Gwasanaeth Ynni
Energy Service

Public Sector Low Carbon Heat – Technology Introduction & Project Learnings

November 2023

Gwasanaeth Ynni
Energy Service

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1. Heat in the Welsh Public Sector

Introduction

The transition to low carbon heat is one of the most significant challenges the public sector faces on the journey to net zero.

This Learnings Report for the public sector provides an introduction of the implementation learnings from previous Energy Service support:

- Low Carbon Heat Pilot – Desktop Advice and Evidence (March 2021) *(for Welsh Government)*
- Public Sector Low Carbon Heat Grant 2021/22 *(pilot grant scheme for the public sector)*

The Desktop Advice and Evidence report provided Welsh Government with a summary of low carbon heat technology, an analysis of the scale of transition needed, case studies, and evidence to influence future funding.

Following on from the Advice and Evidence report, in September 2021 capital grant funding was made available for public bodies who could deliver exemplar projects by March 2022. This initial capital grant was developed by the Energy Service and administered by Salix Finance. A total of £3.2m was invested into 11 schemes across 5 public bodies. Case studies from some of these projects have been provided within the report.

In 2022, a Low Carbon Heat Development Grant was made available to develop investment ready projects. Learnings from this development grant are not included within this report.

Policy Context – Legislation, Strategies, & Ambitions

The Welsh Government has ambitious targets for reducing carbon emissions and for generating locally owned renewable energy.

It is committed to maximising the wider benefits for Wales from the transition to a zero carbon economy, ensuring a fairer and healthier society for all.

Key Commitments

- Net Zero Public Sector by 2030
- 1GW of electricity generated in Wales locally owned by 2030
- 100MW additional public sector & community group renewable energy 2021-26
- Welsh Government and Senedd Climate Emergency declarations 2019

Decarbonisation Plans & Guidance

- Net Zero Wales Carbon Budget 2 (2021-25)
- Net Zero 2030: Public Sector Route Map (2021)
- Welsh Public Sector Net Zero Reporting Guide
- Local and Shared Ownership of Energy Projects in Wales (2022)

Wider Interacting Policy, Plans & Drivers

- Programme for Government 2021–2026
- Prosperity for All - A Climate Conscious Wales (2020)
- Prosperity for All - Economic Action Plan (2017)
- Well-being of Future Generations (Wales) Act 2015
- Future Wales: The National Plan 2040 (2021)
- Towards a Just Transition in Wales (2021)
- Beyond recycling: making the circular economy a reality (2021)
- Cymraeg 2050 & Welsh Language standards

Policy Context – Public Sector Net Zero Routemap

The Welsh Government has also set a target for the public sector within Wales. The Net Zero Carbon Status by 2030 routemap for decarbonisation across the Welsh public sector provides a strategic overview of the priority areas for action and milestones needed for the Welsh public sector to collectively reach net zero by 2030.

The framework is intended to support public sector organisations in the development of their own strategic plans setting out a three-staged journey towards net zero:

Moving up a gear 2021–2022

Where understanding the context and what needs to be done is vital, and where action needs to accelerate.

Well on our way 2022–2026

Where there is an expectation that low carbon is becoming the norm and we are definitely on the way to a net zero Welsh public sector.

Achieving our goal 2026–2030

Where choosing zero carbon has become routine, culturally embedded, and self regulating.

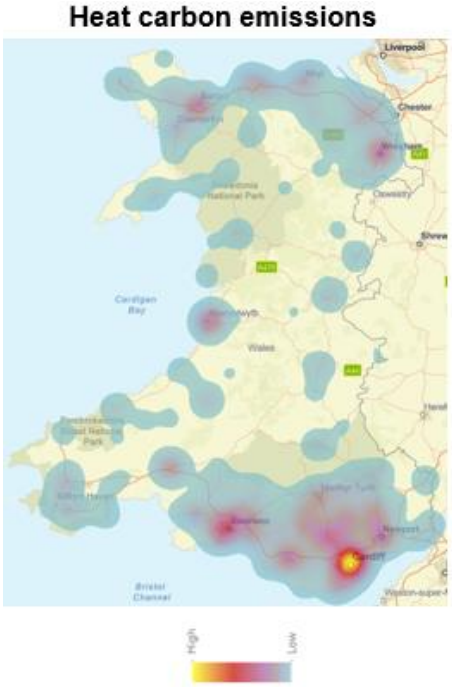
Desktop Assessment

A desktop assessment of the heat usage within the Welsh public sector has been carried out using the DEC database (2021 data).

4,610 buildings
in DEC database

382,786 tCO_2e
emissions from heat in public sector sites. Equivalent to Torfaen CBC

