

High Temperature Heatpumps in Food Industry

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High Temperature Heatpumps in Food Industry

01 Presenter



- ▶ Guido Sutter
- ▶ Master in Mech. Engineering ETHZ
- ▶ Specialisation in Fluid/Aero-Dynamics, Thermodynamics

02 Company, Function



- ▶ Nestlé, Vevey, Zone EUROPE
- ▶ Sustainability Manager Manufacturing
- ▶ Decarbonisation of Manufacturing

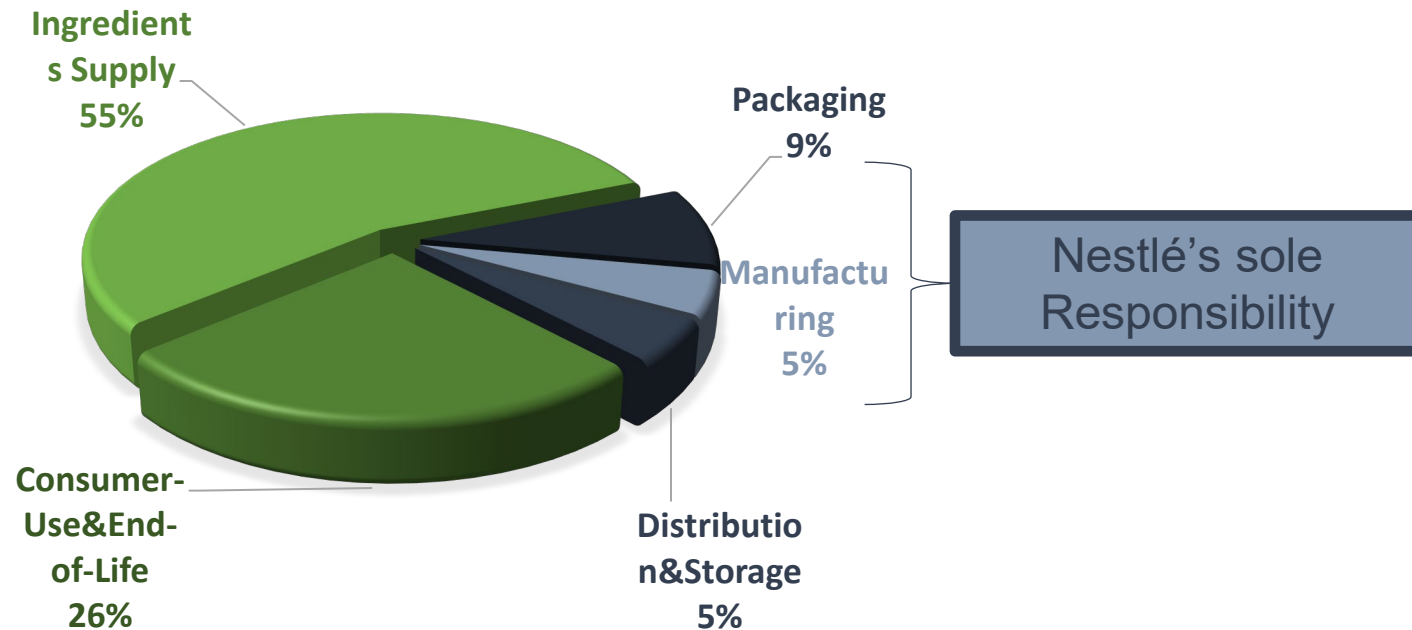
03 Special Interests



- ▶ Food and Food Industry
- ▶ Efficiency, Sustainability
- ▶ Change and Rethink

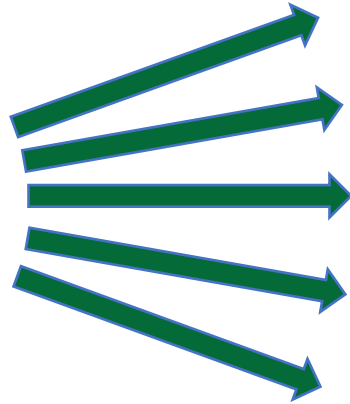
Manufacturing represents only ~5% Value chain But scope 1 (Self used) has Now it's own reduction target

Total Carbon emissions of Nestlé



- **Credibility:**
«Clean up our own house»
- **Expectation:**
Fulfill the Public's and NGO's expectations
- **Readiness:**
Be ready for the ultimate target 2050: Zero Carbon

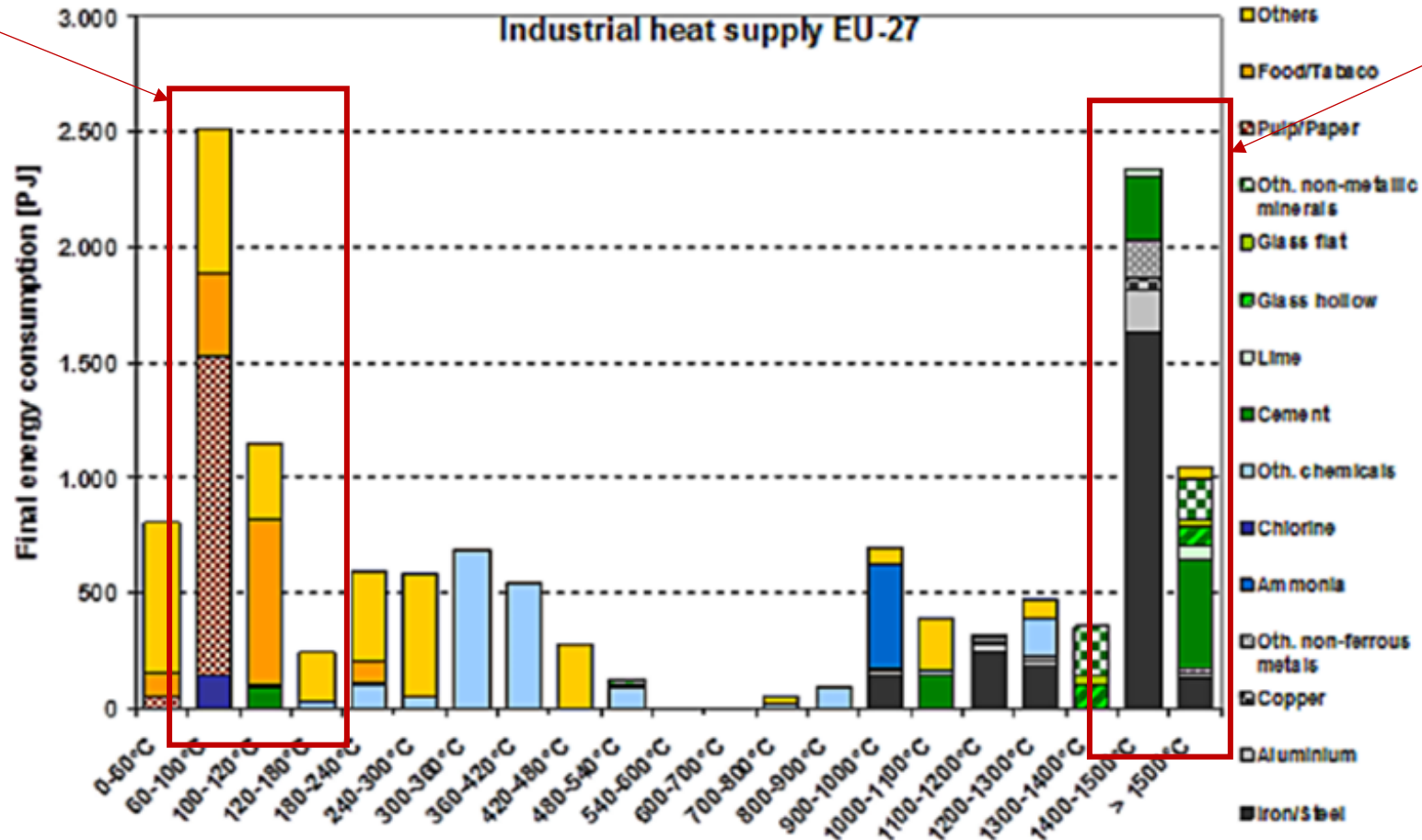
Unit operation efficiency is a big opportunity



	Efficiency
Petfood Dryers	50%
Pizza ovens	25%
Waver ovens	20%
Spray Dryers	50%
Noodle Dryers	40%
Roasters	20%
Retorts	10%
PET Pre-form heater	20%

