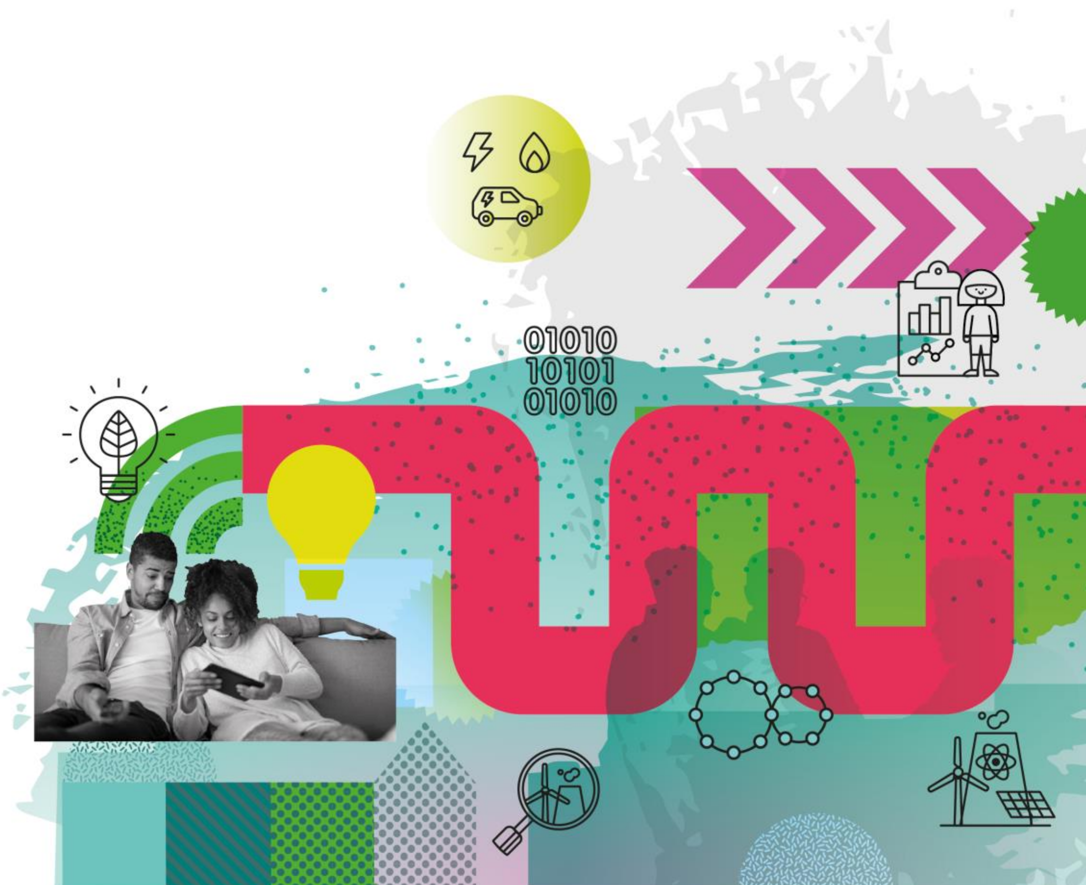
Local Energy Asset Representation for

York & North Yorkshire

29th June 2021



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29/06/2021	1.0	Final draft.

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Contents

Acronyms & Initialisms

A	Amperes
ASHP	Air Source Heat Pump
BEIS	Department for Business, Energy & Industrial Strategy
CO_2	Carbon dioxide
DCLG	Department for Communities and Local Government (now the Ministry for Housing, Communities and Local Government, MHCLG)
DfT	Department for Transport
DVLA	Driver and Vehicle Licensing Agency
ESWI	External Solid Wall Insulation
EV	Electric Vehicle
FIT	Feed In Tariff
ESC	Energy Systems Catapult
GSHP	Ground Source Heat Pump
GW	Gigawatt (1,000 MW)
GWh	Gigawatt-hour (1,000 MWh)
HUG1	Home Upgrade Grant 1
HV	High Voltage
I&C	Industry & Commercial
ISWI	Internal Solid Wall Insulation
$ktCO_2$	Kilo-tonnes of carbon dioxide
kV	Kilovolts (1,000 V)
kW	Kilowatt
kWh	Kilowatt-hour
LA	Local Authority
LAD3	Local Authority Delivery Scheme 3
LAEP	Local Area Energy Plan(ning)
LEAR	Local Energy Asset Representation
LEP	Local Enterprise Partnership
LPG	Liquefied Petroleum Gas
LSOA	Lower-level Super Output Area
LV	Low Voltage
MHCLG	Ministry for Housing, Communities and Local Government (formerly Department for Communities and Local Government, DCLG)
MSOA	Middle-level Super Output Area
MVA	Megavolt Amperes
MW	Megawatt (1,000 kW)
MWh	Megawatt-hour (1,000 kWh)
PV	Photovoltaic
NAEI	National Atmospheric Emissions Inventory
ONS	Office of National Statistics
REPD	Renewable Energy Planning Database
V	Volts
VOC	Volatile Organic Compounds
WWTW	Waste Water Treatment Works
YNY	York & North Yorkshire

1. Introduction

Part of a world-leading network of innovation centres, Energy Systems Catapult (ESC) was set up to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. ESC is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia, and research. We take a whole system view of the energy sector – from power, heat and transport to industry, infrastructure, and consumers – helping us to identify and address innovation priorities and market barriers to decarbonise the energy system at the lowest cost.

As part of our offering, the Local Energy Asset Representation (LEAR) was developed. LEAR is a local energy system modelling tool developed by ESC that pulls together information on energy demand, generation, storage and distribution assets, social factors like fuel poverty and characteristics like building design types and local geography, using data analysis and aspects of machine learning. It enables planners and innovators to strategically decide how they might deploy and grow low carbon businesses.

This LEAR has been created by collating and processing data from a variety of sources and using in house modelling techniques. It gives an understanding of the buildings in the local area; their annual and peak energy demands and the energy networks that serve them. It also provides some information on the levels of employment and deprivation in the area. It is not expected that the information contained in this document exactly matches the items it reports on but, rather, provides a reasonable representation of them.

This document should be read in combination with the accompanying *Local Area Energy System Representation Datasets and Methodology*[1] document to understand the data used and how it has been processed. Accompanying Excel workbooks contain the data presented graphically in this document.

[1] Issued alongside this document. Also available on request from eris@es.catapult.org.uk.

1.1. York & North Yorkshire

The York & North Yorkshire Local Enterprise Partnership (YNY LEP) commissioned ESC to produce a LEAR to support their vision for decarbonisation of the local economy. The vision is:

A resilient low carbon economy, where solutions to address the climate crisis are implemented to make our area a better place to live and create a more competitive economy.[2]

This document provides a representation of the local energy system in York & North Yorkshire covering an area of well over 8,000 km^2 and a population of around 825,000 people.

The decarbonisation of the York & North Yorkshire area is within the context of the UK's legal binding target to reach net zero emissions by 2050 and milestone of 78% reduction compared to 1990 levels by 2035 (Carbon Budget 6). Locally, five local authorities have declared a climate emergency setting challenging decarbonisation targets up to twenty years ahead of the UK as a whole (Table 1).

Table 1: Table of climate emergency declarations in the York & North Yorkshire Local Enterprise Partnership area.

	Climate Emergency Declared	Notes
Craven District Council	Yes	Carbon neutral by 2030 including scope 1, 2 & 3 emissions.
Hambleton District Council	No	Carbon neutral by 2030.
Harrogate Borough Council	No	Aligned to the West Yorkshire Combined Authority target of net zero by 2038.
Richmondshire District Council	Yes	Net zero carbon in the district by 2030.
Ryedale District Council	Yes	Net zero carbon emissions by 2030.
Scarborough Borough Council	Yes	Carbon neutral by 2030.
Selby District Council	No	Carbon neutral before 2050, with aspirations of achieving this by 2030.
City of York Council	Yes	Net zero carbon emissions by 2030.
North Yorkshire County Council	No	Net zero Council by 2030.
York & North Yorkshire LEP	No	Net zero region by 2034 and net negative by 2040.

The emissions attributed to an area varies depending upon the method used. One way is to use local authority CO_2 data which attributes the carbon to the end-use rather than where the emissions take place e.g. some of the emissions relating to electricity production are attributed to a domestic dwelling using

[2] https://www.businessinspiredgrowth.com/wp-content/uploads/2019/05/York-North-Yorkshire-East-Riding-Local-Energy-Strategy-FINAL.pdf [Accessed: 08/06/2021].

their lighting. These emissions are broadly split into three categories: industrial & commercial (I&C), domestic, and transport. Table 2 shows the breakdown of these in each local authority area:

Table 2: Local Authority CO_2 Emissions

Local Authority Area	**Total 2018 [ktCO_2]**	**Ratio I&C : Domestic: Transport**	**Change in Emissions 2005-2018**
Craven	355.1	31% : 29% : 40%	-28%
Hambleton	679.5	31% : 24% : 45%	-31%
Harrogate	835.2	34% : 34% : 32%	-31%
Richmondshire	342.3	29% : 26% : 45%	-28%
Ryedale	488.0	41% : 21% : 38%	-24%
Scarborough	526.9	36% : 35% : 28%	-36%
Selby	795.5	55% : 18% : 27%	-27%
York	819.0	29% : 36% : 35%	-37%
TOTAL	**4,841.4**	**37% : 28% : 35%**	**-31%**

The data above are from the 'subset' dataset which gives the "territorial CO_2 emissions estimates that are within the scope of influence of Local Authorities". The subset dataset therefore excludes large industrial sites, railways, motorways, and land-use.[3]

[3] For the whole dataset, and annual updates, visit: https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas [Accessed: 08/06/2021]. Updates are typically in late-June each year.

1.2. Report Structure

In order to represent an area as large as York & North Yorkshire, the region had to be split into three sub-regional areas: 'East', 'South' and 'West' North Yorkshire. Figure 1 shows this graphically.

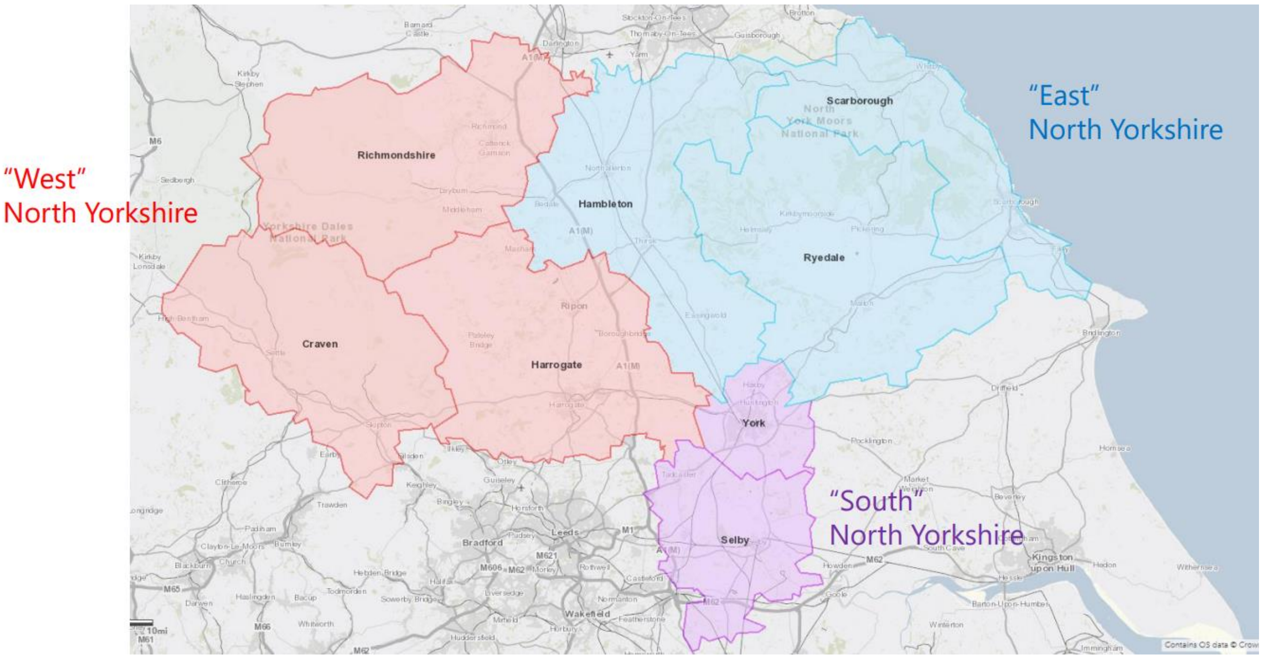

Figure 1: York & North Yorkshire was split into three sub-regions to carry out the modelling and analysis.

This LEAR report is broken into four key sections: each of the three sub-regional areas are considered before looking at some examples of insights that can be gained from the data.

2. York & North Yorkshire Sub-Regional Analysis

This section of the report will provide information and mapping for each of the three sub-regional areas of East North Yorkshire (Hambleton, Ryedale, Scarborough), South North Yorkshire (Selby & City of York), and West North Yorkshire (Craven, Harrogate & Richmondshire). As these maps cover an area equal to 2-3 local authority areas some of the detail can be lost. More detail is provided in the Insights section of this report and all maps and data are available in the data pack which accompanies this report.

2.1. East North Yorkshire (Hambleton, Ryedale & Scarborough)

The area of East North Yorkshire has been defined in this report as covering the local authority areas of Hambleton, Ryedale & Scarborough which collectively cover an area of 3,635 km^2 and have a population of around 255,000.

2.1.1. Building Stock

This section will provide an overview of the building stock – both domestic and non-domestic – across the East North Yorkshire sub-region. The geographical location of the building stock will be shown, as will the relative rurality across the sub-region, and breakdowns of the domestic and non-domestic stock by category.

Figure 2 shows that across the East North Yorkshire sub-region, the building stock is fairly evenly distributed around the North York Moors National Park. The larger conurbations on the coast such as Whitby and Scarborough can be clearly seen.

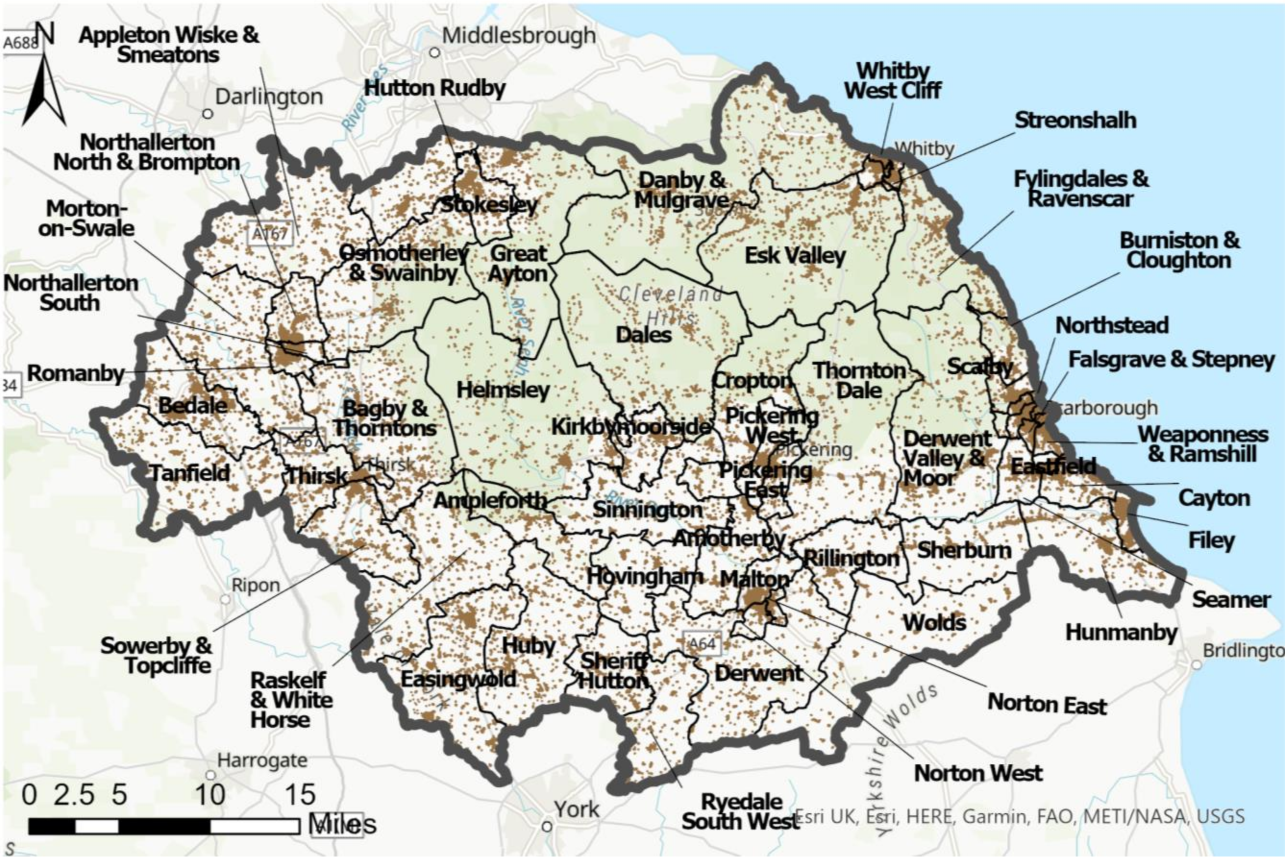

Figure 2: Building stock distribution across the East North Yorkshire sub-region.

These areas correlate well to the rural/urban classifications given in the rurality map (Figure 3).

Figure 3: Rurality of the East North Yorkshire sub-region.

Figure 3 shows the rurality of the East North Yorkshire sub-region by Lower-level Super Output Area (LSOA) and overlayed by electoral wards. Most of the land area in East North Yorkshire is classified as rural towns and villages with the more urban areas matching those noted in Figure 2

Using data provided by Historic England[4], the location and grade of listed buildings and scheduled monuments can be mapped within the sub-region. In addition, data published by Historic England on Battlefields, World Heritage Sites and Parks & Gardens is mapped alongside (Figure 4).

[4] https://historicengland.org.uk/listing/the-list/data-downloads

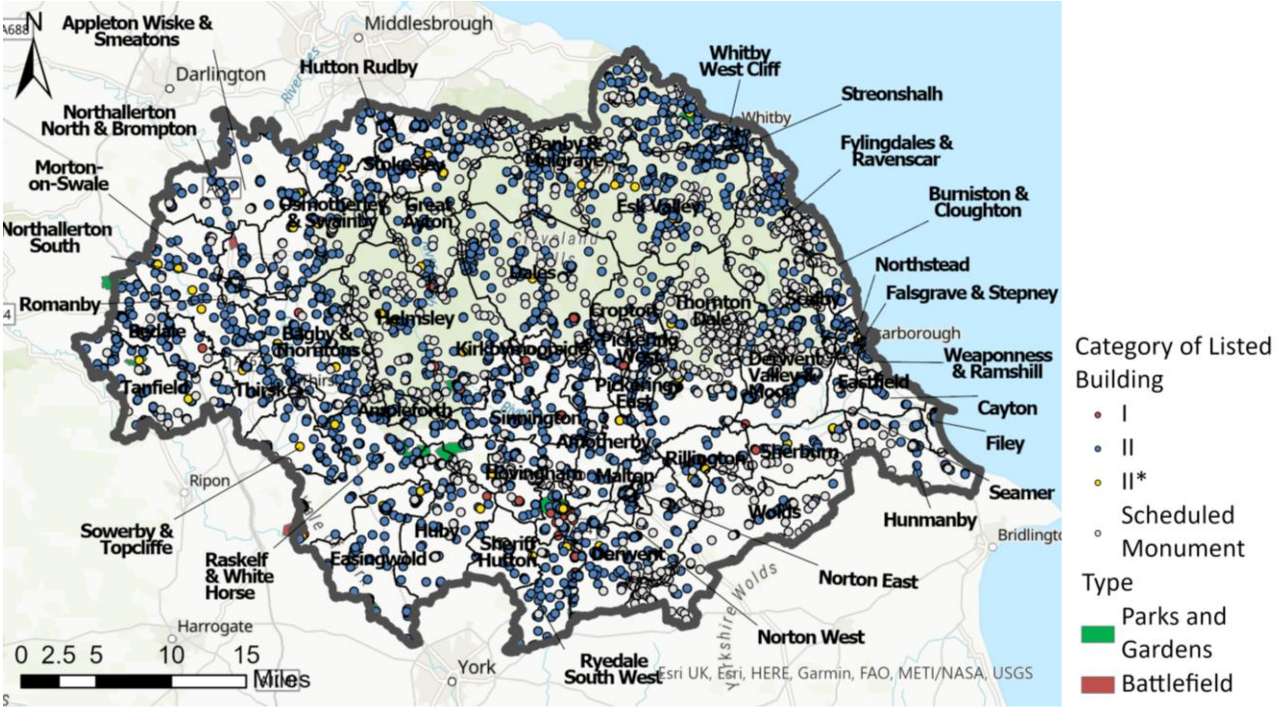

Figure 4: Location of listed buildings in the East North Yorkshire sub-region grouped by grading according to Historic England

Figure 4 shows the large number of listed buildings, scheduled monuments, and areas of interest that could all pose a challenge to decarbonising the building stock. Table 3 shows the Listed Status of the buildings and the number of occurrences.

Table 3: Summary of listed buildings across East North Yorkshire by grade category.

Grade Category	Number
Grade I	134
Grade II	5,362
*Grade II**	5,624
Scheduled Monument	1,192

To understand the housing stock in more detail, the domestic stock has been segmented by:

- Type (converted flat, detached, purpose-built flat, semi-detached, and terrace)
- Construction date (pre-1914, 1914-1944, 1945-1964, 1965-1979, post-1980)
- Floor area [m^2] (under 50, 50-70, 70-90, 90-110, 110-200, 200-300, over 300)
- Main heating system (ASHP, biomass, electric (no storage), electric storage, gas, GSHP, oil/LPG)
- Loft insulation level [mm] (no loft, no insulation, 1-99, 100-199, over 200)
- Wall type (filled cavity, unfilled cavity, solid with ESWI, solid with ISWI, uninsulated solid)
- Window type (single glazing, double glazing, triple glazing)

Table 4: Number and percentage of dwelling types across the East North Yorkshire sub-region.

Dwelling Type	Number	Percentage
Converted Flat	3,000	2%
Detached	35,000	27%
Purpose Built Flat	35,000	26%
Semi-detached	35,000	27%
Terrace	25,000	18%
Total	**140,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

Table 4 shows that there is an even spread of the housing types across the sub-region. Figure 5 shows that detached dwellings are typically the most dominant in rural areas, whereas semi-detached and flats are more common in urban areas.

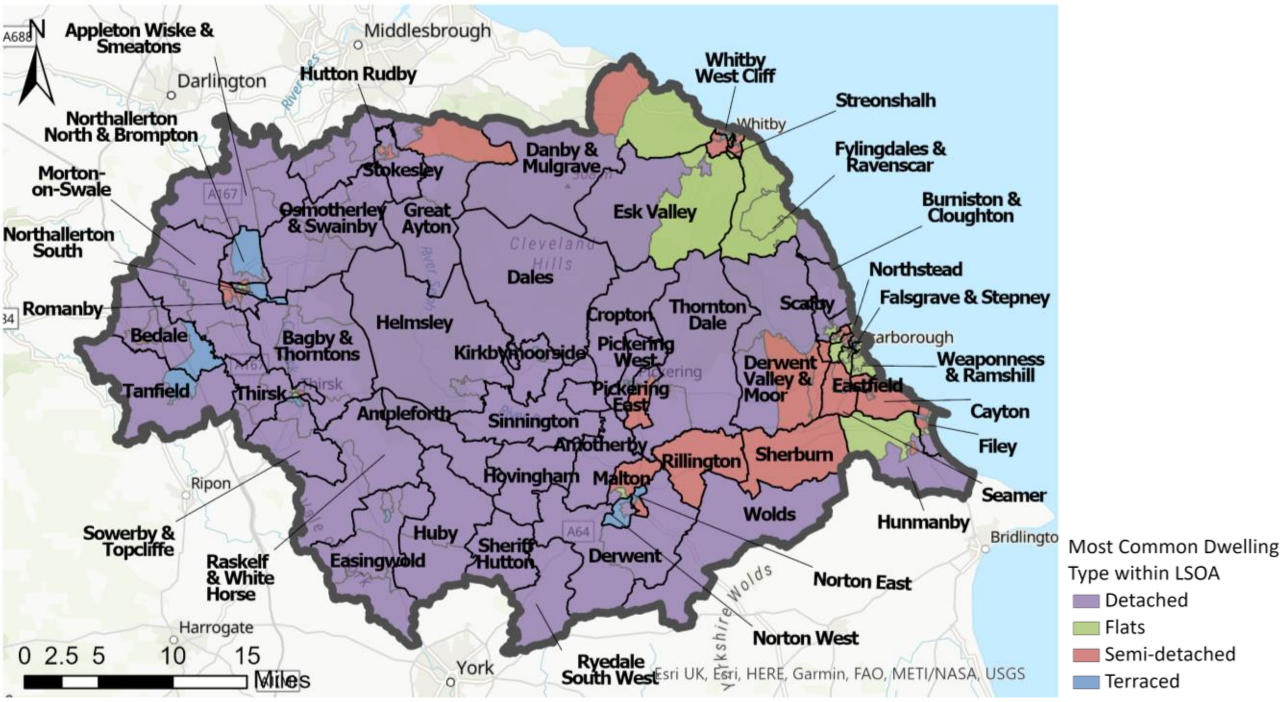

Figure 5: Most common dwelling type within each LSOA across the East North Yorkshire sub-region.

A notable finding, shown in Table 5 is that half of all domestic dwellings in the sub-region were constructed from 1965 onwards meaning that the energy efficiency of those dwellings is likely to be more suited to the transition to a low carbon heating system e.g. heat pump. However, there are a still a significant number of dwellings that were built before 1914 which will likely require more substantial intervention to bring their heat loss to a point where a heat pump could be considered.

Table 5: Number and percentage of dwellings constructed in different periods across the East North Yorkshire sub-region.

Dwelling Construction Period	Number	Percentage
Pre-1914	30,000	22%
1914-1944	18,000	13%
1945-1964	20,000	16%
1965-1979	30,000	23%
1980-present	35,000	27%
Total	**140,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

By combining the dwelling type and the construction period, it can be seen in Figure 6 that modern (post-1980) purpose-built flats represent the largest proportion of the housing stock (c. 16,000 dwellings, 12%) followed closely by modern detached (c. 13,000 dwellings, 9.5%). Pre-1914 terrace and detached dwellings together represent nearly 14% of the total housing stock of the sub-region. Intra-war (1914-1944) semi-detached dwellings alone represent almost 9% of the domestic stock.

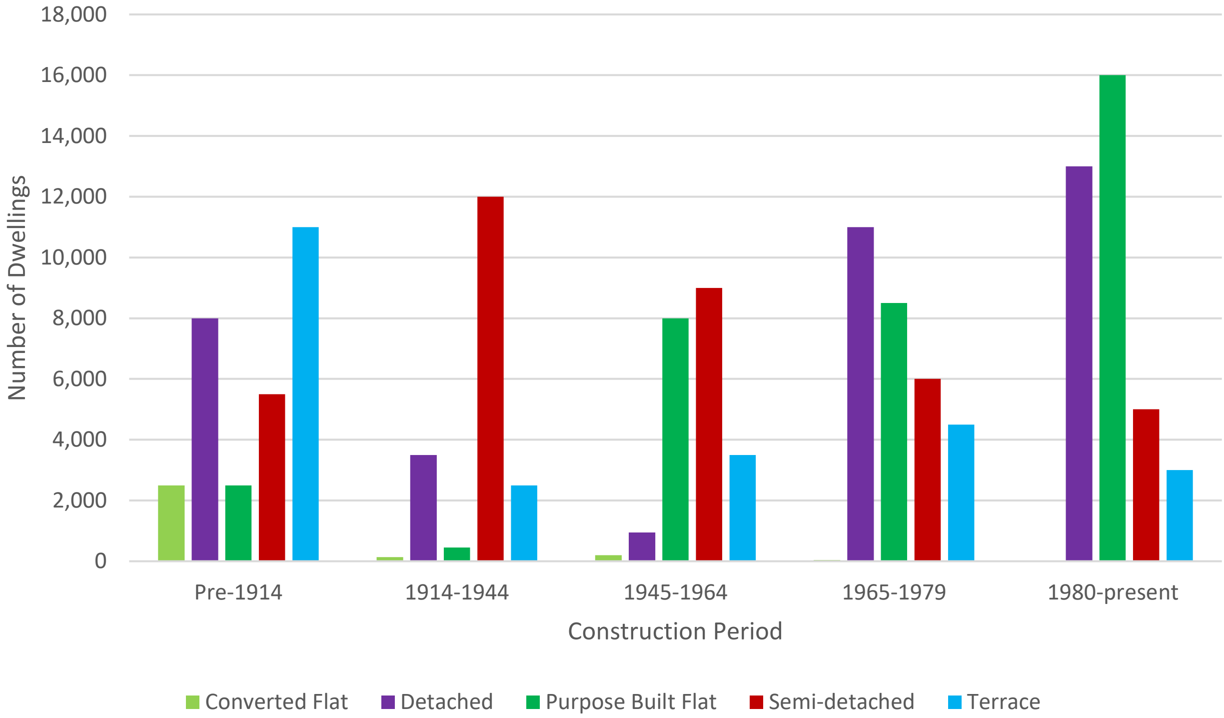

Figure 6: Estimated number of dwellings within each construction period (by dwelling type) across the East North Yorkshire sub-region.

This can be visualised spatially (Figure 7) to show the most prevalent construction year in each LSOA in the East North Yorkshire sub-region.

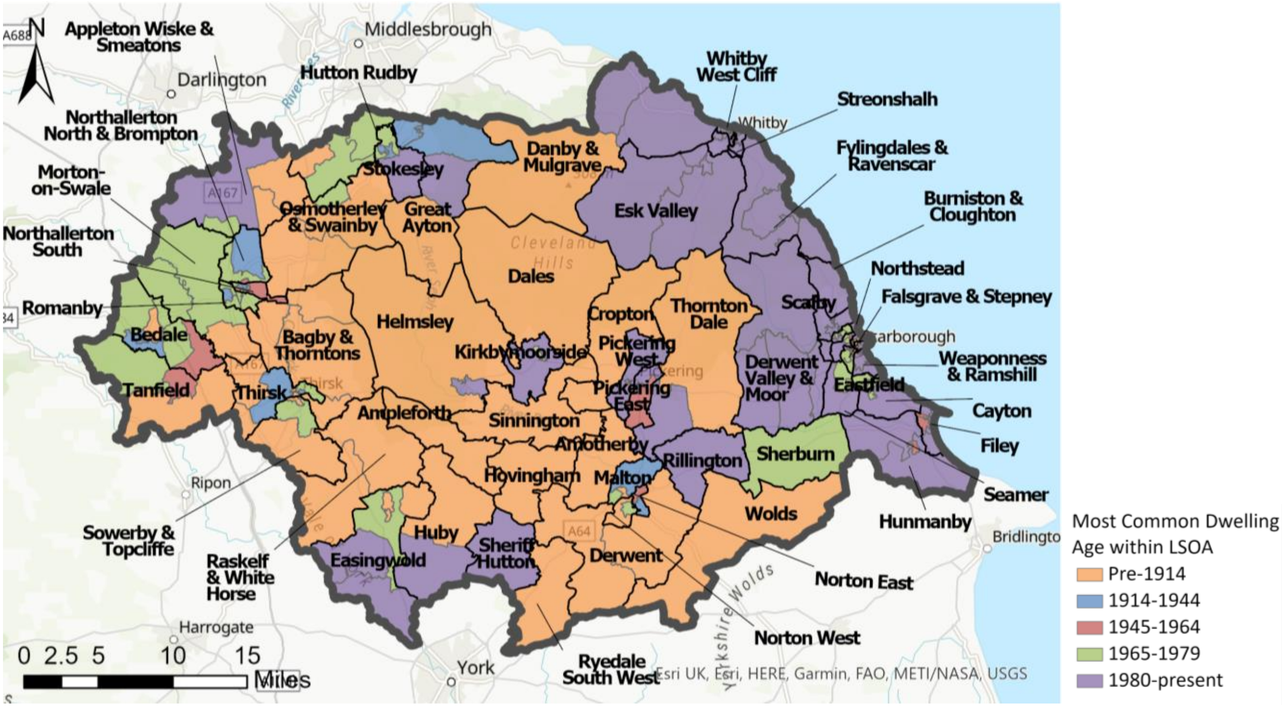

Figure 7: Most common construction period within each LSOA across the East North Yorkshire sub-region.

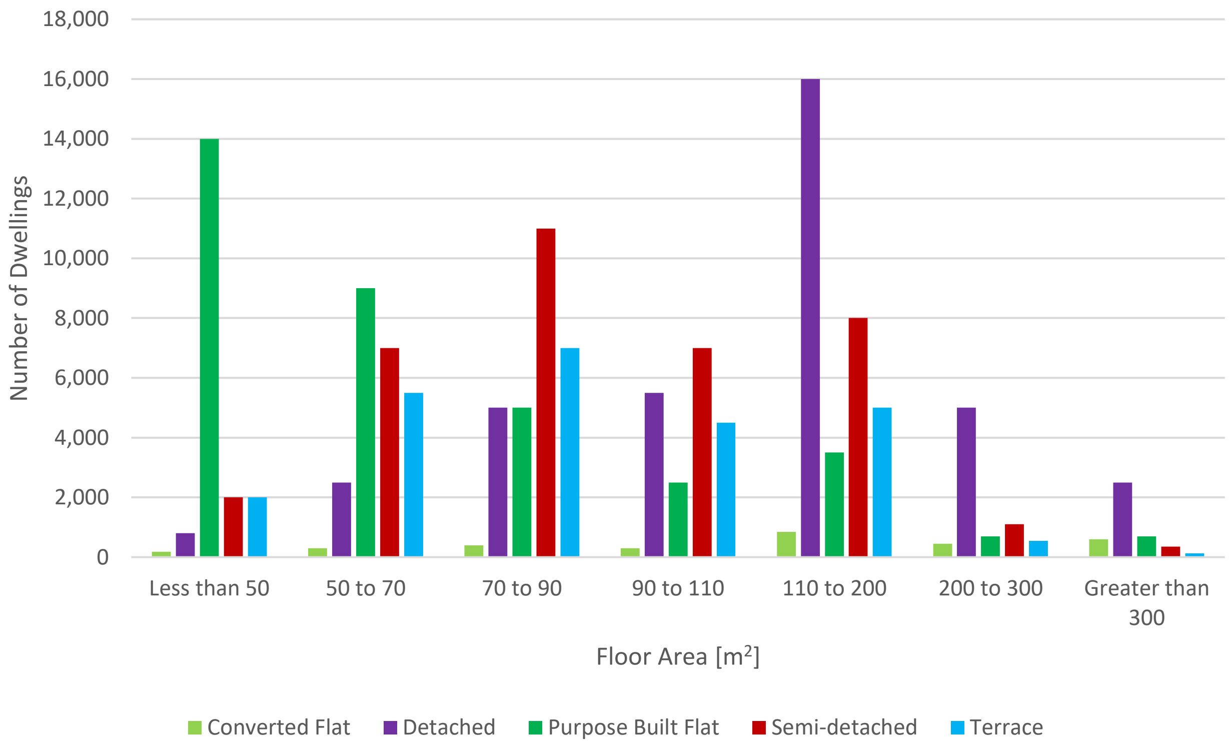

Figure 8: Estimated number of dwellings within each floor area band (by dwelling type) across the East North Yorkshire sub-region.

From Figure 8 as expected flats (particularly purpose-built flats) have a lower floor area than semi-detached and detached dwellings. Two-thirds of purpose-built flats have a floor area of under 70m^2 whilst nearly half of detached dwellings have a floor area of 110-200m^2.

Dwellings in the East North Yorkshire sub-region are overwhelmingly heated using a fossil fuel boiler (89%) with the remainder being made up from electric storage heaters (10%). Electric storage heaters are often used in modern flats where heat losses are low. Oil/LPG boilers are typically used in off-gas grid areas which in turn are often rural. Figure 9 shows that 40% of detached dwellings use oil/LPG boilers as their main heating system. Gas boilers are prevalent throughout the housing stock.

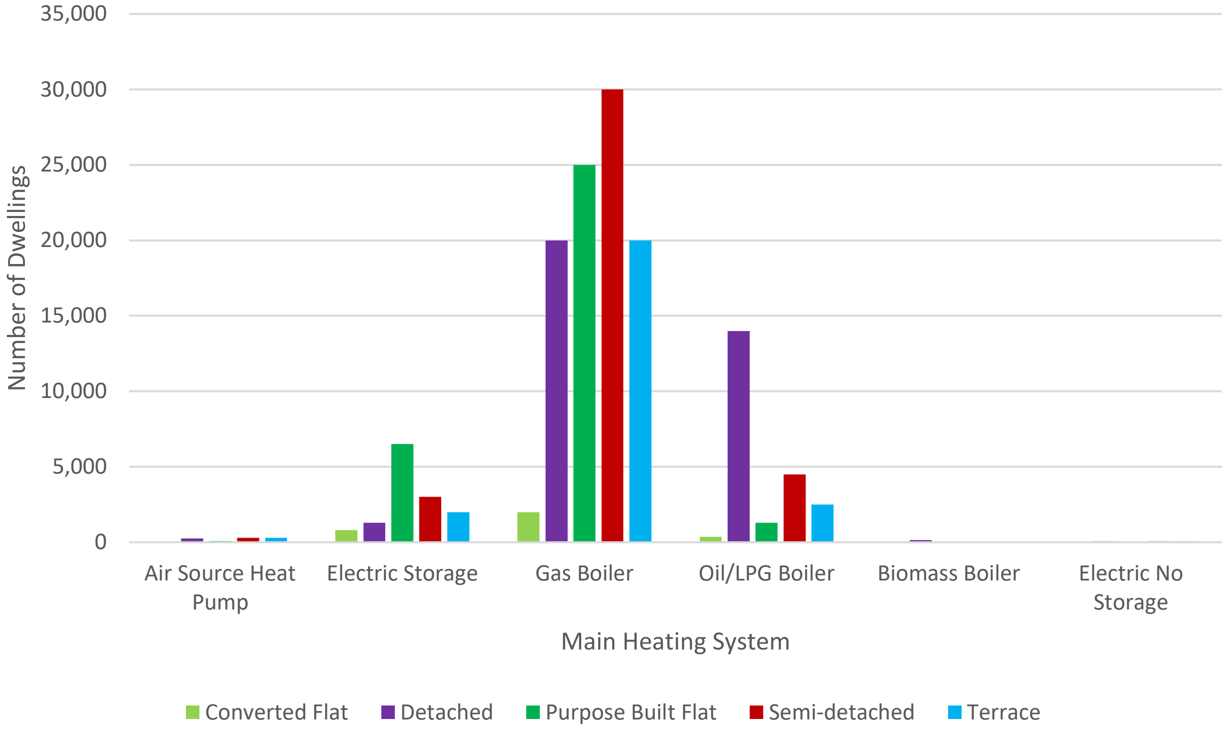

Figure 9: Estimated number of dwellings by main heating system (by dwelling type) across the East North Yorkshire sub-region.

To make a heating system as efficient as possible insulation is required to reduce the heat loss from a dwelling. Figure 10 shows the level of loft insulation in each dwelling type. Flats (both converted and purpose built) are assumed not to have a loft to insulate as even those on the top-floor are unlikely to be able to access the loft space in which to add insulation. There are also a small number of detached, semi-detached, and terraced properties that are classified as having no loft; this is usually due to them having a 'room-in-roof' where the loft has been converted into part of the living area.

The expected level of loft insulation in the UK is 270mm meaning that there are at least 37% of the dwellings in the East North Yorkshire sub-region that would benefit from additional loft insulation.

