OST
Eastern Switzerland
University of Applied Sciences
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2024

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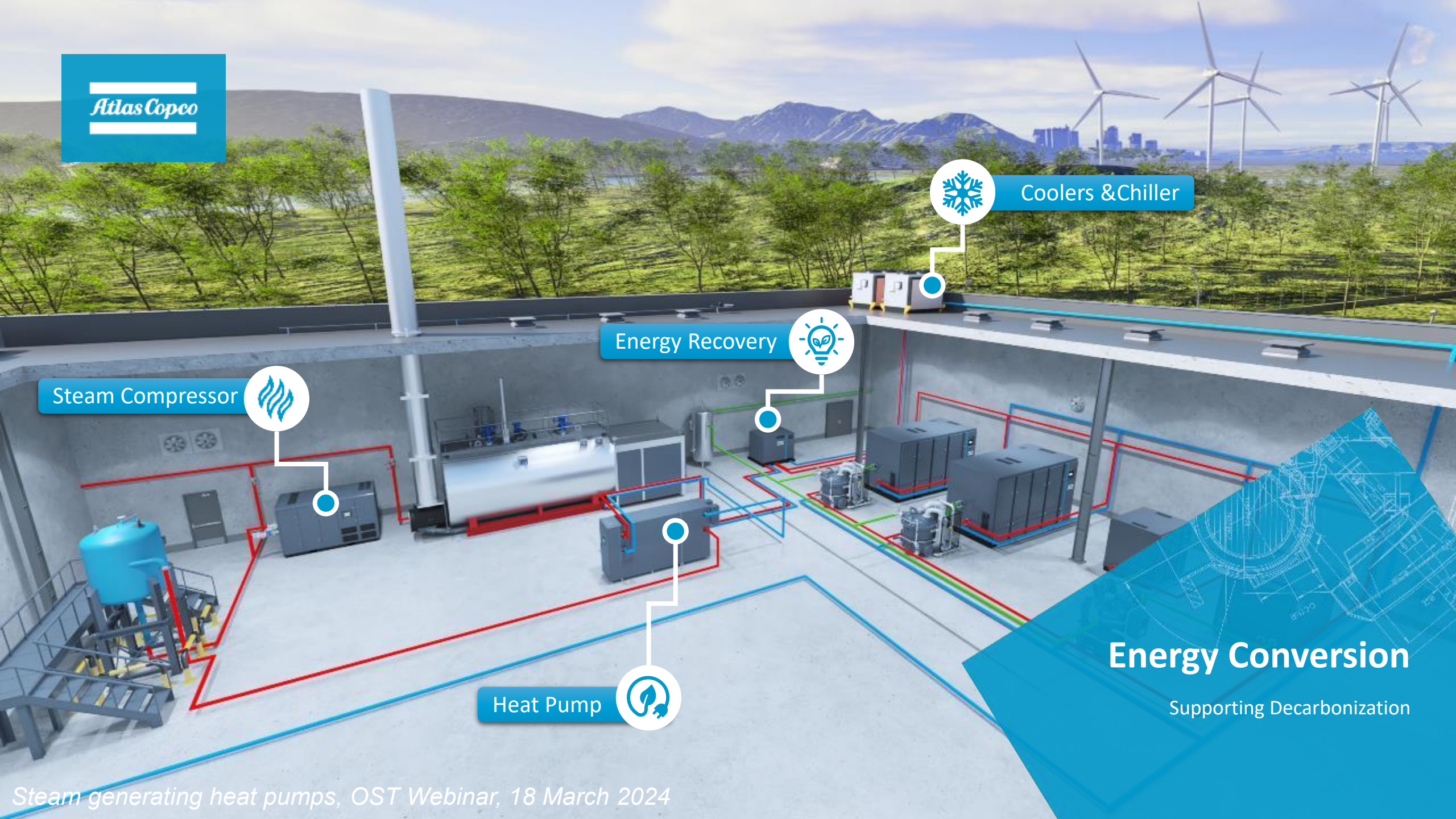
Atlas Copco

Transforming air compressor energy into process value for steam compression

Steam generating heat pumps, OST Webinar, 18 March 2024



Energy Conversion

Supporting Decarbonization

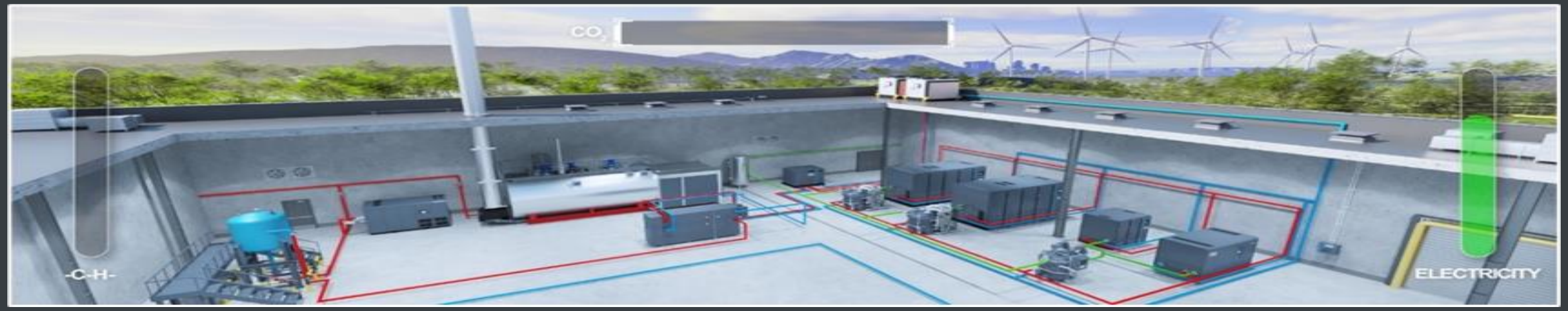
This is the Atlas Copco Group

Business Facts 2023

- Customers in more than **180** countries
- **53 000** employees in **70** countries
- Established in **1873** Stockholm, Sweden
- Turnover of **173** BSEK ≈ **15,1** BEUR*
- More than 40 production facilities

*Based on the average exchange rate in 2022.

