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Case story | Sondex® Plate Heat Exchangers

London **Underground air recycled** to heat up homes

In collaboration with Colloide Engineering Systems.

10%

reduction in heating bills using renewable energy

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Travelling the London Underground can be an extremely hot experience for the millions of commuters and visitors every day. But what if the surplus hot air could be put to good use? Danfoss proudly takes part in a new state-of-the-art energy project by Colloide Engineering Systems.

In Islington, North London, sits an abandoned tube station, part of, what is now, the Northern Line - the oldest deep level underground line in the world. Following the closure of City Road station in the early 1920s, most of the station was demolished, with the only part left being a ventilation shaft for the underground line below. Now, the last remaining surface structure from the former station has been demolished - but for a very good reason.

Introduction

Danfoss Heating aim to increase energy efficiency in buildings by providing climate-friendly solutions that are used in areas such as air conditioning, smart home heating and building optimisation. We are also active in the growing field of district heating infrastructure for cities and urban communities where we offer a full range of innovative products and services, as described in this case study.

Hot air from the friction of wheels, swells, and trains is now being utilised to heat up homes and businesses.

For this project, Danfoss was proud to partner with Colloide Engineering Systems, a highly skilled process engineering company. Colloide have specialist skills in water treatment, energy, environmental and facilities engineering solutions, with wide ranging experience, from innovative 'first of its kind' district heating projects to biomass heating installations on farms.

The History

The station opened in 1901, an intermediate stop between Angel and Old Street on the Northern line. It closed just 21 years later due to low usage. City Road saw its last action in the second world war, when it was opened as an air raid shelter. Most of the station's surface buildings were flattened in the 1960s, but this former lift shaft was kept in place for ventilation. The last of the surface structure will now be replaced by a rust-coloured energy centre serving the nearby housing estates with heating and hot water.

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The Project

155 steps and 23 meters deep down in the underground, you will find a world-first construction project, launched by Colloide Engineering Systems, Bunhill 2 Heat and Power Network.

The new energy centre uses state-of-the-art technology on the site of the disused Underground station that commuters have not seen for almost 100 years. The remains of the station have been transformed to house a new 500kW ammonia heat pump driven by the heat recovery from a heat exchanger coil within the London Underground shaft, recovering the warm air lost throughout the northern line tube.

The scheme recycles the wasted heat to provide heating and hot water to more than 1,350 homes, a school and two leisure centres in Islington. This provides a blueprint for decarbonizing heat in potential future schemes in London reducing heating bills and carbon emissions while improving air quality and making cities more self-sufficient in energy. Bunhill Heat and Power Network links together the existing Bunhill phase 1 heat and power network with the new Bunhill phase 2 extension.

> **"Bunhill 2 Energy Centre is a world-first scheme where they are capturing the heat from the underground train network, and utilizing it to heat homes and a primary school. This is an excellent way to reduce hot air in the underground and at the same time support the CO2 reduction in London."**
>
> *-Martyn Neil, Danfoss*

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The Challenges

During the course of this project, Colloide Engineering Systems identified a number of challenges:

- *Working with existing plant rooms, all of which needed to be upgraded to accept heat from the district heating network*
- *Engineering the communication network between the energy centres and the plant rooms*
- *Engineering associated with an ammonia-based heat pump in the centre of London*
- *Working on very congested, tight sites.*
- *The number of different partners involved and ensuring all parties worked cohesively together.*
- *The complexity and uniqueness of the project, with no similar previous projects to refer to.*

In addition to this, Colloide had to consider the many residents in close proximity whilst working in a very busy part of London. During the construction period, the already heavily congested roads had to be dug up and a lot of work had to be carried out around the site in order to install the Energy Centre and new district heating network. Therefore, it was imperative throughout this project to work closely with the Council, local residents and the local community. As a result, a resident liaison officer was appointed, who communicated directly with those living and working in the local area.

Access to the plantrooms were through normal domestic doors rather than full width plantroom doors, and in some cases down through old stairwells, as the breaking out of some walls or windows in order to facilitate the installation was not permitted. This meant that the substations could not be any wider than 1100mm, in which case building on site would potentially be easier or a modular skid would need to be designed.

The Solution

To help control the temperature on the Tube network there are a series of ventilation shafts that carry hot air from the Tube tunnels up to ground level.

Warm air created by trains and machinery in the Underground network goes up the ventilation shaft and is pushed by a two-metre 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.

