A successful DC Refurbishment

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Overview

- We have refurnished our data centre after >15 years of service.
- Part One: Objectives and Deployed Solution.
- Part Two: Project Observations.

Part One:
Solution

Objectives

- Refurnish the data centre with the aim to
  - Support LHC+ computing through to >2035.
  - Increase capacity.
  - Improve efficiency.
  - Improve resilience.
  - Reduce environmental impact.

Final Design

- 39 racks in three rows, average of 10KW per rack. Hot aisle containment with five in row coolers (N+1) per row. Single phase power to rack. four 32 amp (2+2). Can have 20KW in a rack or use as redundant power supply.

- Hot aisle containment with in row coolers: cold aisle 26C, hot aisle 45C (optimal efficiency for coolers). I've been buying servers with front facing VGA+USB connections.

- Drop out tiles in case for fire suppression system gas

- No raised floor, Overhead power and cooling.

- One rack blocked by support column. One rack used for room infrastructure: room switches, MOD bus connection to Building management system (BMS) for alarms.

- Use APC kit throughout DC. APC Data centre expert (DCE) software used for centralised monitoring and management of DC (not plant room equipment).


Power distribution boards
In row coolers
Lights
Camras
Cooling water
9M
Cable mangment bridge
Room infrascture rack
12M
SERVER RM
Sliding Access Door
Cable Ladder
Structural Column
Sliding Door
WALL INSULATION
9300
1200
1327
1658
1279
300
600


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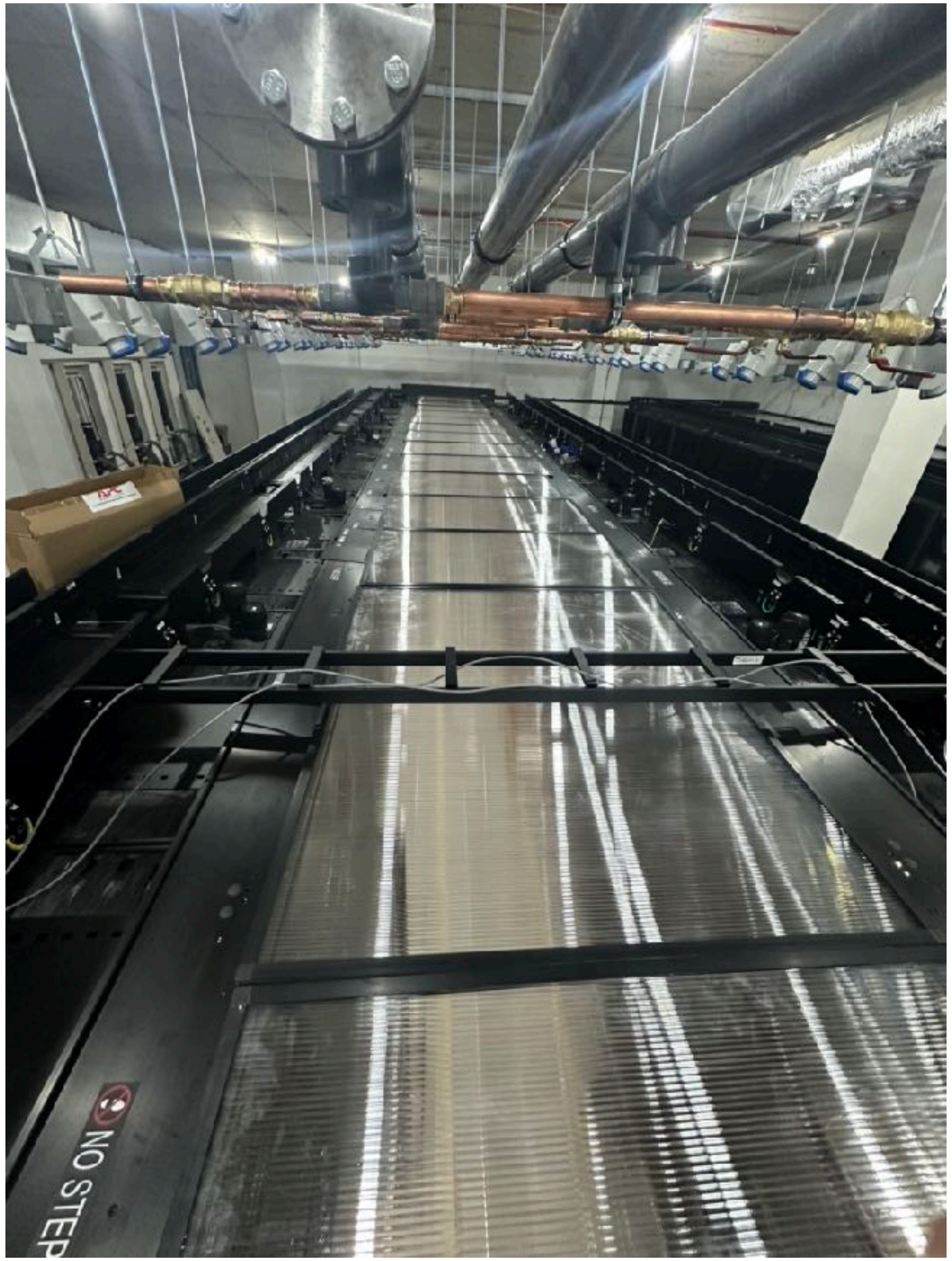