Energy Conversion

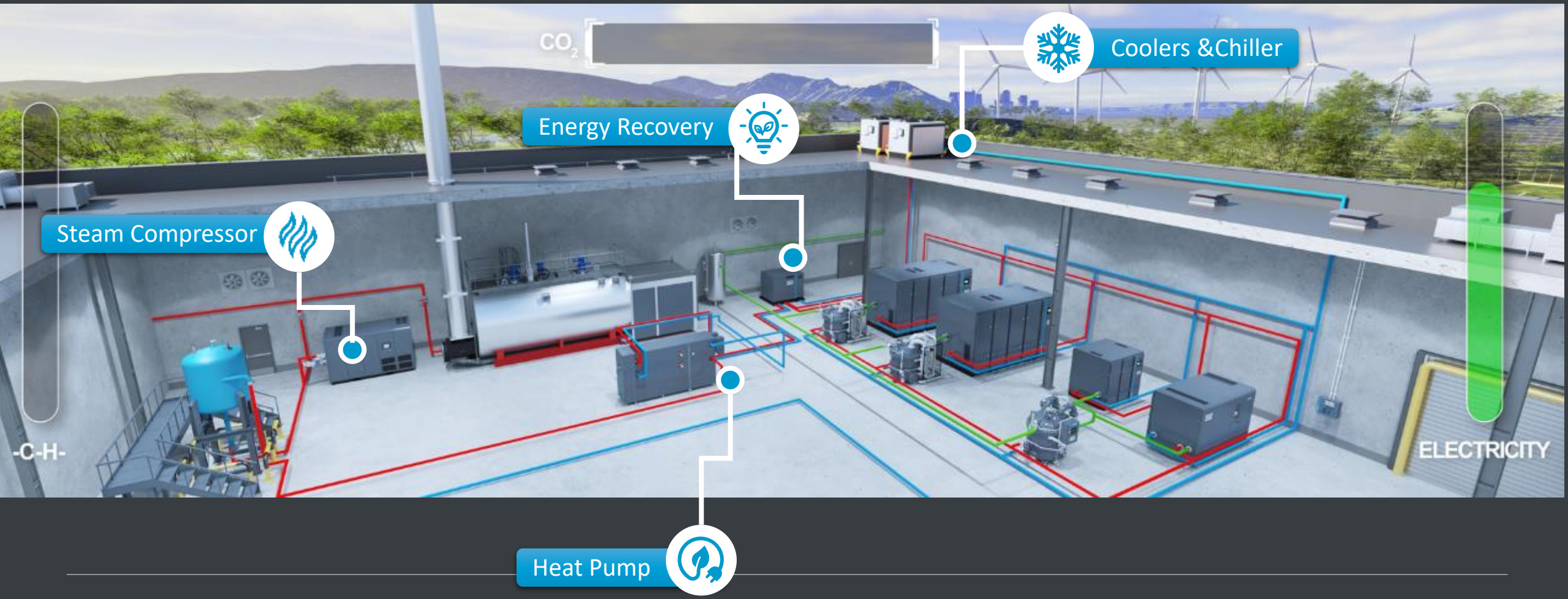


ENERGY CONVERSION

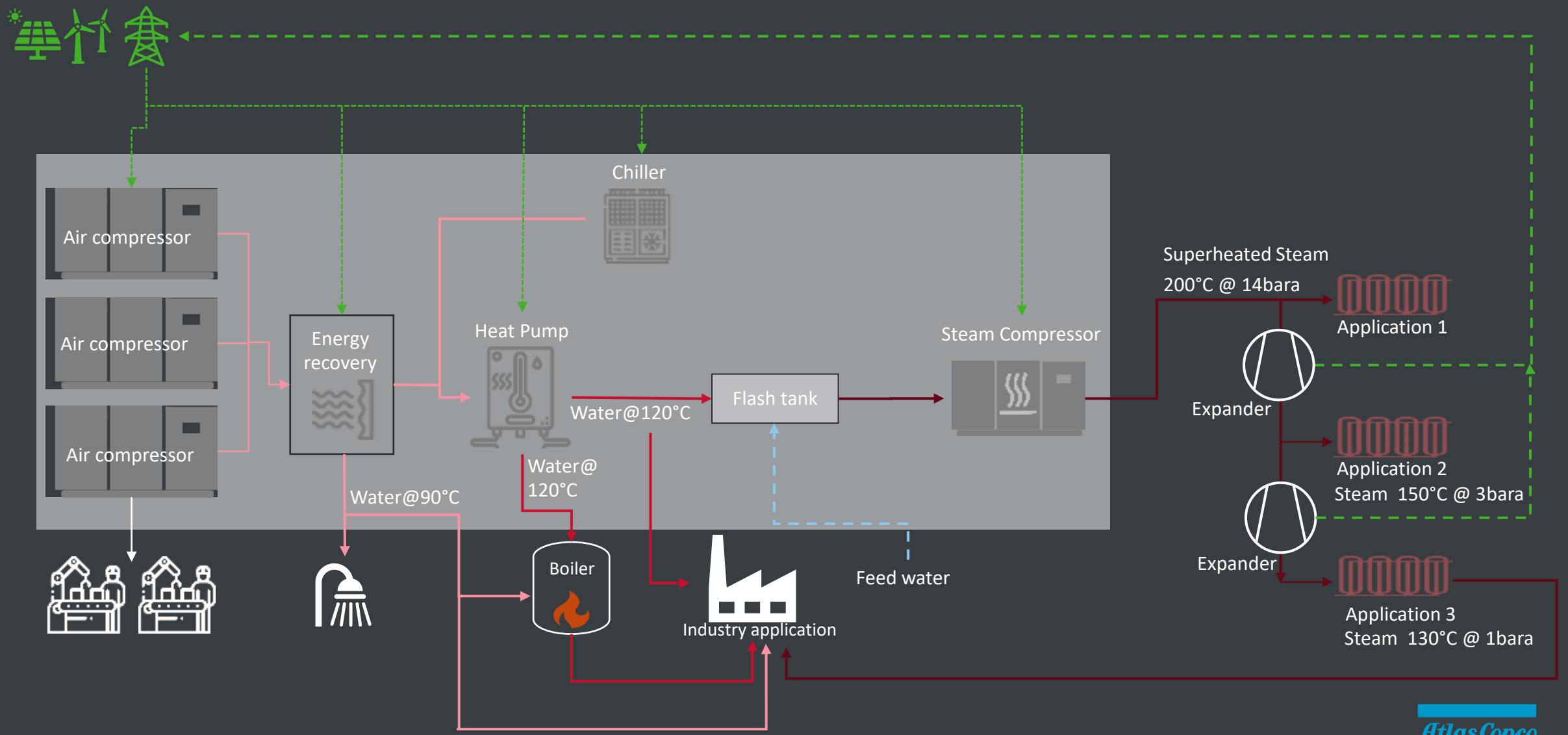
Energy to Heat	Energy to Steam	Energy to Electricity	Energy to Cool
Industrial Heat Pump Up to temperatures 120°C Heat recovered > 80% of compressor power	Steam Compressor 90° to 120° input Steam Output: up to 200°C at 14bara	Expander Air, steam, nitrogen, natural gas Efficiency up to 75%	Sorption chillers aBsorption input 95°C aDsorption input 65°C Cooling output: upto 70% of heat input
Energy recovery Up to temperatures 90°C Heat recovered > 80% of compressor power		Organic Rankine Cycle 90°C to 120°C input Electricity output: 4% to 9% of heat input	Industrial Cooling solutions Chillers, (A)D cooler

