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NH_3 Heat Pumps

Is Australia ready for the large Heat Pumps?

Ricardo Claussen Hoffmann
Johnson Controls Australia

WHAT IS A LARGE HEAT PUMP?

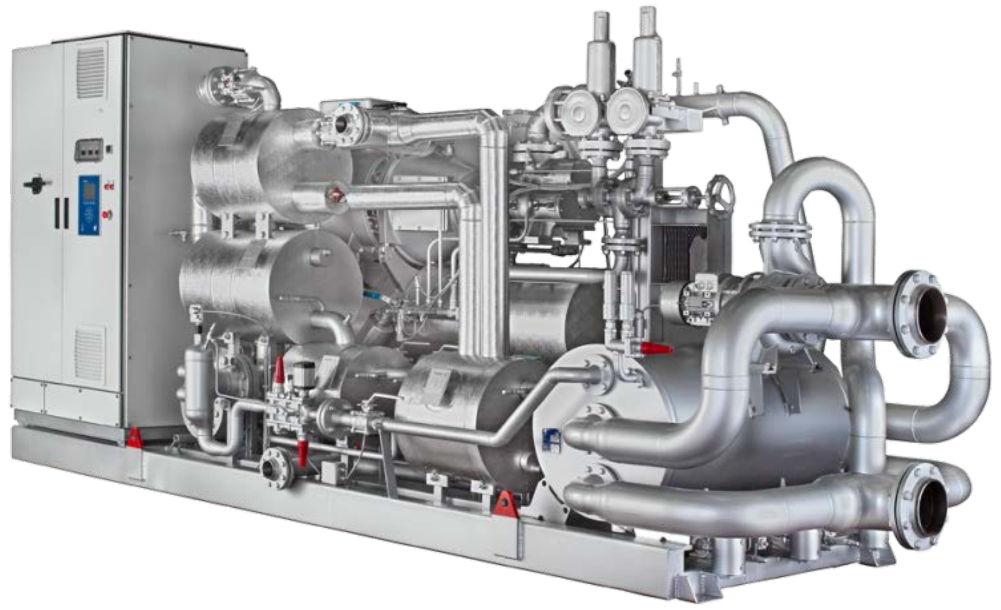
A HEAT PUMP is:

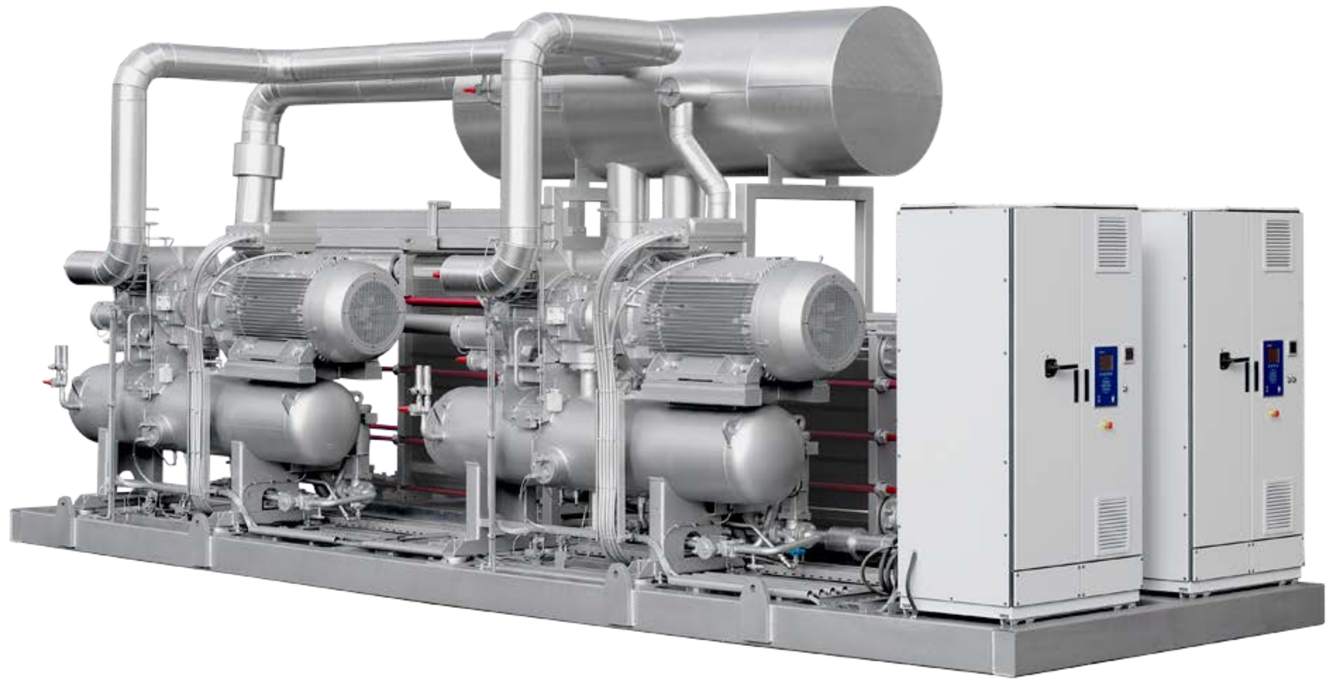
- accordingly to ASHRAE, a Heat Pump extracts heat from a source and transfers it to a sink at a higher temperature;
- in Engineering, … the term Heat Pump is generally reserved for equipment that heats for beneficial purposes, rather than that which removes heat for cooling only