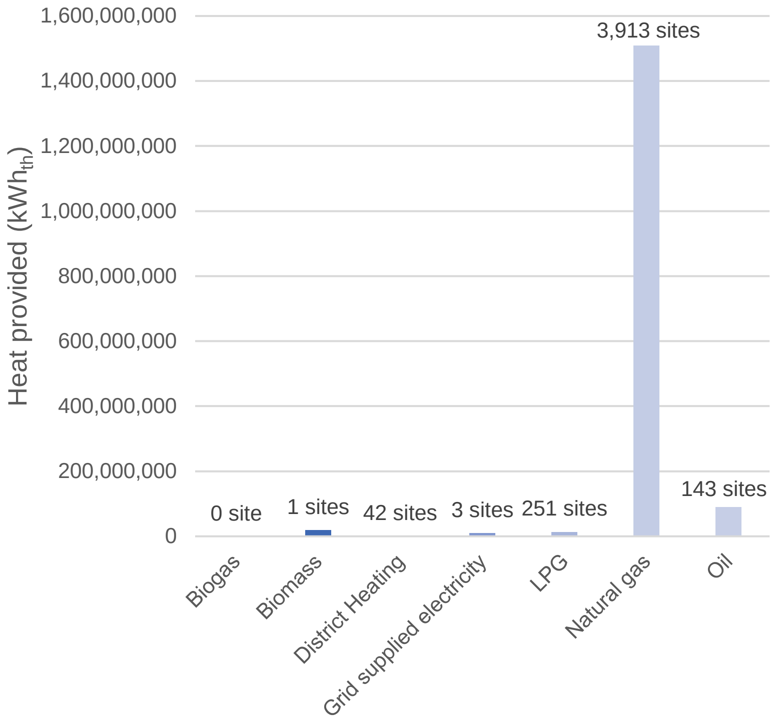
£79.2m
estimated cost of heat in 2021



Scale and Distribution of Existing Heat Sources

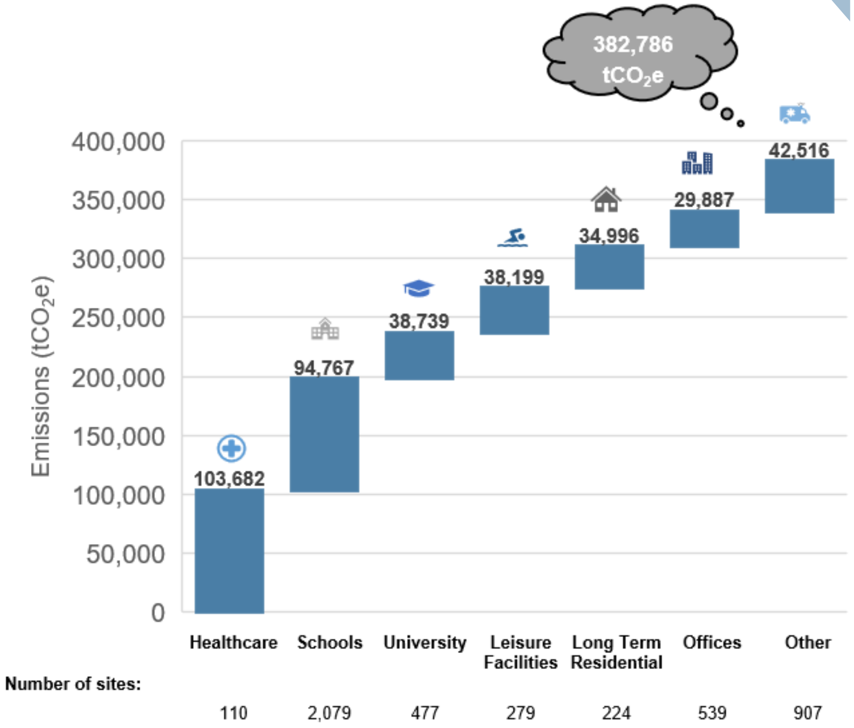
The amount of carbon associated with heat within the public sector has been broken down further, by building use and by fuel type.

The majority of the heat is generated by burning natural gas, with around 15% of 4,610 sites not having access to a gas supply, and therefore using other fuels such as electricity, oil or LPG.



Estimated Emissions by Sector

When assessing the distribution of heat emissions across the different sectors in Wales, the Healthcare and Education sectors (including universities) account for over 60% of the total emissions.



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2. Technology Introduction

Technology Introduction

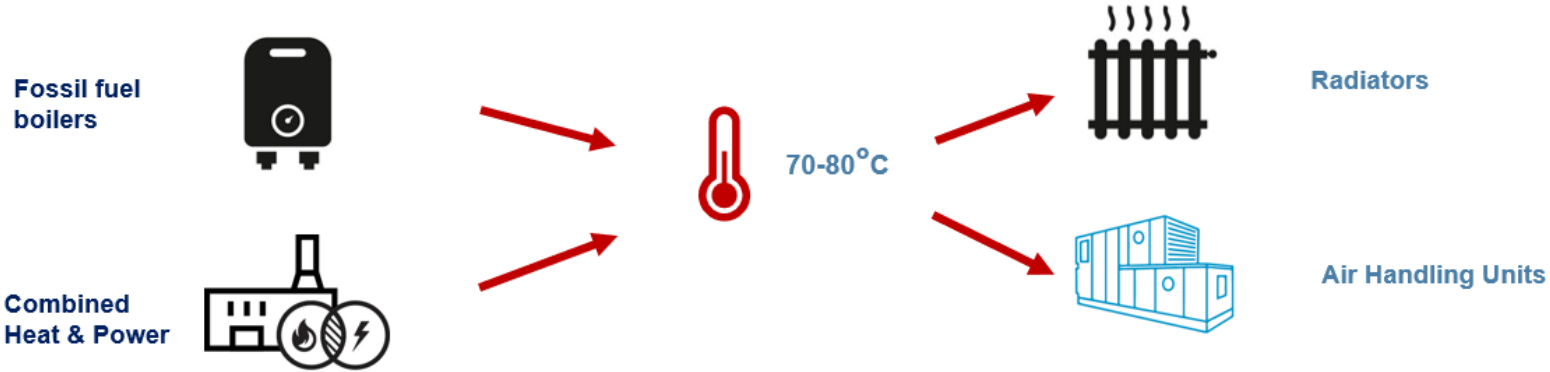
Not all non-domestic buildings are the same, and their heating systems can vary widely based on the building operation, building age, and even contractor technology preference.

The following sections give an overview of the things to consider for decarbonising the heat in each individual building, and covers the following:

- Typical Existing Systems
- Low Carbon Technologies
- Carbon Intensity
- Whole Building Approach
- Implementation

Typical Existing Heat Generation

A typical building heating system operates using a hot water system which circulates Low Temperature Hot Water (LTHW) at temperatures of around 82 °C, with returns designed to be around 71 °C. These temperatures can be achieved by fossil fuel boilers or combined heat & power units. The circulated LTHW typically serves radiators and/or Air Handling Units (AHUs), plus Domestic Hot Water (DHW) calorifiers.



Low Carbon Heat Technologies

The most effective route to reducing carbon emissions is to move away from burning fossil fuels.

This leaves alternate fuels for heat such as biomass or electric, where electric heating can be used directly or via heat pumps to achieve improved efficiencies.

This section covers:

- Electric options for low carbon heat
- Combustion options for low carbon heat
- A technology comparison of the carbon case

Low Carbon Heat Technologies

Electric Options

Electric Boilers

Generates heat by putting a current through a heating element

Pros: Readily available, proven technology, high temperature capable

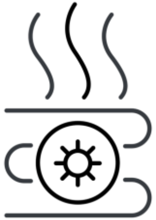
Cons: Can be expensive to run due to higher electric tariffs, not as efficient as heat pumps

Direct Electric Heaters

Generates heat by putting a current through a heating element

Pros: Readily available, inexpensive, proven technology, no need for wet heating system

Cons: Can be expensive to run due to higher electric tariffs, not as efficient as heat pumps

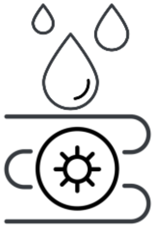


Air Source Heat Pump

Utilises energy from the air to generate heat

Pros: Readily available, proven technology

Cons: Standard models have temperature limitations, not as efficient as other heat pump types



