NET ZERO NEIGHBOURHOODS

REDESIGNING NEIGHBOURHOODS
FOR A LOW CARBON FUTURE

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LDN COLLECTIVE

WEST LONDON BUSINESS 30
LEADERSHIP FOR THE WORLD'S MOST CONNECTED PLACE

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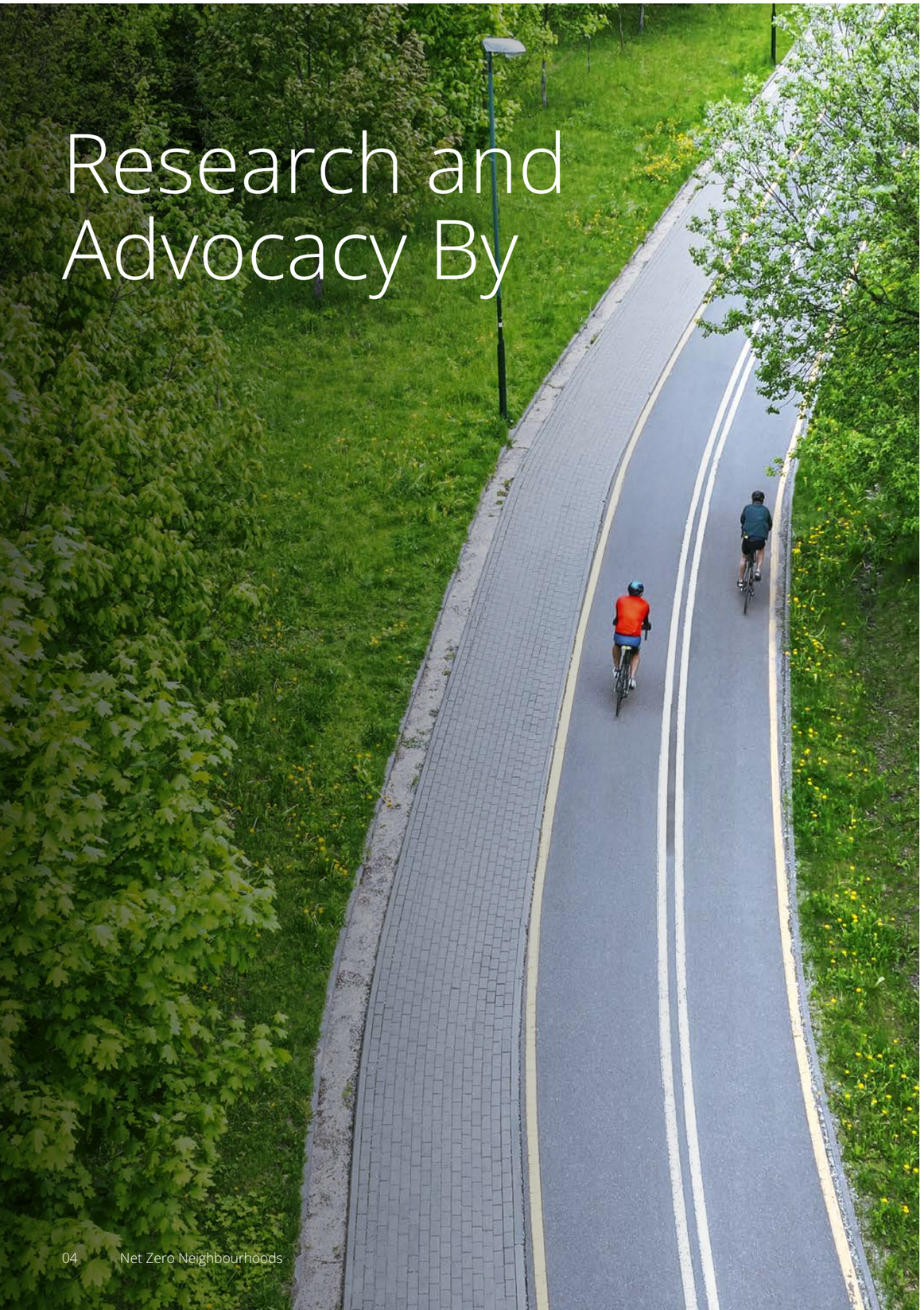


Research and Advocacy By

AESG

AESG is an international consultancy, engineering and advisory firm, committed to driving sustainability in the built environment and beyond. With the highest calibre leadership team in our field, we pair technical knowledge with practical experience to provide hands-on, bespoke strategic solutions to our clients.

We have one of the largest dedicated specialist consultancy teams working on projects within the building, urban planning, infrastructure and strategic advisory sectors. With decades of cumulative experience, our team offers specialist expertise in sustainable design, sustainable engineering, fire and life safety, façade engineering, commissioning, digital delivery, waste management, environmental consultancy, strategy and advisory, cost management and acoustics.

Our mission is to continue to be the consultancy of choice for clients to solve their greatest challenges through collaboration, innovation and advanced technical solutions. As signatories to the WorldGBC's Advancing Net Zero Buildings Commitment, AESG is committed to supporting the construction industry to reach the Net Zero Carbon Emission targets by 2030 and 2050. As members of the Council on Tall Buildings and Urban Habitat, the UK Green Building Council, and the Emirates Green Building Council, AESG actively provides leadership to the global sustainable building movement.

aesg.com

LDN COLLECTIVE

The LDN Collective is a network of built environment experts and creatives fighting to improve people's lives and the planet's prospects. Our members are experts in social impact, zero carbon and modern methods of construction as well as architecture, engineering, graphic design and film-making. As a diverse and eclectic group, we are bound by a set of values and a cost-effective business model. Whether it's a thought leadership campaign or the design and construction of a piece of city, we are a 'one stop shop' for projects anywhere in the world.

Our projects are setting new standards for environmental, social and financial goals, including a masterplan for a new garden community in Huntingdonshire with 5000 homes and a hub for green industries; design and delivery of mixed-use urban regeneration projects; #ParkPower the most comprehensive study of London's green spaces ever undertaken and a vision for the future of health and wellbeing highly commended by the Wolfson Prize.

ldn-collective.com

WEST LONDON BUSINESS 30
LEADERSHIP FOR THE WORLD'S MOST CONNECTED PLACE

West London Business is a business-led non-profit established in 1994 with a diverse membership including companies such as Heathrow, Quintain, Amazon and Argent Related, SMEs, social enterprises, FE colleges and universities. We are proud to represent hundreds of member companies from multinationals to SMEs and have a reach of 25,000+ supporters receiving our e-newsletters. We have long term strategic partnerships with local authorities, the GLA, local chambers and business groups, as well as non-profits.

West London is an amazing sub-region: it's a £73bn+ economy and the second largest economic powerhouse in the UK. Our members commit to work together to raise West London's global economic competitiveness, whilst catalysing action for people and planet. Over the past thirty years we have delivered significant positive impacts for the local economy, society and environment.

westlondon.com

Foreword

> The greatest challenge of our times is our ability to address the impacts of climate change, to try and reduce global warming and the catastrophic loss of biodiversity on planet earth.

Max Farrell

Founder & CEO, LDN Collective
Chair of Built Environment,
West London Business

Addressing climate change at the neighbourhood scale is a complex challenge that can only be done collectively, and it needs immediate and radical action to be taken. Within the UK, government at every level has committed to achieve net zero within the next 15-30 years, yet local authorities face significant challenges funding the transition. In response, 3Ci (the Cities Commission for Climate Investment) has proposed the Net Zero Neighbourhoods model, which packages together projects like residential retrofit and waste management to attract private sector investment. 3Ci is currently engaging with local authorities to develop demonstrators for Net Zero Neighbourhood projects.

One of the unintended consequences of our transition to net zero that has had an adverse impact in West London, is the lack of electricity supply. Last year, developers in Hillingdon, Ealing and Hounslow were told they face more than a ten year wait for any new homes to be provided with electricity, because of demands on the grid particularly from data centres. We urgently need to lower demands on the grid in order to build much needed new homes, prioritising retrofit of existing buildings in order to reduce embodied as well as operational carbon.

This piece of work, carried out by global sustainability experts AESG and supported by West London Business and the LDN Collective, identifies 10 key principles for planning and designing net zero neighbourhoods, 10 global case studies to learn from and the latest innovations that are accelerating change. We hope it gives confidence to local authorities, developers and the built environment industry to embrace more radical innovation, explore new funding models and skill up to retrofit at scale.

Please do not hesitate to contact myself or Sam Luker of AESG, if you would like to discuss any aspect of this further.

Yours sincerely,

Max Farrell

Founder & CEO, LDN Collective
Chair of Built Environment,
West London Business

INTRODUCTION

Net Zero Neighbourhoods

This research and advocacy builds upon the Cities Commission for Climate Investment's comprehensive Net Zero Neighbourhoods Programme. The programme supports a placed-based, multi-intervention approach at the local level, in order for the UK to achieve net zero by 2050.

The strategy is to unlock barriers by providing business models for public and private sector investment, funding the transition to net zero in the places and communities where we live, work and travel. The financial mechanism is referred to as 'blended funding' which combines public sector and place-based impact investing with private sector investment seeking financial returns.

This report highlights a series of case studies built throughout the world, and identifies key principles based on the available evidence.

The report is divided into the following sections;

- The Barriers Facing Net Zero Neighbourhoods
- Solutions to Overcome These Barriers
- Overview of the Net Zero Neighbourhoods Programme
- 10 Key Principles for Net Zero Neighbourhoods
- 10 International Case Studies
- Delivery Vehicles for Net Zero Neighbourhoods
- Learning From The Past, Looking To The Future

The report has been developed by AESG's globally renowned team of sustainability experts, supported by West London Business and the LDN Collective. The research highlights 10 key areas of focus with 10 neighbourhood scale case studies.

The focus areas range from optimisation, renewable technology, heat networks, renewable energy, demand response and energy storage through to funding mechanisms, digitisation and automation.

The report advocates for the rollout of Net Zero Neighbourhoods throughout the UK giving confidence to local government, private investment and the built environment community. We hope it will also be of interest to the general public, as the journey to net zero needs everybody to be on board.

What Are The Barriers

ECONOMIC

FINANCIAL COMMERCIAL
Lack of workable models for the recovery of private investment.

SOCIO ECONOMIC
The cost of intervening falls disproportionately on the poor and discourages public sector support.

ECONOMIC
The lack of emphasising and quantifying benefits have made for a weak economic case and a lack of government support.

SOCIAL

GOVERNANCE
Lacking the coordination and delivery vehicle for intervention.

POWERS
Councils lack the powers to drive action beyond their own assets.

GOVERNMENTAL

BEHAVIOUR
Building owners generally have other priorities, lack of knowledge and don't have to act.

BEHAVIOURAL
Landlords, and citizens more broadly, view decarbonisation as a non-priority.

PUBLIC OPINION
Lack of awareness, poor information, resistance to changes to homes and net zero actions.

TECHNOLOGICAL

TECHNICAL
Mature technology, but technically challenging to implement in combination.

DATA
Lack of detailed and reliable data.

ELECTRICITY SYSTEM CAPACITY
High uncertainty about reinforcement requirements.

INDUSTRY

HUMAN RESOURCE CAPACITY, SKILLS AND ACCREDITATION
Few resources are currently devoted to a huge systematic challenge while upskilling and professional certifications are currently limited.

SUPPLY CHAIN
Industry standards and knowledge don't meet the needs, constraints scaling even if we have the money and projects.

REGULATORY
Limits local innovation in energy contracting and delivery.

Current Solutions

LOCALLY LED
Be locally led and designed.

BLENDED FINANCE
Blend public and private finance, and generate revenues that remove personal costs of decarbonisation.

NO COST TO ASSET OWNERS
Providing financial aid for asset owners to increase incentives.

MULTI-INTERVENTION PLACE-BASED
Be place-based and focused on neighbourhoods and communities.

SCALABLE AND REPLICABLE
Ensure that projects are scalable and replicable elsewhere. Prioritise knowledge transfer.

WIDER BENEFITS
Generate wider benefits to society, such as clean air, better health and quality of life outcomes.

GOVERNANCE, MANAGEMENT AND PROCUREMENT
Integrate national, regional, and local authorities in a multi-stakeholder governance structure. Provide governance, management, procurement and technical support and structures.

Addressing The Barriers

The Net Zero Neighbourhood Programme

The Net Zero Neighbourhood programme is a programme that:

- Provides a **place-based approach to mass, nationwide decarbonisation** (greenhouse gas reductions): It is a neighbourhood-level approach that **promotes community buy-in** and is **led by the local authority** (with support).
- Facilitates multiple interventions in one place: It will be a one-stop-shop that delivers (primarily) **building retrofit solutions** (including solar PV, degasification, and central heating and insulation upgrades) at a building-level, while also **providing secondary interventions based on community requests and needs** (promoting a differentiated approach). These additional interventions may include:
  - **Natural capital** (green infrastructure - ecological and environmental enhancements such as tree planting, etc.)
  - **Transport interventions** that promote active travel (cycle lanes, bike storage, etc.)
  - **Waste solutions** (such as community composting, repair café etc.)
  - **Other community infrastructure** (such as a town hall or youth centre, etc.) facilitate the delivery of to scale up delivery, generate efficiencies and derive wider socio-economic benefits.
- Provides a **blended funding model**: this combines public funding (government) and outcome-seeking funding, with profit-seeking private investment, and
- **Generates revenues**: that can be used to fund the programme (repayable finance) and removes the need for individual residents and asset owners to personally fund the significant costs of decarbonisation, and providing household incentive to participate (energy cost savings).

As a result, the Net Zero Neighbourhood programme provides a pathway to supporting the UK's Net Zero Strategy, overcoming existing barriers to change, and achieving the target of net zero by 2050.

The aim of this research is to assist local authorities, investors, developers and communities to find new ways of retrofitting neighbourhoods for a low carbon future. The piece will build upon the work within the Outline Business Case (OBC) document published by 3Ci (Cities Commission for Climate Investment) in June 2023, with the intention of providing case studies and additional technical and financial information.

** The Case for a National Net Zero Neighbourhoods Programme, 3ci, June 2023*

Case Studies

10 Key Principles

THE 10 KEY PRINCIPLES OF NET ZERO NEIGHBOURHOODS

The research piece will aim to provide 10 clear areas of focus that would need to be achieved through the demonstrator projects.

1 OPTIMISATION
Ensuring that building massing, orientation and window to wall ratios are optimised so that energy use is minimised as well as material use and embodied carbon.

2 BUILDING FABRIC
Augmenting the building fabric to ensure that heat loss is minimised and therefore the energy consumption and carbon emissions are minimised.

3 ELECTRIFICATION
Electrification of building services to ensure that energy demand can be supplied by the generation of renewable technology.

4 HEAT NETWORKS
Utilising heat networks where the demand warrants it. In particular, 5th generation ambient loop heat networks in mixed use development areas that can share heating and cooling energy. Heat networks, also enable the use of waste heat.