The food industry is a low temperature industry

Food, Paper

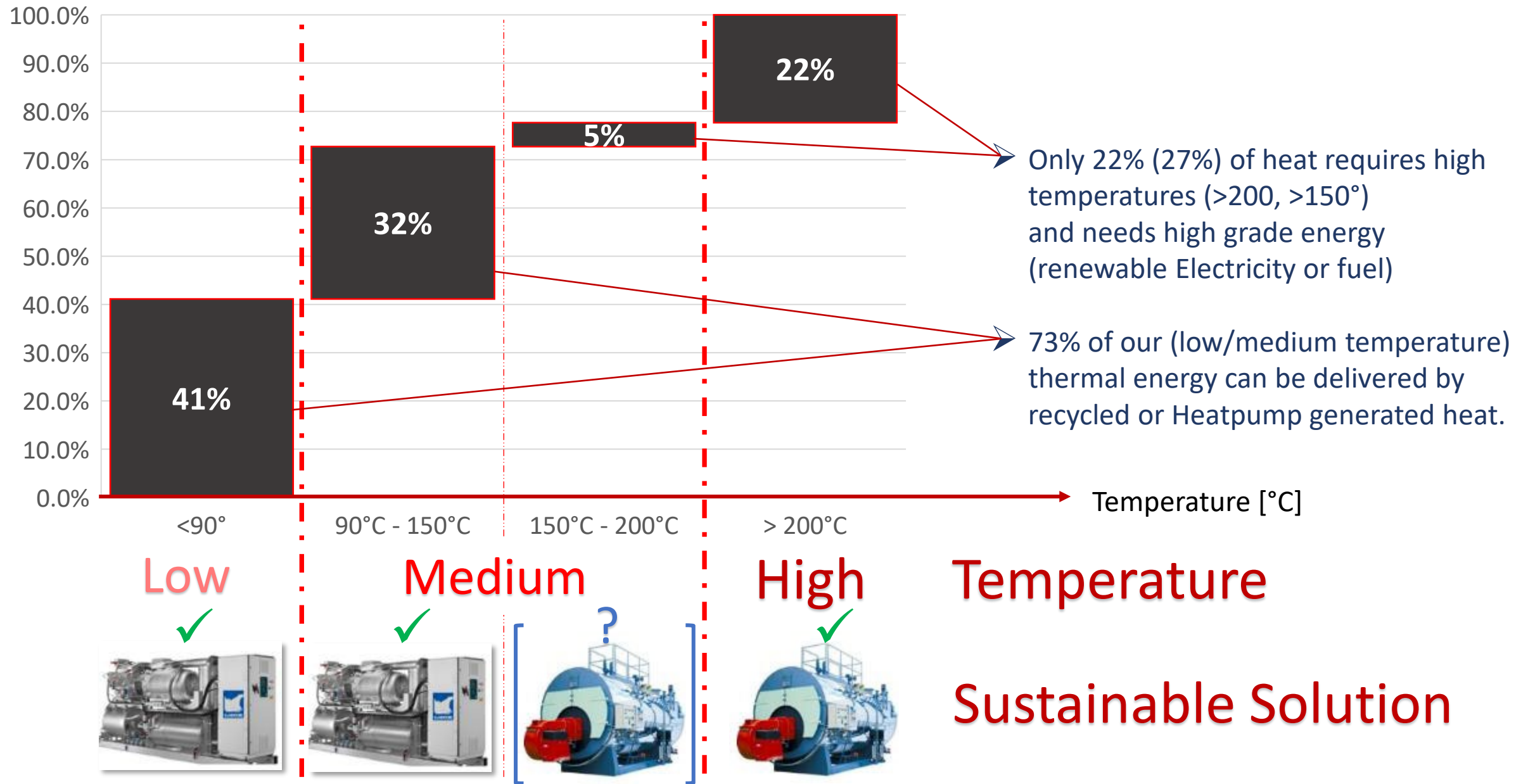


Steel, Cement

Source: SP Technical Research Institute of Sweden

Abbildung 13: Wärmebedarf von 27 EU Länder aufgeschlüsselt nach Temperaturen und Industriezweige (IEA, 2012).

The food industry is a low temperature industry

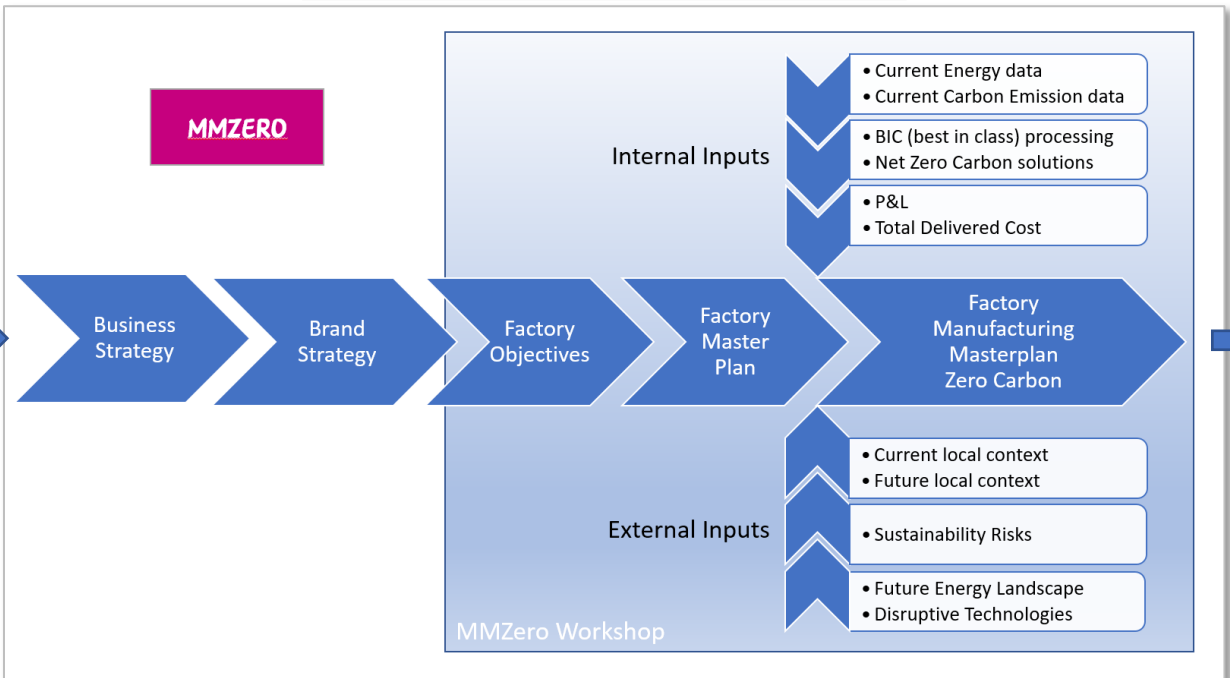


Holistic Plan for Factories

TEAM

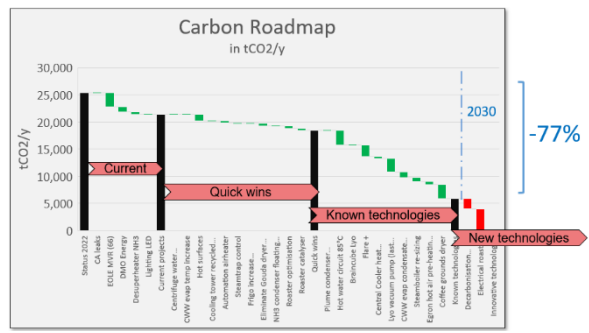


process



Results

1) Carbon Roadmap



2) CAPEX Phasing Plan

Timeline										
2023	2024	2025	2026	2027	2028	2029	2030	2031-34	2035-39	2040s
	Phase 0		Phase 1		Phase 2		Phase 3		Phase 4	
	Quick win		Implement Known Tech. 1		Implement Known Tech. 2		Implement New Tech.		Replacement of Fuel	
CAPEX	0.1 Mio CHF		1.7 Mio CHF		0.5 Mio CHF		0.8 Mio CHF		8 Mio CHF	
Payback	<0.8 Year		<4.2 Years		<5 Years		<1.2 Years		Negative Payback	