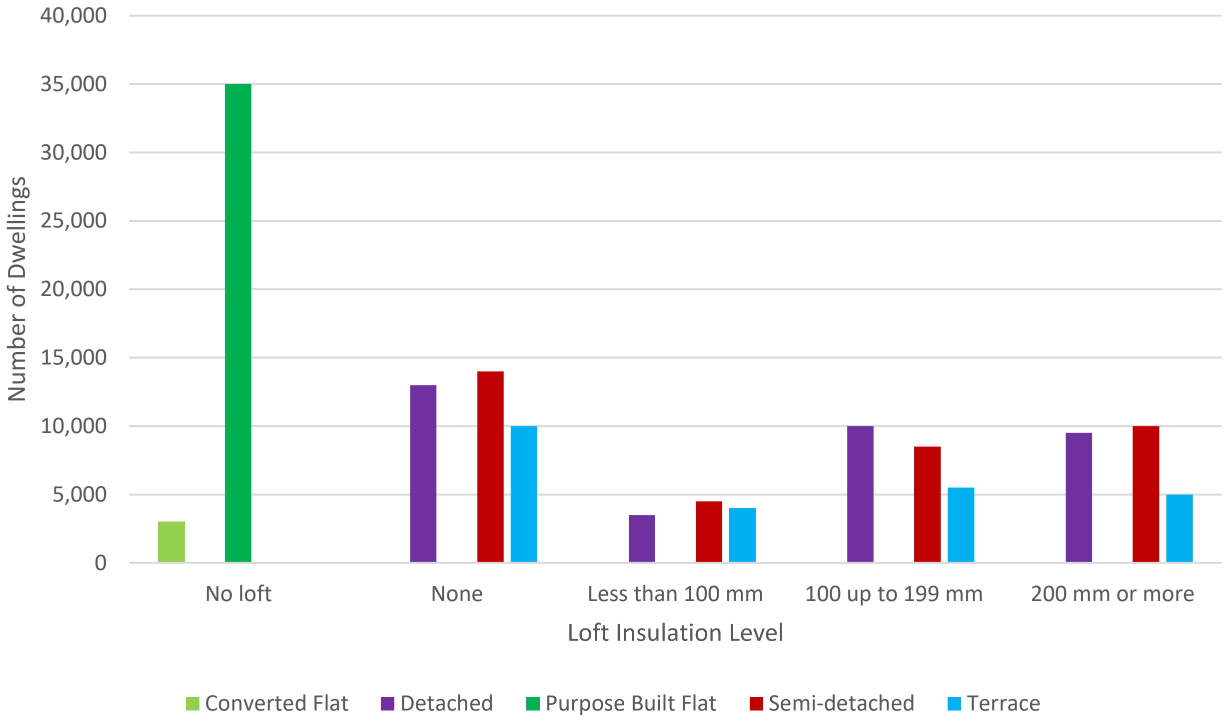

Figure 10: Estimated level of loft insulation (by dwelling type) across the East North Yorkshire sub-region.

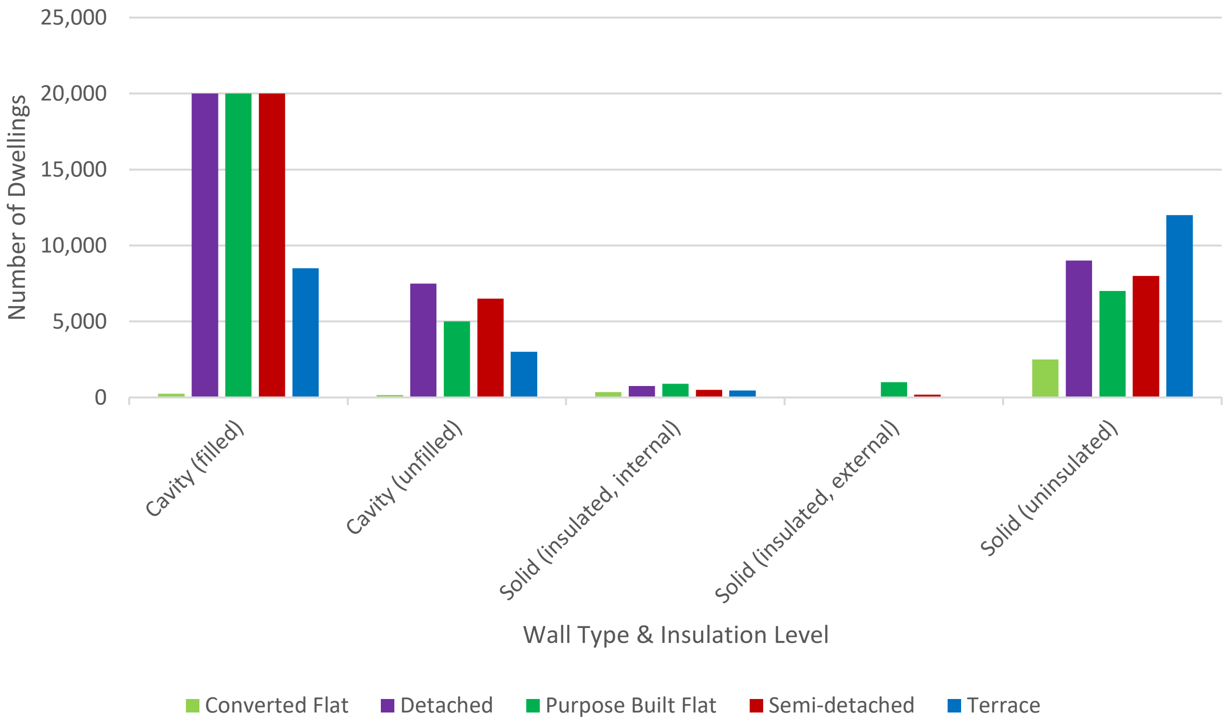

Figure 11: Estimated wall type and insulation level (by dwelling type) across the East North Yorkshire sub-region.

Figure 11 shows that cavity walls are the most prominent wall type across the East North Yorkshire sub-region, with 52% being insulated and 17% uninsulated. Cavity wall insulation can be difficult on some archetypes where there are hung tiles or render on the external face of the brickwork, also around conservatories. Whilst these are deemed 'hard-to-treat' there are methods for ensuring that the cavity can be filled, albeit at a higher cost. Figure 11 also shows that nine-out-of-ten of the solid wall properties in the East North Yorkshire sub-region are uninsulated. This may be due to listed status, other planning restrictions, occupant behaviour/preference, or cost.

Over 95% of dwellings in the East North Yorkshire sub-region have double glazing, including over 90% of all detached, semi-detached, and terrace dwellings, and purpose-built flats (Figure 12). Converted flats are further behind with around 15% of them still having single glazed windows. Triple glazing is not prevalent in the housing stock.

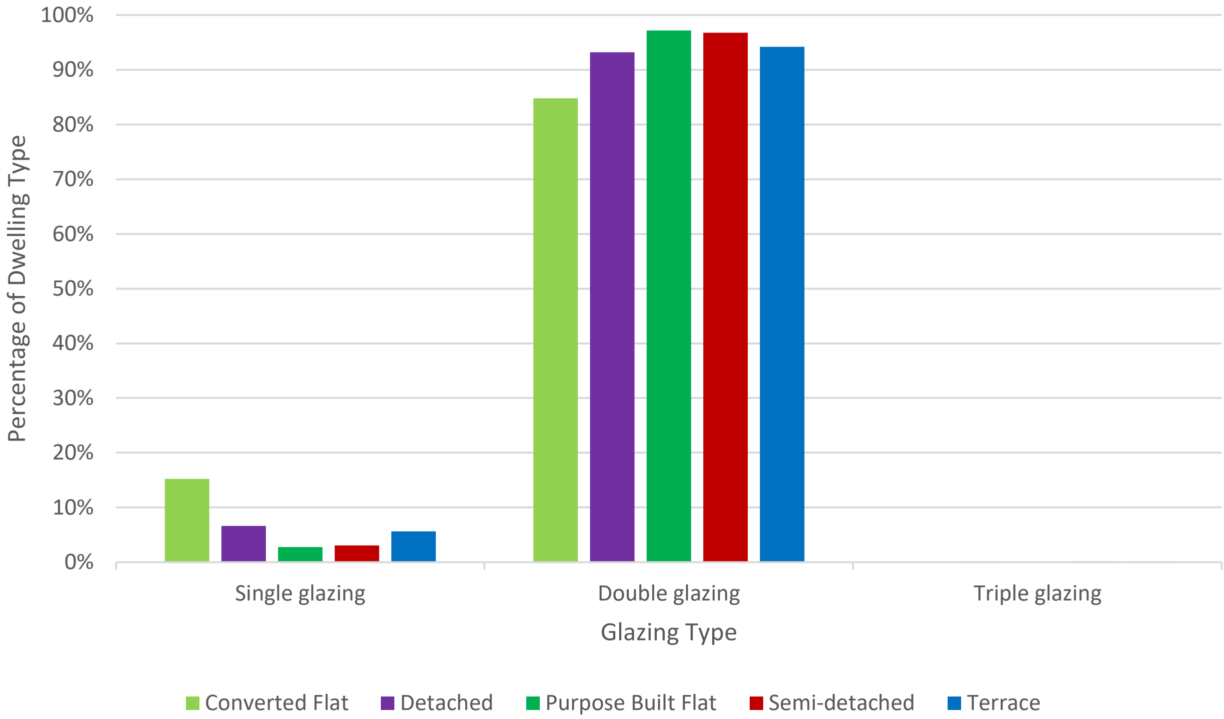

Figure 12: Estimated proportion of glazing type per dwelling type across the East North Yorkshire sub-region.

As well as the domestic stock, the non-domestic stock needs to be considered. The breakdown of the non-domestic building stock across the East North Yorkshire sub-region is shown in Table 6.

Table 6: Breakdown of the non-domestic building stock by type across the East North Yorkshire sub-region.

Type	Floor Area [m²]	Percentage of total floor area	Number of non-domestic buildings	Percentage of non-domestic buildings
Retail	11,000,000	61%	50,000	65%
Factory	3,500,000	20%	11,000	15%
Office	1,200,000	6%	5,000	7%
Education	950,000	5%	2,500	3%
Warehouse	900,000	5%	4,500	6%
Other	700,000	4%	3,000	4%
Total	**19,000,000**	**100%**	**75,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

Data from the National Atmospheric Emissions Inventory (NAEI)[5] has been used to identify large individual emission point sources i.e. emissions from a known location. As well as CO_2, this data shows air pollutants, heavy metals, and base cations[6], and greenhouse gases (GHGs)[7]. The point sources included within the project boundary are shown below in Figure 13. It should be noted that this dataset is for fixed emission sources only, and that non-fixed emissions such as those from road traffic are not included.

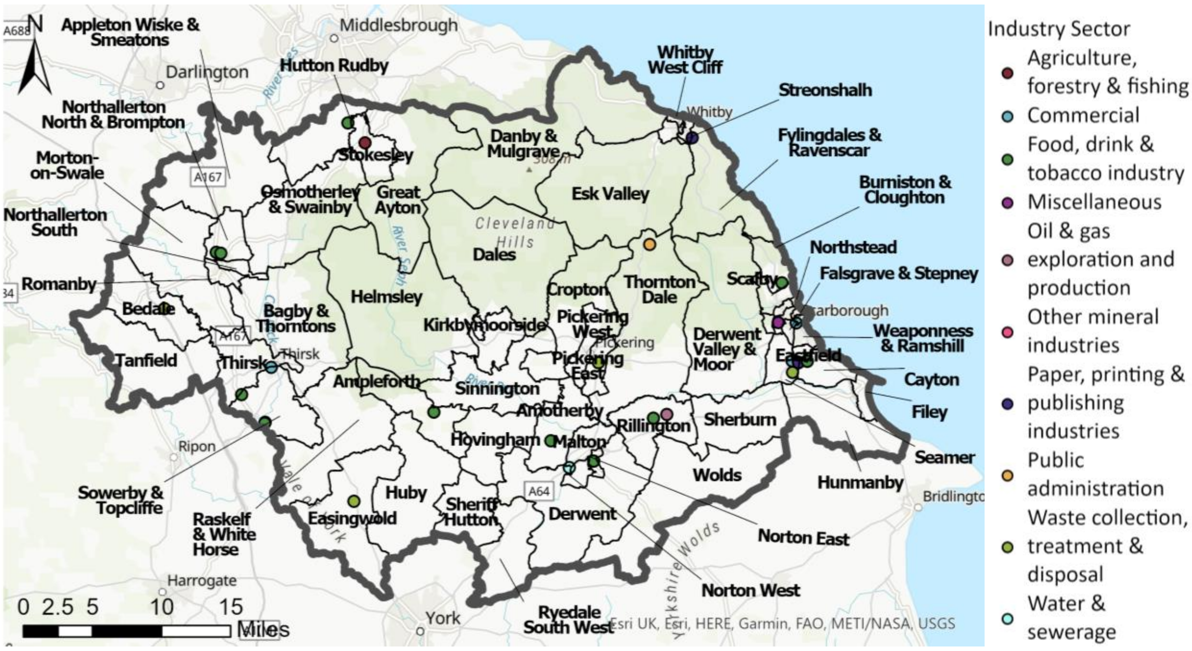

Figure 13: Individual emission sources identified by the National Atmospheric Emissions Inventory (NAEI) across the East North Yorkshire sub-region.

Often the high emitters are located closely together on an industrial park or similar, therefore the definition given in Figure 13 is lacking. However, the data pack accompanying this report provides the same image at an LA level providing more clarity.

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[5] https://naei.beis.gov.uk/
[6] https://naei.beis.gov.uk/overview/ap-overview
[7] https://naei.beis.gov.uk/overview/ghg-overview

2.1.2. Energy Demands

This section will show the estimated annual consumption and peak demands across the East North Yorkshire sub-region in the domestic and non-domestic sectors, and the geographic distribution by LSOA.

Table 7 and Table 8 below show the total figures for the sub-region. Please note: Electricity is supplied locally at 400V (three-phase) which is then connected to a dwelling at 230V (single-phase), therefore for the purposes of these calculations all domestic properties are assumed to be connected at 400V. Large non-domestic loads are assumed to be connected to the electricity network at 11kV; other non-domestic are connected at 400V. Total electricity demand is therefore the sum of demand at the 11kV level and 400V level. Demand from power generators and utilities are not included in these figures.

Table 7: Annual energy consumption [MWh] across the East North Yorkshire sub-region.

Energy Type	Domestic Annual Consumption [MWh]	Non-Domestic Annual Consumption [MWh]	Total Annual Consumption [MWh]
Electricity (11kV)	0	130,000	**130,000**
Electricity (400V)	250,000	550,000	**800,000**
Gas	500,000	650,000	**1,150,000**
Oil	25,000	0	**25,000**

Table 8: Annual peak demand [MW] across the East North Yorkshire sub-region.

Energy Type	Domestic Peak Demand [MW]	Non-Domestic Peak Demand [MW]	Total Peak Demand [MW]
Electricity (11kV)	0	40	**40**
Electricity (400V)	80	180	**250**
Gas	450	250	**650**
Oil	20	0	**20**

The total peak demand is not the sum of the peak demands for domestic and non-domestic buildings since the peak demands of the different sectors occur at different times.

The following maps (Figure 14 to Figure 17) show the distribution of estimated peak and annual energy consumption for both domestic and non-domestic buildings across the East North Yorkshire sub-region. Peak demands shown on these maps may not all occur at the same time of day or time of year. For example, an area predominantly made up of domestic dwellings is likely to have a peak energy demand during the early evening in winter. In contrast, an area that is mainly made up of commercial offices will have maximum energy demand around the middle of the day. Mixed-use areas could have a different peak time depending upon the nature of their buildings.

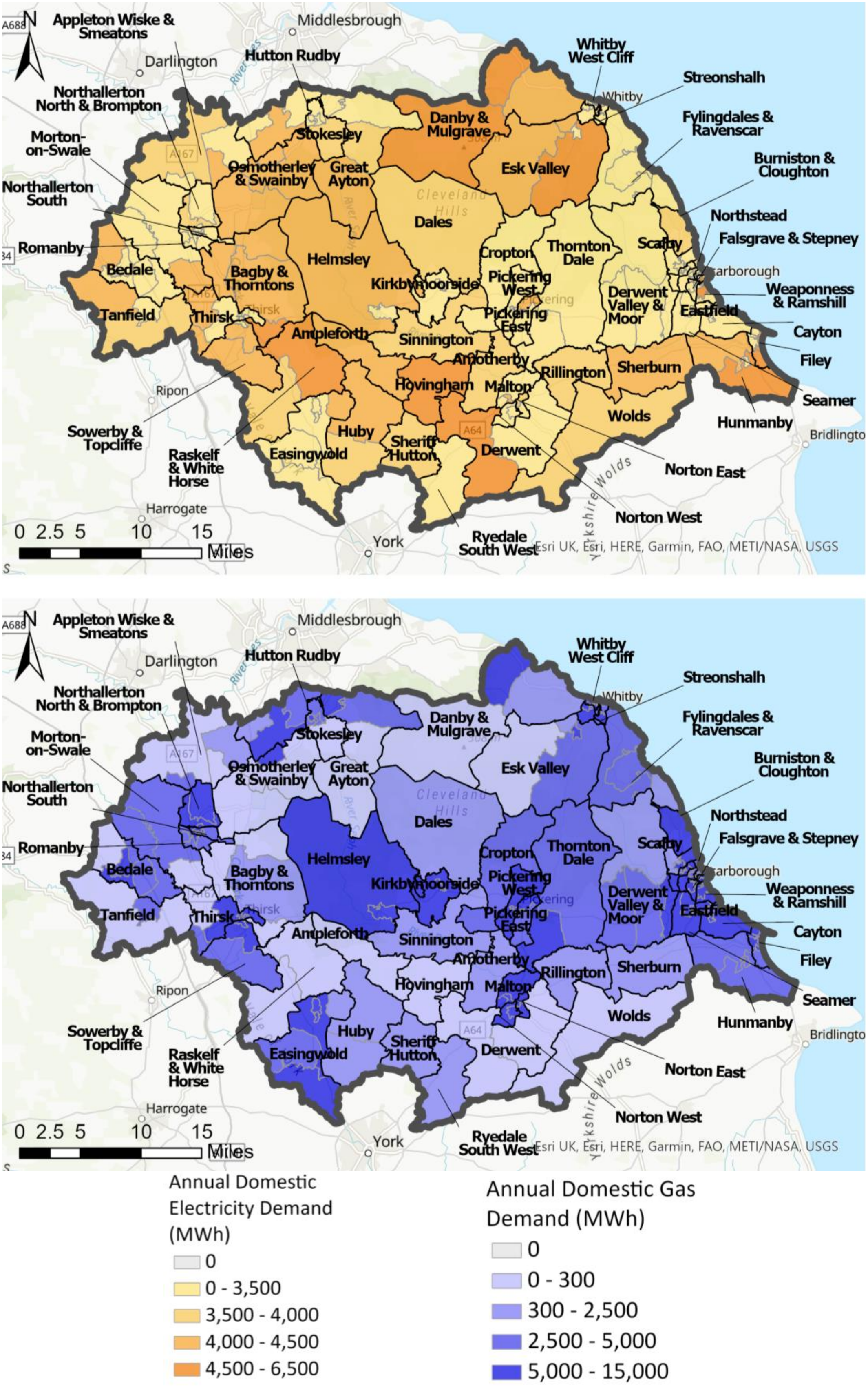


Figure 14: Estimated current domestic annual energy consumption by fuel and LSOA across the East North Yorkshire sub-region.

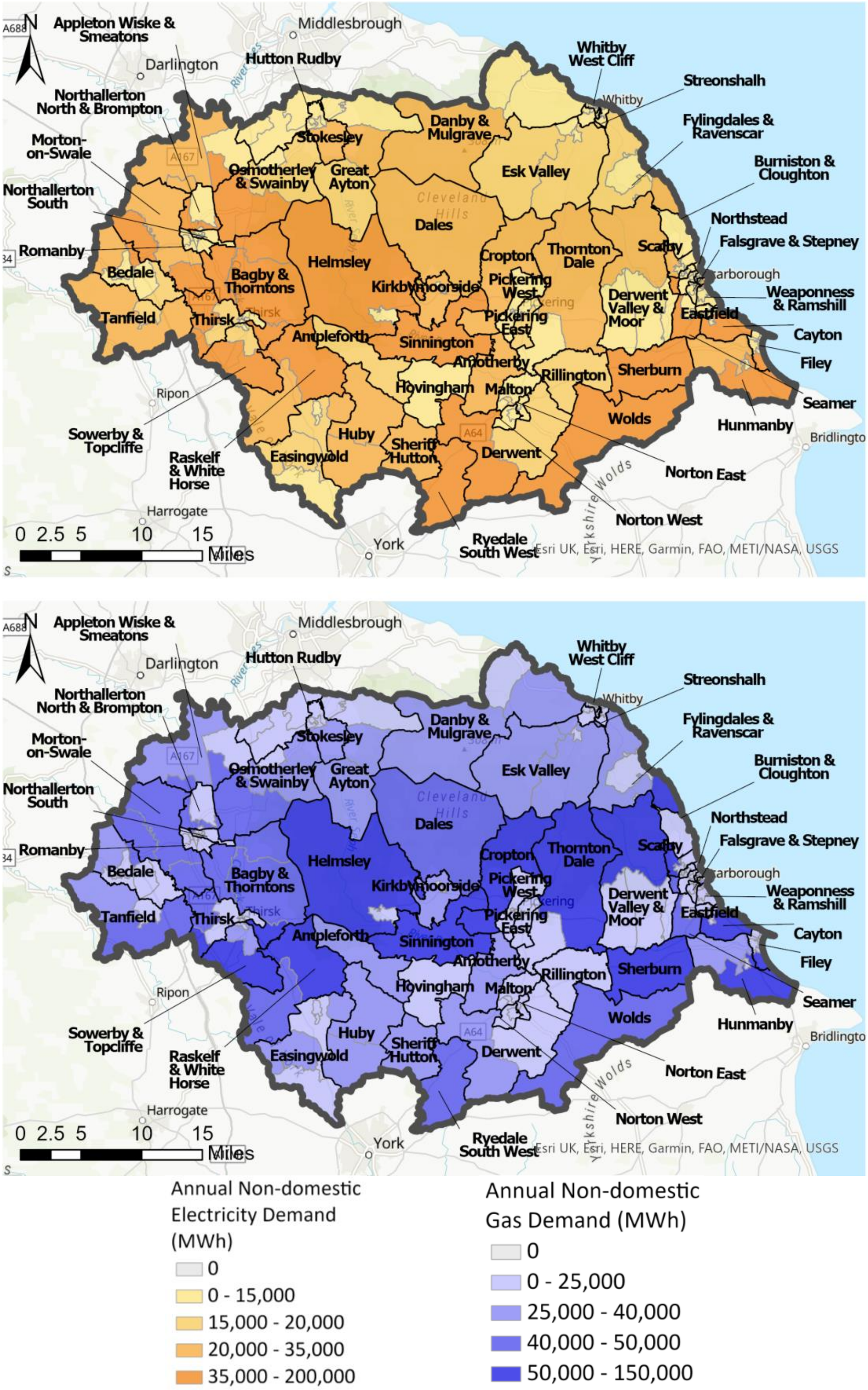


Figure 15: Estimated current non-domestic annual energy consumption by fuel and LSOA across the East North Yorkshire sub-region.

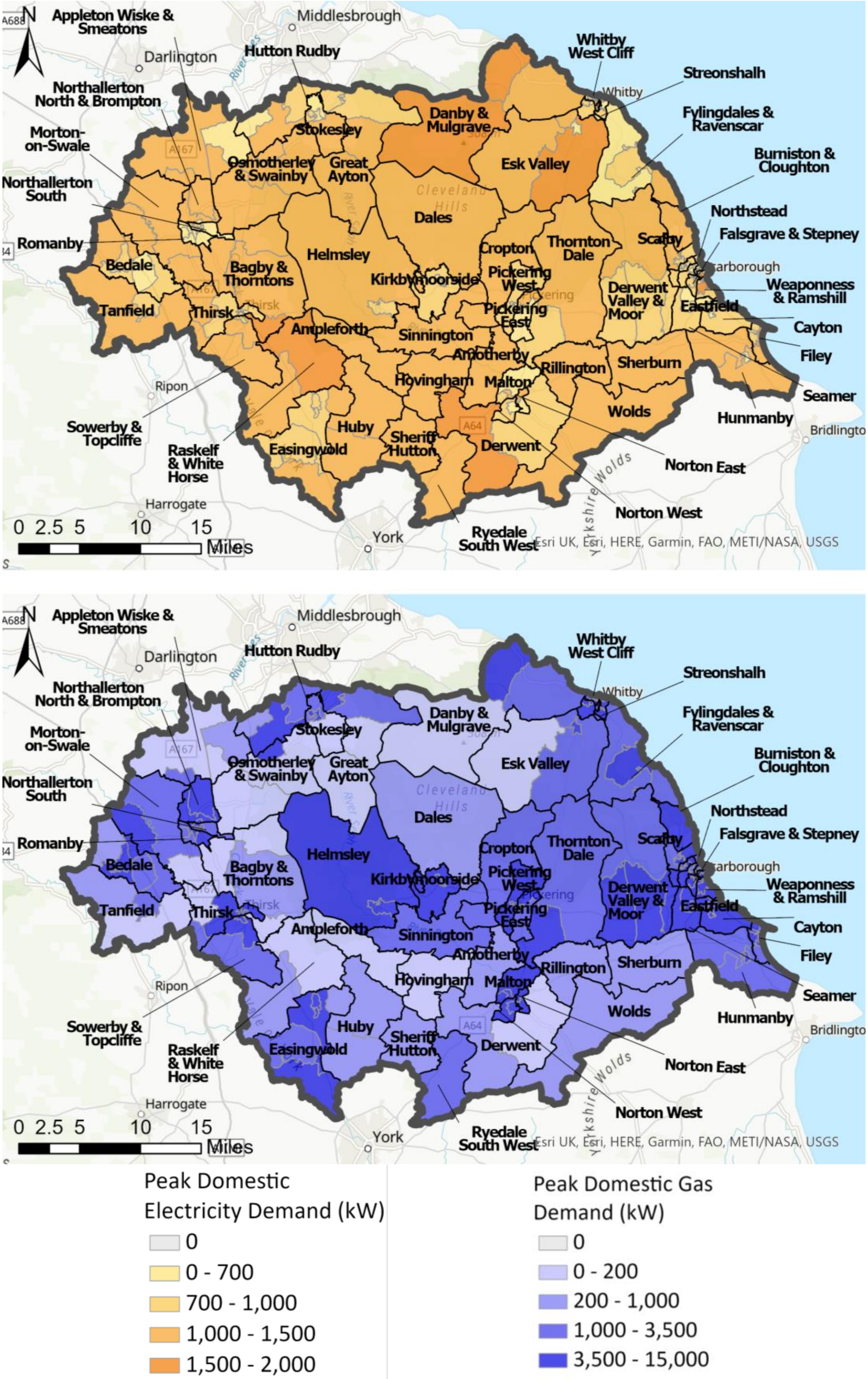


Figure 16: Estimated current domestic peak energy demand by fuel and LSOA across the East North Yorkshire sub-region.

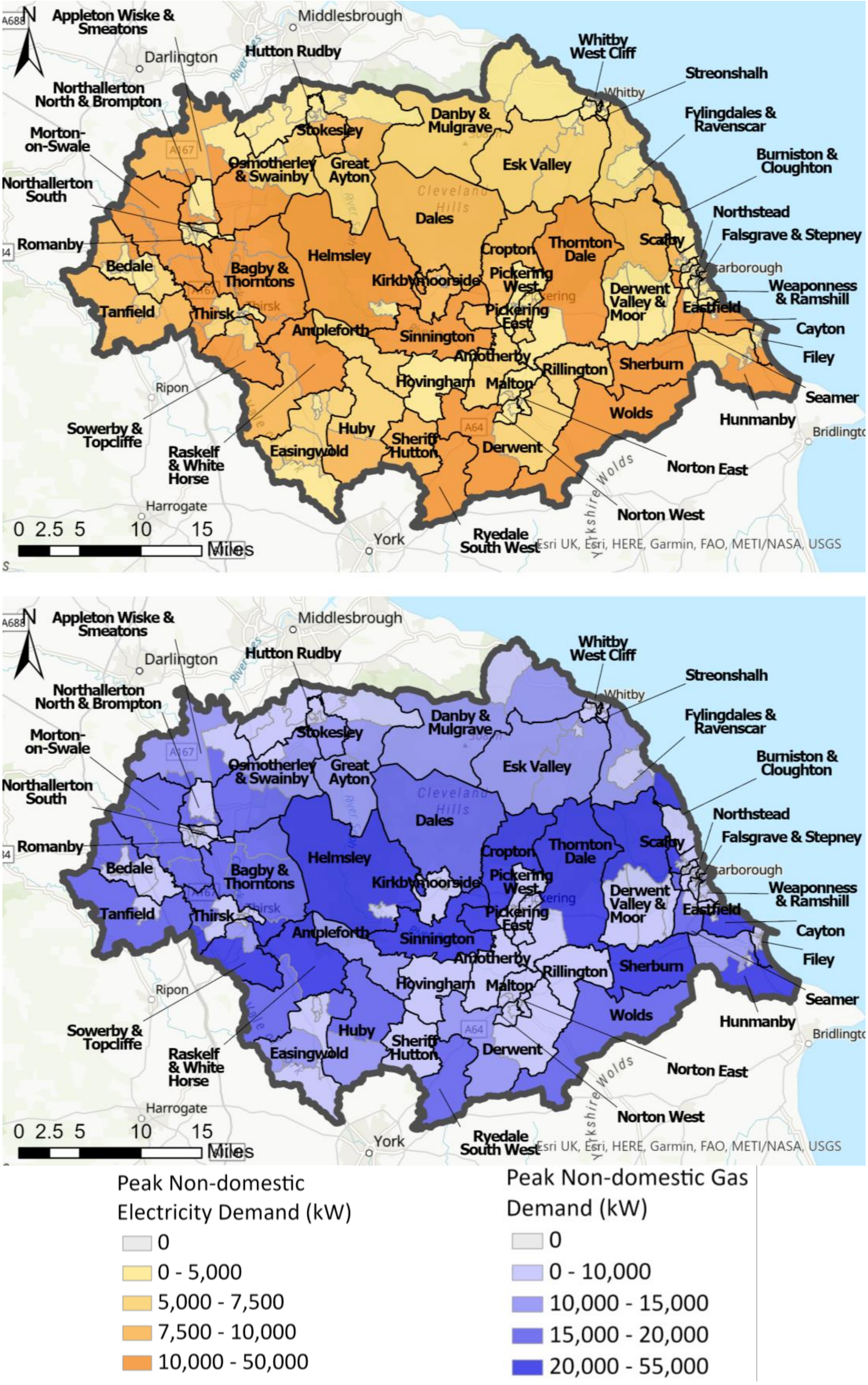


Figure 17: Estimated current non-domestic peak energy demand by fuel and LSOA across the East North Yorkshire sub-region.

Figure 18 shows an estimate of the total electricity demand profile for the East North Yorkshire sub-region for different days of the year representing the lowest typical demand and the highest. The peak day is also shown, which is used to determine a worst-case scenario on the network. Electricity demand includes heat, lighting, appliances, and electric vehicle charging when chargepoints are known to exist in the local area. The profile is for domestic and non-domestic buildings combined.

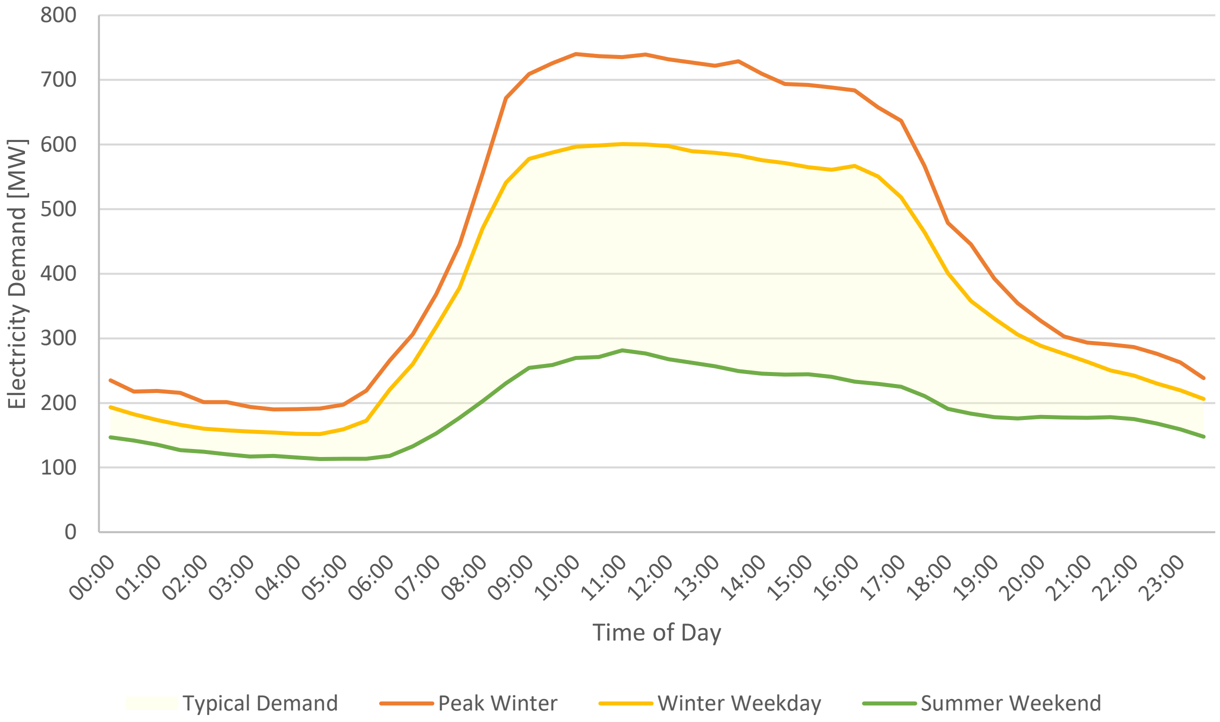


Figure 18: Estimated electricity demand profiles for different days of the year across the East North Yorkshire sub-region.

As expected, the demand is far lower on a summer weekend when compared to a winter weekday.

Summer weekend represents the lowest end of demand profile; being summer means there is less need for heating, and weekend suggests that office/factory buildings are using less electricity, in contrast to a typical winter weekday.

The area between these two demand profiles has been highlighted as the typical demand i.e. the electricity demand will likely be within the shaded area at any given time.

Figure 19 shows the estimated gas demand profile, and Figure 20 shows the estimated oil demand profile, for the East North Yorkshire sub-region for the same days. Gas and oil demand include both heat and hot water and covers domestic and non-domestic buildings combined.

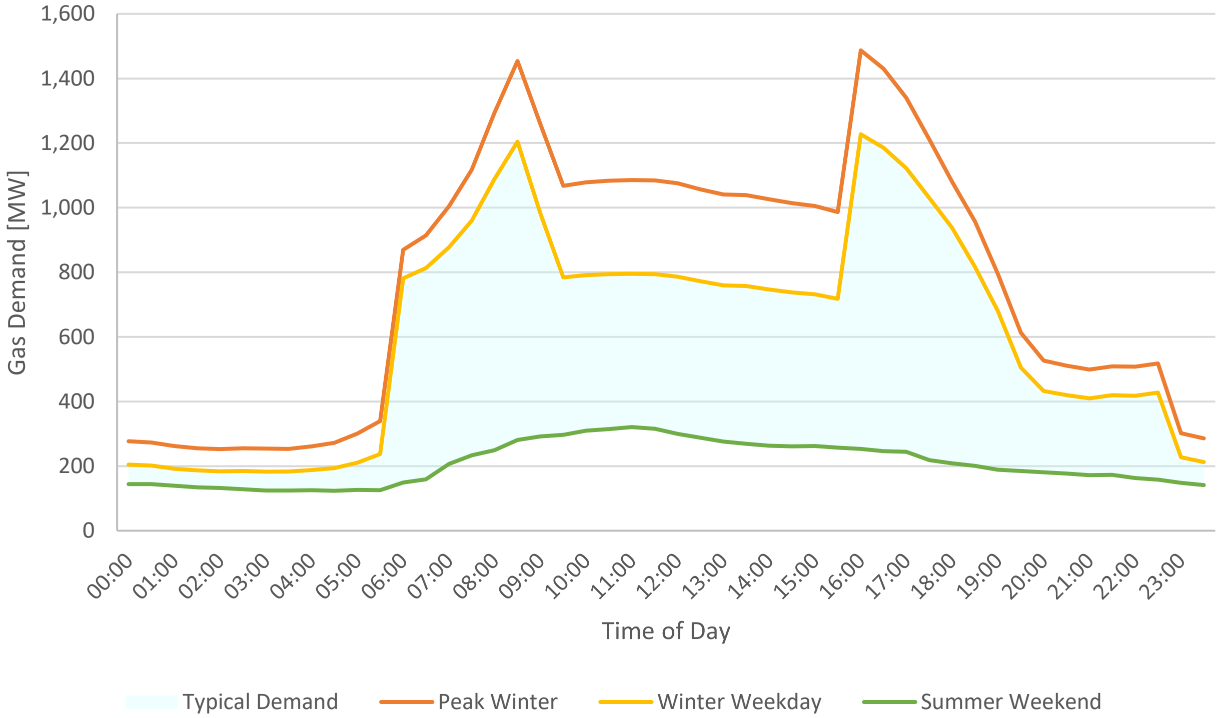


Figure 19: Estimated gas demand profiles for different days of the year across the East North Yorkshire sub-region.

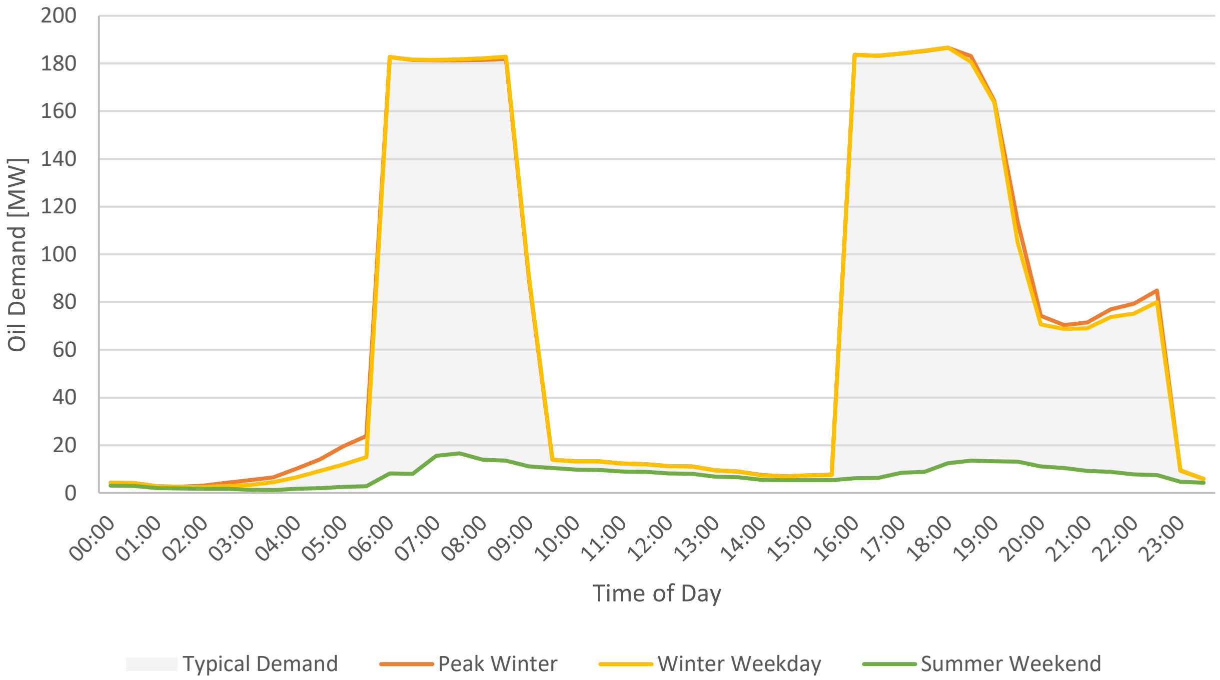


Figure 20: Estimated oil demand profiles for different days of the year across the East North Yorkshire sub-region.

