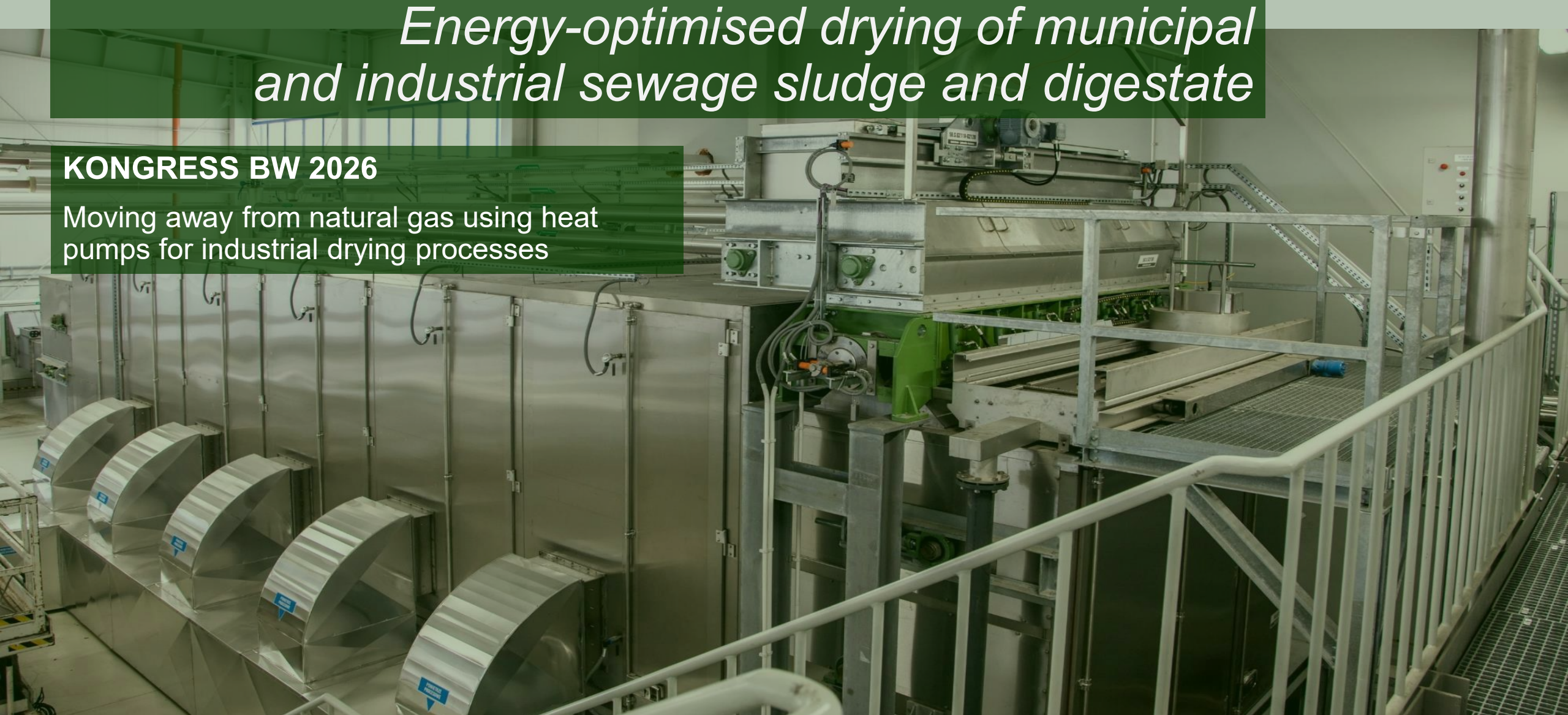


*Energy-optimised drying of municipal
and industrial sewage sludge and digestate*

KONGRESS BW 2026

Moving away from natural gas using heat
pumps for industrial drying processes



Energy-optimised drying of municipal and industrial sewage sludge and digestate

KONGRESS BW 2026,

Drying Technology Forum

Moving away from natural gas using heat pumps for industrial drying processes

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21.10.2026

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INTRODUCTION

Sewage sludge in Germany:

Annual sewage sludge production nationwide:	1.7 million tonnes of dry solids
Share sent for thermal recovery:	currently 80%
Total quantity of dewatered sludge:	6.8 million tonnes
Disposal costs for dewatered sludge:	approx. EUR 900 million (approx. EUR 135 per tonne)

Why dry sewage sludge?