APC
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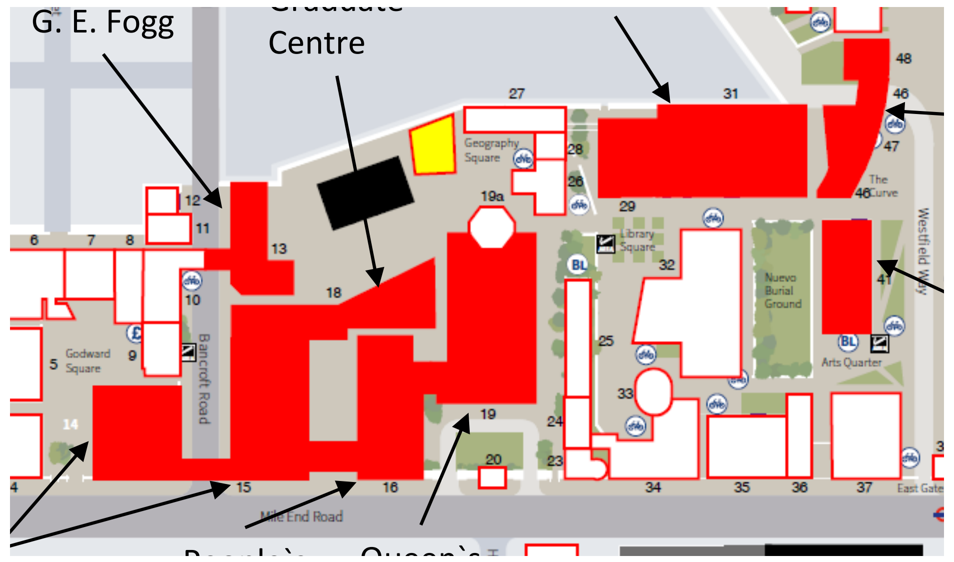
Final Design

Plant room

- Chilled water circuit to cool computing (17C in 23C out).

- Total cooling capacity 390KW provided by three 200KW water source heat pumps (N+1), take 23C water back to 17C. High quality hot water circuit operates at 65C in 75C out.

- Hot water (75C) circuit feeds into either the district heating system via a 500KW heat exchanger or two 300KW dry air coolers. Note dry air coolers operate at 75C! Can be used all year round (but less efficient).



