THE UNIVERSITY OF BRITISH COLUMBIA

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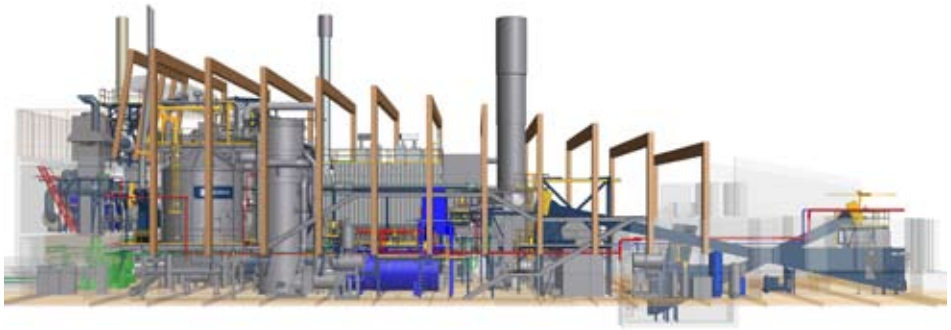
UBC BIOMASS RESEARCH AND DEMONSTRATION FACILITY

THE UNIVERSITY OF BRITISH COLUMBIA

Groundbreaking Renewable Biomass CHP System – A First in North America



UBC Bioenergy Research and Demonstration Facility (BRDF)

- Customer: University of British Columbia (UBC)
- Location: Vancouver, BC
- Application: Combined heat and power (CHP) solution consisting of Nexterra gasification and syngas conditioning system and GE Jenbacher gas engine
- Nexterra Scope of Work: Turnkey gasification system
- Capacity: 2 MWe of electricity and 9,600 lbs/hr of steam
- Fuel: Locally sourced urban wood residuals
- Building: Architecturally designed building constructed from innovative cross laminated timber (CLT) building product

System Highlights

- First system of its kind in North America
- Will reduce GHG emissions by 5,000 tonnes/year – equivalent to taking more than 1,000 cars off the road
- Key component of UBC's aggressive targets to reduce greenhouse gas emissions
- Will displace 12% of campus natural gas consumption
- A core component to UBC vision of the campus as a Living Laboratory

Expected System Performance

Electricity Production	15 million kWh/yr
Annual Gas Displacement	25 million kWt-hrs/yr
Avoided CO_2 Emissions	5,000 tonnes yr
Avoided CO_2 Emissions (Car Equivalent)	1,000 cars/yr
Wood Fuel Required	12,500 bone dry tonnes/yr

"We have developed a terrific partnership with Nexterra. Their technology is a great fit with our clean energy and climate action goals and we are very grateful for the tremendous support we have received from all project partners including the Province of BC, the federal government, City of Vancouver, FP Innovations, BC Bioenergy Network and Sustainable Development Technology Canada."

– Pierre Ouillet, UBC's Vice President of Finance, Resources and Operations

"With the track record at the Product Development Center and the successful start-up of GE's Jenbacher gas engine at UBC, Nexterra is well on the road to delivering a renewable biomass CHP solution that meets the demanding real-world reliability requirements of district energy providers and distributed power producers worldwide."

– Roger George, General Manager, North America, GE Gas Engines

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Nexterra Gasifier


Original Architect Rendering

BRDF Sign


BRDF Entrance


BRDF Exterior


Cloverdale Fuel Truck


BRDF Walkway


Gasifier at Night

Photo Credits: Mits Naga; Don Erhardt; Jeff Giffin
Building Graphic: McFarland Marceau Architects