Typical utility room

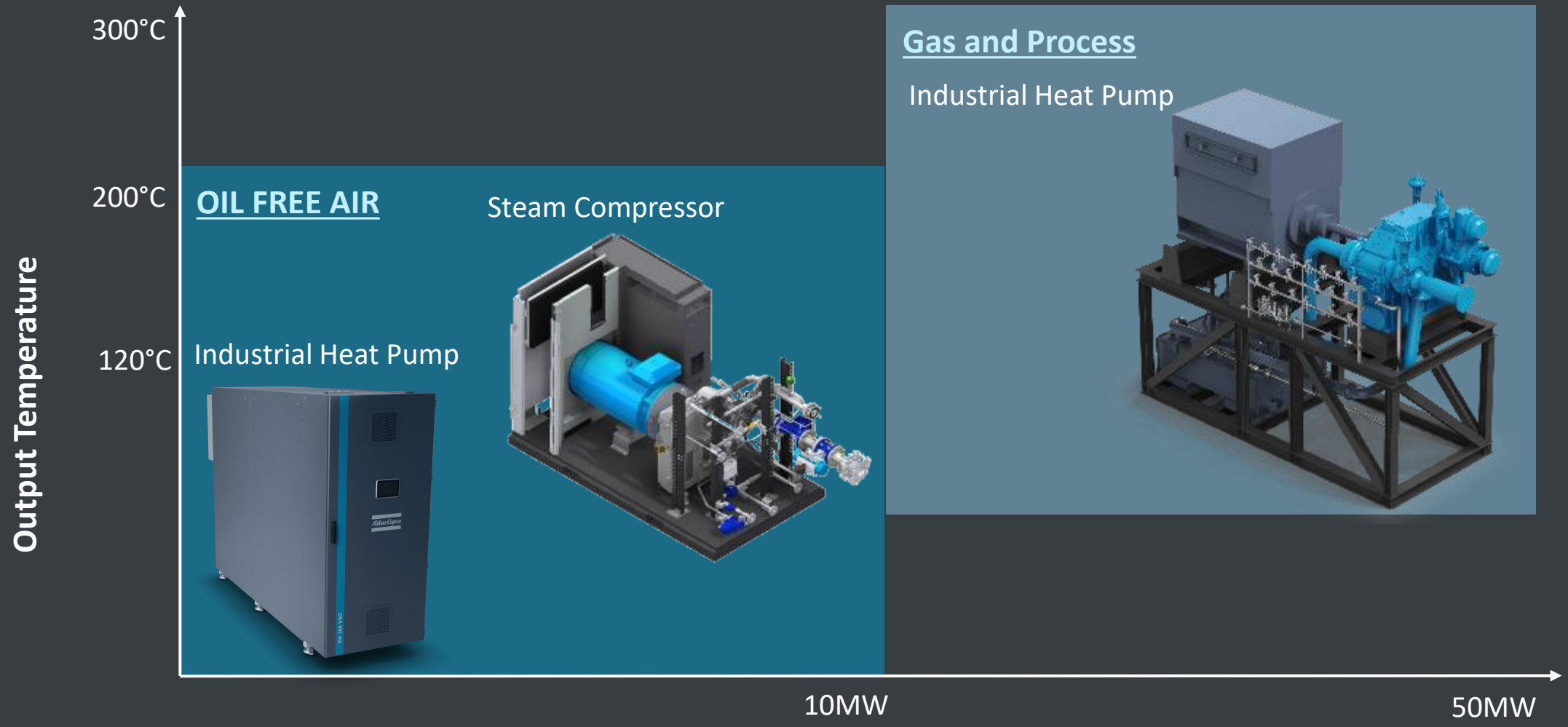
Utility room of the future / now



Low carbon utility room

