NDY
A TETRA TECH COMPANY

11 MOUNTS BAY RD

ELECTRIFICATION OF HEATING

August 2025

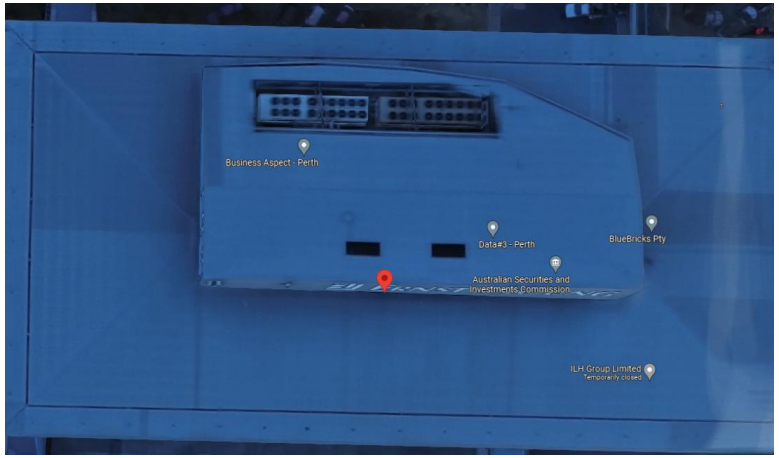
INTRODUCTION & CIBSE READINESS

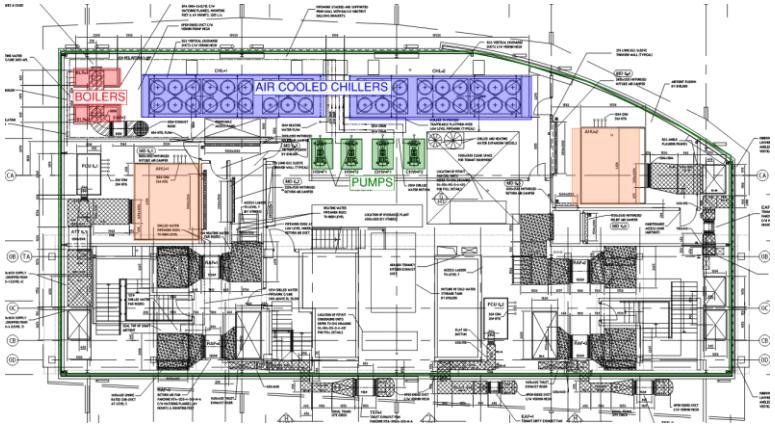
- Electrification of existing office building
- Demonstration of Readiness
  - Anticipate emerging risks
    - Climate Modelling
  - Absorb emerging risks
    - Improvements in resilience / system performance
  - Adapt to emerging risks
    - Reduction in emissions

11 MOUNTS BAY RD - SITE

- 5-storey building (plus ground floor podium level)
- Located Perth CBD
- Levels 1 – 5: Typical office floors,
- Total NLA: ~11,0000m^2

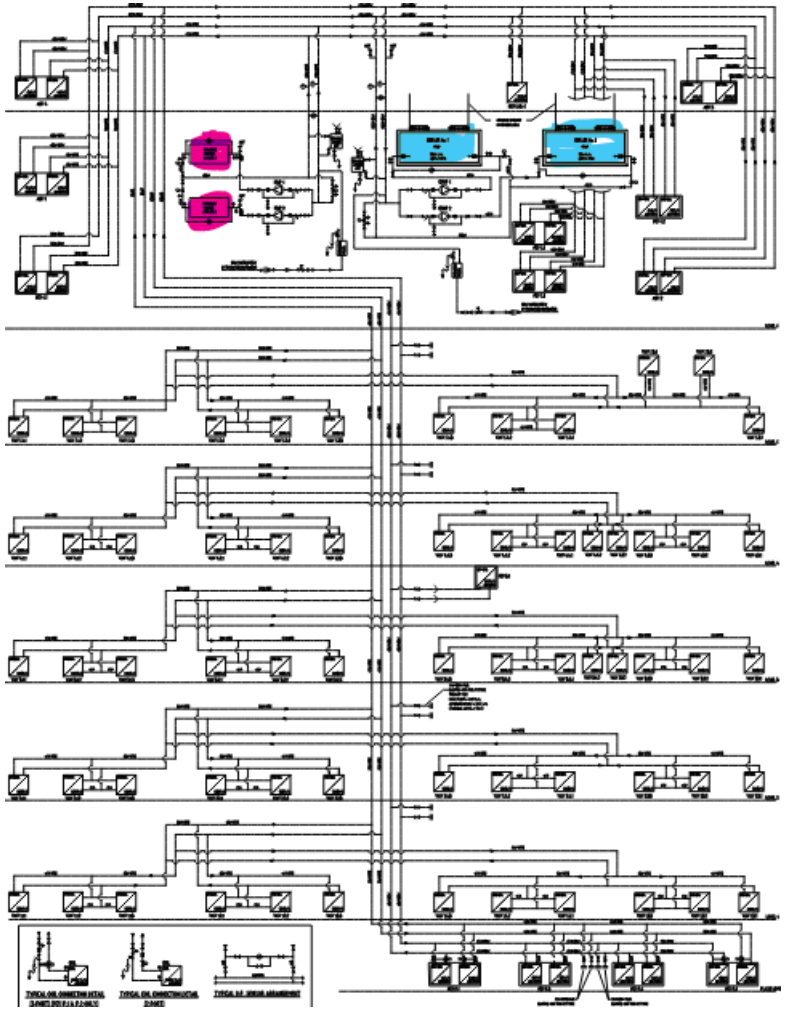
EXISTING PLANT LAYOUT





- All plant located on Level 6 plantroom
- 2x Air-Cooled Chillers
- 2x Boilers
- Pumps
- AHUs
- Only existing ventilated plant area – Air-Cooled Chillers
- No other external plant space

