

The LandEnergy logo consists of the word "LandEnergy" in a white, sans-serif font, set against a solid green rectangular background.

LandEnergy



clean energy ahead
TURBODEN

A PRATT & WHITNEY POWER SYSTEMS COMPANY

The All-Energy 2010 logo features the text "ALL-ENERGY2010" in a white, bold, sans-serif font, with "EXHIBITION & CONFERENCE" in a smaller font below it. The text is set against a black background with a glowing orange and red circular graphic element.

ALL-ENERGY2010
EXHIBITION & CONFERENCE

20th May 2010

Turboden and Land Energy: ORC turbogenerator in pellet application. A case history

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About us



Turboden, a **Pratt & Whitney Power Systems** company, is a European leader in ORC technology for the generation and cogeneration of heat and power from renewable energy and heat recovery.

Pratt & Whitney, a division of United Technologies Corporation (UTC), is a world leader in the design, manufacture and service of aircraft engines, industrial gas turbines and space propulsion systems.



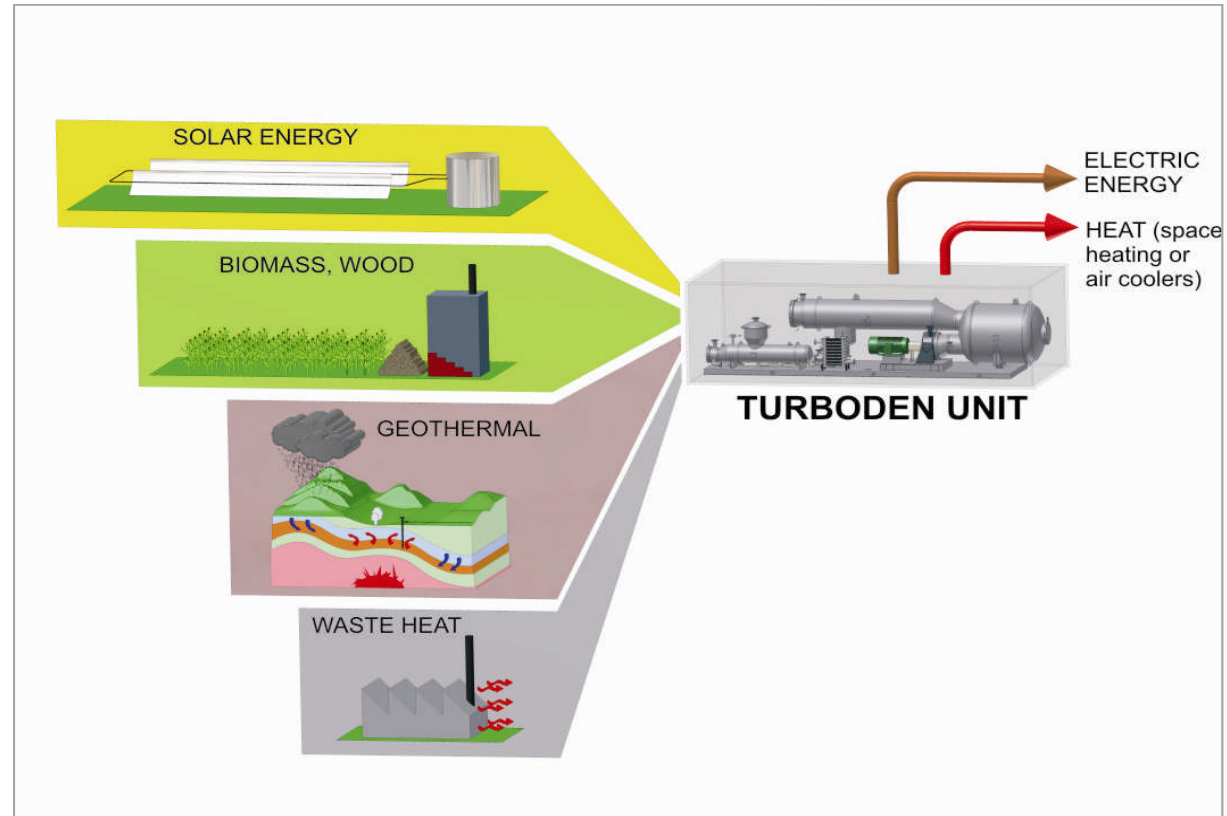
- operating profit of \$2.12 billion in 2008
- revenues of \$12.97 billion
- 38,577 employees
- more than 9,000 customers
- 180 countries

Pratt & Whitney Power Systems (PWPS), the industrial gas turbine business of Pratt & Whitney, provides power generation and mechanical drive solutions for the electric generation, oil and gas markets, including service through the entire product life cycle

PWPS also manufactures and markets the **PureCycle®** system that can harness heat in the form of hot water from many different sources such as geothermal or oil & gas co-produced fluids, reciprocating engines, and industrial waste heat to generate clean and reliable electricity.

