

Bunhill Heat and Power Network

Taking waste heat from the London Underground to provide cheaper, greener heat to local communities





Figure 1. The new energy centre

Foreword

Islington Council's Bunhill Heat and Power Network (BHPN) is the first scheme in the world to take waste heat from an underground train network and use it to provide lower cost, greener heat to local homes, schools and leisure centres.

This ground-breaking scheme has the potential to be replicated not only across Islington and London but in any major city with an underground network. That's because heat networks, such as BHPN, are able to harness a wide range of renewable and waste heat sources that are already available within a city.

This project is playing an important role in Islington's commitment to reducing carbon emissions, helping lower heating bills, improving air quality and making the capital more self-sufficient in energy. Indeed, it forms an important part of the Mayor of London's approach to decarbonising heat in London and helping London to become net zero carbon.

Islington Council has been at the forefront of action to reduce carbon emissions for many years. We are on target to reduce carbon

emissions in the borough from 2005 levels by 40% in 2020 and, in June 2019, we declared a Climate Emergency and pledged to work towards making Islington net zero carbon by 2030.

Islington Council is also helping thousands of residents out of fuel poverty with initiatives such as the SHINE network, our Energy Advice team and Warmth on Prescription all helping to reduce fuel bills in the borough. Work to tackle fuel poverty and help residents save money on their fuel bill are priorities in the council's corporate plan 'Building a Fairer Islington – Our Commitment 2018-22'.

This innovative project of recycling waste heat from the London Underground to heat local homes will make a significant contribution towards making Islington a fairer place.

Cllr Rowena Champion
Executive Member for
Environment and Transport
Islington Council

The Bunhill Heat and Power Network (BHPN)

BHPN links together the existing Bunhill phase 1 heat and power network with the new Bunhill phase 2 extension. The network is located in the London Borough of Islington's densely populated, urban Bunhill district, close to the major Old Street roundabout.

The Bunhill phase 2 project is an extension of the existing Bunhill heat and power network which has been providing cheaper, greener heat to over 800 homes in Redbrick, St Luke's Estate and Stafford Cripps estates, St Luke's Housing (76 Central Street) and Worcester Point as well as Ironmonger Row Baths and Finsbury leisure centres, since 2012.

The original network, Bunhill phase 1, is powered by a Combined Heat and Power (CHP) engine at an energy centre in Central Street. This CHP engine is powered by gas and uses heat created from producing electricity to heat buildings and provide hot water. Unlike

normal electricity production that wastes up to two thirds of the fuel used to make it, the waste heat the CHP generates is captured for the heat network.

The success of Bunhill phase 1 encouraged the council to extend the network to supply heat and hot water to 550 additional properties on the King Square Estate (Rahere House, President House, Turnpike House, Barnabas House and Macclesfield House) and the recently rebuilt Moreland Primary School, as well as creating capacity to add further private connections in the future.

To achieve this, a new Energy Centre was constructed, with a pipe distribution network, and Islington partnered with Transport for London (TfL), who were upgrading the London Underground ventilation shaft at the junction of Moreland Street and Central Street, to provide the additional heat from the Tube.

Figure 2. The Bunhill phase 1 energy centre: Central Street



Figure 3. Map of the Bunhill Heat and Power Network



Bunhill phase 2

The Bunhill phase 2 project is the extension of Bunhill Phase 1 to form the BHPN. The project involved the construction of a new Energy Centre at the site of London Underground's ventilation shaft at the corner of Moreland Street and Central Street which extracts heat from the Underground system and distributes it through a network of pipes to the King Square Estate and Moreland School. This provides cheaper heat to King Square residents and Moreland School whilst also reducing carbon emissions by over 500 tonnes per year.

An additional pipe distribution network connects with the existing Bunhill network. This makes both networks operate more efficiently and allows one energy centre to take over supply if the other were to fail. All of the Islington estates connected to network still have their communal boilers which can provide further resilience to the heat supply.

By building a new Energy Centre, the network now has the capacity to supply heat to more buildings that want to connect.

