Heat Pump and Paper Industry

EHPA-Repower EU

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Introduction of Speakers

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Thank you EHPA for the kind invitation to speak here!

Atlas Copco

This is the Atlas Copco Group

Customers in more than **180** countries

43 000 employees in **70** countries

Established in **1873** Stockholm, Sweden

Turnover of **111** BSEK/ **11** BEUR

A decentralized Group

BOARD OF DIRECTORS

PRESIDENT AND CEO

GROUP MANAGEMENT

COMPRESSOR TECHNIQUE

- Compressor Technique Service
- Industrial Air
- Oil-free Air
- Professional Air
- Gas and Process
- Medical Gas Solutions
- Airtec

VACUUM TECHNIQUE

- Vacuum Technique Service
- Semiconductor Service
- Semiconductor
- Semiconductor Chamber Solutions
- Scientific Vacuum
- Industrial Vacuum

INDUSTRIAL TECHNIQUE

- Industrial Technique Service
- MVI Tools and Assembly Systems
- General Industry Tools and Assembly Systems
- Chicago Pneumatic Tools
- Industrial Assembly Solutions
- Machine Vision Solutions

POWER TECHNIQUE

- Power Technique Service
- Specialty Rental
- Portable Air
- Power and Flow

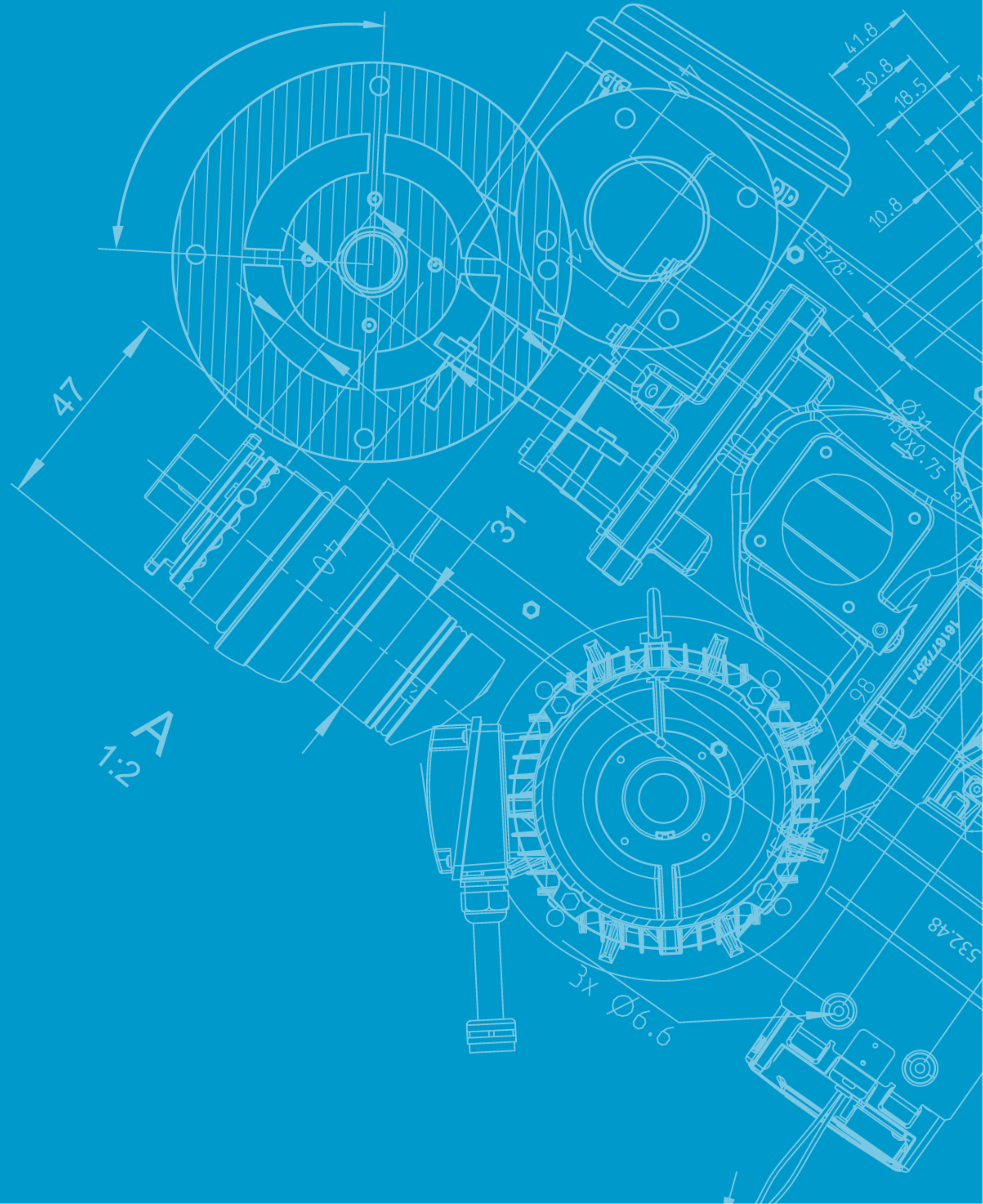
Atlas Copco Energas – An overview