5 RENEWABLE ENERGY
Generating as much renewable energy as possible through rooftop PV and in some cases wind turbines.

6 DEMAND RESPONSE & ENERGY STORAGE
Through both thermal storage and electricity storage, with the aim of dealing with peaks in demand to ensure that renewable energy is still utilised.

7 SOCIO-ECONOMIC BENEFITS
Realising and leveraging the additional socio-economic benefits to assist with the rollout of Net Zero Neighbourhoods.

8 FUNDING MECHANISMS
Enabling Net Zero Neighbourhoods to be funded and repayment mechanisms set up to attract investors as well as interested neighbourhoods.

9 LOCAL AUTHORITY ENGAGEMENT
Obtaining Local Authority buy in is essential in reducing upfront capital costs to attract investors as well as identifying sites and bringing together multiple parties.

10 DIGITISATION & AUTOMATION
Digitising assets to enable them to be monitored and tracked online, and decisions can be based on live dynamic simulations while maximising efficiencies, reducing energy consumption and ensure that energy used is procured at a time of highest renewable generation.

Case Studies Overview

1995

VAUBAN, GERMANY

Known as Europe's most sustainable town, Vauban has over 4,200 dwelling constructed using Passivhaus principles. Also known as the 'Solar City', all dwellings are orientated to ensure maximum efficiency for the PV on all roofs.

2002

BedZED, SUTTON, UK

BedZED is a smaller scheme, constructed on a brownfield site and designed to be free of fossil-fuel consumption through the use of a biomass boiler. It was constructed in 2002 and was the UK's first large-scale, mixed-use sustainable community producing roughly 100 homes.

2006

CAMBRIDGE CITY COUNCIL – CLIMATE CHANGE STRATEGY, UK

Cambridge City Council have acquired several governmental grants to enable the development of the city. Most of the focus so far has been on the retrofit of both privately owned and council owned homes as well as raising general awareness for sustainable practices in local businesses.

2010

NEIGHBOURHOOD ENERGY UTILITY, VANCOUVER, CANADA

The False Creek Neighbourhood Energy Utility has used waste thermal energy captured from sewage to provide space heating and hot water to buildings since 2010 and is continuing to add buildings onto the heat network as the area develops.

2014

ENERGISE BARNSLEY, YORKSHIRE, UK

Neighbourhood scheme set up to reduce energy bill and promote sustainability in vulnerable households. Funded through a retail bond and a loan from ethical lender Charity Bank, implementation of PV was completed on over 300 sites in 2014 with 90 residential batteries added by 2019.

RENEWABLE HEAT RETROFIT, BORDERS COLLEGE, SCOTLAND, UK

Using waste heat from the local sewage network in Scotland to heat 3 buildings on a college campus, one of which is a listed Victorian Mill. The heat is supplied from the five plant rooms within the building and distributed to meet thermal comfort standards.

2015

TALLAGHT DISTRICT HEATING SCHEME, IRELAND

The creation of a private heat network which uses excess heat from Amazon Web Services' data centre to provide low carbon heat to a network customers. Buildings heated by this project include County Hall, Tallaght County Library, the SDCC Innovation Centre - Work IQ with plans to connect 133 apartments in 2025.

2022

UNIVERSITY OF WEST LONDON, EALING, UK

The University of West London is committed to becoming Net Zero by 2030. They are achieving this through the installation of a ground source heat pump and PV across the roofs, with the aim to install all technology with minimal disruption to the rest of the campus.

2023

KENSA HEAT THE STREETS, CORNWALL, UK

Kensa Utilities has funded and retained ownership of the world's first retrofit of ground array infrastructure in the road, reducing the upfront cost of the ground source heat pump for the homeowners.

2023

GREENHAUS, MANCHESTER, UK

The 'Greenhaus' is a nine-storey development of 96 affordable homes in Chapel Street, Salford. Once construction is finished in early 2024, it will be the largest Passivhaus social housing scheme in Manchester and the North West of England.

2024

1 VAUBAN
Freiburg, Germany

Apartment buildings at Vauban with PV panels covering the entire roof area

"Holistic sustainable living, with key objectives implemented from the beginning

PROJECT OVERVIEW

Vauban is a city district in Freiburg often known as the "solar city" and is classed as the most sustainable town in Europe. Typical buildings feature key passive design principle including:

- Highly efficient insulation materials
- Timber frames
- Low air tightness levels
- Solar photovoltaic panels on the roof, angled to provide optimum energy production
- Electric heat pumps
- Low U-value windows

The town also discourages the use of cars by adding a large rental fee for car parking spaces which are located on the outskirts of the town and few roads, instead cycle paths and pedestrian zones have been prioritised, with an electric tram that connects the city.

BARRIERS

TECHNICAL CAPABILITIES AND TECHNOLOGY
Since initial construction of the city began in 1995, large advances in sustainable technology have occurred.

HUMAN RESOURCE, SKILLS AND CAPACTIY
Since initial construction of the city began in 1995, large advances in the understanding and training of sustainable practices have taken place.

BEHAVIOUR
The district is mostly composed of young people and young families. Around 2000 adolescents live in the area creating an unbalanced age structure.

KEY PRINCIPLES

ELECTRIFICATION
Smart meters were inputted in 2019 into the majority of dwellings.

RENEWABLE ENERGY
All dwellings have maximum amounts of PV at optimum angles to provide positive energy buildings.

LOCAL AUTHORITY ENGAGEMENT
The development of Vauban was led by the local community, with a small group in 1995 creating the initial fundamentals.

BUILDING FABRIC
All houses were built with improved low energy standard, with 150 houses reaching Passivhaus standards.

OPTIMISATION
All dwellings are orientated south and angled to provide maximum energy through PV.

SOCIO-ECONOMIC BENEFITS
Nearly 25% of housing is social housing and is indistinguishable from other dwellings.

1 VAUBAN
Freiburg, Germany

OTHER FEATURES OF THE CITY

65% of the electricity is produced locally using CHP and solar → 40 - 80% efficiency increase

Rainwater is collected separately to be used in houses. The groundwater is treated to remove contaminants before being released back into a small river.

All houses are constructed to meet at least 65kWh/m²

A co-generation plant uses 80% wood chip + 20% natural gas

Organic household waste is treated with an anaerobic digester.

Around 150 homes meeting Passivhaus standards of 15kWh/m²

Buildings are limited to a height of 12.5m to allow cooling breezes from the mountains to cool the city during warmer months.

Just 32% of land is used for urban development, including all transportation, 42% for forests, 27% for agriculture, recreation, water protection

Close up of PV covered roof at Vauban

DESIGNERS
- Exemplar sustainable development at scale in Europe.
- Design around sustainable principles to allow for the most efficient use of technology (i.e. orientation of buildings)

PLANNERS/ GOVERNMENT
The ability to develop a holistic sustainable city at scale to high energy efficiency standards and with high percentages of social housing.

INVESTORS
- More funding resources for small independent groups are needed, to avoid delayed payments and putting the liquidity of the project in danger.
- Development more resilient and retains value.

FUNDING SOLUTIONS

The process of urban development in Vauban was supported by the Forum Vauban association which was approved by the City of Freiburg as the coordinator of citizens' participation in 1995. Since 1996 the Federal Environmental Foundation supported the association with a grant for research into the impact of citizens' participation in urban planning.

The total investment in Rieselfeld is in the order of €500 million for a total of 4,200 dwellings. Land value works out at €430/m². Building costs are €3,300/m² on average but only €2–2,400 for cooperatives.

TOTAL INVESTMENT
€500 million
4,200 dwellings

LAND VALUE
€430/m²

BUILDING COSTS (AVERAGE)
€3,300/m²

COOPERATIVES
€2,000 - €2,400/m²

1 VAUBAN
Freiburg, Germany


View of PV panels on roofs at Vauban

LESSONS LEARNT

Vauban has released lessons learnt explaining the handling of finances was an overwhelming responsibility. More funding resources for small independent groups are needed, to avoid delayed payments and putting the liquidity of the project in danger. Additionally, "recycling" of old military bases or industrial areas could slow down sub-urbanisation.

RESULTS

The project is being monitored using lifecycle and regional material flow analysis with the GEMIS software. This is the first time that a complete urban neighbourhood has been analysed with respect to buildings, infrastructure, electricity supply, heat supply, water and waste, traffic and private consumption with a full life-cycle perspective and using regional data. The gathering of local data was possible for all areas except private consumption, for which national average data was used.

Through this, the following provisional figures were developed:

ENERGY SAVINGS PER YEAR
28GJ
calculated as "CER" (Cumulative Energy Requirements)

REDUCTION OF SULPHUR-DIOXIDE (SO_2-) EQUIVALENTS PER YEAR
4 tonnes

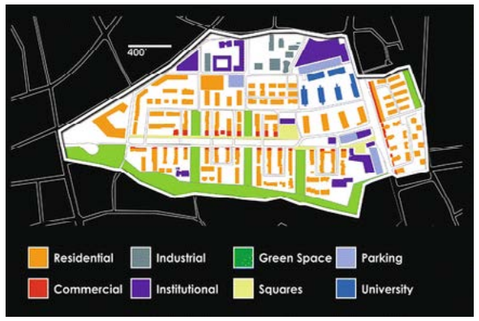
REDUCTION OF CO_2-EQUIVALENTS PER YEAR
2,100 tonnes

SAVING OF MINERAL RESOURCES PER YEAR
1,600 tonnes

A highly efficient co-generation plant (CHP) operating with wood-chips is connected to the district's heating grid. Good insulation and efficient heat supply creates CO_2-savings of 60%. A large number of solar collectors and photovoltaic modules were installed. Around 65% of the electricity needed in Vauban is produced on-site through CHP and photovoltaic.

The ecological traffic concept reduced the number of private cars, provided good public transportation, and a car sharing system. Streets and other public spaces became playgrounds for children or other public uses.

Rainwater is collected separately for in-house use or filtrated into the ground. A new sanitary concept using vacuum toilets and biogas plants was introduced by one co-building group.




View of masterplan at Vauban

AWARDS AND COMMENDATIONS

Vauban was:

- Presented as a Best Practice at the 1996 UN Habitat II conference in Istanbul.
- A finalist of the Partnership Award at the "Business and Municipality" conference in Bremen 2001.

KEY TAKEAWAYS

- Implemented key infrastructure first using a fabric first approach and orientated for maximum efficiency.
- Clear targets for energy and water usage had been set and communicated to the community, reducing the target as technologies have improved.
- Reduced infrastructure for unsustainable modes of transportation.
- Retrofitting new technologies.
- Community buy-in.

2 BedZED

Sutton, UK

View of apartment buildings at BedZED

> Innovative technologies and strategies to create a small sustainable community with valuable lessons learnt

PROJECT OVERVIEW

BedZED was conceived in 1997 when sustainability charity Bioregional and green architect Bill Dunster learnt that Sutton Borough Council was preparing to sell a brownfield site for development. Constructed in 2002, it was the UK's first large-scale, mixed-use sustainable community.

The site produced 100 homes with approximately 220 residents with large amounts of shared outdoor space.

BedZED was designed to be free of fossil-fuel consumption once it was built, radically reducing its residents' emissions of climate-changing carbon dioxide gas and giving them energy security. This was achieved by implementing:

- Biomass Boiler
- Open green spaces
- Photovoltaic panels
- Passive design principles
- Reduced water consumption with sub-metering

BARRIERS

BEHAVIOUR
There was an initial misuse of the building due to a lack of understanding from the residents.

TECHNICAL
The original wood-powered boiler had to be turned off in 2005 due to technical difficulties.

HUMAN RESOURCE CAPACITY, SKILLS AND ACCREDITATION
Prefabrication also risking the de-skilling of construction trades, and reducing opportunities for local construction work.

KEY PRINCIPLES

ELECTRIFICATION
Smart meters are inputted in 2019 into the majority of dwellings.

RENEWABLE ENERGY
PV is placed on top of all buildings with a biomass boiler used to heat all units.

LOCAL AUTHORITY ENGAGEMENT
Initially selling the plot of land to Peabody to enable BedZED.

BUILDING FABRIC
52% of its construction materials by weight were sourced within 56 km of the site while 15% by weight (3,304 tonnes) were recycled or reclaimed.

OPTIMISATION
The eight main accommodation blocks are solar oriented, with double glazing covering all vertical south-facing facades.

SOCIO-ECONOMIC BENEFITS
Conversion of an unused brownfield site into sustainable housing.

2 BedZED

Sutton, UK

View of the alleyway at BedZED

DESIGNERS

- Exemplar sustainable development in the UK.
- Design around sustainable principles to allow for the most efficient use of technology (i.e. orientation of buildings)
- Various example of sustainable technologies.

PLANNERS/ GOVERNMENT

- Innovative use of brown field site to ensure sustainable development.
- Environmental economists showcased the financial value on BedZED's benefits over the conventional competitor demonstrating that that 'the benefits flowing to the borough outweigh the loss of any capital receipt achievable.

INVESTORS

Land Sale and agreement to provide an environmentally and socially concious development enabled the purchase of the land at lower than market rates.

FUNDING SOLUTIONS

In 1998 the London Borough of Sutton, the site's owner and the local planning authority, backed the idea of an exemplary, sustainable mixed-use development, more ambitious than anything previously attempted in the UK. The council agreed to sell its plot of land to Peabody at a price slightly lower than the full market value, having sought assurances that the government would have no objection. It justified this on the basis that building BedZED (Beddington Zero Carbon Energy Development), an idea conceived by the sustainable charity Bioregional and architect Bill Dunster, rather than a conventional housing estate would secure wider community benefits including reductions in climate-changing carbon dioxide emissions. Construction began in 2000.

IDEA PROPOSAL BY LONDON BOROUGH SUTTON TO CITY COUNCIL

1998

CONSTRUCTION BEGAN

2000

LESSONS LEARNT

At BedZED the idea was to supply all energy required on-site, generated by a CHP plant using locally sourced woodchip to generate both heat for hot water and electricity. The plant was operational for long periods but is now famously idle whilst Peabody consider the options for replacement. The main reason it didn't work is that it is too small scale to justify the maintenance needed to keep it operating.

Currently around 20% of BedZED's electrical demand is met by on-site photovoltaics. They were originally installed to power electric cars but since the market hasn't taken off yet this energy is being used in the buildings.

Of course, technology develops all the time, but for now the lesson is that it is not sensible to say that all energy should be generated on-site in all cases. What is possible, technically and economically, will vary by location, type and scale of the buildings.

ON-SITE PHOTOVOLTAICS PROVIDE AROUND

20%

of BedZED's electrical demand

TOTAL ENERGY CONSUMPTION AND CO_2 EMISSIONS/M^2 (RESIDENTIAL)

		BedZED 2007	BedZED 2007 if CHP in operation	UK AVerage (based of dwellings built in 2002)
Heating and Hot Water	kWh/m^2/yr	48.0	48.0	231.8
	CO_2/m^2/yr	9.3	1.2	45
Electrical Load	kWh/m^2/yr	34.4	34.4	45.5
	CO_2/m^2/yr	10.6	-8.9	18.4
Total Energy Use	kWh/m^2/yr	82.4	82.4	275.3
	CO_2/m^2/yr	19.9	-7.7	63.3

2 BedZED

Sutton, UK

RESULTS

Between 2012 and 2015, BedZED's annual gas consumption was 36% lower than a typical conventional development in Sutton, London of the same size and mix (100 homes plus office, college and community space).