2.1.3. Energy Networks

A good understanding of the energy networks is vital to formulating a forward plan for the decarbonisation of any area. For example, identifying dwellings that are not on the gas network can help to focus a heat pump roll-out programme thus reducing the risk of competing heating vectors such as hydrogen or heat networks being a more financially viable option in the future. To identify those off-gas areas, Xoserve[8] postcode data was used (mapped in Figure 21) before being cross-referenced with Ordnance Survey records to calculate how many dwellings are estimated to be on- or off-gas (Table 9).

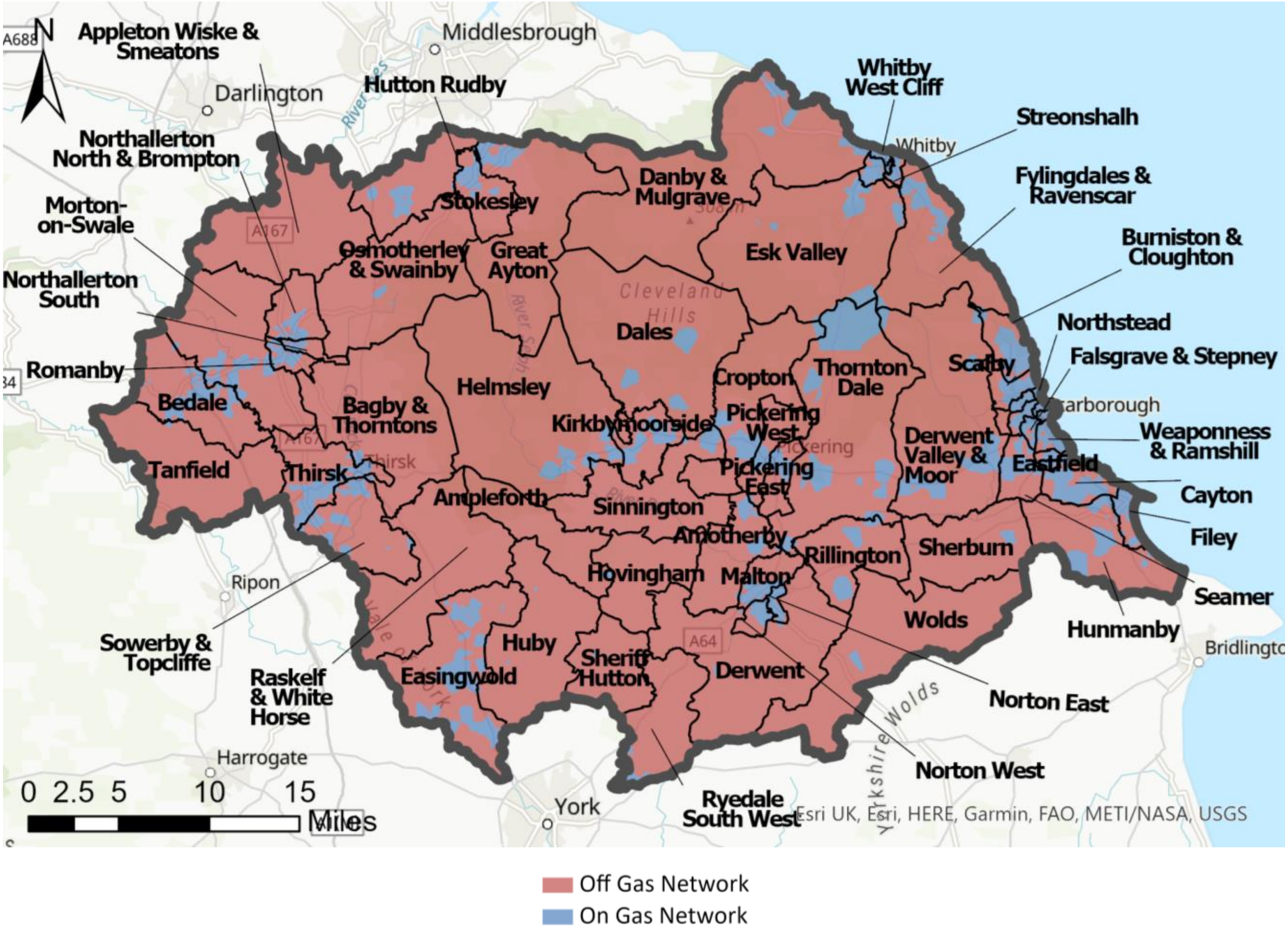


Figure 21: On-gas and off-gas areas of the East North Yorkshire sub-region.

Table 9: Estimate of on-gas and off-gas dwellings across the East North Yorkshire sub-region (rounded to nearest 5,000)

	Number
Off-Gas Dwellings	**35,000**
On-Gas Dwellings	**100,000**

Comparing Figure 21 and Table 9 leads to the conclusion that the off-gas grid areas are sparsely populated. This is confirmed by comparing to Figure 2 showing the location of the building stock.

[8] https://www.xoserve.com/wp-content/uploads/Off-Gas-Postcodes-V2.xlsx

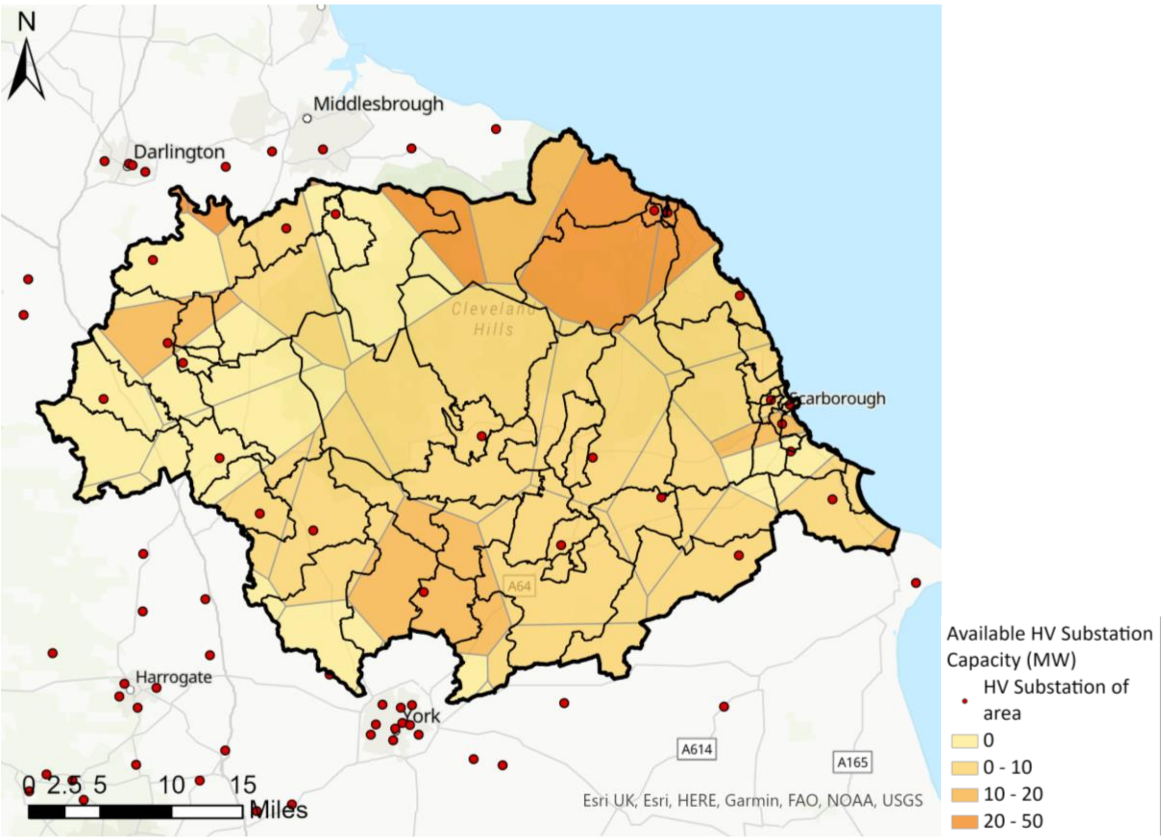


Figure 22: Available high-voltage substation capacity across the East North Yorkshire sub-region.

Figure 22 shows an estimate of the available capacity on each 33kV-to-11kV substation and the extent of the area served by each substation. Capacity is calculated by subtracting the combined peak electrical demand on buildings in each area from the rated capacity of each substation. Those substations shown outside of the West North Yorkshire boundary may serve buildings within it. Substations outside of the boundary have been included since it is likely some may serve assets within the project boundary. This is seen by new polygons that begin next to the project boundary. It should be noted that available capacity of areas on the North Yorkshire boundary may be overestimated since the demands of buildings outside of the county have not been modelled.

Where network connection is important from a project planning perspective the actual areas served should be established in conversation with the local Distribution Network Operator, (DNO) Northern Powergrid. These capacity estimates are intended to give an indication of the capacity available on different parts of the network within the local energy system representation area and are not a substitute for detailed network modelling and analysis conducted by the local DNO. Substations identified as generation only in the DNO data are assumed to have no available capacity. Substations are not included in the analysis where DNO data on locations and capacities are unavailable. Where capacity data is unavailable, but locations are available, the 11kV-to-400kV capacity was set to the most prevalent substation capacity across all of North Yorkshire of 49kW. Where capacity data is only available in MVA, it is assumed that capacity in MVA is equal to capacity in MW, unless power factors are available.

Figure 23 shows an estimate of the number of buildings, both domestic and non-domestic connected to each 33kV-to-11kV substation. As with capacity, the extent has been calculated as the area closest to each substation.

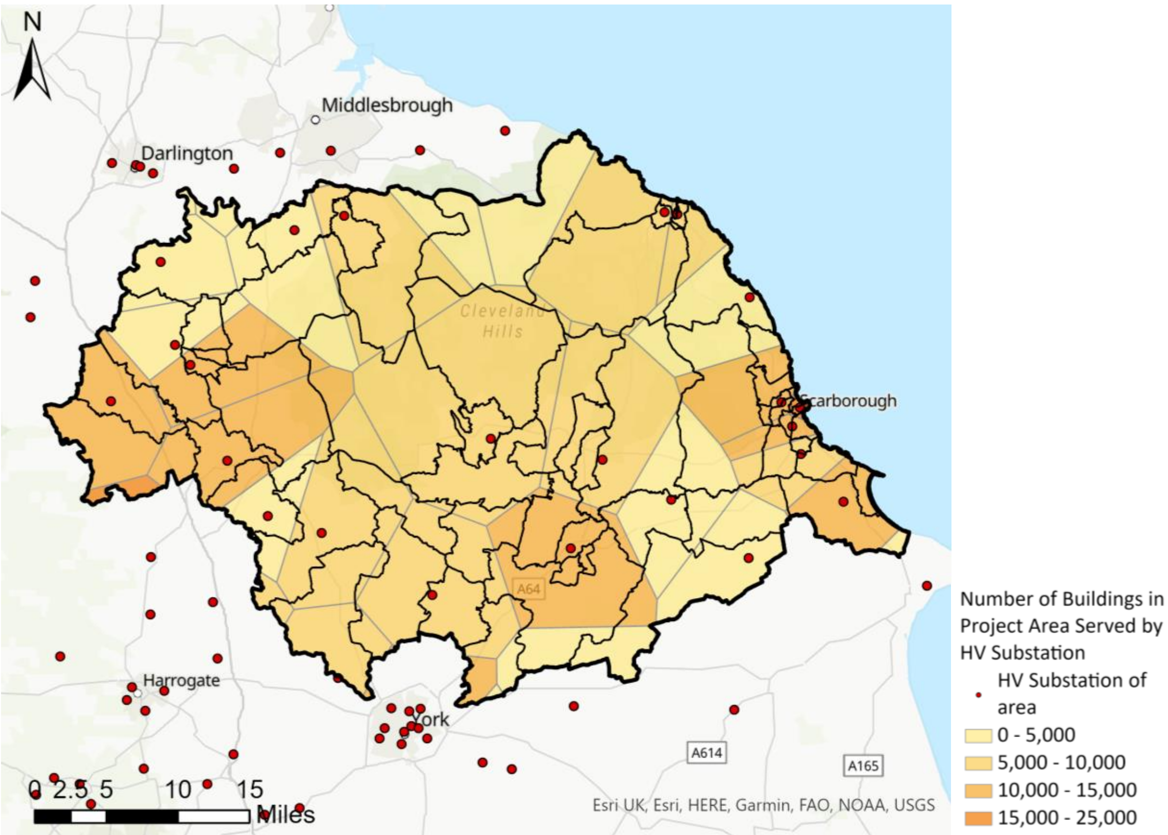


Figure 23: Number of buildings within the South North Yorkshire sub-region served by each high-voltage substation.

2.1.4. Embedded Generation

The Renewable Energy Planning Database (REPD) was used to identify large scale embedded generation across the East North Yorkshire sub-region. These sites, and the associated technologies, are shown in Figure 24. Data on domestic feed-in tariffs from BEIS are used to identify the amount of domestic solar photovoltaic (PV). The total installed capacity for each technology along with an estimate of the annual electricity generated in the local area is given in Table 10. Table 10 shows the proportion of annual electricity demand across the East North Yorkshire sub-region estimated to be met currently using local embedded generation. Additional embedded generation technologies may be present in the area but not reported here if they are not recorded in the REPD or if they are below 100 kW.

Table 10: Estimated renewable energy capacity and estimated generation as a proportion of electricity demand in the East North Yorkshire sub-region.

Renewable Tech	Installed Capacity [MW]	Annual Generation [GWh]	Proportion of Annual Demand
Domestic Solar PV	22.1	35	1.4%
Other Solar PV	5.9	5.5	0.2%
Biomass	2	11	0.4%
Landfill Gas	1.3	6	0.2%
Anaerobic Digestion	1.5	8	0.3%

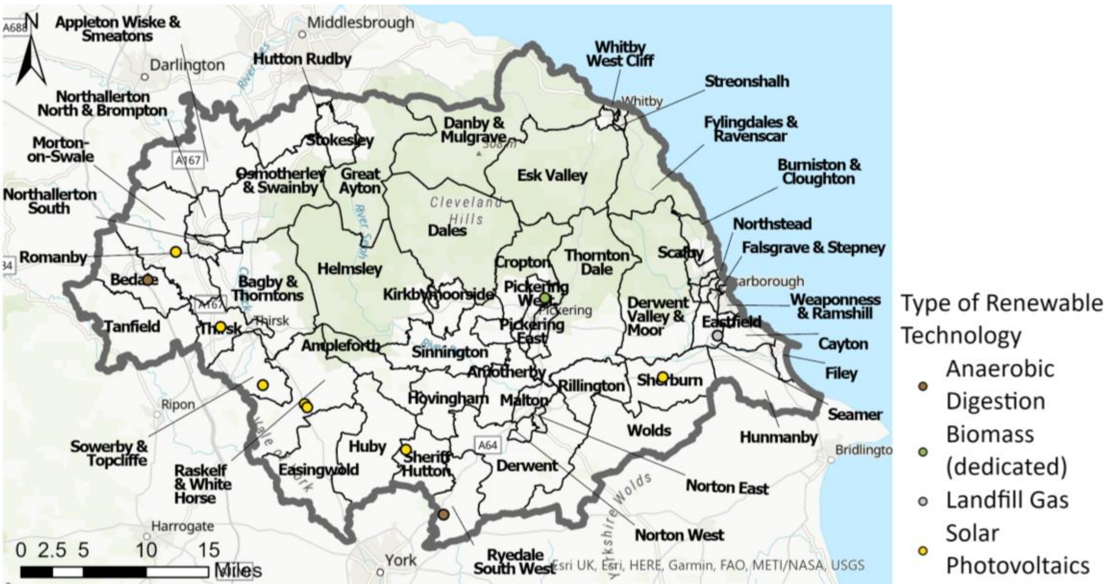


Figure 24: Existing embedded generation in the East North Yorkshire sub-region according to REPD database (October 2020).

As can be seen from Table 10, domestic solar PV is the largest contributor to the annual demand of any installed renewable technology. Although not all installations of solar PV are registered for the feed-in tariff (FIT), and not all FITs were given to solar PV, the majority will be and therefore Ofgem's Feed-in Tariff Installation Report[9] is a useful way of identifying the overall capacity and number of registrations in each LSOA. Figure 25 and Figure 26 show the installed capacity of renewables and number of registrations respectively.

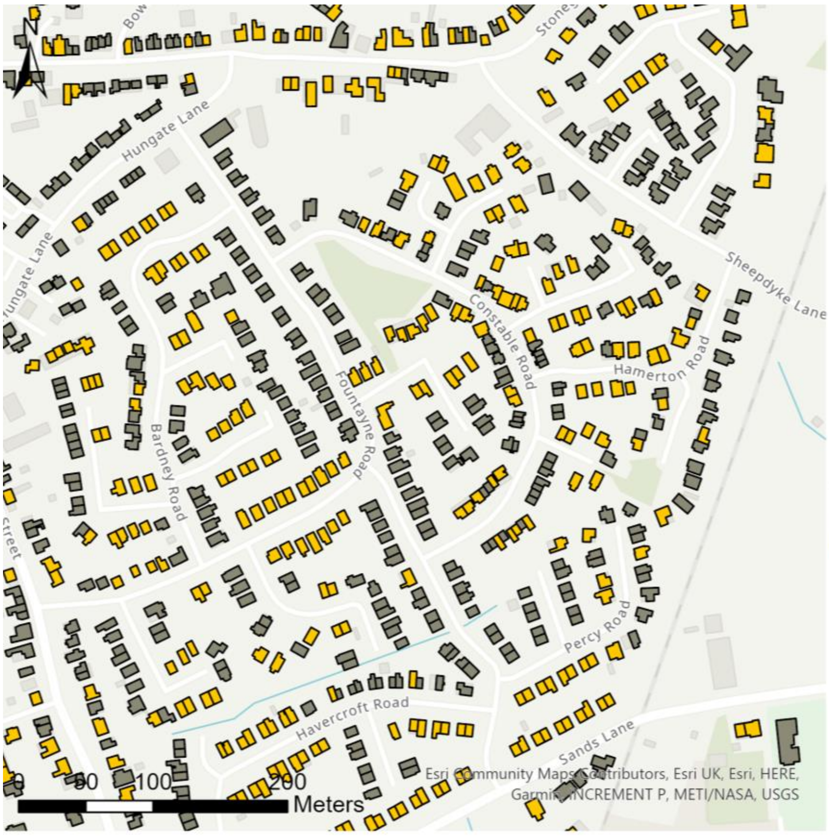
[9] https://www.ofgem.gov.uk/environmental-programmes/fit/contacts-guidance-and-resources/public-reports-and-data-fit/installation-reports

Figure 25: Aggregated capacity of renewable installations registered for FIT within each LSOA of the East North Yorkshire sub-region.

Figure 26: Number of renewable installations registered for FIT within each LSOA of the East North Yorkshire sub-region.

To assess the potential for domestic on-roof solar PV within the East North Yorkshire sub-region, the footprint and orientation of all dwellings have been analysed to calculate the potential generating capacity. These results are then aggregated to 200m radius areas to identify places best suited for mass deployment. The dwellings identified as suitable for rooftop solar PV in each of the three best areas are shown in Figure 27 to Figure 29.

As a purely spatial exercise this analysis does not consider local planning constraints and should not be used as a replacement for a detailed feasibility study or installation design.



1st most concentrated area in East North Yorkshire.

Not suitable

Suitable

Dwellings eligible for PV in area: 336

Combined capacity of these dwellings: 922kW

Figure 27: Dwellings identified as suitable for rooftop PV panels. (Location: Hunmanby, Filey)

2nd most concentrated area in East North Yorkshire.

Not suitable

Suitable

Dwellings eligible for PV in area: 284

Combined capacity of these dwellings: 876kW

Figure 28: Dwellings identified as suitable for rooftop PV panels. (Location: East Ayton, Scarborough)

Figure 29: Dwellings identified as suitable for rooftop PV panels. (Location: Cayton, Scarborough)

In total these three areas alone have a total potential solar PV capacity of 2.645 MW.

2.1.5. Domestic & Public EV Charging

Data from the Zap-Map®[10] has been used to identify the locations and power outputs of public Electric Vehicle (EV) chargepoints across the East North Yorkshire sub-region. The locations and the speed of the chargepoints are shown in Figure 30. In total there are 111 public chargepoints with a combined capacity of 2,389kW. The locations and the speed of the chargepoints are shown in Figure 31.

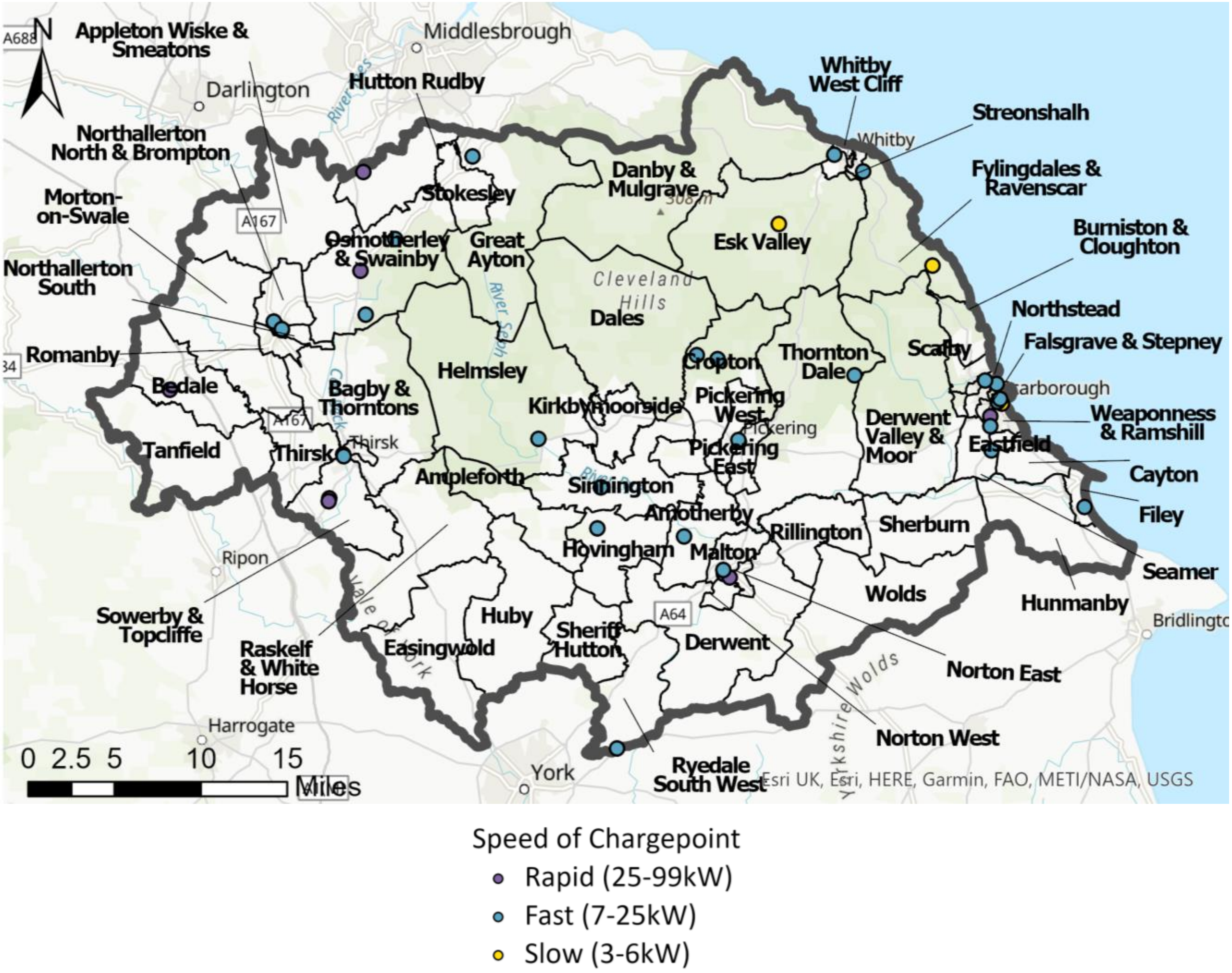


Figure 30: Location of public chargepoints according to Zap-Map® (December 2020)

Chargepoint data provided by Zap-Map®

The Driver and Vehicle Licensing Authority (DVLA) publishes data on the numbers and types of different vehicles registered within different Local Authority Areas. This gives an indication of the number of EVs that might be registered within the sub-region as shown in Table 11.

EV chargepoints in Ryedale District Council area include 22kW chargers in Helmsley, Kirkbymoorside, Pickering and Malton. In addition to these there are 43-50kW chargepoints available in Malton and Norton.

[10] https://www.zap-map.com/

It should be noted that leased vehicles will be registered to the leasing company which may not be based within the project area.

Using National Travel Survey data representative charge profiles have been generated for both public and domestic charge points. The estimated peak demands for domestic chargepoints are shown in Table 11.

Table 11: Summary of plug-in vehicles[11] registered in the East North Yorkshire sub-region according to data from DfT

Number of Plug-in Vehicles	Percentage of Total Vehicles	Estimated Peak Demand [kW]
681	0.55%	**974**

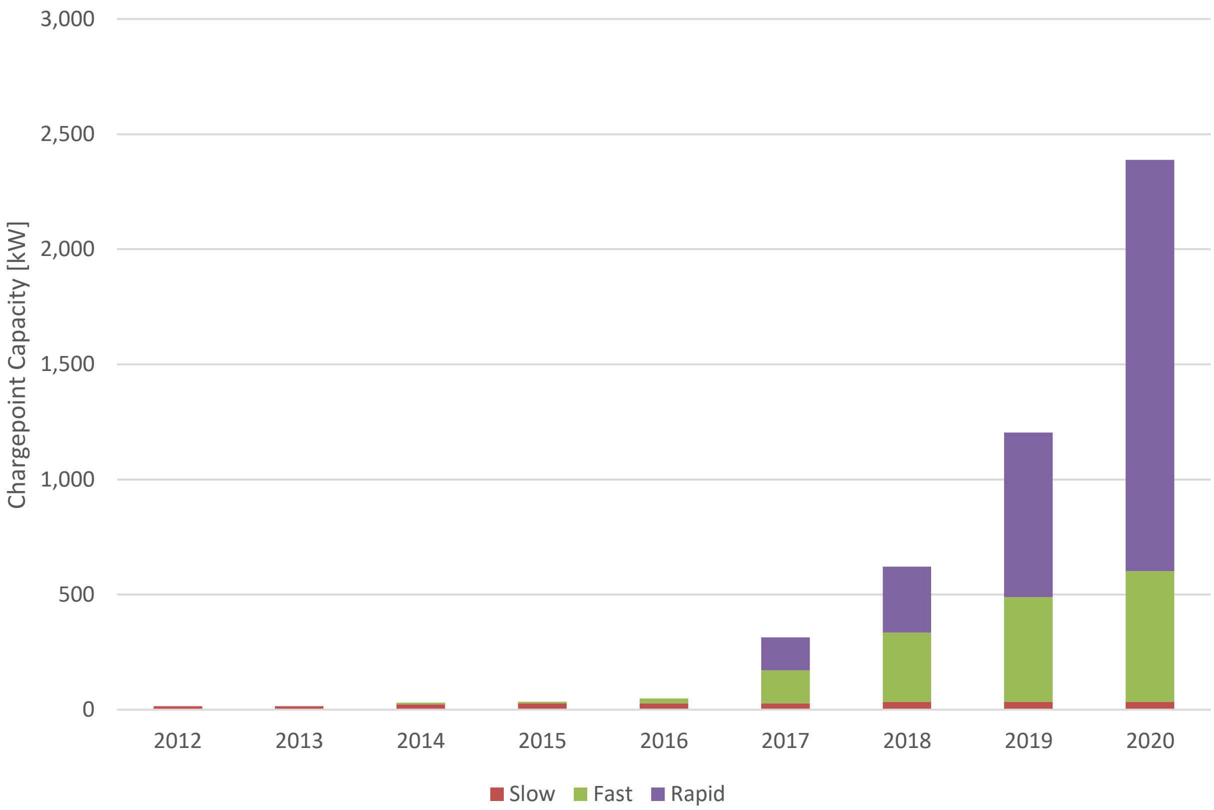


Figure 31: Chargepoint connector total capacity (kW) within the East North Yorkshire sub-region over time.

Using the date that each chargepoint was added to the Zap-Map database the uptake of chargepoints in the area can be analysed. Figure 31 shows this uptake in total kW rating of connectors within the East North Yorkshire sub-region by charger type.

Ordnance Survey Mastermap Topography and Land Registry INSPIRE polygons have been used to identify houses which have space for off-street parking. This is done by attempting to fit a standard UK parking space of 4.8m x 2.4m in the owned area between the house and its nearest road. This helps identify homes that may be able to charge an EV on a driveway, and areas that will require alternative charging solutions for on-street parking. Figure 33 shows the results of this analysis aggregated by road.

[11] Plug-in vehicles are all models identified as being fully electric or plug-in hybrid.

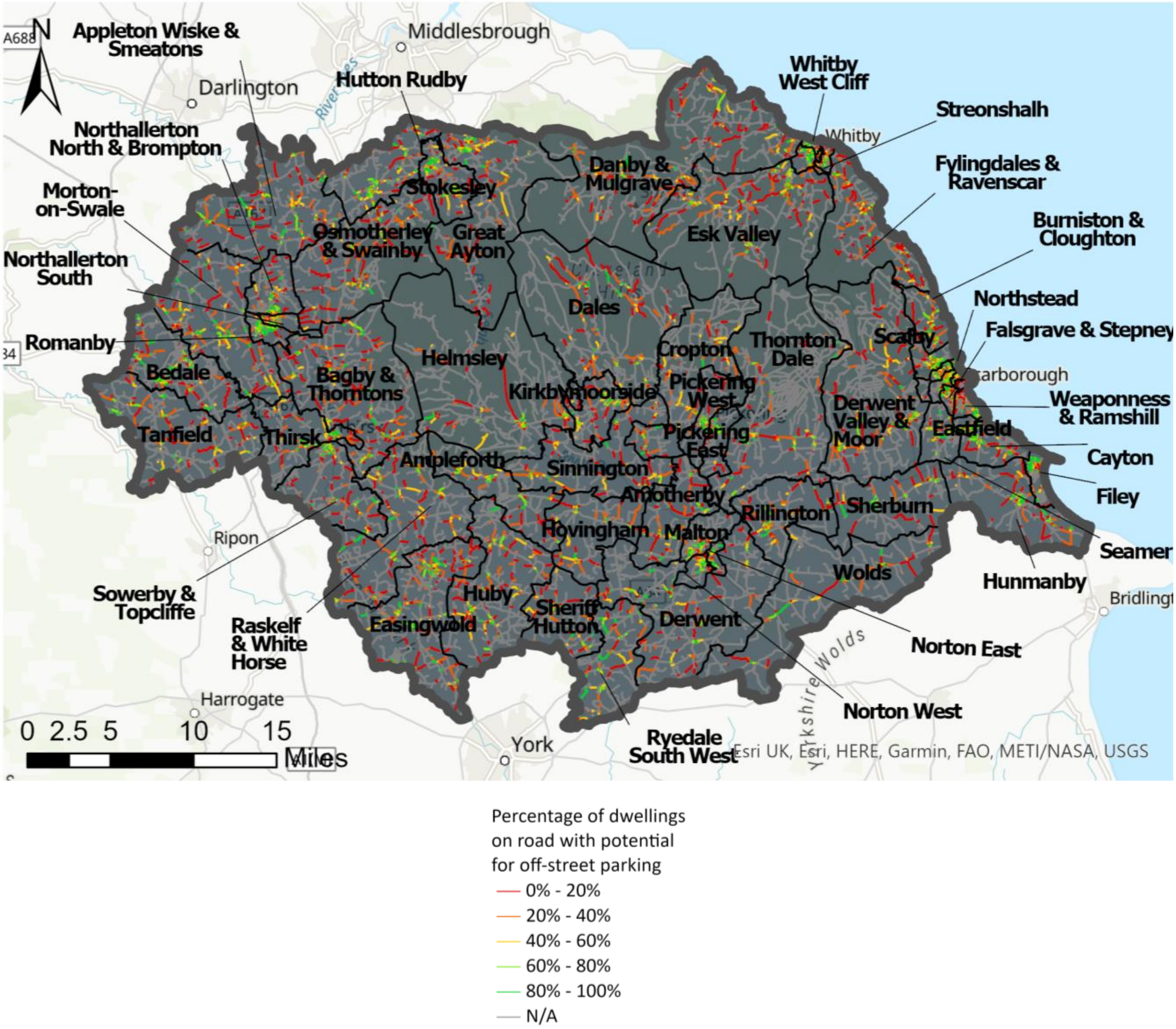


Figure 32: Percentage of dwellings with off-street parking on each road within the East North Yorkshire sub-region.

As a purely spatial exercise this analysis does not consider local planning constraints and should not be used as a replacement for a detailed feasibility study.

2.1.6. Social Data

National data have been used to provide an indication of fuel poverty (Figure 33) and multiple deprivation (Figure 34) across the East North Yorkshire sub-region.

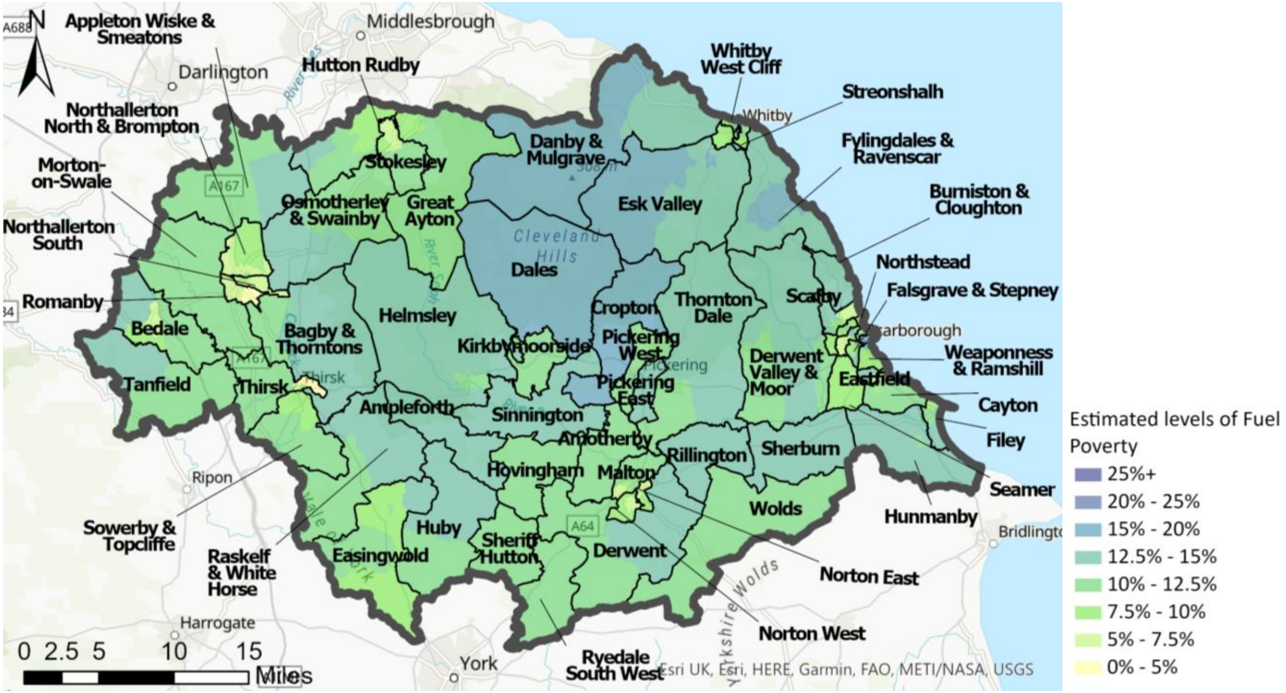


Figure 33: Estimated levels of fuel poverty according to 2020 BEIS data

Using the ranked Index of Multiple Deprivation[12] data published by The Department for Communities and Local Government (DCLG) at LSOA level it is possible to compare localised levels of deprivation within the East North Yorkshire sub-region against the rest of England. For mapping purposes these are shown by octile, with values falling in octile 1 being within the most deprived 1/8th of the country and values falling in octile 8 being within the least deprived 1/8th of the country.

[12] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015
For descriptions of the underlying indicators used in the indices of deprivation please refer to this document: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/467775/File_8_ID_2015_Underlying_indicators.xlsx

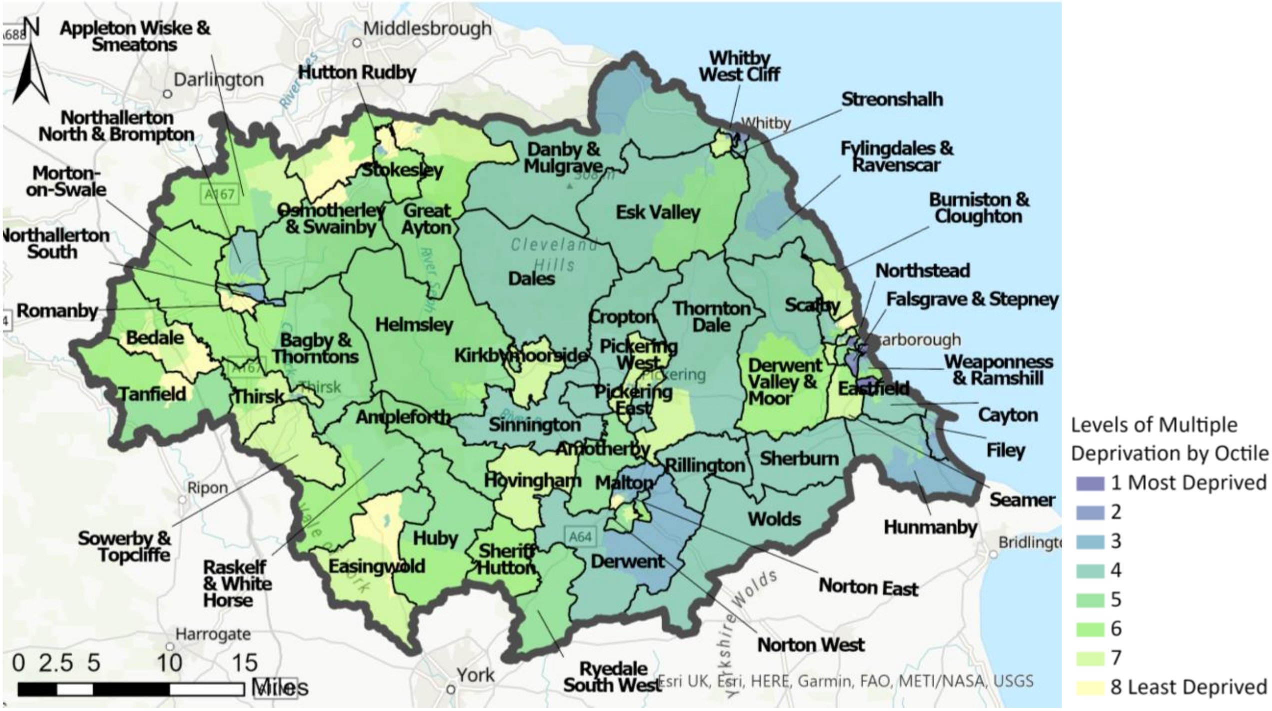


Figure 34: Ranking of English indices of deprivation 2019

The multiple indices that make up the IMD can be found in the accompanying data/maps to this report.

2.2. South North Yorkshire (Selby & City of York)

The sub-regional area of 'South North Yorkshire' has been defined in this report as covering the local authority areas of Selby and City of York which collectively cover an area of 871km^2 and has a population of around 300,000.

2.2.1. Building Stock

This section will provide an overview of the building stock – both domestic and non-domestic – across the South North Yorkshire sub-region. The geographical location of the building stock will be shown, as will the relative rurality across the sub-region, and breakdowns of the domestic and non-domestic stock by category.