A LARGE HEAT PUMP is:

- equipment focused in industrial applications OR large commercial applications;
- offers large heating capacities;
- water cooled;

AMMONIA BASED SABROE HEAT PUMPS:

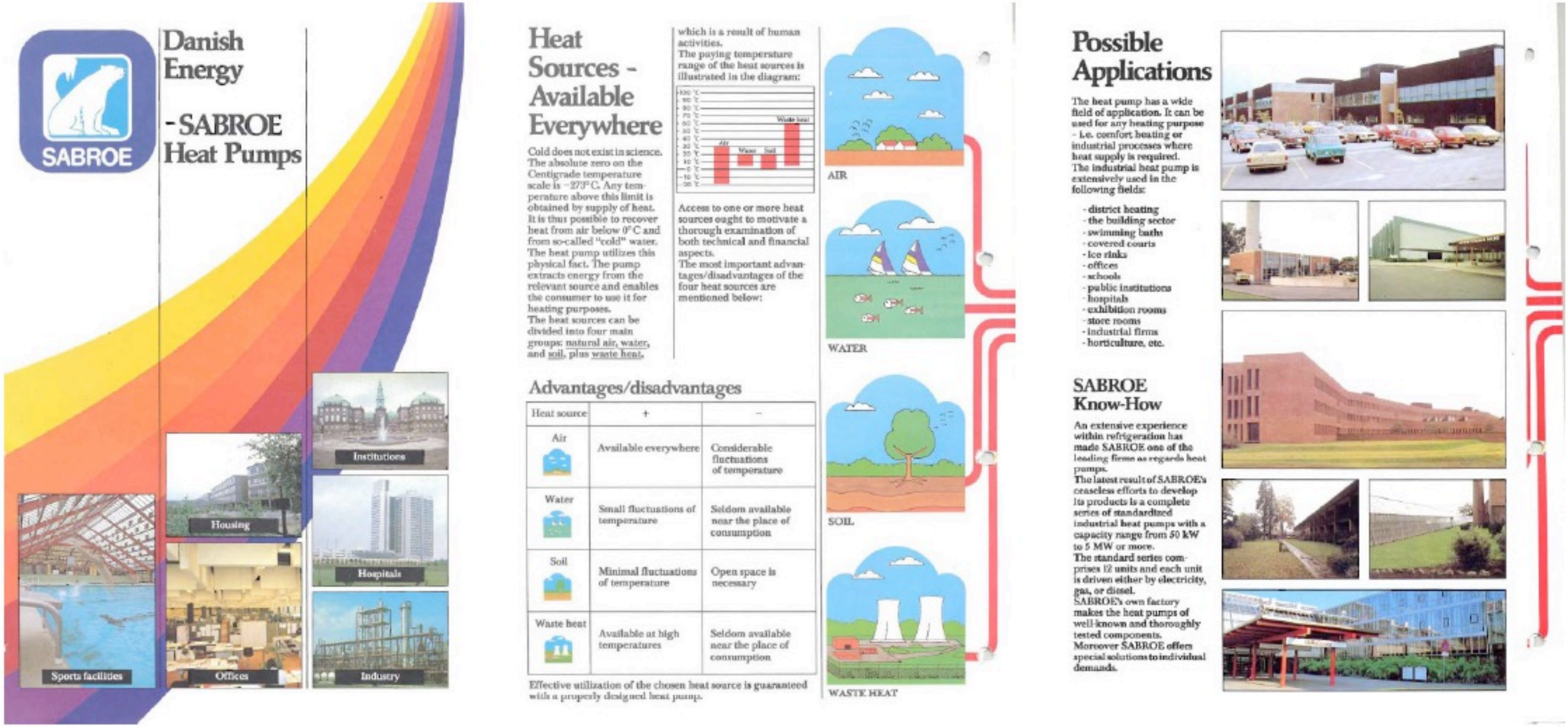




- Recip compressors;
- Screw compressors;
- Water cooled;
- Heating capacity from 150 KW to 13,000KW;
- Single Stages units;
- Two Stages units;
- Factory tested;
- Hot water up to 90°C;