EXISTING WATERSIDE LAYOUT



2X AIR COOLED CHILLERS AND 2X GAS FIRED BOILERS ON THE ROOF

NO COOLING TOWERS / TENANT CONDENSER WATER LOOP

CHILLED WATER CONNECTIONS PROVIDED TO EACH FLOOR FOR TENANT CONNECTIONS

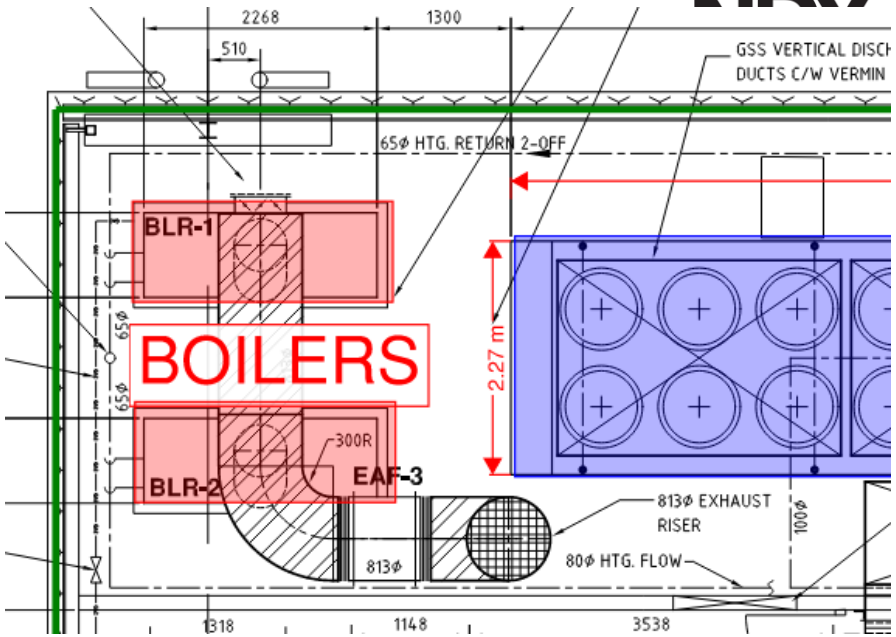
HEATING WATER PROVIDED TO PERIMETER VAV'S ON ALL FLOORS FOR REHEAT

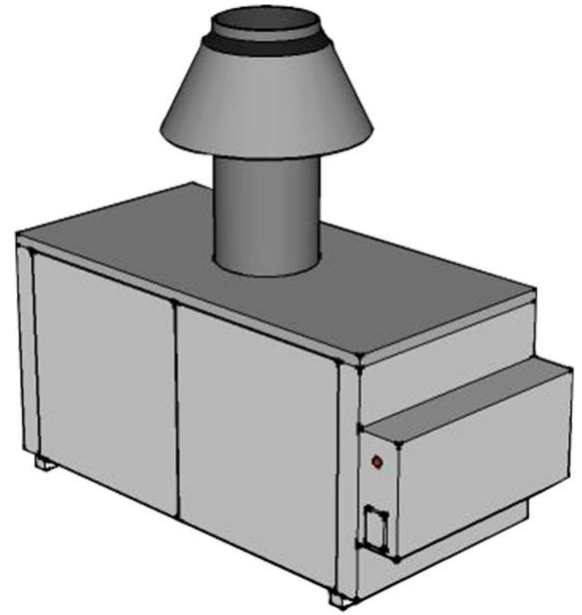
EXISTING BOILERS

- 2x Raypak B1922 NCM/ID gas fired boilers
- 400 kW_R Heating Capacity each
- 5.1 L/s @ 75-55°C HW F&R Temperatures

- Gas Supply: 1922 MJ/hr each
- Small single phase power supply
- Dimensions (approx.): 2.6m x 0.8m each
- Weight (empty): 460 kg each

Total Existing Heating Capacity: 800 kW





Electric Heat Pumps -

OPTIONS

- **Option 1**:
  High Temperature Air-Sourced Heat Pumps (like gas-fired boilers)
- **Option 2:**
  Air Source Heat Pumps + Water-Sourced Heat Pumps (connected in series)
- **Option 3:**
  Low Temperature Air-Source Heat Pumps (space efficient)

11 MBR – PLANT LOCATION - OPTIONS

Location A: Create a new plant deck (not preferred)

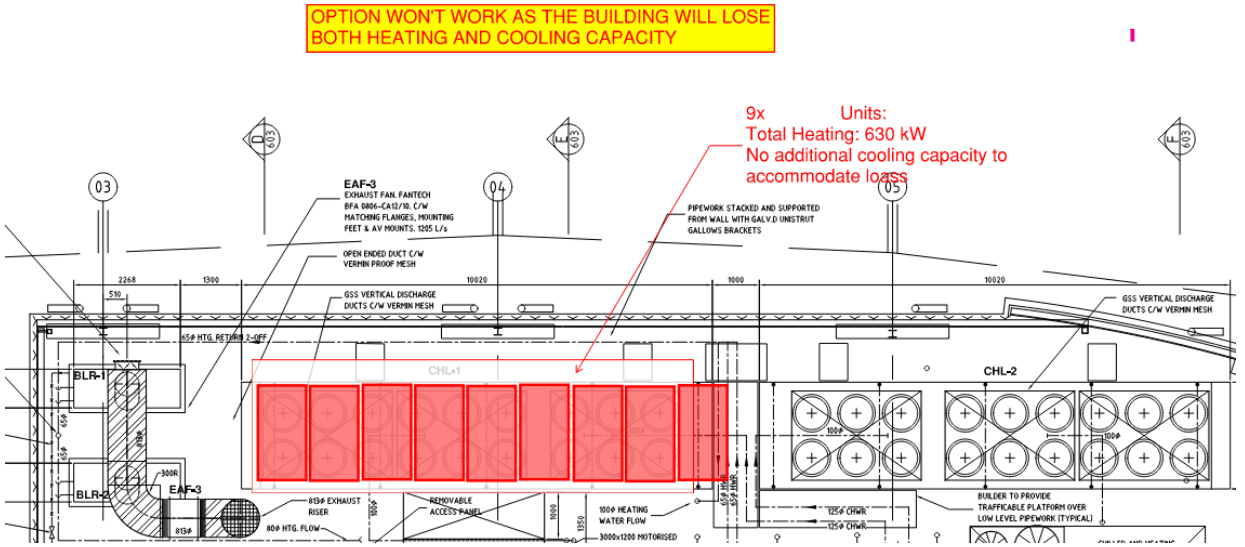
Location B: Delete 1 or both air-cooled chillers

Location C: Delete boilers and utilise space for low temperature heating water option.

