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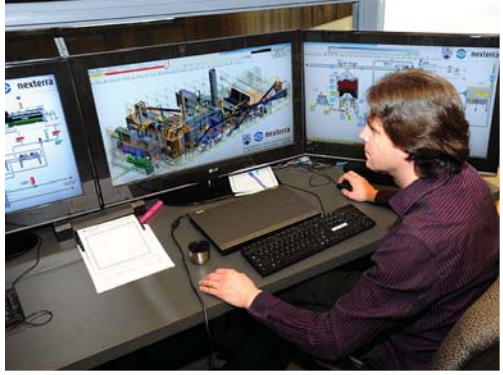

By **Jamie Zachary**

Fuel for change

Nexterra Systems turns up the heat on gasification commercialization

For most people, being told they are full of hot air would be considered an insult. For the folks at Nexterra, it's perhaps the greatest compliment.

For the past decade, the Vancouver-based gasification company has been cleaning up industry one gasification facility at a time.

The 50-person company recently made international headlines when it unveiled an energy-from-waste combined-heat-and-power system (CHP) at the University of British Columbia that uses the company's gasification and syngas conditioning technologies in what Nexterra is hailing as the first of its kind in North America.

Not bad for an outfit operating in an industry that arguably has more hype than most.

"(The gasification industry has) lots of promise, probably a lot of groups have had a lot of hype, but not all that much substance. We like to think we're in the substance business," says Mike Scott, who replaced Jonathan Rhone as the company's president and chief executive in October 2011.

"It's really the platform that we started with that has made it possible for us to survive and deliver in the real world."

Nexterra's CHP system at UBC is the first energy-from-waste combined-heat-and-power system in the 2-10 MWe-size range in North America. ***Photos courtesy Nexterra Systems.***

Nexterra in the beginning . . .

Nexterra, headquartered in Vancouver, was established as a private company in 2003. Over the next three years, the company developed and tested its core gasification technology at a product development centre in Kamloops, B.C., before opening its first commercial plant in 2006,

Today, Nexterra is majority owned by ARC Financial Corp, the Tandem Expansion Fund and Business Development Bank of Canada. Calgary-based ARC Financial has supported Nexterra with five investments totalling more than $25 million over the course of its partnership.

Over the past decade, Nexterra has left its mark on a number of renewable energy projects across North America.

In 2006, Nexterra made its first foray into the gasification industry by developing a system that coverts low-value wood waste into syngas that is then used to replace natural gas at the Tolko Industries' Heffley Creek plywood mill in Kamloops, B.C. The system reduces greenhouse gas emissions at the plant by 12,000 tonnes annually, and has displaced millions of dollars in natural gas during the course of its more than 50,000 hours of operation since it started.

"Getting that first customer signed up and delivering a system that worked, and has been operating for close to seven years, was certainly a big milestone," says Scott.

A year later, Nexterra provided a gasification system for a cogeneration plant at the University of South Carolina. At peak capacity the plant generated 60,000 pounds per hour of steam used to heat the campus, as well as 1.38 megawatts (MW) of electricity before it shut down.

Some of the company's biggest successes came in 2009, when the company opened industry-first gasification projects in New Westminster, B.C., and Victoria.

In New Westminster, Kruger Products became the first company in the pulp and paper industry to adopt Nexterra's gasification system. The system at Kruger's mill converts locally sourced wood waste into clean-burning syngas to produce 40,000 pounds per hour of steam that is fired directly into a boiler in place of natural gas.

Also in 2009, Nexterra made history with Canada's first urban biomass gasification project: Dockside Green, a residential and commercial development located on the Upper Harbour in Victoria. The system produces heat and hot water for the entire development using locally sourced wood residues. The system emits virtually no pollution, odors or noise.

In 2010, Nexterra completed a biomass gasification system at the University of Northern British Columbia in Prince George, B.C., that enabled the university to utilize locally sourced wood biomass to produce clean-burning syngas, displacing the natural gas used for heating the campus.