Water / Ground Source Heat Pump

Utilises energy from water or ground to generate heat

Pros: Readily available, proven technology, good COPs can be achieved, high temperature capable

Cons: Can be expensive to install, suitable heat source required

Low Carbon Heat Technologies

Combustion Options

Biomass Boilers

Generates heat from burning woodchip or pellets

Pros: Readily available, proven technology, high temperature capable

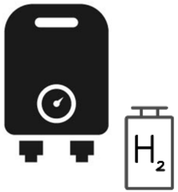
Cons: High site traffic due to fuel deliveries, not technically Net Zero, not as efficient as heat pumps

Biofuel Boilers

Generates heat from burning biofuel

Pros: Less space required than biomass, high temperature capable

Cons: Increased site traffic due to fuel deliveries, not technically Net Zero, not as efficient as heat pumps



Hydrogen Boilers

Generates heat from burning hydrogen

Pros: High temperature capable, potential to be Net Zero (depending on hydrogen source)

Cons: Hydrogen market not established. Utilising renewable power for heat pumps is more efficient.

Combustion options are not as efficient as the usage of electric options or heat pumps, they require additional traffic to sites to deliver fuel, or have a lack of readily available fuel types.

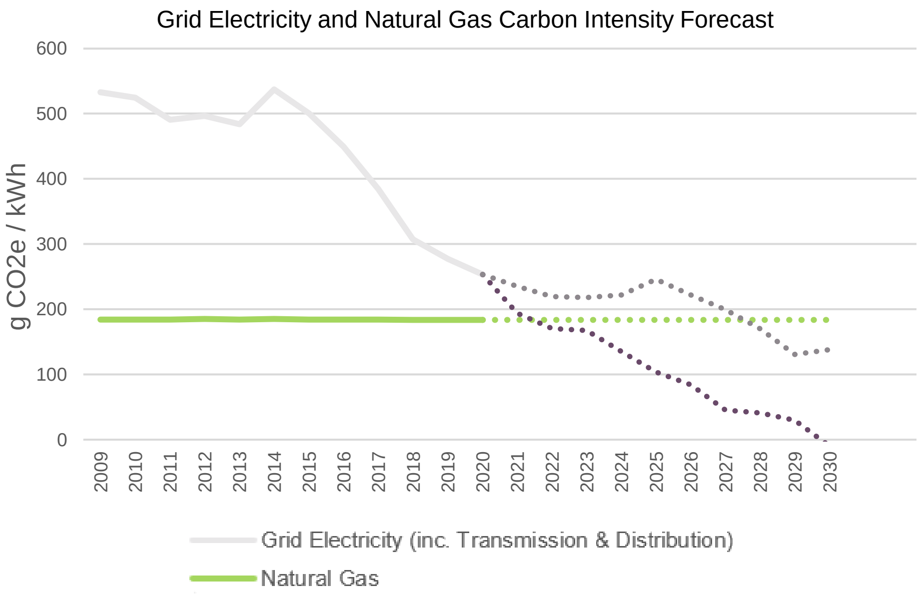
For these reasons, they should only be considered where it is not possible to install a heat pump or electrical option.

Electrification of heat will be the main focus in the remainder of the report, due to the ease of their availability and their potential to be a Net Zero carbon option.

Key Changes Impacting the Carbon Case

The demand for sustainable energy is accelerating the pace of change within the energy industry, and the National Grid has decarbonised rapidly over the last 6-7 years. As can be seen in the figure on the right, there has been over 50% reduction in the carbon intensity of the grid since 2014.

The impact is that previous measures to reduce carbon by retaining gas, such as higher efficiency gas boilers or gas combined heat and power, will be increasingly worse for emissions when compared with electric heat generation technologies.



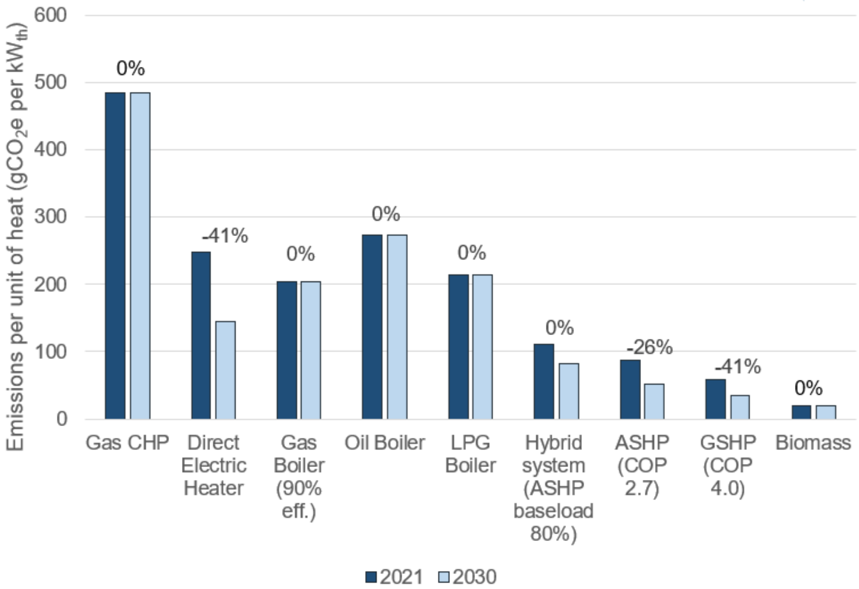
2021 vs 2030 Technology Carbon Intensity

As the grid continues to decarbonise, the savings made by moving away from gas to electric heating generation improve over time.

Past installation of gas CHP have provided both carbon and utility savings for public sector bodies, however due to the decarbonisation of the grid, a gas CHP is already at a carbon detriment to modern, efficient gas boilers.

Although CHP can still generate revenue savings, by 2030, it is predicted the carbon intensity of a CHP will be around five times that of a heat pump.

Gas CHP is expected to be up to 5 times more carbon intensive than heat pumps by 2030



2021 vs 2030 Technology Carbon Intensity
*COP – Coefficient of Performance

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3. Low Carbon Heat Solutions

Whole Building Approach

With rising energy costs, effective design for optimised solutions is important. Where there is the opportunity, often a higher capital spend upfront will result in savings in the future.

A balance needs to be made between capital expenditure and future running cost.

