


HVAC Systems in Achieving Energy Efficiency and Net Zero

July 24

**Twenty  ne
Engineering**

► Who Are Twenty One Engineering

Founded in 2017 by Phil Draper FCIBSE CEng

Proven record around energy and operational improvement for past 20 years

Involved in icons designed buildings such as 22 Bishopsgate and The Leadenhall Building

Supporting World renown clients such as UK's largest Stadium and worlds largest Social medial

'Hands on' approach to supporting building

► Overview of Topics

1. Metering design / operation and best use of
2. Retrofit of large scale heat pump to commercial applications
3. Operation of a building around M&E

► Metering

► Main tool for decarbonising

- Eyes into the building operation
 - Can only see true issues if accurate
 - Can only see actual issues if designed and verified correctly
 - Can only be used if easy to integrate
- If you don't trust it, you don't use it**



► Metering

Commercial Offices Energy Metering and Energy Management System Guide to Implementation

2.2 Deliverables of each Stage

The below points cover the general requirements to be completed at each stage.

2.2.1 Stage 2 Design

- Basic Metering layout – covering all intended meter position

3.2 Metering Design Approval Process

The Responsibility and approval to proceed of each stage; as detail

Version

3.3 Metering Location Check List

The following shall be used as a check list for development by the MEP Design Consultant. This is a generic consumption meter list and shall be used to identify the proposed meter fit-out

5.0 Utilities Charge Strategy

The text below details the recharge strategy for direct and shared services (heating, cooling and AHU's) and how the energy usage for each will be calculated.

7.0 Commissioning

7.1 General

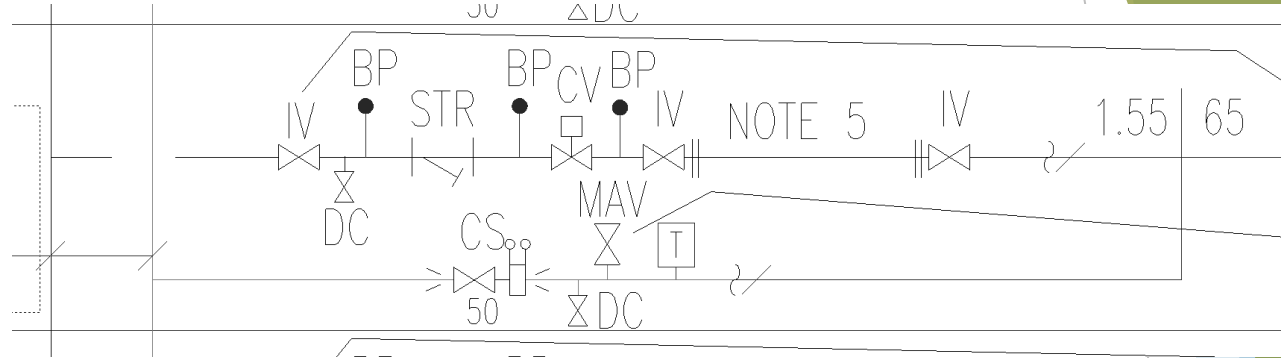
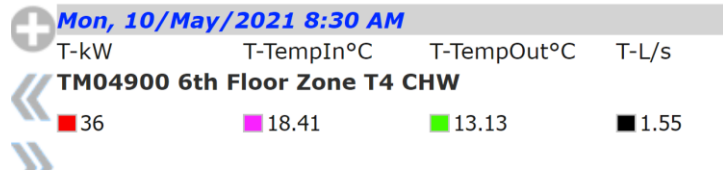
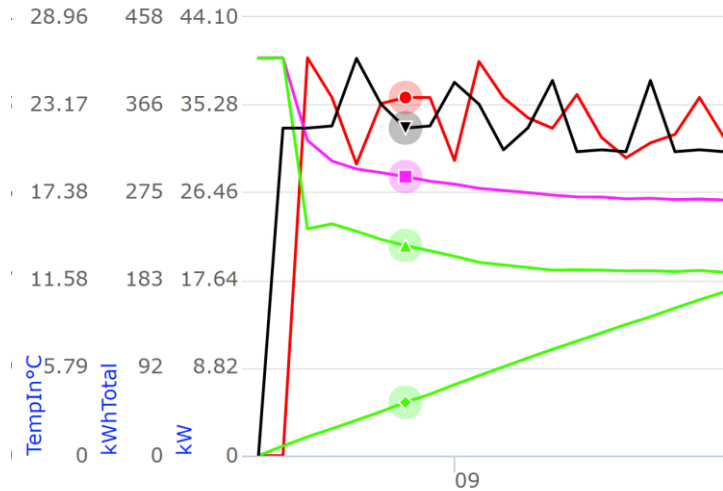
The commissioning and setting to work of the Energy Metering and Energy Management System is an immensely important stage of the installation and the most common causes of failure of a system are incomplete commissioning, including failure to calibrate each meter using portable meters to

