Optimising Designs For Electrification
CIBSE ANZ Seminar Series

Sam Snutch - September 5th, 2023

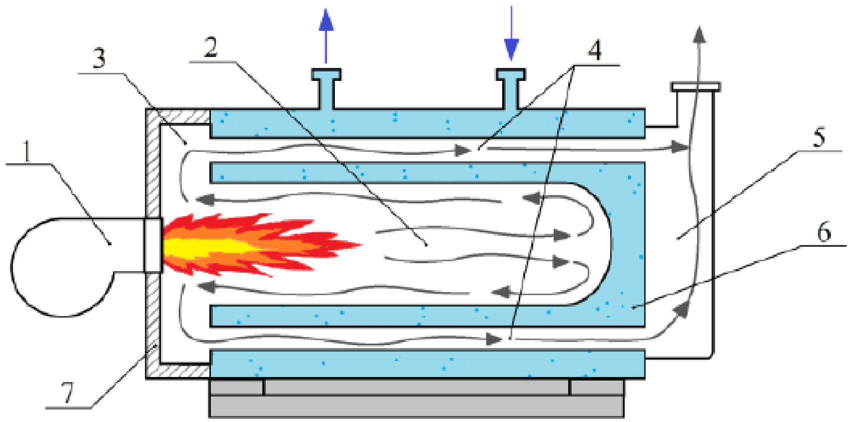
Why Electrify?

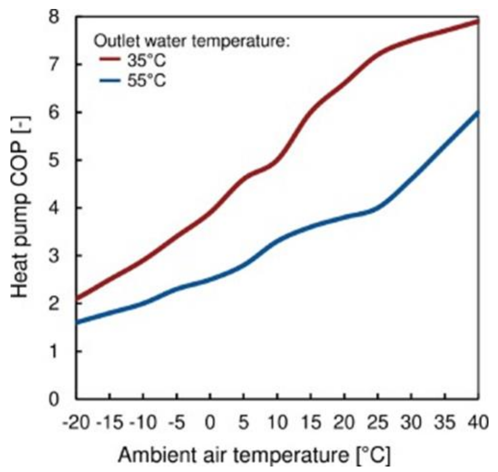
Gas Characteristics

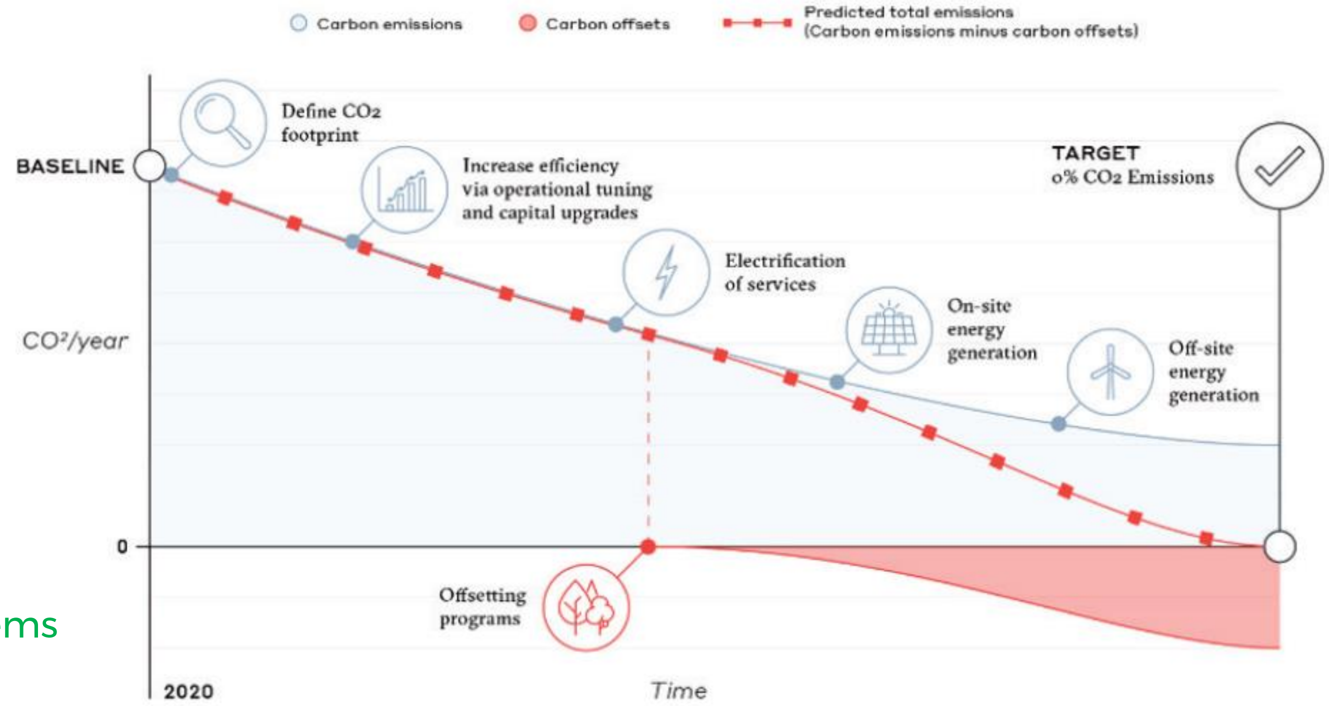
- Simple technology
- Low Cost
- Low Cost Distribution
- Not capacity sensitive
- High Energy Density (55MJ/kg)
- Efficient at high temperatures
- High Delta Ts – Efficient Pumping
- Robust Operation
- Low Embodied carbon
- **Very High Operational Carbon**

Electric / Heat Pump Characteristics

- Complicated
- High Cost
- High Cost Distribution
- Capacity sensitive
- Low Delta T's
- Efficient at low temperatures
- Flow Sensitive
- High Embodied Carbon (4.5x Boiler)
- Low / Zero Operational Carbon possible
- High COPs
- Capable of use in high total efficiency systems







Capacity Sensitivity

Cost

Load	Air cooled HP	Boiler	Electrification Uplift
800kW	$ x	$ y	4.48
1000kW	$ 1.17x	$ 1.03y	5.07
Capacity Uplift	117%	103%	

