Hybrid Alternative Energy System
for the
Center for Community Renewal -
General Description
4.26.09

The Center for Community Renewal (CCR) is a 270,000 square foot facility for Community Renewal International (CRI). The CCR, located in the historic central business of Shreveport, Louisiana, is an integral part of the replication strategy for CRI. The work of CRI is developing and deploying a social technology to systematically build human capital essential for communities to become sustainable. To reflect their mission CRI established criteria for the CCR building design and operation to reflect the best of sustainability for both renovation (approximately 140,000 s.f.) and new construction (approximately 130,000 s.f.) portions of the project. Criteria include achieving LEED platinum, net zero energy and carbon neutral. Beyond these benchmarks CRI challenged the design team to explore alternative energy strategies to advance the science and practice of sustainability with a concept of *"an ever renewing building"*. Through research and evaluation of regional climatic characteristics and alternative energy technology advances CRI proposes developing a hybrid system that will deploy several on-site integrated alternative energy generation strategies – geothermal heat pump (GHP) to reduce power demand and solar photovoltaic and wind to generate on site power. Additionally, further investigation may lead to possible inclusion of bio-fuels in this hybrid strategy.

The CCR is an ideal demonstration project for advancing the concept of on-site hybrid alternative energy generation. Among the benefits of increasing hybrid options for buildings are: additional strategies for distributed power, improved energy utilization efficiency in buildings, reduced transmission power losses, reduced greenhouse gas emissions and reduced public infrastructure costs. New technology advances are resulting in alternative energy applications for climatic areas not considered optimal based on currently used technology and practices. For example, the Shreveport climate, with an abundance of intermittent sun and wind, is not considered optimal for wind or solar. However, with advances in technology such as variable speed generators and solar thin films, both can now be considered practical in the coming years. Deploying a hybrid strategy for the CCR will accelerate the use of technology advances as well as development of new best practices. Maximizing the efficiency of this hybrid strategy will also require control systems development to manage multiple source generation and power consumption. The CCR demonstration project, documentation / validation of operations, and interactive learning integrated into the building design are part of the CRI strategy of sustainable communities training. It is an innovative methodology that links training to grow human capital with learning to build sustainable environments.

To address the complexities of the hybrid concept for the CCR the design team is developing a collaboration approach with industry and higher education to meet the challenges and take full advantage of the opportunities for innovation. The University of Texas, the Trane Company, Hubbell Lighting and Controls, CERT (Consortium of Education Research & Technology) and several alternative energy companies are among those currently in discussions with the MHSM design team. Connecting technological advances in diverse areas is a ripe field for innovative new approaches to sustainable design solutions. Nurturing collaborations and exploring options / scenarios requires new ways for knowledge resources around the globe to connect and contribute to concept development, design and operations of the CCR. ***CRI Green*** is a web 2.0 site, hosted by Near Time and I-Open (Foundation for open economic networks), that provides tools for project collaboration and information sharing for the CCR project. This project communications innovation will prove a replicable process of collaboration for future projects that involve research and development of new concepts.

Developing on-site hybrid energy systems for buildings can significantly contribute to a distributed power grid, reduce peak electricity demand and reduce electric power transmission losses. In the U.S. for 2004 transmission losses were 265,180,000,000 million kWh or approximately 8% of electric power produced. Urban cores are high users of electricity, however, the density of urban cores result in greater efficiency per acre of land as less dense development patterns require more infrastructure and greater transmission loss per square foot of building served (this is a theory that makes sense but will need some verification). Transmission loss still occurs in dense urban cores due to location of power generating source.

The CCR project is approximately 390,000 square feet per acre density in the center of the central business district. As part of project documentation load savings to the electric utility including the reductions in transmission loss will be measured as one of the cost benefits beyond the limits of the project property. It is likely that a hybrid system will perform above net zero and produce more power into the electric grid than the CCR will use.

The CCR hybrid will utilize wind, solar and geothermal heat pump technologies. Integrating these technologies as part of the architecture is an important aspect of the future of alternative energy in the built environment. Design of the CCR will also demonstrate how the engineering science of these systems shape new vocabularies in architectural design as part of a whole building approach to sustainable design. The following paragraphs provide a brief overview of several developments in these alternative energy areas that support strong consideration of a on-site hybrid power generation design for the CCR.

Nano and thin film technolgy are improving efficiencies and reducing cost of solar photovoltaics. These advances are more suitable for building materials

integration, particularly glass systems in combination with recent innovations in low-e glass and glass with printed ceramic frit patterns. Orientation and optimal positioning to the sun are becoming less important for photovoltaics as less expensive collection systems are developed. Solar collection efficiency improvements that allow collection of shaded sunlight open the possibility of vertical wall collection systems on all faces of high rise buildings in dense urban cores. These developments can be demonstrated as part of the CCR hybrid energy system.

Capturing wind energy has relied on steady wind within a limited velocity range partially due to use of constant speed generators. This technology limitation has resulted in wind farms locating in areas of the US that have these predictable characteristics. Recent development of variable speed generators and mini turbines allows consideration of wind solutions in areas with average wind speeds as low as 4 mph. The variable speed generators will also capture winds at higher speeds and improve overall efficiency of wind capture. It is becoming practical to consider wind power in areas like downtown Shreveport, Louisiana where the average wind speed is approximately 8 mph with a wide range of wind speed that at times is affected by high rise buildings around the site for the CCR.

Geothermal Heat Pump (GHP) technology will be incorporated as part of the hybrid system to reduce load for power consumption. The site in North Louisiana is ideally suited for geothermal using the ground as a heat source and heat sink consumes less nonrenewable energy because the earth is cooler than outdoor air in summer and warmer in winter. Improvements in technology could result in geothermal providing 100% of the heating and air conditioning requirements for the CCR. The following are excerpts from a December 2008 report, *Geothermal (Ground-Source) Heat Pumps: Market Status, Barriers to Adoption, and Actions to Overcome Barriers*, published by the Oak Ridge Lab sponsored by DOE that describe the potential of GHP as part of a hybrid system:

“Although heat pumps consume electrical energy, they move 3 – 5 times as much energy between the building and the ground as they consume… the GHP industry could integrate the most advanced commercially available components into their heat pumps and increase this multiplier effect to 6 – 8, and theoretically the multiplier could be as high as 14… Asian manufacturers in particular are mass producing concepts such as variable-speed compressors, variable-refrigerant-flow systems, integrated heat pumps that serve multiple uses (e.g., heating, cooling, and water heating) and heat pumps using CO2 as the refrigerant.

Ground resources — including the Earth, surface water, recycled gray water, sewage treatment plant effluent, retention basin storm water, harvested rainwater, and water from a subsurface aquifer — whether alone or in combination with outdoor air in a hybrid configuration, have great potential. GHP

infrastructure can be designed at the scale of a community or a building, and can serve new construction or retrofits of existing communities and buildings.

In a commercial geothermal system, the cooling tower and boiler used in a water source building are replaced with a geothermal loop field. Since no boiler or chillers are required the building benefits by having less overall equipment and reduced operation costs. Building aesthetics are also improved by eliminating outdoor equipment and additional space is gained by eliminating the boiler and additional support equipment. Controls and transfer switching technology improvements manage and optimize the hybrid power generating system."

The CCR system design will first focus on energy load reduction through a whole building design approach associated with the LEED certification process. Further load reduction will be achieved by the geothermal portion of the hybrid system. The power generation portion of the hybrid system will be achieved by a combination of solar collection and wind power. At 270,000 square feet in the central business district of a southern sun belt climate the CCR will be a model project to serve as demonstration to other communities across the south.