

How paper factory Vrancart cut its natural gas consumption by 50%

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INTRODUCTION:

When gas prices spiked and Romania's energy markets turned volatile, paper manufacturer Vrancart faced a choice: absorb the cost or engineer a way out. They chose the latter. The result is a 15 MWth RDF-fired combined heat and power plant, built by HoSt Bioenergy Systems, that now replaces half the factory's natural gas consumption with renewable energy generated from its own waste.

A Romanian paper factory under pressure

Vrancart SA is one of Romania's most established paper and packaging manufacturers. Based in Adjud, in the Vrancea county of eastern Romania. The company produces corrugated cardboard and packaging materials at an industrial scale, serving customers across Romania and international markets. Like every company of its kind, Vrancart's manufacturing process is energy-intensive. Paper production demands continuous, reliable supplies of steam for drying and process heat, alongside electricity to drive its equipment.

For years, that energy came predominantly from natural gas purchased from the grid. It was a model that worked well enough until it didn't. The energy market shock that followed Russia's invasion of Ukraine in 2022 sent gas prices across Europe to levels that fundamentally threatened industrial competitiveness. Romanian industry was far from immune. Gas prices that had once been a manageable operating cost became, almost overnight, a threat to production margins.

Vrancart's leadership recognised that the answer to energy price volatility was not better purchasing contracts or hedging strategies. It was structural. The company needed to generate its own energy, from a fuel source it controlled, at a cost it could predict.

That thinking led directly to the decision to invest in an on-site combined heat and power plant fired by refuse derived fuel (RDF): the combustible waste that Vrancart's own recycling operations already produced in substantial quantities.

The project, delivered by Dutch bioenergy specialist HoSt Bioenergy Systems, was commissioned in 2024. It represents one of the most compelling examples in the European paper industry of how waste-to-energy technology can transform an energy liability into a competitive advantage.

The Challenge: Energy costs, waste management, and regulatory pressure

High dependence on external energy

Paper manufacturing is one of the most energy-intensive industrial sectors. Steam is required throughout the production process, particularly in the drying phase, and must be available continuously and at consistent pressure and temperature. Any interruption in supply carries immediate production consequences.

For Vrancart, this reliance on externally sourced natural gas created two compounding vulnerabilities. The first was cost: energy represented a considerable share of operating expenditure, and that share grew sharply as European gas markets tightened. The second was security of supply: dependence on a commodity traded on volatile international markets introduced a level of operational risk that is, in principle, avoidable for a manufacturer with access to its own combustible waste streams.



Figure 1: Combustion of RDF.



Figure 2: (Above) Fuel - Fine recycling rejects.



Figure 3: (Right) Fuel RDF.

RDF as an untapped fuel source

Vrancart's manufacturing process generates significant quantities of residual material that cannot be recycled back into the production cycle. Paper recycling produces rejects: a mixture of paper fibres, plastics, and other contaminants that are separated out during the pulping and screening process. The plant also generates paper sludge, a wet residual from the water treatment stages of paper production. Together, these streams constitute the raw material for refuse derived fuel.

RDF is produced by shredding, separating and processing residual waste to create a consistent, energy-dense solid fuel. For Vrancart, the availability of in-house RDF production presented an obvious opportunity. Instead of paying to dispose of these waste streams, the company could combust them for heat and power. Additional RDF sourced from external municipal and industrial waste collections could supplement the on-site supply and ensure the plant operates at full capacity year-round.

The calorific value of the combined fuel mix, comprising paper rejects, paper sludge, waste wood, and supplementary municipal waste, made it highly suitable for grate combustion technology. The economic case was compelling: converting a disposal cost into an energy revenue was a double benefit that strengthened the business case for investment considerably.

Regulatory requirements and emission standards

Any plant combusting RDF in the European Union must comply with the Industrial Emissions Directive (IED) and the Waste Incineration Directive (WID), which set stringent limits on particulate emissions, NO_x, SO₂, HCl, CO, dioxins and furans, and heavy metals. Romania, as an EU member state, applies these standards in full. Meeting them requires a comprehensive flue gas cleaning system, continuous emissions monitoring, and careful combustion control.

