City of York
Local Area Energy Plan

CATAPULT Energy Systems

CITY OF YORK COUNCIL

LOCAL AREA ENERGY PLAN

Summary

Summary

To reach a net zero energy system by **2040**, the York local area energy plan requires a capital investment of

£3.8 billion

Total (excluding electric vehicles and charging infrastructure)

Including:

£0.7 billion

in dwellings (including building fabric efficiency, heating systems and rooftop solar PV)

£0.5 billion

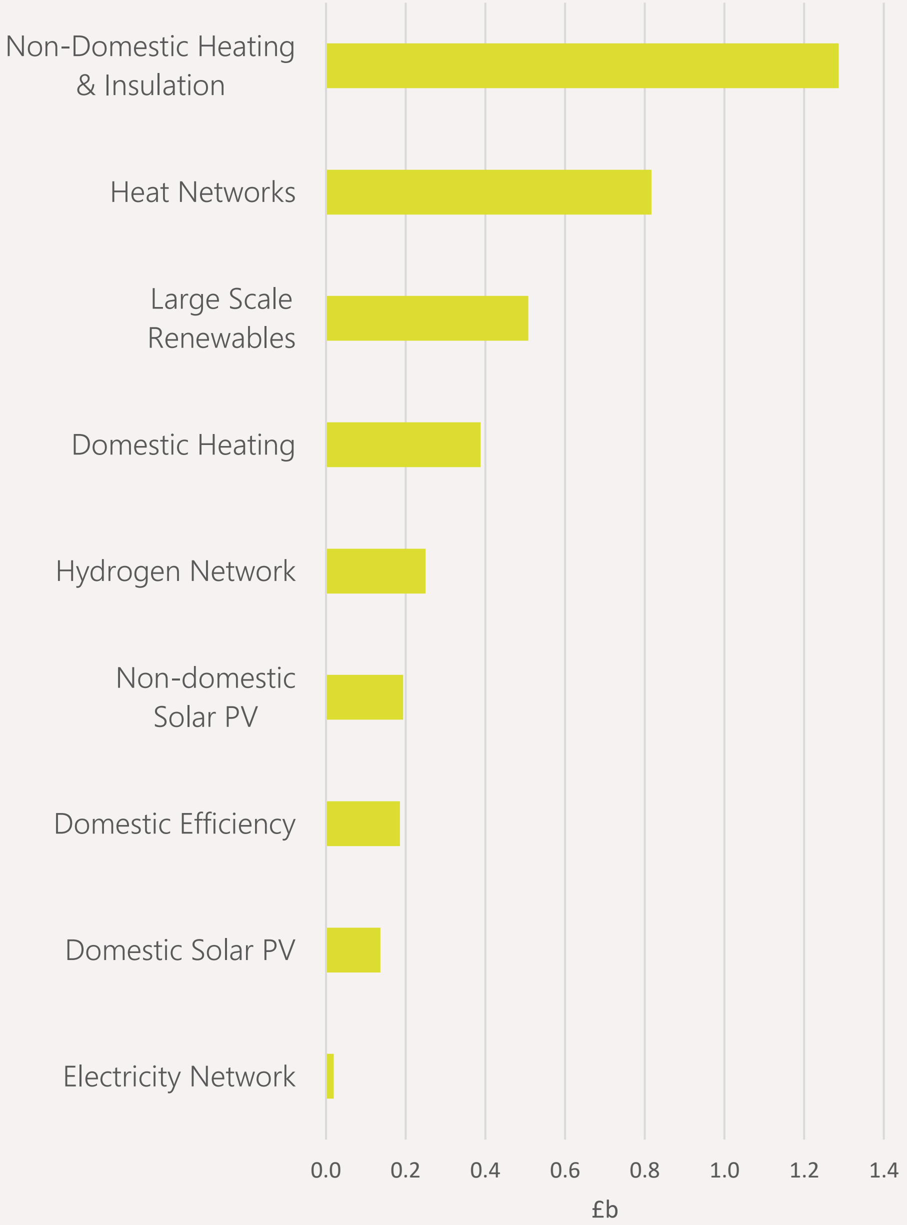
In large scale renewable generation

Saving:

1.2 million tonnes CO_2

From buildings cumulatively to 2050 against a business-as-usual pathway – equivalent to more than eight return flights to New York for every household.

Total Capital Investment to 2040



York's energy system will have been transformed, with:

73,000

heat pumps installed in dwellings

At least 20,000 **new connections to a district heat network**

44,100

dwellings retrofitted with insulation, glazing and draughtproofing improvements

91,000

fully electric vehicles

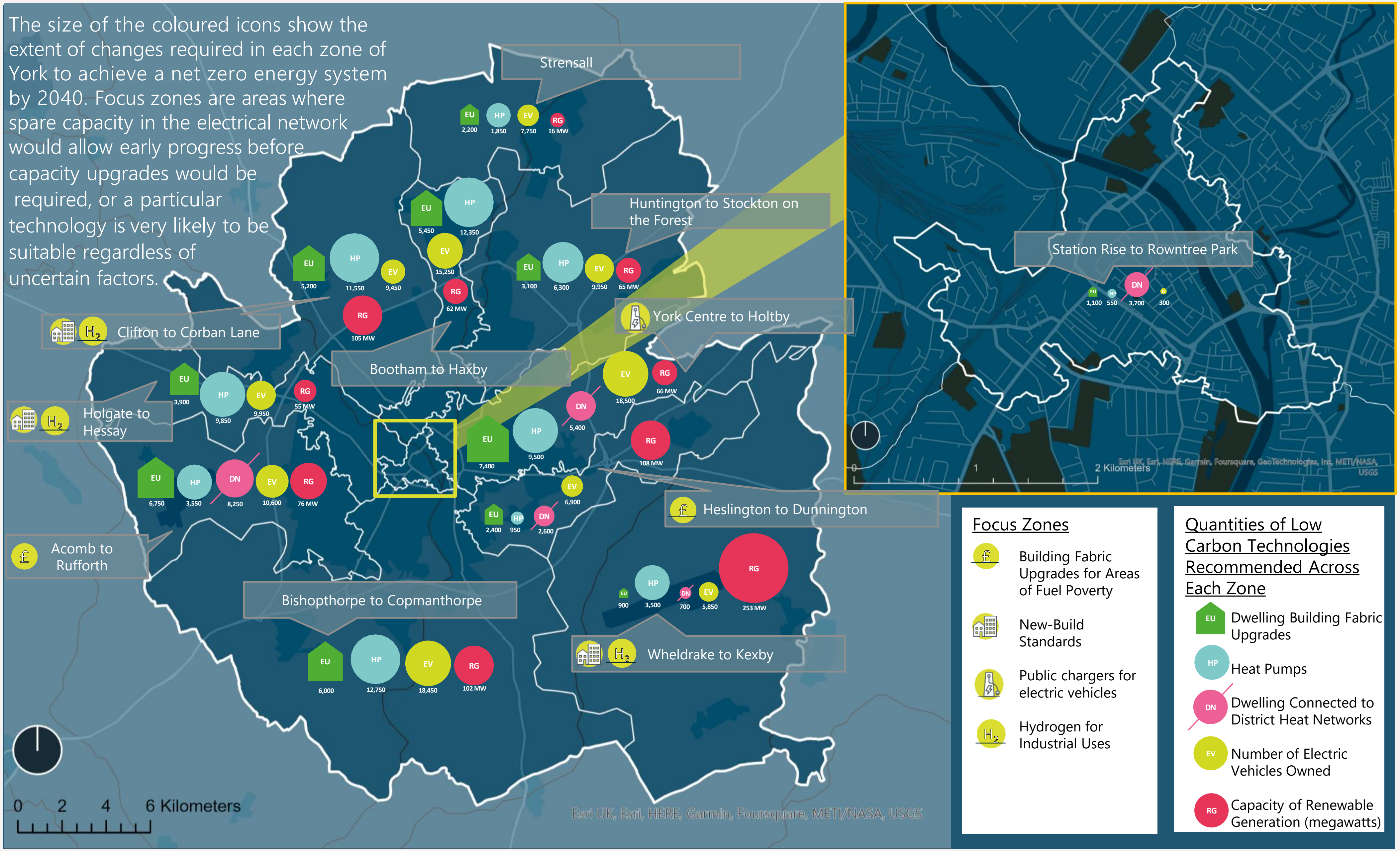
24%

dwellings generating their own electricity with rooftop solar

920 MW

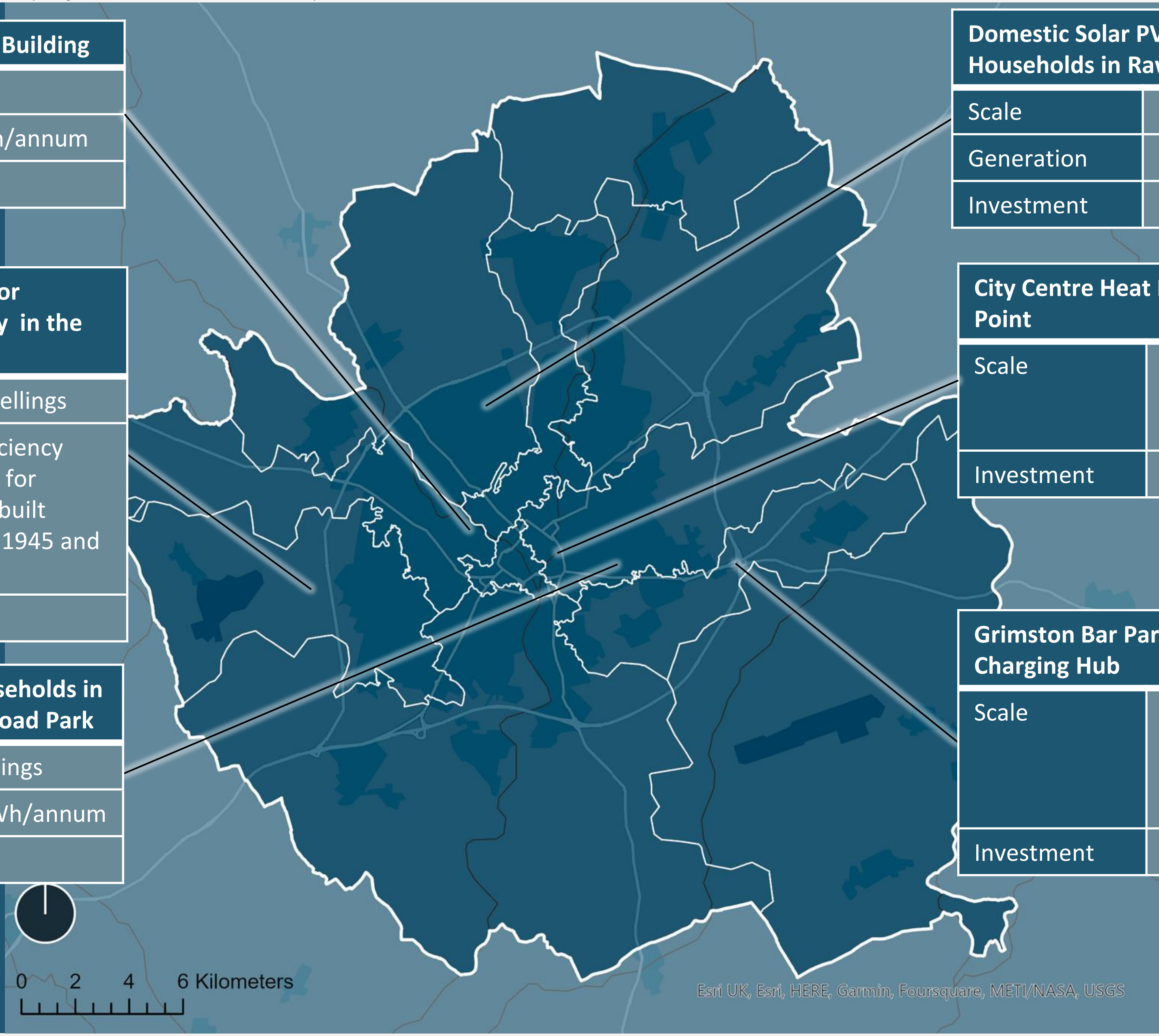
of large scale renewable generation

Plan on a Page



Outline Priority Projects Summary

Demonstrator and low regrets projects for near-term implementation



Rooftop Solar for Heritage Building	
Scale	0.64 MW
Generation	290 MWh/annum
Investment	c. £575k

Building Fabric Upgrades for Households in Fuel Poverty in the Acomb to Rufforth Zone	
Scale	1,000 dwellings
Type	Basic efficiency upgrades for terraced built between 1945 and 1979
Investment	c. £1.1m

Domestic Solar PV for Households in Fuel Poverty around Hull Road Park	
Scale	500 dwellings
Generation	1,575 MWh/annum
Investment	c. £3.2m

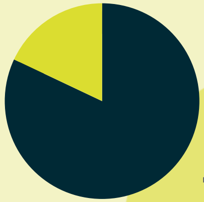
Domestic Solar PV for Able-to-Pay Households in Rawcliffe	
Scale	1,000 dwellings
Generation	3,200 MWh/annum
Investment	c. £6.4m

City Centre Heat Network Starting Point	
Scale	2,400 dwellings 1,250 non-domestic buildings
Investment	£90m

Grimston Bar Park & Ride Solar Charging Hub	
Scale	30MW ground-mount solar array and 50-100 public EV chargers
Investment	£16m

Current State

Setting the Scene: York Today



18%

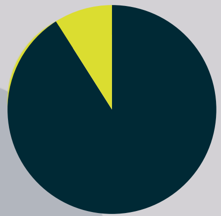
of dwellings already insulated

BUILDINGS

Currently 18% of the dwellings in York are insulated to a good standard, or do not have potential for further insulation.

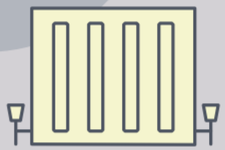
HEATING

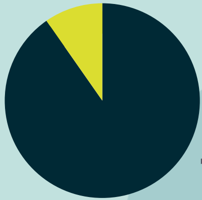
91% of buildings currently use gas for heating, and less than 1% use another form of fossil fuel such as oil. The remainder already use some form of low carbon heating such as heat pumps, biomass or electric resistive heating.



9%

of heating already low carbon





10%

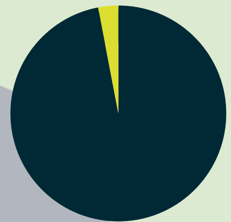
of vehicles already low carbon

VEHICLES

Around 9,150 of the cars and vans currently registered in York are either plug-in hybrid or pure electric, making up 10% of those vehicles. The remaining 85,750 are petrol, diesel or hybrid.

ELECTRICITY

97% of electricity consumed comes from the National Grid. Solar panels on around 3% of dwellings and on some non-domestic buildings make a small contribution to local energy demand, as well as the Harewood Whin landfill gas generator.

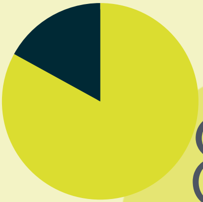


3%

of electricity consumed in York produced locally

Destination

The Destination: York 2040



83%

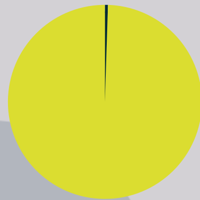
of dwellings insulated to their full potential by 2040 (including new builds)

BUILDINGS

Around 63% of York's total current housing stock will require building fabric upgrades, bringing the majority of dwellings up to a high standard of efficiency. The supply chain would need to provide upgrades to over 44,100 dwellings by the year 2040. New builds will also add to the proportion of well-insulated dwellings.

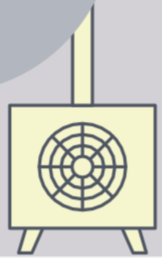
HEATING

Virtually all fossil fuelled heating systems need to be replaced in order to reach net zero. This can occur as current heating systems reach their natural end-of-life but scrappage (or similar) schemes will need to be considered to ensure that all heating systems are decarbonised before the target date.



99%

low carbon



100%

low carbon

VEHICLES

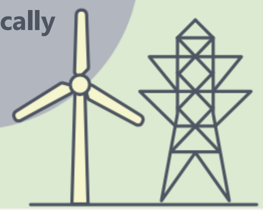
Electric vehicle use is projected to rise rapidly, and would need to reach 100% to hit the net zero target. Steps will need to be taken to cater for vehicle users with provision of public charge points, and to assist residents to install domestic chargers. These chargers will place new demands on the electrical distribution system.

ELECTRICITY

The push to generate low carbon electricity results in a greater proportion of York's energy being produced locally. There is enough land and roof space for solar PV and wind to generate all of the energy needed on an annual basis. In reality, there would likely be issues with generating this amount of electricity as large excesses would be produced, particularly in summer months

100%

generated locally



The Pathways

Three pathways to net zero were modelled to understand which of the recommended actions could be affected by different net zero target dates. The three ambition levels are described as:
Low: Aligning with the national 2050 net zero target
Medium: A balanced approach, achieving a net zero energy system locally by 2040, ahead of the UK as a whole.
High: An extremely ambitious push for a net zero energy system locally by 2030.

This plan focusses primarily on the medium ambition scenario, with key similarities and differences between the scenarios drawn out where appropriate. Actions that are common across these scenarios are considered to be 'low regrets' and can be undertaken as soon as possible. Actions that are not common and are identified later in the pathway will require decision points and early enabling actions to remove barriers.

The key similarities and differences between these ambition levels are summarised as follows.

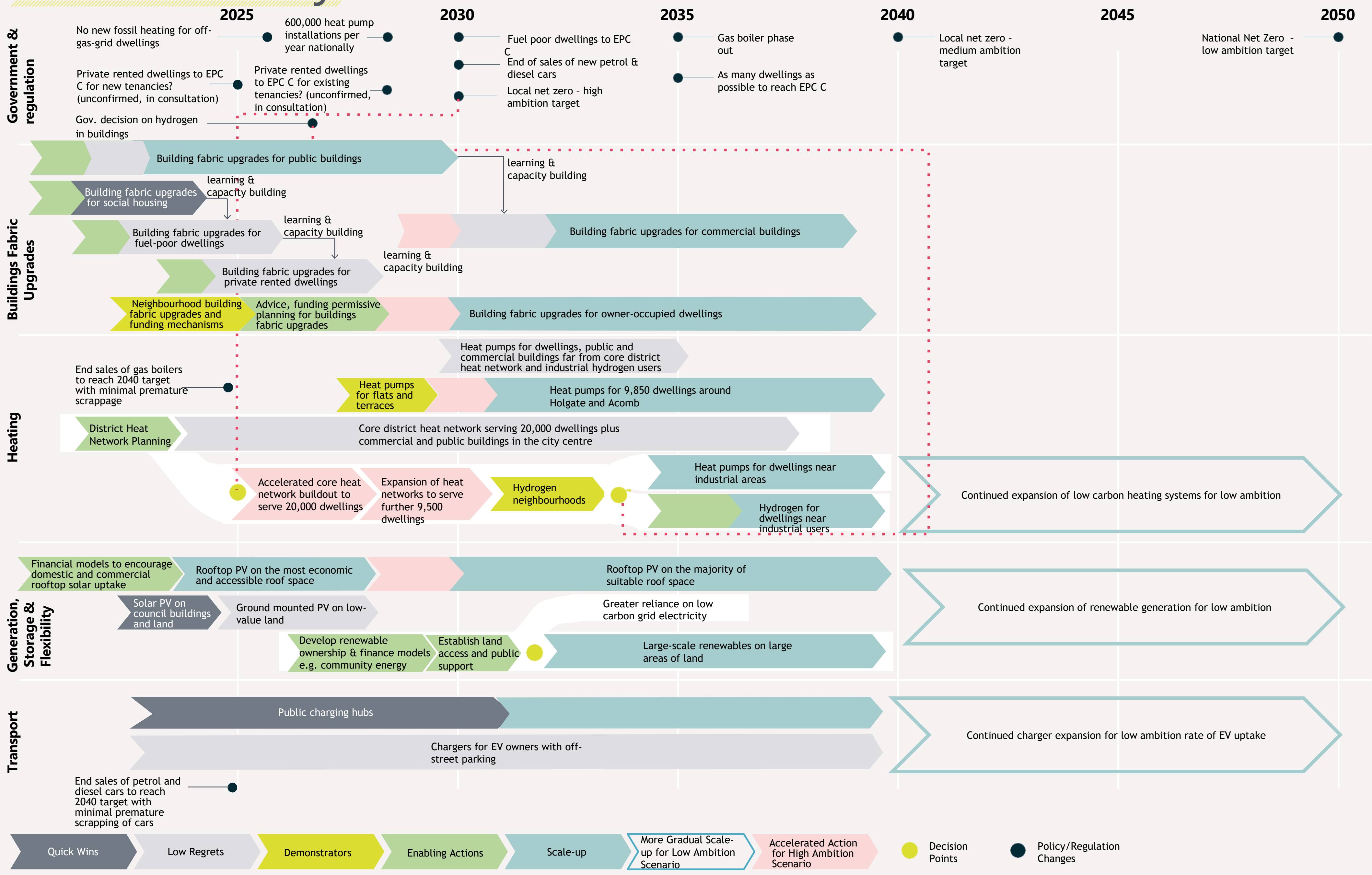
Low regrets

- Basic efficiency upgrades for almost every dwelling which has upgrade opportunities.
- Heat pumps installed in dwellings which are far from any likely heat networks or industrial users of hydrogen
- District heat networks to serve public, commercial and private buildings in the areas of dense heat demand
- Electric vehicle chargers for dwellings with off-street parking and public charging points in key hubs such as retail parks, supermarkets, etc.
- Solar PV on rooftops and on low value areas of land

Key decisions

- Deeper building efficiency upgrades which will tend to have long payback periods, but can have additional benefits such as fuel poverty alleviation and employment creation
- Hydrogen to heat dwellings close to areas of industrial use instead of heat pumps: once more evidence is available on the viability, cost, emissions and policy around hydrogen for building heating in York, a decision can be made about dwellings in these areas. Hydrogen may be able to reduce the upfront cost and disruption of low carbon heating system installations.
- Further deployment of ground-mount solar PV to reduce emissions from consumption of grid electricity. In theory, very large areas of land could be used to produce most of York's energy requirements on an annual basis, though the development of this extent of land could be challenging. Visual impact of developments would need to be assessed as part of feasibility studies, as well as alternative land uses. Greater deployment of local renewables can bring economic benefits and accelerate decarbonisation, while greater reliance on decarbonised grid electricity can reduce the difficulties around developing large areas of land.