6.0 Software Requirements

The EMS system should also be able to undertake the following

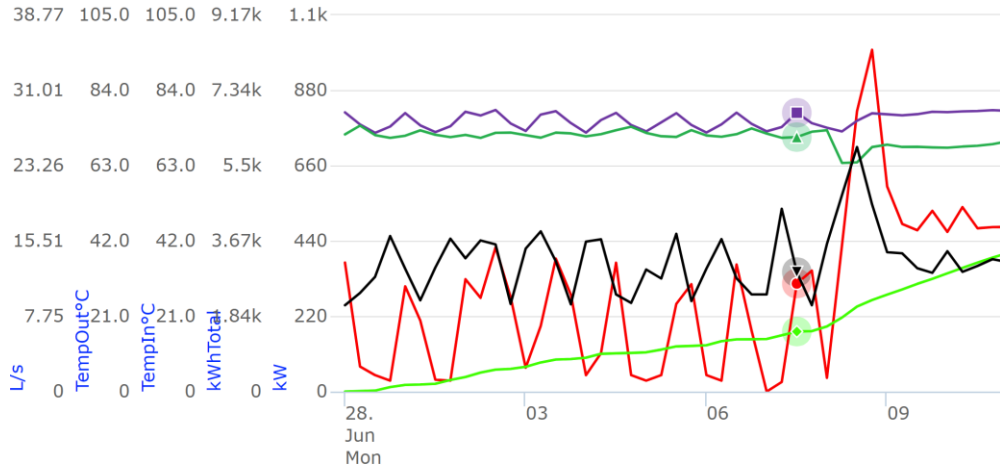
- Manual data inputs where BMS data is not available or incorrect
- Manual data input where utilities consumption is not available or incorrect