What we do

ORC is an outstanding technology for distributed production of combined heat and power (CHP) from various renewable energy sources



- standard size turbogenerators for biomass and waste heat recovery: from 400 kWe to 3 MWe
- customized ORC units for low temperature heat sources: up to 10 MWe



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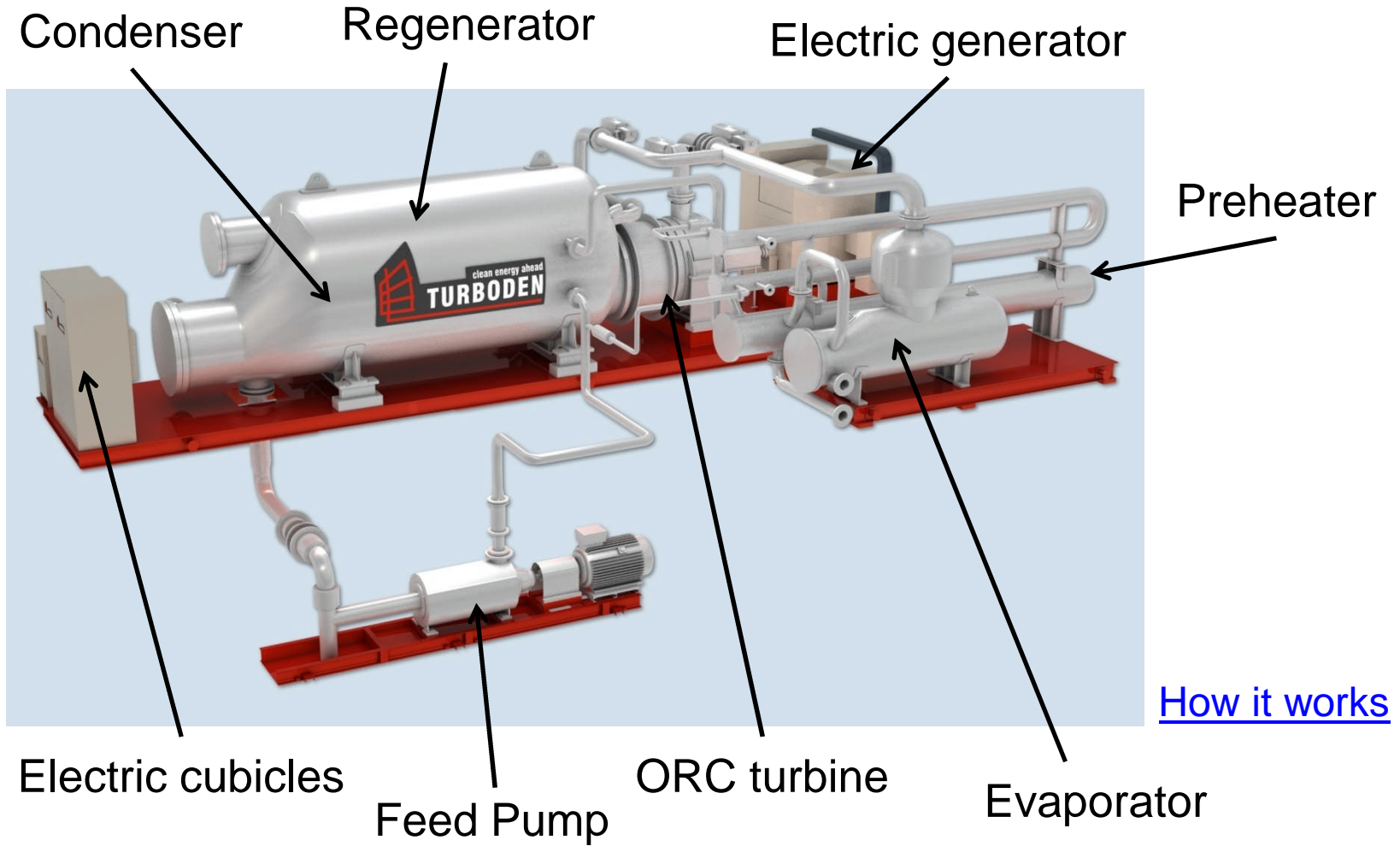
TURBODEN ORC PLANTS IN THE WORLD



