Integrated Energy System Retrofits for Industrial Operating Cost Reduction and Decarbonization through EaaS

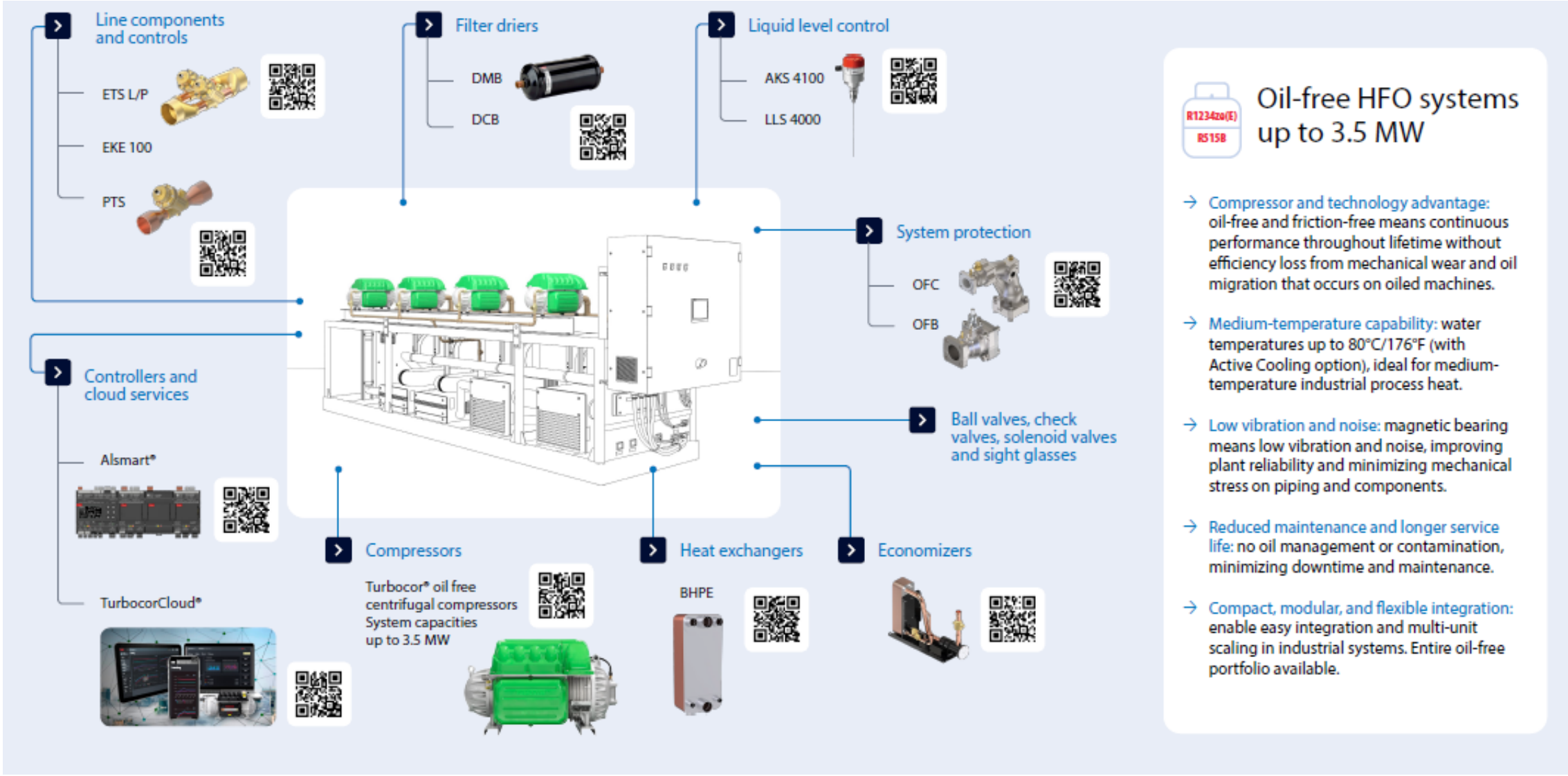
Decarbonized & Sustainable Industry Conference – November 4th, 2026

