<td>$191,397, but since Emanuel has moved to NCSU, ASU will get a subcontract for $77,880; **Neufeld is serving as the on-site PI</td>
<td>November 2010 – November 2011</td>
</tr>
</tbody>
</table>

**Project No. 11-0133**

**Title:** RUI: Acquisition of a Mobile Tower System for Interdisciplinary Atmospheric Research

**PIs:** Ryan Emanuel*, Howard Neufeld**, Brett Taubman, James Sherman and Baker Perry

**Funder:** NSF-MRI

**Amount:** $191,397

**Duration:** November 2010 – November 2011

**Continuing Grants / Contracts**

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>PI</th>
<th>Sponsor</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10-0032</td>
<td>Effects of small dams on N.C. mollusk population</td>
<td>Michael Gangloff</td>
<td>N.C. Wildlife Resources Commission</td>
<td>$87,120</td>
<td>04/01/2010 – 03/31/2012</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>PI</th>
<th>Sponsor</th>
<th>Amount</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10-0134</td>
<td>Climate Action Network through Direct Observation</td>
<td>Brett Taubman</td>
<td>NASA</td>
<td>$389,931</td>
<td>04/01/2010 – 03/31/2013</td>
</tr>
<tr>
<td>Project No.</td>
<td>Title</td>
<td>PI</td>
<td>Sponsor</td>
<td>Amount</td>
<td>Duration</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------</td>
<td>----------------------------------------------</td>
<td>------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>A10-0252</td>
<td>Assessment of Small Dam Impacts on Freshwater Mussels and Fishes in the Tar, Roanoke, Neuse, and Chowan River Drainages, North Carolina and Virginia</td>
<td>Michael Gangloff</td>
<td>NC Department of Environment and Natural Resources (DENR) - APNEP Restoration</td>
<td>$64,009</td>
<td>04/01/2010 – 12/31/2010</td>
</tr>
</tbody>
</table>

**Proposals Under Review**

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>PIs</th>
<th>Funder</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-0292</td>
<td>Environmental Education Regional Grants Climate Action Network through Direct Observations and Outreach (CAN-DOO)</td>
<td>Brett Taubman, Jim Sherman, Baker Perry and Laura England</td>
<td>U.S. Environmental Protection Agency (EPA)</td>
<td>$99,797</td>
</tr>
</tbody>
</table>

**Proposals Not Funded**

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
<th>PIs</th>
<th>Funder</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-0063</td>
<td>Collaborative REU Site: High Elevation Outcrop Communities as Sentinels of Climate Change</td>
<td>Howard Neufeld, Michael Madritch and Eva Gonzales</td>
<td>NSF-REU</td>
<td>$140,800</td>
</tr>
<tr>
<td>11-0080</td>
<td>Science, Technology, Engineering, and Mathematics Talent Expansion Centers (STEP Centers) - The National Institute for Climate Science Education (NICSE)</td>
<td>Eric Marland and John Pine</td>
<td>NSF</td>
<td>$10,000,000</td>
</tr>
</tbody>
</table>
2. FACULTY PARTICIPATION AND COLLABORATIONS

SAERECC administered projects in the 2010-2011 fiscal year that involved 10 faculty researchers from 5 different departments (Table 3). One researcher was from NCSU. The AppalAIR group has the most collaborations and they are detailed below.

**Table 3. Involvement of Faculty in SAERECC Related Grants and Contracts.**

<table>
<thead>
<tr>
<th>Campus Researchers</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>10</td>
</tr>
<tr>
<td>Biology</td>
<td>Neufeld, Gangloff, Madritch, Gonzales and England</td>
</tr>
<tr>
<td>Geography &amp; Planning/CAS</td>
<td>Perry and Katz</td>
</tr>
<tr>
<td>Physics</td>
<td>Sherman</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Taubman</td>
</tr>
<tr>
<td>Geology</td>
<td>Emanuel*</td>
</tr>
</tbody>
</table>

*now at NCSU

**Off-Campus Collaborative Efforts**

1. National Oceanic and Atmospheric Administration (NOAA) ([http://www.esrl.noaa.gov](http://www.esrl.noaa.gov)) - AppalAIR is the only participating site east of the Mississippi River in NOAA's global aerosol monitoring network. Dr. Pat Sheridan, of NOAA, is the contact for this collaboration.

2. Grandfather Mountain ([http://www.grandfather.com](http://www.grandfather.com)) - AppalAIR monitors the weather at the summit of Grandfather Mountain and will be operating a second atmospheric monitoring station behind the Top Shop in the coming months.