Room capacity 390KW
GridPP will share with SPCS / Research IT

Day one GridPP demand 150KW. Agrement to expand

Basic Design

District heating — 75C — Hot water store

Hot water store — 75C → Heat exchanger

Dry air cooler

Cluster — 26C → Heat pump

Heat pump — 75C — Hot water store

Heat exchanger / Dry air cooler — 65C → Heat pump

Heat pump — Cold water store

Cold water store — 17C → Cluster

Heat pumps
3 x 200 KW, PUE 0.3*

Heat exchanger
500KW

Dry air cooler
2 x 300 KW, PUE 1.3*

***Heat pumps consume apx 30KW for every 100KW transferred**

Increase Capacity

- ☑ Increase number of usable racks from 15 to 38.
- ☑ Increase power supply to DC 150KW to 390KW.
- ☑ Bonus - flexible rack power up to 20KW.
- ☑ Bonus - Use deep racks (1200mm vs 1070) flexible equipment limits.

Improve Efficiency

- Not aiming for specific PUE! Implement best practice within the available budget.
- ☑ Move from air conditioning (CRAC-refrigerant) to air handler units (CRAH-water).
- ☑ Use hot aisle containment (expected to be more efficient than no containment / cold aisle containment).
- ☑ Temperature deltas chosen to me most energy efficient: cold aisle 26C, Hot aisle 45C*; In water 17C, out water 23C.
- ☑ Not using UPSs. LED lighting. New equipment.
- ☑ Consolidate from other campus server rooms.

***wet-bulb globe temperature" (WBGT) 47°C -> WBGT of 32.2°C -> 25% work / 75% rest**

Improve Resilience

- ☑ Install A/B power supplies on each rack.
- ☑ 5+1 in row coolers per row, 2+1 heat pumps,
- ☑ Alternative heat exhaust options (dry air coolers or heat exchangers for district heating system).
- ☐ For reasons of space, cost and need.
  - ☐ No backup power generator.
  - ☐ No UPS for room.

Reduce Environmental Impact

- ☑ See efficiency section.
- ☑ Heat recovery: Reuse heat from DC and push into the District heating system. Don’t wast power in cooling to atmosphere.
- ☑ Heat recovery: Move from gas heating to electric heating. Lower carbon cost due to increasing renewable contribution.
- ☑ Use water instead of refrigerant gas.

Part Two: Observations

Project Observations

- Objectives: Having a clear achievable objectives agreed by users of the facility for the project and used as a reference to make sure what actually happens is aligned with the objectives.

- Project management: Vital to getting the project into shape was an experienced project manager, estates not IT. Who is familiar with building infrastructure (cooling, electrical, civil).

- Financial case: to build the project we had to make the case, both financial and impact, for providing the extra costs associated with expanding the capacity and installing the heat recovery. The project was also independently and accurately priced using a quantitative surveyor.

DC Build Observations

- APC chosen as there was already a large amount of APC kit which could be reused. APC is a recognised brand, easier to get though procurement.
- Total cooling capacity of 390KW limited by space. limits DC design.
- There is no raised floor. no floor loading issues no ramps but power, cooling and network, have to come from above the racks.
- A large number of lower power density racks provide for flexibility. Lower power density means single phase PDUs can be used.
- For reasons of space, cost and need there is no backup power generator and no room UPS. There are two separate power feeds to each rack but only one to the In row coolers which limits the usefulness of the resilience.
- Originally there was no area assigned for storage space in the DC. A Non ideal solution was to share space next to the electrical distribution panels.

Monitoring and Management

- Original cooling of the data centre had no remote monitoring or management. Lost of manual interventions required.

- The new cooling system is integrated into the BMS and this provides monitoring of the state of the system, ability to raise alarms that are seen by the estates management, and also the system performance (energy use and reuse).

- Dedicated monitoring and management service. Using the APCs Data Centre Expert we are able to integrate the management and monitoring of the PDUs, in row coolers, temperature and humidity sensors and video surveillance into one application.

- MODBUS interface between the BMS and DCE allowing selected alarms and metrics to be exchanged between the two systems.