Danfoss Industrial Systems Solutions



Danfoss and Heat Pumps

What We Do



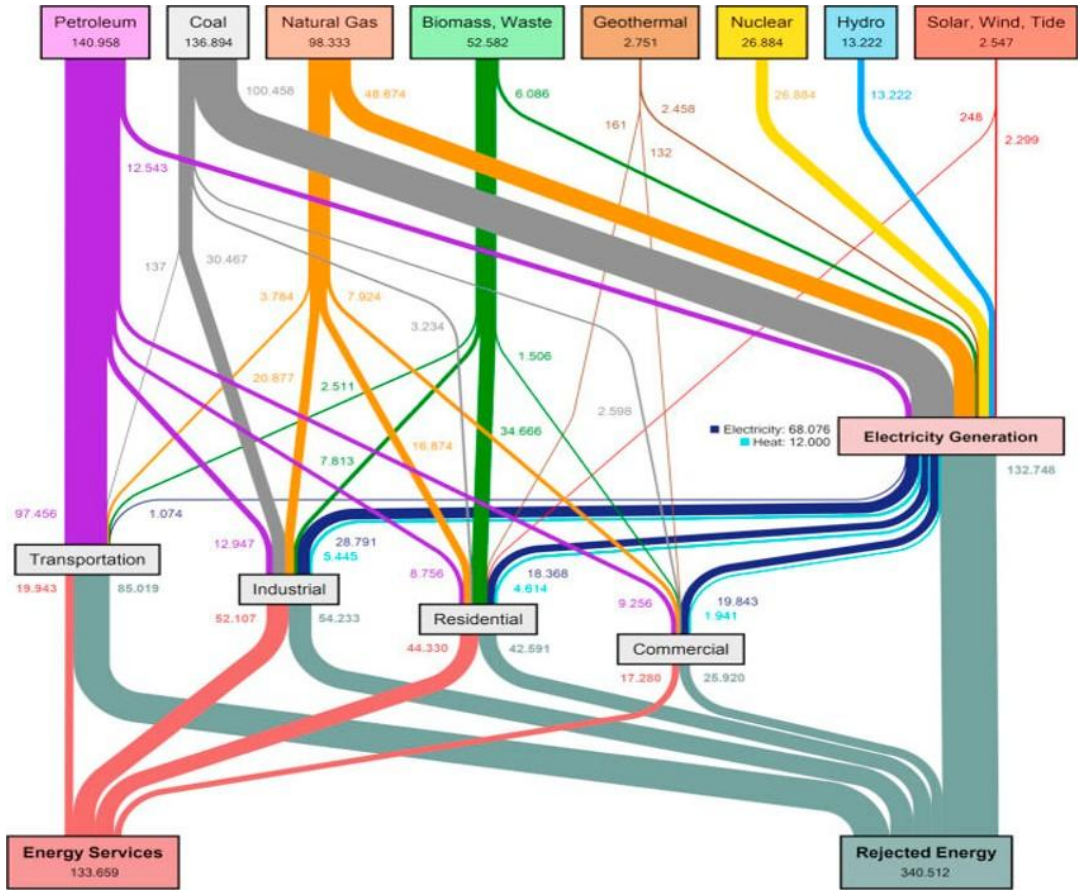
The Excess Heat Opportunity

Today, 72% of the global energy input (consumed primary energy carriers) is currently lost after conversion.

The future energy system will look radically different and use a lot less primary energy.

Such a system will be characterized by:

- "electricity-only" renewables (mainly solar and wind),
- electrification of many end uses that currently rely on burning fossil fuels,
- reusing unavoidable waste heat,
- much improved end-use efficiency,
- enhanced flexibility.



