



Our Carnet of Selected References

Update as of May, 2022

Arranged in reverse chronological order (newest to oldest)

Index

Plant Name	Place	Application	Plant	Operating since	Pag.
Sardinia 01	Sardinia (Italy)	Heat recovery from furnace	1xZE-200-LT	04/22	4
France 01	Marseille (France)	Thermal recovery from engine	1xZE-100-LT	05/2021	6
Emilia-Romagna 01	Province of Piacenza (Emilia-Romagna, litalia)	Thermal recovery (glas-work)	1xZE-200-LT	05/2021	8
United Kingdom 01	South Gloucestershire (United Kingdom)	Energy from Biomass (pruning clippings)	1xZE-105-CHP	12/2020	10
Tunisia 01	Tunis District (Tunisia)	Hybrid Solar (solar + biogas boiler)	1 x ZE-60-DSG	08/2018	12
Corea 01	Yellow Sea Islands (Jeollanam-do, South Korea)	Thermal Recovery (thermal power plant)	2 x ZE-40-ULH	04/2018	15
Umbria 01	Province of Perugia (Umbria, Italy)	Energy from Biomass (pruning clippings)	2 x ZE-100-LT	03/2018	16
Lombardy 03	Province of Brescia (Lombardy, Italy)	Energy from Biomass (end-of-life pallets)	1 x ZE-150-LT	02/2017	18
Veneto 04	Province of Padova (Veneto, Italy)	Energy from Biomass (pruning clippings)	2 x ZE-100-LT	12/2016	20
Calabria 01	Province of Cosenza (Calabria, Italy)	Energy from Biomass (pruning clippings)	1 x ZE-175-LT	09/2016	22
Germany 02	Lower Saxony (Germany)	Thermal Recovery (biogas engines)	1 x ZE-40-ULH	08/2016	26
Sicily 02	Province of Enna (Sicily, Italy)	Hybrid Solar (solar + gas boiler)	1 x ZE-50-ULH	11/2015	28
Sicily 01	Province of Ragusa (Sicily, Italy)	Energy from Biomass (fruit crate prod. waste)	1 x ZE-175-LT	06/2015	30
Lombardy 02	Province of Varese (Lombardy, Italy)	Energy from Biomass (sawmill waste)	1 x ZE-100-LT	06/2014	34
Germany 01	Saxony-Anhalt (Germania)	Thermal Recovery (biogas engine)	1 x ZE-50-ULH	05/2014	36
Friuli 01	Province of Pordenone (Friuli V.G, Italy)	Energy from Biomass (poultry manure from	1 x ZE-150-LT	12/2013	38
Aosta 01	Province of Aosta (Val d'Aosta, Italy)	Thermal Recovery (vegetable oil engine)	1 x ZE-40-ULH	12/2013	40
South Tyrol 04	Province of Bolzano (South Tyrol, Italiy)	Thermal Recovery (vegetable oil engines)	2 x ZE-50-ULH	05/2013	42
Lazio 01	Province of Rome (Lazio, Italy)	Thermal Recovery (gasifiers and engines)	1 x ZE-50-ULH	03/2013	44
South Tyrol 03	Province of Bolzano (South Tyrol, Italy)	Thermal Recovery (gasifiers and engines)	1 x ZE-50-ULH	02/2013	46
Veneto 03	Province of Venezia (Veneto, Italy)	Thermal Recovery (hot air turbines)	1 x ZE-50-ULH	10/2012	46
South Tyrol 02	Province of Bolzano (South Tyrol, Italy)	Thermal Recovery (vegetable oil engine)	1 x ZE-50-ULH	10/2012	46
Veneto 02	Province of Padova (Veneto, Italy)	Thermal Recovery (biogas engine)	1 x ZE-50-ULH	07/2012	48
Lombardy 01	Province of Mantova (Lombardy, Italy)	Thermal Recovery (biogas engine)	1 x ZE-50-ULH	06/2012	54
Veneto 01	Province of Venice (Veneto, Italy)	Thermal Recovery (biogas engine)	1 x ZE-50-ULH	04/2012	56
South Tyrol 01	Province of Bolzano (South Tyrol, Italy)	Thermal Recovery (vegetable oil engine)	1 x ZE-50-ULH	02/2012	58



Sardegna-01

Manager: Private company • **Località:** Sardinia

Plant: 1 Module ZE-200-LT ORC system **Application:** Electricity generation by heat recovery from furnace Thermodestructor



Free Energia, realized an Energy Efficiency plant in ESCo formula, recovering heat from a Thermodistiller Furnace to generate electricity through ORC technology and recovering thermal energy for SE TRAND's Thermal Power Plant.

The heat recovery system operates by taking the high-temperature flue gas from the pyrogasifier through a superheated water heat exchanger and distributing it to the ORC system to generate electricity.

The customer, Se Trand, handles the transportation, storage treatment and disposal of SRF (css-cdr-hospital) waste.

The solid waste is transported and brought inside a rotary kiln, in which the waste begins a mixing process and syngas production. A pressurized water generator is then placed, which transfers heat from the pyrogasifier

gases to the carrier fluid of our ORC, water pressurized to 160°C.

The 160°C pressurized water enters the ORC system through a piping system that has two heat exchangers: one adapted to supply hot water for the thermal application and the other to dissipate waste heat.

The installed ORC module produces 200 electric kW, used directly for the customer's system. It absorbs a thermal power of 1400 kWt from the flue gases exiting at 1050°C.

The system, like all ZE systems, is mounted on a self-supporting frame (skid) that includes exchangers, turbogenerator, and control panel. The skid is housed indoors in a small purpose-built room and operated in full automation, without the need for an operator as it is operated entirely remotely.

The cooling system consists of an adiabatic cooler designed to dissipate the unusable heat produced by the plant. The adiabatic cooling function helps to react to high temperatures.



Heat exchanger



Three-way Diverter Valve



ZE-200-LT Turbine



ORC system's electrical cabinet



Sardinia 01 : SE Trand Plant



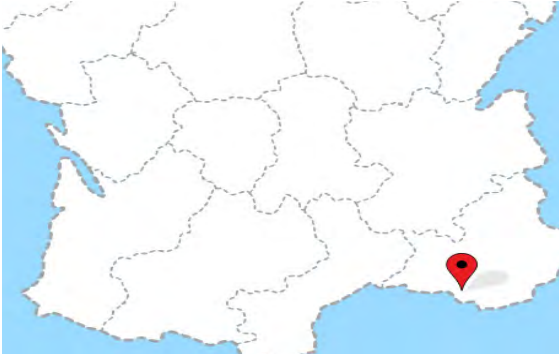
Sardegna 01 : ZE-200-LT Module in test-area



France-01

Manager: Private Company • **Place:** Marseille

Plant: 1 Organic Rankine Cycle Module (ORC) ZE-100-LT **Application:** Electric generation by heat recovery from engine



The client represents a **shipping company** specializing in luxury cruises that decided to implement **ORC technology** inside one of its ships. The goal of the vessel, which is equipped with a total of four main engines, two for propulsion and navigation and two for electric power generation, is to recover energy from the running engine in order to decrease the fuel consumption of the generator engines to reduce the environmental impact of cruising on the one hand, and the cost of fuel to the company on the other.

The **100 kW ORC machine (ZE-100_LT)**, redesigned in its dimensions to better fit into the vessel's engine room, yet without losing its performance, is powered by 740kWth thermal power drawn from heat from the exhaust gases of one of the main engines transferred to the carrier fluid from presurized hot water at **160°C** through the use of an economizer.

Condensation (of the organic fluid in the ORC system) on board ship can be achieved by taking advantage of seawater, which is always available both at sea and at berth through an intermediate clean water loop and the use of an inspectable plate heat

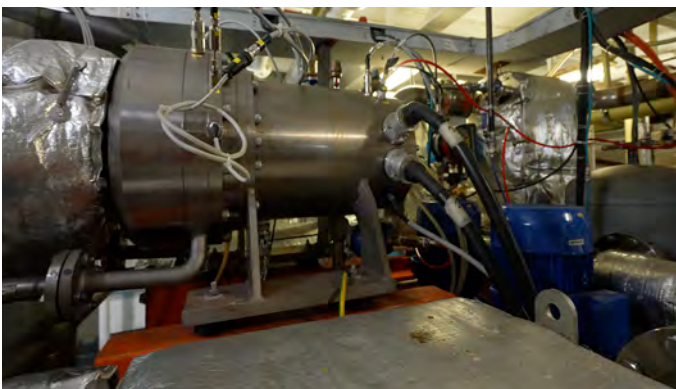
exchanger.



Electrical cabinet



Three-way Diverter Valve



Turbine installed inside of the boat



ZE-100-LT Module Control Panel



Francia 01 : Scambbiatore ORC ZE-200-LT



France 01 : Silver Sea



Emilia-Romagna 01

Manager: Private firm • **Location:** Province of Piacenza

Plant: 1 modulo a ciclo Rankine Organico (ORC) ZE-200-LT **Application:** Electricity generation by thermal recovery from glass



Vetreria di Borgonovo Spa is a glass factory located in Piacenza. Covers 52000 m² and produces about 45 000 tonnes of glass per year using two melting furnaces.

The basic idea is to recover the thermal power of the flue gas after the ceramic candle filter in order to decrease the temperature and to produce electricity.

In this way, thanks to the recovery, the customer avoided waste heat and improves the fumes system by not having to add false air for cooling the flue gas after the filter, which would be mandatory to avoid damages to the ventilation system.

In this way, an additional advantage of the installation is the lower electrical consumption of the fans that were used for the introduction of flue gas.