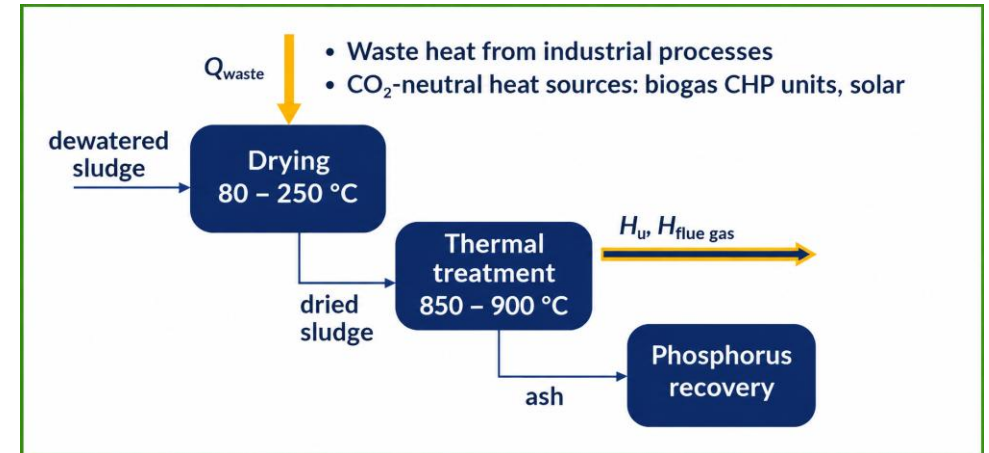
Dry sewage sludge offers several advantages over wet sludge from wastewater treatment. Reasons for dewatering followed by drying include:

- Reduced sludge volume
- Improved storage and transport properties
- Microbiological stabilisation and improved hygiene
- Increased calorific value

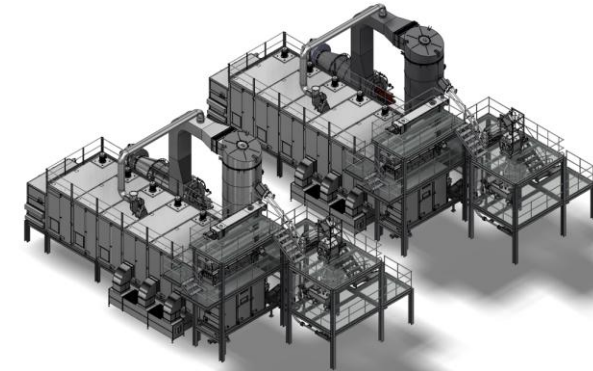
Energy demand and costs of sewage sludge drying:

Energy input: approx.	750 kWh/t of wet sludge
Energy costs for drying	
Option A: Direct heating with fuel:	EUR 65–75/t of wet sludge
Option B: Heating with a heat pump, Electricity demand: 200 kWh/t of wet sludge	
Costs:	EUR 20–60/t of wet sludge

quantities and costs:



Drying plant for a city of approx. 300,000 inhabitants



HISTORY

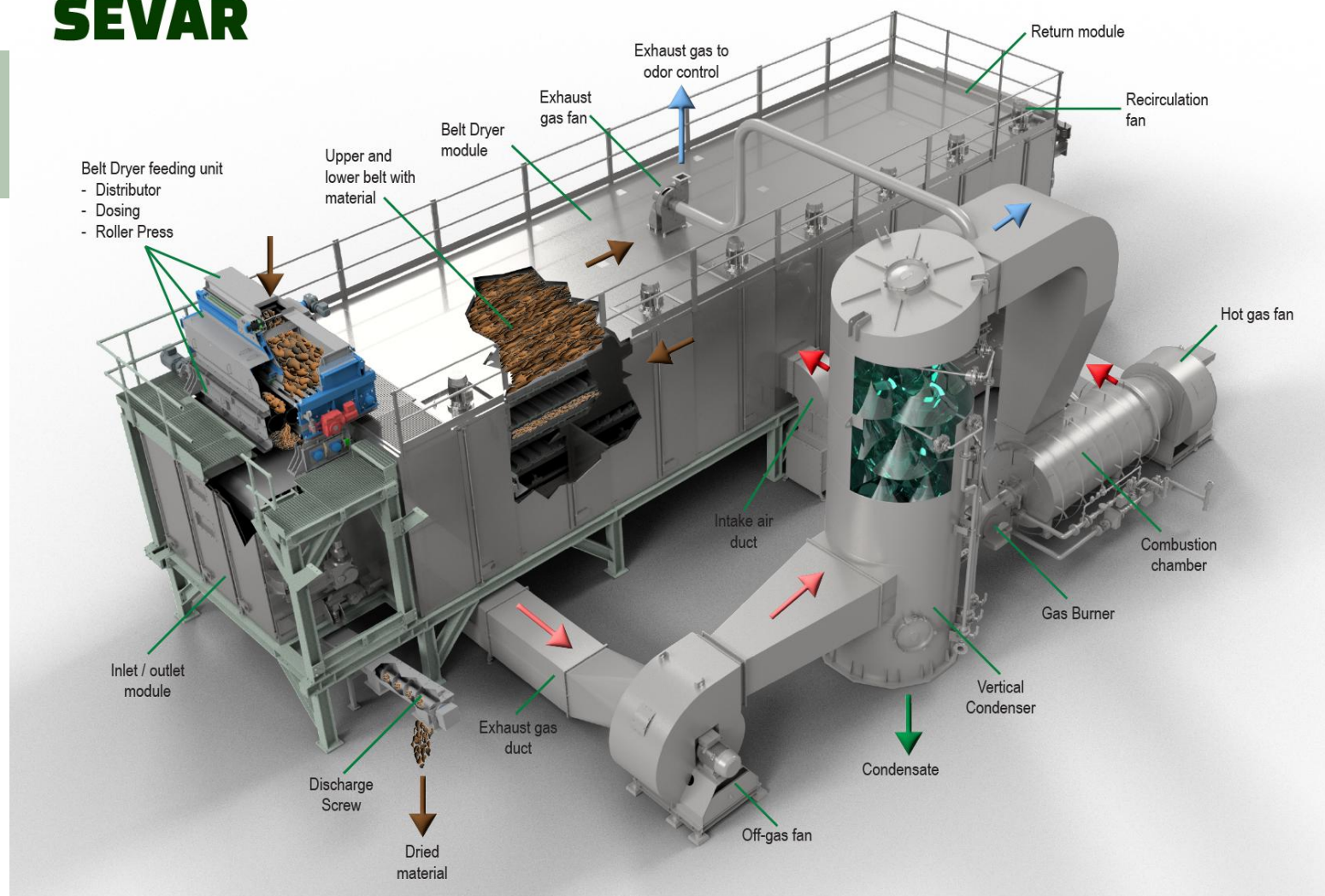
1980	SEVAR GmbH founded
1985–1988	Development of the first belt dryer for sewage sludge
1989–1995	Installation of the first drying plants for wastewater treatment plants of up to 500,000 population equivalents. Mainly direct heating using biogas, natural gas and fuel oil; occasional use of low-pressure steam.
1995–2000	Equipping new drying plants with systems to recover waste heat from CHP units and thermal processes
1998–2005	Development of a fixed-bed gasifier to produce synthesis gas for electricity generation in a CHP unit, with waste heat used for drying
2008–2010	Co-development of a dryer using waste heat from a biomass-fired ORC turbine (Albstadt WWTP)
from 2012	Development of a drying system using low-temperature heat from a heat pump. Hot-water temperatures were limited to 65 °C by the refrigerants available at the time.
from 2018	Optimisation of the dryer–heat pump heat integration using CO ₂ as refrigerant, enabling hot-water temperatures of 80–90 °C
since 2023	Use of multi-stage heat pumps with R1234ze and R290 refrigerants

TECHNOLOGY

Previously:

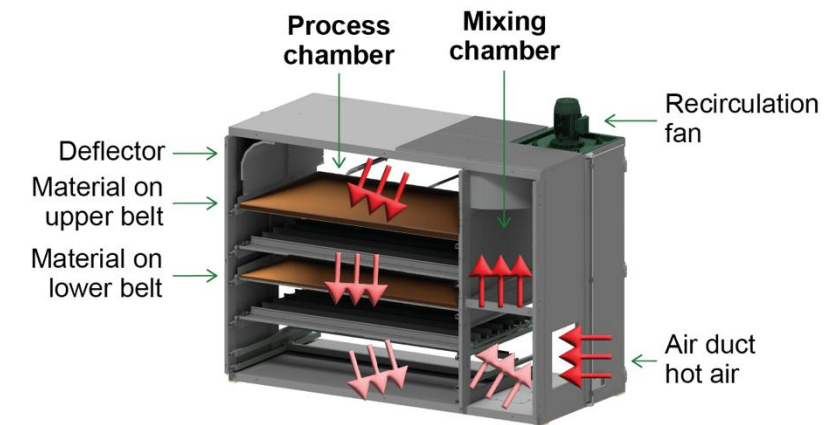
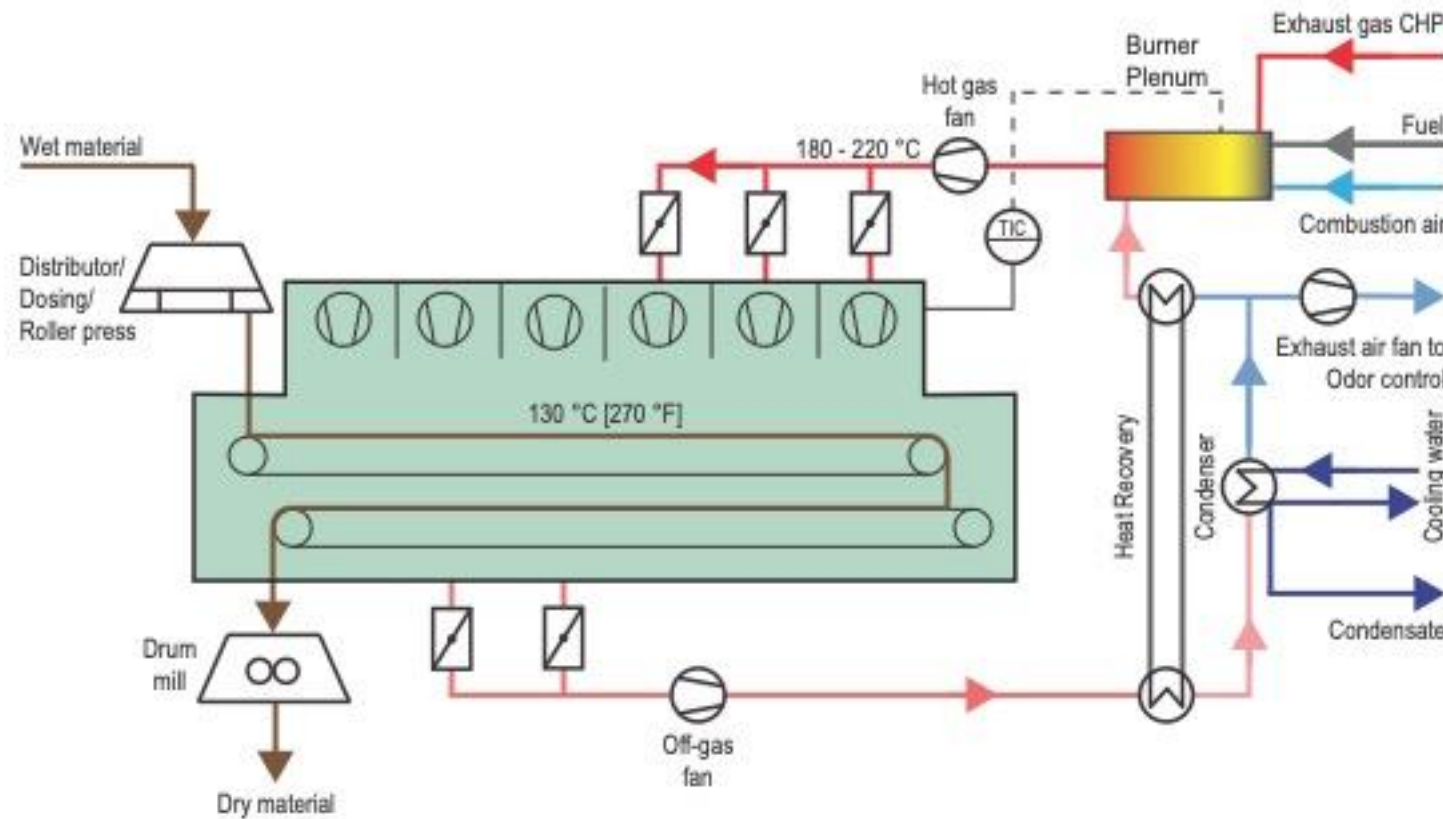
Belt dryer with
direct heating