For Vrancart, meeting EU emission standards was a requirement for the project, not an afterthought. The chosen technology partner would need to demonstrate deep experience in emissions-compliant waste combustion and a track record of installations that had passed regulatory approval processes across multiple European jurisdictions.

As the EU advances its circular economy agenda, the Landfill Directive will prohibit the landfilling of any waste suitable for recycling or energy recovery from 2030. Vrancart is already ahead of this transition. Waste is not discarded, but converted into an energy resource.



Figure 4: Exterior of the CHP plant.

The solution: HoSt's RDF-Fired Combined Heat and Power Plant

What is a combined heat and power plant?

A combined heat and power (CHP) plant, also known as a cogeneration plant, generates both electricity and usable heat from a single fuel source simultaneously. Where a conventional power station converts at best around 35 percent of the fuel's energy content into electricity and discharges the remainder as waste heat, a CHP plant captures that thermal energy and puts it to productive use. Overall system efficiency can reach 88 to 93 percent, and higher still with the addition of a flue gas condenser.

In an industrial setting such as a paper mill, CHP is particularly powerful because the demand for process steam and the demand for electricity are both constant and large. Steam from the boiler drives the production process directly; the steam turbine extracts electrical energy from the pressure differential before the exhaust steam is supplied to the factory. The result is a highly integrated energy system that extracts maximum value from every tonne of fuel combusted.

Selecting HoSt as a partner

Vrancart approached the market with a clear set of requirements: a proven technology for combustion and mixed waste combustion, regulatory compliance with EU waste incineration standards, and a supplier with demonstrable experience.

HoSt Bioenergy Systems, headquartered in Enschede in the Netherlands, met each of these criteria. Founded in 1991 and an independent company since 1999, HoSt has delivered more than 450 bioenergy installations across more than 35 countries. Its biomass and waste combustion portfolio spans grate-fired boiler plants from 8 MWth to 50 MWth and CHP plants up to 12 MWe. The company's combustion technology is designed for fuel flexibility, handling moisture contents from 10 to 55 percent and fuels with low ash melting points that include RDF, and straw. Crucially for Vrancart, HoSt offered a standardised yet configurable solution.

Plant design and integration

The plant is built around a 15 MWth water-tube steam boiler operating at 50 bar and 410 degrees Celsius. The water-cooled furnace is equipped with a membrane wall that provides optimal temperature control across the combustion chamber, ensuring stable, efficient combustion even as fuel composition varies.



Figure 5: Interior of the CPH plant.

Fuel arrives at the plant having been pre-treated through shredding and the magnetic separation of ferrous metals (iron). Vrancart generates the primary fuel supply from its own paper recycling rejects, and paper sludge. This is supplemented by externally sourced RDF from for example waste wood, or municipal waste streams to maintain the consistent capacity of 15 MWth.

The steam generated in the boiler drives a back-pressure steam turbine that produces 1.7 MWe of electricity. Back-pressure turbines are chosen in industrial CHP applications because the steam exhausted at the back-pressure side retains sufficient thermal energy to be useful in the production process. At Vrancart, the exhaust steam is delivered to the factory at 6 barg and 175 degrees Celsius, supplying 18.5 tonnes per hour of process steam directly to the paper production line. This direct integration with the existing factory steam network was engineered to be seamless, with the CHP plant functioning as the primary source of process heat for the mill.

The plant's compact design, with a building height of just 17 metres, was specifically engineered to fit within the available footprint on the Vrancart site. This compactness, achieved without compromising performance, is a hallmark of HoSt's standardised plant configurations.

Figure 6: Festive opening of the plant.



Flue gas cleaning and emissions compliance

Meeting WID and IED emission standards for waste incineration requires a multi-stage flue gas cleaning system. The Adjud plant is equipped with a full suite of cleaning technology. Flue gases leaving the combustion chamber pass through a two-second retention zone at temperatures above 850 degrees Celsius, ensuring complete burnout of organic compounds including dioxins and furans. From there, a cyclone removes coarse particulates before the gas enters the main bag house filter, where fine particulate matter is captured. An additive injection system introduces reagents to neutralise acidic gases, and a DeNOx system controls nitrogen oxide emissions.

Continuous emissions monitoring systems (CEMS) provide real-time verification that the plant operates within permitted limits at all times. The installation was designed and permitted to meet the most stringent EU requirements for waste-to-energy plants, providing Vrancart with regulatory certainty for the full operational life of the asset.