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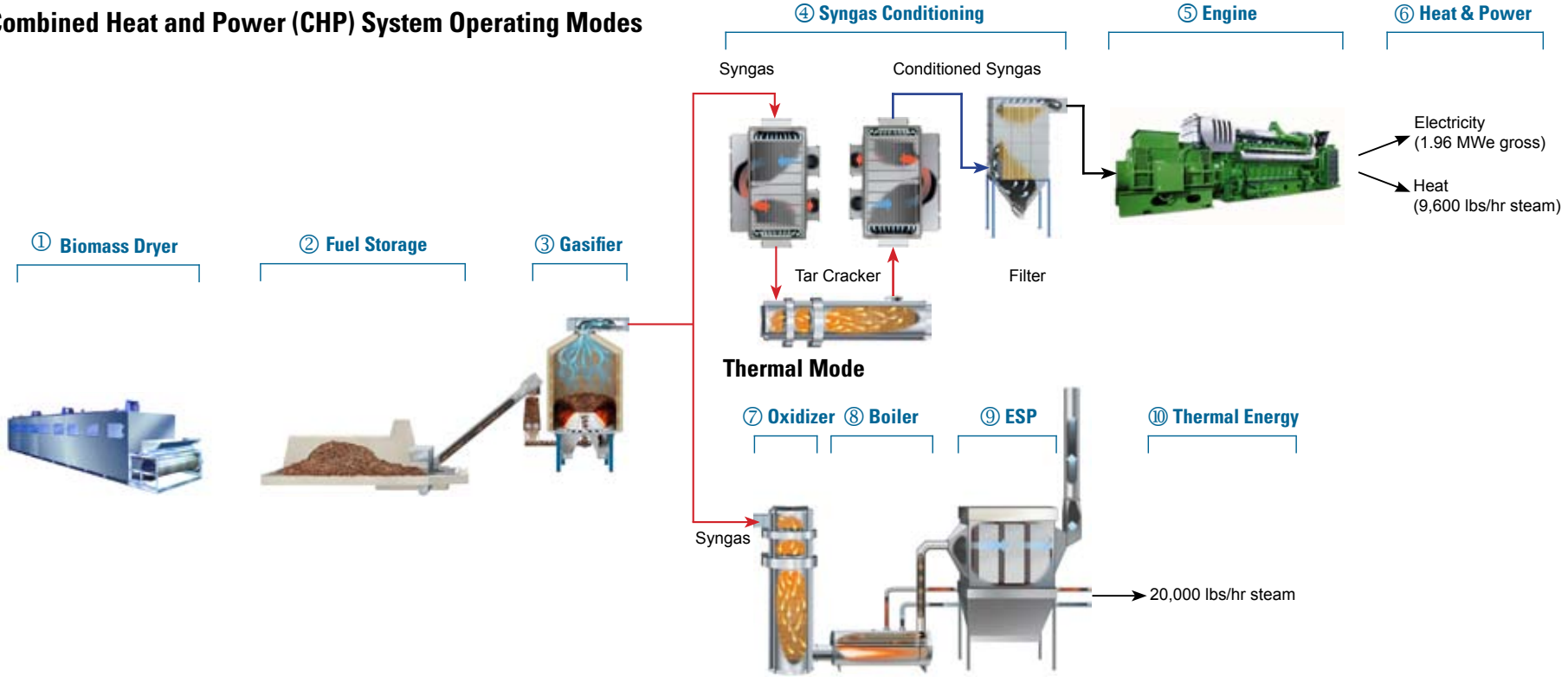
Combined Heat and Power (CHP) System Operating Modes



Demonstration (Combined Heat & Power) Mode

① Biomass Dryer - dries "wet" (e.g. up to 55% moisture content) biomass to 20% moisture content.

② Fuel Storage - wood residue delivered to storage facility and conveyed to gasifier.

③ Gasification Technology - gasification process converts wood residue into clean, renewable synthetic gas or "syngas."

④ Syngas Conditioning Technology - syngas is conditioned and upgraded to meet fuel specification for engine.

⑤ Engine - high-efficiency internal combustion engine operates on syngas instead of natural gas to generate electricity & heat.

⑥ Heat & Power - system will produce 2 MWe power (4% of current peak use) and 9,600 lbs/hr steam (=12% of current campus use)

Thermal Mode

⑦ Oxidizer - the syngas is conveyed into an oxidizer where it is combusted, with the resulting flue gas directed through a boiler.

⑧ Boiler - hot flue gas enters the boiler to produce steam for campus heat distribution.

⑨ Electrostatic Precipitator (ESP) - the flue gas is cleaned in an ESP that filters out virtually all particulate matter.

⑩ Thermal Energy - system will produce 20,000 lbs/hr steam or 25% of current campus use.

Entrance Work Area

Truck Unloading Fuel

State-of-the-Art Controls System

Nexterra Board at Gasifier

Walkway – Oxidizer to Gasifier

Syngas Thermal Cracking/Conditioning System

ESP and Boiler

GE Jenbacher Engine

Photo Credits: Don Erhardt and Mits Naga

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Nexterra and GE Demonstrate Transformative New CHP System

The CHP project at UBC is North America's first commercial demonstration of a transformative application that combines Nexterra's gasification and syngas conditioning technologies with GE's high efficiency Jenbacher internal combustion engines.

The successful start-up of the system at UBC represents the culmination of more than four years of product development work and collaboration with GE's Gas Engines Division. Prior to installing the 2 MW gas engine at UBC, Nexterra successfully completed more than 5,000 hours of trials at its Product Development Centre (PDC) in Kamloops, BC, including over 3,000 hours utilizing a 239 kWe Jenbacher engine.

