Maximizing energy utilization from biomass residues with ORC Technology

clean energy ahead
TURBODEN
a group company of MITSUBISHI HEAVY INDUSTRIES, LTD.

Turboden is a leading company in the development and production of ORC (Organic Rankine Cycle) turbogenerators.

This state-of-the-art equipment, particularly suitable for distributed generation, allows the production of heat and power from renewable sources (biomass, geothermal, CSP) and heat recovery in industrial processes.

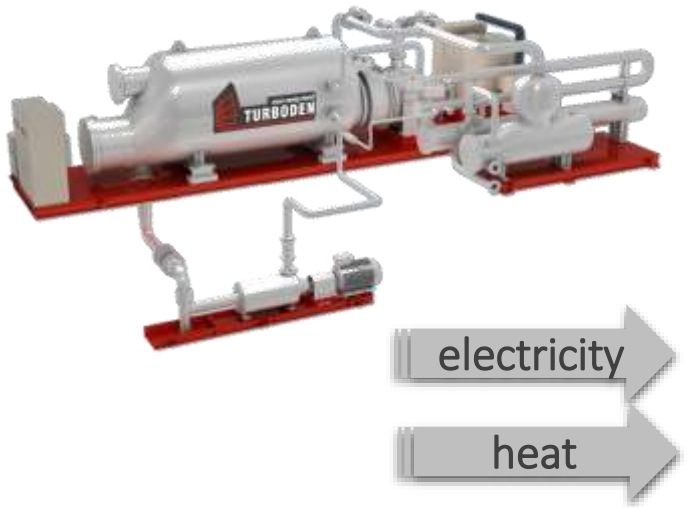
The company which was **founded in 1980** in Milan by Mario Gaia, Associate Professor at *Politecnico di Milano,* has now **more than 35 years of experience**.

In 2013 Turboden became **part of Mitsubishi Heavy Industries group (MHI),** one of the worlds' leading heavy machinery manufacturers with consolidated sales of over $ 33 billion (in fiscal 2014.

Today Turboden has more than **320 plants** in **34 countries** accounting for more than **400 MW** installed.

ISO 9001

MITSUBISHI
HEAVY INDUSTRIES, LTD.



More than 300 plants worldwide

The majority fed by solid biomass

Size	Plant in Operation		Under Construction		Total	
MW	no.	MW	no.	MW	**no.**	**MW**
0.2 - 6.5	234	274.1	45	86.6	**279**	**360.7**

Turboden experience from Central to Eastern Europe

Austrian business model

- Small villages (mountain area) → distributed generation
- Thermal energy needed (district heating)
- Biomass of good quality available on site (sawmill waste wood, forest thinning, etc.)
- No needs of certified steam engineer
- Emphasis on renewables

Ideal conditions for small/middle size (200 kW÷1 MW) ORC CHP biomass power plants

Austria is the best European example of biomass utilization, with 13% of the energy needs covered by this source. Around 20% of households have heat and sanitary water from biomass.

Biomass ORC units in Europe

Germany	*74*
Italy	*75*
Austria	*30*
Latvia	*15*
Poland	*11*
etc..	

First **Germany** and later **Italy** and other EU countries followed the successful Austrian model, thanks also to:

- High price of electricity

- Incentive for renewable energy (feed-in tariffs)

Strong growth of this market between 2005 and 2010

Turboden Biomass Plants in Eastern Europe and CSI

POLAND	
N° plants	11
MW installed	8.6
Description	CCHP –luxury hotel District heating Pellet industry sawmill

ESTONIA	
N° plants	2
MW installed	3.2
Description	District Heating

CZECH REPUBLIC	
N° plants	2
MW installed	3.1
Description	District heating

RUSSIA	
N° plants	4 under construction
MW installed	16.7
Description	District Heating Wood industry

Krnca (SLOVAKIA)	
Startup	2013
ORC	10 CHP Split
Power	1 MWe
Water temp.	60 – 80 °C
Description	Pellet Industry

LATVIA	
N° plants	15
MW installed	16.9
Description	District Heating Sawmill

Esol d.o.o. – Crnomalj (SLO)	
Startup	2012
ORC	10 CHP Split
Power	999 kWe
Water temp.	60 – 80 °C
Description	Wood Drying

BELARUS	
N° plants	4
MW installed	8.9
Description	District Heating

CROATIA	
N° plants	8
MW installed	8.8
Description	District heating Wood drying Sawmill Pellet plants

