

HEAT  
ELECTRIFICATION

# High-Temperature Heat Pump and MVR Technologies

Turboden S.p.A.

A Group Company of  MITSUBISHI HEAVY INDUSTRIES



# Over 45 Years of a Viable Sustainability



Since 1980, Turboden S.p.A. is a pioneer in the **energy transition**, offering technological solutions to industries and utilities for power generation and heat electrification.

The strength of being part of **Mitsubishi Heavy Industries group**, together with the **extensive experience** in engineering, supplying, and maintaining **low-carbon industrial solutions**, make Turboden a dependable partner for innovative systems.

Having established itself as a **world-leading company in sustainable power production**, with 470+ Organic Rankine Cycle (ORC) plants in more than 50 countries, Turboden further expands its expertise by developing **advanced Heat Pumps and Mechanical Vapor Recompression (MVR) solutions**, including the delivery of the world's largest steam-generating heat pump.



## Our Mission

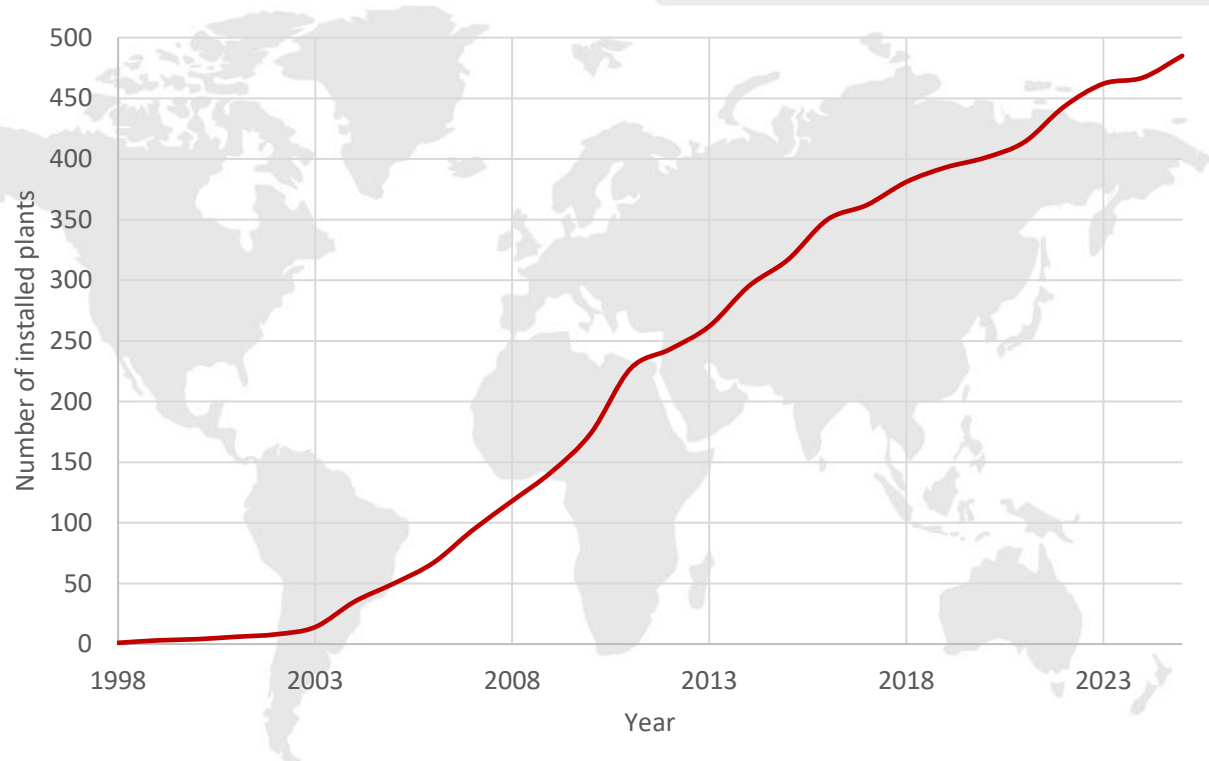
*We provide unique, reliable and advanced technologies founded on our core proprietary turbomachinery, with the aim of maximizing the value of renewable resources and energy efficiency.*

## Our Vision

*We accelerate the transition to a world powered by low-carbon technologies.*



# Global and Proven Experience



Overall capacity  
installed  
**1+ GWe**



Largest plant  
under construction  
**300 MWe**



Largest plant  
in operation  
**29 MWe**

Worldwide presence in  
**50+ countries**

Around  
**470+ plants**



**HEAT  
ELECTRIFICATION**

3 units, 33 MWth



**HIGH TEMPERATURE  
POWER GENERATION\*  
+ COGEN**

450+ units, 840 MWe



**GEOTHERMAL  
POWER GENERATION**

24 units, 457 MWe

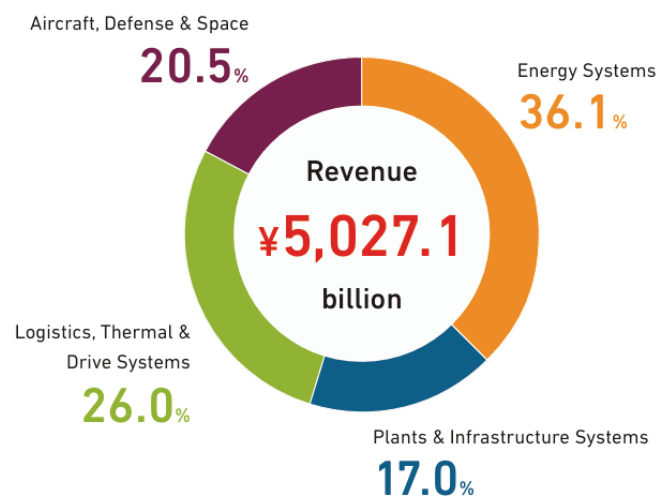
Last update: July 2026  
\* ORC and gas expanders included.

# MHI at a Glance



MHI Group manages its operations through **three business domains and five segments**. We have grouped these business domains and segments based on the similarity of their respective customers and product characteristics into four reporting segments: **Energy Systems**; **Plants & Infrastructure Systems**; **Logistics, Thermal & Drive Systems**; and **Aircraft, Defense & Space**.

