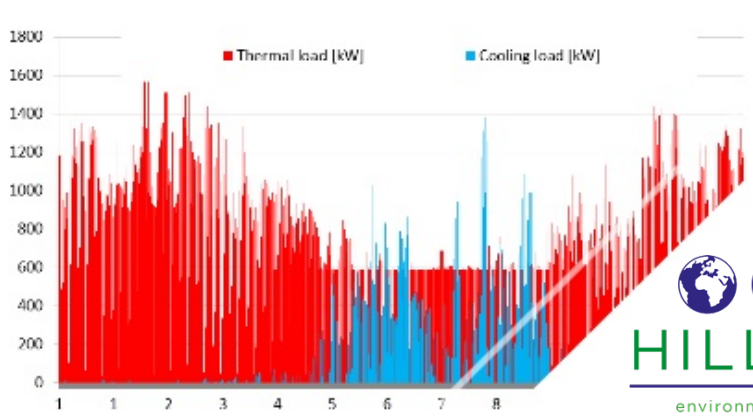
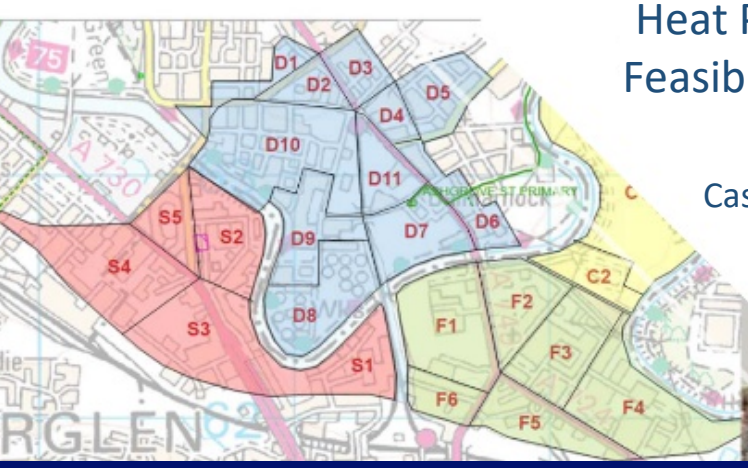


HILLSIDE
environmental services

Heat Pump DHN Feasibility Project

Case Study



The Road to Net Zero, Preparing the infrastructure

Clyde Gateway, Glasgow

HILLSIDE
environmental services

Introduction

Clyde Gateway is an urban regeneration company consisting of a partnership between Glasgow City Council, South Lanarkshire Council and Scottish Enterprise.

The main focus for Clyde Gateway is the east end of Glasgow and Rutherglen aiming to redevelop 840 hectares of land, to provide high quality offices, retail and leisure facilities and urban living space.

At the heart of the project is an ambition to adopt low carbon and smart energy systems that remove reliance on fossil fuel, reduce incidents of fuel poverty and support a range of social improvements for the area.

As a specialist team of professionals, dedicated to the design and delivery of decentralised energy solutions, the team at Hillside Environmental were engaged by the Clyde gateway team to provide feasibility support in the deployment of heat pump technology for 4th & 5th Generation heat networks, primarily evaluating the extensive sewer infrastructure around the development to provide the primary thermal load.

The Hillside team commenced initial feasibility and evaluation work in June 2015. The feasibility program extended over a period of 4 years, as the options evolved, and this case study outlines the approach and solutions that arose.

Hillside Environmental is proud to be a carbon-negative business.

The Road to Net Zero

Committee on Climate Change

"A net-zero GHG target for 2050 will deliver on the commitment that the UK made by signing the Paris Agreement. It is achievable with known technologies, alongside improvements in people's lives, and within the expected economic cost that Parliament accepted when it legislated the existing 2050 target for an 80% reduction from 1990. However, this is only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay."

The World Green Building Council has recognised that, in most cases, net zero energy buildings are not feasible. Rather than generating all energy needs on-site, a combination of on-site and off-site energy generation combined with other energy-efficient measures is more achievable on a mass-scale. Already, the move to renewable energy has significantly reduced the carbon intensity of the UK grid, from around 560 g of CO_2 e per kWh in 2012 to 256 g of CO_2 e per kWh now and forecast of that reducing further. Electrification of the heat used for heating buildings and hot water, with that heat deriving from low-carbon, non-fossil-fuel, renewable sources allows us to make significant progress on the road to Net Zero.