To control and manage the recovery there is a bypass with adjustable shutters in order to direct the flue gas according to the recovery and operation required by ORC and client plant.

The installed module is a ZE-200-LT and has a nominal power of 200 kW which absorbs about 1400 thermal kW. Recovery is carried out employing a heat exchanger which intercepts the fumes from the furnaces and uses them to heat some water, the vector fluid necessary for the operation of the ORC system. The fumes are cooled from a temperature of about 450° C down to 200°C while on the secondary side of the heat exchanger, pressurized water circulates at 10 bar at 140°C, which thanks to the heat of the fumes is heated up to 160° C.

For the condensation stage the client has chosen an adiabatic cooler system to allow operation even in cases of higher ambient temperatures. Due to its characteristics, the system is very constant thanks to the low variability of production and furnace operation characteristics of glass factories.

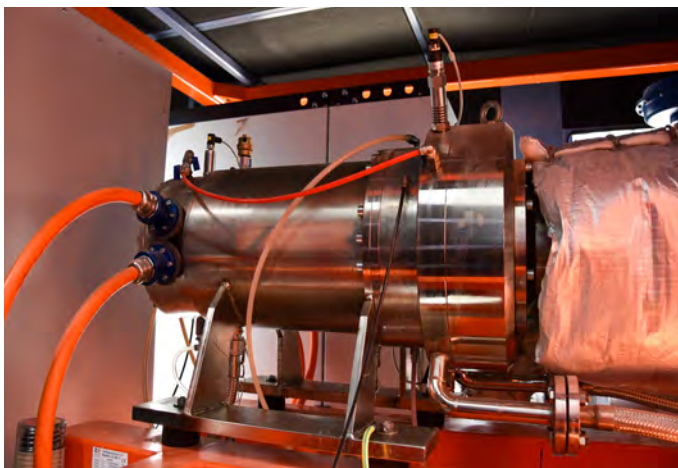
The system is mounted on a self-supporting frame (skid) which includes heat exchangers, turbogenerator and control panel. In this case the skid is positioned on a special external structure inside an customized container and operated fully automatic and don't a technical operator as it is managed entirely remotely.



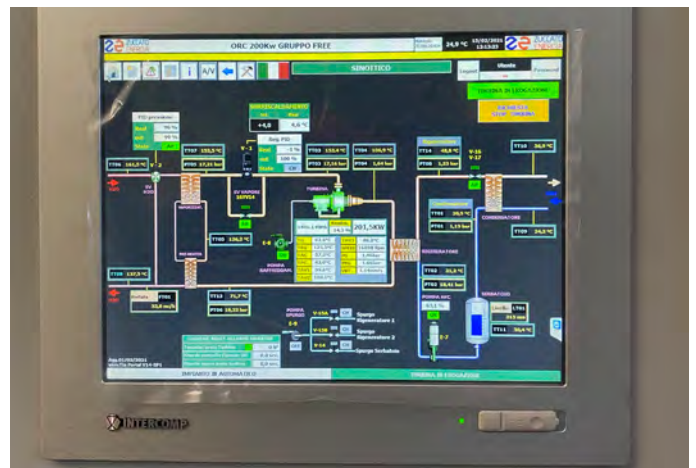
Electrical Panel



Three-way Diverter Valve



ORC system turbine



ORC ZE-200-LT Module Control Panel



Emilia-Romagna 01 : The ORC ZE-200-LT module before installation



Emilia-Romagna 01 : The ZE-200-LT ORC module installed.



United Kingdom 01

Manager: Private Firm • **Location:** United Kingdom

Plant: 1 x ZE-105-CHP power generation module

Application: Power generation in combination with a boiler burning biomass (pruning residues)



The owner of this plant is one of the largest agricultural producers of potatoes and onions in England, which has 4 warehouses to store its freshly harvested products until the distribution trucks arrive.

The idea behind it, is to have an always functioning power plant that deals with disposing of the waste biomass (mainly residual mowing and pruning) produced by the landowners and the industries in the surroundings and, while, producing electrical and thermal energy for the storage of the products and the thermal utilities used by the staff on site.

The client, therefore, decided to equip itself with a system capable of enhancing the biomass with which it powers a boiler of over 1.2 MW. The generated heat is used to power a 105 kWe ZE-105-CHP module.

Our system has a thermal output at 60/80 ° C which is reused to supply hot water to the heating systems on the site but, above all to keep the warehouses for potatoes and onions heated, which are constantly monitored in temperature and humidity to remain at the ideal conditions for the correct conservation of the product.

The deposits are heated by heat exchangers which use the water leaving the ORC to heat some air which is introduced into the deposits through fans. The system, like all Zuccato Energia systems, is mounted on a self-supporting frame (skid) which includes heat exchangers, turbogenerator and control panel. The skid is housed indoors in a built room together with the boiler and it operates fully automatically, without the need for an operator as it can be managed entirely remotely.

Before the installation of the ORC, the customer had to use diesel oil to heat the deposits and rooms for employees with consequent purchase costs and the high rate of pollution resulting from combustion. Now instead, the fuel used to power the boiler (pruning cuttings) is an environmentally friendly and renewable resource.



Loading hopper



ZE-105-CHP ORC module



Boiler preheating system and superheated water at the ORC.



The ZE-105-CHP ORC seen from the control panel side



United Kingdom 01 : The Entire plant



United Kingdom 01 : The ZE-105-CHP module in place



Tunisia 01

Manager: State University • **Location:** Tunis (Tunisie)

Plant: 1 x ZE-60-DSG LT-ORC power generation module

Application: Diabathic hybrid plant (thermic solar power+biogas boiler)



This plant - the first Zuccato Energia plant in Africa - is located in the region of Tunis, the capital of Tunisia.

It is an experimental hybrid plant, built in collaboration with several European academic and industrial entities within the frame of the RE.EL.COOP project, financed by the European Union.

This plant shows some parallels with our Sicily 2 installation in Sicily, Italy. In both plants the goal is not as much energy production as the demonstration of various engineering principles, and in both plants concentration-type thermal solar panels work side-by-side with a gas boiler as an alternate power source.

The Tunis plant, however, shows several differences with the Sicily one, the main being - for the first time in a Zuccato Energia plant - the use of 160°C saturated steam as vector fluid in direct heat exchange with the working fluid without the use of an intermediate steam/water heat exchanger. The new working point required a full turbine blade redesign, and several modifications were made to the "hot side" of the ORC module, adding various devices to better handle and exploit this new vector fluid.

From the thermal source viewpoint, the plant relies on a small solar field made of Soltigua parabolic concentrators, using a boiler fueled by the biogas produced in a fermentation plant fed by the food residues of the local university dining hall as an alternate heat source. Residual heat from the condensation stage of the ORC is dissipated by a battery of dry coolers.

While the plant as a whole is the concerted effort of a dozen firms, the heart of the whole plant - The ZE-60-DSG Organic Rankine Cycle power module - has been entirely designed and developed in-house by us. It is a compact, skid-mounted system, which is now hosted - together with the boiler - in a small building adjacent to the main campus building.

The compact size of the ORC module has simplified shipping while its capacity to interface through secure ORC protocols with the web for control, monitoring and diagnostics (a common characteristic of all our ORC modules) has allowed our company's technicians to supply real-time assistance to their colleagues commissioning the plant in Tunis.



A general overview of the plant



The solar field seen from another angle



The white building protecting the skid (L).



The ZE-60-DSG skid seen from the door



The biogas boiler (R) and the ORC module skid (L)



The ZE-60-DSG ORC Module during commissioning



A detail of the plant's custom turbine



The dry coolers with the main campus building in the background



The dry coolers from the opposite side



Tunisia 01 : The heat exchangers. This is the first plant by ZE using live saturated steam as a vector fluid.



Tunisia 01 : The solar field at sunset, taken from the canopy adjacent to the building housing the skid.



Korea 01

Manager: Private Korean Firm • **Location:** South Korea **Plant:** 1 x customized ZE-40-ULH LT-ORC module

Application: Heat recovery from engines (Heavy fuel diesel gensets)



This plant – our first installation in the Far East – is located in the main hamlet of a small island located in the Yellow Sea off the southeastern shore of South Korea.

This small island, occupying less than 20 km², is home to about 3000 persons who rely for their electricity on a local power station based on eight large diesel gensets.

A Korean private firm has received from the plant owner (KEPCO) the task to increase plant efficiency. To do so it asked us to manufacture a 30-kWE nominal output-Low-Temperature Organic Rankine Cycle Module with a peak output power of 40 kWE and maximum efficiency of 9% designed to operate by recovering the heat from the 1-MW diesel engine operating one of the gensets according to their specifications.

The plant – a self-contained module in open-frame, non-containerized configuration – has been located under a little awning off the main entrance to the generator room, and has been interfaced with generator #8 through a heat exchanger placed in the exhaust chimney.

The compact size of the plant has simplified shipping, while its remote interface with the Internet for control, monitoring and diagnostics has made it possible for our technicians to give real-time assistance to their colleagues performing plant start-up nearly 9000 km away.



Satellite view. The plant is in the SW corner of the large white building in the center.



The entrance to the power plant.



The generators building. The skid is on the right, below a small awning



The ZE-40-ULH module during installation



The large diesel genset from which waste heat is recovered



A general view of our skid installation and the cooling tower



The hot-side piping conveying heat to the ORC. The heat exchanger is on the platform at the top



A front view of the turbine



A back view of the turbine



Korea 01 : The cooling tower and the awning hosting the ZE-40-ULH organic Rankine cycle power generation module



Korea 01 : A detail of the ORC skid - the steel cylinder in the middle is the turbogenerator



Umbria 01

Manager: Private Italian Firm • **Location:** Umbria, Italy

Plant: 2 x ZE-100-LT Module

Application: Power generation in combination with a boiler burning biomass (pruning residues)



The client who commissioned us this plant is a large **holiday farm** located in the Umbria countryside near the border with Tuscany, that includes several restructured historical buildings, as well as a **60-hectares park** including woods and fields. They decided to monetize the waste biomass their park produces (i.e. pruning residues) by using its combustion to generate electricity taking advantage of the existing **state incentives**.