Composition of Revenue by Segment (FY2024)

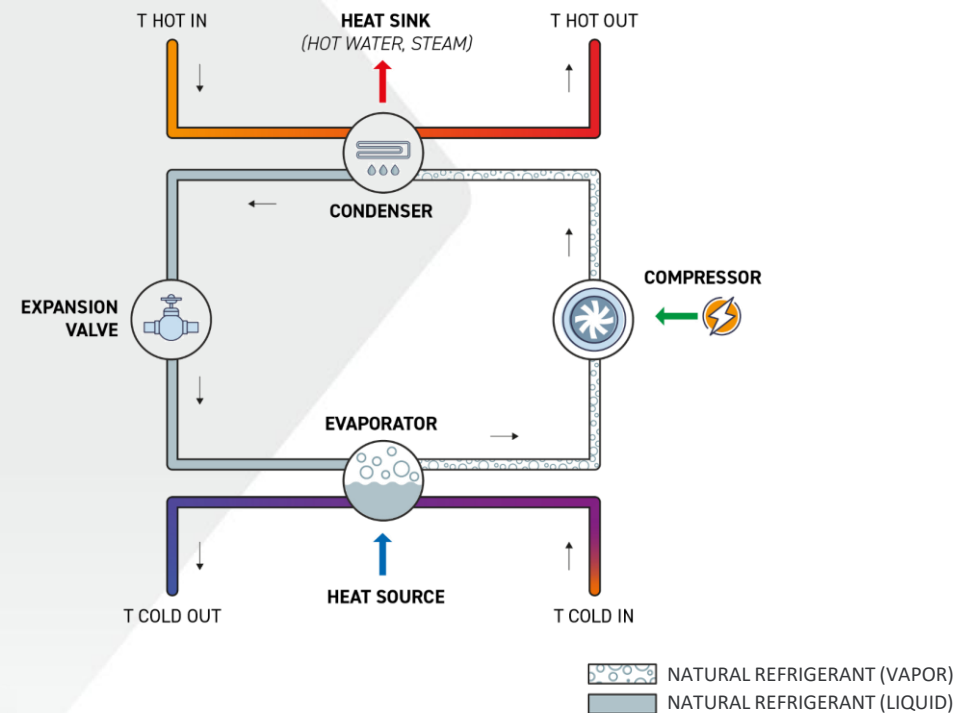


|                |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Energy Systems | <b>Main Businesses</b> <ul style="list-style-type: none"> <li>Gas &amp; steam power systems*</li> <li>Nuclear power systems</li> <li>Aero engines</li> <li>Compressors</li> <li>Marine machinery</li> </ul>                                                         | <b>Internal Organizations and Major Subsidiaries</b> <p>Energy Systems<br/>Nuclear Energy Systems</p> <ul style="list-style-type: none"> <li>Mitsubishi Heavy Industries Aero Engines, Ltd.</li> <li>Mitsubishi Heavy Industries Compressor Corporation</li> <li>Mitsubishi Heavy Industries Marine Machinery &amp; Equipment Co., Ltd.</li> </ul>                                                                         |  |
|                | <b>Main Businesses</b> <ul style="list-style-type: none"> <li>Metals machinery</li> <li>Commercial ships</li> <li>Environmental systems</li> <li>CO<sub>2</sub> capture systems</li> <li>Engineering</li> <li>Machinery systems</li> </ul>                          | <b>Internal Organizations and Major Subsidiaries</b> <p>Plants &amp; Infrastructure Systems<br/>→ GX Solutions<br/>Machinery Systems</p> <ul style="list-style-type: none"> <li>Primetals Technologies, Limited</li> <li>Mitsubishi Shipbuilding Co., Ltd.</li> <li>Mitsubishi Heavy Industries Environmental &amp; Chemical Engineering Co., Ltd.</li> <li>Mitsubishi Heavy Industries Machinery Systems, Ltd.</li> </ul> |  |
|                | <b>Main Businesses</b> <ul style="list-style-type: none"> <li>Material handling systems</li> <li>Engines</li> <li>Turbochargers</li> <li>HVAC systems</li> <li>Automotive air-conditioning system</li> </ul>                                                        | <b>Internal Organizations and Major Subsidiaries</b> <p>Logistics, Thermal &amp; Drive Systems</p> <ul style="list-style-type: none"> <li>Mitsubishi Logisnext Co., Ltd.</li> <li>Mitsubishi Heavy Industries Engine &amp; Turbocharger, Ltd.</li> <li>Mitsubishi Heavy Industries Thermal Systems, Ltd.</li> </ul>                                                                                                        |  |
|                | <b>Main Businesses</b> <ul style="list-style-type: none"> <li>Commercial aviation</li> <li>Defense aircraft</li> <li>Missile systems</li> <li>Naval ships</li> <li>Maritime systems (torpedoes)</li> <li>Special vehicles (tanks)</li> <li>Space systems</li> </ul> | <b>Internal Organizations and Major Subsidiaries</b> <p>Commercial Aviation Systems<br/>Integrated Defense &amp; Space Systems</p> <ul style="list-style-type: none"> <li>MHI RJ Aviation Inc.</li> </ul>                                                                                                                                                                                                                  |  |