Committee on Climate Change

Damaging climate impacts are already being felt today.

Reducing global emissions faster will hold warming to lower levels.

Every degree matters.

4ºC

3ºC

2ºC

1.5ºC

1ºC

Unchecked emissions growth would lead to very severe and widespread climate change at 4°C or more by 2100.

The world is moving towards a low-carbon future, reducing some risks. We are currently on track for around 3°C of warming by 2100.

The world has committed to reduce emissions faster to keep warming 'well-below' 2°C. This would help limit the most damaging effects of climate change.

Keeping below 1.5°C would limit many important risks further, helping to protect key ecosystems and reducing impacts on poorer people around the world.

Damaging climate impacts are already being felt today at 1°C of warming.

Climate change is here today:

- The frequency of heatwaves has increased around the world. Many extreme events are being made more likely due to climate change.
- Sensitive ecosystems, such as coral reefs, are being damaged due to extreme heat.
- Animals on the land and the ocean are shifting their territories in response to climate change.

UK action to address climate change can have an international impact

The UK can and should act as a leader in the global response to climate change - UK emissions contributed to causing it, and its leadership can have an international impact.

The UK has been a leader on climate change action. The UK has the opportunity to continue its leadership and join other countries already pursuing net-zero emissions targets.

The UK has committed to act by signing the Paris Agreement. This provides many options for countries to collaborate to reduce their emissions and prepare for the impacts of climate change.

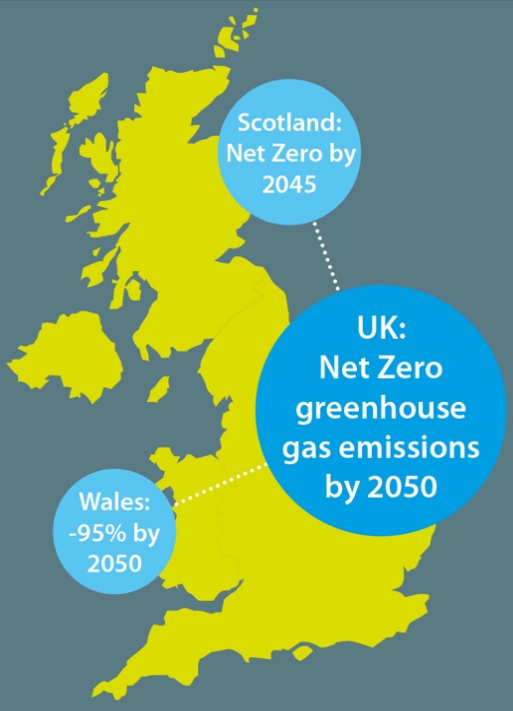
Annual costs of achieving net-zero emissions are between 1-2% of GDP in 2050, comparable to those estimated in 2008 for achieving an 80% target.

80% reductions in emissions relative to 1990 levels
estimated 2008

100% reduction in emissions in 2050
estimated today

Innovation has driven down the costs of key technologies, such as offshore wind & battery storage.

Some costs to consumers, such as increased heating bills, can be offset by cheaper transport costs (thanks to a widespread shift to electric vehicles) and cheaper electricity bills (thanks to low cost renewable electricity).



There are many benefits of phasing out harmful emissions

For the economy
New green industries with new jobs and export opportunities for the UK.

For the individual
Quieter streets, cleaner air, less congestion.

Smarter cities and more comfortable homes.

Healthier lifestyles, with more active travel and healthier diets.

For the country
More biodiversity, cleaner water, more green space to enjoy.

Reduced global warming, avoiding climate damages like flooding.

Using known technologies, the UK can end its contribution to global warming by reducing emissions to Net Zero by 2050

Emissions today

This transition will require a concerted effort and action by all

Any remaining emissions in 2050 must be offset

Clyde Gateway requirements

With a 20-year program of development, that concludes in 2028, Clyde Gateways ambition is to lead the way on achieving unparalleled social, economic and physical change across their communities covering an area of 840 Hectares in the East end of Glasgow.

