

TURNING WOOD RESIDUES INTO RELIABLE POWER

Alessandro Guercio, Turboden's biomass sales and business development manager, discusses why ORC cogeneration fits the energy profile of PB, OSB and MDF production

The production of wood-based panels (such as particleboard, MDF or OSB) is a highly energy-intensive process, as it requires high energy inputs in several phases of the supply chain.

In particular, the drying of wood particles or fibers, hot pressing, and steam generation for the refiner in the case of MDF, represents the most significant consumption items, making thermal energy a key factor for production continuity and efficiency.

Within this sector, waste and processing residues (wood dust, offcuts, scraps, bark) are typically used for thermal energy production, covering a significant portion of the plants' heat demand. This practice is now well established and makes it possible to reduce disposal costs and dependence on fossil fuels, while at the same time improving the environmental profile of the production process.

In this already efficient context, the introduction of cogeneration represents an additional added value. In addition to heat, cogeneration in fact also allows the production of electrical energy from the same wood residues, significantly increasing the overall energy efficiency of the plant. The self-produced electrical energy can be self-consumed within the plant, reducing exposure to costs and volatility in the electricity market.

Cogeneration, therefore, does not replace the traditional use of waste for thermal-only production, but constitutes a technological evolution that enables better valorization of the available biomass. The benefits translate not only into an economic advantage, but also into greater environmental sustainability and greater energy resilience of the production site, strengthening a circular economy model already rooted in the wood panel sector.

ORC TECHNOLOGY SOLUTIONS

In the wood panel sector, biomass cogeneration by means of an ORC (Organic Rankine Cycles) today represents a noticeably simpler and more effective solution to

implement compared to the traditional steam cycle. This greater simplicity is not only plant-related, but also operational, managerial and permitting-related, and is the result of a better fit of ORC to the typical needs of this industrial segment.

Unlike the conventional steam Rankine cycle, ORC makes it possible to operate with boilers that use thermal oil as the heat transfer fluid, avoiding the production and management of high-pressure steam.

This eliminates the need for critical components such as high-pressure boilers, complex water-steam circuits, chemical water treatment systems and stringent inspection practices linked to regulations on steam generators. The result is a more compact, safer plant that is more easily integrable into existing facilities. It should also be noted that thermal oil is the heat transfer fluid widely used in wood based panel production.

In the wood panel context, where the priority is often continuity of operation and reliable availability of process heat, ORC also offers superior flexibility: it better tolerates load variations, frequent start-ups and shutdowns, and enables stable cogeneration even at medium-small sizes, typical of biomass plants supporting production.

A further advantage is the simplicity of valorizing the cogenerated heat in the form of hot water up to 130°C, which can be directly used for drying or preheating, without having to resort to complex intermediate solutions. This makes ORC particularly suitable for plants where heat and power are both strategic but with well-defined temperature levels, as in the case of dryers in the wood panel sector.

In summary, biomass cogeneration with ORC is configured as a more accessible, robust and consistent technology with the industrial requirements of the wood panel sector, reducing the technical and operational barriers typical of the steam cycle and promoting a faster spread of distributed generation from renewable sources.

SELECTION OF WORKING FLUIDS FOR ORC CYCLES

One of the key elements of Turboden's technological success in the ORC field is the careful selection of working fluids, considered not as a standardized choice but as a strategic design variable.

The primary objective is to maximize the thermodynamic performance of the plant, ensuring high conversion efficiency even in the presence of non-conventional thermal sources or with variable temperature profiles. To this end, Turboden uses organic fluids characterized by:

- Saturation curves suitable to reduce or eliminate the risk of condensation in the turbine;
- High thermal stability in the range of expected operating temperatures;
- Good heat transfer properties, enabling more compact and efficient heat exchangers.

Alongside performance, a central role is played by the reduction of environmental impacts. Turboden has progressively oriented its choices toward fluids with:

- low ODP (Ozone Depletion Potential);
- contained GWP (Global Warming Potential);
- compatibility with increasingly stringent environmental regulations, both European and international.

This approach makes it possible to minimize the environmental footprint of the plant throughout the entire life cycle, in line with the typical applications of ORC (biomass, heat recovery, geothermal, renewable sources).

A further selection criterion is safety, both for personnel and for the plant. The adopted fluids are chosen by carefully evaluating:

- flammability and toxicity;
- behaviour in the event of accidental leaks;
- compatibility with materials and with the system's operating conditions.

Turboden's approach is therefore strongly engineered and customized: each project

involves optimization of the working fluid as a function of the thermal source, environmental conditions and regulatory requirements, contributing decisively to the reliability and industrial diffusion of ORC.

