Small Scale CHP Technology

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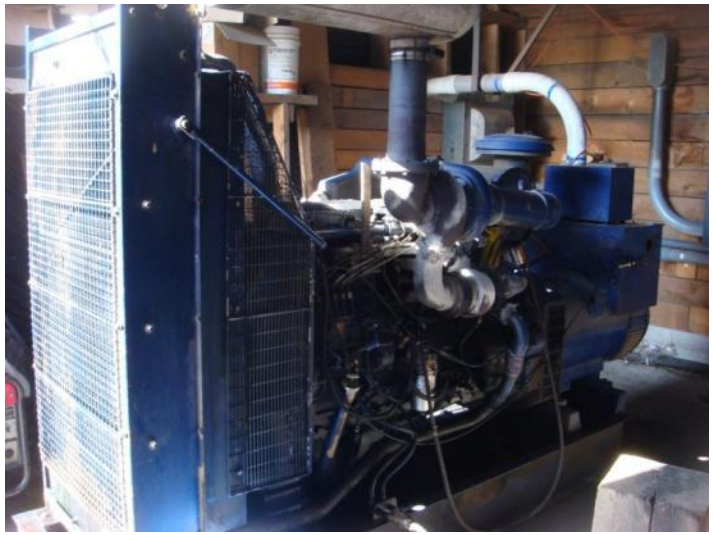
Biomass Technology Prime Movers Options and Scale

- Steam Turbines and Engines
  500 kWe-10 MWe
- Wood Gas Engine gensets
  10 kWe- 2000 kWe
- Stirling Engines
  10 kWe-140 kWe
- ORC gensets
  250 kWe - 2 MWe

Existing Gensets 75 kWe-1 MWe

- Existing population of gensets
- Operating MODE (Ownership, and operation)
  - Private
  - Native corporation
  - Utility
- Costs
- Incentive for change
  - Costs
  - Opportunities
    - Lower fuel cost
    - Reliability