This facility has decided to **valorize the waste biomass** (pruning clippings) produced as part of its operations by exploiting its combustion to generate electricity by taking advantage of government incentives in this regard. The biomass is used to fuel a Herz-Binder moving grate boiler, which channels the **1.6MW of thermal power** thus generated to feed two ZE-100-LT ORC modules supplied by Zuccato Energia.

These modules are housed in a purpose-built thermal power plant, each mounted on its own skid including turbine, exchangers and control system but operating in parallel. **The total electrical output of 200 kW** is fed into the grid via a nearby electrical substation.

The plant was built under the **project financing** formula by an Energy Service Company or ESCO, which fully financed the plant by receiving as consideration its ownership and the amount of incentives for the first years of its life, during which the developer will provide the biomass necessary for its operation at an agreed cost. After that period, the plant will become wholly owned by the developer, who will thus have obtained it at virtually zero cost

Like all biomass, pruning clippings are an **environmentally friendly**, renewable and incentive-neutral energy resource with respect to CO2 production-that released in combustion is the same as that captured in due course by plants as they grow.



The power station entrance gate.



The power station building. Large door opens on boiler room, small one on ORC room.



The ORC modules through the open ORC room door. The front of the power station building with the



The front of the power station building with the biomass storage area in foreground.



The rear of the power station with (L to R) biomass storage, fuel hopper and control room door.



The fuel loading hopper, with feeding rakes on the bottom.



A peek inside the operating boiler.



One of the two ZE-100-LT modules in its seat.



The boiler (R) and the ash filter (L).



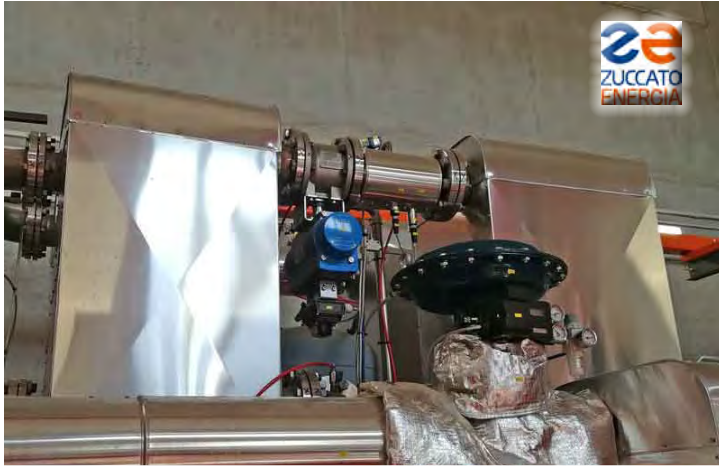
*Flue gas treatment system and chimney.
On the right, the dry cooler.*



A detail of the dry cooler control panels.



The nearby electrical cabin.



Umbria 01 / Perugia : A detail of the heat exchangers



Umbria 01 / Perugia : The flue gas exhaust chimney



Umbria 01 / Perugia : A detail of one of the two ZE-100-LT ORC modules in their own room



Lombardy 03

Manager: Private Italian Firm • **Location:** Lombardy, Italy

Plant: 1 x ZE-150-LT ORC module

Application: Primary energy production with a boiler fueled by biomass



Located in a large Lombardy town in the province of Brescia, this plant is operated by a company that is in the trucking pallet business and has all the permits for **transport, storage, and disposal of wood waste**. In order to valorize the waste wood biomass it comes in possession of (pallets that can no longer be used), it has equipped itself with a 1 MWT Herz moving grate boiler, most of whose heat goes to feed an ORC ZE-150-LT unit supplied by Zuccato Energia.

The versatility of our systems, which can provide excellent performance even at part load, is exploited in this plant whose generating system has been **depowered to 135 kW** electrical from the nominal 150 kWE to meet customer requirements. In addition, **an economizer** located on the boiler flue gas line recovers some of its waste heat to dry and preheat the woody biomass.

The system, like all ZE systems, is mounted on a self-supporting frame (skid) that includes exchangers, turbogenerator, and control panel. The skid, in indoor configuration, is housed indoors in a small purpose-built room and operated in **full automation, without the need for an operator** as it is operated entirely remotely. Waste heat produced by the condensing stage of the ORC is disposed of through a special closed evaporative tower located outside.

The plant was built using the project **financing formula**: in fact, with the collaboration of Zuccato Energia, the developer was put in contact with an ESCO that fully financed the plant, receiving as consideration its ownership and the amount of incentives for the first years of its life, during which the developer will supply biomass at zero cost. After that period, the plant will become fully owned by the developer, who will thus have obtained it at virtually zero cost.

Woody biomass is environmentally friendly and renewable, and has zero ecological impact with respect to CO2 production because as it burns it releases the same amount of CO2 captured in due course from the plants themselves into the atmosphere.

Below and on the opposite page you can find a photo gallery related to this plant.



A general view of the building housing the plant.



The biomass hopper, with a rake-style feeding system.



The boiler seen from the right side.



The ZE-150-LT ORC module in place, seen from the control panel side.



The turbogenerator (silver cylinder) inside the skid frame.



The skid seen from the hydraulic connections side.



The shredder which reduces the unusable pallets into wooden chips.



The water treatment system feeding the evaporative cooling tower.



L to R: the bag filter for flue gases, the chimney and the cooling tower.



Lombardia 03 / Brescia: The ZE-150-LT organic Rankine cycle power generation module, seen from the control panel side



Lombardia 03 / Brescia: A detail of the ORC skid - the steel cylinder in the middle is the turbogenerator



Veneto 04

Manager: Private Italian firm • **Location:** Veneto, Italy

Plant: 2 x ZE-100-LT ORC modules

Application: Primary energy production in connection with a boiler fueled (wood prunings)



This plant is operated within a large agriturismo facility located in a small town in the Venetian countryside in the province of Padua, which decided to equip itself with a system capable of valorizing waste biomass produced as part of its agricultural activities.

The biomass (consisting mainly of pruning clippings) is used to fuel an Ahena Boilers mobile grate boiler with a total capacity of 1.6 MWT.

The heat generated by the above boiler is used both to power two ZE-100-LT organic Rankine cycle modules supplied by Zuccato Energia and, in smaller quantities, to generate hot water for plumbing uses.

The two ORC modules, mounted on separate skids including the turbine, exchangers and control system, are housed in a dedicated thermal power plant.

The two ORC modules, mounted on separate skids including the turbine, exchangers and control system, are housed in a dedicated thermal power plant.

Operating in parallel, the two ZE-100-LTs produce a total of 200 kW_e of energy, contributing significantly to the company's energy balance.

Cooling for the condensing phase is provided by a simple evaporative tower located outside the thermal power plant.

As mentioned above, the boiler uses pruning clippings and other woody waste from the facility as fuel, which are environmentally friendly and renewable resources made competitive for energy production by state and regional incentives.

Like all biomass, such fuel has zero ecological impact with respect to CO₂ production because as it burns it releases into the atmosphere the same amount of CO₂ captured in due course by plants as they grow.

Below and to the right you can find a photo gallery related to this plant.



A general view of the agriturismo.



The boiler building hosting the ORCs and the boiler.



The evaporative cooling tower.



The biomass loading hopper.



The boiler in its room behind the ORC modules.



The control panels for the ORCs



The mains grid interface panels.



A detail of the boiler and its ash filter.



The flue gas treatment system and the boiler room



Veneto 04 / Padova: The two skid-mounted ZE-100-LT Organic Rankine Cycle modules in their room



Veneto 04 / Padova: A detail of the ORC skids - the silver cylinder (middle) is one of the turbogenerators



Calabria 01

Manager: Private Italian Firm • **Location:** Calabria, Italy,

Plant: 1 x ZE-175-LT ORC module in indoor configuration

Application: Primary energy production in connection with a boiler fueled (prunings pruning)



The client of this plant is a licensed waste manager, which started in the purge sector and later evolved to the waste transport and treatment sector, where it now operates on behalf of numerous institutional clients.

The company decided to equip itself with a facility to waste-to-energy the woody biomass (branches and pruning clippings from state forests) it collects as part of its work in order to eliminate the economic and environmental costs of transporting such biomass.

Instead of being transported to the landfill, the material is now treated at their site by shredding it and burning it in a 1300 kWt moving grate boiler. The heat thus produced goes to generate electricity through an Organic Rankine Cycle (ORC) power generation module model ZE-175-LT, supplied by Zuccato Energia. This ORC system is housed indoors and, like all Zuccato Energia systems, is supplied installed within a self-supporting

frame (skid) that also includes the control panel and parallel switchboard. In contrast, components that require more ventilation (e.g., cooling tower for the condensing stage) are located externally.

Untreated virgin wood is an environmentally friendly and renewable energy source made competitive for energy production by state and regional incentives, and it has a minimal environmental footprint because the CO₂ released during combustion is the same as that captured in due course by the plants from which it is derived. There is also the added environmental benefit of fossil fuel savings and reduced pollution resulting from on-site processing.

A photo gallery related to this plant can be found below and to the right.