11 MBR –OPTION 1

- High temp heat pumps
- Units large physically for heating output
    - Delete Air-Cooled Chiller

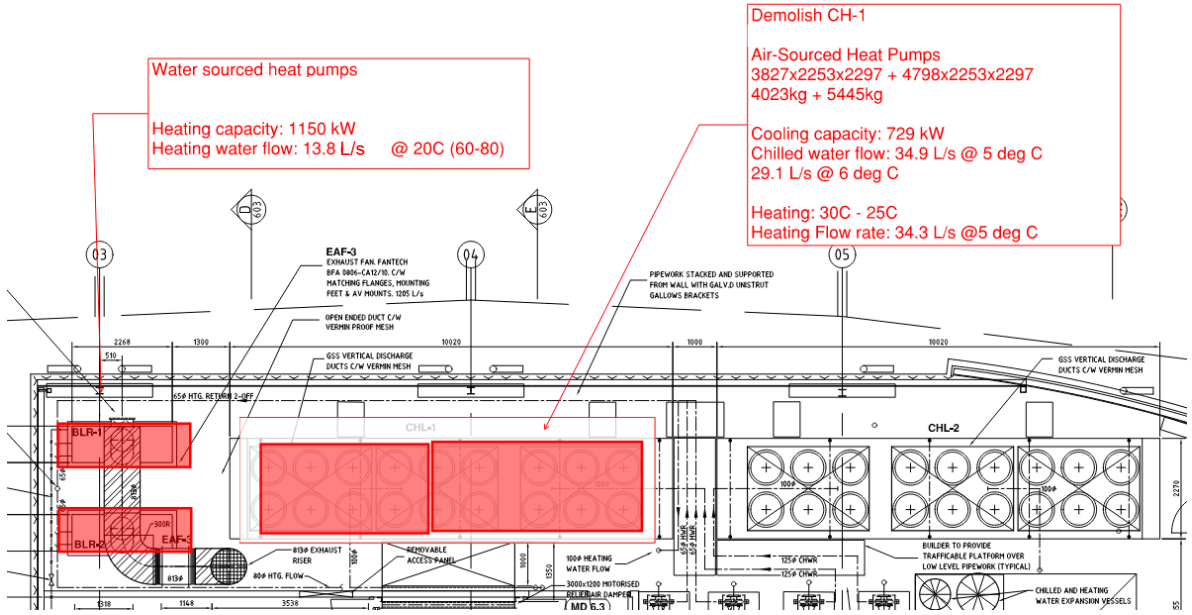
Won't work as building will lose both heating and cooling capacity



11 MBR –OPTION 2

- Delete Air-Cooled Chiller
  - Air-sourced heat pumps
- Delete Boilers
  - Water-sourced heat pumps
- Connected in series

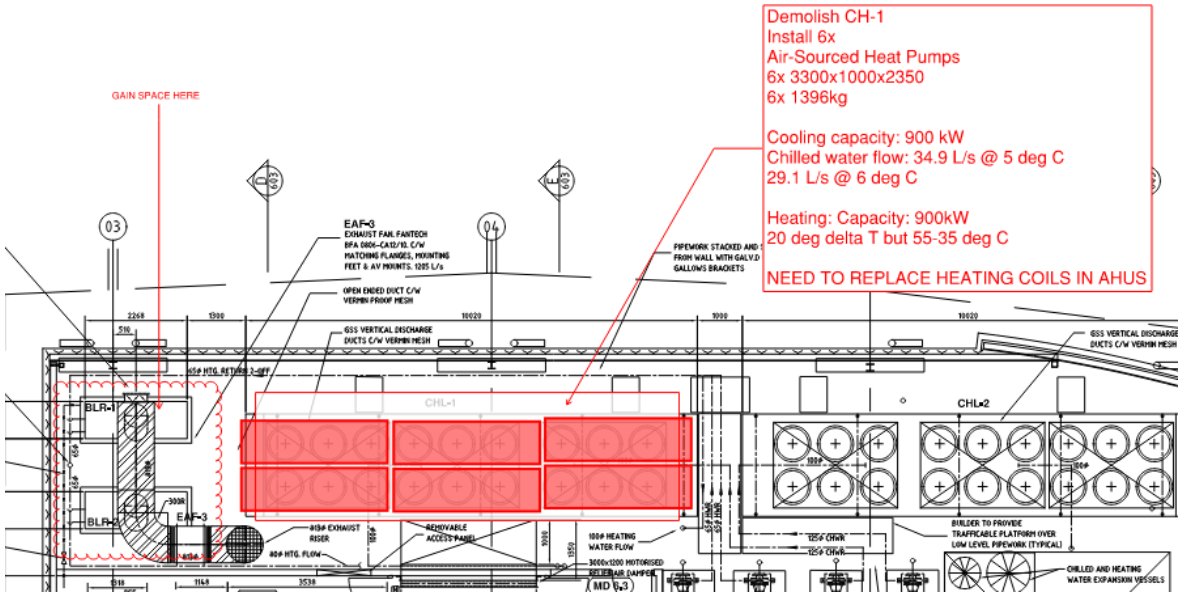
- **Fits in space available**
- **Power upgrade (for Cooling)**
- **High cost (capital & demo)**
- **Poor Energy Efficiency (Low COP)**
- **Embodied Carbon waste**



11 MBR –OPTION 3

- Delete Air-Cooled Chiller
  - Air-sourced heat pumps

- **Fits in space available**
- **No power upgrade**
- **Better Energy Efficiency**
- **Reduced Embodied Carbon**
- **Lower temp = heating coil replacement?**