Why is the market focused on Heating Electrification

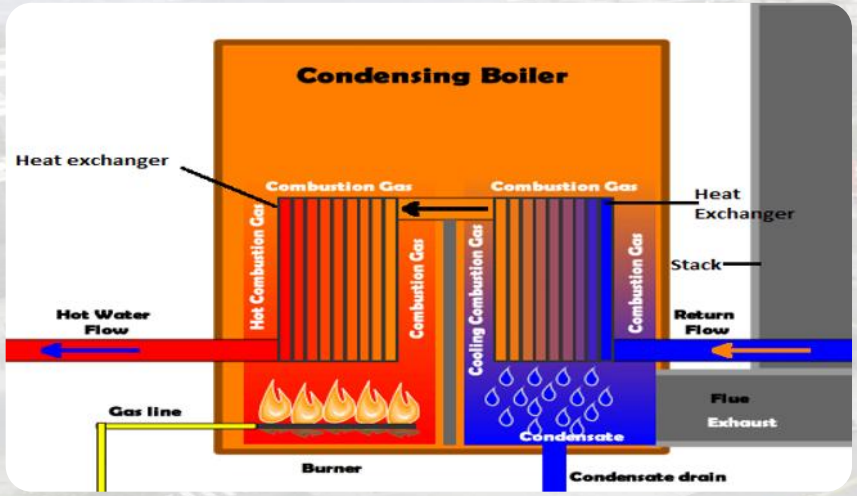
Efficiency & Decarbonization

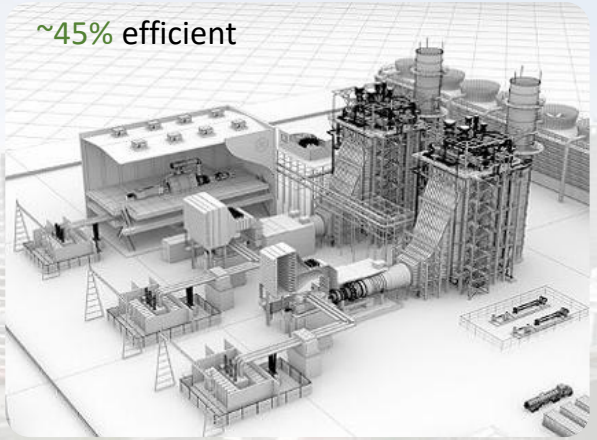
Fossil fuels	Heat pumps

- Inefficient
- Drive CO_2 & other gas emissions impacting environment

CO_2 SO_2 NOx

COP~1





Transmission & Distribution

-5 -10%



COP~2.5-3.5

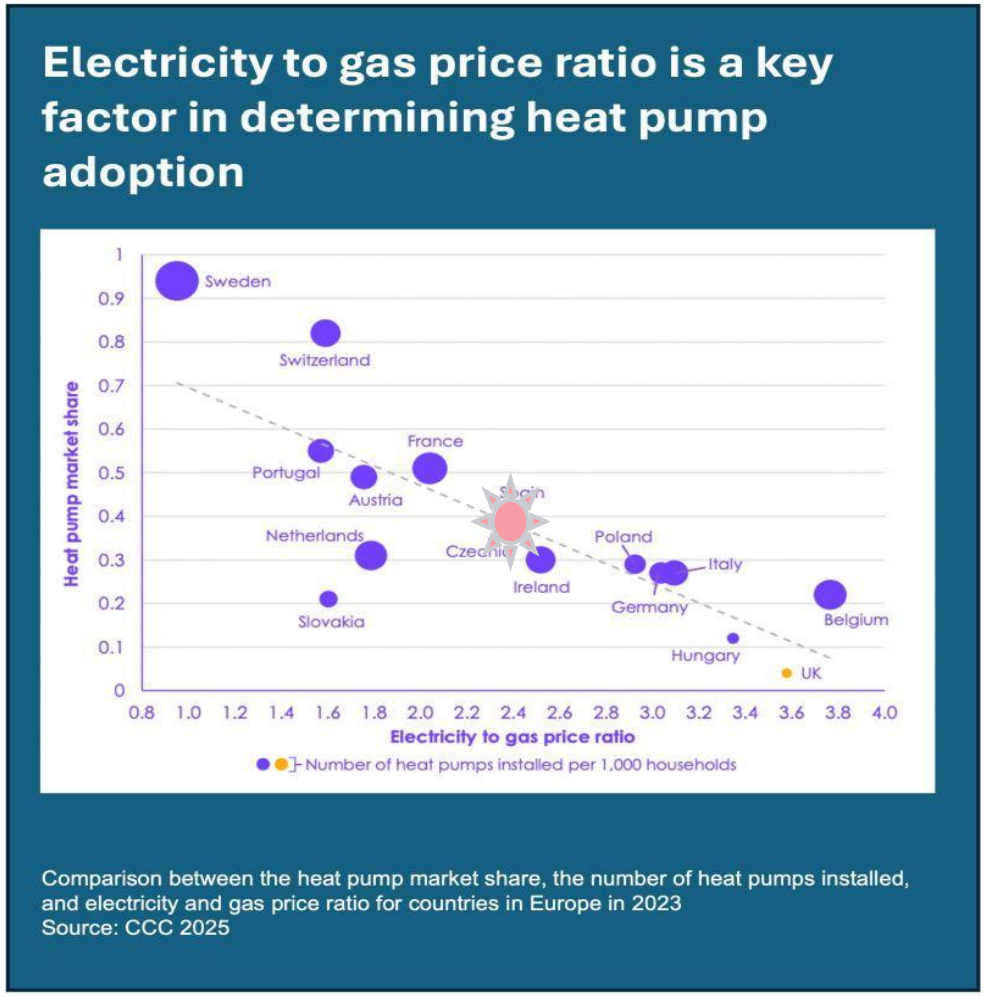
- More efficient
- Efficiency increases at part-load/lift
- Goal is to **exceed spark spread**

Heat Pump Part Load Efficiency

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Spark Spread

- Electrification COP > spark spread = payback
- Ratio driven by both electricity and gas cost
- Wide variation by country
- Variation also in real-time vs average