**Turboden** is part of GX (Green Transformation) Solutions Division



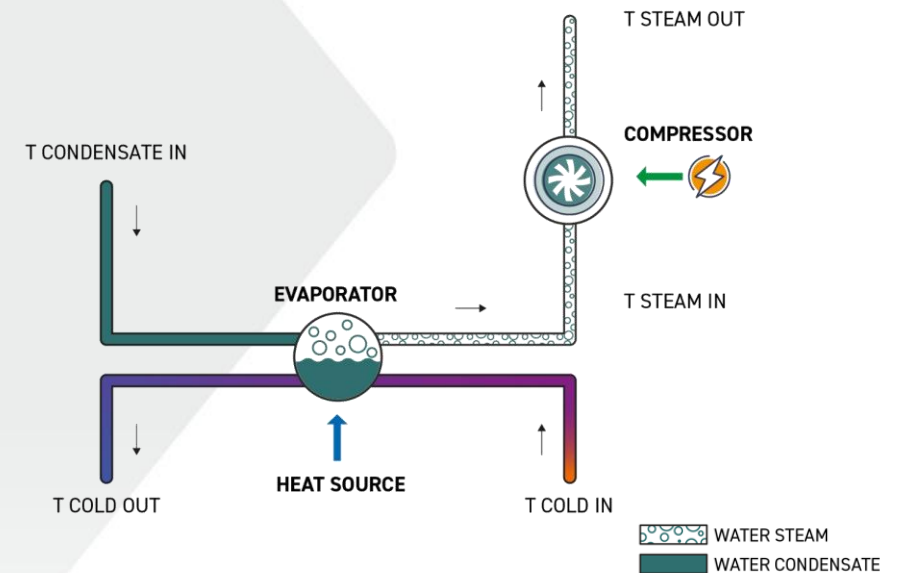
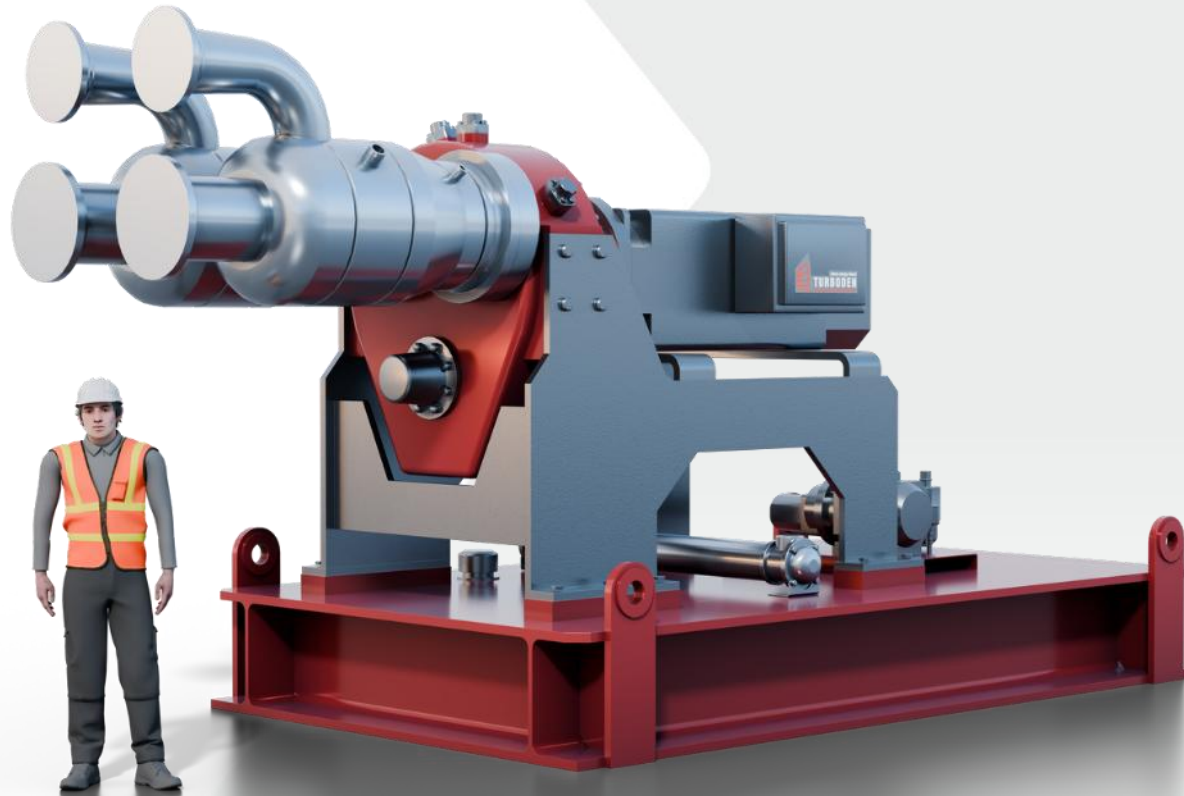
# A Portfolio to Cover Large Sizes and High Temperatures



## LHP

Large Heat Pumps (LHP) are utility-scale heating plant, designed to transfer large quantities of heat from a lower temperature source to a higher temperature heat user, such as district heating grid or industrial process.

# A Portfolio to Cover Large Sizes and High Temperatures



## MVR

Mechanical Vapor Recompression (MVR) system, acting as an open cycle water heat pump, increases both the temperature and the pressure of a water stream, to generate steam at specific conditions needed.

# Turboden Compressor Technologies Portfolio

## TURBODEN HIT COMPRESSOR\*



Integrally geared compressor double stage overhung

- Heavy duty machine designed for continuous operation with reduced maintenance
- Thermal power range: 5 MW to 30 MW
- Impeller diameter from 200 to 1,200 mm
- Enhanced flexibility for optimal part load operation and quick process adaptation
- Maximum safety with no harmful fugitive emissions

\*Patent granted

## MITSUBISHI HEAVY INDUSTRIES COMPRESSOR



API617 beam type compressors

- Special Purpose API centrifugal compressor designed for critical process operation
- Thermal power up to 80 MW
- Impellers diameter up to 1,700 mm
- High reliability and availability
- DGS sealing system with leakage recovery system

