

Case Studies for Deploying Combined Heat and Power (CHP) to Support Brownfields, Industrial Park, and Controlled-Environment Agriculture Projects

I. MIXED USE AND HIGH DENSITY BROWNFIELD REDEVELOPMENT PROJECTS

Austin Energy - Mueller Airport Redevelopment Area, Austin, Texas

Redevelopment Project – Mueller redevelopment area is a 700 acre former airport, and is planned to accommodate 4.7 million sq. ft of commercial space and 4,500 residences. Most of the site was classified as a brownfield because of airport-related contamination (spilled fuel) and a former landfill. The 470,000 sq ft Dell Children's Hospital (pictured at left) is an anchor and the primary customer for the CHP plant.



On-Site Energy – Austin Energy's tri-generation system, as follows: electricity - generation of 4.3 MW (1.2MW to the hospital, 3.1MW for plant equipment and the grid); Heat Recovery Steam Generator 22,000 lb/hr; three packaged centrifugal chillers: 2 @ 2500 tons and 1 @ 1500 tons; one absorption chiller (700 tons).

Energy-Redevelopment Synergies – CHP plant serves the 470,000 sq ft Dell Children's Hospital with electricity and chilled water. The district energy is also available along a loop road, and the following are linked in: Ronald McDonald House, Strictly Pediatrics Medical Office Complex, Southwest Educational Development Lab, and the headquarters of the Seton Family of Hospitals. Note several other businesses along the loop road did not link in, either because they were too small or because of the cookie-cutter designs of certain

retailers.

Key Financing – Private financing through a revenue bond was the primary vehicle; also benefited from a DOE Demonstration Grant.

St. Paul Energy Park – District Energy System Enhances Urban Redevelopment District

Redevelopment Project – A district energy system was developed in 1986 to supply inexpensive and reliable energy to a 218-acre industrial redevelopment area about two miles from downtown. The community was designed as a mixed use, live-work-play community, a model of what would later be known as sustainable development. Energy Park now includes 25 buildings with 2.6 million sq ft of space, 92 companies and 4,200 jobs. The businesses are about $\frac{3}{4}$ office and $\frac{1}{4}$ industrial.



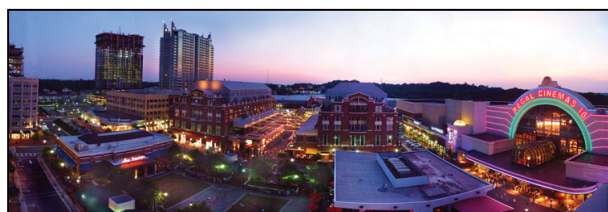
On-Site Energy – Evergreen Energy operates the district energy plant, which generates steam @49 MMBQ's per hour; the feedstock is natural gas. Expansion to include electricity generation, making the system a full CHP provider, is being considered.

Energy-Redevelopment Synergies – redevelopment has benefited from lower capital costs in initial construction and operating cost energy savings. The largest employer is U.S. Bancorp, a back office operation with heavy

energy demands, occupying 361,000 sq ft, operating around the clock, and employing over 2,000 people. Other significant businesses benefitting include: Power Motion, Quality Tool, GLF Companies, Merrill Corp, and a hotel. GLF and Merrill are printers.

Key Financing – The original financing was a combination of federal UDAG loans and grants, supplemented by Port Authority funds loaned to the project based on the projected revenue stream from user contracts. Current plans/proposals would be financed through revenue bonds and the federal Production Tax Credit.

Atlantic Station - District Energy and Mixed Use/Brownfields Redevelopment



Redevelopment Project - Atlantic Station is a \$2 billion, 13 million sq ft mixed use redevelopment of the former Atlantic Steel mill near downtown Atlanta. The project, which is about 50 percent built-out, involved a \$50 million cleanup of the former Atlantic

Steel property. Atlantic Station is often cited as a model for sustainability, with numerous green buildings, TOD, ride-sharing, and other elements. CB Richard Ellis is owner and master developer.