Establishment	July 16, 1984 (date of registration)
Shareholders	Atlas Copco Holding GmbH, Essen, Germany (100 %)
Certification	DIN EN ISO 9001, DIN EN ISO 14001, DIN ISO 45001, DIN EN ISO 50001, SCC
Facility size	Total area: 66 000 m^2 Factory area: 28 500 m^2
Construction code	All common international codes and standards
Products manufactured	▪ Custom-made integrally-geared centrifugal compressors in single and multi-stage (1 – 8 stages) configurations ▪ Turbo-expanders for process gas applications and energy recovery (incl. solutions for power plants) ▪ Corresponding aftermarket products and services for our products

Product overview

Type	Technology	No. of stages	Max. power kW	Max. pressure bar a	Types of gases
Compressors	Integrally-geared for process gas	1 – 8	37 000	205	All
	Non-geared for air	1 – 3	37 000	7	Air
	Non-geared for polyolefins	1	6 000	40	PE / PP
	Oil-free gas screw	1 – 3	1 100	30	(Bio)-methane, NG, BOG, CO2, mixed refrigerant
	Oil-injected gas screw	1	250	16	(Bio)-methane, NG, BOG, CO2, mixed refrigerant
Expanders	Geared	1 – 4	23 000	250	All
	Non-geared	1 – 4	23 000	200	All
	Oil-free gas screw	1 – 3	500	25	Natural Gas (pipe-line)
Compander	Geared	1 – 8	37 000	205	All

