

**TURBODEN**

**BIOMASS**

Cod. 11-COM.P-1-rev.79

ORC COGENERATION SYSTEM FROM YOUR GREEN FUEL.



## LEADER IN BIOMASS SINCE 1980

Since its foundation Turboden has been committed to delivering efficient and reliable cogeneration solutions from renewable sources.



# ORC SYSTEM



Turboden Organic Rankine Cycle (ORC) plants produce electric power and heat with high efficiency and automatic operation by using any kind of biomass, from virgin wood to organic residues from various production processes.

## KEY POINTS

- Large range size up to 20 MWe per single shaft
- Generate profit by valorizing a renewable source
- Provide a reliable source of power also for island mode operation
- Reduce specific production cost by decreasing energy demand
- Improve company sustainability
- Reduce CO<sub>2</sub> emissions

# TURBODEN BIOMASS UNIT DESIGN

## CHP SOLUTIONS (low and high temperature cogeneration)

Turboden units generate Combined Heat and Power (CHP) solution - providing either hot water or higher temperature heat medium (e.g. saturated steam or thermal oil).  
Alternatively Turboden can provide also electric power only solutions.

### POWER-ONLY

Electrical efficiency  
up to  
**30%**

### CHP

Electrical efficiency  
up to  
**22%**



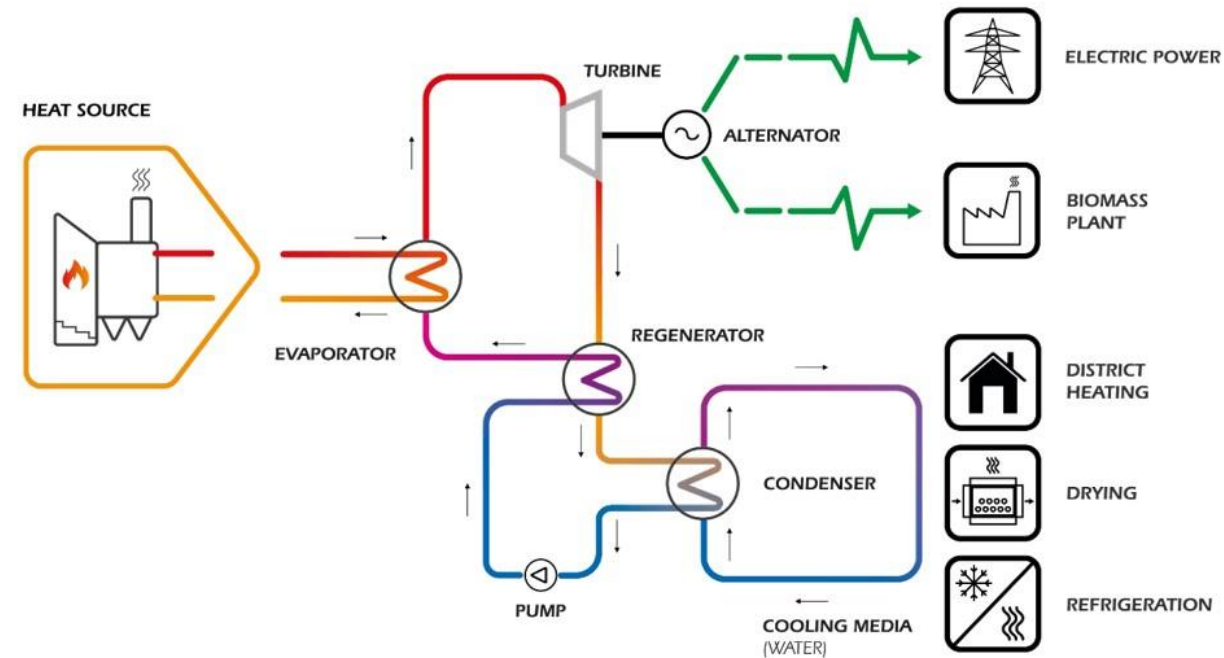
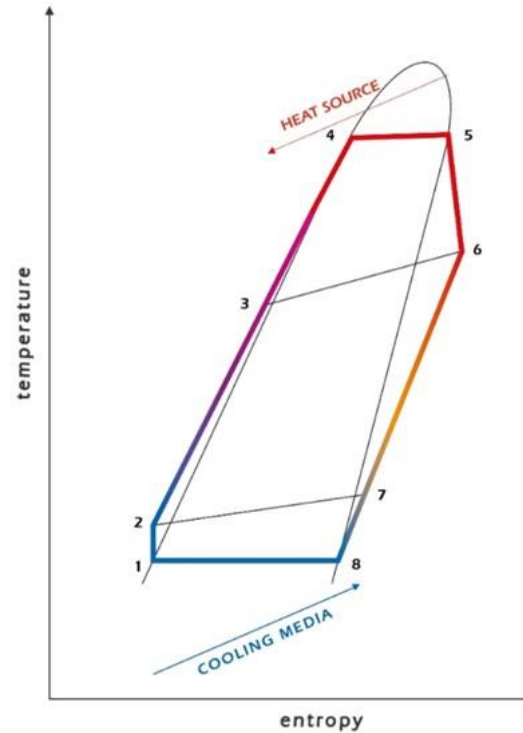
# THE ORC CYCLE – HOW IT WORKS

