

Appalachian Energy Center Appalachian State University Work Plan

July 1, 2017 – June 30, 2019

The Appalachian Energy Center (AEC) at Appalachian State University conducts energy research and applied program activities in the areas of energy efficiency, renewable energy technologies, forecasting and modeling, economic development, and policy analysis in a multidisciplinary environment that leverages the expertise of faculty, staff, and students from across the University as a resource for private industry, local, state and federal governments, and non-profits. Through its outreach programs and research, the Appalachian Energy Center provides benefits to communities and citizens across the State of North Carolina, including the creation of new jobs and businesses, and increased investment and income. The overarching goal of the AEC activities described here is to foster and facilitate interdisciplinary research, education and outreach to positively impact important energy decisions.

The AEC utilizes a highly qualified set of energy related expertise provided by our staff, University collaborators, and partners throughout the state. With the recent budgetary reductions enacted, the scope of work over the next two years will be adjusted to continue existing efforts as best as possible with a focus on strengthening activities with a high promise of growth and supplemental revenue generation. This is not to discount the importance of continuing to work in more mature areas, but to realize that the energy landscape is changing and modifications will be needed.

A. Extension, Education, and Outreach

This work seeks to disseminate knowledge related to energy efficiency and renewable energy through education, outreach, and extension programming. Specific areas of work by Appalachian Energy Center staff and Appalachian faculty members include:

Extension Services and Development Assistance

The Appalachian Energy Center's energy extension and renewable energy development assistance programming will serve the public and private sectors in Western North Carolina and beyond. We engage Appalachian students in hands-on learning experiences by conducting low cost site assessments, economic feasibility studies and energy audits. We also conduct product performance evaluations for industry partners utilizing existing Appalachian facilities such as the Solar Energy Research and Demonstration Laboratory and Small Wind Research and Demonstration sites. We see this as an exciting area for growth for the AEC. Funding from the Appalachian Chancellor's office was acquired in the previous cycle and external proposals were developed.

Workforce Development and Continuing Education in Building Science and Renewable Energy Technologies

The annual Appalachian Energy Center Workshop Series offers continuing education and training opportunities for experienced professionals looking to stay competitive and those seeking to broaden their knowledge base or transition into the energy field. Our workshops are appropriate for those already working in directly related fields such as architects, engineers, contractors and code inspectors and those working in fields that impact energy decisions such as appraisers, realtors, lawyers, and accountants. Each year the workshop series has approximately 200 attendees, providing education to the enrollees, and exposing a larger constituency to the work and resources available within the AEC.

The workshop series focuses on the areas of solar power, building science, small wind energy, and micro-hydro power. Continuing education can be earned (AIA, Appraisers, CLE, GBCI, NABCEP, NCBEEC, NCBI,

NCDOI, PDH) with approximately 10 workshops available each year. AEC staff coordinate, manage, and develop the workshop topics in conjunction with Appalachian faculty members. Organizational / logistical considerations will be made to increase the number of available seats for this popular program.

Outreach and Community Engagement

Through outreach and community engagement activities we serve as a resource for community members and educators to increase awareness and understanding of energy issues and support energy conservation and renewable energy adoption. This effort provides information via a website, quarterly newsletter, and offers workshops and facility tours to community members, students and K-12 educators. The AEC will continue to use staff expertise in these areas to acquire additional funding to support the work. Local schools will be assisted in preparing grant proposals for energy related projects on their campuses. Staff will assist in planning and participate in the annual ASU STEAM Expo (STEAM = Science Technology Engineering Arts Mathematics) which is part of the larger NC Science Festival.

Engagement with the community will continue to be a focus area. Development of a few community workshops and events will benefit the citizenry and expose the broader community to the work of the AEC. Staff will be encouraged to serve on one or more University, local, state or regional board, committee, task force, working group, etc. that is pertinent to their work. This sort of engagement will not only keep the AEC abreast of current happenings, but also provides the opportunity for us to be of service to a broader purpose, one that might result in a productive collaboration.