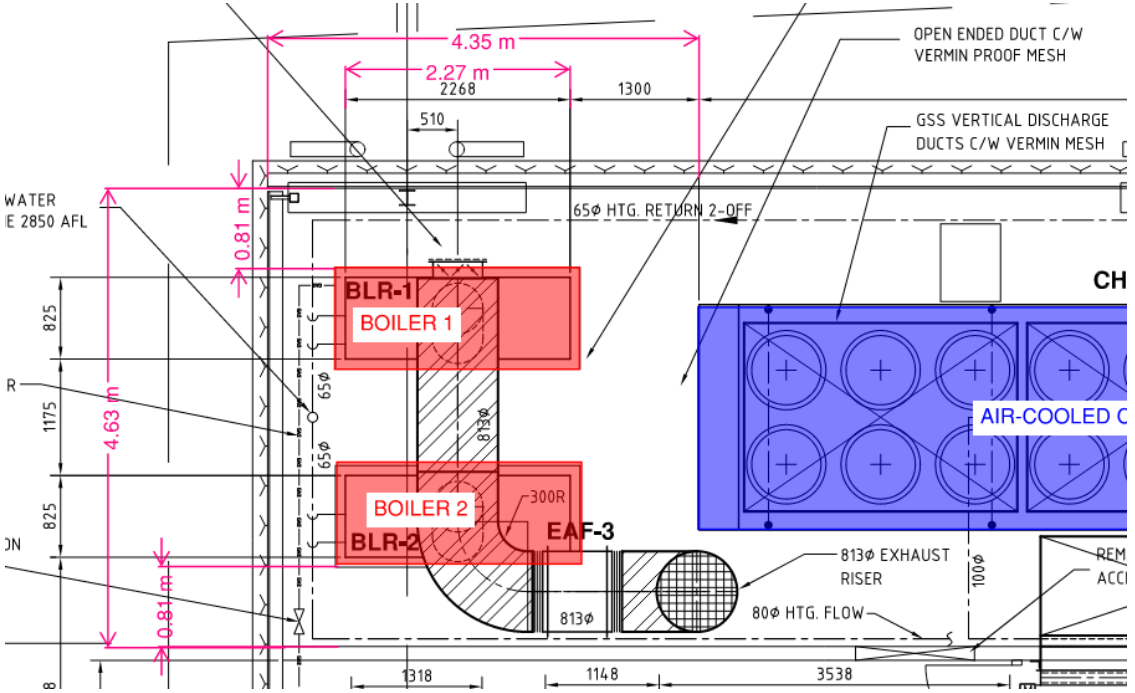


OPTIONS SUMMARY

	OPTION 1 (High temp HP's)	OPTION 2 (Internal + external)	OPTION 3 (Low temp HP's)
Internal Plant Area Required?	N/A	✓	N/A
External Plant Area Requirement (Rank)	3	2	1
High Temperature HW	✓	✓	✗
Heating and Cooling?	✗	✓	✓
COP (Rank)	2	3	1
Unit Cost (Rank)	3	2	1

BACK TO THE DRAWING BOARD

- Chillers are only ~5 years old
- The client's strong preference is to utilise the plant space vacated by the boilers to install the new heat pumps.
- Much less space available



11 MBR – PLANT LOCATION - OPTIONS

Location A: Create a new plant deck (not preferred)

Location B: Delete 1 or both air-cooled chillers

Location C: Delete boilers and utilise space for low temperature heating water option.

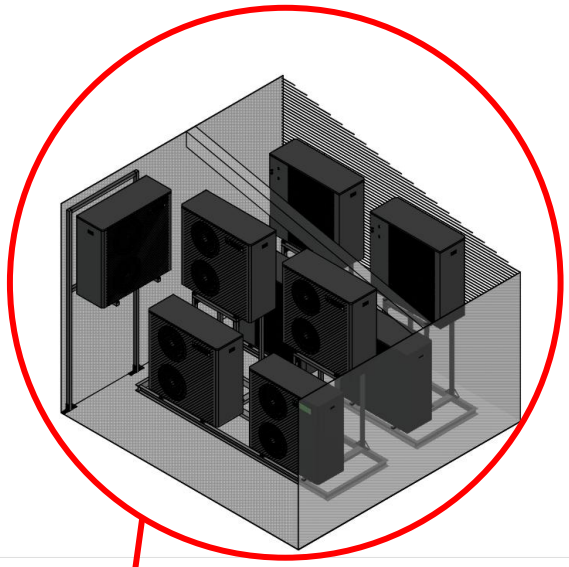
BUT WAIT…

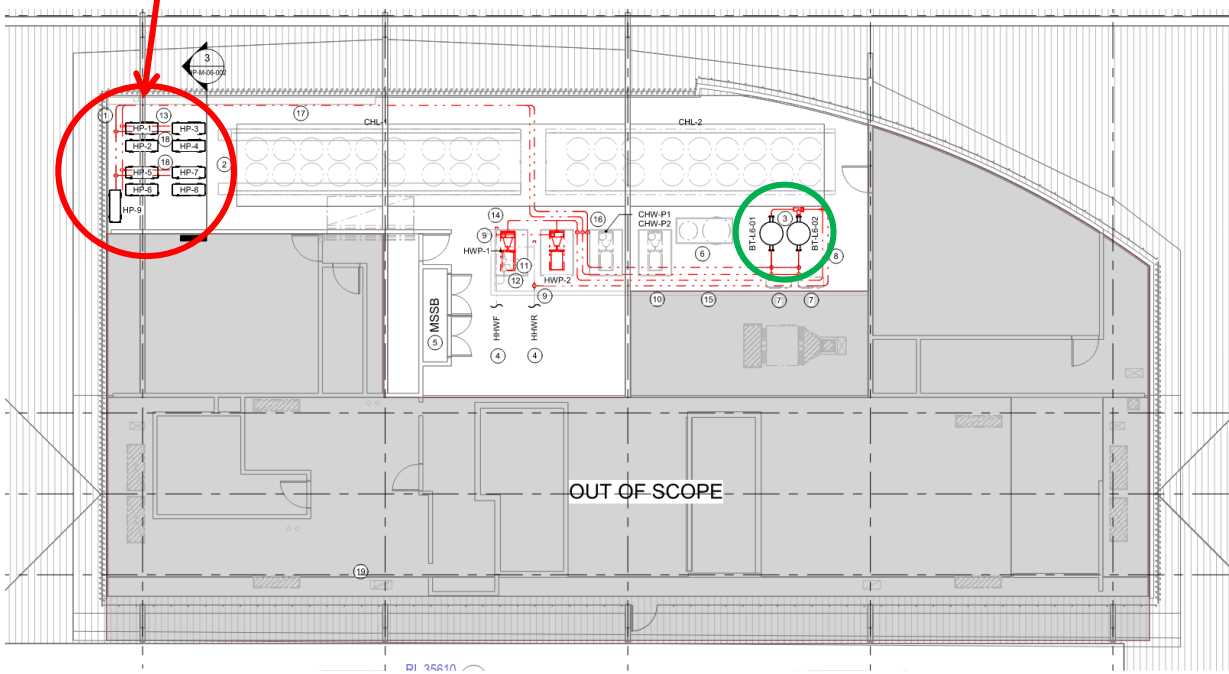
- Feedback from site states boilers are never both running at the same time
- Run at low loads for the majority of the year.
- Maximum operational heating load **~400kW.**