Building on a successful legacy from the 2014 Commonwealth games, which adopted a district energy network powered by Combined Heat and Power turbines supplying private wire power and heat to the Athletes village and Emirates arena developments - Click here for details – the Clyde Gateway team were exploring options to expand on the opportunity by considering heat pump technology and the use of 4th & 5th Generation district heating and cooling networks as a differentiator to attract commercial developers to the site.

Due to the site's proximity to the Dalmarnock wastewater treatment works, Hillside were approached following the Borders College launch case study here to explore the use of Sewage heat recovery in this setting.

The project had 4 key aims

1. Evaluate the wastewater energy capacity in the area:

2. Establish the energy capacity at various locations:

3. Develop an economic model & investment appraisal:

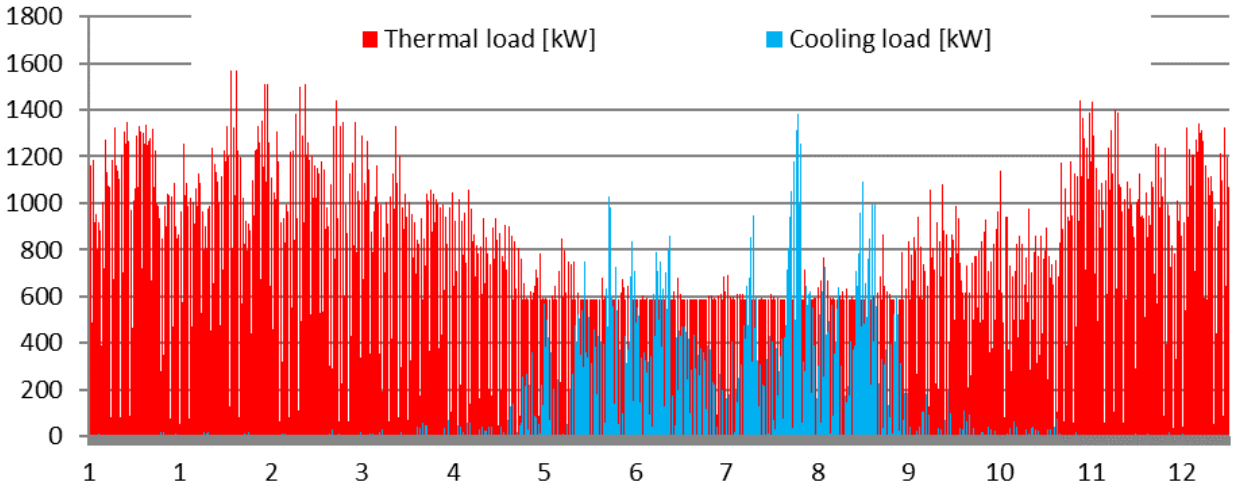
4. Develop a marketing tool to promote to developers

The Challenge

As Scotland's biggest and most ambitious regeneration programme, the Clyde Gateway is redeveloping 840 hectares of reclaimed industrial land. One legacy of the areas industrial heritage is the density of buried utility and services infrastructure

Alongside identifying appropriate locations for accessing the wastewater infrastructure, the project required a substantial evaluation of the buried infrastructure to support mapping of the potential heat network.

With master plan data available, Hillside created a synthesised thermal load at each location to provide a preliminary line of sight over the most productive locations for heat pump DHN, leading to a more focused and detailed appraisal for the feasibility study.



Choice of thermal energy source

Evaluation of a variety of thermal resources to run a heat pump system was conducted, to establish the most productive resource for the system to connect to.

Located next to the River Clyde, and Dalmarnock wastewater treatment works, the project presented a unique opportunity to evaluate the relative merits of both resources in determining the most productive option to run heat pumps from.

Whilst wastewater heat recovery was a new concept being introduced to the UK, it was chosen ahead of river source operation, because of its proximity to the Dalmarnock treatment works, with the volume and thermal consistency of wastewater flow around the area, which modelled higher system efficiency for the project.

