DETAILED PROJECT DEVELOPMENT FOR THE CAMBRIDGE CITY-CENTRE HEAT NETWORK

To: Cllr Rosy Moore
Executive Councillor for Climate Action and Environment
Environment and Communities Scrutiny Committee, 29 June 2023

Report by:
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Wards affected:
All

Non-Key Decision: subject to a successful feasibility study, approve in-principle match-funding from the Council's Climate Change Fund for the 'Detailed Project Development' stage of the Cambridge City-Centre Heat Network.

1. Executive Summary

The Cambridge City-Centre Heat Network Feasibility Study stage, shortly concluding, has had three objectives:

i) Demonstrate a viable pathway to zero-carbon for Cambridge's historic city-centre:

The project aims to help achieve the City Council's target set out in the Climate Change Strategy 2021-2026. "To reduce direct emissions from Council buildings and assets to net zero carbon by 2030". This was our initial primary purpose for starting to explore a heat network with renewable heat for the city centre, to help decarbonize council buildings that would otherwise (because of their location or construction) be difficult to treat.

It quickly became clear that there were opportunities to develop the project jointly and share the task with partners at the University of Cambridge, who face similar challenges in terms of their city centre estate, and potentially other partners in the tightly constrained urban setting of the city centre. In

this way, the project would also help contribute to the Council's vision for Cambridge to be net zero carbon by 2030.

Exploring the development of a city-centre heat network is one of Cambridge city's identified measures to address the causes and consequences of climate change.

The University of Cambridge has a Science Based Target to cut energy related Scope 1 (direct) and 2 (indirect) CO_2 emissions from its operational estate to absolute zero by 2048.

Heating and hot water in buildings typically accounts for one third of UK greenhouse gas emissions. A modern heat network provides a 21st century heating and hot water solution for Cambridge's historic city-centre and beyond.

ii) Feasibility:

The study aims to provide a clear set of recommendations, based on detailed technical and economic analysis of a heat network proposal for the city-centre. It will consider heat sources, energy centre locations, pipe routes and potential customers.

iii) Heat Network Expansion:

To determine if the Cambridge City-Centre Heat Network has the potential to physically expand and adapt over time. This would provide a pathway for decarbonising the city more extensively, including, potentially, residential areas in due course, creating the opportunity for the city-centre heat network to act, potentially, as both:

a) A launchpad for a city-scale heat network that could help decarbonise much of the city and protect Council, University and other customers from rising energy prices.

b) Creation of an innovation platform by combining big infrastructure with Cambridge's research expertise, science, cleantech and Artificial Intelligence. A super-efficient and environmentally friendly city-scale heat network would enable Cambridge to showcase sustainability leadership at a global level, demonstrating how it is driving both carbon reduction, academic ambition and Cambridge's cleantech economy.

AECOM's 'Mapping and Masterplanning Study' (Work Package 1) suggests that the Cambridge City-Centre Heat Network is likely to be feasible. The subsequent 'Feasibility Study' (Work Package 2) is scheduled to report in summer 2023, enabling the Cambridge City-Centre Heat Network to move to Detailed Project Development stage.

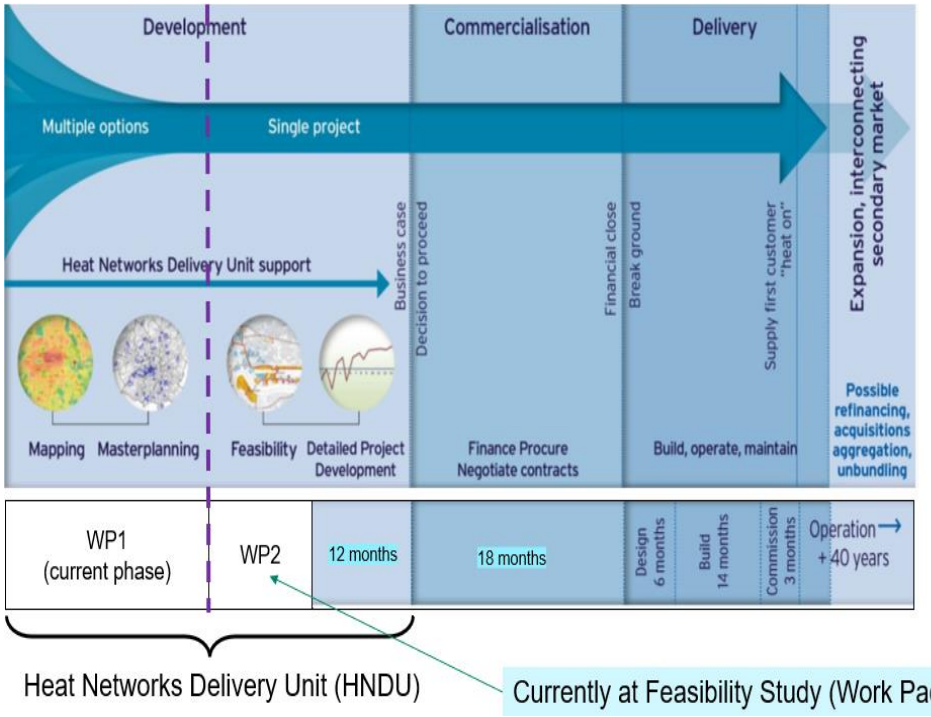
This approach follows government's well-defined methodology for developing heat networks and large-scale infrastructure projects, in line with HM Treasury's Green Book Guidance, as shown in Figure 1, overleaf.

The decision required relates to Council approval and match-funding needed to move to the next stage of Detailed Project Development.

The Detailed Project Development would provide a more thorough assessment of the physical and financial aspects of the project. It could include options analysis and advice on governance, financing and commercial models.

Once the Detailed Project Development stage had been completed, a further decision on whether and how to proceed with build-out and delivery of a network, and if, or what investment, would be required.

Figure 1, UK Government's Methodology for Developing a Heat Network



- Heat Mapping and Masterplanning phase (Work Package 1) has been completed
- Feasibility Study (Work Package 2) is now underway
- Time for decision making and procurement (e.g. of consultants) between phases not included in the timeline

iv) Recommendations

The Executive Councillor is recommended to:

1) Provide 'In-principle' approval to use up to £180,000 of the Council's Climate Change Fund for match-funding of the next phase of Detailed Project Development, subject to a satisfactory outcome from the feasibility study; a successful second government Heat Network Delivery Unit grant application; confirmation of a match-funding contribution from the University of Cambridge, clarification of additional expected resourcing requirements and sources and approval from the Executive Councillor for Finance and Resources.

2) Approve delegated authority to the Assistant Chief Executive (as heat network Project Sponsor) to make the final decision in consultation with the Executive Councillor, chair of Environment and Communities Scrutiny Committee and opposition spokes, once the Feasibility Study is completed in summer 2023.
3) Note the potential requirement for a further additional council and partner investment in technical assessment, at a later date, subject to exploration of alternative sources of funding (see section on risks and mitigations on pages 9-11).

v) Background

Heat networks have the capability to provide heating and hot water for cities. Heating and hot water in buildings account for around one third of UK greenhouse gas emissions. Gas boilers currently account for greater than an 80% share of the UK's heating market. The government forecasts that at least 18% of the UK's building stock will be connected to heat networks by 2050.[1]

The Council declared a climate emergency in 2019. The Council's Climate Change Strategy 2021-26 shares a vision for Cambridge to be net-zero carbon by 2030. The Council's strategy sets out six key objectives for how it will address the causes and consequences of climate change, including reducing carbon emissions from City Council buildings and reducing energy consumption and carbon emissions from homes and buildings in Cambridge. Initial findings demonstrate the feasibility of a 100% renewable and zero-carbon heat network in Cambridge city-centre, which would provide environmentally friendly heating and hot water to the city-centre. Over time, this could be expanded to create a city-scale heat network across Cambridge.

The Cambridge City-Centre Heat Network creates a unique opportunity to bring together collaborative systems thinking and cleantech innovation, where the overall impact is much bigger than the sum of its parts. It could showcase Cambridge's economic, environmental and social sustainability to an international audience, providing a practical demonstration of how to transform a historic city into a truly sustainable and low-carbon city centre.

Cambridge has the ingredients for a successful heat network:

[1] Cambridge District Energy – Heat Mapping and Masterplanning Report (Work Package 1), 15 May 2023.

1. **100% renewable and zero-carbon heating and hot water for connected buildings in Cambridge's historic city-centre, with first 'Heat On' potentially by 2030:** implementation of the Cambridge City-Centre Heat Network is likely to be the most efficient way to create a net zero carbon city centre. The annual carbon savings that can be achieved by the Council alone are forecast to be around 1,400 tonesCO_2/year, with up to 56,000 tonnes being saved over the lifetime of the scheme (40yrs). The annual carbon savings for the full build are forecast to be around 3,200 tonnes CO_2/year, with a forecast 128,000 tonnes CO_2 being saved over the lifetime of the scheme (40yrs).
2. **Scale:** a large city-centre core scheme balances ambition and practical delivery. Implementing a city-centre heat network could efficiently decarbonise more buildings, with a small number of partners controlling most of the anchor heat loads.
3. **Heat pump-led heat networks:** are the new normal, replacing gas Combined Heat and Power (CHP), which were viewed as the clean 'go to' technology only 10 years ago. Heat networks are future-proofed 'Plug and play' systems that have flexibility to add or change heat sources without building level interventions.
4. **City Council, University of Cambridge and Colleges:** are enablers of change, with significant influence in the city as landlords and climate leaders. The Council is also the planning authority. This unique partnership which controls the majority of buildings in the city-centre, has access to funding and the Council has local policy levers.
5. **Significant heat demand and expansion opportunity:** heat networks are either underway or planned for several strategic developments across the city. There would be scope to connect and expand out from the city centre into other commercial/research centres and residential areas in the future, ultimately connecting Council housing stock and private homes.
6. **Listed buildings in historic Conservation Area:** with little or no visual impact, a heat network is likely to be the best (and potentially only) way to fully decarbonise these historic buildings at scale in the Cambridge City-Centre Conservation Area. The alternative approach, attempting to decarbonise individual listed buildings with current technology is likely to be difficult due to tight space and planning constraints.
7. **Clean air:** helps reduce NO_x in 'Clean Air Zone,' which directly responds to the city-centre Air Quality Management Area.
8. **Planning Policy requires connection:** the Council has led the way in UK heat network policy with its 'Strategic District Heating Area,' which requires heat network connections. This fits well with national policy, with forthcoming regulation of heat networks and Heat Zones, which will mandate connection.