The ORC turbogenerator uses medium-to-high temperature thermal oil to preheat and vaporize a suitable organic working fluid in the evaporator (4>5).

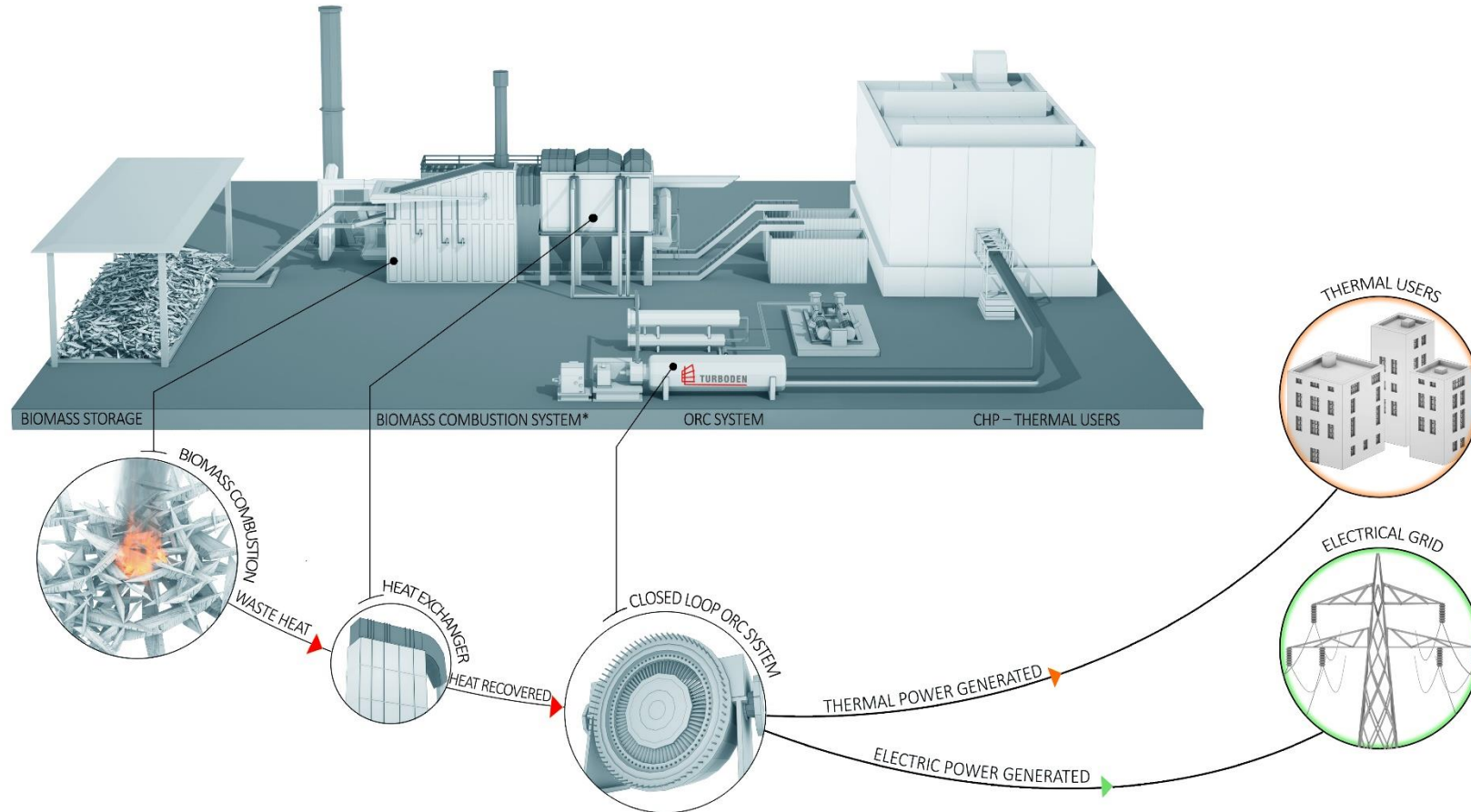
The organic fluid vapor rotates the turbine (5>6), which is directly coupled to the electric generator, resulting in clean, reliable electric power.