Prices indicative based on Rawlinson’s

Capacity Sensitivity

Spatial

800kW vs 1000kW

25% Increase in capacity

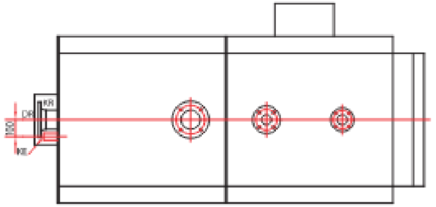
Unit Footprint within **5%**

Room Footprint within 2%

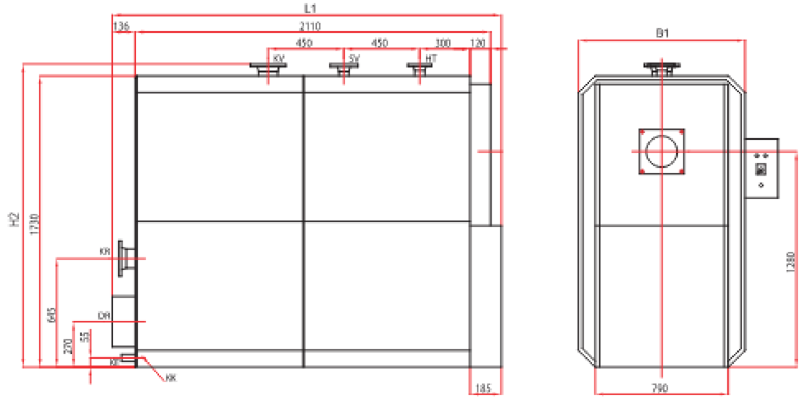
Example – Automatic Heating Eurogen Condensing Boiler

Dimensional Data

Mod	KV/KR DIN16	HT DIN16	SV DIN16	KK R^3	KE R^3	DR mm	L mm	B mm	H1 mm	L1 mm	B1 mm	H2 mm
450	100	50	50	40 mm	32 mm	300	2085	9110	1595	1810	710	1710
600	100	50	50	40 mm	32 mm	300	2110	990	1738	1810	790	1850
800	125	65	65	40 mm	32 mm	300	2510	990	1738	2110	860	1850
1000	125	65	65	40 mm	32 mm	400	2335	1060	1922	2010	860	2037
1250	150	80	80	40 mm	32 mm	400	2735	1060	1922	2410	1064	2037
1400	150	100	80	40 mm	32 mm	400	2437	1390	1802	2740	1064	2016
1800	200	100	80	40 mm	32 mm	450	2980	1390	2052	3420	1204	2242
2100	200	100	100	40 mm	32 mm	450	3200	1100	2052	3640	1204	2242
3200	250	100	100	50 mm	32 mm	760	2100	1750	2070	2050	1750	2300



K 450-1250 kW



PORT SCHEDULE		
PORTS	SIZE	DESCRIPTION
KV	100MM DIN16	BOILER SUPPLY
KR	100MM DIN16	BOILER RETURN
HT	50MM DIN16	H.T. LINE DRINKING WATER
SV	50MM DIN16	SAFETY VALVE
KK	40MM	BOILER CONDENSATE
KE	32MM	DRAIN
DR	Ø300	FLUE CONNECTION

Automatic Heating reserves the right to change specifications without notice.

EUROGEN

Capacity Sensitivity

Spatial

25% Increase in Capacity

25% Increase in Footprint

Example for illustrative purposes
approx. 400kW

Capacity Sensitivity

Cost

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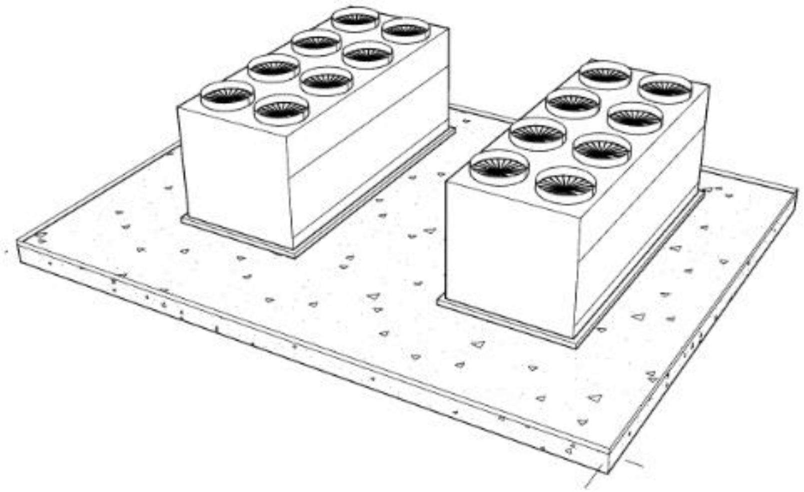
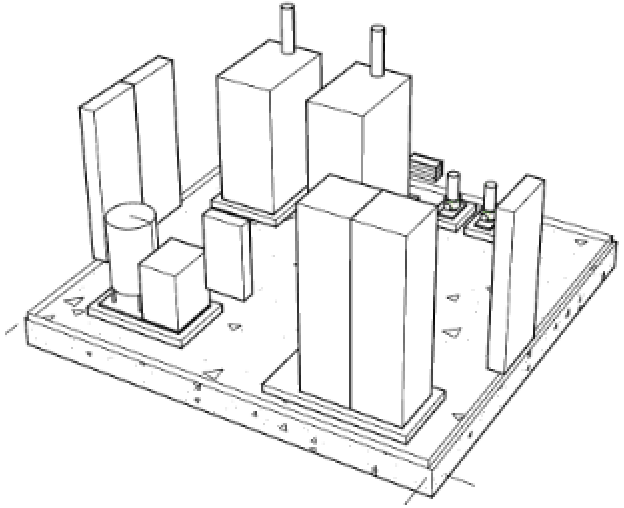
Capacity Uplift	117%	103%	