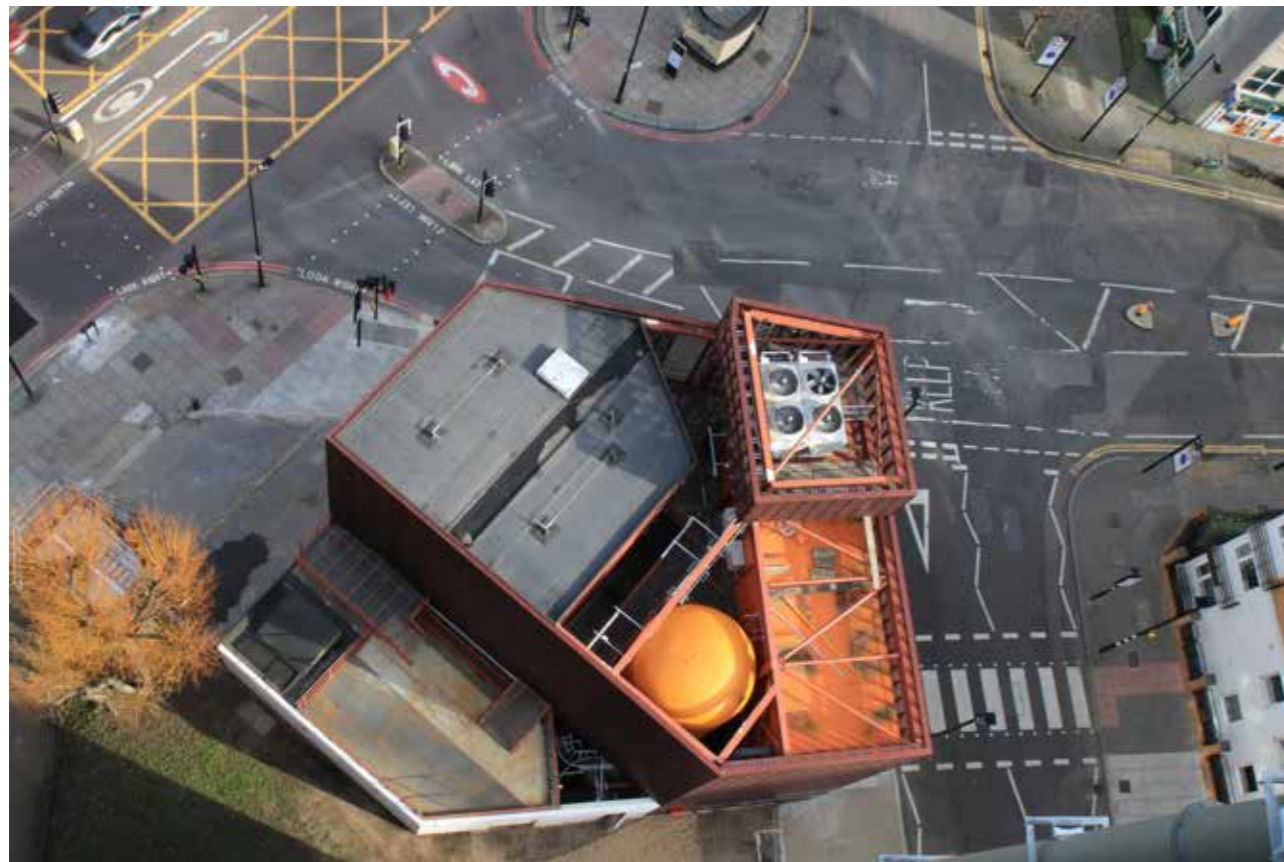


Figure 4. The new energy centre: aerial view



Figure 5. The heat pump in new energy centre



Figure 6. The new energy centre from Moreland Street

How does it work?