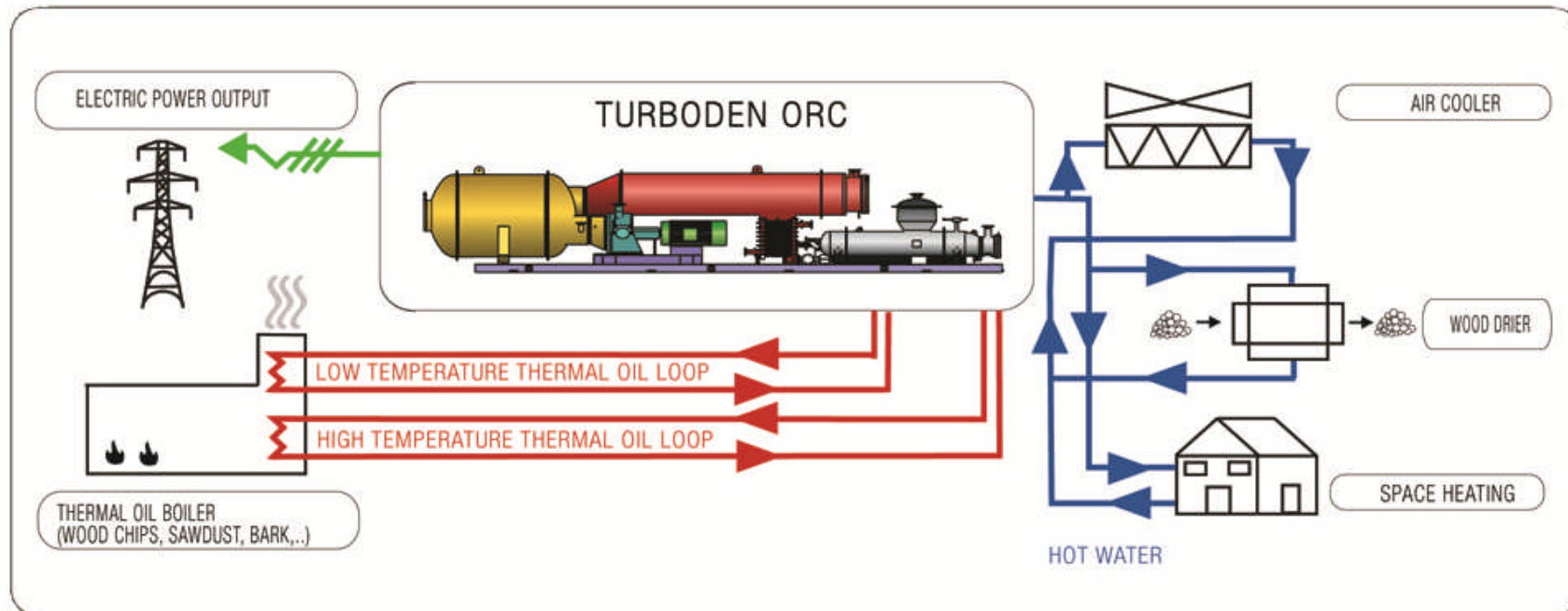
BIOMASS		HEAT RECOVERY		GEOTHERMAL		TOTAL PLANTS	
in operation	109	in operation	4	in operation	3	in operation	116
under construction	30	under construction	9	under construction	0	under construction	39
TOTAL	139	TOTAL	13	TOTAL	3	TOTAL	155

Update March 2010

Modular ORC Units



Scheme of a CHP plant



Advantages of ORC technology

Technical advantages

- Very high turbine efficiency (up to 85%)
- Low mechanical stress of the turbine due to the low peripheral speed
- Low RPM of the turbine allowing the direct drive of the electric generator without reduction gear
- No erosion of blades, no water treatment system due to absence of water
- Low mechanical stress of the cycle due to much lower pressure than steam cycle