Prices indicative based on Rawlinson's

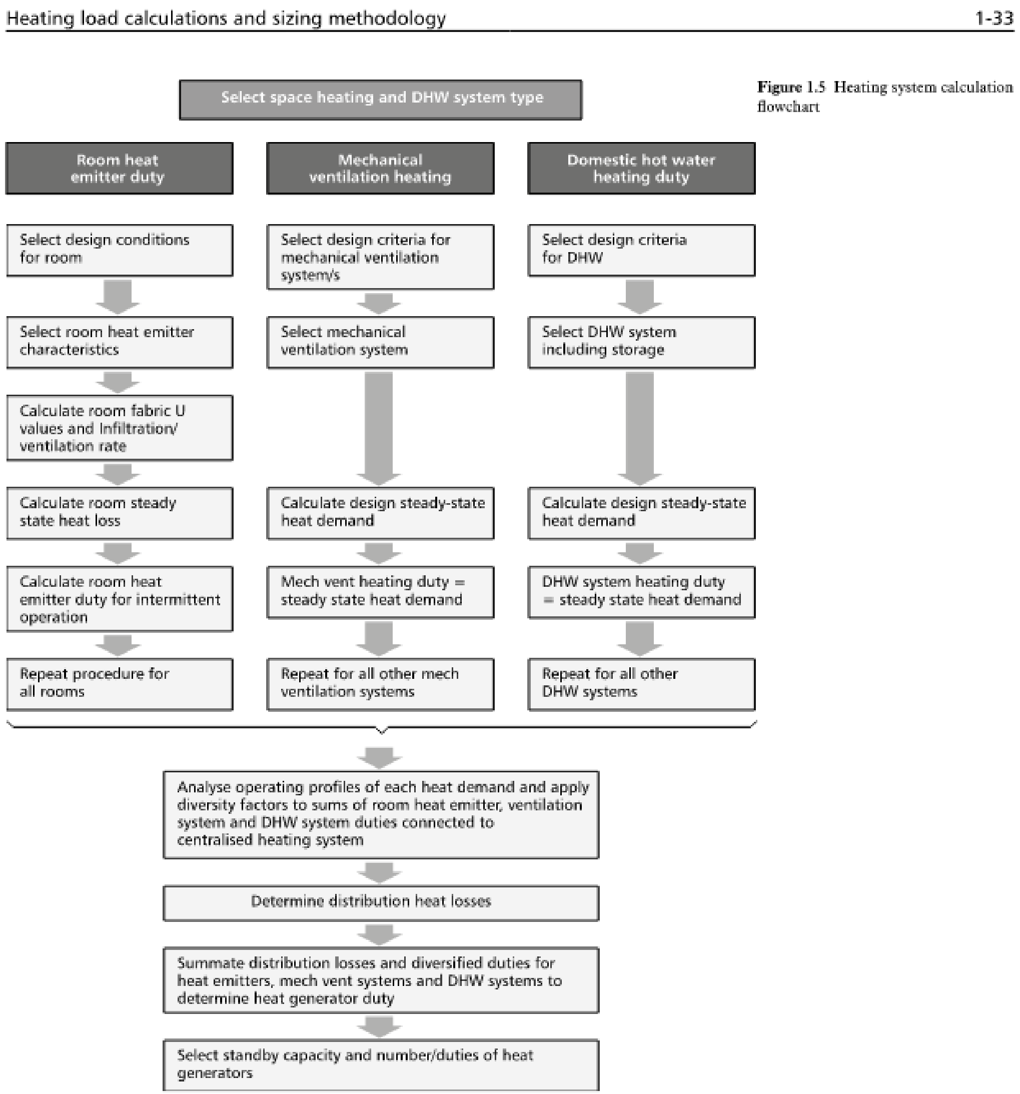


Spatial

Load	Air cooled HP	Boiler PR	Electrification Uplift
800kW	97m2	40m2	2.42
1000kW	106m2	41m2	2.58
Capacity Uplift	109%	102%	



Defining Loads for Electric Systems

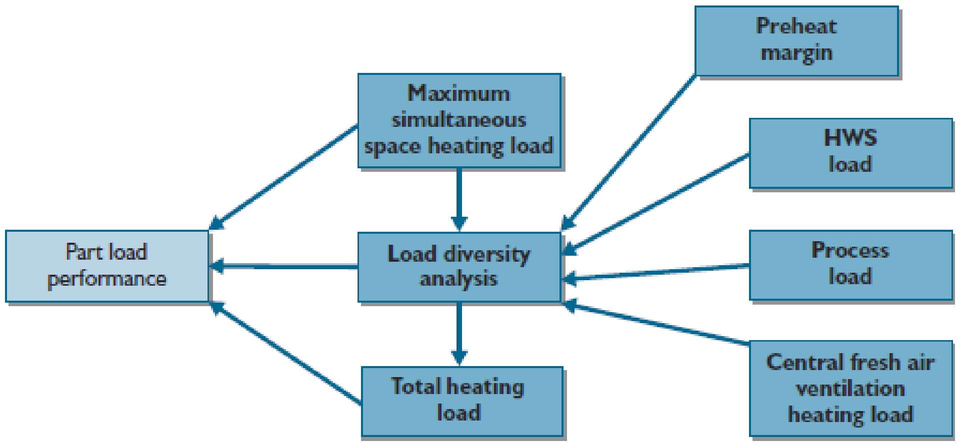


CIBSE Guide B

HEATING LOAD ESTIMATE
(Warm air heating only)

The heating load evaluation is the foundation for selecting air heating equipment. Normally, the heating load is estimated for the winter design temperatures (*Chapter 2*) usually occurring in the morning just before occupancy; therefore, no credit is taken for the heat given off by internal sources (people, lights, etc.). This estimate must take into account the heat loss through the building structure surrounding the spaces and the heat required to offset the outdoor air which may infiltrate and/or may be required for ventilation. *Chapter 5* contains the transmission coefficients and procedures for determining heat loss.