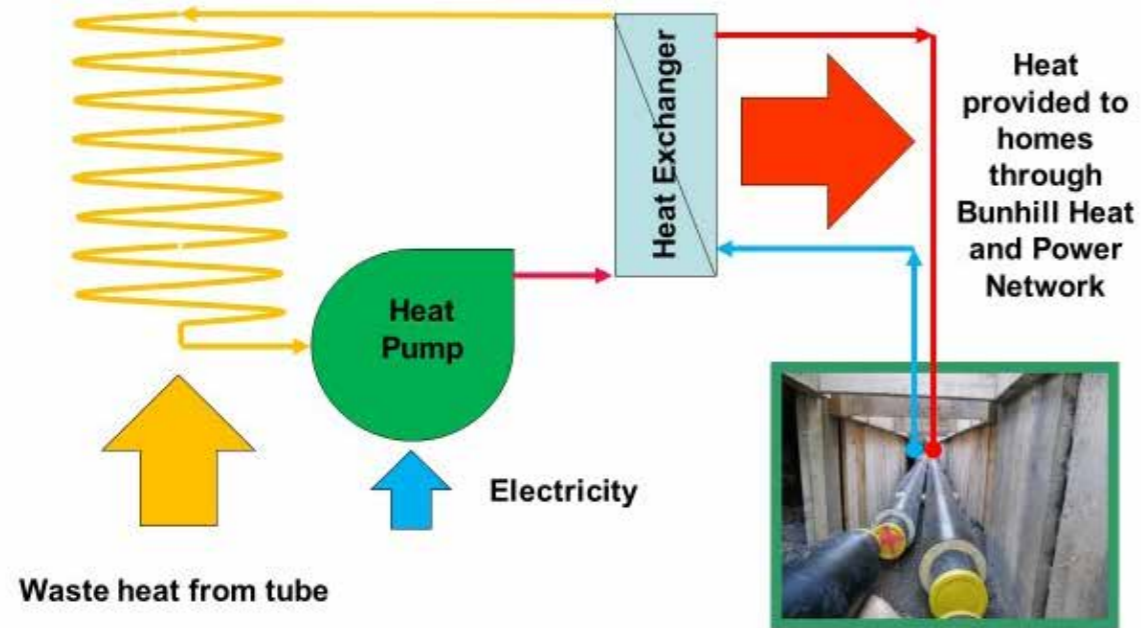


Figure 7. How the new energy centre supplies heat to local homes

To help control the temperature on the Tube network for customers and staff, there are a series of ventilation shafts that carry hot air from the Tube tunnels up to ground level. One of these ventilation shafts is located at the corner of Moreland Street and Central Street.

Warm air created by trains and machinery in the Underground network goes up the ventilation shaft and is pushed by a fan through a machine called a heat pump. The heat pump captures heat from the warm exhausted air, via a closed loop water circuit in the ventilation shaft. This is used to heat a gas, which is then put through a compressor, converting it into a very hot liquid and making the pipes that hold it very hot as well.

These hot pipes are used to heat the water that runs in the pipes of the Bunhill Heat Network so that they can heat the buildings connected to the network. The pipe network is very well insulated to minimise the amount of heat lost on the way to the buildings.

Taking advantage of the properties of a refrigerant gas, the hot liquid in the heat pump passes through the water in the pipes and in doing so turns back into gas. The heat pump is then ready to be warmed up again by more warm air from the Tube. In addition, the fan in the ventilation shaft has the potential to be reversed in the summer to provide cooling to the Tube network, helping to make journeys more comfortable.



Figure 8. Thermal store in the new energy centre



Figure 9. Ventilation shaft fan

A successful partnership

Islington and TfL have worked closely on this project to make sure waste heat from the Tube network can be used to heat and provide hot water to local buildings and homes.

The extension of BHPN was coordinated with TfL's upgrade of their existing ventilation shaft and careful joint working was required to ensure that all elements of the construction were fully integrated and coordinated on the small site.

Why are we doing this?

The project brings a number of key benefits for local residents and the wider community:

- The Bunhill phase 2 extension to the Bunhill Network will bring cheaper, greener heat to another 550 homes and Moreland School
- This is on top of the 800 homes that were already receiving heat from the network
- All Islington Council tenants connected to the network receive a 10% discount on their heating charges
- The Bunhill phase 2 extension to the Bunhill network will result in approximately a 500 tonne reduction in carbon emissions per year
- Adding a new Energy Centre to the Bunhill network increases the resilience of the network as one Energy Centre can take over if the other one develops a fault or requires maintenance
- The new Energy Centre and extension to the BHPN helps the capital become more self-sufficient in energy
- The project has increased understanding of the opportunity that waste heat can play in decarbonising heat networks, how waste heat can be integrated into heat networks and the role that heat networks can play in decarbonising a city's heat supply and supporting its wider energy system.