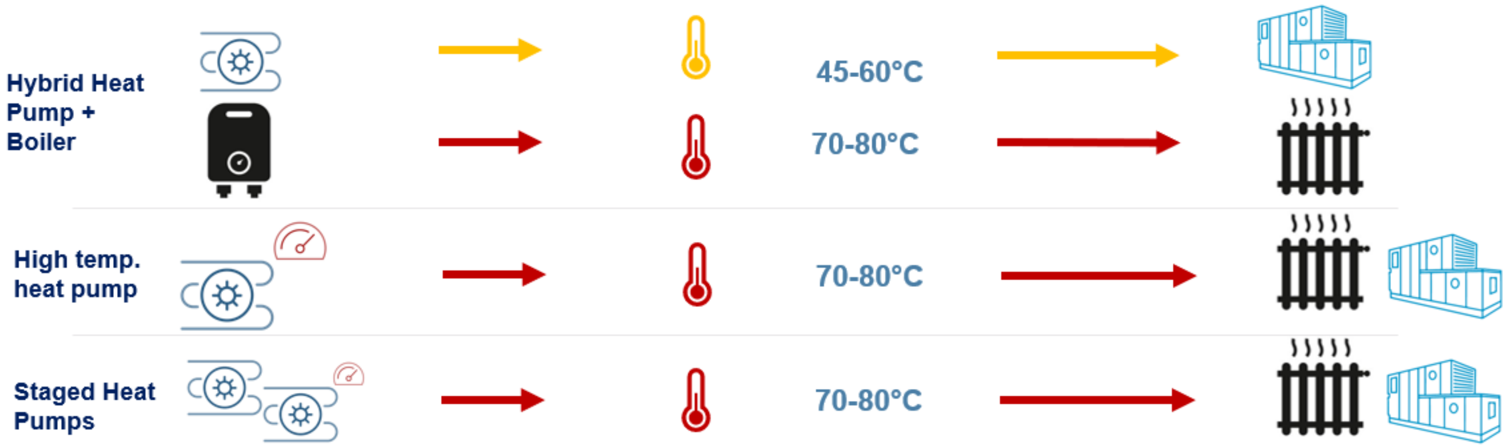
The thermal performance of a building is not be a barrier to retrofitting a heat pump. However, a ‘fabric first’ approach should be considered, particularly for any ‘easy win’ upgrades, such as:

- Loft Insulation - *where it doesn’t already exist*
- Draft Proofing - *resealing of windows / doors*

These types of improvement can reduce the primary energy use, and help to enable lower temperature solutions with reduced operating costs.

High Temperature Solutions

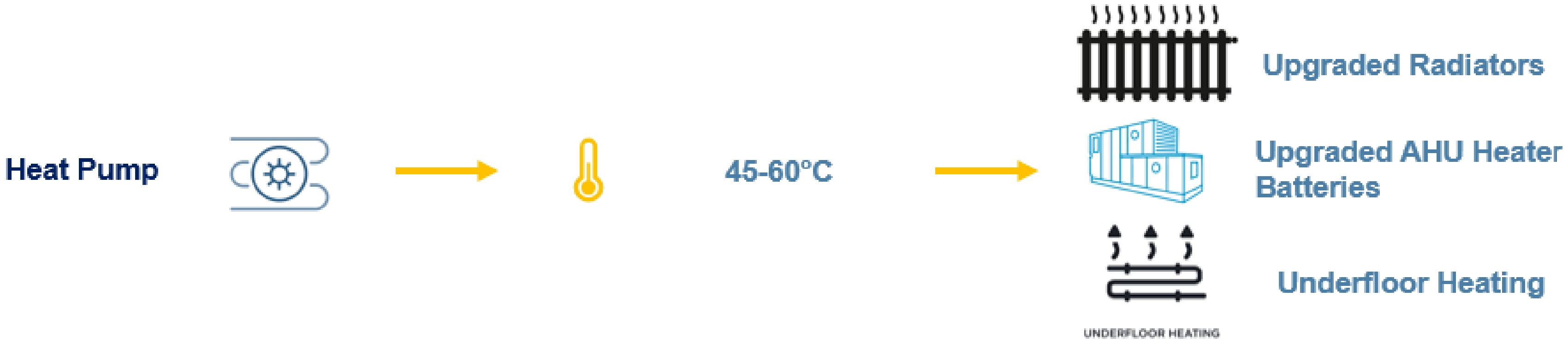
These solutions require minimal to no secondary side changes (emitters and fabric), which can save in capital costs and disruption on site.



It’s important to remember that although the higher temperature options may be less intrusive to install, the efficiencies are unlikely to be as good as a lower temperature options.

Lower Temperature Solutions

Higher temperatures aren't necessarily required to heat a space. Lowering the temperatures of the heating system allows for better efficiencies and reduced heat demand, therefore reducing running costs.



Many buildings are capable of being operated at a lower temperature, so it might be that not all the emitters need changing. Even so, the need for emitter changeover should not be a barrier to installing a low carbon heat solution.

Key Considerations

- **Electrical Loading and Capacity** – Consider how heat pump installs will impact the electrical load for the site. This should also be considered alongside any PV generation or Electric Vehicle charging. It is important to engage with the DNO to understand the impact of this.

- **Appropriate Sizing** – Size a heat pump to suit the load of the building. Gas boilers have often been oversized; just because you have 200 kW of boiler doesn't necessarily mean you need 200 kW of heat pump.

- **Design & Planning** – Consider the location of the heat pump, space constraints in the plant room or externally, plus the visual and noise impact of the new plant. These are all aspects that can cause issues when it comes to gaining planning permission, and can have an impact on the delivery programme.

- **Installation Programme** – What time of year is this being carried out? Ideally works to a heating system would be carried out over the summer / shoulder months, so that there isn't the need for temporary boiler plant, which can be expensive.

- **Measurement & Verification** – It is critical to ensure that the new system is performing as it should, whilst also keeping running costs to a minimum.