A bird's-eye view of the client's premises



The biomass storage area



The ORC module skid seen through the shack doors



A detail of the ORC module control panel



The ORC module; in background, the braking resistors cabinet



The boiler seen from the flue gas processing side



The vector fluid expansion vessel



The cooling tower



The tower base hosts the cooling water treatment system



Calabria 01 / Cosenza : The ZE-175-LT ORC module in its place, seen from the control panel side



Calabria 01 / Cosenza : The boiler seen from the biomass loading side



Germany 02

Manager: Private Germany firm • **Location:** Niedersachsen (Lower Saxony), Germany

Plant: 1x ZE-40-ULH LT-ORC energy module in indoor configuration

Application: Waste heat recovery from a MAN genset fueled by biogas



Located in a small town in Germany's Lower Saxony state about 60 kilometers from Bremen, this plant stems from the operator's desire to increase the efficiency of a thermoelectric micro power plant based on a biogas-fueled MAN motogenerator in order to take full advantage of German federal incentives provided for microgeneration systems powered by renewable sources.

The system supplied by Zuccato Energia consists of a ZE-40-ULH module with a power output of 40 kWe, and operates by carrying out heat recovery from the cooling jackets and fumes of the micro power plant engine, thus making a significant contribution to the overall productivity of the plant.

The ORC system used in this installation is entirely housed in a small shed located in the countryside just outside the village. The system is operated in full automation, without the need for an operator as it is operated entirely remotely. The facility houses the entire system, including the motogenerator, ORC skid including turbine, exchangers and control panel. Cooling for the condensing phase is provided by dry-coolers located outside the shed.

Biogas burned by the motogenerator is an environmentally friendly and renewable energy source made competitive for energy production by state and regional incentives. It has zero ecological impact with respect to CO2 production because as it burns it releases into the atmosphere the same amount of CO2 captured in due course by the plants on which the animals have been feeding.

Below and to the right you can find a photo gallery related to this plant.



An overview of the village



The hangar that hosts the plant



The entrance door and the dry coolers for the condensation stage



The ZE-40-ULH ORC module seen from the control panel side



Germania 02 / Bassa Sassonia: The ORC Module seen from the hydraulic connections side



Germania 02 / Bassa Sassonia: The container hosting the biogas-fueled MAN gaset



Sicily 02

Manager: Private university institution • **Location:** Sicily, Italy
Plant: 1x ZE-50-ULH LT-ORC energy module in outdoor installation
Application: Didactic hybrid plant (gas boiler + thermic solar power)



The young private university that commissioned this plant did so in order to equip itself, as part of its engineering faculty, with what is described as an “experimental prototype subsystem with a modular, diffuse solar thermodynamic system” operating as part of a national research project.

This plant-whose purpose is not so much energy production per se as it is the demonstration of various engineering principles-combines a methane boiler with a series of solar thermal panels of the concentrating type as a thermal source and was built on a small plot not far from the university.

Zuccato Energia won the contract for the construction of the entire energy system, including the hot line (i.e., boiler and heat conveyance systems), cold line (evaporative cooling systems), and energy production module. The latter is a low-temperature organic Rankine cycle (LT-ORC) module model ZE-50-ULH, manufactured by Zuccato Energia itself, in containerized outdoor realization.

The thermal energy required to run the plant is 90% supplied by the high-efficiency, low-emission natural gas boiler produced by ICI Caldaie, while the solar panels - PTMx parabolic systems made by Soltigua, already a partner of Zuccato Energia in the RE.EL.COOP European project for the realization of a hybrid (biomass+solar) plant in Tunis - provide a thermal contribution of about 10% under peak conditions.

Below and to the right you can find a photo gallery related to this plant.



A satellite view of the faculty, with our plant in the lower right corner.



The solar concentrators; behind them, the cooling tower



A detail of the solar panels, supplied by Soltigua



An overview of the solar concentrators area



Behind the cooling tower, the ORC module, in its weatherproof containerized enclosure



The rear of the tower; in background, the boiler, protected by grid fences, and located under a lean-to



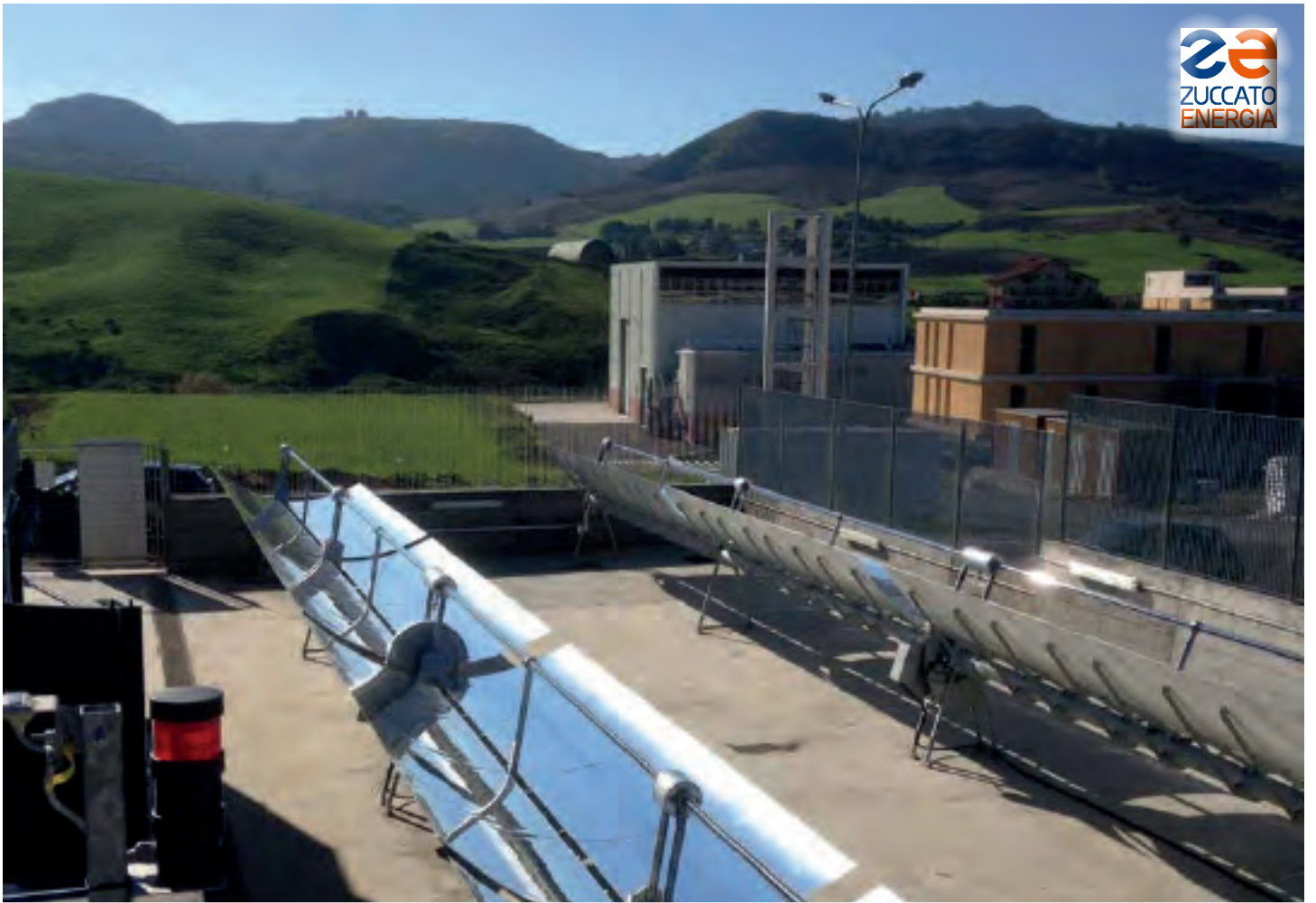
The ICI boiler which supplies most of the thermal energy for the plant.



The pumps which manage the hybrid heating system



The plant commissioning plaque.



Sicilia 02 / Enna : The solar concentrators area



Sicilia 02 / Enna : Foreground to background: the cooling tower, the containerized ZE-50-ULH ORC module, the boiler housing



Sicily 01

Manager: Private Italian Firm • **Location:** Sicily, Italy

Plant: ZE-175-LT ORC power generation module in indoor installation

Application: Power generation from biomass (wood scraps from production of wooden horticultural trays and crates)



The client of this plant is a major company specializing in the production of wooden packaging for agricultural use (mainly fruit and vegetable crates and pallets), which has decided to monetize its production waste by burning it in a special boiler after reducing it to chips for easier handling and combustion.

The heat thus produced is used to generate electricity through a ZE-175-LT organic Rankine cycle power generation module, supplied by Zuccato Energia and housed inside a small, purpose-built building.

This micropower plant uses a 1300 kW mobile grate boiler, equipped with a dust suppression system and connected to an ORC system housed, like all Zuccato Energia systems, within a self-supporting frame (skid) that also includes the control panel and parallel switchboard. The braking resistor panel, which needs more ventilation, in this installation is separate and placed near a dedicated ventilation opening.

Cooling for the condensing phase uses an externally located EvapCo evaporative tower.

The fuel used as mentioned above is untreated virgin wood, an environmentally friendly and renewable energy source made competitive for energy production by state and regional incentives. It has zero ecological impact with respect to CO2 production because as it burns it releases into the atmosphere the same amount of CO2 captured in due course by the plants from which it is derived.

Below and on the opposite page you can find a photo gallery related to this plant.



An aerial overview of the site.



The ZE-175-LT skid being tested before shipping in Zuccato Energia's test area



The skid being loaded on the truck for shipping to Sicily



A general view of Ortoimballaggi's wide loading area.



Part of the warehouse. The client is a leader firm in the production of agricultural packaging



Part of the production line. Only quality, untreated virgin wood is used.