9. **Gap funding is available from UK government:** Heat Network Delivery Unit, Green Heat Network Fund and UK Infrastructure Bank.
10. **Cambridge's track record in heat network development:** we are not starting from scratch. The University of Cambridge is developing a heat network in Eddington, West Cambridge, with a peak heating demand of 13MW. A 5MW Water Source Heat Pump takes waste heat from both the West Cambridge Data Centre and the Cavendish III cryostats.

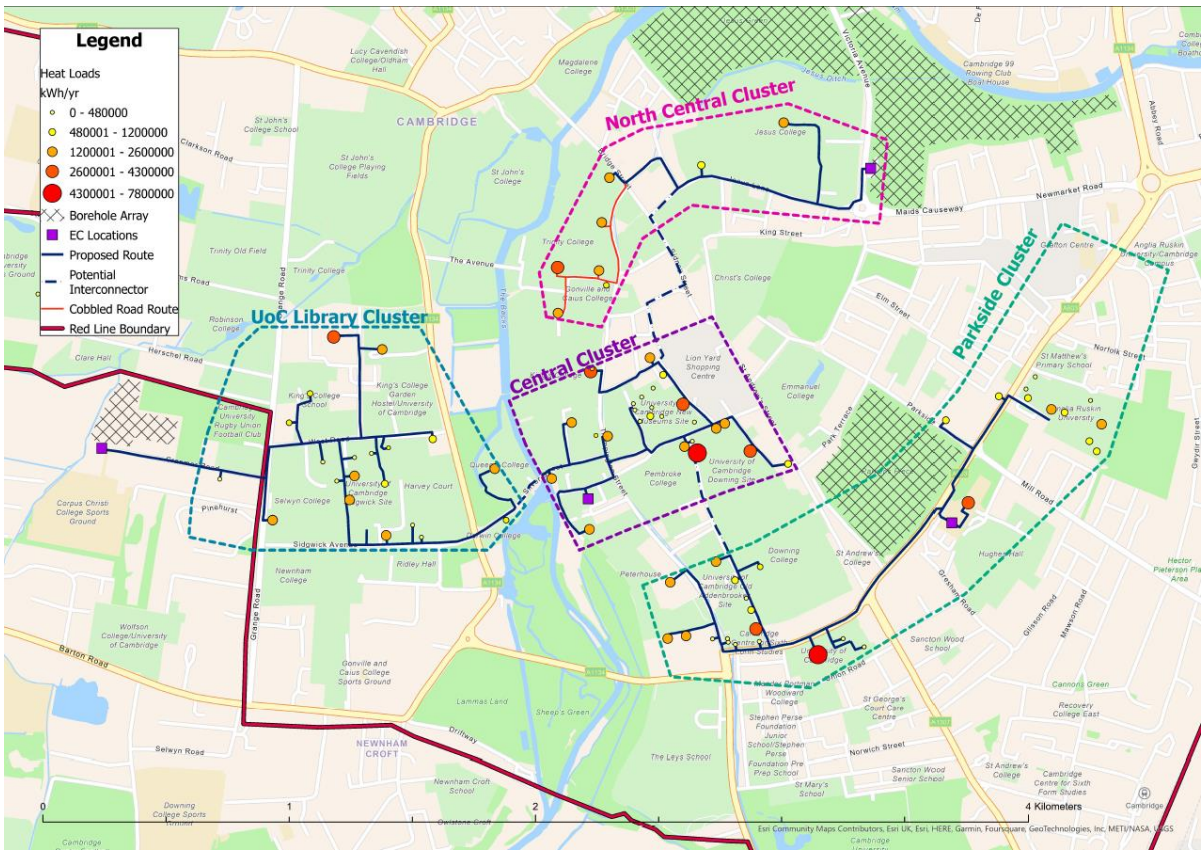
    Closed-loop Ground Source Heat Pumps are installed at Homerton College, Jesus College dining halls, and King's College Croft Gardens. Emmanuel College development on Park Terrace uses open-loop ground water sourced heat pumps. Pembroke College is looking to use an Air Source Heat Pump for its site. An Inter Collegiate Climate Group is assessing the potential for water sourced heat pumps using the River Cam.

Cambridge's prosperity is built on networks, innovation and partnerships. It is about systems thinking and city-scale collaboration. As was highlighted at the Cambridge Climate Leader's event in March 2023, delivering the Cambridge City-Centre Heat Network is the perfect response to the climate emergency using systemic change.

For the Council the project offers significant carbon savings, a healthy financial return from any subsequent capital investment, and increased energy security as a customer and anchor heat load.

Heat Mapping and Masterplanning (Work Package 1)

Map 1, Four shortlisted clusters for phased development of the Cambridge City-Centre Heat Network



Key findings of the feasibility study so far:

1. **The Cambridge City-Centre Heat Network is looking technically and economically viable:** all 4 Phases in Map 1 (Parkside, Central, North Central and University of Cambridge Library) and Full Build-Out show a positive Net Present Value (NPV), so projected revenues exceed the anticipated costs). Investments should only proceed where there is positive NPV, which is the case here.
2. **Detailed Project Development requires funding mechanisms to be explored and discussed to identify how the network will be funded:** all 4 Phases and Full Build-Out have an Internal Rate of Return (IRR) of 6 to 9% with no grants. Full Build-Out offers the highest IRR of 9%.
3. **As a result, the Council and University have maximum flexibility in how to fund the final scheme:** a public sector funded project typically needs at least 6% IRR, whilst a private-funded project is likely to require between 9 to 12%. Detailed Project Development will investigate the opportunities to fund it directly by the Council and/or University, with private-sector partners, with the support of philanthropic donations and/or through community investment in local green infrastructure.
4. **All 4 Phases and Full Build-Out are eligible for the government's £288 million Green Heat Network Fund:** a successful capital grant creates the opportunity to reduce tariffs and connection charges for the Council, University & Colleges, whilst maintaining a similar investment return.

5. **The total forecast construction cost is £165m:** each Phase is relatively balanced and is forecast to cost £35-52m, based on today's prices.
6. **The Colleges and University have most of the heat demand:** supported by Council buildings and a small percentage of private customers. This simplifies the process of securing heat network customers.
7. **Full Build-Out is the preferred option as it delivers the highest economic returns and highest carbon savings:** heat networks operate best at scale. More heat sources enable the heat network to account for seasonal variations in the performance of different energy generating technologies. Peak heat is expensive to provide and reduces with a diverse customer base and a range of heat demand profiles.
8. **Parkside Cluster (Phase 1):** this is looking like the most economically advantageous individual cluster and would include all project partners, including Parkside Pool (Council owned), Chemistry Building (University of Cambridge), ARU campus and, potentially, Downing College, Hughes Hall, and Peterhouse (Colleges).
9. **The highest carbon savings would be from Full Build:** North Central with Trinity, Jesus and St John's Colleges (Phase 2) and the University of Cambridge Library Cluster with Queens' College, Selwyn College and the Sidgwick site (Phase 3) offer the highest decarbonisation potential of individual Phases. They also include GSHP capacity to serve the wider network. Central Cluster (Phase 1) is the heart of the network in the iconic historic city-centre. It could include The Guildhall and Corn Exchange (City Council), the New Museums Site and West Building Downing Site (University of Cambridge), St Catharine's, King's and Pembroke Colleges.
10. **The Cambridge City-Centre Heat Network requires 50% less electricity compared to individual Air Source Heat Pumps:** this helps balance the National Grid and reduce the need for expensive electrical upgrades. Heat networks with large centrally powered heat pumps are much more efficient than heat pumps installed at individual buildings.

Other local and social benefits:

1. **Significant carbon savings:** all Phases can deliver around 87% carbon savings compared to individual gas boilers and a 50% carbon saving compared to individual Air Source Heat Pumps.
2. **Faster decarbonisation of heating in the city-centre, enabling buildings to decarbonise:** helps both the Council and University meet their ambitious decarbonisation targets, and work towards the Council's vision for Cambridge to be net zero by 2030.
3. **Reduced complexity in adaptation of the local power grid:** supports the centralised district heating approach which electrifies heating and hot water supply more efficiently.

4. **Improved air quality in the city-centre:** gas fire heating is removed from the City-Centre Air Quality Management Area (AQMA).
5. **No visual impact in the City-Centre Conservation Area:** beyond disruption caused during the build phase, there is an opportunity to make a visual, educational and statement feature of the energy centres. This could potentially add to the public realm and provide a visible and powerful statement of zero-carbon living.
6. **Helps create a circular economy:** the ability to access additional waste heat and/or renewable heat sources as they become available.
7. **Helps protect the Council, University of Cambridge, and other bodies that connect from future energy price hikes:** by reducing their need to buy from the grid.
8. **Creates an innovation platform with global reach:** attracting green investment, commercialising green technologies and accelerating the global transition to a zero-carbon economy.
9. **Creates a launchpad for expansion:** potential for a city-scale heat network across Cambridge. Future expansion could benefit our communities, connecting social housing to the network.
10. **The public sector heat loads act as a catalyst for further growth through private sector connections:** both as infill development and expansion.

Options Analysis

1. *Do nothing:* do not take forward the Cambridge City-Centre Heat Network to Detailed Project Development. This would remove any risks, costs or uncertainty associated with proceeding, but stop the project and all its potential benefits listed above. Note that the Council and University would likely have key enabling roles in any heat network, regardless of whether they choose to ultimately invest in and/or own the heat network.

2. *Proceed to Detailed Project Development for Full-Build Out:* this is the preferred option for the reasons listed above. Full build-out makes best use of the Ground Source Heat Pumps, reducing reliance on Air Source Heat Pumps in the space constrained central cluster. Multiple energy centres increase the network's reliability for customers.