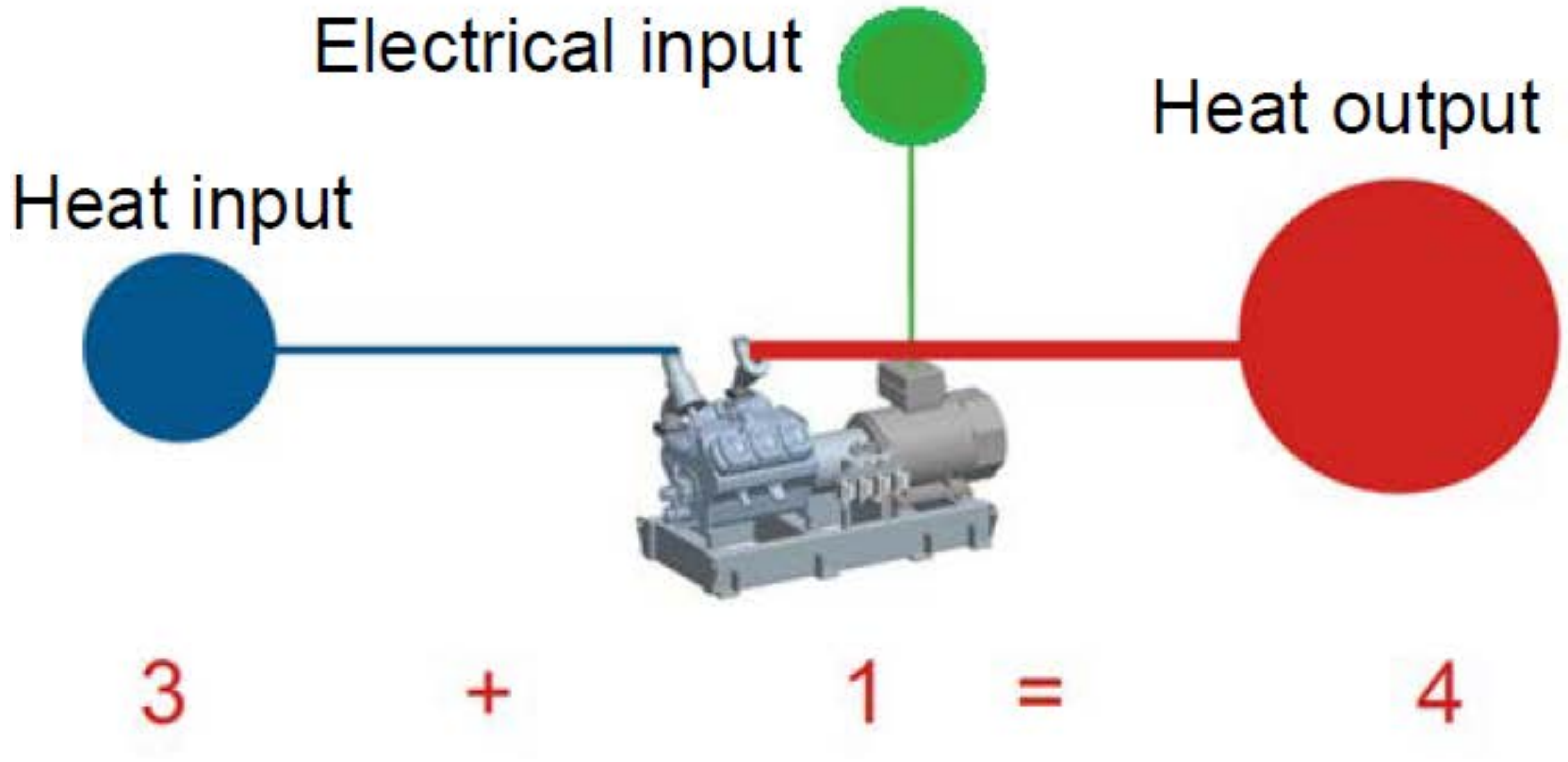
SABROE
BY JOHNSON CONTROLS

HEAT PUMPS ARE NOT A NEW TECHNOLOGY:



Brochure from 1982 / first equipment commercialized in 1967

HEAT PUMPS USES THE ENERGY INPUT IN BOTH SIDES OF THE SYSTEM:



$COP_{Cool} = 3$

$COP_{Heat} = 4$

$COP_{Cool + Heat} = 7$

ADVANTAGES FOR THE HEAT RECOVERY USING HEAT PUMPS:

- Reduced operating costs
- CO_2 footprint reductions
- Reduced water consumption and chemical
- LEED points

REDUCED OPERATING COSTS – AUSTRALIAN EXAMPLE:

Hot Water Requirement	Equipment	Average Efficiency	Energy Consumption	Cost of Source	Cost of Hot Water	HP Saving vs Gas Boiler
1 KWh	Gas Boiler	COP = 0.8	1 KWh / 0.8 = 1.25 KWh	$10/GJ = $0.0360/KWh	1.25KWh x $0.0360/KWh = $0.0450	
1 KWh	Water Cooled Heat Pump (NH^3)	COP = 6.0	1 KWh / 6.0 = 0.167 KWh	$0.15/KWh	0.167KW/h x $0.15/KWh = $0.02505	-44%

Energy costs considered:

- cost of gas: $10 per GJ
- cost of electricity: $0.15 per KWh

CO2 FOOTPRINT REDUCTIONS – AUSTRALIAN EXAMPLE:

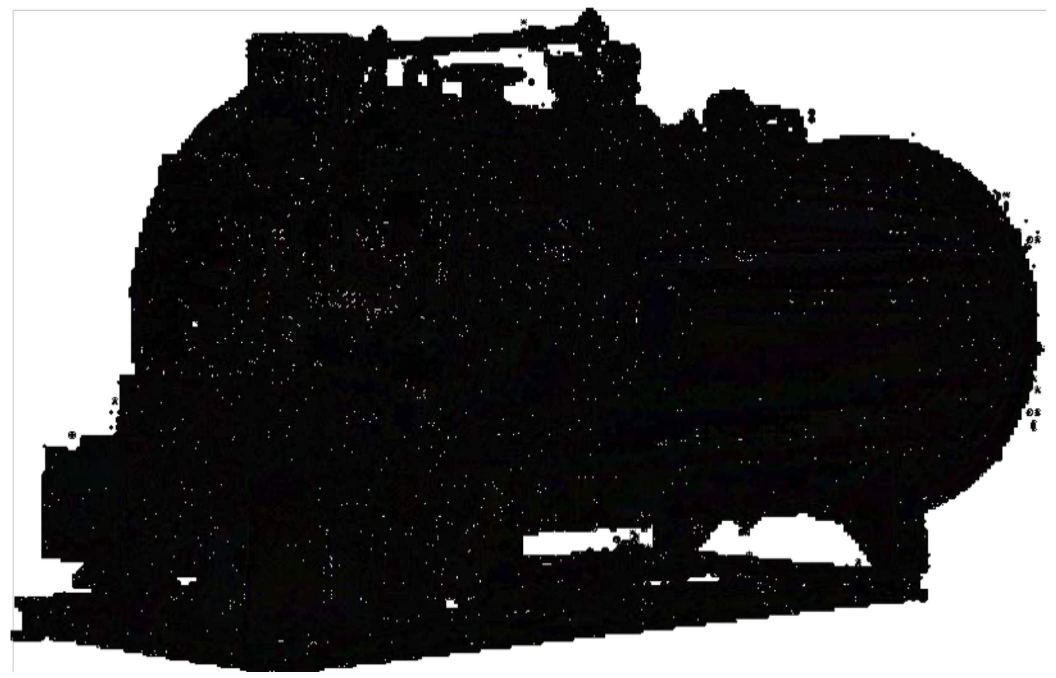
Hot Water Requirement	Equipment	Average Efficiency	Energy Consumption	CO_2 Source Emissions*	Carbon Footprint	HP CO_2 Footprint reduction vs Gas Boiler
1 KWh	Gas Boiler	COP = 0.8	1 KWh / 0.8 = 1.25 KWh	185 g CO2 / KWh	1.25 KWh x 185g CO2 / KWh = 231 g CO2	
1 KWh	Water Cooled Heat Pump	COP = 6.0	1 KWh / 6 = 0.167 KWh	1080 g CO2 / KWh (VIC) 830g CO2 / KWh (NSW & ACT) 790 g CO2 / KWh (QLD) 700 g CO2 / KWh (SWIS in WA) 620 g CO2 / KWh (NWIS in WA) 490 g CO2 / KWh (SA) 140 g CO2 / KWh (TAS)	0.167 KWh x 1080g CO2 / KWh = 180 g CO2 (VIC) 0.167 KWh x 830g CO2 / KWh = 139 g CO2 (NSW & ACT) 0.167 KWh x 790g CO2 / KWh = 132 g CO2 (QLD) 0.167 KWh x 700g CO2 / KWh = 117 g CO2 (SWIS in WA) 0.167 KWh x 620g CO2 / KWh = 103 g CO2 (NWIS in WA) 0.167 KWh x 490g CO2 / KWh = 82 g CO2 (SA) 0.167 KWh x 140g CO2 / KWh = 23 g CO2 (TAS)	-22% (VIC) -40% (NSW & ACT) -43% (QLD) -49% (SWIS WA) -55% (NWIS WA) -64% (SA) -90% (TAS)