Operational advantages / results

- Automatic and continuous operation
- Simple start-stop procedures
- No operator attendance needed
- High efficiency at partial load and operation down to 10% of nominal power
- Very safe and quiet operation
- Low maintenance requirements: planned maintenance once per year, no major overhauls
- Very High Availability (e.g. Admont, AUT: operation since 1998, availability > 98%)
- Long life – designed for 20+ years



Translate in user advantages

LandEnergy – a case study



About us

- Activities:
 - Wood Pellet Production
 - Biomass CHP
 - ESCOs
- History
 - Privately owned company formed in 2006
 - Foresight Group are lead investor



Where we are

- Offices

 - London (Head Office)

 - Helmsley, N. Yorks (Design & engineering centre)

- Pellet Production

 - Bridgend, S. Wales - (Pellet production, operational)

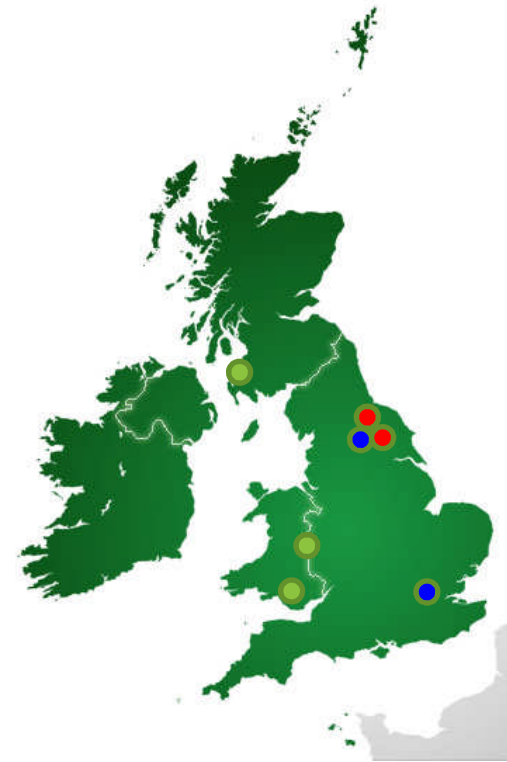
 - Presteigne, Wales (CHP & Pellet production, pending)

 - Girvan, Scotland (CHP & Pellet production, pending)

- ESCO sites

 - Kirkdale Energy Centre (biomass fired district heating)

 - Helmsley swimming pool (Pellet fired pool heating)



Our requirements I

- Girvan, Ayrshire
 - Wood pellet production
 - 60,000t per annum
 - Continuous process
 - On Site Heat & Power generation
 - Economics of Grid v. On site
 - Biomass CHP
-

Our requirements II

- Preference - Low temperature belt dryer (for wood fibre)
 - 9.5MWth (peak)
 - Hot water output 80-90DegC range
 - Power for pellet production
 - 1.5MWe (average)
 - Power balance to grid
 - 8,000 hour performance

 - Specified: Turboden 22 CHP Split
-

Why ORC?

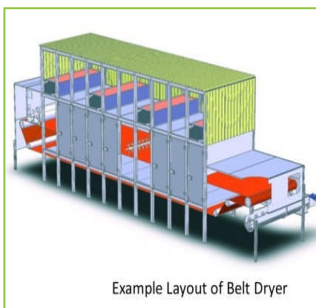
- High availability
 - >8,000 hrs pa
 - Out of the box guarantees
 - Output guarantee 2.322MWe (On Turboden 22 CHP Split model)
 - Liquidated Damages for under performance
 - Capex similar to steam
 - 2.5MWe scale is right for LE
 - But >3MWe steam is more cost effective
 - Investor confidence
-

Why ORC?

- Low Opex
 - Low noise (relative to steam)
 - Little operator input
 - Low regulatory hurdles
 - No high pressure steam circuits
 - Long life
 - Admont, Austria : 12 years near non stop running
 - Outsourced maintenance/monitoring package
 - OptiTurbo
-

Project Specification

LandEnergy



Example Layout of Belt Dryer

Location	
client	Land Energy
ORC plant type	Turboden 22 CHP Split
Nominal power at the furnace	14 MW
Approx. annual fuel consumption (at full load)*	43.500 ton
Nominal el. Power ORC	2.322 kW
Nominal thermal power ORC (hot water)	10.031 kW
Thermal power utilization	Belt dryer
Year of construction	3 rd quarter 2010

*assuming a boiler efficiency of 88% and a low heat value of the fuel equal to 2,6 kWh/kg



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Thanks for your attention!



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