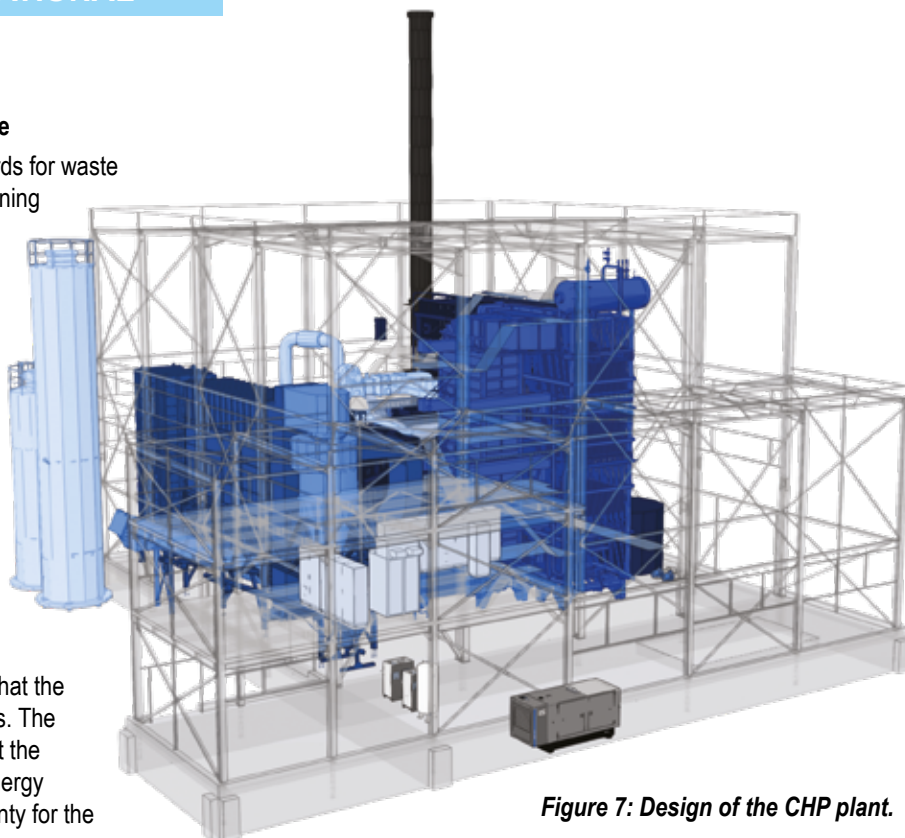


Figure 7: Design of the CHP plant.

Project results: performance, savings, and business

Energy self-sufficiency, savings and business

Since commissioning in 2024, the plant has performed in line with design specifications, delivering 15 MWth of thermal energy and 1.7 MWe of electricity on a continuous basis. The practical outcome for Vrancart is that approximately 50 percent of the factory's natural gas consumption has been replaced by renewable heat generated on-site from its own waste streams. This is a structural shift in the energy profile of the business, achieved through capital investment rather than market exposure.

The back-pressure steam turbine supplies electricity directly to the factory, partially offsetting grid electricity consumption. While the primary value driver in this project is thermal (steam replaces gas), the concurrent electricity generation adds a further layer of energy cost reduction and supports the overall economics of the investment.

Financial return and payback period

The financial case for the Adjud plant rests on two parallel revenue streams: avoided energy costs and avoided waste disposal costs. Before the plant came online, Vrancart was purchasing natural gas to produce the process steam its paper production required, and paying for the disposal of the RDF streams it generated. The plant converts both of these cost lines into assets.

At the energy price levels that prevailed during and after the 2022 European energy crisis, the return on investment for RDF-fired CHP installations of this type is compelling. HoSt cites a typical payback period of two to four years for installations in this category, depending on fuel availability, energy price assumptions, and the scale of the pre-existing waste disposal cost. For Vrancart, the combination of high in-house RDF availability, proximity to external RDF supply, and the sustained elevation of European gas prices created a financial profile at the favourable end of that range.