4. Implementation Approach

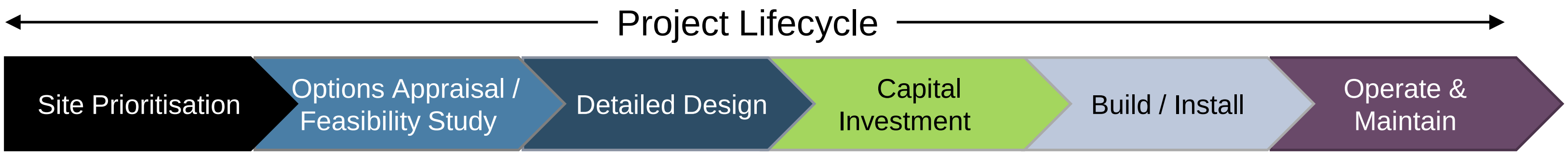
Project Lifecycle

There are several procurement approaches for low carbon heat projects, and the best approach depends on a number of factors:

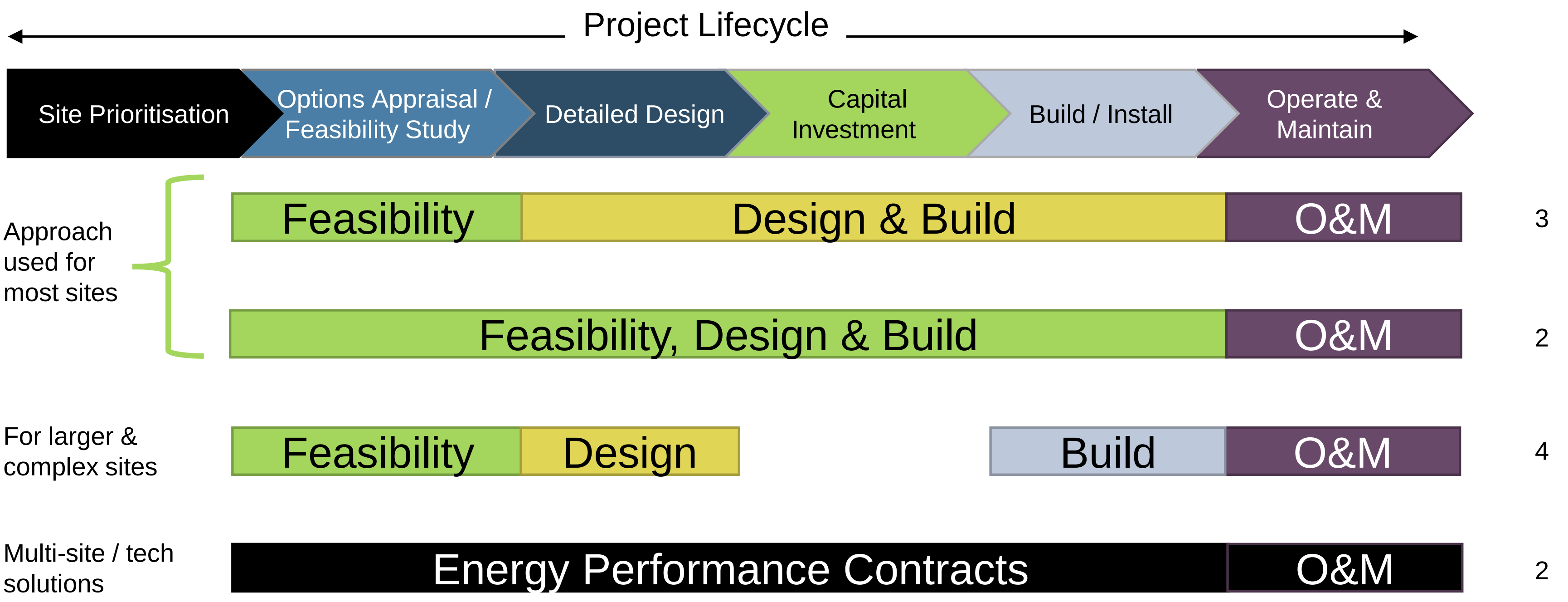
- scale of project
- complexity of project
- interactions / other measures
- funding type
- organisational preferences

The next page shows four approaches for procurement across the project lifecycle shown below.

The procurement effort will depend on the approach taken – the number of procurement activities are shown on the right of the slide.



Procurement Approach Options

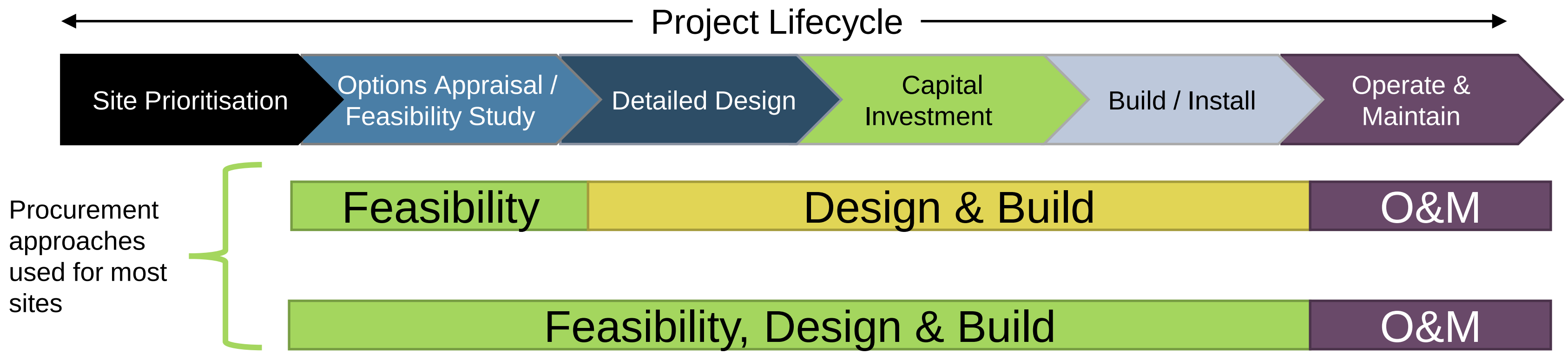


Approach for most sites

For most public sector sites, the two approaches shown below are the most common.

Site Prioritisation is often carried out by the organisation, however it is possible for this to also be contracted out. Feasibility / Options Appraisal assesses the most effective route forward for the site / building. This should be driven by carbon savings, as well as economic performance.