The exhaust vapor flows through the regenerator (6>7), where it heats the organic liquid (2>3) and is then condensed in the condenser and cooled by the cooling circuit (7>8>1).

The organic working fluid is then pumped (1>2) into the regenerator and evaporator, thus completing the closed-cycle operation.



# EXAMPLE OF A BIOMASS PLANT WITH ORC SYSTEM

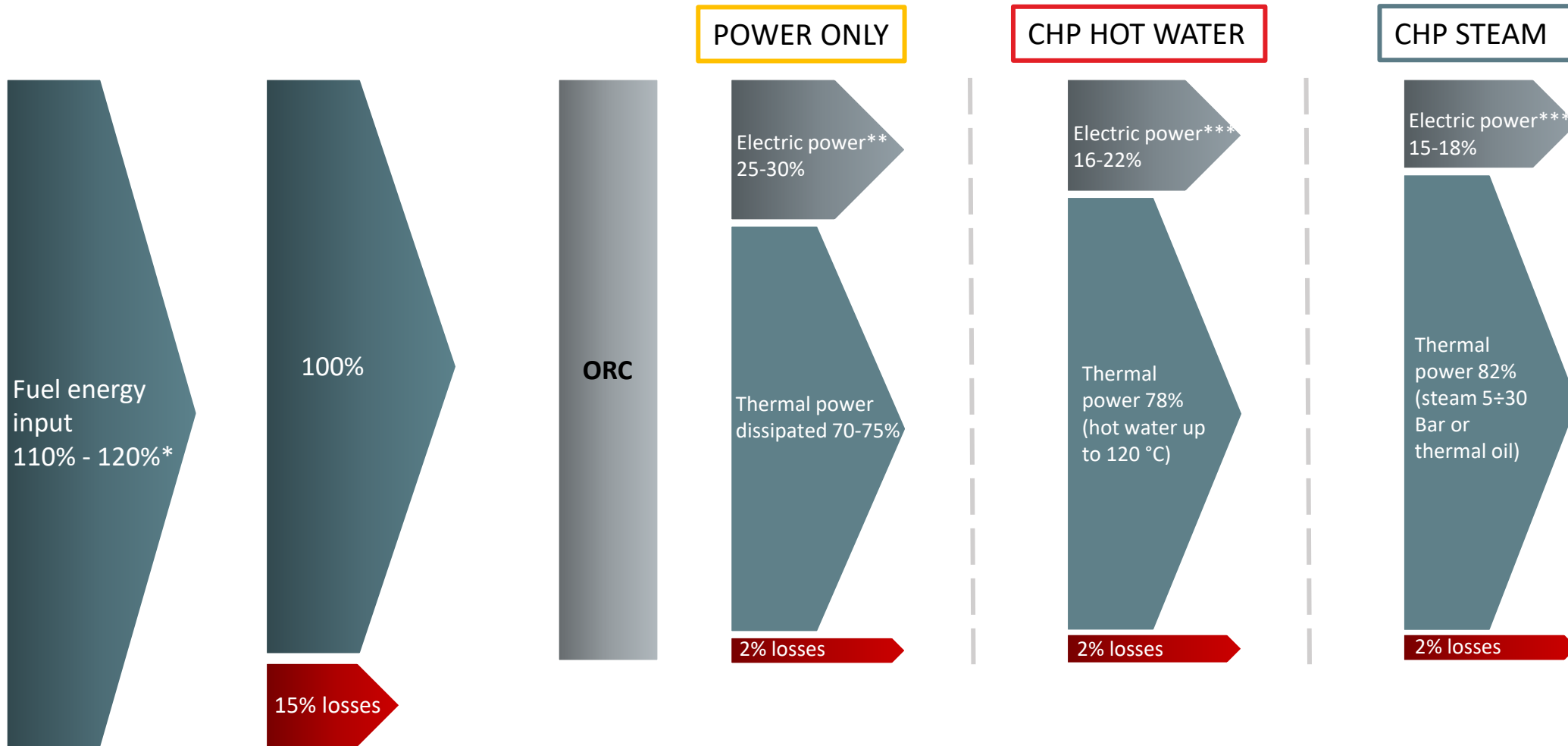


## HEAT TRANSFER FLUID

The heat from biomass combustion 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 superheated water.

\*In alternative to more traditional combustion systems, gasification and pyrolysis solutions may be applied.