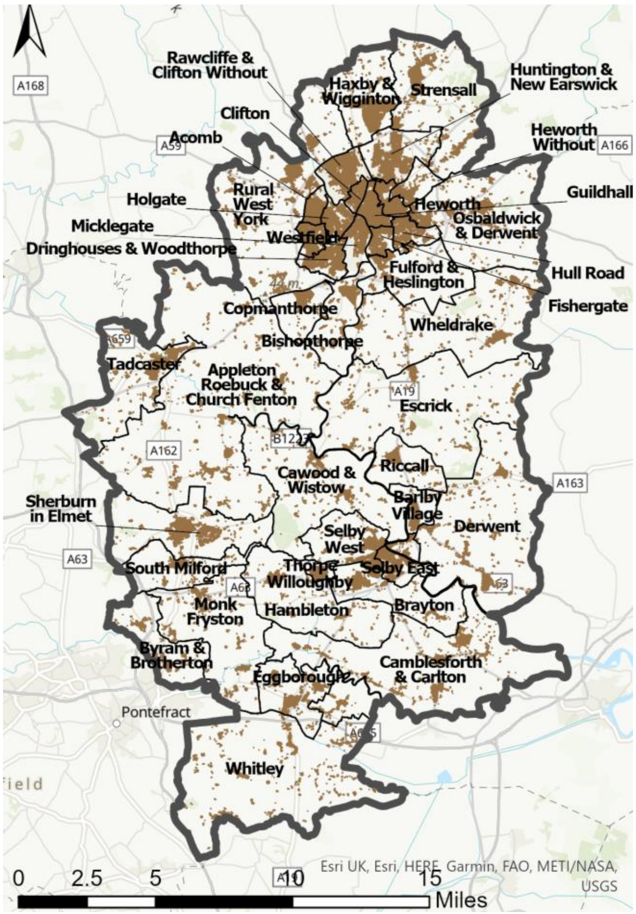


Figure 35: Building stock distribution across the South North Yorkshire sub-region.

Figure 35 shows that across the South North Yorkshire sub-region, the building stock is distributed into clusters around conurbations including York and Selby with the building stock being less densely situated elsewhere, particularly across the central belt of the sub-region.

These areas correlate well to the rural/urban classifications given in the rurality map (Figure 69).

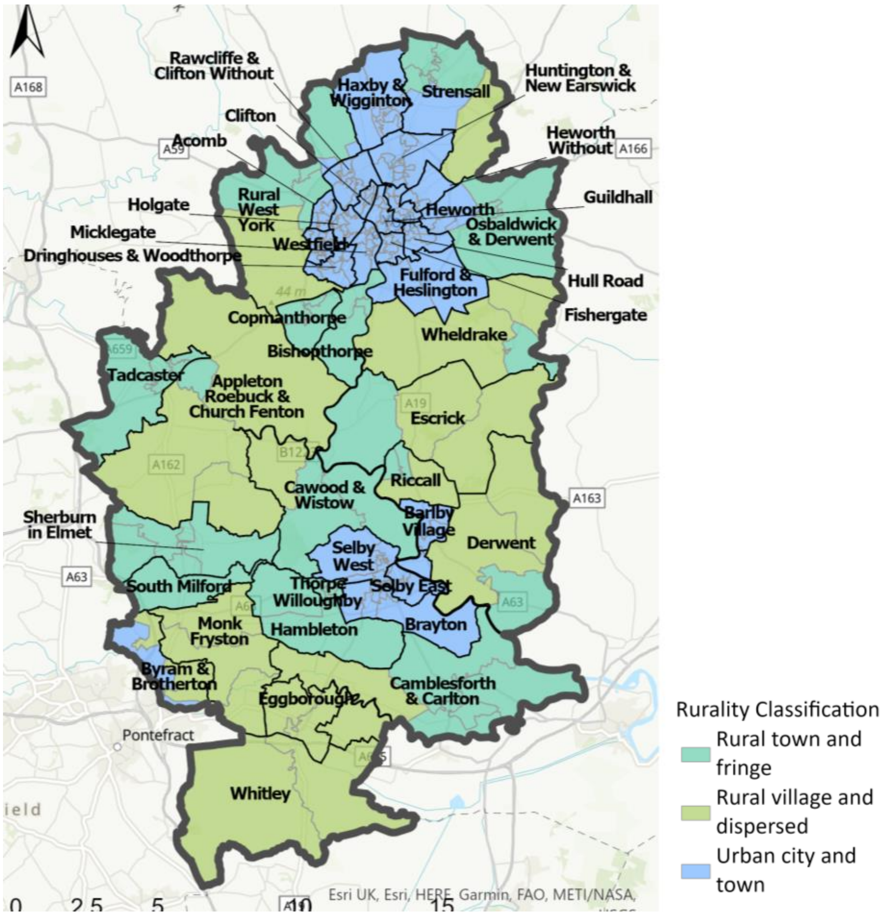


Figure 36: Rurality of the South North Yorkshire sub-region.

Figure 36 shows the rurality of the South North Yorkshire sub-region by Lower-level Super Output Area (LSOA) and overlayed by electoral wards. Most of the land area in the South North Yorkshire sub-region is classified as rural towns and villages with the more urban areas matching those noted in Figure 68.

Using data provided by Historic England[13], the location and grade of listed buildings and scheduled monuments can be mapped within the sub-region. In addition, data published by Historic England on Battlefields, World Heritage Sites and Parks & Gardens mapped alongside (Figure 70).

[13] https://historicengland.org.uk/listing/the-list/data-downloads

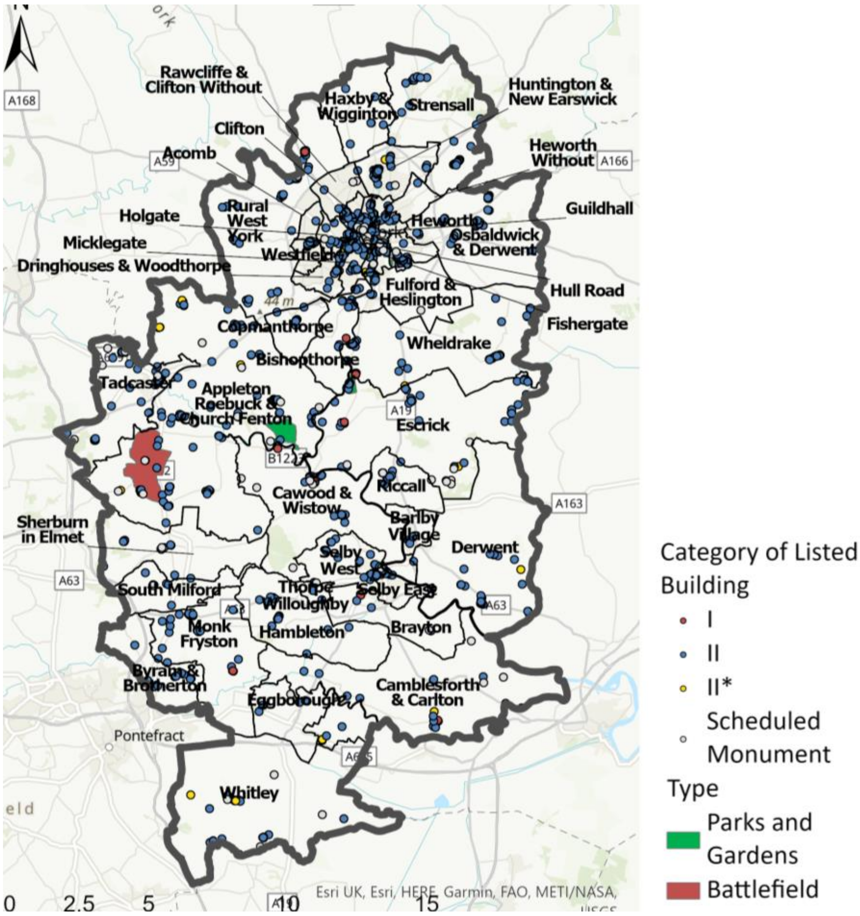


Figure 37: Location of listed buildings in the South North Yorkshire sub-region grouped by grading according to Historic England

Figure 37 shows the large number of listed buildings, scheduled monuments, and areas of interest clustered in similar locations to the building stock as a whole. This could all pose a challenge to decarbonising the building stock. Table 12 shows the Listed Status of the buildings and the number of occurrences.

Table 12: Summary of listed buildings across South North Yorkshire by grade category.

Grade Category	Number
Grade I	99
Grade II	1,938
*Grade II**	2,147
Scheduled Monument	66

To understand the housing stock in more detail, the domestic stock has been segmented by:

- Type (converted flat, detached, purpose-built flat, semi-detached, and terrace)
- Construction date (pre-1914, 1914-1944, 1945-1964, 1965-1979, post-1980)
- Floor area [m^2] (under 50, 50-70, 70-90, 90-110, 110-200, 200-300, over 300)
- Main heating system (ASHP, biomass, electric (no storage), electric storage, gas, GSHP, oil/LPG)
- Loft insulation level [mm] (no loft, no insulation, 1-99, 100-199, over 200)
- Wall type (filled cavity, unfilled cavity, solid with ESWI, solid with ISWI, uninsulated solid)
- Window type (single glazing, double glazing, triple glazing)

Table 13: Number and percentage of dwelling types across the South North Yorkshire sub-region.

Dwelling Type	Number	Percentage
Converted Flat	1,900	2%
Detached	35,000	26%
Purpose Built Flat	20,000	17%
Semi-detached	45,000	34%
Terrace	30,000	22%
Total	**130,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

Table 13 shows that larger dwelling types are more prevalent across the sub-region. The prevalence of the dwelling types in each LSOA area (Figure 38) shows that detached dwellings are typically the most dominant in rural areas, whereas semi-detached are more common in urban areas, with flats being most common in the central York LSOAs. Over one-third of all dwellings in the South North Yorkshire sub-region are semi-detached.

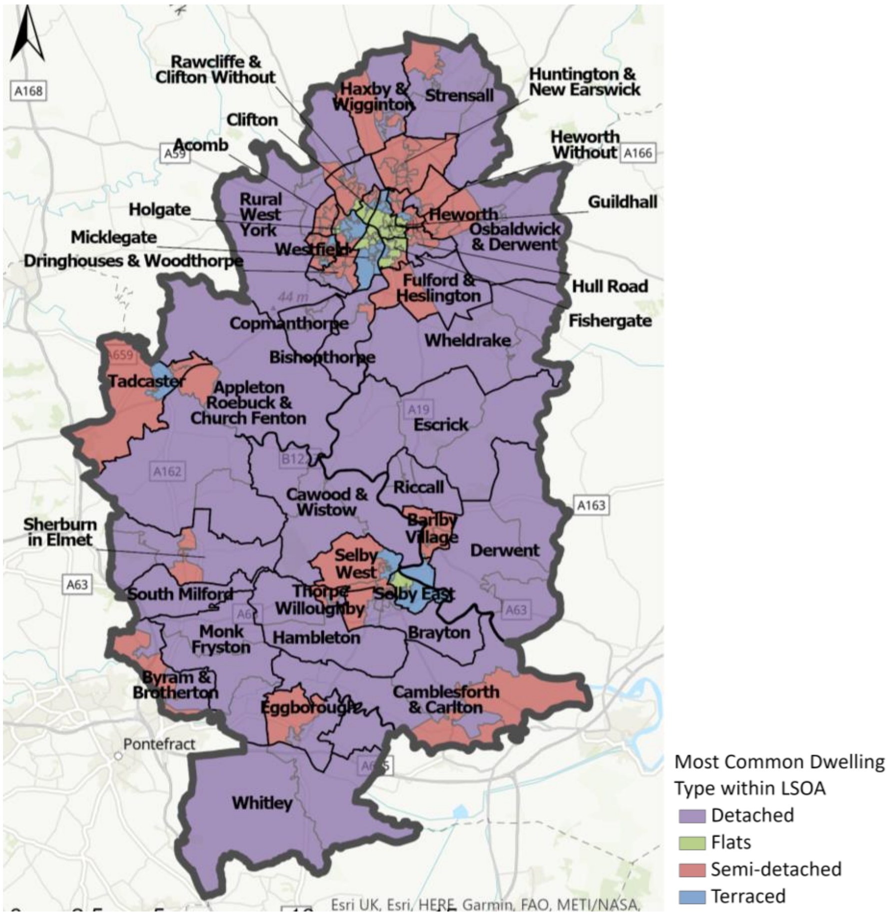


Figure 38: Most common dwelling type within each LSOA across the South North Yorkshire sub-region.

A notable finding, shown in Table 14 is that over 50% of dwellings in the South North Yorkshire sub-region were constructed between 1945 and 1979.

Table 14: Number and percentage of dwellings constructed in different periods across the South North Yorkshire sub-region.

Dwelling Construction Period	Number	Percentage
Pre-1914	20,000	17%
1914-1944	15,000	11%
1945-1964	35,000	28%
1965-1979	35,000	26%
1980-present	20,000	18%
Total	130,000	100%

Due to rounding, some totals may not correspond with the sum of the separate figures.

By combining the dwelling type and the construction period, it can be seen in Figure 39 that almost 15% of all dwellings in the sub-region are 1945-1964 semi-detached dwellings. Terraced dwellings tend to be much older with around 50% being built prior to 1914. Detached dwellings are being built more commonly in recent years with 75% of all detached dwellings having been built after 1965.

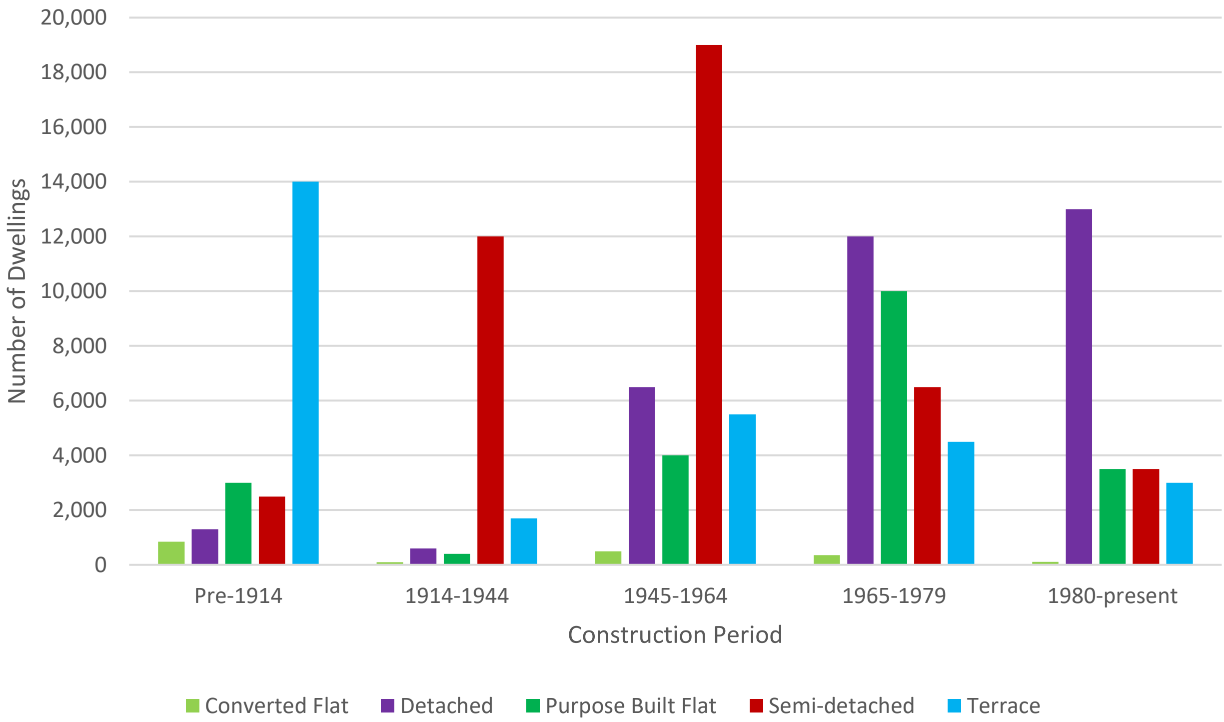


Figure 39: Estimated number of dwellings within each construction period (by dwelling type) across the South North Yorkshire sub-region.

This can be visualised spatially (Figure 40) to show the most prevalent construction year in each LSOA in the South North Yorkshire sub-region. Figure 40 shows a prevalence of 1945-1979 built dwellings in many of the larger electoral wards. In the centre of the urban areas, pre-1914 dwellings are more prevalent which we know from Figure 39 are likely to be terraced dwellings.

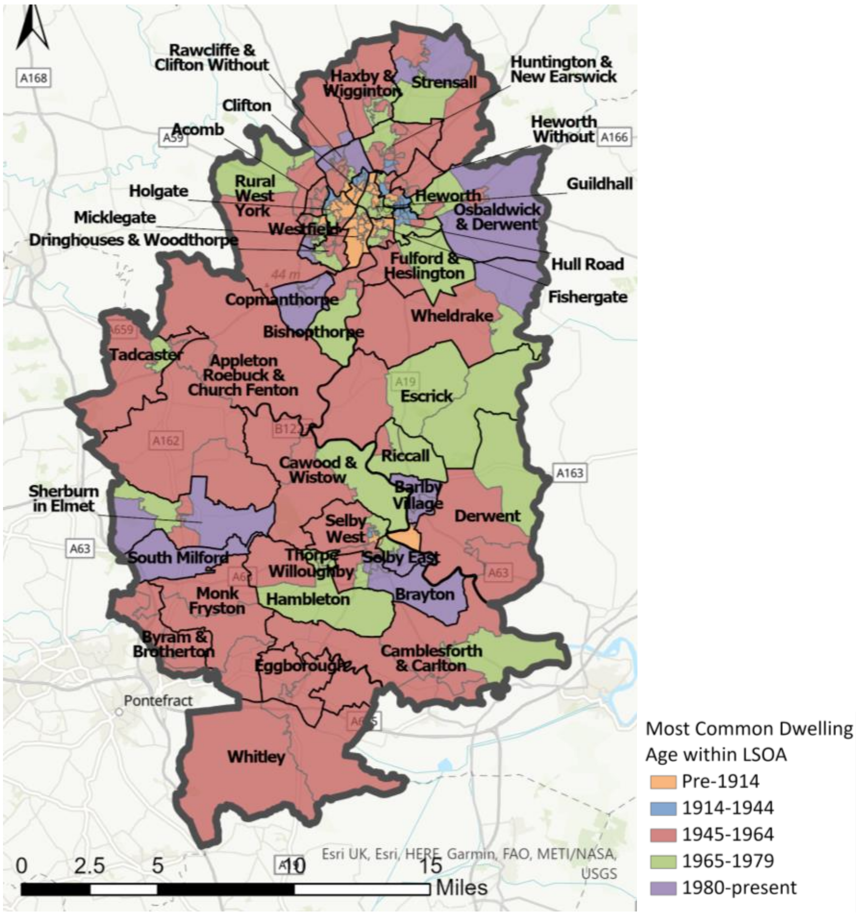


Figure 40: Most common construction period within each LSOA across the South North Yorkshire sub-region.

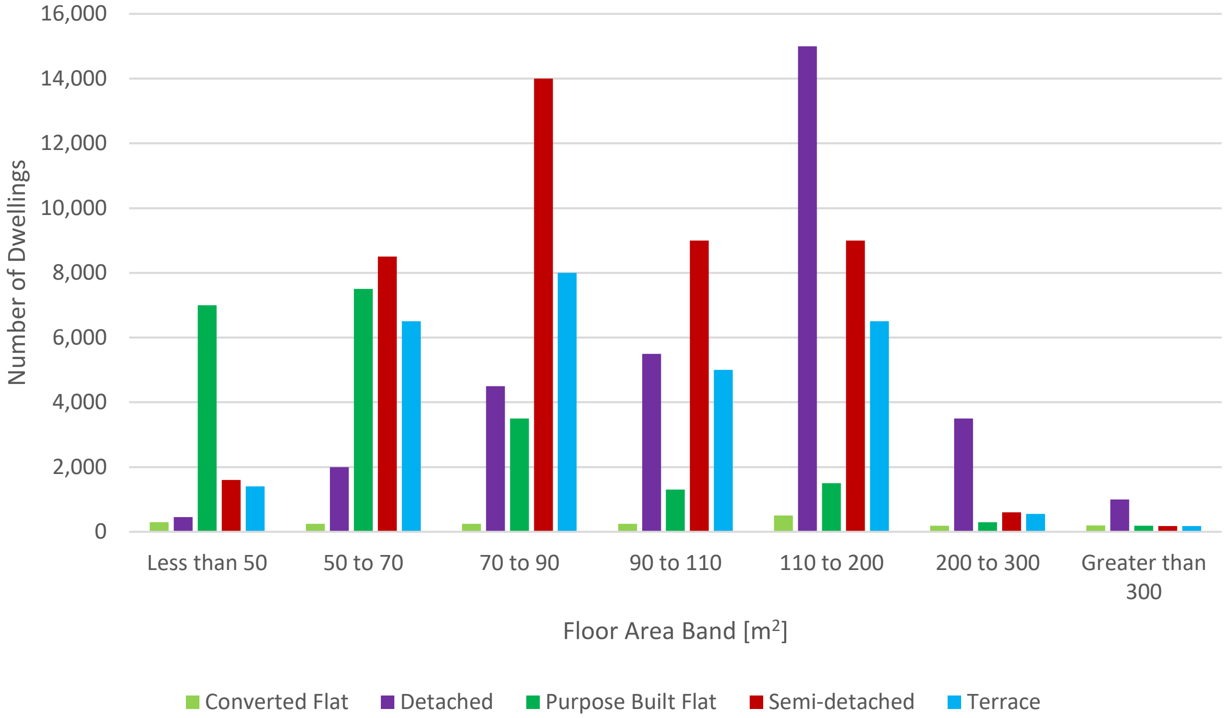


Figure 41: Estimated number of dwellings within each floor area band (by dwelling type) across the South North Yorkshire sub-region.

From Figure 41 as expected, flats (particularly purpose-built flats) typically have a lower floor area than semi-detached and detached dwellings. Over two-thirds of purpose-built flats have a floor area of under 70m^2 whilst 47% of detached dwellings have a floor area of between 110 and 200m^2.

Dwellings in the South North Yorkshire sub-region are overwhelmingly heated using a fossil fuel boiler (93%) with the remainder being made up from electric storage heaters (6%). Electric storage heaters are often used in modern flats where heat losses are low. Oil/LPG boilers are typically used in off-gas grid areas which in turn are often rural. Figure 42 below shows that 15% of detached dwellings use oil/LPG boilers as their main heating system. Gas boilers are prevalent throughout the housing stock.

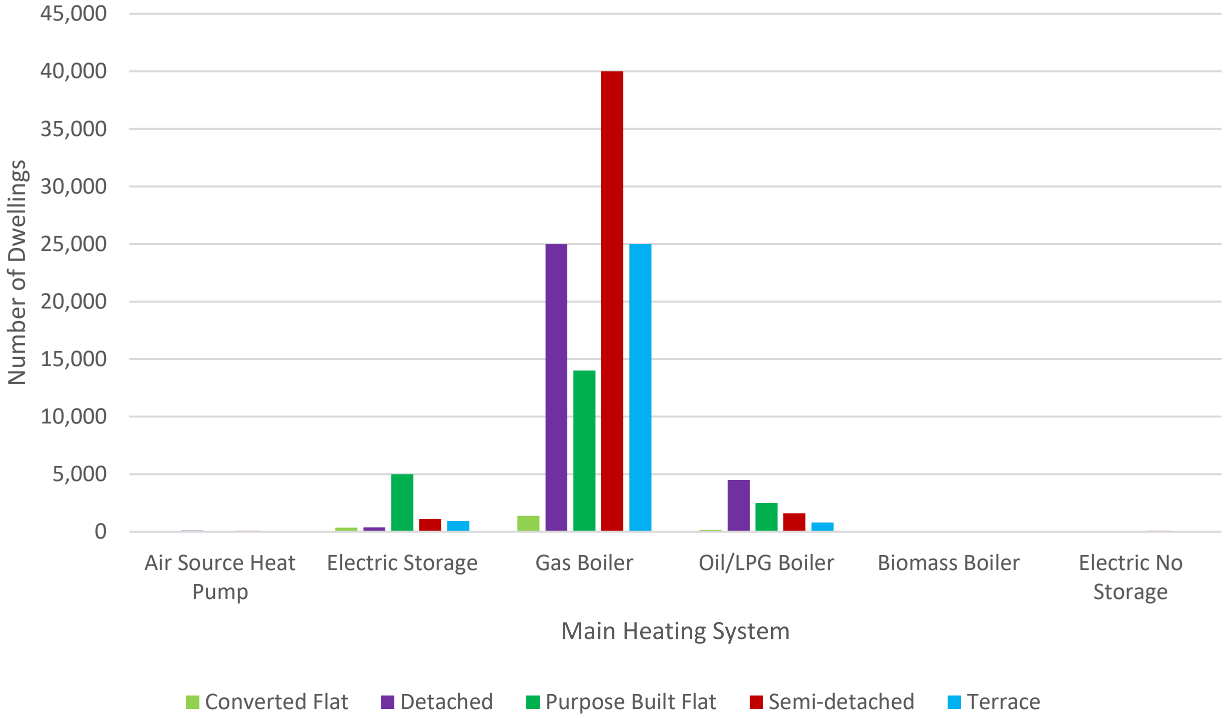


Figure 42: Estimated number of dwellings by main heating system (by dwelling type) across the South North Yorkshire sub-region.

To make a heating system as efficient as possible insulation is required to reduce the heat loss from a dwelling. Figure 43 shows the level of loft insulation in each dwelling type. Flats (both converted and purpose built) are assumed not to have a loft to insulate as even those on the top-floor are unlikely to be able to access the loft space in which to add insulation. There are also a small number of detached, semi-detached, and terraced properties that are classified as having no loft; this is usually due to them having a 'room-in-roof' where the loft has been converted into part of the living area.

The expected level of loft insulation in the UK is 270mm meaning that there are a significant proportion (75%) of those with a loft who would benefit from additional insulation. 46% of terraced houses have no loft insulation whatsoever (Figure 43).

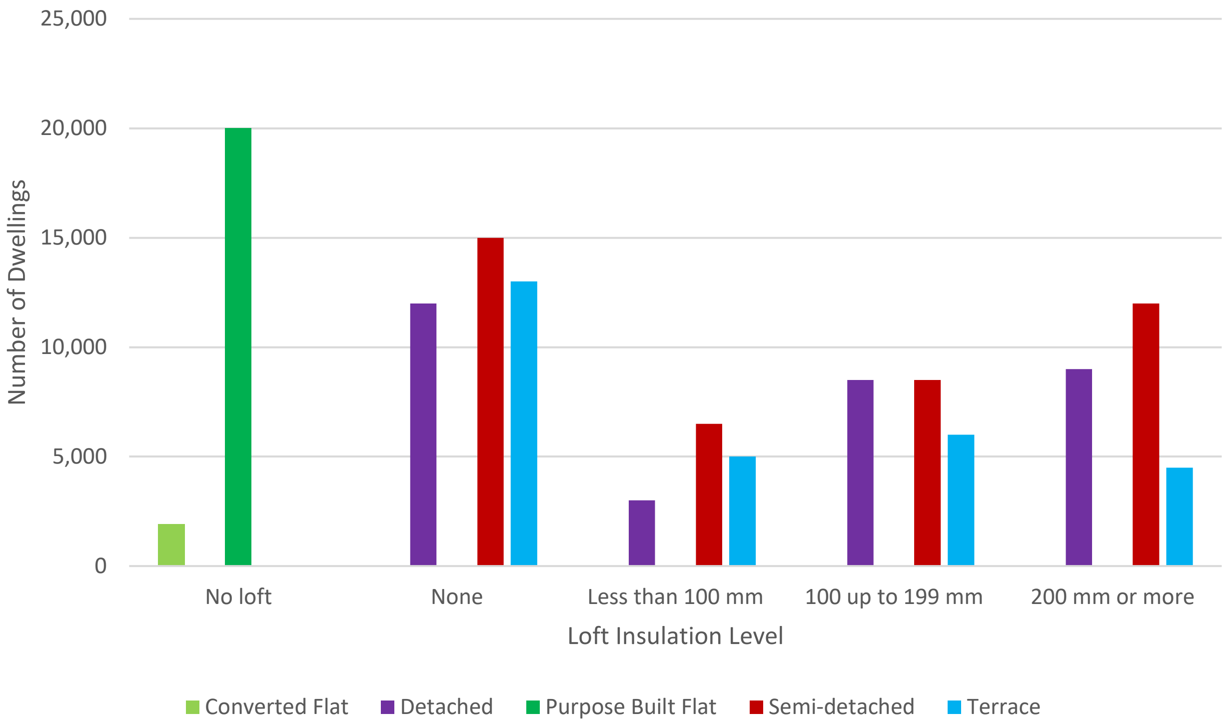


Figure 43: Estimated level of loft insulation (by dwelling type) across the South North Yorkshire sub-region.

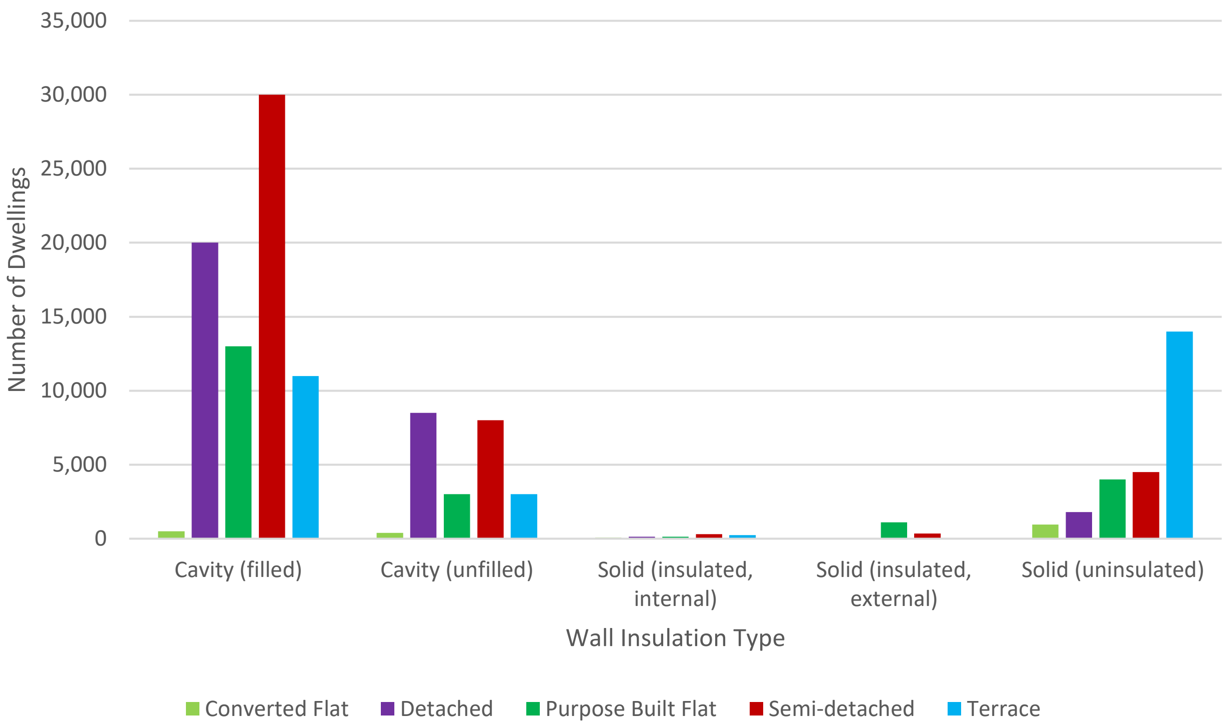


Figure 44: Estimated wall type and insulation level (by dwelling type) across the South North Yorkshire sub-region.

Figure 44 shows that cavity walls are the most prominent wall type (78%) across the South North Yorkshire sub-region, with 76% of these being insulated. Cavity wall insulation can be difficult on some archetypes where there are hung tiles or render on the external face of the brickwork, also around conservatories. Whilst these are deemed 'hard-to-treat' there are methods for ensuring that the cavity can be filled, albeit at a higher cost. Figure 44 also shows that 91% of the solid wall properties in the South North Yorkshire sub-region are uninsulated. This may be due to listed status, other planning restrictions, occupant behaviour/preference, or cost.

96% of dwellings in the South North Yorkshire sub-region have double glazing (Figure 45). Triple glazing is not prevalent in the housing stock.

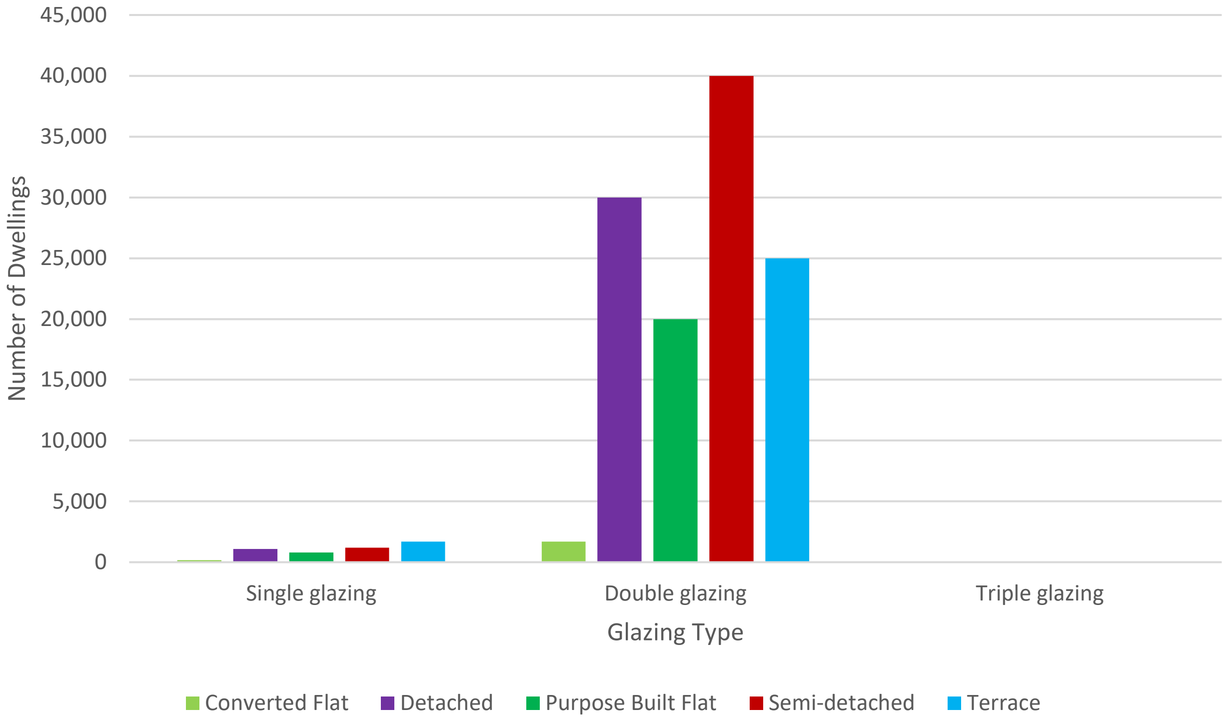


Figure 45: Estimated proportion of glazing type per dwelling type across the South North Yorkshire sub-region.

As well as the domestic stock, the non-domestic stock needs to be considered. The breakdown of the non-domestic building stock across the South North Yorkshire sub-region is shown in Table 15.

Table 15: Breakdown of the non-domestic building stock by type across the South North Yorkshire sub-region.

Type	Floor Area [m²]	Percentage of total floor area	Number of non-domestic buildings	Percentage of non-domestic buildings
Retail	5,500,000	42%	7000	19%
Factory	4,000,000	32%	15,000	41%
Office	1,100,000	9%	8,500	23%
Education	950,000	7%	4,000	10%
Other	850,000	6%	1,700	5%
Warehouse	450,000	3%	950	3%
Total	**13,000,000**	**100%**	**35,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

Data from the National Atmospheric Emissions Inventory (NAEI)[14] has been used to identify large individual emission point sources i.e. emissions from a known location. As well as CO_2, this data shows air pollutants, heavy metals, and base cations[15], and greenhouse gases (GHGs)[16]. The point sources included within the project boundary are shown below in Figure 46. It should be noted that this dataset is for fixed emission sources only, and that non-fixed emissions such as those from road traffic are not included.

[14] https://naei.beis.gov.uk/
[15] https://naei.beis.gov.uk/overview/ap-overview
[16] https://naei.beis.gov.uk/overview/ghg-overview

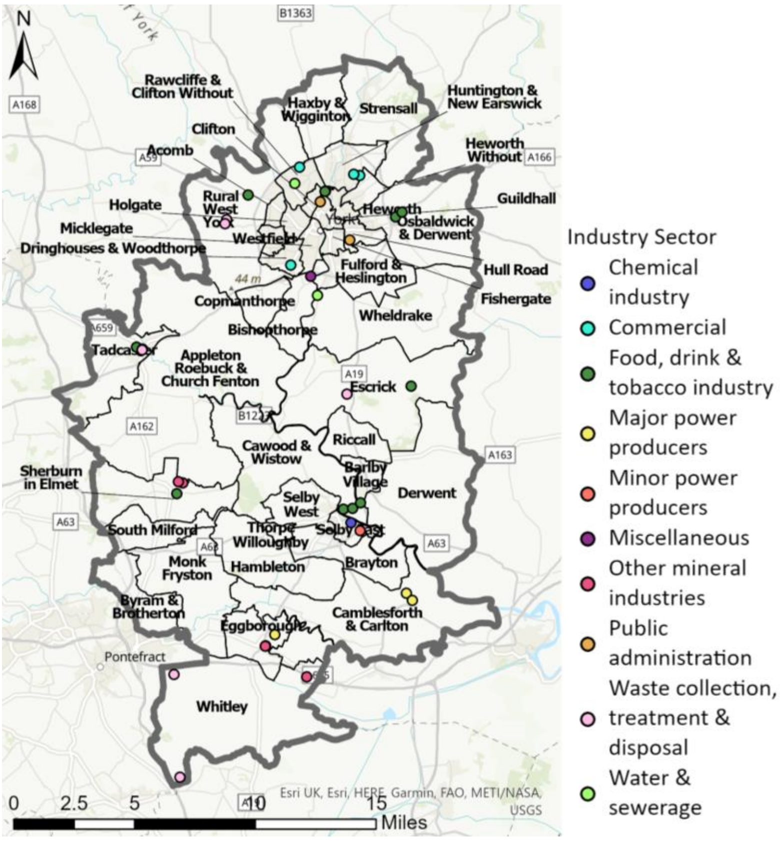


Figure 46: Individual emission sources identified by the National Atmospheric Emissions Inventory (NAEI) across the South North Yorkshire sub-region.

Often the high emitters are located closely together on an industrial park or similar, therefore the definition given in Figure 46 is lacking. However, the data pack accompanying this report provides the same image at an LA level providing more clarity.

2.2.2. Energy Demands

This section will show the estimated annual consumption and peak demands across the South North Yorkshire sub-region in the domestic and non-domestic sectors, and the geographic distribution by LSOA.

Table 16 and Table 17 below show the total figures for the sub-region. Please note: Electricity is supplied locally at 400V (three-phase) which is then connected to a dwelling at 230V (single-phase), therefore for the purposes of these calculations all domestic properties are assumed to be connected at 400V. Large non-domestic loads are assumed to be connected to the electricity network at 11kV; other non-domestic are connected at 400V. Total electricity demand is therefore the sum of demand at the 11kV level and 400V level. Demand from power generators and utilities are not included in these figures.

Table 16: Annual energy consumption [MWh] across the South North Yorkshire sub-region.

Energy Type	Domestic Annual Consumption [MWh]	Non-Domestic Annual Consumption [MWh]	Total Annual Consumption [MWh]
Electricity (11kV)	0	850,000	850,000
Electricity (400V)	400,000	1,200,000	1,600,000
Gas	900,000	2,000,000	2,900,000
Oil	90,000	0	90,000

Table 17: Annual peak demand [MW] across the South North Yorkshire sub-region.

Energy Type	Domestic Peak Demand [MW]	Non-Domestic Peak Demand [MW]	Total Peak Demand [MW]
Electricity (11kV)	0	250	250
Electricity (400V)	120	400	450
Gas	650	800	1400
Oil	65	0	65

The total peak demand is not the sum of the peak demands for domestic and non-domestic buildings since the peak demands of the different sectors occur at different times.