Airah DA09



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Defining Loads for Electric Systems

Worked Example

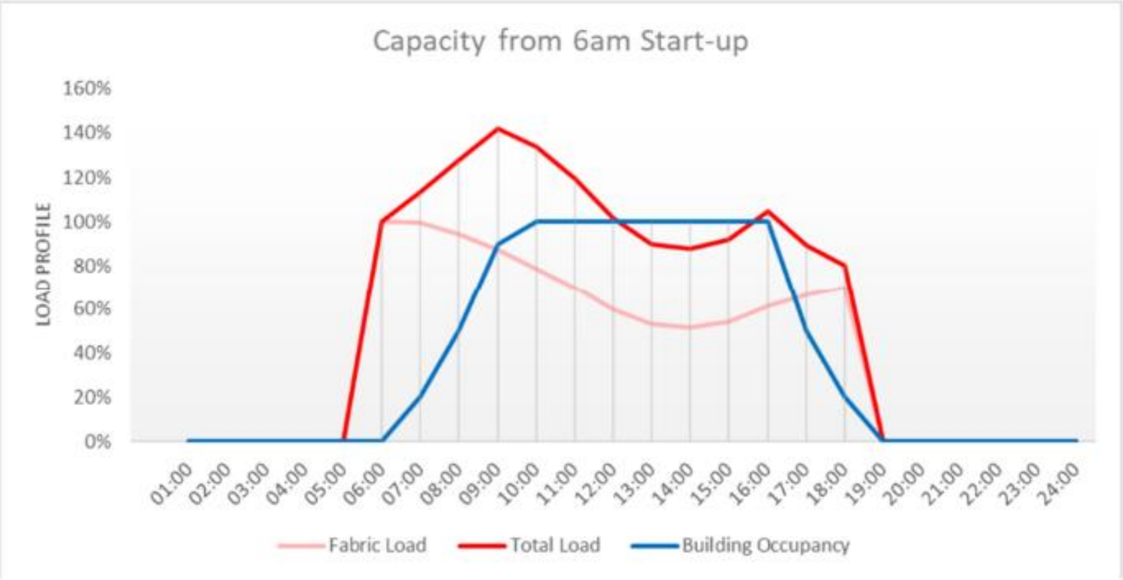


Figure 3. Heating Load Profile

		REDUCED HEATING CRITERIA OPTIONS		
ITEM	BASE CASE	NON GREENSTAR (OPTION 1)	MINIMUM OA (OPTION 2)	DATA ANALYSIS (OPTION 3)
Fabric Load (Estimated)	420 kW	420 kW	420 kW	640 kW
OA Load (Estimated)	690 kW	460 kW	230 kW	
Warm Up Cycle (Estimated)	70 kW	70 kW	70 kW	70 kW
4-Pipe @ 60%	710 kW	570 kW -20%	440 kW -38%	410 kW -43%
Capacity Installed	1420 kW	1140 kW	880 kW	820 kW

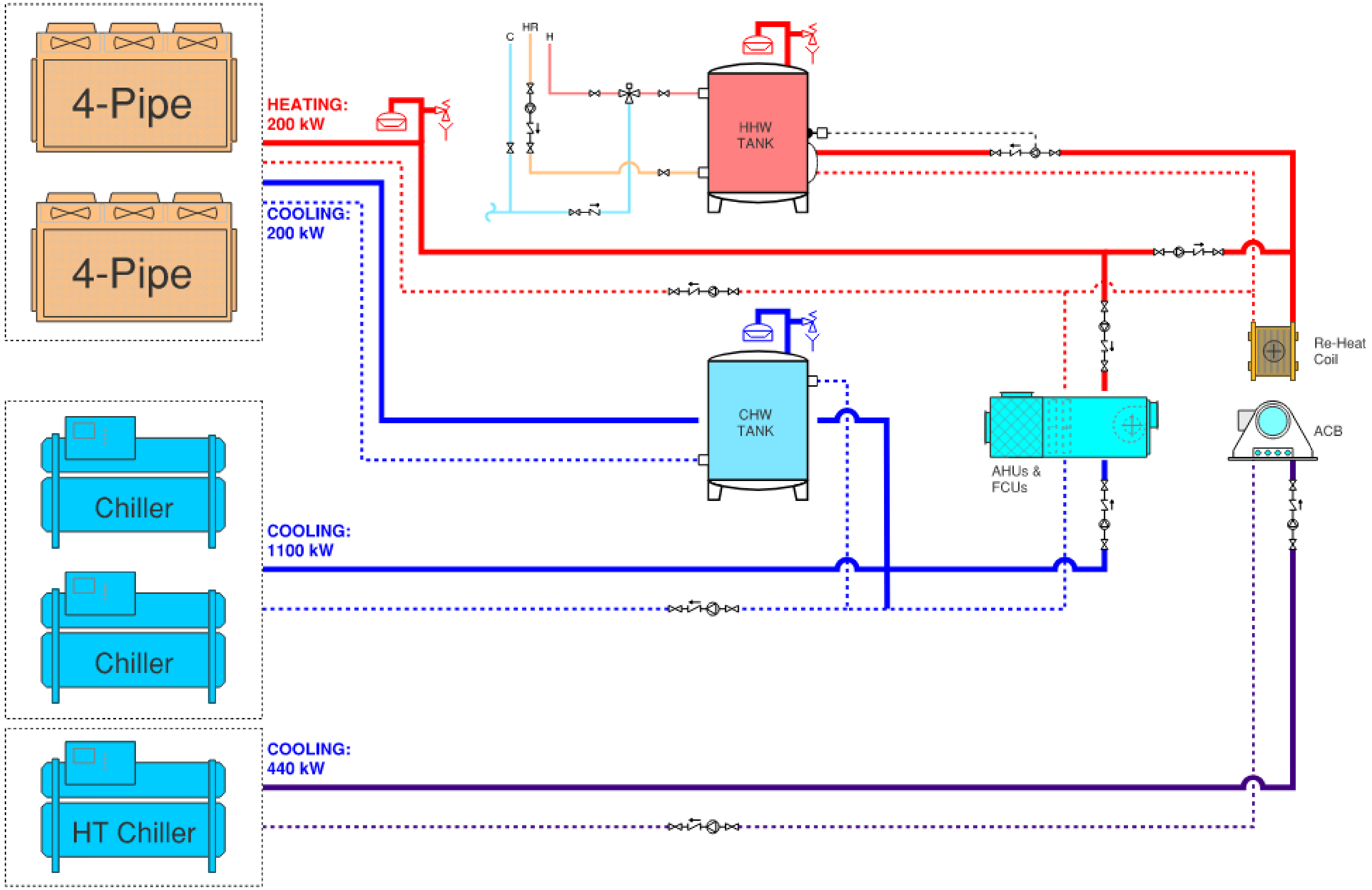
* *4-Pipe chillers are sized at 60% of the total load to meet the PCA redundancy requirements and to add an aditional 20% total safety factor*

Defining Loads for Electric Systems

Worked Example

50% CHW LOAD
25% HHW LOAD

- Maximise Simultaneous Heating and Cooling
- Utilise 4-Pipe In total cooling
- Additional water saving low load option



DHW Consideration

What is demand? Could point of use electric systems be sufficient?