3) A Lot of learnings



MMZero identifies Great Savings

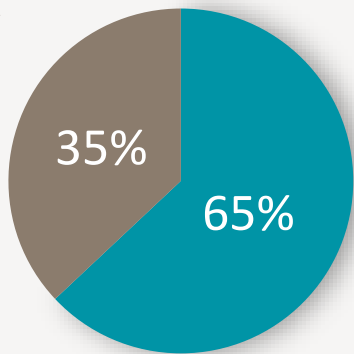


MMZero
Manufacturing Masterplan
Zero Carbon

Outlook 2030

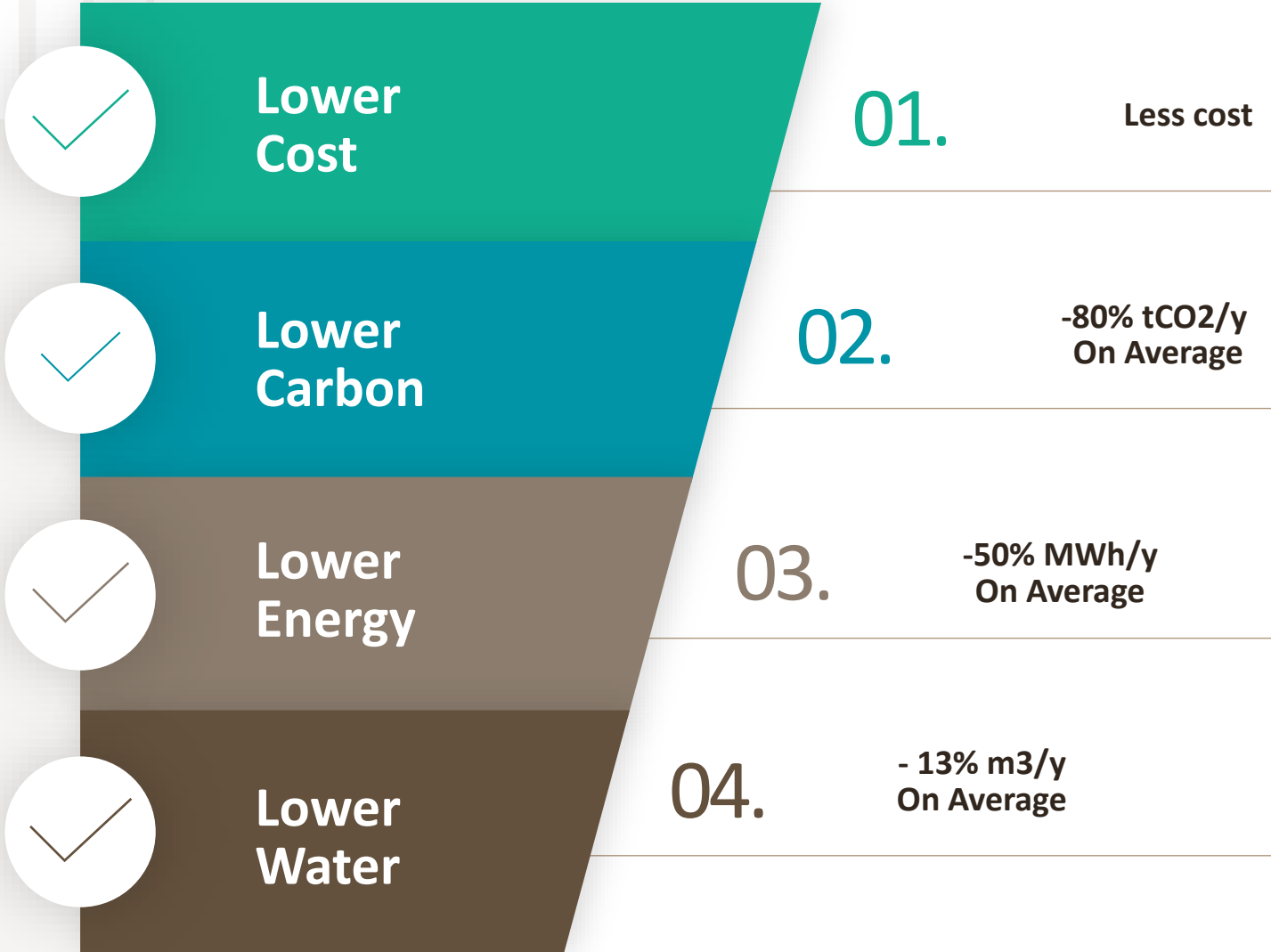
Status 2025

Carbon
Coverage



■ MMZero done ■ Still to do

100x



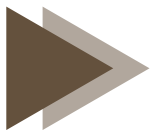


-82%
CO₂



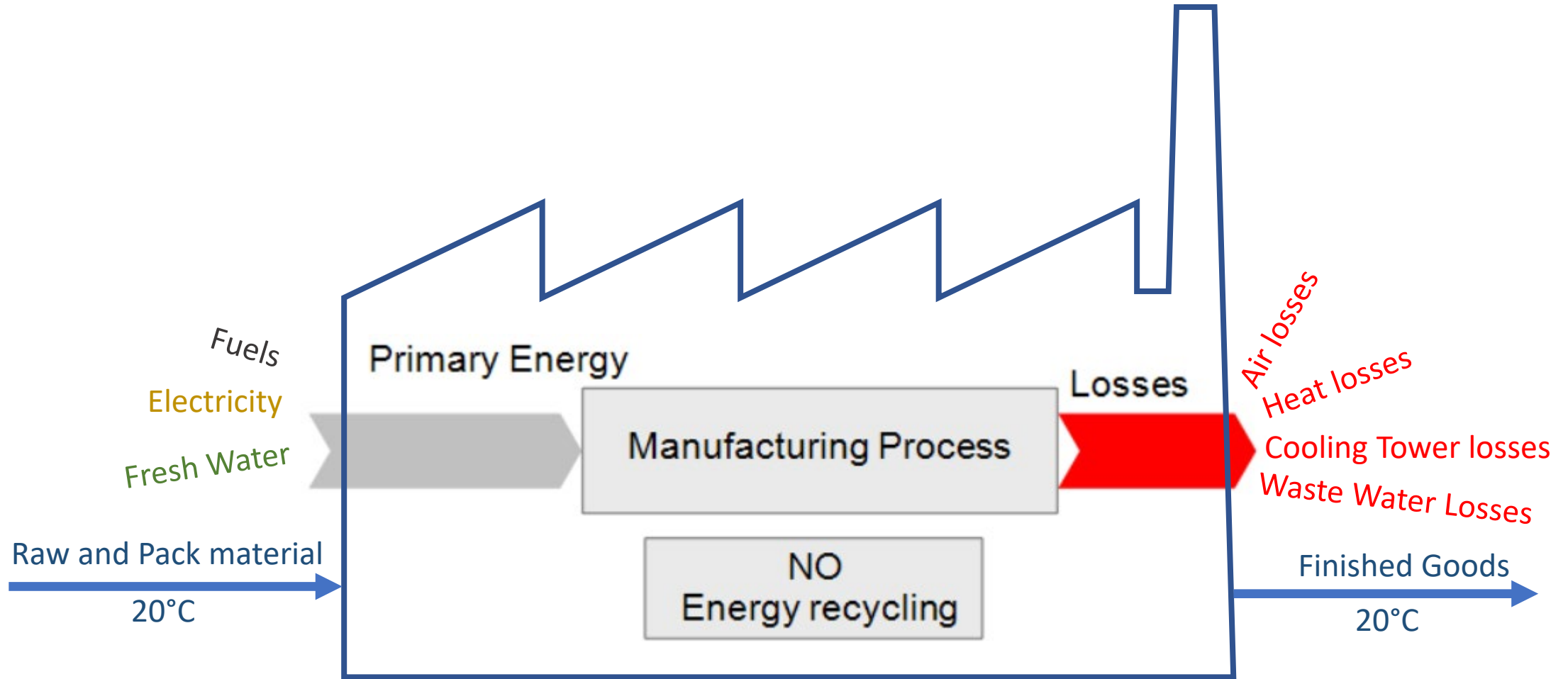
-56%
Energy

EXAMPLE