Its annual electricity consumption during that period was 27% less. Consequently, it is estimated that BedZED's greenhouse gas emissions (tonnes of carbon dioxide equivalent) from heating and electricity use were 32% less than from an equivalent conventional development during that four-year period.

In 2015 analysis was completed on the energy and water consumption, and the associated bills, of a typical two-person BedZED household. It was found that the combined energy bills (for heating and electricity) were 68% less than for the average London home. This household's water bills were 45% less than the London average. The combined saving amounted to £1,094 a year.

BEDZED'S ANNUAL GAS CONSUMPTION (2012-2015)

36% lower

than a typical conventional development in Sutton, London

BEDZED'S ANNUAL ELECTRICITY CONSUMPTION

27% less

BEDZED'S ANNUAL GHG EMISSIONS

32% less

than from an equivalent conventional development

BEDZED'S COMBINED ENERGY BILLS (HEATING & ELECTRICITY)

68% less

than average London home

BEDZED'S HOUSEHOLD WATER BILLS

45% less

than average London home

COMBINED SAVINGS

£1,094

a year

Occupants thriving at BedZED

Occupants thriving at BedZED

Wind catchers at BedZED

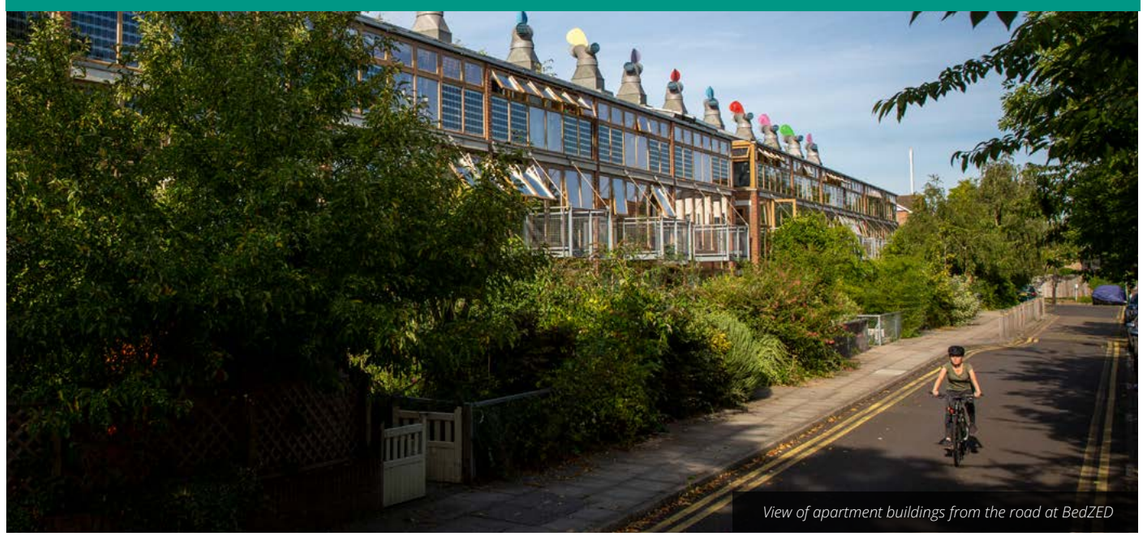
AWARDS

BedZED has won several prestigious award including:

- Shortlisted for the Stirling Prize 2001
- London Lifestyle Award – Evening Standard New Homes Award 2001
- Special Awards: Sustainability – RIBA London Awards 2003
- Best Project & Sustainability Award - Housing Design Awards 2003
- Ashden Award 2003

KEY TAKEAWAYS

- Innovative technologies implemented (such as CHP plant) and learnt from when unsuccessful
- Clear targets for energy and water usage had been set and communicated to the community
- New build using brown field site



View of apartment buildings from the road at BedZED

3 CAMBRIDGE CITY COUNCIL

Climate Change Strategy, UK

View of new apartment buildings developed as part of the Climate Change Strategy

> Council making small changes over a long period of time to create a sustainable neighbourhood

PROJECT OVERVIEW

Cambridge City Council has outlined 6 main objectives within their climate change strategy to be implemented. They are:

- Reducing carbon emissions from City Council buildings, land, vehicles and services.
- Reducing energy consumption and carbon emissions from homes and buildings in Cambridge.
- Reducing carbon emissions from transport in Cambridge.
- Reducing consumption of resources, reducing waste, and increasing recycling in Cambridge.
- Promoting sustainable food.
- Supporting Council services, residents and businesses to adapt to the impacts of climate change.

All 6 of the objectives have been clearly defined with targets set for each one.

The Council has successfully secured funding from Government to support retrofit activity in the past. Over the period of the Council's previous climate change strategies, they have:

- Delivered 1402 insulation measures through a combination of the national CERT scheme and the Council-funded Cambridge Home Insulation Scheme
- Retrofitted 433 homes in Cambridge with loft, cavity wall and/or solid wall insulation using £2million from the national Green Deal for Communities programme from 2014-2016. This programme was part of a wider £7.8 million Cambridgeshire wide partnership programme called Action on Energy, which was one of the most successful Green Deal delivery programmes in the country.
- Funded Cambridge Carbon Footprint through the Council's Sustainable City Grants to run annual Open Eco Homes events, which provide opportunities to attend energy efficiency workshops and visit low carbon homes in Cambridge. In 2020, 517 residents attended Open Eco Homes events.

DELIVERED

1,402 insulation measures

RETROFITTED

433 homes

with loft, cavity wall and/or solid wall insulation

GAINED

£2 million

from the national Green Deal for Communities programme (2014-2016)

517 residents

attended Open Eco Homes events in 2020

BARRIERS

BEHAVIOUR
Decarbonising homes will require huge investment by homeowners and landlords.

ECONOMIC
Since initial construction of the city began in 1995, large advances in sustainable technology have occurred.

AVAILABLE DATA
There is currently a lack of understanding of the current state of many council and non-council owned homes.

3 CAMBRIDGE CITY COUNCIL

Climate Change Strategy, UK

KEY PRINCIPLES

RENEWABLE ENERGY
Implementation of air source heat pumps and solar panels.

LOCAL AUTHORITY ENGAGEMENT
Cambridge City Council set up the Sustainable City Grant.

BUILDING FABRIC
Implementation of air source heat pumps and solar panels.

OPTIMISATION
The materials used during the retrofit process have been selected to decrease the embodied carbon while increasing energy efficiency of the home.

SOCIO-ECONOMIC BENEFITS
Plans to improve both council owned and private homes with different initiatives.

DESIGNERS	Simplification and implementation of insulation and renewable energy measures at scale and speed.
PLANNERS/ GOVERNMENT	Local council showcasing what is possible when a localised zero carbon delivery scheme is set up and actively managed. Government grants are readily available for these schemes.
INVESTORS	• All funding obtained from national government grants or local funding • Potential for scheme to be supercharged by private investment.

FUNDING SOLUTIONS

The Cambridge city council has acquired several different grants to fund their sustainability targets, with the majority being government-funded schemes such as the new Green Homes Grant Local Authority Delivery (LAD) scheme.

From 2020/21 to 2022/23, Cambridge City Council have committed to investing a further £2.5 million to improve the energy efficiency of the remaining Council homes with EPC ratings of D to G, with the aim of bringing these up to a C rating or above where feasible. National funding to date has primarily focussed on energy efficiency measures such as loft, cavity and external wall insulation.

CAMBRIDGE CITY COUNCIL HAVE COMMITTED TO INVESTING A FURTHER

£2.5 million

BUSINESS AND INSTITUTIONS

If Cambridge is to reach net zero carbon emissions, it is vital for institutions and businesses in the city to reduce carbon emissions from their buildings. The Climate View systems suggests that the following interventions could potentially significantly reduce emissions from institutional, industrial and commercial buildings in the city:

- Energy efficient non-residential buildings (5% of total carbon emissions)
- Low carbon heating of non-residential buildings, including district heating schemes, heat pumps, hydrogen, biogas, or biofuels (18% of total carbon emissions)
- Solar PV on roof-space (12% of total carbon emissions for homes and non-residential buildings combined).


Net zero facade design

ENERGY EFFICIENT NON-RESIDENTIAL BUILDINGS

5%

of total carbon emissions

LOW CARBON HEATING OF NON-RESIDENTIAL BUILDINGS

18%

of total carbon emissions

SOLAR PV ON ROOF-SPACE

12%

of total carbon emissions for homes and non-residential buildings combined

The council will be taking a range of steps to help encourage institutions and businesses to reduce their carbon emissions through:

- Using planning policy to ensure high standards in on new non-residential buildings in Cambridge. The current Local Plan requires all new non-residential development to meet the BREEAM Excellent standard.
- Hosting workshops to support SMEs to reduce their energy use.
- Targeting communications to businesses. For example, in 2020 and 2021 a flyer was sent to over 4,000 businesses (alongside requests for Council Tax payment) highlighting the key steps they can take to reduce their carbon footprint, including energy efficiency and renewables in buildings.
- Commissioning Cambridge Carbon Footprint to produce the Climate Change Charter, which enables businesses and institutions to commit to reduce their carbon emissions.


Community viewing retrofit installation

3 CAMBRIDGE CITY COUNCIL

Climate Change Strategy, UK

COMMUNITY ENGAGEMENT

Council has also worked with local community groups to encourage residents to reduce consumption, and re-use or repair existing goods. For example, through its Sustainable City Grants fund, the Council has funded Cambridge Carbon Footprint (CCF) to run a series of events as part of their Circular Cambridge project, including:

- The world's largest repair café in 2017, which was attended by 550 people. There were a record-breaking 232 successful repairs of household items at the event.
- Cambridge's first sustainable fashion festival in November 2018, which was attended by 850 people and included a sewing repair café, a clothes swap, upcycling workshops and a pop-up clothed market.
- Further engagement activities in 2019/20 including stalls at local festivals, repair cafes and clothes swaps at Cambridge University events, and upcycled art displays.

WORLD'S LARGEST REPAIR CAFÉ (2017)

550 attendees

SUCCESSFULLY REPAIRED

223 household items

CAMBRIDGE'S FIRST SUSTAINABLE FASHION FESTIVAL (2018)

850 attendees

Community involvement in repair café

NEXT STEPS

Over the next 5 years, the Council will seek opportunities to support homeowners and landlords to reduce carbon emissions from private homes, including:

- Commissioning a retrofit study to identify what energy efficiency and renewable energy measures would need to be installed for different property archetypes in Cambridge to reach different carbon emissions standards. The study would provide an evidence base for bids for Government funding and would provide guidance for residents on what measures would be most effective in their property. The scope for utilising satellite and drone thermal imaging techniques being developed by researchers at the University of Cambridge will also be explored.
- Promoting group-buying schemes, such as the Cambridgeshire-wide Solar Together scheme. This enables residents to purchase solar PV panels and battery storage at significant discounts. In autumn 2020, 999 Cambridge residents registered for the first round of the scheme, of which 293 accepted offers for solar PV and/or battery storage.

CAMBRIDGESHIRE-WIDE SOLAR TOGETHER SCHEME

999 Cambridge residents

registered for the first round in 2020

293 residents

accepted offers for solar PV and/or battery storage

KEY TAKEAWAYS

- Several smaller interventions implemented over a longer time period when grants were achieved
- Roadmap of future plans and investments for housing and local businesses
- Clearly defined targets for housing and business
- Initial focus on housing (both council owned and private)
- Large scale community engagement including schemes to reduce residents day-to-day carbon footprint outside of the home
- Workshops provided for housing a businesses to guide and assist the community

Installation of PV panels on historic buildings in Cambridge city centre

4 NEIGHBOURHOOD ENERGY UTILITY

Vancouver, Canada

False Creek Inlet

> The heat trapped in the sewerage system contained and harnessed for heating buildings cleanly

PROJECT OVERVIEW

The False Creek Neighbourhood Energy Utility uses waste thermal energy captured from sewage to provide space heating and hot water to buildings in Southeast False Creek, parts of Mount Pleasant, False Creek Flats, and Northeast False Creek.

The NEU targets 70% of its energy supply to come from renewable energy sources. The utility is self-funded, simultaneously providing a return on investment to City taxpayers and affordable rates to customers.

The utility began operations in 2010 and has rapidly expanded to serve over 6.4 million square feet of residential, commercial, and institutional space, as of 2021.

New developments located in the False Creek Neighbourhood Energy Utility (NEU) service area are required to connect to the City-owned system for space heating and domestic hot water, as per the Energy Utility System By-Law.

BARRIERS

ECONOMIC
Developers, facing mandatory connection, had some apprehensions about the costs associated with the heating systems when compared to the business as usual electric heating systems..

PUBLIC OPINION
Concerns voiced by the community included possibility of odour, air pollution and contamination and the unaesthetic presence of industrial smokestacks.

TECHNICAL
There were some concerns over the sewer heat recovery system because the technology was relatively unknown to the community.

KEY PRINCIPLES

BUILDING FABRIC
The project secured federal and provincial grant funding through the cleanBC Communities Fund.

SOCIO-ECONOMIC BENEFITS
Reduction in bills and carbon emissions for all participation properties.

HEAT NETWORKS
Heat is recovered from untreated urban wastewater and heat pumps are used to transfer the energy to a closed-loop hot water distribution system.

LOCAL AUTHORITY ENGAGEMENT
The City of Vancouver were the sole owners of the project and assumed risks related to high capital costs.

4 NEIGHBOURHOOD ENERGY UTILITY

Vancouver, Canada

The Southeast False Creek development was conceived as a legacy project of the Vancouver 2010 Olympics.

INITIAL STEPS

The Olympics providing a catalyst to develop a sustainable neighbourhood in the polluted brownlands at the heart of Vancouver's growing core. The massive plan to clean up and build the games' athletes village also brought tight construction timelines for the development and the district energy system.

The original plan to use a biomass plant to provide heat was the lower cost and lower GHG option, but was abandoned for a sewer heat recovery system as a result of public opposition over concerns around air quality and potential delays from regional government approvals. With the tight Olympic games timelines, the city pivoted their technological approach. The city ran a steering committee consisting of various city departments (finance, legal, planning, engineering) simplifying the project coordination.

SYSTEM

Heat is recovered from untreated urban wastewater at the Southeast False Creek Energy Centre and heat pumps are used to transfer the energy to a closed-loop hot water distribution system. An insulated closed-loop underground piping system circulates the hot water heated from the sewage recovery around the neighbourhood to be used in the showers and sinks of the community.

Sewage heat recovery systems, though similar to regular geothermal ground source heat pumps, are more efficient because the sewage runs hotter and installation is cheaper. During the coldest nights of the year, the heat pumps are supplemented with high-efficiency natural gas boilers to achieve optimal heating levels. The heat pump technology heats the water to about 65°C, which is sufficient for residential space heating and domestic water heating.