B. Clean Energy Conversion and Supply

This work seeks to support design, manufacturing, and implementation of renewable energy systems in North Carolina. Specific areas of work by Appalachian Energy Center staff and Appalachian faculty members include:

- Continued support of the Appalachian Solar Energy Research and Demonstration Laboratory. The solar lab actively supports outreach, education, and applied research projects. Applied research projects aim to identify and characterize solar technologies that perform well in North Carolina conditions. Verification and dissemination of solar system performance will allow North Carolina citizens to choose the technologies that offer the best return on investment. The facility allows potential solar adopters the chance to see first-hand installed modern technologies. The solar lab also offers Appalachian students valuable hands-on experience with a range of solar technologies. These students will likely join the North Carolina workforce and contribute to the growing renewable energy sector in the State. Partnerships with solar equipment manufacturers may be pursued.
- Continued support of the Appalachian Small Wind Research and Demonstration Facility on Beech Mountain. This facility provides valuable information about wind turbine performance and durability to small wind manufacturers and utilities, while providing students and the community with hands-on experience with small wind technology. Appalachian faculty and students are actively engaged in education, outreach, and research projects that utilize the facility. These projects benefit businesses and citizens of North Carolina interested in design, manufacturing, and implementation of wind energy systems. Research activities may include topics such as blade design, noise levels, impact on local bird populations, relationship of wind turbine performance to utility loads, storage technologies, etc. This work will also continue to include the monitoring and reporting of estimated output of wind energy facilities in North Carolina as installations expand in number and size.
- Support ongoing efforts to increase agricultural production of biodiesel crops, improve biodiesel production processes, and test emissions of vehicles utilizing biodiesel manufactured from various feed-stocks grown in North Carolina. This work includes education, outreach, and research activities that lead to an increase in the production and use of biodiesel fuel in North Carolina. Workshops and other technical assistance will be provided to support market development through growers of oil seed crops, as well as to biofuels manufacturing companies. This work will utilize the Biodiesel Research, Development, and Production Facility at the Catawba County EcoComplex in collaboration with Blue Ridge Biofuels, a private company that produces fuel at the facility. The EcoComplex Facility Management fund augments this operation.
- Support continued landfill gas (LFG) to energy project work in North Carolina. This work will include continued support of the counties with which the Center has previously worked, as well as support to additional local governments seeking to initiate a LFG project.
- Identify landfills in North Carolina which are good candidates for new landfill gas development and/or additionally capturing waste heat from existing landfill gas fueled generators.
- Appalachian Energy Center staff will provide technical analysis and input, as well as economic and financial analysis assistance for these projects.
- Appalachian Energy Center staff will also seek to work with private industry to create public-private partnerships for the development of landfill gas and biogas utilization projects in NC.

- Testing of state-of-the-art, cost effective systems for the utilization and treatment of landfill gas on small to medium-sized landfills in North Carolina. This work would include testing of gas separation technologies that would allow for higher quality methane fuel and clean carbon dioxide.
- On-going work with counties and other landfill owners to develop a system of remote monitoring to reduce operation and maintenance costs of landfill gas systems and create maximum return from sale of environmental attributes such as carbon credits and REC's.
- Expansion of LFG work to further research on community and farm based anaerobic digestion of organic wastes as a fuel source.
- Work with Environmental Research Group and US EPA's Landfill Methane Outreach Program to document existing community-based and socially pro-active landfill gas development in the US and internationally.
- Continued research on Waste as a Resource to include MSW, food and agricultural waste.

C. Energy Consumption and Efficient Infrastructure

This work seeks to improve the energy efficiency of both new and existing buildings as well as some transportation systems in North Carolina. Specific areas of work by Appalachian Energy Center staff and Appalachian faculty members may include:

- Education, outreach, and research activities that lead to an increase in the number of high performance buildings constructed in North Carolina. This work includes some continued support of and participation in the activities of the North Carolina Energy Efficiency Alliance (NCEEA), such as promoting high efficiency program standards and conducting building science training for appraisers, realtors, and building professionals.
- Support of affordable housing efforts, such as those of Habitat for Humanity and regional housing authorities, to increase the energy efficiency of affordable houses being constructed in North Carolina. This work includes homeowner education related to system operation and occupancy behavior; and assistance to these organizations in the design, material selection, and construction of their houses.
- Support of improved North Carolina building codes and their implementation through education, outreach, and research. This work includes building performance analyses that support decisions regarding inclusion of particular energy related items in the code, as well as outreach to and education of North Carolina building professionals related to the building science of the code requirements.
- Thermal characterization of building materials and systems that can lead to improved wall and roof system designs. This work could lead directly to a reduction in installation costs and improved resistance to heat transfer for buildings in North Carolina and beyond.
- Support the development, commercialization, and deployment of emerging transportation technologies through analysis of the state's competitive position and potential to benefit from both supply and demand side approaches, and through participation in education and outreach activities related to these technologies. These technologies include hydrogen based rail systems (Hydrail) and electric vehicles.
- Continued examination of the impact of simplified duct design on comfort and performance. This work will continue to assist residential builders in North Carolina by reducing HVAC system costs and providing improved comfort for their clients.

