WEST DUNBARTONSHIRE ENERGY CENTRE

VITAL ENERGI

STAR REFRIGERATION

The Scottish Government
Riaghaltas na h-Alba

hpcy
heat pump city of the year 2021

West Dunbartonshire COUNCIL

Overview

West Dunbartonshire Council is proud to present the West Dunbartonshire Energy Centre at Queens Quay.

Not only has its development been a key element in the transformation of the former John Brown's Shipyard from an industrial landscape into a vibrant and diverse community, but it also sets out the Council's commitment to transition towards a net zero future.

Clydebank's shipbuilding heritage is world-renowned, with many famous liners, battleships and other vessels created on the Clyde waterfront. So, it is fitting that we are continuing that legacy by putting our most famous resource to good use, to protect the planet for future generations.

The ground-breaking project features Scotland's largest Water Source Heat Pump installation to date, taking water from the nearby River Clyde and using it to generate heat which is then distributed to customers through an underground district heating pipe network. The Council established a wholly public owned energy company West 'Dunbartonshire Energy LLP' to oversee the strategic development of the district heating network.

The ambitious £20million project, which was supported with £6.1m funding from the Low Carbon Infrastructure Transition Programme (LCITP) was completed in December 2020 with the initial phase providing heat to Council offices at Aurora House, the Titan Enterprise Centre, Clydebank Leisure Centre and the new care home at the site, Queens Quay House.

The main heat supply pipes (Trunk main) have been laid across the entire length of the Queens Quay site and have been designed with future extension in mind. Points of connection are also in place ready to supply a new NHS Health Centre, over 140 flats with ancillary retail units, as well as Clydebank Library and Clydebank Town Hall. Future connection of West College Clydebank campus and other commercial uses to be delivered are under active consideration.

The introduction of the network will make a major contribution towards West Dunbartonshire Council's climate change targets, as well as allowing residents of more than 1,000 proposed new homes due to be built on the site to enjoy reliable low carbon heating. The district heat network provides an alternative to individual gas boilers at a similar or lower cost.

The low carbon system has been designed to enable future expansion beyond Queens Quay, with scope to heat the Golden Jubilee Hospital, and other areas where high heat demand will justify further extension.

"This district heating system will have a hugely positive impact on Clydebank and West Dunbartonshire as a whole, allowing the Council to take steps to address fuel poverty among tenants and residents, as well as working to achieve carbon reduction targets by removing more than 4,000 tonnes of carbon from the environment every year for the next 40 years."

Councillor Iain McLaren,
Convener of Infrastructure,
Regeneration and Economic Development

The Solution

West Dunbartonshire Council had an ambition to shape the future, with three core ambitions:

1
Lower energy bills for existing and new residents, offering reduced typical consumption costs through a competitive tariff structure with no additional cost for regular service, repairs or replacement.

2
Reduced carbon emissions using an innovative water source heat pump, utilising the River Clyde.

3
Increased security of supply, ensuring minimum downtime and constant access to heat for all customers *(system resilience)* **with total consumption costs** *(unit charges)* **lifecycle maintenance and future replacement.**

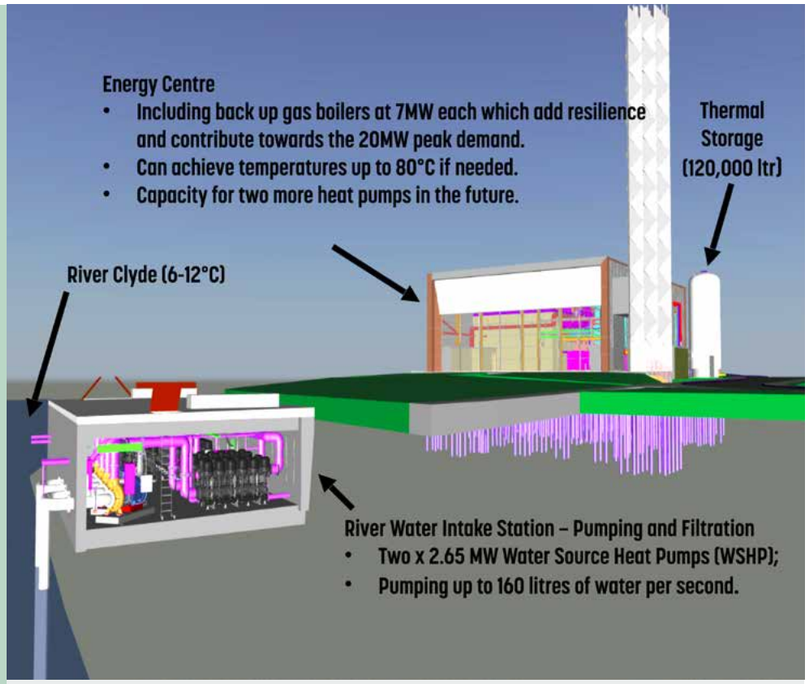
The Benefits

- **Savings will be the equivalent to the total carbon footprint which would otherwise be generated by 1,240 local homes using fossil fuels as a primary source of domestic heating.**
- **Providing clean, inexpensive energy**
- **Improve comfort, health and wellbeing of residents**

Based on heating demand estimates, it was proposed that 5MW water source heat pumps, additional boilers, hot water storage and ancillary network equipment would be required, with a focus on encouraging expansion within the network to deliver a cumulative reduction of at least 130,000 tonnes of CO^2 by 2040. Vital Energi were procured as the chosen contractor to deliver the overall project, with Star Renewables providing the water source heat pump technology.