3. North Carolina Division of Air Quality ([http://daq.state.nc.us](http://daq.state.nc.us)) - The NC Division of Air Quality is assisting AppalAIR in the maintenance and calibration of their trace gas instruments.

4. MRI: Mountain Research Initiative ([http://mri.sncatweb.ch](http://mri.sncatweb.ch)) - AppalAIR is a member institution of the Mountain Research Initiative, which functions to coordinate and disseminate information about atmospheric research in mountains around the world.

5. State Climate Office of North Carolina ([http://www.ncclimate.ncsu.edu](http://www.ncclimate.ncsu.edu)) - AppalAIR. This office maintains climatic records for the state and supports some of our meteorological monitoring.
6. Watauga County Schools (http://www.watauga.k12.nc.us) - Through the NASA-CANDOO grant (AppalAIR), school kids can join science clubs and learn about the atmosphere.

7. Pisgah Astronomical Research Institute (http://www.pari.edu) - AppalAIR participates in a summer science camp for kids through this institute.


9. Department of Atmospheric Science, UNC-Asheville (http://www.atms.unca.edu/atms.shtml) - AppalAIR collaborates with faculty member Dr. Doug Miller on atmospheric modeling efforts.

10. Department of Forestry and Environmental Resources, NC State University (http://cnr.ncsu.edu/fer/index.html) - Founding AppalAIR member Ryan Emanuel has recently accepted a position with NC State University, but remains a member of the AppalAIR research group. Ryan's specialty is ecohydrology, the measurement of mass fluxes of water and carbon dioxide between the atmosphere and the ecosystem.

11. Discovery Place, Inc. – Collaborating partner with AppalAIR on a proposal to the U.S. Environmental Protection Agency.

12. N.C. Science Museum – Collaborating partner in providing science support to the Museum programs and activities.

3. PUBLICATIONS BY SAEREC AFFILIATED MEMBERS RELATED TO SAEREC EFFORTS
(bolded names refer to people affiliated with SAEREC)

Peer Reviewed Manuscripts


Masters Theses


4. RESEARCH PRESENTATIONS in FISCAL YEAR 2010-2011
   (bolded names refer to people affiliated with SAEREC)


Seimon, A. (Presenter & Author), Perry, L. B. (Author Only), Reconstructing Climate Variations over South America and the Antarctic Peninsula over the last 2000 Years, "Cordillera Vilcanota, Peru Precipitation Studies: Explicit Simulations of Oxygen Isotope Ratio Profiles in Seasonal Snowfall," PAGES, Valdivia, Chile. (October 28, 2010).

Perry, L. B. (Presenter & Author), Seimon, A. (Author Only), Kelly, G. M. (Author Only), Reconstructing Climate Variations over South America and the Antarctic Peninsula over
the last 2000 Years, "Precipitation Patterns in the Cordillera Vilcanota, Peru," PAGES, Valdivia, Chile. (October 28, 2010).


**Taubman, B. F.** (Presenter & Author), **Sherman, J. P.** (Presenter & Author), Beuttell, W. B. (Author Only), **Sheridan, P.** (Author Only), AeroCenter 2010-2011 Seminar Series, "Aerosol Radiative Properties in the Southeastern U.S.-Initial Results from the Appalachian Atmospheric Interdisciplinary Research program (AppalAIR) at Appalachian State University," NASA Goddard Space Flight Center, Greenbelt, MD. (March 1, 2011).

**Adair, K.** (Presenter & Author), **Taubman, B. F.** (Author Only), **Sherman, J. P.** (Author Only), **Sheridan, P.** (Author Only), 6th Annual State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS), "Investigation of Regional Impacts on Ambulatory Cases of Asthma in Watauga County," State of North Carolina, Raleigh, NC. (November 20, 2010).

**Sherman, J. P.** (Presenter & Author), **Taubman, B. F.** (Presenter & Author), Georgia Institute of Technology Department of Civil and Environmental Engineering, Weekly Colloquium Series, "Initial Results from Appalachian Atmospheric Interdisciplinary Research (AppalAIR)," Georgia Tech, Atlanta, GA. (October 13, 2010).