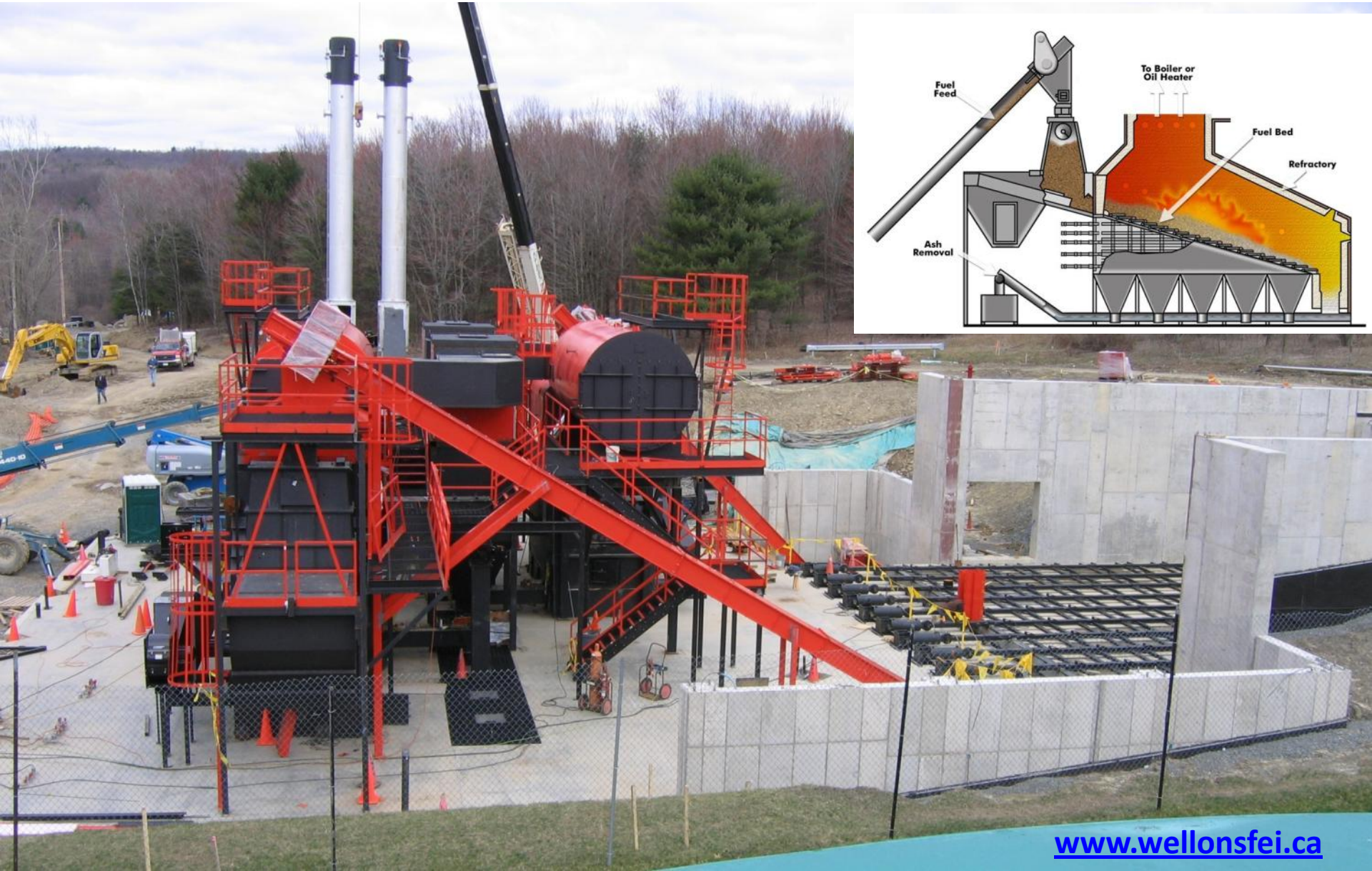


Hoonah

Constraints and Demand

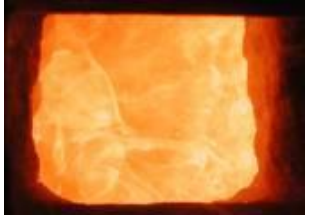
- Constraints for Small Power Generation
  - Cost
  - Opportunities for Combined Heat and Power
  - Heat and Power Contracts, PPA
  - Infrastructure/Logistics
- Demand for Small Power
  - Size and distribution of gensets
  - Annual fuel and power consumption
  - Biomass availability (SE, Interior)
  - Heat and power consumers
    - Tourism
    - Government – Military
    - Industry (Wood, Fish)
  - Existing infrastructure
    - Oil
    - Propane
    - Biomass

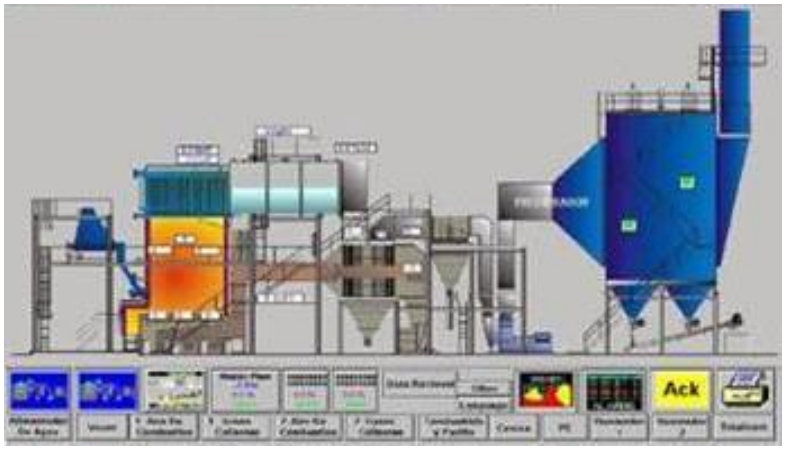
Wood Fired Boilers Are Common to Steam or Thermal Oil



www.wellonsfei.ca

Spreader Stokers 1-10 MWe





3 MWe Wood Boiler, Chile
www.mcburney.com

0.5 MWe Turbine + Dry Kilns
www.hurstboiler.com

Gasifiers Power Boilers and Engines

Nexterra Gasifiers and Boiler at Hefley Plywood, Tolko, BC (2006)

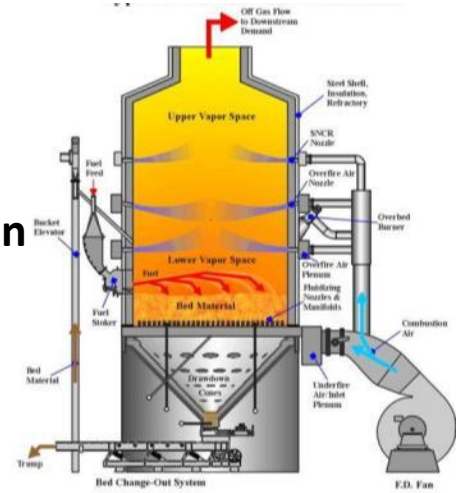
1. **Wood Fuel Bin**
2. **Gasification Hearth**
3. **Ash removal**
4. **Gas exit**