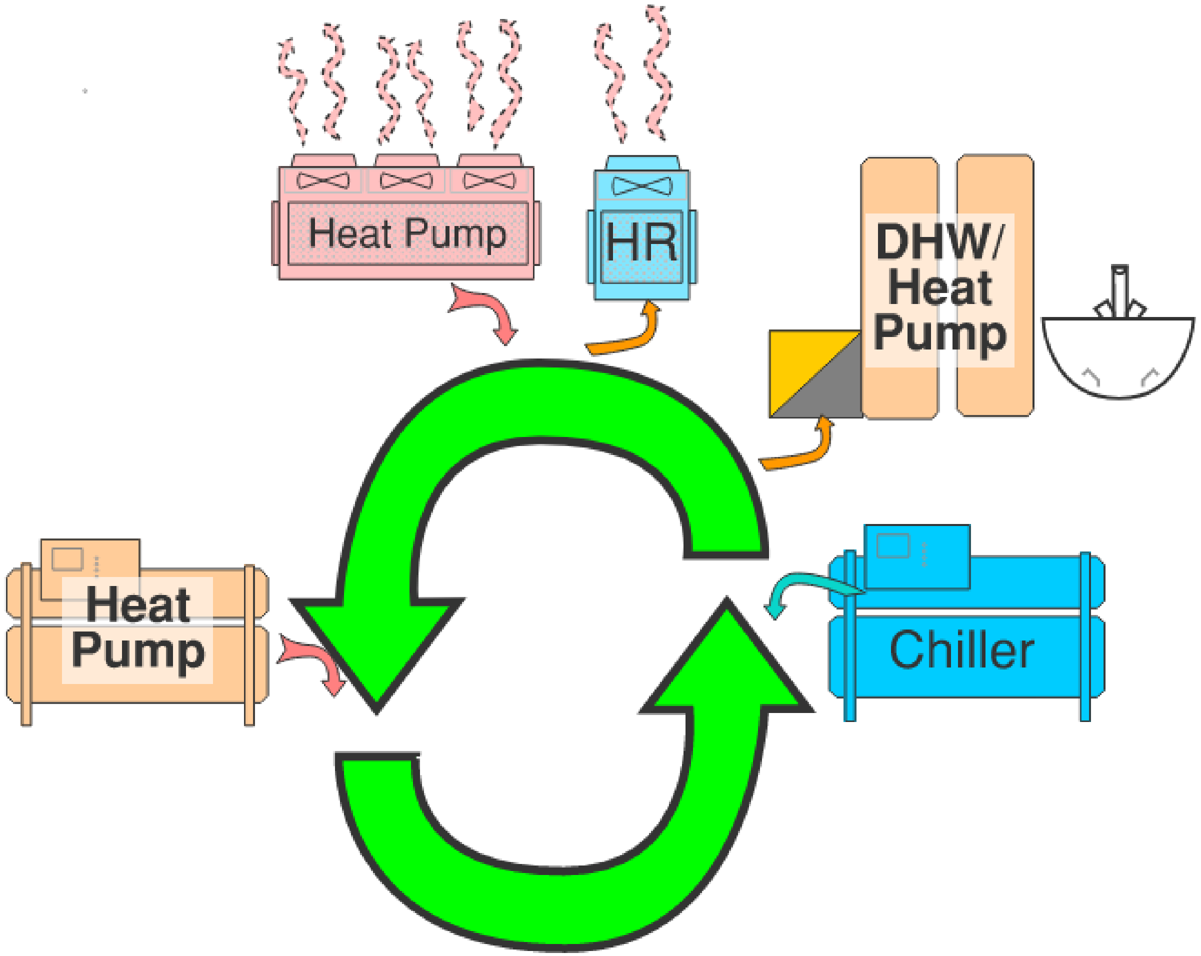
- Reduced distribution and storage losses
- Improved use vs consumption characteristic
- Reduced embodied carbon

https://www.stiebel-eltron.com.au/dhf-instantaneous-3-phase-water-heater#downloads

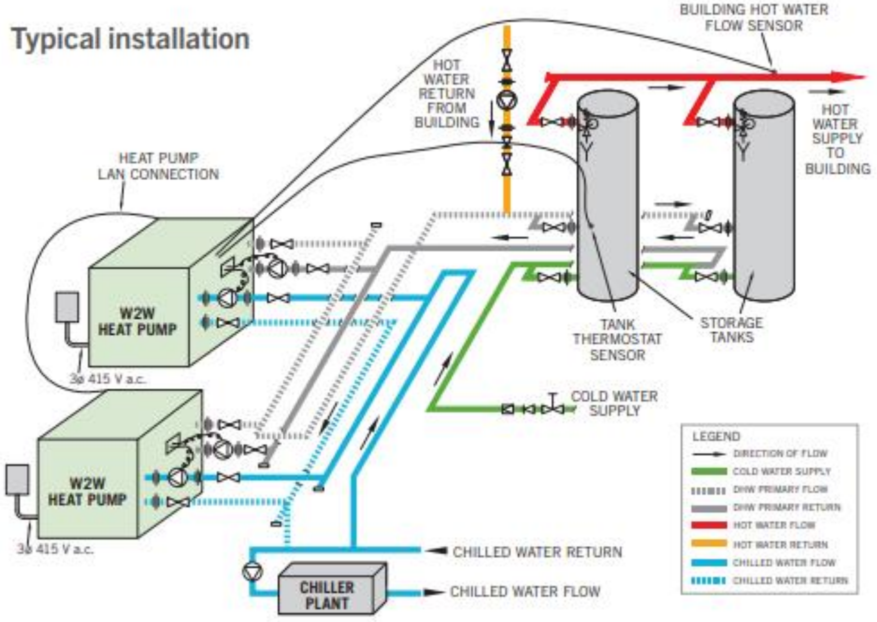
Are Separate Systems A Missed Opportunity?