MMZero
Nescafe



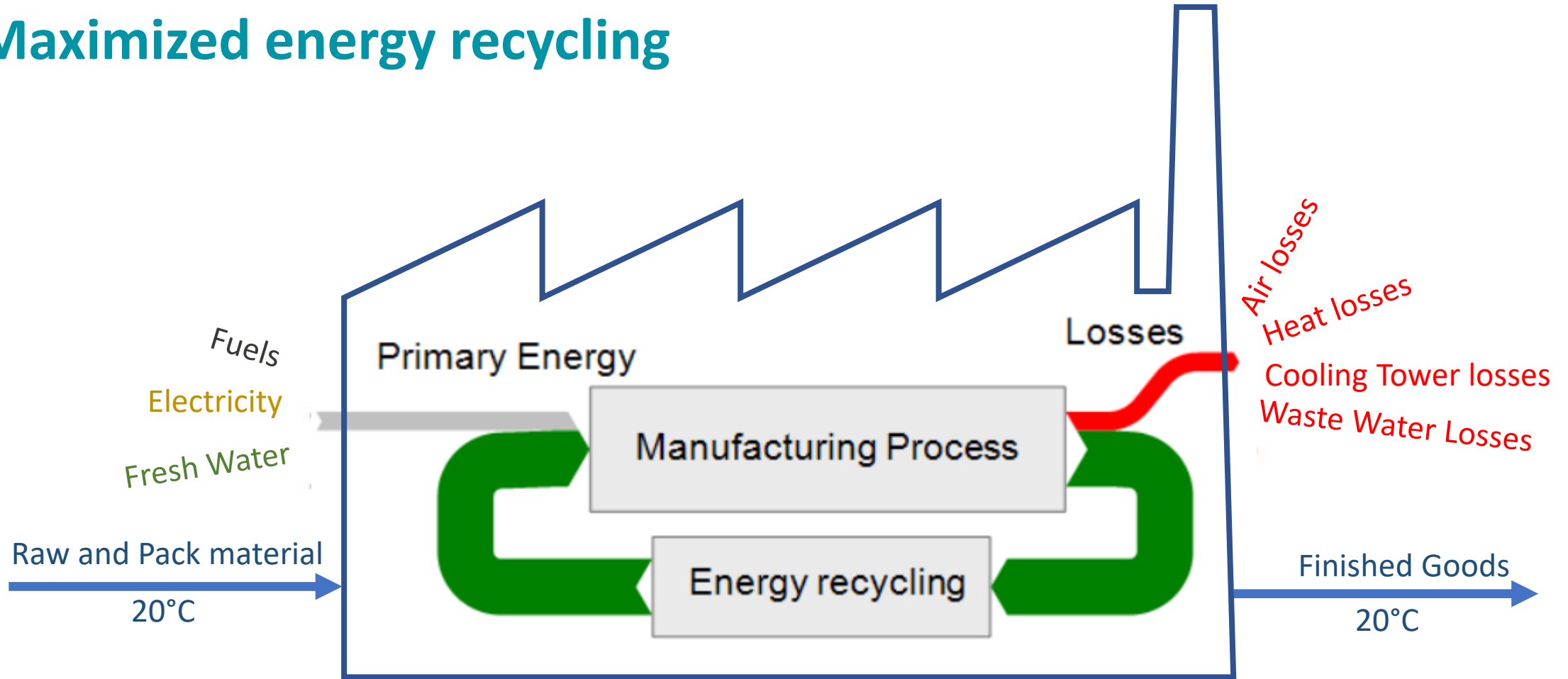
Our Traditional Set-up

Primary Energy in - Waste heat out

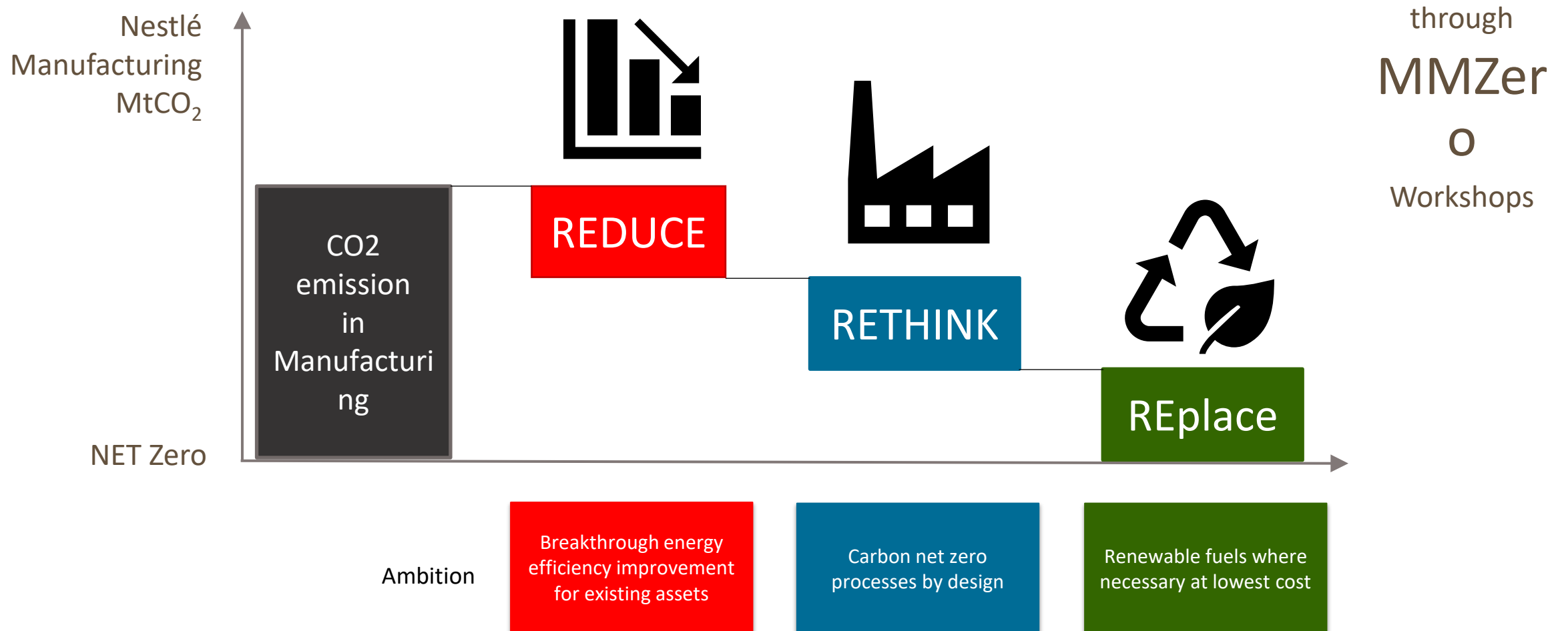


Our NEW Set-up

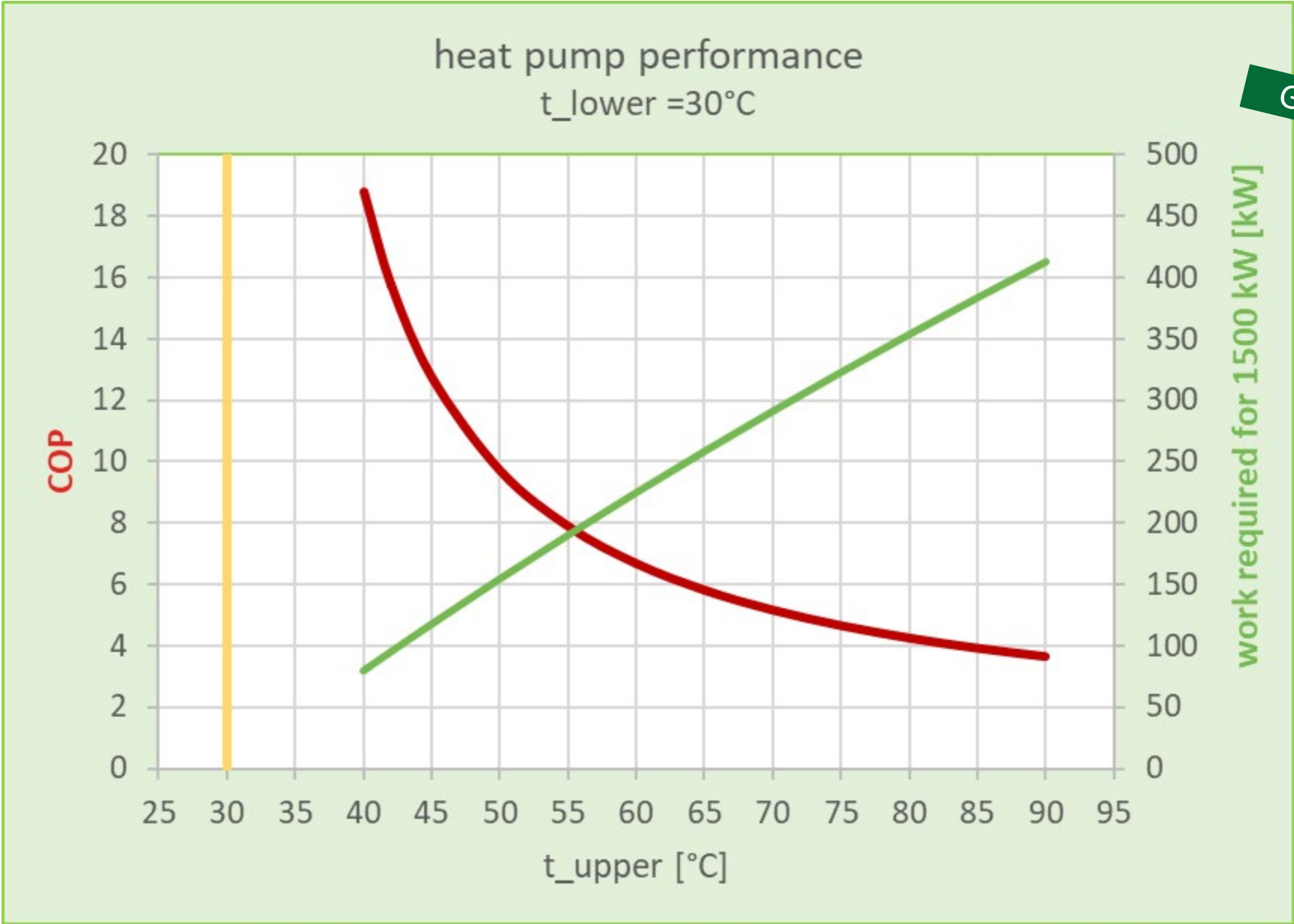
Minimized Primary Energy in - Waste heat out
Maximized energy recycling



OUR STRATEGY to decarbonize manufacturing



KPI's – Coefficient of performance (COP)