The Pathway


2025
2030
2035
2040
2045
2050
Government & regulation
No new fossil heating for off-gas-grid dwellings
600,000 heat pump installations per year nationally
Fuel poor dwellings to EPC C
End of sales of new petrol & diesel cars
Local net zero - high ambition target
Gas boiler phase out
As many dwellings as possible to reach EPC C
Local net zero - medium ambition target
National Net Zero - low ambition target
Private rented dwellings to EPC C for new tenancies? (unconfirmed, in consultation)
Private rented dwellings to EPC C for existing tenancies? (unconfirmed, in consultation)
Gov. decision on hydrogen in buildings
Buildings Fabric Upgrades
Building fabric upgrades for public buildings
learning & capacity building
Building fabric upgrades for social housing
learning & capacity building
Building fabric upgrades for fuel-poor dwellings
learning & capacity building
Building fabric upgrades for commercial buildings
Building fabric upgrades for private rented dwellings
learning & capacity building
Neighbourhood building fabric upgrades and funding mechanisms
Advice, funding permissive planning for buildings fabric upgrades
Building fabric upgrades for owner-occupied dwellings
Heating
Heat pumps for dwellings, public and commercial buildings far from core district heat network and industrial hydrogen users
End sales of gas boilers to reach 2040 target with minimal premature scrappage
Heat pumps for flats and terraces
Heat pumps for 9,850 dwellings around Holgate and Acomb
District Heat Network Planning
Core district heat network serving 20,000 dwellings plus commercial and public buildings in the city centre
Heat pumps for dwellings near industrial areas
Accelerated core heat network buildout to serve 20,000 dwellings
Expansion of heat networks to serve further 9,500 dwellings
Hydrogen neighbourhoods
Hydrogen for dwellings near industrial users
Continued expansion of low carbon heating systems for low ambition
Generation, Storage & Flexibility
Financial models to encourage domestic and commercial rooftop solar uptake
Rooftop PV on the most economic and accessible roof space
Rooftop PV on the majority of suitable roof space
Continued expansion of renewable generation for low ambition
Solar PV on council buildings and land
Ground mounted PV on low-value land
Greater reliance on low carbon grid electricity
Develop renewable ownership & finance models e.g. community energy
Establish land access and public support
Large-scale renewables on large areas of land
Transport
Public charging hubs
Chargers for EV owners with off-street parking
Continued charger expansion for low ambition rate of EV uptake
End sales of petrol and diesel cars to reach 2040 target with minimal premature scrapping of cars
Quick Wins
Low Regrets
Demonstrators
Enabling Actions
Scale-up
More Gradual Scale-up for Low Ambition Scenario
Accelerated Action for High Ambition Scenario
Decision Points
Policy/Regulation Changes

Buildings

Overview

A large proportion of dwellings across York are recommended for building fabric upgrades (also known as retrofit) to meet net zero. This is consistent across all ambition levels, with earlier targets requiring more rapid treatment of dwellings. The map shows how these fabric upgrade measures (insulation, glazing and draughtproofing) are likely to be distributed across the region. In total, 44,100 dwellings across York are recommended for upgrades at a cost of £185m. Upgrades are split into "basic" and "deep", explained on the following pages.

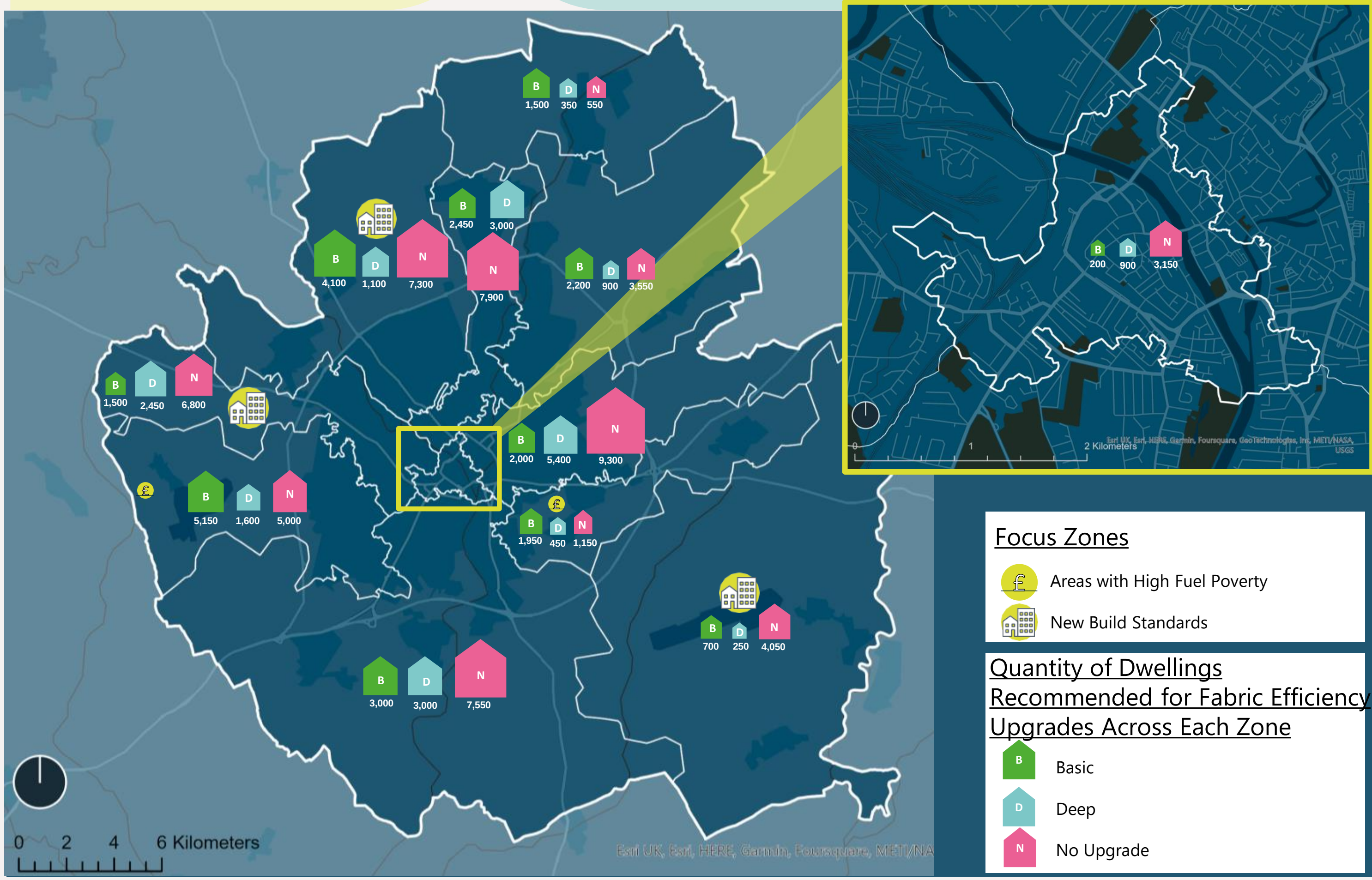
Prioritising the delivery of building fabric upgrades in areas with high levels of fuel poverty will maximise the impact of bill savings and the health benefits of warmer dwellings. These priority zones are shown on the map by the '£' symbol. Areas with large numbers of new build dwellings planned can prioritise building to net zero standards (e.g. Passivhaus), potentially encouraged a local design code or supplementary planning document.

While this plan outlines the lowest cost path to a net zero energy system, additional deep retrofits may be desirable to meet other local priorities, particularly fuel poverty alleviation and general energy affordability.

Previous schemes run by York City Council using funding from BEIS dwelling Upgrade Grant and Social Housing Decarbonisation Fund, as well as the development of a Housing Retrofit Action Plan can be learnt from and scaled up to help meet these high levels of roll out.

44,100
dwellings (63%) recommended for building fabric upgrades

over
£185m
capital investment in domestic building fabric upgrades required

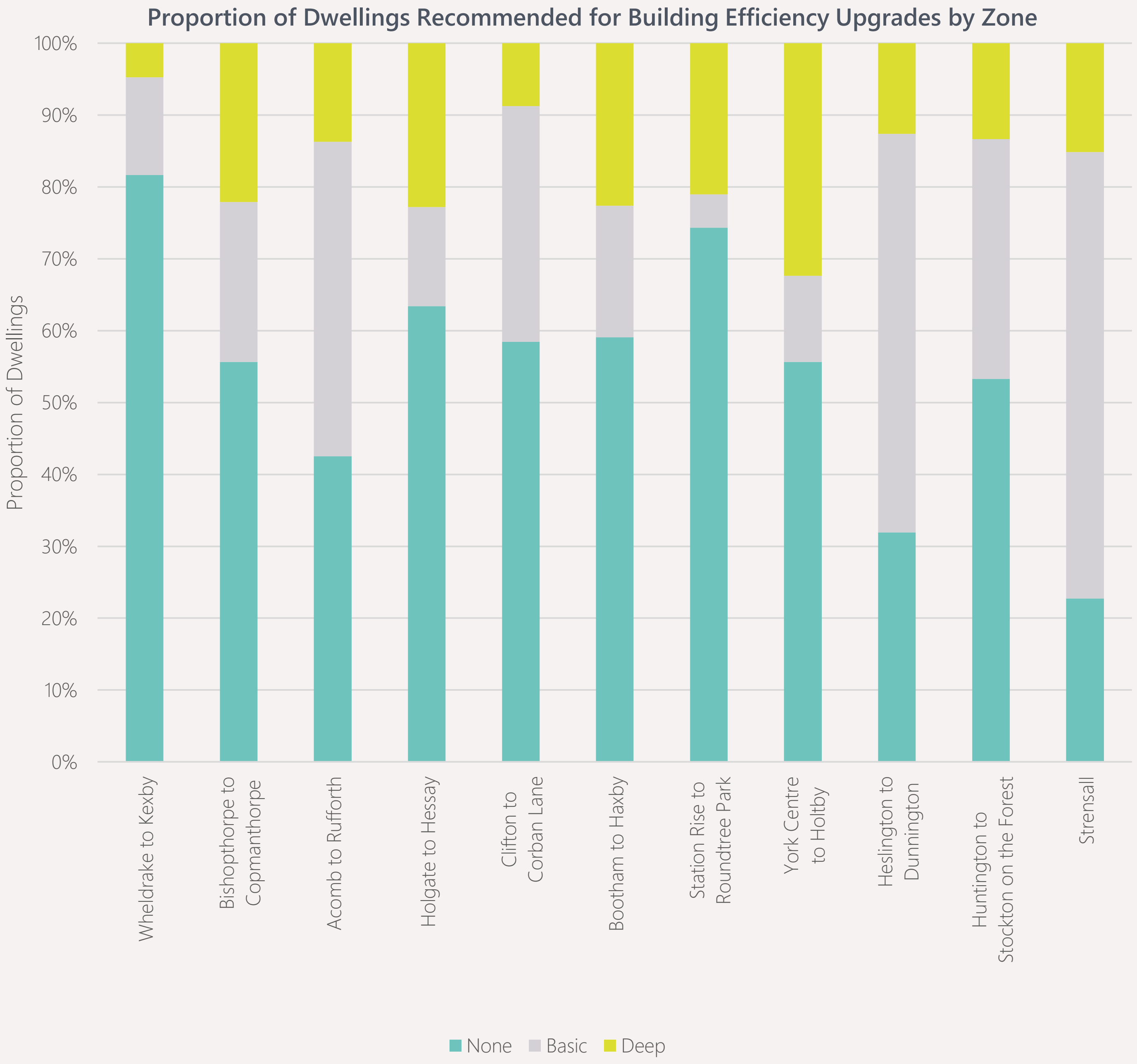


Zones and Dwelling Types

Building fabric upgrades are improvements to the fabric of domestic and non-domestic buildings to reduce heat loss. Upgrades can include draught proofing, loft and cavity wall insulation (referred to here as “basic” upgrades), double or triple glazing, internal or external wall insulation, floor insulation and door upgrades (“deep” upgrades). These measures can improve comfort and health of occupants, reduce bills, and make it easier to transition to low carbon heating systems, whilst also reducing the need to upgrade the electrical network. Since fabric upgrades can reduce the size and cost of heating system needed, it makes practical sense to complete them before heating system replacements take place, or at the same time to minimise disruption to occupants.

The graph shows the extent of upgrades recommended across each zone of York, which is influenced by the types of dwellings in each area. Where there is a high proportion of flats (such as the Station Rise to Rowntree Park zone) or new builds (such as the Wheldrake to Kexby zone), fewer upgrades are recommended. In contrast, there are areas such as the Strensall zone where the majority of dwellings look suitable for cost-effective fabric upgrades.

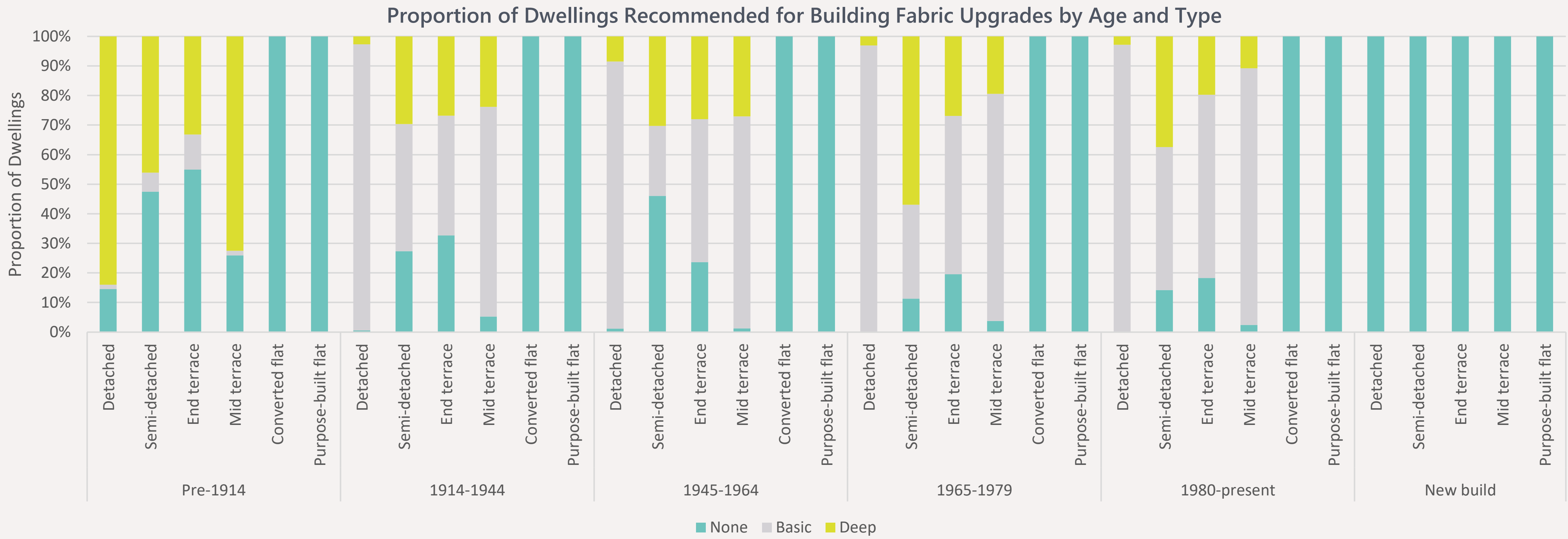
Dwellings which aren’t highlighted for upgrades by cost optimal modelling are not necessarily ruled out from benefiting from upgrades. Other factors such as prevalence of fuel poverty, or a focus on the health and comfort benefits of dwellings which are easier to keep warm could drive the decision to go beyond the suggested cost-optimum.



Zones and Dwelling Types

Building age and construction is a major factor in which types of efficiency upgrades are recommended. As shown in the graph below, basic upgrades are recommended across much of the housing stock built after 1914, whereas older dwellings are likely to require deep upgrades, which can be less cost-effective. This is due to the oldest group of dwellings having been built with solid walls, requiring either internal or external insulation, with cavity walls only becoming the norm from around 1930. Terraces, being the most common building type of the age bracket with solid walls, could make sense to tackle on a street-by-street basis, since attempts to insulate single dwellings within terrace rows are likely to be awkward and limited in their effectiveness. Deployment at this kind of scale could also prove vital for achieving acceptable costs, which is a major hurdle for solid wall insulation.

Modern buildings have little potential for cost-effective upgrades, and opportunities for individual flats are limited. While the modelling approach does not identify upgrade opportunities in any type of flat, some types of converted flats may have similar opportunities to houses, though there may be a need for multi-stakeholder buy-in. Purpose-built flats such as multistorey blocks will tend to require whole-building approaches.



Focus Zones

Focus zones highlight areas where particularly large numbers of a certain solution are recommended, directing efforts towards delivery at scale in that zone, often in advance of other parts of the plan. Focus zones can account for factors such as the socio-economic conditions in an area, network capacity, or characteristics of the building stock, which could bring specific advantages, learning opportunities or challenges to delivery in that location.

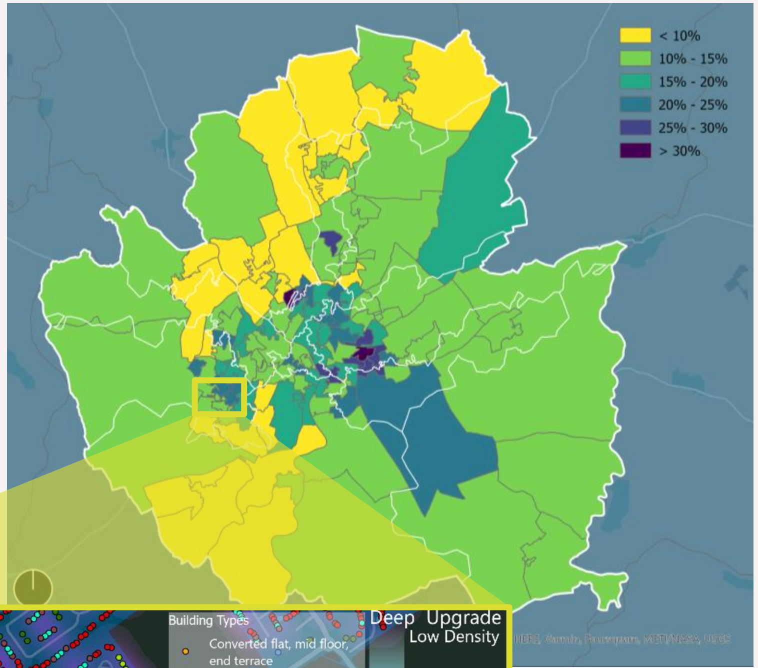
The Acomb to Rufforth zone & The Heslington to Dunnington zone

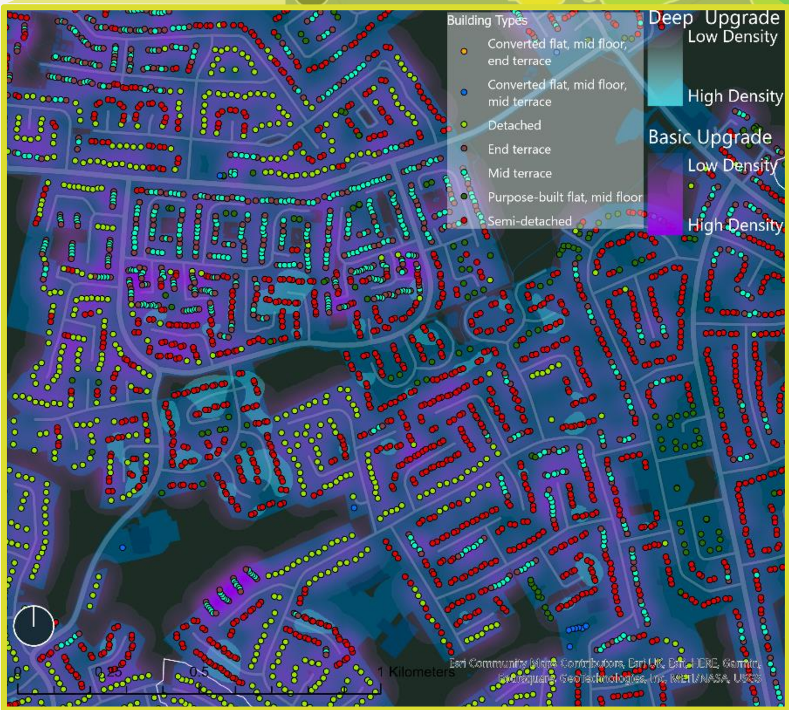
are focus zones because they have high levels of fuel poverty, coinciding with high potential for cost-effective fabric upgrades. Prioritising delivery of efficiency projects in this area would unleash the high potential for impact and benefits. Over 4,400 dwellings in the Acomb to Rufforth zone and 2,200 in the Heslington to Dunnington zone would benefit from basic upgrades, with almost 2,000 dwellings benefiting from deep upgrades across the two zones. In these zones, a large number of semi-detached dwellings built between 1914 and 1979 could be insulated (2,000 in the Acomb to Rufforth zone and 1,150 in the Heslington to Dunnington zone). Additionally, almost 1,000 terrace dwellings built between 1945 and 1979 in the Acomb to Rufforth zone are suitable for basic upgrades.

The York Centre to Holtby zone

is where the most deep fabric upgrades could take place. 1,700 terraces built before 1914 could be considered for deep upgrades, along with 1,400 semis built between 1914 and 1979.