3. *Only proceed to Detailed Project Development for an individual phase:* whilst this will deliver benefits and is feasible, it misses the opportunity for Full Build-Out. Heat networks operate best at scale. A more efficient heat network offers better customer tariffs for the Council and University, an accelerated route to decarbonise the city-centre and the opportunity to deliver a city-scale heat network across Cambridge.

Risks and Mitigation

The Recommendations in this report are based upon several assumptions:

	Risk	Mitigation
a	Dependency on a successful second HNDU funding bid for £465k for 18 months of Detailed Project Development, including HNDU confirmation that they deem Cambridge City-Centre Heat Network to be a 'large' project.	Pre-meet with Deputy Director for Heat Networks at Department of Energy Security and Net Zero (DESNZ)
b	The need to complement the heat network project with a robust energy efficiency retrofit programme, to reduce the overall capital investment required in the heat network's energy centres.	The Council's Asset Management and Decarbonisation Plan. Resources to manage and deliver the plan.
c	Proposed energy centres need to be fit-for-purpose and energy sources need to meet the energy supply outlined. The full network route also includes potentially crossing the River Cam. Due to the age, design, and conservation status of many bridges developing a cost-effective solution to the crossing will be key to inclusion of phases beyond the river.	Technical assessments will be required at Detailed Project Development, which is likely to involve: ○ Borehole testing at each of the Ground Source Heat Pump locations, to confirm the amount of renewable heat that is available. This is likely to cost £70-£100k per borehole, so could amount to some hundreds of thousand pounds. ○ Structural surveys of the shortlisted locations for the Air Source Heat Pumps, to make sure the rooves are strong enough and to again de-risk the project. This is forecast to cost approx £5k per site (minimum) and up to £50k in total. ○ Any testing required in relation to the river

		crossing, so that the heat network pipe can connect the University of Cambridge Library Cluster (Phase 3) with Central Cluster (Phase 4). This is forecast to cost approx. £20-50k in total.
d	Funding for the technical assessments (see c above) is likely to be subject to a further Council decision during or after the Detailed Project Development stage. To aid this process, the governance and funding options analysis will be prioritised, whereby the Council and other stakeholders determine how much control, risk and financial reward they each seek. Individual organisations will also have the choice to be heat customers only and pay a Connection Charge for each building that connects to the heat network. Once this process has been completed, the Council will know if it needs to help de-risk the project by agreeing to fund or part-fund these technical assessments.	Funding for these mitigations will be explored from a range of sources, including potential partner institutions in the heat network zone, but may require additional Council and University investment, e.g. through a budget bid.
e	Recruitment and capacity to manage and deliver the project	Resourcing needs will be clarified in the next stage, and clear roles / job descriptions developed, utilising existing council and partner capacity where possible, recognising the risk of competing demands.

Implications

a) Financial Implications

The total cost of the Cambridge City-Centre Heat Network's Detailed Project Development (DPD) depends on the size and number of phases in the core scheme. The total forecast cost will be confirmed through the Feasibility Study, it is likely to cost around £825,000. This figure excludes additional technical or archaeological surveys that may be required due to the complexity of Cambridge's historic city centre.

£465,000 of the total cost might be able to be funded by HNDU (subject to a successful funding bid), leaving a total estimated additional funding requirement of around £375,000 for the Council, University of Cambridge and any other funding partners. Please note that these are early estimates. Officers, with external advice, will provide more accurate forecasts as the Feasibility Study progresses, taking advice from HNDU on latest market costs. Officers will also scope out exactly what resource requirements are needed, which in turn impacts the funding requirement.

Requirement

Project management	£	180,000.00
Technical study	£	645,000.00
Conservation	TBC	
Technical tests	TBC	
Total	**£**	**825,000.00**

Funding

		DPD investment
HNDU Funding (PM)	£	90,000.00
HNDU Technical	£	375,000.00
Council	£	180,000.00
University of Cambridge	£	180,000.00
Total	**£**	**825,000.00**

b) Staffing Implications

There are likely to be a number of roles and functions requiring input from council staff, consultants, contractors, partners and others. These are likely to include:

- Programme Management
- Stakeholder engagement
- Procurement

- Legal advice
- DPD delivery
- Conservation advice
- Exploration of governance models
- Advice on funding models
- Retrofit programme management

c) Equality and Poverty Implications

An Equality Impact Assessment has been conducted on progressing the project to Detailed Development Phase. There is expected to be no impact at Detailed Project Development Phase however there are both positive and negative impacts identified if the project progresses to construction and delivery which will be reviewed and where possible, mitigated. Please refer to Appendix 3: Heat Network Feasibility Study Equality Impact Assessment.

d) Net Zero Carbon, Climate Change and Environmental Implications

The heat network would have a High Positive impact on climate change as the heat network, (if progressed to construction and delivery) would provide zero carbon heating and hot water to the city-centre creating significant carbon savings. The annual carbon savings that can be achieved by the Council alone are forecast to be around 1,400tonesCO2/year, with up to 56,000 tonnes being saved over the lifetime of the scheme (40yrs). The annual carbon savings for the full build are forecast to be around 3,200 tonnes CO2/year, with a forecast 129,000 tonnes CO2 being saved over the lifetime of the scheme (40yrs). The full build heat network could deliver around 87% carbon savings compared to individual gas boilers and a 50% carbon saving compared to individual Air Source Heat Pumps. This is due to the efficiency offered by large commercial-scaled heat pumps.

Assuming 100% renewable electricity is used to power the heat pumps, as intended, the Council and University will achieve zero-carbon Scope 1 (direct - fuel) and Scope 2 (indirect - electricity) emissions for the connected buildings from first ‘Heat On’ potentially in 2029/2030. This would require continued purchase of 100% green electricity, noting that some electricity may be generated locally from roof-mounted solar panels.

The heat network would require, and complement, delivery of the Council’s Asset Management and Decarbonisation Plan. This was approved at Strategy & Resources Scrutiny Committee in March 2023, and provides a phased programme of energy efficiency improvements of Council owned

buildings as part of a wider programme of asset maintenance, to help create a net-zero Estate by 2030.

The Carbon Management Plan 2021 – 2026 sets out how the City Council will reduce emissions from its buildings, land and vehicles.

e) Procurement Implications

The Council will facilitate procurement of consultants and project management teams to undertake Detailed Project Development. There are two procurement options available:

1. Public procurement process.
2. Utilise an appropriate framework to appoint pre-shortlisted consultants by competition (as with the existing Feasibility Study). This is likely to be the preferred option.

f) Community Safety Implications

No community safety implications, the Detailed Project Development stage is primarily a desktop study.

12. Consultation and communication considerations

In addition to the significant level of stakeholder buy-in obtained for the initial government funding bid in Spring 2022 from the Council, Vice-Chancellor of the University of Cambridge and 18 University Colleges, significant momentum has built as the project has continued to develop. This has included presentations to:

- The UK heat network industry at Homerton College in November 2022 in partnership with the Danish Embassy
- The City Leaders Climate Change Group event in March 2023, with attendees from the Council, the University of Cambridge, Anglia Ruskin University, local tech companies and the Cambridge Institute for Sustainability Leadership.

To support the development of Work Package 1 and 2, the Council developed a web page and email address specifically for the Cambridge City-Centre Heat Network: https://www.cambridge.gov.uk/city-centre-heat-network This has resulted in several Expressions of Interest from high-profile organisations seeking to connect to the new heat network.

The aims of the project have been communicated publicly via press release and Cambridge Matters.

To demonstrate the level of widespread support from public and private-sector organisations, additional letters of support will be sought for the funding bid from key stakeholders, including Cambridgeshire County Council linked to the Local Area Energy Plan, and significant owners managers of property in the city centre.

Further engagement on the potential benefits of the network is expected to take place in the next stage.

13. Background papers

1) City Council's Climate Change Strategy
2) University of Cambridge's Carbon Reduction Strategy, 2020 Update
3) Committee report on the Asset Management Plan from March's Strategy & Resources Scrutiny Committee meeting
4) Heat Demand and Masterplanning Work Package 1 Study

14. Appendices

Appendix 1, Background
Appendix 2, Highlight Summary of AECOM's Heat Mapping & Masterplanning Report
Appendix 3, Heat Network Feasibility Study Equality Impact Assessment

15. Inspection of papers

To inspect the background papers or if you have a query on the report please contact Catherine Stewart, Climate Change Officer, tel. no 01223 457086 e-mail Catherine.Stewart@Cambridge.gov.uk

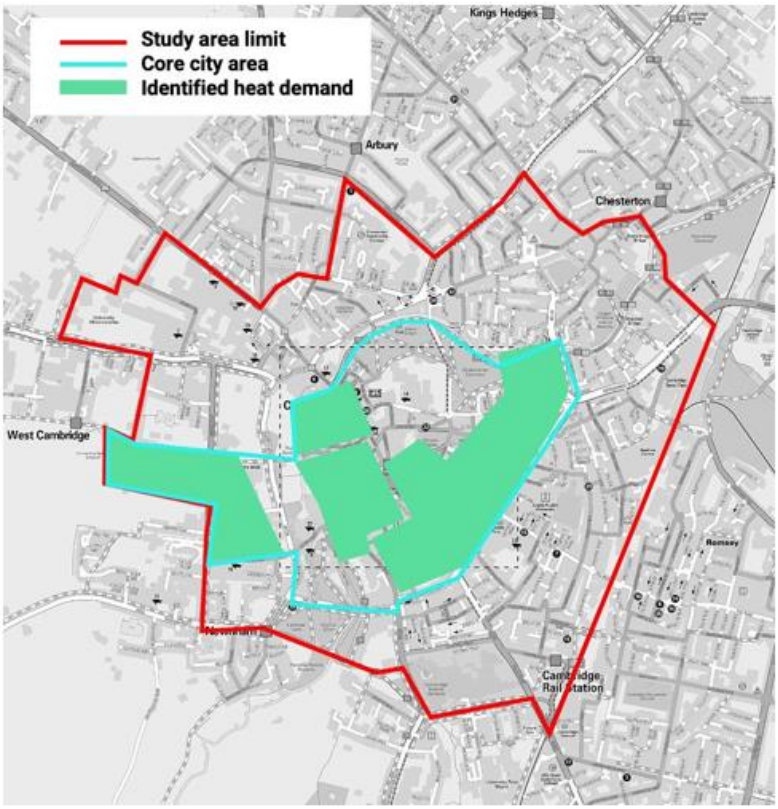
Appendix 1, Background

What's the story so far?