* http://http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/publications/national-greenhouse-accounts-factors-july-2017

NORMAL SCENARIO – SYSTEMS TOTALLY SEPARATED:

CO_2

Gas or Oil

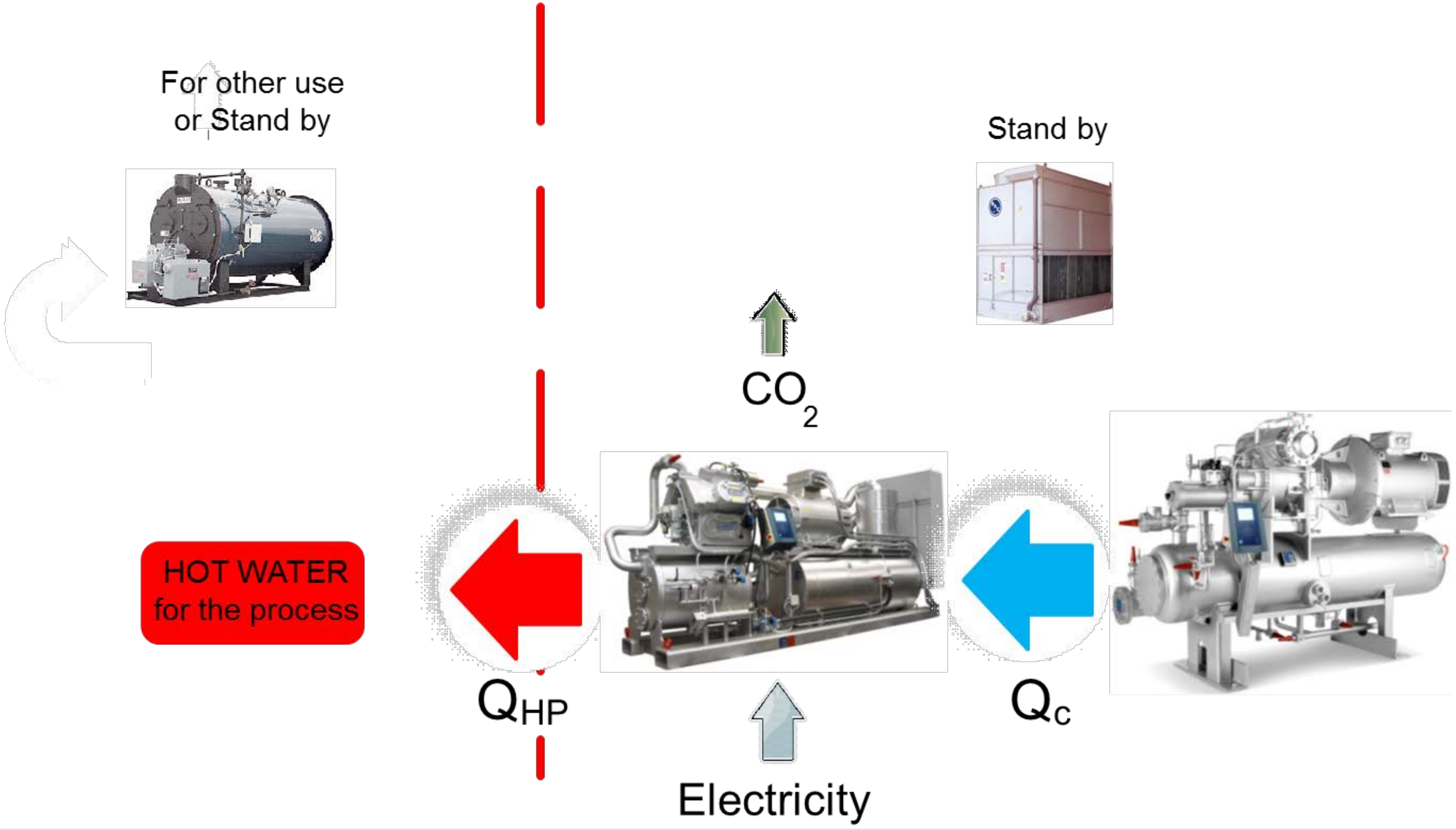