Future Concerns

- There has been history in the DC of a make do and mend. There is a need to up our game here and develop a long term care plan.
- A major concern is the possibility of leaks from pipes above the racks. It does not take too much water to cause problems in a DC. A large number of leak detectors have been installed and included in the monitoring system with alarms.
- Modern computing is moving towards high density, high power requirements and liquid cooling. This DC is not designed to handle this type of equipment. This may limit the type of equipment that we can install for GridPP.

Summary

- Final tests of DC carried out on last Tuesday, used 200KW of heat load units to test automatic running, failover, power failure etc…
- Waiting for paper work to be completed for official handover. Doing commissioning work on the cluster until official then.
- I did't appreciate just how complex a infrastructure project is.
- Lots of small thing to do at the end e.g. risk assessment. Alarm thresholds, cable management,

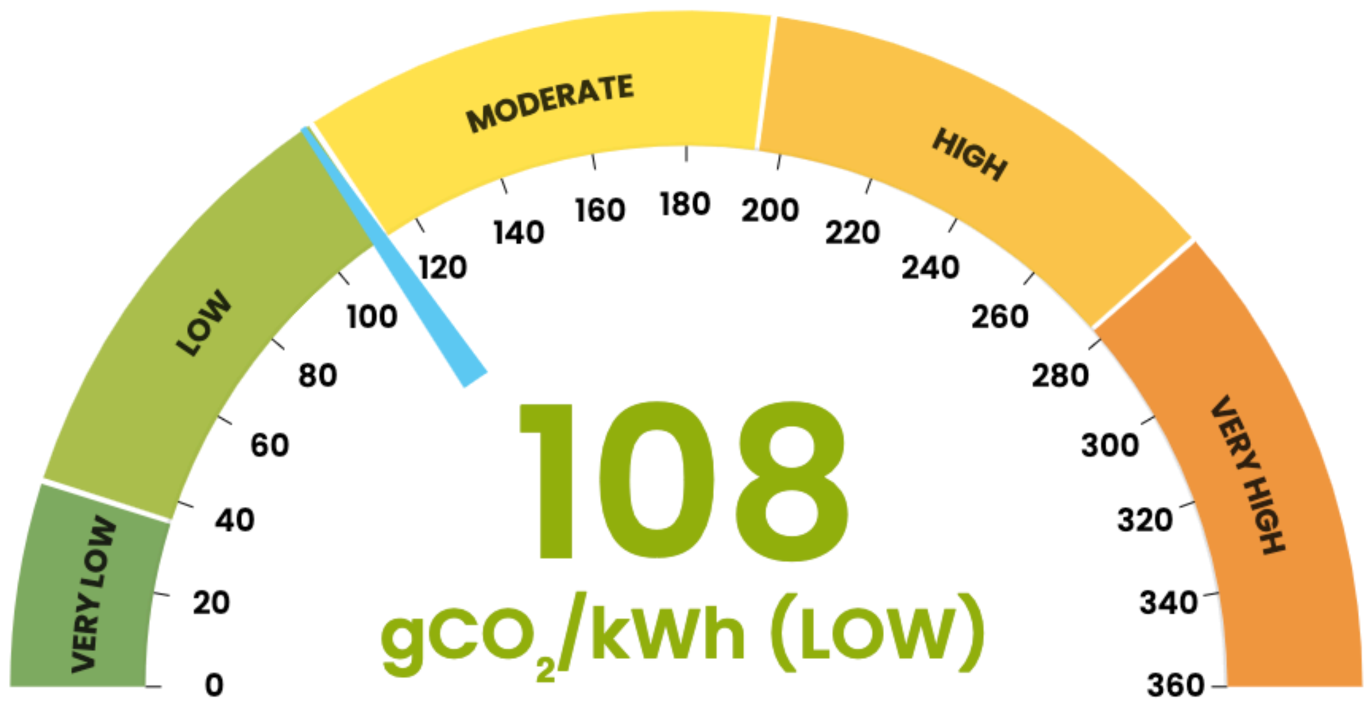
Backup

Exit full screen

NESO Carbon Intensity Dashboard

Share

Current Carbon Intensity



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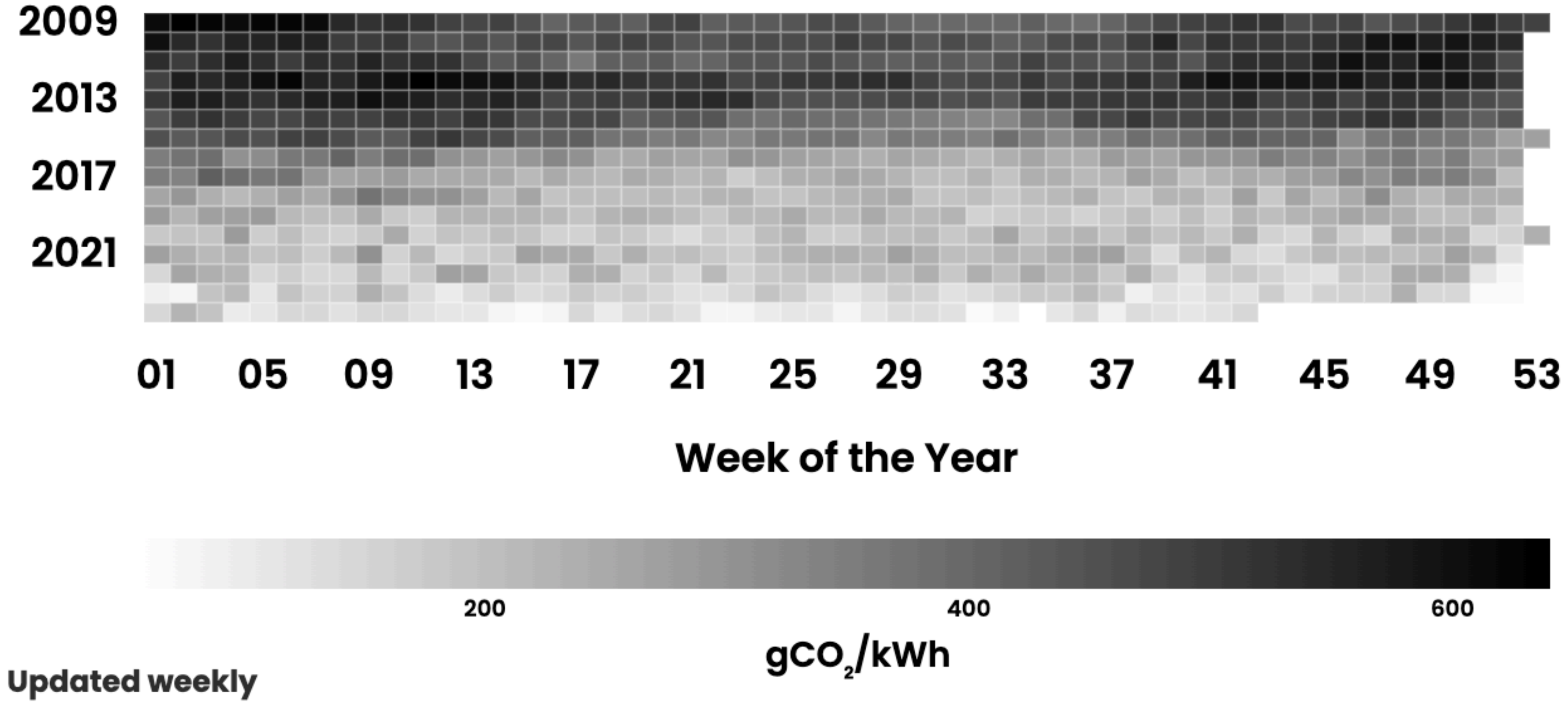
History of Carbon Intensity of Generation