On-Site Energy - Atlantic Station is served by a district energy chilled water system that was designed and built simultaneously with the Atlantic Station redevelopment project. There are over 2 miles of piping, with up to 36" piping size. The first phase, which has been operating for five years, consists of three 2,500 ton centrifugal chillers, roughly corresponding to the first 2 million square feet of space. The phase I system is approximately at capacity and phase 2 (another 7,500 – 9,000 tons) will need to be built to accommodate more development. Veolia Energy Atlantic Station, LLC is the owner and operator. Plans call for an 8 MW fuel cell CHP plant.

Energy-Redevelopment Synergies - The district energy system is a competitively-priced reliable source of energy and all significant buildings are enrolled. The district system also helps meet sustainability goals and contributes to high LEED ratings of many of the buildings within the redevelopment area. The

density of the redevelopment project helped make the district chilled water system work, partly because most of Atlantic Station is built on top of parking garages and the pipes could be channeled through the parking garages rather than more expensive underground construction.

Key Financing - \$24 million Fulton County revenue bond.

Dockside Green – Victoria’s Model Sustainable Community Served by District Energy (current) and CHP (planned)



Redevelopment Project – Dockside Green is a new urbanist mixed use harborfront brownfields project in Victoria, British Columbia. Total build-out is 26 buildings, 1.3 million sq ft, including 1,300 DU’s; five buildings are complete. The 18-acre site was previously a copper mine.

On-Site Energy – The capacity of the district energy system is 8 million BTUs per hour; however, slower build-out has meant that the system is operating at only 20 percent of capacity. A full CHP system was announced in 2009 but remains on the drawing boards due to the real estate market slow-down and financing hurdles. The capacity is in the range of 1 -2 MW. The feedstock is renewable bio-mass. Corix Utilities Ltd and FortisBC owns the district energy system.

Energy- Redevelopment Synergies – New development at Dockside Green enjoys three advantages: capital cost savings in energy infrastructure; operating cost/energy usage savings of up to 30 percent; and marketing advantages relative to sustainability (LEED Platinum). Dockside Green has received more than 20 awards for energy efficiency, carbon reduction, and sustainability, and is generally regarded as being among the greenest communities in the world.

Key Financing - Financing was primarily private with additional governmental support from BC Hydro, the provincial government and the City of Victoria. British Columbia’s carbon reduction mandates (33 percent by 2020) and carbon tax factor into the incentives for the full CHP system.

II. INDUSTRIAL PARKS

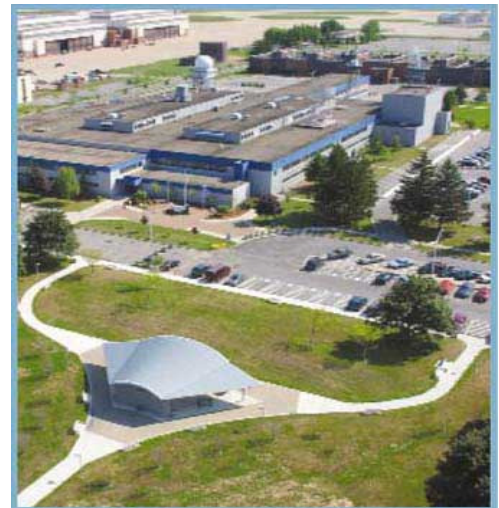
GUSC Energy Inc. a subsidiary of Griffiss Utility Services Corp, Griffiss Business and Technology Park, Rome, NY

Redevelopment Project - – Griffiss Business and Technology Park in Rome, NY is an industrial park redevelopment of the former Griffiss Air Force base (a former Superfund site). The Griffiss Utility Services Corp (GUSC) is a non-profit organization created by the Griffiss Local Development

Corporation to manage the energy system for the Griffiss Park. The 3,500 acre park has successfully attracted over 80 businesses with a total of 5,800 employees.

On-Site Energy - The Park features a district energy system, which was inherited from the Air Force. Four 90,000-lb/hr boilers pump steam through a 26-mile distribution system. A full CHP plant, with a combined production capacity of 18 MW and fueled by bio-mass, is beginning to go under construction.