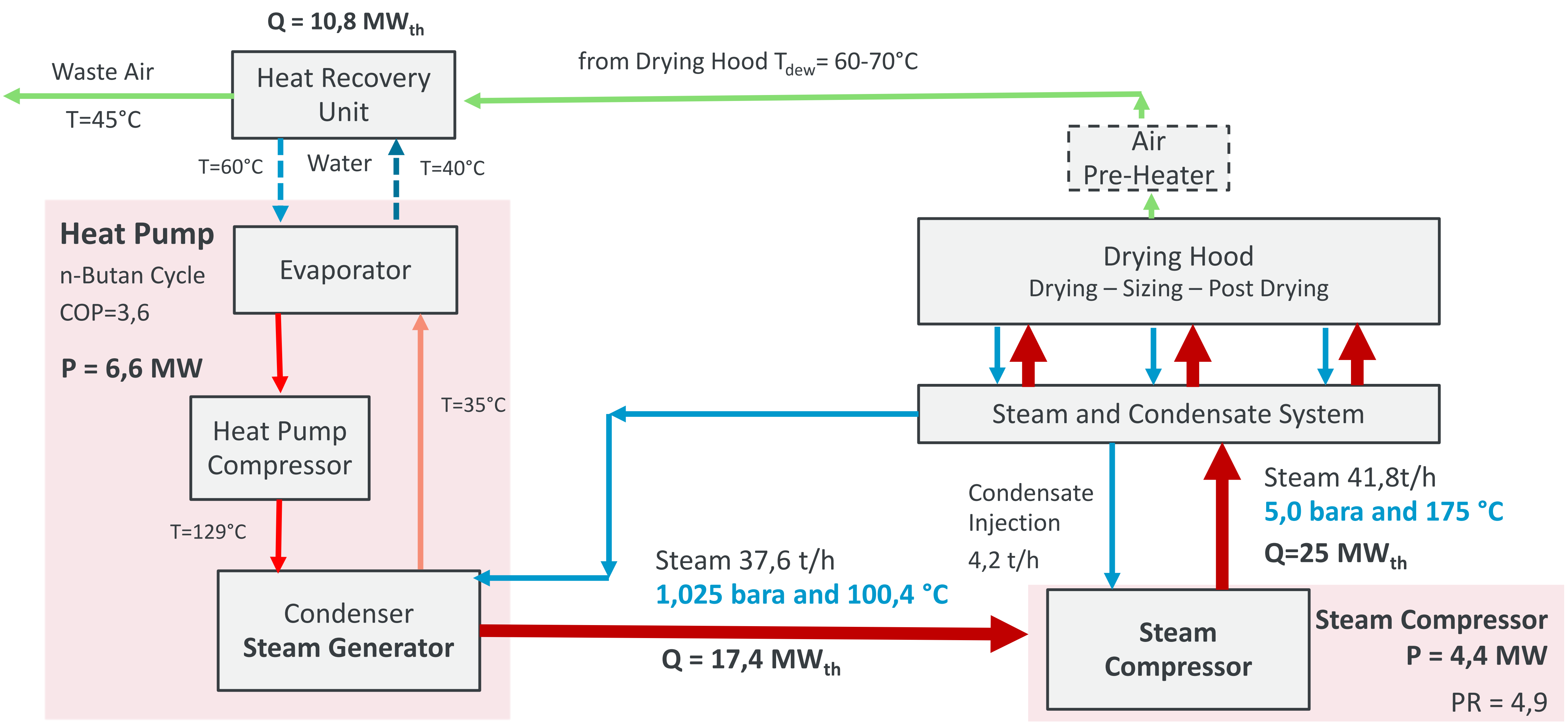
Steam Generation



Case Overview

- **Upgrade of the steam production** in a German Paper Mill
- The plant has already a shortage of steam for the actual paper production
- Future Increase of Cardboard production requires additional steam
- **Turn Key Supply of a Heat Pump System**
- Heat Pumps System for Base Load Steam Demand
  - Approx. 42 t/h Steam
  - 5 bar
  - 175 °C
  - Total COP =2,3
  - 11 MW heat recovery from Drying Hood

