Biomass Solutions for Urban Communities

International Union of Air Pollution Prevention and Environmental Protection Associations'
World Clean Air Congress

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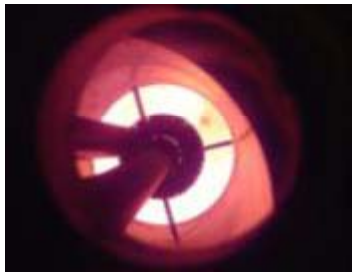


Nexterra Overview

Company

- Global leader in biomass gasification technology and systems
- Supplies turnkey biomass gasification systems for public institutions and industrial customers
- Enables customers to generate, clean renewable energy from low cost sources of waste biomass
- Ultra low emissions, high efficiency and solution package ideally suited to urban environments
- World class partners, well capitalized with an experienced team

Strategic Relationships

GE – Advanced power systems

Johnson Controls – institutions

Andritz – WWT/municipal partner

Tolko Industries – Kamloops
- 38 MMBtu/hr plywood plant heating system
- Displaces natural gas
- CO2e reduction: 12,000 tpy
- Commissioned 2006

University of South Carolina
- 72 MMBtu/hr campus heat & power
- CO2e reduction 20,000 tpy
- Commissioned 2008

Dockside Green, Victoria
- 7 MMBtu/hr district heating system
- Heating & Hot Water for residential complex
- CO2e reduction 3,400 tpy
- Commissioned May 2009

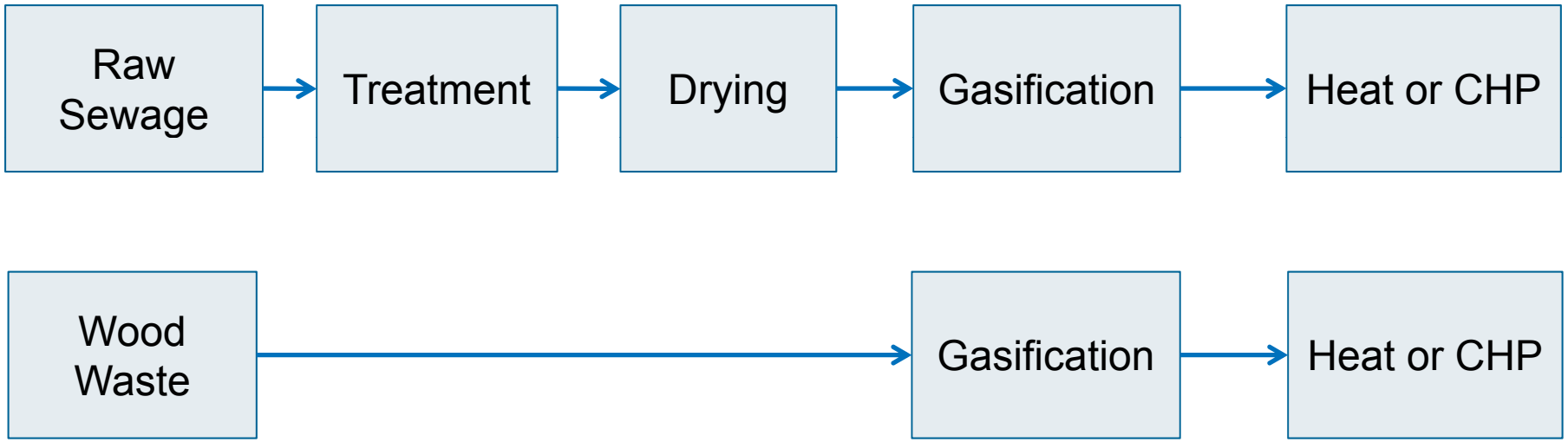
US DOE Oak Ridge National Labs
- 60 MMBtu/hr steam system
- JCI/Nexterra selected by DOE
- CO2e reduction: 23,000 tpy
- Startup: 2011

Kruger Products (Scott Paper)
- 40 MMBtu/hr steam system
- Gas displacement in a boiler
- Commissioned: Q4/2009
- CO_2e Reduction: 22,000 tpy