Estimated Proportion of Dwellings in Fuel Poverty





An example area of dwellings in the Acomb to Rufforth zone suitable for upgrades

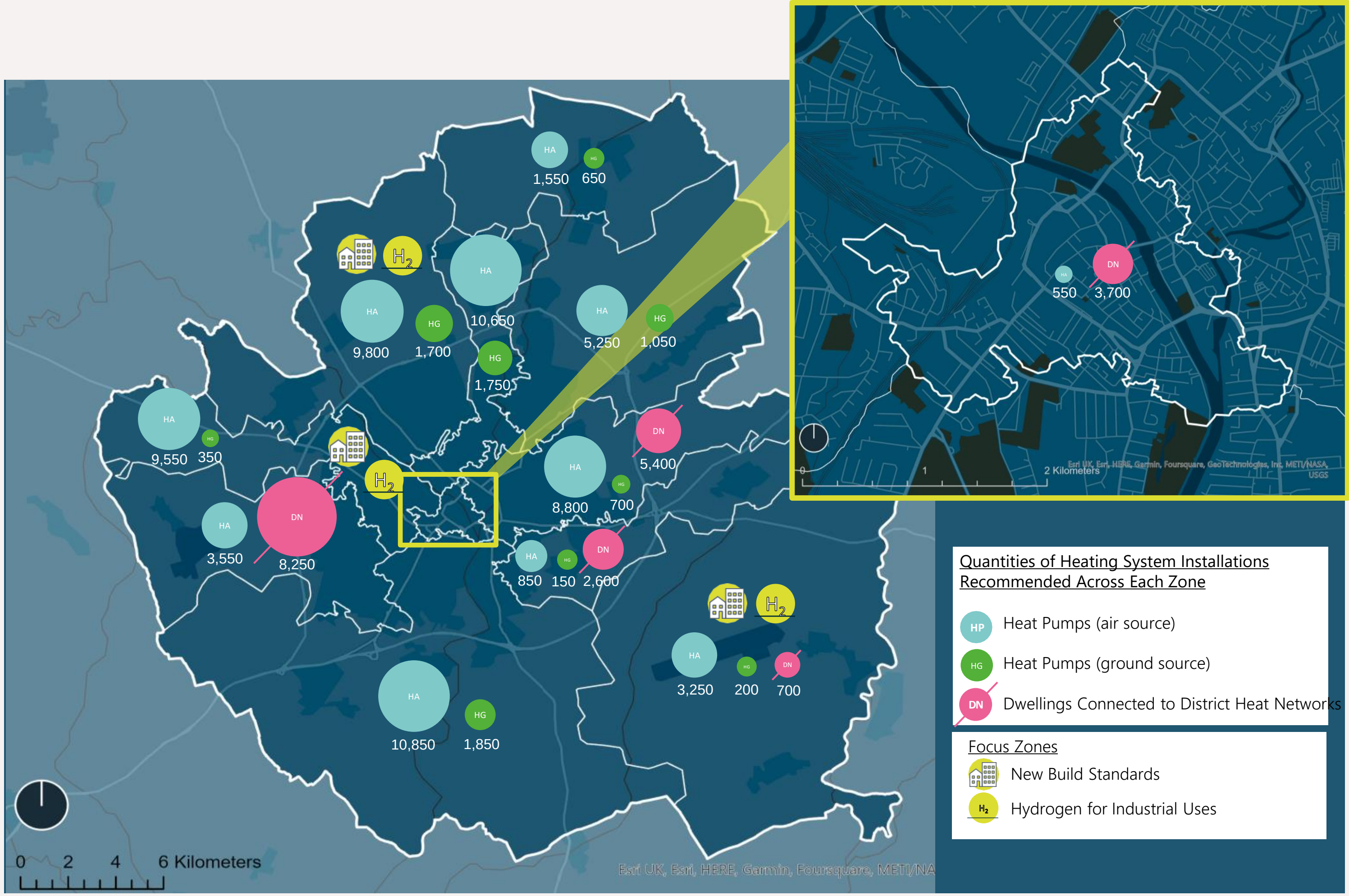
Heating

Overview

Gas boilers make up the majority of heating systems in dwellings (91%) and non-domestic buildings, with fossil fuel use in buildings accounting for 36% of emissions in York (excluding industry). To reach net zero, these will need to be replaced with low carbon heating systems. Heating systems can be replaced at their natural end-of-life, however supply chain capacity and household awareness will need to be built ahead of time to ensure the low carbon options are available, straightforward and attractive when replacements occur, which can often be during a break-down. The sale of new fossil fuel heating systems would need to end by 2025 to meet a 2040 net zero target, in order to minimise premature replacements of boilers (based on a 15 year lifespan). This is significantly more ambitious than any cut-off date likely to be imposed by central government, with 2035 currently being considered*.

Heat pumps are the most widely suitable technology for decarbonising heating within York, with growing evidence** that they can be installed in the full range of property archetypes. Heat networks can serve dense town centre locations (supported by some existing electric resistive heating).

Off-gas-grid dwellings using fossil fuel heating systems make up a very small minority (less than 1%) of households in York, and so are not considered as a separate stage of the plan. There may be opportunities to use hydrogen for heating dwellings near industrial users of hydrogen. Areas with large numbers of new build dwellings planned can prioritise building to net zero standards, avoiding the need for costlier retrofit later.



73,000
dwellings recommended for heat pump installations

20,000
dwellings recommended for connection to district heat networks

c.£390m
capital investment in domestic heating systems required

* https://www.gov.uk/government/publications/heat-and-buildings-strategy

** https://es.catapult.org.uk/news/electrification-of-heat-trial-finds-heat-pumps-suitable-for-all-housing-types

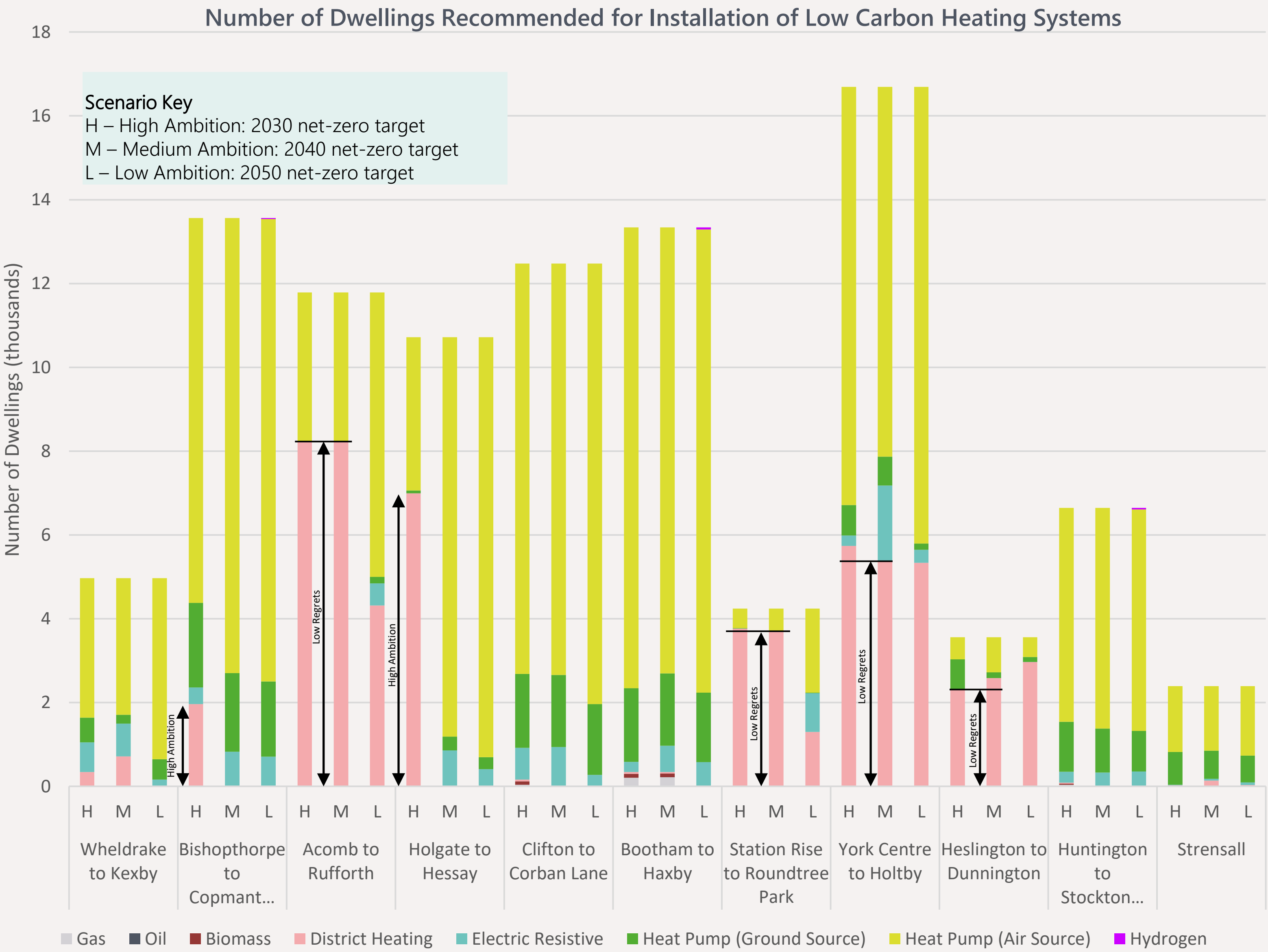
Domestic Buildings

The level of ambition of the scenario affects the type of heating system recommended for some dwellings, as well as the pace of installations, as shown in the chart. In particular, earlier net zero targets call for a larger heat network to make more efficient use of higher carbon grid electricity in the earlier years, whereas the later targets allow cleaner grid electricity to be used in slightly less efficient individual dwelling heat pumps. Examples where the ambition level does or doesn't affect the heat network size are highlighted by the arrows in the chart. District heat networks could also be advantageous for dwellings with limited space for the additional equipment required with a heat pump system (e.g. terraces).

Ground source heat pumps can be a more advantageous option in rural areas than in urban areas, where larger properties and more garden space can make them a viable option. However, air source heat pumps would also be suitable for many of these properties, reducing installation costs in exchange for slightly higher running costs. Property specific consideration would be needed to determine the preferred solution. In addition, shared ground loop systems may also be an option for clusters of suitable properties

Hydrogen boilers could also provide a low-carbon replacement for fossil gas boilers, but they are dependent on a supply of hydrogen becoming available at acceptable cost and carbon emissions, explored in full on page 27.

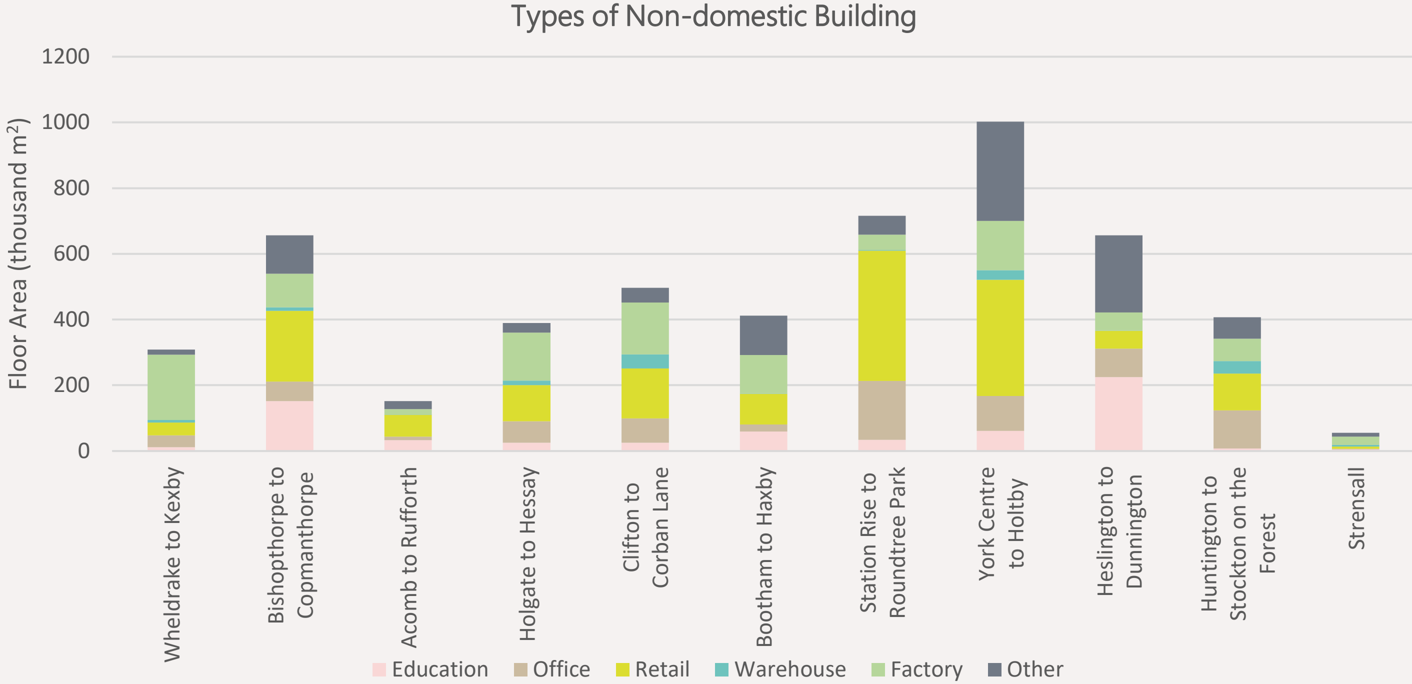
The most suitable choices of heating systems for each zone are largely consistent between different levels of ambition for the net zero target date, with only slight variation in places as shown in the chart. This indicates that choices of heating system are mostly low regrets. Where variation is seen, the case for picking one technology over another is more marginal, suggesting that either option would be sound, and local factors and preferences can drive the decision.

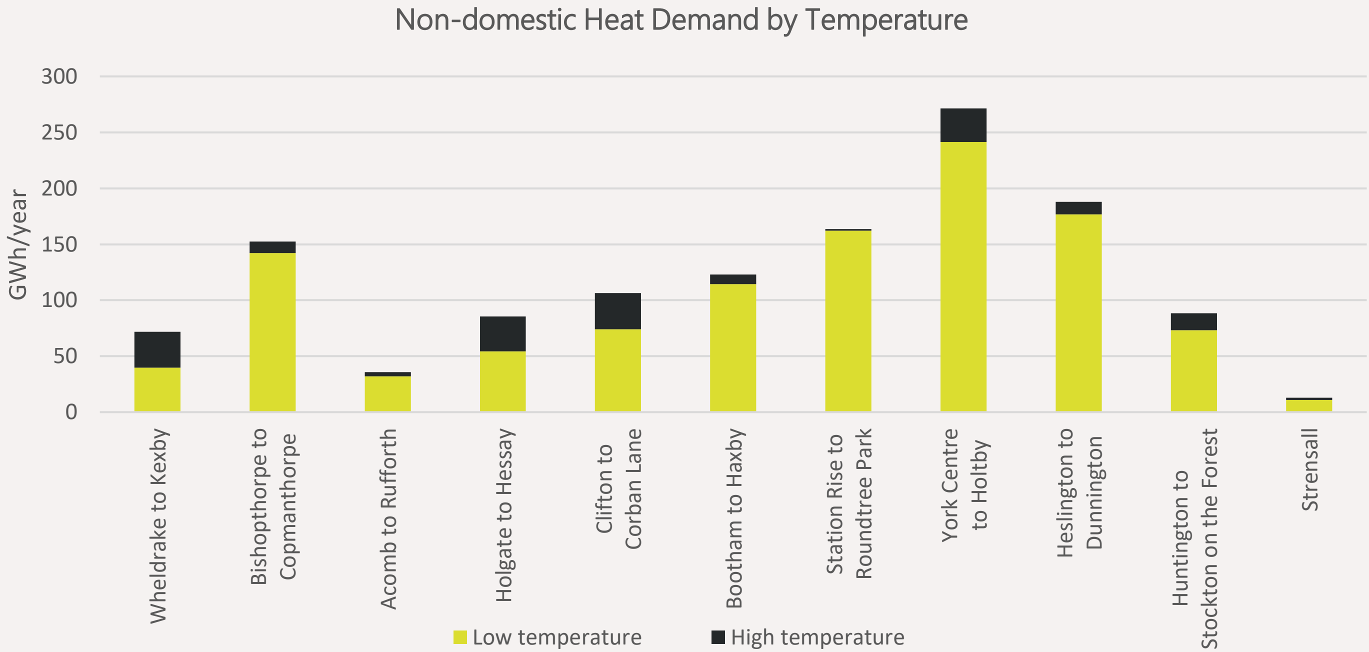


Non-domestic Buildings

Non-domestic buildings are categorised into a range of uses, shown in the chart (right). Much of the demand for heat in non-domestic buildings is low temperature heat for providing space heating and hot water to buildings, with similar decarbonisation options as domestics. However, a small portion of heat is likely to be required at high temperature for specialised industrial processes, as shown on the chart on the right.

High temperature heat is likely to be more difficult to electrify or provide with district heating, making a stronger case for hydrogen to replace fossil fuels for these applications. In the modelled pathways, hydrogen isn't assumed to be available until the mid-2030s at the earliest, meaning that the high ambition scenario is unable to decarbonise high-temperature processes in time for the target, while the medium ambition scenario would require significant planning and rapid deployment for hydrogen becoming available shortly before the net zero target date. However, earlier decarbonisation of these processes could be achieved with local electrolysers to produce hydrogen in the absence of a pipeline supply.



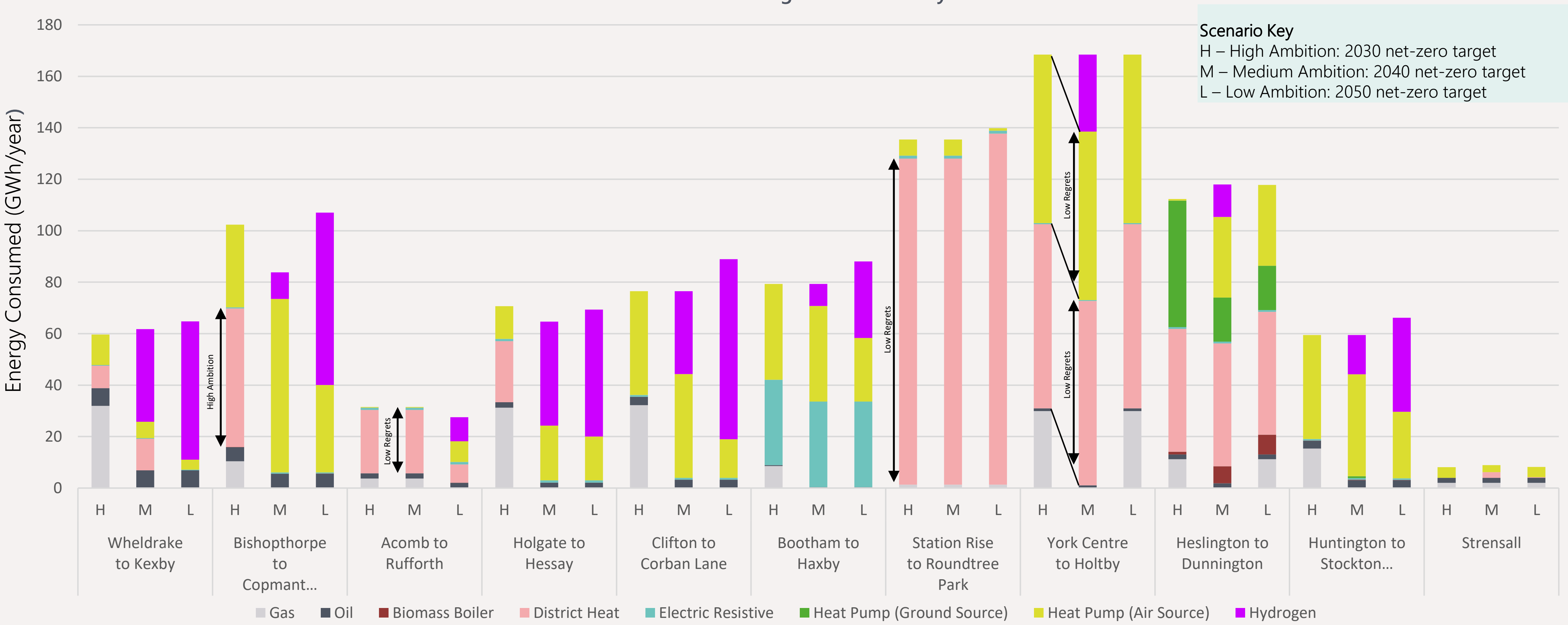


Non-domestic Buildings

The decarbonisation of low temperature heat, used to provide space heating and hot water in non-domestic buildings, follows a similar pattern to domestic decarbonisation, with many of the fossil fuel systems being replaced with heat pumps, or by connecting to district heat networks in dense central areas as shown in the chart. However, non-domestic buildings differ from dwellings, with significant amounts of space heating provided by hydrogen in the scenarios where it's available. More hydrogen is used in the lower ambition scenarios, as the later carbon target date leaves more time to wait for hydrogen availability before replacing heating systems. Building fabric upgrades are bundled with the heating system upgrades shown here, and other efficiency measures such as recommissioning and upgrades of building management systems, LED lighting and lighting control can be implemented at the same time, often improving the economics of the project.

In the high ambition scenario, pipeline hydrogen is not available in time for the 2030 target to replace gas use for high temperature applications, though on-site electrolysers could enable earlier conversion to hydrogen.

Decarbonisation of Heating in Each Zone by Ambition Level



Heat Pump Focus Zones

The Bishopthorpe to Copmanthorpe zone, Clifton to Corban Lane zone and Bootham to Haxby zone have the largest roll-out of air source heat pumps (10,850, 9,800 and 10,650 respectively) across the full range of ages and types of dwellings, from flats to detached, and from pre-1914 to new build. This will require significant supply chain scale-up, citizen awareness and buy-in, and attractive commercial offerings to compete with existing fossil fuel options. The map gives a sense of the distribution of air-source installations across York.

Bishopthorpe to Copmanthorpe and Clifton to Corban Lane have some spare capacity in the electrical distribution system, allowing roll-out to commence before encountering constraints (though upgrades are likely to be required to reach full heat electrification, especially when combined with electric vehicle charging requirements). The York Centre to Holtby zone also has substantial spare capacity, and with 9,500 heat pumps to be installed in total, this area would make a good heat pump focus zone from an infrastructure perspective.