D. Emerging Issues, Policy, Economics, and Societal Impacts

Activities under this area of work support the pursuit of economic prosperity, new jobs, technological development and deployment, and the growth of business and industry with a focus on more productive use of natural resources, more efficient and efficacious use of energy, and increased activity by businesses in energy or environment related markets with activity and opportunities for North Carolina. This work will be accomplished through applied research, analysis, program and project development, and education and outreach in topic areas that include the following:

Greenhouse Gases

The Greenhouse Gases topic is focused primarily on two distinct but related areas – implementation of the EPA regulations on GHG emissions within North Carolina and greenhouse gas accounting (e.g., carbon footprint calculations, carbon offset protocol design, jurisdictional-scale aggregate accounting). This topic, in particular, will require flexibility as these policies and their implementation are only now beginning to take shape at the state level, but this work is anticipated to concentrate on identifying and understanding tradeoffs, barriers, and opportunities for a variety of policy options.

Environmental Asset Markets

The Environmental Asset Markets topic area includes work related to the markets for renewable energy certificates (RECs), carbon offsets, renewable fuel credits, and other intangible forms of commoditizing and monetizing attributes related to energy. We intend specific work in this area to consist of market analysis (including policy options impacting these markets), examining opportunities for these markets to support increased economic activity or income, and education and outreach efforts to facilitate participation and understanding of these markets. We are also working to implement a self-verified Carbon Offset Purchase and Sale Agreement Work for the Wilkes County landfill gas project between Wilkes County government and the Appalachian State University Office of Sustainability.

Development & Deployment

The Development & Deployment topic area covers a broad range of subjects, all of which are focused in some way on growth and improved economic outcomes for citizens and businesses. Some specific focal points include: expansion, refinement, and continued application of community-based economic development models (particularly those that leverage energy in some way); development, facilitation, and adaptation of project development structures for both energy- and environmental asset-related projects; and the many facets related to the development, deployment, integration, and adoption of new energy-related technologies such as smart grid/smart home and energy management systems, hydrogen fuel cells for transport (i.e. trains specifically) and stationary applications, energy storage, and other emerging technologies related to the energy field.

E. Efficient Distribution and Grid Integration

This work seeks to improve the efficiency of energy distribution across the State. Specific areas of work by Appalachian Energy Center staff and Appalachian faculty members include:

Distributed Generation & Emerging Power Systems

The Distributed Generation & Emerging Power Systems area covers activities that address renewable energy/distributed generation, smart grids, increased demand-side engagement, energy storage and related technologies. Specific focal points will include the policy, financial and economic aspects of rate structure design, net metering, avoided cost rates, integrated resource planning, third-party retail sales, government sales, novel mechanisms for financing and incentivizing, and similar issues.

Electric Utility Operations and Infrastructure Innovations

Through collaboration with New River Light and Power (NRLP), the Appalachian Energy Center is part of a team that is working to innovate the operation of the electric utility. The NRLP Living Laboratory will expand upon ongoing NRLP infrastructure upgrades to increase data collection and management capabilities four-fold and enable monitoring of not only customer usage but also discrete sections of the distribution grid up to the substation level. This project will develop the various policies, procedures, administrative, and management processes and mechanisms necessary to ensure the integrity of the laboratory's activities, adequate protection of NRLP's interests, and that all regulatory requirements are fulfilled. The knowledge gained from this project will be easily transferable to other small utilities across the State. Areas of research include integrating intermittent and distributed generation, peak contributions and coincidence for solar and wind, and load control.

F. Administration

Administration funds are required for administration staff support and general expenses. These funds will support one-half of the program specialist's salary and benefits (Appalachian's Research Institute for Environment, Energy and Economics (RIEEE) provides the other half), travel for the Center Director to attend meetings related to the work herein, and necessary office expenses. The program specialist and director are responsible for business operations of the center, including managing related, external research projects, administering an internal seed-funding program, and coordinating the use and development of aforementioned research facilities. Appalachian State University's Office of Academic Affairs provides funds for the AEC Director's salary and benefits and office space for all AEC staff.