The following maps (Figure 47 to Figure 50) show the distribution of estimated peak and annual energy consumption for both domestic and non-domestic buildings across the South North Yorkshire sub-region. Peak demands shown on these maps may not all occur at the same time of day or time of year. For example, an area predominantly made up of domestic dwellings is likely to have a peak energy demand during the early evening in winter. In contrast, an area that is mainly made up of commercial offices will have maximum energy demand around the middle of the day. Mixed-use areas could have a different peak time depending upon the nature of their buildings.

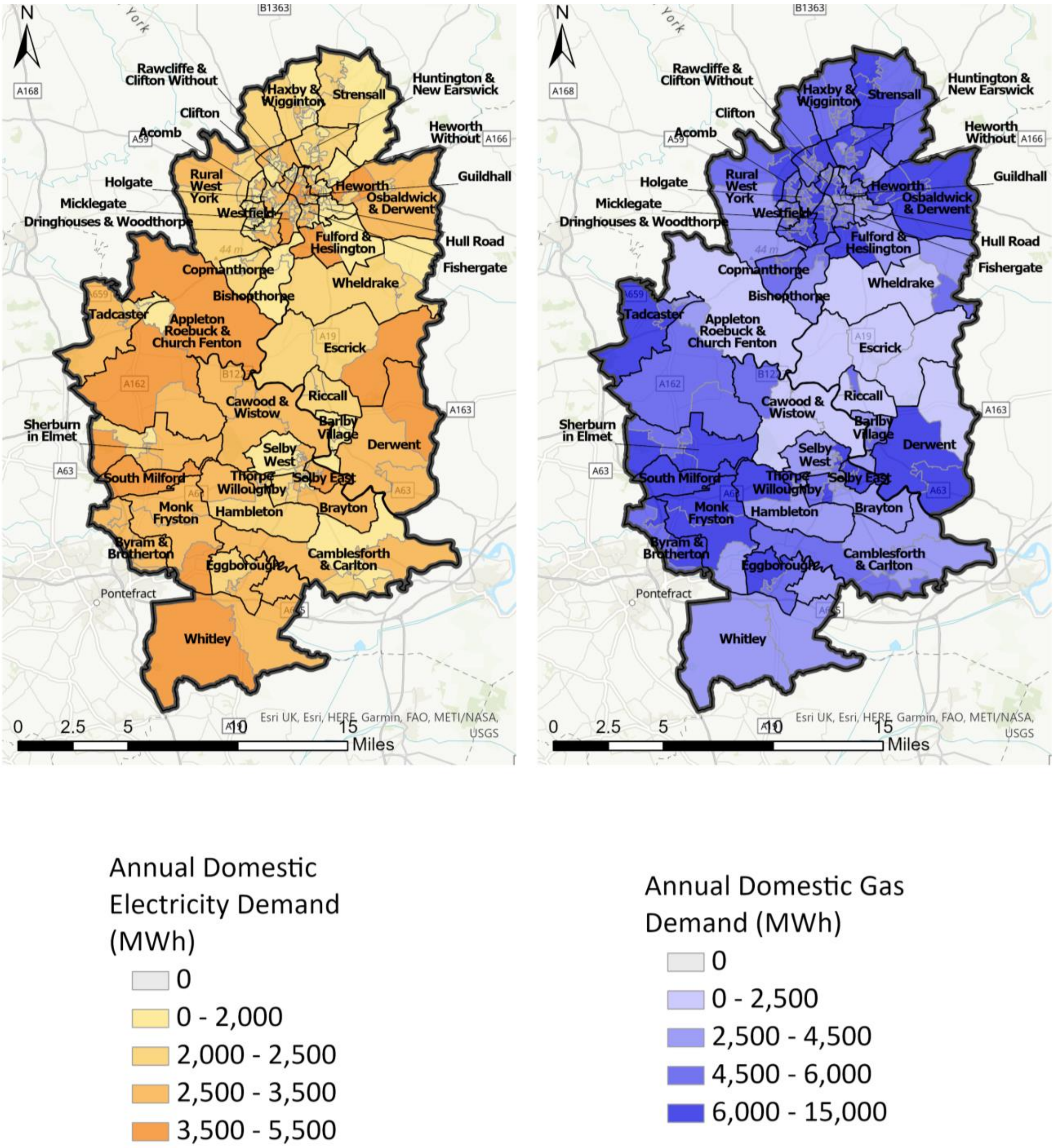


Figure 47: Estimated current domestic annual energy consumption by fuel and LSOA across the South North Yorkshire sub-region.

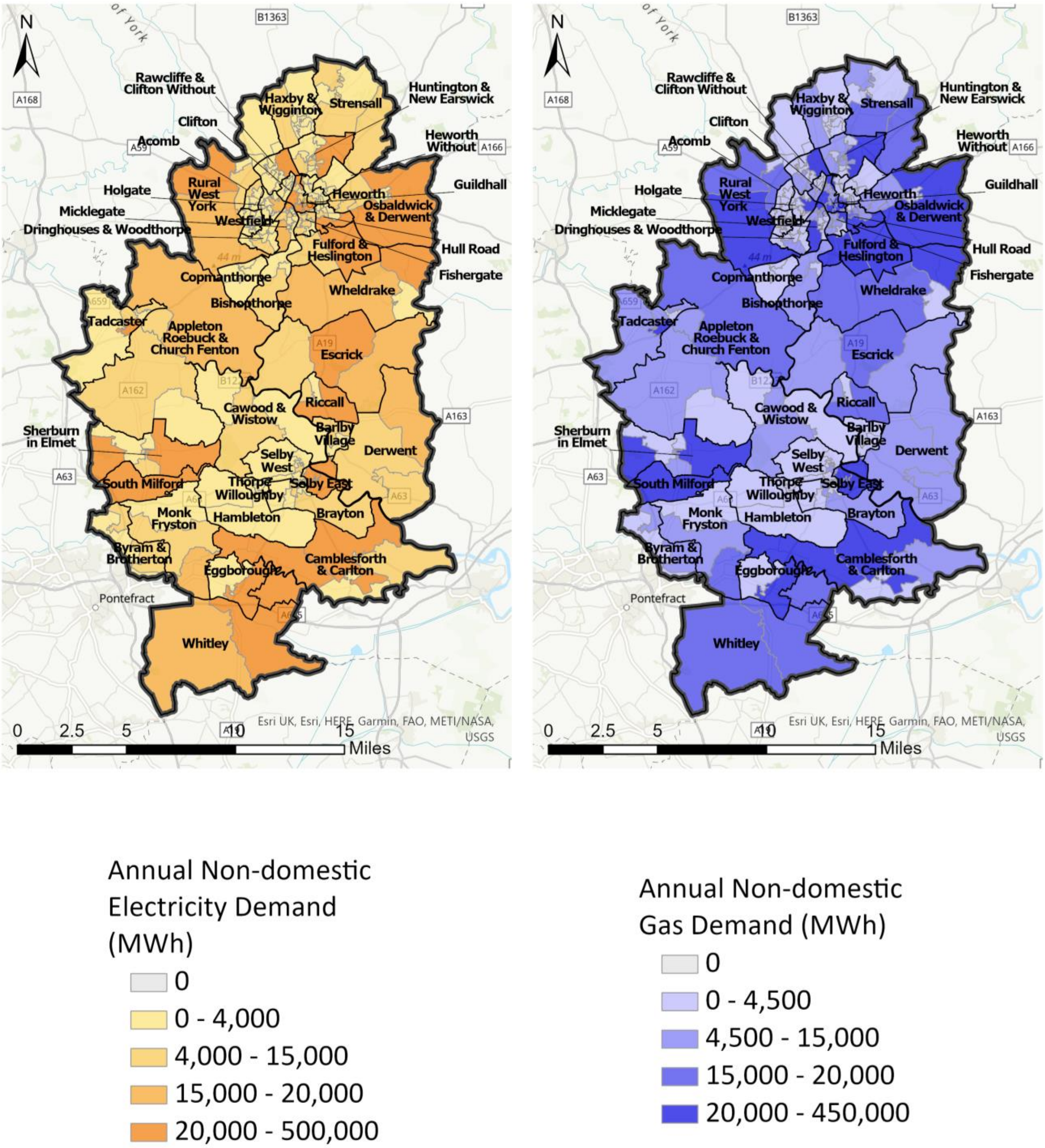


Figure 48: Estimated current non-domestic annual energy consumption by fuel and LSOA across the South North Yorkshire sub-region.

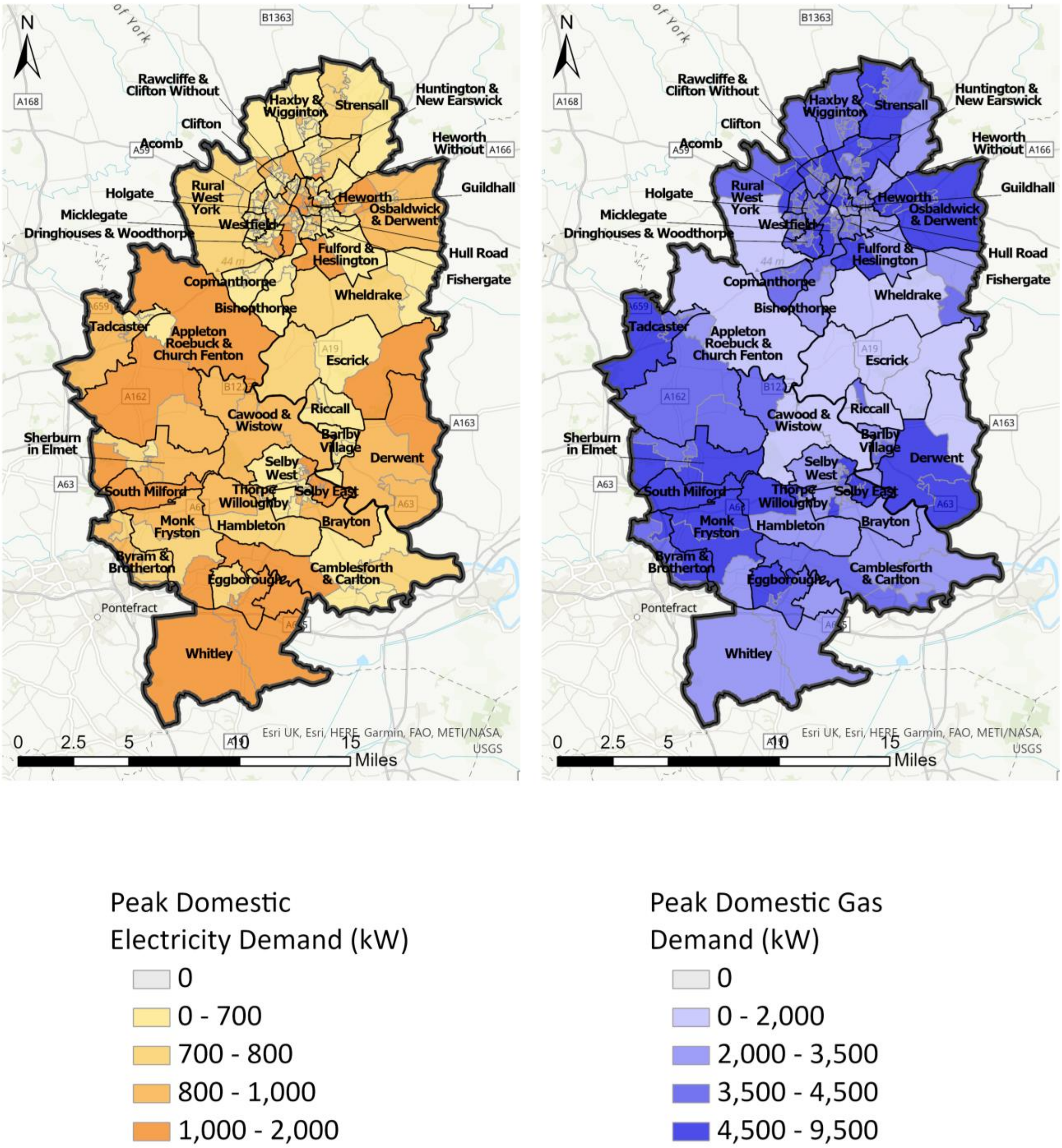


Figure 49: Estimated current domestic peak energy demand by fuel and LSOA across the South North Yorkshire sub-region.

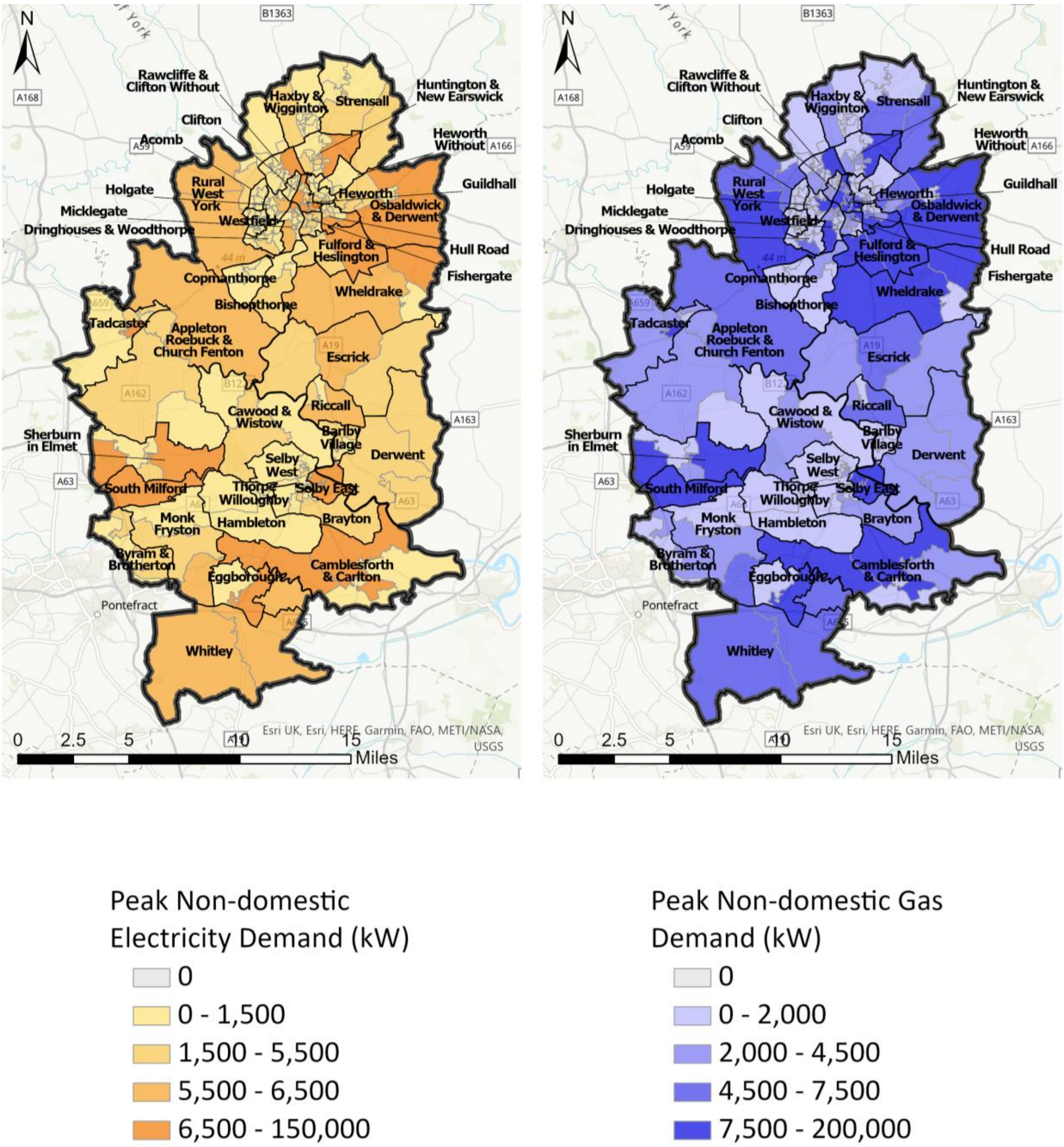


Figure 50: Estimated current non-domestic peak energy demand by fuel and LSOA across the South North Yorkshire sub-region.

Figure 51 shows an estimate of the total electricity demand profile for the South North Yorkshire sub-region for different days of the year representing the lowest typical demand and the highest. The peak day is also shown, which is used to determine a worst-case scenario on the network. Electricity demand includes heat, lighting, appliances, and electric vehicle charging when chargepoints are known to exist in the local area. The profile is for domestic and non-domestic buildings combined.

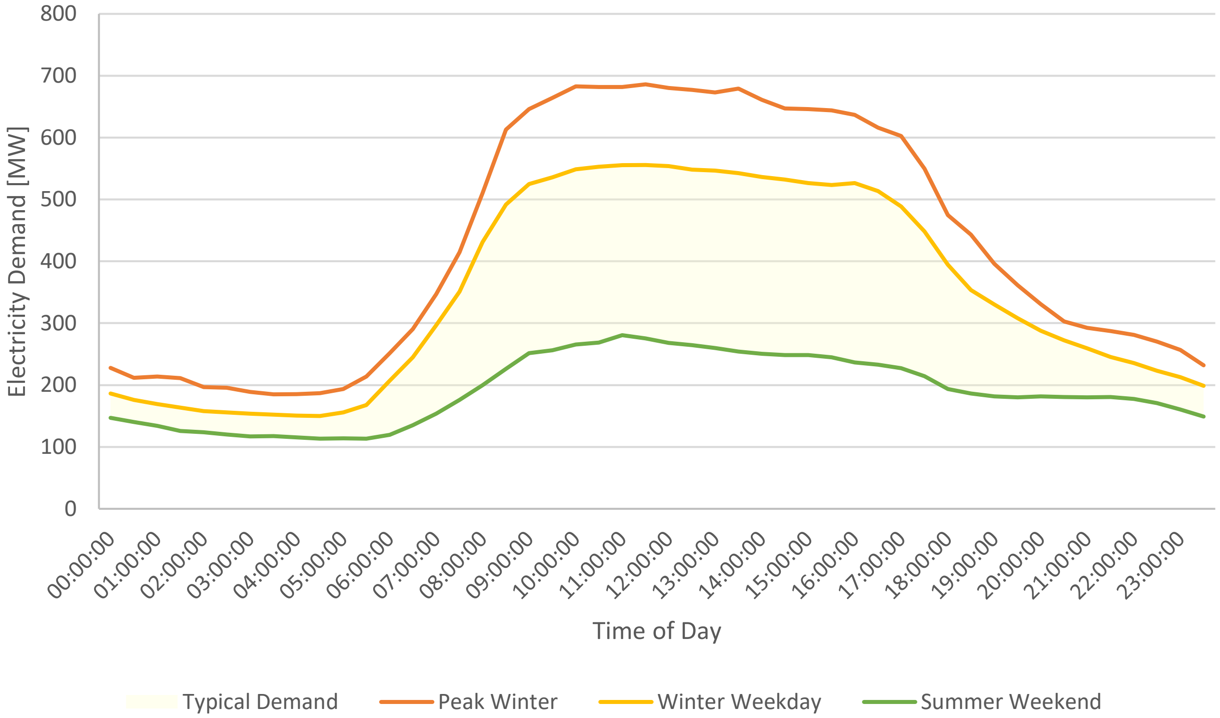


Figure 51: Estimated electricity demand profiles for different days of the year across the South North Yorkshire sub-region.

As expected, the demand is far lower on a summer weekend when compared to a winter weekday.

Summer weekend represents the lowest end of demand profile; being summer means there is less need of heating, and weekend suggests that office/factory buildings are using less electricity, in contrast to a typical winter weekday.

The area between these two demand profiles has been highlighted as the typical demand i.e. the electricity demand will likely be within the shaded area at any given time.

Figure 52 shows the estimated gas demand profile, and Figure 53 shows the estimated oil demand profile, for the South North Yorkshire sub-region for the same days. Gas and oil demand include both heat and hot water and covers domestic and non-domestic buildings combined.

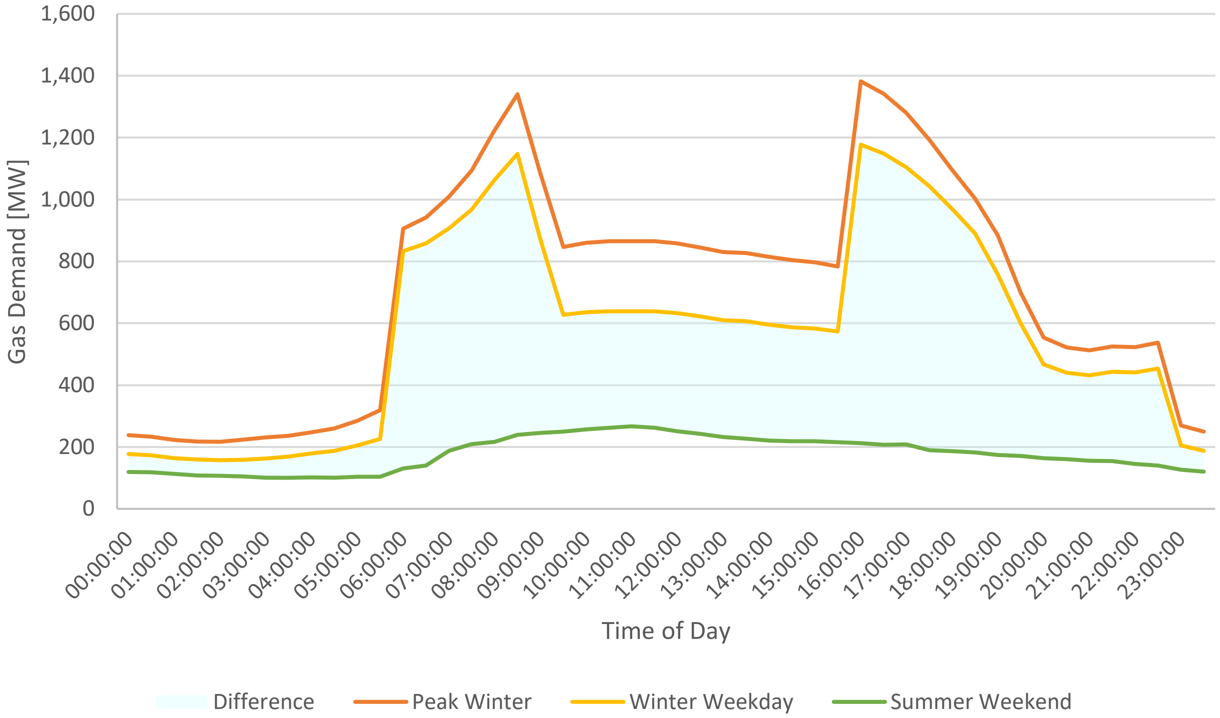


Figure 52: Estimated gas demand profiles for different days of the year across the South North Yorkshire sub-region.

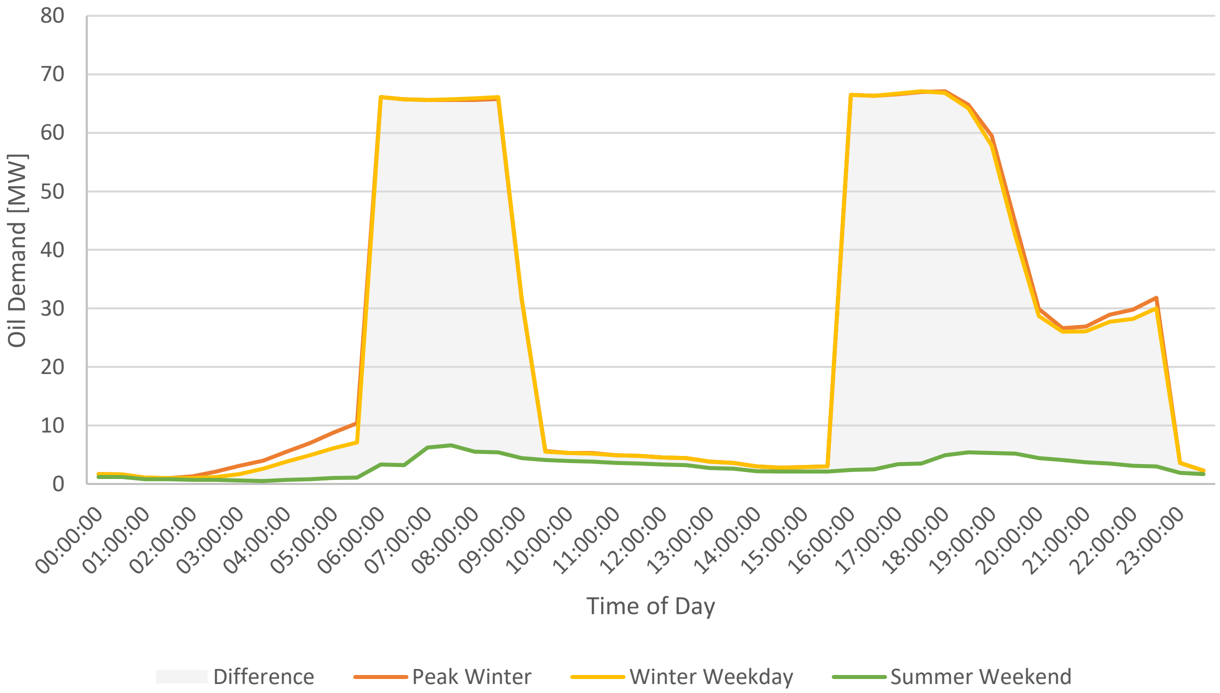


Figure 53: Estimated oil demand profiles for different days of the year across the South North Yorkshire sub-region.

2.2.3. Energy Networks

A good understanding of the energy networks is vital to formulating a forward plan for the decarbonisation of any area. For example, identifying dwellings that are not on the gas network can help to focus a heat pump roll-out programme thus reducing the risk of competing heating vectors such as hydrogen or heat networks being a more financially viable option in the future. To identify those off-gas areas, Xoserve[17] postcode data was used (mapped in Figure 54) before being cross-referenced with Ordnance Survey records to calculate how many dwellings are estimated to be on- or off-gas (Table 18).

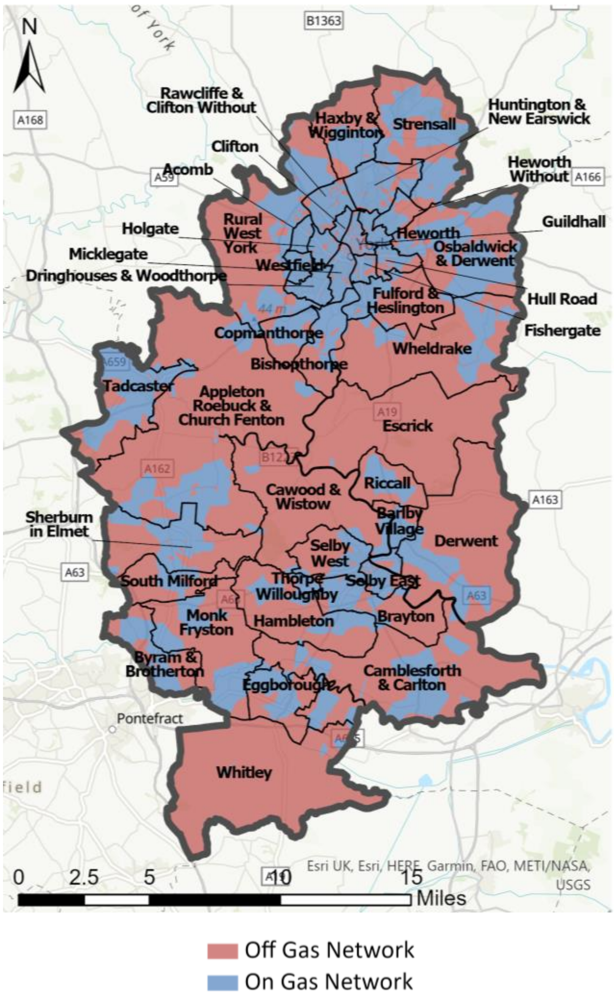


Figure 54: On-gas and off-gas areas of the South North Yorkshire sub-region.

Table 18: Estimate of on-gas and off-gas dwellings across the South North Yorkshire sub-region (rounded to nearest 5,000)

	Number
Off-Gas Dwellings	18,000
On-Gas Dwellings	110,000

Comparing Figure 54 and Table 18 leads to the conclusion that the off-gas grid areas are sparsely populated. This is confirmed by comparing to the location of the building stock.

[17] https://www.xoserve.com/wp-content/uploads/Off-Gas-Postcodes-V2.xlsx

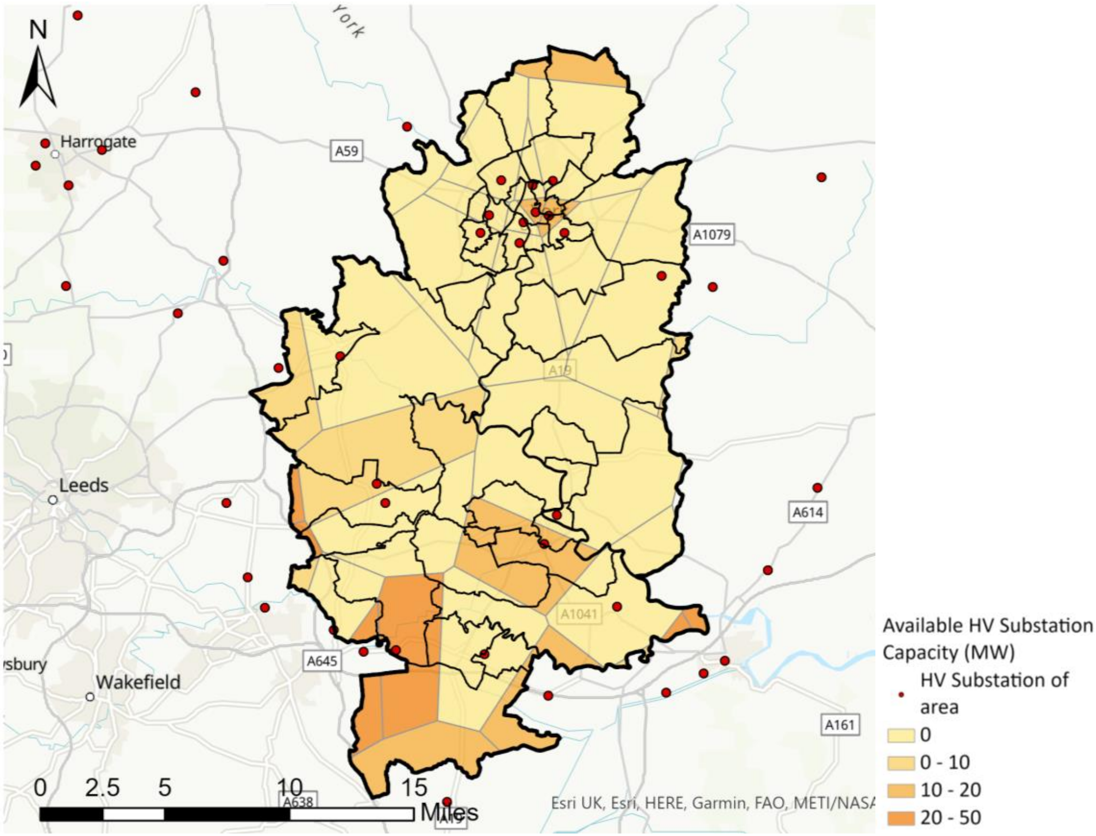


Figure 55: Available high-voltage substation capacity across the South North Yorkshire sub-region.

Figure 55 shows an estimate of the available capacity on each 33kV-to-11kV substation and the extent of the area served by each substation. Capacity is calculated by subtracting the combined peak electrical demand on buildings in each area from the rated capacity of each substation. Those substations shown outside of the South North Yorkshire boundary may serve buildings within it. Substations outside of the boundary have been included since it is likely some may serve assets within the project boundary. This is seen by new polygons that begin next to the project boundary. It should be noted that available capacity of areas on the North Yorkshire boundary may be overestimated since the demands of buildings outside of the county have not been modelled.

Where network connection is important from a project planning perspective the actual areas served should be established in conversation with the local Distribution Network Operator, (DNO) Northern Powergrid. These capacity estimates are intended to give an indication of the capacity available on different parts of the network within the local energy system representation area and are not a substitute for detailed network modelling and analysis conducted by the local DNO. Substations identified as generation only in the DNO data are assumed to have no available capacity. Substations are not included in the analysis where DNO data on locations and capacities are unavailable. Where capacity data is unavailable, but locations are available, the 11kV-to-400kV capacity was set to the most prevalent substation capacity across all of North Yorkshire of 49kW. Where capacity data is only available in MVA, it is assumed that capacity in MVA is equal to capacity in MW, unless power factors are available.

Figure 56 shows an estimate of the number of buildings, both domestic and non-domestic connected to each 33kV-to-11kV substation. As with capacity, the extent has been calculated as the area closest to each substation.

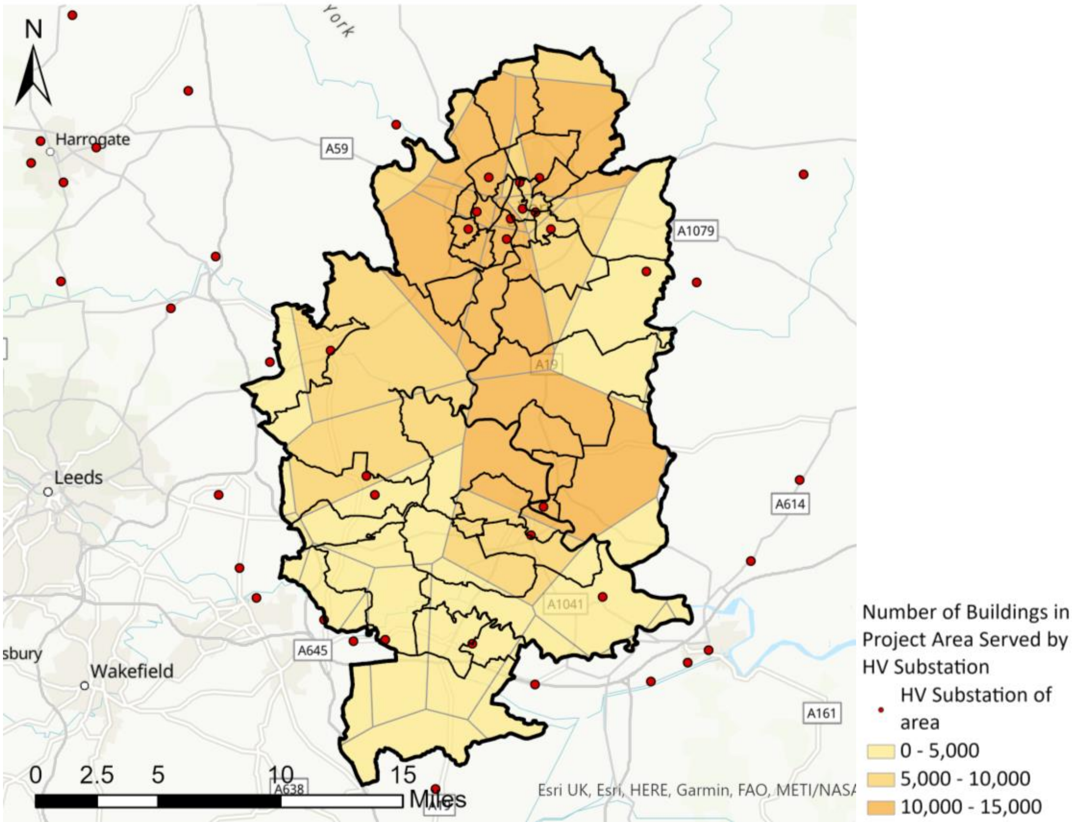


Figure 56: Number of buildings within the South North Yorkshire sub-region served by each high-voltage substation.

2.2.4. Embedded Generation

The Renewable Energy Planning Database (REPD) was used to identify large scale embedded generation across the South North Yorkshire sub-region. These sites, and the associated technologies, are shown in Figure 57. Data on domestic feed-in tariffs from BEIS are used to identify the amount of domestic solar photovoltaic (PV). The total installed capacity for each technology along with an estimate of the annual electricity generated in the local area is given in Table 19. Table 19 shows the proportion of annual electricity demand in the project area estimated to be met currently using local embedded generation. Additional embedded generation technologies may be present in the area but not reported here if they are not recorded in the REPD or if they are below 100 kW.

Table 19: Estimated renewable energy capacity and estimated generation as a proportion of electricity demand in the South North Yorkshire sub-region.

Renewable Tech	**Installed Capacity [MW]**	**Annual Generation [GWh]**	**Proportion of Annual Demand**
Domestic Solar PV	18.7	30	1.2%
Other Solar PV	5	4.5	0.2%
Onshore Wind	24	55	2.3%
Biomass (Co-firing)	645	3,500	149.1%
Biomass (Dedicated)	1,290	7,500	298.3%
Landfill Gas	2.4	10	0.4%

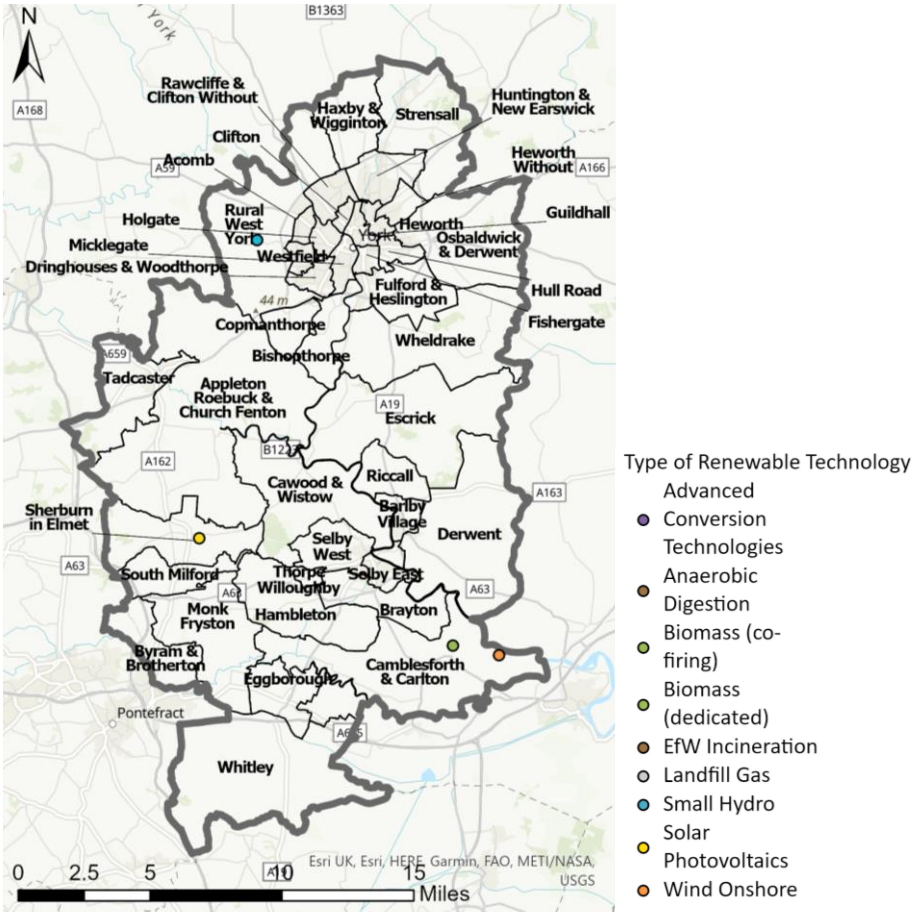


Figure 57: Existing embedded generation in the South North Yorkshire sub-region according to REPD database (October 2020).

Although large biomass dominates in electrical generation, as can be seen from Table 19 domestic solar PV contributes over 1% to the annual demand of the sub-region. Although not all installations of solar PV are registered for the feed-in tariff (FIT), and not all FITs were given to solar PV, the majority will be and therefore Ofgem's Feed-in Tariff Installation Report[18] is a useful way of identifying the overall capacity and number of registrations in each LSOA. Figure 58 and Figure 59 show the installed capacity of renewables and number of registrations respectively.