Engine applications to 2 MWe in development

www.nexterra.ca

Energy Products of Idaho Gasifier at BFC Gas & Electric, IA (1998)

- **Fluidized Bed gasification/ combustion**
- **Staged gasification**
- **Ag waste fuels**

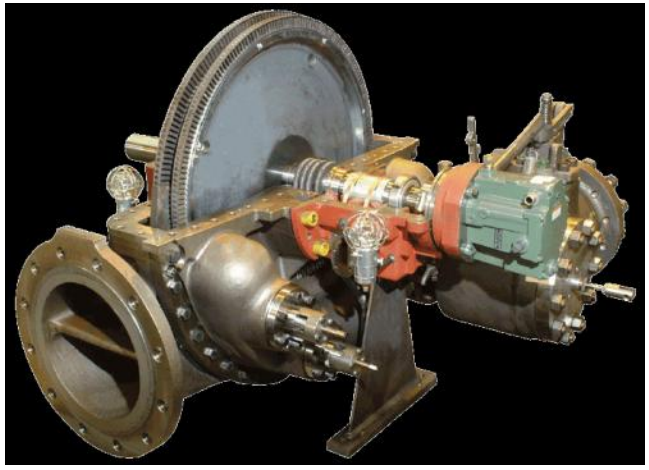


www.energyproducts.com

Steam Turbines and Engines Require Heat Loads

500 kWe Back Pressure Turbine NH

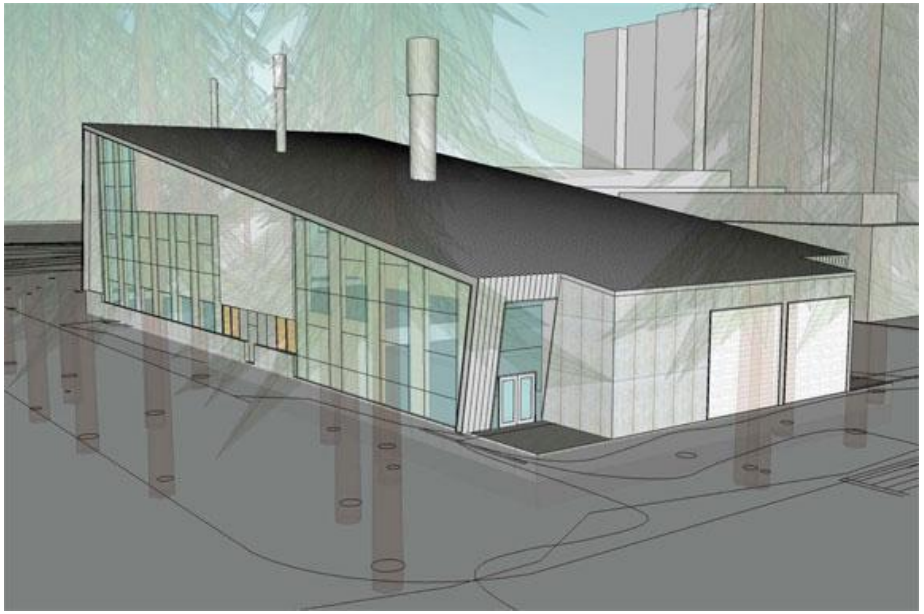
800 kWe 1930s Skinner Steam Engine, WA



AESI Turbine 500 kWe+

No recent US steam engine installations

Nexterra 2 MWe CHP Project: University of British Columbia



Capacity: 2 MW electricity and 9,600 lbs/hr steam

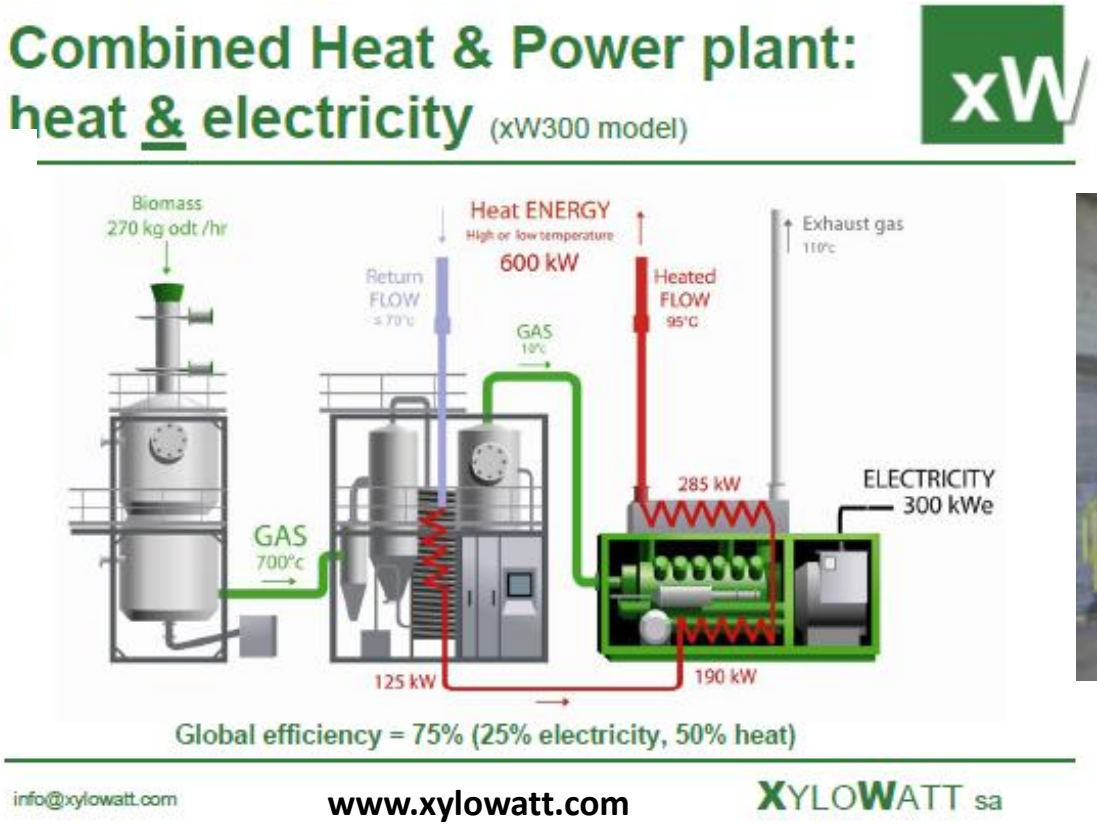
Process:

- Wood biomass is gasified to produce syngas
- Syngas goes through a conditioning system to remove impurities