239 kWe Jenbacher Engine at PDC

Installing GE Jenbacher Engine at UBC

Engine at UBC CHP Plant

Photo Credits: Don Erhardt and Mits Naga

UBC Campus a Living Lab

UBC is transforming itself from primarily a research powerhouse to an innovation hub for British Columbia and North America. The "Campus as a Living Laboratory" concept brings together research, operations and industry partners to address some of the most pressing sustainability issues facing society today. The University combines the talent of its researchers and knowledge of its operators with the expertise of some of the world's most innovative companies – many of them based in BC including Nexterra.

The Bioenergy Research and Demonstration Facility provides unique opportunities to conduct research in many areas including community scale heat and power systems, hydrogen and fuel cells, and electro-chemical battery storage.

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Innovative Cross Laminated Timber Construction System

The UBC Bioenergy Project worked with the Canada Wood Council and FP Innovations to develop an innovative building construction system using Cross Laminated Timber. CLT panel technology has been successfully utilized in Europe for residential and commercial projects, but this will be the first large scale North American demonstration of the building system in a commercial building.

Advantages and Benefits of CLT Construction:

- Cost competitive with conventional steel and concrete systems
- Modular construction; versatile for interior and exterior surfaces
- Environmentally friendly; provincially sourced fiber including pine beetle kill wood
- Excellent shear strength and stiffness for tall walls of the plant
- High strength-to-weight ratio; offers excellent seismic resistance
- Offers higher levels of fire resistance
- Acoustics and sound attenuation – betters City of Vancouver noise bylaw
- Standardized panel sizes, simple connection details and less component parts

Photos: McFarland Marceau Architects

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THE UNIVERSITY OF BRITISH COLUMBIA

About University of British Columbia Vancouver, British Columbia

The University of British Columbia is one of Canada's largest and most prestigious public research and teaching institutions. Located in Vancouver, BC and in the Interior city of Kelowna, UBC is a global centre of research and learning. UBC is consistently ranked among the world's 40 best universities, one of only two Canadian universities in this category.

From its beginnings as an early adopter in campus sustainability, UBC has fostered a thriving community of sustainability researchers, teachers and students, and operational experts. UBC is now turning itself into a living laboratory and innovation hub in environmental sustainability by combining its sustainability leadership in teaching, research and operations.

UBC selected Nexterra Systems Corp. and GE to develop the UBC Bioenergy Research and Demonstration Facility (BRDF). The first-of-its-kind Combined Heat and Power (CHP) system is located at UBC's Vancouver campus where it will provide clean, renewable heat and electricity for the campus, while offering a platform for bioenergy research. Research groups from the Clean Energy Research Centre (CERC), the Centre for Interactive Research on Sustainability (CIRS), the Institute for Resources, Environment and Sustainability, the Faculty of Applied Science and the Sauder School of Business will all be involved in this project.

The project was jointly funded by the Canadian and BC provincial governments, as well as industry partners. The plant opened in September 2012.

For more information:
www.ubc.com

Partners:

Canada

SUSTAINABLE DEVELOPMENT TECHNOLOGY CANADA

BC Bioenergy Network
PARTNERING FOR A GREENER FUTURE

FPInnovations

BRITISH COLUMBIA

"This exciting facility targets a major challenge facing society – the need for new, clean energy solutions that work at a community scale. This is a flagship example of UBC as a living laboratory, where researchers, staff, students and partners collaborate on innovations targeting the pressing challenges of our day."

– Stephen Toope, President, The University of British Columbia

About Nexterra Systems Corp. Vancouver, British Columbia

Nexterra is a leading provider of plant-scale, energy-from-renewable-waste systems that generate energy and fuels for a range of customers, including district energy providers, industrial process plant operators and independent power producers. Nexterra systems integrate seamlessly with customer operations, providing both environmental and operational advantages, including high reliability and class-leading emissions performance.

Projects include:

- University of British Columbia, Vancouver, BC
- U.S. Department of Energy (DOE), Oak Ridge National Laboratory, Oak Ridge, TN
- U.S. Department of Veterans Affairs (DVA) Medical Center, Battle Creek, MI
- University of Northern British Columbia, Prince George, BC
- Dockside Green Development, Victoria, BC
- Kruger Products Limited, New Westminster, BC
- Tolko Industries Ltd., Heffley Creek Division, Kamloops, BC
- Nexterra Product Development Centre (PDC), Kamloops, BC

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