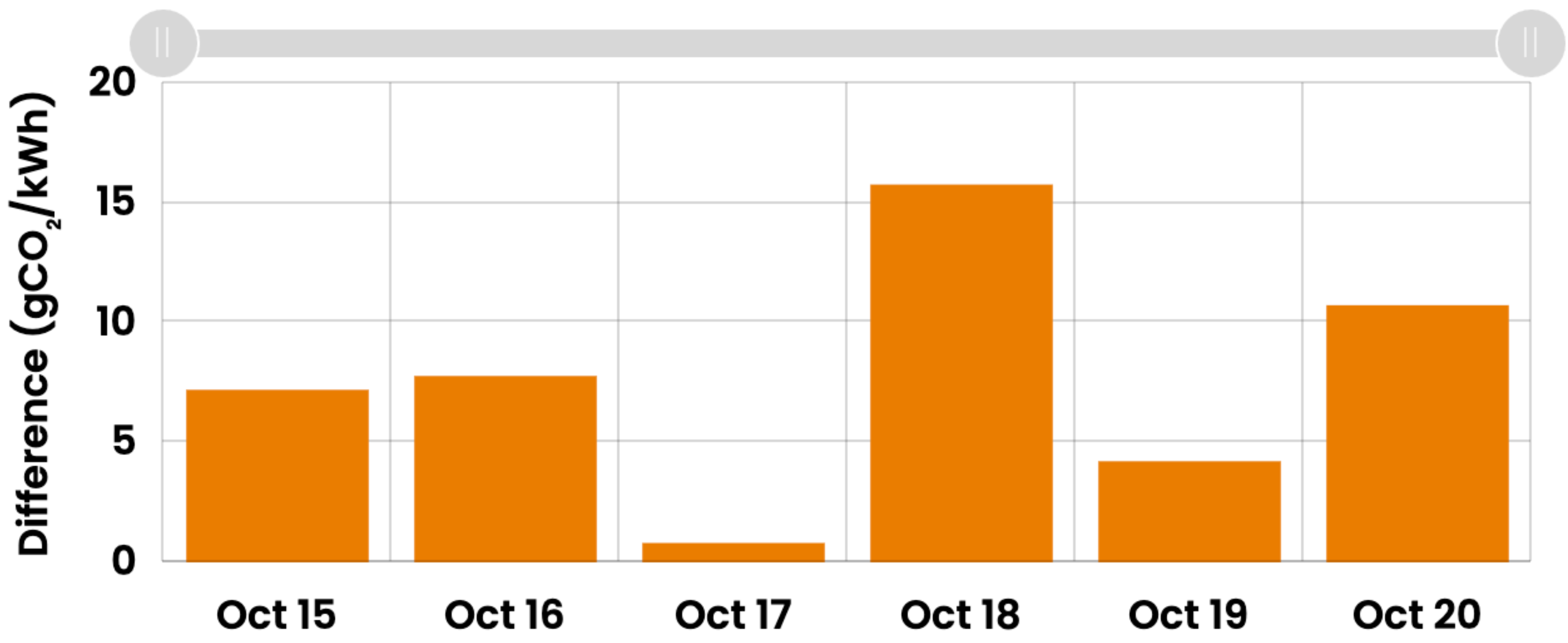
Updated weekly

Current Generation Mix and Carbon Emissions

Biomass | Coal | Gas | Hydro | Imports | Nuclear | Solar | Wind | Other

Updated every 30 minutes

Carbon Intensity of Balancing Actions



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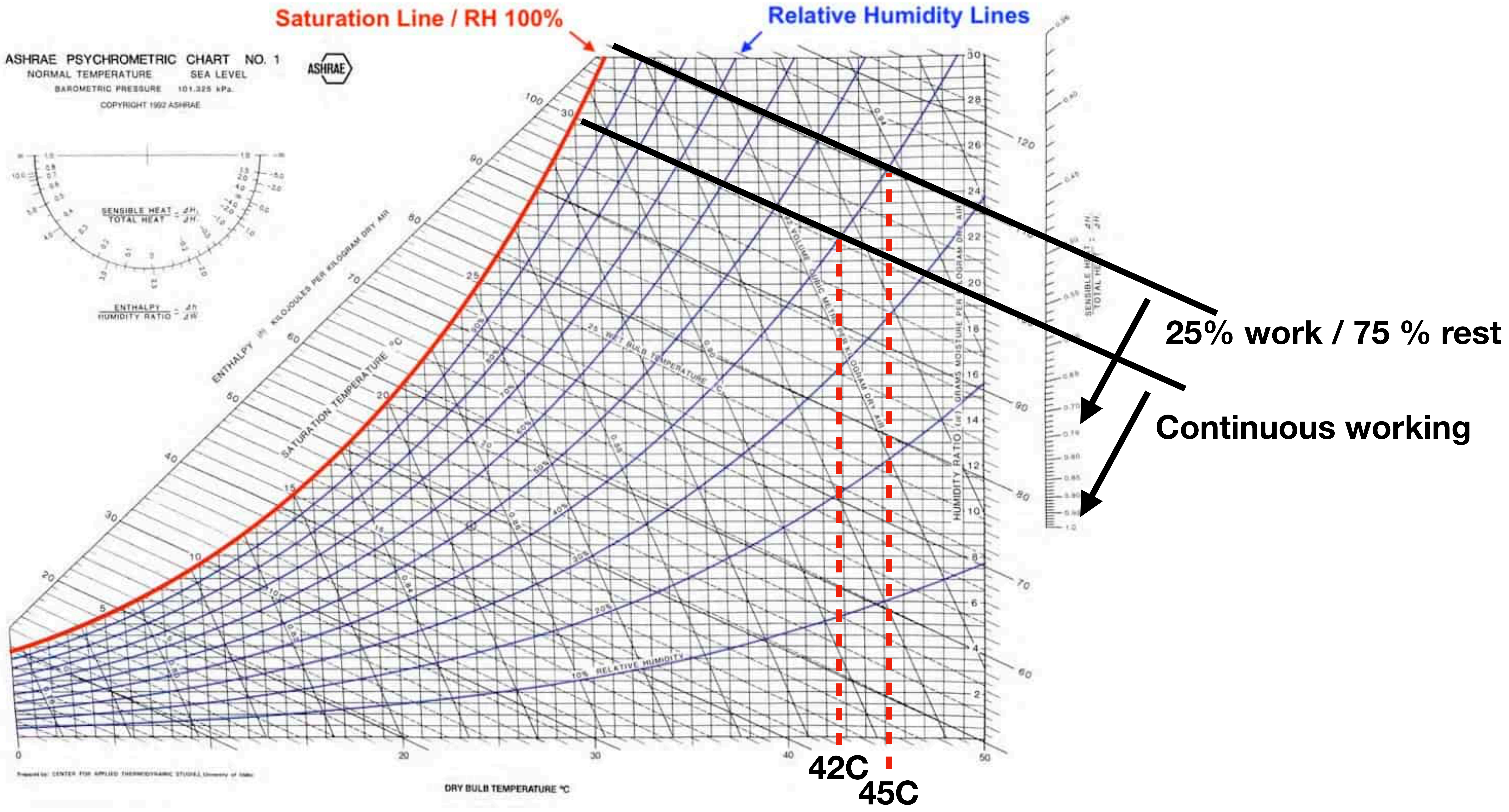