Steam for industrial processes	18.5 t/h at 6 barg, 175°C
Boiler specification	Water-tube, 50 bar, 410°C
Furnace type	Water-cooled membrane wall
Fuel throughput	5.3 tonnes per hour
Fuel types	Paper recycling rejects, paper sludge, waste wood, municipal RDF
System efficiency	> 90%
Annual operating hours	> 8,300 hours per year
Flue gas cleaning	Cyclone, bag house filter, additive injection, DeNOx, CEMS
Emissions compliance	WID / IED / BREF
Construction start	2023
Commissioning	2024
Building height	17 m (compact design)

Figure 8: Project details.



Figure 9: The process

The comparison before and after the start of the war in Ukraine is instructive as context. European TTF natural gas prices, which had traded below 20 euros per megawatt-hour for most of the decade prior to 2021, surged above 300 euros per megawatt-hour at their peak in August 2022 and have remained structurally elevated compared to historical norms. Ongoing instability in the Middle East has added a further layer of uncertainty, with regional conflict periodically disrupting LNG shipping routes and amplifying price volatility across European energy markets. For a manufacturer consuming gas at industrial scale for process heat, the financial exposure is real and persistent. The CHP plant effectively mitigates the company's exposure to that risk across the operational lifetime of the asset.

Waste processed and environmental impact

The plant processes 5.3 tonnes of RDF per hour, operating at over 8,000 hours per year. This represents a substantial annual volume of waste material diverted from landfill or from third-party waste-to-energy facilities, and converted into productive energy for on-site use. Every tonne of RDF combusted in place of natural gas displaces fossil fuel consumption and reduces the associated CO₂ emissions.

A proportion of the calorific value in RDF derives from biogenic sources (paper fibres, wood, organic sludge), which are considered carbon-neutral in EU regulatory frameworks. The displacement of fossil natural gas delivers a genuine reduction in net greenhouse gas emissions. For a company operating under the European Green Deal policy environment, with increasing investor and customer scrutiny of scope 1 and scope 2 emissions, this improvement in the carbon profile of operations carries both regulatory and commercial value.

Reliability, availability, and first maintenance stop

Industrial energy assets of this complexity are only as valuable as they are reliable. A CHP plant that supplies process steam to a continuous paper production line must operate with high availability; any unplanned outage has an immediate impact on the manufacturing schedule.

The Adjud plant has demonstrated the high availability that HoSt's technology is designed to achieve, with an availability rate consistent with the greater than 8,300 hours per year specification. The planned maintenance stop, an important early milestone for any newly commissioned installation, confirmed that the plant's systems were performing as designed.

The simplicity and accessibility of HoSt's equipment design, which is engineered to minimise both the frequency and duration of maintenance interventions, is a factor that Vrancart's operations team noted specifically.

Conclusion: RDF-Fired CHP as a proven route to energy independence

The Vrancart project in Adjud demonstrates, with precision, the value that RDF-fired combined heat and power technology can deliver for energy-intensive manufacturers who generate combustible waste. In a single investment, Vrancart has achieved three objectives that previously required separate strategies: it has reduced its energy costs, it has eliminated a waste disposal burden, and it has transformed its exposure to volatile external energy markets from a structural vulnerability into a managed, predictable operating cost.

The technology itself is well-suited to replication. Paper mills, cardboard producers, and other manufacturers in the paper and packaging sector almost universally generate RDF-grade waste streams. The fuel is available, the combustion technology is proven, and the regulatory framework for compliant operation is well established across the EU. What the Vrancart case adds to this picture is a real-world performance reference: a plant that was commissioned in 2024, is operating at design capacity, has completed its first planned maintenance stop, and is delivering the financial returns that were projected.

For other manufacturers facing the same structural challenge, the question is less whether this technology works and more whether the conditions are in place to make the investment case compelling. Given the sustained elevation of European energy prices, the increasing regulatory pressure on waste disposal, and the growing commercial value of demonstrable progress on carbon reduction, those conditions are, for many companies, already met.

"RDF-fired CHP is one of the most effective routes available to industrial manufacturers seeking genuine energy independence. The Vrancart project shows what is possible when the right technology, the right fuel supply, and the right engineering partner come together. We are proud to have delivered a plant that is now a cornerstone of Vrancart's energy strategy, and we look forward to more projects like it across the paper and packaging sector."

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