SEVAR



OPERATING PRINCIPLE

DIRECT FUEL-FIRED DRYING

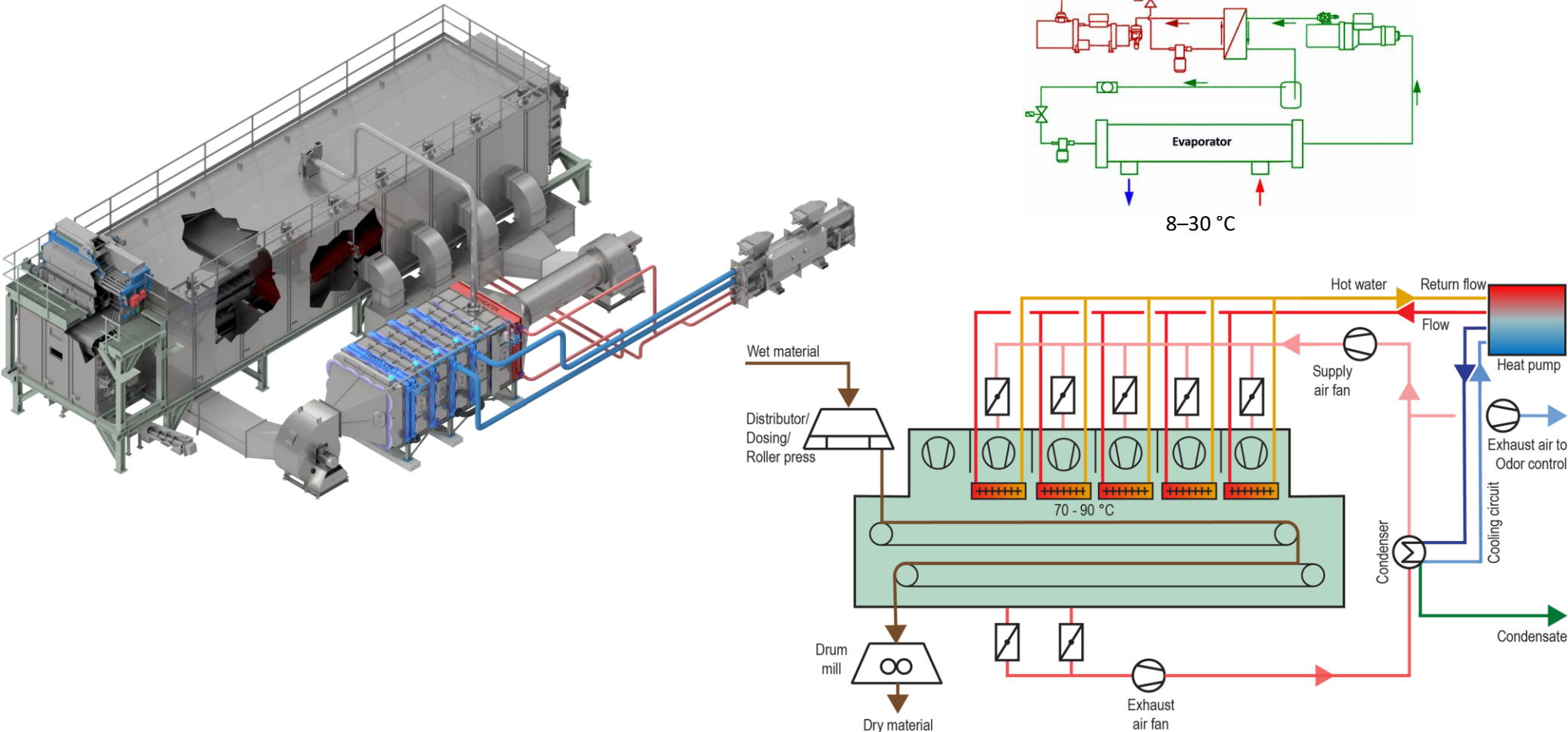
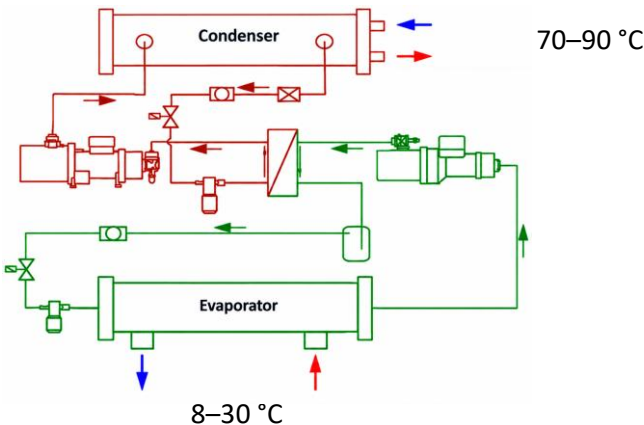


Cross-section of dryer module

TECHNOLOGY

Dryer heating with a heat pump:

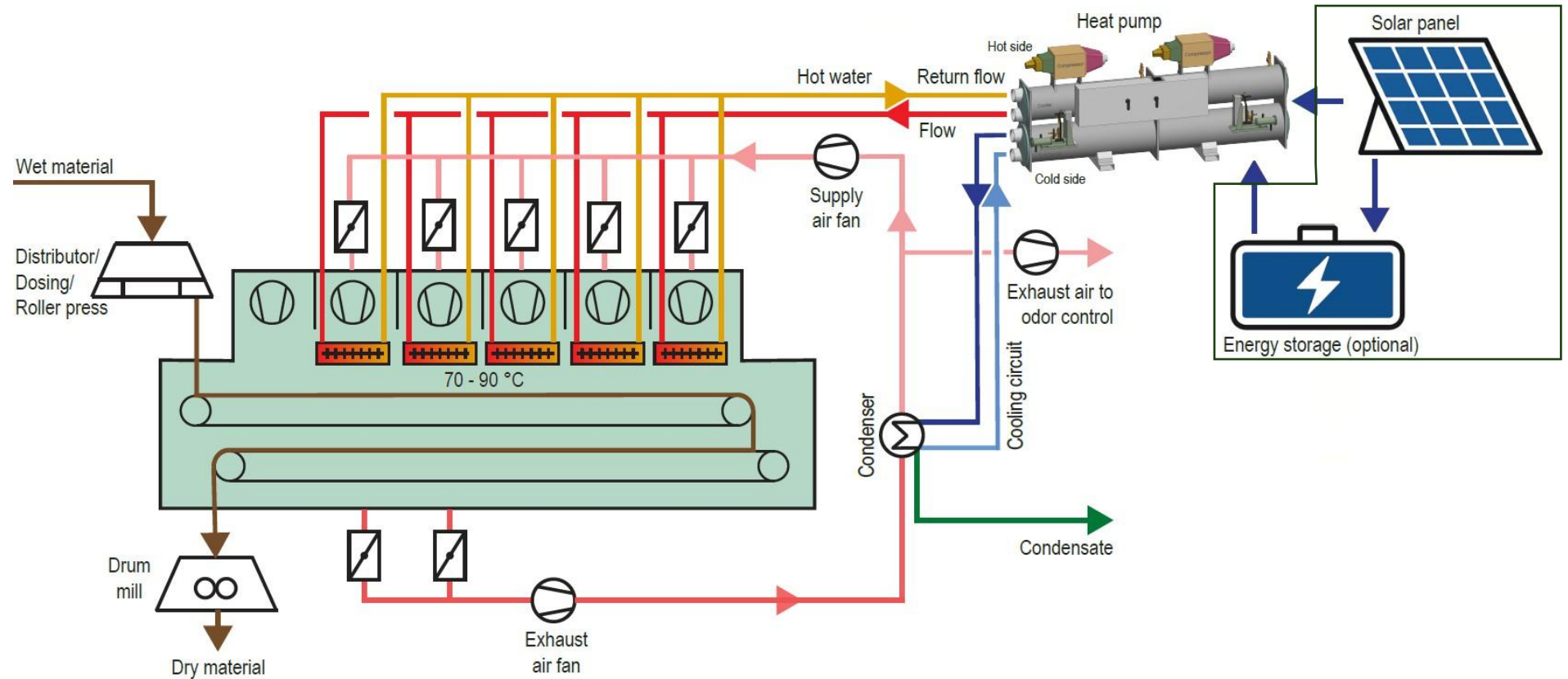
Heat pump schematic
Two-stage, up to 2,500 kW



PROCESS FLOW DIAGRAM

Belt dryer with heat pump – indirect heating

Heat pump:
Recovery of waste
heat from the dryer



CASE STUDY / REFERENCE PROJECTS

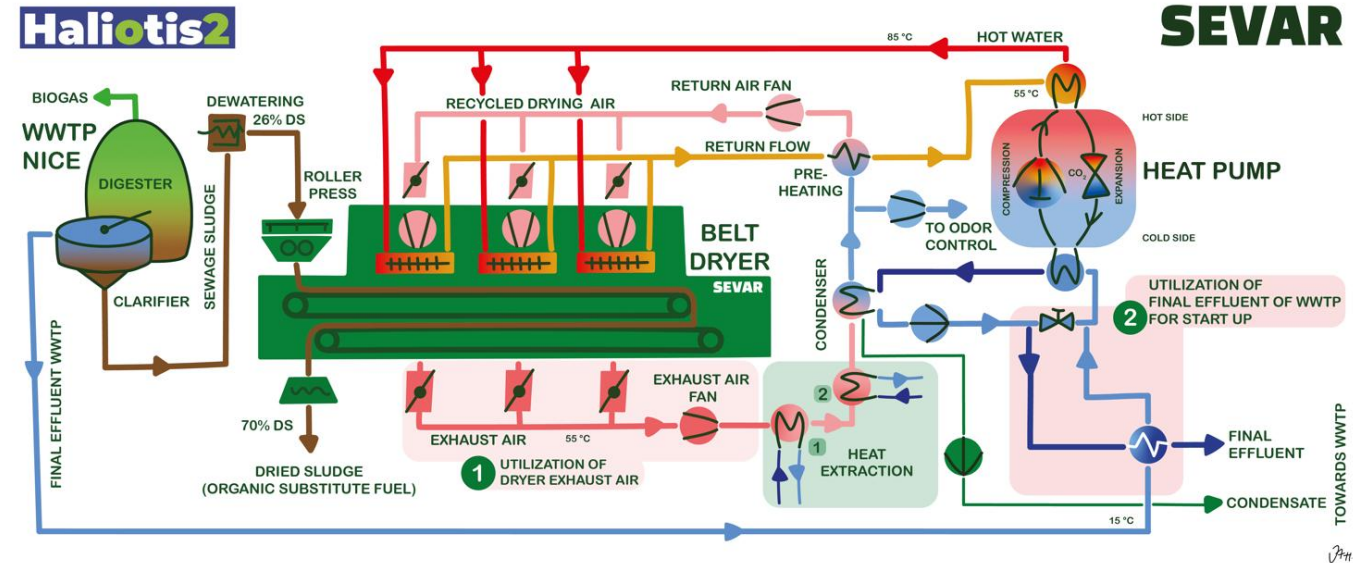


Location: Nice, France
Wastewater treatment plant capacity: 700,000 PE
Sewage sludge production: 50,000 t/year

Concept:

Haliotis 2 is designed to recover and recycle a large proportion of the resources used on site. Biomethane produced by anaerobic digestion of sewage sludge is used to heat homes in the region and to produce biofuel for local public buses. Treated wastewater is reused as service water or temperature-controlled process water.