# THREE MAIN POSSIBLE SCHEMES

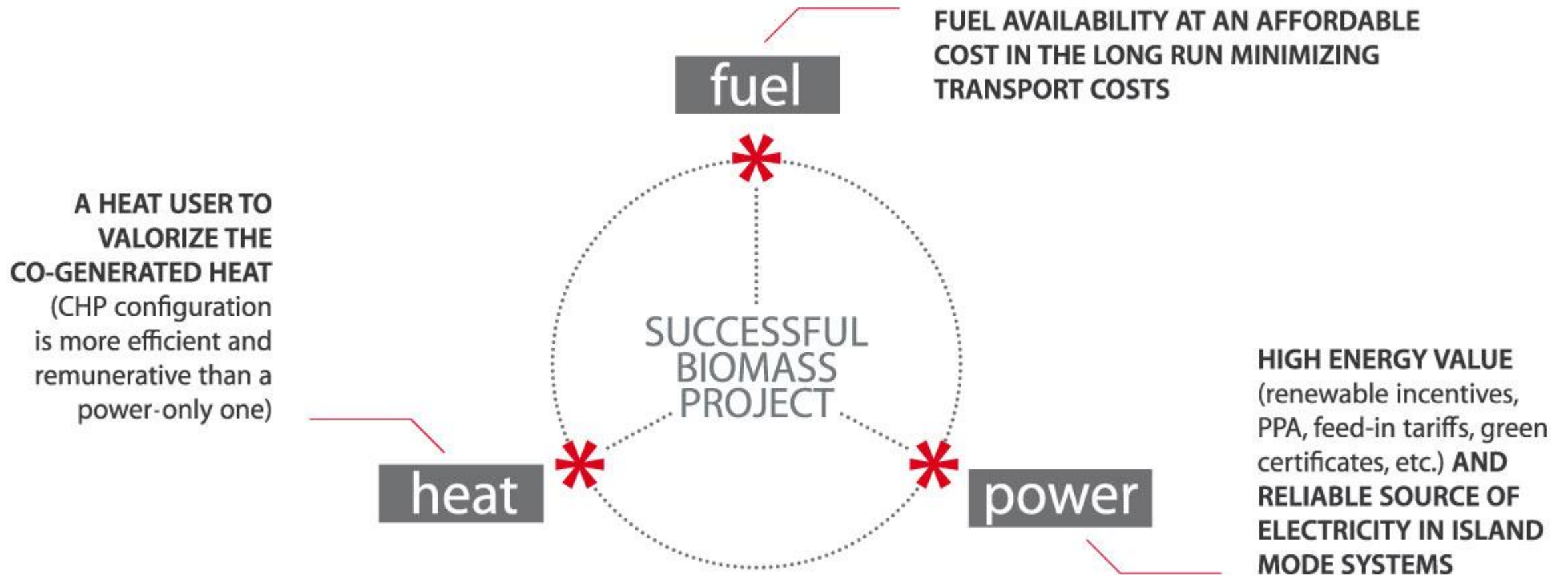


\* Depending on fuel and boiler features

\*\* Depending on size and environmental temperature

\*\*\* Depending on heat output temperature

# KEY FACTORS FOR SUCCESS

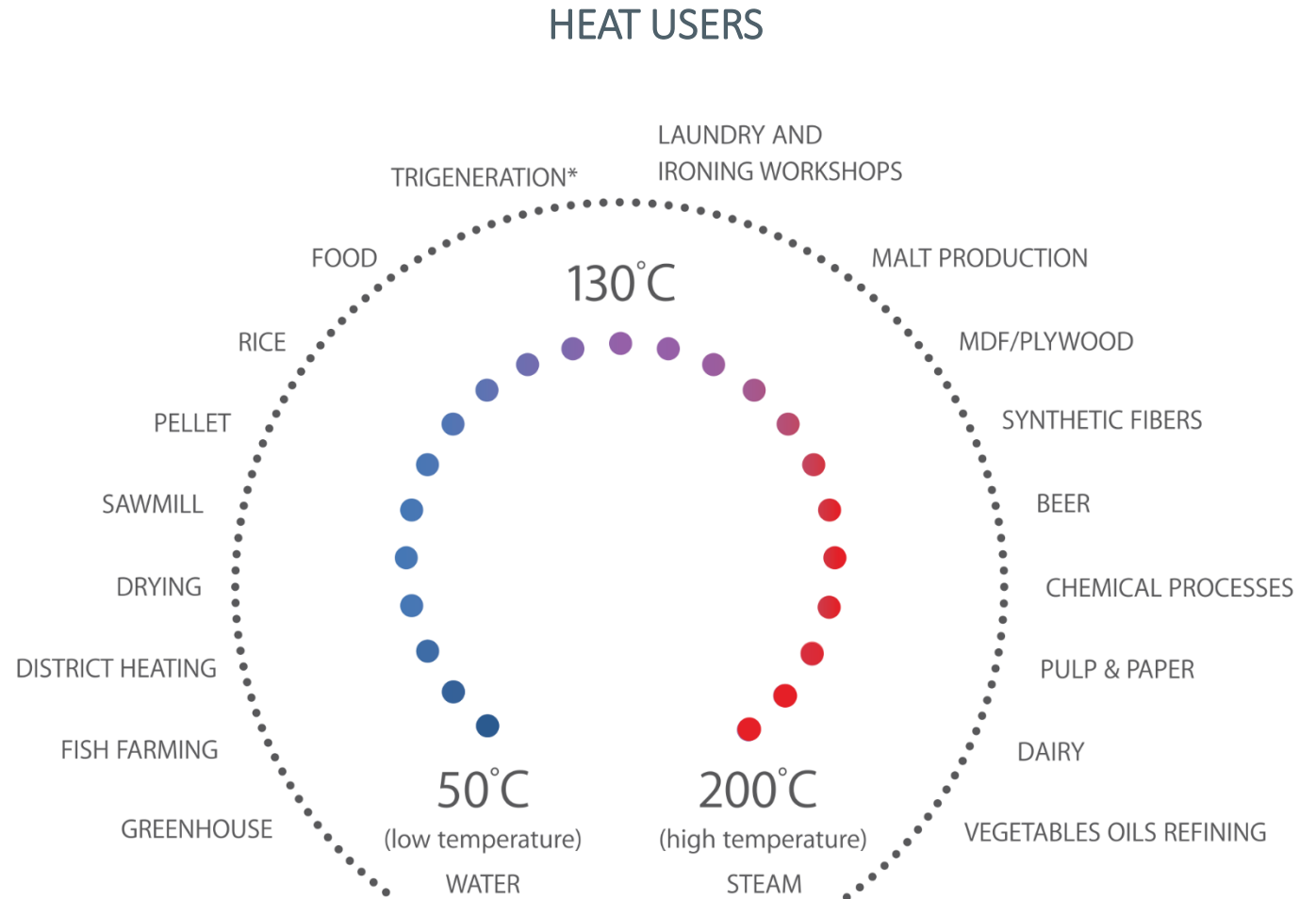




# APPLICATIONS

## TYPICAL FUELS

- sawmill residues or by-products
- bark
- wood dust and chips
- pellet
- furniture waste
- particle board screen dust
- recycled wood waste
- olive pomace and pits
- bruning & trimmings
- barley dust
- malt dust
- rice husks
- almond shells
- sunflower husks
- coffee husks and spent ground
- corn cobs
- coconut shells and husks
- empty fruit bunches
- palm kernel shells
- cotton gin waste, stalks
- paper



\* with absorption chiller.