Inside the False Creek facility, heat pump technology is used to heat up clean, fresh water on a separate circuit from the wastewater

FUNDING

The project has secured federal and provincial grant funding of up to $10.2 million through the cleanBC Communities Fund, and up to $550,000 from the Federation of Canadian Municipalities Green Municipal Fund.

The total project cost is $14 million and completion is expected in late 2022.

The rates for the project were similar to a traditional utility with revenue coming from the customer base. The city implemented a mandatory connection requirement to reduce the risk of and improve the economies of scale of the project. The city also ran deficits during the early years to make the project cost-competitive in the short-term.

The city carried out the construction and procurement of expensive equipment in stages to mitigate the high capital costs. The plant capacity and construction was staged to align with the evolution of the project's development. The city provided additional capacity to the system when new neighbourhood buildings were constructed. This helped delay the most capital intensive portion of the project towards the end of the build-out when higher customer demand (and revenue) was present, making for more favourable economics.

THE PROJECT SECURED FEDERAL & PROVINCIAL GRANT FUNDING OF UP TO

$10.2 million

through the cleanBC Communities Fund

AND UP TO

$550,000

from the Federation of Canadian Municipalities Green Municipal Fund

TOTAL PROJECT COST

$14 million

KEY FACTS

5,750,000 sq ft

floor area serviced by the False Creek Neighbourhood Energy Utility in 2019.

22,600,000 sq ft

floor area expected to be serviced by the False Creek Neighbourhood Energy Utility at full system build-out.

50,000MWh

Total energy produced by the utility in 2019.

6km

Total length of distribution system pipe in 2019.

3,500 tonnes

of CO_2 saved. The equivalent of taking 928 cars off the road in 2017.

34 buildings

connected to the utility in 2019.

4,920 Residential Suites

Connected to the Southeast False Creek Neighbourhood Energy Utility in 2019.

False Creek Energy Centre

The Energy Centre was designed to showcase the innovative use of sustainable technology. The building that houses the utility infrastructure has a certified LEED Gold rating. Its large windows allow people to look inside and see components of the utility.

The stacks

The most visible part of the building is five exhaust flues, or stacks, which resemble a hand reaching up on the east side of the Cambie Street Bridge. The 'fingernails' of the hand are LED light fixtures that change colour to reflect the amount of energy being produced by the utility.

4 NEIGHBOURHOOD ENERGY UTILITY

Vancouver, Canada

DESIGNERS

- Heat provided to a significant number of buildings, showcasing the potential of the technology.
- Distribution as per a typical heat network.

PLANNERS/ GOVERNMENT

The City of Vancouver were the sole owners of the project and responded to consultation and environmental analysis in developing the plans for the system.

INVESTORS

Vancouver were the sole owners of the project and assumed risks related to high capital costs. This allowed the council to maintain control of the network and to recuperate costs.

RESULTS

The planned system expansion will serve over 2,100,000m^2 of development at full build-out, with GHG savings forecast at 14,000 tons of CO_2-equivalent per year, roughly a 70% reduction in GHG emissions.

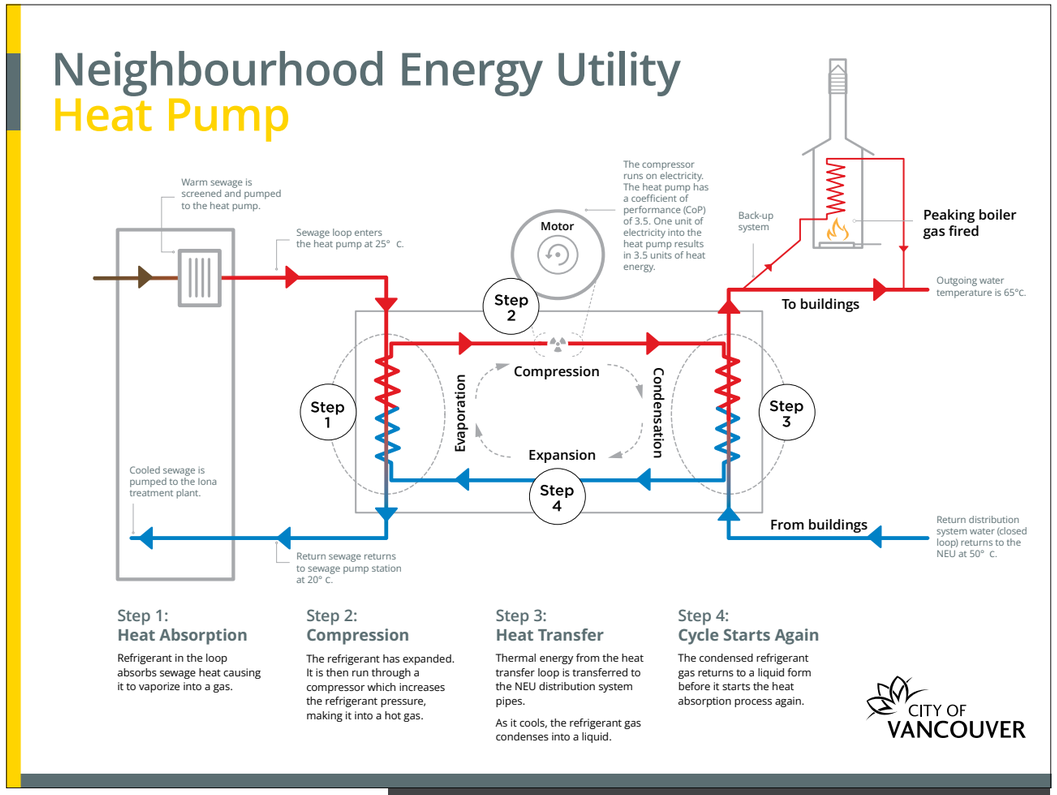
THE PROJECT SECURED FEDERAL & PROVINCIAL GRANT FUNDING OF UP TO

$10.2 million

through the cleanBC Communities Fund

AWARDS

The NEU has won multiple awards, including the International District Energy Association's Champion City UN Environment District Energy in Cities Initiative Public Sector Leadership Award in 2018.



Schematic of False Creek Heat Pump showcasing how heat is absorbed from the sewage pipes

KEY TAKEAWAYS

Heat is recovered from untreated urban wastewater at the Southeast False Creek Energy Centre and heat pumps are used to transfer the energy to a closed-loop hot water distribution system.

New developments are required by law to connect to the City-owned system for space heating and domestic hot water.

GHG savings have been forecast at 14,000 tons of CO_2-equivalent per year.

5 ENERGISE BARNSLEY

Yorkshire, UK

PV panels retrofitted onto existing buildings in Barnsley

> Retrofit program providing vulnerable households with sustainable energy sources

PROJECT OVERVIEW

Based in Barnsley, UK, Energise Barnsley was set up in partnership with Barnsley Metropolitan Borough Council in 2014, with aims to reduce energy bills and promote sustainability in vulnerable households.

The scheme hopes to deliver under the following 6 segments:

- Solar photovoltaic
- Battery Storage
- Demand-side response
- Peer-to-peer trading
- Asset management
- Community funding

Energise Barnsley

To date, 1.5MW of rooftop solar installations have been completed across 321 sites in 2016/17, 40 domestic batteries were installed in 2018 with a further 50 residential batteries installed in 2019.

The initial project meetings started in late 2014 with the intention to deploy as much solar PV across the council portfolio through a community energy solar scheme as grid, rooftop survey and tenant consent would permit. 321 Barnsley council homes have been recipients of these solar PV installations so far, which equals approximately 900kWp of capacity (compared to the initial target of 2MW). Of these installations, more than 75% of homes were bungalows inhabited by elderly individuals, with 25% of all residents on pre-payment meters. Sixteen non-domestic properties such as schools and community buildings have also had installations completed.

40 batteries have been installed into homes owned by social housing providing Berneslai Homes in the Oxspring neighbourhood. 30 of these properties were already fitted with rooftop solar arrays. The homes are 70% occupied by retired consumers, half of which are living alone. Households are equipped with solar electricity monitors to display when solar panels are generating electricity, and so when the greatest largest savings can be made. Residents are free to select their own energy supplier, though Energise Barnsley has been working with tenants to analyse the savings from the solar and battery to see whether switching to a ToUT would be Beneficial.

SOLAR PV HAS BEEN INSTALLED IN

321

Barnsley council homes

SOLAR PV EQUALS APPROXIMATELY

900kWp

of capacity

OF ALL THE INSTALLATIONS

75%

bungalows inhabited by elderly individuals

25%

on pre-payment meter

16

non-domestic properties such as schools and community buildings

BATTERY INSTALLED

40

into homes owned by social housing providing Berneslai Homes in the Oxspring neighbourhood

30

homes were already fitted with rooftop solar arrays

70%

of the homes are occupied by retired consumers, half of which are living alone

5 ENERGISE BARNSLEY

Yorkshire, UK

BARRIERS

TECHNICAL
Some of the batteries were initially set to Beijing time. This was corrected, but there was a tendency to revert to Beijing time after a power cut.

ECONOMIC
There were challenges developing the project and estimating the costs.

HUMAN RESOURCE CAPACITY, SKILLS AND ACCREDITATION
Requirement to upskill staff among the Berneslai Homes electrical team to reduce cost and prevent the requirement of specialists.

KEY PRINCIPLES

ELECTRIFICATION
Introductions of in-home smart energy systems with smart batteries and smart meters.

RENEWABLE ENERGY
Over 1.5MW of rooftop solar installations over 321 sites.

LOCAL AUTHORITY ENGAGEMENT
Energise Barnsley is the largest local authority and community energy solar PV and battery storage project in the UK.

BUILDING FABRIC
Current plans to construct new build, code 4 sustainable homes.

ENERGY STORAGE
40 domestic batteries were installed in 2018 with a further 50 residential batteries installed in 2019.

SOCIO-ECONOMIC BENEFITS
Participants energy bills fall around 30% due to solar installations, and 20% more due to the battery units.

FUNDING MECHANISM
£2mn were raised through retail bond of £800,000 and £1.2mn loan from ethical lender Charity Bank.

DIGITALISATION & AUTOMATION
More than 800MWh of low-carbon electricity generated in the first year.

DESIGNERS	Simplification and implementation of insulation and renewable energy measures at scale and speed.
PLANNERS/ GOVERNMENT	Establishment of separate entity with unique funding mechanisms created to maximise the rollout of renewable technology. This in turn has created a significant socio-economic benefit to the occupants.
INVESTORS	Project funding raised through retail bonds to attract local investment from investors and the community.

The community showcasing their engagement and benefit in the Barnsley Community Energy Coalition

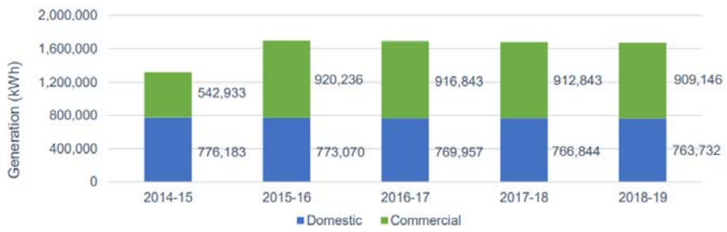
5 ENERGISE BARNSLEY

Yorkshire, UK

FUNDING SOLUTIONS

Project costs of £2mn were raised through retail bond of £800,000 and £1.2mn loan from ethical lender Charity Bank. Investors in the five-year bond had received three years of interest in 2019 of 5% per annum. The bond, dubbed the 'Barnsley Solar Bond', raised the £800,000 target in under three months over the summer of 2016, allowing local residents to invest in the scheme to benefit from the returns. Local ownership in the community bond is in excess of 60%.

The full cost of the storage solutions was funded by local DNO Northern PowerGrid through the NIC. Total cost of the project was circa £250,000 to cover the two-year lifetime costs of all project participants and hardware. Of the 40 domestic batteries installed, half were 2kWh and half 3kWh units. Of the 40 batteries, 28 were connected to solar PV arrays as only 65% of the solar PV was allowed to connect by the DNO.



PROJECT COSTS RAISED

£800,000
through retail bond

£1.2 million
loan from ethical lender Charity Bank

FIVE-YEAR BOND INVESTORS HAD RECEIVED

3 years
of interest in 2019

5%
per annum

BARNSLEY SOLAR BOND RAISED £800,000 TARGET IN UNDER

3 months
over the summer of 2016

COMMUNITY BOND LOCAL OWNERSHIP

60%
excess

PROJECT TOTAL COST CIRCA

£250,000

40 DOMESTIC BATTERIES INSTALLED

20 units
2kWh

20 units
3kWh

65%
of the solar PV was able to connect to the DNO

RESULTS

Participants in the trial saw energy bills fall around 30% as a result of the installation of solar panel, and 20% more as a result of the battery units. Over £40,000 of savings were made on electricity bills in the project's first year (2014-15), with more than 800MWh of low-carbon electricity generated during this time.

ENERGY BILLS FALL AROUND

30%
from the installation of solar panel

20%
from the battery units

IN THE PROJECT'S FIRST YEAR (2014-15)

£40,000+
electricity bills savings were made

800MWh
low-carbon electricity generated

NEXT STEPS

The Barnsley Domestic DSR project targets new build properties (Code 4 Sustainable Homes) with already installed dual purpose ASHPs and solar PV, adding a smart battery and a smart control system to generate analytical household energy demand data.

A second set of households, built to post war standards, have been retrofitted with dual-purpose ASHPs and will provide an additional subset of analytical data to test the DSR model. This will in turn form the basis of a DSR commercial model engaging Norther Powergrid and Oxford Brookes.

AWARDS

Energise Barnsley won the most commendable collaboration between community and commercial /public/ third sector partners community energy award in 2018.

PV on roofs of industrial buildings

KEY TAKEAWAYS

- Funded through retail bond of £800,000 and £1.2mn loan from ethical lender Charity Bank.
- Retrofit housing only, plans to build new sustainable homes
- Focus on vulnerable households.
- Initial program focusing on implementation of PV. Battery storage added once funding was in place.
- Large amounts of community engagement with clear communication of the costs and savings achieved.

6 RENEWABLE HEAT RETROFIT

Borders College, Scotland

Modern buildings within the Borders College University

> Retrofitting current infrastructure to provide heat to surrounding buildings

PROJECT OVERVIEW

Through the upgrade of the existing plant room, Borders College alongside Hillside Environmental Services retrofitted a low temperature 4th Generation heat network driven by heat pumps, with thermal energy input coming from wastewater directly tapped from the town sewer line. The heat network provides heating for three buildings of differing styles within a single campus at Galashiels.

The three buildings have quite different challenges in terms of heating:

- Main Building - A modern building extended and redeveloped in 2007. It houses college catering, corporate office accommodation, the college library, lecture halls and educational facilities.
- TTC - A modern building housing technical training for vehicle mechanics and engineering students. It has a large open workshop and office accommodation space.
- High Mill - A Victorian mill and home to the textile department of the university, jointly run with Herriot Watt University. A listed building that retains the old cast iron heat distribution infrastructure. The five plant rooms serving the campus comprise three around the Main Building and one each in High Mill and TTC. They housed gas boilers in various stages of repair and life expectancy.