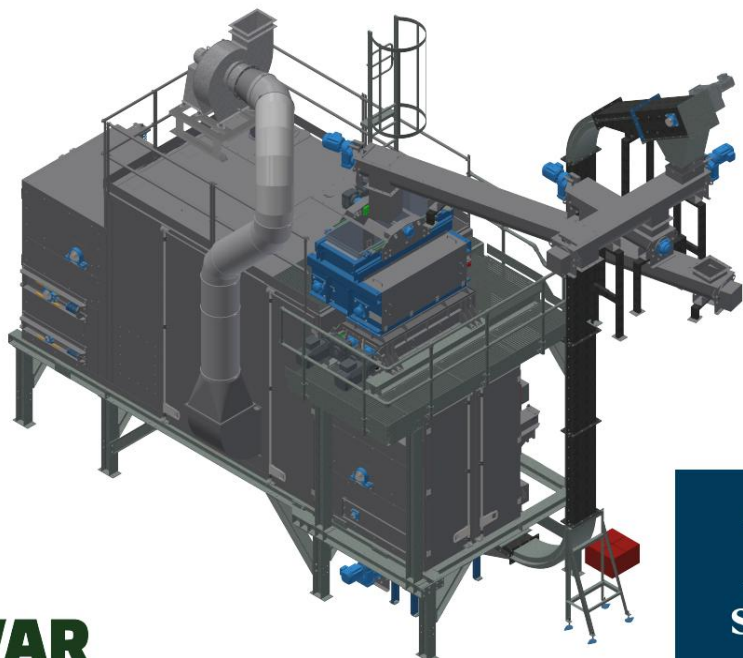
The digested sludge, dewatered to a moisture content of 70%, is dried to a residual moisture content of 30% to produce an organic substitute fuel.



The belt dryers are heated with hot water at a supply temperature of 85 °C. The hot water is provided by a cascaded heat-exchanger and heat-pump system that recovers heat from the dryer exhaust air. The moisture-laden exhaust air passes through an indirect condenser, where its remaining heat is transferred to a water circuit on the cold side of the heat pumps. The heat-pump refrigerant circuit extracts heat from this water circuit with a temperature difference of 6 K and raises the temperature of the water circuit on the hot side by 30 K. The hot-side water circuit heats the recirculated drying air.

After condensation in the indirect condenser, the dryer air is returned to the dryer in recirculation mode. The cooled return water from the dryer heating circuit preheats the recirculated air, increasing the temperature difference between supply and return in the hot-side water circuit. The heat-pump system provides 1,600 kW of thermal power for dryer heating.

REFERENCE



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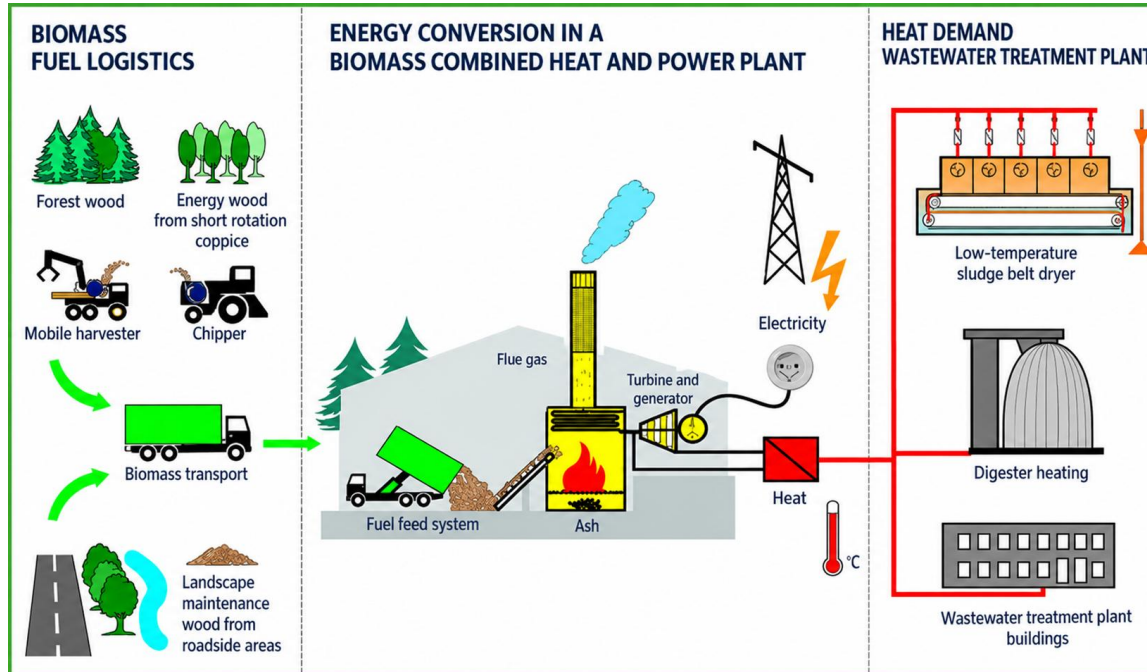
Customer:	Nijhuis Saur Industries
Location:	Crolles, France
Dryer type:	BD 1500/2
Year of installation:	2022
Material:	Mineral sludge from a semiconductor manufacturer's wastewater treatment plant
Heating system:	Single-stage heat pump, COP 3.2
Heating water temperatures:	65/55 °C
Wet feed:	200 kg/h
Inlet moisture:	85%
Operation:	Continuous, 24 h/day; fully automatic