Dolan, Chrisha, **Howard S. Neufeld**, Ruth E. Dewel and Guichuan Hou. 2011. Leaf anatomical characteristics do not explain differences in sensitivity to ozone in cutleaf coneflower


5. PUBLIC ENGAGEMENT

The AppalAIR group has hosted several public engagement events, most associated with the NASA-CAN DOO grant:

a. Hardin Park and Bethel Science Clubs (Spring 2010 – present)
b. ASU/PARI Climate Science Camp for Homeschoolers (August 15-20, 2010)
c. ASU/PARI Homeschool Science Day (November 5, 2010)
d. Continuing Education Workshop for Watauga County teachers (October 7, 2010)
e. NC Science Festival Host
f. AppalAIR Grand Opening

CAN-DOO sponsors science clubs at local elementary schools (Hardin Park and Bethel, grades 2 thru 8). Over 100 students at Hardin Park, and 25 at Bethel, are signed up for this program. A weekly science club was begun at Hardin Park Elementary School in Boone, NC, during the spring of 2010 and continued through the 2010-2011 school year. CAN-DOO also successfully implemented a bi-weekly science club at Bethel Elementary School during the 2010-2011 school year. In addition to participating in weekly climate science-based activities each week, including graphing of climatic data and conducting a weather balloon launch, students performed a site-suitability analysis for the installation of a weather station on each elementary school campus. Weather stations include automated temperature, pressure, relative humidity, and insolation sensors, as well as manual precipitation gauges. Hourly- (if not finer-) resolution data are automatically logged, and each site is a member of the Community Collaborative Rain, Hail, and Snow network (CoCoRaHS). Both clubs will resume a weekly schedule in September 2011 with 3rd-5th graders meeting one afternoon during the first and third weeks of each month and 6th-8th graders meeting one afternoon during the second and fourth weeks of each month, with a focus on climate stewardship. Teachers at each school have volunteered to record and enter online daily precipitation measurements and AOD measurements performed using a hand-held sun photometer. Daily measurements will commence when school starts in August 2011. These schools are the first of a network of measurement locations that CAN-DOO is hoping to expand into other regions of NC.
CAN-DOO has now established an international collaboration, with the St. Michael’s School in Bloemfontein, in South Africa. This collaboration was made possible through the efforts of Carla Ramsdell, while she and her family were in South Africa, where Jeff Ramsdell was on an off-campus-scholarly assignment. Students there will feed weather data into an international database with which to compare to data from students here in Watauga County. CAN-DOO hopes to establish several of these international locations so that students from around the world can share their weather and climate data.

CAN-DOO also runs the ASU/PARI Climate Science Camp for Homeschoolers, which last summer ran from August 15-20, 2010 and again in May, 2011. The PARI/ASU Summer Climate and Space Science Camp advances the CAN-DOO mission by: (1) Enhancing participants’ awareness of climate science and NASA’s role in advancing our understanding of the Earth System; (2) Introducing science, technology, engineering, and mathematical (STEM) principles to participants through applied climate science activities. Twenty-four participants (grades 7-12) in the camp were exposed to the entire scientific investigative process, as applied to cutting-edge topics in climate science. Students assembled and calibrated atmospheric instruments, participated in data collection and analysis, and compared their data with NASA data products and local research-grade measurements made at ASU as well as with online weather and climate models. In the process, they developed basic STEM proficiency in (a) maintaining a scientific notebook to properly record scientific data; (b) using spreadsheets to enter, process, and graphically represent their data; (c) accessing and critically interpreting scientific data to use it in the proper context. Classroom discussions introduced the participants to basic climate science topics and reinforced the hands-on activities. Approximately 30 homeschool students (mostly middle school age) and their parents participated in this NASA funded CAN-DOO activity (ASU/PARI Homeschool Science Day (November 5, 2010) at the Pisgah Astronomical Research Institute. The format was very similar to the camp, but condensed into one day.

CAN-DOO also successfully integrated climate science modules into the daily citizen science curriculum at Grandfather Mountain in July 2010 and that continues presently. Measurements, including precipitation and aerosol optical density, are recorded and entered online daily. CAN-DOO personnel (Ginger Kelly, lead collaborator) have also successfully designed and implemented an updated and interactive climate and weather exhibit in the Nature Museum. This exhibit includes two large monitors displaying a running “Climate Science 101” slideshow as well as current conditions at the Top Shop and Swinging Bridge (note: the current conditions display is still being worked on). A website is being developed to communicate with our instrumentation and to display current weather conditions as well as historical record data for the mountain. The exhibit also includes three touchpad stations where visitors can interact with online NASA products and take a climate quiz to find out if their depth of climate knowledge. Upgrades to the touchpad setup are still being considered and may be implemented in Fall 2011 to enhance the interactive nature of the exhibit.