# EXAMPLES OF SUCCESSFUL PROJECTS



	SAWMILL, WOOD-BASED PANEL	RICE, CEREALS, FOOD PROCESSING	DISTRICT HEATING	PELLET AND CHARCOAL PROD.	POWER ONLY
	87 plants	8 plants	166 plants	41 plants	20 plants
Fuel	Wood residues (e.g. bark, sawdust, etc.) from sawmill production process.	Rice husks, corn cobs, recovered locally from the rice/cereals processing industry.	Various depending on geographical area (typically wood chips).	Wood residues (e.g. bark, sawdust, etc.) from pellet and charcoal production process.	Various depending on geographical area.
Power	Used to feed internal auxiliaries; it can also be used to sustain island operation.	Used to feed internal auxiliaries; it can also be used to sustain island operation.	Incentives as a renewable source. Also used partly to power internal users.	Used to feed internal auxiliaries.	Incentives as a renewable source.
Heat	Fully used in drying chambers as hot water or low-pressure steam.	Used for rice processing as hot water or steam, cereal drying.	Used to feed the heating network.	Used as hot water for wood drying in the process.	No use.
Note	Fuel generated as by-product by the industry, heat and electricity valorized internally by the same industry.	Fuel produced as by-product by the facility, heat and electricity valorized internally by the same industry.	Fuel collected from various sources, heat sold to the local district heating network, electricity partly used internally, and the rest sold to the grid.	Fuel generated as by-product by the facility, heat and electricity valorized internally by the same industry.	Fuel collected from various sources, electricity sold to the grid. Business model viability subject to biomass price fluctuation.

# CHP IN WOOD INDUSTRY

**CUSTOMER:**

Stia Holzindustrie

**COUNTRY:**

Austria

**STATUS:**

in operation since 1999

**ORC SIZE:**

0.5 MWe

**DESCRIPTION:**

CHP in a wood factory (wooden flooring and panels)

**FUEL:**

wood residues

**HEAT CARRIER:**

thermal oil

**WATER TEMPERATURE (IN/OUT):**

60 - 90 °C

Longest Turboden  
ORC in operation

More than 80 plants  
integrated with  
wood industries



# POWER GENERATION IN SAWMILL

**CUSTOMER:**

West Fraser Mills

**COUNTRY:**

Canada

**STATUS:**

in operation since 2014 – 2015

**ORC SIZE:**

26 MWe (4 x 6.5 MWe)

**DESCRIPTION:**

power only in two large sawmills

**FUEL:**

residues from sawmill process (mainly bark)

