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Clean Energy from Landfill Diversion Plus the Bonus of Biochar

Innovative solution cuts wastewater treatment plant's energy bill by one-third

By Nancy Cooper, Aries Clean Energy

Lebanon, Tennessee, is located twenty-five miles east of downtown Nashville. Its location just outside a major city but close to an international airport and three major interstates has families and industry making the move to Lebanon. The city has a population of just over 32,000 and until recently, its commuter rail transportation system direct to downtown Nashville was helping reduce emissions, but the city had no other "green" initiatives. No other city in Tennessee area has commuter rail.

While planning for future growth, the city's mayor and council were looking for a "green" way to address the growing municipal solid waste issues. The closest and largest landfill, just in the next county, was (and still is) filling up fast and expecting to close in a few years.

The city engaged Aries Clean Energy as a first step toward being more independent with its waste solution. Aries proposed a downdraft gasification plant that would use waste wood and biosolids from the wastewater treatment plant for its fuel, diverting wood waste from the landfill. The plant would generate enough electricity behind the meter to offset a third of the wastewater treatment plant's energy bill.

THE APPROACH

Aries Clean Energy developed the PHG LF64 (64T/day) downdraft gasification system on one acre in Lebanon that operates on the following specifications:

- **Input Materials:** Waste wood is chipped to 1- to 3-inch size; biosolids from the wastewater treatment plant are delivered to the gasification plant where they are blended with this wood before gasification.

- **Process:** Syngas produced from the gasifier is combusted in an industrial thermal oxidizer (an emissions control device). Thermal energy is used to heat water, which drives three Organic Rankine Cylinder generators with a total output daily capacity of 420 Kw that offsets the electrical usage at the wastewater treatment plant next door.
- **Output:** 15 percent of wood input results in biochar comprising 85 percent carbon and recyclable.

THE RESULTS

The Aries Clean Energy downdraft gasification system yields waste, energy, and emissions benefits for Lebanon, Tennessee:

- **Waste:** More than 16 million pounds diverted from landfills each year (wood and biosolids)
- **Energy:** More than 45,000 MWh power generation over the twenty-year life of the project
- **Emissions:** More than 5,000 pounds of carbon emissions averted annually

THE IMPACT

The effect of the gasification plant on the city and residents of Lebanon extends far beyond the results mentioned above. There are several positive outcomes because of the plant that reach far outside the city limits. Hundreds of visitors from all over the world have trekked to Lebanon to look and learn more about renewable energy at the plant site. Local industries and educators have found that the renewable energy plant can also play a part in helping them become better environmental stewards.



The Lebanon Gasification Initiative most recently has received the 2017 project of the year honors from the Tennessee Chapter of the American Public Works Association (TCAPWA). (photo credit: Dillon Fuller)

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Syngas produced from the gasifier is combusted in an industrial thermal oxidizer, an emissions control device. (photo credit: Dillon Fuller)

The Lebanon Gasification Initiative most recently has received the 2017 project of the year honors from the Tennessee Chapter of the American Public Works Association (TCAPWA).

This award recognizes a project in a Tennessee city that epitomizes outstanding planning, construction, and management. This project becomes the Tennessee Chapter's nomination to the National APWA Top Ten Projects of the Year.

"This kind of recognition spotlights how much teamwork it takes to build and implement a project like this," says Lebanon Mayor Bernie Ash. "It is rewarding to see how a public private partnership can work together for good. And the fact that educators and local industry can also benefit because of this plant is just fantastic!"

This marks the fifth industry award for the innovative plant. Earlier in 2017, the plant received

honors from the State of Tennessee Governor's Stewardship Award and Project of the Year accolades from myriad industry publications. The Greater Nashville Regional Council presented the 2017 Local Government Award for Public Works and Utility Infrastructure to the city last month.

Like many cities this size, Ash says tackling the solid waste issue is best done taking one step at a time. He sees this waste-to-energy plant as the first step toward a total material recovery facility line for the city's waste.

"I'm pleased to say that with the detailed planning initiated by Aries, construction and implementation have progressed very smoothly. As with any power plant, we've had some bugs to work out, but overall, it's been a great team-building experience," says Ash.

The city is also involved in being "green" in other areas. It has installed more than 6,000 solar

panels at the WWTP and at the water treatment plant. City vehicles are being converted to natural gas. And a pilot residential recycling program is also underway.

WOOD WASTE DIVERSION

Since the start of wood waste collection to use as feedstock for the Lebanon Gasification Initiative, three local companies combined have diverted 4,300 tons of wood from local landfills since the plant went on line according to According to Lincoln Young, chief operations officer of Rockwood Recycling. Rockwood collects, prepares, and delivers the wood for the Lebanon plant's fuel. That's the equivalent of keeping 945 tons of carbon emissions out of the atmosphere or the greenhouse gas emissions from 673 passenger vehicles driven for one year according to equivalents set up by the Environmental Protection Agency. More than a dozen

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Biochar is the carbon-rich product that is left over after the completion of the gasification process. (photo credit: Dillon Fuller)

local businesses are currently participating in the program with Rockwood, a major component of the public/private partnership surrounding the Lebanon plant.