Throughout the Design and pre-construction process the team at Hillside provided advice and support to the various stakeholders to move the project to delivery.

- Energy Analysis and Benchmark of heat supply, including analysing the BMS data and producing thermal load calculations.
- Technical design for installation and operation of heat pump and buried infrastructure, including the Energy Centre design and heat network routing with heat loss calculations to enable the centralised distribution.
- Established the connection arrangements & system integration to the five college plant rooms serving the buildings' heating system.
- Established an access agreement with the local water company and developed the sewer interface

BARRIERS

PUBLIC OPINION
The use of sewers encountered some push back during stakeholder engagement.

TECHNICAL
Wastewater heat recovery was a new concept being introduced to the UK.

GOVERNANCE
Part of the retrofit occurred on a listed building creating difficulties not only around governance but also the building fabric performance.

KEY PRINCIPLES

HEAT NETWORKS
Transferring excess heat from a local sewage line to the college to heat 3 of the buildings.

RENEWABLE ENERGY
The college has plans to implement PV and battery storage technology to the site.

LOCAL AUTHORITY ENGAGEMENT
Local Authority stakeholders were consulted throughout the project and attended the project launch.

ELECTRIFICATION
A cloud-based management system with HMI monitors and controls the process through an on-site PLC, including switching to gas generated heat if required to maintain comfort levels.

SOCIO-ECONOMIC BENEFITS
The college has had reduced heating bills throughout three of the buildings. The site has also been used for educational purposes.

6 RENEWABLE HEAT RETROFIT

Borders College, Scotland

DESIGNERS — A working example of industrial heat recovery from a sewage line.

INVESTORS — The commercial risk is taken by the technology provider and funding partners, allowing the college to support a pioneering approach. The college continues to reduce carbon emissions over time by paying for heat supply at a rate competitive with their gas service.

FUNDING SOLUTIONS

The use of heat supply contracts and commercial finance was adopted as the business model to support the project delivery, and Hillside corporate finance expertise was instrumental in delivering a successful financial approach.

The establishment of a Special Project Vehicle (SPV) was used to allow funders to invest as equity stakeholders with primary risk on the technology providers and main contractors, with limited financial risk to the college.

All stakeholders were involved in the development of contractual and commercial arrangements required to deliver the construction and post commissioning operational services.

- College as Heat off-takers
- SHARC (wastewater heat recovery supplier) as Design, Build and Operate contractors
- Private equity funders

The commercial risk is taken by the technology provider and funding partners, allowing the college to support a pioneering approach. The college continues to reduce carbon emissions over time by paying for heat supply at a rate competitive with their gas service.

High Mill, a historic building within Borders College heated by the heat pump system

HEAT PUMP RETROFIT

Heat pump installation at Borders College

Distribution pipework at Borders College

A key objective of the project, regardless of the source of thermal energy, was to prove the feasibility of retrofitting a heat-pump energy centre extracting waste heat from a sewage pipe into the campus environment.

That way, for future projects in other settings, alternative heat sources can be deployed into the heat pump model depending on availability.

During the design process the capacity of the existing heating system was evaluated, and it was shown:

- That it would be possible to maintain comfort levels at lower flow temperatures
- Boilers and heat distribution plant were found to be oversized
- Installed plant in boiler rooms at various stages of life expectancy but operational
- Installed BMS accepted as functional, with some adjustments required for flow temperatures and handshake between systems

It was felt that High Mill, a Grade 2 listed Victorian mill, would present the greatest challenge in terms of meeting thermal comfort levels. A contingency was therefore established to reactivate the gas boilers if required.

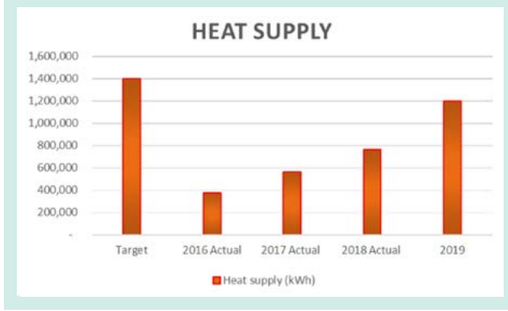
6 RENEWABLE HEAT RETROFIT

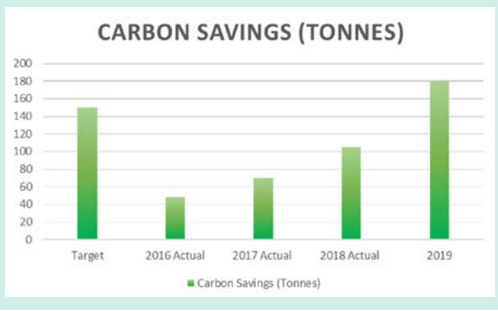
Borders College, Scotland

Control system managing the heat pump system

RESULTS

The system was launched in December 2015, to an audience of over 200 Scottish engineers and local authority stakeholders by Fergus Ewing, then Scottish Energy Minister. Since then, the College has been happy to share their experience as a pioneer in this area, and in the first three years of operation have been host to an amazing three hundred plus visits from the UK and beyond.





LESSONS LEARNT

Particularly during the summer period, sewer flow dropped, creating system availability challenges - however, as the low flow periods coincide with higher sewer temperatures, a valve control arrangement was created to facilitate multiple water passes when more energy is available for extraction from the warmer water.

The sewer resource remains productive down to 10^{0}C, but at periods below this the frost protection on the heat pumps begins to trip the units. These are rare events but coincide with periods of high demand, particularly overnight / early morning in preparing for occupation. In order to resolve the challenge, the team carried out several modifications such as adopting modulation between heat pump and Gas boiler back up and developing the controls regime to further automation response to low temperature event.

AWARDS

During Autumn 2017, the system was recognised for its pioneering achievements, winning two prestigious awards:

- EAUC Green Gown Awards – Newcomer of the Year
- Scottish Green Energy Awards – Best Innovation

KEY TAKEAWAYS

Retrofitting plant rooms of 3 buildings including a grade 2 listed building to accommodate heat pump.

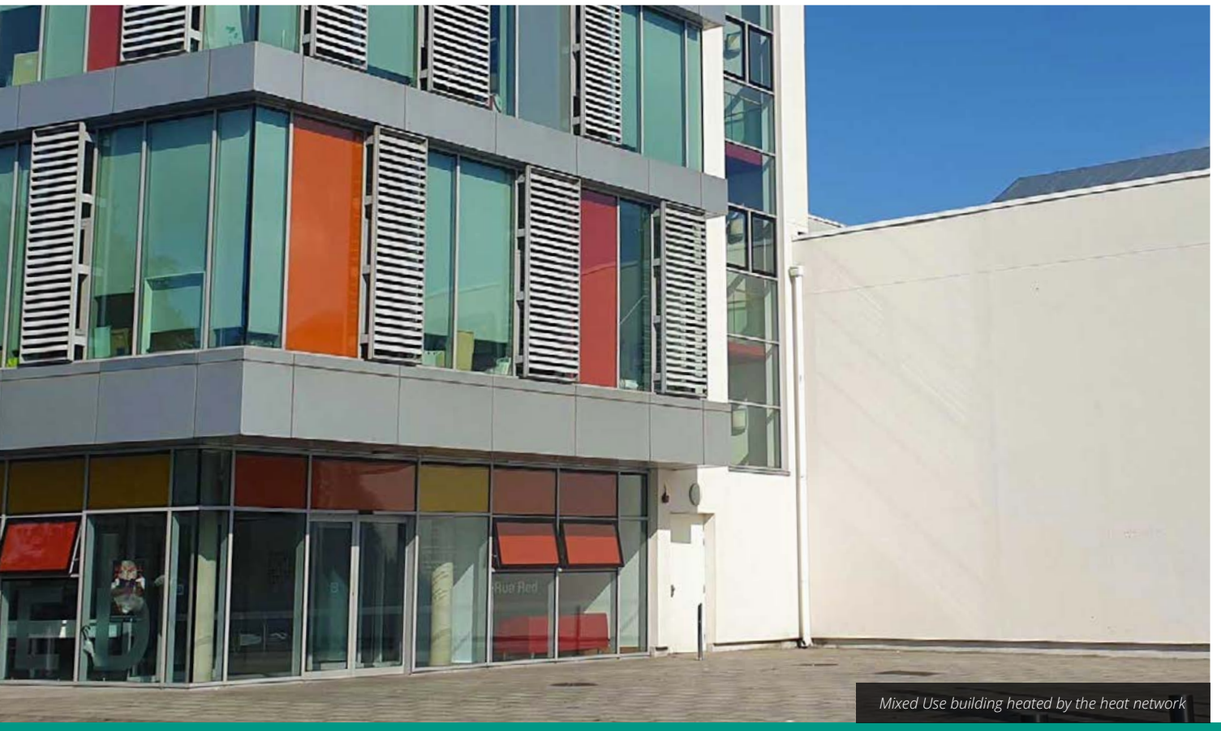
Using a combinations of innovative technologies and existing infrastructure to heat buildings.

Transparent communication of lessons learnt – sewer flow dropping over the summer months causing issues.

The implemented technologies are now available to be studied to enable innovation and implementation in other areas.

7 TALLAGHT DISTRICT HEATING SCHEME

Ireland



Mixed Use building heated by the heat network

> Using innovative technology to heat the borough of Tallaght through excess heat from data centre

PROJECT OVERVIEW

The Tallaght District Heating Scheme (TDHS) is the first large-scale district heating network of its kind in Ireland. The scheme went live early in 2023 and operates under Heat Works, Ireland's first not-for-profit energy utility, fully-owned by South Dublin County Council.

The scheme will make a significant contribution to reducing carbon emissions in the area, saving almost 1,500 tonnes of CO_2 each year and establishing Tallaght as a leader in innovation in the area of climate change. The TDHS delivers a high level of innovation, as waste heat from the nearby Amazon data centre will supply the heat to the network. During normal operation, heat demand will be 100% covered from the data centre waste heat.

The network initially will provide heat to 32,800m² of public buildings. Customers of Heat Works include South Dublin County Council and the Technological University Dublin, Tallaght. Buildings heated by this project include County Hall, Tallaght County Library, the council's Innovation Centre and 133 affordable apartments, which will connect in early 2025. The university buildings include the Main Building, the Sports-Science, Health and Recreation Building, followed by the new Catering College, to be completed in 2024.

BARRIERS

TECHNICAL
Installation of complex structural steel frame, diagonal sheet metal (copper) shingle cladding, incorporating ventilation louvres and specialist access doors.

BEHAVIOUR
Significant coordination with numerous stakeholders, including South Dublin County Council, Codema, Fortum eNext Ireland Ltd., Amazon Web Services and TU Dublin-Tallaght.

HUMAN RESOURCE CAPACITY, SKILLS AND ACCREDITATION
Coordination with numerous specialist subcontractors regarding installation of all District Heating systems and equipment.

KEY PRINCIPLES

HEAT NETWORKS
Transferring excess heat from a data centre to a local district heat network to heat homes and other buildings in the local area.

RENEWABLE ENERGY
The Amazon Web Service's data centre is being powered by a 115megawatt wind farm in Country Galway.

LOCAL AUTHORITY ENGAGEMENT
South Dublin County Council initiated this pilot project, to exemplify the environmental value and potential of District Heating in Ireland.

SOCIO-ECONOMIC BENEFITS
Reduction in heating bills for all those connected to the heat network.

DESIGNERS	The potential of waste heat recovery from data centres to provide significant capacity.
PLANNERS/ GOVERNMENT	The possibility of heating a huge amount of commercial and residential space from a singular data centre. Providing low carbon heat and reduces the capacity drawdown from the local grid.
INVESTORS	Funding from the EU has enabled the project, however, there is potential for innovative funding mechanisms to ensure cheap heat to the local buildings whilst also providing a swift ROI for investors.

7 TALLAGHT DISTRICT HEATING SCHEME

Ireland

FUNDING SOLUTIONS

The Tallaght District Heating Network was partly funded by the European Union's Interreg NWE programme (Heatnet), Project Ireland 2040 Climate Action Fund and through direct funding from SDCC. In the Governments Climate Action Plan 2023, the increased ambition is that Ireland will reach up to 0.8 TWh of district heating by 2025 and up to 2.7 TWh by 2030.

DISTRICT HEATING IN IRELAND WILL REACH UP TO

0.8TWh
by 2025

2.7TWh
by 2030

South Dublin County Council initiated this project to exemplify the environmental value and potential of district heating in Ireland.

KEY FACTS

- The collaboration between the council, Amazon's engineering teams, Fortum (the contractor) and the Dublin energy agency Codema has resulted in a low-carbon solution, optimising the potential of recyclable heat combined with innovative heat pump technology – the first example of its kind in Ireland.
- Average age of the equipment is less than one year, with construction finishing towards the end of 2022.

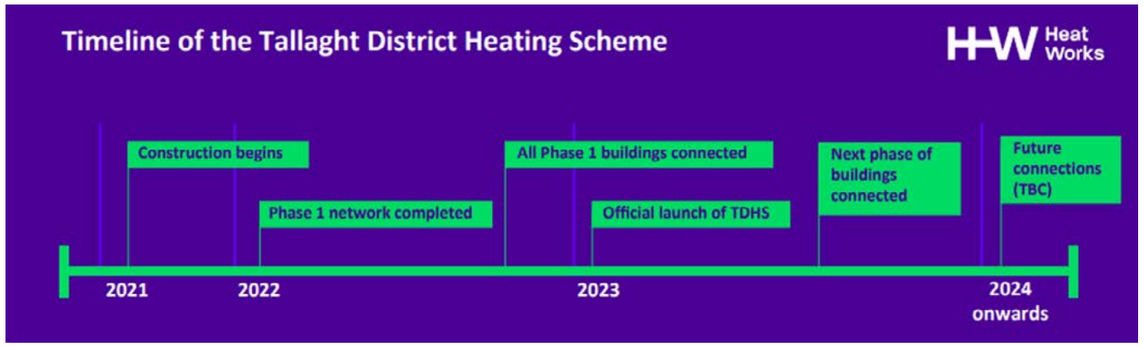
Insulated distribution pipework connecting the server heat pumps with the buildings

HOW IT WORKS

Heat is collected through heat recovery coils in the air handling units of the data centre. This heat is brought to the energy centre where it is raised from circa 25°C up to between 70°C and 85°C using a 3MW heat pump installation

Heat is then delivered through the DH network, which is constructed from insulated steel bonded pipework fitted with a leak detection system. A 3MW electric boiler provides the backup heat supply. Fully fossil free solution.

Initially providing heat to 43,189m^2 of public buildings (municipal and university buildings), with further expansion planned to public and private customers in 2024 and 2025.



RESULTS

The scheme will make a significant contribution to reducing carbon emissions in the area, saving almost 1,500 tonnes of CO_2 each year and establishing Tallaght as a leader in innovation in the area of climate change.