## TURBODEN STEAM COMPRESSOR

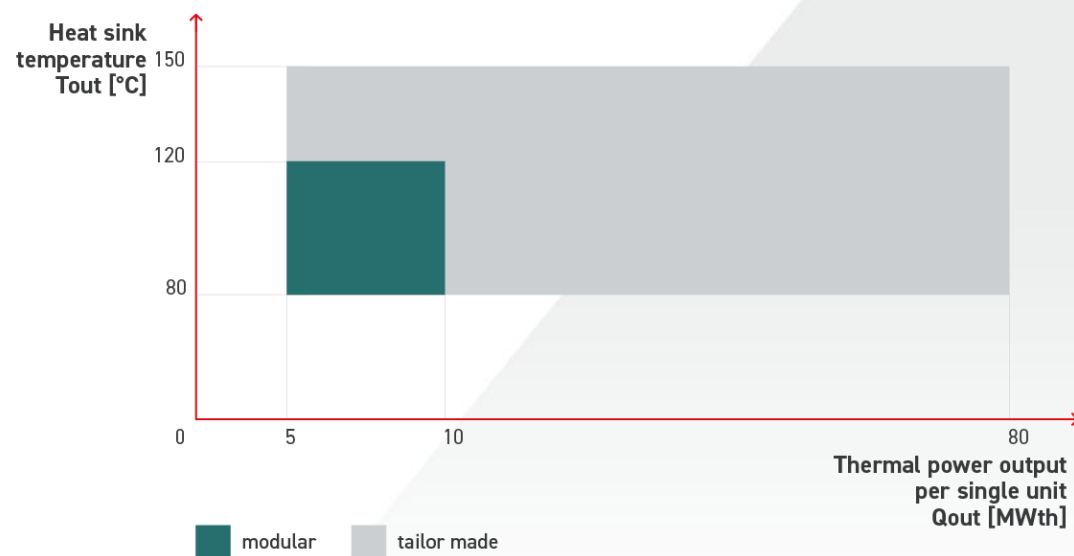


Integrally geared multistage centrifugal compressors

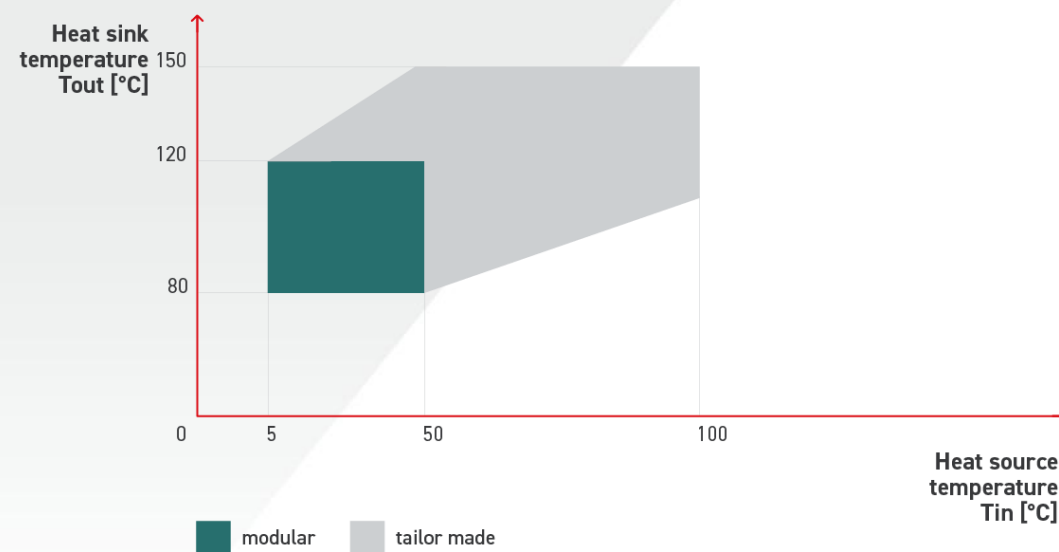
- Innovative product line designed for water steam compression
- Mechanical power range: from 100 kW to 10 MW
- Design conditions: up to 30 bar(a)/285°C (tailor-made configuration can be discussed on project specifics)
- Fluids: steam
- Suitable for MVR and direct steam recompression

# High-Temperature Heat Pumps for Hot Water Production

THERMAL POWER OUTPUT VS HEAT SINK TEMPERATURE

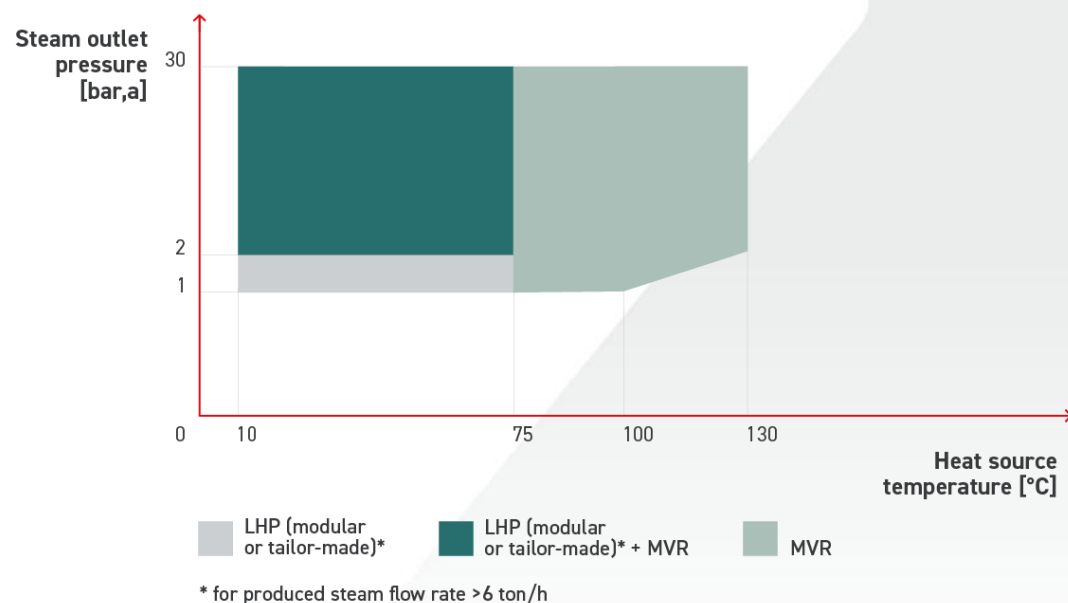


HEAT SOURCE TEMPERATURE VS HEAT SINK TEMPERATURE

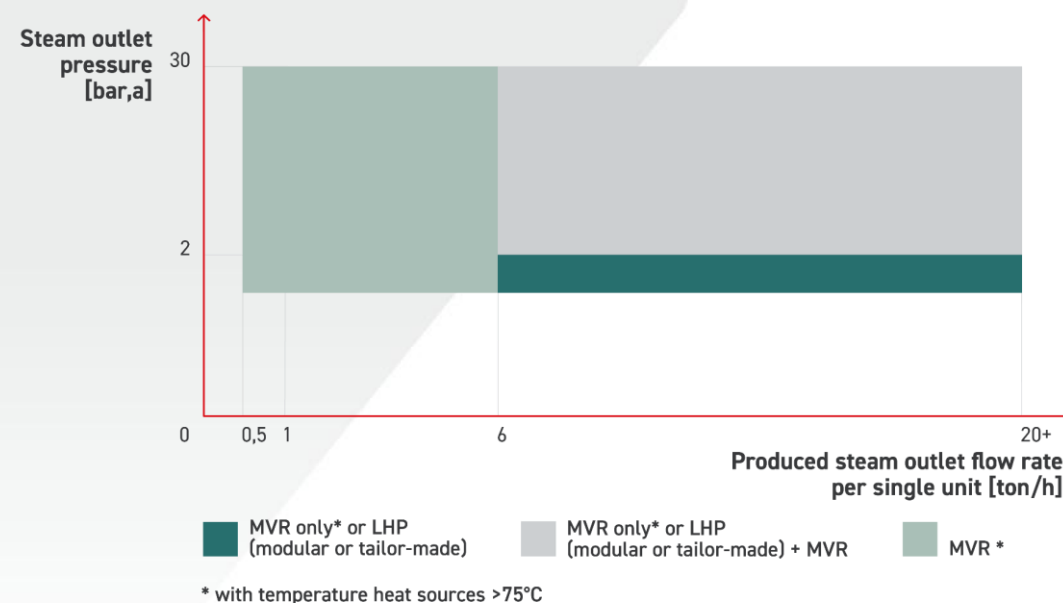


# High-Temperature Heat Pumps for Steam Generation

HEAT SOURCE TEMPERATURE VS STEAM OUTLET PRESSURE



PRODUCED STEAM OUTLET FLOW RATE VS STEAM OUTLET PRESSURE



# Dependable Partner to Reduce Carbon Footprints



Turboden delivers reliable heat-upgrade systems designed to decarbonize the following sectors:



**district heating networks** exploiting multiple heat sources including cooling water from industries



**industrial applications**, such as pulp & paper, refinery & petrochemical, chemical & pharmaceutical, food & beverage



**Carbon Capture and Storage (CCS)** improving sequestration efficiency by up to 20% compared to conventional systems

# Flexibility to Manage Different Fluids



Natural refrigerants with low ODP and GWP<sup>1</sup>



Cost effectiveness (hydrocarbons up to 10 - 15 times lower than equal performances HFOs)



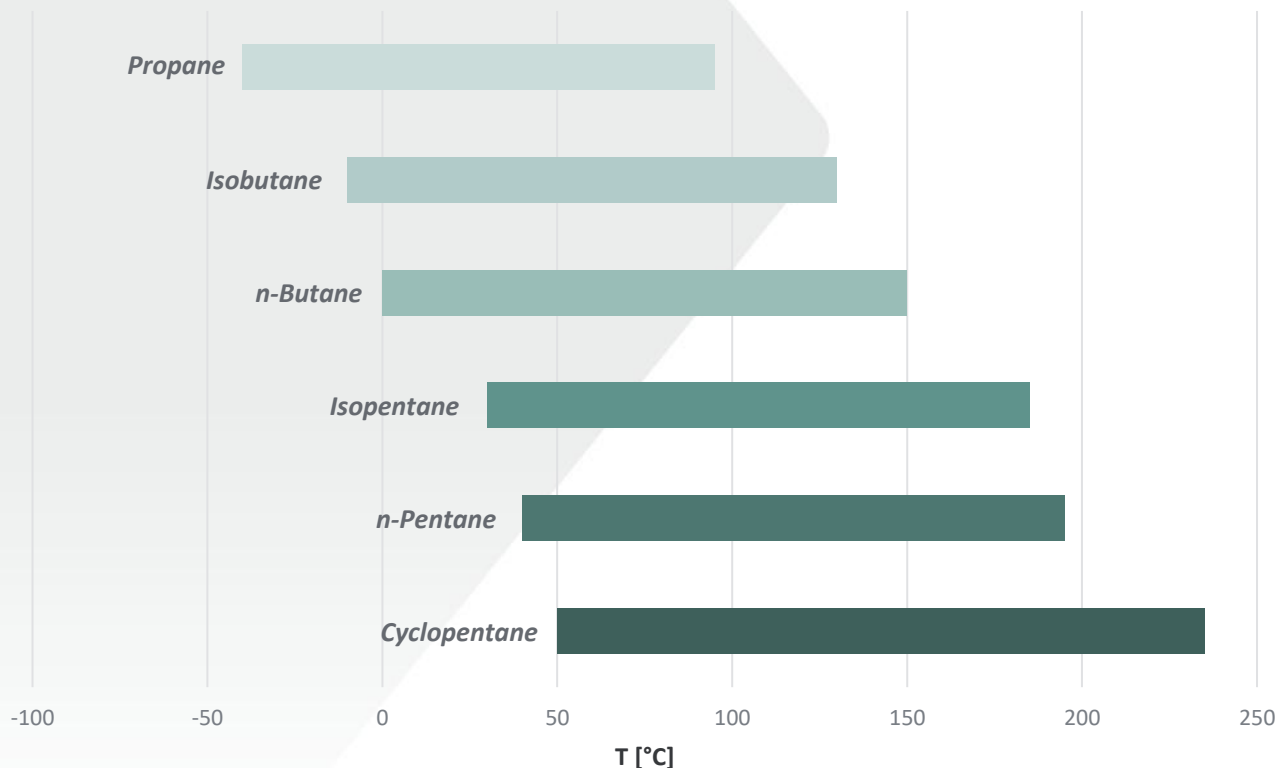
HFOs within possible PFAS ban<sup>2</sup>



High temperature suitable



Flammability handled as usual best practice in industrial plants<sup>3</sup>



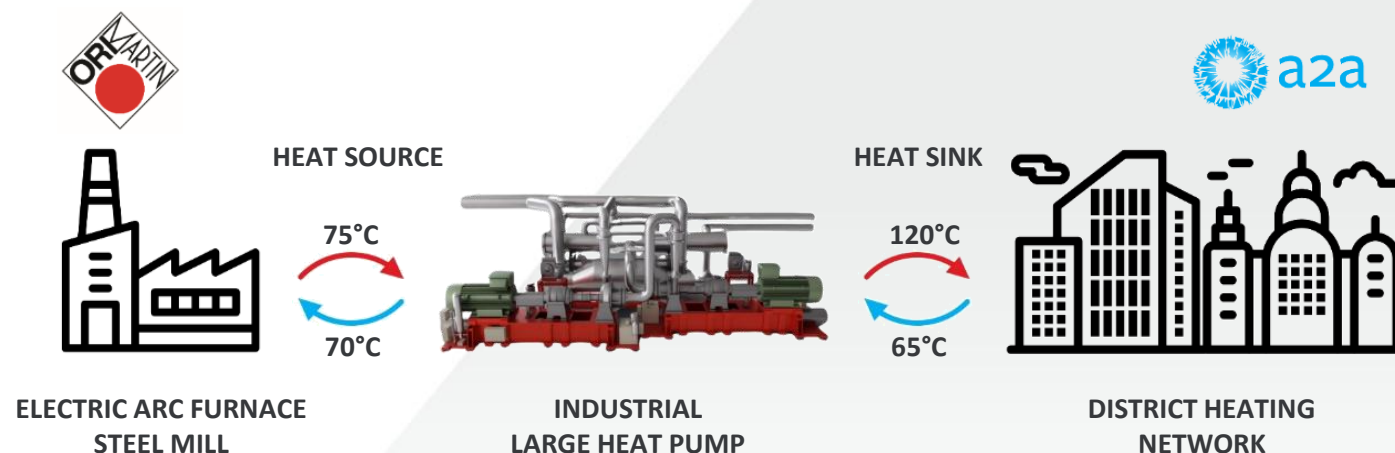
<sup>1</sup> GWP: Global Warming Potential. ODP: Ozone Depletion Potential.

<sup>2</sup> Council of the EU and the European Council, <https://www.consilium.europa.eu/en/press/press-releases/2023/10/05/fluorinated-gases-and-ozone-depleting-substances-council-and-parliament-reach-agreement/>.