[18] https://www.ofgem.gov.uk/environmental-programmes/fit/contacts-guidance-and-resources/public-reports-and-data-fit/installation-reports

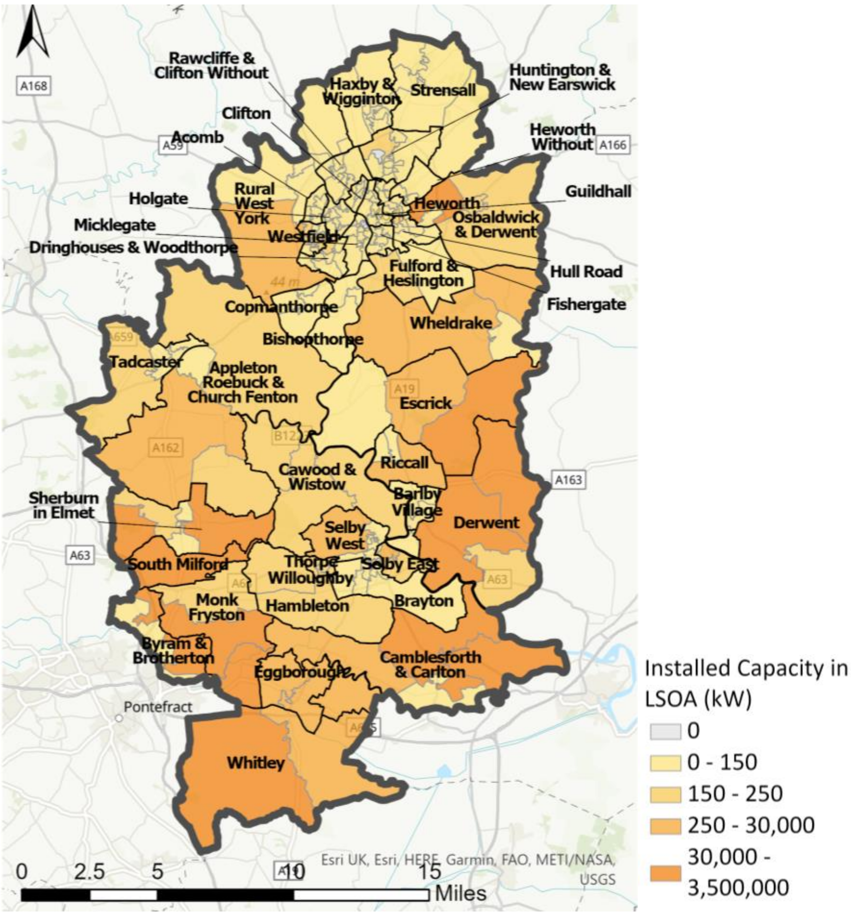


Figure 58: Aggregated capacity of renewable installations registered for FIT within each LSOA of the South North Yorkshire sub-region.

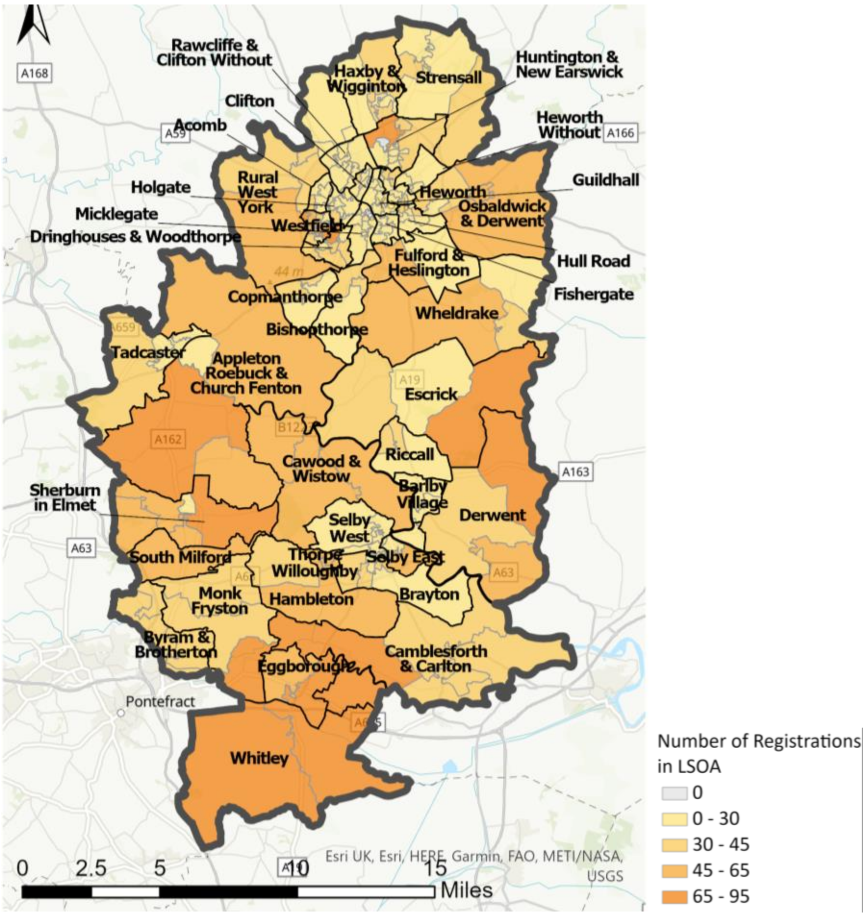


Figure 59: Number of renewable installations registered for FIT within each LSOA of the South North Yorkshire sub-region.

To assess the potential for domestic on-roof solar PV within the South North Yorkshire sub-region, the footprint and orientation of all dwellings have been analysed to calculate the potential generating capacity. These results are then aggregated to 200m radius areas to identify places best suited for mass deployment. The dwellings identified as suitable for rooftop solar PV in each of the three best areas are shown in Figure 60 to Figure 62.

As a purely spatial exercise this analysis does not consider local planning constraints and should not be used as a replacement for a detailed feasibility study or installation design.

1st most concentrated area in S North Yorkshire.

Not suitable

Suitable

Dwellings eligible for PV in area: 491

Combined capacity of these dwellings: 1,222kW

Figure 60: Dwellings identified as suitable for rooftop PV panels. (Location: Huntington, York)

2nd most concentrated area in S North Yorkshire.

Not suitable

Suitable

Dwellings eligible for PV in area: 353

Combined capacity of these dwellings: 1,163kW

Figure 61: Dwellings identified as suitable for rooftop PV panels. (Location: Nether Poppleton, York)

Figure 62: Dwellings identified as suitable for rooftop PV panels. (Location: Huntington, York)

In total these three areas alone have a total potential solar PV capacity of 3.482 MW.

2.2.5. Domestic & Public EV Charging

Data from the Zap-Map®[19] has been used to identify the locations and power outputs of public Electric Vehicle (EV) chargepoints across the South North Yorkshire sub-region. The locations and the speed of the chargepoints are shown in Figure 63. In total there are 141 public chargepoints with a combined capacity of 2,782kW.

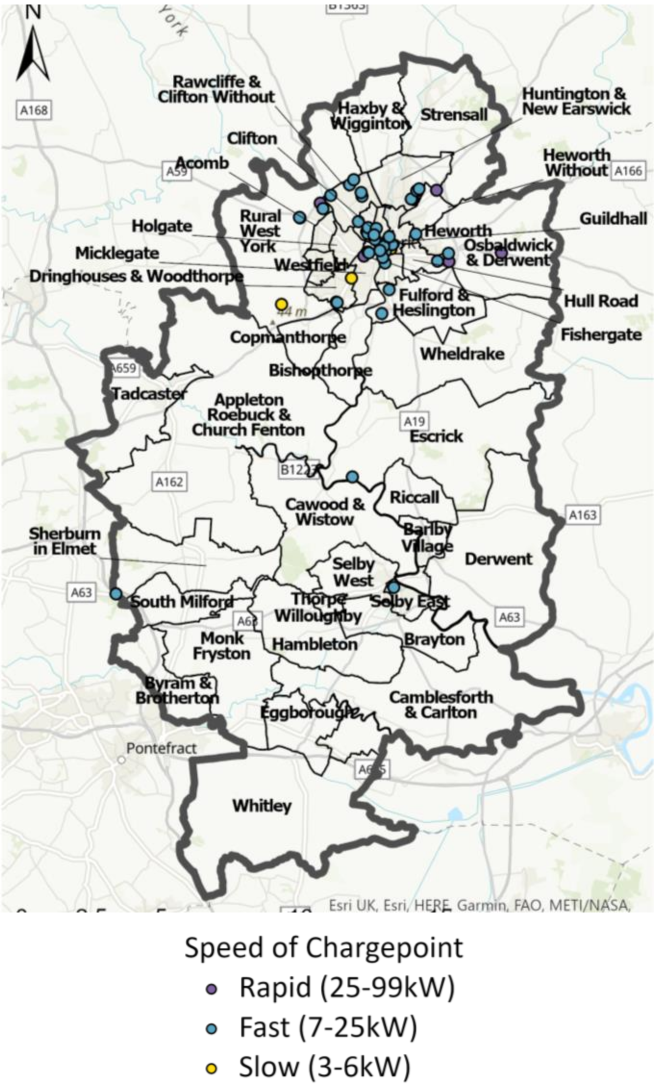


Figure 63: Location of public chargepoints according to Zap-Map® (December 2020)

Chargepoint data provided by Zap-Map®

The Driver and Vehicle Licensing Authority (DVLA) publishes data on the numbers and types of different vehicles registered within different Local Authority Areas. This gives an indication of the number of EVs that might be registered within the sub-region as shown in Table 20.

It should be noted that leased vehicles will be registered to the leasing company which may not be based within the project area.

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[19] https://www.zap-map.com/

Using National Travel Survey data representative charge profiles have been generated for both public and domestic charge points. The estimated peak demands for domestic chargepoints are shown in Table 20.

Table 20: Summary of plug-in vehicles[20] registered in the South North Yorkshire sub-region according to data from DfT

Number of Plug-in Vehicles	Percentage of Total Vehicles	Estimated Peak Demand [kW]
1,008	1.06%	1,668

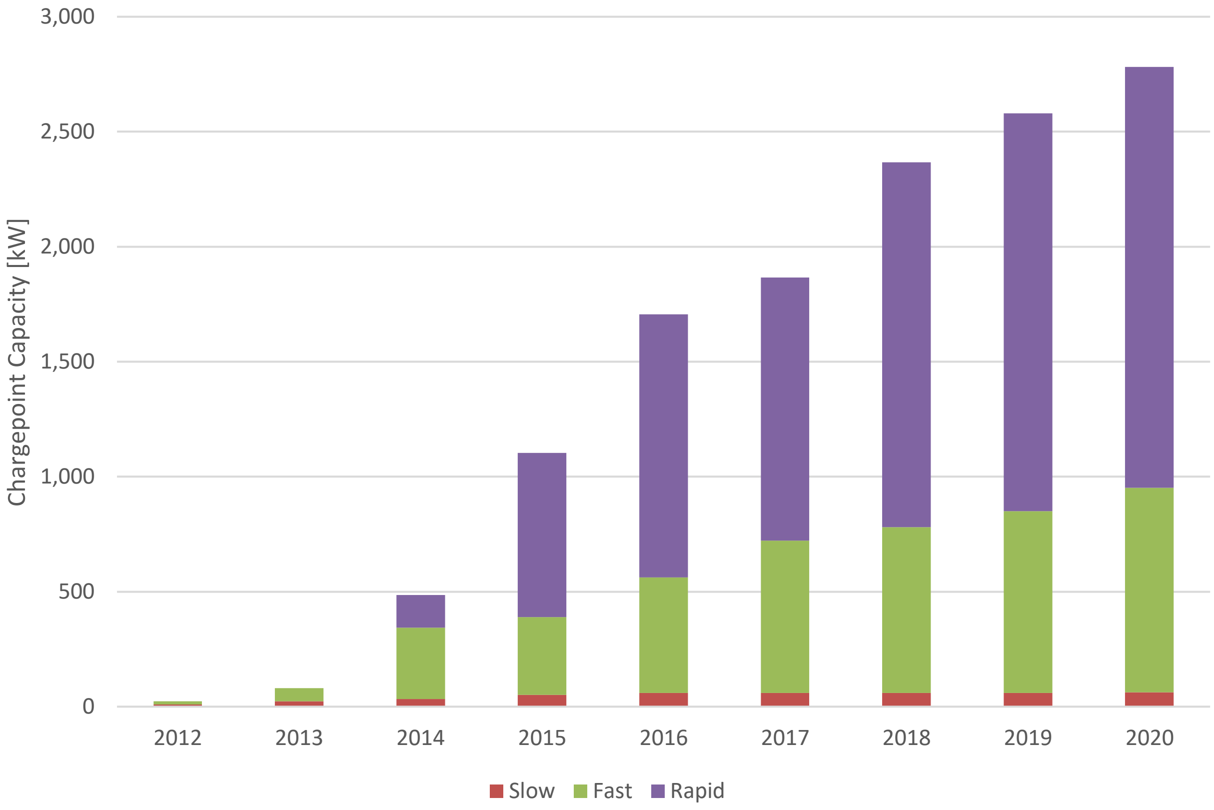


Figure 64: Chargepoint connector total capacity (kW) within the South North Yorkshire sub-region over time.

Using the date that each chargepoint was added to the Zap-Map database the uptake of chargepoints in the area can be analysed. Figure 64 shows this uptake in total kW rating of connectors within the South North Yorkshire sub-region by charger type.

In addition to those electric vehicle charging points shown on the map, there are also additional publicly accessible chargepoints within the Selby District boundary including:

- Lidl Selby – One 22kW and two 50kW chargepoints
- Morrisons Selby – One 22kW and two 50kW chargepoints
- South Parade Car Park – Two 11kW chargepoints

City of York Council are in the process of rolling out a significant electric charging network upgrade. This includes a major expansion of 7.4kW chargepoints, new 50kW chargepoints, and the introduction of 175kW chargers. In 2021, City of York Council have installed (or will soon install) public charging for 136 parking bays with a further 32 across their two HyperHubs in Monks Cross and Poppleton accompanied by 100kW of PV capacity in each location and almost 350kW of battery storage.

[20] Plug-in vehicles are all models identified as being fully electric or plug-in hybrid.

Ordnance Survey Mastermap Topography and Land Registry INSPIRE polygons have been used to identify houses which have space for off-street parking. This is done by attempting to fit a standard UK parking space of 4.8m x 2.4m in the owned area between the house and its nearest road. This helps identify homes that may be able to charge an EV on a driveway, and areas that will require alternative charging solutions for on-street parking. Figure 65 shows the results of this analysis aggregated by road.

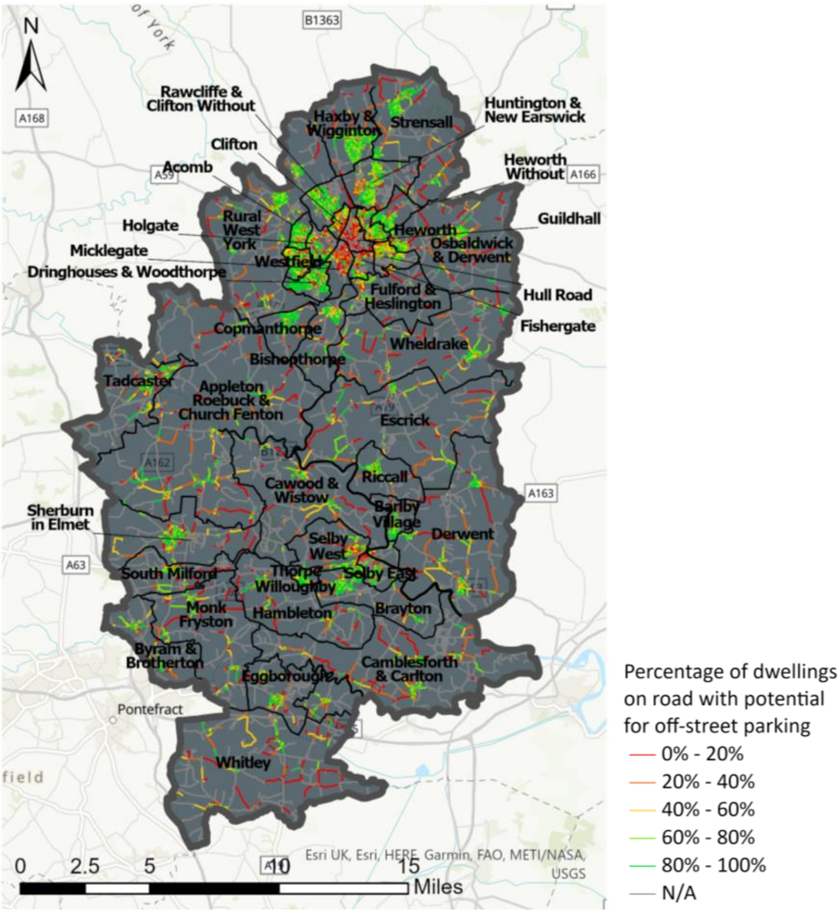


Figure 65: Percentage of dwellings with off-street parking on each road within the South North Yorkshire sub-region.

As a purely spatial exercise this analysis does not consider local planning constraints and should not be used as a replacement for a detailed feasibility study.

2.2.6. Social Data

National data have been used to provide an indication of fuel poverty (Figure 66) and multiple deprivation (Figure 67) across the South North Yorkshire sub-region.

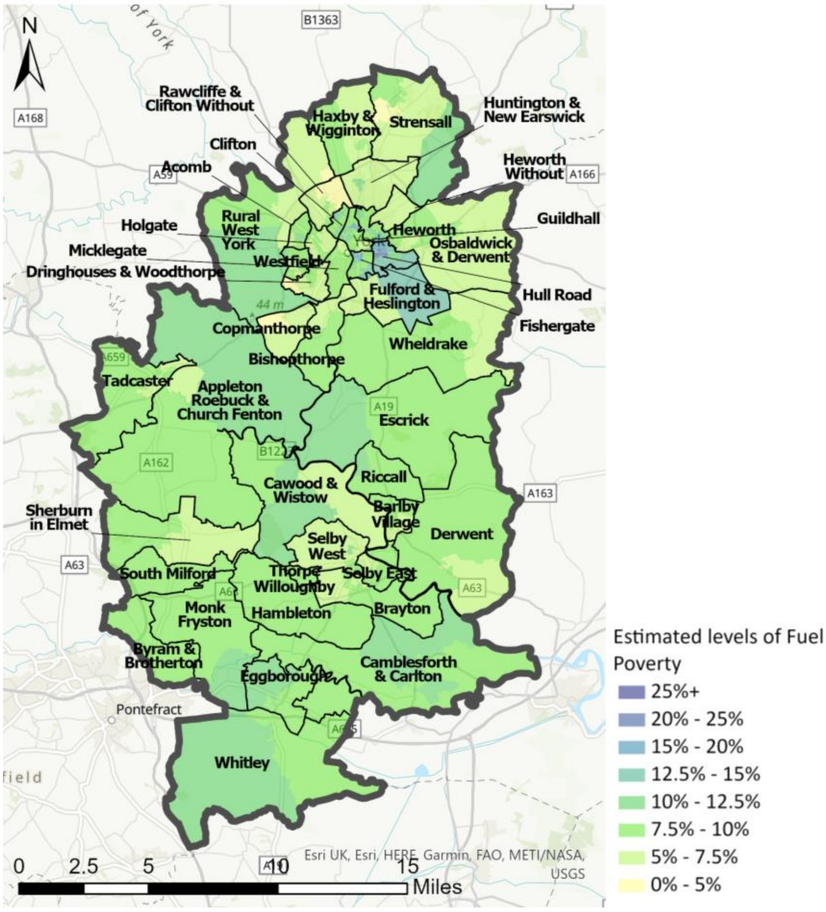


Figure 66: Estimated levels of fuel poverty according to 2020 BEIS data

Using the ranked Index of Multiple Deprivation[21] data published by The Department for Communities and Local Government (DCLG) at LSOA level it is possible to compare localised levels of deprivation within the South North Yorkshire sub-region against the rest of England. For mapping purposes these are shown by octile, with values falling in octile 1 being within the most deprived 1/8th of the country and values falling in octile 8 being within the least deprived 1/8th of the country.

[21] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015
For descriptions of the underlying indicators used in the indices of deprivation please refer to this document: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/467775/File_8_ID_2015_Underlying_indicators.xlsx

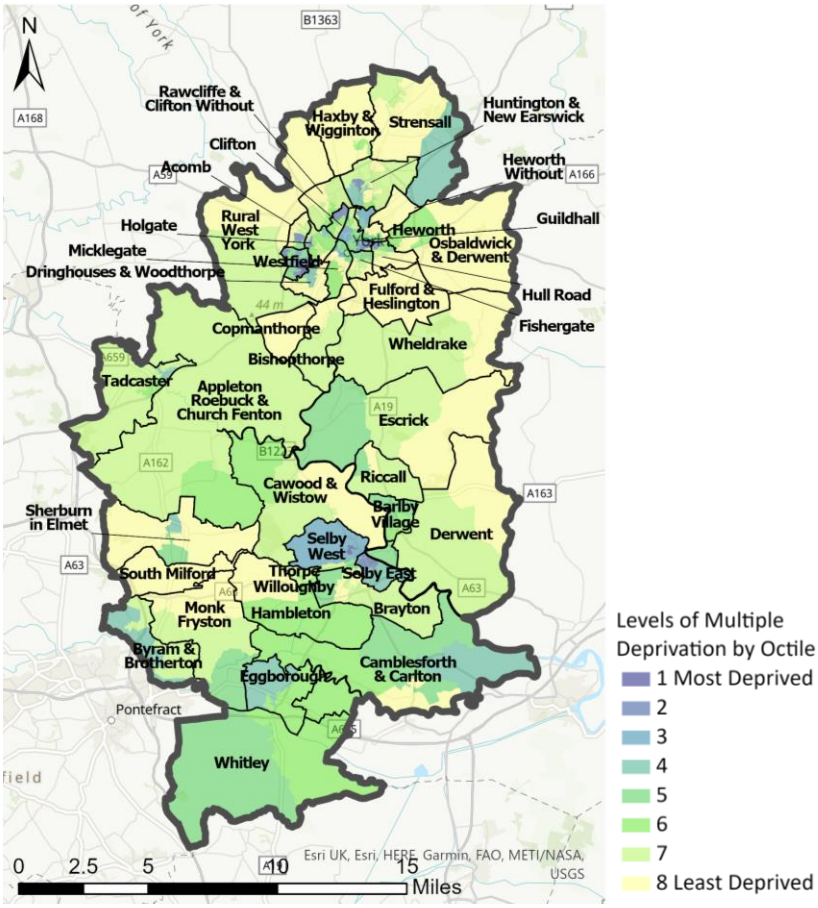


Figure 67: Ranking of English indices of deprivation 2020

The multiple indices that make up the IMD can be found in the accompanying data/maps to this report.

2.3. West North Yorkshire (Craven, Harrogate & Richmondshire)

The sub-regional area of 'West North Yorkshire' has been defined in this report as covering the local authority areas of Craven, Harrogate and Richmondshire which collectively cover an area of 3,804 km^2 and have a population of around 271,000.

2.3.1. Building Stock

This section will provide an overview of the building stock – both domestic and non-domestic – across the West North Yorkshire sub-region. The geographical location of the building stock will be shown, as will the relative rurality across the sub-region, and breakdowns of the domestic and non-domestic stock by category.

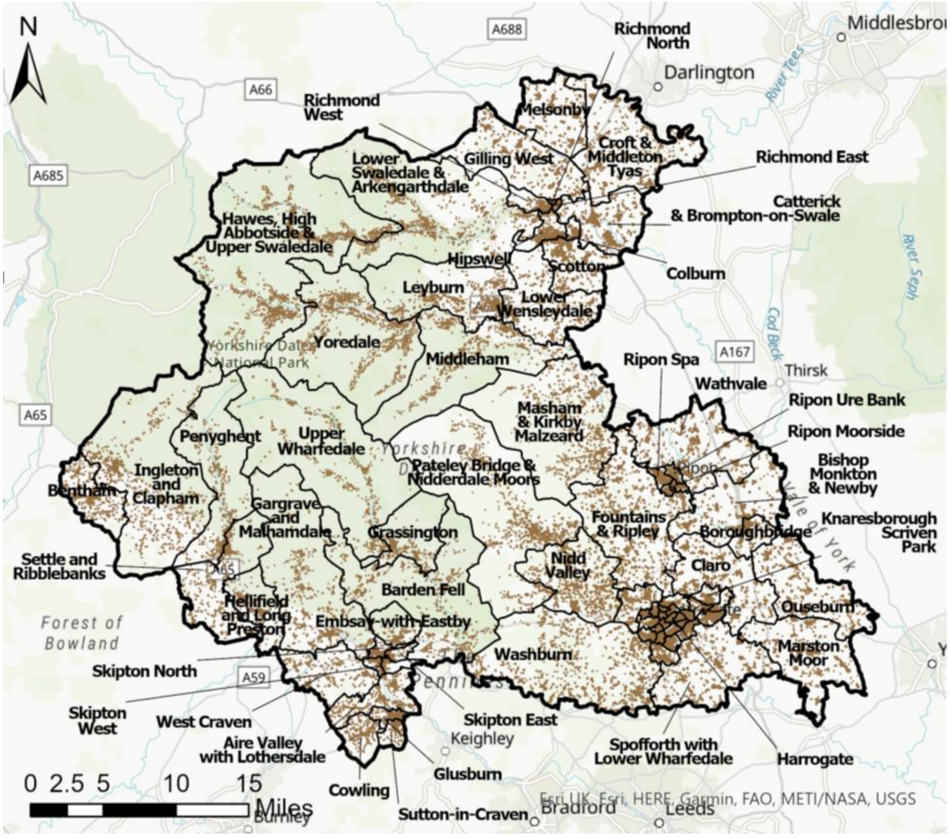


Figure 68: Building stock distribution across the West North Yorkshire sub-region.

Figure 68 shows that across the West North Yorkshire sub-region, the building stock is distributed into clusters around conurbations including Harrogate, Richmond, Ripon, and Skipton with the building stock being less densely situated elsewhere, particularly in the Yorkshire Dales.

These areas correlate well to the rural/urban classifications given in the rurality map (Figure 69).

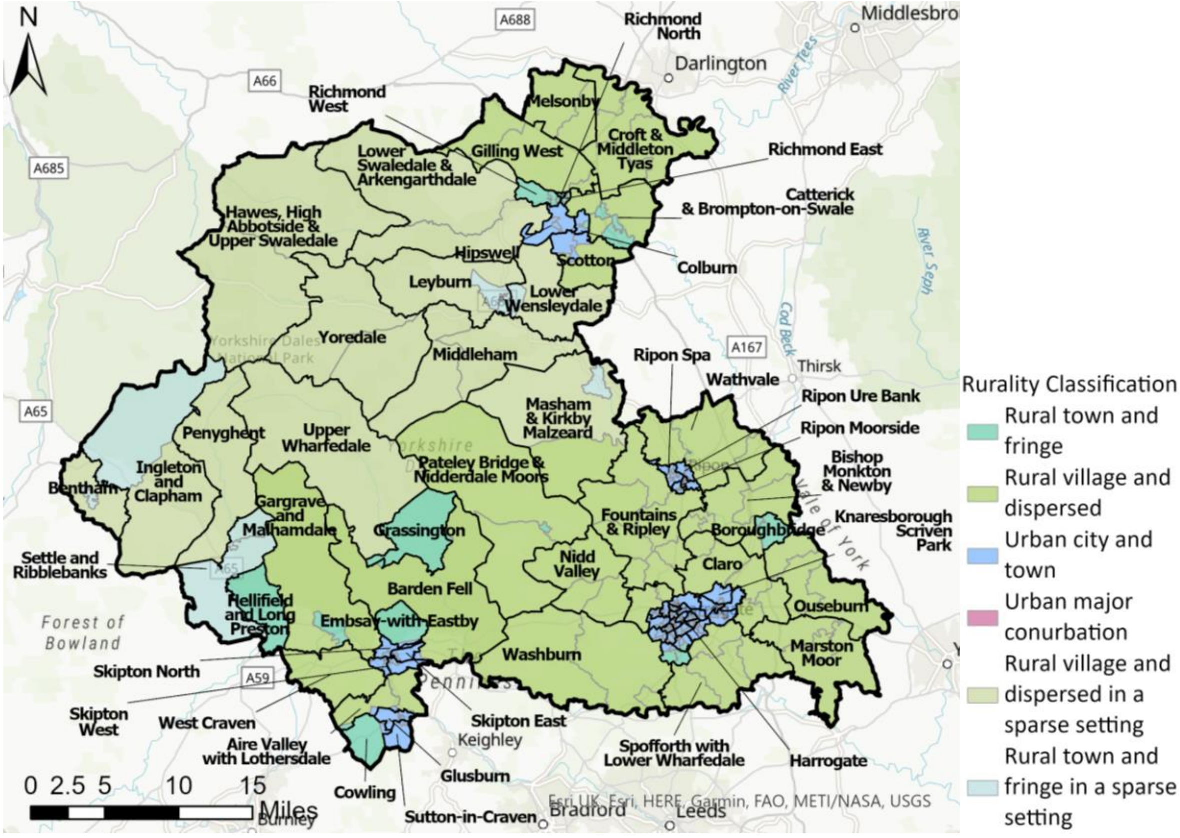


Figure 69: Rurality of the West North Yorkshire sub-region.

Figure 69 shows the rurality of the West North Yorkshire sub-region by Lower-level Super Output Area (LSOA) and overlayed by electoral wards. Most of the land area in the West North Yorkshire sub-region is classified as rural towns and villages with the more urban areas matching those noted in Figure 68.

Using data provided by Historic England[22], the location and grade of listed buildings and scheduled monuments can be mapped within the sub-region. In addition, data published by Historic England on Battlefields, World Heritage Sites and Parks & Gardens mapped alongside (Figure 70).

[22] https://historicengland.org.uk/listing/the-list/data-downloads

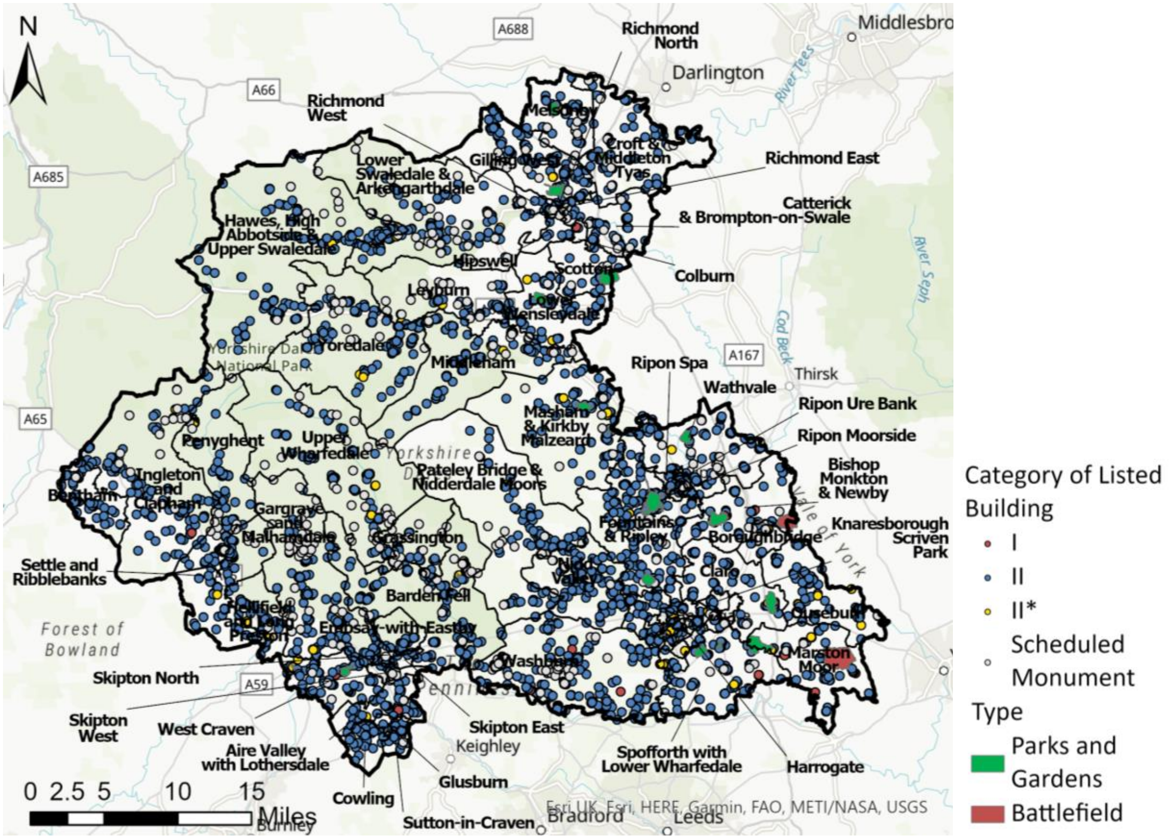


Figure 70: Location of listed buildings in the West North Yorkshire sub-region grouped by grading according to Historic England

Figure 70 shows the large number of listed buildings, scheduled monuments, and areas of interest clustered in similar locations to the building stock. This could all pose a challenge to decarbonising the building stock. Table 21 shows the Listed Status of the buildings and the number of occurrences.

Table 21: Summary of listed buildings across West North Yorkshire by grade category.

Grade Category	Number
Grade I	115
Grade II	5,467
*Grade II**	5,717
Scheduled Monument	494

To understand the housing stock in more detail, the domestic stock has been segmented by:

- Type (converted flat, detached, purpose-built flat, semi-detached, and terrace)
- Construction date (pre-1914, 1914-1944, 1945-1964, 1965-1979, post-1980)
- Floor area [m^2] (under 50, 50-70, 70-90, 90-110, 110-200, 200-300, over 300)
- Main heating system (ASHP, biomass, electric (no storage), electric storage, gas, GSHP, oil/LPG)
- Loft insulation level [mm] (no loft, no insulation, 1-99, 100-199, over 200)
- Wall type (filled cavity, unfilled cavity, solid with ESWI, solid with ISWI, uninsulated solid)
- Window type (single glazing, double glazing, triple glazing)

Table 22: Number and percentage of dwelling types across the West North Yorkshire sub-region.

Dwelling Type	Number	Percentage
Converted Flat	3,500	3%
Detached	35,000	28%
Purpose Built Flat	20,000	18%
Semi-detached	35,000	27%
Terrace	30,000	24%
Total	**120,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

Table 22 shows that larger dwelling types are more prevalent across the sub-region. The prevalence of the dwelling types in each LSOA area (Figure 71) shows that detached dwellings are typically the most dominant in rural areas, whereas semi-detached are more common in urban areas.

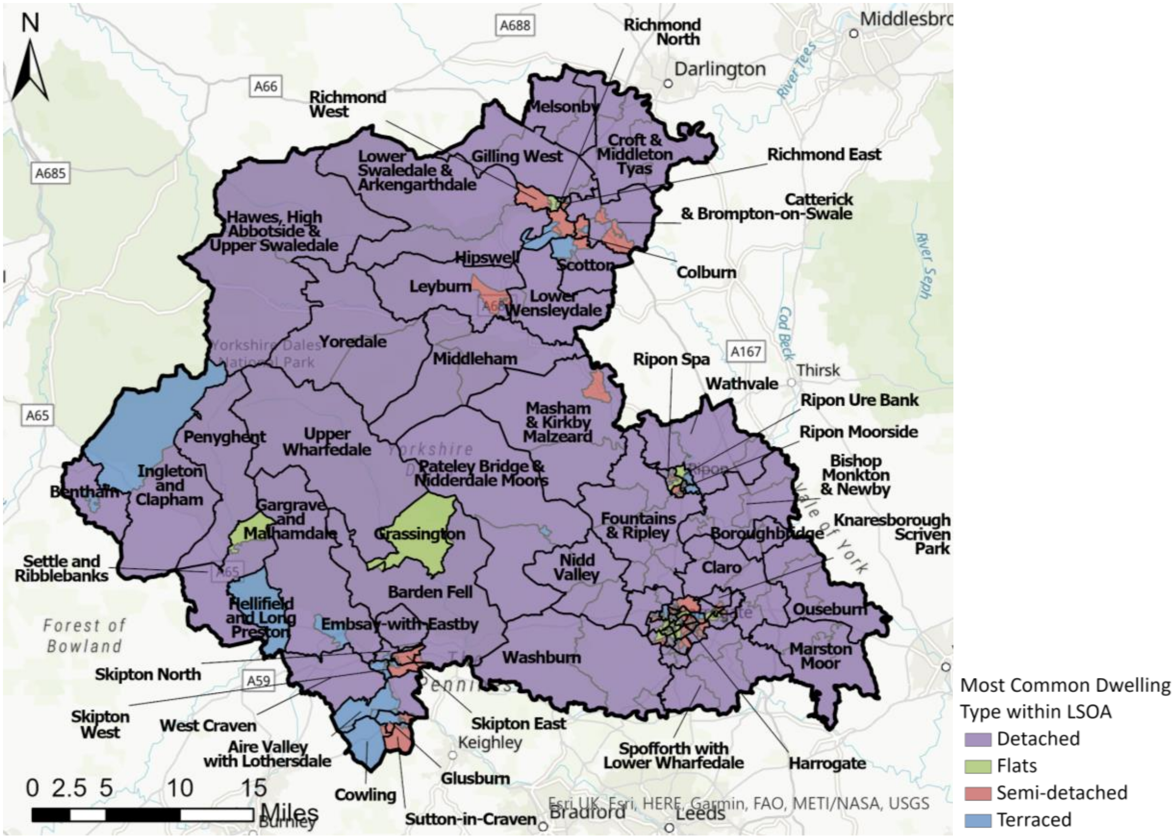


Figure 71: Most common dwelling type within each LSOA across the West North Yorkshire sub-region.

A notable finding, shown in Table 23 is that almost a quarter all domestic dwellings are over a century old which will likely require more substantial intervention to bring their heat loss to a point where a heat pump could be considered.

Table 23: Number and percentage of dwellings constructed in different periods across the West North Yorkshire sub-region.

Dwelling Construction Period	Number	Percentage
Pre-1914	30,000	22%
1914-1944	10,000	8%
1945-1964	40,000	31%
1965-1979	30,000	24%
1980-present	18,000	14%
Total	**120,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

By combining the dwelling type and the construction period, it can be seen in Figure 72 that over half of the pre-1914 dwellings are terraced (c.14,000, 11%). The most prevalent however is the post-war (1945-1964) semi-detached (c.16,000, 13%)

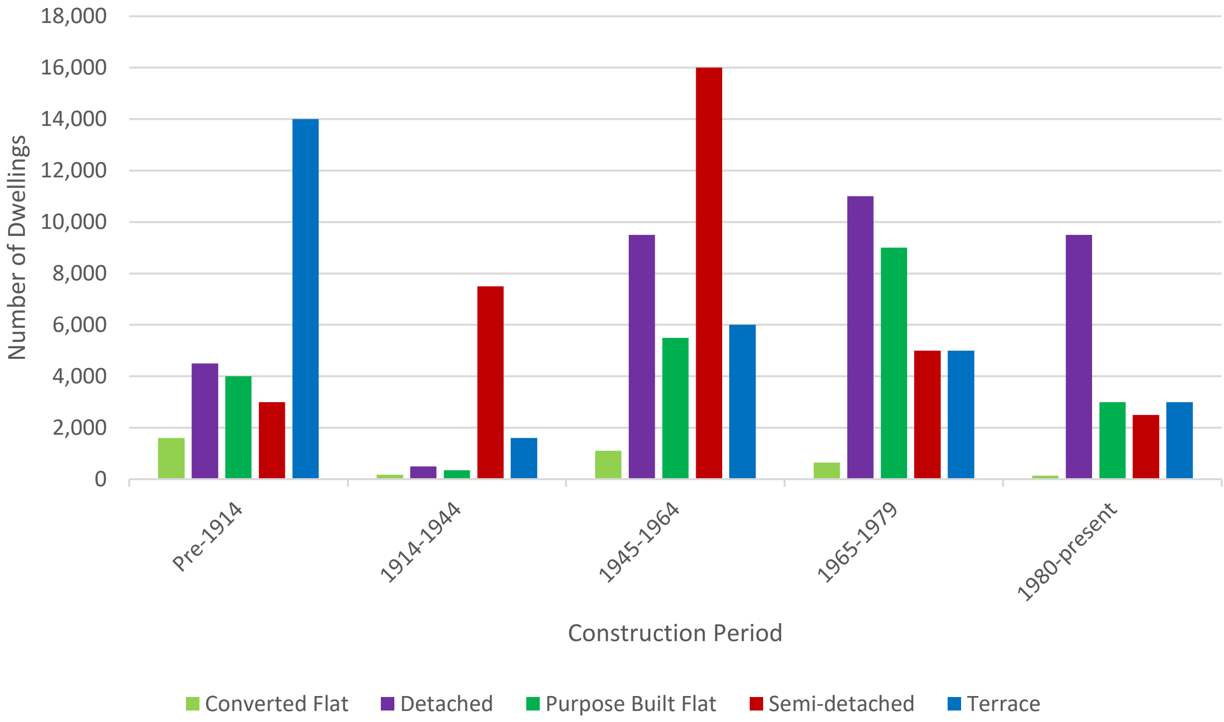


Figure 72: Estimated number of dwellings within each construction period (by dwelling type) across the West North Yorkshire sub-region.