Go to Calculation



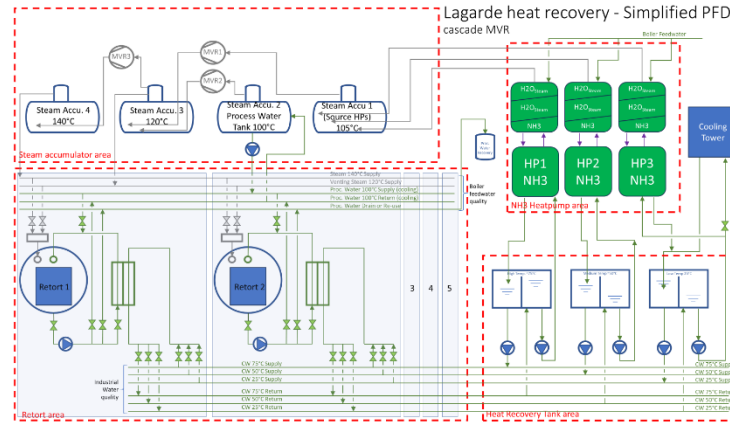
Research and Development

System integration is key – Aim for highest COP_{heatpump}



Heatpump

+



System Integration

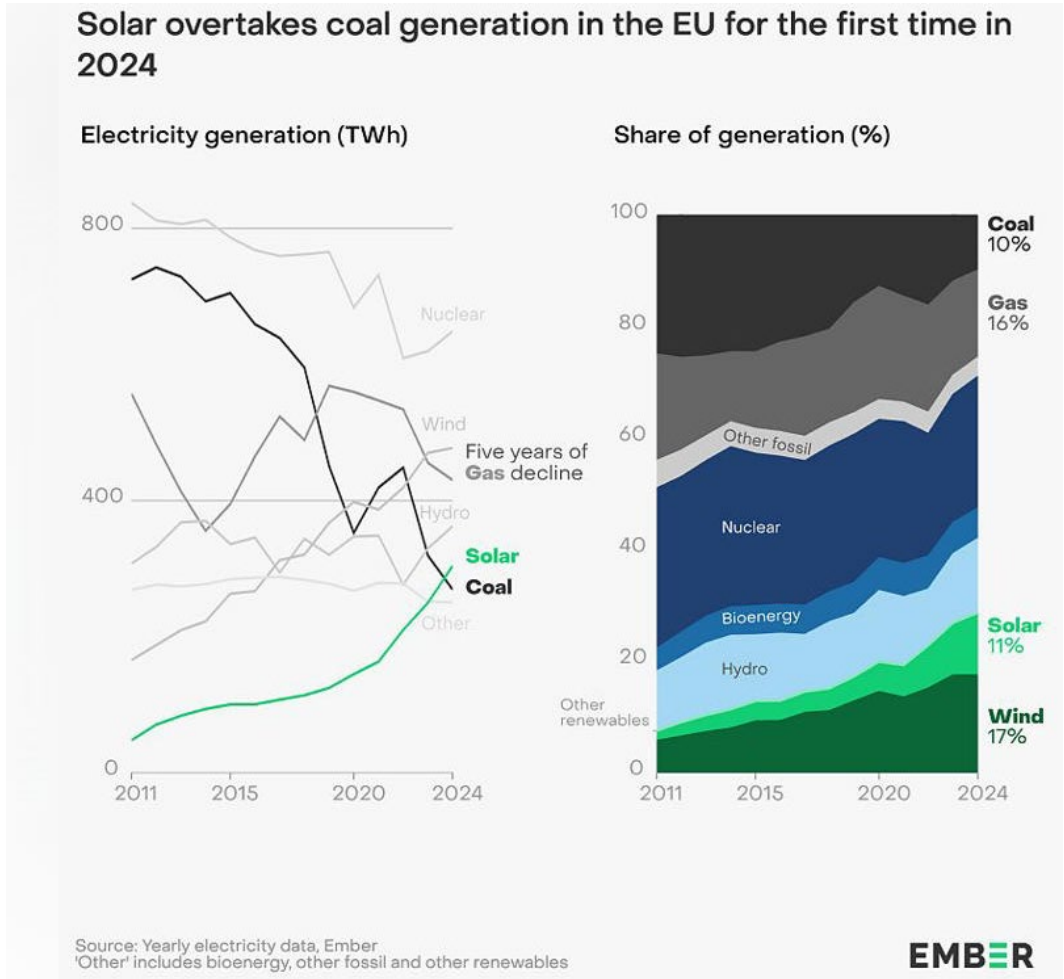
= Success

$$\checkmark COP_{\text{system}} = \frac{\text{gain}}{\text{effort}} = \eta \frac{T_h}{T_h - T_l} > \frac{\text{electricity price}}{\text{gas price}}$$

T_h : High Temperature (Sink)
 T_l : Low Temperature (Source)

Solar and Wind produce electricity at lowest cost

Tendency: lower Electricity/Gasprice ratio

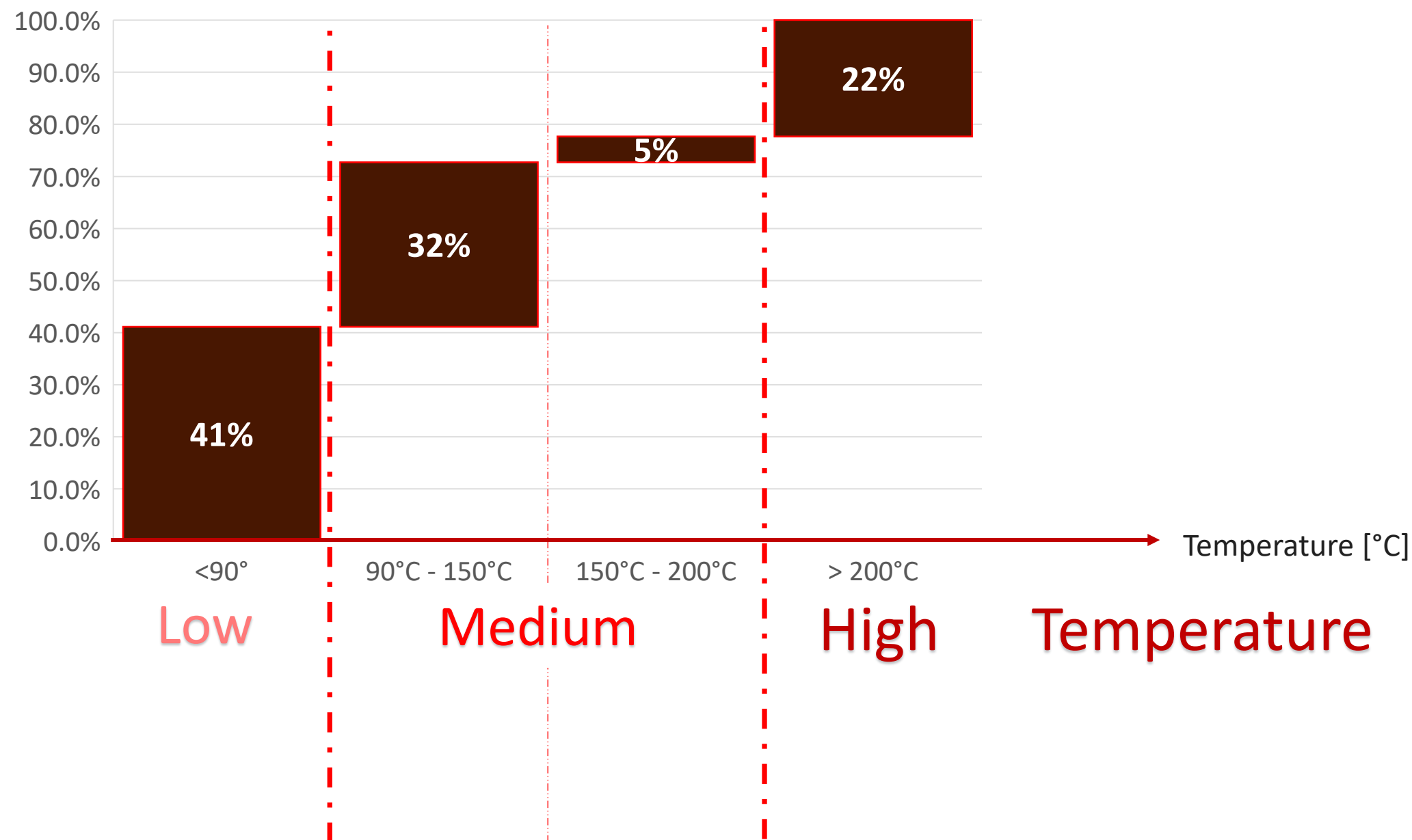


Technology	Cost CHF/MWh
New Nuklear	180
Gas peaking	168
Current Market Price	150
Coal	117
Gas combined cycle	70
PV Utility scale	60
Wind power	50
Old (existing) nuklear	40-60

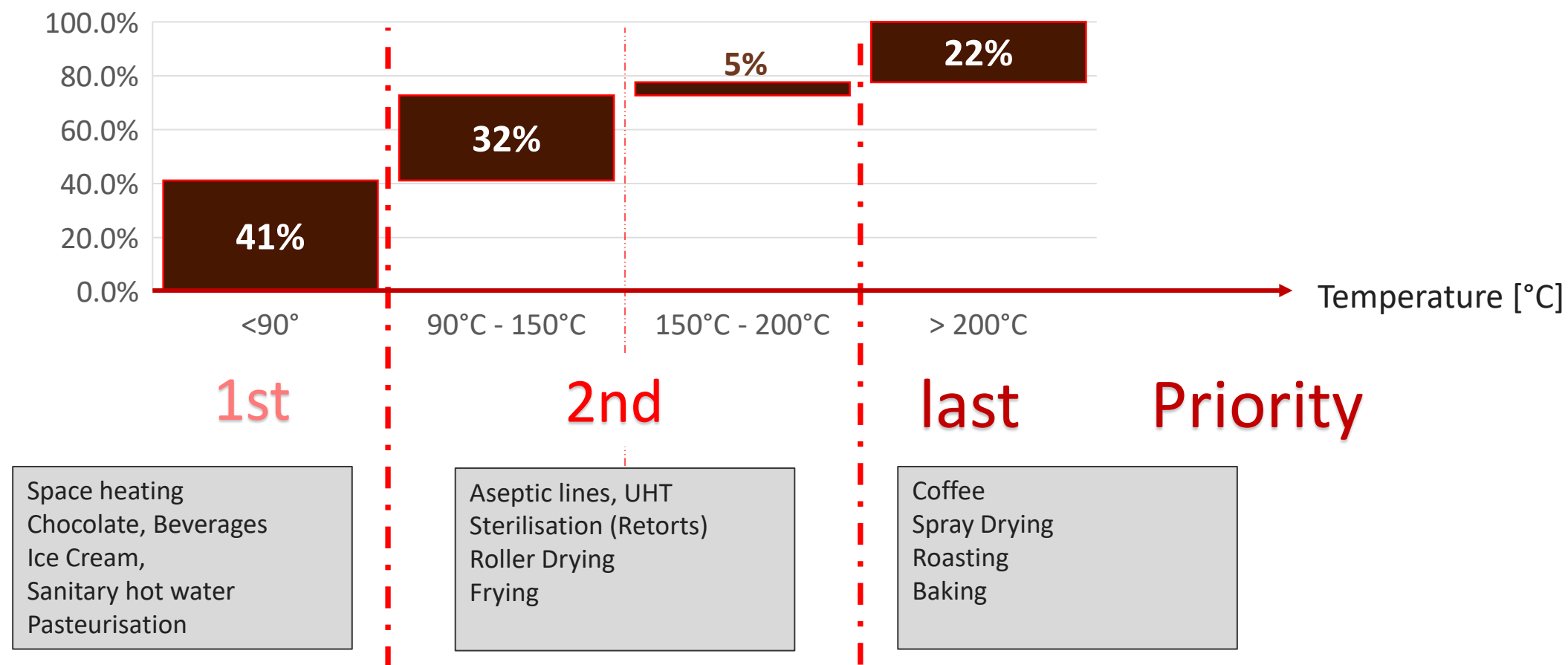
Electricity/Gasprice ratio = 2.5 – 3
is decreasing year over year