Case: Base Load Heat Pumps Steam Generator for a German Paper Mill

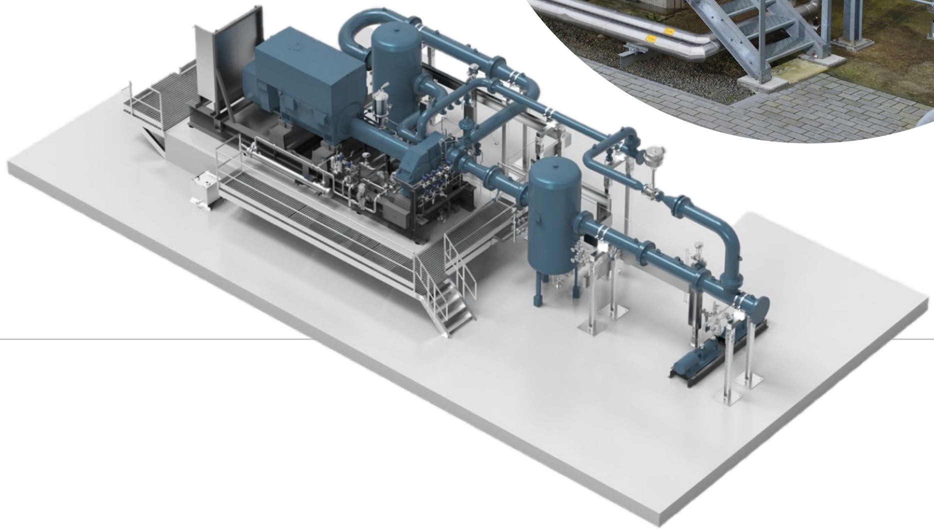


Heat Pump Products

Sample References

Heat Pump, 40$MW_{thermal}$

Steam Compressor, Product Steam 12 bara @ 275°C



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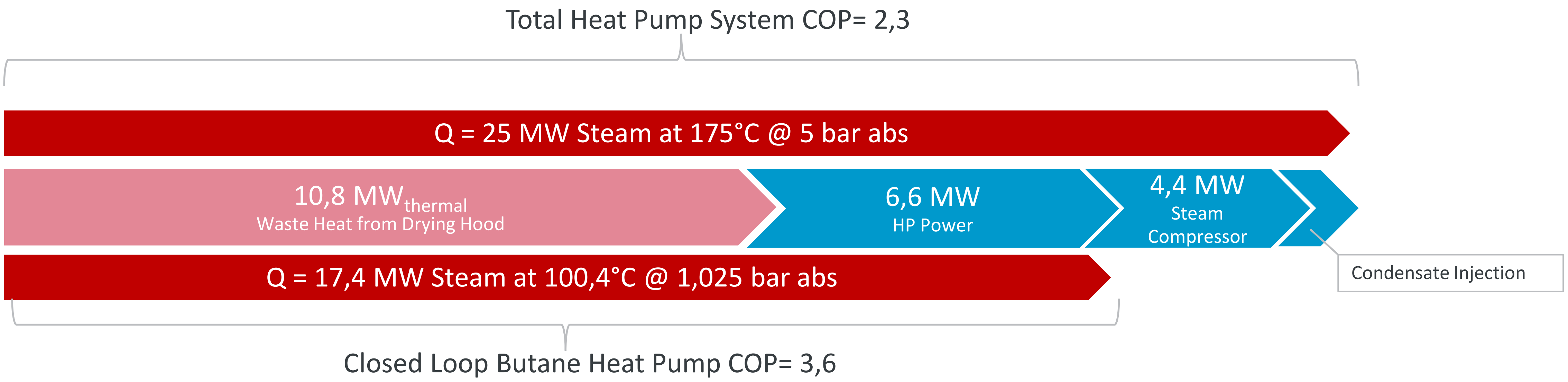
Heat Pumps Steam Generator for German Paper Mill

