NREL
NATIONAL RENEWABLE ENERGY LABORATORY

U.S. DEPARTMENT OF ENERGY

Using Net-Zero Energy Projects to Enable Sustainable Economic Redevelopment at the Former Brunswick Air Naval Base

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- The conclusion of this study finds that by combining an aggressive building energy efficiency retrofit program with a biomass combined heat and power (CHP) system, Brunswick Landing could become one of the **first net-zero energy developments in the country**.
- NREL recommends that MRRA proceed to a more detailed implementation analysis to determine the optimal mix of technologies, partner companies, and financing mechanisms that Brunswick Landing might utilize to implement a project.

Under a contract through the U.S. Environmental Protection Agency, the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) was asked to do a comprehensive analysis of the former Brunswick Naval Air Station (an EPA Super Fund site), now known as Brunswick Landing which is under management by the Midcoast Regional Redevelopment Authority (MRRA). NREL examined the property and its assets to look for renewable energy as well as sustainable economic redevelopment opportunities that could be used to redevelop the site.

NREL analyzed eight different renewable energy technologies: solar photovoltaics (PV), solar domestic hot water heating (SDHW), solar ventilation preheating, wind, fuel cells, micro gas turbines, biomass combined heat and power (CHP), and geothermal heat pumps as well as opportunities for energy efficiency upgrades in the buildings and infrastructure.

NREL's analysis examined the following:

- the economics of individual renewable energy technologies;
- the systemic benefits that can be gained when cost-effective renewable energy technologies are integrated with other systems and businesses in a community, thus multiplying the total monetary, employment, and quality-of-life benefits they can provide to a community; and
- opportunities for *industrial symbiosis* which can be defined as the concept of using the waste from one process as a feedstock for another process; lowering "disposal" costs, and up-cycling the former "waste" into a value-added commodity.

Conclusion: Biomass CHP

NREL concludes that the technology that has been identified to offer the strongest combined economic opportunity is a combined heat and power (CHP) system. Critical factors contributing to this conclusion include the abundant local wood resources, the system's quick payback, and CHP's ability to be combined systemically with other micro-enterprises. Other factors contributing to NREL's conclusion include the following:

- By utilizing the State of Maine's Community Based Renewable Energy Production Incentive Pilot Program MRRA can enter into a long-term agreement with the Maine public utility commission and the local utility that ensures MRRA would be paid for their cost to generate the wood-powered electricity, plus a reasonable profit *(NOTE: this rate can go up to a maximum of $0.10/kilowatt hour (kWh) and contracts can be signed for up to 20 years.)*
- By leasing the power plant from a third party, MRRA could indirectly take advantage of significant federal tax incentives that would reduce the installed cost of the system. Under a worst-case scenario, if MRRA installed a 2 MW wood-powered boiler and steam turbine to generate power and installed a pipeline system to

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distribute waste heat from the turbine to buildings (with no incentives for the pipeline), and if there were no building tenants to purchase the waste heat, the payback of the system would be 10 years.

- Waste heat from the power plant can be leveraged in a number of ways to spur economic growth or to create new businesses. A fairly typical way to do this is to give away free heat to entice new tenants to sign leases. However, the heat could also be leveraged to pay for part of a tenant's building energy improvements when combined with tax incentives, thus increasing the impact of the long-term PUC/utility contract and the resulting waste-heat resource on the physical.

- By combining a CHP system with other optional systems, the waste hot water and carbon dioxide coming from the wood power plant could be used to jumpstart a greenhouse industry growing local foods and providing jobs all winter long. Carbon dioxide from power plants is commonly used in Europe to accelerate the growth of greenhouse crops by at least 30%. The moist, heated air resulting from the wood chip drying process could be used for locally grown produce that could be cultivated year-round in greenhouse facilities. This strategy ties in nicely with the large tourism and retiree industry in the Midcoast region and the burgeoning local and quality food movement. In addition, Bowdoin College also represents a huge potential bulk market and has committed themselves to supporting the purchase of local food. None of these large markets have local organic buying options during the winter season.

Many additional optional business opportunities can be added around the main starting biomass CHP cluster, which generates electricity and heat for the buildings:

- By taking advantage of a newly-created corporate structure named low-profit limited liability company (L3C), which allows a nonprofit to control a for-profit corporation as long as it has a social mission, this biomass CHP business, or the new businesses in Brunswick Landing's business incubator, could access new sources of capital that have not been traditionally accessible to start-up companies.

- Brunswick Landing can take advantage of NREL's prescreening of DOE's holdings of clean-tech intellectual property to act as technology matchmaker with potential local entrepreneurs for future start-ups.

- Initial discussions with consultants who specialize in other tax incentives not related to renewable energy, such as New Market tax incentives, indicate that there is a high possibility that Brunswick Landing would qualify for these tax incentives for the projects proposed. These tax incentives would be in addition to the tax incentives already included in the financial calculations presented in NREL's analysis.

An examination of the full potential for the manufacturing sector is outside the scope of NREL's analysis. However, many other symbiotic business opportunities will become available as additional businesses relocate in Brunswick Landing and as more information emerges about possible manufacturing processes, wastes, and feedstocks. It is recommended that this be investigated further in the future.

Other Renewable Energy Sources?

In addition to the biomass, NREL evaluated seven renewable technologies, of these, only solar ventilation preheating was found to be economically viable for large-scale deployment. Solar ventilation preheating was found to have a payback of approximately 7.4 years if done as a standalone project, and a payback of approximately two years if done during the upgrading of the facade of a building.

State tax incentives and rebates would buy down the cost enough to allow a very small solar PV and a very small wind system to become economically viable for demonstration purposes, but not on a large scale at this time.

Natural gas micro turbines were found to have a payback of 6.2 years, but this would require that 1 MW of capacity be installed at one time and that all of its waste heat be sold. This would be a challenge with the current low occupancy rate and uncertainty at Brunswick Landing. Selling only 50% of the heat would make the payback increase to 17 years.

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