A template for the future?

Heat networks work best in densely built, urban areas as heat has to travel shorter distances to the buildings connected and so there is less heat loss in the pipework. The Bunhill 2 project is a world-first in taking waste heat from a Tube network ventilation shaft and the partnership with TfL provides a template that has the potential to be replicated across London using the many ventilation shafts on the Tube network. Many major cities across the UK and around the world have underground railway systems, all of which need to vent heat to ground level, so there is a huge amount of potential for this project to be replicated across the globe.

In addition, urban areas have a large variety of waste heat sources, such as data centres, that could be harnessed in a similar way to provide heating and hot water to local homes and businesses.

Opportunities for more local energy networks in Islington

Given their potential to provide lower cost, greener heat, Islington is exploring opportunities to connect more homes and businesses to heat networks, using waste heat sources, both through further connections to the Bunhill network and by building new energy centres and networks. Learning from the Bunhill 2 project will be invaluable to this process as well as the partnerships that have been established during the construction of Bunhill 2.

For more information please contact: Islington Council's Energy Services at bunhillheatandpower@islington.gov.uk



Figure 10. Breaking ground over existing vent shaft



Figure 12. Laying ventilation shaft head house foundations



Figure 11. Ventilation shaft head house steel frame



Figure 13. Ventilation shaft steel frame



Figure 14. Laying foundations



Figure 15. Laying the underground pipe network in Central Street



Figure 16. Craning thermal store into the new energy centre



Figure 18. Installing the carbon scrubber



Figure 17. Starting the installation of façade panels



Figure 19. Completed installation of façade panels



Figure 20. Insulated pipes



Figure 21. Inside the ventilation shaft

Project Partners

The Bunhill phase 2 project is an outstanding example of collaborative working between Islington Council's Energy Services Team and a wide range of partners and contractors. Islington Council would like to thank the following partners for their invaluable input in this world-first project:

- **Transport for London** – As a key partner in the Bunhill 2 scheme, TfL upgraded its City Road mid-tunnel ventilation system to enable the capture and utilisation of waste heat from the Northern line tunnels to provide hot water to local homes and businesses. TfL is also carrying out further research to identify opportunities for similar projects across the Tube network as part of its Energy & Carbon Strategy.
- **Celsius** – A European Union-funded project that provided funding for the new energy centre and heat network expansion as part of a wider project exploring low carbon innovation in heat networks in several European cities, including Cologne, Genoa, Gothenburg and Rotterdam.
- **The Mayor of London** – Brought together Islington Council and TfL to form the partnership that has delivered the Energy Centre for the Bunhill phase 2 project. City Hall also funded the early feasibility work for the project and co-ordinated London's overall involvement in the Celsius project.
- **Cullinan Studios** – Provided the architectural concept design for the new Energy Centre; consulting extensively with the local community, Planners and local Councillors to secure Planning Permission. McGurk Architects were then appointed to take the design through to completion.

- **Ramboll** – Carried out feasibility studies to confirm that the heat pump concept was financially and technically viable and acted as Client Engineer developing the design of the system, and worked as Islington's Contract Administrator.
- **Colloide Engineering** – Design and Build contractor for the Bunhill phase 2 project.
- **Gleeds** – Acted as Cost Manager during the project, valuing the amount of work carried out under the contract.
- **GEA** – Sub-contracted by Colloide, designed, manufactured and installed the heat pump system in the new Energy Centre.
- **Topic Plan** – provided Testing and Commissioning assurance for the project.
- **AECOM** – Provided support and advice to Islington Council on the Construction Design and Management (CDM) Regulations to ensure suitable Health and Safety management arrangements were in place during construction.
- **Toby Paterson** – Created artwork panels for the face of the new Energy Centre representing a quiet celebration of the often overlooked and occasionally undervalued everyday infrastructure that defines so many Londoners' lives.
- **Inner Circle Consulting** – worked alongside Islington's internal team on this important and strategic energy project to strengthen project leadership and enhance internal capacity.



WATSON & PARTNERS ENERGY CENTRE