Uptake of air source heat pumps across York

Heat Pump Focus Zones

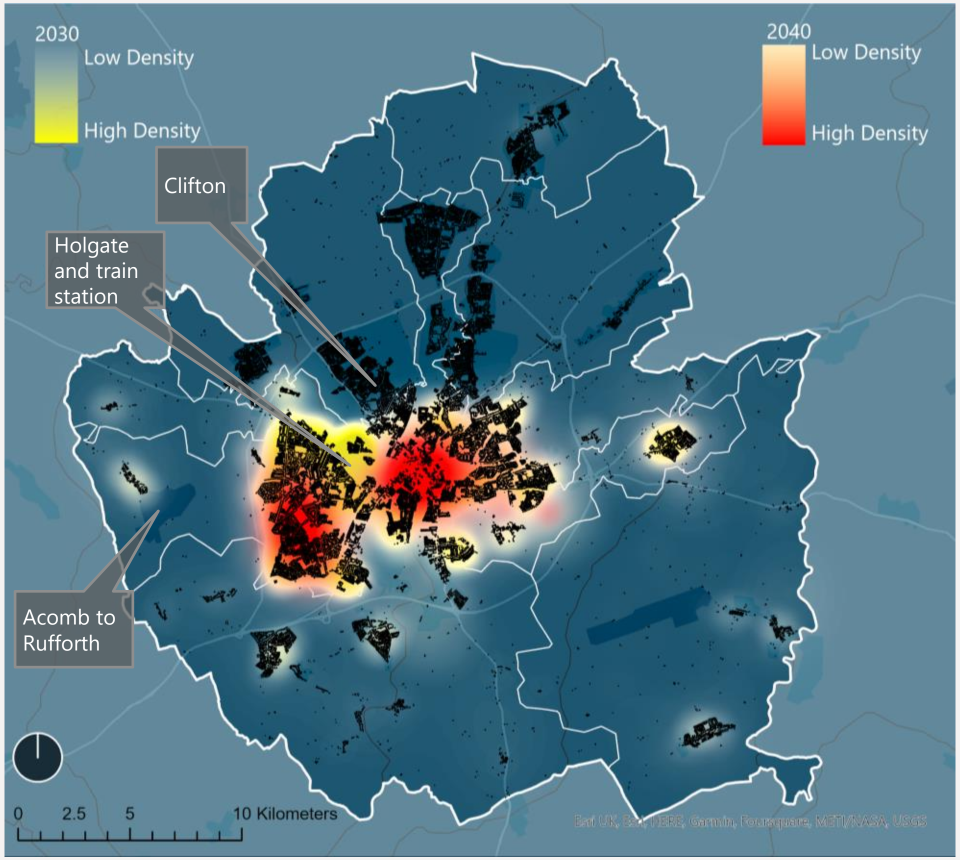
Example neighbourhoods in Wigginton and Haxby with high uptake of ground source heat pumps

Air source heat pumps are typically the most cost-effective heat pump type due to their lower capital costs compared to ground source heat pumps. However, there is an economic case for installing ground source heat pumps in some detached dwellings in the Bishopthorpe to Copmanthorpe zone, the Clifton to Corban Lane zone and the Bootham to Haxby zone (1,850, 1,700 and 1,750 respectively). For these large properties with available land, the higher heat demand can justify the higher upfront cost of ground source, since it achieves higher efficiencies and lower running costs. Additionally, lower peak demands can reduce network upgrade costs. The map gives an example of a neighbourhood where dwellings suitable for ground-source cluster together, which could form a demonstration neighbourhood.

When installing a low carbon heating system, it's advisable to carry out any basic building efficiency upgrades at the same time or beforehand to avoid needlessly oversizing the new heating system or incurring high running costs. The current requirement to qualify for the government's Boiler Upgrade Scheme (open till April 2025) is that there is no outstanding recommendation for loft or cavity wall insulation in the building's energy performance certificate*.

* https://www.gov.uk/guidance/check-if-you-may-be-eligible-for-the-boiler-upgrade-scheme-from-april-2022

District Heat Networks



Density of buildings recommended for connection to district heat network in medium ambition scenario (red) and high (yellow)

Heat supplied through underground pipes from a centralised energy centre, or a network of decentralised energy centres, tends to be the most suitable solution for denser urban zones, particularly where there are large numbers of buildings that require retrofit to make them suitable for heat pumps which is either too expensive or impractical (e.g. historic attractions). Heat networks cause less disruption in dwellings during installation compared to some other options, though there are wider considerations such as traffic disruption during pipe laying, and space restrictions in city centres, which are of particular issue in a medieval city like York.

The red shading in the map shows core district heat coverage, where buildings are connected to the network in both medium and high ambition scenarios, so are low regrets. The yellow shading shows the extended coverage in the high ambition scenario. From the map it is also apparent that the density of Clifton and its adjacency to the core heat network could make it suitable for expansion of the core heat network, as an alternative to using individual heat pumps in that area.

Areas in and around the city centre, as well as in the Acomb to Rufforth zone have the density which makes heat networks likely to be viable. Energy masterplanning has already been undertaken for the York Central development, a major brownfield redevelopment site. The options studied include connection of the new residential and commercial buildings around the train station, as well as the railway museum, to a new district heat network which could be supplied by a water source heat pump.

This development could form the origin of a larger network, expanded to cover more of the city. The compatibility with net zero targets of investing in new gas-fired assets such as a CHP to serve this network should be carefully considered, as the grid energy displaced by a CHP will be increasingly low carbon in the years ahead*. If a CHP is selected as the heat source, the design of the network should ensure its future compatibility with heat pumps (e.g. pipes sized for low flow temperatures).

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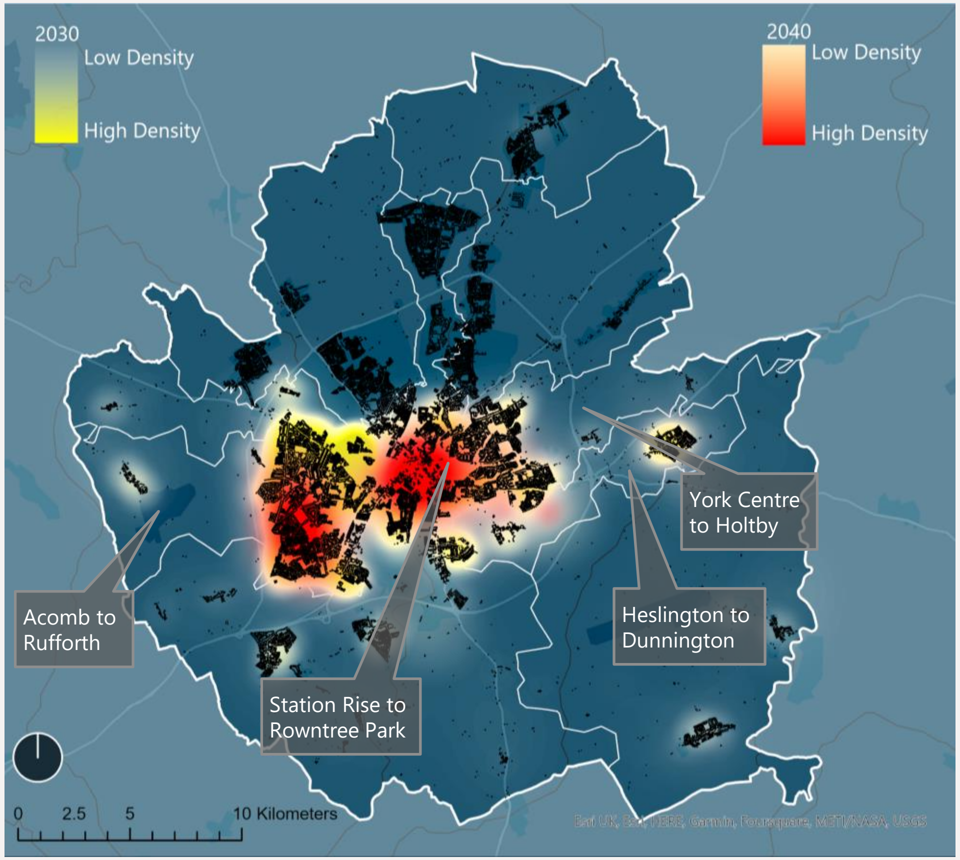
https://www.cibse.org/knowledge-research/knowledge-portal/an-operational-lifetime-assessment-of-the-carbon-performance-of-gas-fired-chp-led-district-heating

District Heat Networks

Heat networks could serve over 20,750 dwellings (55%), concentrated predominantly in the zones listed below. The Green Heat Network Fund* will have quarterly application rounds from March 2022 until 2025 and could provide funding for heat networks in York.

York sits on a productive aquifer** which has the potential to provide significant quantities of low carbon heat for heat networks. Heat network development projects should consider working with York Hospital, the University of York and Nestle all of which have large demands for heat and may be both anchor loads and providers of heat for use in networks.

Zone	No. of Dwellings Connected	Domestic Peak Demand (MW)	Non-domestic Peak Demand (MW)	Total Peak Demand (MW)
Acomb to Rufforth	8,215	16.6	9.8	22.7
Station Rise to Rowntree Park	3,685	8.5	42.1	48
York Centre to Holtby	5,385	11.5	21.9	30.2
Heslington to Dunnington	2,585	5.5	16.1	20.3



Density of buildings recommended for connection to district heat network in medium ambition scenario (red) and high (yellow)

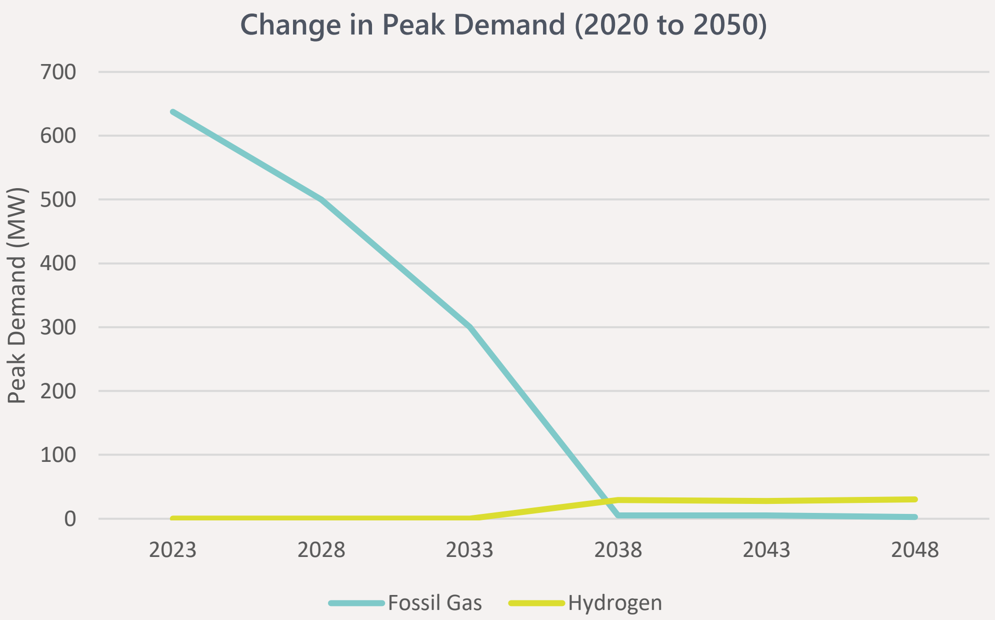
* https://www.gov.uk/government/publications/green-heat-network-fund-ghnf
** http://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSHydroMap&_ga=2.227016797.1726030392.1645026282-782257203.1645026282
Figures shown are based on the medium ambition scenario. Total peak demands are lower than the sum of domestic and non-domestic peaks, as they will not fully coincide in time

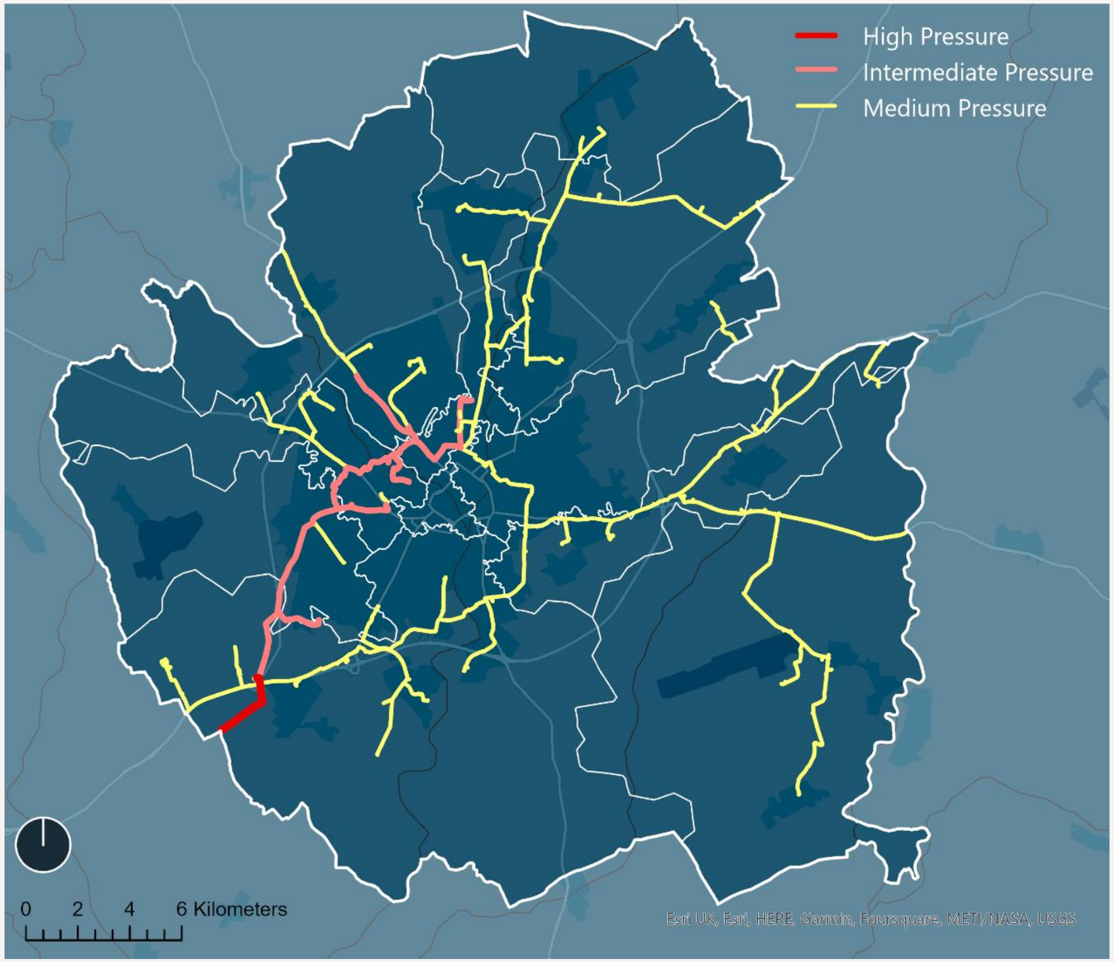
Gas Network

The gas network in York is operated under license by Northern Gas Networks and currently supplies fossil gas to the majority of dwellings (extents of the high-pressure network shown in the map). It is used predominantly for domestic heating, hot water and cooking, but also supports a range of non-domestic and industrial local energy demands.

The current total fossil gas consumption across York is around 1,625 GWh per year. Meeting the net zero goal would mean a steep decline in fossil gas consumed across York, illustrated in the graph below (based on following the 2040 net zero pathway).

Meanwhile, parts of the gas network could be repurposed to supply hydrogen around industrial areas – this is detailed on the following page.





Map of the existing gas network in York

Hydrogen

It is assumed that hydrogen will become available from a converted gas network in the mid-2030s under the H21 scheme*, and therefore cannot contribute to a 2030 net zero target. Even by 2040, the use of hydrogen for dwelling heating is likely to be minimal, as the cost and carbon intensity of hydrogen** are less favourable than for electrification of heat.

There are, however, uses of fossil gas in industry for high temperature processes that would be difficult to electrify, and this is where hydrogen could be usefully deployed. Once these industrial clusters are supplied by hydrogen, it could make sense for nearby buildings, including any dwellings in the area, to also be heated by hydrogen, avoiding the disruption, upfront cost and space requirements of heat pump installation. This could be valuable in dwellings where space for heat pump equipment is constrained, such as the terraces around the train station and Hazel Court recycling centre.

Use of hydrogen for high-temperature industrial processes.

An example area around the Hazel Court recycling centre where industrial hydrogen use could benefit nearby hard-to-electrify dwellings

- https://h21.green/about/

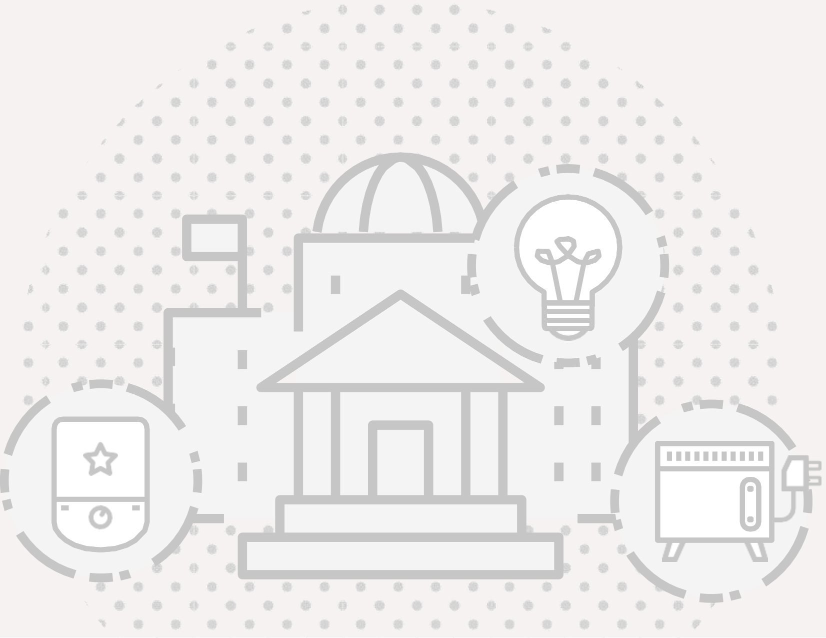
** Hydrogen production cost based on BEIS figures https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011506/Hydrogen_Production_Costs_2021.pdf

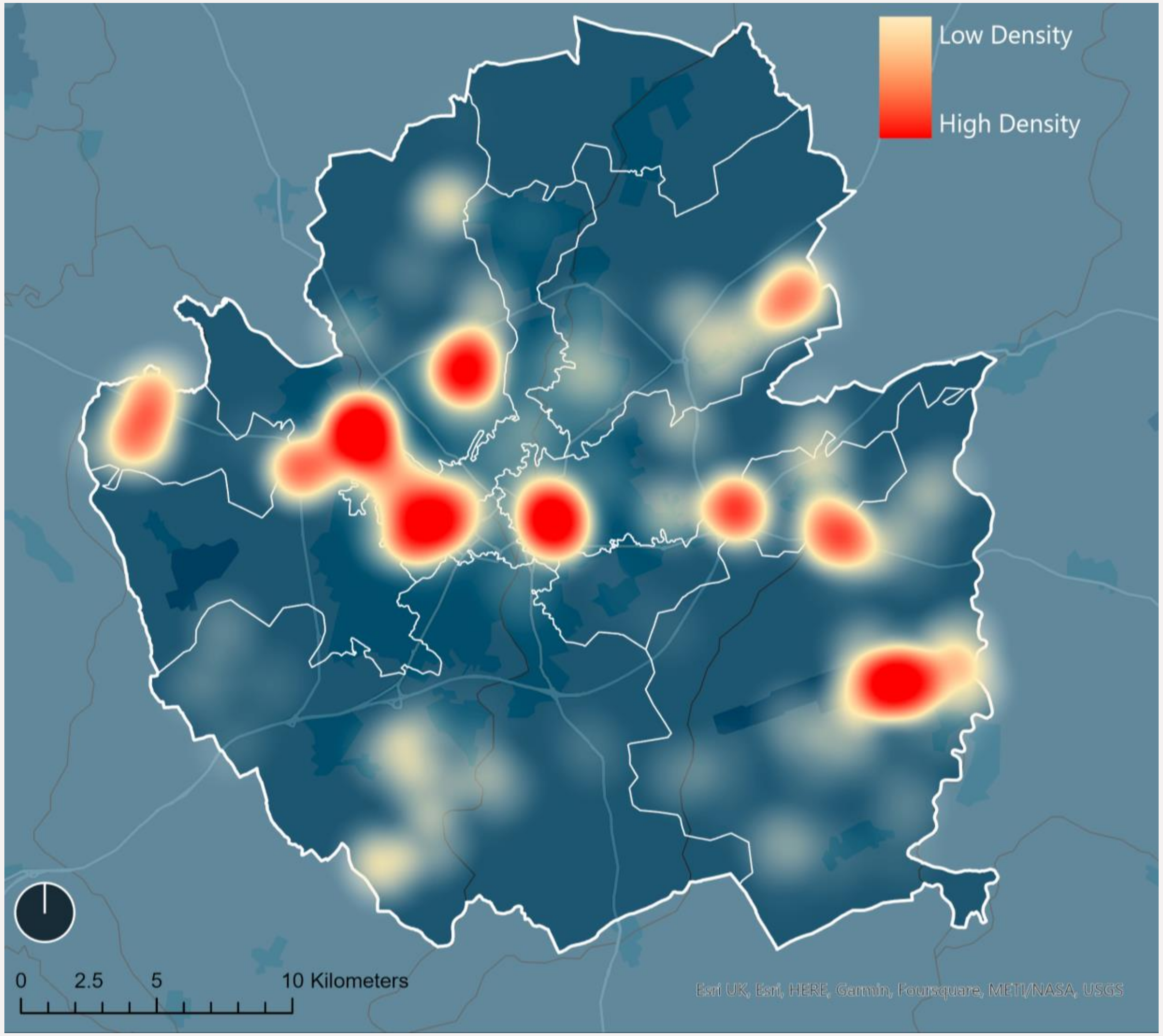
Carbon intensity based on the East Coast Hydrogen Feasibility Report https://www.nationalgrid.com/gas-transmission/document/138181/download

Hydrogen

Areas with high-temperature industrial processes which are unlikely to be reached by a hydrogen network could investigate the use of electrolysers to produce hydrogen on-site. Such electrolysers could form central supplies for a small cluster of nearby users of hydrogen, as shown in the map.