Heating

$$$$$$

Cooling

IDEAL SUSTAINABLE SOLUTION: SYSTEMS INTEGRATED



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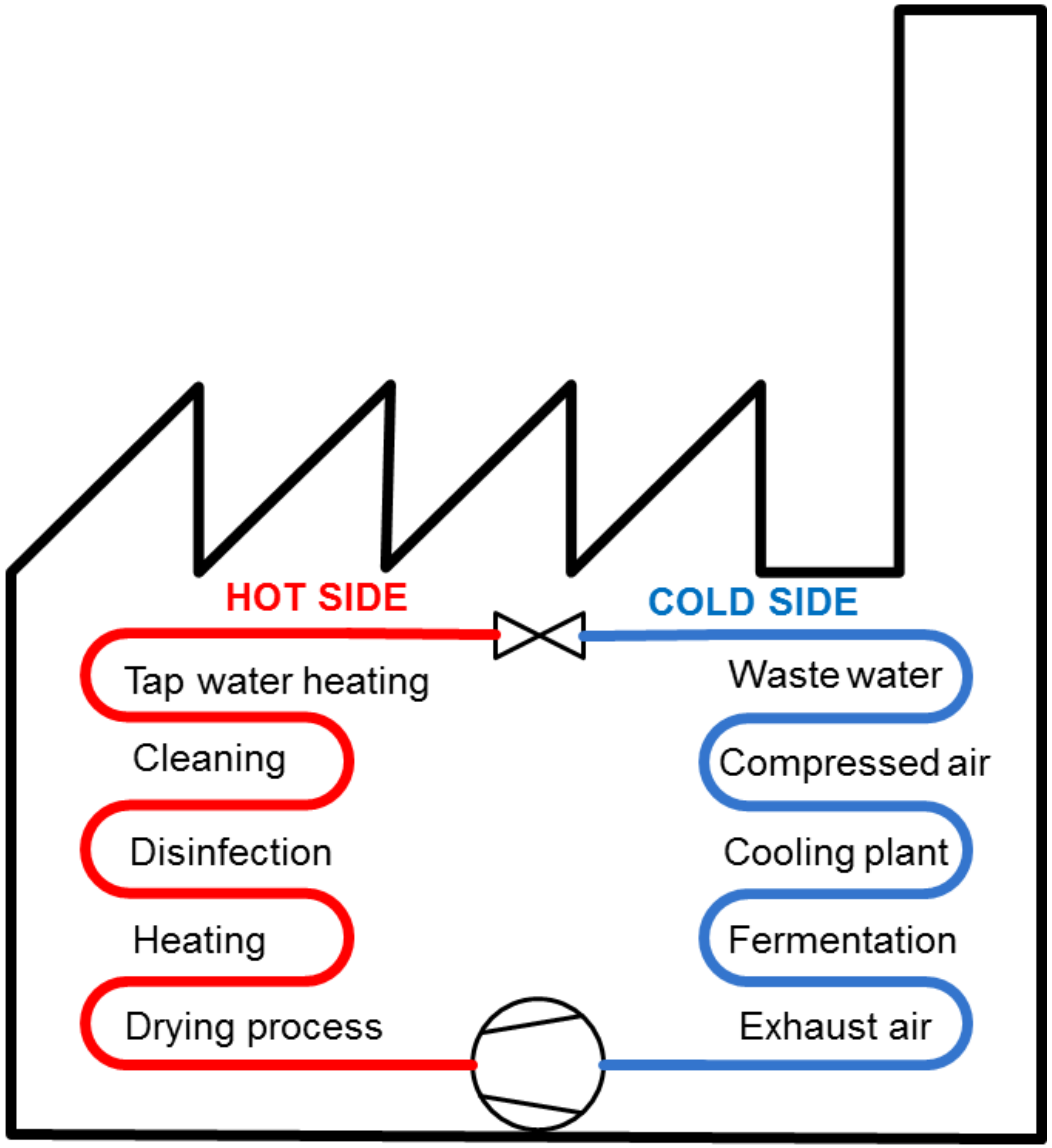
LOOKING FOR SOLUTIONS – COOLING / HEATING