Building Energy – Krusevac (SRB)	
Startup	2017
ORC	50 CHP
Power	4500 kWe
Water temp.	60 – 80 °C
Description	District heating

Eco Energy – Sarnitsa (BG)	
Startup	2013
ORC	12 HRS split
Power	1200 kWe
Water temp.	25 – 35 °C
Description	Power only

ROMANIA	
N° plants	2
MW installed	2.7
Description	District heating Sawmill

Roundtable discussion

Opportunities and challenges

Best conditions

- Huge biomass potential
- Low biomass cost
- Food and forest industry
- Thermal energy needed (district heating)
- Strong government commitment in renewables

Barriers

- Lack of policy framework
- Lack of finance
- Lack of knowledge

ORC Key driver

All power plants remotely controlled

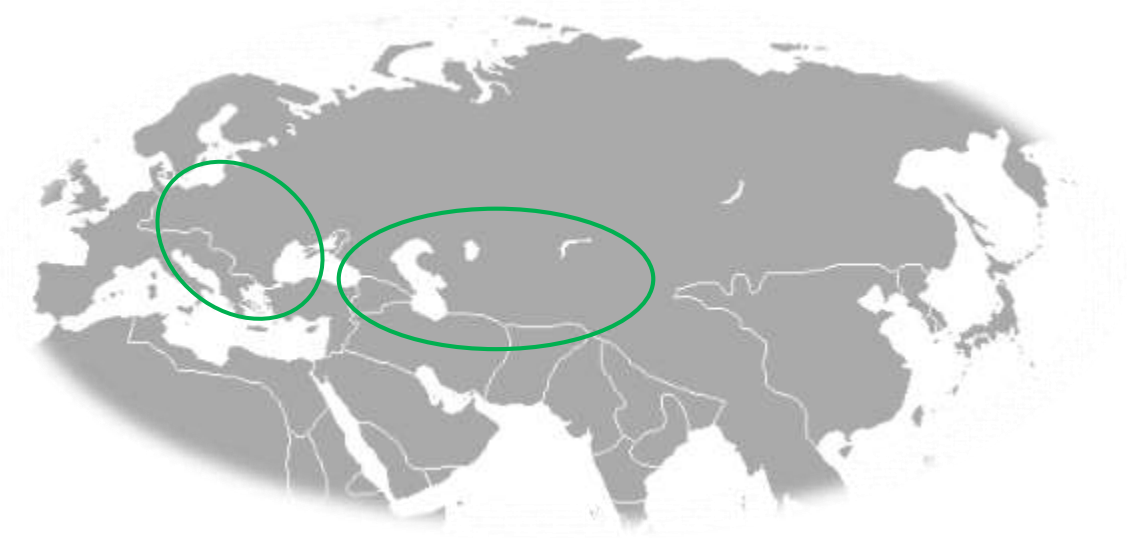
High availability (>98%)

Low O&M required

Proposals

Turboden ORC technology proved its suitability for distributed energy production power plants

Given the high availability of biomass in Eastern Europe and Central Asia ORC-biomass power plants represent concrete solutions to produce green electricity with a reliable alternative and renewable source



The European experience shows that targeted national policies can entail a huge development of distributed ORC power plants

HOW?

1. Definition of national targets for solid biomass in the energy mix
2. Steady regulatory framework with Feed in Tariff (FiT) for power and heat production
3. Dissemination of best practices

The European experience can be replicated in other countries of Eastern Europe and Central Asia, for a greater and greener sustainability of these regions

Back up slides

European current legislation

European directive 651/2014 valid from 1/07/2014 to 31/12/2020.

- Art.42:

Power > 1000 kW → FEED IN PREMIUM established with auction.

Power < 1000kW → FEED IN PREMIUM without auction

The premium must be added to the price of the electricity sold by the producer.

