Hybrid Micro Energy Project (HMEP)

The Cold Climate Housing Research Center (CCHRC) is collaborating with BP, the State of Alaska, the Fairbanks North Star Borough, Siemens, GW Scientific, Remote Power Incorporated, the University of Alaska Fairbanks, EEInternet, the Cooperative Extension Service and the Golden Valley Electric Association on a two-year demonstration project that will test and monitor a hybrid system composed of solar photo voltaic, solar thermal, wind and a biomass Combined Heat and Power (CHP) unit. The Hybrid Micro Energy Project (HMEP) will be designed for the high-latitude challenge of minimal solar energy during the long winter when energy demand is greatest and bountiful solar energy when demand is less. During the cold months of the year the hybrid system will utilize the biomass CHP unit as well as demonstrate the potential of wind to augment heat and power needs. The HMEP project, funded primarily by BP, the Fairbanks North Star Borough, and the State of Alaska, will be based at CCHRC's Cold Climate Building and Infrastructure Research and Testing Facility (RTF) in Fairbanks, Alaska. CCHRC is a 501c(3) corporation founded by members of the Alaskan home building industry The RTF is CCHRC's research and testing facility which is in itself a set of research and demonstration projects with over 600 sensors monitoring each component in the building from the foundation to the roof. Project deliverables will include: ongoing web-based performance reports, final report, PowerPoint presentation, an education course on renewable energy systems and at least one public meeting to present the demonstrations and results of the project. Hybrid micro-power systems are particularly suited for Alaska's rural communities as an economical and sustainable supplement to diesel for producing electricity and heat. A hybrid micro-power system designed for rural Alaska that is simple to install and easy to maintain has worldwide potential—every step we can take puts us further down the road toward sustainable communities.

The Hybrid Micro Energy Project (HMEP) is composed of the following integrated systems:

Solar Photovoltaic System: Knowledge of several individual local solar installations have shown that solar can be successful in the North. What is lacking is a demonstration solar photovoltaic project with operational results based on unbiased scientific monitoring and analysis. The purpose of this project is not to demonstrate a large, utility-scale solar generation project common to urban areas. Rather, it is to design, install, demonstrate, monitor, and evaluate a 10 kW PV system that can be integrated with other energy systems.

Solar Thermal System: CCHRC installed three solar thermal panels on the RTF roof during a training program to certify new installers. The system can be integrated with other energy systems and will include data monitoring equipment, analysis and reporting on the efficiency and performance of the solar thermal systems.

Wind System: The application of wind-energy resources for home owners and small villages is dependent on local wind resources. Understanding wind resources at the property location is important for evaluation and design of effective wind-energy systems. A network of weather station sites in the Fairbanks area will be utilized to show wind information in ways directly related to wind-energy evaluations. A home-owner scale hybrid wind/solar system on Murphy Dome will be used to demonstrate a working system to help homeowners, small businesses, and small communities see a working demonstration site that incorporates wind and solar power, with a battery bank and back-up generator system to produce reliable power in an arctic climate. Selected information will be placed on the Internet to help reach public users. This will include a near-real-time "Wind Resources" map for the Fairbanks area and operational data of the test hybrid wind/solar system. Data collection will include wind and solar conditions, operational information, recommendations to consider for system design and example approaches to reduce home energy loads.

Biomass System: The Cold Climate Housing Research Center (CCHRC) plans to demonstrate a biomass-fired combined heat and power (CHP) unit and integrate the power and heat into CCHRC's Research and Test Facility (RTF). Biomass refers to: (1) energy crops grown specifically to be used as fuel, such as fast-growing trees; (2) agricultural residues and by-products, such as straw, sugarcane fiber, and rice hulls; and (3) residues from forestry, clearing of fire breaks, construction, and other wood-processing industries. CHP technology, also known as cogeneration, is an efficient, clean, and reliable approach to the generation of power and thermal energy from a single fuel source by utilizing heat that is otherwise discarded from conventional power generation to produce thermal energy. CHP's higher efficiencies reduce air emissions of nitrous oxides, sulfur dioxide, mercury, particulate matter, and carbon dioxide, the leading greenhouse gas associated with climate change. New, and still in the pre-commercial phase are small-scale modular systems that can be configured in a CHP mode with efficiencies as high as 80% — a dramatic improvement over the average 33% efficiency of conventional district-scale power plants. CCHRC will test local biomass resources such as forestry and wood products residue as well as community waste such as paper or plastic to displace diesel fuel and to reduce village waste streams. CCHRC will demonstrate methods for storing biomass fuel such as wood chips, pellets or waste products. Also demonstrated will be a method for feeding the biomass into the unit in keeping with our goal that the system operates with as little daily maintenance as possible and as long a run-time as possible.

There are three main types of biomass technologies:

- Gasification (the conversion of biomass into a gas) is touted to be the cleanest, most efficient combustion method known. It has been used for decades. Examples include the thousands of vehicles which were directly fueled by wood burning downdraft gasifiers during World War II. Gasification systems includes updraft, downdraft, fixed bed, fluidized bed, open core, charcoal and plasma gasifiers. Gasifiers are then coupled with engine-based generators to produce electricity. Engine choices for this technology include standard internal combustion engines, external combustion engines (such as Stirling engines or Organic Rankine Cycle (ORC) turbines or engines), steam engines or micro-turbines.
- Anaerobic digestion is the decomposition of wet and green biomass through bacteria in an oxygen free environment to produce a mixed gas of mainly methane and carbon dioxide (i.e. biogas).
- Bio-oil or bio-diesel is the production of oil through a thermo-chemical process that converts solid biomass into a liquid fuel.

CCHRC is currently conducting a review of these technologies and will send requests for proposals to potential suppliers of biomass CHP units at the conclusion of this review.

Demonstration projects are vital to confirming the viability of biomass, solar, and wind technologies and the integration of systems prior to large-scale replication in Alaska. CCHRC's work in this area will be important to the introduction of new renewable energy technology to rural Alaska and will be of substantial value to decision making groups including, but not limited to, government agencies, utility companies, community representatives, regulators, and others.

CCHRC values outreach and education to disseminate research information so it produces practical, applicable results. Education on renewable energy systems as well as heating, ventilation, air quality, water usage, site planning, energy efficient building materials and technology and recycling is a large component to our Outreach and Education program. It is particularly important in these times of climatic, cultural and economic change that everyone works together toward solutions to our shared challenges and to impart knowledge in a manner than is easy to understand and access. **The application of hybrid power technologies can be advanced by testing and verification of the performance of alternative energy systems in northern climates, the economic analysis of the investment and implementation costs as well as education about and promotion of this technology.**