FOOD & BEVERAGE INDUSTRY



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MAPPING A BREWERY FACTORY

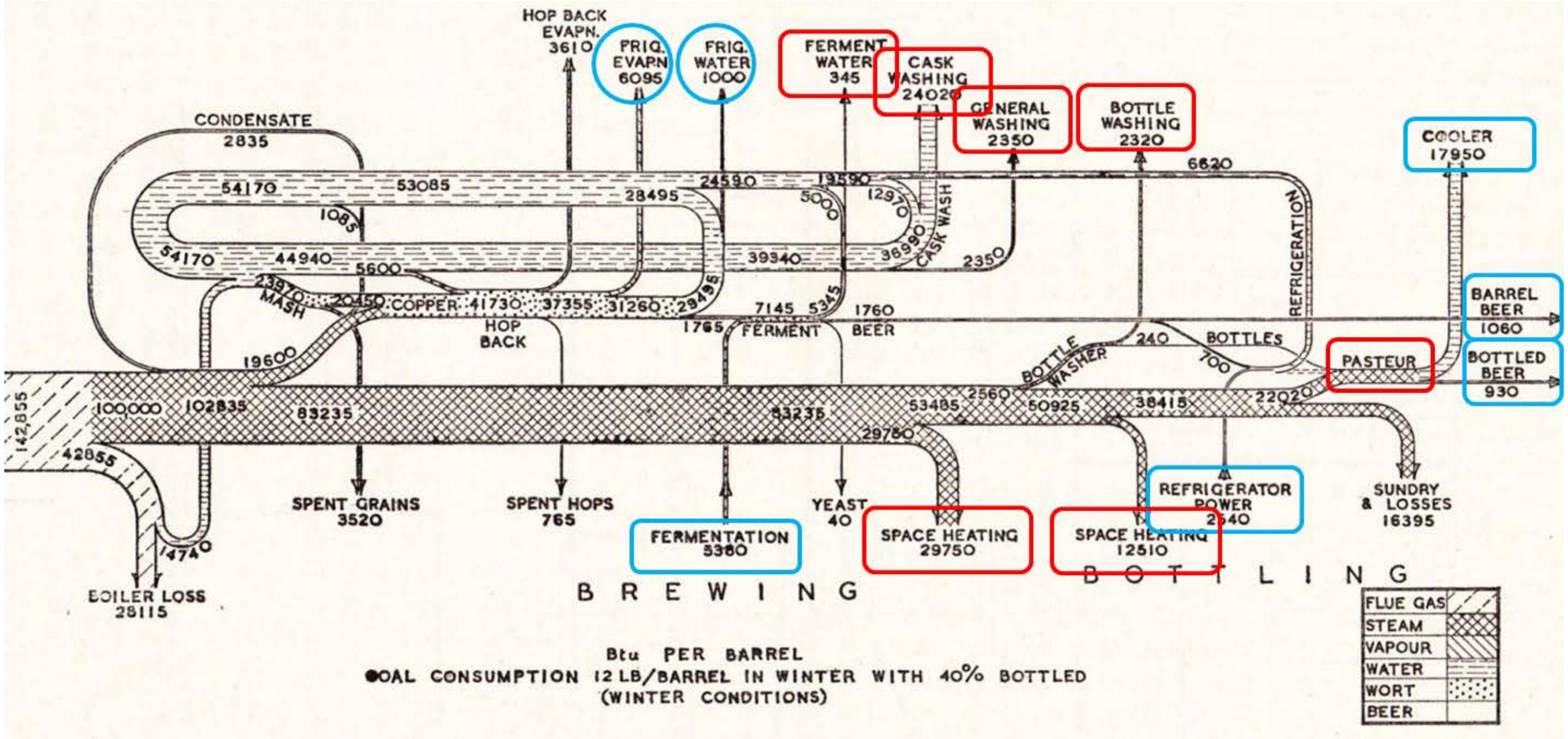

FIG. 366. BREWERY HEAT DISTRIBUTION WITH BOGEY HEAT REQUIREMENTS. TECHNIQUE ALTERED

MAPPING A SEAFOOD FACTORY

Source	Temperature level	Capacity	Current way out
Refrigeration	30	3000	Cooling tower
AC chiller	30	1000	Cooling tower
Compressed air	50	1000	Cooling tower
Waste water	25	1000	Sewer
Exhaust air	30	2000	Out in the blue
Total heat source capacity		**8000**	

In the same site we have 4 boilers with a capacity of 1600 KW each (6400 KW in total)