CAN-DOO was involved in scheduling a public lecture at Grandfather Mountain in July by Dr. Bruce Doddridge from the NASA Langley Research Center. Although this talk was technically in
the next fiscal year, it was very well received by the public, and was an event that CAN-DOO will repeat with another climate speaker in summer 2012.

Finally, Ginger Kelly now performs Outreach for the CAN-DOO grant. Her duties involve working with principals and staff at each elementary school for feedback and input on their science clubs, as well as to plan for the upcoming school year and to update each school website with current science club information. She has also been monitoring precipitation totals at Hardin Park periodically this summer as well as working with Wendy Patoprsty at the Agricultural Extension Office on a rain garden project at Bethel Elementary, which will serve as a year-long stewardship project for our science club students at Bethel. She is also working with faculty in the College of Education at ASU and Biology to recruit undergraduate volunteers to assist with the science clubs. She also works very closely with Grandfather Mountain staff to research and format hardware, choose online products to display, and design webpages to host the climate quiz and current conditions products.

AppalAIR hosted three events for the NC Science Festival, including the **AppalAIR Grand Opening** event on September 23, 2010, the weather balloon launch on September 23, 2010, and a scientific talk by David Easterling, “**Observed and Projected Climate Change**”, on September 22, 2010. Easterling is one of the authors on the Nobel Peace Prize report for the 2007 IPCC and a research scientist at the NCDC in Asheville, NC. All of these events were free and open to the public. The AppalAIR Grand Opening brought dignitaries from across the university, state agencies, and the governor’s office to view the facilities and to participate in the events listed above. Approximately 150 people attended the opening, which was held at the Broyhill Inn & Conference Center and at the AppalAIR building just behind the Center.

CAN-DOO was proud to bring in Dr. Bruce Doddridge from the NASA Langley Research Center to give a public lecture at Grandfather Mountain in July 2011. This talk was very well received by the public, and was an event that CAN-DOO will repeat with another wonderful speaker in summer 2012.

In addition, CAN-DOO personnel, under the guidance of Ginger Kelly, have established an interactive exhibit in the Grandfather Nature Museum about climate change. Baker Perry has provided winter weather forecasting for ASU, and was also a guest speaker to the Board of Visitors and Congressional Staff in November of 2010. Baker has also been a citizen science advisor to the Grandfather Mountain Stewardship Foundation, has managed the meteorological station at Beech Mountain Resort and Grandfather Mountain, and has been a cooperative observer and spotter for the National Weather Service.

Through the efforts of Laura England and Carla Rmsdell, who serve as the two main Outreach Associates of the RIEEE, an outreach session called Plug Into the Daily Planet, which is an outreach effort of the Nature Research Center (NRC), a unit of the North Carolina Museum of Natural Science, was held on the campus of Appalachian State University on Tuesday, March 22, from 11:30 am to 12:30 pm in the Calloway Peak Room at the Plemmons Student Union. Dr. Margaret Lowman, Director of the NRC, gave a presentation about the new research and
education center at the Museum, and entertained questions from the audience of faculty, students and staff. In addition, representatives from University Documentary Film Services were present to describe their services, since one item that is being requested from NC residents and academics is video of their research efforts.

Howard Neufeld continued his public outreach with regard to predicting fall leaf color by providing interviews to newspapers (Asheville Citizen Times), and to the Walt Disney Company, which was searching for sites to scout out for a film they are producing (The Odd Life of Timothy Green). Neufeld also was a contributing author to the following NASA publication: Ladd, Irene, John Skelly, Margaret Pippin and Jack Fishman. 2011. Ozone-Induced Foliar Injury: Field Guide. Langley Research Center, 100 NASA Road Hampton, VA 23681 (NP-2011-03-355-LaRC; 144 pgs). This publication is a methods manual for secondary school teachers who want to provide instruction to their students on the effects of ozone on plants.

6. DEVELOPMENT

SAERECC is working to develop research clusters (see above), as well as to get its webpage online soon. Mike Gangloff is coordinating website development, with Rachael Hoch, a Biology graduate student, doing the technical work. They both are requesting that affiliate faculty provide them with a brief (1-2 paragraphs) overview of their SAERECC-related research activities. A working website template can be found at http://saerec.appstate.edu. We anticipate an active website by the end of August.

7. ACTIVE PROJECTS

SAERECC is currently working with the ASU Physical Plant, Dr. Michael Madritch, and graduate student Jason Harkey, on a tree inventory of the campus. This project started in the spring semester of 2011 and will continue through this year. The end result will be an inventory of all trees, categorized by species, health status, size, location, and condition. Eventually, a carbon inventory, using a program from the US Forest Service, will be run to determine the carbon sequestration potential of these trees as well as their economic impact to the campus.