Recognising that there is uncertainty associated with the cost and carbon projections used for hydrogen, near-term focus should be centred on the identified heat pump and district heat network focus zones, keeping options open for areas outside the focus zones. The UK government is expected to clarify its strategy on the use of hydrogen for heating buildings in 2026, which will give a steer on the decisions for these areas.

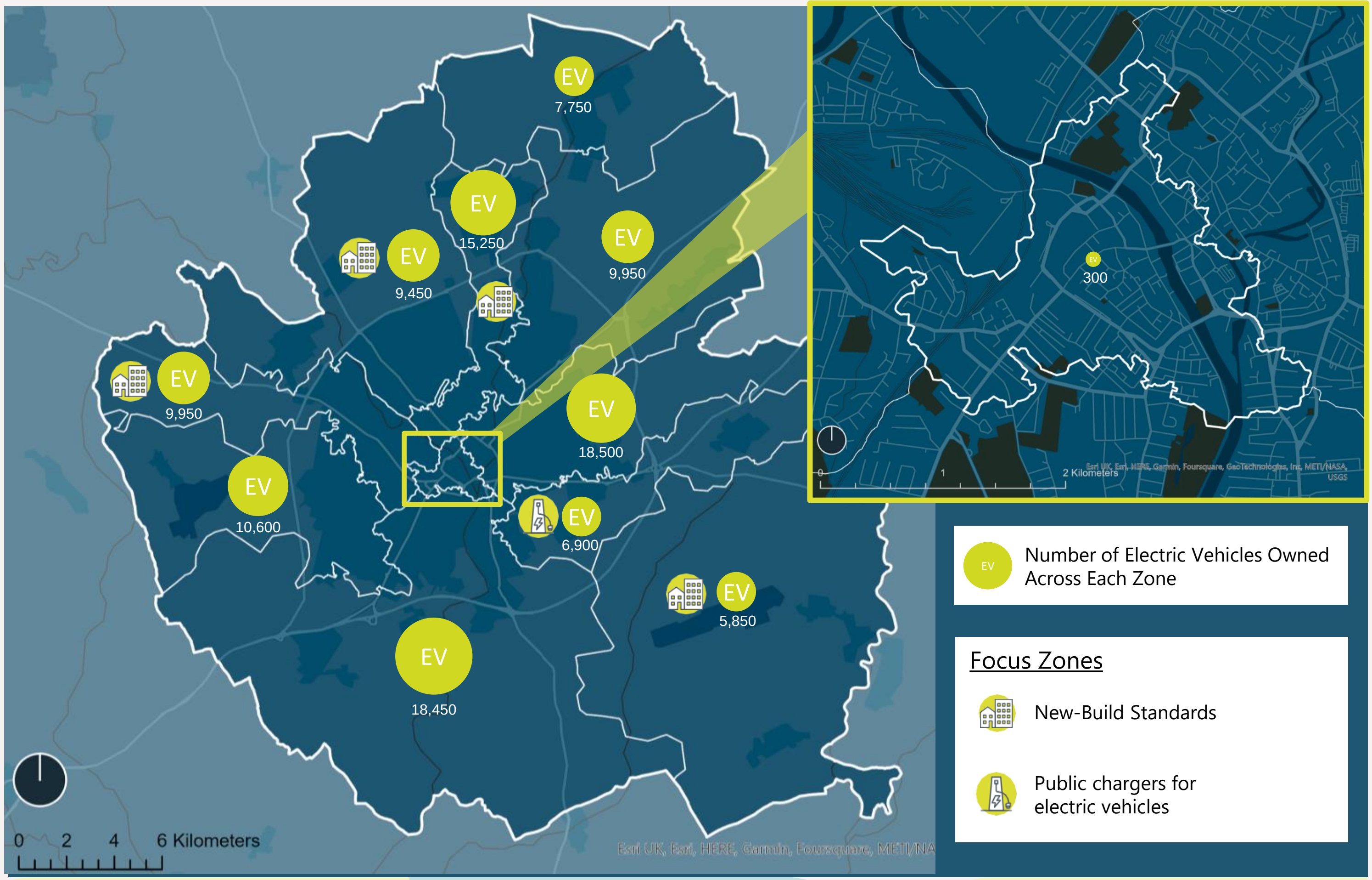




Use of hydrogen for high-temperature industrial processes

Transport

EV Overview



Electric vehicles (EVs) are expected to grow significantly in number as a proportion of total vehicle fleet, as purchase costs match or fall below those of petrol and diesel vehicles, local clean air zones favour clean vehicles, and national policy phases out petrol and diesel vehicle sales by 2030 and hybrids by 2035. Reaching net zero ahead of the national target would require strong incentives for residents to shift to electric vehicle purchases earlier, which could lead to the scrappage of working vehicles.

Projections of an increasing proportion of private electric vehicles were used to anticipate the electricity demand across York for charging these vehicles, and the associated infrastructure upgrades that would be required. EV uptake is higher in the more suburban and rural areas of York, with city dwellers being less likely to own cars.

Areas with large numbers of new builds expected can ensure dwellings are built with EV chargers in place, avoiding the need for costlier retrofit at a later date.

113,000
Electric cars and vans by 2040

168 GWh/year
Energy consumption for charging when 100% of cars and vans are electric

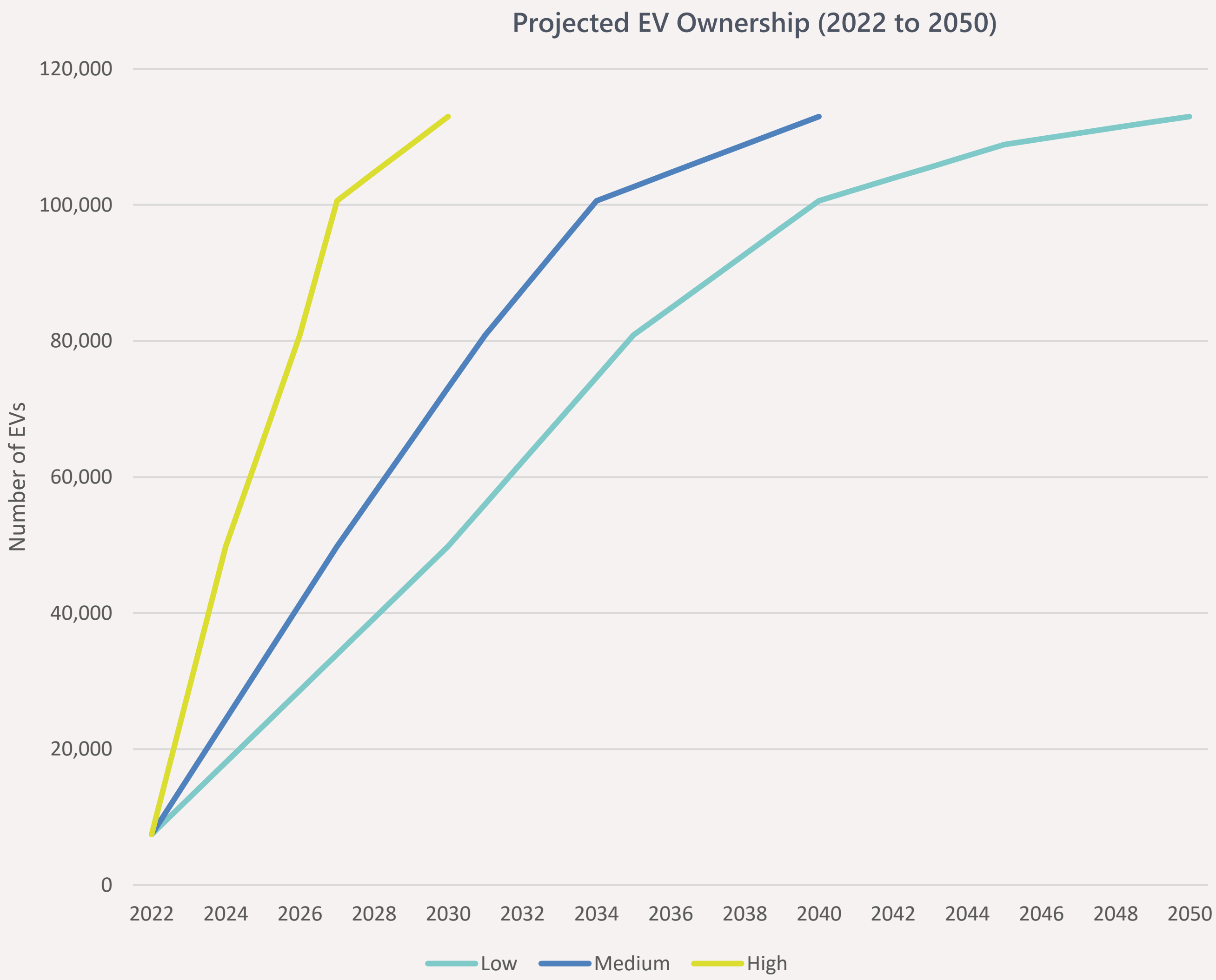
48%
Households have off-street parking, suitable for home charging

EV Projections

Based on projections by Transport for the North, plug-in cars and vans are expected to grow from their current level of around 9,150 in the year 2022 to 49,800 vehicles (~50% of the total fleet) by 2030 and over 113,000 (100%) by 2050. To reach net zero before the national target, this transition would need to happen even faster, with the sale of new petrol and diesel vehicles having to end by 2025 if premature replacement of vehicles is to be minimised (assuming a 15 year vehicle lifespan).

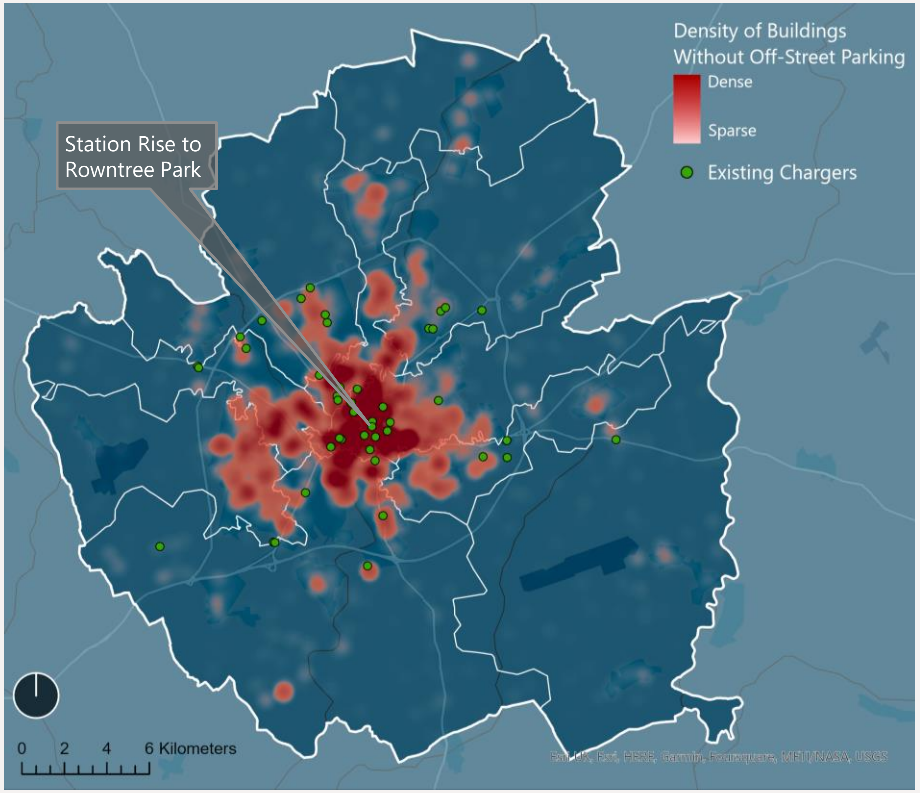
Currently there are few options available to local authorities that give this level of control, however the introduction of low emission zones which charge non-EV owners for entering certain areas can help to drive behaviour. Access to abundant and reliable charging infrastructure will also be important to encourage the transition and keep up with demand. This provides confidence to residents that they can be part of the transition and reduces the 'range anxiety' often cited as a block to EV uptake.

For more information about the Transport for the North data which fed into this plan please visit: https://evcivisualiser.z33.web.core.windows.net/

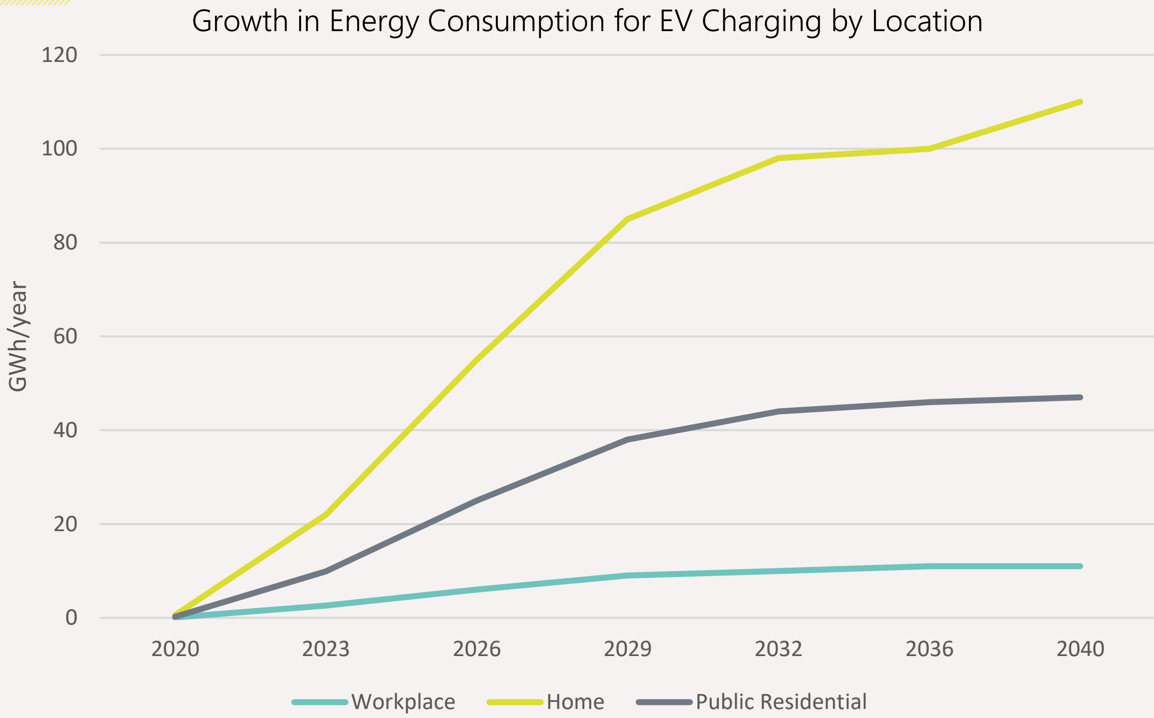


EV Charging Infrastructure

Density of housing without off-street parking & existing charge points



Areas of high-density housing without off-street parking are largely concentrated around York city centre, as seen on the map above. Only 17% residents in the Station Rise to Rowntree Park zone have off-street parking, where prioritisation of public charging infrastructure would be crucial to ensure an equitable transition to low carbon transport.



Those residents without off-street parking will require ready access to charging hubs, kerb-side charging, destination charging, workplace charging, etc. Given that only 48% of the residents of York have access to off-street parking, significant investment needs to be directed towards public EV infrastructure. Funds such as ORCS (On-street residential charge point scheme) and Local EV Infrastructure Fund can be utilised to support the development of this infrastructure. The City of York Council's EV Charging Strategy* sets out plans to further develop York's already extensive public charging network (with around 130 charge points currently available), building HyperHubs to deliver ultra-rapid charging at strategic locations.

The electricity requirement to charge electric vehicles in various locations is expected to grow as shown in the graph above. Home charging is likely to remain the most cost-effective and convenient way of charging an electric vehicle, therefore those who have access to off-street parking are assumed to choose this option whenever possible.

* https://www.york.gov.uk/downloads/file/6264/city-of-york-public-ev-charging-strategy

EV Focus Zones

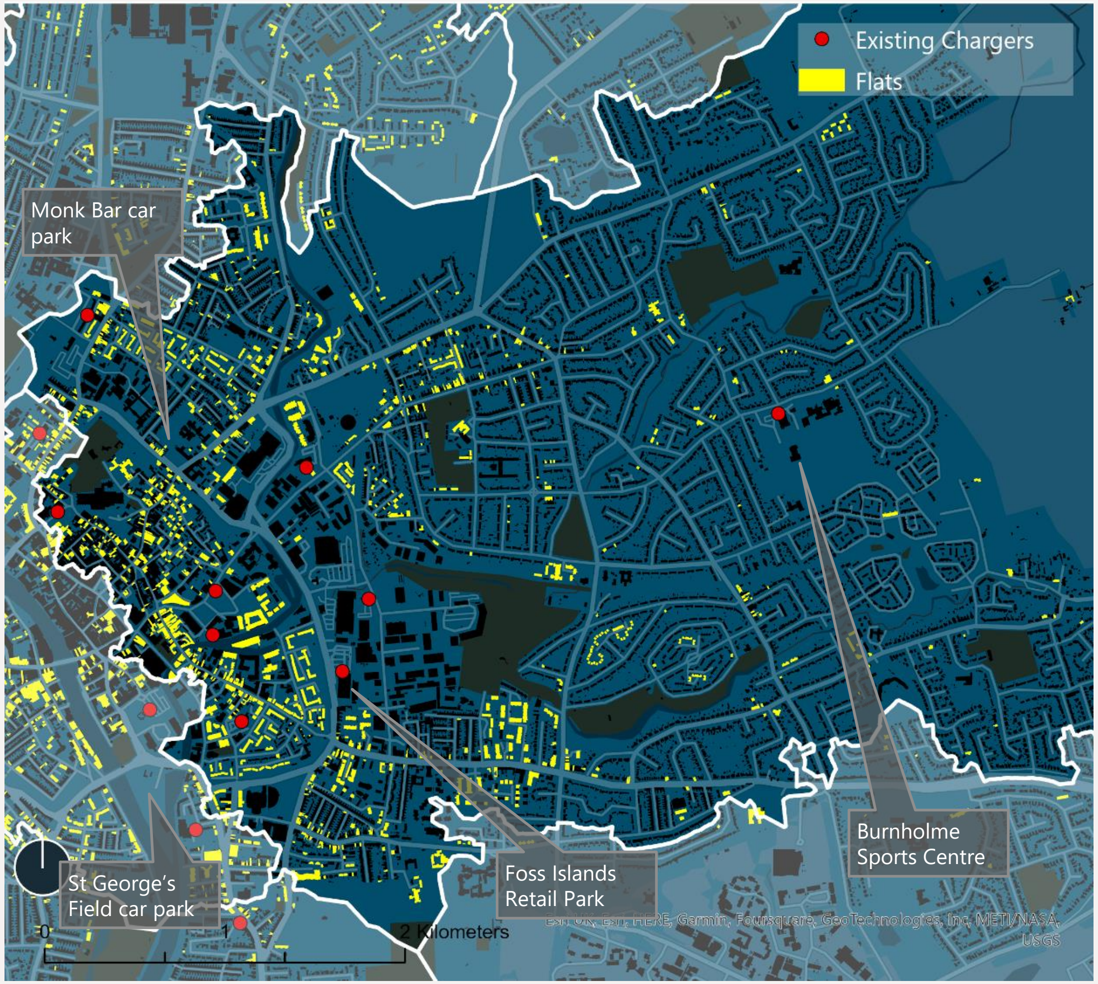
The Bishopthorpe to Copmanthorpe zone and the York Centre to Holtby zone have the largest expected uptake of EVs due to high private vehicle ownership, with around 18,500 expected in each zone by 2040 for the medium ambition pathway. Given there is significant spare capacity on the electrical network in the York Centre to Holtby zone, this has been identified as a focus zone for installation of public charging infrastructure.

Currently, there are around 135 public charge points around the city, but further expansion would be needed to keep up with demand in the near future. Given that there are a large number of flats in the York Centre to Holtby zone and little off-street parking (as shown in the map), it is likely that most charging will need to be provided by public charging infrastructure. This would include a mixture of kerb-side and destination/site charging.

The Foss Islands retail park, with a number of large supermarkets and major outlets, is a clear opportunity for the expansion of public charging provision, where residents and visitors will routinely spend prolonged periods parked. Beyond this, other public facilities such as the Burnholme Sports Centre could host EV chargers.

The Grimston Bar park & ride (off map) will host parked cars for prolonged periods – another opportunity to expand public charging (in addition to the chargers already present). There are a number of car parks in and around the city centre such as St George's Field which could have charging infrastructure installed, in addition to those such as Monk Bar which already have planned roll-out.

In the Wheldrake to Kexby zone, the Holgate to Hessay zone and the Clifton to Corban Lane zone, where substantial numbers of new dwellings are anticipated, EV charging can be fitted during construction, incentivising EV ownership and avoiding the need for costlier retrofit. Strategic transport planning in these areas to provide access to quality public transport and active travel routes could encourage behaviour changes that reduce car dependency, while promoting health.



Map showing flats and existing EV chargers in the York Centre to Holtby zone

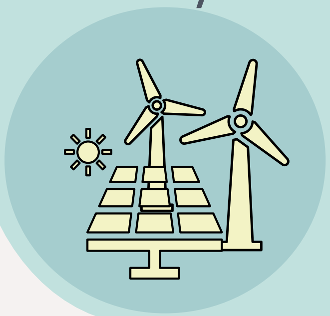
In areas where demand is likely to be high, City of York Council should work with private providers to increase provision of charge points whilst targeting public sector funding towards providing charging infrastructure in areas where the private sector could struggle to build a business case. This could be due to lower charge point utilisation or where problems with network constraints or high connection costs could be additional barriers.

