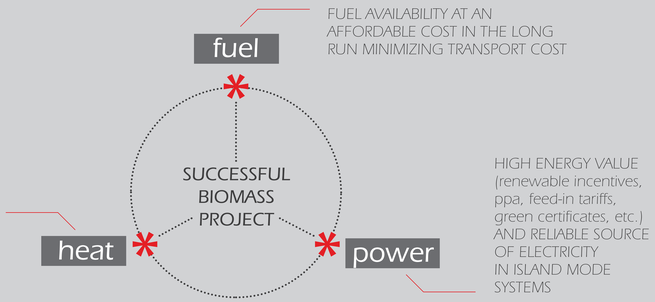
## Green fuel into useful power

Turboden **Organic Rankine Cycle** (ORC) units are employed for electric power only generation and **Combined Heat and Power** (CHP) with **high efficiencies** by exploiting any kind of biomass, from virgin wood to organic residues from various production processes. Turboden turbogenerators in this field can generate **up to 20 MW** electric per single shaft.

## The key factors for success




## Why ORC for your biomass plant

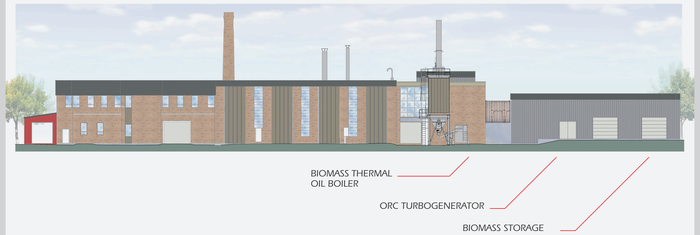
- generate profit from leveraging biomass availability, heat demand and high electricity value
- add a reliable source of power, even in remote locations with island mode operation
- improve company sustainability
- reduce $CO_2$ emissions
- automatic operation with no operator attendance required
- minimum maintenance requirements
- electrical efficiency for CHP / CCHP models up to 22%
- electrical efficiency for power only* models up to 30%
- high-efficiency and full flexibility operation from 10% to 110% of the nominal load

* Power only means the generation of electric power only with no valorization of the condensing heat

## District heating example

# Dalhousie University

DALHOUSIE UNIVERSITY 1818 2018




Bio

**SITE**: BIBLE HILL, NOVA SCOTIA, CANADA
**ORC UNIT:** TURBODEN 10 CHP
**ELECTRIC POWER:** 1 MW
**COMMISSIONING DATE:** APRIL 2018

**First ORC Combined Heat and Power application for a University Campus.** ORC recovers heat from a biomass thermal oil boiler fed by wood residuals and supplies both electricity and hot water for district heating application.

« For our biomass Combined Heat and Power plant, we partnered with Turboden due to their reputation of having unparalleled experience in biomass based Organic Rankine Cycle generators »

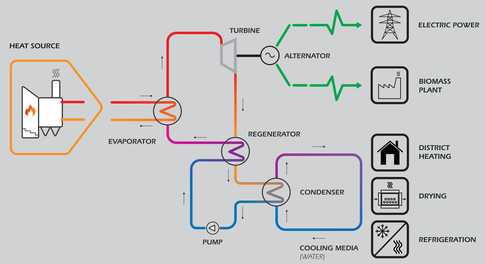
Peter Cherry, P.Eng., PMP, Senior Project Manager, Dalhousie University

clean energy ahead
TURBODEN
a group company of MITSUBISHI HEAVY INDUSTRIES

## Add power to your biomass plant


* Depending on specific fuel, CHP configuration, and boiler supplier | ** Depending on size, heat sink temperature (for CHP unit), and heat dissipation system type (for power only unit)
*** In the form of hot water @ 80°C up to saturated steam @ 12 bar

## How it works




The ORC turbogenerator makes use of a closed thermodynamic cycle to convert heat into electricity. The thermal power recovered from the biomass combustion vaporizes a suitable organic working fluid, which then expands through the turbine and produces clean and reliable electric power through the alternator. After passing through the regenerator for internal heat recovery, the vapor is cooled down, condensed and finally pumped back to start the cycle again. The heat from the hot source is transferred to the ORC working fluid by means of an intermediate circuit or directly via the combustion gases in direct exchange systems. The media used in the intermediate circuits are thermal oil, saturated steam or pressurized water.

## Turboden global & proven experience

**357** Total Turboden plants

**38** Countries

**558 MWe** Total capacity

**13 million hours** Cumulative operation time

**98+%** Average availability