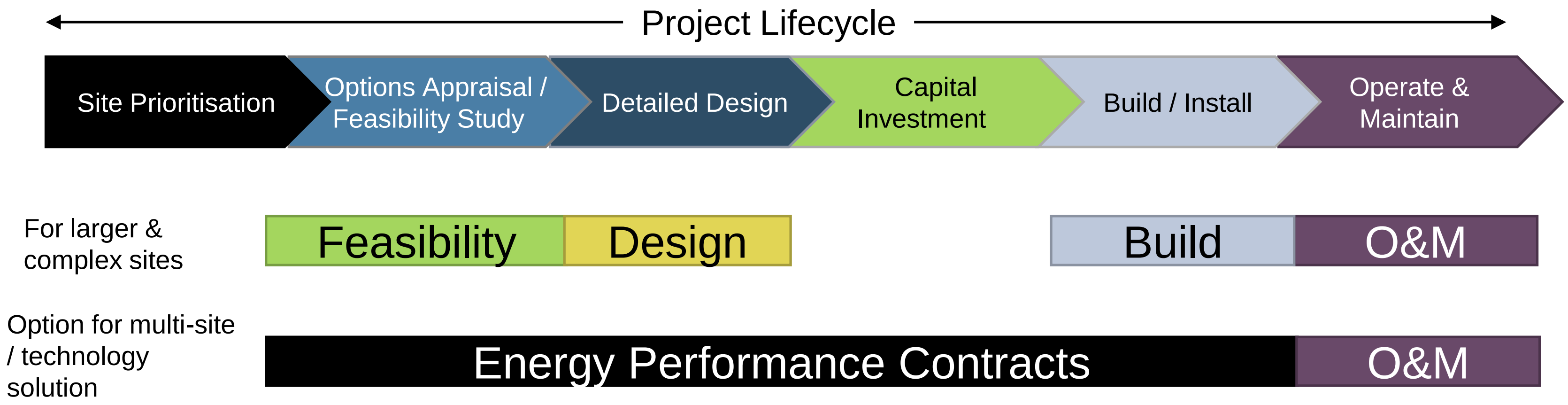
It is then possible to progress the preferred option through to design & build, which can be combined with feasibility, depending on the type of services a contractor can offer.



Approach for large / complex or multi-technology

Other approaches include breaking out each of the stages under separate contracts. This route is more applicable to large and more complex sites.

Energy Performance Contracts, such as Re:fit, are best utilised when rolling out low carbon solutions across multiple sites in one programme.



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Case Studies

Low Carbon Heat – Learnings Case Study

Ysgol Bryn Derw at Kimberly Park Nursery

Ysgol Bryn Derw – Project Overview

Nursery exterior with heat pump enclosure

Site Details

Kimberly Nursery School, Blaen Y Pant Crescent, Newport, Wales, NP20 5QB.

Application For Grant

Newport City Council applied for a heat pump grant of £60,000, which was awarded in September 2021. Work began in February 2022 and the whole-building refurbishment was completed in the Summer of 2022.

Design Features

The original school is comprised of an old and inefficient 50-60 year old building and the heat pumps were planned as part of a larger refurbishment project. The refurbishment project included the following associated measures:
- Rendered external wall insulation
- Double glazing
- Roof insulation

Heat Pump Suitability

The heating system emitters were provided as low surface temperature radiators and fan convectors that typically operate at 60-80°C which is not ideal for heat pumps which typically operate at 50°C. To overcome this issue, a direct electric boiler was installed to raise water temperature from 50°C to 65°C.

Ysgol Bryn Derw – Heat Decarbonisation

Existing Heating System

The existing gas boilers, rated at 35 kW, were at the end of their economic life.

Heat Pump Solution

2 x Daikin EPRA 18DAW1 heat pumps were fitted along with 2 direct electric ‘top up’ boilers.

- The heat pumps have a heat output of 18 kW each (36 kW total) and provide an output temperature of 50˚C.
- The average Coefficient of Performance (CoP) is 2.73 at 50˚C.

An external compound was constructed adjacent to the existing boiler room to accommodate and protect the heat pumps.

Further Upgrades

To accommodate the heat pumps, the electrical supply had to be upgraded. As well as this, electric boilers were installed to boost the 50˚C output temperature to 65˚C.

External heat pumps

Inside the plant room

Control Panel

Ysgol Bryn Derw – Learnings

Challenges

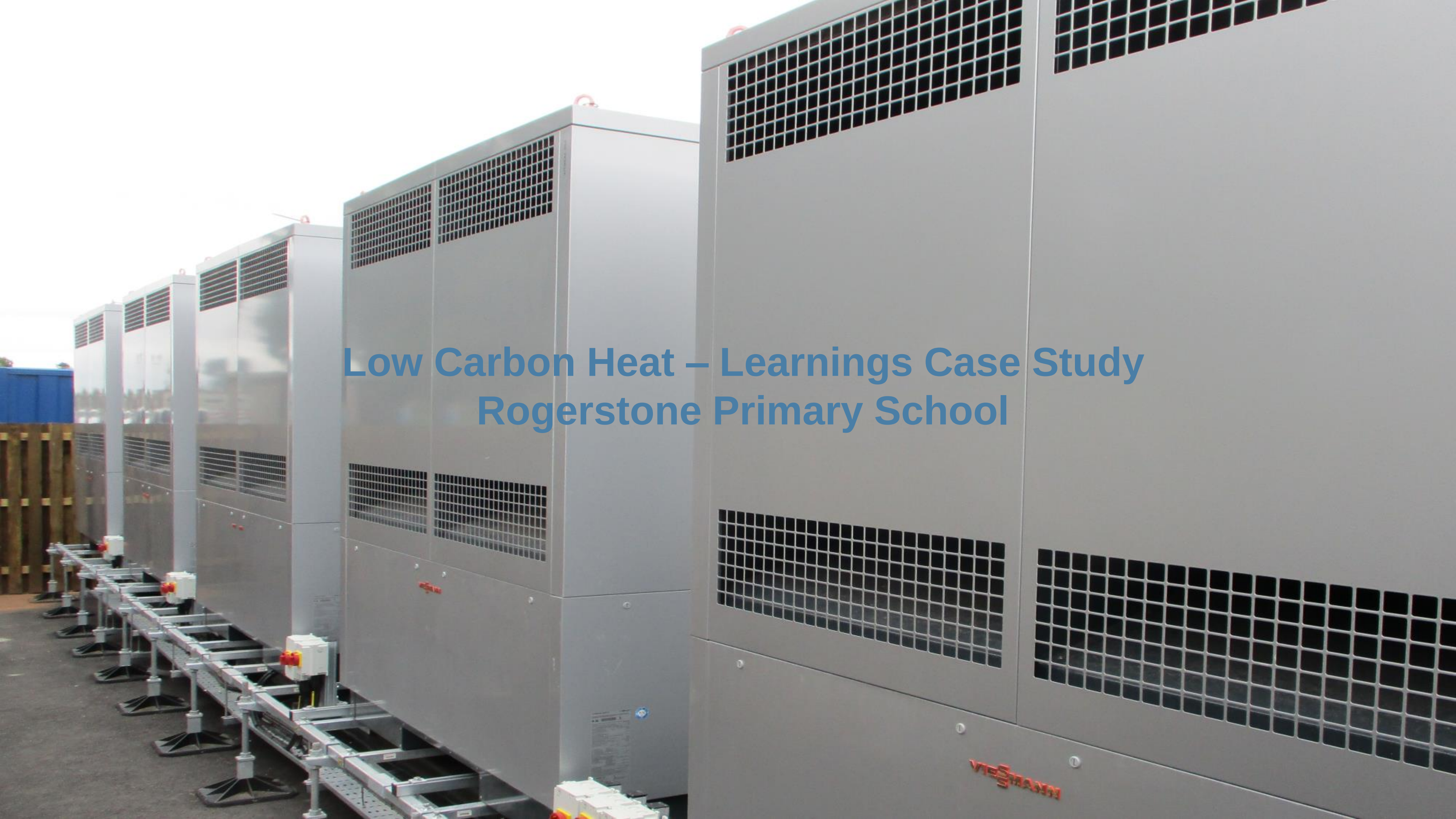
- A low operating temperature heating system such as underfloor heating was not present in the building (heat pumps work best at lower output temperatures).
- The electricity meter was damaged during construction.
- The electricity supply required upgrading owing to the additional electrified heating loads.
- The installation of heat pumps was part of a larger construction project, so the design and construction specifications had to be adapted during the process, which was not ideal.
- The project was time-intensive.