The wooden scraps destined to become fuel for the boiler



The chipping machine reduces the scraps in fast-burning small wooden chips



Wood chips being taken for loading in the boiler's fuel hopper.



The building which hosts the ORC module. Behind, a glimpse of cooling tower and chimney.



A detail of the ORC building. The skid may be glimpsed through the open door



The ZE-175-LT Organic Rankine Cycle energy module, seen from the right side.



The ZE-175-LT ORC module in its skid, seen from the left side.



The 1300-kWT movable grate boiler, fueled by wooden chips.



R to L: boiler, dust trap and and flue gas treatment system



The dust trap. Wood burns cleanly, requiring only minimal flue gas treatment



The wood chips loading screw which brings fuel to the boiler



The cooling tower which dissipates the excess heat of the ORC condensation stage



Sicilia 01 / Ragusa : The ORC system being tested in Zuccato Energia's Test Area



Sicilia 01 / Ragusa : The ORC ZE-175 LT module on site at the customer's premises, viewed from the right side.

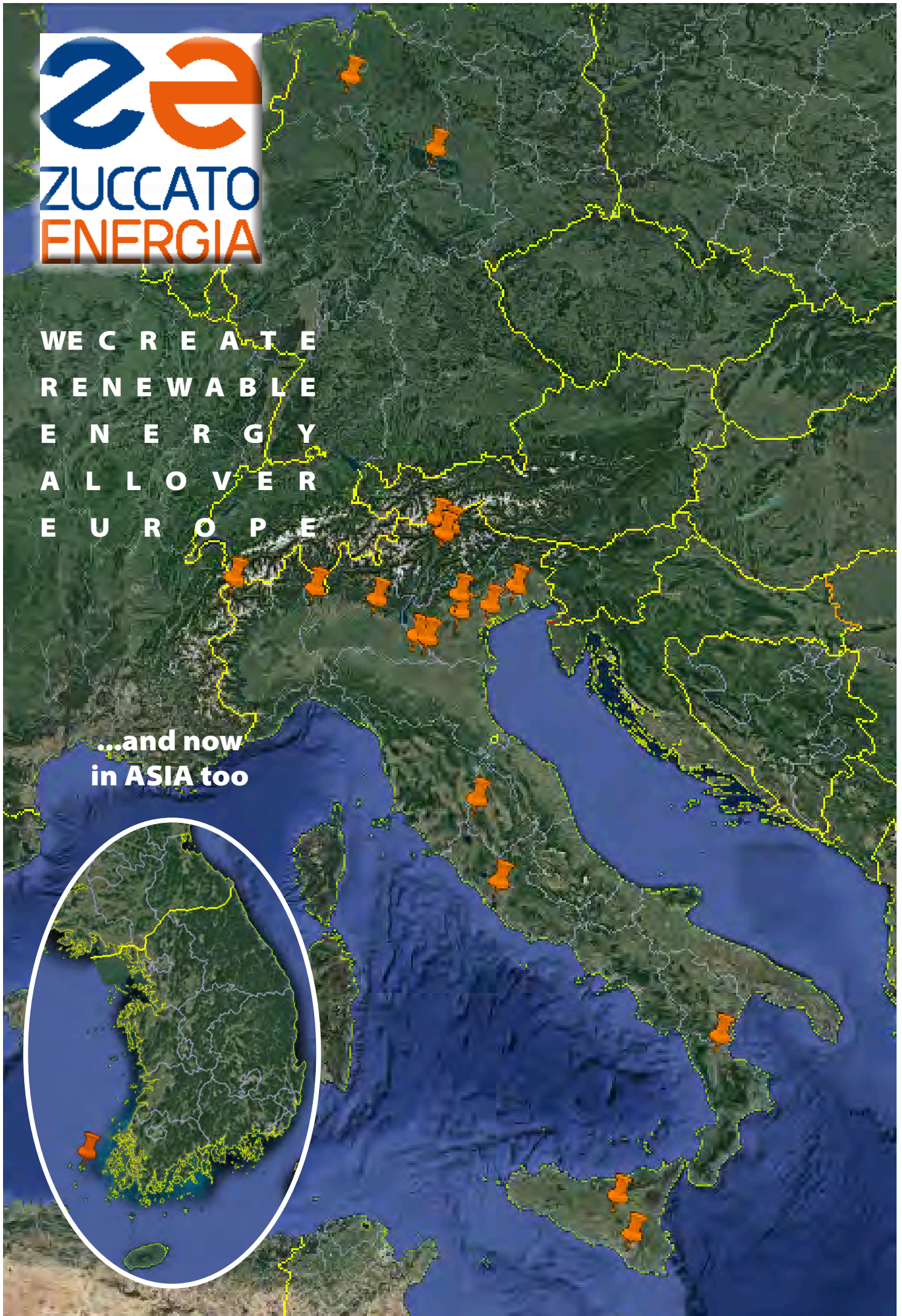


Sicilia 01 / Ragusa : The 1.3MWt moving grate boiler , fed with wood chips (fruit crate production waste)



WE CREATE
RENEWABLE
ENERGY
ALLOVER
EUROPE

...and now
in ASIA too





Lombardy 01

Manager: Private Firm • **Location:** Lombardy, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-100-LT, power 100 kWE (nom.).

Application: Electricity generation from biomass-fired boiler (Waste from sawmill activity)



A sawmill in the Varese area, the client of this plant, decided to convert its processing waste, consisting of wood fragments and bark, into energy by shredding it in a special machine to make it more easily handled and combustible and then burning it in a moving grate boiler that provides a continuous flow of superheated water to an Organic Rankine Cycle (ORC) module for energy production supplied by Zuccato Energia.

The system provided by Zuccato Energia is an ORC module model ZE-100-LT that operates by taking thermal energy directly from the boiler via a superheated water loop.

The use of such an environmentally friendly carrier liquid significantly increases the safety of the system compared to systems that use diathermic oil for this function, which in the face of fractionally better efficiency has the drawback of environmental toxicity and flammability.

Mounted-as in all Zuccato Energia systems-on a self-supporting frame (skid), the ORC module is housed outdoors under a large canopy. A peculiarity of this installation is that given the system's location in a semi-residential area, it has been enclosed in a sound-absorbing enclosure to virtually zero its already low noise emissions.

A further special feature of the system is the reuse of waste heat dissipated in the condensation phase to dry the wood chips destined for the boiler so as to increase their calorific value. The electricity produced is, as usual, fed into the national distribution grid.

The wood chips used as fuel in this installation-because they are derived from untreated virgin wood that has undergone purely mechanical processing-are considered biomass for all intents and purposes and therefore constitute a renewable energy source.

Below and on the opposite page you can find a photo gallery related to this installation.



Aerial view of the farm; right, the canopy under which the plant is housed



The ZE-100-LT skid as it is being loaded for shipment



The skid during installation in the soundproof enclosure.



The sound-absorbing enclosure when completed.



From left to right: the wood chip storage (green), the waste hopper (red),



Detail of the conveyor between the chipper and the woodchip yard



Detail of the wood chip conveyor to the boiler. On the bottom the skid.



Detail of thermal connections to the boiler, fully insulated



The cooling tower: some of the waste heat is used to dry the wood chips.



Lombardia 02 / Varese : Plant overview: ORC module (white), boiler (red) , wood chip storage and loading (green)



Lombardia 02 / Varese: The ORC ZE-100-LT module in its sound-absorbing enclosure (left) and the moving grate caldai (right)



Germany 01

Manager: Private Firm • **Location:** Harz District, Saxony-Anhalt, Germany

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Heat recovery from engine (Genset powered by biogas)



This plant is located in a German town in the Harz district of the state of Saxony-Anhalt.

The purpose of its implementation is the efficiency upgrading of a thermoelectric micro power plant based on a biogas-fueled MAN genset, which benefits from federal incentives provided for microgeneration systems powered by renewable sources.

The system supplied by Zuccato Energia consists of a ZE-50-ULH module with a capacity of 50 kWE and operates by carrying out heat recovery from the cooling jackets and fumes of the micro power plant engine, thus making a significant contribution to the overall productivity of the plant.

The ORC system used in this installation is entirely housed in a small freestanding precast concrete building located by the side of a road in a craft area.

The 'plant is operated in full automation, without the need for an operator as it is operated entirely remotely. The prefabricated structure houses the entire system, including the motor-generator, the ORC system mounted on a self-supporting frame (skid) including turbine, exchangers and control panel, as well as an air-conditioning system for the switchgear part.

Cooling for the condensation phase is provided by a dry cooler placed on the roof of the prefab.

Biogas used as fuel by the motogenerator is an environmentally friendly and renewable energy source made competitive for energy production by state and regional incentives. It has zero ecological impact with respect to CO2 production because as it burns it releases into the atmosphere the same amount of CO2 captured in due course by the plants on which the animals fed.

Below and to the right you can find a photo gallery related to this plant.



The plant in a satellite photo.



The plant as seen from the main road



*The east side of the prefab.
On the roof, the dry cooler of the condensation stage.*



The west side of the facility with the access doorand



The skid seen from the access door



The ORC ZE-50-ULH skid in place inside the building.



*The same skid during shipment
from the Zuccato Energia plant*



The back (south) side of the plant



A detail of the dry cooler placed on the roof



Germany 01 / Sassonia-Anhalt: The west side of the plant with the access door during one of the rare maintenance operations



Germany 01 / Sassonia-Anhalt : The ORC ZE-50-ULH skid in place inside the building. The turbogenerator can be seen in the foreground.



Friuli 01

Manager: Private Firm • **Location:** Friuli-Venezia Giulia, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-150-LT, power 150 kWE (nom.).