Savings for heating equate to

1,240 **homes using fossil fuels**



System Design

To design the system, Vital Energi brought extensive expertise and knowledge within the energy sector. Therefore providing us with predicted heat demands. They then looked at historical heating data to provide us with accurate profiles for the new build sections of the development. For the existing buildings, gas usage data was utilised to model future energy needs. This allowed a clear picture of requirements for the size the development should be and allowed the right decisions to be made in relation to the heat pumps. Analysis showed that while peak demand would reach approximately 20 Megawatt Thermal (MWth), however, this level would typically only be required for 25 hours per year.

One of the biggest challenges faced during the development of the project was designing a system which would maximise the use of the Water Source Heat Pumps (WSHP), as these are eligible for RHI and, using decarbonised grid electricity as a primary energy source, are extremely efficient in reducing carbon emissions. This was made possible in part by utilising a large thermal store which allows the system to optimise off peak supply costs and the relatively slow heat pump reaction times to deliver a constant supply of heat to meet fluctuations in demand.

The system uses two 2.65 Megawatt (MW) WSHPs which it is intended will run as close to maximum output required as possible to optimise efficiency while delivering most of the annual heat demand. This configuration means that in the summer months, when demand is low, one heat pump can be taken offline at any given time to perform scheduled maintenance, with the other still providing heat. The scheme also has added resilience due to the gas boilers installed within the energy centre which, when used, can deliver an additional 15 Megawatt (MW) to meet peak demand. These boilers are only be used during peak demand times or as a backup option, meaning overall, they produce minimal local carbon or NOx emissions.

WSHPs rely on electricity but have a high coefficient of performance. This means for every MW of electricity used, the heat pumps produce approximately 3MW of heat. While the system is already effective at reducing carbon emissions, it will become even more environmentally friendly as the electricity grid continues to decarbonise in the future.

Because of the increase of renewable electricity generation contributing to the grid it is expected that the grid carbon factor should decrease by over 87% between the years 2018 and 2044, with the heat pumps carbon emissions decreasing by a similar amount over that period.

Understanding the River & Ecosystem and its Influence on Design

We made a firm commitment that the system would not damage the river's ecology, and a comprehensive picture was created to consider key factors including water temperature, wildlife, eco structure and average flow rate. As well as preserving

the river's ecology, the average flow rate was important in determining the distance between where water is taken from and where the water is returned to. This was to ensure the system did not collect cooler water which had already been through the system. The former floatation/fitting out basis acts as a heat reservoir and buffer to mitigate the impact of chilled water being returned from the heat pumps. The abstraction system feeds the heat pumps with 125 litres of water per second each and so ensuring that accuracy of design calculations and providing an effective filtration system were extremely important.

Designing a 21st Century Heating System & Updating Existing Buildings

One of the main challenges in the design was the fact that the heat network would be providing energy to a mixture of new-build premises and older existing buildings. The older buildings were designed for historic heating systems which favour a higher 82°C flow and 71°C degree return, which differs from the new builds which are typically based around a 75°C flow and 45°C return or in some cases lower.

To allow the older buildings to operate with lower flow and return temperatures, we carried out a retrofit of the heating systems by modifying the heating controls and radiators. This enabled a site-wide uniform flow and return temperature, giving the heat pumps a higher coefficient of performance and making the overall system more efficient. Over time with fabric improvements, it may be possible to achieve improved network efficiency by further reducing flow and return water temperatures.

Delivering an Optimised Energy Centre for the Future

Creating an efficient layout, but also one in which operation and maintenance could be delivered in a safe and efficient manner, was paramount. To minimise the building footprint and make best use of the internal volume a mezzanine solution was designed, which provides adequate floorspace for additional plant and future expansion.

The heat pump process uses ammonia as a refrigerant therefore an emergency ventilation scheme had to be developed to ensure it met relevant legislation as well as safeguarding anyone in the energy centre or further afield. An internal enclosure which also provides acoustic attenuation was installed to house the heat pumps and associated plant. This is vented via the 30m flue together with flues for the gas boilers. The chimney design was informed by a flue dispersion model which considered the future surrounding residential developments.

The Energy Centre is designed to include future phases and planned expansion, creating an easily expandable district heating network. Extra capacity has been catered for with space inside for a third and fourth heat pump to be installed as required. To achieve net zero aspirations the natural gas boilers will be replaced in due course with suitable alternatives. The introduction of hydrogen as a potential fuel offers potential which will be explored.

Project Summary

TITLE

WEST DUNBARTONSHIRE ENERGY CENTRE - COMPLETED DEC 2020

LOCATION

QUEENS QUAY, CLYDEBANK

PROJECT AMBITION

SUPPORTING THE COUNCIL'S COMMITMENT TO TAKE ACTION FOR A NET ZERO FUTURE

FEATURES AND BENEFITS

- **FEATURES SCOTLAND'S LARGEST WATER SOURCE HEAT PUMP, TAKING WATER FROM THE RIVER CLYDE**
- **LOWER ENERGY BILLS**
- **REDUCED CARBON EMISSIONS**
- **INCREASED SECURITY OF SUPPLY, PROVIDING CLEAN, INEXPENSIVE ENERGY**
- **IMPROVED COMFORT AND HEALTH AND WELLBEING OF RESIDENTS**

https://www.queens-quay.co.uk/district-heating/