The second project is to explore the feasibility of restoring the trail system in the ASU Nature Preserve, and creating entrance ways for the public. The Director attended a trail teleconference in Belk Library on Wednesday, October 6th in 2010 to explore various ways of funding trail restoration. Additional avenues for funding are currently be investigated.

The third project is a collaborative effort with Drs. Beverly Collins from Western Carolina University, and Jonathan Horton from UNC-Asheville, for organizing a southeast regional phenology meeting. Financial support has already been promised from the USGS National Phenology Network and the US Forest Service in Raleigh. Involvement of the Nature Museum in Raleigh, and other agencies is anticipated. A planning meeting of those interested in this endeavor is planned for the fall also.
Dr. Mike Gangloff has a number of active grants that have gone through SAEREC. One involves examining a 40 year legacy of environmental devastation at the hands of the Army Corps of Engineers. His research group is surveying relict habitats on the East Fork Tombigbee River that were severed by the construction of the Tenn-Tom waterway. This waterway has directly contributed to the extinction of three freshwater mussel taxa. The second project has two foci; one involves conducting a survey of the western Florida panhandle (three river systems) for a suite of mussels that are nearly extinct and will soon be protected as Threatened & Endangered species. The second is working with USFWS to assess impacts of water demand and flow variability on endangered mussel populations in the Apalachicola River. In the past year, the Gangloff lab has found two previously undescribed species of mussel, and is working on describing them and publishing those discoveries. These conservation projects have strong potential for multiple years of additional funding. Dr. Gangloff has been working on the Apalachicola since 2005 and his research group has been funded by several agencies.

Dr. Gabriele Katz, in Geography & Planning, has three contracts to study ways to control the invasive Russian Olive Tree in Arizona. She has also studied how restoring streams affects the forests adjacent to them, and this work is being published in the journal Restoration Ecology. Finally, the AppalAIR people have a new grant to set up a mobile air sampling tower, and will be working on getting that project underway this fall. In addition, several AppalAIR members continue to work on their NASA CanDoo grant, which runs through 2013.

II. PROBLEMS / NEEDS

1. SUPPORT

The greatest impediments to implementing the goals of SAEREC are:

- finding enough time for faculty to write research grants,
- to provide course releases for those who are funded to do research, and
- to provide financial support to allow faculty to attend meetings, buy equipment, or fund graduate and undergraduate students to do research with them.

SAEREC would greatly benefit by having full-time staff researchers. Currently, Dr. Mike Gangloff is serving 0.25 FTE as assistant director for SAEREC. His duties are to assist the Director in organizing SAEREC, in facilitating outreach and education, to upgrade the webpage, and to write grants. The opportunity to provide course releases would encourage faculty to write grants and submit them through SAEREC as well as allow them to carry out that research if they are funded. Incentives such as course releases and providing additional indirect back to the PI of a grant serve as investments of resources that will bolster the productivity of faculty in each of our proposed research clusters, and that should generate even more external funding for SAEREC.
This funding model is particularly relevant for the Educational Outreach initiative that RIEEE is pursuing. We have identified a core of faculty members and part-time employees who have interests in this topic, and we will be holding a meeting in the fall to coordinate activities for this group. These people will need seed money and time to get operational before they begin writing for external grants. One outreach grant is currently in review, and more are contemplated.

All the Center Directors would like to have some funding to support programs within the RIEEE, including the establishment of a seminar series. Once we have a regular income from indirect, we will be able to support such activities internally, but for now, we need some seed money to get things going.

2. SPACE

At this point, we are using the Biology Conference Room for meetings of SAEREC personnel. This appears to be adequate for the time being. However, it would be preferable if all RIEEE personnel could be clustered in a suite of offices in order to facilitate communication and to better interact with support people, such as administrative assistant Amanda Perry.

3. ADMINISTRATIVE SUPPORT

It is important for SAEREC to get recognized as a formal center so as to get an organization code. This will make tracking grants much easier, as well as the allocation of indirect.

The development of SAEREC has been possible only with the support and encouragement provided by John Pine, Director of RIEEE, and the resources that he has made available to the Center. The recent hiring of Amanda Perry has greatly helped us to organize proposal submissions, awards and to get a hold on our finances, especially with regards to indirect funds.

Lastly, the functioning of SAEREC is also dependent on my interaction with Dr. Mike Gangloff, who is assisting me in getting this organization up and running. Such support will become even more necessary in the future as the number of proposals and awards goes up, and more faculty become involved with SAEREC.