- Art.43:

Power < 500kW → FEED IN TARIFF

Considering the price of biomass (> 50÷60,- €/ton in Europe) each country defined its incentive

ITALY

Decreto incentivi – premium:

300<Pel<1000 kWe →185 €/MWh

1000<Pel<5000 kWe →115 €/MWh

75 ORC biomass power plants realized by Turboden

GERMANY

Decreasing incentive – feed in tariff (comprehensive of electricity price) from 230 €/MWh (in 2009) to the current level of ~ 100 €/MWh

74 ORC biomass power plants realized by Turboden

UK

Renewables Obligation Certificates – premium:

96 €/MWh for power only

128 €/MWh for cogeneration (heat and electricity)

8 ORC biomass power plants realized by Turboden

Other worldwide experiences:

In **Turkey**, since 2012, an incentive for biomass power plants is in place: 130 $/MWh of feed in tariff for renewables + 20 $/MWh for local content greater than 50%. Turboden installed **five ORC biomass plants for a total power of 17,5 MWe**

Turboden Biomass Plants in the Balkans

Esol d.o.o. – Crnomalj (SLO)	
Startup	2012
ORC	10 CHP Split
Power	999 kWe
Water temp.	60 – 80 °C
Description	Wood Drying

PANA – Turopolje (HR)	
Startup	2015
ORC	10 CHP Split
Power	1045 kWe
Water temp.	60 – 80 °C
Description	Sawmill

Vrbosko Eko Energija – Vrbovsko (HR)	
Startup	2016
ORC	18 CHP Split
Power	1862 kWe
Water temp.	60 – 90 °C
Description	Drying kilns

Lika Energo Eko – Ubdina (HR)	
Startup	2012
ORC	10 CHP Split
Power	999 kWe
Water temp.	60 – 80 °C
Description	Pellet plant

AAT Geotermae– Prelog (HR)	
Startup	2017
ORC	4 MW Geothermal
Power	4200kWe
Water temp.	110–70 °C (in/out ORC)
Description	Geothermal

Bioenergana Bjelovar – Bjelovar (HR)	
Startup	2017
ORC	10 CHP Split
Power	1045 kWe
Water temp.	60 – 80 °C
Description	District Heating

MB Holding – Velika Ciglena (HR)	
Startup	2017
ORC	16 MW geotermal
Power	16000 kWe
Water temp.	170–70 °C (in/out ORC)
Description	Geothermal

Spin Valis – Pozega (HR)	
Startup	2015
ORC	14 CHP Split
Power	1450 kWe
Water temp.	60 – 80 °C
Description	Sawmill

Building Energy – Krusevac (SRB)	
Startup	2017
ORC	50 CHP
Power	4500 kWe
Water temp.	60 – 80 °C
Description	District heating

Moderator – Ubdina (HR)	
Startup	2017
ORC	3CHP
Power	340 kWe
Water temp.	60 – 80 °C
Description	Pellet plant

Pelet Groupa – Novska (HR)	
Startup	2014
ORC	10 CHP Split
Power	999 kWe
Water temp.	60 – 80 °C
Description	Pellet plant

Quercus – Novska (HR)	
Startup	2017
ORC	10 CHP Split
Power	1045 kWe
Water temp.	60 – 80 °C
Description	Wood Drying

Eco Energy – Sarnitsa (BG)	
Startup	2013
ORC	12 HRS split
Power	1200 kWe
Water temp.	25 – 35 °C
Description	Power only

Turboden presence in the Eurasian Custom Union

#	Location	ORC Module (size)	Client	Heat Source	Status
1	Russia - Toržok, Tverskaya oblast	2x TURBODEN 28 CHP (5.7 MWe)	Modern Lumber Technology	Wood biomass	Under construction
2	Russia- Arkhangelsk Region	2x TURBODEN 22 CHP (4.6 MWe)	Ustyanskiy Timber Industry Complex	Wood biomass	Under construction
3	Russia - Khabarovsk Region	TURBODEN 50 CHP (5 MWe)	Prodesa Medioambiente	Wood biomass	Under construction
4	Russia - Yamal Nenets Region	2x TURBODEN 10 CHP (2 MWe)	Zvezda-Energetika	Wood biomass	Under construction
5	Belarus, Rechitsa, Речица	TURBODEN 22 CHP Split (2.2 MWe)	Polytechnik Luft- und Feuerungstechnik GmbH	Wood biomass	In operation since June 2011
6	Belarus, Rechitsa, Речица	TURBODEN 22 CHP Split (2.2 MWe)	Polytechnik Luft- und Feuerungstechnik GmbH	Wood biomass	In operation since June 2011
7	Belarus, Baran	TURBODEN 30 CHPRS (3.2 MWe)	Polytechnik Luft- und Feuerungstechnik GmbH	Wood biomass	In operation since December 2013
8	Belarus, Minsk	TURBODEN 14 CHP (1.3 MWe)	Altenergy SIA	Wood biomass	In operation since March 2015