UNBC, Prince George
- 15 MMBtu/hr campus heat
- CO2e reduction: 3,500tpy
- Startup: Q4 2010

Integrated Resource Management

- Cities are increasingly examining the use of carbon neutral fuel resources that can be sourced locally
- Gasification can be a significant component of an integrated approach to managing and extracting value from municipal waste streams



- Woody biomass resources are typically are available from municipal tree trimmings and from construction and demolition waste
- Biosolids are available from local wastewater treatment plants

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Biomass: Carbon Neutral Solution

- Renewable and carbon neutral
- Substitution in place of fossil fuels will reduce GHG emissions
- Locally sourced fuel such as locally produced wood residue, pine beetle kill, municipal tree trimmings, recycled construction and demolition waste etc.
- Dispatchable (base-load capable) source of energy
- Lower cost than natural gas or oil

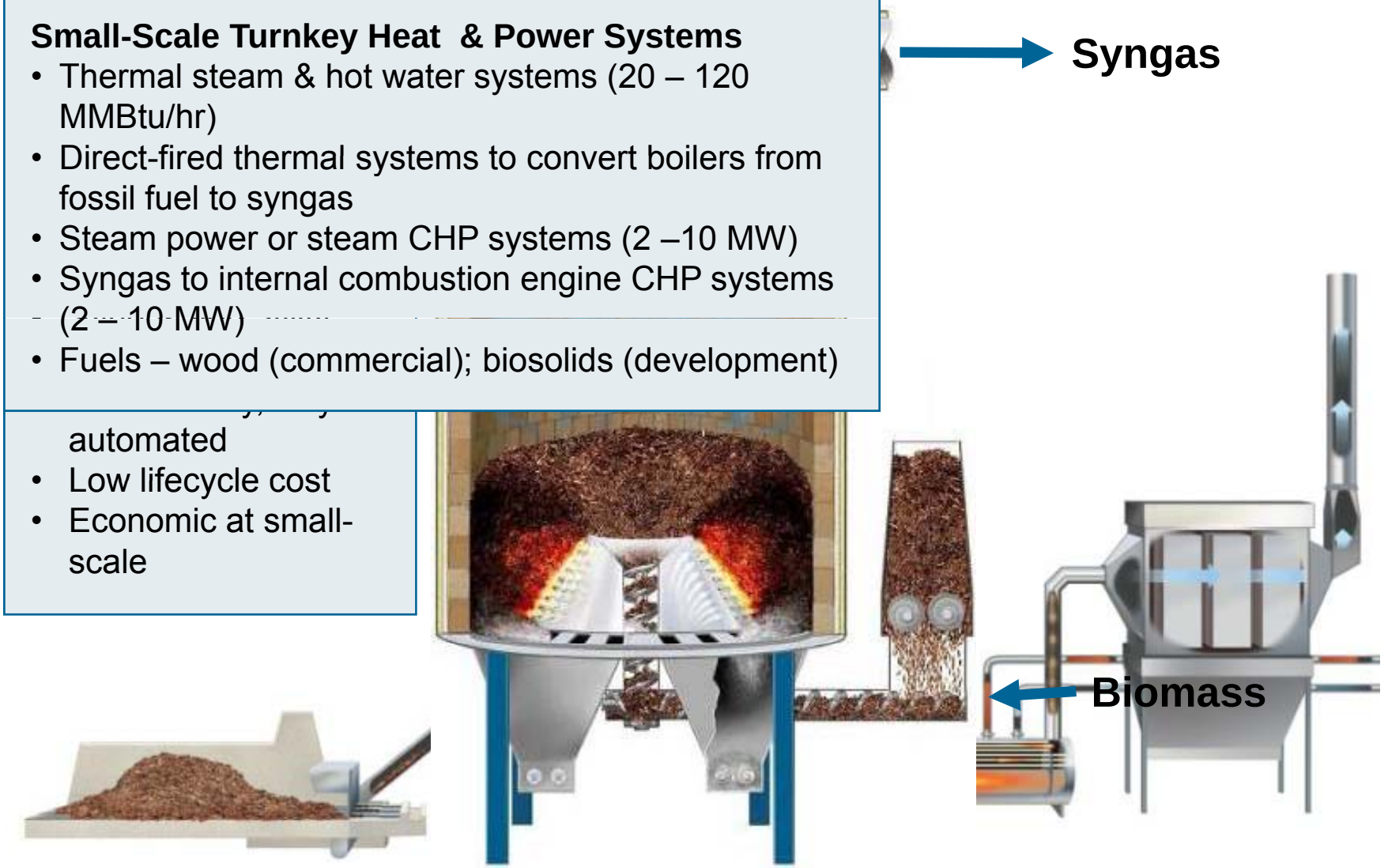
System Packages for On-Site Heat and Power