Operational in 2011, the system has since reduced UNBC's natural gas consumption by 89 per cent, lowered energy costs and decreased greenhouse gas emissions by 3,500 tonnes per year, equivalent to taking 1,000 cars off the road.

More recently, Nexterra has been busy south of the border. In February 2012, the company completed work on an energy-from-renewable-waste system at the U.S. Department of Energy's Oak Ridge National Laboratory in Tennessee.

Representing the cornerstone of the facility's $94-million project, the Nexterra system replaced the lab's aging fossil-fuel heating system, as well as upgraded the entire campus to more energy-efficient electrical, water and other systems. Nexterra's system is reducing the facility's greenhouse gas emissions by an estimated 23,000 tonnes per year, the equivalent of removing 4,000 cars from the road each year.

Nexterra is also nearing completion of an $18-million biomass heat and power system at the U.S. Department of Veterans Affairs Medical Center in Battle Creek, Mich.

The UBC project requires two to three trucks of biomass per day.

Scheduled to open later this year, the Nexterra system will provide clean, carbon-neutral heat and power to the campus. It will also reduce greenhouse gas emissions by an estimated 14,000 tonnes annually and reducing the facility's carbon footprint by approximately 80 per cent.

Nexterra and UBC

Nexterra's most recent contribution came closer to home at UBC, where it has created an energy-from-waste combined-heat-and-power system (CHP) that uses the company's gasification and syngas conditioning technologies in combination with partner GE Energy's high-efficiency Jenbacher internal combustion engines.

The result is what Nexterra is hailing as North America's first demonstration of its kind.

"This project represents a significant milestone for Nexterra," says Scott. "We are seeing significant interest in the next-generation solution around the globe."

The system, dubbed the Bioenergy Research and Demonstration Facility, is housed in a building constructed of cross-laminated timber (CLT) and set in the midst of an "urban forest," as described by Nexterra.

It works by converting locally sourced waste wood into a clean, engine-grade syngas that is suitable for use in a high-efficient, industrial-scale gas engine – in this case GE's Jenbacher gas engine – to produce heat and power.

More specifically, renewable woody biomass – including City of Vancouver tree trimmings, clean construction and demolition debris and wood waste from local furniture manufacturers – is gasified and converted into syngas that is used to produce hot water to heat the campus and/or directly fire into the gas engine to produce electricity.

The UBC project requires about 12,500 bone-dry tonnes of wood waste per year, averaging two to three trucks per day.

The result is Nexterra's system can produce up to 2 megawatts of clean, renewable electricity – enough to power approximately 1,500 homes – to offsets the university's existing power consumption, which is estimated currently to be about 40 megawatts of electrical output (MWe) annually.

The Nexterra system also generates 3 MW of thermal energy — enough steam to displace up to 12 per cent of UBC's natural gas consumption. This is expected to reduce UBC's greenhouse overall gas emissions by up to 5,000 tonnes per year, which is the equivalent of taking more than 1,000 cars off the road.

General Electric's Jenbacher engine at UBC uses syngas created by gasifying biomass to produce power and heat. *Photos courtesy Nexterra Systems.*

The CHP application offers 20 per cent high electrical efficiency and lower water consumption than conventional technologies, potentially transforming what Nexterra refers to as a "large niche market for small-scale (2-10 MWe) biomass CHP and power generation," says Scott. Small-scale, in this case, refers to one-10th the size of conventional large biomass-to-steam power systems.

The benefits to the CHP system goes beyond its ability to displace grid-purchase electricity for use "inside the fence," and save customers on electricity and heating costs, says Scott.

It's also able to displace fossil fuels used to produce hot water or steam, offer compliance with mandated renewables targets like that in the U.K., open access to feed-in-tariffs and incentives, greenhouse gas remission reduction and/or value for carbon offset credits.

Nexterra and gasification

Gasification is nothing new, dating back more than 100 years.

Where Nexterra's niche lies in how its been able to effectively commercialize it by developing a technology that allows flexible fuel choices while delivering fewer emissions and requiring lower operating costs.

"The basics of gasification technology has been around for decades. The challenge is making it work with a variable feedstock in a real-world setting," says Scott, noting the issue often lies with feedstocks that vary in moisture and size.