This can be visualised spatially (Figure 72) to show the most prevalent construction year in each LSOA in the West North Yorkshire sub-region. Figure 72 shows a prevalence of 1945-1964 built dwellings in many of the larger electoral wards.

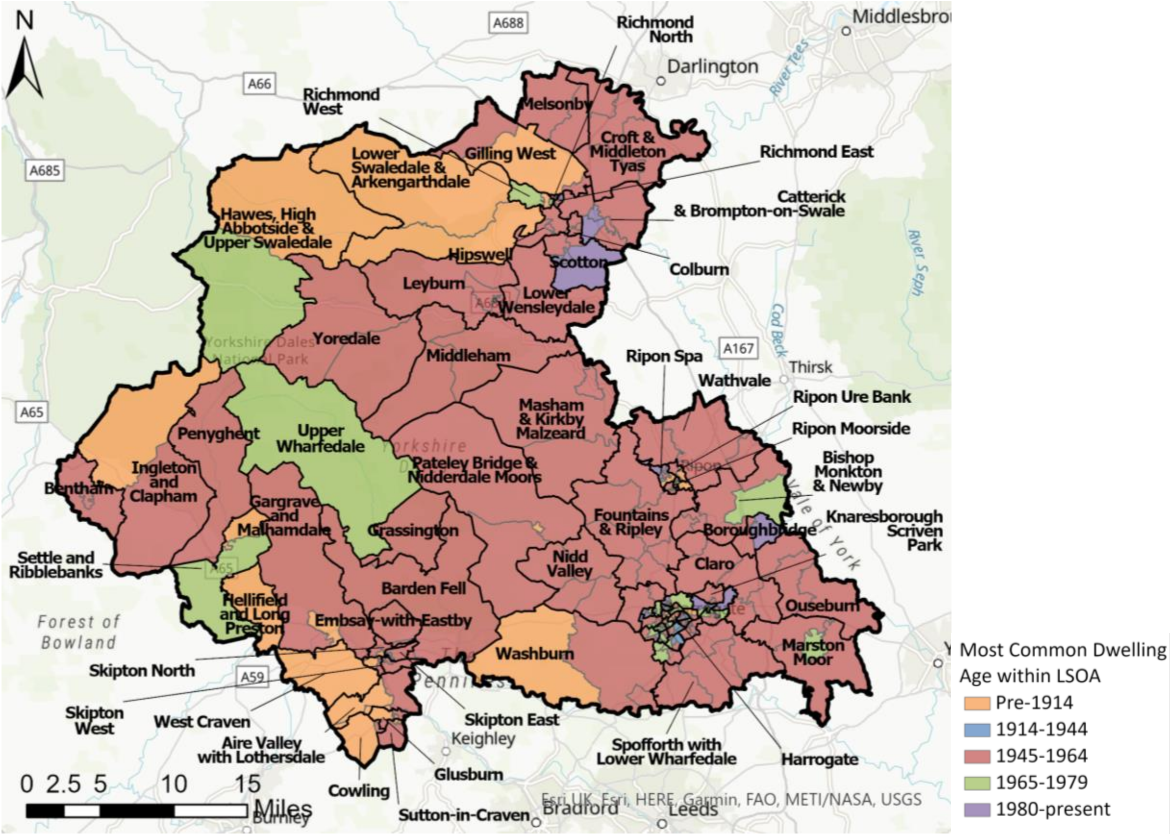


Figure 73: Most common construction period within each LSOA across the West North Yorkshire sub-region.

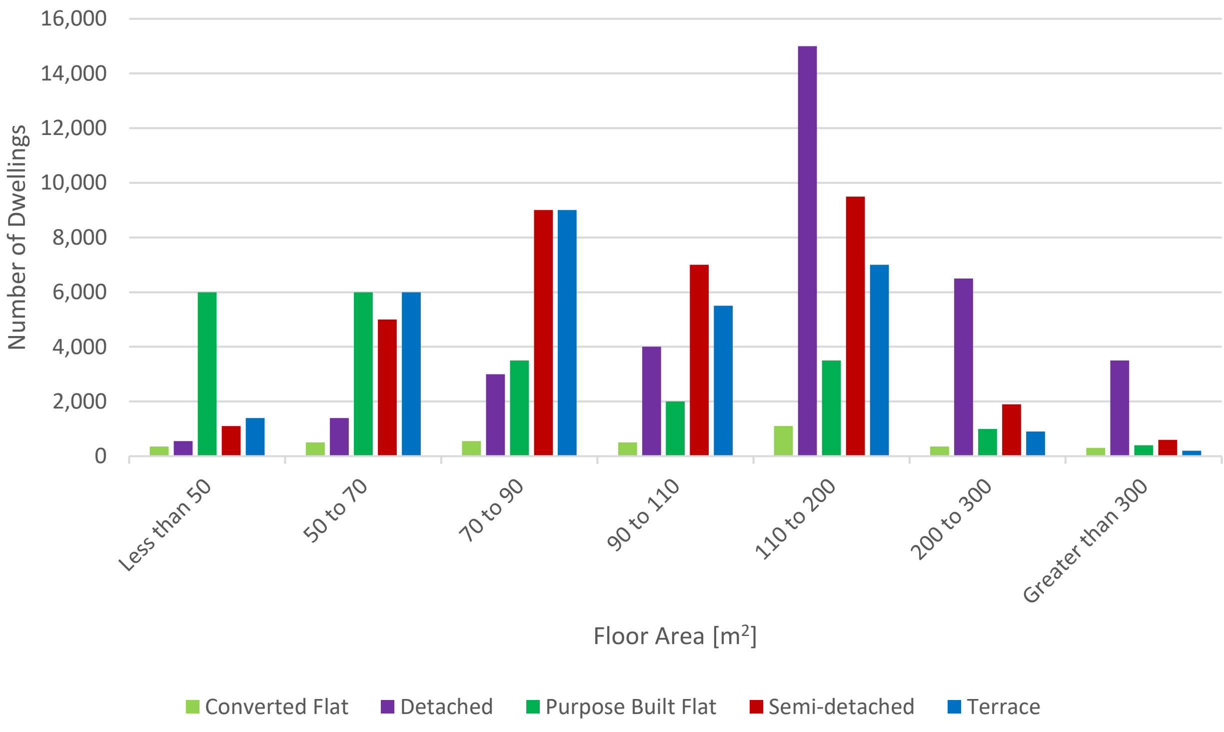


Figure 74: Estimated number of dwellings within each floor area band (by dwelling type) across the West North Yorkshire sub-region.

From Figure 74, as expected, flats (particularly purpose-built flats) typically have a lower floor area than semi-detached and detached dwellings. 54% of purpose-built flats have a floor area of under 70m^2 whilst 44% of detached dwellings have a floor area of between 110 and 200m^2.

Dwellings in the West North Yorkshire sub-region are overwhelmingly heated using a fossil fuel boiler (90%) with the remainder being made up from electric storage heaters (8%). Electric storage heaters are often used in modern flats where heat losses are low. Oil/LPG boilers are typically used in off-gas grid areas which in turn are often rural. Figure 75 below shows that over one-third of detached dwellings use oil/LPG boilers as their main heating system. Gas boilers are prevalent throughout the housing stock.

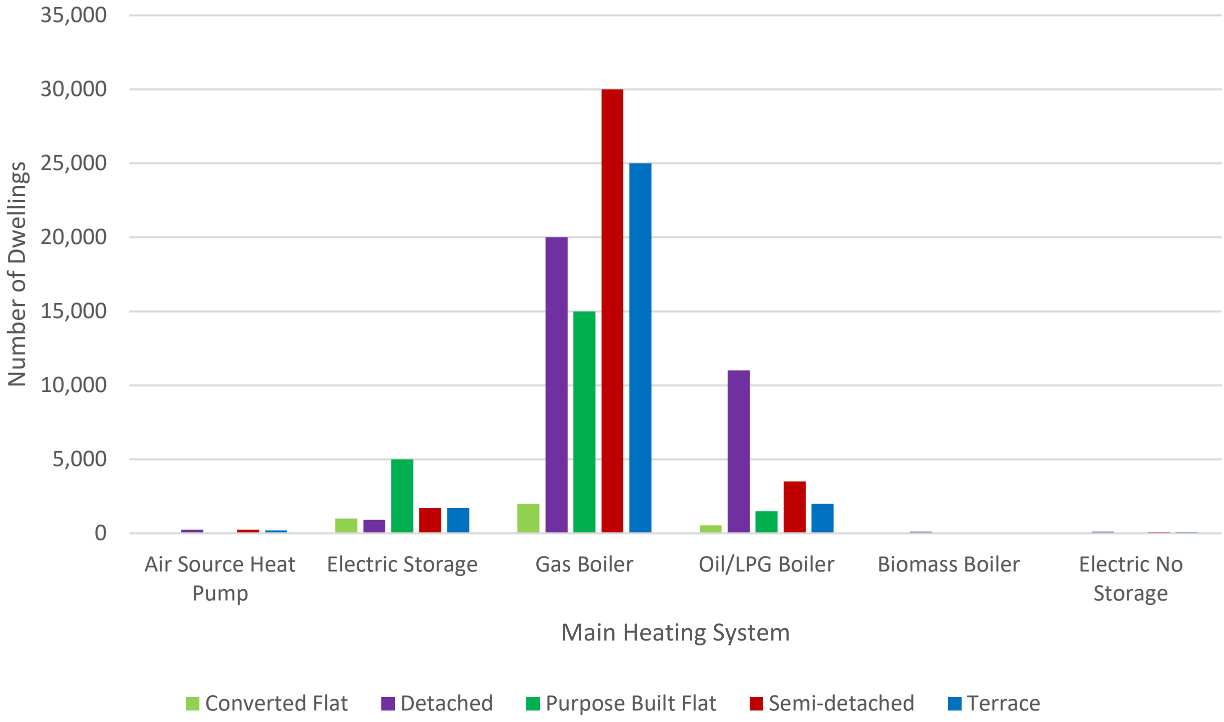


Figure 75: Estimated number of dwellings by main heating system (by dwelling type) across the West North Yorkshire sub-region.

To make a heating system as efficient as possible insulation is required to reduce the heat loss from a dwelling. Figure 76 shows the level of loft insulation in each dwelling type. Flats (both converted and purpose built) are assumed not to have a loft to insulate as even those on the top-floor are unlikely to be able to access the loft space in which to add insulation. There are also a small number of detached, semi-detached, and terraced properties that are classified as having no loft; this is usually due to them having a 'room-in-roof' where the loft has been converted into part of the living area.

The expected level of loft insulation in the UK is 270mm meaning that at least 43% of the dwellings in the West North Yorkshire sub-region that would benefit from additional loft insulation, particularly semi-detached and terraced dwellings which have 25% and 30% of the stock with under 100mm of loft insulation, respectively.

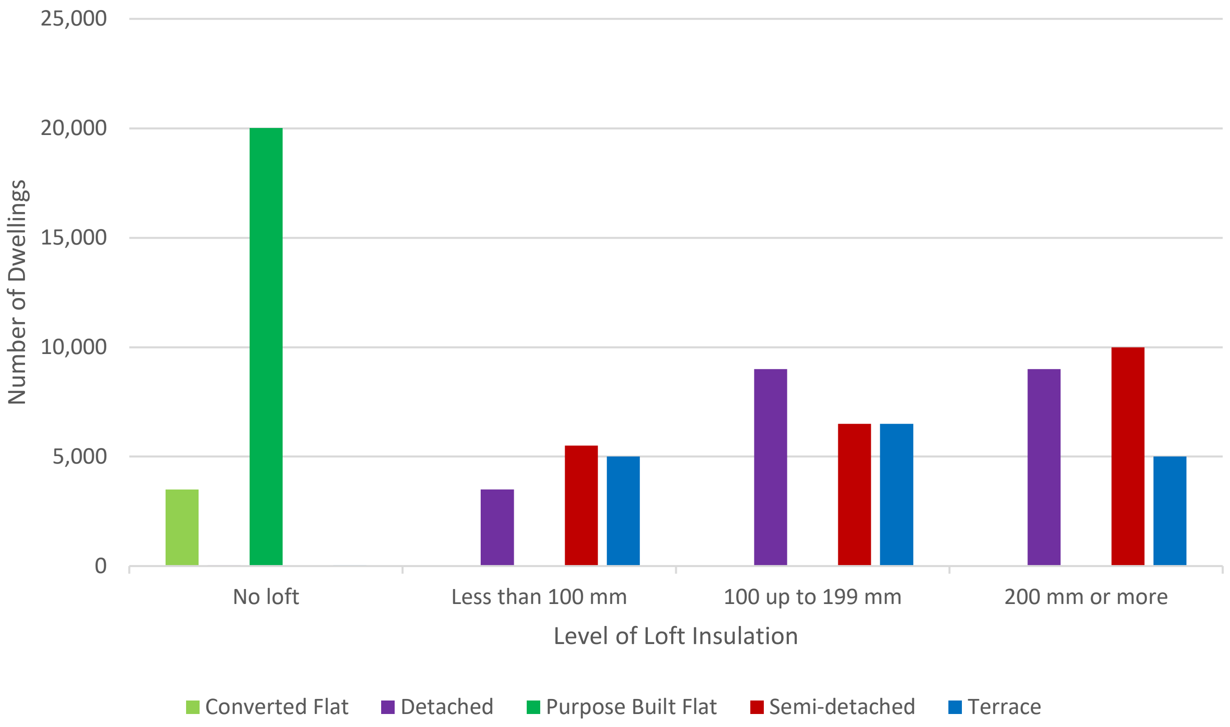


Figure 76: Estimated level of loft insulation (by dwelling type) across the West North Yorkshire sub-region.

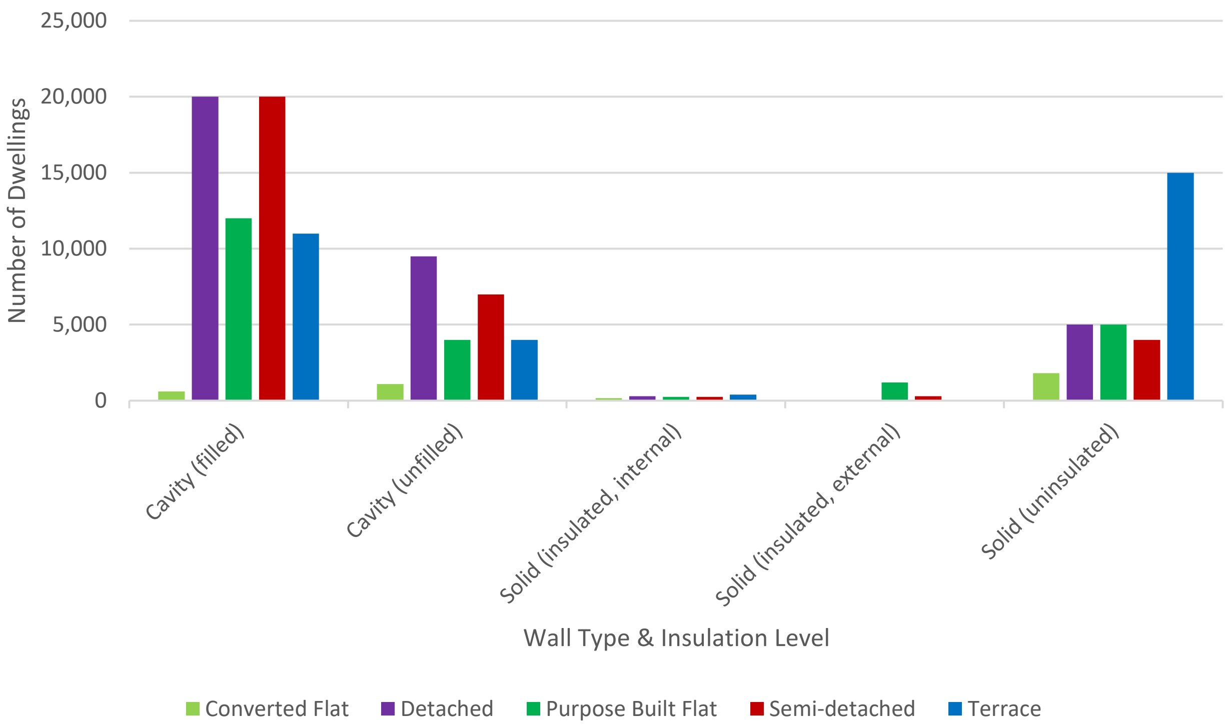


Figure 77: Estimated wall type and insulation level (by dwelling type) across the West North Yorkshire sub-region.

Figure 77 shows that cavity walls are the most prominent wall type across the West North Yorkshire sub-region, with 52% being insulated and 21% uninsulated. Cavity wall insulation can be difficult on some archetypes where there are hung tiles or render on the external face of the brickwork, also around conservatories. Whilst these are deemed 'hard-to-treat' there are methods for ensuring that the cavity can be filled, albeit at a higher cost. Figure 77 also shows that 91% of the solid wall properties in the West North Yorkshire sub-region are uninsulated. This may be due to listed status, other planning restrictions, occupant behaviour/preference, or cost.

Nearly 94% of dwellings in the West North Yorkshire sub-region have double glazing, including over 97% of all semi-detached dwellings (Figure 78). Detached dwellings and converted flats have the highest prevalence of single glazing at 9% and 8% respectively. Triple glazing is not prevalent in the housing stock.

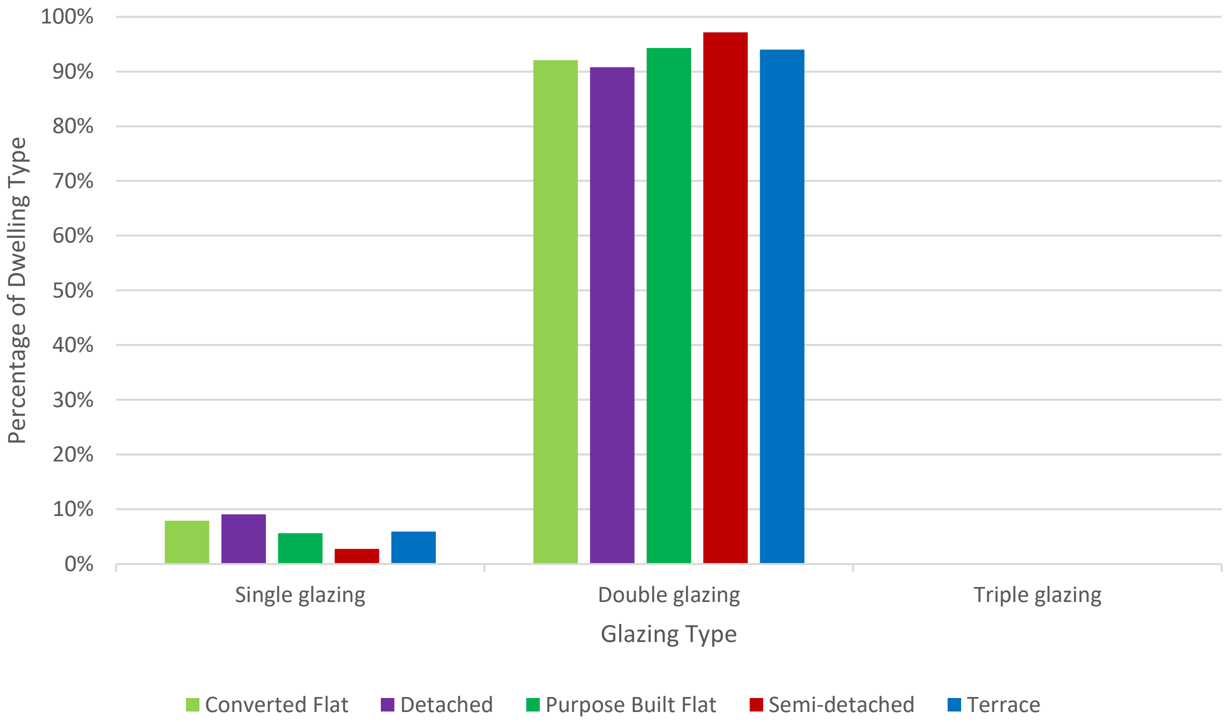


Figure 78: Estimated proportion of glazing type per dwelling type across the West North Yorkshire sub-region.

As well as the domestic stock, the non-domestic stock needs to be considered. The breakdown of the non-domestic building stock across the West North Yorkshire sub-region is shown in Table 24

Table 24: Breakdown of the non-domestic building stock by type across the West North Yorkshire sub-region.

Type	Floor Area [m²]	Percentage of total floor area	Number of non-domestic buildings	Percentage of non-domestic buildings
Retail	8,500,000	53%	35,000	59%
Factory	4,000,000	25%	11,000	18%
Office	1,200,000	8%	3,500	6%
Education	1,100,000	7%	5,500	9%
Other	800,000	5%	2,500	5%
Warehouse	500,000	3%	2,000	4%
Total	**16,000,000**	**100%**	**60,000**	**100%**

Due to rounding, some totals may not correspond with the sum of the separate figures.

Data from the National Atmospheric Emissions Inventory (NAEI)[23] has been used to identify large individual emission point sources i.e. emissions from a known location. As well as CO_2, this data shows air pollutants, heavy metals, and base cations[24], and greenhouse gases (GHGs)[25]. The point sources included within the project boundary are shown below in Figure 79. It should be noted that this dataset is for fixed emission sources only, and that non-fixed emissions such as those from road traffic are not included.

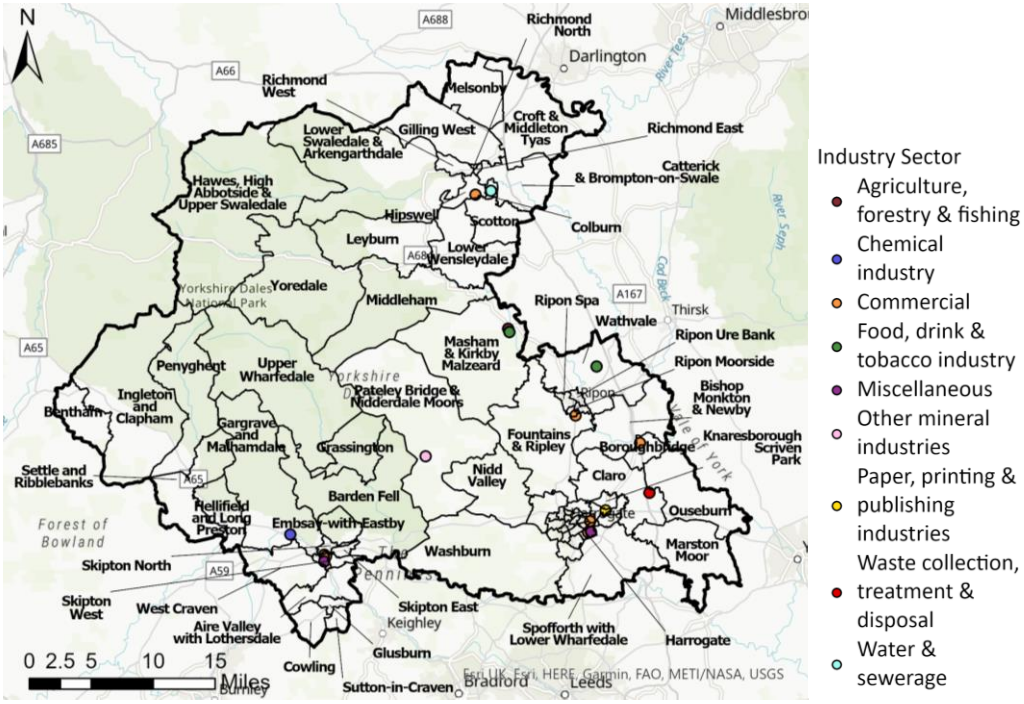


Figure 79: Individual emission sources identified by the National Atmospheric Emissions Inventory (NAEI) across the West North Yorkshire sub-region.

Often the high emitters are located closely together on an industrial park or similar, therefore the definition given in Figure 79 is lacking. However, the data pack accompanying this report provides the same image at an LA level providing more clarity.

[23] https://naei.beis.gov.uk/
[24] https://naei.beis.gov.uk/overview/ap-overview
[25] https://naei.beis.gov.uk/overview/ghg-overview

2.3.2. Energy Demands

This section will show the estimated annual consumption and peak demands across the West North Yorkshire sub-region in the domestic and non-domestic sectors, and the geographic distribution by LSOA.

Table 25 and Table 26 below show the total figures for the sub-region. Please note: Electricity is supplied locally at 400V (three-phase) which is then connected to a dwelling at 230V (single-phase), therefore for the purposes of these calculations all domestic properties are assumed to be connected at 400V. Large non-domestic loads are assumed to be connected to the electricity network at 11kV; other non-domestic are connected at 400V. Total electricity demand is therefore the sum of demand at the 11kV level and 400V level. Demand from power generators and utilities are not included in these figures.

Table 25: Annual energy consumption [MWh] across the West North Yorkshire sub-region.

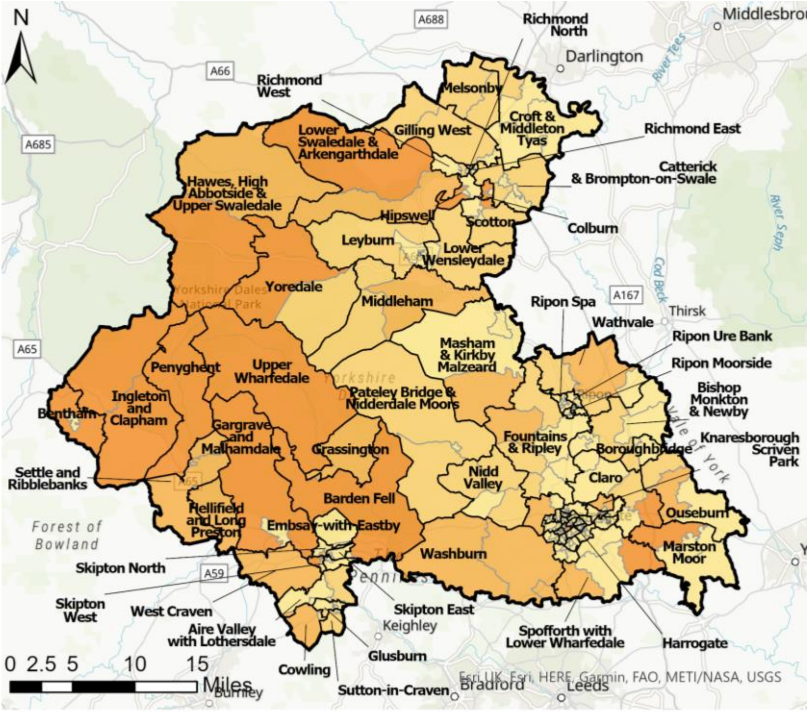
Energy Type	Domestic Annual Consumption [MWh]	Non-Domestic Annual Consumption [MWh]	Total Annual Consumption [MWh]
Electricity (11kV)	0	170,000	170,000
Electricity (400V)	450,000	1,800,000	2,250,000
Gas	800,000	2,500,000	3,300,000
Oil	200,000	0	200,000

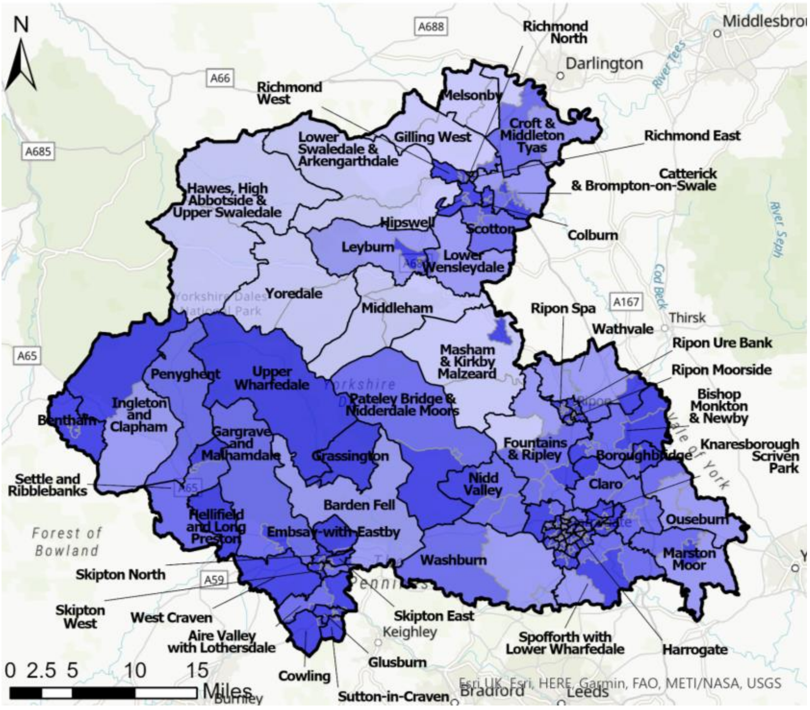
Table 26: Annual peak demand [MW] across the West North Yorkshire sub-region.

Energy Type	Domestic Peak Demand [MW]	Non-Domestic Peak Demand [MW]	Total Peak Demand [MW]
Electricity (11kV)	0	50	50
Electricity (400V)	140	600	650
Gas	650	900	1,500
Oil	170	0	170

The total peak demand is not the sum of the peak demands for domestic and non-domestic buildings since the peak demands of the different sectors occur at different times.

The following maps (Figure 80 to Figure 83) show the distribution of estimated peak and annual energy consumption for both domestic and non-domestic buildings across the West North Yorkshire sub-region. Peak demands shown on these maps may not all occur at the same time of day or time of year. For example, an area predominantly made up of domestic dwellings is likely to have a peak energy demand during the early evening in winter. In contrast, an area that is mainly made up of commercial offices will have maximum energy demand around the middle of the day. Mixed-use areas could have a different peak time depending upon the nature of their buildings.





Annual Domestic Electricity Demand (MWh)

- 0
- 0 - 3,000
- 3,000 - 3,500
- 3,500 - 4,000
- 4,000 - 5,500

Annual Domestic Gas Demand (MWh)

- 0
- 0 - 300
- 300 - 2,000
- 2,000 - 4,500
- 4,500 - 15,000

Figure 80: Estimated current domestic annual energy consumption by fuel and LSOA across the West North Yorkshire sub-region.

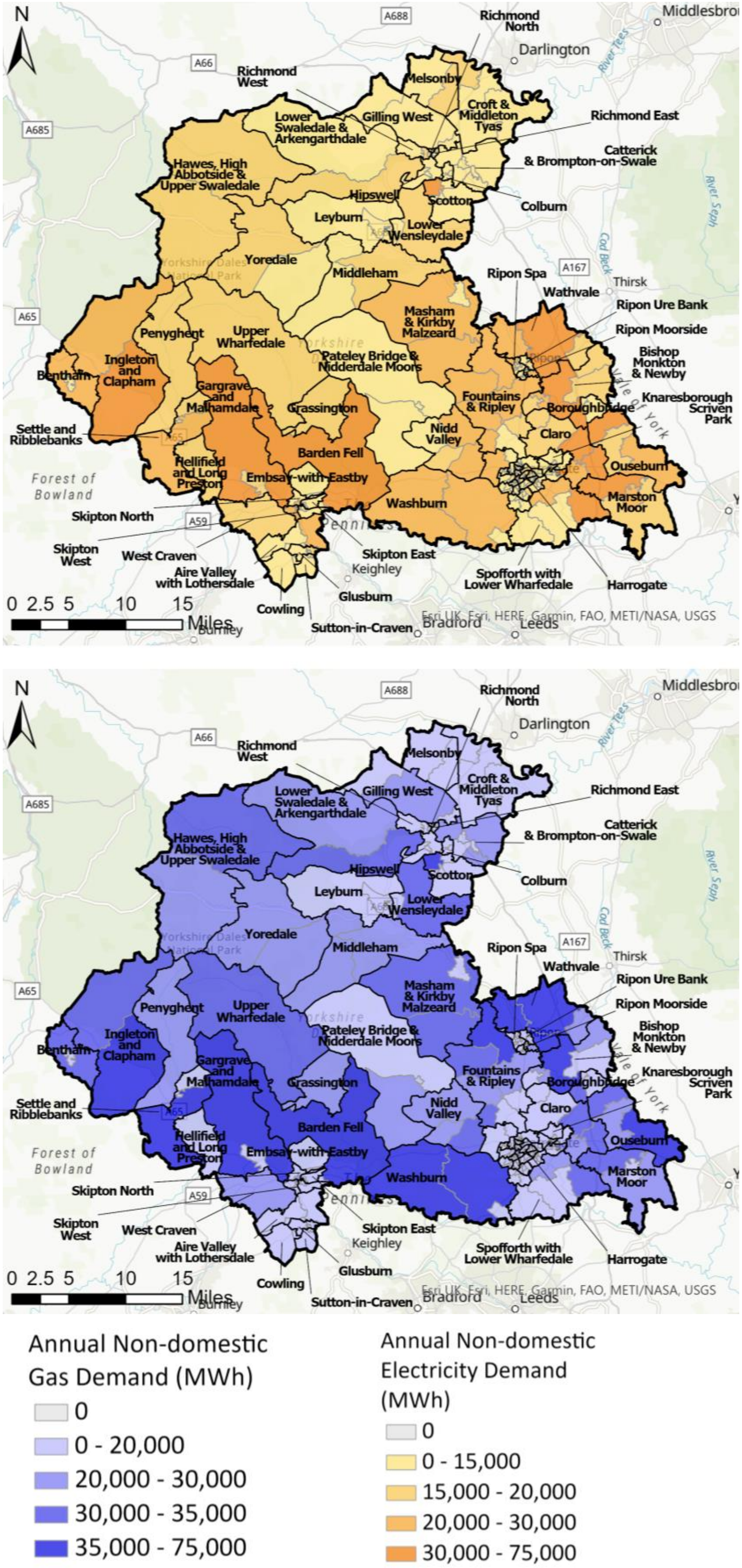


Figure 81: Estimated current non-domestic annual energy consumption by fuel and LSOA across the West North Yorkshire sub-region.

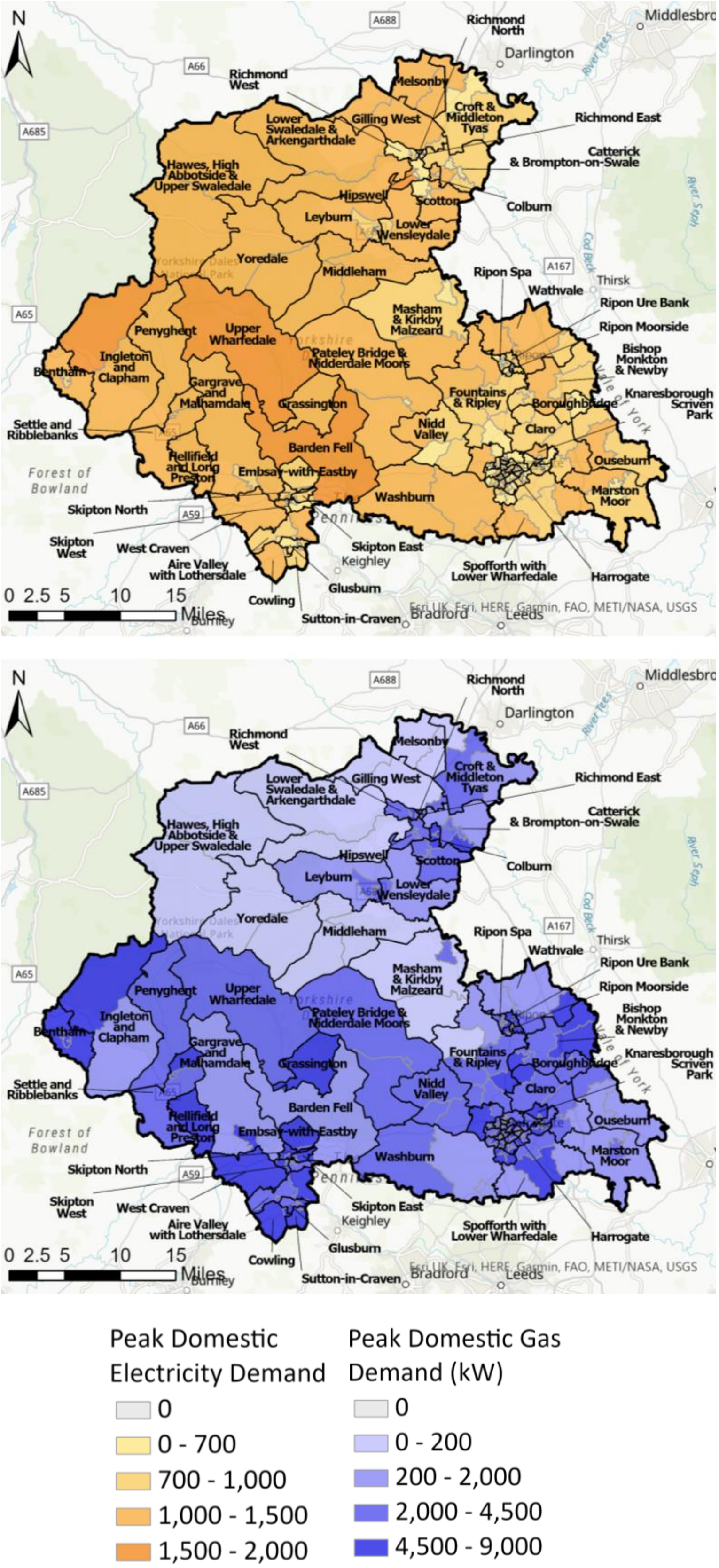
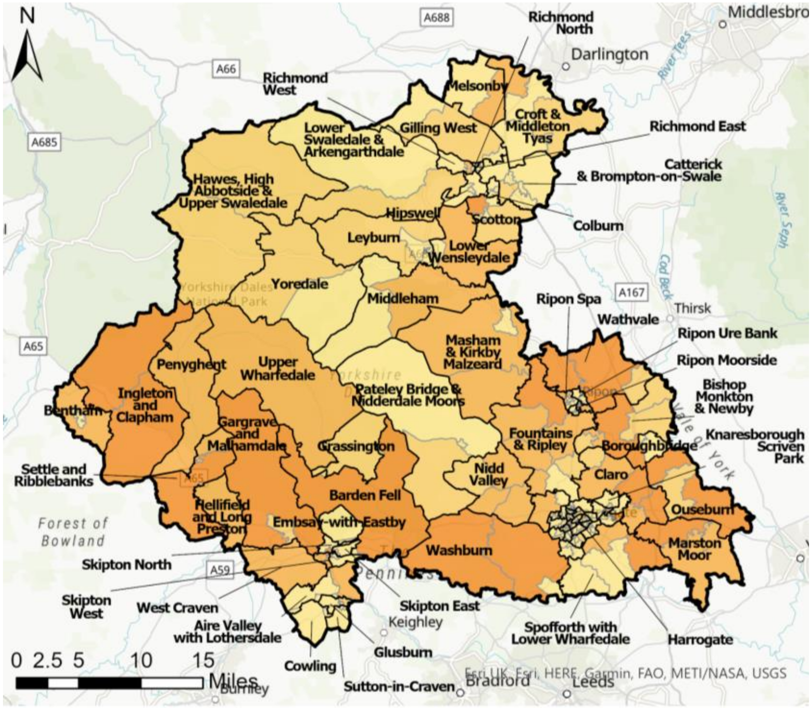
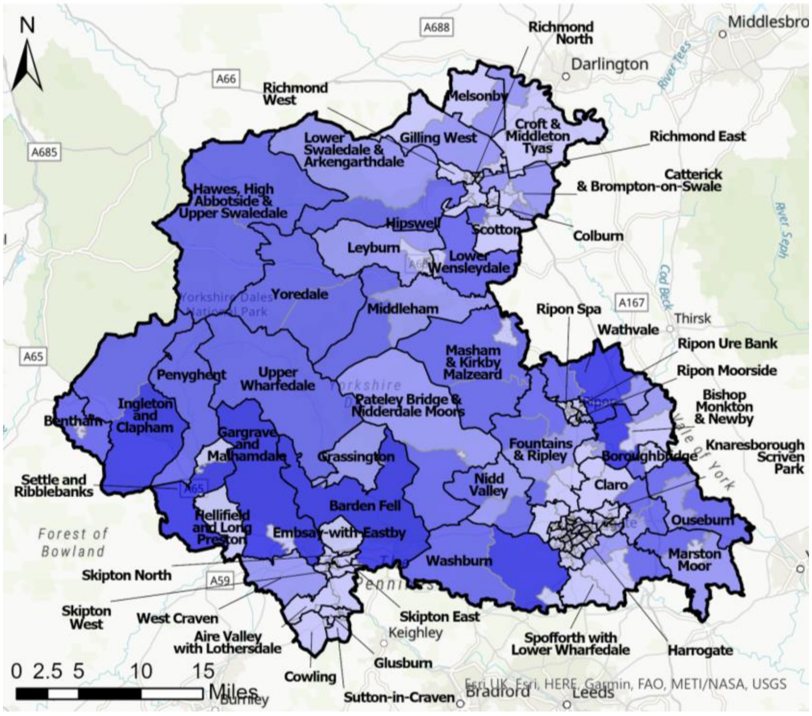


Figure 82: Estimated current domestic peak energy demand by fuel and LSOA across the West North Yorkshire sub-region.