With an arterial network of wastewater infrastructure around the area, the Hillside team worked with Scottish water to establish the daily diurnal flows and temperature ranges of the wastewater treatments works identifying a thermal capacity of between 17.8 and 30MW_{th}

Further, more granular analysis of the feeding pipework was then conducted to detect the most productive and accessible pipe routes in the re-development area, identifying 2 key opportunities for further investigation

- Shawfield &
- Dalmarnock

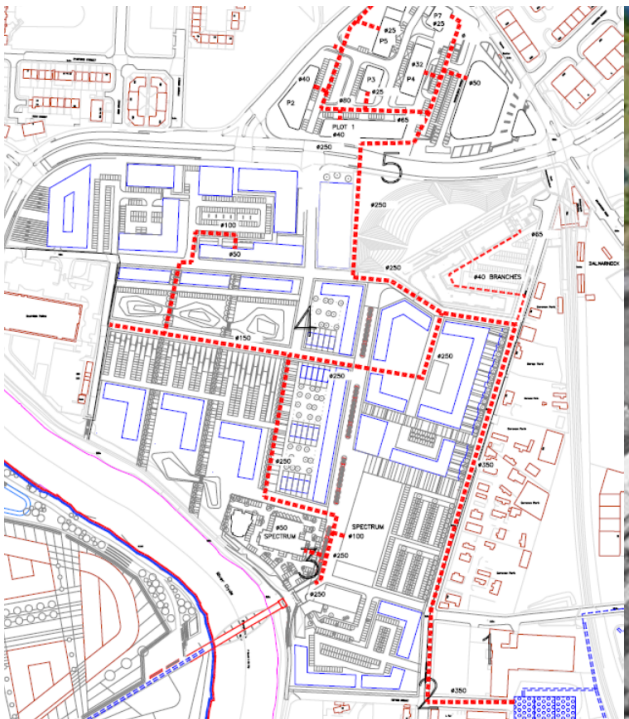
Feasibility Outcomes

Shawfield was identified as a candidate for 5th generation ultra-low temperature network delivery, with opportunities to integrate on site renewable power, batteries and thermal stores in facilitating a decentralised, energy sharing solution.

Dalmarnock was identified as a 4th generation solution driven by a hybrid trigeneration solution combining CHP and heat pump technology, to establish a power, heating and cooling service, that provide connected balancing to the Shawfield operation as required.

Throughout the feasibility process the team at **Hillside** supported Clyde gateway during various engagement and planning meetings with Highbridge, the chosen developer partner for the Shawfield location, Covering.

- Awareness briefings and commercial scenario planning
- Impact assessment reports on building designs and opportunities to reduce plant room space.
- Concept design for installation and operation of heat pump and buried infrastructure, including the Energy Centre design, energy aggregation through deployment of integrated technology & controls, heat network routing and infrastructure interfaces to enable the centralised distribution.
- Established an access agreement with the local water company and developed the sewer interface
- Mapping an energy services financial model and draft heads of terms for potential occupiers of the site.



Utility interface

Navigating and mapping the developments congested utility and buried services, involved the Hillside team in significant route planning for the new heat infrastructure, including

Highways

To establish the road opening and wayleaves requirements

Network Rail

To manage the network interface with a shallow rail tunnel serving the Glasgow subway network

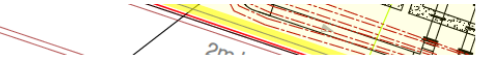
Scottish Water

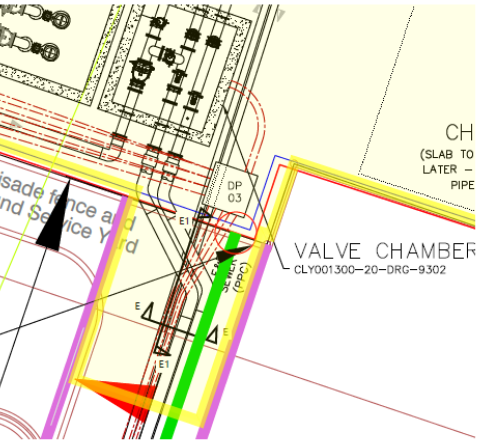
Establishing the main access arrangements for the connections