COP of Steam Generating Heat Pump



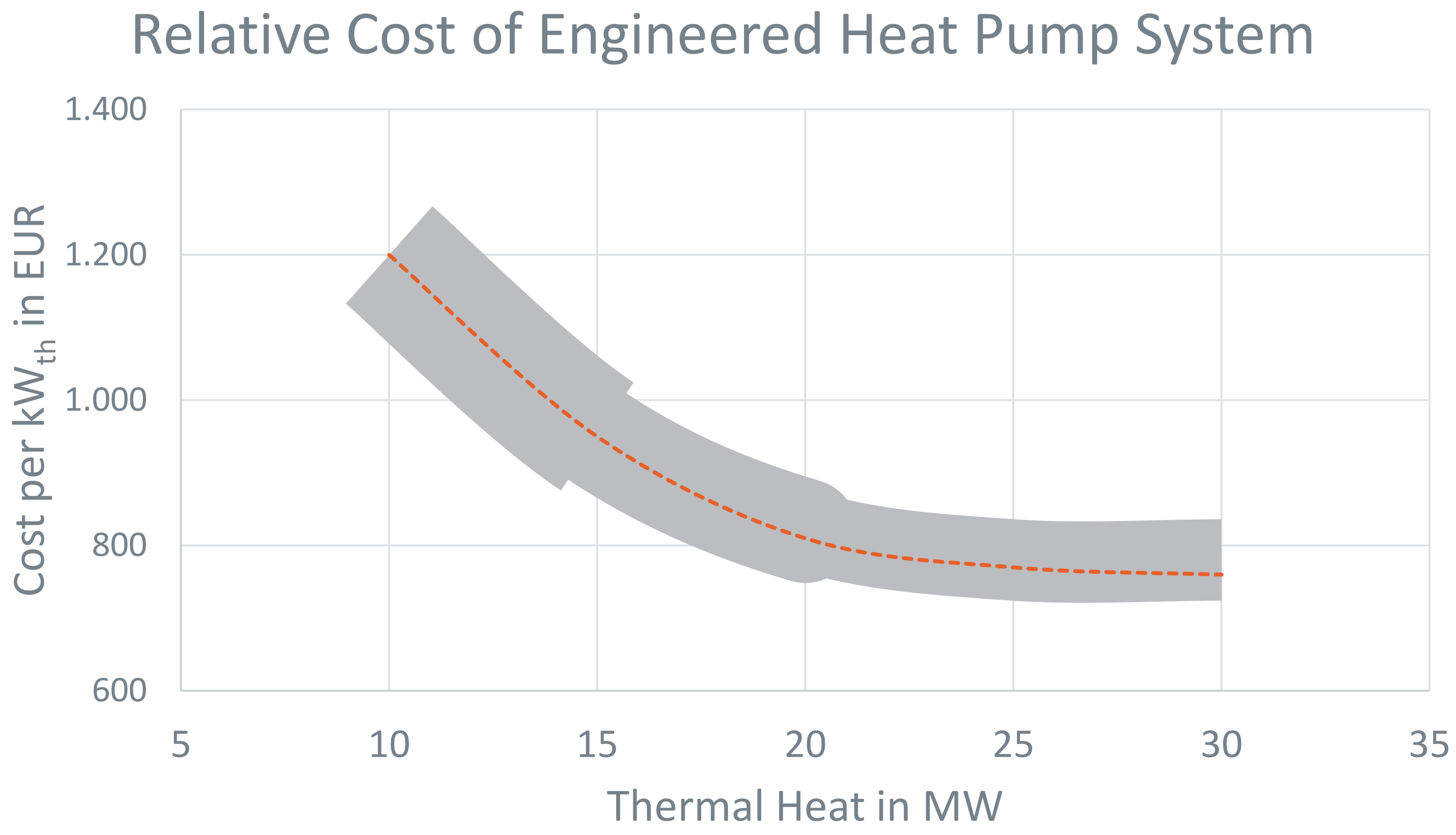
Steam compressor used to increase pressure and temperature of the steam

What if 150°C is sufficient?

=> Higher efficiency if you go to lower Temperature

Large scale engineered Heat Pumps Steam Generator Systems

Avarage CAPEX per $MW_{thermal}$ of a Engineered Heat Pump System



Case: Base Load Heat Pumps Steam Generator for a German Paper Mill

OPEX, CAPEX & TCO comparison – Base Load Steam Production

		Gas Fired Boiler	Electric Boiler	Heat Pump Steam Generator
Steam Demand		175 °C @ 5 bar abs; ~42 t/h		
Required Heat	kW	25.000		
Efficiency	%	96,00	99,00	230,00
Primary Energy Demand*3	kWh	26.042	25.253	10.870
Yearly Primary Energy Consumption	**MWh**	**216.719**	**210.152**	**90.457**
Total price per kWh	EUR/kWh	0,07	0,22	0,23
Price per kWh	EUR/kWh	0,04	0,13	0,15
Tax and Duties*1	EUR/kWh	0,01	0,04	0,04
Grid usage fee	EUR/kWh	0,01	0,05	0,04
Carbon tax	EUR/kWh	0,01		
Energy Cost yearly	**TEUR**	**15.170**	**46.233**	**20.805**
CO2 Emission *2	**tons/year**	**43.517**	*4	*4
OPEX - 10 years	**TEUR**	**151.703**	**462.333**	**208.050**
CAPEX (approx.)	**TEUR**	**1.300**	**1.500**	**24.000**
TCO - 10 years	**MEUR**	**153.003**	**463.833**	**232.050**