- Syngas is then directly fired into a GE Jenbacher gas engine to produce heat and electricity

www.nexterra.ca

European Suppliers Expand Small CHP Capacity

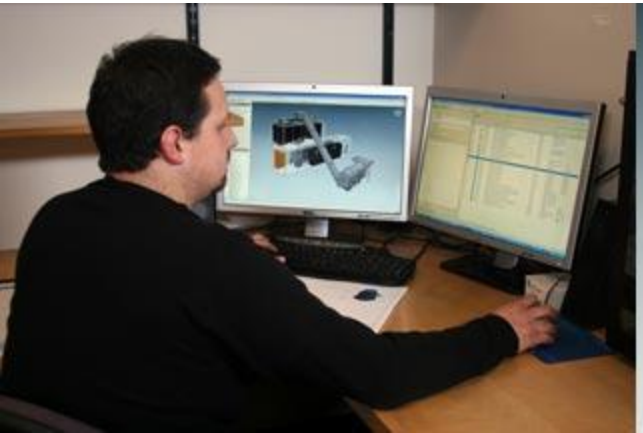
Xylowatt NOTAR Gasifier



300 kWe Module

Community Power Corporation 100 kWe Development and Demonstration Gasifier-Generator

Dixon Ridge Walnut Farm 17,000 hrs CHP
30 + Gasogens 25-100 kWe
Syngas to liquid fuel demo
www.gocpc.com



40 kWe CHP Development Gasifier Heats CA Greenhouse Biochar Used as Growing Media

Heat and Power for Icy Straits

- Power $0.65/kWh
- Heat even in summer.

10-20 kWe Development gasifier

Hoonah

1. **Developed by a Creative Community**
2. **Tested by Students at Colorado State University**
3. **Field tested in Alaska sawmill**
4. **Demonstrated to cruise customers**