Local Generation

Overview

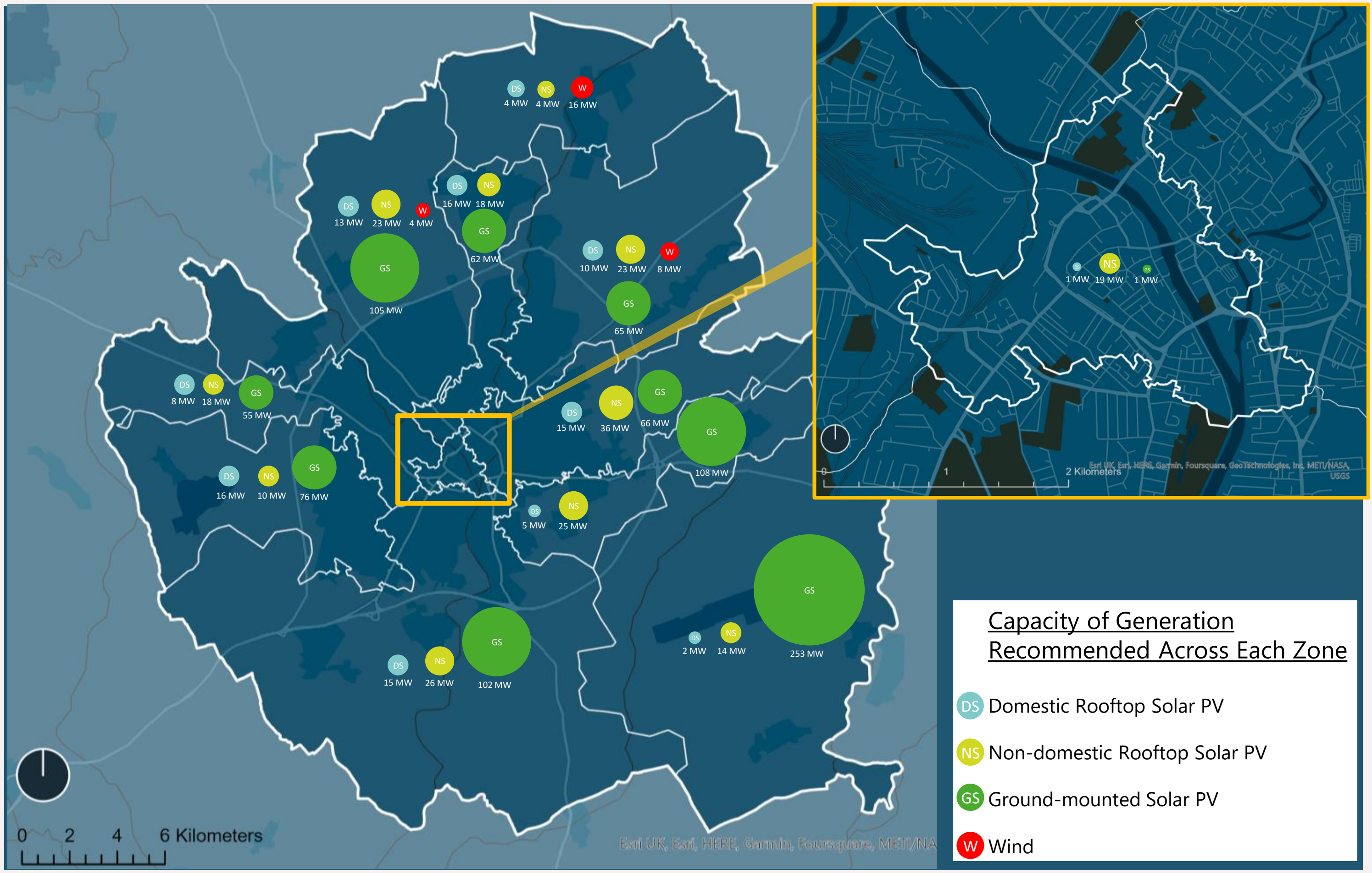
1,240MW

of wind and solar generation capacity could be developed



£840m

Investment in local renewable generation



Electrification of heat and transport is essential for decarbonisation, since oil and gas supplies are unlikely to decarbonise, or face major uncertainties doing so. This electrification will increase York's annual demand for electricity from 773 GWh to 1,273 GWh between 2020 and 2040. York can participate in producing that electricity from low carbon sources by deploying rooftop and ground-mounted solar as well as onshore wind, which will reduce the area's emissions faster than relying on grid decarbonisation.

Local generation of electricity is less essential for reaching net zero than eliminating local fossil fuel use in buildings and vehicles. This is because the electricity network is on a credible path to full decarbonisation, with an intention to reach net zero by 2035. Renewable generation built in York can contribute to national progress as well as accelerating local emissions reductions. The area, which is suitable for large scale renewable projects, could produce more energy than is used locally, even allowing York to become a net exporter if fully developed.

To further reduce the spend on imported electricity from the grid, York may wish to explore the use of power purchase agreements (PPAs)* and novel approaches such as local market places and peer-to-peer (P2P) networks. These all aim to maximise the consumption of local production within the area.

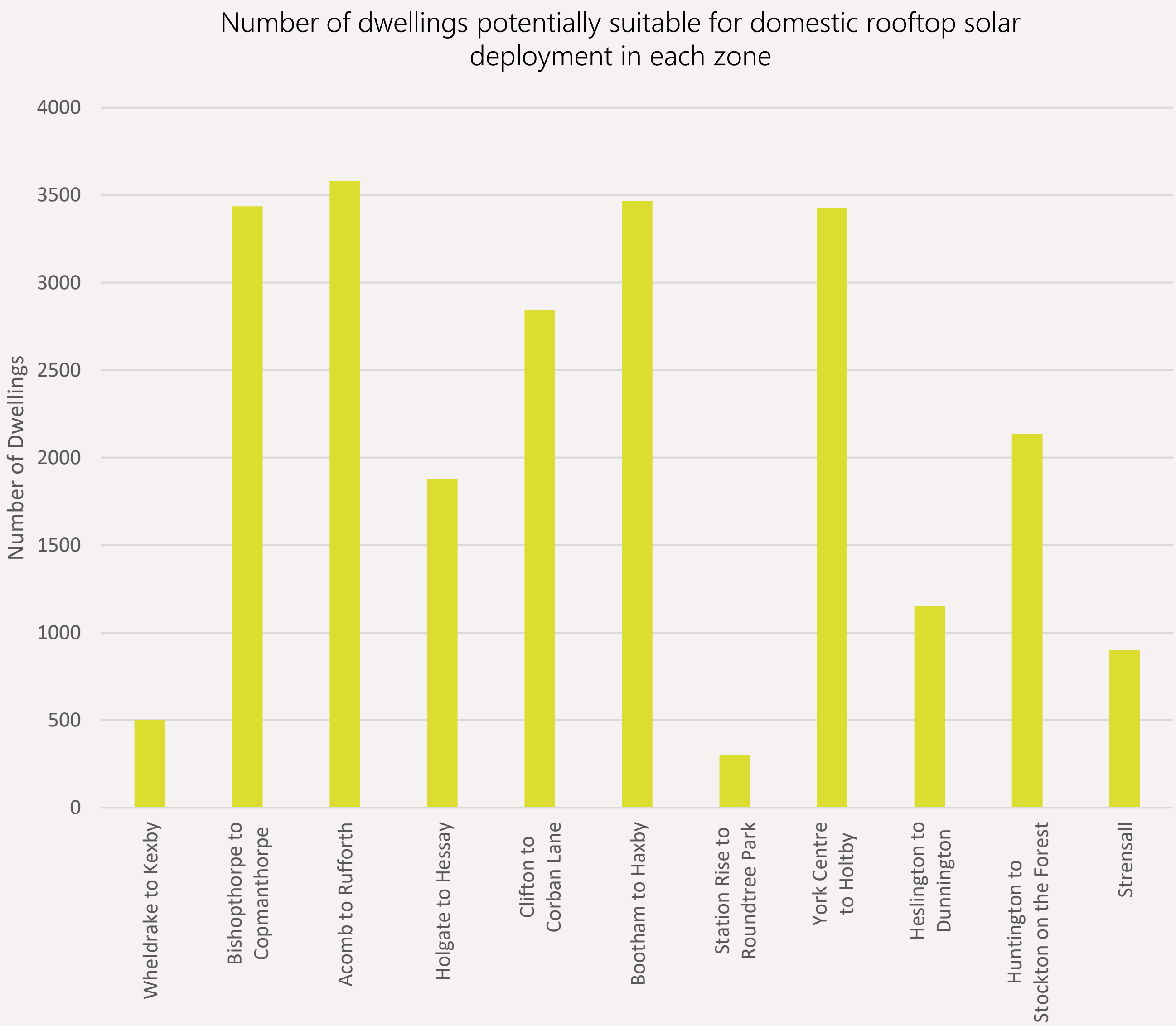
* For an example of a virtual PPA with large solar developments, see https://www.novartis.com/news/media-releases/novartis-set-achieve-100-renewable-electricity-its-european-operations

Domestic Solar PV

Although more expensive per unit of energy generated than ground mounted solar and wind, domestic PV makes use of roof space that would otherwise be unused and can provide direct financial benefits to householders. The recent energy crisis has resulted in rising costs of wholesale energy, which further improves the investment case for rooftop solar while energy prices remain high. A large rollout of domestic PV is of value regardless of the net zero target date chosen and therefore is deemed to be low regret.

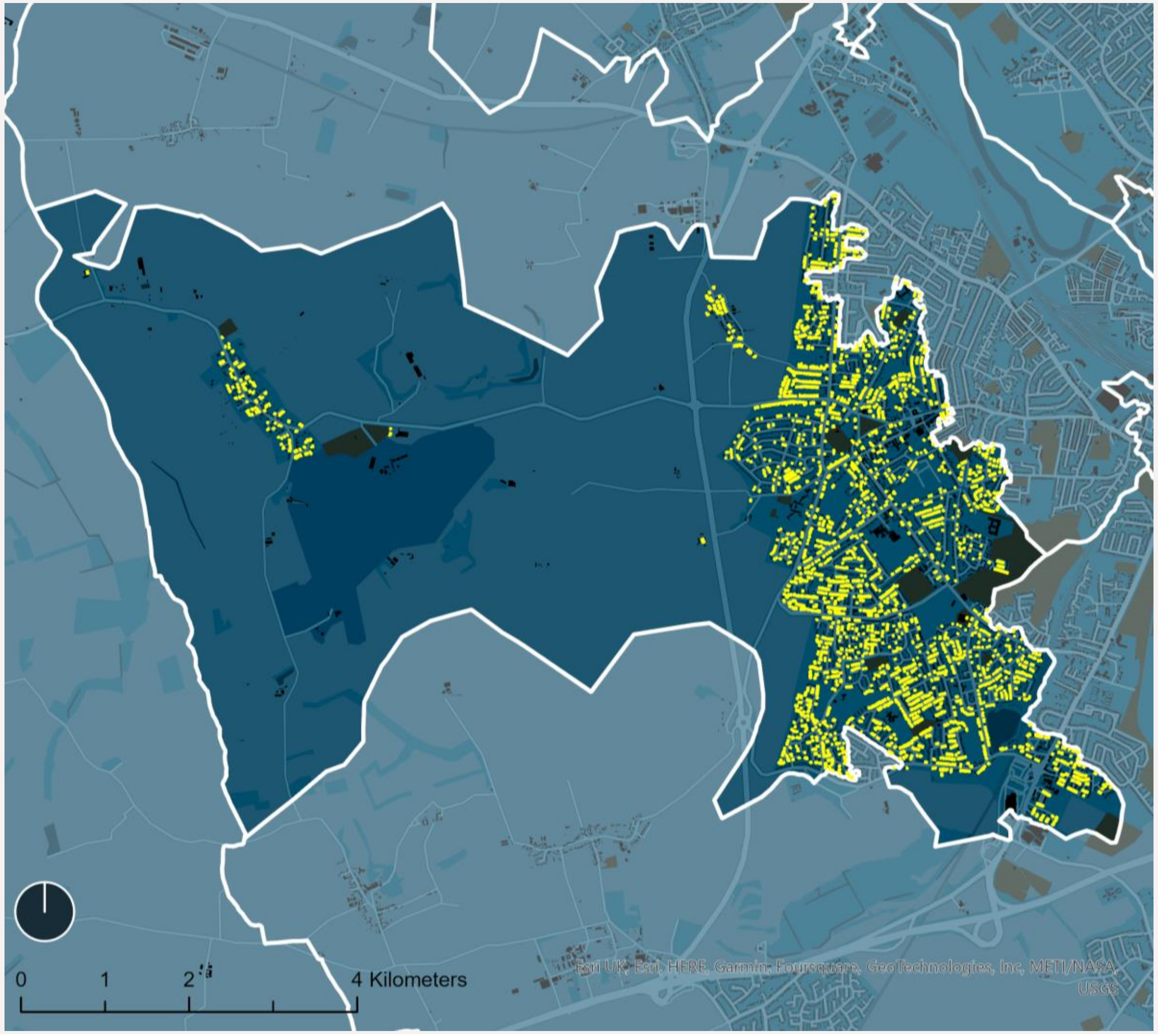
Based on roof orientation and pitch, dwellings are identified for solar PV suitability. If fully developed, a capacity of 105 MW could be installed for a total investment of £137 million. This would contribute 91 GWh per year to York's 1,235 GWh electricity demand in 2040 (with electrified heating and transport).

Local authority owned housing and social housing could be prioritized for roll-out of domestic PV in York. This approach could stimulate supply chain and skills in the area, preparing them for a larger roll out in private rental and owner-occupied residences. To assist owner-occupiers to invest in solar installations, programmes such as group buying schemes, which can be initiated by the LA, can be utilised to develop economies of scale and reduce costs to residents.



Domestic Solar Focus Zone

The Acomb to Rufforth zone has the greatest capacity for new generation in the local network, suggesting a large number of dwellings can install rooftop solar PV before network constraints are encountered. This also coincides with the greatest number of dwellings likely to be suitable for solar PV (over 3,500), making the Acomb to Rufforth zone ideal for an early focus of effort. Whole neighbourhood approaches could be taken to raise the profile of domestic solar to householders and drive down costs with scale and efficiency of installation.



Dwellings with potential for rooftop solar PV in the Acomb to Rufforth zone

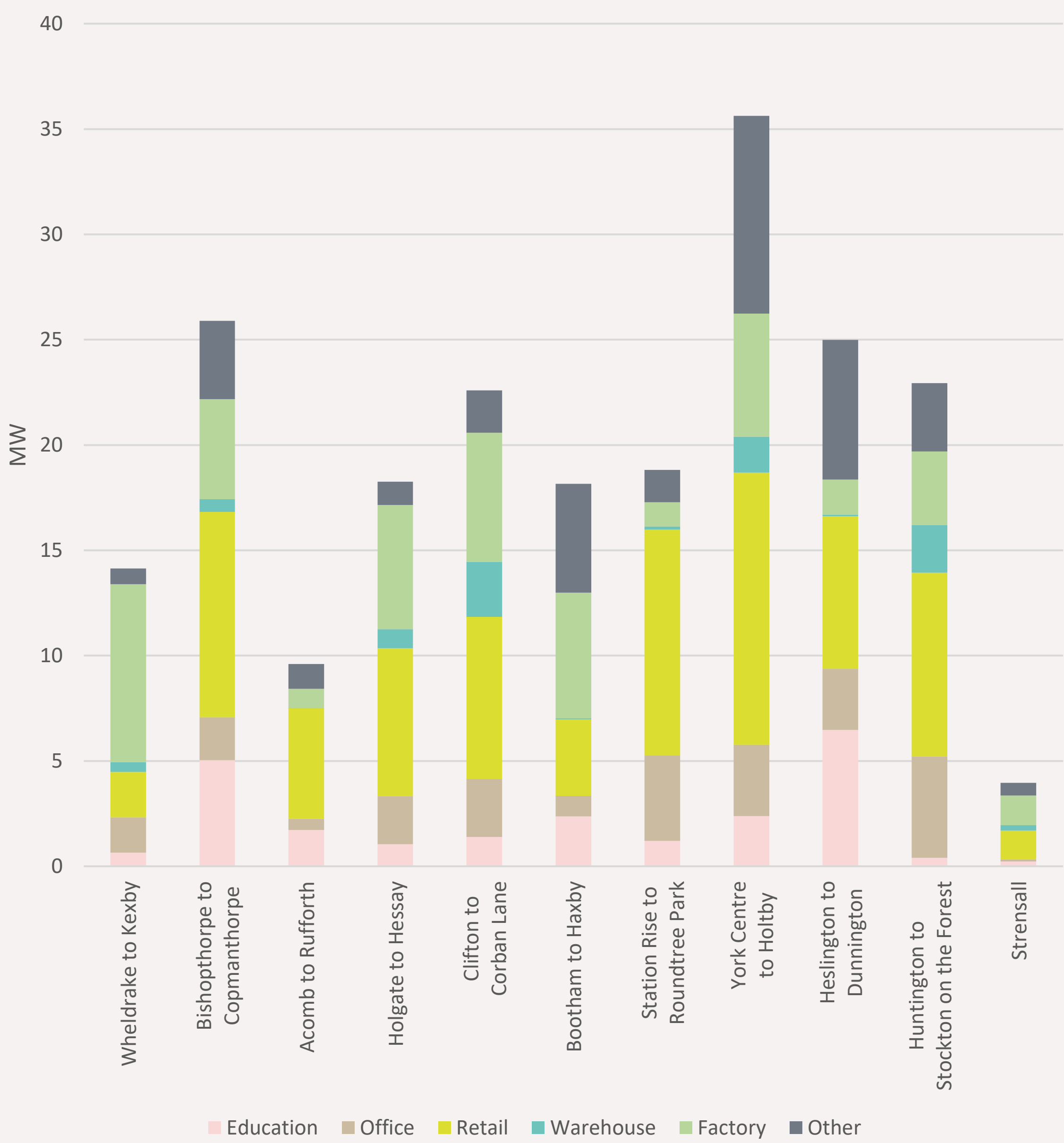
Non-Domestic Solar

Non-domestic solar installations also contribute to cost effective decarbonisation plans for York, regardless of the level of ambition. They have the potential to be more cost effective than domestic solar, but there are some challenges that arise when the building owner is not the bill payer. These projects would be low regret and should give confidence that they are an appropriate investment. The chart shows the potential capacity for non-domestic solar deployment, based on available roof space and assumptions about the extent to which it could be developed.

Non-domestic building construction is more variable than domestic, and it is not possible to say if a building is suitable for PV without a site survey of the roof construction, load bearing capacity and the extent to which other building services such as cooling vents are present.

With almost 10MW of rooftop solar already deployed on non-domestic sites, available roof space could host up to 215 MW of PV capacity if fully developed. This would contribute 207 GWh/year of electricity, for an investment of £195m.

Rooftop Solar PV Potential on Non-Domestic Buildings in Each Zone



Large-Scale Renewables

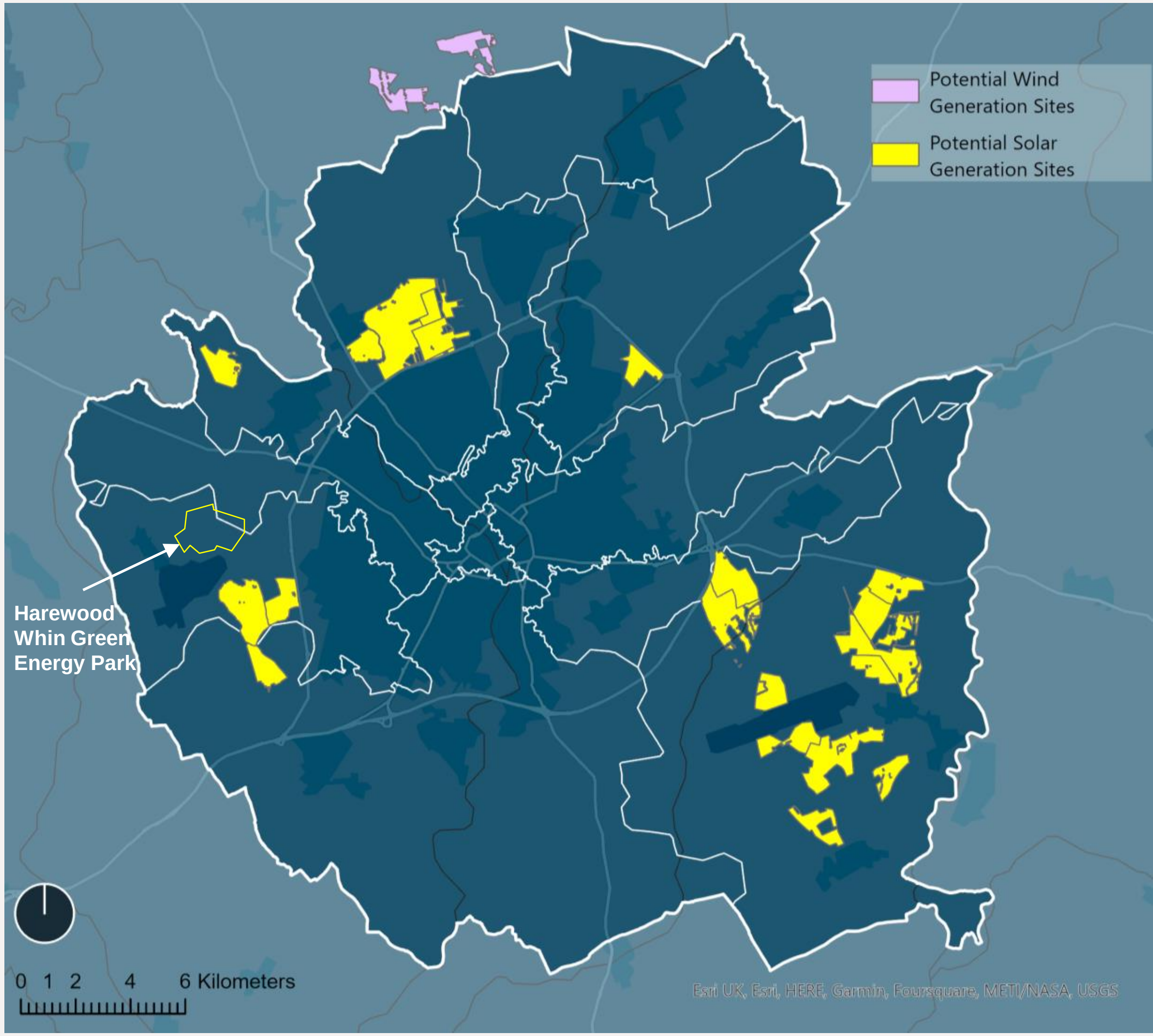
Large-scale renewable generation, particularly ground-mounted solar PV and onshore wind are the most cost-effective way to produce low-carbon electricity, due to economies of scale. Arrangements such as power purchase agreements (PPAs) and community ownership co-ops can capture this value locally. Many examples of community ownership models can be found in the UK, with local residents enjoying income or bill savings from the schemes.