Expert consultants Sustainability Co. were appointed to develop a collaborative partnership for the initial government Heat Network Delivery Unit (HNDU) funding bid in July 2022, with letters of support from the Chief Executive and Leader of Cambridge City Council, the Vice-Chancellor of the University of Cambridge and 18 Colleges.

The Council, in partnership with the University of Cambridge secured £97,680 government grant funding to refresh the previous 2019 Heat Mapping and Masterplanning Study (work Package 1) and develop a subsequent Feasibility Study for the Cambridge City-Centre Heat Network (Work Package 2). In addition to the £97,680 grant, £33,00 match-funding was provided and equally split between the City Council and University of Cambridge.

The partners developed a scope of works and through a procurement exercise using the GLA's framework of heat network specialists, appointed AECOM to complete the study, which is focused on the phased development of Core City Area outlined in blue, supported by the wider Study Area outlined in red:



Approval is now sought to progress from Feasibility Study to ‘Detailed Project Development’ stage, in accordance with the government’s well-defined methodology for developing heat network projects.

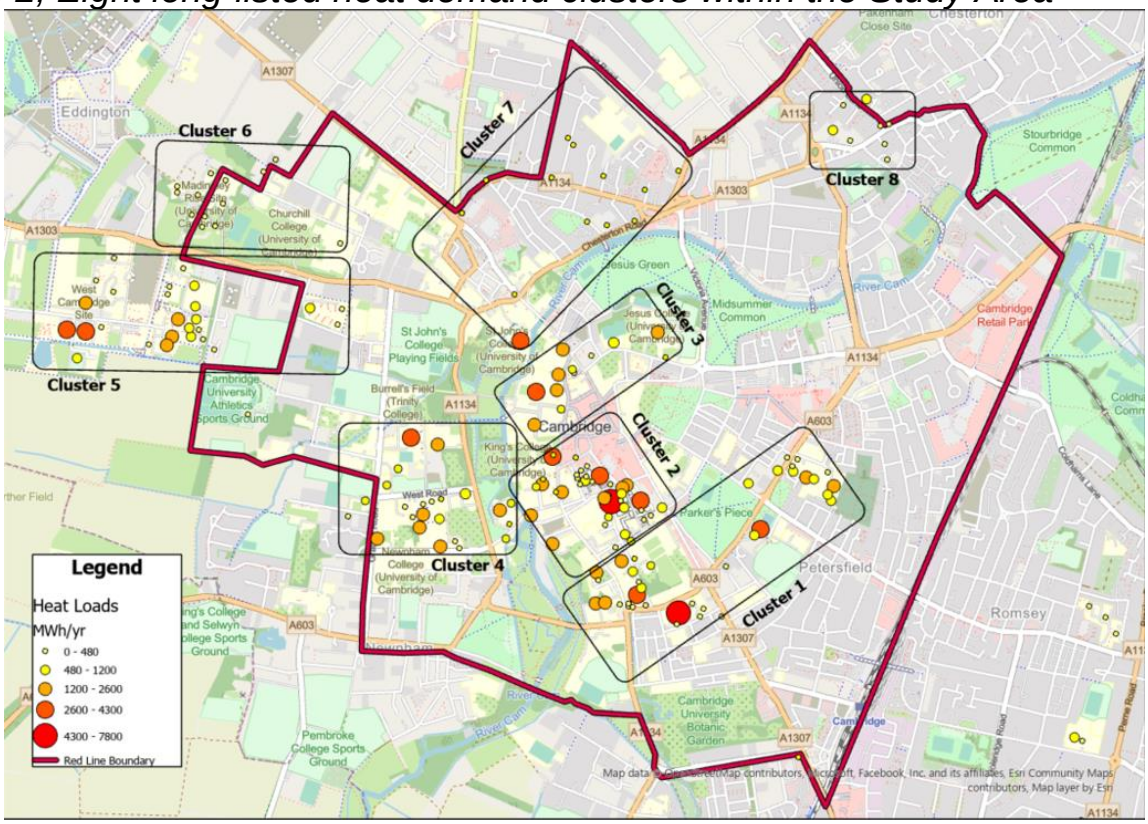
Government grants are available to support this process, which is why a further Heat Network Delivery Unit (HNDU) grant application for £375,000 match funding is being prepared to support ‘Detailed Project Development.’

Summary of AECOM's Heat Mapping & Masterplanning

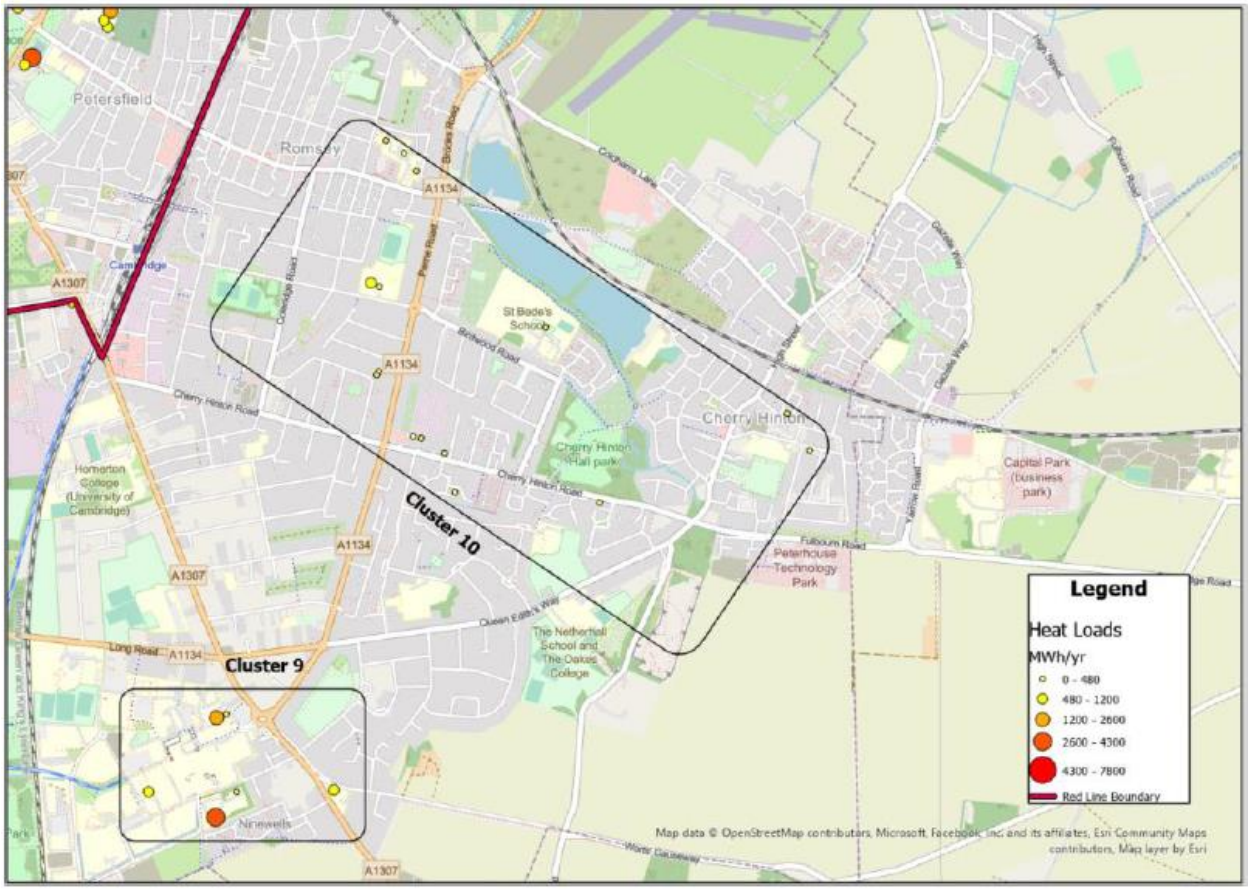
Key Findings from Work Package 1 (WP1):

- 4 individual viable networks can be interconnected into one single large network in Cambridge city-centre.
- Several technically viable locations are identified for Energy Centres.
- 86% of estimated thermal load is based on metered data. Strong data quality provides confidence.
- 113 buildings are identified in the red line boundary with a significant annual heat demand of 113GWh.
- 8 clusters were identified, of which Clusters 1 to 4 were prioritised for immediate consideration due to their heat density and location within the red line boundary.
- Cambridge Science Park has 3.8MW heat demand but is 5.5km from the red line boundary. The Science Park heat capacity available is not sufficient to justify the cost of connecting it to the proposed heat networks in the city centre at this stage. A satellite heat network could be explored to supply existing buildings within the Science Park.
- Cambridge University Hospitals, Addenbrookes, and Royal Papworth have a significant heat load and there is an existing heat network. This is being investigated further through the Feasibility Study.