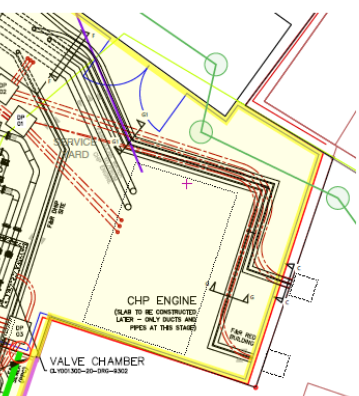
Scottish Southern Electric

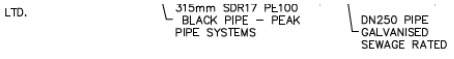
The local DNO and contracted utility partner of Clyde Gateway, providing support around grid capacity planning & use of utility corridors established to minimise disruptive impacts on new installations.

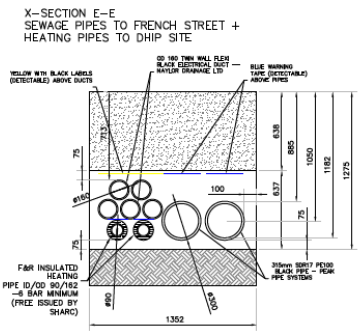
Using GPR surveys and trial digs to validate service interfaces, as well as managing the grid capacity upgrades a series of routes and satellite energy centres were mapped and used for planning the renewable energy infrastructure.