<sup>3</sup> HEX construction according to ASME and international standard. ATEX requirements: IEAC 600079-10 as ZONE 2. Ventilation according to EN378. Turboden experience with 40+ reference plants in operations adopting hydrocarbons.

# Case History: ORI Martin Steelworks

Instead of wasting the heat generated during the steelmaking process and dissipated through cooling towers, the customer enhanced its value by installing a LHP to upgrade the heat for district heating, taking advantage of a more efficient and sustainable solution.



## PROJECT FEATURES

- Country: Italy, in operation since 2023
- Size: 6 MWth (equivalent to 3,500 houses)
- Exploitation of steel mill waste heat to serve local district heating network
- Output: pressurized water at 120°C delivered to the district heating network

## TECHNICAL FEATURES

- Centrifugal innovative compressor designed by Turboden
- LHP working fluid: synthetic refrigerant



**WATCH THE VIDEO**

# Case History: ORI Martin Steelworks

LOW-PRESSURE  
COMPRESSOR SKID

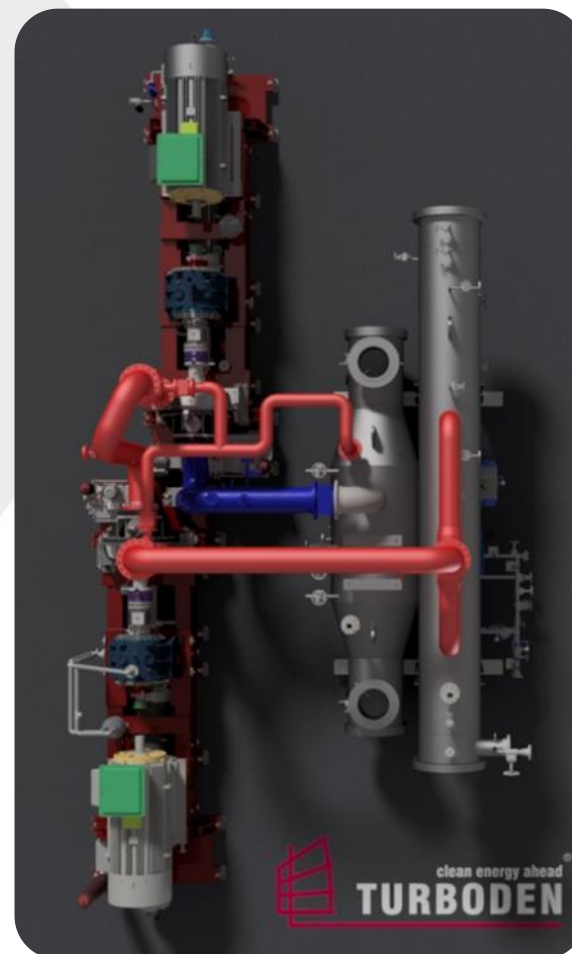
CONDENSER

SUB-COOLER

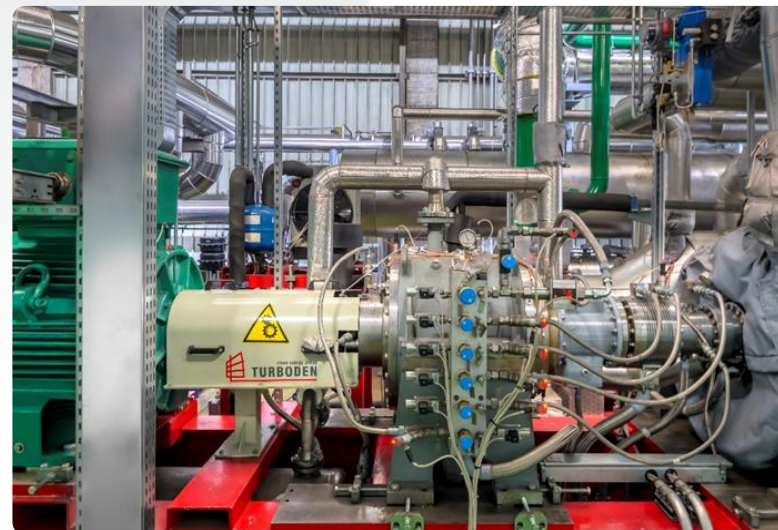
EVAPORATOR

HIGH-PRESSURE  
COMPRESSOR SKID

clean energy ahead  
**TURBODEN**

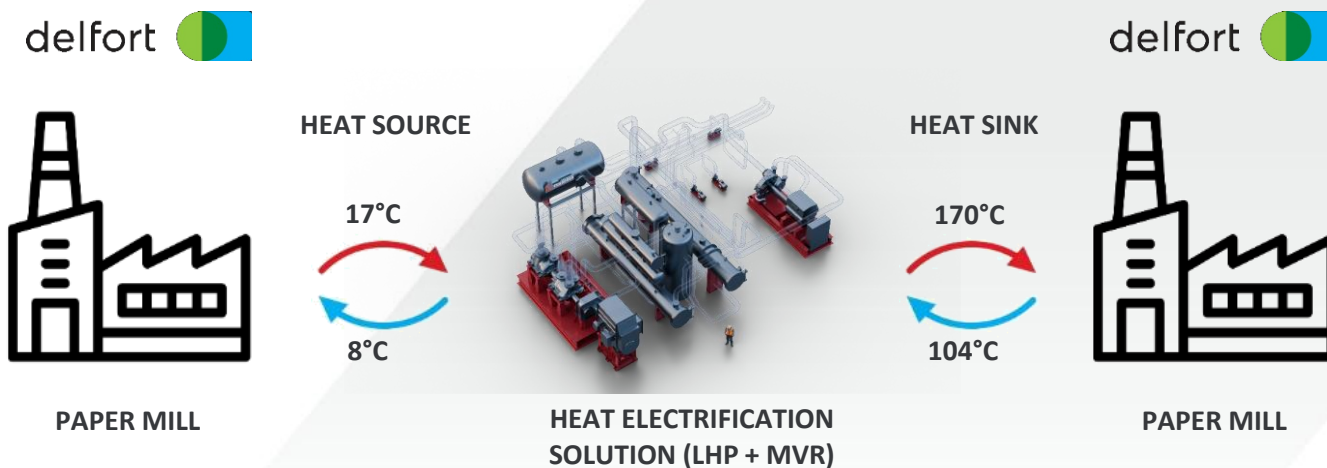


# Case History: ORI Martin Steelworks



# Case History: Delfort Paper Mill

The customer valorized the low-temperature wastewater from the paper mill by installing an innovative heat-upgrade solution, a LHP together with an MVR, to produce valuable steam for the paper mill itself.