TALLAGHT DISTRICT HEATING SCHEME WILL SAVE ALMOST

1,500 tonnes
of CO_2 each year

Proposed distribution pipework route

KEY TAKEAWAYS

Implementation of district heat network through waste heat from data centres.

Funded by the European Union's Interreg NWE programme (Heatnet), Project Ireland 2040 Climate Action Fund and SDCC.

Initial focus to public buildings with plans of expansion to more public and some private buildings in the future.

8 UNIVERSITY OF WEST LONDON

Ealing, UK

University of West London main building connected to new heating system

> Making small changes to reach Net Zero targets without causing disruption to students

PROJECT OVERVIEW

University of West London (UWL) contracted Ameresco as principal contractor and designer, who partnered with NIBE Energy Systems UK and JKN Renewables, Ltd. The first and main challenge was to design a ground source heat pump (GSHP) system for the university without disrupting the main car park on the campus to reduce the impact on students. This, in turn, resulted in an innovative solution, combining a ground source heat pump system working with boreholes and solar PVT panels. The designed system not only supplies 222 kW of PV electricity generation but, crucially, acts as a collector system for the GSHP, capturing naturally occurring energy in the air to drive the heat pump process, and therefore reducing the number of boreholes required. The old gas boilers previously heating the campus were replaced with 584 solar PVT panels in combination with 34 169-meter boreholes to provide 900 kW of heating and hot water throughout the site. Further reducing disruption across the campus, JKN Renewables carried out an off-site build, with the pre-built PVT and plant room modules being delivered on time despite constraints caused by the COVID-19 pandemic

BARRIERS

PUBLIC OPINION
Minimal disruption to the student's during construction was required.

TECHNICAL
Innovation was required for the project to minimise effects on the students and the local community.

HUMAN RESOURCE CAPACITY, SKILLS AND ACCREDITATION
Additional training was required for staff at the university to ensure the GSHP and PV are maintained.

KEY PRINCIPLES

HEAT NETWORKS
Old gas boilers previously heating the campus were replaced with 584 solar PVT panels in combination with 34 169-meter boreholes.

RENEWABLE ENERGY
The designed system supplies 222 kW of PV electricity generation.

SOCIO-ECONOMIC BENEFITS
The college has had reduced heating bills throughout their building while providing minimal disruption to the surrounding areas.

DESIGNERS	Retrofit of existing buildings with innovative GSHP and solar system that generates electricity as well thermal energy.
PLANNERS/ GOVERNMENT	The potential for extensive retrofit of estates through off-site builds which increase efficiency as well as reducing build time and disruption/pollution.
INVESTORS	• The University secured £5.1m from the Public Sector Decarbonisation Scheme (PSDS). • Public sector funding rounds release significant sums of money for decarbonisation.

8 UNIVERSITY OF WEST LONDON

Ealing, UK

FUNDING SOLUTIONS

The University secured £5.1m from the Public Sector Decarbonisation Scheme (PSDS) with support from the Retrofit Accelerator - Workplaces team. This was the largest amount awarded to a UK university during the first round of PSDS funding.

As part of their wider commitment to becoming a leader in environmental sustainability management, UWL commissioned a social value report that forecasted a social return on investment (SROI) of £15m from the project. That means for every £1 invested, there is a £2.98 social return.

UWL SECURED

£5.1 million

from the PSDS with support from the Retrofit Accelerator - Workplaces team

UWL COMMISIONED A SOCIAL VALUE REPORT THAT FORECASTED

£15 million

Social Return on Investment (SROI)

Borehole drilling

Air source heat pumps

Ground source heat pump

GROUND SOURCE HEAT PUMPS

JKN set about designing the system and immediately recognised this was going to be a hybrid design involving, Ground Source Heat Pumps (GSHP), boreholes and PV-T panels (combined photovoltaic and thermal), included in the installation were 15 x Nibe 1345 60Kw GSHP's on pre-fabricated skids to be located in the main plant room, 34 x 169m boreholes around the ground areas of the campus were drilled and 584 x PVT panels installed on prefabricated A-frames for the installation, saving time and reducing the disruption to the Campus during the installation phase. The University is now capable of generating enough energy to heat an estimated 70 homes every year or enough electricity to make as many as 4,282,560 cups of tea thanks to work to drastically cut greenhouse gas emissions and reduce the amount of energy needed to run its buildings.

PRODUCT

15x NIBE 1345 GSHP

SYSTEM SIZE

900kW

ANNUAL GENERATION

2,300,000kWh

ANNUAL ENERGY SAVING

£5,500.00+

ANNUAL PV GENERATION

188,000kWh

The Paul Hamlyn Library within University of West London Ealing site

RESULTS

The proposal has secured funding from major high street lenders NatWest.

529 tonnes

of CO_2 saved per year

29%

overall energy savings

£5.1 million

PSDS funding secured

£15 million

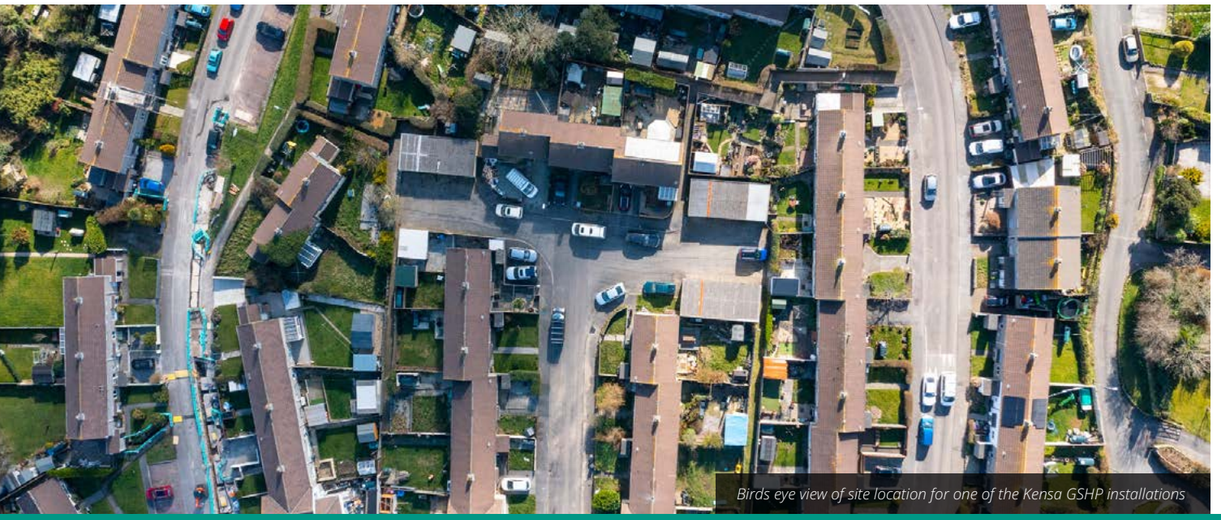
social value return on investment

KEY TAKEAWAYS

- Implementation of several innovative solutions to help reach net zero targets.
- Large support from local authority through funding.
- Low impact on surrounding buildings and people.
- Commissioning of a social value report that forecasts a social return on investment of £15m from the project.

9 KENSA HEAT THE STREETS

Cornwall, UK



Birds eye view of site location for one of the Kensa GSHP installations

> Reducing upfront costs of ground source heat pumps to enable homeowners to reduce their heating bills

PROJECT OVERVIEW

This pilot project aimed to demonstrate a pathway for decarbonisation of heating on the UK through reduction of the upfront cost of ground source heat pumps. By installing ground array infrastructure with no upfront cost in return for a fixed standing charge from households, Kensa's objective was to improve the accessibility of low carbon heating and unlock private investment in the technology.

The project also assessed the cost and efficiency of the Heat the Streets approach, which involved installing heat pump technology street-by-street in domestic properties. This approach offers economies of scale and is well suited to the mass heat pump deployment required for the UK to reach it's net-zero targets by 2050.

98 homes
fitted with ground source heat pumps

22
enabled for future connection

102
boreholes drilled

28%
carbon savings for new build

3,382 tonnes
of carbon saved over the life of the project

11,319m
total depth of boreholes

71%
carbon saving for retrofit

£628
average bill saved per year

BARRIERS

ECONOMIC
High upfront costs with limited governmental support.

PUBLIC OPINION
Limited awareness and understanding of the benefits and installation process of ground source heat pumps.

HUMAN RESOURCE CAPACITY, SKILLS AND ACCREDITATION
Ground source heat pumps require specialist installation, sometimes adding cost and complexity to the installation process.

KEY PRINCIPLES

RENEWABLE ENERGY
Ground source heat pump installed of 98 homes.

SOCIO-ECONOMIC BENEFITS
Reduction in bills and carbon emissions for all participation properties.

FUNDING MECHANISMS
All upfront costs are covered by Kensa with a fixed standing change for each household.

HEAT NETWORKS
102 boreholes have been drilled to supply heating through a ground source heat pump to 98 homes.

9 KENSA HEAT THE STREETS

Cornwall, UK

DESIGNERS

- A street wide retrofit solution for low carbon and low cost decarbonised heat.
- Use of heat from roads to supercharge the efficiency of the ground source heat pumps.
- Householders are able to switch energy suppliers.
- Ultra-efficient and reliable.

PLANNERS/ GOVERNMENT

- Perfect solution for retrofit of low density social housing to reduce tenant bills and decarbonise an area.
- Exempt from Heat Network Metering and Billing Regulations.

INVESTORS

Novel mechanism whereby upfront capital cost was provided by Kensa and costs recovered via standing charges and cheaper tariffs over existing gas and electric systems.

FUNDING SOLUTIONS

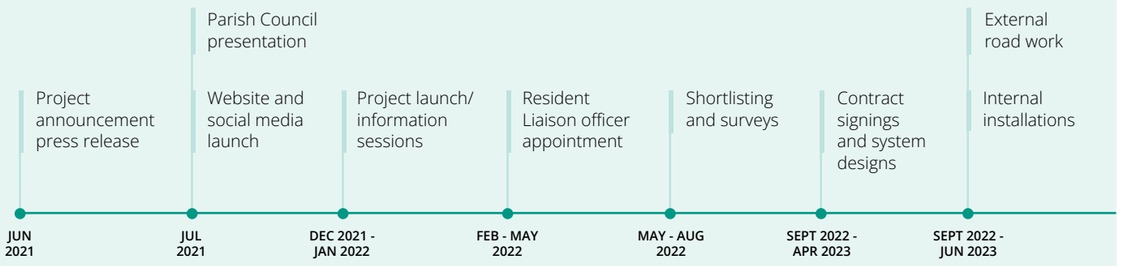
The project is receiving up to £3.4m of funding from the England European Regional Development Fund as part of the European Structural and Investment Funds Growth Programme 2014-2020. The Ministry of Housing, Communities and Local Government (and in London the intermediate body Greater London Authority) is managing Authorit +for European Regional Development Fund. Established by the European Union, the European Regional Development Fund helps local areas stimulate their economic development by investing in projects which will support innovation, businesses, create jobs and local community regenerations.

THE PROJECT IS RECEIVING UP TO

£3.4 million

of funding from the England European Regional Development Fund

SIMPLIFIED PROJECT TIMELINE



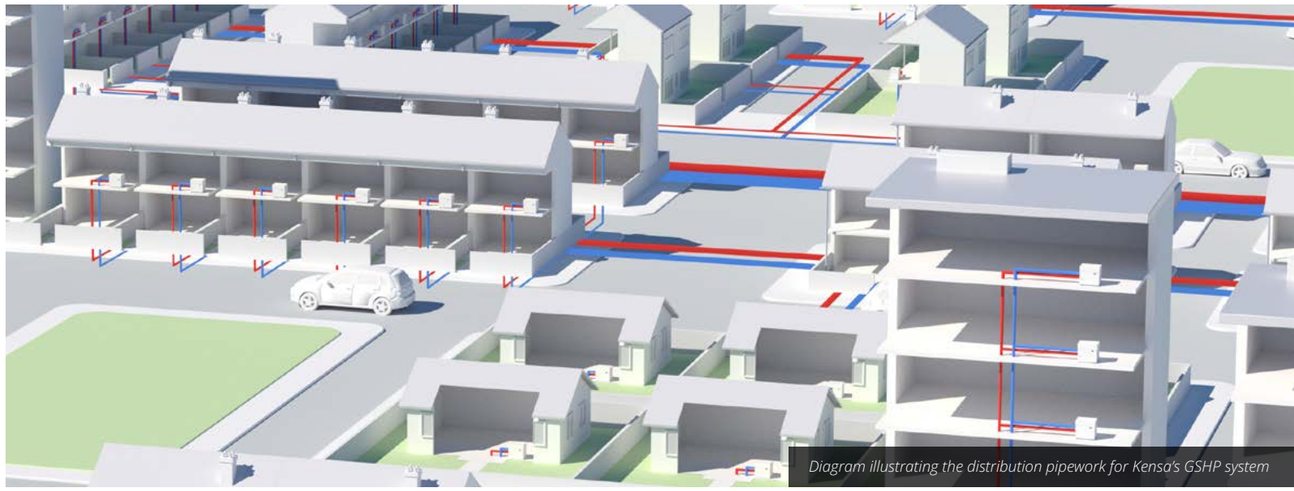


Diagram illustrating the distribution pipework for Kensa's GSHP system

RESULTS

Heat the streets customers, who had their new ground source heat pump systems installed, were offered the opportunity to complete a 5-minute survey. The survey was completed anonymously, and customers were not offered an incentive to provide feedback.

Fifteen of the seventeen respondents were private retrofit residents, one being a landlord/ landlady and one was a social housing tenant. 35% of the respondents had been thinking about changing their system before they were offered heat the streets.

50%

of private homeowners agreed to feel comfortable with signing a 20-year contract with the other 40% were ambivalent

94%

of customers would recommend others to take part in the heat the streets

Customers found the external works less disturbing than expected

94%

of customers would recommend others to take part in the heat the streets

88%

of customers have found since having their new system installed that their heating bills have either stayed the same or are costing them less. Some customers are yet to be able to see that change In their heating costs due to the infancy of their new GSHP being installed

The top 3 reasons customers reported for choosing to be part of Heat the Streets were:

1. **To reduce carbon emissions**
2. **To reduce heating bills**
3. **No upfront costs due to the heat pump being free**

10 GREENHAUS

Manchester, UK

Rendered image of the Greenhaus scheme

> Using tested methods on a large scale to provide affordable, energy efficient homes

PROJECT OVERVIEW

The 'Greenhaus' nine-storey, all electric, development of 96 affordable homes in Chapel Street, Salford, will be the largest Passivhaus social housing scheme in Manchester and the North West of England.

Properties that are built to Passivhaus standards enjoy reduced energy consumption of around 90% compared to building regulations, helping residents to reduce their fuel bills and cut their carbon footprints. The homes at Greenhaus will benefit from triple-glazed windows and the latest in insulation technology, using minimal energy for heating and cooling.