► Metering



If set up correct the EMS is able
 to be used for on going
 commissioning

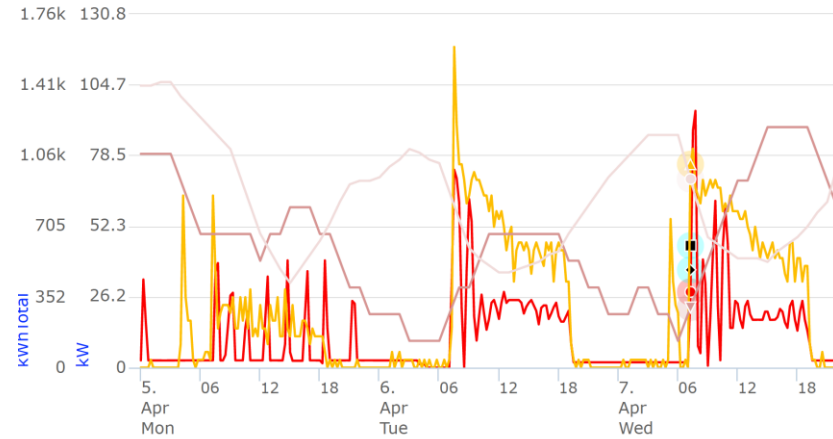
► Metering



Mon, 28/Jun/2021 7:30 AM

T-kW	T-TempIn°C	T-TempOut°C	T-L/s	T-kWhTotal
315.48	77.72	70.94	12.29	1,461.9

TM00600 LTHW Primary Level 15



PV00000 Chillers Total

- 28
- 487

GS00107 Main Gas Meter

- 104
- 1,332

B-degC

- 888002 London
- 2.25
- 53.50

Able to detect and help size

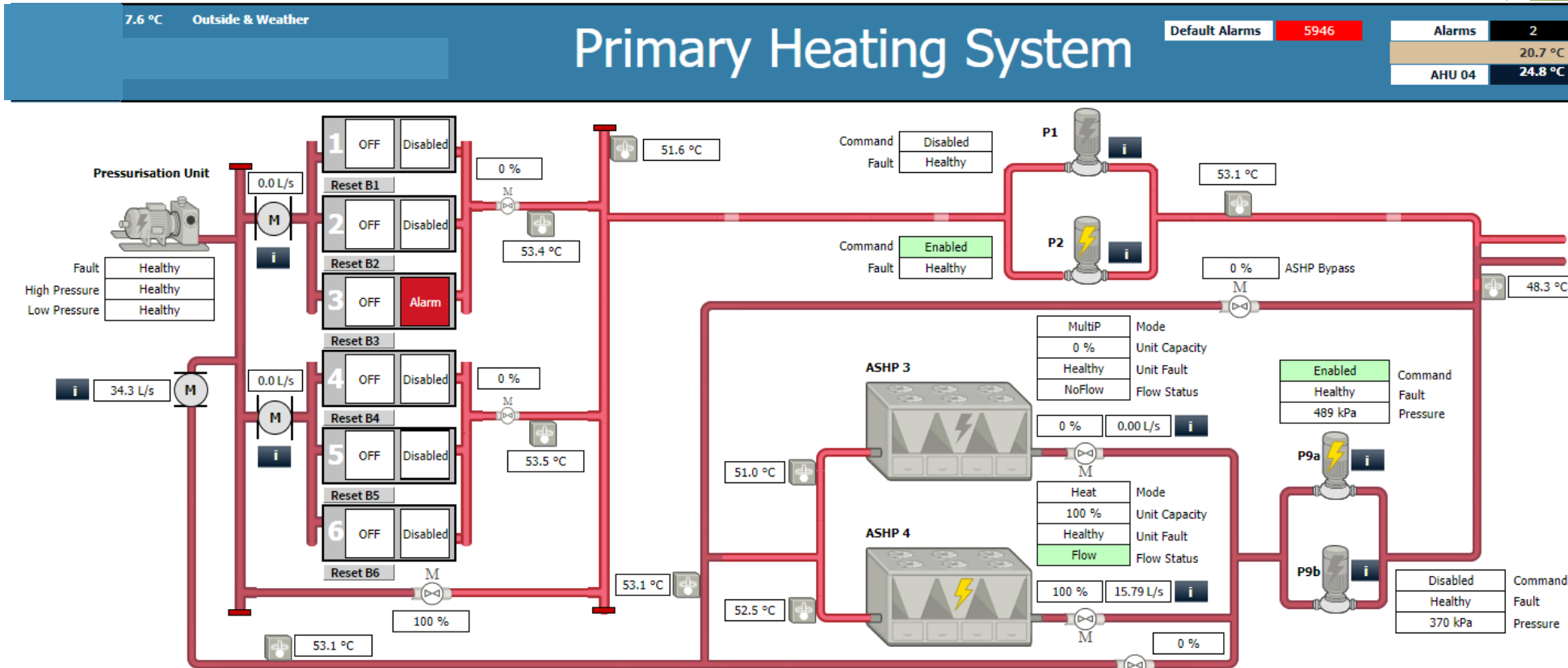
► Zero Carbon

- Method to identify opportunities and method for introduction
 - Efficient systems are more cost effective to convert
 - Plan around Heating / Cooling replacements – Asset Replacement Plans
 - Route plan per system to incorporate small wins to achieve the optimal performance – Including SMART
 - Controls are key to avoid additional costs for larger equipment for systems actual requirements

► Zero Carbon

- Consideration around the system demands and reducing peaks
 - Consideration to separating DHW from Primary Heating
 - Review periods of simulations heating and cooling needs
 - Review means of reducing Peak Fresh air with heat recovery / pre conditioning
 - Implementation of CO2 control to reduce early morning Fresh air loads
 - Consider hydraulic changes to improve System deltas through out the seasons

Hybrid system



- Daikin 4 pipe Heat pumps
- Boilers able to operate with Heat pumps
- FCU / VAV system
- Completed Summer 2021