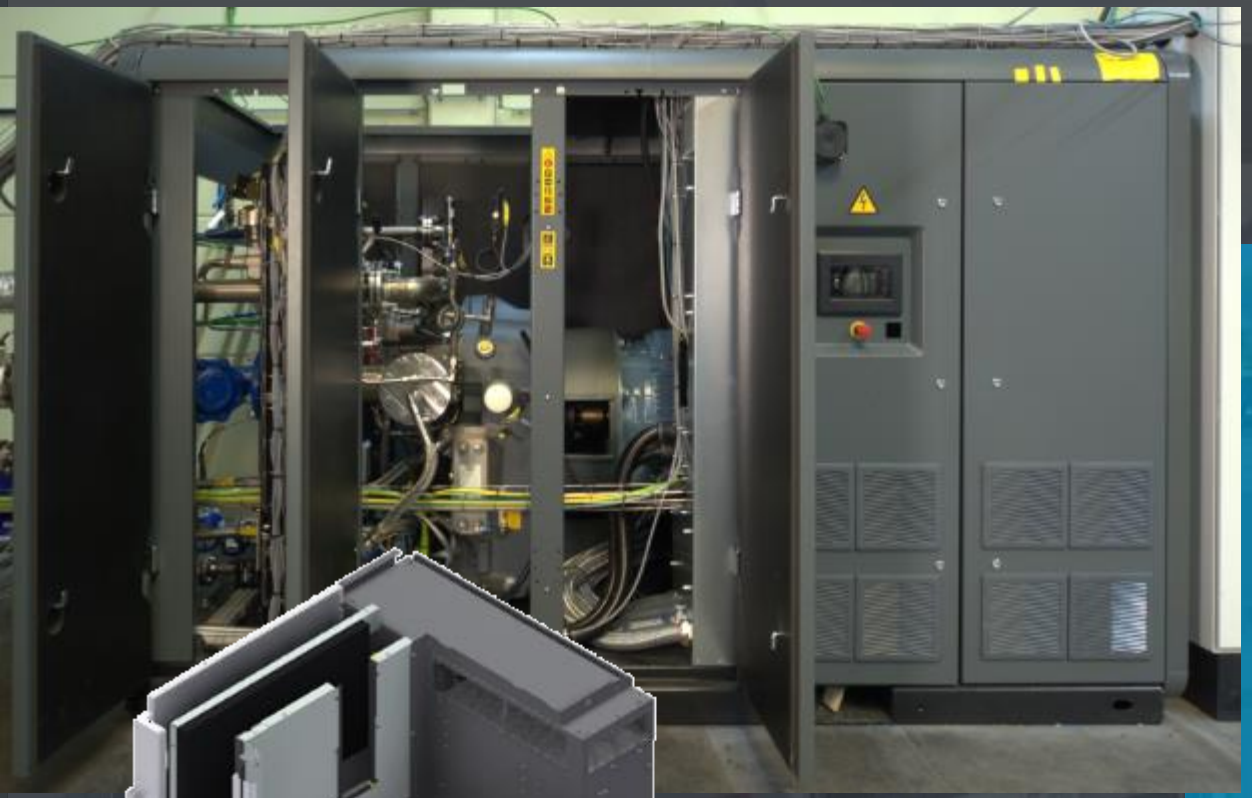


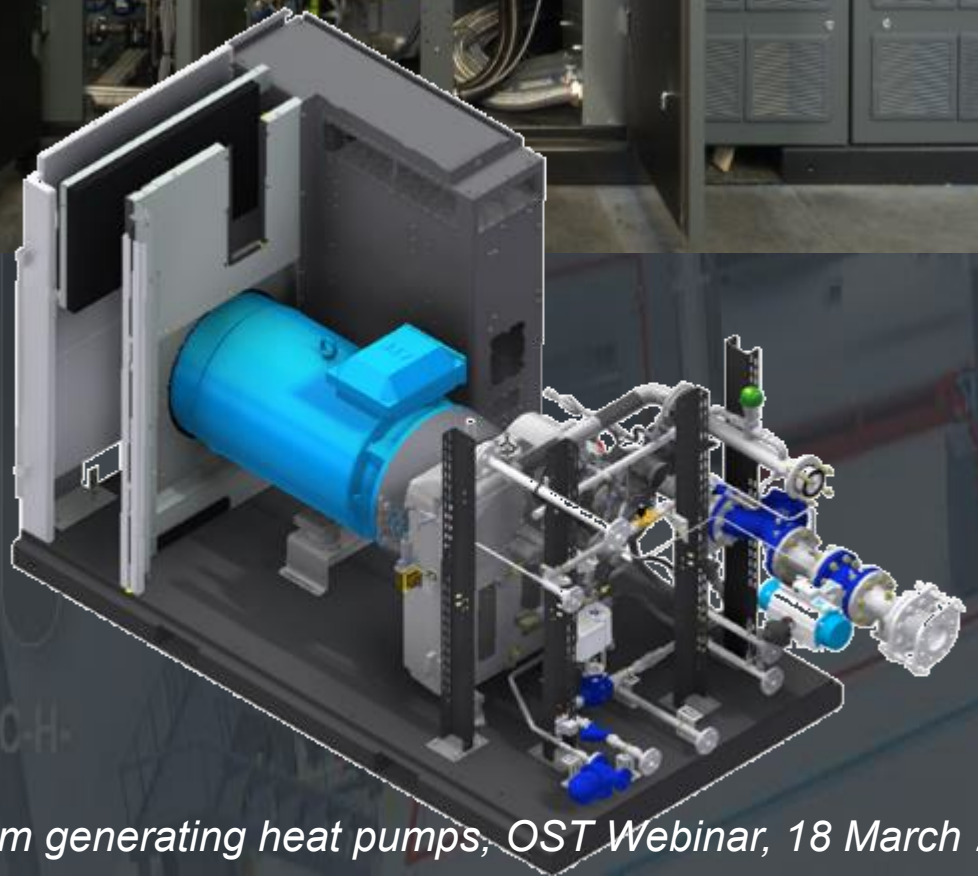
Atlas Copco’s High Temperature solutions