"Because the basics are simple, this is why we've ended up with hundreds of companies around the world getting started but unable to commercialize it.

"We've taken a very step-by-step approach to commercializing the technology. We've only bitten of chunks that we though we could chew.

"We started with arguably more straightforward applications of gasification technology, but now we're pushing into areas where we're making the gas clean and suitable for use in a big internal combustion engine to produce power."

Nexterra's gasification technology operates on fuel with moisture content from six to 60 per cent, and up to three inches minus particle size. Comparative combustion systems, on the other hand, can often only process a smaller fuel particle, making it more expensive to users.

Fuel for Nexterra's systems, meanwhile, has ranged from forest industry waste wood to, in the UBC case, demolition debris. The company is also exploring the possibility of using dried sewage sludge.

By comparison, traditional combustion systems generally operate with either wet or dry fuel, and some can only utilize a smaller fuel particle, making it more expensive.

From an operational standpoint, Nexterra's systems have much lower concentrations of particulate entrained in the flue gas system entering the boil than other combustion systems. The reduced particulate loading in the flue gas results in reduced soot blowing, cleaning surface wear and downtime to maintain the boiler.

Low particulate carryover also extends the life of the components downstream of the boiler, including the flue gas ducts, ID fan rotor and electrostatic precipitator ash convey-

ers.

On the emissions side, Nexterra's gasification technology has a leg up on other gasification or conventional combustion systems in that it produces lower particulate, carbon monoxide, volatile organic carbons and oxides of nitrogen, says Raymond McAllister, communications and media relations with Nexterra.

"Particulate, VOC and TOC emissions are equivalent to a natural gas boil system based upon EPA AP-42 data," he says, noting Nexterra's systems consume all fuel, resulting in ash with minimal carbon content.

"Lower emissions are easier to permit and more acceptable to local residents."

And because Nexterra uses renewable biomass in its gasifiers, its technology is deemed greenhouse-gas neutral. Over the past 10 years, the company has reduced emissions from 3,500 to 22,000 tonnes per year.

"(We) believe there's lots more to do."

Mike Scott

Nexterra and the future

While Nexterra's technology has seemingly hit new heights, natural gas prices have plummeted to new lows in North America.

Until the past two years, North America represented the company's major market. Yet the drastic drop in natural gas prices from $8 to $2 MMBtu (one million BTu) has hurt many renewable energy technologies, including Nexterra.

While the company continues to search out new projects in Canada and the U.S., its focus is on finalizing projects overseas where natural gas prices are still $8 to $14 MMBtu and there are mandated renewable energy subsidies, says McAlllister.

"The double whammy of bargain basement natural gas prices in North American and a world recession has sent many renewable energy technologies to the graveyard of great ideas," he says.

"While there are still some promising markets for Nexterra's systems in North America, there is great interest in other jurisdictions which have high fossil fuels costs, abundant biomass wastes and regulations and investments that favour the production of renewable energy."

Scott says Nexterra's next step is in expanding to markets such as the U.K., Japan, Asia and Brazil.

The company recently signed a strategic alliance agreement with U.K.-based Stopford Projects Ltd., and plans to announce alliances with additional companies in the U.K. and Asia over the coming year, according to McAllister.

Nexterra is also focusing on developing new, lower-cost feedstocks, particularly biosolids of sewage sludge from wastewater plants. The company has already successfully processed biosolids, and is now seeking a partner within the waste-treatment industry to develop a full-scale commercial demonstration of the technology.

"We're proud of what we've accomplished, but believe there's lots more to do," says Scott, noting the company is further testing the use of dirtier construction and demolition debris as a potential fuel source in the U.K.

"The technology, particularly in industrial clean tech, is probably only 25 to 30 per cent of the battle. That's just the beginning. The 10 years that it's taken us to continue to advance the technology is a testament to, and evidence of, how much patience, time, determination and persistence it requires to develop new industrial-skill energy technology. It's not for the faint at heart."

About the Author: Jamie Zachary is the editor of PROCESSWest.