Core Technology

Small-Scale Turnkey Heat & Power Systems

- Thermal steam & hot water systems (20 – 120 MMBtu/hr)
- Direct-fired thermal systems to convert boilers from fossil fuel to syngas
- Steam power or steam CHP systems (2 –10 MW)
- Syngas to internal combustion engine CHP systems (2 – 10 MW)
- Fuels – wood (commercial); biosolids (development)

- automated
- Low lifecycle cost
- Economic at small-scale



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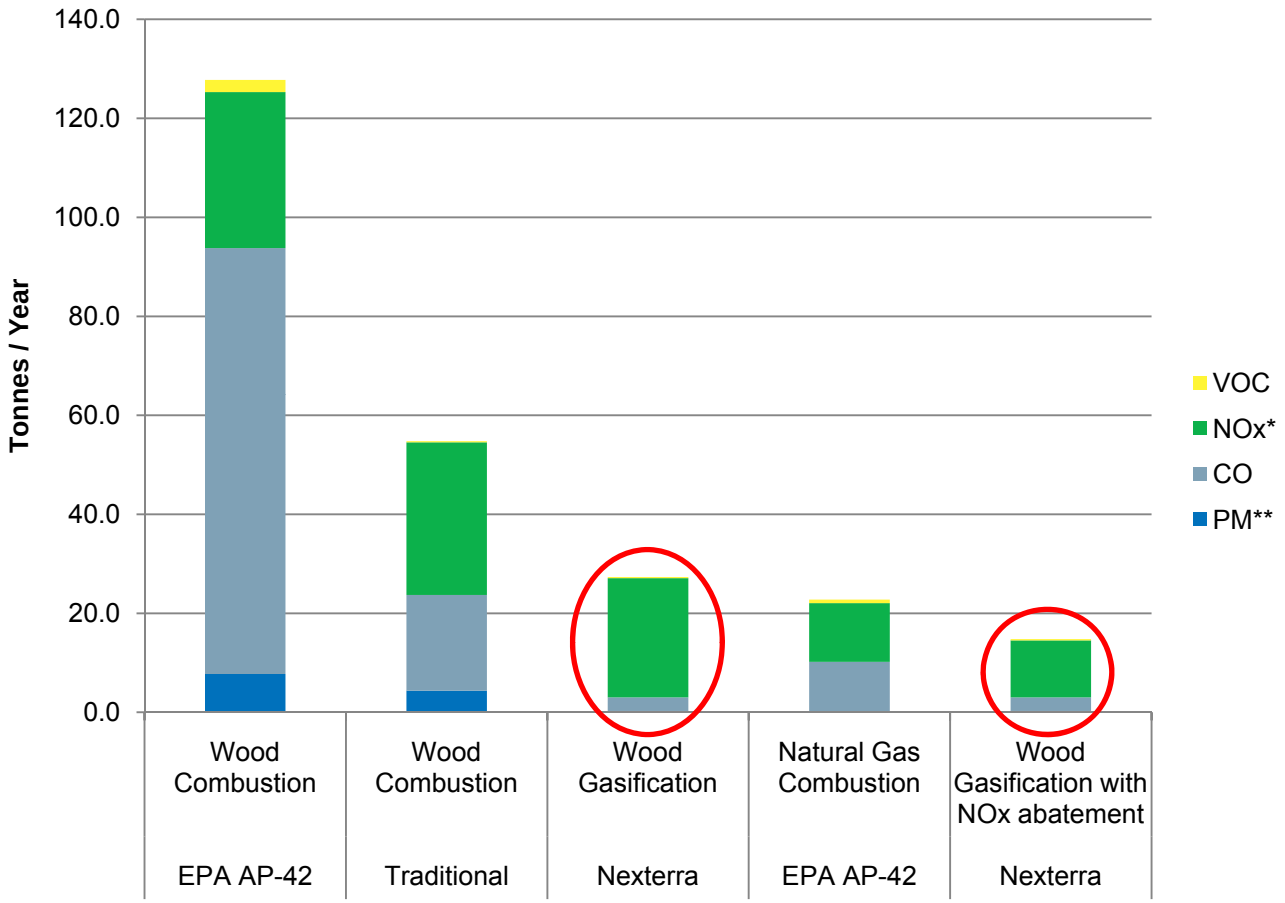
Air Emissions: Comparisons