Energy-Redevelopment Synergies – The current district energy system produces steam to approximately 70 percent of the space in the industrial park (or 6 million sq. ft.) About half of the businesses in the park are steam users, including the Air Force Research Lab, Premier Aviation, Oneida County International Airport, Northeast Air Defense, ITT Advanced Engineering, - Logoplaste (plastic packaging), Mascoma Biofuels, MGS Manufacturing (wire, cable, and fiber). Note the park has tripled in size (as measured by employment) since the time that GUSC began offering steam energy. The CHP plant will further improve efficiencies, expand capacity in producing steam, and will provide 10 to 15 percent of the Park's electricity needs.



Key Financing – For the CHP project, \$5.4 million Treasury grant linked to ITC (30% credit due to biomass' classification as renewable).

Eastman Business Park, Rochester - Former Kodak Industrial Park Uses CHP to Attract Energy-Intensive Industrial Uses



Redevelopment Project – Eastman Business Park is 1,200 acres, 900 retained by Kodak and 300 acres available for redevelopment with new industrial uses. There are 3,000 jobs associated with 35 tenants in the Eastman Business Park, and 3500 jobs still in

Kodak operations. The park has recently attracted 4 new clean technology companies, which, in addition to benefiting from CHP energy utilities, are also taking advantage of on-site bio-refineries, analytical services, thin film development, coating technology and logistics support.

On-Site Energy – Tri-generation system with the following: electricity production capacity of 130,000 kilowatts (all to business park occupants); steam capacity of 1,500,000 pounds per hour; chilled water

capacity of 60,000 tons. The feedstock is coal with natural gas back-up. In addition, there is industrial water capacity of 50 million gallons per day, along with wastewater treatment capacity of 40 million gallons per day.

Energy-Redevelopment Synergies – virtually all the businesses in the park use CHP-generated electricity, chilled water, and steam. In addition to Kodak, there are seven large manufacturers in the business park. Businesses save in operating costs, on the order of 20 – 30 percent, and energy savings are a significant factor in the success of the Park. A typical business is also saving substantial capital costs (not building their own boilers and HVAC systems).

Key Financing – System upgrades are privately financed.

III. ECO-INDUSTRIAL PARKS

Catawba County, NC EcoComplex - Planned CHP Project Links Greenhouse and Eco-Industrial Uses



Redevelopment Project – The Catawba EcoComplex is an already-successful eco-industrial park and reuse of a county landfill. The CHP system will move the eco-park toward the dual goals of zero waste and carbon neutrality, as well as enhance marketing to businesses that can take advantage of the energy resources.

On-Site Energy – There is a current LFG recovery plant that produces 3.0 MW for sale to the grid. The biomass CHP plant (in design) will produce 3 megawatts of clean, cost-

effective electricity for sale to a local utility, as well as thermal energy to existing and planned businesses. It is scheduled to go under construction late in 2011.

Energy-Redevelopment Synergies - The steam heat will be used by: Gregory Wood Products and Pallet One for drying kilns, the County for a proposed new sludge maintenance facility, the Appalachian State biodiesel research facility, and will be used by the planned greenhouse. Current employment in the EcoComplex totals 250 jobs. They are also negotiating with a 250-job industrial user.

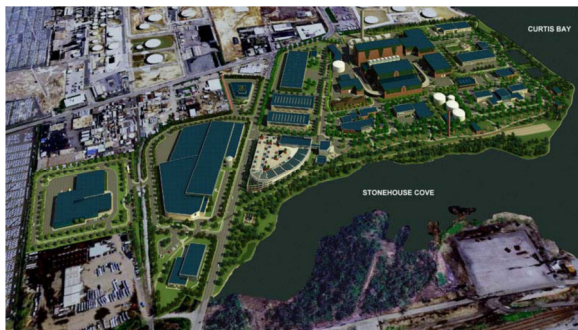
Chief Financing Mechanism – GO or revenue bonds. The County is considering other governmental incentives in order to enhance the economic viability of the project.