Industrial Heat Pump

- Delivering high temperature water up to 120°C
- Heating Capacity up to 3.5MW
- COP between 2 – 6
- Higher efficiency with sub-cooler
- Variable Speed Drive
- Global Monitoring system

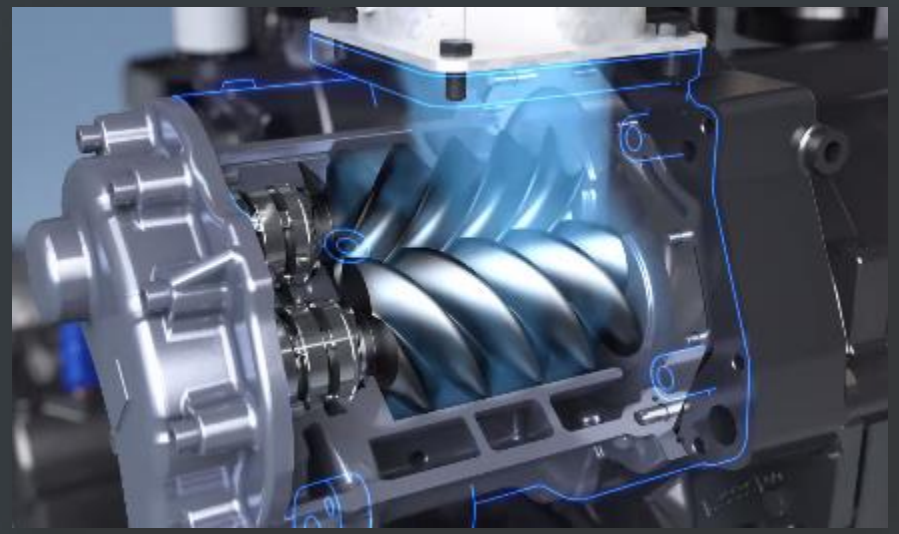


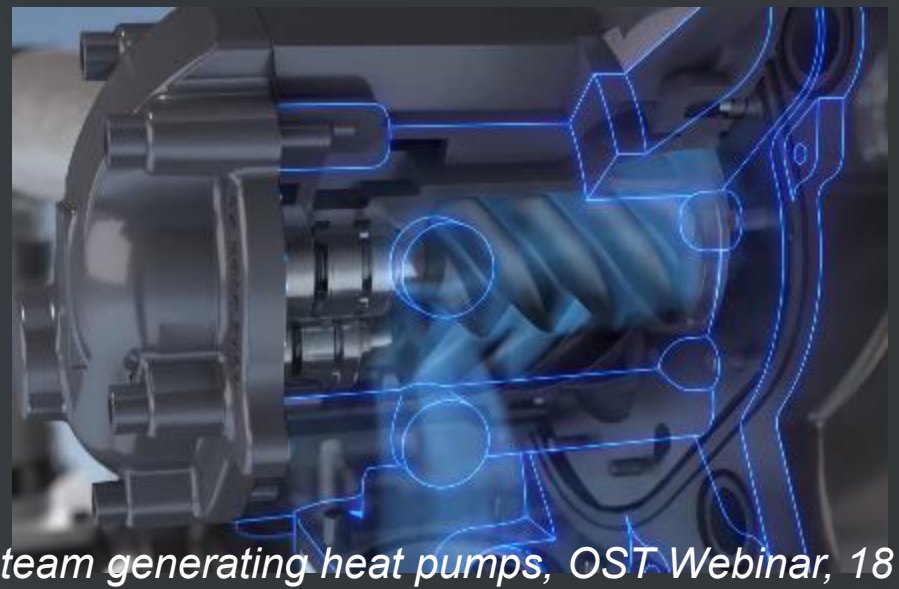


Steam compressor

- Oil free and air free dry superheated steam
- COP between 2-10
- Variable Speed Drive
- Control and Monitoring Elektronikon®
- Heat of compression becomes extra steam
- Inlet T> 80°C @ 0.45bar(a)
- Outlet T< 200°C @ 14bar(a)
- Full connectivity to Smartlink