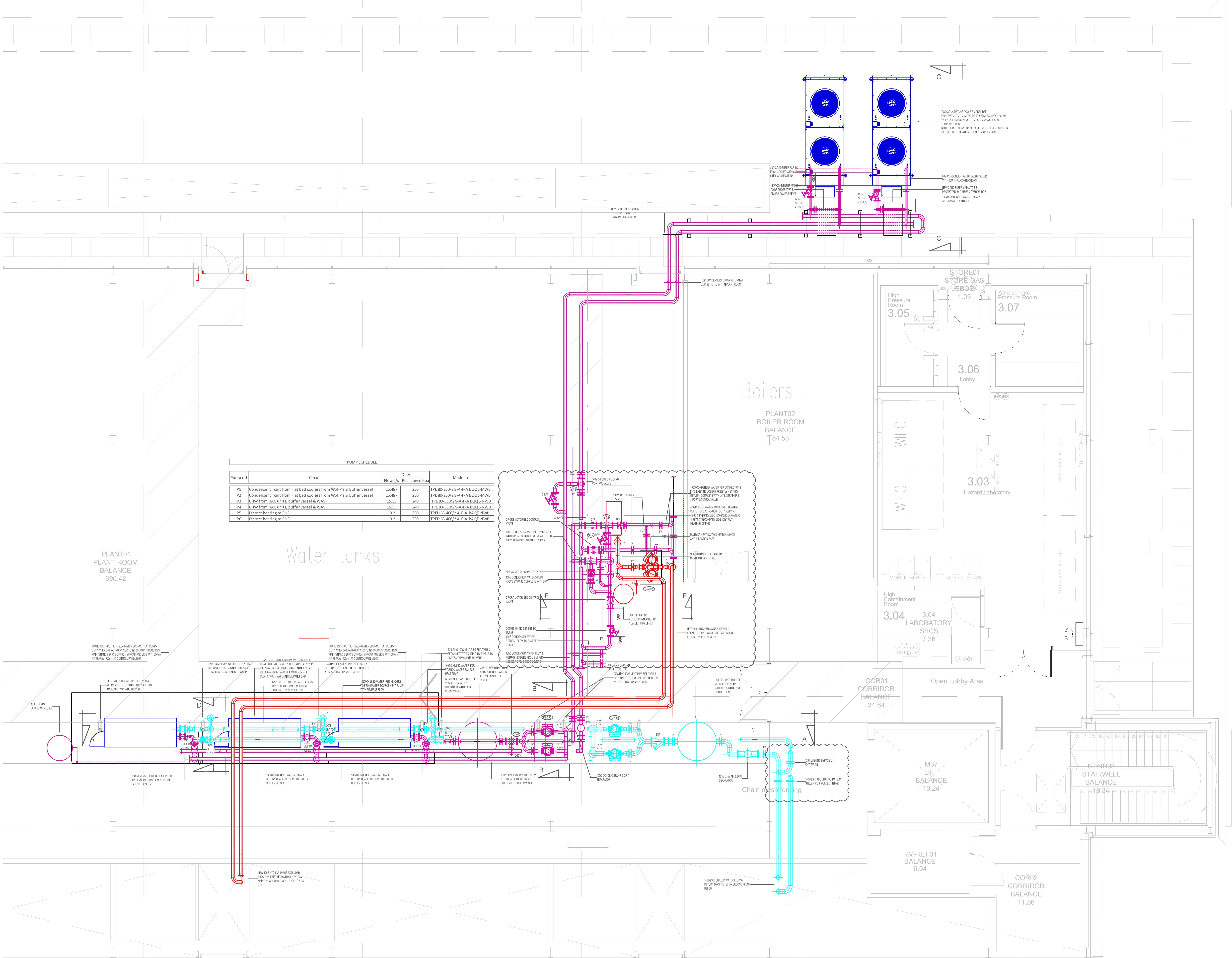
Working conditions





PUMP SCHEDULE

Pump ref	Circuit	Duty: Flow L/s	Duty: Resistance Kpa	Model ref
P1	Condenser circuit from Flat bed coolers from WSHP's & Buffer vessel	15.487	250	TPE 80-250/2 S-A-F-A BQQE-MWB
P2	Condenser circuit from Flat bed coolers from WSHP's & Buffer vessel	15.487	250	TPE 80-250/2 S-A-F-A BQQE-MWB
P3	CHW from HAC units, buffer vessel & WASP	15.53	240	TPE 80-330/2 S-A-F-A BQQE-NWB
P4	CHW from HAC units, buffer vessel & WASP	15.53	240	TPE 80-330/2 S-A-F-A BQQE-NWB
P5	District heating to PHE	13.2	350	TPED 65-460/2 A-F-A-BAQE-NWB
P6	District heating to PHE	13.2	350	TPED 65-460/2 A-F-A-BAQE-NWB