https://www.rheem.com.au/rheem/products/Heat-Pumps/c/heat-pumps

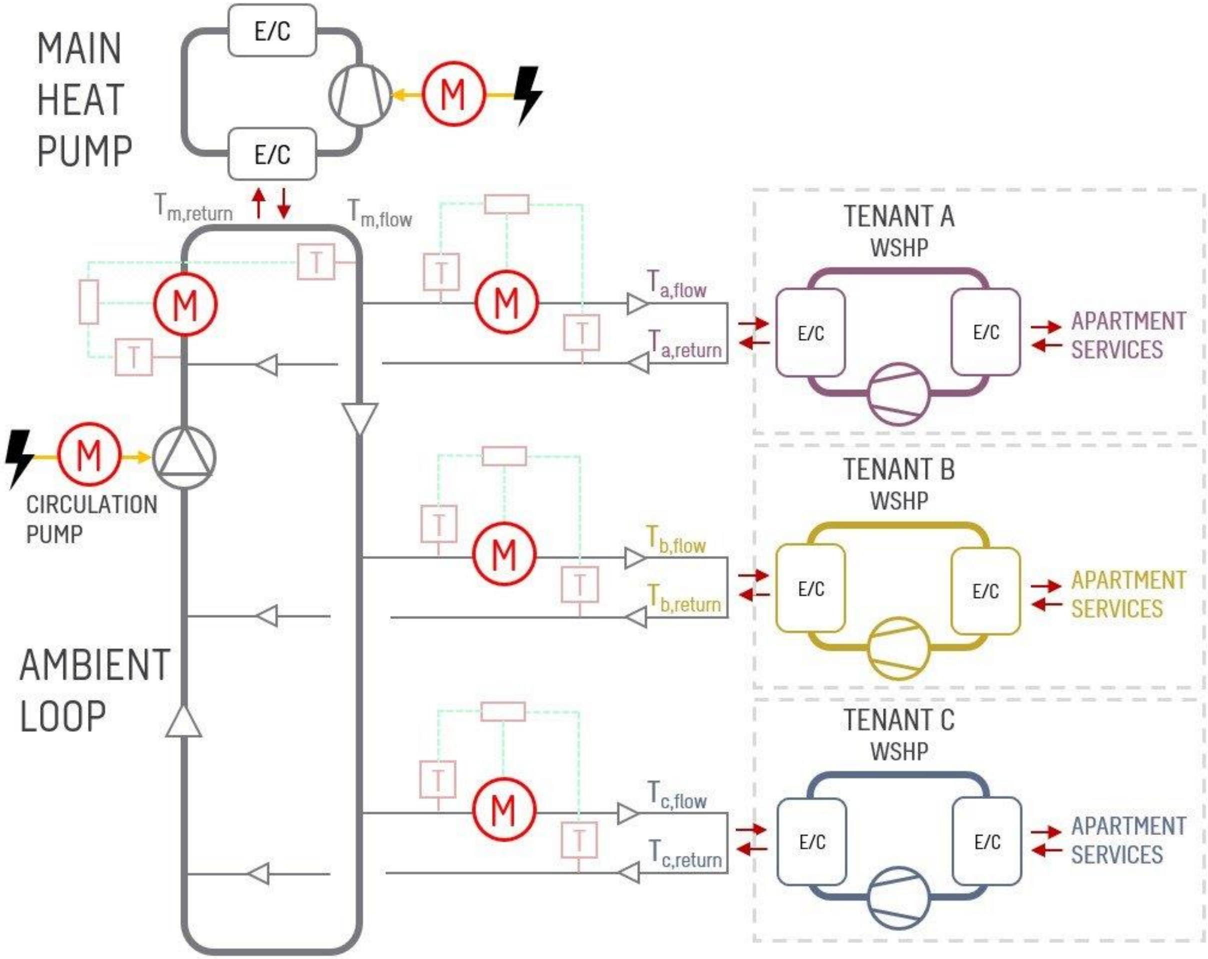
Heat Recovery and Ambient Loops



Typical installation

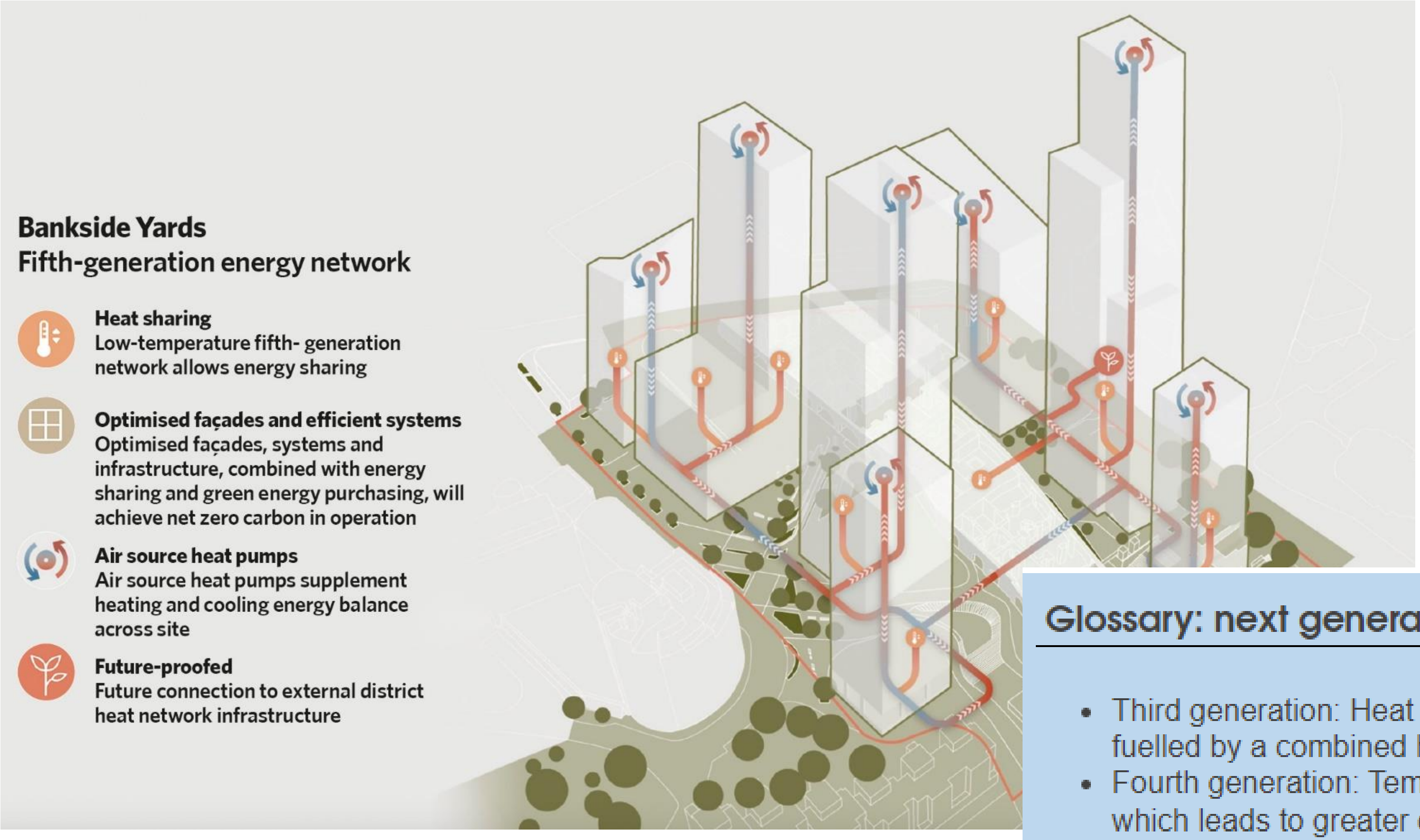


Heat Recovery and Ambient Loops



https://www.sweco.co.uk/insights/news/ambient-loop-district-heating-worth-the-energy/

Heat Pumps and District Ambient Loops – 5th Generation Heat Networks



https://www.cibsejournal.com/case-studies/generation-gains-designing-a-5th-generation-energy-network-in-central-london/

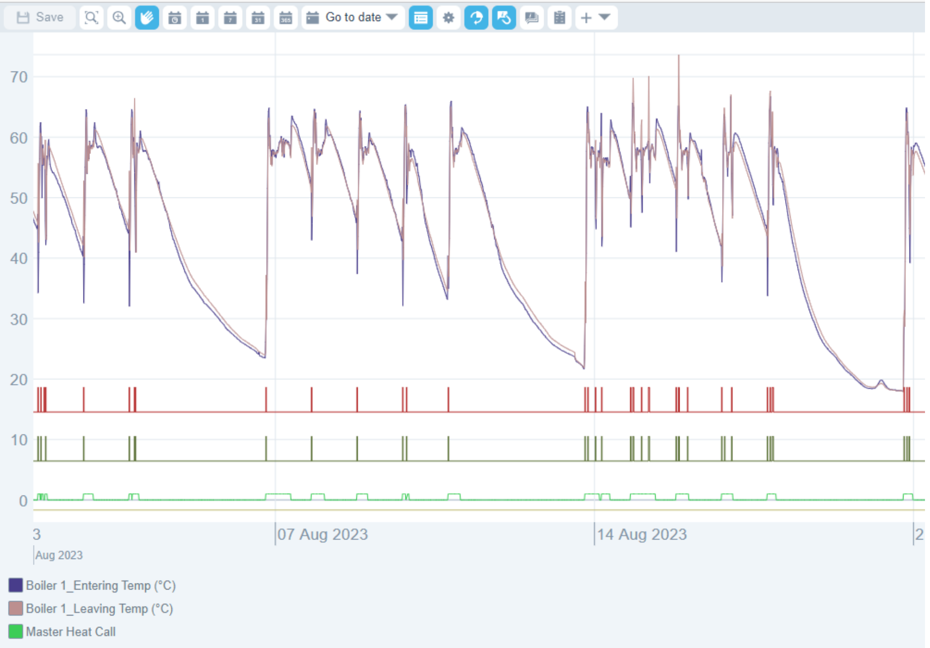
Glossary: next generation