Steam compressor

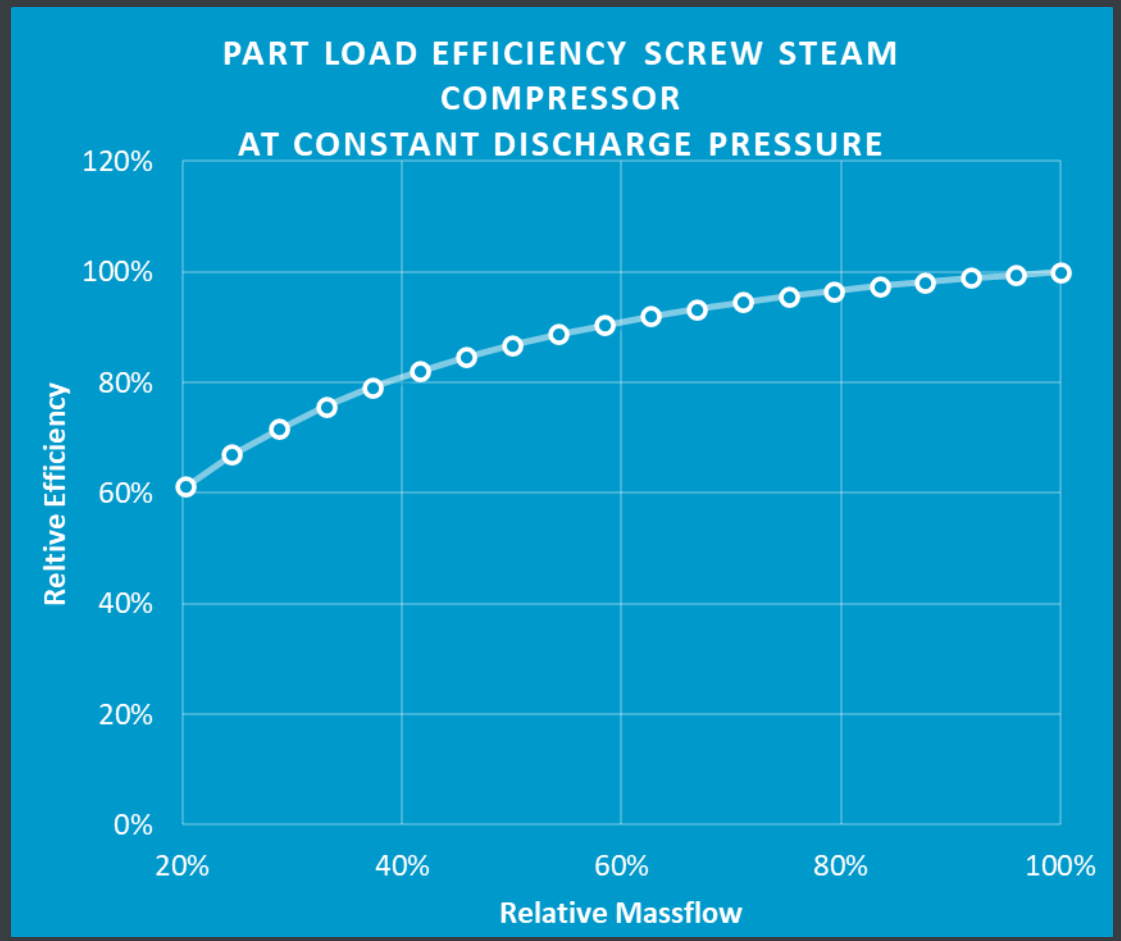




Oil-free screw

- Volumetric compression:
  - Flow ~ rpm
  - Pressure is independent of speed
- High pressure ratio per stage ($1{,}8 < \pi < 6...10$)
- Flow regulation with Varible Speed Drive
- Liquid injection in inlet
  - Increases efficiency
  - Converts heat of compression into extra vapour

Steam compressor



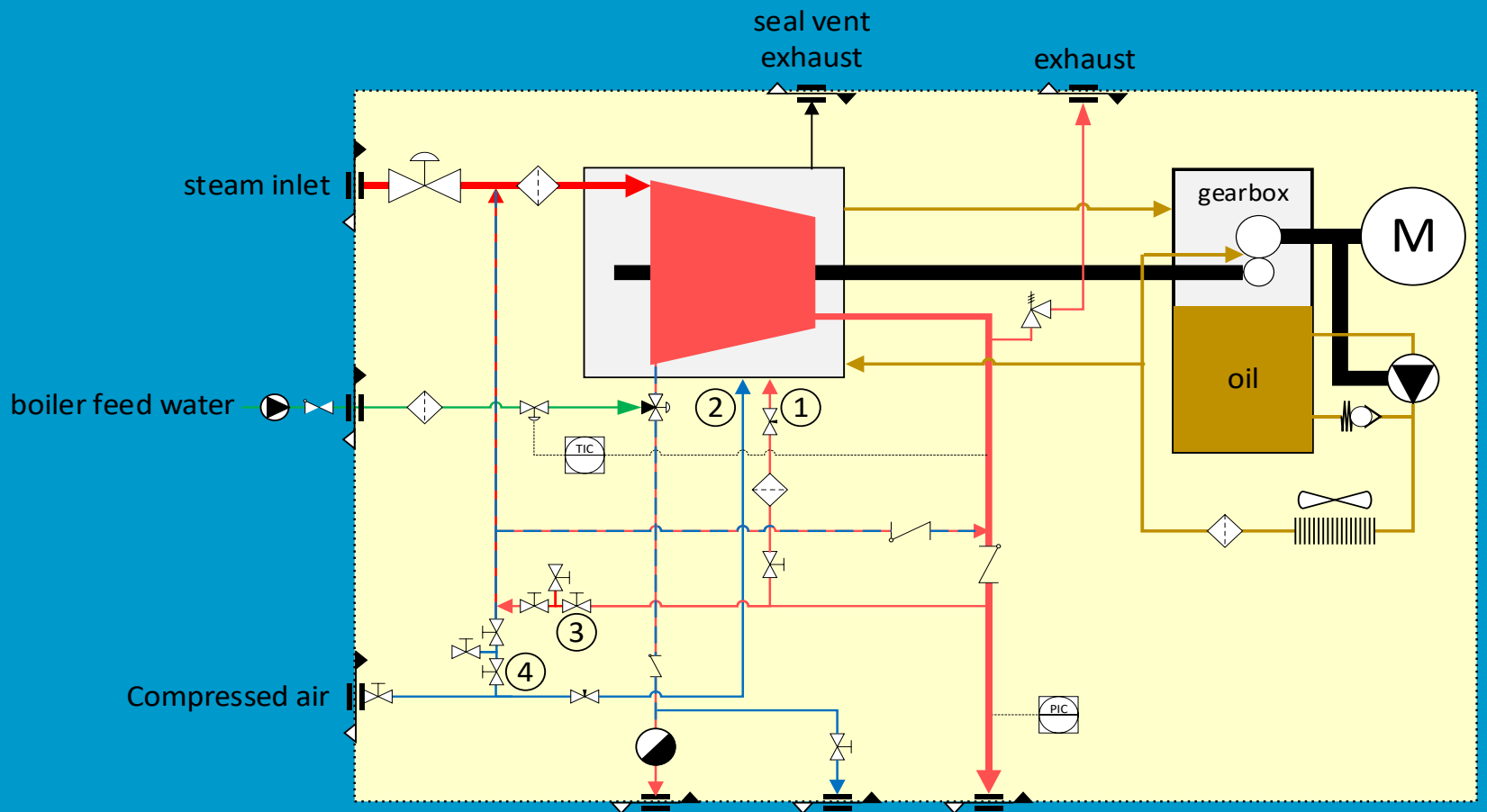
Oil-free screw compression

- Speed controlled
- Optimal over a large operating range
  - High part-load efficiency
  - Large flow and pressure window
  - 1 design fits all
- Fast reaction:

  From minimum to maximum load in seconds

  Accurate process regulation, better than most valves

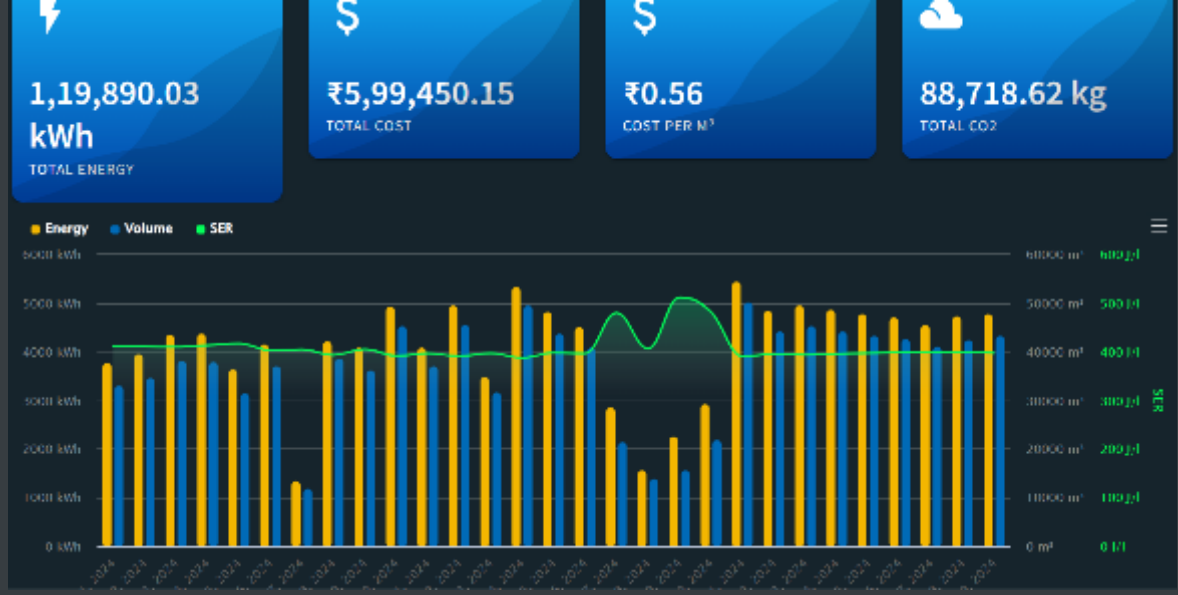
Steam compressor flow diagram



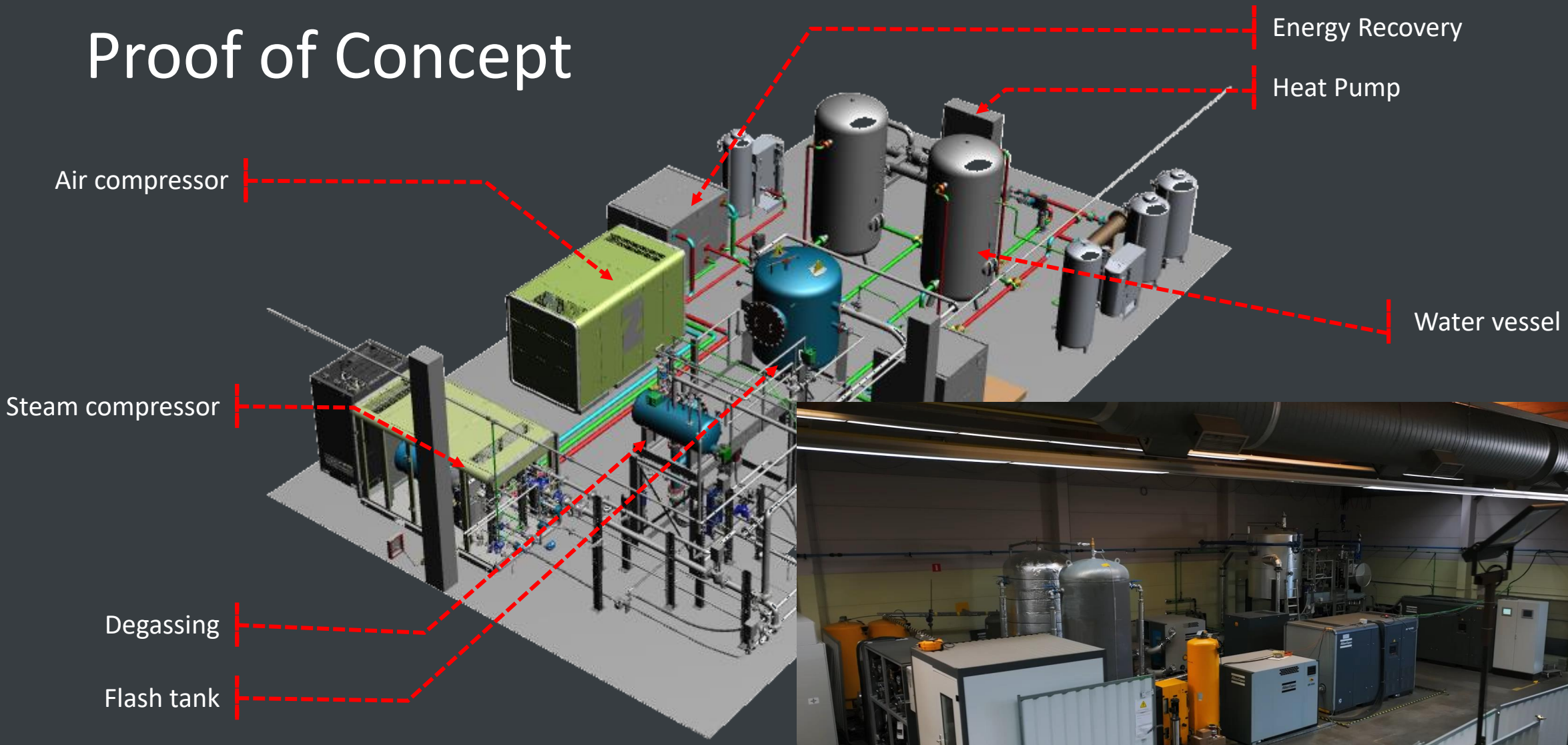
(1) blocking steam
(2) blocking air
(3) wet-blow steam
(4) dry-blow air