*1 Excluding VAT and other recoverable taxes and levies; *2 200,8 g CO_2/ kWh; *3 95% utilization assumed; *4 100% renewable energy assumed

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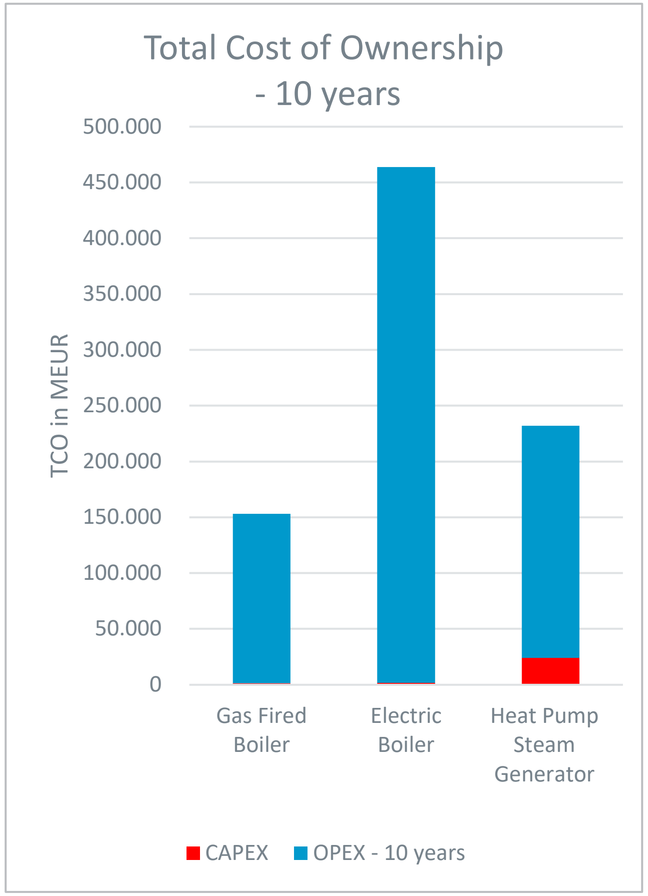
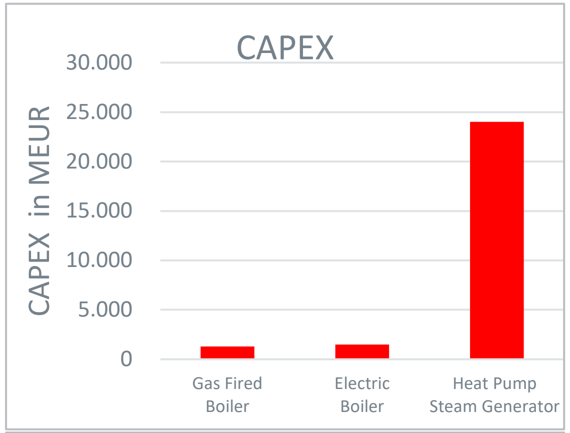
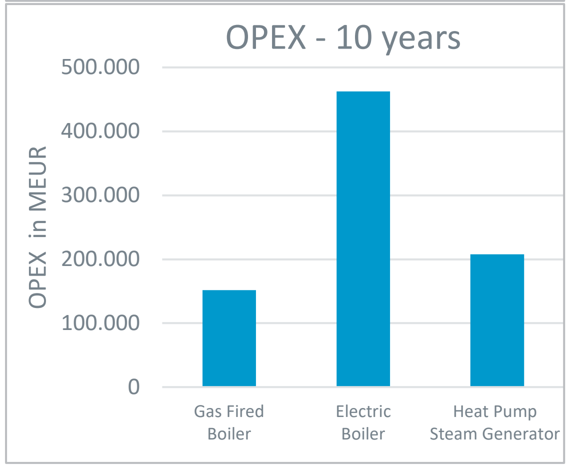
Case: Base Load Heat Pumps Steam Generator for a German Paper Mill