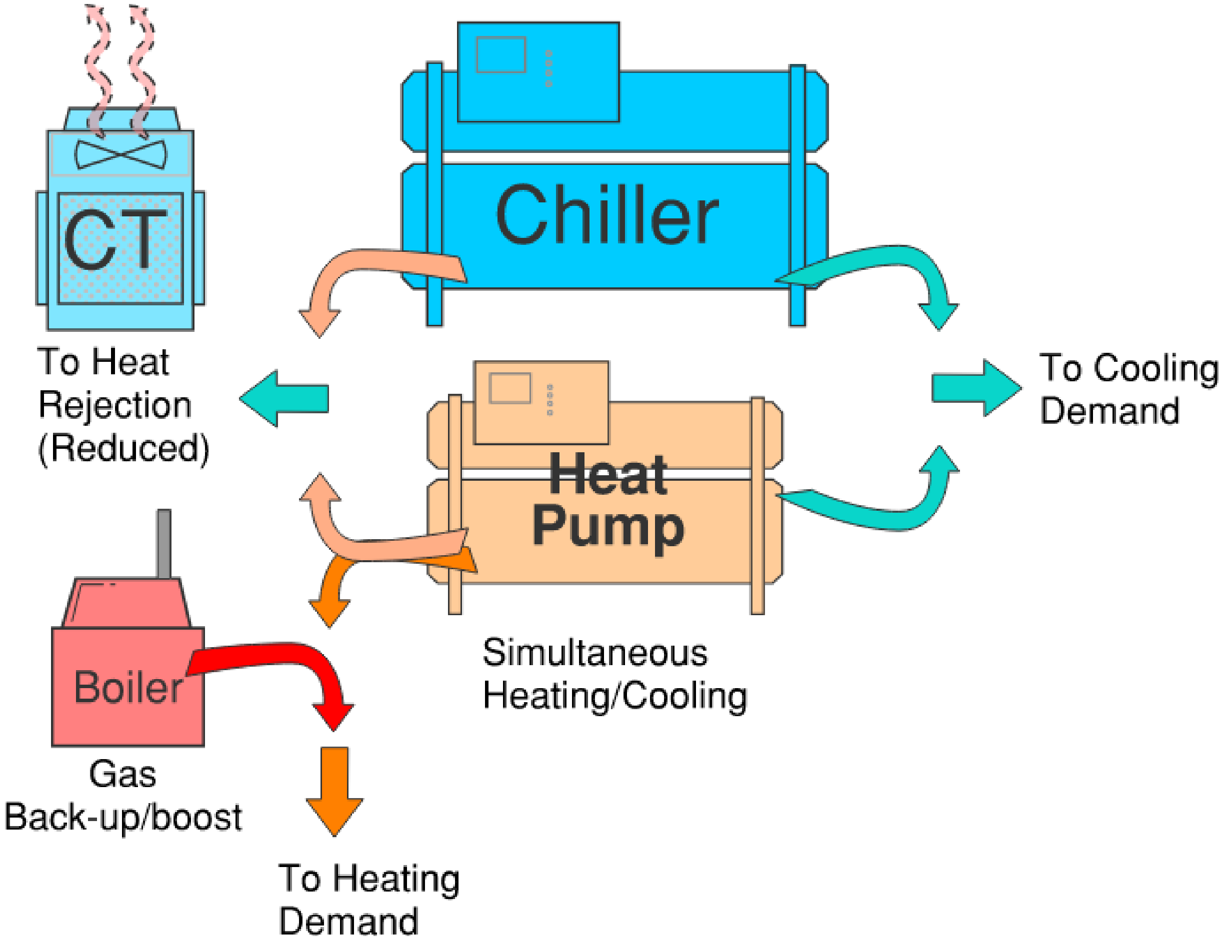
- Third generation: Heat distributed at 90/70°C flow/return usually fuelled by a combined heat and power energy centre.
- Fourth generation: Temperatures are below 55/25°C flow/return, which leads to greater efficiencies, especially if using heat pumps or energy from waste. Onsite renewable generation can be integrated.
- Fifth generation: An ambient temperature energy network (which will run below 25/20°C at Bankside Yards) has a wider range of lower-grade heat sources, and accepts simultaneous cooling heat rejection, along with heat supply.