The requirements for land purchase, planning permission, public acceptance and connection to the grid can put limits on their scale and deployment. While obstacles to development could delay the journey to net zero, they will not necessarily make it impossible to reach, since grid electricity is also [expected to reach net zero by 2035](#).

To give an impression of scale, land in York has been assessed for its suitability for ground-mounted solar and onshore wind. Around 3,900 hectares is suitable to build ground-mounted solar, which is enough space to host 950 MW of solar capacity. This is greater than what was found by the 2014 Renewable Energy Study by AMEC however there were differences in methodology whereby only the top thirteen sites were selected out of a shortlist of fifty-six.

A further 800 hectares of suitable land was found for wind turbines in areas of Hambleton and Ryedale immediately adjoining the York area boundary, sufficient to build 28 MW of capacity for an investment of £33m. No land within York was deemed suitable for onshore wind development using the criteria established. This contradicts the 2014 Renewable Energy Study undertaken by AMEC which found parcels of land with a potential installed capacity of 24 MW. Yorwaste are seeking to install up to 28 MW of solar PV and 2 MW of wind generation at their Harewood Whin Green Energy Park.

The remaining annual energy demand after developing rooftop solar and wind to their full potential could be met by developing 94% (893 MW) of the ground mounted solar potential. This would contribute 858 GWh per year of electricity for an investment of £475m.



Land suitability for large scale renewable developments

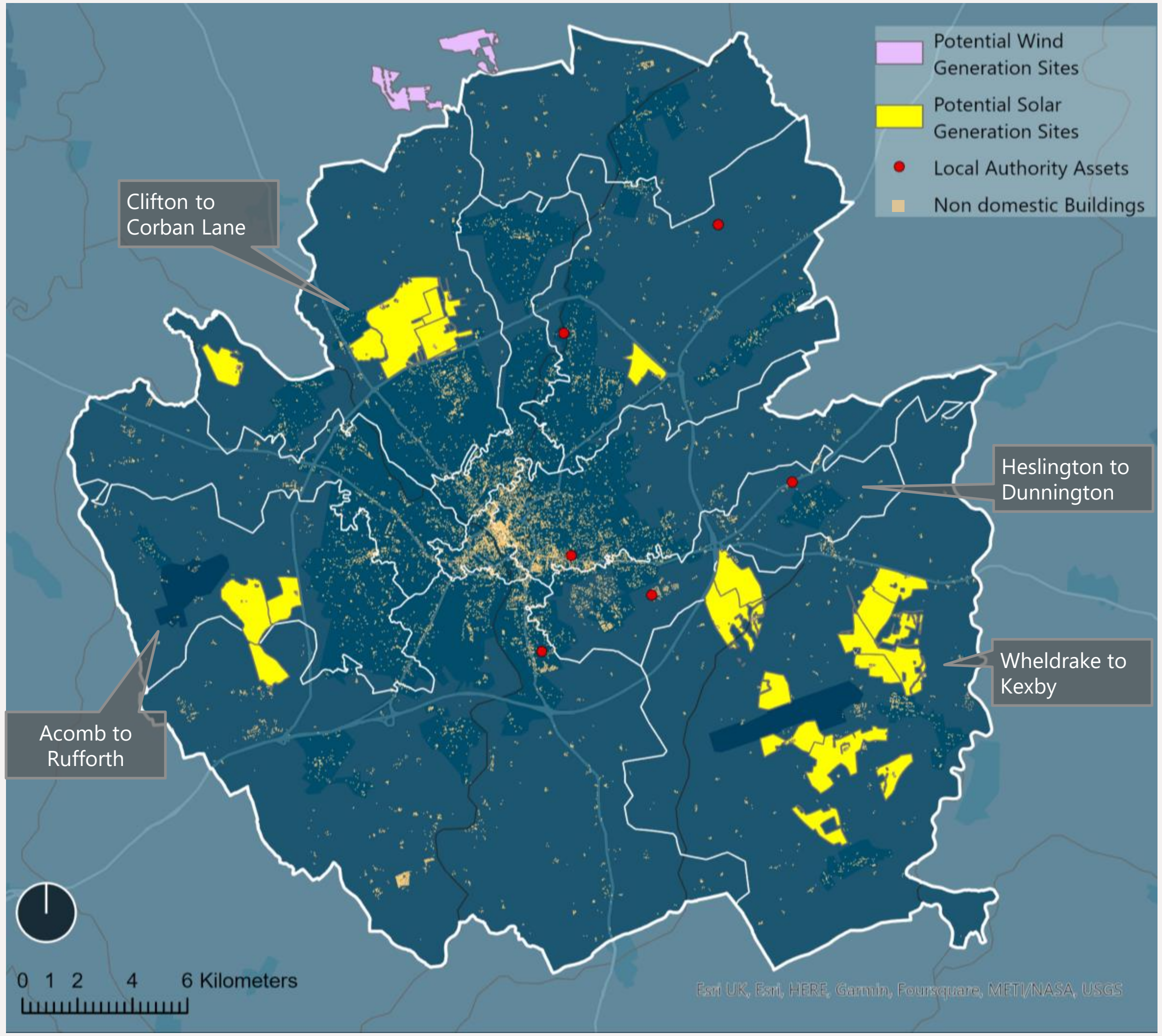
* Costs based on BEIS figures, including pre-construction cost and infrastructure cost scaled to capacity
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911818/GC20_Key_Data_and_Assumptions.xlsx

Large-Scale Renewables

It is not expected that ground-mounted solar would be built upon a single piece of land, but over a large number of distributed plots across York. These could become part of a local energy marketplace if permitted by regulation, where generation assets could be matched with off-takers requiring electricity, allowing local businesses to directly benefit from the production of locally generated low carbon electricity. Sites are selected according to criteria including vicinity of roads, quality of agricultural land, areas of outstanding beauty and other factors. Sites which would accommodate less than 10 MW or more than 50MW of solar capacity are excluded. For wind, less than 2MW and more than 10MW is excluded, to identify projects of suitable scale for investment and deployment.

The map highlights where non-domestic buildings and council-owned assets are located alongside land which has been deemed suitable for ground-mounted solar and wind.

As an additional benefit, well designed and located ground mounted solar and wind farms can support York's commitment to biodiversity and protecting local wildlife. Many site specific measures can be taken to improve biodiversity, e.g. restoring peatlands on on-shore wind sites.



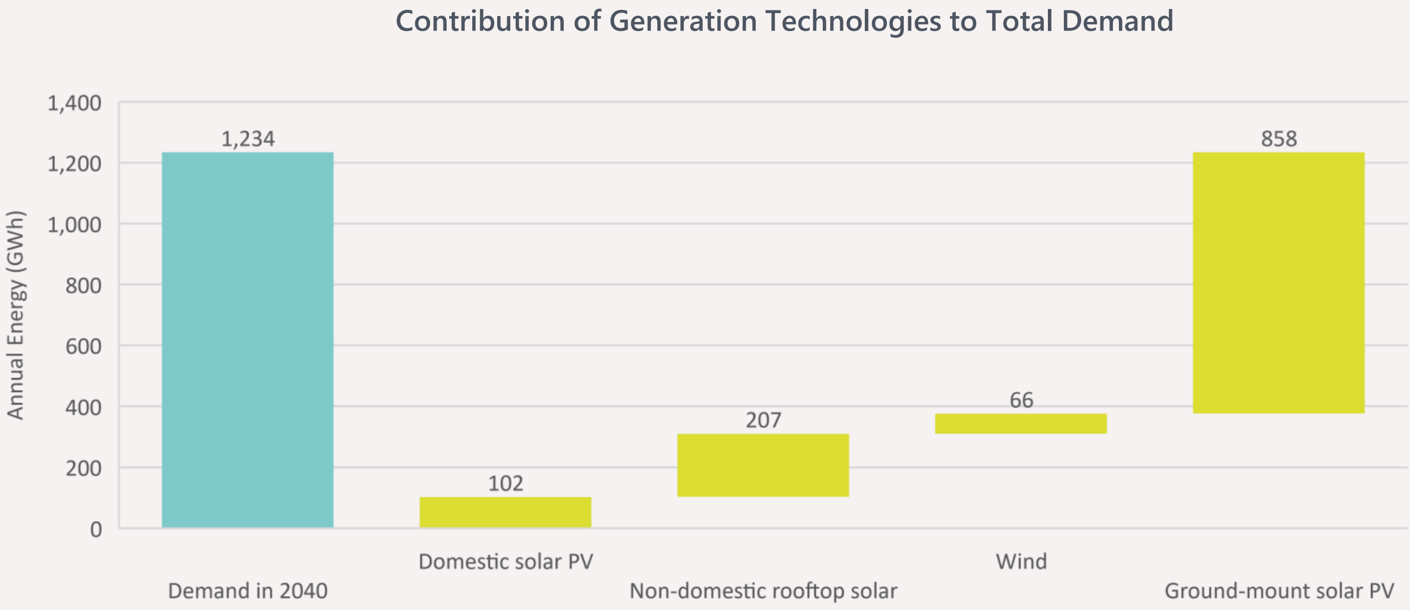
Land suitability for large scale renewable developments overlayed with potential purchases of energy

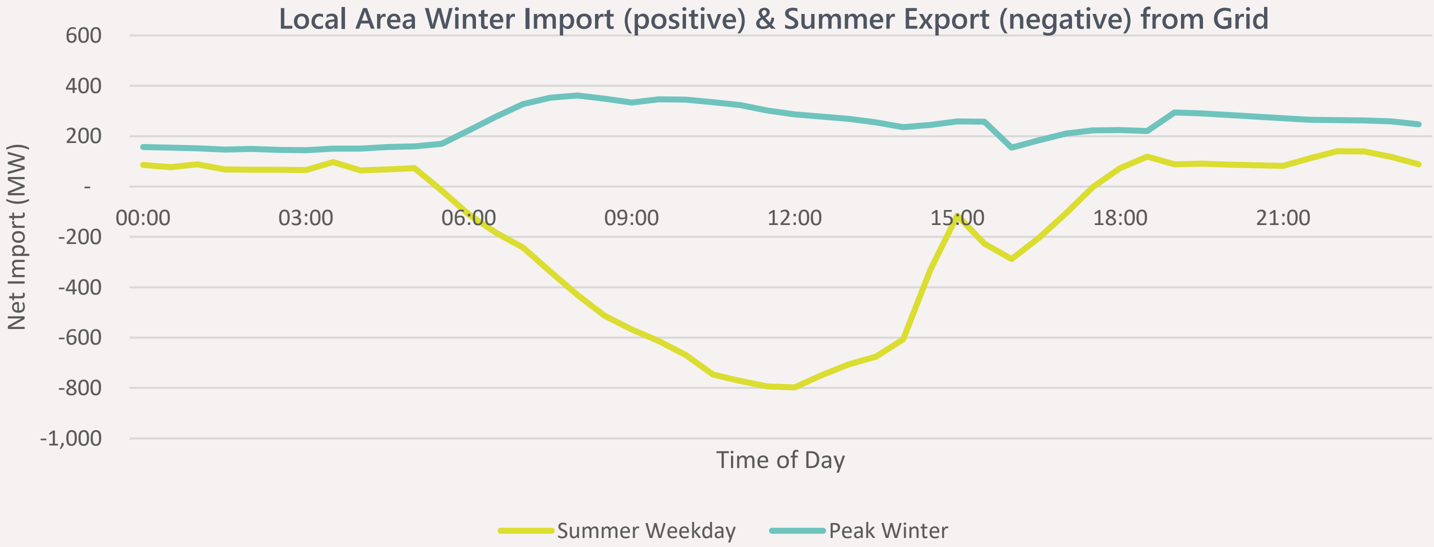
The Wheldrake to Kexby zone, the Acomb to Rufforth zone and the Clifton to Corban Lane zone contain large amounts of solar potential, however, LA assets as well as non-domestic sites are scattered and not always close to generating sites, thus making it difficult to benefit from proximity to generation.

The Heslington to Dunnington zone, with its potential for solar in close proximity to a number of LA assets, could be a potential for private wires and PPA contracts, as well as P2P markets.

Batteries and other types of energy storage could be co-located with ground mounted solar and wind. Co-located battery storage can help to smooth generation and enable participation in grid balancing services, increasing revenue streams available.

Large-Scale Renewables





Priority has been given to fully developing domestic and non-domestic rooftop solar, as no land is needed, and residents and owners can make direct use of the generation. Wind has also been prioritised for maximum development given that its generation profile matches winter heating demand, and the land around wind turbines remains useable for other purposes. The development of ground mounted solar is then scaled to cover the remaining local requirement for energy, on a net annual basis. The contribution of each type of generation is visualised against the total local demand in the top graph.

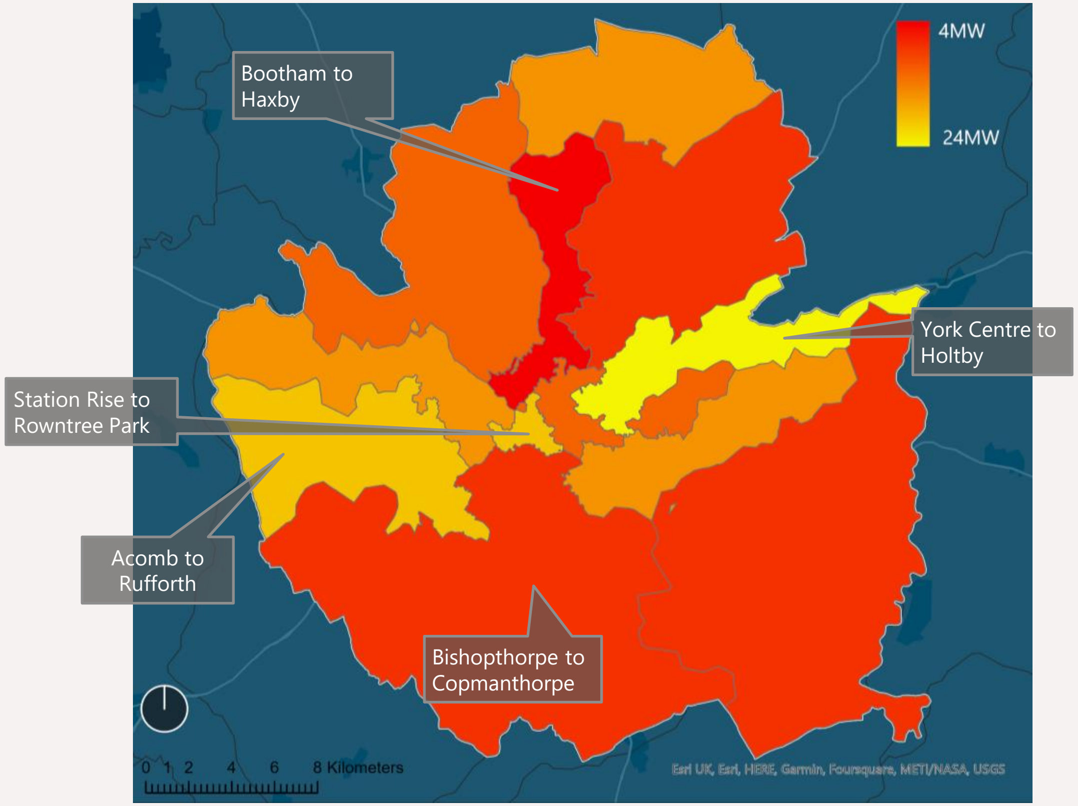
Since renewable generation will vary with weather, time of day and season, York would still need to import from the electricity grid when supply from local generation does not meet demand. Wind and solar are somewhat complementary, with wind increasing in winter months and occurring through the night, while still days are often very bright. Battery storage would enable more of the generated electricity to be utilised locally at times of demand, but would not be suitable to store the energy inter-seasonally to use the summer surplus in winter. Local hydrogen production may offer a viable option for seasonal storage.

Without seasonal storage, the large quantity of solar generation would result in a large summer export to grid from the area (shown in lower graph). There is limited local capacity for increased generation in the area (see https://www.northernpowergrid.com/generation-availability-map). Greater grid capacity would be required to absorb this surplus than the capacity needed to supply the area in winter. Any large scale deployments of solar generation will need to be coordinated with Northern Powergrid to ensure that network capacity is available.

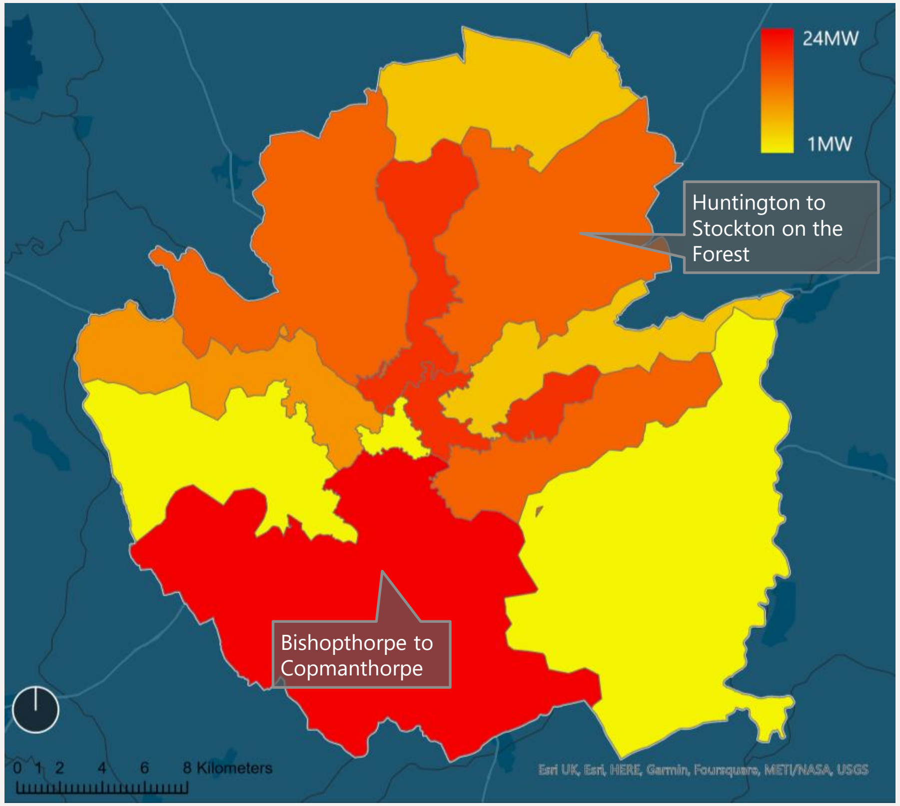
National Grid's Future Energy Scenarios envisage around 20 gigawatts (GW) of solar in the North of England by 2050. If distributed evenly by household, this would be about 315MW for York. This implies that generating all of York's annual demand locally could require more local renewable capacity than the grid is likely to be able to accept.

Networks, Storage & Flexibility

Upgrading the High Voltage Network



Current headroom on the high-voltage network



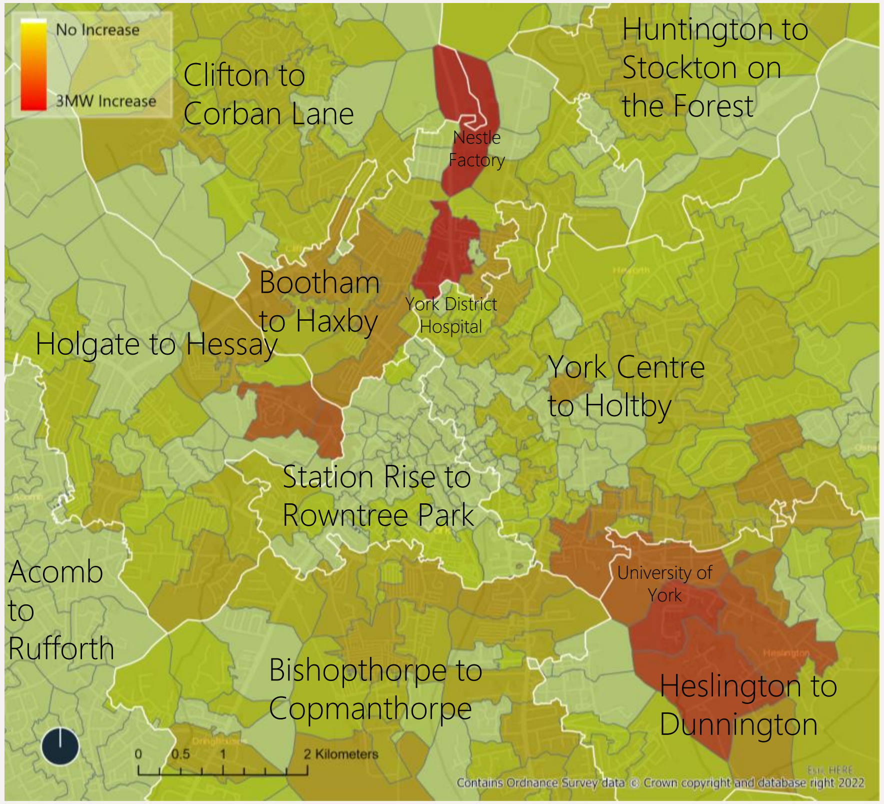
Increase in peak demand on the high-voltage network to 2040

A total gross investment of £20m in capacity upgrades is estimated across the high and low voltage networks by 2040 to accommodate the changes in this pathway. Ofgem's Open Letter on the Green Recovery Scheme "is aimed at accelerating low regrets, shovel ready network investment under the remainder of the RIIO-ED1 period [ends 31 March 2023] to stimulate economic recovery and support faster delivery of decarbonisation benefits for customers, while supporting Government's climate change ambitions."