USDOE/Sealaska/Merrick & Company

200 Hr Test All Power Labs 10 kWe Power Pallet Genset

Engines and Energy Conversion Laboratory, Colorado State University, April 2011

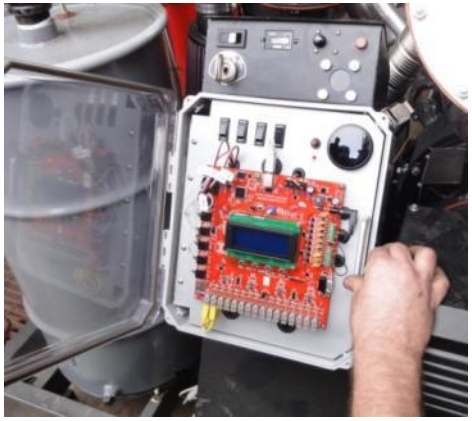
www.eecl.colostate.edu

Hopper-Dryer-Gasifier-Char

Engine Exhaust Pyrolyzes Chips

Chipped Fuel

Filter-Engine Intake

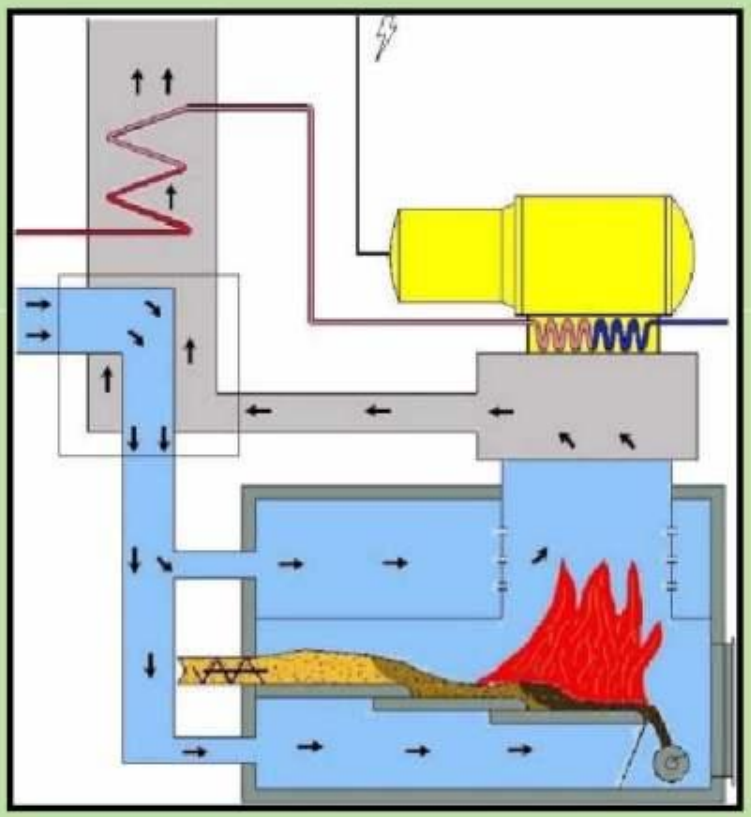


Computer Control

www.gekgasifier.com

Stirling Engine Principle

Engine Driven by External Heat Source



www.stirling.dk

All Heat and
60% of
Power and
biochar to
Danish
Organic Farm

www.blackcarbon.dk

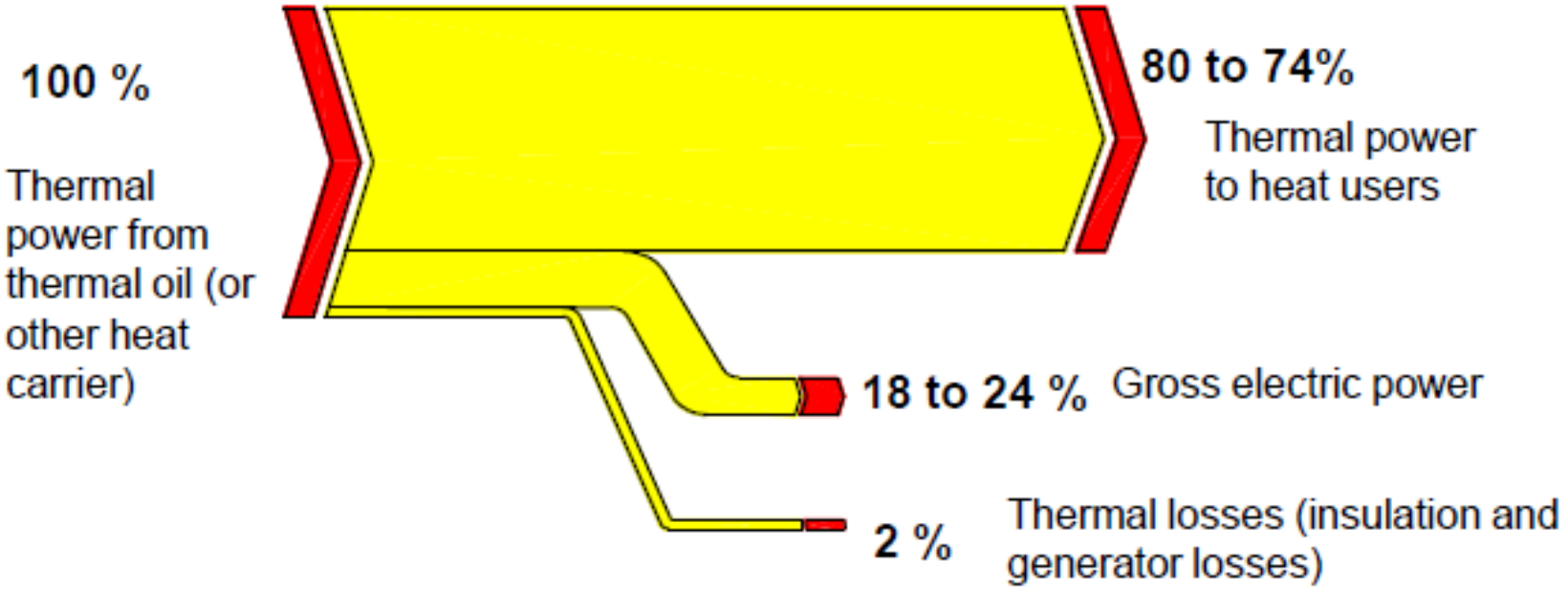
Engine and Combustion Chamber

Gasifier

Combined heat and power modules with an output of 35-140 kWe power and 140-560 kWth heat.