Key Learning Points

- The importance of a clear specification cannot be understated. Unfortunately, incorrect fencing without air gaps was installed around the heat pumps, which now has to be replaced. Mistakes such as these cause delays and increase the costs of a project.
- The heat pumps could perhaps be re-piped to be cascading so to operate at higher temperatures without the need for direct electric boilers.
- The heat exchange fins on the back of the heat pumps have already accumulated lots of pollen. The heat pumps were positioned in a way that made it difficult to access them for cleaning. Positioning the heat pumps to make them easily accessible for maintenance work would be beneficial.

Fins with pollen accumulation

Supplementary direct electric boilers



Low Carbon Heat – Learnings Case Study
Rogerstone Primary School

Rogerstone Primary – Project Overview

School corridor 'Integrated Solar PV'

School classroom 'northlight' windows – covering walls

Site Details

Rogerstone Primary, Ebenezer Drive, Rogerstone, Wales, NP10 9YX.

Application For Grant

Newport City Council applied for a heat pump grant of £475,712, which was awarded in September 2021. Work began in February 2022 and the project completed in July 2022.

Design Features

It was constructed in 2005 as a low energy school and was insulated to a high standard at its time. The building features double glazed windows, controllable natural ventilation and has floor to ceiling 'northlight' windows to maximise natural light using daylight linked lighting controls.

The school also benefits from underfloor heating, BMS controls, solar PV and solar thermal hot water generation. Originally heated from 2 gas condensing boilers.

Heat Pump Suitability

The site was well-suited to the installation of a heat pump for the following reasons:
- Low temperature underfloor heating utilised.
- Heat pumps could be installed close to the plant room, helping to reduce costs.
- There were photovoltaics (PV) on-site to provide electricity to the heat pumps.

Rogerstone Primary – Heat Decarbonisation

Existing Heat Source

2 wall hung gas boilers rated at 288 kW in total.

Heat Pump Solution

5x 56kW Viessman Vitocal 300-A (type AWO 302.B60) heat pumps, with an output temperature of 55˚C.

Average stated Coefficient of Performance (CoP) is 3.05 (maximum CoP is 4.3).

2 of the 5 heat pumps have a diverting valve to provide higher temperature heat at 64˚C for domestic hot water.

2,500L buffer vessel, with the design intent that this can act as a heat store enabling operation at either:

- Low ‘off peak’ electricity tariff times, and/or,
- Maximum outdoor temperatures to achieve best CoP.

Further Upgrades

To accommodate the heat pumps, the school electricity supply had to be upgraded.

The existing solar thermal system was repositioned from the north side of the building to the south to operate at maximum efficiency.

Integration of heat pumps into school site

Inside the heat pump compound

Solar thermal & hot water service cylinders

Rogerstone Primary – Learnings

Challenges

- A full power supply upgrade was not needed in practice and only the fuses had to be upgraded. However, the school's electrical system was not designed to run heat pumps, so a new isolator and larger panel had to be installed.
- Trenching hit the foundation of a previously existing building. Additional equipment was required to continue, which caused a time delay.
- The project was more time-intensive than originally anticipated.

Key Learning Points

- The buffer vessel's capacity of 2,500L is perhaps too small to allow it to act as a significant heat store. Fitting larger buffer vessels to future sites would be beneficial to allow them to charge off-peak and/or maximise CoP.
- The selected external air temperature for the heat pumps is -7˚C, but in reality, air temperature in Newport is rarely below -3˚C, and only for short periods of time. For future sites, heat pumps will be selected on a minimum operating temperature of -3˚C instead. For this site, it would have allowed one fewer heat pump to be installed.

2500L Buffer vessel – now envisaged as too small to act as a heat store

Low Carbon Heat – Learnings Case Study
Ysgol Moelfre

Ysgol Moelfre – Project Overview

Site Details

Ysgol Moelfre, Moelfre, Isle of Anglesey, Wales, LL72 8LJ.

Application For Grant

The Isle of Anglesey County Council applied for a heat pump grant in 2021 for £91,250, which was awarded in January 2022. Work began in July 2022 and the project was completed in August 2022. These works precede a Phase 2 RE:FIT Program installation of 20.77 kWp Solar PV array in 2022/2023.

Original Features

The school was constructed in the 1980's with typical insulation levels for a building of this era including single and double glazing, 300mm of roof insulation and cavity wall insulation. The school was heated from an oil-fired boiler that provided space heating at 80°C flow and 70°C return water via steel pipework to fan convectors. Domestic hot water is generated using a number of point of use direct electric heaters.

Heat Pump Suitability

The site was well-suited to the installation of a heat pump for the following reasons:

- The existing oil-fired boiler was life expired and ready for replacement.
- Oil as a heating fuel was costly with associated high carbon emissions.
- Heat pumps could be installed close to the plant room, helping to reduce costs.
- The school's electricity supply was upgraded in 2018 in anticipation for the installation.

Ysgol Moelfre

New air source heat pumps located outside the existing boiler room

Ysgol Moelfre – Heat Decarbonisation

Existing Heat Source

The existing heat source to the school was a life expired 1980's Strebel RU 15-5 Boiler with Nu-Way NOL 20-23 T16 150 Oil burner.