Application: Primary production of electricity from poultry-fired boiler



Raising broilers (“broilers”) is the core business of the large poultry company that commissioned Zuccato Energia to build this plant.

That company had the problem-common to many poultry farms-of disposing of the so-called “poultry manure” produced by the raised animals and managed to solve it thanks to a specially designed boiler that serves as a heat source for an ORC system supplied by Zuccato Energia.

The ORC module converts that heat into electricity, which is fed into the grid at the advantageous all-inclusive tariff provided by the Italian state for newly built energy systems powered by renewable sources.

The system provided by Zuccato Energia, consisting of a ZE-150-LT module depowered to 140 kWE at the customer’s request, operates by taking thermal energy directly from the boiler via a superheated water loop, and is housed in a dedicated room.

Due to the customer’s need for a low-voltage connection, the inverter panels were not installed on board the skid as in the standard model, but housed in external cabinets. An additional peculiarity of the system is the use of an air cooling system (dry cooler) instead of the traditional water evaporative tower for cooling in the condensing phase.

The fuel used in this installation is poultry manure (i.e., a mixture of poultry droppings, feathers, feed and bedding). A recent ruling reaffirms that this material is considered biomass and therefore can fuel a renewable energy power plant; such use may allow access to the incentive mechanisms for renewable electricity provided by the July 6, 2012, DM.

Below and on the following pages you can find a photo gallery related to this plant.



Company overview



The storage of fuel (poultry manure)



The boiler (left) and the flue gas treatment plant



The flue gas treatment plant with the cover removed
To show the filter cyclones



Fuel loading hopper and chimney



General view of the fuel loading auger



A detail of the loading auger and burner



General view of the dry cooler



A detail of the dry cooler



General view of the ZE-150-LT module in its shelter



The ORC ZE-150-LT system in detail with the turbine in the foreground



The 150 kWE turbine of the ZE-150-LT system.



The ORC skid control panel



Friuli 01 / Pordenone: The fuel loading hopper (right) and the chimney with its flue gas treatment system.



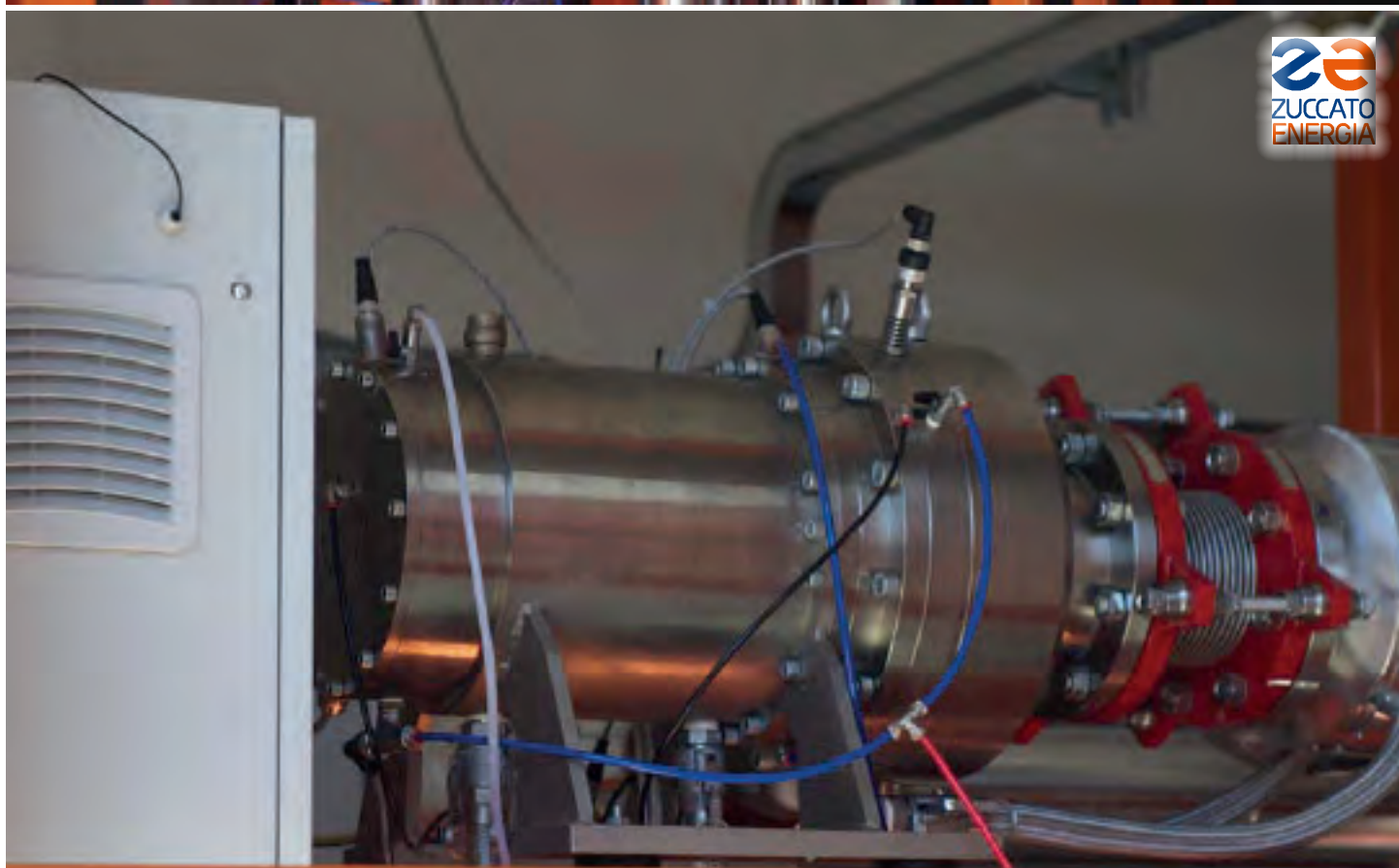
Friuli 01 / Pordenone: The Manure-fired moving grate boiler(left) and the flue gas treatment system.



Friuli 01 / Pordenone: General view of the dry cooler that dissipates heat from the condensing stage of the ORC module



Friuli 01 / Pordenone: Vista generale del dry cooler che dissipa il calore dallo stadio di condensazione del modulo ORC



Friuli 01/ Pordenone: Close-up view of the 150 kW turbogenerator that forms the heart of the ORC module



Aosta 01

Manager: Private Firm • **Location:** Valle d'Aosta, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Thermal recovery from engine (vegetable oil-fueled Daewoo genset)



The client of this plant is a hotel located in the mountains of Val d'Aosta, on the road from Aosta to Courmayeur.

The 'plant is a thermoelectric micro power plant that was born from the desire to take advantage of the incentives provided by the Italian state for newly built energy plants powered by biomass or renewable sources.

The ORC system provided by Zuccato Energia for such a micro power plant consists of a ZE-40-ULH module - that is, a normal ZE-50 ULH de-powered from 50 to 40 kWE to take advantage of the reduced thermal available.

The system recovers heat from the cooling jackets and exhaust fumes of a single Doosan Daewoo P222LE engine modified to run on vegetable oil or animal fats, connected to a 420 kWE generator.

Zuccato Energia, as a manufacturer, has been able to modify the frame (skid) on which this system is mounted, reducing its size by allowing the system to be installed in a space that would otherwise be insufficient to accommodate standard or other manufacturers' modules.

The biofuel currently used (EU-sourced rapeseed oil from a certified and tracked supply chain) is an environmentally friendly and renewable energy source made highly competitive for energy production by state and regional incentives.

The 'electricity produced is totally fed into the grid; the installation, like all biomass installations, is zero-impact as far as CO2 is concerned since the one released by combustion is the one captured by the plants during growth.

Below are some pictures related to this installation.



The hotel facade



The back with the thermal power plant under construction



Interior view of the thermal power plant



Overview of the vegetable oil engine



The vegetable oil engine in more detail



"puffer" (thermal storage tank) and the ORC module



General view of the ORC ZE-40-ULH module from the switchboard side



The ORC ZE-40-ULH module in greater detail



The cooling tower, housed in an underground room with a grid ceiling



Aosta 01 / Aosta: General view of the boiler room - motor (green), thermal buffer (red) and ORC module (white)



Aosta 01 / Aosta: The ORC ZE-40-ULH module in greater detail.



South Tyrol 04

Manager: Private Firm • **Location:** South-Tyrol, Italy

Plant: 2 organic Rankine cycle (ORC) modules mod. ZE-50-ULH, power 50 kWE (each).

Application: Thermal recovery from engine (MAN 420 genset powered by vegetable oil)



The developer of this plant is a well-known construction company based in a small town in the mountains behind Bolzano.

Like others in the area, the plant is a vegetable oil thermoelectric micro power plant created to take advantage of government incentives for microgeneration based on biomass and renewable sources.

The ORC system supplied by Zuccato Energia - consisting of two ZE-50-ULH modules with a capacity of 50 kWE each - recovers heat from the cooling jackets and flue gases of two MAN 420 gensets of 420 kWE each, which are powered by rapeseed oil.

The addition of the ORC module increases the overall productivity of the 'plant from 840 to 940kWE - an increase of more than 10 percent.

An interesting detail of this ORC plant is that the skids on which it is mounted have been customized by making them narrower and longer than traditional skids to make better use of the reduced space available.

The electricity produced is fed into the grid while the residual thermal energy from the condensing stage is used to heat the farm facility, water and concrete plant or given to the district heating plant as needed.

The biofuel used (EU-sourced rapeseed oil from a certified supply chain) is an environmentally friendly and renewable energy source, made competitive by state and regional incentives, and is also CO₂-neutral as that released from combustion is that at its time captured by the plants during growth.