ORC WITH HIGH-TEMPERATURE SOURCES

Turboden was the first company to believe concretely that ORC cycles could be effectively used not only for low and medium temperature sources, but also for high-temperature sources, such as the thermal oil in biomass boilers.

Historically, conventional steam Rankine cycles were considered the only technologically mature solution for biomass cogeneration. Turboden instead understood that, thanks to appropriate design of the heat exchangers, the turbine and the appropriate choice of working fluid, ORC could offer decisive advantages also in this field, including:

- greater operational simplicity compared to steam cycles (absence of water, no chemical treatment);
- high flexibility under partial load conditions;
- greater reliability and reduced maintenance costs.

In the case of biomass boilers with thermal oil, adoption of ORC makes it possible to valorize high temperatures (typically 280–320 °C) while maintaining a completely closed and safe cycle. This choice has made it possible to:

- significantly expand the application field of ORC;
- make medium-small size plants economically sustainable;
- facilitate integration between power generation and heat production (cogeneration).

Turboden’s pioneering vision has had a significant impact on the market: what was initially considered an innovative and unconventional approach is today a recognized standard in the biomass sector, with numerous plants operating worldwide.

This ability to anticipate technological developments has consolidated Turboden’s position as a global leader in industrial ORC, demonstrating that extending ORC to high temperatures was not only possible, but also technically and economically advantageous.

GROWTH IN WOOD PANEL SECTOR APPLICATIONS

In recent years, Turboden has recorded an increasing diffusion of its ORC systems in the wood panel sector, an industry characterized by complex energy needs and by strong integration between heat and power production. This trend is the result of ORC’s ability to adapt particularly effectively to the thermal profiles typical of such industrial processes.

In plants for the production of PB, OSB and MDF, the use of mineral thermal oils as heat transfer fluid is established practice,

Overview of Turboden ORC references in Europe for wood-based panels production plants

Plant	Country	Production	Configuration	EL Power (MW)	Th Power (MW)
MDF HALLEIN	Austria	MDF Panels	CHP (110°C)	1,5	8
I-PAN (Bonzano Group) 1 5	Italy	OSB Panels	CHP (90°C)	1	5
SIA Betula Premium	Latvia	Pallet Block	CHP (90°C)	1,8	8
SORTILEMN	Romania	Veneer	CHP (95°C)	1,4	7
Kastamonu Entegre	Turkey	MDF Panels	CHP (90°C)	1	5
Starwood	Turkey	MDF, PB Panels	CHP (110°C)	5,5	25
AGT	Turkey	MDF Panels	Power-only	5	-
Kunkel	France	Pallet Block	CHP (110°C)	1,4	7
Alfa Wood II	Greece	Furniture	Power-only	1	-
Alfa Wood II	Greece	MDF Panels	Power-only	1	-
Kastamonu Entegre	Turkey	MDF Panels	Power-only	13,6	-
Kastamonu Entegre	Turkey	PB Panels	CHP (110°C)	13,6	60
Klaipėdos Mediena (VMG Group)	Lithuania	Furniture	CHP (80°C)	1	4
Tableros Hispanos	Spain	PB Panels	CHP (100°C)	3,6	17,5

with maximum operating temperatures that do not exceed 280 °C. These conditions represent an ideal thermal source for ORC cycles, which allow part of the thermal energy to be converted into electricity without interfering with the continuity and stability of the production process.

A distinctive element of the Turboden approach is the valorization of the cogenerated heat, which is not dissipated but used as a process resource. In the wood panel sector, this heat is particularly valuable for supplying drying systems, which significantly affect the overall energy balance of the plant.

In particular:

- in particleboard and OSB panel plants, the cogenerated heat in the form of hot water up to 120°C is suitable to supply belt dryers;
- in MDF plants, the same heat is used for preheating the air intended for flash dryers, and the water for steam generation intended for the refiner, improving process efficiency and reducing the need for primary fuel.

This integration between electricity generation and thermal use makes it possible to achieve highly efficient cogeneration, perfectly aligned with the needs of the sector. ORC fits into the process without introducing additional operational complexity, maintaining high reliability even in the presence of continuous production cycles and load variations.

The growth of Turboden references in the wood panel segment shows how ORC is not only a technology for energy recovery, but a strategic element for optimizing the industrial layout, capable of increasing the energy self-sufficiency of plants, reducing operating costs and cutting emissions associated with energy production.

Thanks to this consolidated experience, Turboden has established itself as a benchmark technology partner for the wood industry, demonstrating that the combination of high diathermic oil temperatures and intelligent use of condensation heat represents a mature, replicable and economically advantageous solution. •



Turboden ORC technology