11 MBR – REDESIGN

- Delete Gas-Fired Boilers

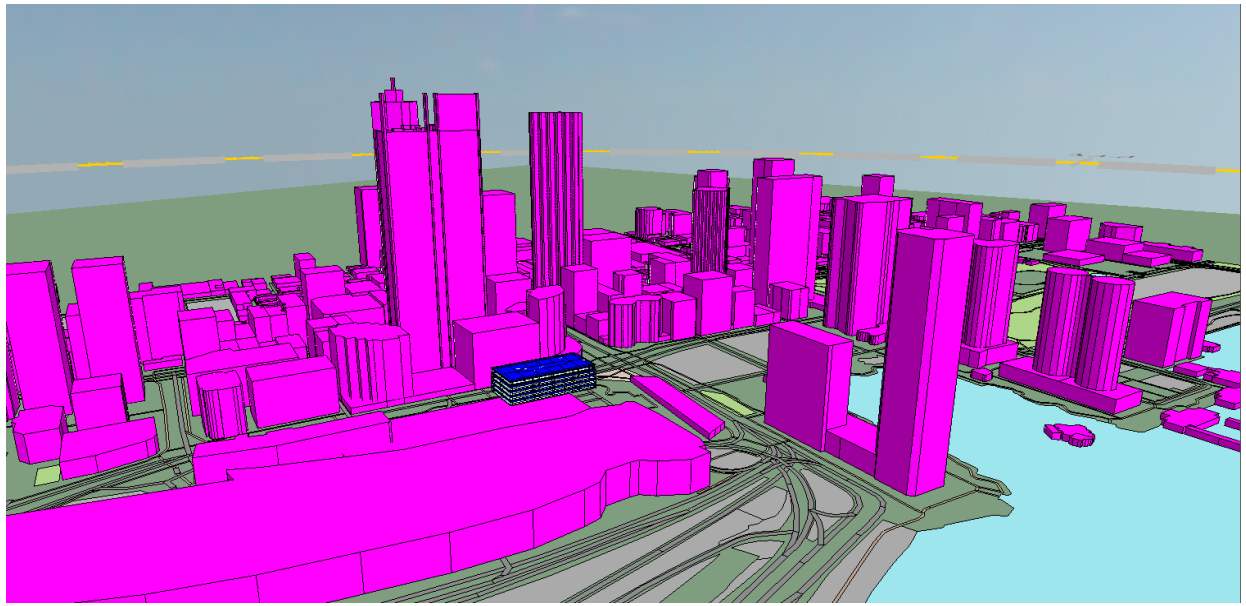
- **Small Modular Heat Pumps**
- **Buffer Tanks**
- **Can fit within access hatch into plantroom**
  - **No crane lift required**