Below and on the opposite page are some pictures of this installation.



The company's main entrance



Overview from the company yard



One of the two customized ZE-50-ULH modules is unloaded from the truck



The cooling towers, located at the back of the building.



South Tyrol 04 / Bolzano: The first ORC ZE-50-ULH module during installation. Note the custom-made skid.



South Tyrol 04 / Bolzano: The complete installation with both modules, flanked by the motors whose heat it recovers.



Lazio 01

Manager: Private Firm • **Location:** Lazio, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (each).

Application: Heat recovery from processes (wood pyrogasification) and engines (syngas-fired)



A large multiplex cinema with adjoining shopping arcade located in the province of Rome is the site of this plant.

There, two Burkhardt gasifiers produce fuel gas (syngas) through the pyrolysis of wood pellets; the syngas produced goes to power two specially modified MAN engines connected to electric generators for a total output of 360kWE.

The ORC module we supplied draws thermal power from both the gasifiers, (heat produced by the pyrolysis process, otherwise lost in the outgoing gases), and the motogenerators (cooling jackets and waste heat contained in the flue gas).

The plant supplied by Zuccato Energia - consisting of a standard ZE-50-ULH module - adds an additional 45 kWE to the 360kWE fed into

the grid by the above-mentioned plant, bringing the total power fed into the grid to 405 kWE and realizing a performance increase of about 9 percent over the "naked" system.

The skid used in this installation is a standard model, and due to its compactness and relative quietness it was possible to install it in a technical space located under the cinema itself, while gasifiers, motors and cooling tower are located outside.

The fuel used by the gasifiers is biomass, in this case locally produced wood pellets. Like all biomass-fueled plants, this installation is carbon-neutral in that the CO2 released from combustion is equal to that captured by the plants as they grow.

Below are some pictures of the installation.



General aerial view of the complex



Side detail of Burkhardt cogenerators



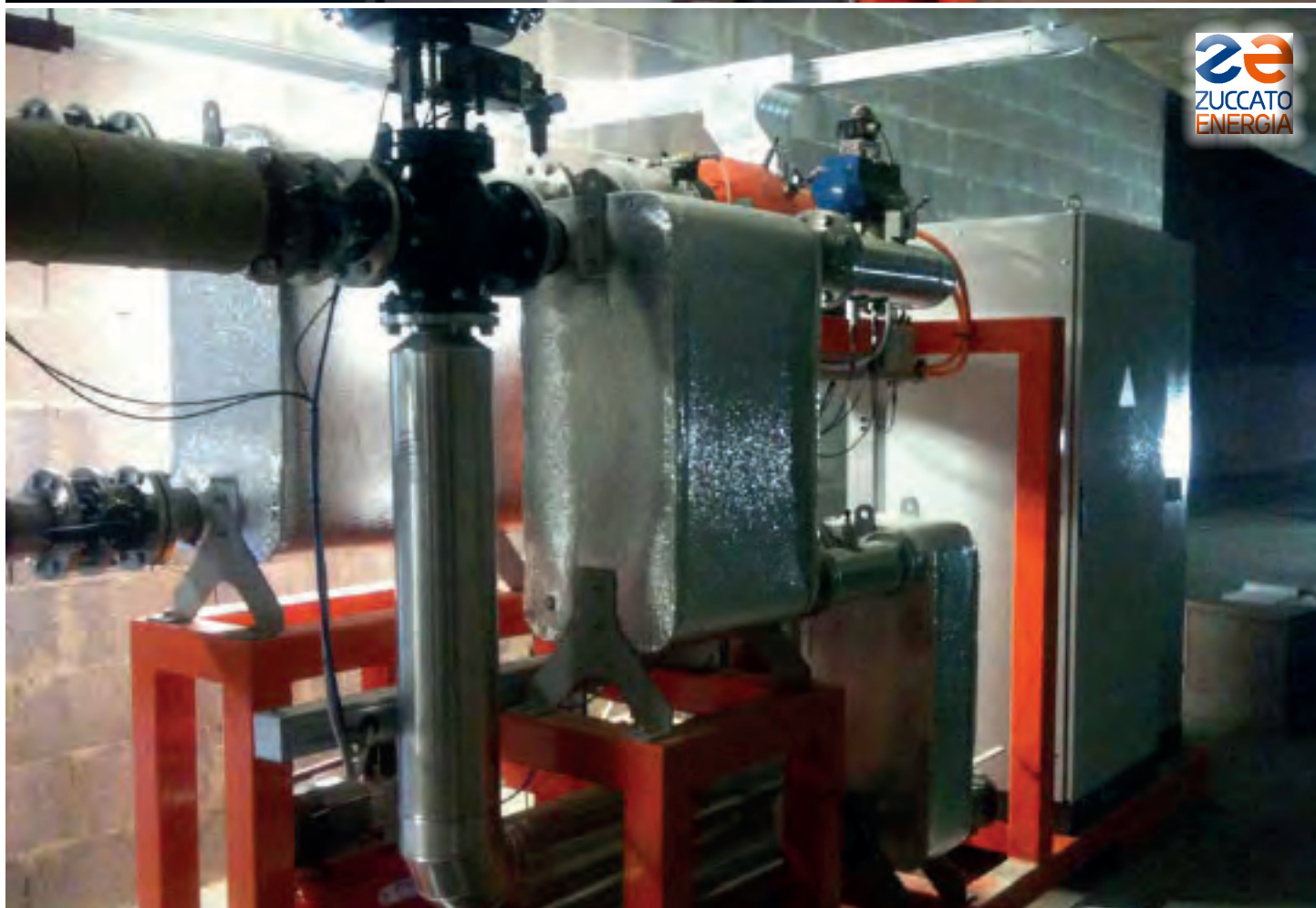
The cogenerators and the cooling tower (blue, right)



The gasifier room with ash discharge in the foreground



Lazio 01 / Roma: ORC module ZE-50-ULH in its underground room located under one of the movie theaters.



Lazio 01 / Roma: ORC ZE-50-ULH module viewed from the heat exchanger side



South Tyrol 03

Manager: Private Firm • **Location:** South Tyrol, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Heat recovery from processes (wood pyrogasification) and engines (syngas-fired)



The client of this plant is a special-purpose company based near Merano, dedicated to the production of electricity from renewable sources, established as a technology demonstrator of Burkhardt gasification technology in association with an ORC system.

In fact, the plant to which our ORC system is connected consists of two Burkhardt gasifiers that produce combustible gas (syngas) through the gasification of wood pellets; the syngas thus produced goes to feed two specially modified MAN engines connected to electric generators for a total output of 360kWE.

The ZE-50-ULH system we supply draws thermal power from both the gasifiers (heat from the gasification process otherwise lost in the outgoing gases) and the motogenerators (heat otherwise lost from the cooling jackets and flue gas).

The system supplied by Zuccato Energia - consisting of a standard ZE-50-ULH module - adds an additional 45 kWE to the 360 kWE fed into the grid by the aforementioned installation, bringing the total power fed into the grid to 405 kWE and realizing a performance increase of about 9 percent over the "bare" system. The skid used in this installation is a standard model, and due to its compactness it was possible to install it in the same technical space used for the gasifiers and engines.

The fuel used by the gasifiers (locally produced wood pellets) is zero-impact in terms of CO2 as that released by combustion is equal to that at its time captured by plants during growth.

Below and on the right page are some pictures related to this installation.



General aerial view of the complex



The skid in place seen from the side of the hydraulic connections



General view of Burkhardt gasifiers



Internal perspective of the plant



South Tyrol 03 / Meran: The ZE-50-ULH low-temperature ORC module at the customer's site, viewed from the side.



South Tyrol 03 / Meran: One of the gasifiers from which the ORC module recovers thermal waste.



Veneto 03

Manager: Local municipal corporation • **Località:** Venice, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Applicazione: Thermal rec. from engines (hot air turbines) / Prod. from biomass (pruning clippings)



The developer of this plant is one of the largest multi-utility municipal companies in Italy. It is a wholly publicly owned company, owned by a consortium consisting of about fifty municipalities in the Veneto region, whose main activity is to provide environmental, water and energy services to its entire catchment area.

The system is installed at that entity's management and operations center in the province of Venice. The thermal source of the system consists of two biomass boilers capable of generating a total thermal output of about 1.3 MWT.

This thermal energy, in addition to ambient heating and domestic hot water production, is used in two alternative modes among themselves

In the first mode, the heat goes to drive two Turbec hot-air turbogenerators capable, under optimal conditions, of feeding a total electrical power of about 160 kWE into the grid. In this mode, the ORC module we supplied-a standard ZE-50-

ULH module-recovers heat from the cooling jackets of the turbines, adding an additional 50 kWE to the power fed into the grid by the plant, realizing a performance increase of more than 30 percent over the "bare" system.

In the second mode, which is activated when there are no conditions to put the turbines into operation, the heat produced by the boilers is instead piped directly to the ORC system, which feeds its nominal 50 kWE into the grid.

The skid used in this installation is a standard model for indoor installation, and because of its compactness it was possible to install it in a pre-existing technical space (a steel grating mezzanine) within the same building that houses boilers and turbines.

The electricity produced by the system in both modes is fed into the grid and helps make the complex energy self-sufficient along with an existing photovoltaic system. The thermal energy from the system, as mentioned above, is used to heat-via a small local district heating network-the various buildings that make up the management and operations center itself.

The boilers burn as biomass virgin wood chips from local environmental and forestry mowing: collected by the municipal utility itself as part of its institutional public green management activities.

This fuel, like all biomass, has zero environmental impact since the CO2 released from combustion is equal to that captured by plants as they grow.