Heat Pump Solution

5 x Stiebel Eltron HPA-O 13 Premium R410A air to water heat pumps were installed along with a 720 litre buffer vessel and interconnecting heating pipework. A new heat pump manager control panel was also provided.

- The heat pumps have a stated data plate capacity of 13.93 kW each (69.65 kW total) at 55˚C.
- The stated Coefficient of Performance (CoP) is 2.42 at 55°C and external temperature of 7°C.
- The heating hot water set point at the buffer vessel is 50°C.

Further Upgrades

- The existing fan convectors were all replaced with low temperature operating models as a part of the installation .
- A new heating circulation pump was installed.
- It is notable that the school lighting has been 95% converted to LED lighting with Thorlux smart lighting automatic controls.

Air source heat pump pipework feeds into a buffer vessel with outflow feeding existing pipework circuits via a new pump. The buffer vessel also includes 2 x 6 kW immersion heaters.

Existing pipework feeds new low temperature fan convectors. Note LED lighting has been installed.

Upgraded electricity supply

Ysgol Moelfre – Learnings

Challenges

- The original heating pump failed and was required to be replaced.
- The internal thermostat was installed in a warm location and had to be moved to a cooler location as heating was being switched off when needed.
- The external thermostat is currently reading a false temperature owing to its location next to a warm pipe duct externally. This is due to poor external pipework thermal insulation and air leakage sealing between the plant room and outside.

Key Learning Points

- The correct location and setting up of controls is not to be underestimated and adequate time and resources should be planned at commissioning.
- External pipework has been thermally insulated using a poor grade of ‘armaflex’ insulation. Aluminum clad ‘Stucco’ cased rockwool pipe insulation would have been more suitable.
- Pipework valves and brackets are exposed and cause the valuable heat generated to be wasted.
- The pipework clips used only have very thin insulating material between the pipe and the clip and act as cold bridges between the pipe and the wall wasting generated heat.
- The remaining single glazing could have been upgraded to double glazing.

Controls (top) suggests that external temperature is 14.5°C but actual outdoor temperature is only 7.9°C. The external sensor (below) was found to be heated from warm air escaping from a pipe duct leading into the plant room.

Thermal insulation is missing on brackets and valves with associated heat losses and waste. It was noted that external insulation is via domestic grade ‘armaflex’ and exposed brackets are causing excessive heat losses.

Low Carbon Heat – Learnings Case Study
Council Offices – Llangefni

Council offices, Llangefni – Project Overview

Site Details

Ynys Mon Council Offices, Llangefni, Isle of Anglesey, Wales, LL77 7TW.

Application For Grant

The Isle of Anglesey County Council applied for a heat pump grant in 2021 for £1,033,601, which was awarded in January 2022. Work began in August 2022 and the project is yet to be completed.

Original Features

The offices were constructed in the 1990's with typical insulation levels for a building of this era including loft insulation, cavity wall insulation and double glazing. The building was extended in 2008, with the extension being built with passivhaus principles.

Heat Pump Suitability

The site was well-suited to the installation of a heat pump for the following reasons:

- Gas as a heating fuel has high carbon emissions and suitable for replacement.
- Heat pumps could provide higher flow temperatures, allowing for reduced amount of intrusion of the works into common areas of the building
- The existing Solar PV array would help to cover the costs of the increased electricity usage

Existing gas boilers

External route to roof level plant room & location for modular plantroom

Council offices, Llangefni – Heat Decarbonisation

Heat pump buffer tanks within the modular plant room

Existing Heat Source

The council building is heated with 2 x 200 kW gas fired boilers and 2 x Rinnai continuous flow hot water heaters. The boilers serve 5 air handling units, radiator circuits, and fan convector units. The boilers had no weather compensation on any of the circuits.

Heat Pump Solution

The heat pump solution consists of 2 x 500 kW Carrier water source heat pumps connected to 2 x dry air coolers (to act as an air source heat pump).

The dry air coolers are to be positioned on the roof of the building, with the heat pumps and ancillaries to be in a modular plant room located on the land to the side of the building.

Further Upgrades

- The existing air handling units were replaced to more efficient units.
- New electrical distribution board was installed.
- Solar PV, Solar carports and battery storage have all been installed.

Two water source heat pumps within the modular plantroom

Council offices, Llangefni – Learnings

Challenges

- Severe delay to the project due to delays with planning permission.
- Difficulties in design due to the heat pump being located in a flood risk area (adjacent to river).
- Installers went into administration shortly after planning permission was granted, leading to new installers needing to be appointed.
- Additional ground surveys needed to be carried out to establish the appropriate foundation type for the modular plant room (due to proximity to the river).

Key Learning Points

- Planning Permission, allowing suitable time for this process, especially as acoustics and environmental reports needed to be generated as part of this.
- Additional design considerations and surveys required due to river proximity, time for these should be built into the project programme.
- Security of suitable installers capable of delivering within the timescales required.
- Funding not being accessible over more than one financial year has caused additional pressures on this larger project.

Dry air coolers and the modular plantroom, before being lifted into position

Ground survey works being carried out

Low Carbon Heat – Learnings Case Study
National Museums Wales

National Museums of Wales – Project Overview

Site Details

Grant funding for three small heat pumps across their St Fagan's, Big Pit, and Drefach sites.

Heat Pump Solution

St Fagan's site, the existing gas boiler and radiators were stripped out and replaced with a 4 kW air source heat pump and double bank radiators. This allows the heat pump to run at a lower operating temperature to give an improved efficiency. The building now runs on a flow temperature of 50°C for the space heating, with the hot water being provided by point of use heaters.

The Big Pit and Drefach site also had their LPHW gas fired calorifiers replaced with 8 kW heat pump calorifiers as part of this funding round.

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Cefnogi ymdrech Cymru i greu economi sero net llwyddiannus
Supporting Wales' drive to a successful net zero economy

Key Learnings & Summary

Summary

Delivering low carbon heating can be complex, however, despite the challenges, the market is engaged and there are learnings from the increasing number of ongoing projects as low carbon heat starts to become 'business as usual'.

To recap the key considerations when planning for low carbon heat projects:

- Whole Building Approach
- Electrical loading and capacity
- Appropriate sizing of the low carbon heat technology & thermal storage
- Design & Planning considerations
- Installation Programme
- Ongoing Measurement & Verification

The public sector is leading the way, with low carbon heat now being considered at an early stage during regional & local area energy planning, through to the install of low carbon heat to replace existing fossil fuel systems. The role of private organisations and households is still also critical to deliver Net Zero.

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