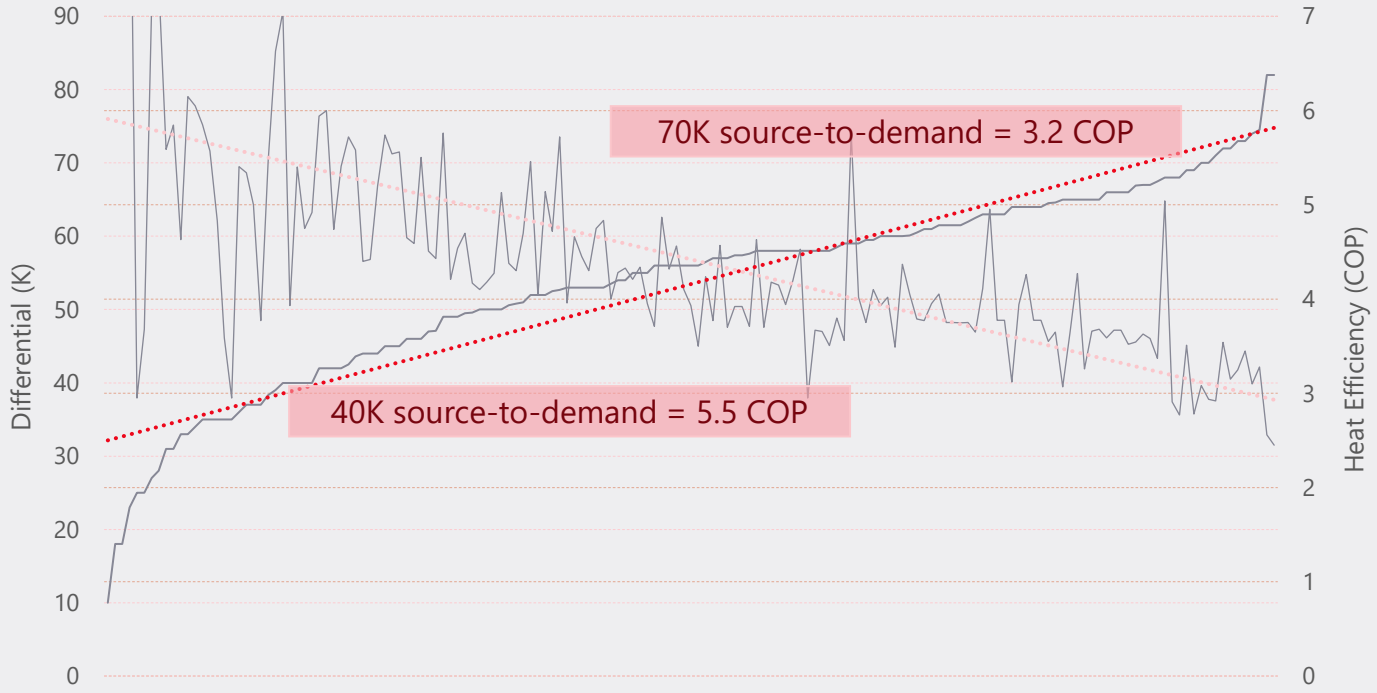


EU detailed version: https://energy.ec.europa.eu/data-and-analysis/energy-prices-and-costs-europe/dashboard-energy-prices-eu-and-main-trading-partners-2024_en

Source-to-Demand

Differential Drives Efficiency

Heat Pump – System Differential and Associated Efficiency



- Range of heat source to heat supply differential (K)
- Corresponding heat pump system efficiency (COP)
- 0.3-60MW+ systems

1K differential = 2% heat pump efficiency = 2% Operating Cost

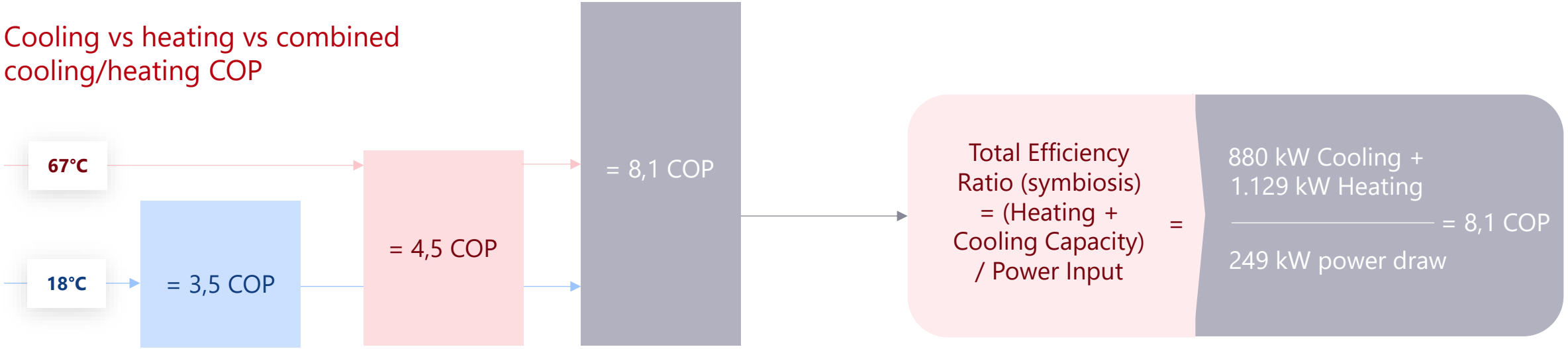
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Why is the Industrial Market Focused on Heat Recovery?