Hybrid Savings



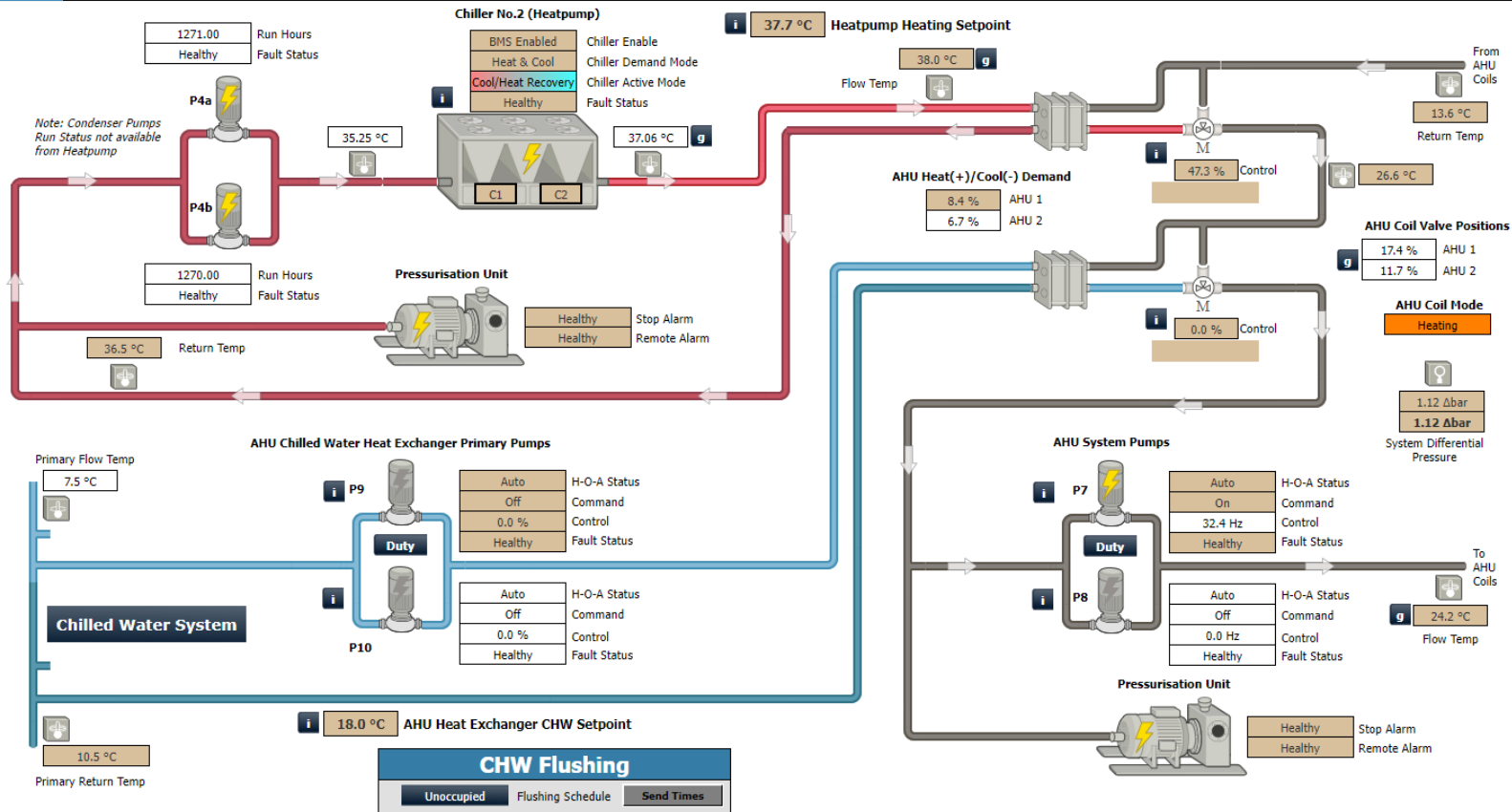
Final gas reductions hoping to be in excess of 95%
 Additional Controls and building monitoring key to final reduction possibilities