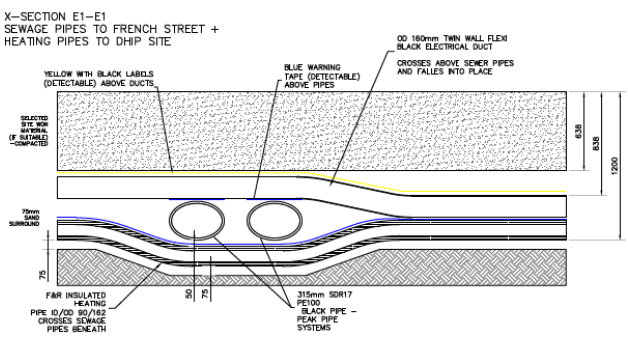


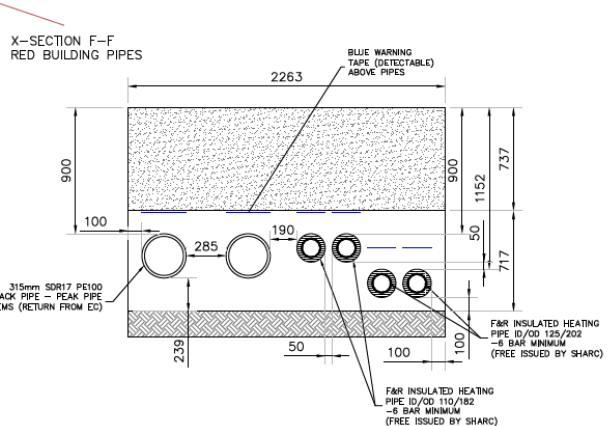


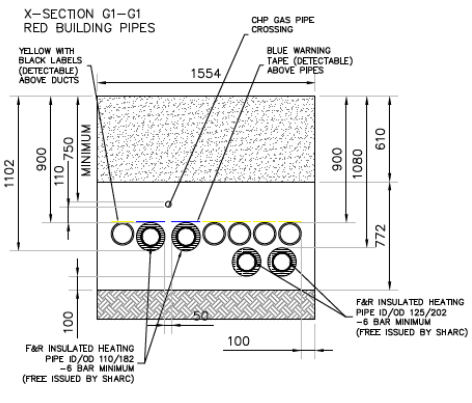


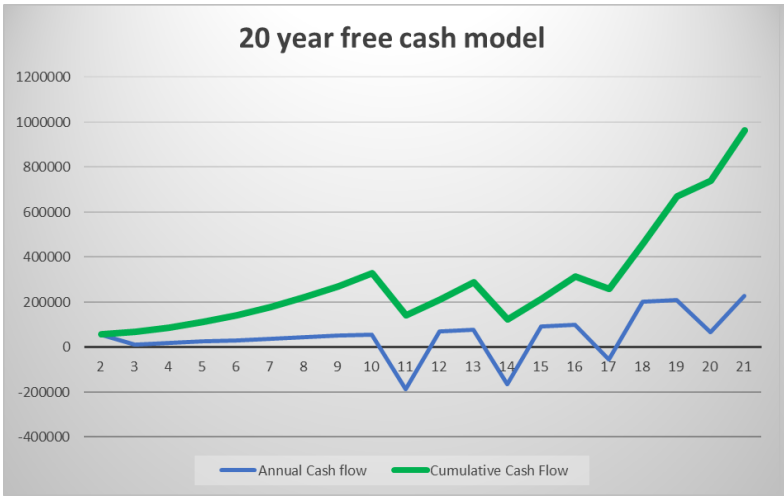


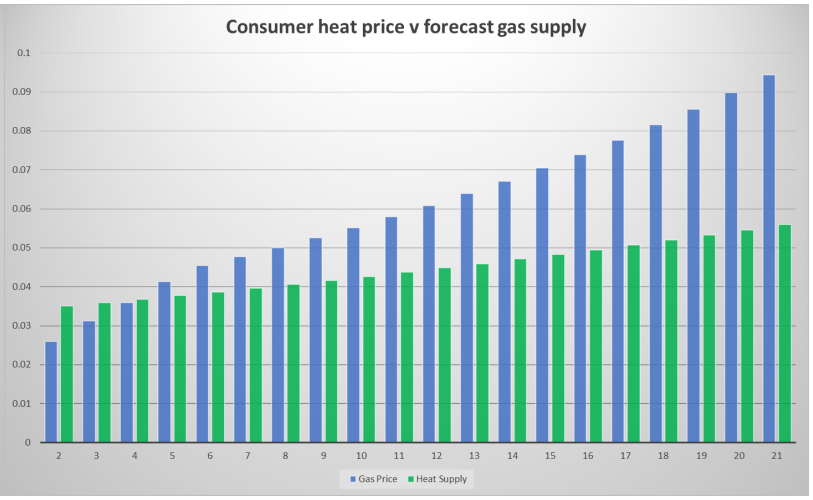












Financial Modelling

Establishing the whole life model of the project, covering a 20, 30 & 40 year horizon was a key element of the feasibility work

Critical elements for evaluation were

Cash flows

To identify key financial needs during the operational phase

Consumer pricing

Alleviating fuel poverty and protecting the community from market shocks is a critical element of the project objective and the financial modelling required clarity on the forecast price points v the modelled gas supply, to establish commercial structures once the system operators were appointed.

Carbon emissions profiling

Clarifying the environmental credentials of the installation was a vital part of the feasibility planning, to confirm the impacts on the Scottish net zero ambitions. As an electric heating system there were 2 scenarios mapped out as a counterfactual to natural gas supplies.

1. *Using grid supplied electricity*
2. *Utilising on site renewables, battery and smart technology*

The carbon and financial profiles of both scenarios are very positive, with the smart grid option providing accelerated decarbonisation but with higher capex to accommodate a shallower financial return.

The Clyde gateway team have, used the modelling and feasibility work to establish the business case for adopting the low temperature network solutions and are working with the appointed developers to establish the program for installation as the site build out.

They have also used the tools in securing ERDF Interreg grant support to fund the Shawfield (5^{th} Gen) project

Promoting the opportunity

Supporting the Clyde gateways promotional objective was a key element of the work, helping them to recruit developers and occupiers for the various sites around the areas.

The Hillside team supported the development of promotional video to articulate the opportunities during recruitment of developers for the site locations – click the image to visit the published version on YouTube.

Next Steps

The feasibility study has now provided the Clyde gateway team with a concept design that has informed the client of the technical – financial – environmental and social opportunities of adopting heat pumps to support their development and the tools are being used to promote to stakeholders and procure the energy operators for the development.

Further steps on the Road to Net Zero

For more information, and to take the next steps on your own Road to Net Zero, contact Hillside Environmental for a free, no-obligation discussion.

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