Efficiency Potential

Partload Percent	Source Water Entering T	Source Water Leaving T	Hot Water Returning T	Hot Water Supplying T	Cooling Capacity	Heating Capacity	Power Input	COP Cooling	COP Heating
	°C	°C	°C	°C	kW	kW	kW	W/W	W/W
100.0%	20,2	18,2	45,1	67,0	880	1.129	249	3,5	4,5
87.5%	20,2	18,5	48,0	67,0	770	980	210	3,7	4,7
75%	20,2	18,7	50,6	67,0	660	843	183	3,6	4,6
62.5%	20,2	19,0	53,1	67,0	550	718	168	3,3	4,3
51%	20,2	18,7	58,1	67,0	450	586	136	3,3	4,3
43%	20,2	19,0	59,4	67,0	375	500	125	3,0	4,0
34%	20,2	19,2	61,1	67,0	300	387	87	3,5	4,5
27%	20,2	19,4	62,3	67,0	240	308	68	3,5	4,5
21%	20,2	19,0	61,6	67,0	188	250	63	3,0	4,0
							Average	**3,4**	**4,6**

Cooling vs heating vs combined cooling/heating COP



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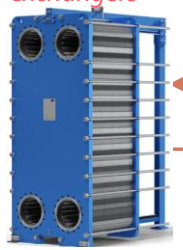
Industrial Electrification Retrofits