Variable temperature system

8.6 °C Outside

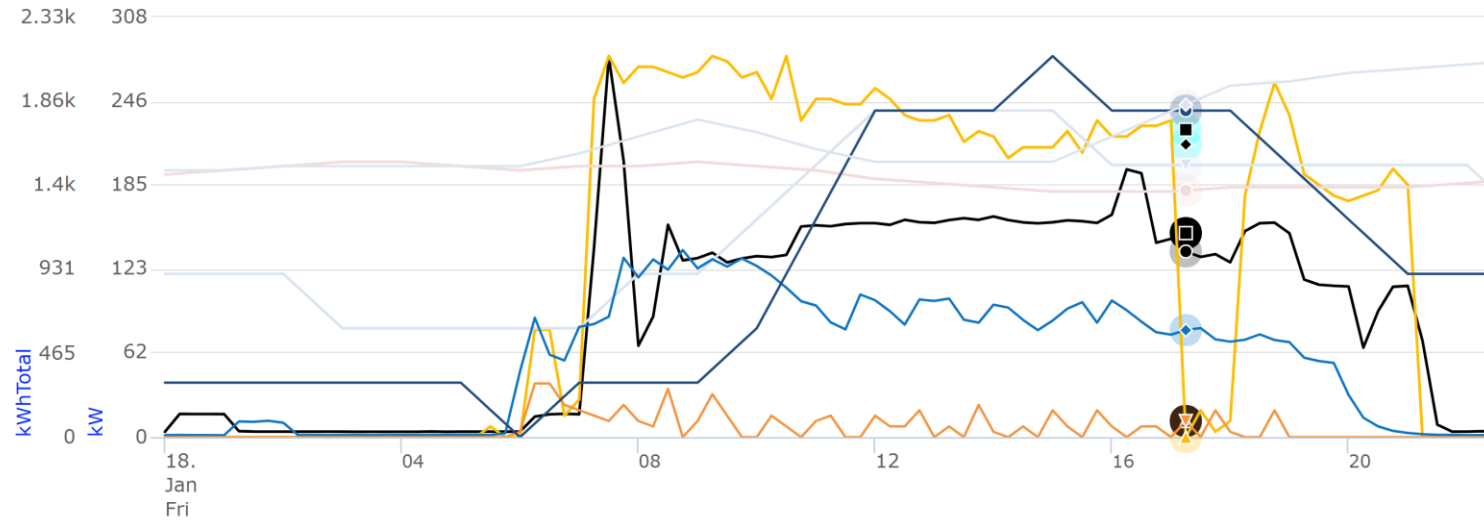
AHU Heat Exchangers

Total Alarms	30	AHU 01	17.1 °C
Critical Alarms	21	AHU 02	16.8 °C
Network Alarms	0	AHU 03	18.9 °C



- Daikin 4 pipe Heat pumps
- Gas Boilers able to operate with Heat pumps
- FCU system
- Completed Summer 2021

Variable Temperature Savings

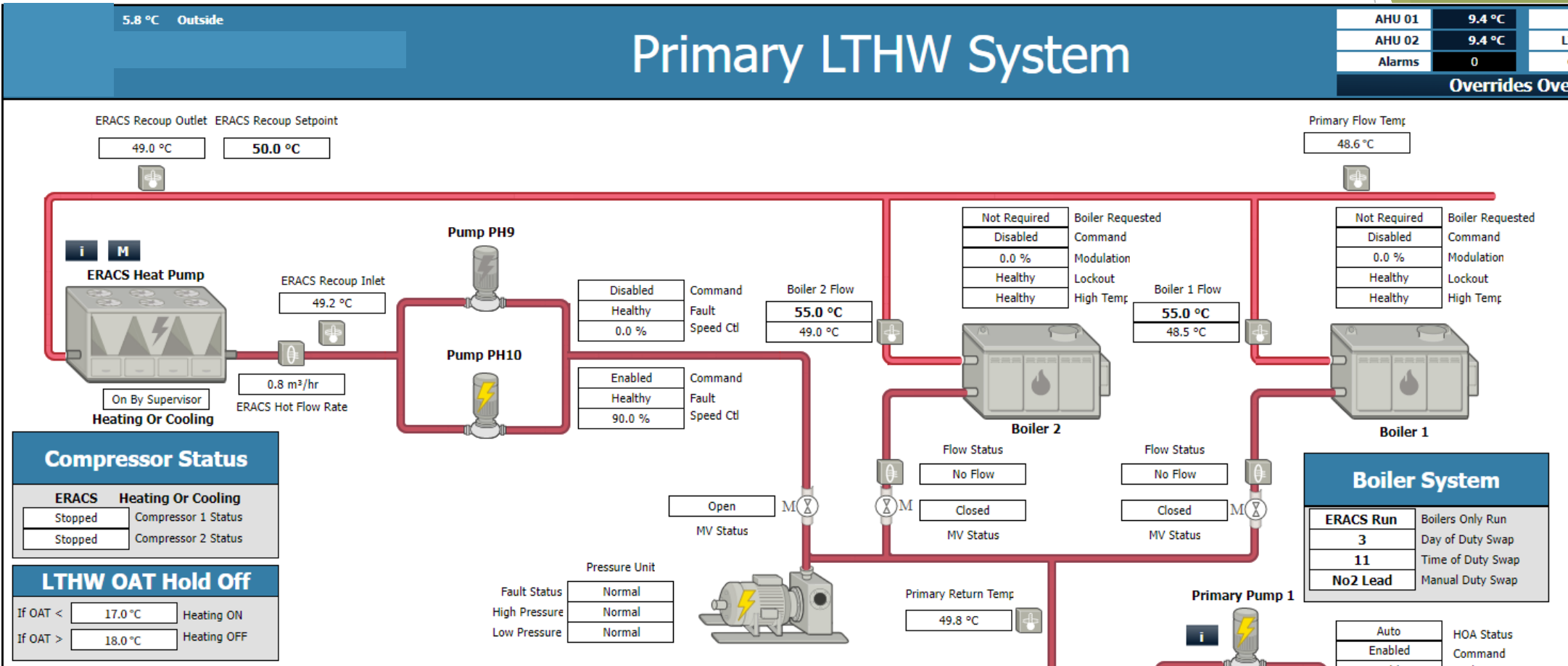


PV00061 VM Elec Shared Services - Chillers [12729]	PV00061 VM Elec Shared Services - Chillers [12
136.05	1,620.9
78.43	1,129.9
0	251.70
1.20	13.20
5	58.25
6	78.50

