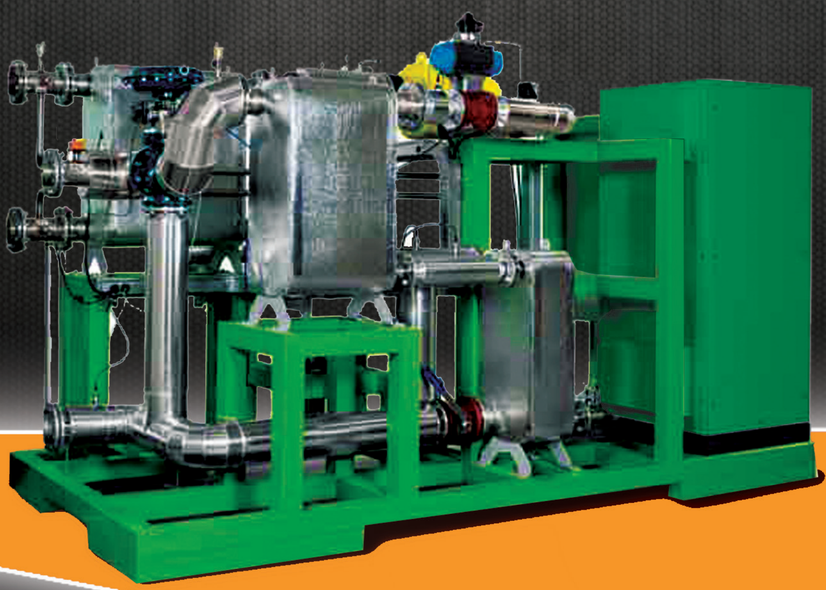
TOMORROW IS CREATED TODAY

COGETHERM EMA-50

CHP



Low-Temperature
Organic Rankine Cycle (ORC)
Power Generation Module

COGETHERM EMA-50 POWER GENERATION MODULE

Its performances make it ideal for primary power production as well as for waste heat recovery and other low-temperature applications (e.g. geothermal power).

Said thermodynamic cycle in fact, thanks to a special fluid medium, can offer optimal performances in a plant this size, as well as having several advantages over the operational cycles of traditional steam engines and turbines:

- Low Operational Temperature allowing the use of "weak" thermal sources.
- High Condensing Temperature
- No Turbine Blade Erosion which gives higher reliability and lower maintenance costs.
- Low Operational Pressure (max 6 bar) meaning higher safety levels, less legal implications, and lower plant costs;
- No Atmospheric Exhaust as the Rankine cycle is a closed cycle.
- No Water or Steam Consumption leading to lower management costs, less bureaucracy, lower plant complexity.
- Low Noise Levels allowing operators to work without hearing protection and leading to less controversies in residential installations.

EMA 50 modules have been custom designed from scratch with the purpose of becoming the power generation stage of small power CHP (Combined Heat and Power) plants and heat recovery systems,
so to increase efficiency as much as possible we implemented several performance- boosting
engineering solutions such as:

- Low Operational Temperature allowing the use of "weak" thermal sources.
- High Condensing Temperature
- No Turbine Blade Erosion which gives
- Direct Turbine-to-Generator Coupling which eliminates the performance losses inherent in gearboxes.
- Custom-Designed Inverters for each model of module, to obtain optimal output performance.

All of this contributes to give our systems a high thermal efficiency, which in optimal conditions allows them as total system efficiency (thermal power input vs electric power output) up to 9.6%, a very high value for a system this size.

THE WORKING FLUID

The special working medium we use is the key component which made studying and creating these high-tech solutions possible.

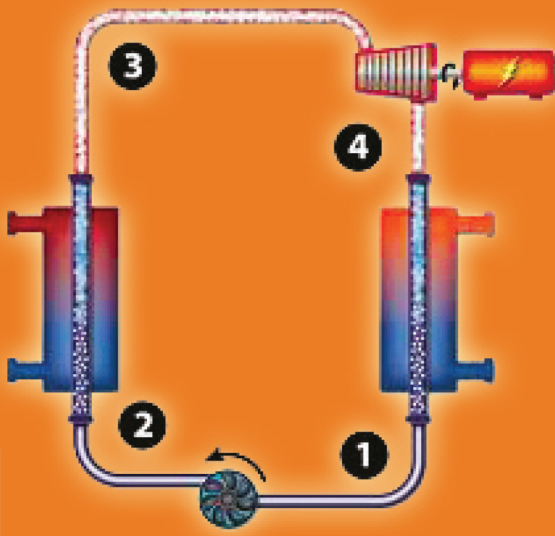
The organic medium used in the system WES proposes has the following excellent specifications:

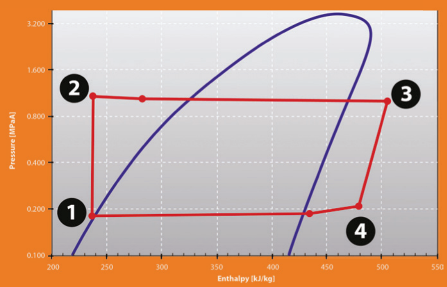
- **Wide working range** (60-165°C) which allows exploiting low-temperature heat sources once thought useless, such as geothermal sources and engine cooling.
- **High condensing temperature**
- **Completely dry in all of its states** thus avoiding cavitation and turbine blade erosion.
- **Non-toxic, non-flammable, 100% biodegradable and ozone-friendly** so even accidental spills are not hazardous.
- **Requires little or no reintegration** as it works in a closed cycle.
- **Requires no filtering/reconditioning** thus reducing plant complexity and size.