One example, Young says, is the Carlex Glass America aftermarket distribution center in Lebanon that specializes in automotive replacement glass and produces original equipment glass, such as laminated windshields and performance backlights. Carlex is a subsidiary of Central Glass.

A product like automotive glass requires special packaging during storage and transport. Until 2016, the thousands of custom wooden crates were used once before heading to the landfill. When facilitating production and logistic activities, waste stream disposal can be problematic, according to Lynda Hogue, director of the aftermarket distribution center.

Carlex's array of products intensifies this issue, she adds. The plant generates a multitude of

crates, cardboard, wood pallets, racks, packaging materials, and more from the manufacturing and distribution processes. In addition, millions of pieces of glass per day are transported and distributed.

Carlex's renewable results:

- **2015:** 515 tons of waste sent to the landfill
- **2016:** 687 tons of waste wood sent to the Lebanon downdraft gasification plant for fuel; 42 tons sent to the landfill after Rockwood Recycling harvests all recyclables
- **May 2017:** 665 tons diverted; only 56 tons to the landfill
- **2018 YTD:** 123 tons diverted; 5.92 tons to the landfill

BIOCHAR OPPORTUNITIES

The University of Tennessee Institute of Agriculture (UTIA) is studying Lebanon's biochar in five different areas of the state. Biochar is the carbon-rich product that is left over after the completion of the

gasification process. At the City of Lebanon plant, for every 100 pounds of wood gasified, about 85 pounds of wood is converted into a gas that is used to generate electricity, and 15 pounds is a carbon-rich biochar by-product. Associate Professor of Biosystems Engineering and Soil Science at the University of Tennessee Dr. Forbes Walker is heading up the studies. Biochar can be used as a soil enhancement because its carbon properties capture and hold water that leads to deeper roots and increased growth. In August, the Tennessee Recycling Coalition awarded its Video of the Year award to the UTIA-produced video about biochar. The video, *Biochar—A Futuristic Look at Recycling*, can be seen can be viewed on the Aries Clean Energy website.

EFFECTS ON FESCUE

The effects of different amounts/concentrations of biochar on the growth of fescue is underway in Wilson County (county where the Lebanon plant is located). Biochar from the plant containing biosolids from the wastewater treatment plant was weighed and spread by hand on the one-third-acre test area. The first fescue harvested and soil sampling took place last summer. There are also control sites with no biochar added. There are areas where urea (fertilizer) only was added. The weight amounts are to simulate the tonnage per acre that will be needed.

Walker thinks this type of study is unique in the biochar world. He cannot find where anyone has done research like this. He hopes when the results are in, he will be able to tell a farmer how much biochar to use on his fields to achieve a specific result. For example, if a farmer is primarily a cattle farmer, he will want to use the combination that produces the most protein in the fescue. Walker hopes to publish results after this growing season ends and soil sampling is complete.

DAIRY FARMERS

A local dairy farmer in Wilson County has agreed to use the Lebanon biochar in his manure storage pit. He is anticipating that the biochar will not only act as a filter but also accelerate the breakdown of the manure and control the odor. The first application has not been scheduled at the time of this writing.

CHICKEN BROILER HOUSES

The UTIA team has received a grant to research the use of the Lebanon biochar in a chicken broiler house in Bradley County as a means to control odor and act as a filter. It is hoped that the biochar may be part of the solution for the growing ammonia problem and bacteria issues for chicken growers. Then, at the end of the growing season, all the leftovers are windrow composted. The addition of biochar is hoped to

speed up the composting process by several days because it takes in the moisture. Chickens sometimes ingest some of the biochar but it does not harm them.

FLOOD CONTROL

Funding from the U.S. Department of Agriculture is making possible the testing of Lebanon's biochar versus sawdust as a flood water deterrent in three West Tennessee locations. When the land floods, sand residue is deposited as the water leaves. This lessens the amount of land available for farming. It is hoped that when biochar is mixed with the sand, the land will be reclaimed for planting. The Ames Plantation in Fayette County as well as sites in Madison and Gibson counties are being earmarked for this testing. Walker will publish results after harvest is complete.

Ames Plantation, home of the National Field Trial Championship

for All-Age Bird Dogs, is privately owned and operated by the Trustees of the Hobart Ames Foundation as Successor Trustees under the Will of the late Julia C. Ames. Ames Plantation also functions as one of the University of Tennessee's AgResearch and Education Centers. ♦

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