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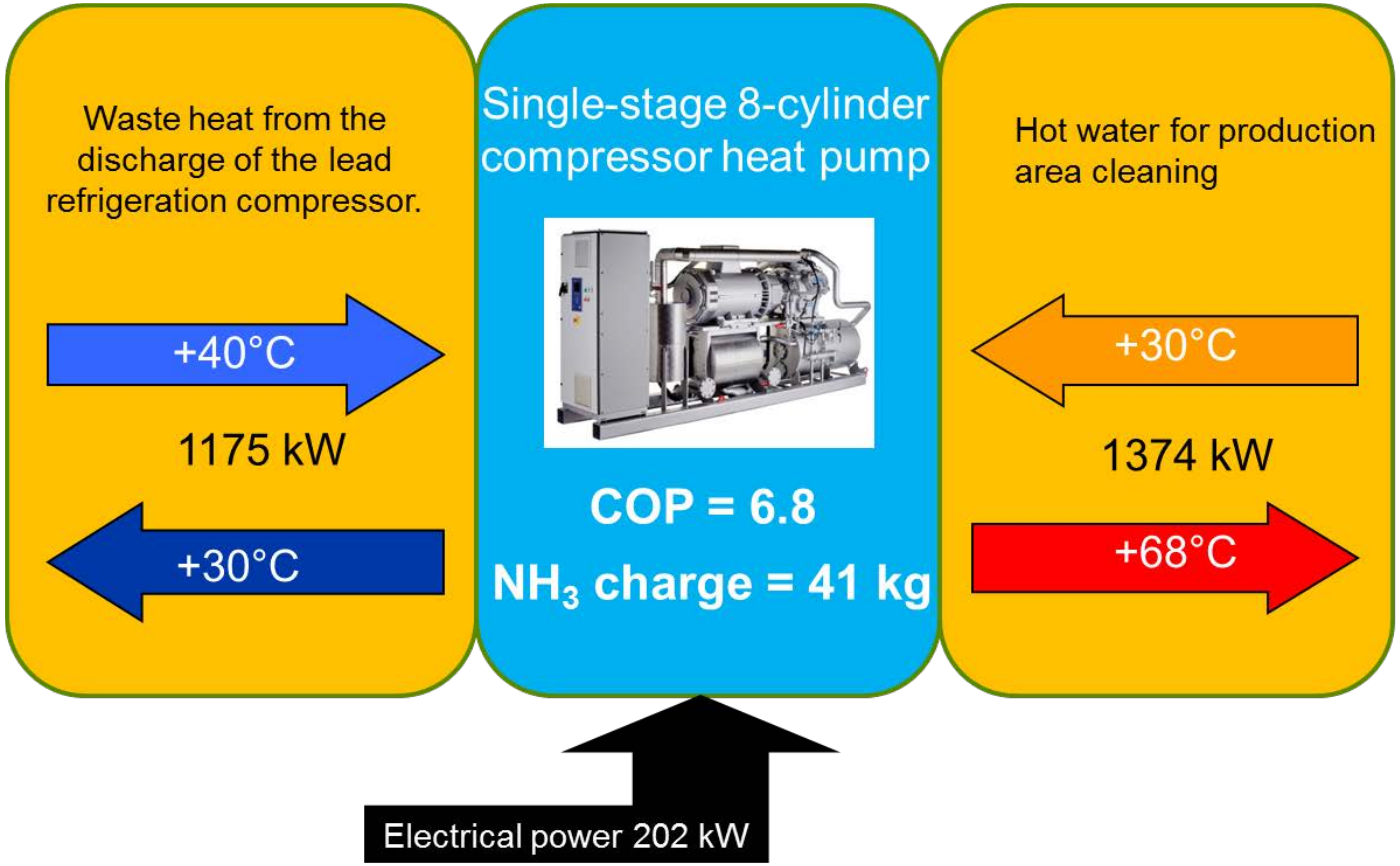
AUSTRALIAN CURRENT SITUATION FOR HP APPLICATIONS

- **Rapid escalation in gas prices and potential gas supply constraints;**
- **Need to move to low carbon energy solutions;**
- **Despite of small number of local HP examples, there are many business case under analysis;**
- **A2EP (Australian Alliance for Energy Productivity) released recently a study about "High Temperature Heat Pumps for the Australian food industry";**
- **ARENA (Australian Renewable Energy Agency) considers HP applications as an example of Renewable energy and grants can be offered for approved projects. The key funding decision questions are:**
  - ❖ **is the project innovative or novel?**
  - ❖ **is there a pathway to commercialization?**
  - ❖ **will the project help unlock future investment?**

AUSTRALIAN BUSINESS CASE UNDER DEVELOPING



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IN CONCLUSION:

- **There are many possibilities for recovering heat in industrial process in AUSTRALIA;**

- **The creation of a good business case, mapping all the heat sources in the system, is crucial for the project success;**

- **Applications where you can use heating and cooling will show higher COP's;**

- **Heat Pump technology is considered as a renewable source of energy and also can reduce the CO^2 footprint of the facility that is using it;**

- **ARENA can help some approved projects with partial funding;**

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Thank you very much!