The food industry is a low temperature industry

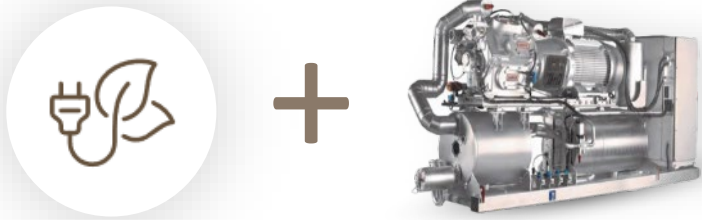


The food industry is a low temperature industry



Examples

EXAMPLE Europe Decarbonisation by Heatpumps



▶ Heatpumps to reduce GHG-emissions by up to 50%

ZERO CARBON
is Feasible &
**Implementation is
already done**

2022-2025

13 MW Heat Capacity installed
By 11 Heatpumps < 85°C

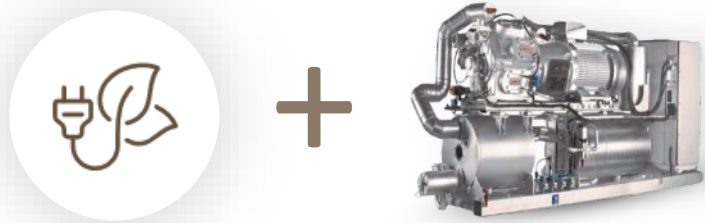
Impact 20'000 tCO₂/y savings

2026-2030

20+ MW Heat Capacity
Under Execution or planning

Impact 30'000 tCO₂/y savings

Konolfingen Infant Formula Decarbonisation



Heatpumps to reduce GHG-emissions by up to 50%

ZERO CARBON

First large Heatpump and first stratification tank implementation

2023

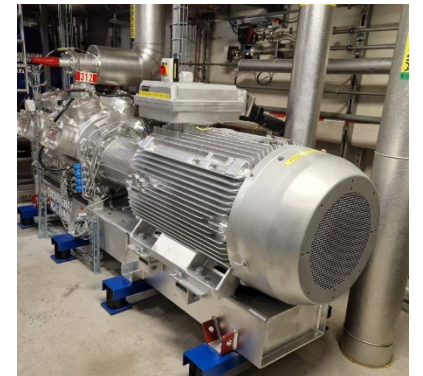
1.3 MW Heat Capacity
10'000 MWh/y savings (-20%)

Impact 2'000 tCO₂/y

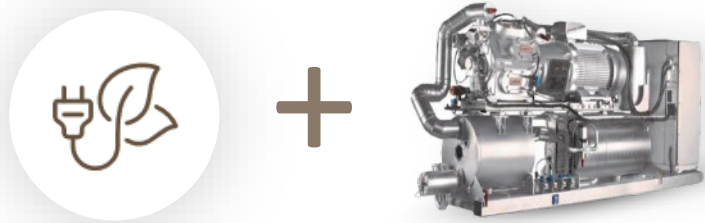


Scope:

- ✓ Heatpump
- ✓ Stratification tank
- ✓ Energy circuit 85°C/75°C



Biessenhofen Infant Formula Decarbonisation



Heatpumps to reduce GHG-emissions by up to 50%

ZERO CARBON

Stepwise decarbonisation program following the MMZero strategy

2024 (done), 2026 (project)

1.8 MW Heat Capacity

8'000 + 10'000 MWh/y savings (-21%)

Total impact 3'600 tCO₂/y

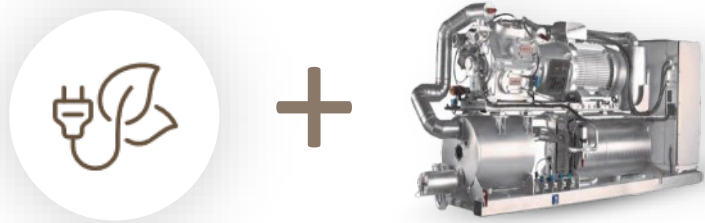


Scope:

- ✓ Heatpump
- ✓ Stratification tanks
- ✓ Energy circuits
85°/75°C, 65°/45°C



Holesov CZ Confectionery Decarbonisation



▶ Heatpumps to reduce GHG-emissions by up to 50%

ZERO CARBON

Air drying of jellies
by heat pump

2025 (done)

3 x 1.2 MW Heat Capacity
11'000 MWh/y savings (-45%)
Total impact 2'200 tCO₂/y

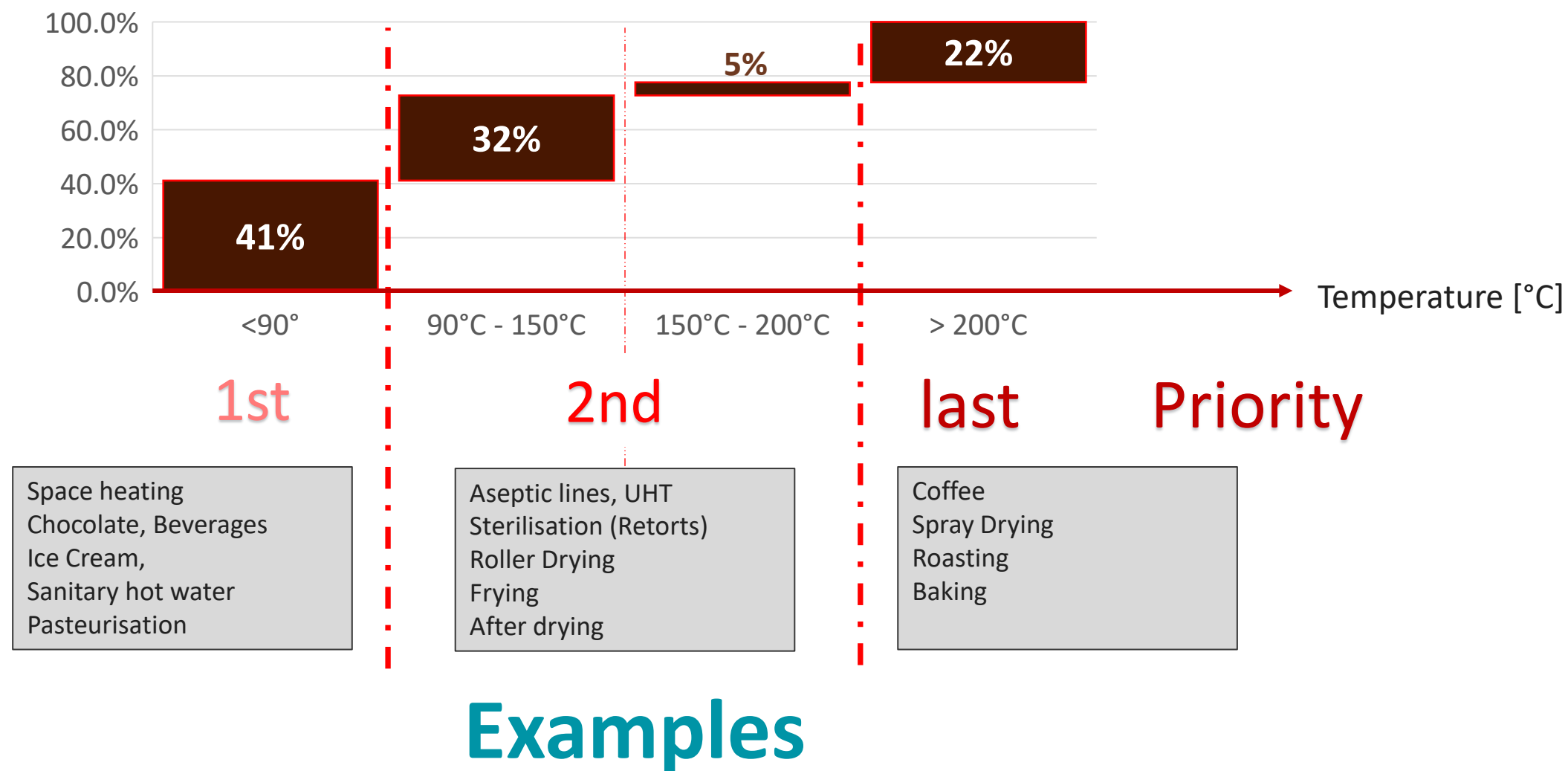


Scope:

- ✓ Heatpump
- ✓ Stratification tank
- ✓ Integration 83°/77°C



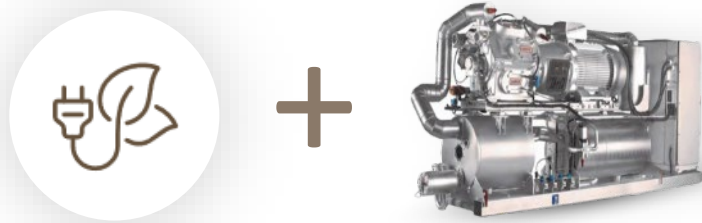
The food industry is a low temperature industry



France

Petfood Retorting

Decarbonisation



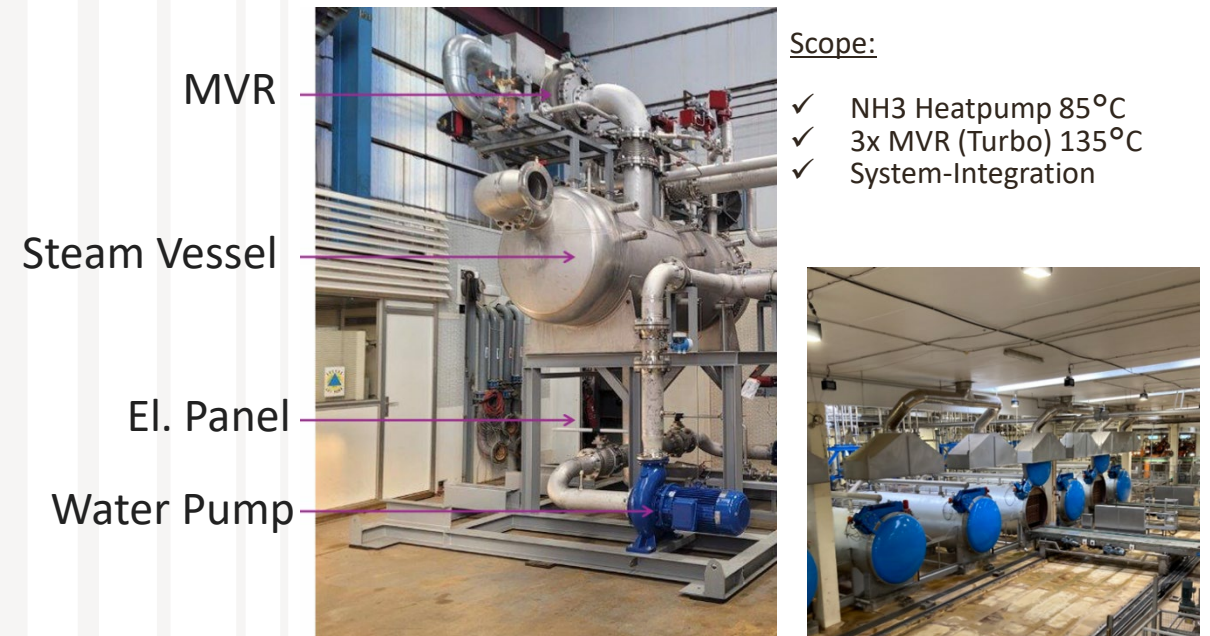
▶ Heatpumps to reduce GHG-emissions by up to 50%

ZERO CARBON

Full decarbonisation of Retorting process by steam generating heatpump

2026 (planned)

1.1 MW Heat Capacity
9'000 MWh/y savings (-95%)
Total impact 1'800 tCO₂/y



MVRs – Steam re-compression – Product Comparison

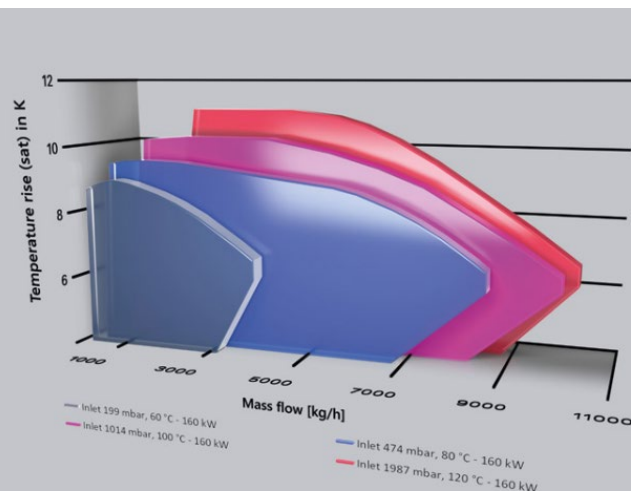
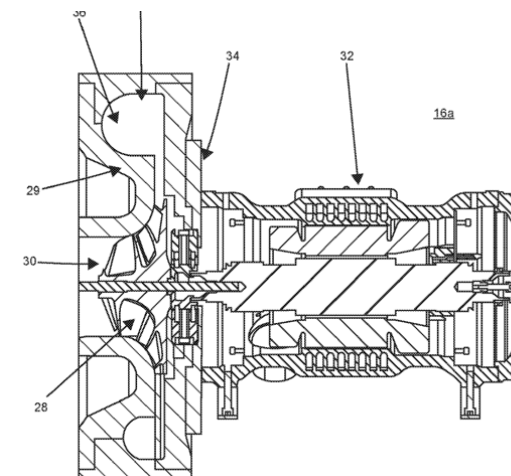
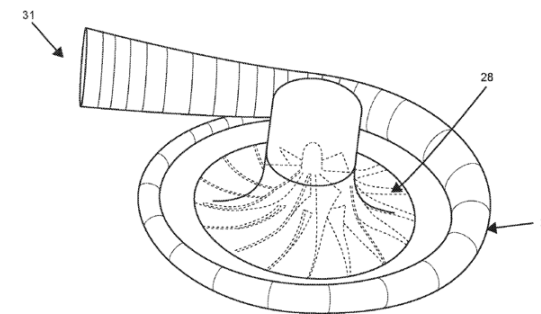


Product Comparison

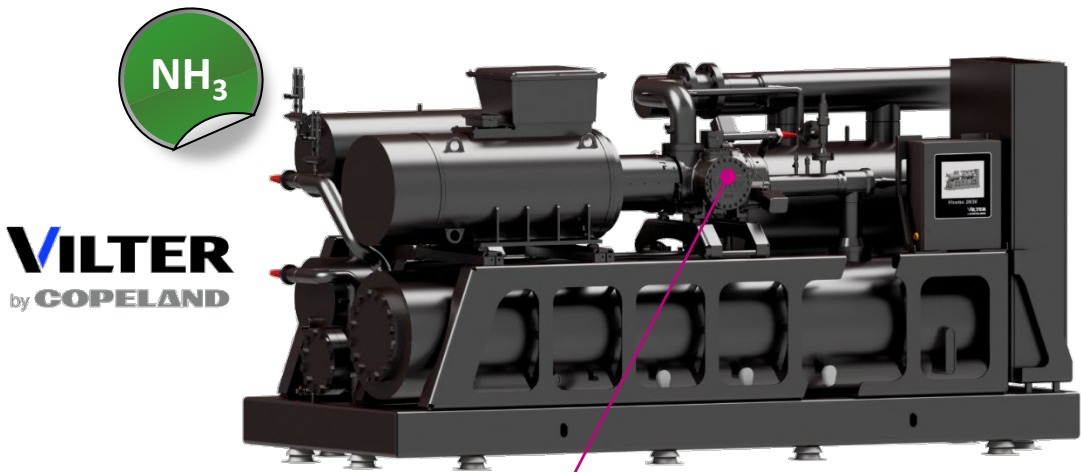
Feature	Piller	SPX
 Recompression Ratio	1.4	≤ 2.6
 RPM	Up to 11,000	35,000-70,000
 Capacity Turndown Ratio	65%	65%
 CIP Ready	Yes	Yes
 Compressor Type	Open	Semi-hermetic
 Shaft Sealing	Piloted	None
 Motor Efficiency	IE3-4	IE5