Process Cooling Recovery to Facility and Process Heat

Heat Recovery

Diversion from Cooling Tower

Existing heat exchangers



Existing cooling towers



16C

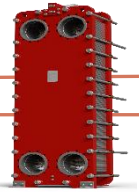
24C

26C

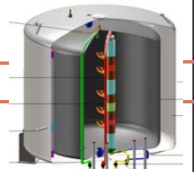
18C



Extruded parts cooling



Heat exchanger



Source storage tank

Heat Pump

Single Circuit Oil-Free Turbo

Housed water-water heat pump



24C

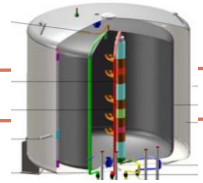
16C



45C

60C

Demand accumulator tank



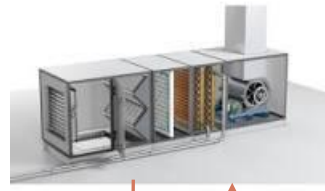
Facility Heat

Accumulator / Heat Tie-In

Existing Radiators



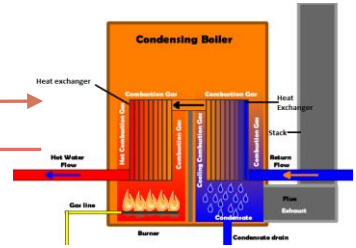
Existing AHUs



45C

60C

Existing Boilers



Process Pre-Heat

Booster Heat Pump

Booster HP



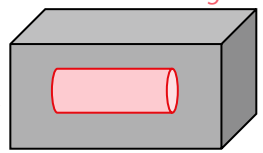
45°C

60°C

75°C

90°C

Process Heating



Industrial Electrification Retrofits

Process Cooling Recovery to Facility and Process Heat

Heat Recovery

Process Cooling Diversion from Dry Coolers



Heat Pump

Single Circuit Heat Pump Replacing Boilers

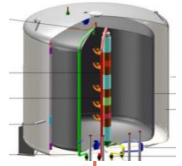


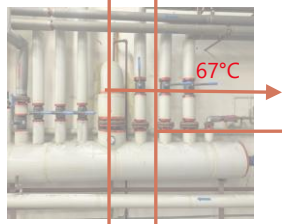




Facility and Process Heat

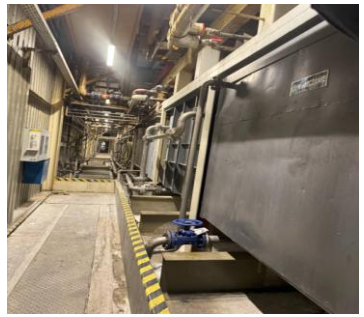
Replace Boilers & Gas as Primary Source











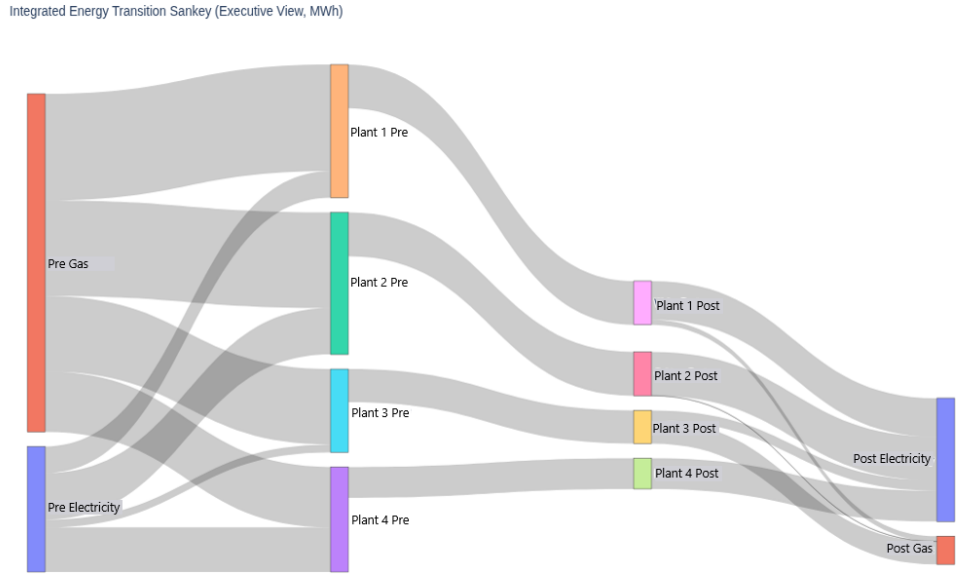
Industrial Electrification Retrofits

Doesn’t Need to Increase Electricity Use, If Utilizing Heat Recovery

- Large Scale Integrated Energy Systems, working with partners
- Application focus – Critical facilities, focused on industrials and hospitals
- Energy audit of six plants, proposals focused on four
- Recovering heat from cooling to electrify heating
- Finance as EaaS to keep off books
- Consumption change post-retrofit:
  - Electricity: 8% reduction
  - Gas: 92% reduction
  - Total energy use: 67% reduction

Net Annual Energy Consumption by Plant Target System – Pre vs Post-Retrofit (MWh)

	Pre-Retrofit			Post-Retrofit		
	Electricity	Gas	Total	Electricity	Gas	Total
Plant 1	1.333	2.749	4.082	1.254	7	1.261
Plant 2	1.284	1.736	3.020	885	0	855
Plant 3	766	3.067	3.833	1.109	149	1.257
Plant 4	224	2.170	2.394	299	654	952
Total	3.607	9.722	13.330	3.546	809	4.355