Map 2, Eight long-listed heat demand clusters within the Study Area



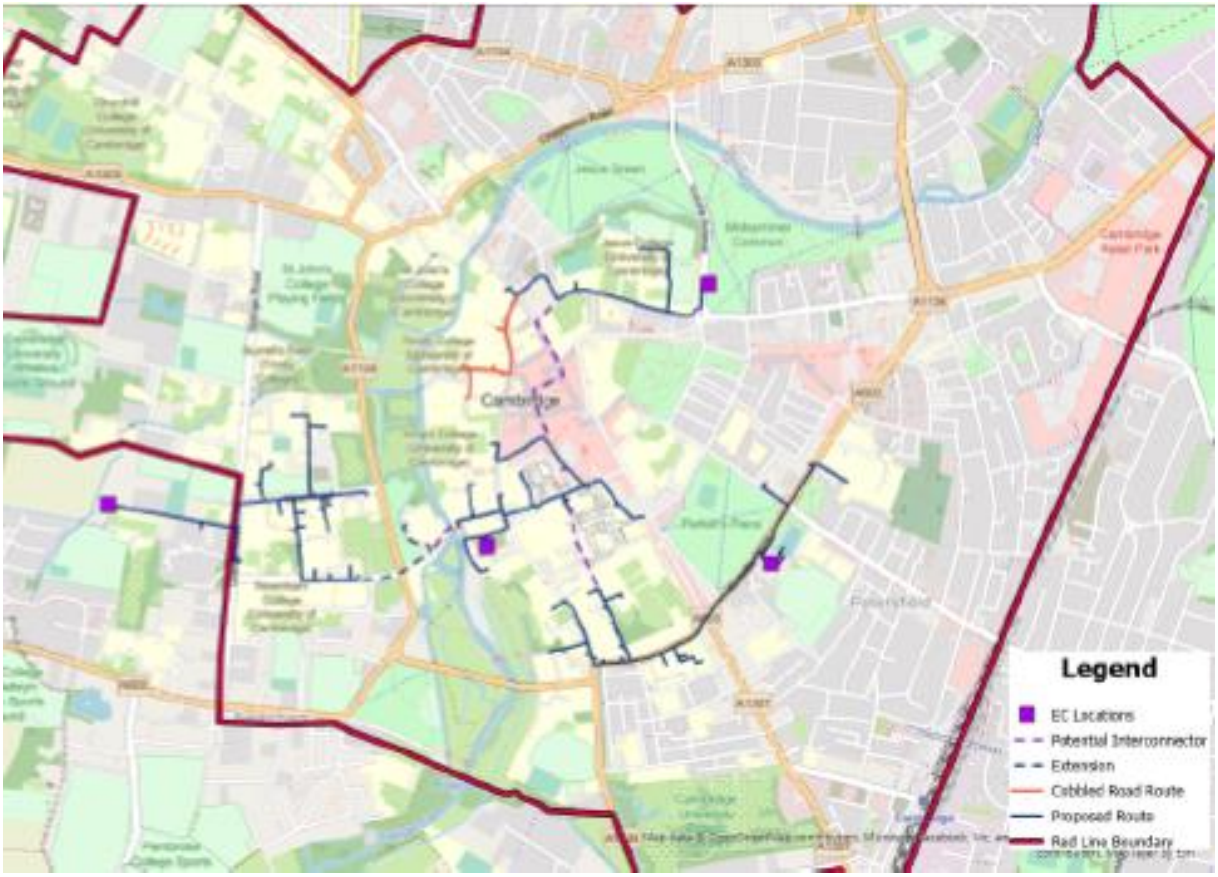
Map 3, Two other long-listed clusters outside of the Study Area (Existing heat network at Addenbrookes Hospital and a relatively low density cluster to the east of the railway line)



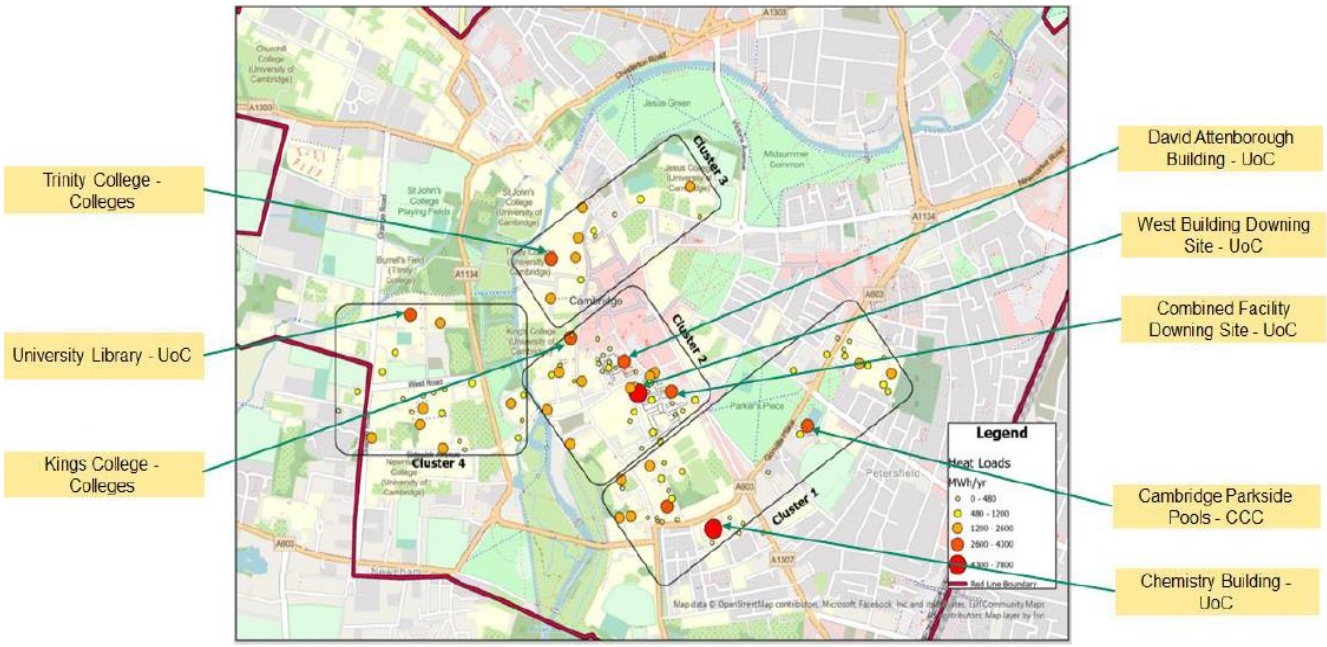
The network routes in Map 4 (overleaf) are based on the following criteria:

1. Taking the shortest route possible from heat source to heat load, reducing capital costs and heat losses.
2. Avoiding constraints such as major roads, rivers, railways and historic roads where possible.
3. Using soft dig where possible to reduce capital expenditure.
4. Follow the route that picks up the most heat load possible.
5. Utilise existing communal heat networks where possible.

Map 4, Proposed pipe routes for the Cambridge City-Centre Heat Network



Map 5, Anchor Heat Loads in the 4 shortlisted phases



Preferred heat sources

The 100% renewable heat could potentially be provided by 3 sources of environmental heat, supported by large thermal stores/water batteries so we can purchase the electricity for the heat pumps when it is cheapest:

1) Ground Source Heat Pumps (GSHPs) and borehole arrays provide around 63% of the heat supply. The boreholes for the Ground Source Heat Pumps are assumed to be located on 3 green spaces in proximity to the main clusters. Once installed, the expectation is that there would be little or no visual impact or loss of amenity to the open spaces:

    a) Parker's Piece: area of c.80,700m². Assuming 60% of this area is available, this would result in a space of c.48,000m². This could accommodate a GSHP with an estimated maximum capacity of 5MW.

    b) Midsummer Common & Jesus Green: have a total area of c.140,000m². Assuming 60% of this area is available, this would result in a space of c.84,000m². This could accommodate a GSHP with a conservatively estimated capacity of 6MW.

    d) End of Cranmer Road area of c.33,300m². Assuming 60% of this area is available, this would result in a space of c.20,000m². This could accommodate a GSHP with an estimated capacity of 3MW, subject to discussions with the Greater Cambridge Shared Planning Service.

    e) Additional green spaces at College sites will be considered in the Feasibility Study.

2) Air Source Heat Pumps (ASHP), account for around 19% of heat supply. The Engineering Building, New Museums sites, and other commercial properties in the city centre were identified as longlisted roof-top locations to accommodate ASHPs.
3) Energy centres with electric boilers for top-up and peak demand (18% of heat supply). There is potential to reduce the number of electric boilers as more details about the renewable heat sources become available.
4) Thermal stores located outside the energy centre buildings.