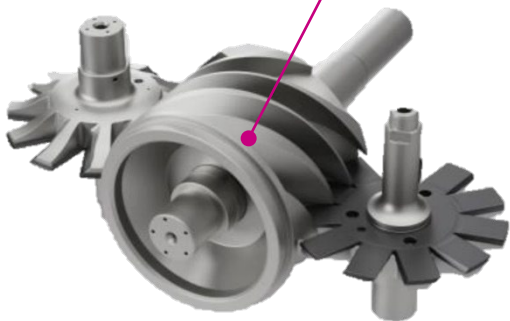
SPXFLOW®



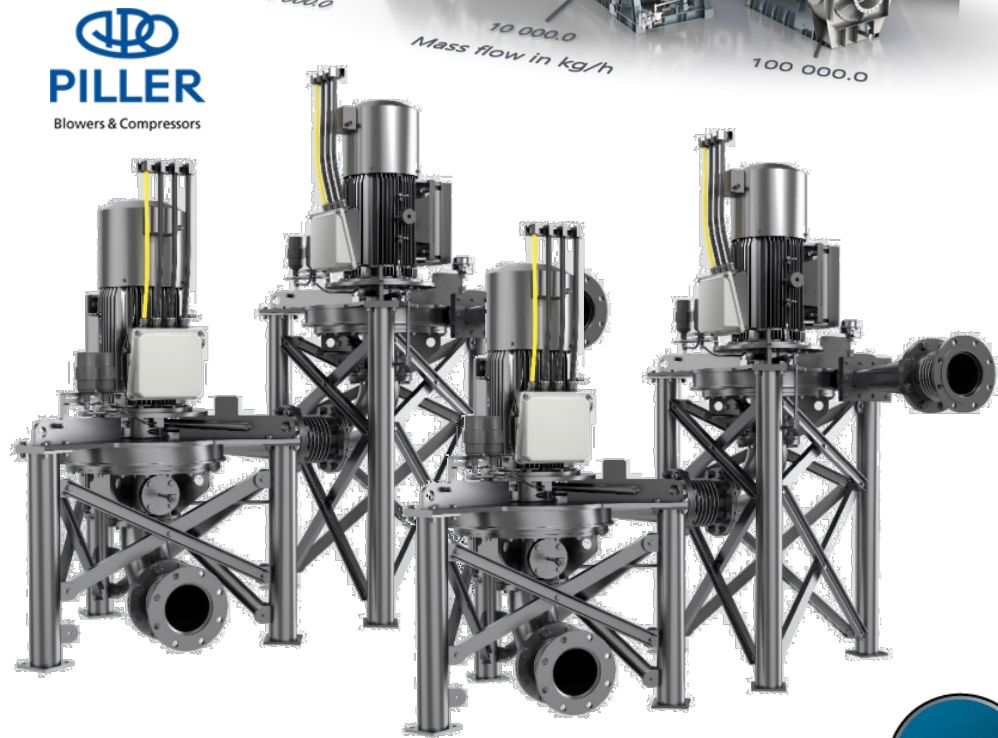
The multi-stage heat pump



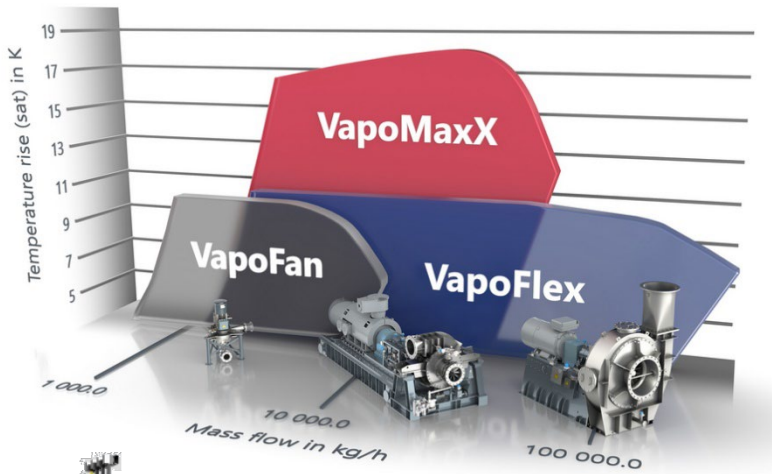
50°C 90°C



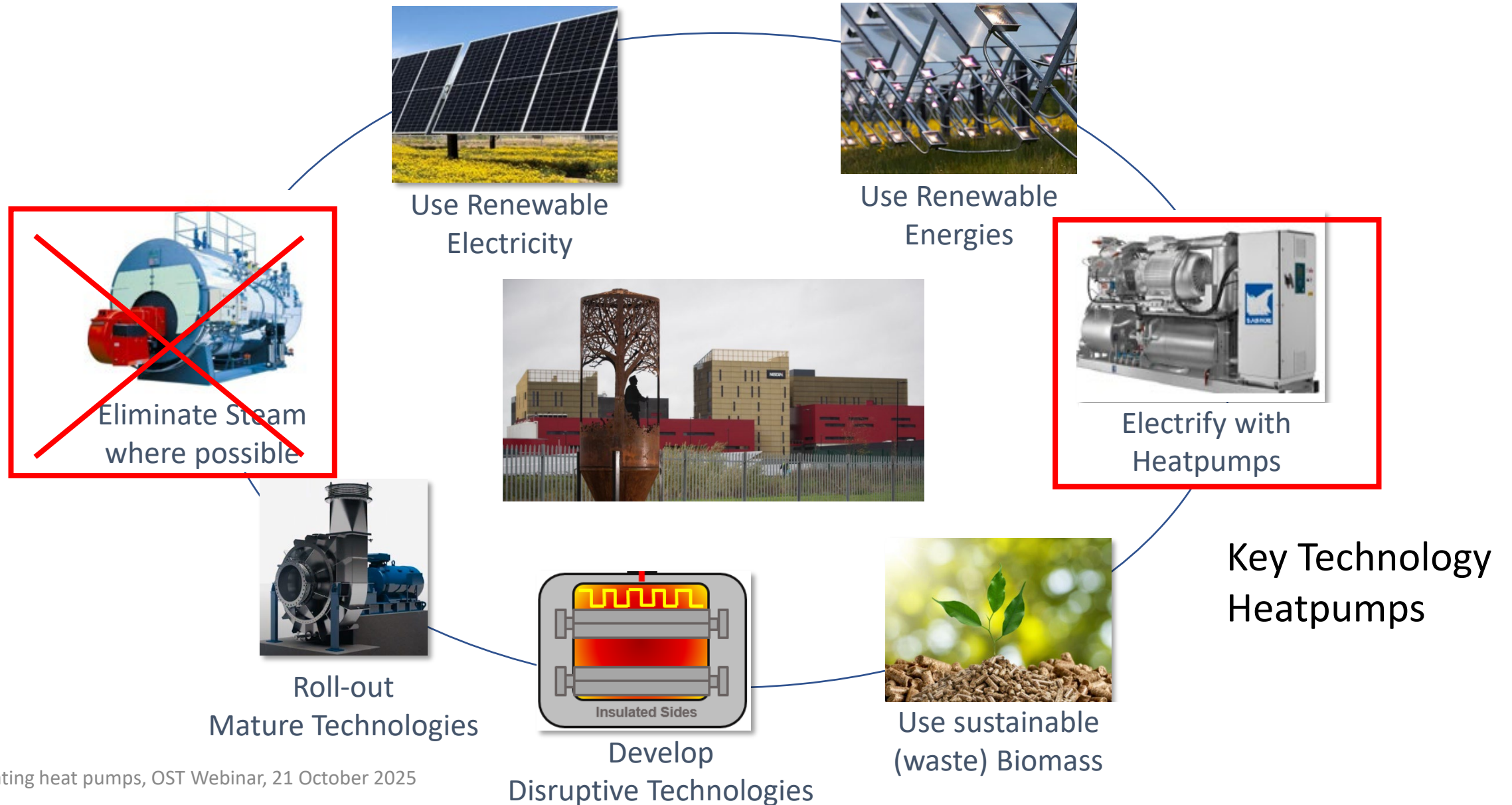
Single screw compressor = Balanced axial and radial loading
Operation proven for high pressure (CO₂ compression)



105°C 140°C
Proven technology on 35+ coffee evaporators



The Food Factory of the FUTURE: 2050



Operations Design Criteria (for High Temperature Systems)

01 Compliant



- ▶ Natural Working Fluids
- ▶ No Halogens (HFC, HF, HFO, ...)
- ▶ Compliant for next 100 years...

02 Reliable, safe Fit for Future



- ▶ Manageable Safety Risks
- ▶ Well known technology
- ▶ Suitable for next 100 years...

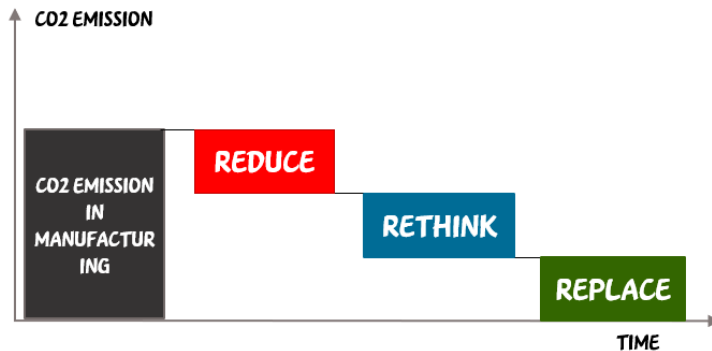
03 Efficient



- ▶ High process efficiency
- ▶ Lowest operational cost
- ▶ Lowest life cycle cost

Summary Recommendations

01 Select right Strategy with right Sequence

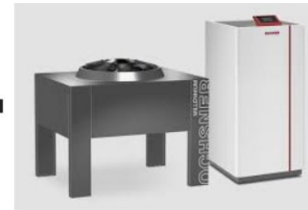


- ▶ REDUCE: «Drive more carefully»
- ▶ RETHINK: «Do it different»
- ▶ REPLACE: “Only if no alternatives”

02 Design System “Fit for Heatpump”



Low temperature radiator



With Heatpump 30°C

03 Aim for highest efficiency



- ▶ Low Temperature Heatpumps: Ammonia
- ▶ High Temperature Heatpumps: Cascade Ammonia - Steam
- ▶ System Temperatures
Low T_{Sink} – High T_{Source}

**Thank you very much for
your attention**