Final gas reductions (less DHW usage) hoping to be in excess of 98%

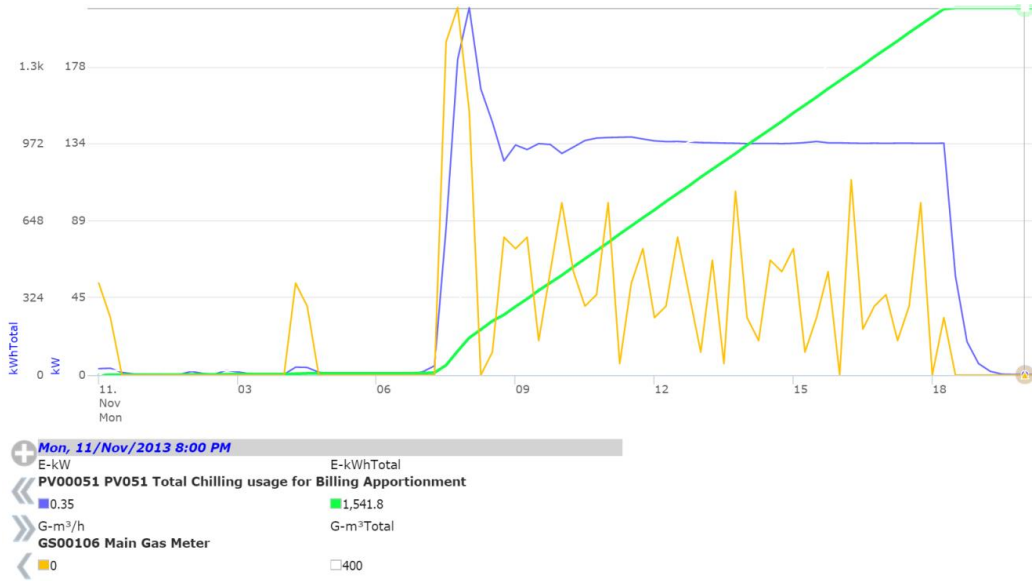
Either system

Primary LTHW System

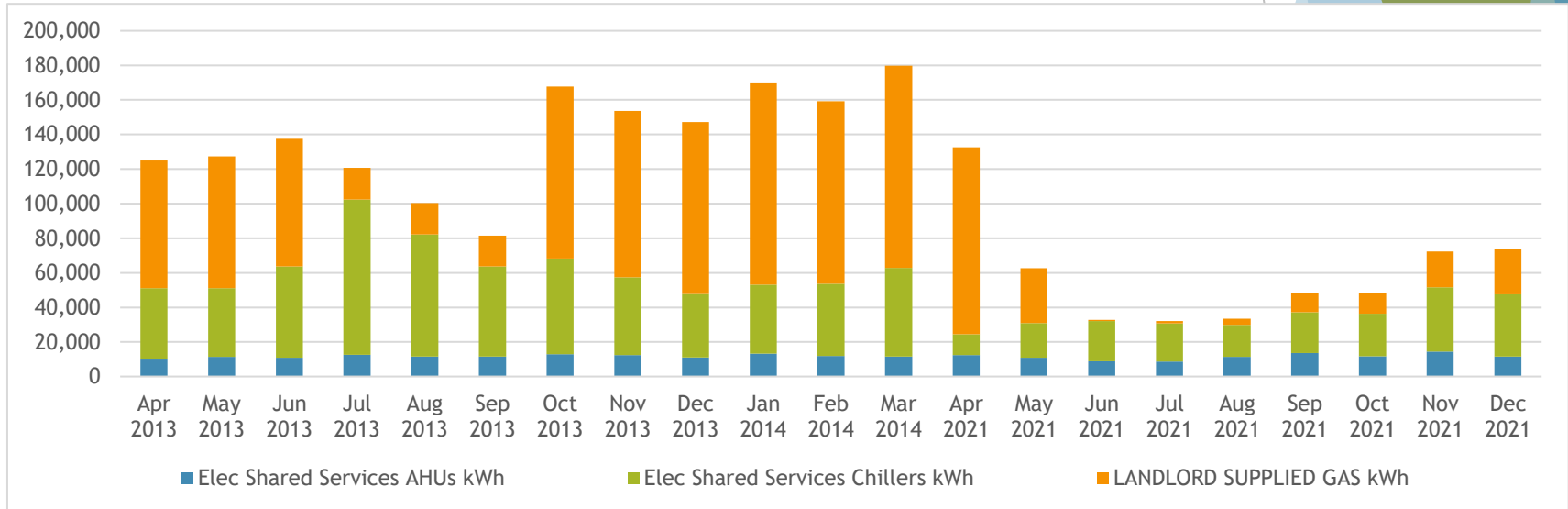


- Climaveneta 4 pipe Heat pumps
- Boilers operate when <5C OAT due to boiler types
- FCU system
- Completed Oct 2014