TCO – Total Cost of Ownership for 10 years





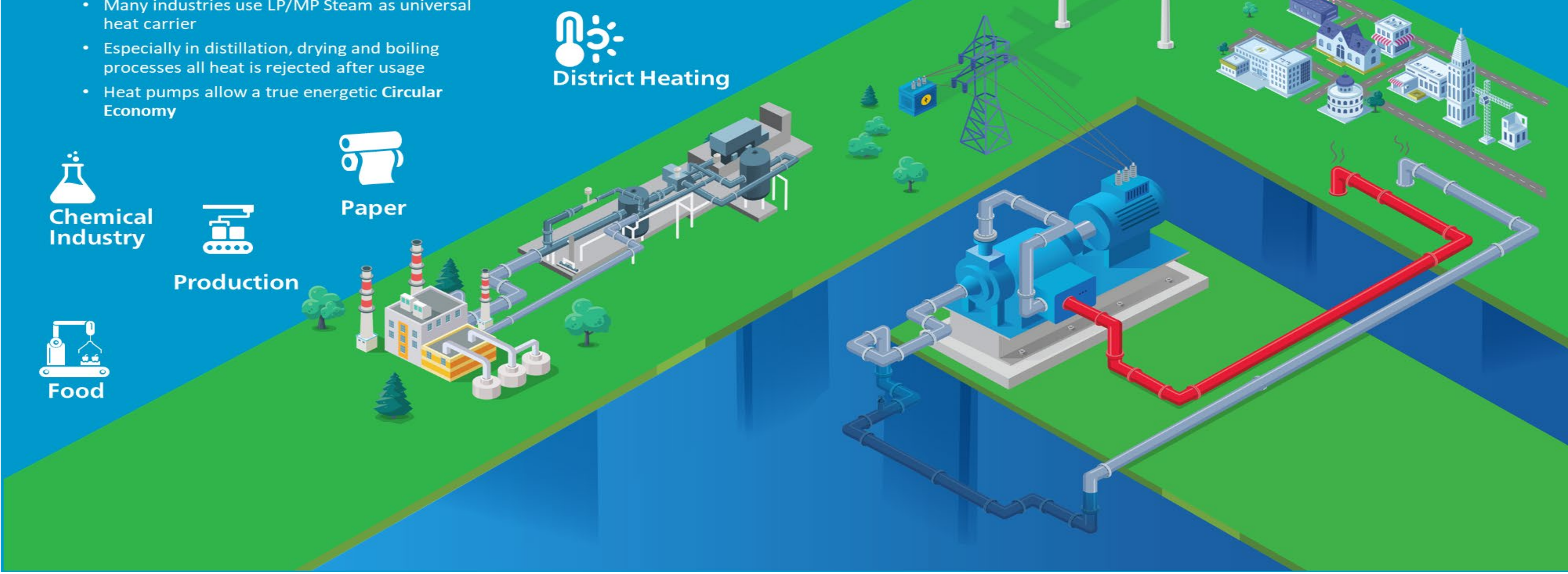


Summary

- Heat Pumps Systems are the most efficient solution for CO2 neutral base load steam generation in Paper Mills
- Significant Reduction of CO2 Emmisions
- TCO compare to electric boilers, the high CAPEX is off set by the high OPEX
- TCO compared to fossile fuel steam generation systems the Electric Energy Cost is the dominating factor
- Electric Energy Price Development
  - Decoupling of the price from Fossile Fuel Price
  - High Electric Energy cost can be offset by CCfD‘s (Carbon Contract for Differences)
  - With the increase of Renewables Energy Production the Electric Energy price is expected to fall

Industrial Applications
Turbocompressor Heat Pumps

- Many industries use LP/MP Steam as universal heat carrier
- Especially in distillation, drying and boiling processes all heat is rejected after usage
- Heat pumps allow a true energetic **Circular Economy**



Thank you!

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