Below are some pictures of the 'installation.



Entrance to the facility



The building housing the system



View of the mezzanine hosting the ZE-50-ULH system



Vista dall'alto del sistema ORC



Top view of the ORC system



Detail of one of Turbec's hot air turbines



Veneto 03 / Venice The ORC ZE-50-ULH module on site at the customer's premises, seen from above.



Veneto 03 / Venice: A detail of the heat exchangers of the ZE-50-ULH organic Rankine cycle module.



South Tyrol 02

Manager: Società privata • **Location:** South Tyrol, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWe (nom.).

Application: Thermal recovery from engines (MAN genset powered by vegetable oil).



The client of this plant, a company specializing in the rental of special vehicles based in the province of Bolzano, has equipped itself with a thermoelectric micro power plant capable of taking advantage of the favorable all-inclusive tariff provided by the Italian state for newly built energy plants powered by biomass or renewable sources.

The system supplied by Zuccato Energia consists of a ZE-50-ULH Organic Rankine Cycle (ORC) module of 50 kWe capacity that performs heat recovery from the cooling jackets and exhaust fumes of a motor-generator (genset) consisting of a MAN 420 model 2842 LE 211 engine powered by vegetable oil connected to a 420 kWe generator.

The connection of the ORC module increases the overall productivity of the plant by more than 10 percent.

The MAN engine used in the genset is, as in many other projects of this kind, a marine engine normally fueled by naphtha specially modified to burn instead vegetable oil, typically rapeseed oil, an EU-sourced fuel from certified environmentally friendly and renewable supply chain made highly competitive for energy production by state and regional incentives.

Like all biomass-derived fuels, vegetable oil is "CO₂-neutral" in that the CO₂ released from its combustion is that at its time captured by plants as they grow.

Below and on the opposite page you can find a short photo gallery related to the installation.



Aerial view of the company



The plant control panels



The ORC module at the headquarters



Vegetable oil tanks during installation.



South Tyrol 02 / Bozen: Plant control room as seen from inside.



South Tyrol 02 / Bozen: The ZE-50-ULH module in its housing.



Veneto 02

Manager: Private Firm • **Location:** Padova, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Heat recovery from engines (2 x Genset MAN powered by biogas from fermentation)

Raising cattle is the core business of the company, which commissioned this plant after deciding to equip itself with a biogas production system fueled by the fermentation of slurry produced by the numerous cattle raised.



The biogas produced by the fermenters goes to feed a thermoelectric micro power plant based on two motogenerators powered by MAN engines, which benefits from the favorable all-inclusive tariff provided by the Italian state for newly built energy plants powered by renewable sources.

The system provided by Zuccato Energia, consisting of a ZE-50-ULH module with a capacity of 50 kWE, recovers the heat otherwise lost from the cooling jackets and fumes of the micro power plant's motors, thus making a significant contribution to the overall productivity of the plant.

Our ORC system in this installation is housed outdoors under a canopy. At the customer's request, the control panel, instead of on board the skid was mounted inside an existing container that also houses the control panels for the motogenerators and fermentation system.

This installation uses an ingenious solution for cooling. In fact, the cooling water - potable but extremely cold as it comes from a local well - after passing through the exchangers is simply fed as drinking water to the livestock, thus preventing the latter from the gastrointestinal problems resulting from ingesting water that is too cold. All this is done in complete safety, as the food-grade stainless steel walls of our condenser exchangers do not give rise to any contamination.

The fuel used (biogas) is an environmentally friendly and renewable, incentivized and "CO2-neutral" energy source since as it burns it releases the same amount of CO2 captured in due course by the plants on which the animals have been feeding.



Aerial view of the company



The ORC skid as it is unloaded at the site



Side view of the plant



The container housing the remote control panels



Detail of the 50 kWE turbogenerator



The cooling towers for the condensing stage.



Lo skid in sede sotto la sua tettoia protettiva



The skid in place under its protective canopy



Panorama of the plant from the south side



Veneto 02 / Padoua: The ORC module (orange) with its terminal block (white) and the containerized control room (green).



Veneto 02 / Padoua: The ORC ZE-50-ULH module seen from the front.



Lombardy 01

Manager: Private Firm • **Location:** Province of Mantua, Lombardy, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Heat recovery from engines (1 x Jenbacher genset fueled by fermentation biogas)



The operator of this plant is a livestock company that specializes in raising pigs, and has decided to equip itself with a biogas production system fueled by fermentation of the slurry produced by the numerous animals raised.

The biogas produced by the fermenters goes to feed a thermoelectric micro power plant based on a 637 kW Jenbacher engine, which benefits from the favorable all-inclusive tariff provided by the Italian state for newly built energy plants powered by renewable sources.

The system supplied by Zuccato Energia, consisting of a ZE-50-ULH module with a capacity of 50 kWE, operates by carrying out heat recovery from the cooling jackets and fumes of the micro power plant engines, thus making a significant contribution to the overall productivity of the plant.

The ORC system used in this installation is entirely housed in an ad hoc container placed outdoors. That container, compact in size (4.2 x 1.5 x h 3.1m), is entirely weatherproof and houses the entire system, including turbine, secondary exchangers, and control panel, as well as an automatic air conditioning system to prevent overheating of the switchgear part in the summer months. Cooling for the condensation phase is provided by an EvapCo evaporative tower located alongside the container.

The fuel used by the motogenerator (biogas) is an environmentally friendly and renewable energy source made competitive for energy production by state and regional incentives. It is CO₂-neutral in that as it burns it releases into the atmosphere the same amount of carbon dioxide captured in due course by the plants on which the animals fed.



General view of fermentation tanks



The slurry loading auger



A glimpse of the container housing the ORC system



The right side of the containerized ORC module.



Lombardy 01 / Mantua: General view of fermenters, motors and the containerized ORC ZE-50-ULH module.



Lombardy 01 / Mantua: The weatherproof containerized ZE-50-ULH module; in the background, the cooling tower.



Veneto 01

Manager: Private Firm • **Location:** Veneto, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Heat recovery from engines (1 x Jenbacher genset fueled by fermentation biogas)



The 'farm responsible for the management of this plant, located in the Venetian region of Italy, is a livestock farm specializing in cattle breeding, and has decided to equip itself with a biogas production system fed by the fermentation of the slurry produced by the numerous animals raised.

The biogas produced by the fermenters goes to feed a thermoelectric micro power plant based on a 637 kW Jenbacher engine, which benefits from the favorable all-inclusive tariff provided by the Italian state for newly built energy plants powered by renewable sources.

The system supplied by Zuccato Energia, consisting of a ZE-50-ULH module with a power output of 50 kWE, generates electricity through heat recovery from the cooling jackets and fumes of the micro power plant's engines, thus making a significant contribution to the overall productivity of the 'plant.

The ORC system used in this installation is entirely housed in an ad hoc container placed outdoors. That container, compact in size (4.2 x 1.5 x h 3.1m), is entirely weatherproof and houses the entire system, including turbine, secondary exchangers, and control panel, as well as an automatic climate control system for the switchgear part. Cooling for the condensation phase is provided by an EvapCo evaporative tower located near the container housing the ORC module.

The fuel used by the motogenerator (biogas) is an environmentally friendly and renewable energy source made competitive for energy production by state and regional incentives. It is "carbon-neutral" in that as it burns it releases into the atmosphere the same amount of CO2 captured in due course by the plants on which the animals fed.



Overview of the 'plant and one of the stables



The plant as seen from one of the stables



One of the two fermenters with the loading auger



The container housing the biogas engine



The ORC module from the control panel side



The ORC module from the control panel side



The ORC module from the control panel side



The cooling tower of the condensing stage



The entire plant as seen from the back



Veneto 01 / Venice: The ORC module in its weatherproof container (left) and the cooling tower (right)



Veneto 01 / Venice: An overview of the entire facility from the rear side.



South Tyrol 01

Manager: Private Firm • **Location:** South Tyrol, Italy

Plant: 1 organic Rankine cycle (ORC) module mod. ZE-50-ULH, power 50 kWE (nom.).

Application: Thermal recovery from engines (1 x MAN genset powered by vegetable oil)



The operator of this plant, located in a small municipality south of Bolzano, is a small-to-medium enterprise that has equipped itself with a thermoelectric micropower plant in order to take advantage of the favorable all-inclusive tariff provided by the Italian state for newly built energy plants powered by biomass or renewable sources.

The system provided by Zuccato Energia consists of an ORC ZE-50-ULH module with a capacity of 50 kWE housed, like all Zuccato Energia systems, on a self-supporting frame (skid) that houses all the main components of the module itself.

In this installation, the ORC module works by performing heat recovery from the cooling jackets and flue gas of the 420 kWE genset based on the MAN 420 model 2842 LE 211 engine fueled by vegetable oil on which the micro power plant is based, increasing the overall productivity of the 'plant by more than 10%.

The eco-fuel used (EU-sourced rapeseed oil from certified supply chain) is an environmentally friendly and renewable energy source made highly competitive for energy production by state and regional incentives. The 'oil is burned in heavy naphtha marine engines converted to use the new fuel and use the mechanical energy produced to drive electric generators.

Like all biomass, such fuel is CO₂-neutral because the CO₂ released from combustion is that at its time captured by plants during growth).



The ZE-50-ULH skid is unloaded.



The ZE-50-ULH skid while being unloaded



The ZE-50-ULH skid while being unloaded



The structure that houses the skid



South Tyrol 01 / Bozen: The vegetable oil engine (left) and the ORC ZE-50-ULH module (right) in their concrete shelter.



South Tyrol 01 / Bozen: A detail of the ZE-50-ULH organic Rankine cycle module in its room.