Energy Answers, Baltimore - CHP Plant to Anchor Eco-Industrial Park

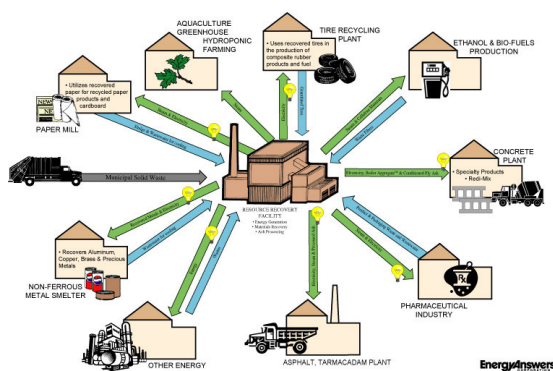
Redevelopment Project – a waste-to-energy CHP plant will be the centerpiece of a 90-acre eco-industrial park re-use of the former FMC fertilizer plant, a brownfields site in the Fairfield industrial area. It will also feature resource recovery of metals separated from the municipal solid waste. The site work is underway.

On-Site Energy – The plant is planned to produce 150 megawatts electricity and generate steam to power industries that co-locate with the CHP facility.

Energy-Redevelopment Synergies – About 75 of the 90 acres will be available for industrial redevelopment with complementary industries. Complementary industries could include: 1) energy intensive/steam heat users; 2) concrete block manufacturers using the ash residue; 3) businesses that use the recovered metals.



Resource Recovery Based Eco-Industrial Park



Key Financing – \$1 billion project with the following incentives: \$200 million Treasury Renewable Energy Grant converting the value of the ITC credit; Maryland General Assembly re-classification of the project to “tier 1 renewable,” which enables Energy Answers to negotiate a better rate from the utility; Baltimore also re-classified the site as a Focus Area under the State Enterprise Zone Program. They applied for the DOE Loan Guarantee, but were not successful.

Pure Energy/Saline Green – CHP to power bio-fuels and related manufacturing in Marshall, Mo.

Redevelopment Project – Saline Green, under development in Marshall, Mo., is essentially an eco-industrial park, except that the related businesses will all be owned by one company. The 15 MW CHP plant will generate thermal energy (steam) and electricity to: 1) power a cellulosic ethanol plant; 2) produce 12 MW renewable electricity, sold to the grid; and 3) produce Furfural Chemicals, a bi-product of processing the bio-mass materials. Of the 200-acre site, 60 acres are part of a now-closed landfill.

On-Site Energy – CHP plant will produce: 15 MW electricity (3 MW used internally and 12 MW sold to the grid); and steam to power:

- A cellulosic ethanol plant, which will produce 10 million gal/year output of ethanol).
- Furfural chemicals manufacturing facility.

The feedstock is woody bio-mass (including switchgrass grown on-site) and LFG.



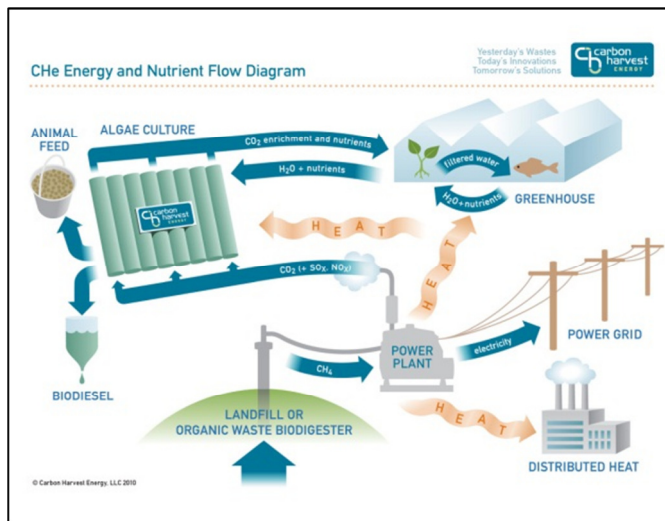
Energy-Redevelopment Synergies – The CHP plant is the key to ethanol and furfural chemicals production facilities. Furfural is a bi-product of processing the bio-mass materials. Furfural is used in

artificial limbs, rubber tires, plastics, and composite materials. The Furfural plant will produce 18,000 metric tons of product. (Note revenues from the Furfural plant are key to project feasibility).