Notes:

Tonnes per year based upon typical 24 MMBtu/hr system, 45% mc fuel
* NOx depends on nitrogen in biomass fuel
** PM with baghouse or ESP

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Dockside Green Case Study

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Dockside Green

- 1.3 million sq/ft of residential, office, and retail space
- Located in the heart of the City of Victoria
- Triple bottom-line development
- Developed by Vancity and Windmill Developments
- First greenhouse gas neutral community in Canada

Dockside Green: Requirements

- State-of-the-art
- Gasification, not combustion
- Proven, reliable technology
- New standard of low emissions
- Community acceptance
- Economically viable
- Ability to handle variable fuel
- Fully automated & operator friendly
- Potential to convert to power (future)

Dockside Green: Design Considerations

- Emissions
- Dust and odor
- Noise attenuation
- Fuel truck traffic
- Building aesthetics and design
- Community acceptance

Dockside Green: Partner Support

Partners:

Vancity

CORIX Utilities

Terasen Energy Services

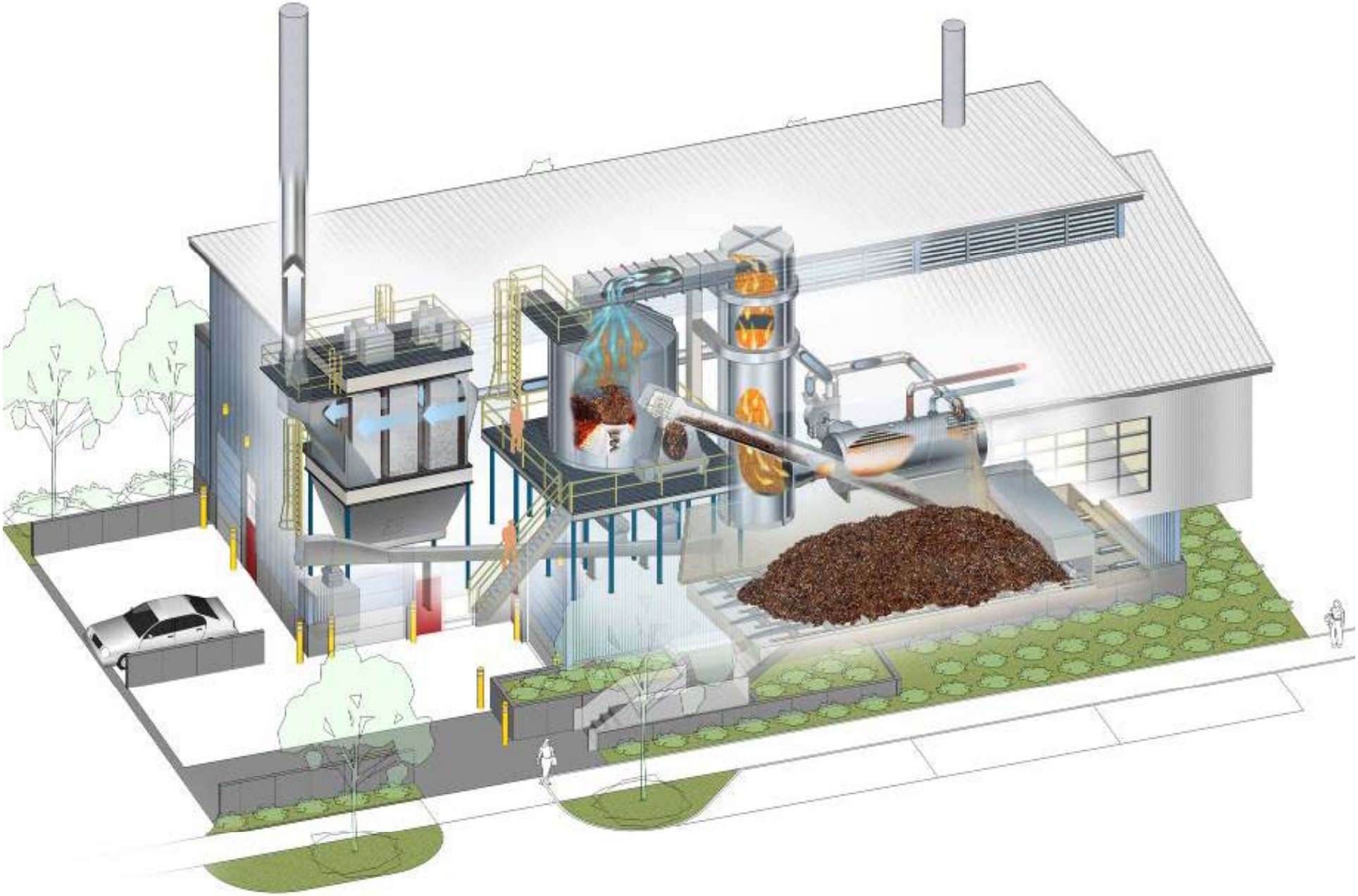
Supporters:

THE CITY OF VICTORIA

BC hydro

Natural Resources Canada

BRITISH COLUMBIA



DOCKSIDE **GREEN**

DOCKSIDE GREEN

Dockside Green – Victoria BC

- District Heating & Hot Water – 8 MMBtu/hr
- Fueled with Urban Wood Waste
- LEED platinum development
- Started up May 2009

DOCKSIDE GREEN

UBC Case Study

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The University of British Columbia

- BC's largest University with over 50,000 students
- Main campus located in Vancouver (Point Grey)
- Reputation for leadership in advanced research and learning
- Commitment to reduce GHGs to 100 per cent below 2007 levels by 2050
- Use the campus as a living laboratory

Centre for Interactive Research for Sustainability (CIRS)

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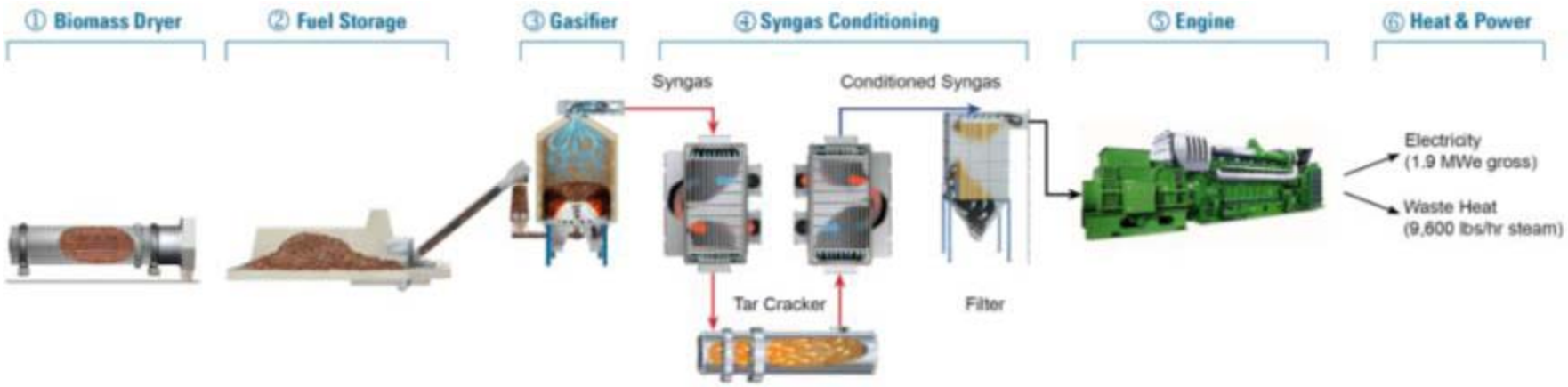
Nexterra Biomass CHP System