## PROJECT FEATURES

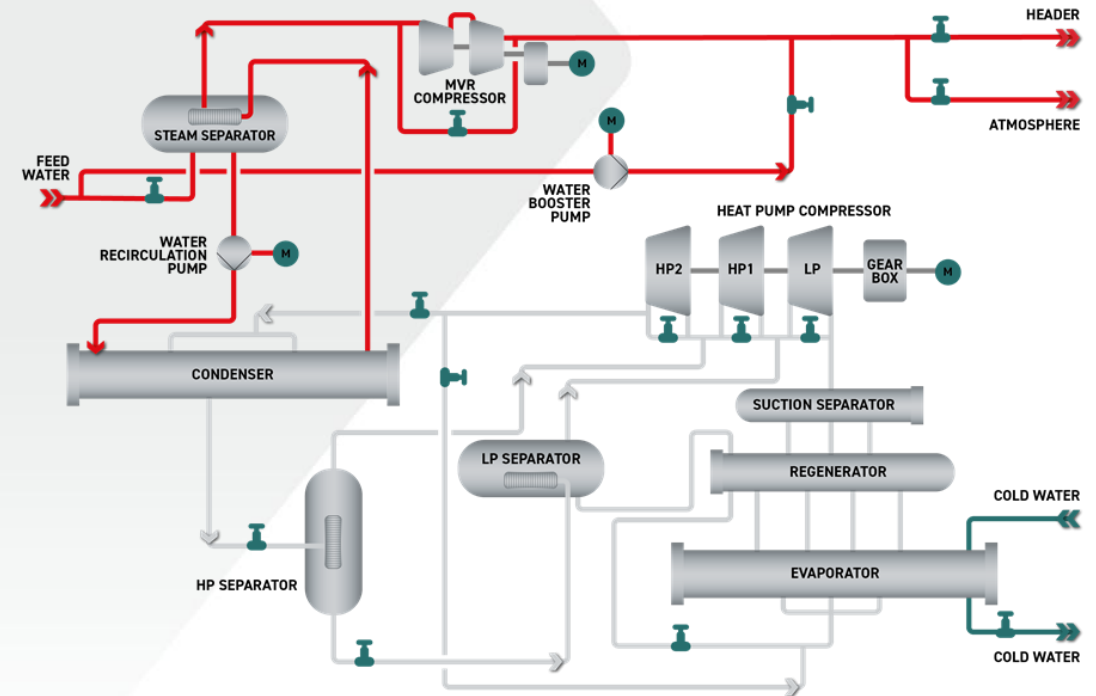
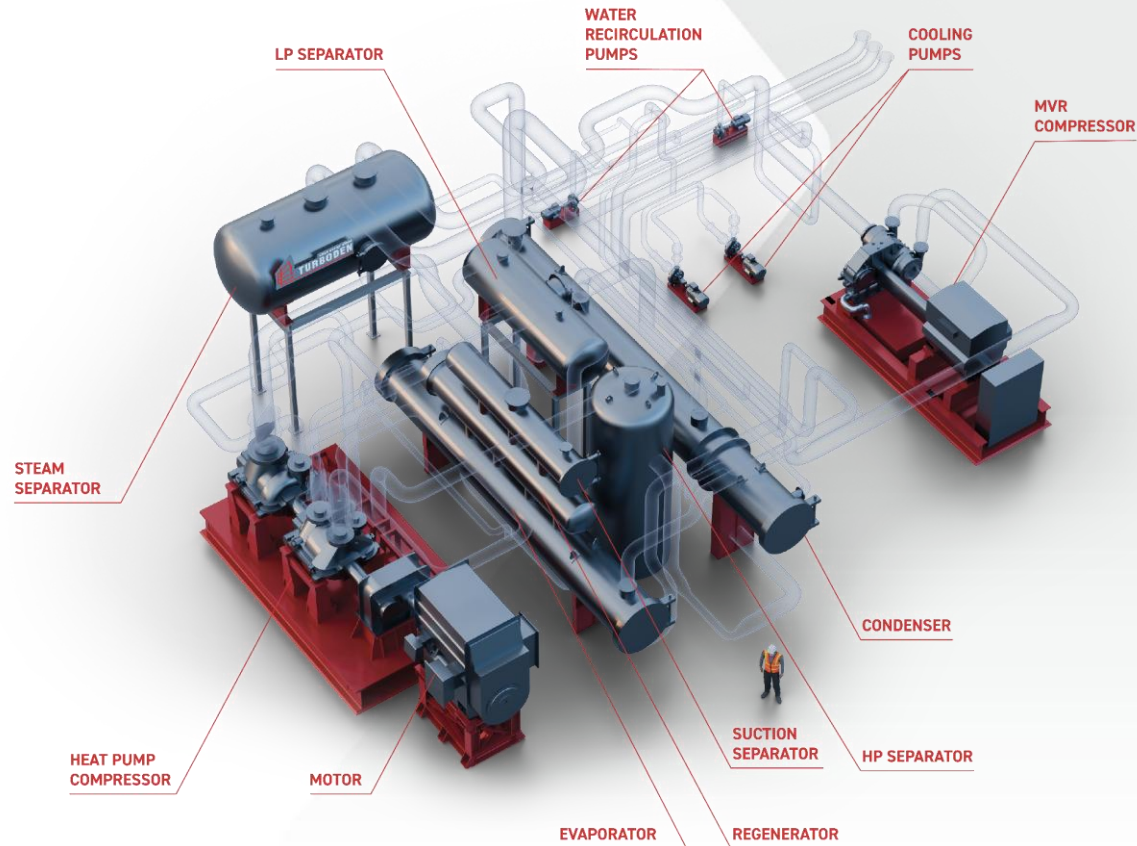
- Country: Finland, in operation since 2026
- Size: 12 MWth
- Exploitation of paper mill waste heat to generate steam at 3.4 bar(a) for the process
- Output: superheated steam at 170°C delivered to the paper mill

## TECHNICAL FEATURES

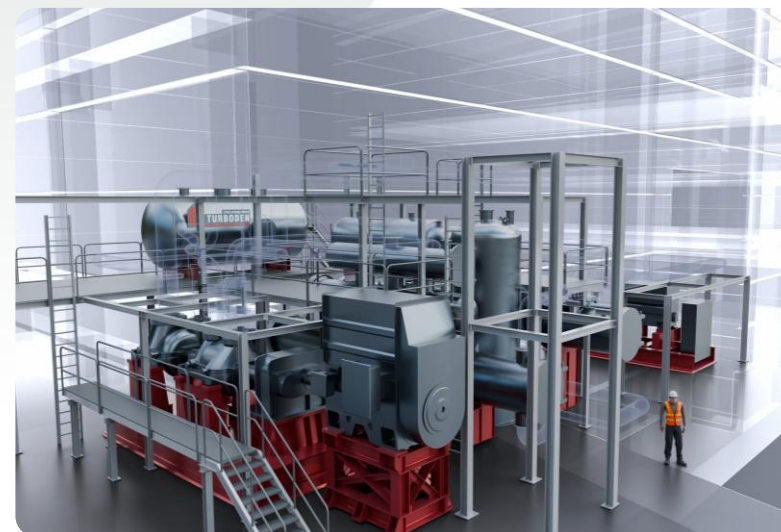
- Integration of LHP with MVR to provide high-temperature steam at high efficiency (COP 2)
- Centrifugal MCO compressor
- LHP working fluid: natural refrigerant