Key Financing – \$87 million, primarily private through hedge fund investment grade bond. Ethanol subsidies are an important factor. The ITC will also be used. They applied to the DOE Loan Guarantee program but were not successful.

IV. SUSTAINABLE AND CONTROLLED ENVIRONMENT AGRICULTURE PROJECTS

Carbon Harvest - LFG Recovery, CHP, and Controlled Environment Agriculture Projects



Redevelopment Project - Carbon Harvest is a triple bottom line business, specializing in projects that involve LFG recovery, CHP energy generation, and steam recovery for “Controlled Environment Agriculture.” They have four projects that involve these elements: Brattleboro, VT; Keene, NH; Lebanon, NH; and Sullivan County (Monticello), NY. All of the projects involve steam generation linked to a greenhouse, aquaculture facility, and algae production facility, all in a closed loop system with nutrient and water re-cycling.

On-Site Energy - The 1.6 MW Lebanon plant and the 250 KW Brattleboro plant are operating. The

Keene and Sullivan projects are planned to generate 600 KW and 1.6 MW, respectively.

Energy -Redevelopment Synergies - Aside from the greenhouse-aquaculture facilities, three of the projects also involve producing steam or electricity for nearby industrial users or industrial parks, as follows: Lebanon serves adjacent asphalt and concrete plants; Keene is planned to serve the Black Brook Industrial Park; and Sullivan is planned to connect to a new industrial park being developed on County owned land.

Key Financing Mechanisms – All of the facilities will use the Energy ITC; one received \$500,000 from EPA Climate Communities; REC's are sold to Dartmouth College through a unique partnership. The Brattleboro project has received \$1.1 million in Vermont state loans and grants.

H2Grow/Innovative Energy – Model City, NY Greenhouse-CHP-LFG project

Redevelopment Project – H2Grow is a greenhouse hydroponic vegetable grower; Innovative Energy developed the greenhouse in order to make use of the waste heat from their 12 MW LFG recovery plant. The twelve-acre facility in Model City (Niagara County), New York, produces 6 million pounds of tomatoes annually.



On-Site Energy – Innovative Energy uses landfill gases (LFG) as the feedstock for a CHP system that generates 12 MW to the grid; waste heat recovery (61 million BTU's per hour) heats 250,000 gallons of water that re-circulates through the greenhouse, thus enabling year-round growing.

Energy-Redevelopment Synergies – The greenhouse saves \$800,000 annually in fuel costs due to the CHP plant; H2Grow employs 40 people. Note that Innovative Energy has built and now operates several other LFG recovery plants, but the greenhouse component was deemed financial infeasible due to a precipitous drop in the price of tomatoes.

Key Financing – Cost was \$10.5 million for the power plant, and \$14 million for the greenhouse (including \$1.5 million for the waste heat recovery system). The financing was private except for \$500,000 from NYSERDA.

The Plant, Chicago, Vertical Farm and Food Business Incubator



Redevelopment Project - Redevelopment Project - A 93,500 sq ft former meatpacking plant has been brought back to life as a food production incubator, including aquaponics, a rooftop greenhouse, brewery, bakery and space for other food production businesses. A shared kitchen area serves multiple

businesses.

On-Site Energy – The CHP plant will produce 420 KW to the buildings tenants, and the building's energy use will be net-zero, or no net energy used from the grid. The steam/thermal energy will produce 2.1 million BTU's per hour. The feedstock is methane from anaerobic digester converting food waste from: on-site and nearby breweries; a fat rendering plant next door; other on-site and nearby food production businesses.

Energy-Redevelopment Synergies – The building's tenants will be able to purchase electricity and steam/thermal from the onsite renewable energy system at rates that are only about a third of typical utility/grid prices. On-site businesses also gain in that food wastes are disposed of on-site as feedstock for the CHP system (converted to methane through the anaerobic digester). The steam will be used by the brewery and the rooftop greenhouse.

Key Financing – Incentives included two state grants - \$838,000 came from the "Food Scrap Composting Revitalization and Advancement Program and \$720,000 in ARRA funds channeled

through the state. Federal assistance may come from the Treasury 1603 grants that convert the value of the Energy Investment Tax Credit.