**HEAT CARRIER:**

thermal oil

**WATER TEMPERATURE (IN/OUT):**

24 - 34°C

The largest lumber  
producer in North  
America

More than 80 plants  
for sawmills  
worldwide



# CHP IN PELLET FACTORY

**CUSTOMER:**

Athens Energy

**COUNTRY:**

United States of America

**STATUS:**

in operation since October 2016

**ORC SIZE:**

8 MWe

**DESCRIPTION:**

power only in a wood pellet factory

**FUEL:**

virgin wood

**HEAT CARRIER:**

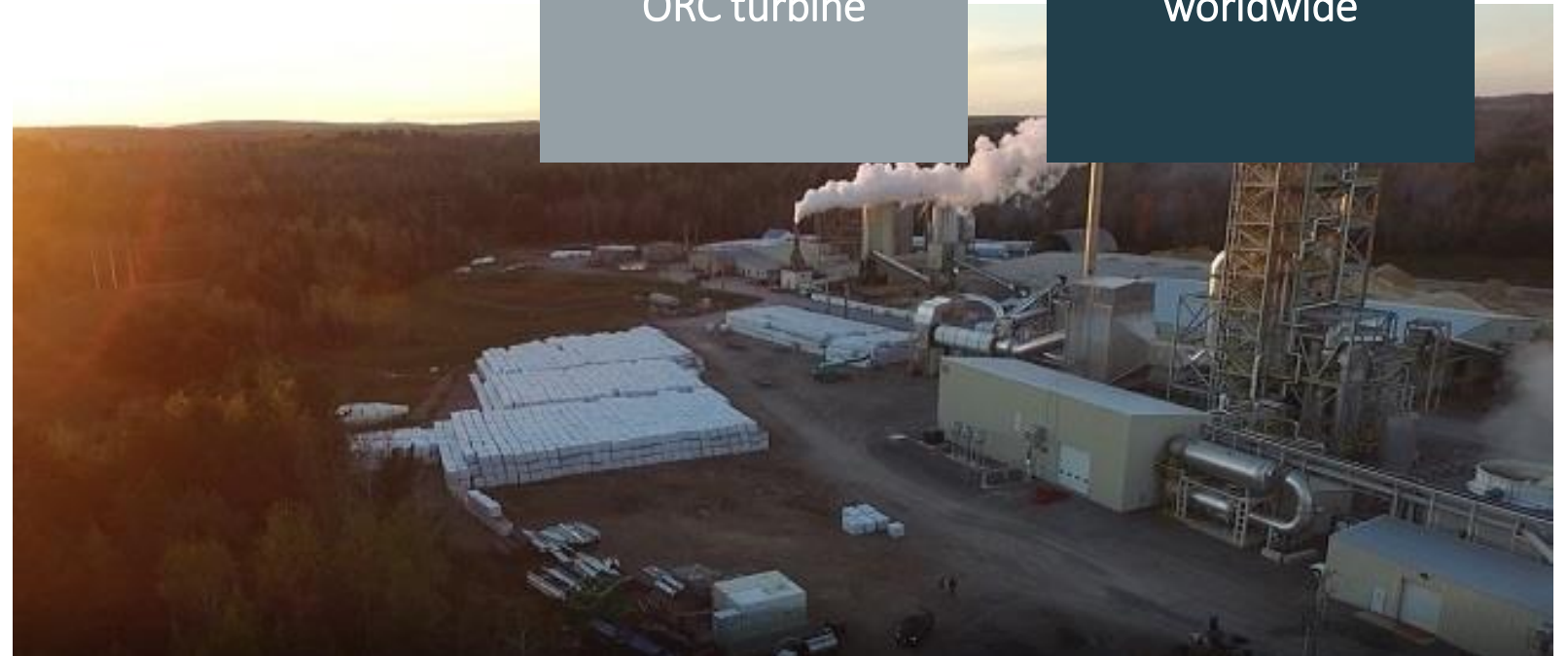
thermal oil

**WATER TEMPERATURE (IN/OUT):**

25 - 33 °C

The largest  
Turboden biomass  
ORC turbine

More than 40 plants  
for pellet industry  
worldwide



# CHP IN WOOD-BASED PANEL INDUSTRY

**CUSTOMER:**

Starwood

**COUNTRY:**

Turkey

**STATUS:**

in operation since October 2016

**ORC SIZE:**

5.5 MWe

**DESCRIPTION:**

CHP in an MDF panels factory

**FUEL:**

panels residues and wood waste

**HEAT CARRIER:**


thermal oil

**WATER TEMPERATURE (IN/OUT):**

90 - 110 °C

**ADDITIONAL FEATURES:**

ORC turbine locally produced by  
Turboden Turkey



About 10 plants  
(CHP and power only  
solutions) in Turkey

Tailored solutions  
for MDF, particle  
board, plywood  
factories, etc.

# CHP FOR DISTRICT HEATING NETWORK

**CUSTOMER:**

Fernheizwerk Toblach-Innichen

**COUNTRY:**

Italy

**STATUS:**

in operation since December 2003

**ORC SIZE:**

1.5 MWe

**DESCRIPTION:**

CHP for the district heating network

**FUEL:**

wood chips

**HEAT CARRIER:**

thermal oil

**WATER TEMPERATURE (IN/OUT):**

60 - 80 °C



Renewable energy  
for houses heating

166 total plants  
for district heating



# POWER GENERATION IN AGRO FOOD INDUSTRY

**CUSTOMER:**

Rice Hull

**COUNTRY:**

California, USA

**STATUS:**

Under construction, expected start-up 2021

**ORC SIZE:**

3.6 MWe

**DESCRIPTION:**


Electric power only with air cooled condenser (no water consumption)

**FUEL:**

rice husk

**HEAT CARRIER:**

thermal oil



Different kind of fuels: rice, cereal, production waste, etc.