# Case History: Delfort Paper Mill

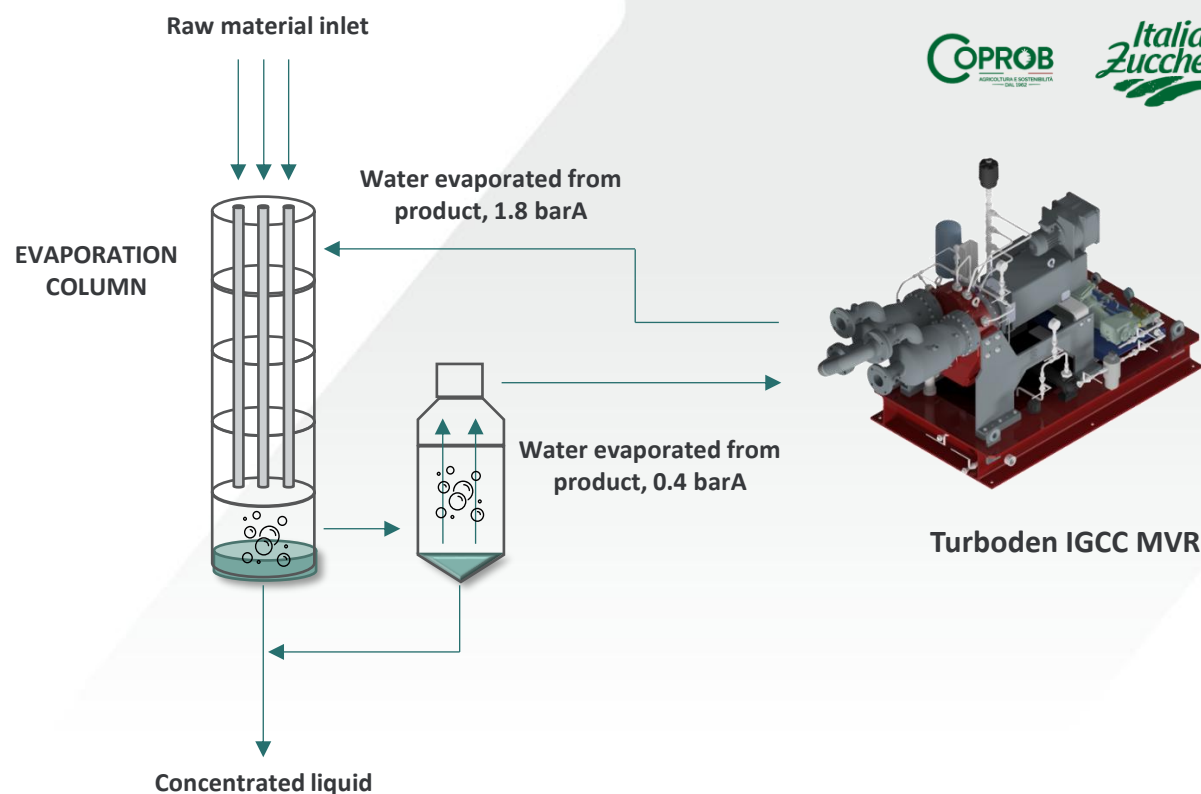


# Case History: Delfort Paper Mill



# Case History: Co.Pro.B. Italia Zuccheri

In the process, heat dries the final product. The resulting water vapor is compressed with a Turboden IGCC compressor and condensed releasing its latent heat, which is efficiently reused to further enhance the evaporation process. A single Turboden MVR is installed in a multi-effect evaporator ensuring easy installation, high reliability and small footprint.



## PROJECT FEATURES

- Country: Italy, under construction
- Size: 22 ton/h of steam
- Single MVR installed in a multi-effect evaporator
- Output: saturated steam at 1.8 bar(a) delivered to the sugar process

## TECHNICAL FEATURES

- Capability to handle process steam
- Three-stage integrally geared centrifugal compressor

The plant is one of the selected industrial heat pumps co-funded by the European Union under the project



# Case History: Co.Pro.B. Italia Zuccheri



# Service & After Sales Support at a Glance

Qualified staff is exclusively dedicated to the customer assistance, both from remote and on-site, with the aim of optimizing the management of the plants. The customer can choose the most suitable service package thanks to the wide range of services offered.



## COVERAGE

1 main office in Brescia, 4 service subsidiaries and 4 international service partner companies.

## ASSISTANCE

- Turboden 24/7 for troubleshooting and remote consultancy
- Turboden software for performance monitoring and operation parameters control

## CUSTOMISED SERVICES

- dedicated staff for remote technical support
- dedicated staff of fields technicians for on-site planned maintenance, predictive maintenance, unplanned and extraordinary maintenance
- dedicated spare parts warehouse
- availability guarantee

# Service & After Sales Support at a Glance



## REMOTE TECHNICAL SUPPORT

Real-time remote technical support through our **Turboden Online Service (TOS 4.0)** platform, enhanced by our proprietary Turboanalytics AI and backed by **24/7 expert assistance** to rapidly detect, prevent, and resolve issues while maximizing performance.



## SCHEDULED MAINTENANCE

Planned maintenance **aligned with customer's production schedules**, offering customized services to **minimize downtime** and **optimize performance**, from basic tasks to full equipment overhauls.



## PREDICTIVE MAINTENANCE

Data-driven monitoring to anticipate issues, with **customized wear-part management** ensuring reliability and continuous coverage.



## AVAILABILITY GUARANTEE

Service programs backed by an **availability guarantee**, with financial compensation if plant availability does not meet expectations.



## EXTENDED WARRANTY

Seamless **coverage beyond expiry**, scalable from main components to a full package, with all repair and fault resolution **costs fully covered**.



[www.turboden.com](http://www.turboden.com)

Turboden S.p.A.

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MOVE THE WORLD FORWARD  **mitsubishi  
heavy  
industries  
group**