REFERENCE



Dryer heated using biomass



Operator:	Klärschlammverwertung Albstadt GmbH
Location:	Albstadt, Germany
Dryer:	BD 3000/6
Material:	Municipal sewage sludge
Heating:	Indirect, using hot water from the waste heat of an ORC turbine with an electrical output of 300 kW
Turbine waste heat:	1,300 kW thermal
Water temperature:	87/70 °C
Throughput:	1,500 kg/h 12,000 t/year
Inlet moisture:	70%
Dried product:	90% dry solids
Use of dried product:	Co-incineration in a cement plant
Operation:	24 h/day, fully automatic



In Albstadt, the biomass-fired ORC plant reduces CO₂ emissions by 1,436 tonnes per year through renewable electricity generation and heat recovery at the wastewater treatment plant. Sewage sludge drying achieves a further reduction of 3,679 tonnes of CO₂ per year. This is due to fuel substitution (sewage sludge dried to 90% dry solids has a calorific value of approx. 3.2 kWh/kg) and reduced transport-related CO₂ emissions.

The total annual CO₂ reduction is 5,115 tonnes, with a total net investment of EUR 7.9 million.

APPENDIX

Economic assessment of a drying plant in the UAE for a wastewater treatment plant with a capacity of 300,000 population equivalents (PE)

	Unit	Diesel-fired dryer	Belt dryer with heat pump grid power only	Belt dryer with heat pump and 750 kWp solar array daytime operation only	Belt dryer with heat pump and 750 kWp solar array + grid power	Belt dryer with heat pump and 2.8 MWp solar array + battery storage
Water evaporation rate	t H ₂ O/h	2	2	2	2	2
Annual operating hours	h	8,000	2,350	2,350	8,000	8,000
Feed material						
Wet feed per year	t/a	22,150	22,150	22,150	22,150	22,150
Dryer size		BD3000/8	BD3000/12	BD3000/12	BD3000/12	BD3000/12
Building dimensions (dryer only)		24.5 m × 10.5 m	32.2 m × 10.5 m	32.2 m × 26 m	32.2 m × 10.5 m	32.2 m × 10.5 m
Investment						
Dryer investment		EUR 2,300,000.00	EUR 3,200,000.00	EUR 5,290,000.00	EUR 3,200,000.00	EUR 2,925,000.00
Solar array		-	-	EUR 500,000.00	EUR 500,000.00	EUR 1,850,000.00
Battery storage		-	-	-	-	EUR 3,825,000.00
Exhaust air treatment		EUR 200,000.00	EUR 200,000.00	EUR 200,000.00	EUR 200,000.00	EUR 200,000.00
Total		EUR 2,500,000.00	EUR 3,400,000.00	EUR 5,990,000.00	EUR 3,900,000.00	EUR 8,800,000.00
Annual operating costs						
Personnel		EUR 30,000.00	EUR 30,000.00	EUR 30,000.00	EUR 30,000.00	EUR 30,000.00
Thermal energy costs		EUR 546,742.86	-	-	-	-
Electricity		EUR 110,080.00	EUR 505,600.00	-	EUR 358,133.33	-
Other costs and service		EUR 115,000.00	EUR 160,000.00	EUR 264,500.00	EUR 160,000.00	EUR 146,250.00
Battery storage		-	-	-	-	EUR 68,500.00
Total operating costs	EUR/year	EUR 801,822.86	EUR 695,600.00	EUR 294,500.00	EUR 548,133.33	EUR 244,750.00
Operating costs per tonne of wet feed		EUR 36.20	EUR 31.40	EUR 13.30	EUR 24.75	EUR 11.05
Payback period	years		8.47	6.88	5.52	11.31
* Prices for UAE and Saudi Arabia: diesel EUR 0.39/l, electricity EUR 0.08/kWh						