- Economic at small-scale 2 – 10 Mwe
- Game changing, breakthrough technology for biomass to power
- Combines Nexterra's gasification technologies with IC gas engines
- Significantly more efficient than conventional steam power generation
- Firm, base load green energy vs intermittent power such as wind or solar
- No steam engineers and natural gas comparable emissions for PM

GE Energy

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Comparison – Biomass Combustion vs. Nexterra CHP

30 MW ABB/Zurn biomass plant, CA

2 MW Nexterra biomass CHP plant

	Old Paradigm	New Paradigm
Model	Centralized	Distributed
Efficiency (power only)	Low (20 - 22%)	High (30%)
Efficiency (CHP)	System dependent	High (60%+)
Scale (economic)	Large (>30 MW)	Small (2–10 MW)
Fuel Footprint	High (30 MW = 250,000 bdtpy)	Low (2 MW = 13,000 bdtpy)
Fuel Truck Traffic	High (30 MW = 30 trucks/day)	Low (2 MW = 2 trucks/day)
Steam Plant Operators	Yes	No
PM Emissions	High volume	Ultra Low – natural gas for particulate
Permitting/Public Risk	Higher	Lower
Construction Time	Long : 24 – 36 months	Short: 12 months
Grid Connection Costs	Higher	Minimal – inside the fence
Urban Friendly	No – scale, traffic, emissions	Yes – scale, traffic, emissions

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CHP System at UBC

GE Energy

UBC – 2 MW Biomass CHP Project

- Fuel Req'd: 12,500 BDMT/year (2/3 trucks/day)
- Gross Power: 1.95 MW
- Net Thermal: 10 MMBTU/hr (80,000 MMBTU/yr)
- CO2 Red: 4,000 tpy (thermal only)
- Footprint: 180' X 90'

Impact on UBC Community

Fossil Fuel Reduction

- Eliminates of up to 9,000 tonnes of fossil-based CO_2 emissions/year – equal to taking 2,250 cars off the road
- Displaces natural gas consumption with locally produced syngas from carbon-neutral biomass

Emissions

- Minimal impact on UBC air shed (no odours or smoke), no water discharge, best-in-class emissions profile
- Full sound attenuation with noise below current neighborhood levels

Fuel Diverted From Landfills

- 25% of fuel donated from city of Vancouver diverted from landfill

Truck Traffic

- Two-three truck loads of wood fuel daily – less than 1% of current truck traffic

Aesthetics

- Architecturally-designed building using latest in wood-based sustainable construction practices

Project Partners

UBC project partners include:

- BC Bioenergy Network
- BC Ministry of Energy, Mines
- BC Ministry of Forests
- Ethanol BC
- FP Innovations
- GE Energy
- Natural Resources Canada
- Nexterra Systems Corp.
- Sustainable Development Technology Canada

Conclusions

- Fuels switching from fossil fuel to biomass is an excellent opportunity for GHG reductions for communities and institutions
- Woody biomass from landfills and tree trimmings + biosolids from wastewater treatment plants can be utilized for energy generation
- Fuel switching can significantly reduce ongoing operating costs
- All biomass conversion systems are not the same – emissions profile is particularly important in gaining public acceptance and support
- Public engagement for these types of projects is critical - must be done early in the process

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Thank-you