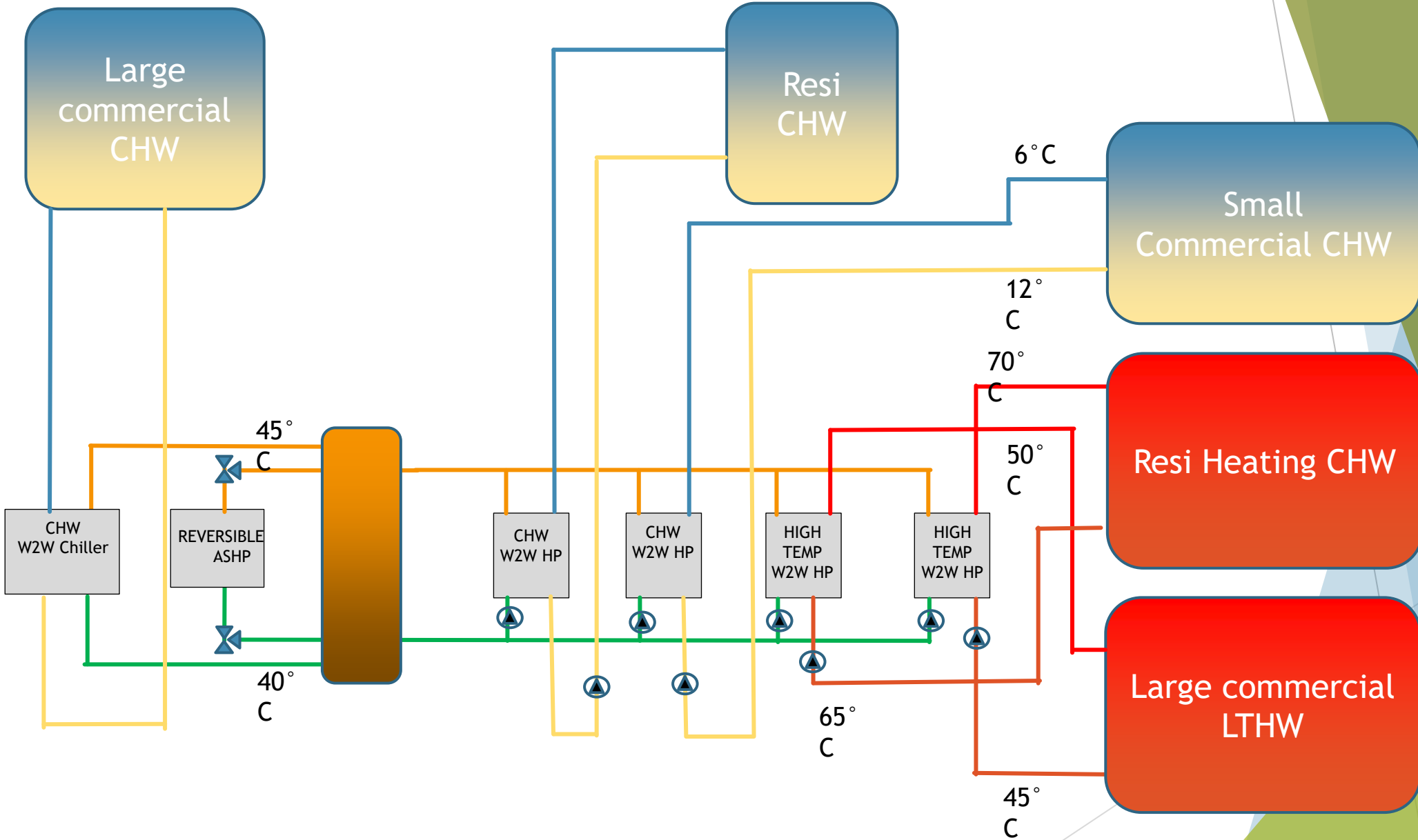
Either System Savings



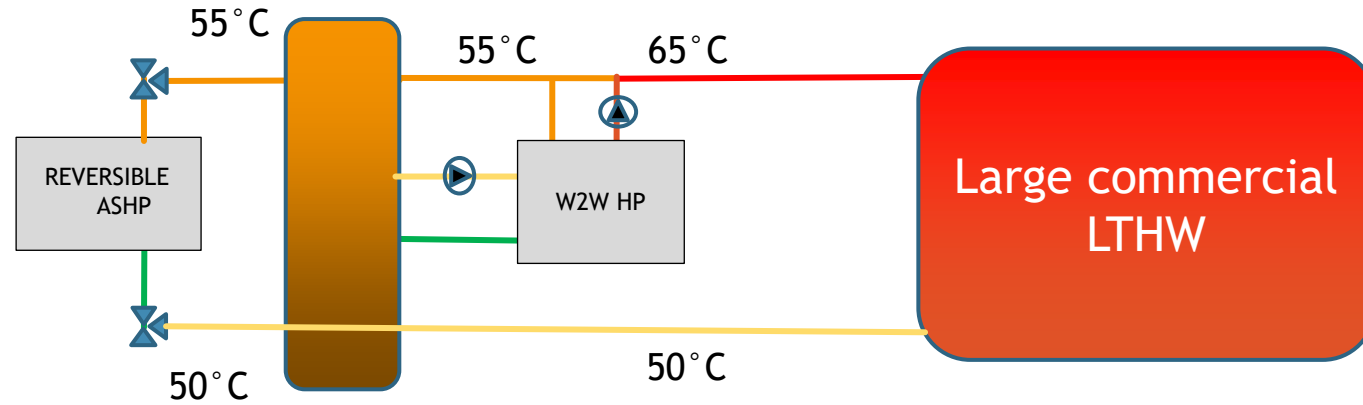
Expected kWh figures (2013 numbers used)	7,301,879	4,922,607
Actual kWh	1,931,177	2,540,700
Saving kWh	5,370,702	2,381,907
Unit Rate	£0.06	£0.20
£	836,064.92	£ 476,381.36



Ambient loop options



Cascade System



- Use of 4 pipe Heat pump to provide $>55^{\circ}\text{C}$ at $<0^{\circ}\text{C}$
- Use of Water to Water Heat pump to elevate LTHW to building loads
- Use of a number of Water to Water Heat pumps could get $>75^{\circ}\text{C}$
- Avoids needs to replace FCU / AHU Coils
- Still recommend controlling Supply temperature based on building loads

Heat Pump Project considerations

- Refrigeration choices
 - Different refrigeration have different properties
- Heat Pumps physical sizes
 - Footprints of heat pumps are larger than Chillers
 - The weight of them is also more than chillers
- Selection considerations
 - Turn down function
 - Temperature range
 - BMS interface
 - Defrost time periods / controls
 - End use supply temperatures variations

► Energy and Reduction

- **Key requirement for decarbonising is minimal kWh usage**
- For operational buildings, there are multiple methods to identify suitable targets and tracking progress
 - General Benchmarking vs Specific building / System targeting
 - NABER UK Star Ratings
 - Routine BMS and physical reviews for progress and accountability
 - Regular energy reviews/ Audits
 - Full building AMR data via suitable EMS
 - Use of AMR data for occupier recharging / Recharging for shared services

► Energy Reduction

- Process around identifying short / medium and long term opportunities
 - Creation of process for energy reviews, frequency and expected outcomes (BMS reviews/ Hydraulic System reviews)
 - Compulsory inspections such as TM44's should be linked more for effective outcomes rather than just compliance
 - Link opportunities to equipment replacement – LTAR
 - Approval process for equipment replacement to be based on a scoring system based on savings over time

▶ HVAC Maintenance

- Consideration to how a change in use with revised techniques can reduce time and improve identification of issues
- Identification of bad is knowing what is good, so suitable records
- Any asset replacement should result in a reduced labour required to 'maintain'
- FCU maintenance a big reason why building perform badly and don't feel comfortable
- Review of skills to apply per task

▶ Thank You

▶ Any Questions

Twenty  ne Engineering