Map 6, Renewable heat sources in the 4 shortlisted Clusters

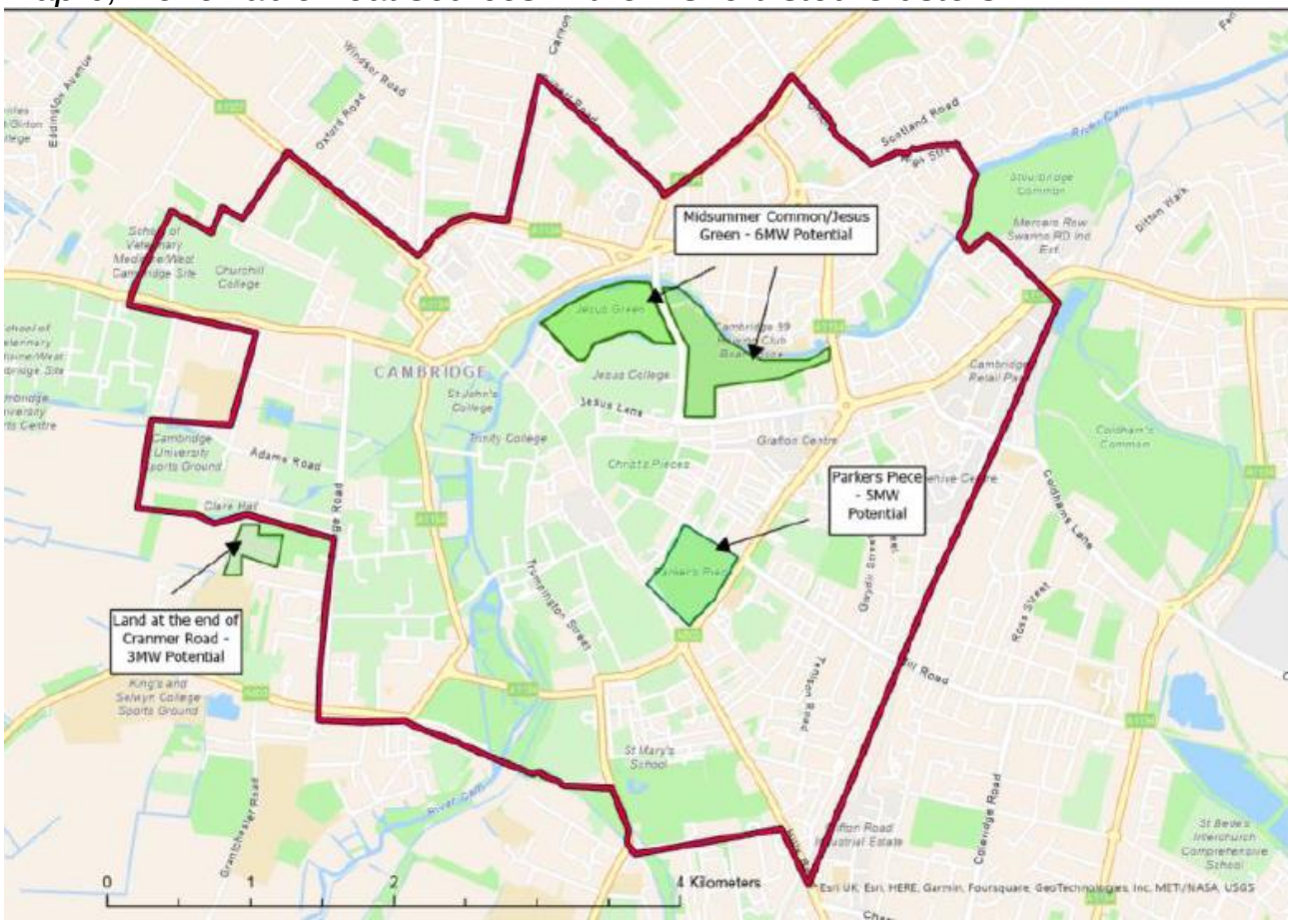


Figure 1, Four shortlisted clusters identified by Heat Mapping & Master planning Study 2023

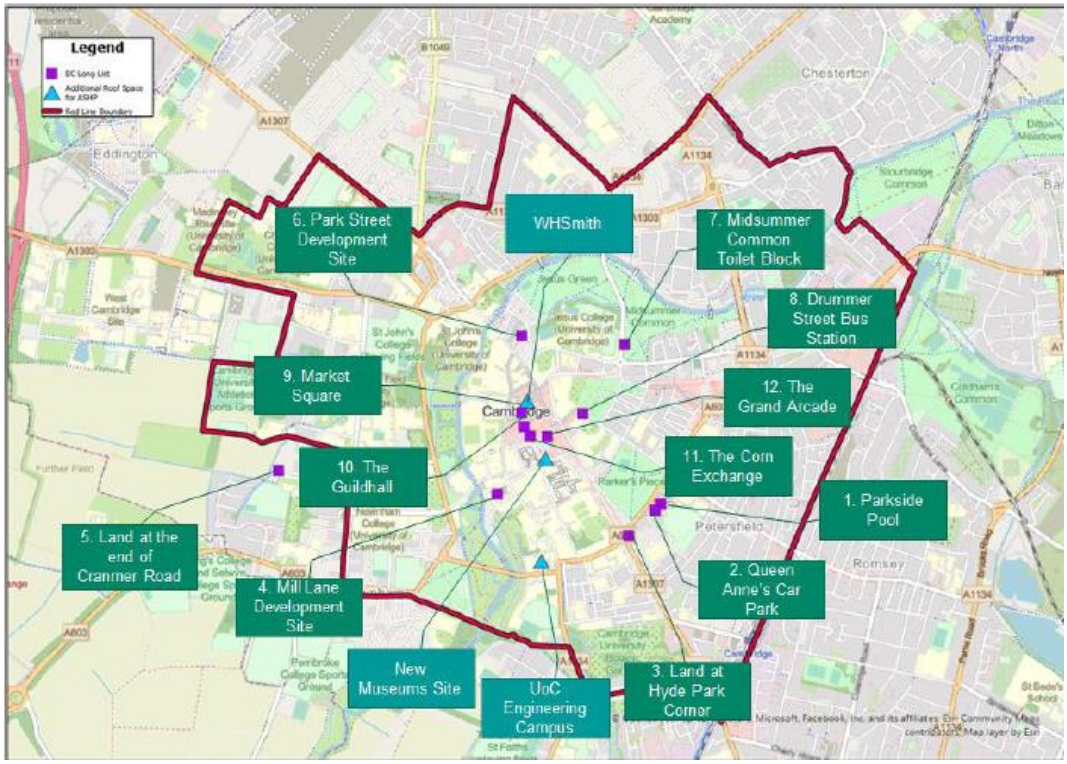
Scenario	Total Plant Installed
Cluster 1 – Parkside	– 5MW GSHP – 449m2 – 3MW ASHP – 168m^2 – Electric Boiler Peaking and Resilience Plant – 392m^2 – 300m^3 Thermal Stores – 350m^2 (external)
Cluster 2 – Central	– 8 MW ASHP – 411m^2 – Electric Boiler Peaking Plant – 559m^2 – 200m^3 Thermal Stores - 200m^2 (external)
Cluster 3 – North Central	– 6MW GSHP – 473m^2 – Electric Boiler Peaking Plant – 457m^2 – 200m^3 Thermal Stores - 200m^2 (external)
Cluster 4 – UoC Library	– 3MW GSHP – 376m^2 – Electric Boiler Peaking Plant – 515m^2 – 200m^3 Thermal Stores - 200m^2 (external)
Full Build	– 14MW GSHP – 600m2 – 10MW ASHP – 610m^2 – Electric Boiler Peaking and Resilience Plant – 840m^2 – 500m^3 Thermal Stores – 1,200m^2 (external)

Preferred energy centre locations

The long-list of energy centre locations is still being developed, based on a few key principles, which include:

1) Seek to design hidden energy centres located in the Conservation Area, design to be in-keeping or enhance current townscape, or seek to make a feature of renewable energy centres in non-sensitive locations, to help showcase the heat network's environmental benefits, zero-carbon living and to promote community buy-in.
2) We have complete flexibility to design each energy centre within its local environment, and where appropriate, to improve the public realm e.g. loosening the currently impacted soil on Parker's Piece to help the grass to grow more healthily.
3) Consider opportunities to link energy centres into the redevelopment of individual sites, e.g. pavilions, toilet blocks.
4) Consider the pros and cons of:
    - Distributed and centralised energy centres
    - Use basement or rooftop locations versus standalone buildings
    - Tall and low-rise buildings

Map 8, Indicative initial long-list of potential energy centre locations



Main customers in the Cambridge City-Centre Heat Network

Technoeconomic modelling from the Heat Mapping and Masterplanning will be refined through the Feasibility Study. The initial outputs from Work Package 1 confirm that of the 113 buildings assumed to connect (for feasibility assessment purposes) during Phases 1 to 4, anchor heat loads include:

Phase	City Council buildings	University of Cambridge	University Colleges	Other
Phase 1 Parkside Cluster	Parkside Pool (2.1MW)	Chemistry Building (5.9MW)	Hughes Hall Peterhouse	
Phase 2 North Central			Trinity College (4.6MW) Jesus College (2.3 MW) St. John's College (3.3MW) Sidney Sussex College	
Phase 3 UoC Library site		UoC Library (4.5MW) Sidgwick Site (6.8MW)	Selwyn College Clare College Newnham College Queens' College	
Phase 4 Central	The Guildhall (1.8MW) The Corn Exchange (0.9MW)	New Museums Site (5.2MW)	Downing College (1MW) St Catharine's College (2.3 MW) King's College (3.8MW) Gonville and Caius College Corpus Christi College	

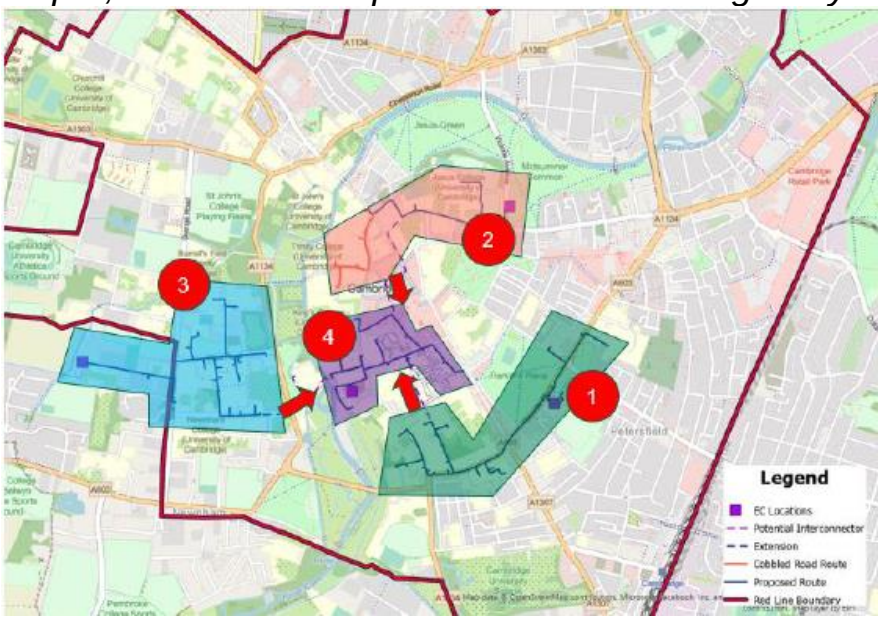
			Trinity Hall Emmanuel College Christ's College	

In addition to these anchor heat loads, many other buildings have been identified as being likely to connect. These can provide potential infill connections as the heat network develops.

Phased development of the Cambridge City-Centre Heat Network

The Heat Mapping and Masterplanning Study recommends phased development of the Cambridge City-Centre Heat Network, as shown in Map 9. The order of construction is based on prioritising networks which connect to Ground Source Heat Pumps, to reduce sole dependency on Air Source Heat Pumps within the space constrained central cluster.

Map 9, Phased development of the Cambridge City-Centre Heat Network



Potential Innovation Platform

Cambridge's two universities and associated research and innovation cluster have a wealth of academic and technical expertise that could be utilised to harness the innovation potential of this project. Cambridge Zero, the

University's flagship climate change initiative, has identified 'Decarbonising the Built Environment' as a Grand Challenge theme within its research portfolio, which brings together existing cross-disciplinary expertise from the Departments of Engineering, Architecture, Land Economy, Chemical Engineering and Biotechnology, as well as the Judge Business School, Cambridge Institute for Sustainability Leadership and the Energy Interdisciplinary Research Centre.