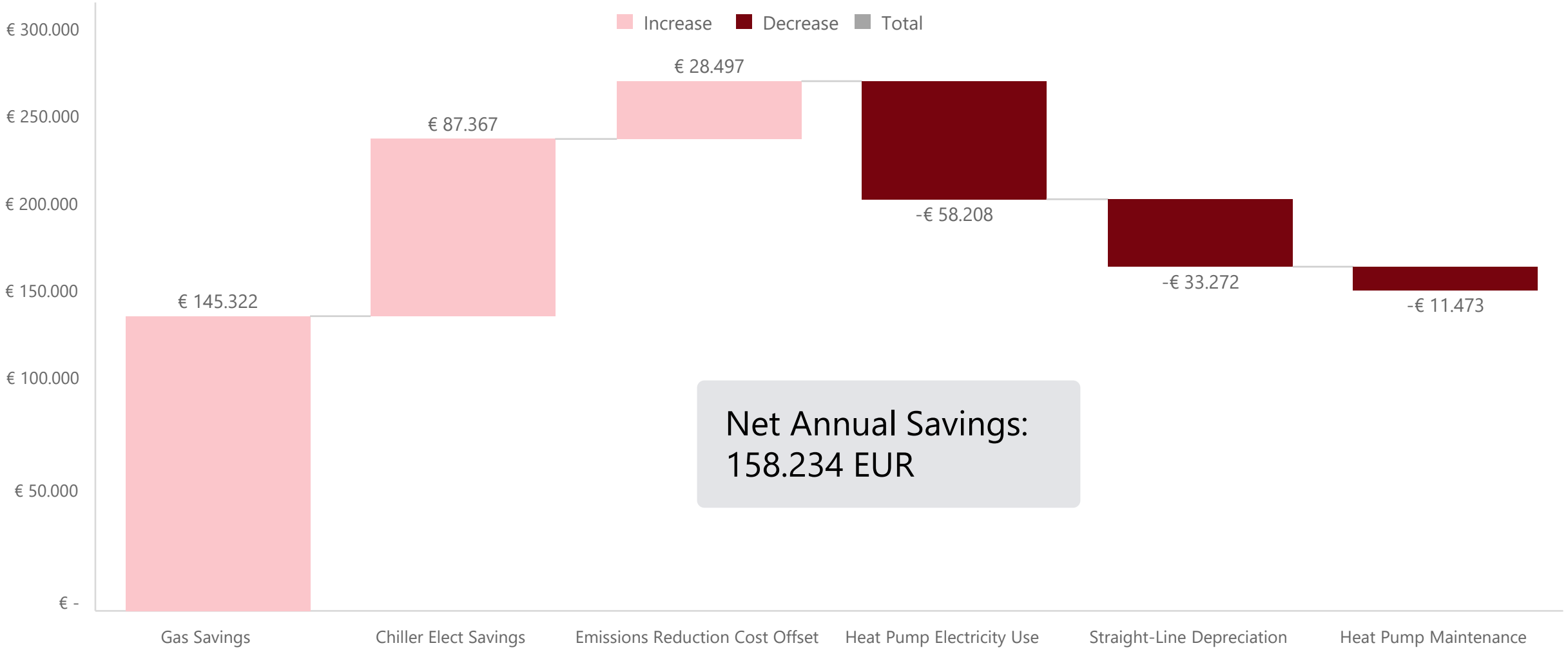


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Industrial Electrification Retrofits

Not Just Gas Savings

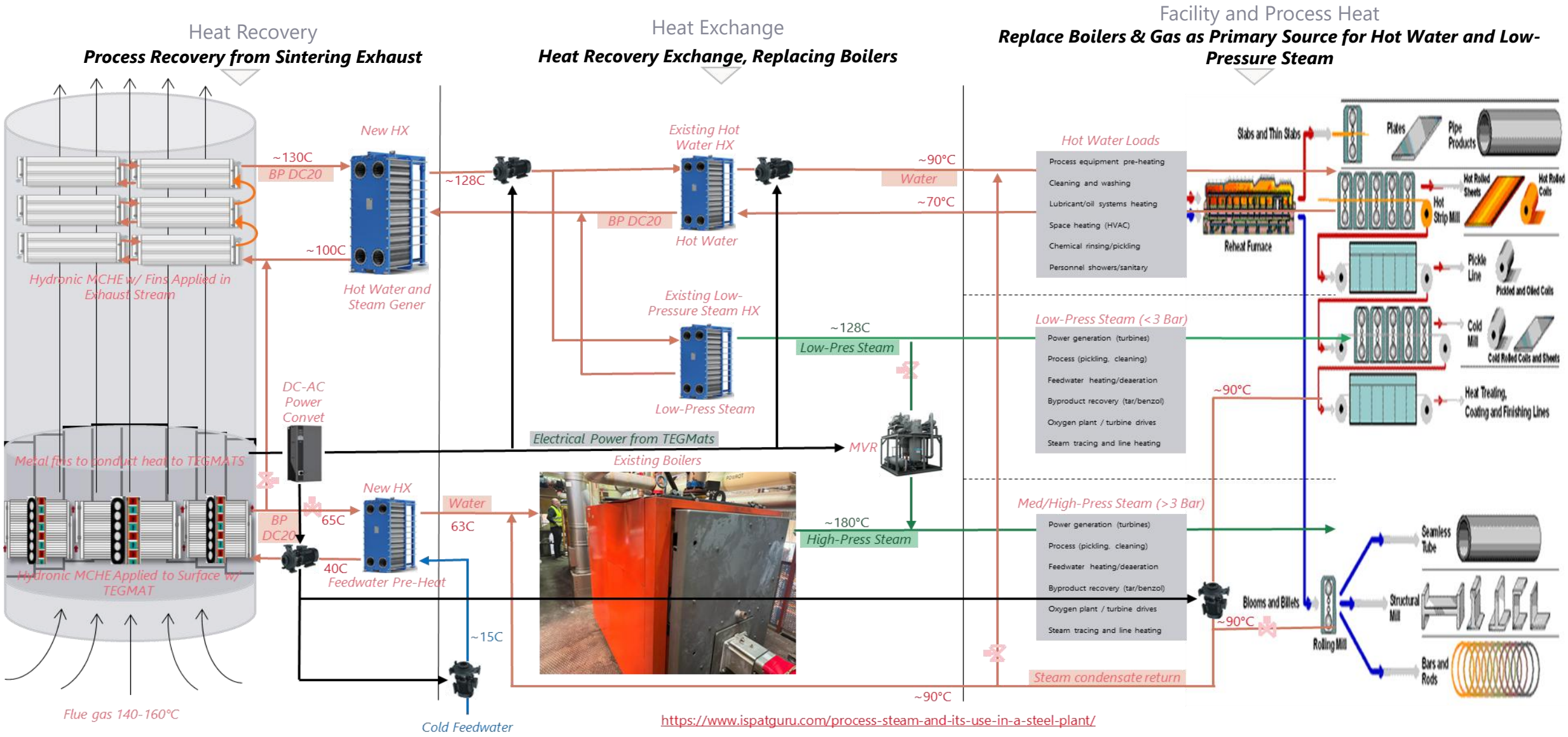
Net Annual Heat Recovery Heat Pump Retrofit Savings