NUMBER OF HOMES
96

PROJECT STAGE
Construction

START DATE
January 2022

COMPLETION DUE
January 2024

BARRIERS

SUPPLY CHAIN
Early engagement was required to ensure the buildability of the design.

TECHNICAL
Due to the complexity of the Passivhaus standard, the project faced challenges around supply chain and construction.

AVAILABLE DATA
The scale of the project in this location is the first of its kind with a lot of innovation and new technology required

KEY PRINCIPLES

OPTIMISATION
Both the form and orientations have been optimised to increase solar gain and reduce heat loss.

RENEWABLE ENERGY
Implementation of PV on the roof and battery storage.

LOCAL AUTHORITY ENGAGEMENT
The council worked in partnership with several other companies to fund and complete the scheme.

BUILDING FABRIC
Aligned to Passivhaus standards – low u-values.

SOCIO-ECONOMIC BENEFITS
All homes within the building are affordable and energy efficient.

DESIGNERS	• The possibility of delivering a Passivhaus social housing scheme at scale. • Reduces energy demand by 90% over a building regs compliant scheme.
PLANNERS/ GOVERNMENT	Setting up partnerships with joint ventures to ensure that the developments are delivered to provide social and environmental benefits.
INVESTORS	• Viability of delivering a Passivhaus social housing scheme at scale. • A strategic joint venture delivered in partnership with Salford Council. • Salix Homes has also recently struck a deal with major high street lender NatWest to help finance the Greenhaus development.

10 GREENHAUS

Manchester, UK

Elevational view of the Greenhaus scheme

The plans for Peru Street are designed to create a cohesive, sustainable, and thriving community, which:

- minimise operational energy use to address fuel consumption issues
- promote sustainable transport with good transport connections within walking distance and storage for 100 bikes
- include open-plan living areas to provide sufficient space for residents to work from home
- incorporate Juliette balconies to create a connection between the internal and outside areas
- include four fully accessible ground-floor apartments with nearby parking.

FUNDING SOLUTIONS

A joint venture between the English Cities Fund (ECF) and Salford housing provider, Salix Homes and part of ECF's £1bn, 50-acre Salford Central masterplan, the Greenhaus project will take the overall percentage of affordable homes to 25% across the entire scheme.

The ECF fund is a strategic joint venture between Muse Developments, Legal & General and Homes England and the scheme is delivered in partnership with Salford Council. Salix Homes has also recently struck a deal with major high street lender NatWest to help finance the Greenhaus development.

GREENHAUS PROJECT WILL TAKE OVERALL PERCENTAGE OF AFFORDABLE HOMES TO

25%

across the entire scheme

PASSIVHAUS ASPECTS

Greenhaus consists of two blocks; six and eight stories high, which form an L-shape that contains a public square. Overall, the scheme provides 96 units for affordable rent, with a mix of one and two-bed dwellings and four wheelchair-adaptable apartments on the ground Floor. Salford housing provider Salix Homes will manage the scheme.

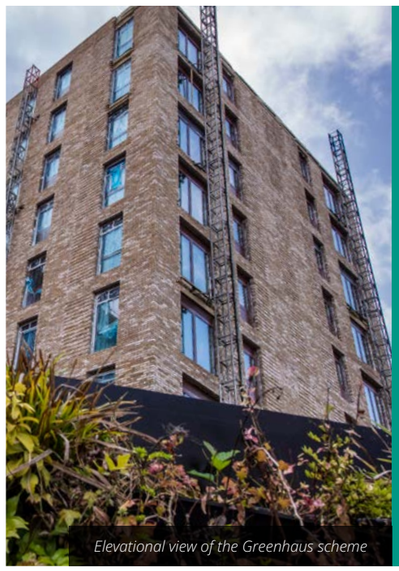
The scheme utilises SFS (steel framing system) in its structural external envelope which is relatively new in Passivhaus design. SFS has a far quicker installation, than the concrete block used on previously certified apartment schemes in the UK. It imposes less weight on the main structure and can be used in conjunction with mast climbers.

Achieving the Passivhaus standard in the UK involves accurate design modelling using the Passivhaus Planning Package (PHPP)

The PHPP is an all-in-one design, verification and certification tool produced by the Passivhaus Institute. It is used from very early in the design process to build up a useful interactive understanding of the design. Initially, only limited information is entered into the PHPP, aligned with the level of design development. During the design process, options can be tested and checked to see instantly what the results on the performance will be.

Once the design is relatively stable, further detail is entered into the PHPP, developing a more granular picture of how the building will perform. At this stage, various aspects of the design can be tested in more detail. Testing elements can lead to an optimised solution for both the design aspirations and building performance. The architect or designer can understand from the PHPP which aspects of the design have the most impact on the performance and therefore, make intelligent choices.

Following on from the success and experience of Greenhaus, plans were submitted for a nearby development to Greenhaus called Peru Street for the same client. It consists of 100 high-quality, affordable, sustainable, one and two-bedroomed Passivhaus apartments within a part five and part six-story building.


Elevational view of the Greenhaus scheme

KEY TAKEAWAYS

- Passivhaus certified building.
- Affordable and energy efficient housing proving 96 homes.
- Promotion of sustainable transport with good transport connections within walking distance and storage for 100 bikes
- Future proofing provisions provided through open spaces allowing for working from home.

Key Takeaways

1995

VAUBAN, GERMANY

- Implemented key infrastructure first using a fabric first approach and orientated for maximum efficiency.
- Clear targets for energy and water usage had been set and communicated to the community, reducing the target as technologies have improved.
- Reduced infrastructure for unsustainable modes of transportation.
- Retrofitting new technologies.
- Community buy-in.

2002

BedZED, SUTTON, UK

- Innovative technologies implemented (such as CHP plant) and learnt from when unsuccessful.
- Clear targets for energy and water usage had been set and communicated to the community.
- New build using brown field site.

2006

CAMBRIDGE CITY COUNCIL – CLIMATE CHANGE STRATEGY, UK

- Several smaller interventions implemented over a longer time period when grants were achieved.
- Initial focus on housing (both council owned and private).
- Roadmap of future plans and investments for housing and local businesses.
- Large scale community engagement including schemes to reduce residents day-to-day carbon footprint outside of the home.
- Clearly defined targets for housing and business.
- Workshops provided for housing a businesses to guide and assist the community.

2010

NEIGHBOURHOOD ENERGY UTILITY, VANCOUVER, CANADA

- Heat is recovered from untreated urban wastewater at the Southeast False Creek Energy Centre and heat pumps are used to transfer the energy to a closed-loop hot water distribution system.
- GHG savings have been forecast at 14,000 tons of CO_2-equivalent per year.
- New developments are required by law to connect to the City-owned system for space heating and domestic hot water.

2014

ENERGISE BARNSLEY, YORKSHIRE, UK

- Funded through retail bond of £800,000 and £1.2mn loan from ethical lender Charity Bank.
- Retrofit housing only, plans to build new sustainable homes.
- Focus on vulnerable households.
- Initial program focusing on implementation of PV. Battery storage added once funding was in place.
- Large amounts of community engagement with clear communication of the costs and savings achieved.

2015

RENEWABLE HEAT RETROFIT, BORDERS COLLEGE, SCOTLAND, UK

- Retrofitting plant rooms of 3 buildings including a grade 2 listed building to accommodate heat pump.
- Using a combinations of innovative technologies and existing infrastructure to heat buildings.
- Transparent communication of lessons learnt – sewer flow dropping over the summer months causing issues.
- The implemented technologies are now available to be studied to enable innovation and implementation in other areas.

2022

TALLAGHT DISTRICT HEATING SCHEME, IRELAND

- Implementation of district heat network through waste heat from data centres.
- Funded by the European Union's Interreg NWE programme (Heatnet), Project Ireland 2040 Climate Action Fund and SDCC.
- Initial focus to public buildings with plans of expansion to more public and some private buildings in the future.

2023

UNIVERSITY OF WEST LONDON, EALING, UK

- Implementation of several innovative solutions to help reach net zero targets.
- Low impact on surrounding buildings and people.
- Large support from local authority through funding.
- Commissioning of a social value report that forecasts a social return on investment of £15m from the project.

2023

KENSA HEAT THE STREETS, CORNWALL, UK

- Affordable solution to installing ground source heat pumps for both council and non-council owned homes.
- Decarbonising heating within homes.
- Individual ground source heat pumps were installed in each property giving homeowners full control over their heating and energy bills.

2024

GREENHAUS, MANCHESTER, UK

- Passivhaus certified building.
- Promotion of sustainable transport with good transport connections within walking distance and storage for 100 bikes.
- Affordable and energy efficient housing proving 96 homes.
- Future proofing provisions provided through open spaces allowing for working from home.

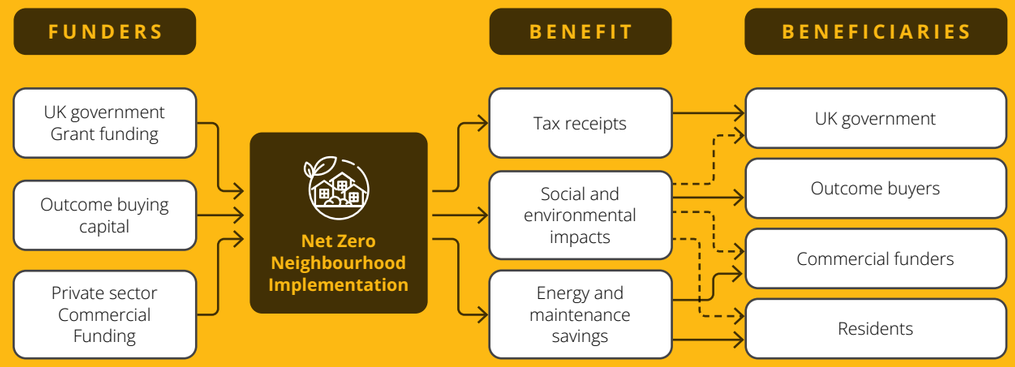
Financial Set Up and First-Steps

The Financial Case, within the 3Ci Net Zero Neighbourhoods document, highlights that there are two key ways to reduce public subsidy level through; reducing the upfront costs, and increasing the value of the energy savings and therefore support for private finance.

The financial model outlines within the document is designed to achieve both by:

- Reducing the upfront implementation costs through procurement economies, implementation economies, and system design economies via a place-based approach, and
- By aggregating the non-subsidy funding component across multiple dwellings: allowing energy savings to be valued over the investment time horizon of institutional investors (30-50 years), instead of individual homeowners (5-10 years).

The linkages between outcomes and funding sources are summarised below:



** The Case for a National Net Zero Neighbourhoods Programme, 3ci, June 2023*

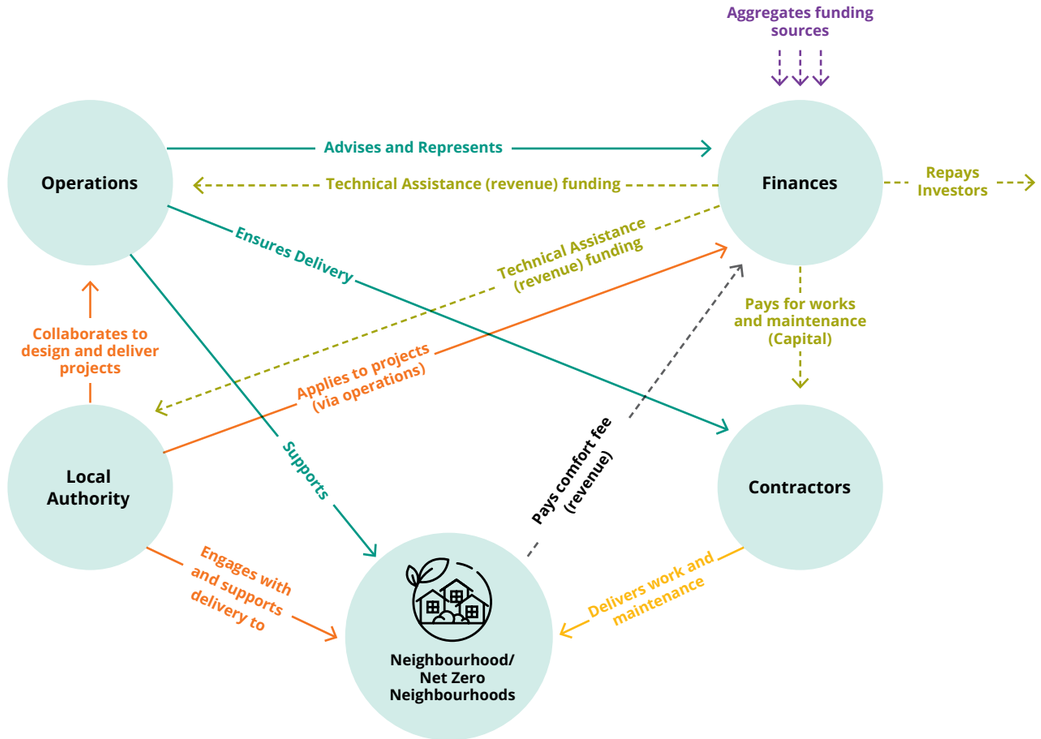
The direct financial benefits comprise the impact on energy bills and maintenance costs for the building occupants, as well as the share of cost savings recouped by the private sector as revenue.

Although not quantified in the model at this stage, it is to be noted that a reduction in the energy bills would also have implications for the private energy providers as well as the UK government. Reduced energy use by the residents would result in less revenues earned by the energy providers, which might further reduce the taxes (on profit) paid by the energy providers to the government.

However, the savings on energy bills for the residents will also result in a higher disposable income which could be used to consume additional energy and purchase other goods and services, thereby generating tax revenue for the government.

Delivery Vehicles

HOW ARE THEY IMPLEMENTED



KEY

- Organisations/ Groups/ Contributors
- Financial Transactions
- Actions from Operations
- Actions from Finances
- Actions from Local Authority
- Actions from Contractors
- Actions From the Neighbourhood

ROLES

Operations

The organisation that provides the operational functions of the Net Zero Neighbourhood programme, primarily to support to local authorities, and oversight of Net Zero Neighbourhoods projects as an agent for the Finances.

Local Authority

Local authorities are the critical link that holds the programme together, and a key objective of the operations team is to support this dynamic and act as an enabler for LAs.

Finances

The financial organisation that deals with contractual and financial matters for the Net Zero Neighbourhood programme.

Contractors

Contractors will be contracted by the Financial organisation and will provide services both in terms of implementation and maintenance.

** The Case for a National Net Zero Neighbourhoods Programme, 3ci, June 2023*

Future Gazing

LEARNING FROM THE PAST, LOOKING TO THE FUTURE

THE GREEN FINANCE INSTITUTE

The Green Finance Institute focuses on the systemic transitions that need to be financed within the real economy, such as the energy efficient retrofitting of buildings, and the decarbonisation of road transport.

Overcoming the barriers to investment in these and other sectors requires harnessing the expertise of broad groups of stakeholders through outcome focused coalitions.