Within this theme there is a particular research interest in the application of Artificial Intelligence (AI), digital and sensing technologies to support the decarbonisation of the built environment. Working collaboratively with internal and external partners, a roadmap for a flagship project is being developed. It will focus on using the University estate as a testbed to develop and demonstrate the co-ordinated site-wide use of interoperable cyber-physical infrastructure, sensing and AI technologies, in decarbonising the estate and its buildings.

The outputs of this project could function as a 'Smart Campus' template to other real estate managers on how to implement decarbonisation through the use of cyber-physical infrastructure, providing demonstrable real-world impact. There is the potential to develop innovative systems with the Cambridge Centre for Smart Infrastructure and Construction, and to access national innovation grant funding.

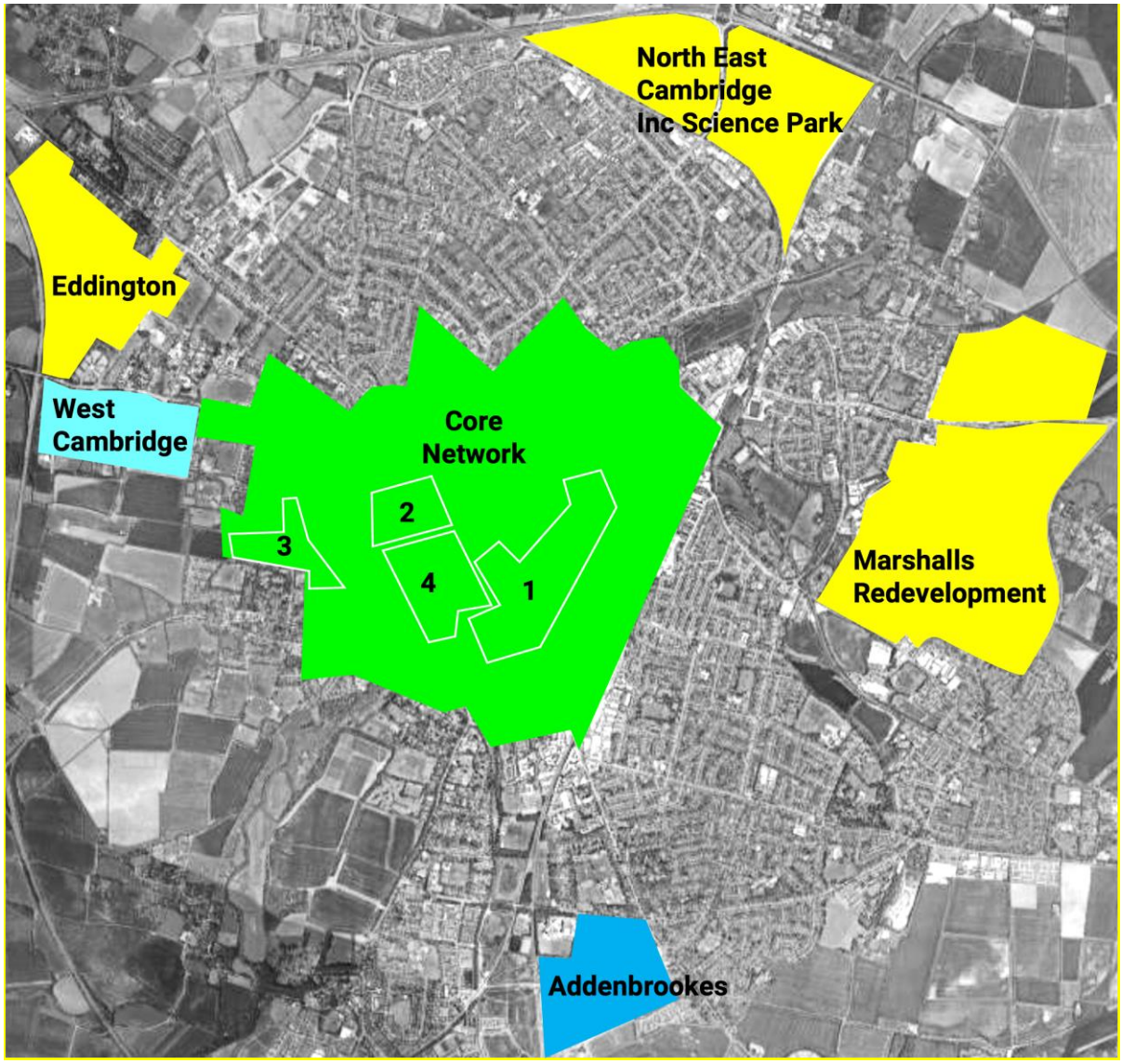
The Cambridge City-Centre Heat Network could ultimately benefit from leveraging cross-departmental academic expertise through Cambridge Zero, while the Cambridge academic and business community would benefit from the heat network as a case study on how to develop and commercialise new research and technologies.

Expansion Opportunities

The Cambridge City-Centre Heat Network will be a key strategic asset that could be expanded to create a city-scale heat network across Cambridge, supporting the Council and University's decarbonisation targets. Expanding the network and operating at scale will improve the operational efficiency of the network and help maintain affordable energy bills for customers, of which the University of Cambridge, Cambridge City Council, and several Colleges will be anchor heat loads in the first instance.

Significant expansion opportunities exist, proving that the Cambridge City-Centre Heat Network provides the perfect launchpad for a city-scale heat network in the medium to long-term. Satellite heat networks that could potentially organically grow to ultimately connect with an expanding city-centre heat network include:

1) West Cambridge and Eddington (westerly extension)
2) Cambridge Science Park and North-East Cambridge (northerly extension)
3) East Cambridge (easterly extension)
4) Addenbrookes Hospital / Biomedical Campus.



In future phases there is also the opportunity to connect the Council's housing stock, and other housing in the city. To help tackle fuel poverty, by ensuring that residents' energy costs are lower than would otherwise be the

case. Widening access to renewable heating technologies that currently remain unaffordable to many.

This is why the Council is planning for both technical interoperability (via an AECOM guidance note) and to future-proof both new buildings for heat network connection (via the Council's Planning team) and existing buildings (via the council's asset management plan).

What does the draft Feasibility Report say?

The Feasibility Study (Work Package 2) will build upon the Heat Mapping and Masterplanning Study (Work Package 1), which was finalised in May 2023. The Feasibility Study is underway and will report in summer 2023, further developing the Heat Mapping and Masterplanning through:

- Energy demand refinement
- Counterfactual: refine assumptions
- Scheme optimisation: plant, load, operational strategy, de-risk assumptions
- Develop Energy Centre RIBA Stage 2 designs
- Refine distribution system: hydraulic analysis, building connection design and route drawings
- Economic modelling: cashflow, target IRR / NPV, carbon reductions

What are the next steps?

The Council and University of Cambridge's will require an experienced heat network client team to develop the scope of work and procure specialist heat network consultants. Together with relevant stakeholders they will develop the strategic, economic, financial, commercial and management cases for the Cambridge City-Centre Heat Network. Collectively the 5 cases form the Outline Business Case, which as the main output from DPD Stage will:

1) Demonstrate strategic fit with local, regional and national policy.
2) Provide a detailed heat network technoeconomic model and design (to RIBA Stage 3).
3) Provide a detailed financial model to aid decision making, describe how the heat network project will be financed and confirm the preferred funding option e.g. public sector borrowing, private investment, social

investment, Green Bond, philanthropy and/or community investment in local green infrastructure.

4) Detail the contractual and commercial arrangements.
5) Show how the project could be governed and the preferred delivery model.

The Outline Business Case would be used to inform a further Council decision on whether to fund Commercialisation Stage. This is when heat network contractors are procured; all legal contracts are drafted and agreed; and the funding is finalised.

Sustainability Co advise that it is best not to combine DPD and Commercialisation Stages as: 1) HNDU match-funding is only available for DPD, with other government funding available for Commercialisation Stage, 2) The Outline Business Case is required to properly define what resource and budget is needed at Commercialisation Stage.

The Commercialisation Stage culminates in Final Investment Decision for the Cambridge City-Centre Heat Network, which is when final heat network designs are completed and heat network construction starts. Delivery of the first phase of a zero-carbon heat network could begin in early 2028, if all stages progressed smoothly:

Indicative timeline

Forecast dates	Heat Network Stage
March 2023	Mapping and Masterplanning completed
Summer 2023	Feasibility Study
Quarter 4, 2023 & Quarter 1, 2023	Develop scope of works, procure client team & procure DPD consultants
Quarter 2 2024 to Quarter 2, 2025	Detailed Project Development Stage
Quarter 3 & Quarter 4, 2025	Develop scope of works, procure client team & procure Commercialisation consultants
Quarter 1 2026 to Quarter 2, 2027	Commercialisation Stage
Quarter 2, 2027	Final Investment Decision

Quarter 3 2027 to Quarter 3, 2028	Detailed technical design (RIBA Stage 4)
Quarter 4, 2028 to Quarter 4, 2031	Construction of Phases 1 to 4 of the Cambridge City-Centre Heat Network

Cambridge City Council Equality Impact Assessment (EqIA)

This tool helps the Council ensure that we fulfil legal obligations of the Public Sector Equality Duty to have due regard to the need to –

(a) eliminate discrimination, harassment, victimisation and any other conduct that is prohibited by or under the Equality Act 2010;

(b) advance equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it;

(c) foster good relations between persons who share a relevant protected characteristic and persons who do not share it.

Guidance on how to complete this tool can be found on the Cambridge City Council intranet. For specific questions on the tool email Kate Yerbury, Equality and Anti-Poverty Officer at equalities@cambridge.gov.uk or phone 01223 457046.

Once you have drafted the EqIA please send this to equalities@cambridge.gov.uk for checking. For advice on consulting on equality impacts, please contact Graham Saint, Strategy Officer, (graham.saint@cambridge.gov.uk or 01223 457044).