THE LOW-TEMPERATURE ORGANIC RANKINE CYCLE

The Rankine Cycle concept, invented in the 1800s by the scottish physicist William Rankine, is quite simple and easily explained with a diagram like the one on the right: a heat source warms up a heat exchanger which transfers the heat to a liquid organic medium, which – exposed to that heat – becomes a gas, greatly increasing its volume. This expanding gas drives a turbine generating mechanical energy (Wout) which can be converted into electric power by a generator connected to the turbine shaft. On leaving the turbine, the medium - in gas form - is conveyed to a condenser , where it cools down

returning to its liquid state. Collected in a specific tank it is then pumped back to the heat exchanger, thus closing the cycle. The low-tempera- ture excess heat the medium releases in the condenser (Qout) can be efficiently used for other uses such as ambiental heating, fuel dessiccation/ preheating and so on (com- bined generation of heat and power).





HEAT EXCHANGERS

The heat exchangers mounted on the WES skids are custom-made, welded-plate type units custom designed to optimize performance with our working fluid. The plates, in 316L stain- less steel, thanks to their custom design are able to exchange heat efficiently while keeping load losses low, with a significant impact on thermal consumptions. Use of 316L stainless steel, a material widely used in our systems, guarantees extreme cleanliness and long-term reli- ability.

REMOTE MONITORING

Thanks to remote monitoring via the GPRS cellular network, WES can supervise each ORC Module operation in real time and act promptly on any malfunction thanks to the received diagnostic codes, thus allowing continued optimal operation.

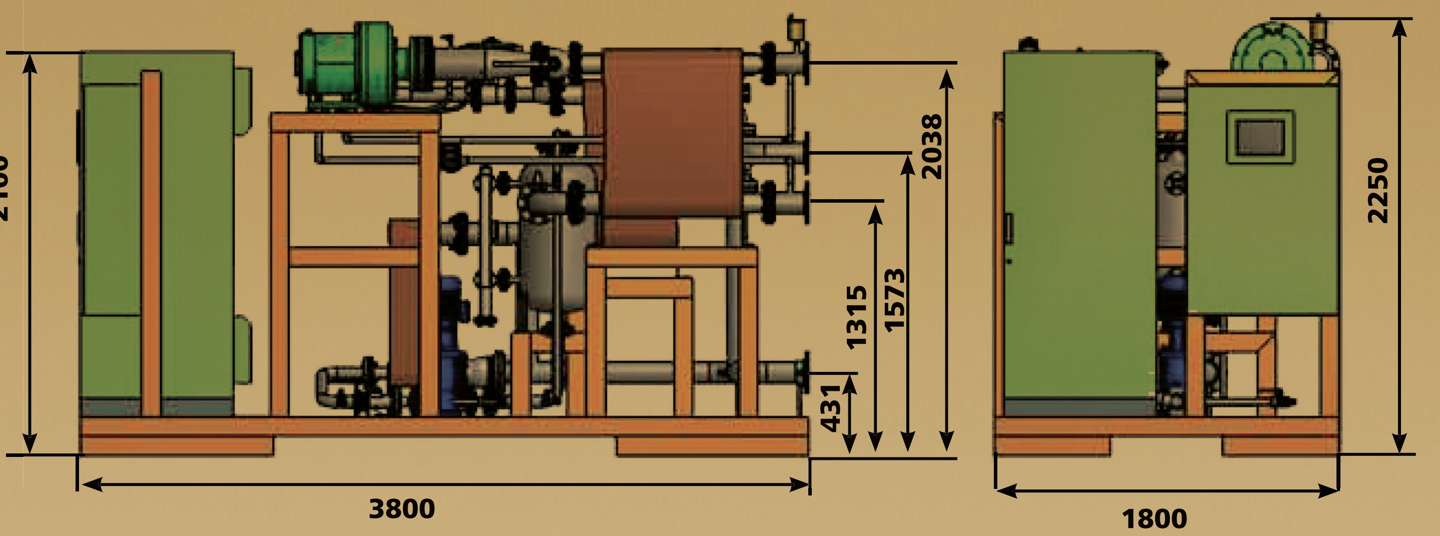
CONTROL PANEL

SPECIFICATIONS TECHNIQUES

THERMAL SUPPLY	
Vector fluid	Hot water
Hot water input temperature	≥94°C
Hot water output temperature	86°C
Thermal Power Input	550 kWT
GENERATOR	
Type	Water-cooled, PM-excited sychronous generator w/rectifier and grid converter
Cooling	Water jacket
Power Output	50kWE
Output Voltage	480-580 VAC
Required Cooling	5 kWT
Coolant	Water-Glycol
Coolant Input Temperature	<40°C
Required Coolant Flow	10 l/min
Additional Cooling	Working fluid injection (opt.)
Generator Seal	Gas-tight to PN 6 bar
NET EFFICIENCY	**9.6% (typ.)**

TURBINE	
Type	Single-stage, radial with fixed nozzles, Idirectly coupled to generator shaft
Input Temperature	85°C
Output Temperature	~60°C
Test Pressure	10 bar
Turbine Body	Welded Steel
Impeller	Aluminium alloy
Speed Control	Feedback Loop On Generator Output Frequency
Working fluid	HFC
Lubrication	Automated, PLC-controlled lubrication system
INVERTER	
Type	IGBT, Grid-Synchronized, Air-Cooled
Power Output	50 kWE
Output Voltage	400 V (360÷445) @ 50Hz ± (47,5÷51,5)
Environment temperature	<40°C
Braking Chopper	Built-in, 200kJ

DIMENSIONS



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