Net Annual Savings:
158.234 EUR

Industrial Electrification Retrofits

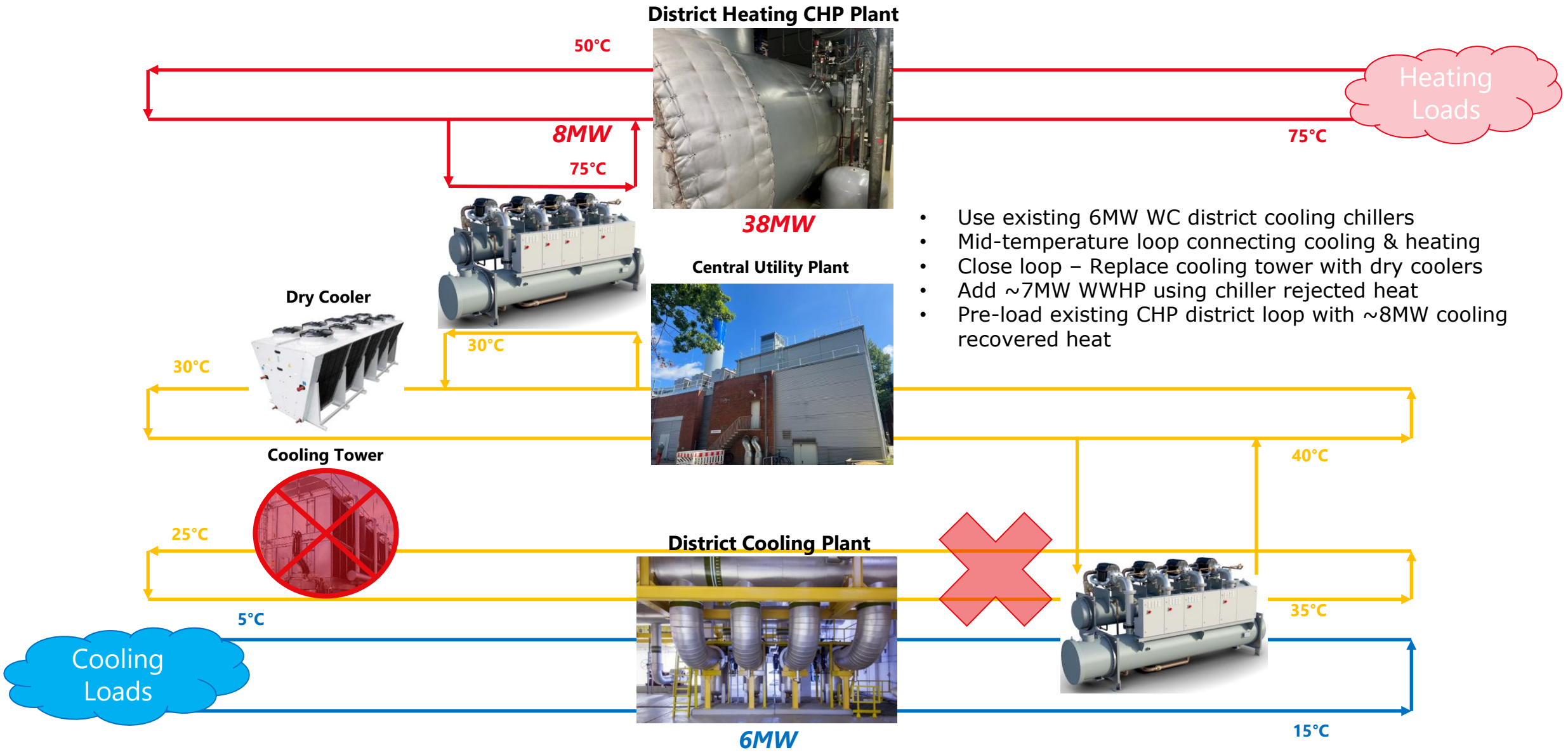
Steel Plant Exhaust Recovery to Process Heating



https://www.ispatguru.com/process-steam-and-its-use-in-a-steel-plant/

Hospital Electrification Retrofit

Critical Facilities Present Optimal Integrated System Opportunities



- Use existing 6MW WC district cooling chillers
- Mid-temperature loop connecting cooling & heating
- Close loop – Replace cooling tower with dry coolers
- Add ~7MW WWHP using chiller rejected heat
- Pre-load existing CHP district loop with ~8MW cooling recovered heat

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Conclusions



- Heat pump efficiency with heat recovery & renewables integration = decarbonization with payback
- Cost ratio of electricity to gas and heat pump differential / resulting efficiency critical to payback
- Critical facilities present optimal integrated system opportunity – Especially industrial based on load and operating hours
- Optimal project is seamless from initial discussion to project execution
- Efficiency and operating temperature optimization important also prior to integrated system
- 1st step is continuously measuring all energy flows

Thank you



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