1. Title of strategy, policy, plan, project, contract or major change to your service
Detailed Project Development phase for the Cambridge City Centre Heat Network

2. Webpage link to full details of the strategy, policy, plan, project, contract or major change to your service (if available)
https://www.cambridge.gov.uk/city-centre-heat-network

3. What is the objective or purpose of your strategy, policy, plan, project, contract or major change to your service?
The Council and University of Cambridge are in working in partnership on the City Centre Heat Network project. A district heat network is large-scale plumbing for a city. It supplies space heating and hot water using one or more energy centre and delivers it to a variety of different buildings in a local area, via a network of underground pipes carrying hot water. This project could provide a solution to reduce carbon emissions from historic buildings in the city centre, such as the Corn Exchange and The Guildhall and University buildings, and help the Council work towards its net zero by 2030 target. The first stage of the Cambridge City centre heat Network project, the Feasibility

study, is due to be finished in summer 2023. The Council is seeking to take the project to the next stage of the project, which is the Detailed Project Development Phase. This phase will be a desktop study, building on work completed in the Feasibility study to develop a Detailed Project Development plan for a City Centre Heat Network, up to RIBA Stage 3. If further funding is available to progress the project, a heat network could begin to be built in 2028. This EqIA therefore reviews the impacts of the next phase (Detailed Project Development phase) and also the possible impacts of future stages of the project, if the project progresses to commercialisation, construction and delivery.

4. Responsible service: Democracy, Inclusive Economy & Climate Group

5. Who will be affected by this strategy, policy, plan, project, contract or major change to your service? **(Please tick all that apply)**	☒ Residents ☒ Visitors ☒ Staff

Please state any specific client group or groups (e.g. City Council tenants, tourists, people who work in the city but do not live here):

The heat network feasibility study outlines a potential network route and energy centres within the historic core of Cambridge. If the project progresses through Detailed Project Development, and commercialisation phases to construction, it may impact the following groups:

Residents / workers / visitors

- If progressed to construction; pedestrian / bus routes may be temporarily closed.

Residents

- If progressed to construction; there will be major carbon reduction in Cambridge City Centre. This will positively impact the health of residents of Market Ward, where there is currently high deprivation in terms of environmental air pollution This is largely due to pollution from dependency on gas boilers and vehicles. The reduction in air pollution will be particularly beneficial to children, elderly people, people with a disability and pregnant women who are more vulnerable to the impacts of air pollution. According to Census 2021 data, approximately 23% of the population in Market Ward are aged 0-19.

Staff

- If progressed to construction, staff will work in more energy efficient buildings, likely to be more comfortable and better for wellbeing and productivity

6. What type of strategy, policy, plan, project, contract or major change to your service is this?	☒ New ☐ Major change ☐ Minor change

7. Are other departments or partners involved in delivering this strategy, policy, plan, project, contract or major change to your service? (Please tick)	☒ Yes ☐ No
If 'Yes' please provide details below: Property Services Planning Service Economic Development Housing Development Agency	

8. Has the report on your strategy, policy, plan, project, contract or major change to your service gone to Committee? If so, which one?
Environment and Communities Scrutiny Committee 29 June 2023

9. What research methods/ evidence have you used in order to identify equality impacts of your strategy, policy, plan, project, contract or major change to your service?
Desktop research: Health matters: air pollution - GOV.UK (www.gov.uk) Population - Ward | Market | Report Builder for ArcGIS (cambridgeshireinsight.org.uk) City Centre Heat Network Feasibility Study Also liaised with Heat network consultant with regards to equalities assessment and implications of heat networks to gain their input from lessons learned from elsewhere to ensure that all possible impacts of a heat network are identified and assessed

10. Potential impacts

For each category below, please explain if the strategy, policy, plan, project, contract or major change to your service could have a positive/ negative impact or no impact. Where an impact has been identified, please explain what it is. Consider impacts on service users, visitors and staff members separately.

(a) Age - Please also consider any safeguarding issues for children and adults at risk

No impact at Detailed Project Development.

Age should be considered if residential properties are brought into a latter design stage of the heat network development as there may be a positive impact for elderly people as the heat network project could improve the energy efficiency of their home and avoid/reduce any health risks of living in a cold home.

There could also be a positive impact on very children and older people if project progresses to delivery due to the reduction in air pollution as a result of the heat network. This is because long-term exposure to air pollution can adversely affect lung function development and cause asthma and development problems in young people. In older people, long-term exposure to air pollution can also cause lung cancer, accelerate the decline of lung function, can increase the risk of strokes and cardiovascular diseases such as heart attacks.

Age and accessibility should also be considered in the construction phases of any future heat network development.

(b) Disability

No impact at Detailed Project Development.

There is potential for a negative impact if the project reaches construction phases so accessibility within the city centre should be considered at this stage to mitigate any impact.

There are public toilet blocks in the city that might be impacted if the project progresses to construction. A number of these are Disabled toilets so there may be an impact on disabled people who need to use these toilets. Moreover, people who have disabilities or long-term health conditions requiring them to use toilets more might be disproportionately impacted if toilets are out of use during the construction phase. If the project progresses to the construction stage, we will review how these impacts can be mitigated.

There may also be a positive impact on people with a disability if residential properties are brought into a latter design stage of the heat network development as the heat network project could improve the energy efficiency of their home and be a more healthy and comfortable environment to live in and avoid/reduce any health risks of living in a cold home. Reducing air pollution will also have a positive impact on people with pre-existing cardiovascular and respiratory conditions (such as asthma) because short and long-term exposure to air pollution increases the risk of heart failure, heart attacks and strokes for people with these pre-existing health conditions

(c) Gender reassignment

No impact at Detailed Project Development.

There are toilet blocks in the city that might be impacted if the project progresses to construction. A number of these are gender neutral toilet blocks so there might be an impact on people who are under the protected characteristic of gender reassignment who use the gender neutral toilets. If the project progresses to the construction stage, we will review how these impacts can be mitigated.

(d) Marriage and civil partnership

No impact has been identified specific to this protected characteristic group.

(e) Pregnancy and maternity

No impact at Detailed Project Development.

There are toilet blocks in the city that might be impacted if the project progresses to construction. This may have an impact on people with baby's who need to use the baby changing facilities. If the project progresses to this stage, we will review how these impacts can be mitigated. Accessibility for small children, push chairs and bikes within the city centre should be considered, if / when the project reaches construction phases as construction may mean that some areas have restricted access at times if there is construction works taking place.

If progressed to Delivery, the reduction in air pollution as a result of the heat network, will have a positive impact on pregnancy and early childhood because air pollution can adversely affect development, and is also associated with low birth weight and premature birth.

There may also be a positive impact on pregnant women if residential properties are brought into a latter design stage of the heat network development, as the heat network project could improve the energy efficiency of their home and be a more healthy and comfortable environment to live in and avoid/reduce any health risks of living in a cold home.

(f) Race – Note that the protected characteristic 'race' refers to a group of people defined by their race, colour, and nationality (including citizenship) ethnic or national origins.

No impact at Detailed Project Development.

If the project progresses to construction, we will identify whether the information provided to tenants of buildings about the construction, needs to be translated to other languages. The council has a corporate translation/interpretation service it can use when needed.

(g) Religion or belief

The heat network feasibility study has engaged with owners of Faith-buildings in the city centre. There will be no impact at Detailed Project development.

Heat network connections to these buildings will be offered on a basis of commercial and technical viability in the 'commercialisation' stages of the project. As this opportunity may not be available to all faith-based groups, there may be an unequal opportunity in decarbonisation assistance that the Council can offer due to the geographical location of Faith buildings and their proximity to the network.

(h) Sex

There are toilet blocks in the city that might be impacted if the project progresses to construction. A number of these are Female toilet blocks and a number of these are Male toilet blocks so there may

be an impact on Males and Females who need to use these toilets. If the project progresses to the construction stage, we will review how these impacts can be mitigated.

(i) Sexual orientation

No impact has been identified specific to this protected characteristic group.

(j) Other factors that may lead to inequality – in particular, please consider the impact of any changes on:

- **Low-income groups or those experiencing the impacts of poverty**
- **Groups who have more than on protected characteristic that taken together create overlapping and interdependent systems of discrimination or disadvantage. (Here you are being asked to consider intersectionality, and for more information see: https://media.ed.ac.uk/media/1_l59kt25q).**

No impact at Detailed Project Development Stage.

If the project progresses to construction and extends to other areas of the city so that domestic homes can connect, it may have a positive impact on those living in fuel poverty where in Market Ward, fuel poverty is 17.6%, higher than the national average (13.2%)

A number of geographical locations are under consideration for energy centres, if some of these locations are confirmed and if the project progresses to construction, this could have temporary or long-term impact upon the homeless community. Locations included for example are toilet blocks that may be used as shelters by this group. Temporary closure, or replacement of services may displace individuals. We will assess the impacts when the location of these energy centres are known.

The heat networks consultant who is also working on this project will bring their knowledge and expertise of the impact of heat networks to identify and mitigate further impacts of the project.

11. Action plan – New equality impacts will be identified in different stages throughout the planning and implementation stages of changes to your strategy, policy, plan, project, contract or major change to your service. How will you monitor these going forward? Also, how will you ensure that any potential negative impacts of the changes will be mitigated? (Please include dates where possible for when you will update this EqIA accordingly.)

Detailed Project Development Phase (Q2 2024 – Q2 2025), will include an EQIA review.

Commercialisation phase (Q1 2026 – Q2 2027), will include an EQIA review.

Final design phase (Q3 2027 – Q4 2028)), will include an EQIA review.

Construction phase (Q4 2028 – Q4 2031), will include an EQIA to be reviewed prior to each construction phase.

If at any project stage, the heat network design is changed to include social or private housing, a new EQIA should be prepared at the earliest stage possible.

12. Do you have any additional comments?

N/a

13. Sign off

Name and job title of lead officer for this equality impact assessment: Catherine Stewart, Climate Change officer

Names and job titles of other assessment team members and people consulted: Helen Crowther, Equality & Anti-Poverty Officer, Janet Hall, Line Undrawn Consultant

Date of EqIA sign off: 14 June 2023

Date of next review of the equalities impact assessment: Q1 2026

Date to be published on Cambridge City Council website: 19th June 2023

All EqIAs need to be sent to the Equality and Anti-Poverty Officer at equalities@cambridge.gov.uk