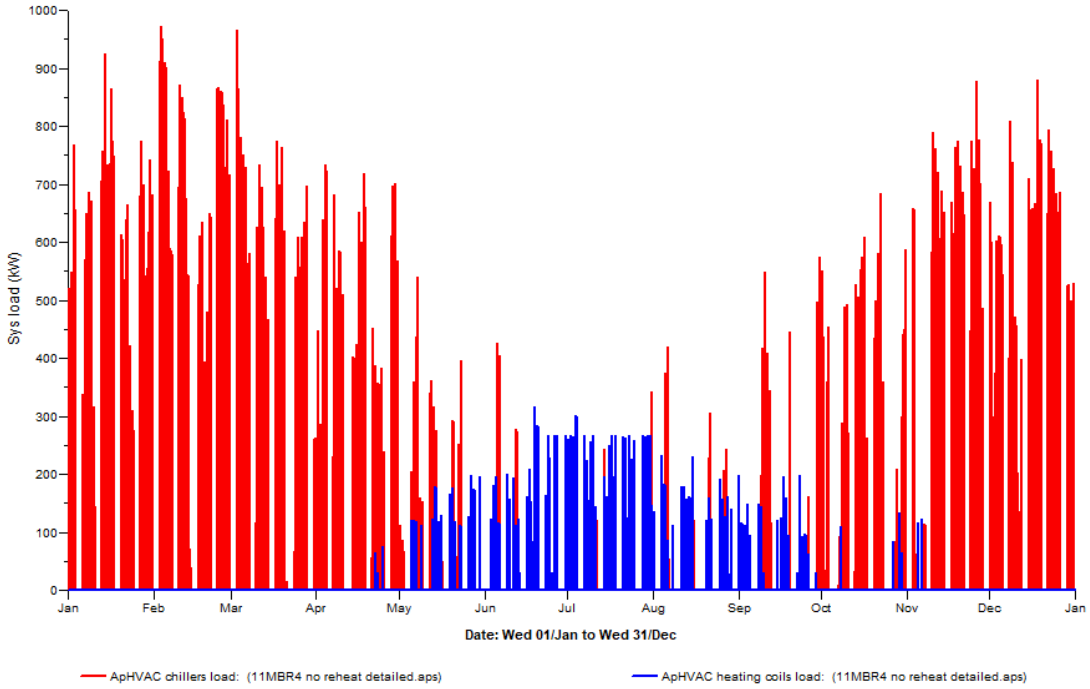




HEAT LOAD ANALYSIS

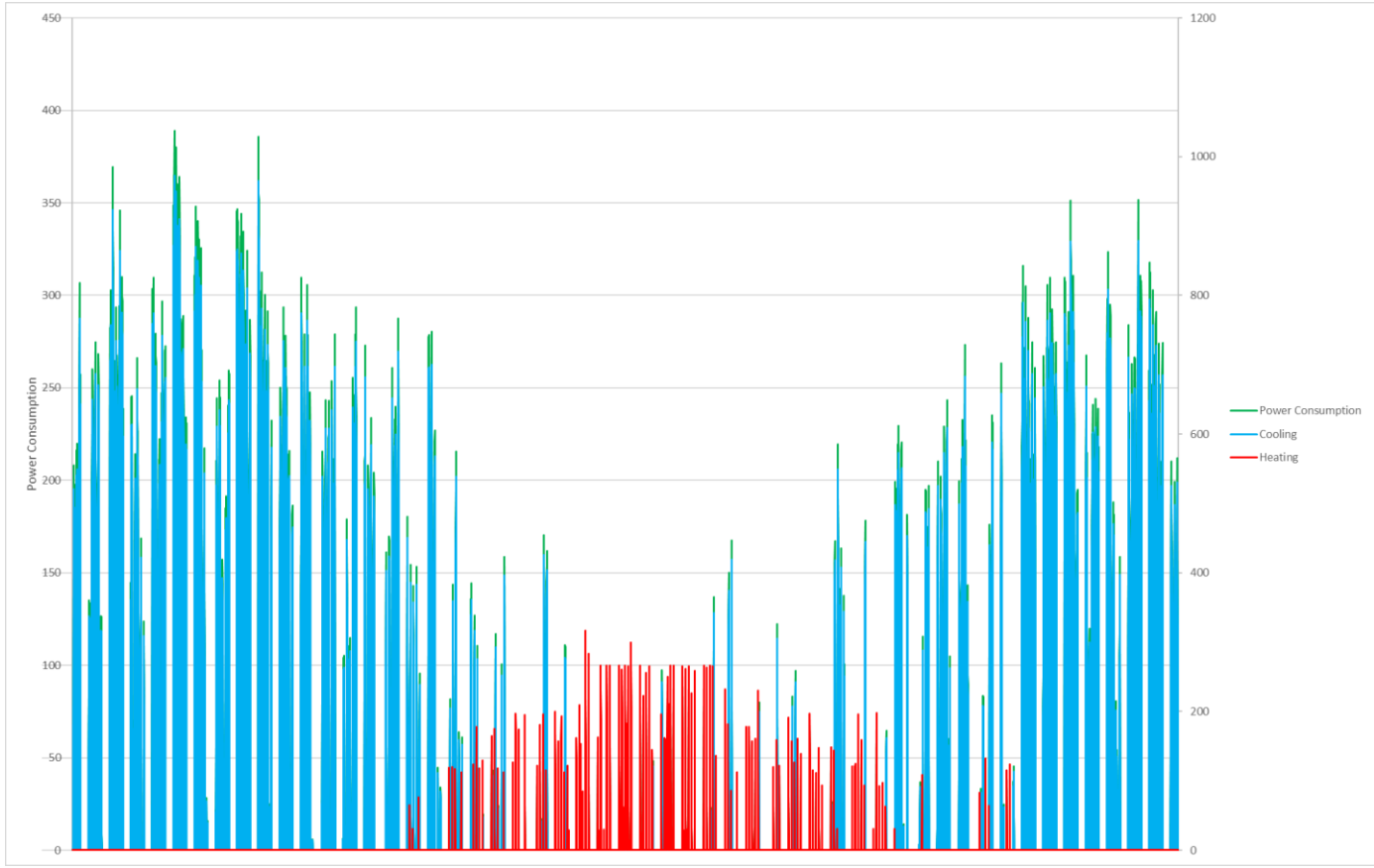
- IES Model – peak heating load **~350kW**
- Cooling Dominant





IS A POWER UPGRADE REQUIRED?

- Peak Power Consumption Occurs at Peak Cooling
  (not simultaneous heating + cooling)



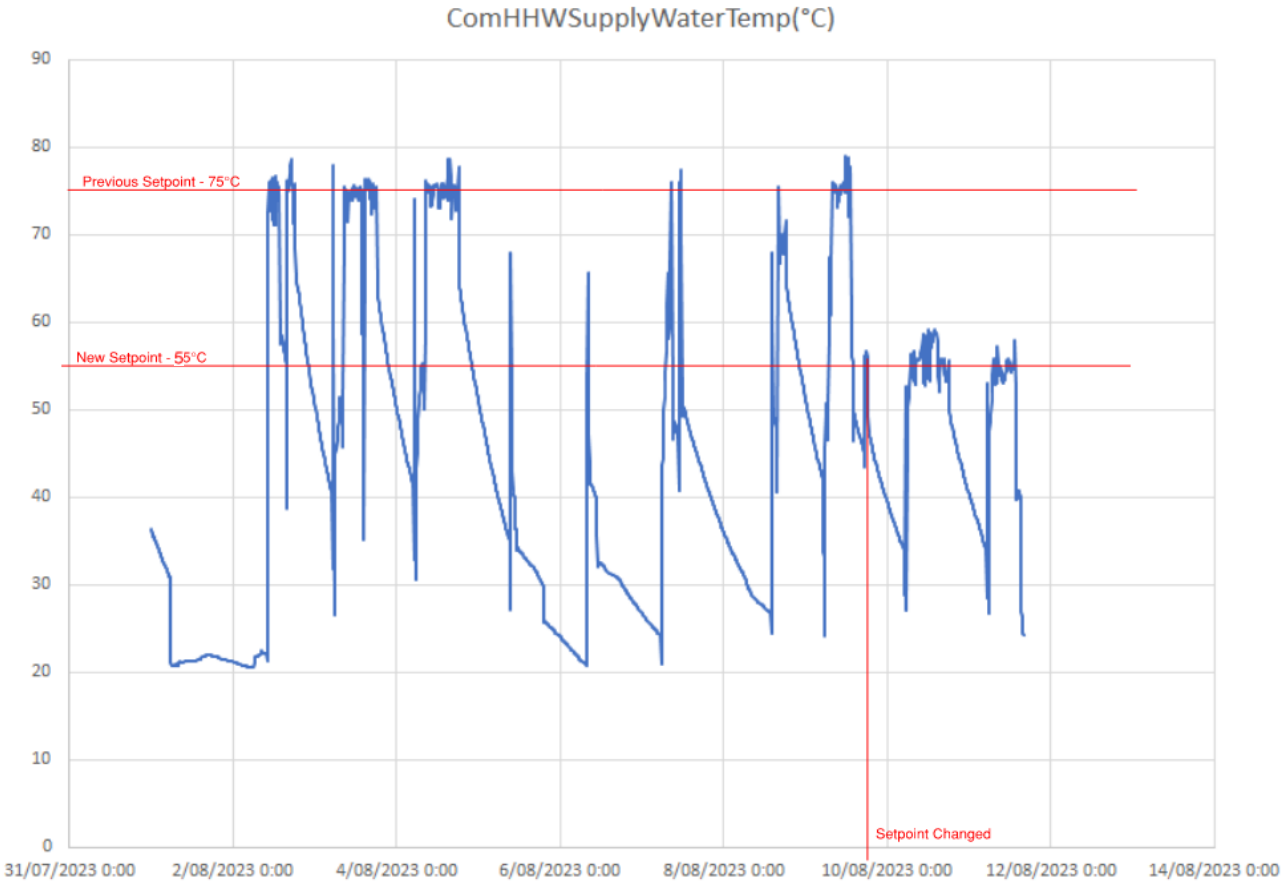
DROP IN HEATING WATER TEMPERATURE

- Proposed heat pumps can only supply 55°C
- Existing heating system oversized = oversized coils
- We believe existing heating coils could meet heating demand with reduced water flow temperature