Existing Building Considerations

Hybrid Solutions

- Dependent on-site constraints/opportunities
- Never assume like-for-like capacity
- Be Data led

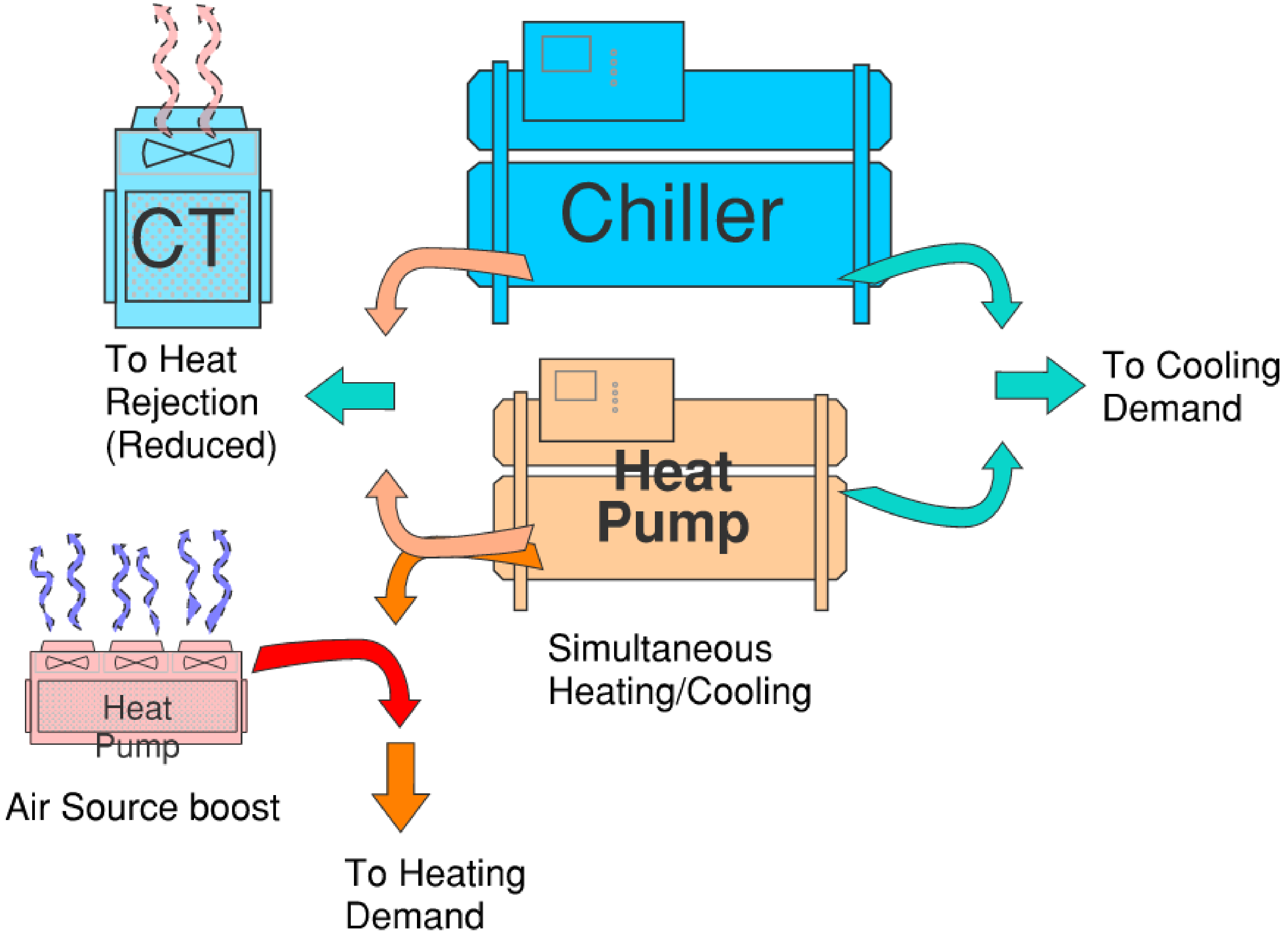




Existing Building Considerations

Phased Solutions

- Don’t let perfect be the enemy of best for project



Take Away Messages

- Design for the technology you are using
- Never assume like-for-like
- Capacity sensitivity amplifies importance of ‘right sizing’
- Be data driven
- Detailed Analysis gives better results capital and operational results
- Test and rethink the business as usual and accepted norms
- Be flexible
- Consider wider Sustainability impacts

Thank you

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