> **"The Bunhill 2 Energy Centre is the first of its kind in the world, and we are assessing whether 56 other ventilation shafts have potential for exporting waste heat."**
>
> *-Transport For London*

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.

As a bonus, the fan can also be reversed to help with cooling the Tube tunnels in the summer months, to make journeys more comfortable for commuters.

The utilisation of two natural gas CHP units, with a combined output of 700Kw and district heat pipework of 1800m, allows a further 550 homes and a primary school to be connected to the existing Bunhill Heat and Power district heating network, which was launched in 2012, with the potential to supply up to 2,200 homes.

"The kit was packaged, the equipment well engineered and designed specifically for this project. It was a plug and play system designed to operate under old and new temperature regimes on a skid that has been pressure tested off-site and fabricated in modular sections, that can be split and reconnected on-site to work around difficult access arrangements and mean minimal on-site work," commented Colloide.

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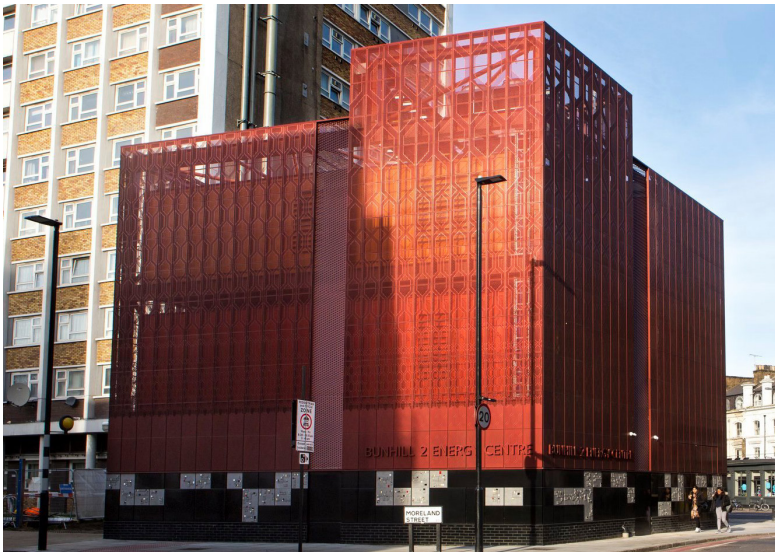
Thanks to the new Energy Centre, the heating bills for council tenants connected to the network will be cut by 10% compared to other communal heating systems, which themselves cost around half as much as standalone systems heating individual homes. The district heating network commits to the UK's net zero carbon target by 2030 as it reuses heat that would otherwise be wasted; those who are connected will be helping to reduce CO2 emissions by around 500 tonnes each year.

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.

"The units to connect the buildings were bespoke substations, designed and specified in conjunction with the designers, 3D models, built and delivered as pre-fabricated units and the Sondex PHE were also used elsewhere in the system as separation of circuits. The involvement in the project for Danfoss, was 4 years in total, from early design, through to contractor installation and commissioning. It is expected that the scheme will continue to phase 3, with further buildings connected."

-Martyn Neil, Danfoss

For this project, Danfoss supplied x11 Sondex plate heat exchangers, and x5 substations to connect the four housing blocks and the school.



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When speaking to Colloide about their reasons for specifying Danfoss plate heat exchangers and substations, they recalled originally planning to build the substations themselves. But due to limited manufacturing space on-site, they contacted a number of PHE and heating substation suppliers for quotes.

> ***"Gulam Seedat from Danfoss was by far the most engaged response we received and it was clear that we were going to get the right involvement in design and testing of the project that we needed, and within budget. The efforts in helping us size plates that would operate on two dT regimes was particularly swaying in the decision to use Danfoss. Danfoss' prefabricated substation also allowed us to gain some confidence from Islington Council and their agent as we were able to use a time tested and well-known supplier of plate heat exchanger systems giving authority to the designs that we produced."***

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Bunhill 2 has already caught the attention of the media. Click below to see what the media is saying about the new energy centre and the innovative solution to recycle excess hot air:

The One Show - Bunhill 2 Energy Centre

BBC News - How the London Underground is heating homes

Watch more on how Colloide launch the world-first project **Bunhill 2 Heat & Power Network**

See why Islington Council are proud to provide **cheaper and greener energy for the locals**

Find out more about the solutions offered by **SONDEX - heat exchangers**

Learn about how Danfoss can help you to stay on top of your projects by using the **Digital Design Centre**

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