Smartlink connectivity

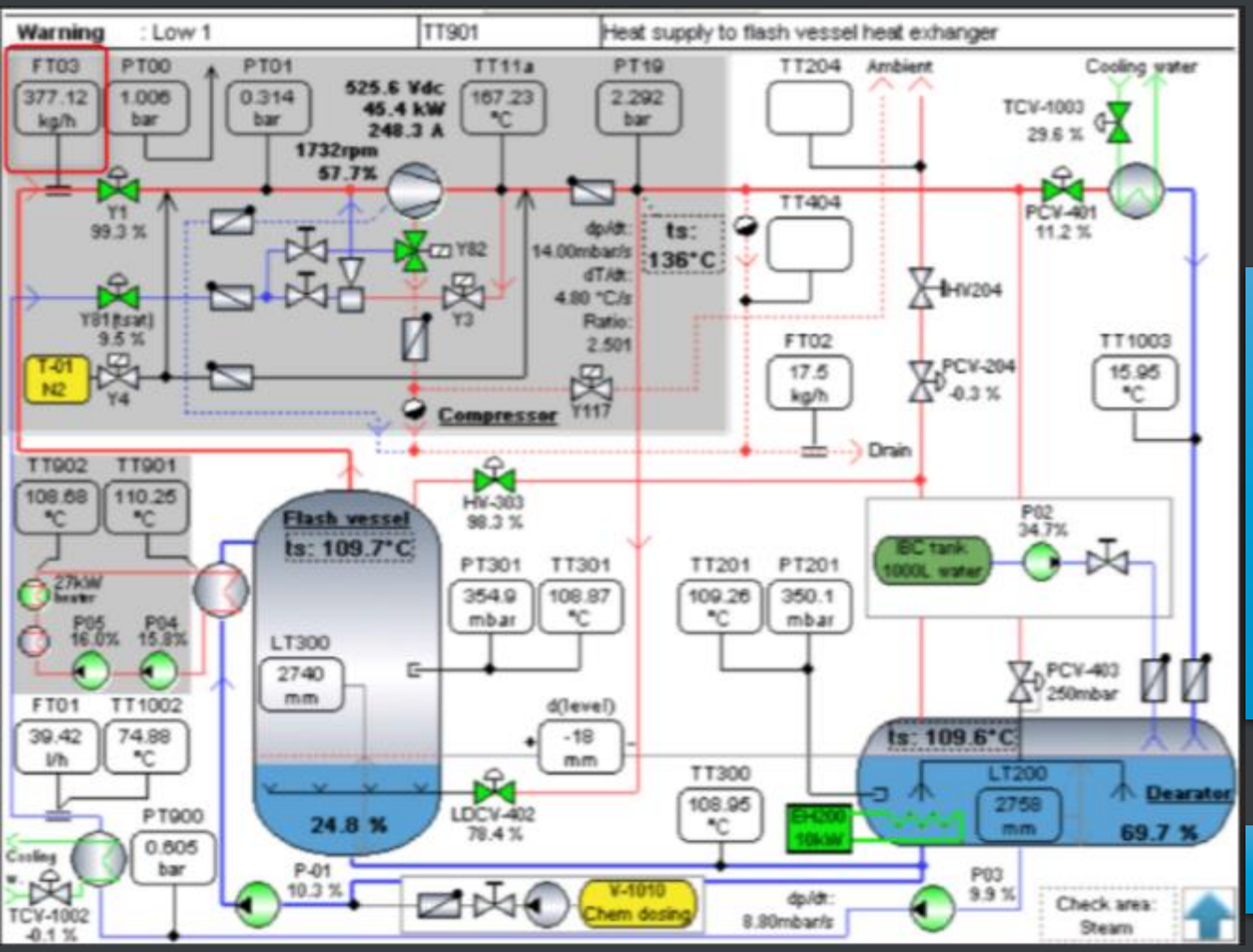
- Over 300.000 compressors connected
- Continuous connection globally
- Data warehouse with AI intelligence
- Maximize uptime and reliability
- Energy saving predictability



Proof of Concept



Test results



Notes:

- Compression element (screws) have been damaged via extensive testing over the last 9months. COP will increase
- Present system is fully controllable
- New compression element will be installed to test full performance map

COP = 6,01

Future steps

- Latest compression element to be installed
- Full mapping of operating window to validate model calculations inc. vacuum inlet
- Development of system controls and optimization
  - air compressor, heat pump and steam compressor
- Analyze the data of the Atlas Copco connected machines globally and analyse the performance of connecting a steam compressor i.e. food and beverage industry
- Plan visits for customers and interested parties to witness the test set up
- Continue to propose and sell globally our steam compressors
  - Over come the mindset for change from end users – decarbonization of their utility rooms
- Move to standard serial production

Atlas Copco Oil-free Air Division partners with our customers across the globe to increase their operational efficiency and reduce the environmental impact of their production or process.

Our technologies help our customers in their ambition to support a low carbon economy.