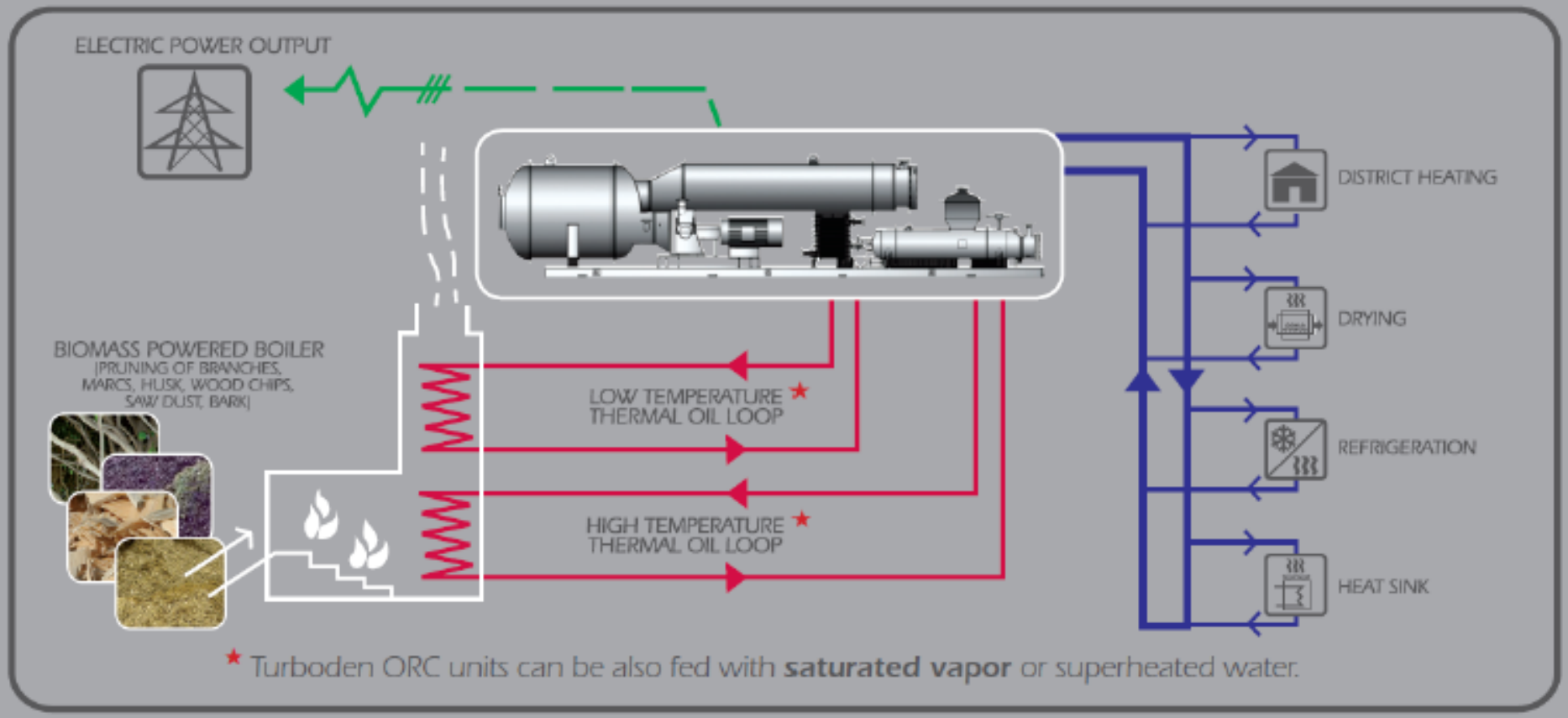
www.stirling.dk

Organic Rankin Cycle Systems Convert Low Quality Heat to Power 250 kWe-2000 kWe



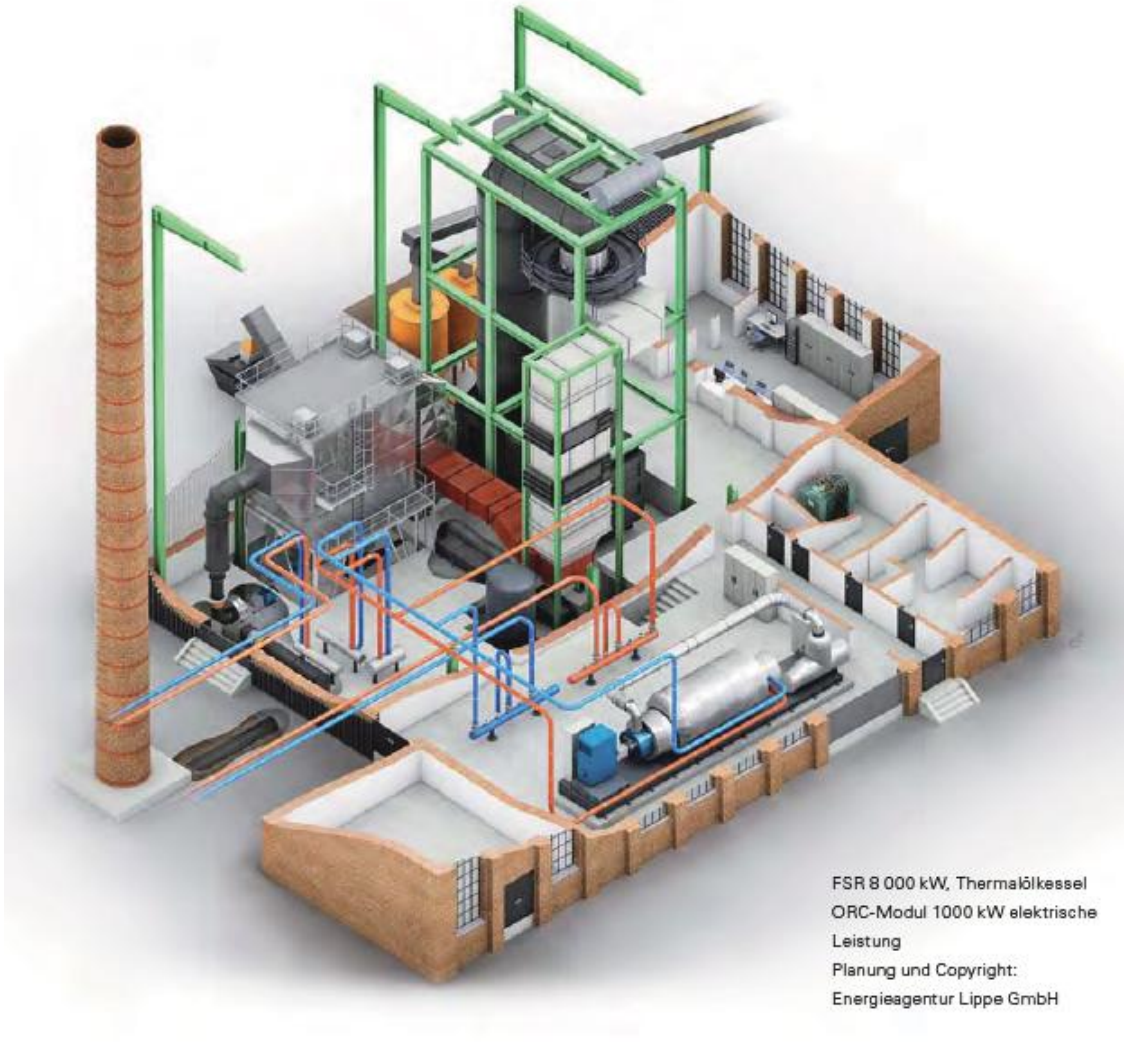
www.pratt-whitney.com

EXAMPLE OF CHP PLANT IN BIOMASS APPLICATIONS



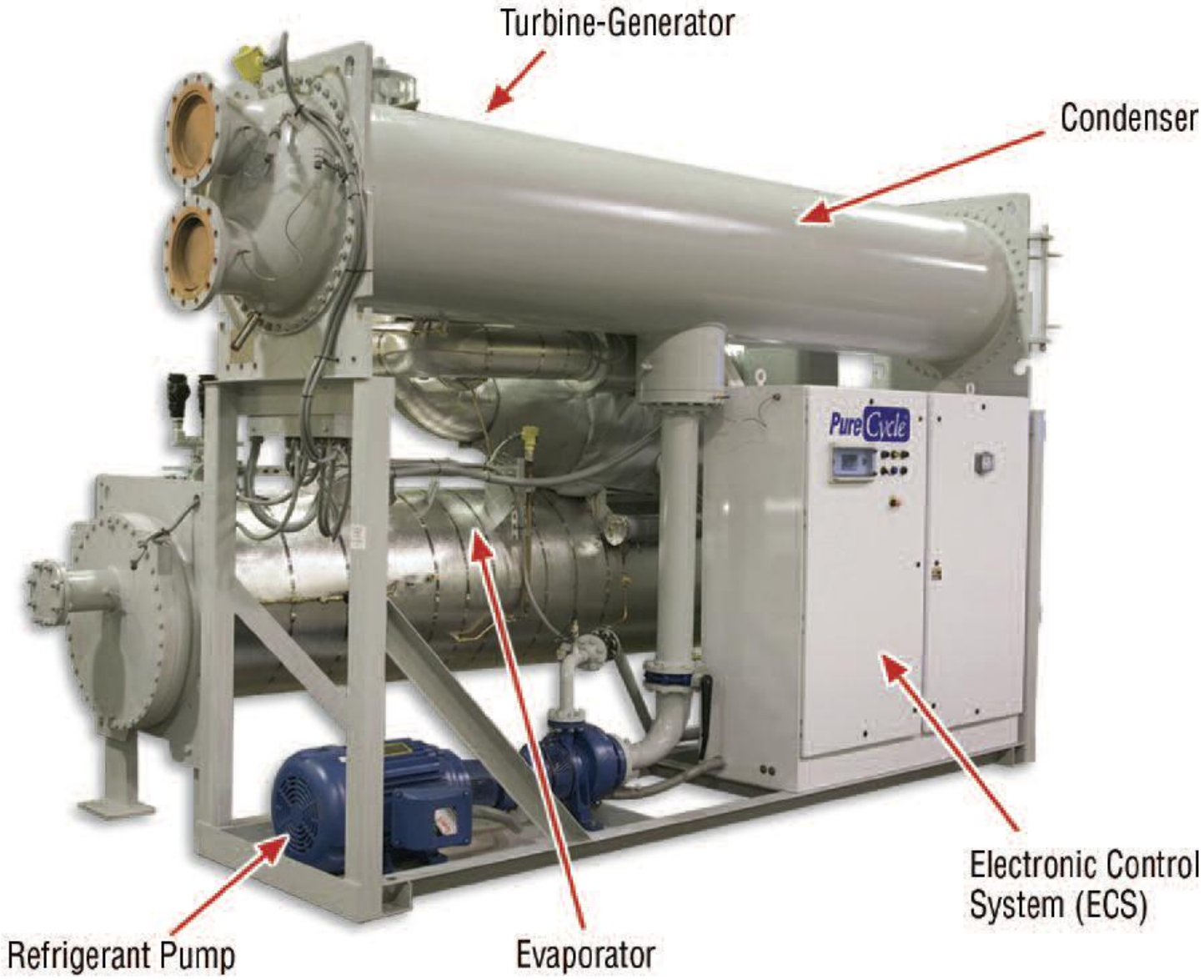
180 Turboden and Pratt & Whitney Industrial Installations

1000 kWe Turboden ORC CHP System (Viessman, GER)



www.viessmann.de/de/Industrie-Gewerbe/Produkte/Holzfeuerungsanlagen.html

250 kWe PureCycle ORS by Pratt & Whitney



K&K Recycling, AK: 600 kWe ORC

SHRED FUEL
1 tph

THERMAL OIL HEATER
10 MMBtu

50% HEAT TO 1 ACRE GREENHOUSE

5 MMBuh
1400 kWt

HEAT TO ORC

{4) 125 kWe Turbines

600 kWe

Potential For Small Scale CHP

- Need heat demand
- Gasifiers available through 2000 kWe. Reliability needs to be proven.
- Stirling applications limited to 140 KWe, high cost.
- ORC needs 250 KWe plus loads plus heat demand. Integrate with process, e.g. pellet mill.
- Steam systems suitable to large continuous heat loads.

www.info.bioenergylists.org

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Design and development of energy and environmental processes

Industries

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