Wanted to test this in practice – turned down the boiler supply temperature to 55°C and monitored space temp on BMS

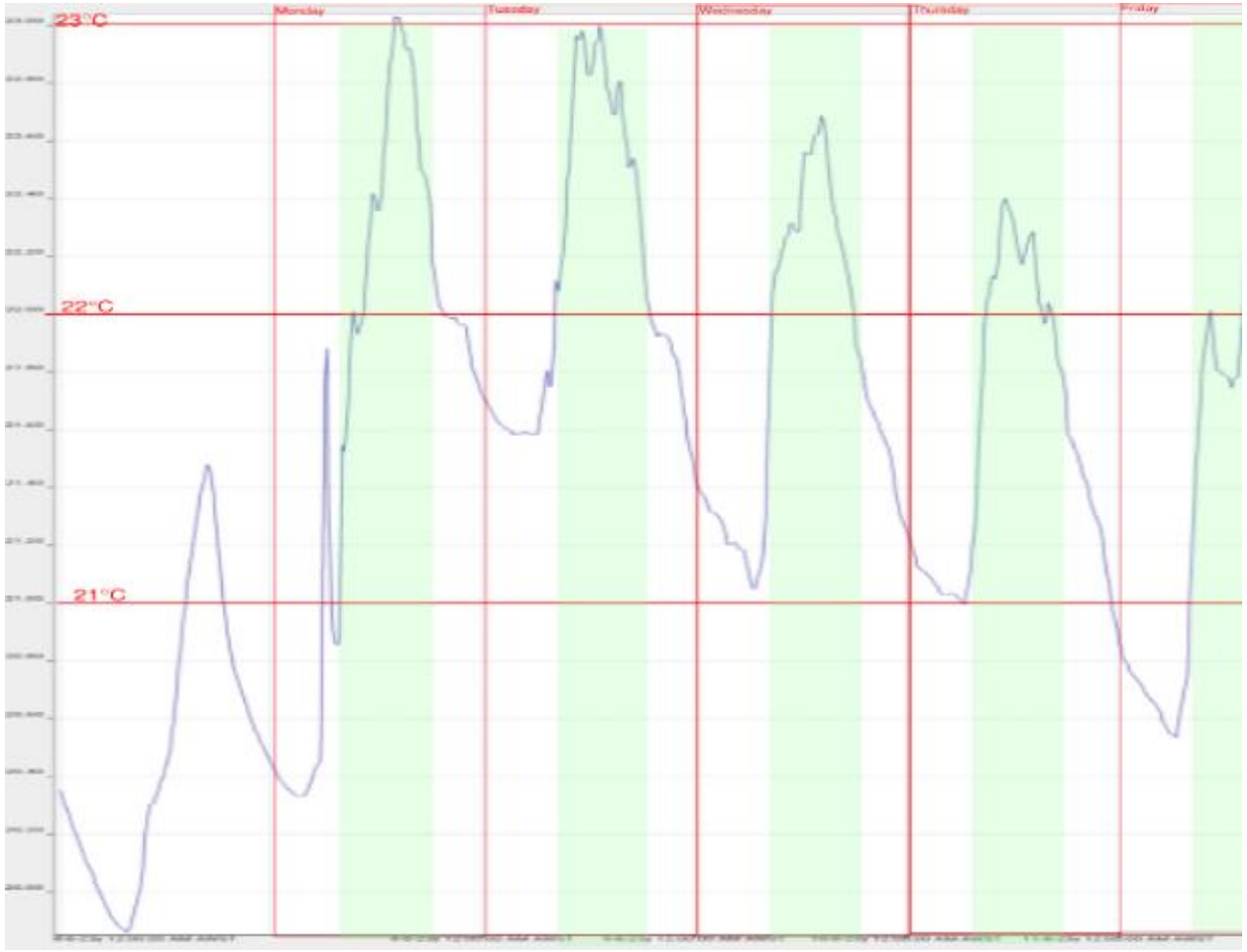
BMS RESULTS

- Heating water flow temperature reduced
- Ran at 55°C over 1 winter month



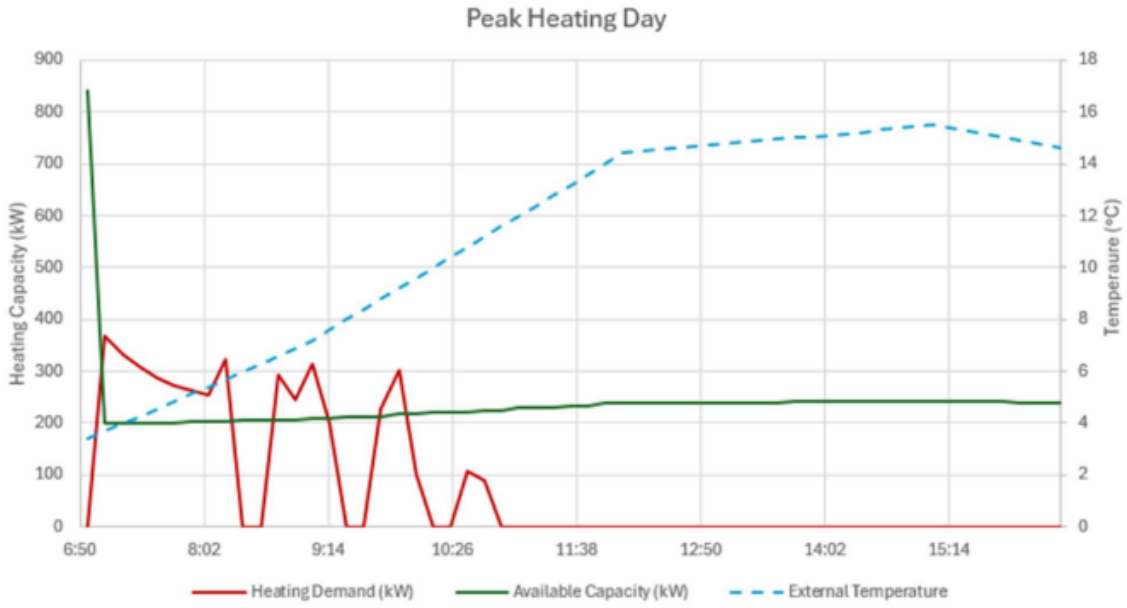
BMS RESULTS

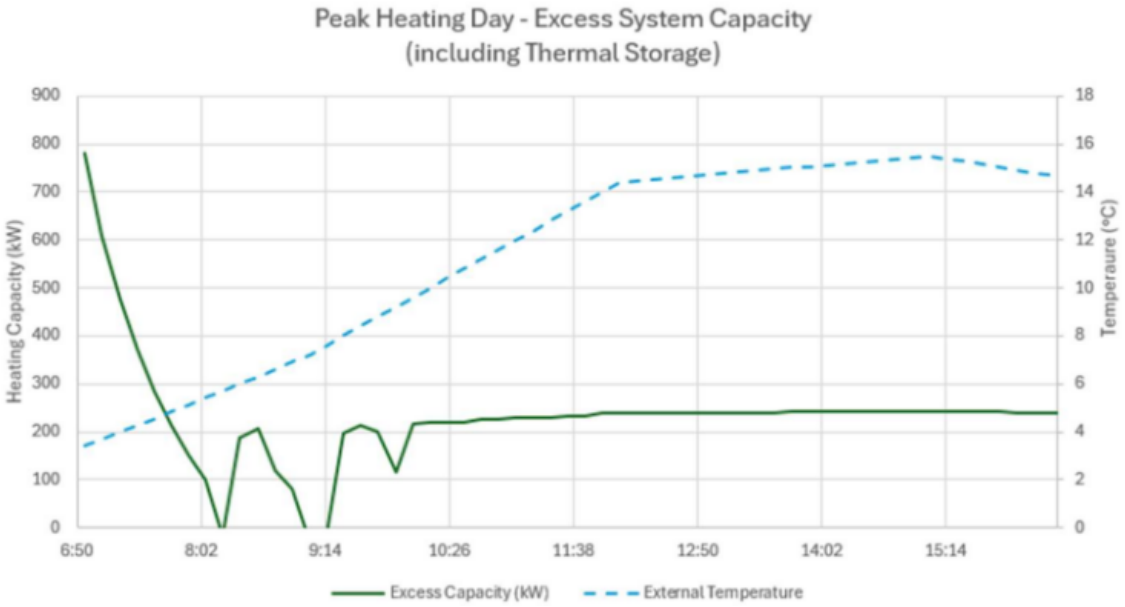
- Space temperature (Worst case/South zone during Winter week)



THERMAL STORAGE

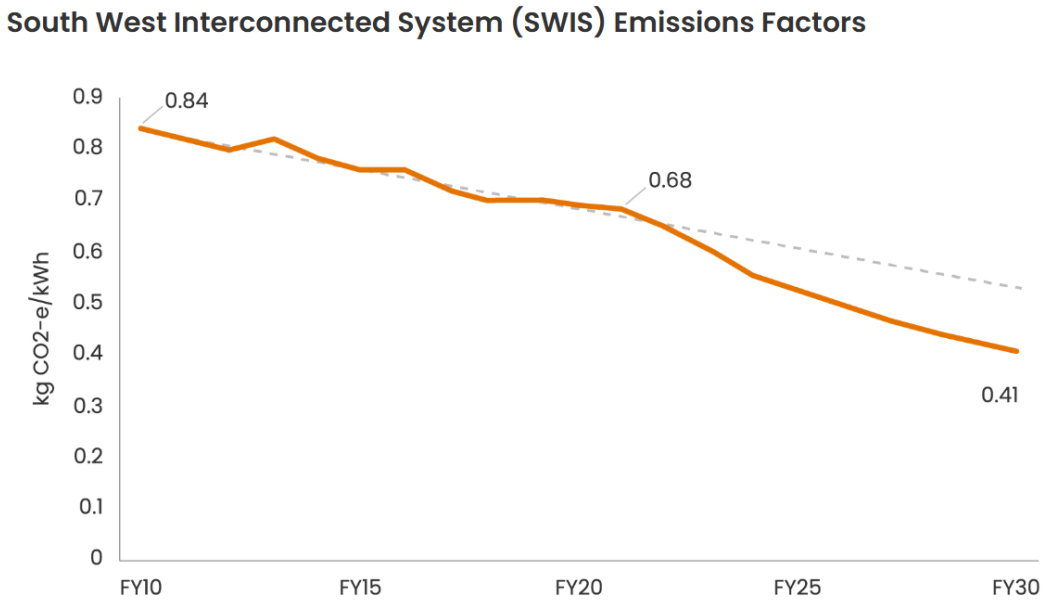
- Buffer Tanks
- Charging overnight to higher water temperatures
- Accounts for derating of heat pumps at lower ambient temperatures
- Maximising efficiency of units





BENEFITS OF ELECTRIFICATION

- Electrification = "greener"?
- COP of ~3:
  - currently the CO_2 emissions of gas heating ~ CO2 emissions of electric heat pumps (based upon current CO conversion coefficients for Perth)
  - Grid is rapidly becoming cleaner so will only improve



Source: Historical Greenhouse & Energy Reporting - Australia's Emissions Projections 2021

- Reduced Running Costs
- Less harmful atmospheric emissions

FURTHER POINTS FOR CONSIDERATION

- No “one size fits all” solution
- Reviewing heating loads not just like for like replacement
- Consideration of heating **and** cooling – need best fit to match heating and cooling load profiles
- Buffer tanks
  - provide minimum system volume
  - thermal storage benefits.

THANK YOU

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