The Green Home Finance Principles (GHFPs) seek to create an industry-recognised framework of market standards and guidelines, which provides a consistent and transparent methodology for the application of financial proceeds towards the purchase, retrofit, or self-build construction of domestic buildings that achieves verifiable environmental benefits.

GREEN HOME FINANCE PRINCIPLES (GHFPS)

1. **Use of Proceeds**
2. **Process for Project Evaluation and Selection**
3. **Management of Proceeds**
4. **Reporting**

ZERO BILLS HOME

Zero Bills is a world-first smart proposition that allows customers to move into homes which have no energy bills for at least five years, guaranteed.

The homes are fully kitted out with state-of-the-art green energy technology – including an air-source heat pump, a home battery, and roof-mounted solar panels – which are then optimised by Kraken, Octopus Energy's tech platform.

Zero Bills households save around £1,800 a year on energy bills compared to those on a standard variable tariff, based on current energy rates.

MAX POWER ENERGY TARIFF

The Max Power Energy Tariff allows businesses with any type of renewable energy source to distribute their excess generation so that other sites can consume it.

This maximises the use of the renewable electricity created to minimise the overall energy costs and lower your bills by up to 25%.

Currently to be eligible for the scheme a business must:

- Have 2 or more sites
- Generate any renewable energy
- Have a working smart meter or half-hourly meter
- Happy to export excess energy back to the grid
- Allow Octopus to assess a year of energy data to check the business is suitable

Future Gazing

LEARNING FROM THE PAST, LOOKING TO THE FUTURE

SNRG
PLACE BASED POWER

FUNDED RENEWABLE ENERGY SYSTEMS

NextGen infrastructure companies such as SNRG design, fund, build and operate the next generation all-electric solution.

A synergy of locally integrated electrical distribution, renewable generation, smart storage, heating, cooling and EV charging solutions. By taking a communal approach that optimises hundreds of homes, buildings and assets into a single system NextGen infrastructure companies such as SNRG are able to reduce the cost, complexity and carbon for developers, building owners, communities and occupiers.

nationwide

COVENTRY Building Society

GREEN ADDITIONAL BORROWING

Several banks and building societies such as Nationwide and Coventry are offering green additional borrowing to their existing mortgage customers who can benefit from a lower rate when they borrow more for energy efficiency improvements.

A simple mechanism that enables customers to overcome the hurdle of the initial upfront capital costs whilst reducing their energy bills and carbon emissions.

Bunhill 2 Energy Centre in London

USING HEAT FROM THE UNDERGROUND

Waste heat from the London Underground network is now capable of providing heating and hot water to homes across London with the pilot scheme taking place in Islington.

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.

The current pilot project in Islington has provided:

- Reliable and secure energy supply.
- Reduces CO_2 emissions by around 500 tonnes each year.
- Reducing heating costs and energy bills for residents to provide a buffer against increasing fuel costs.
- Reducing fuel poverty in the borough.
- Long-term flexible and expandable solution.
- Achieving efficiencies of scale.

Future Gazing

LEARNING FROM THE PAST, LOOKING TO THE FUTURE

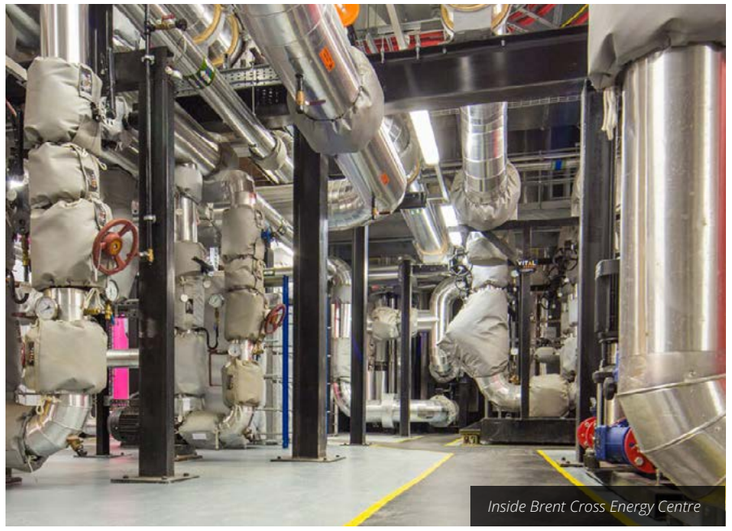
Rendered image of Brent Cross Town

HEAT NETWORKS AND NET ZERO
BRENT CROSS, UK

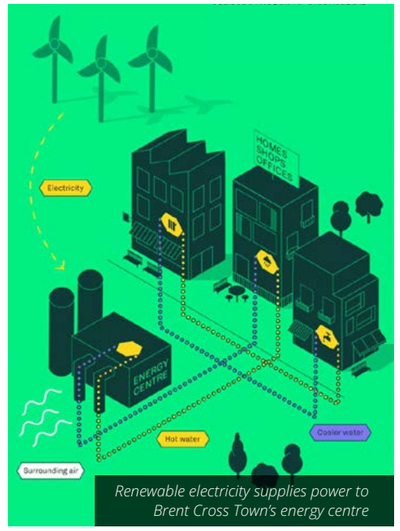
Brent Cross Town aims to be a net-zero carbon town by 2030, addressing the global challenge of the climate crisis.

We will have:

- Neighbourhood-wide district energy heat network created with Vattenfall, the leader in city-scale green energy infrastructure, providing zero-carbon heating to all buildings.
- 100% renewable energy for all energy supplies controlled by Brent Cross Town.
- Thoughtful design of energy-efficient buildings to reduce operational energy demand.
- 40% reduction in embodied carbon compared with standard current practice.
- 6,600 cycle spaces, 2.75 km of new cycling routes, and a pedestrian and cyclist-friendly network of new streets that will be low-speed.



Inside Brent Cross Energy Centre



Renewable electricity supplies power to Brent Cross Town's energy centre

HEAT NETWORK

Working with Related Argent and Barnet Council in London, Vattenfall will design, build and operate a new district heat network for one of Europe's largest redevelopments - Brent Cross Town. This will supply low-carbon heating and hot water to 6,700 new homes and 3 million square feet of new office, retail and commercial space. Operational from 2023, we hope to remove all CO_2 emitting sources from the development - proving that low emission urban regeneration is more than possible in the UK capital.

Alongside other low-carbon heat sources, it will include 8MW of heat pumps which will supply over 80% of the site's total heat requirements. Engineers are also working on a plan to use the infrastructure to cool Brent Cross Town in the summer, as well as heat it in the winter.

Construction of the heat network commenced in 2021 and will be connected to all buildings connected throughout the development.

BRENT CROSS HEAT NETWORK WILL SUPPLY LOW-CARBON HEATING & HOT WATER TO

6,700
new homes

3million sq ft
new office, retail and commercial space

IT WILL INCLUDE

8MW → 80%+

heat pumps which will supply

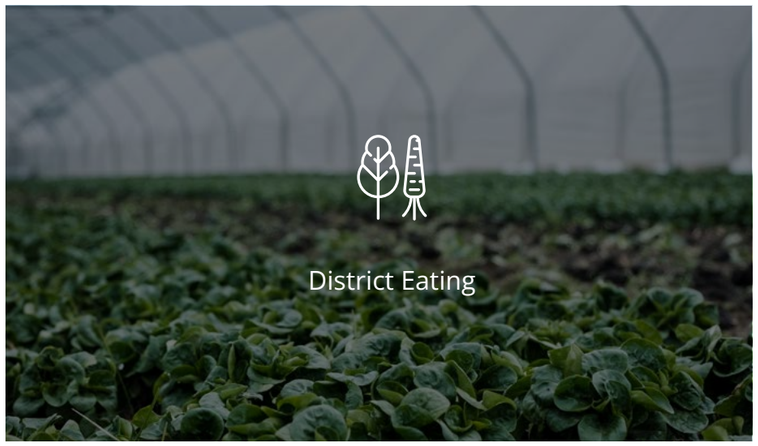
the sites total heat requirements

Future Gazing

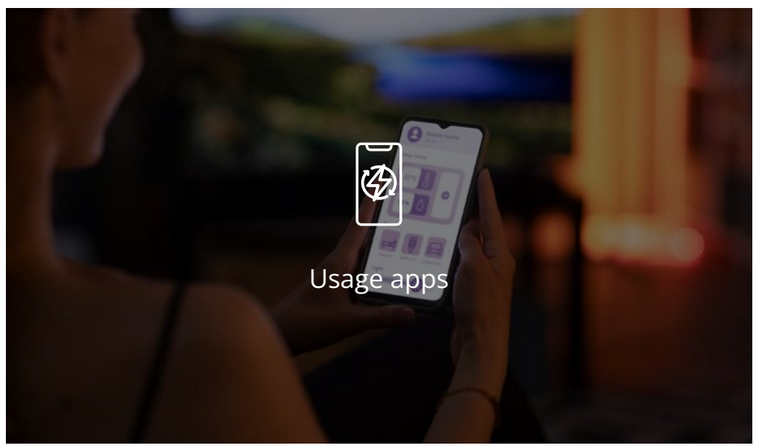
LEARNING FROM THE PAST, LOOKING TO THE FUTURE

OTHER CURRENT RESEARCH

A group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. It can connect and disconnect from the grid to operate in grid-connected or island mode. Microgrids can improve customer reliability and resilience to grid disturbances.



Greenhouses can provide baseload demand for heat networks, increasing efficiency for the whole network and improving the economics. District Eating are working with local authorities to facilitate development of greenhouses across the UK to provide fresh produce and heathy eating habits while reducing carbon emissions.



Implementing and promoting the use of energy tracking apps, allowing tenants a measure of how much power and water is being used within their property, and which areas of the property are using the most energy.

Technology allowing for two-way power flows between your home and your electric vehicle (EV). This means as well as charging your EV as normal, you can use the energy stored in your EV battery to power your home when it makes sense to do so. An EV essentially becomes your own personal energy storage facility.

Final Thoughts

> Approaching Net Zero from the Neighbourhood perspective enables a more holistic and attainable approach to the decarbonisation of our urban environment.

By bringing together a mix of residential, retail and other commercial uses, we are able to create scale and most importantly, a revenue stream that unlocks private capital for decarbonisation projects.

Furthermore, the Net Zero Neighbourhoods approach necessitates collaboration between the public and the private sectors, both of which are working towards the same goal. Innovative funding mechanisms and a focus on socio-economic value facilitates community buy in and the roll out of decarbonisation projects. This enables sustainable design measures to be implemented at the neighbourhood level, facilitating the UK's bottom up transition towards Net Zero.

Sam Luker

Associate Sustainability Director
AESG

1

INNOVATION

The implementation of new technologies and strategies aids the progression of net zero neighbourhoods while also increasing the chances of funding.

2

SMALL STEPS

Creating a detailed roadmap allowing for growth as the development continues. Ensure that there is availability for growth and adaptability as technologies and innovations improve.

3

FABRIC FIRST

Ensure the building fabric (i.e. walls, windows and doors) are at a standard to prevent the requirement for heating prior to implement sustainable heating sources such as heat pumps.

4

COMMUNICATION AND ENGAGEMENT

Creating an environment for which the community surrounding the development has an in-depth understanding of why the changes are taking place and the end goal.

Thank You

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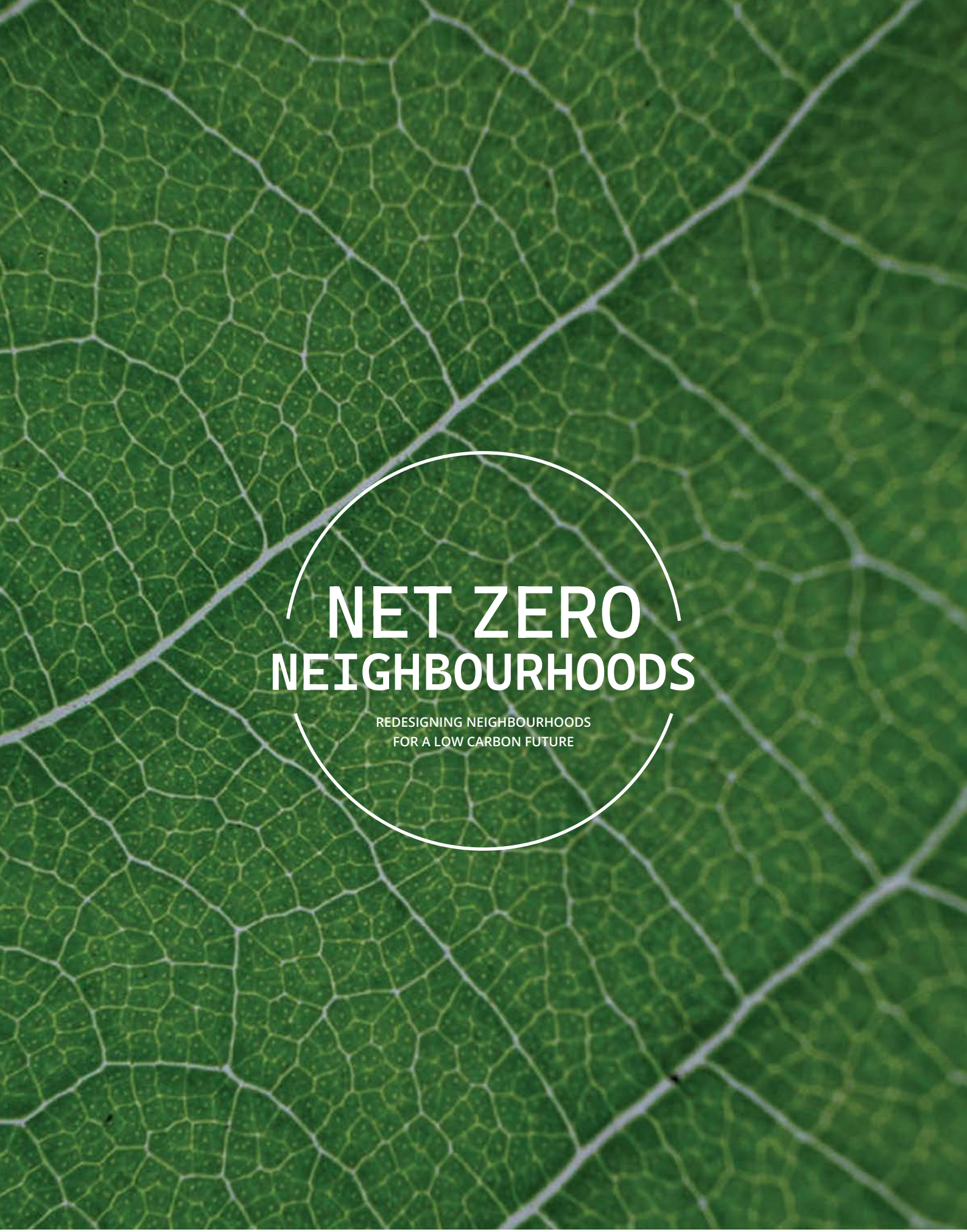

NET ZERO NEIGHBOURHOODS

REDESIGNING NEIGHBOURHOODS
FOR A LOW CARBON FUTURE

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