Profitable management of agro residues



# POWER GENERATION IN AGRO FOOD INDUSTRY

**CUSTOMER:**

Sobono

**COUNTRY:**

The Philippines

**STATUS:**

in operation since December 2017

**ORC SIZE:**

5.5 MWe

**DESCRIPTION:**

CHP in a farm for cereals dryers

**FUEL:**

rice husk

**HEAT CARRIER:**

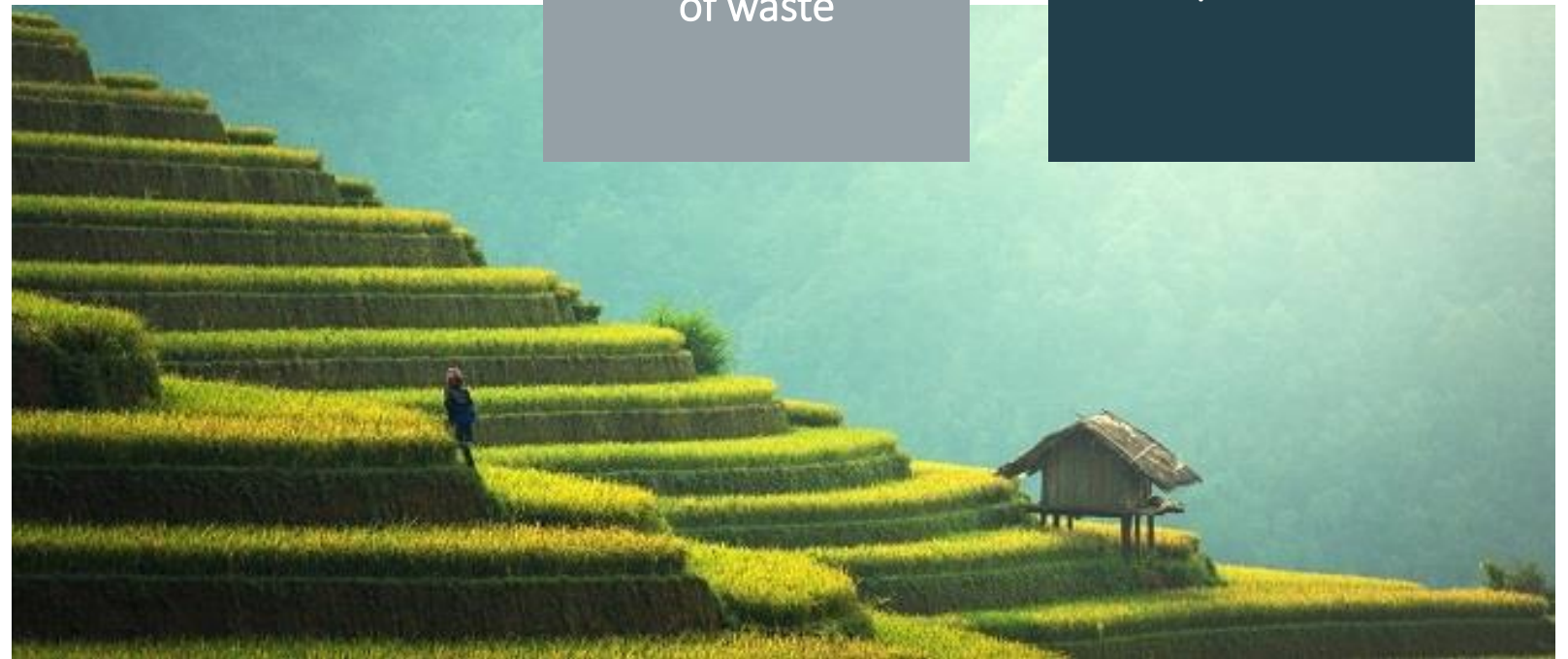
thermal oil

**WATER TEMPERATURE (IN/OUT):**

40 - 80 °C

Efficient exploiting  
of different kind  
of waste

Island mode  
operation



# SELECTED CUSTOMERS





FIND OUT MORE



OUR EXPERIENCE. YOUR POWER.