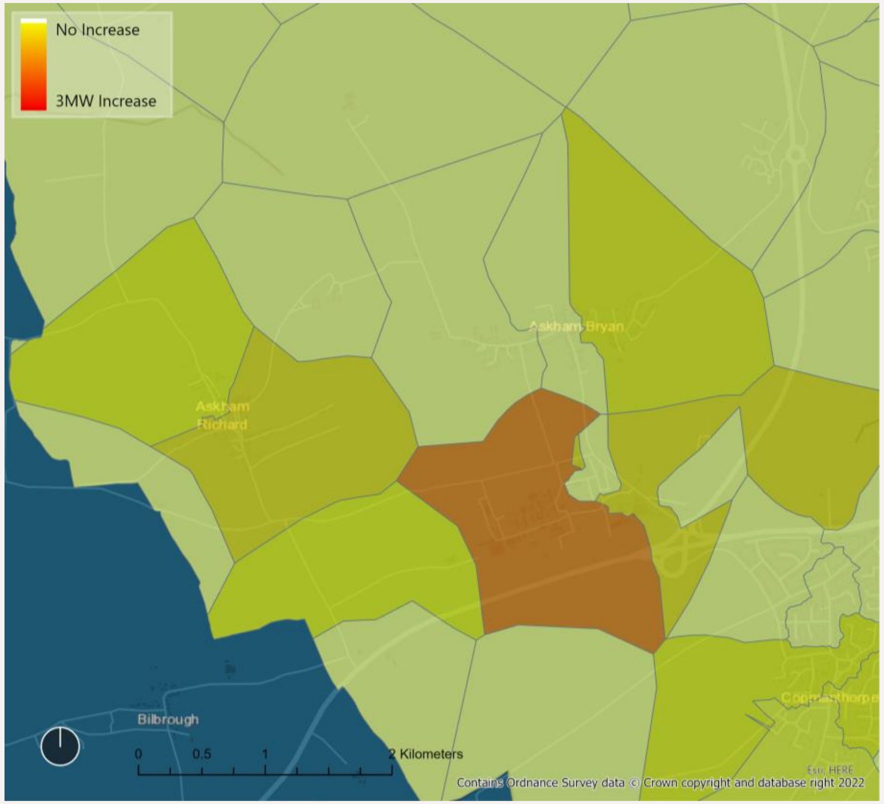
The high voltage network consists of substations on land owned by the distribution network operator, supplying feeders which run to secondary substations, which in turn serve multiple streets. The maps above show the areas of York served by each HV substation.

The amount of headroom currently available on the high-voltage network varies significantly across the area, as shown in the left map. Several zones such as Bishopthorpe to Copmanthorpe and Bootham to Haxby have little headroom available, York Centre to Holtby has a lot more, along with Acomb to Rufforth and Station Rise to Rowntree Park to a lesser degree. Large scale electrification is very likely to trigger the need for capacity upgrades, but several areas have sufficient capacity to get started on small near-term projects. As shown in the map on the right, several areas are likely to require capacity upgrade to accommodate the full extent of electrification needed to reach net zero, such as Bishopthorpe to Copmanthorpe, Bootham to Haxby and Huntington to Stockton on the Forest.

Upgrading the Low Voltage Network



Demand change on the low voltage network around Central York



Increases in peak demand in 2040 in Askham Bryan

The low voltage network consists of smaller neighbourhood substations, supplying feeders which run under pavements or roads to each building or on overhead wires in rural areas. The maps above show for some example areas that parts of the LV network are likely to see significantly more peak demand increase than others, for instance around the York District Hospital and the university campus.

Innovations in flexibility have the potential to delay and reduce the scale of electricity network reinforcement by shifting peak demands to periods of lower demand. DNOs would need to tender for local flexibility services, which could be provided by, for example, smart EV charging.

In some areas flexibility will not be sufficient to manage increased demands without network reinforcement. Discussing plans well in advance with the DNO will ensure that both provision of flexibility and network reinforcement can be planned so that projects are not delayed longer than absolutely necessary through lack of network capacity.

Outline Priority Projects

Overview

In creating the LAEP, near-term projects have been identified that the City of York Council and York & North Yorkshire LEP could start the process of implementation. These near-term projects are either:

- Low regrets –common under various scenarios but may require further enabling action before they can be progressed.
- Quick wins – which can be carried out in the near-term without major blockers.
- Focus zones - specific areas within the LAEP boundary that have a cluster of near- term components.

The purpose of identifying specific outline priority projects is to provide stakeholders with projects that can immediately be implemented to make progress towards net zero. The following section specifies details of these near-term projects, including details such as locations and financial information. Energy Systems catapult "Net Zero Go" platform* provides resources to help local authorities design and develop energy projects.

Further details, information and advice for implementing the Outline Priority Projects can be found towards the end of this document.

* https://www.netzerogo.org.uk/s/

Buildings Efficiency Upgrades

Almost 1,000 terrace dwellings built between 1945 and 1979 are likely to be suitable for basic efficiency upgrades across the Acomb to Rufforth zone. As this is an area of high fuel poverty, efficiency upgrades would be especially impactful in their social benefits.

Identification of social housing in this area is likely to be a good starting point. It may then be possible to design a scheme that targets retrofit of all social housing, but with an offer to owner-occupied households and private landlords to join the scheme while contractors are in the area. This has the potential to reduce costs for all homeowners, at the same time as increasing the number of retrofits carried out.

Zone	Acomb to Rufforth
Building Type	Terrace 1945-1979
Number of Dwellings	1,000
Insulation Type	Basic
Cost	c. £1.1m

Dwellings suitable for efficiency upgrades in sample area of Acomb to Rufforth zone (does not show all dwellings identified for project)

Heating Demonstrators & Enablers

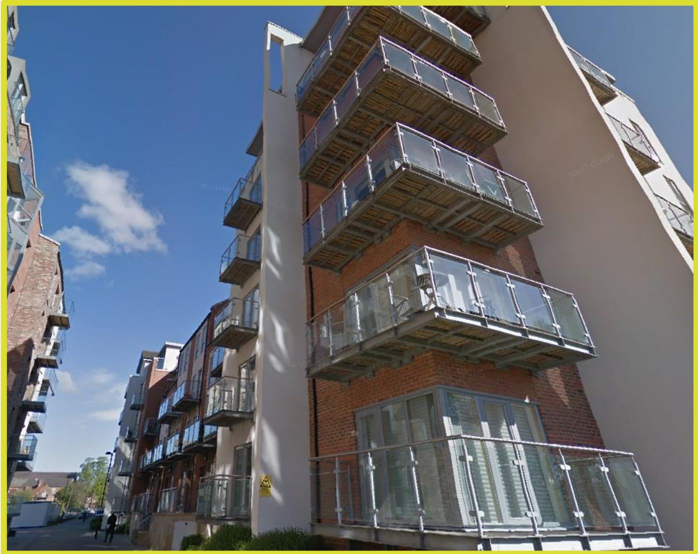
Heat Pump Demonstrators

The Bishopthorpe to Copmanthorpe zone has a significant number of terrace dwellings (just over 4,050) which could be suitable for air source heat pumps making this a good area for early demonstration neighbourhoods. Demonstration neighbourhoods could be valuable for developing the approach for particular housing types, identifying common barriers and finding solutions, such as recommending changes to planning rules.

Terrace dwellings in the Bishopthorpe to Copmanthorpe zone

The York Centre to Holtby zone has many flats (1,650) which could have air source heat pumps installed. Indoor space in both terraces and flats is at a premium and therefore locating the internal equipment could be difficult and is a challenge that will need to be overcome for the decarbonisation of this part of the housing stock. Innovations such as more compact heat storage/batteries* may be part of the future solution. Whole-building solutions which include a central heating supply and a shared distribution could also be investigated.

Zone	Bishopthorpe to Copmanthorpe	York Centre to Holtby
Number of Dwellings	4,050	1,650
Building Type	Terrace	Flats
Heating System	ASHP	ASHP
Total Cost	c. £28m	c. £11m



Flats in the York Centre to Holtby zone

District Heat Network Demonstrators

In addition to the air source heat pumps, the York Centre to Holtby zone also has the greatest number of flats which could connect to a district heat network (2,650). In the Acomb to Rufforth zone, 1,400 terrace dwellings could also connect. Both areas could host demonstrators of heat network connection for these types of dwellings. Early steps could include surveying residents to gauge their appetite and knowledge of heat networks, spreading awareness of the technology, and identifying nearby anchor loads which can vastly improve the efficiency and cost-effectiveness of a heat network scheme.

* https://es.catapult.org.uk/case-study/electrification-of-heat-2000s-flat-heat-pump-installation/

Heat Network Starting Point

The heat network proposed for the York Central Energy Masterplan redevelopment (area A) could form a starting point for further expansion into the city. The area either side of the river near Clifford's Tower has a particularly high density of buildings and heat demand (area B). Although many of these buildings are private businesses, which could be more difficult to get on board, large anchor loads such as the York Castle and Yorkshire museums, student accommodation and the hotels in the area could help secure the viability of a heat network. Heat networks could allow historic buildings such as Fairfax House or York Mansion House to decarbonise with minimal disruption. The heat demands in area B are estimated in the table below.

It may be feasible to extract heat from the river using a water-to-water heat pump, as explored in the York Central Energy Masterplan, which can lead to higher efficiency and lower running costs. York also sits on an aquifer which has potential to provide large quantities of heat.

The mixture of domestic and non-domestic buildings allows for more of a balanced load across the network at any given time. Nevertheless, anchor loads (such as large schools, hospitals, leisure centres) with a steady and constant heat requirement should be sought if possible.
The table shows the split of domestic and non-domestic properties and the peak demands within the starting area marked on the map. (Note: peaks are not additive as domestic and non-domestic peaks will not occur at the same time.)

1. Yorkshire Museum
2. Theatre Royale
3. York Mansion House
4. Travelodge
5. Student Accommodation
6. Hilton Hotel
7. Hampton Hotel
8. Clifford's Tower
9. York Castle Museum
10. York Barbican
11. Novotel

Zone	Number of Domestic Dwellings	Number of Non-Domestic Properties	Domestic Peak Demand	Non-Domestic Peak Demand	Combined Network: Total Peak Demand	Combined Network: Cost
Station Rise to Rowntree Park	1,456	1,233	3.17 MW	26.19 MW	44 MW	c. £90m
York Centre to Holtby	927	981	2.44 MW	13.91 MW		

Onshore Wind

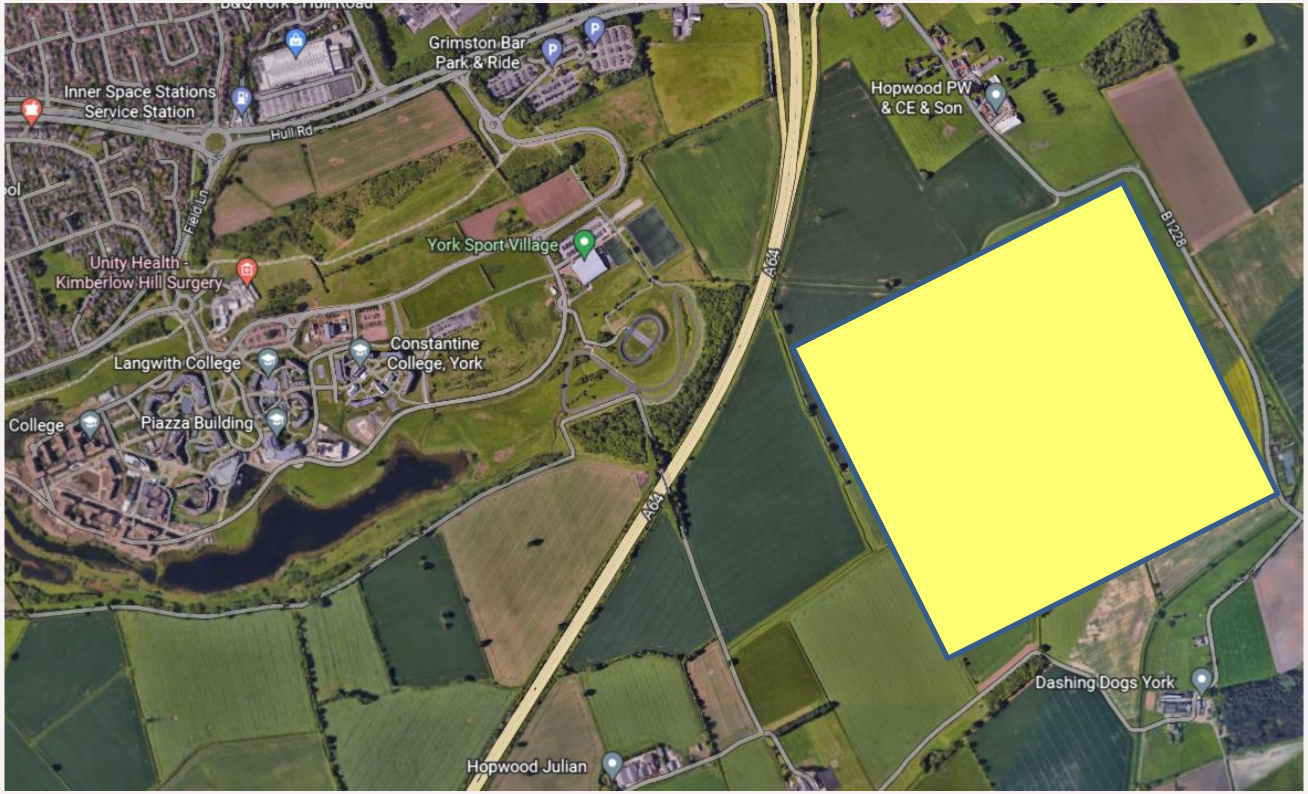
The potential locations for wind turbines north of Wigginton, in the Hambleton area, would be more distant from major consumers, so more likely to feed into the grid. However, a wastewater treatment plant to the north-east of Strensall, Robert Wilkinson Primary Academy to the north and Queen Elizabeth Barracks to the south could be candidates for power purchase agreements.

Zone	North of Wigginton
Size	2 MW
Total Cost	c. £2.4m
IRR	4.5% - 7%
Payback period	15-20 years

Potential Business Models

Ownership	Local authority owns the land and builds a project on it.
	Local authority partners with an organisation and jointly invests.
	Local authority leases the land it owns for others to develop ground mounted PV.
Energy Trading	Via power-purchase-agreements, the LA can secure low-cost electricity with low associated emissions counting towards their footprint.
	Via a power purchase agreement (PPA), a utilities company can be an off taker of all or some of the generation.

Grimston Bar Park-and-Ride Solar Charging Hub



A major area of land suitable for ground solar deployment in the Wheldrake to Kexby zone is near to the Grimston Bar park and ride facility, as well as the east campus of the University of York and the sport village. A 30 MW array (shown as yellow area) would generate power sufficient to supply large numbers of EV chargers and university buildings in favourable conditions. At peak output for example, 30 MW would be sufficient to supply 600 rapid 50 kilowatt (kW) EV chargers or almost 4,300 fast 7 kW chargers.

Zone	Wheldrake to Kexby
Size	30 MW
Total Cost	c. £16m
IRR	7% - 9%
Payback period	15-20 years

Domestic Solar PV

The area around Hull Road Park in the York Centre to Holtby zone has high levels of fuel poverty, coinciding with large numbers of dwellings likely to be suitable for rooftop solar PV. Approximately 500 dwellings in this neighbourhood could be prioritised ahead of the rest of the zone for PV deployment.

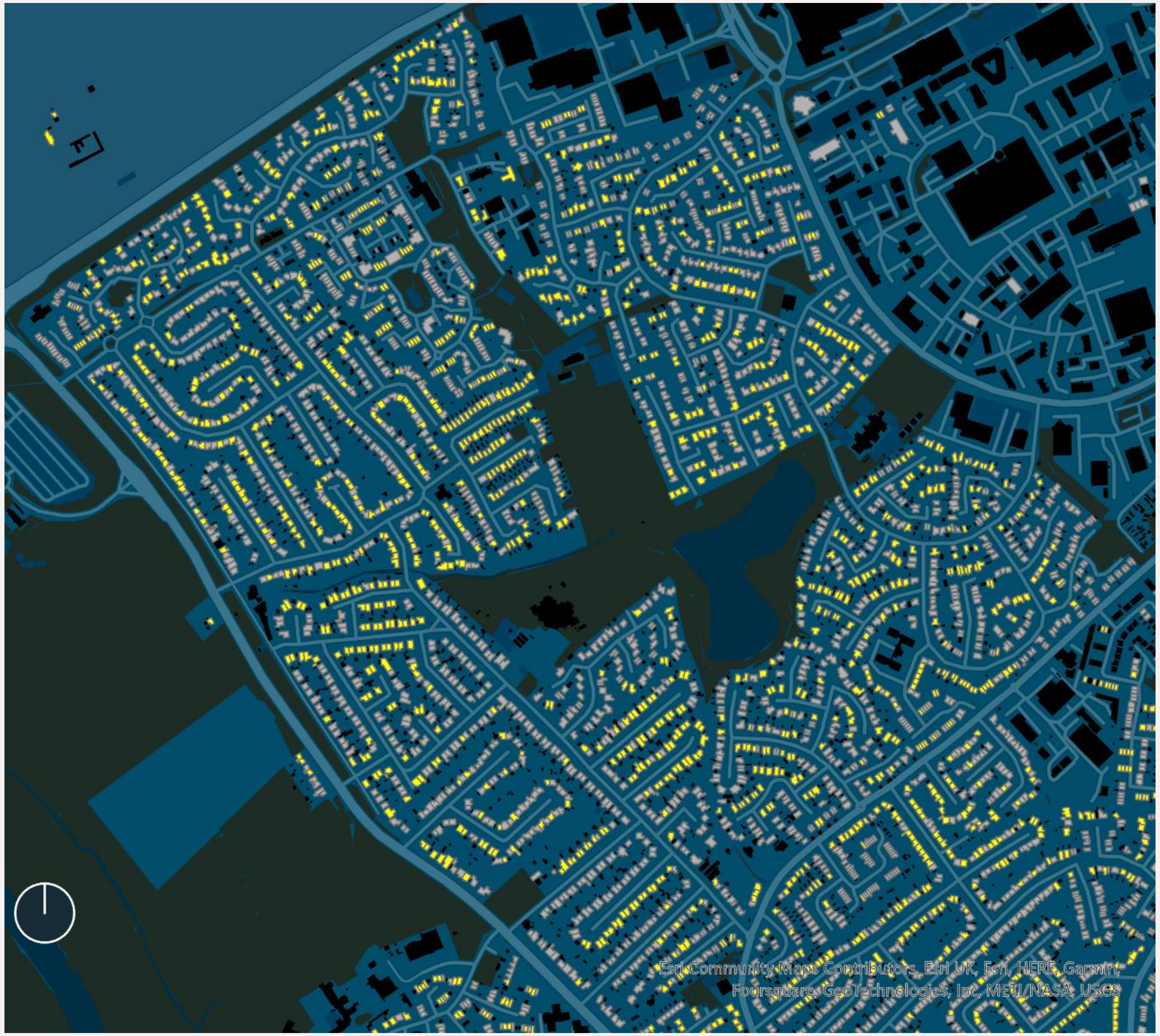
Generating electricity on-site can reduce the requirement to purchase electricity from suppliers which can reduce costs to the household (depending on how the PV installation is paid for). The roll-out of a scheme like this could start with social housing by working with key stakeholders. As with fabric retrofit, it may be possible to offer lower cost installations to private owners by widening such a scheme. Feasibility studies would be required.

Zone	York Centre to Holtby
Number of Dwellings	c. 500
Total Cost	c. £3.2m

Dwellings with potential suitability for rooftop solar PV around Hull Road Park highlighted in yellow

Fuel Poverty	Prioritising fuel poor areas to reduce bills and give residents more autonomy.
Social Housing	Supporting roll-out, particularly, in local authority owned assets to rapidly increase the amount of low carbon electricity generation .
Solar Together	Supporting community buying programmes to reduce capital cost.

Domestic Solar PV



Dwellings suitable for rooftop solar PV in Rawcliffe

Zone	Clifton to Corban Lane
Number of Dwellings	c. 1,000
Total Cost	c. £6.4m

The able-to-pay market is the largest market in any area. With the increase in cost of energy, rooftop solar can provide a mechanism to reduce costs of energy for households. The more affluent area of Rawcliffe has around 1,000 dwellings likely to be suitable for rooftop solar PV.

Private homeowners can purchase rooftop solar panels through a variety of mechanisms, directly paying for them or through innovative business models which include no CAPEX options.

Non-Domestic Solar PV

Large public buildings are well suited for quick win rooftop solar PV projects. Large roof space makes a more cost-effective installation possible. Occupation of the building through the daytime means that a high proportion of the electricity generated can be used on-site, maximising bill savings. Institutions which own their buildings will be best-placed for rapid deployment of projects.

The National Railway Museum's south-facing roof could host 640 kW of solar capacity if completely covered, generating around 617 MWh of energy per year for an investment of around £575k.

The York Leisure Centre has space on its roof for approximately 370 kW of solar PV capacity. For an investment of around £334k, this could generate 292 MWh of electricity per year. More ambitiously, the neighbouring stadium has a roof big enough to accommodate 640 kW on the largest roof, though this would be subject to the structural capabilities of the roof.

The Royal Mail Birch Park depot might be able to host 80 kW of solar panels on its roof, producing 77 MWh of energy per year for an investment of around £72k.

Large roof space of the Monks Cross shopping park

Commercial buildings have some of the largest roof areas, though since many commercial buildings are leased, with bills paid by tenants, installation of solar can be less straightforward. The Monks Cross shopping park hosts multiple businesses under one roof. If most of the south- and south-east-facing roof was used to site solar panels, as much as 1.5 MW capacity could be hosted for an investment of £1.35m.