Peak Non-domestic Electricity Demand (kW)	Peak Non-domestic Gas Demand (kW)
0	0
0 - 4,500	0 - 7,500
4,500 - 5,500	7,500 - 10,000
5,500 - 8,000	10,000 - 15,000
8,000 - 25,000	15,000 - 30,000

Figure 83: Estimated current non-domestic peak energy demand by fuel and LSOA across the West North Yorkshire sub-region.

Figure 84 shows an estimate of the total electricity demand profile for the West North Yorkshire sub-region for different days of the year representing the lowest typical demand and the highest. The peak day is also shown, which is used to determine a worst-case scenario on the network. Electricity demand includes heat, lighting, appliances, and electric vehicle charging when chargepoints are known to exist in the local area. The profile is for domestic and non-domestic buildings combined.

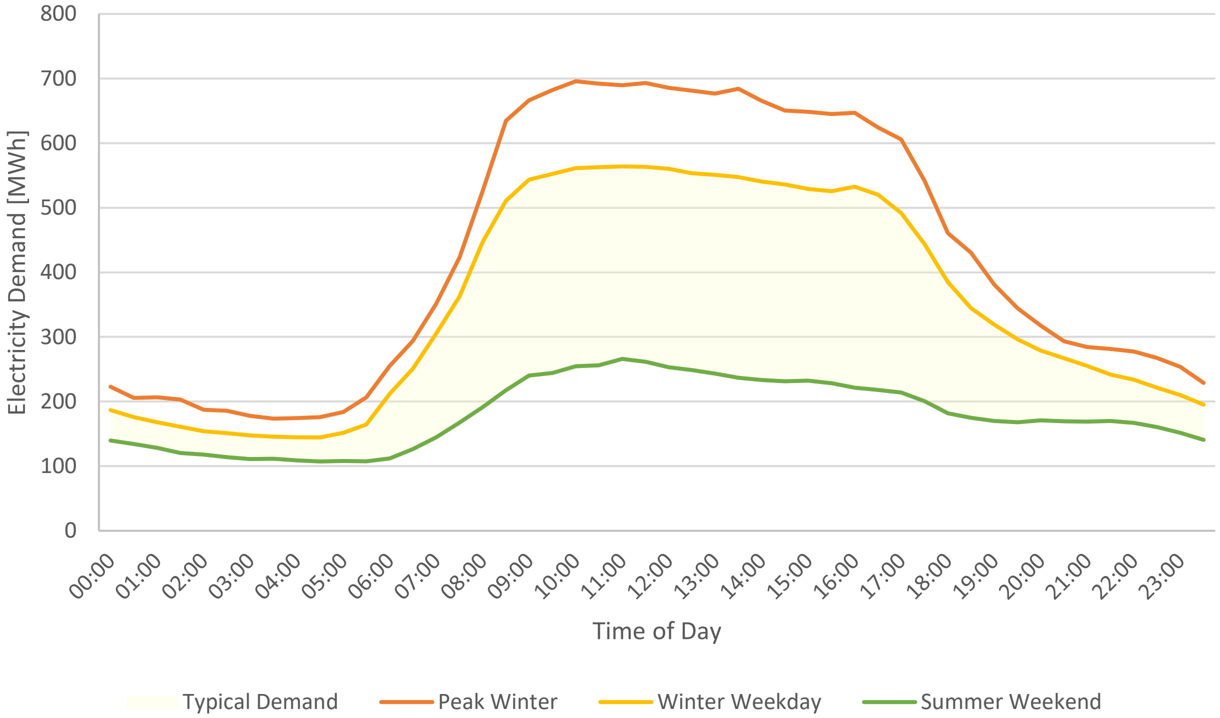


Figure 84: Estimated electricity demand profiles for different days of the year across the West North Yorkshire sub-region.

As expected, the demand is far lower on a summer weekend when compared to a winter weekday.

Summer weekend represents the lowest end of demand profile; being summer means there is less need of heating, and weekend suggests that office/factory buildings are using less electricity, in contrast to a typical winter weekday.

The area between these two demand profiles has been highlighted as the typical demand i.e. the electricity demand will likely be within the shaded area at any given time.

Figure 85shows the estimated gas demand profile, and Figure 86 shows the estimated oil demand profile, for the West North Yorkshire sub-region for the same days. Gas and oil demand include both heat and hot water and covers domestic and non-domestic buildings combined.

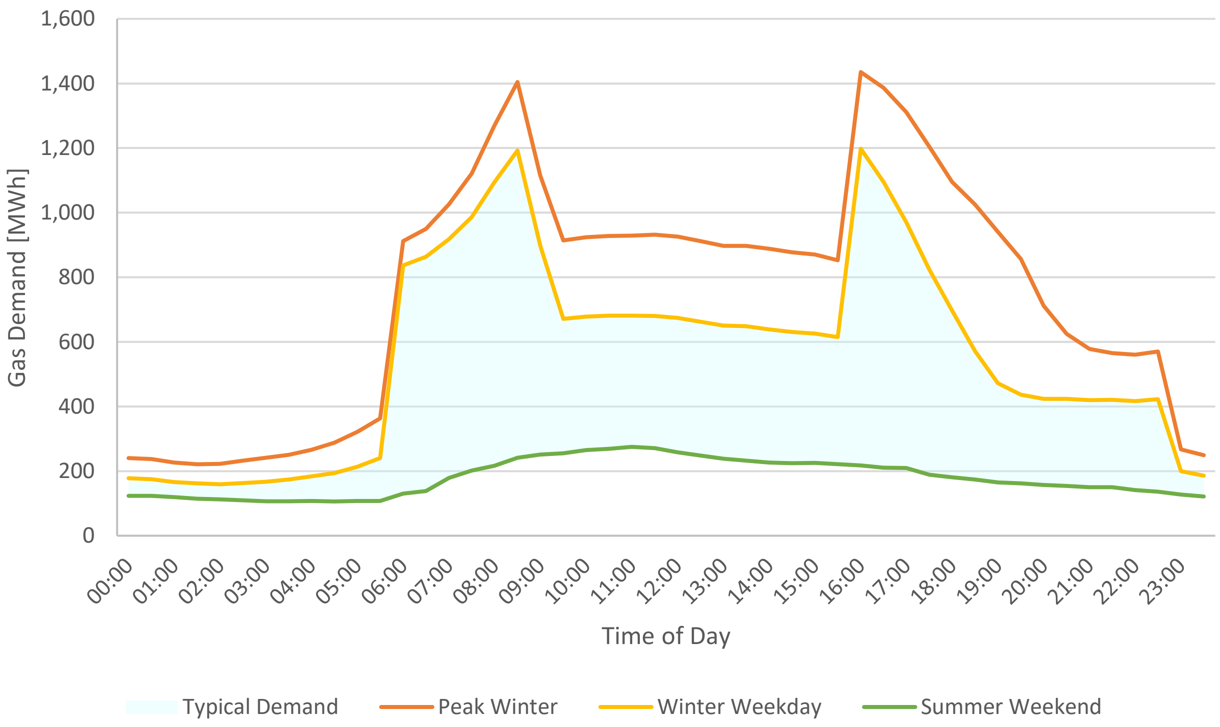


Figure 85: Estimated gas demand profiles for different days of the year across the West North Yorkshire sub-region.

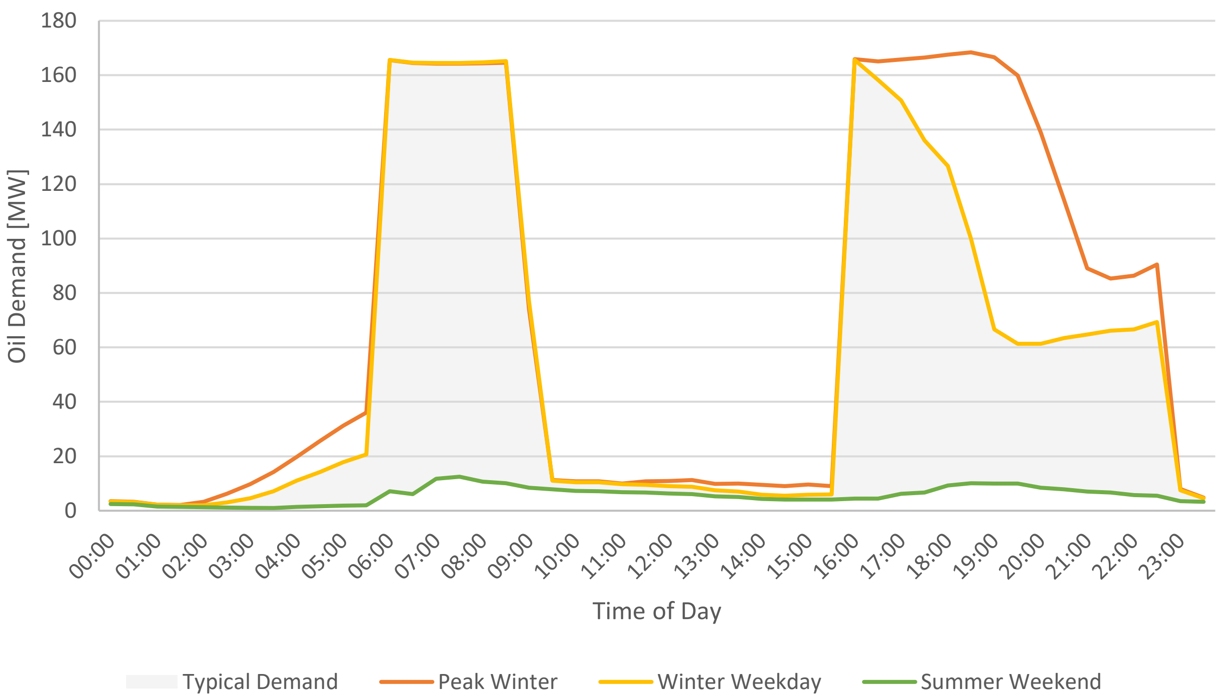


Figure 86: Estimated oil demand profiles for different days of the year across the West North Yorkshire sub-region.

2.3.3. Energy Networks

A good understanding of the energy networks is vital to formulating a forward plan for the decarbonisation of any area. For example, identifying dwellings that are not on the gas network can help to focus a heat pump roll-out programme thus reducing the risk of competing heating vectors such as hydrogen or heat networks being a more financially viable option in the future. To identify those off-gas areas, Xoserve[26] postcode data was used (mapped in Figure 87) before being cross-referenced with Ordnance Survey records to calculate how many dwellings are estimated to be on- or off-gas Table 27).

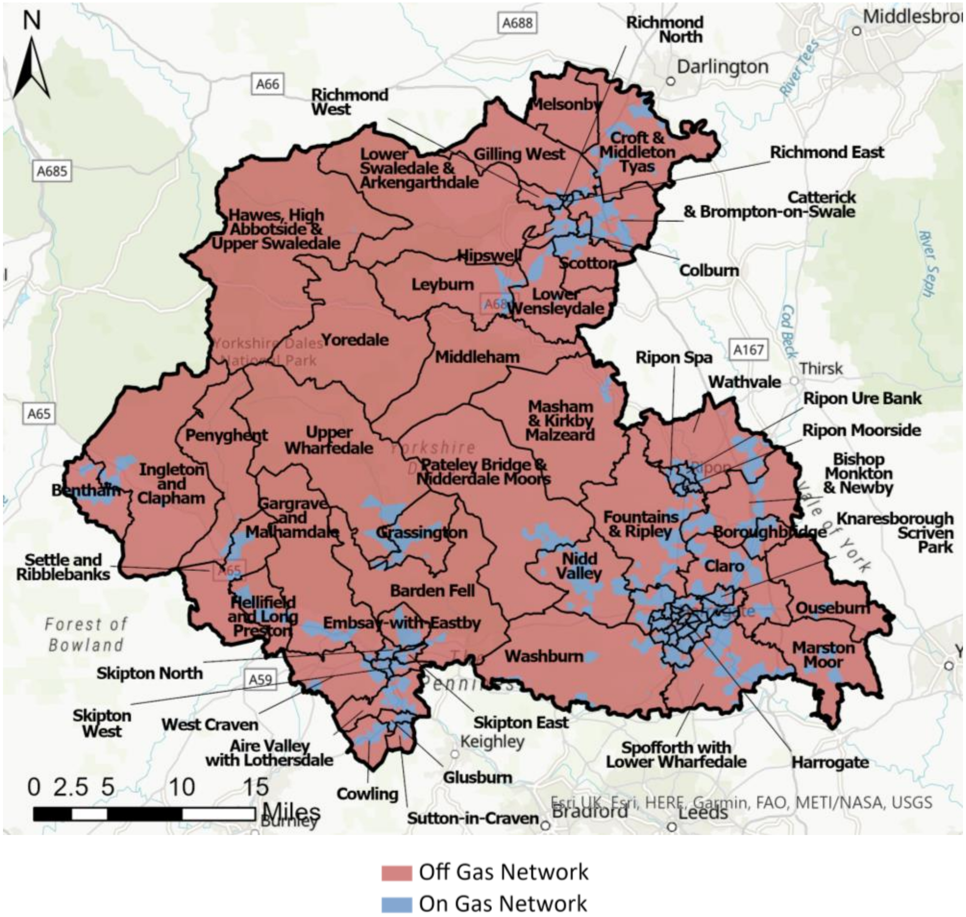


Figure 87: On-gas and off-gas areas of the West North Yorkshire sub-region.

Table 27: Estimate of on-gas and off-gas dwellings across the West North Yorkshire sub-region (rounded to nearest 5,000)

	Number
Off-Gas Dwellings	30,000
On-Gas Dwellings	95,000

Comparing Figure 87 and Table 27 leads to the conclusion that the off-gas grid areas are sparsely populated. This is confirmed by comparing to Figure 68 showing the location of the building stock.

[26] https://www.xoserve.com/wp-content/uploads/Off-Gas-Postcodes-V2.xlsx

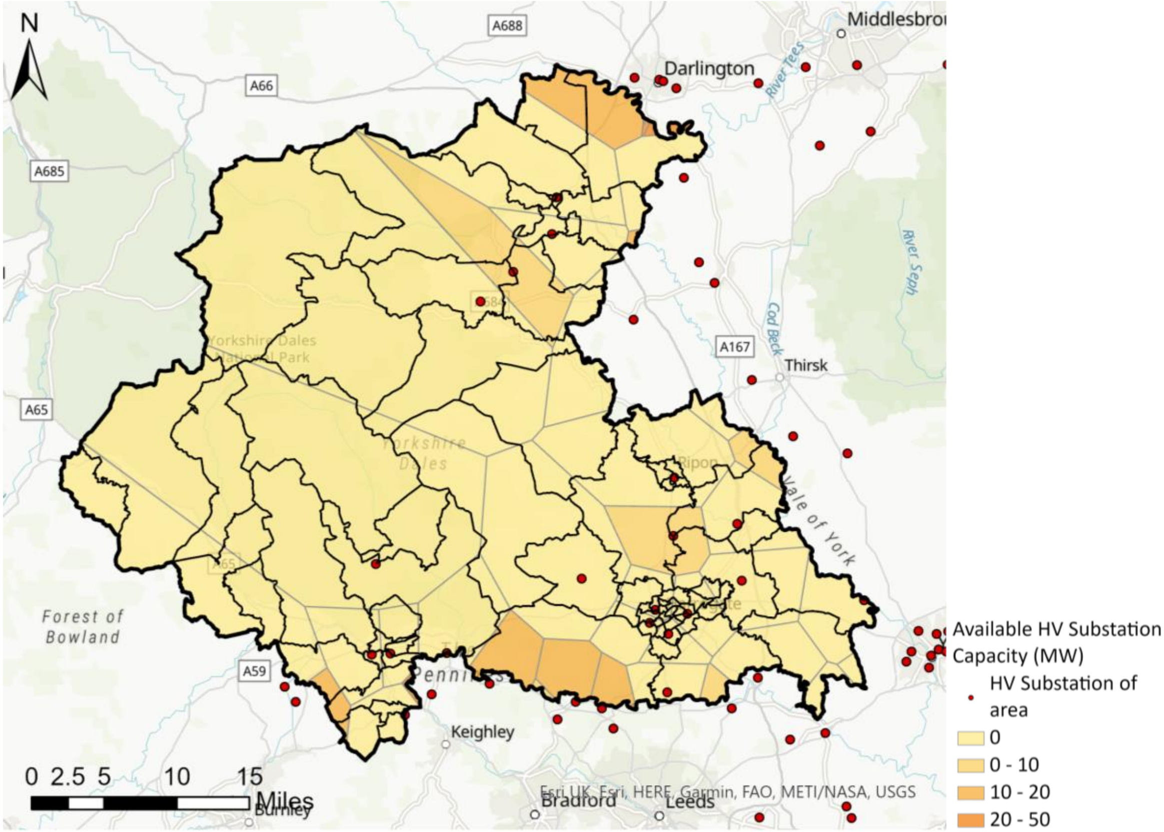


Figure 88: Available high-voltage network capacity across the West North Yorkshire sub-region.

Figure 88 shows an estimate of the available capacity on each 33kV-to-11kV substation and the extent of the area served by each substation. Capacity is calculated by subtracting the combined peak electrical demand on buildings in each area from the rated capacity of each substation. Those substations shown outside of the West North Yorkshire boundary may serve buildings within it. Substations outside of the boundary have been included since it is likely some may serve assets within the project boundary. This is seen by new polygons that begin next to the project boundary. It should be noted that available capacity of areas on the North Yorkshire boundary may be overestimated since the demands of buildings outside of the county have not been modelled.

Where network connection is important from a project planning perspective the actual areas served should be established in conversation with the local Distribution Network Operator, (DNO) Northern Powergrid. These capacity estimates are intended to give an indication of the capacity available on different parts of the network within the local energy system representation area and are not a substitute for detailed network modelling and analysis conducted by the local DNO. Substations identified as generation only in the DNO data are assumed to have no available capacity. Substations are not included in the analysis where DNO data on locations and capacities are unavailable. Where capacity data is unavailable, but locations are available, the 11kV-to-400kV capacity was set to the most prevalent substation capacity across all of North Yorkshire of 49kW. Where capacity data is only available in MVA, it is assumed that capacity in MVA is equal to capacity in MW, unless power factors are available.

Figure 89 shows an estimate of the number of buildings, both domestic and non-domestic connected to each 33kV-to-11kV substation. As with capacity, the extent has been calculated as the area closest to each substation.

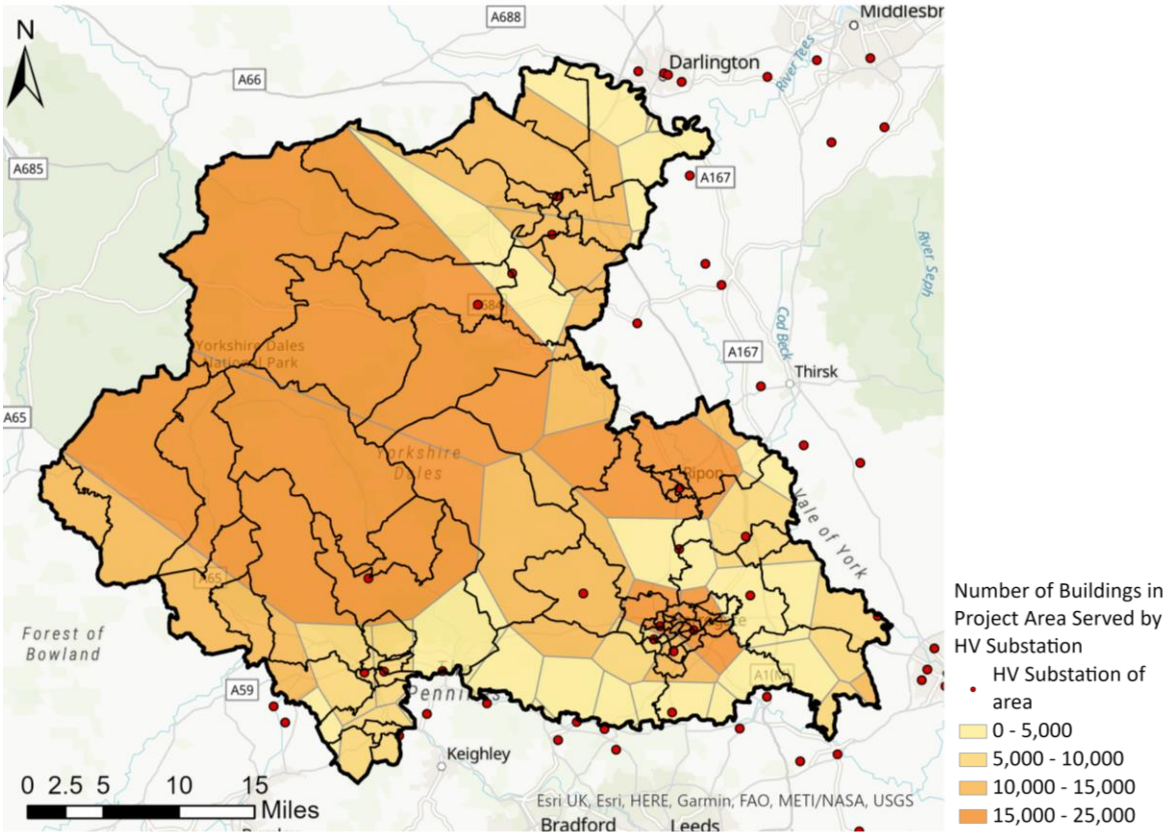


Figure 89: Number of buildings within the West North Yorkshire sub-region served by each high-voltage substation.

2.3.4. Embedded Generation

The Renewable Energy Planning Database (REPD) was used to identify large scale embedded generation across the West North Yorkshire sub-region. These sites, and the associated technologies, are shown in Figure 90. Data on domestic feed-in tariffs from BEIS are used to identify the amount of domestic solar photovoltaic (PV). The total installed capacity for each technology along with an estimate of the annual electricity generated in the local area is given in Table 28. Table 28 shows the proportion of annual electricity demand in the project area estimated to be met currently using local embedded generation. Additional embedded generation technologies may be present in the area but not reported here if they are not recorded in the REPD or if they are below 100 kW.

Table 28: Estimated renewable energy capacity and estimated generation as a proportion of electricity demand in the West North Yorkshire sub-region.

Renewable Tech	Installed Capacity [MW]	Annual Generation [GWh]	Proportion of Annual Demand
Domestic Solar PV	17.6	25	1.1%
Small Hydro	2	6	0.3%
Other Solar PV	20	18	0.8%
Onshore Wind	18.5	45	1.8%
Anaerobic Digestion	1.1	5.5	0.2%
EfW Incineration	27	85	3.6%
Landfill Gas	3	13	0.5%

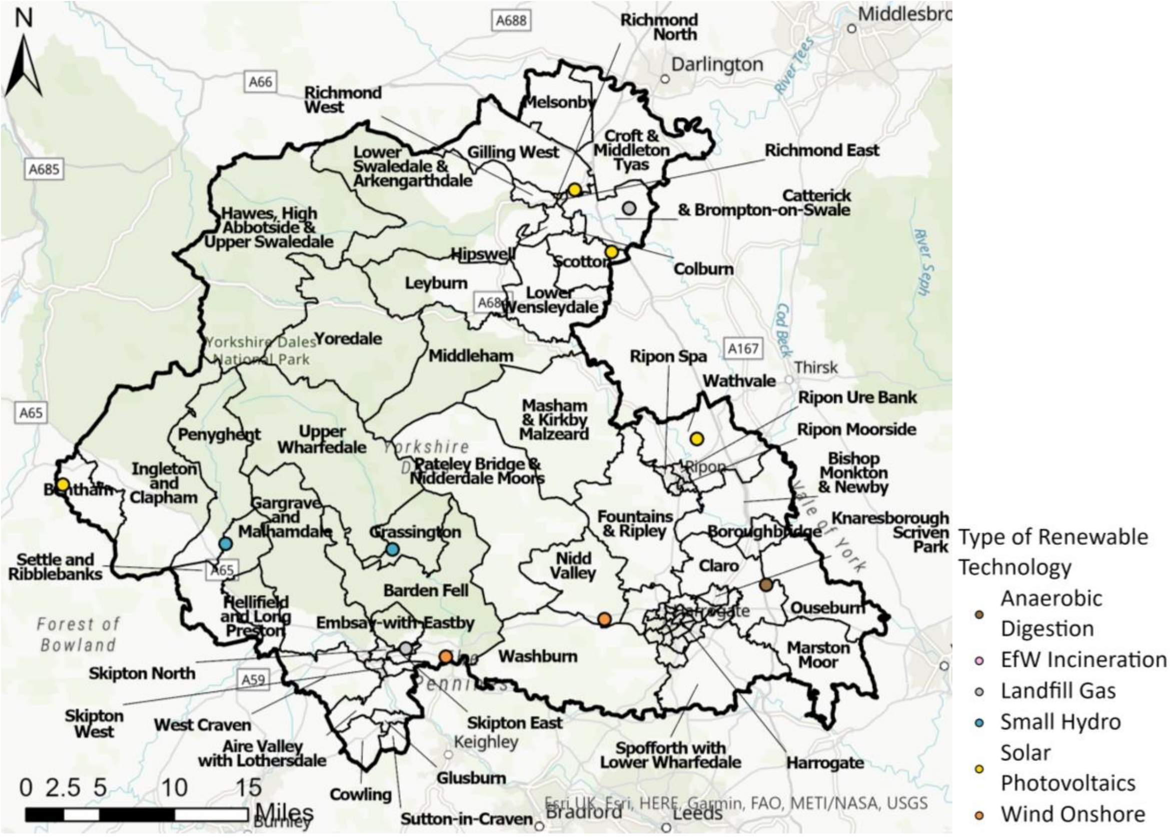


Figure 90: Existing embedded generation in the West North Yorkshire sub-region according to REPD database (October 2020).

As can be seen from Table 28, domestic solar PV is a significant contributor towards meeting the annual demand. Although not all installations of solar PV are registered for the feed-in tariff (FIT), and not all FITs were given to solar PV, the majority will be and therefore Ofgem's Feed-in Tariff Installation Report[27] is a useful way of identifying the overall capacity and number of registrations in each LSOA. Figure 91 and Figure 92 show the installed capacity of renewables and number of registrations respectively.

[27] https://www.ofgem.gov.uk/environmental-programmes/fit/contacts-guidance-and-resources/public-reports-and-data-fit/installation-reports

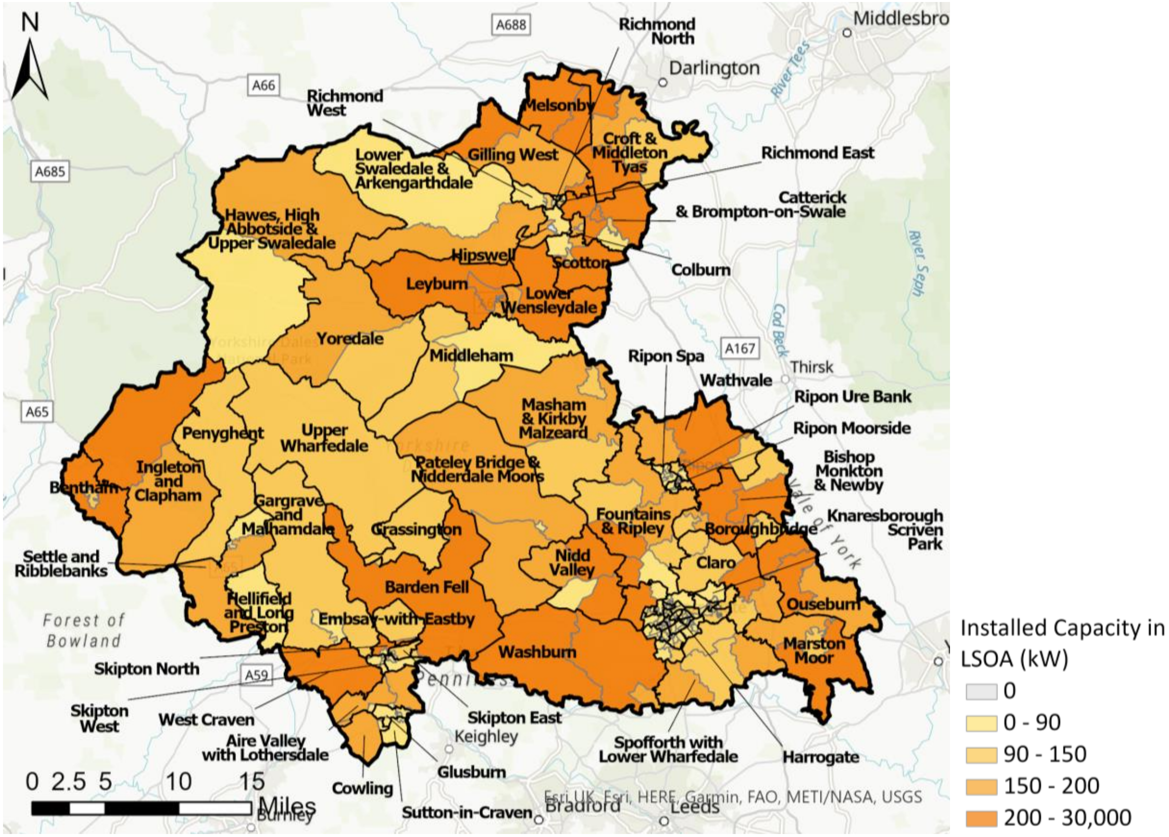


Figure 91: Aggregated capacity of renewable installations registered for FIT within each LSOA of the West North Yorkshire sub-region.

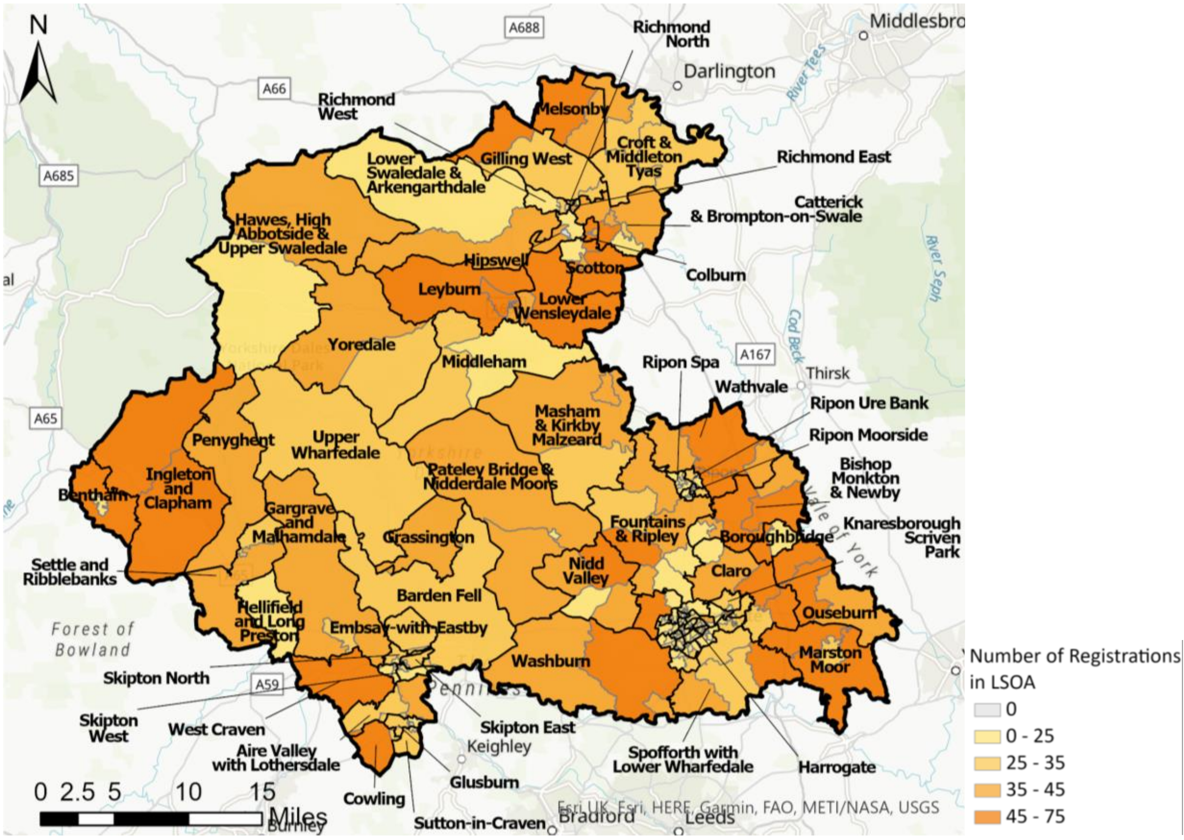


Figure 92: Number of renewable installations registered for FIT within each LSOA of the West North Yorkshire sub-region.

To assess the potential for domestic on-roof solar PV within the West North Yorkshire sub-region, the footprint and orientation of all dwellings have been analysed to calculate the potential generating capacity. These results are then aggregated to 200m radius areas to identify places best suited for mass deployment. The dwellings identified as suitable for rooftop solar PV in each of the three best areas are shown in Figure 93 to Figure 95.

As a purely spatial exercise this analysis does not consider local planning constraints and should not be used as a replacement for a detailed feasibility study or installation design.

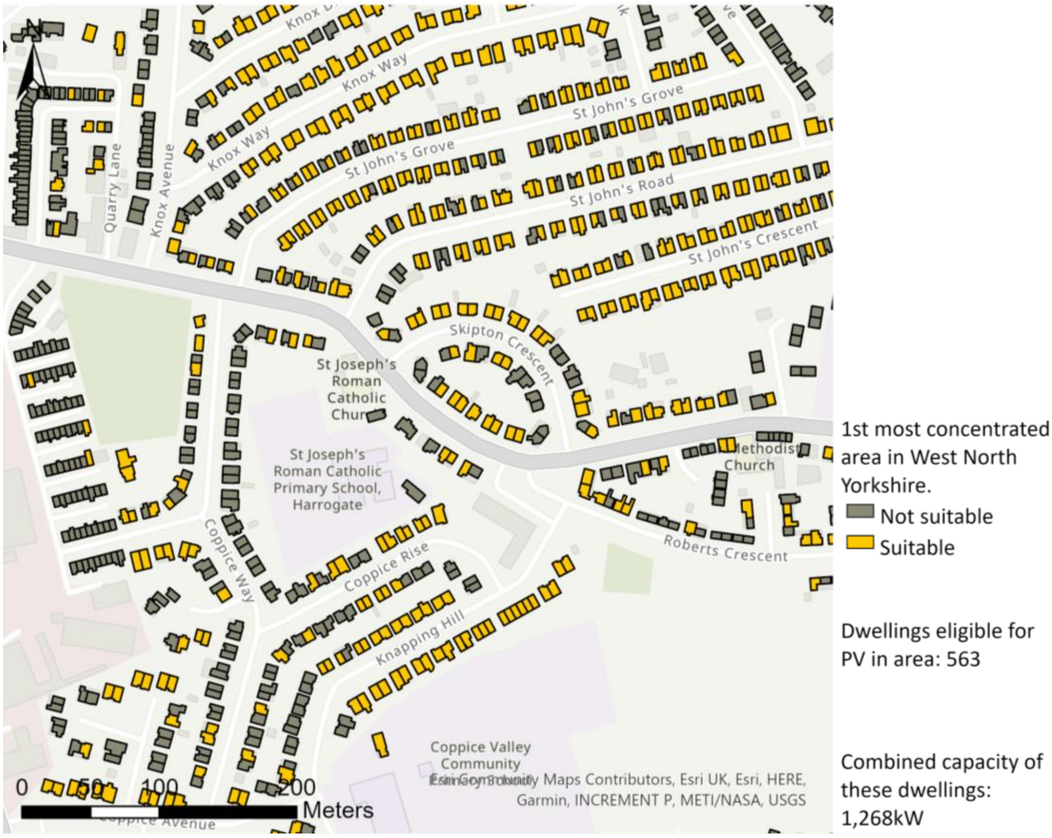
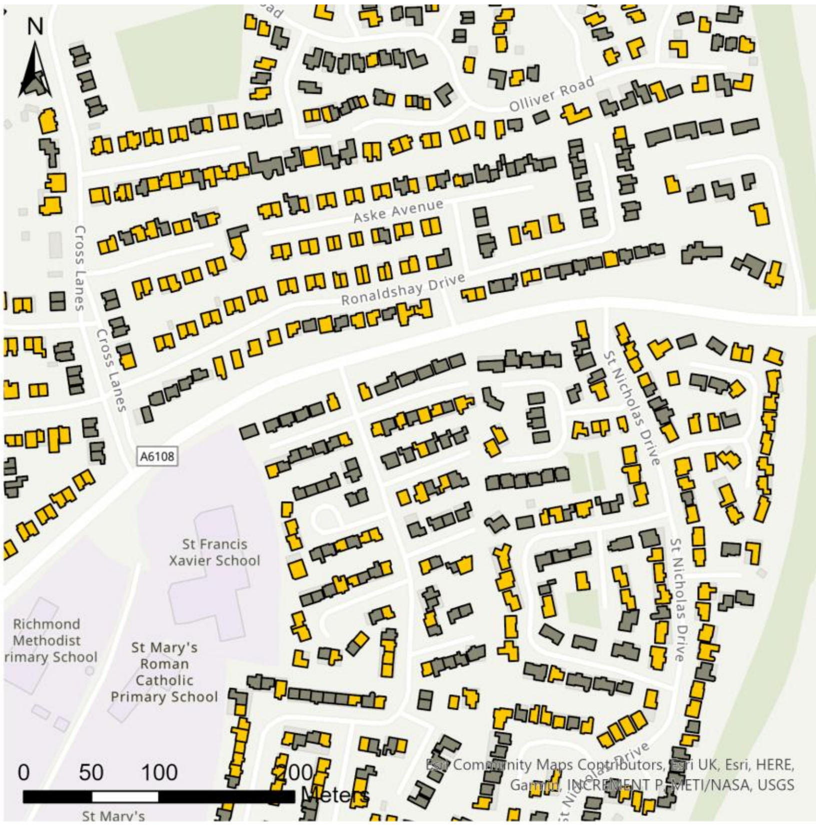


Figure 93: Dwellings identified as suitable for rooftop PV panels. (Location: New Park, Harrogate)



2nd most concentrated area in West North Yorkshire.

Not suitable

Suitable

Dwellings eligible for PV in area: 354

Combined capacity of these dwellings: 1,059kW

Figure 94: Dwellings identified as suitable for rooftop PV panels. (Location: East Richmond)

3rd most concentrated area in West North Yorkshire.

Not suitable

Suitable

Dwellings eligible for PV in area: 355

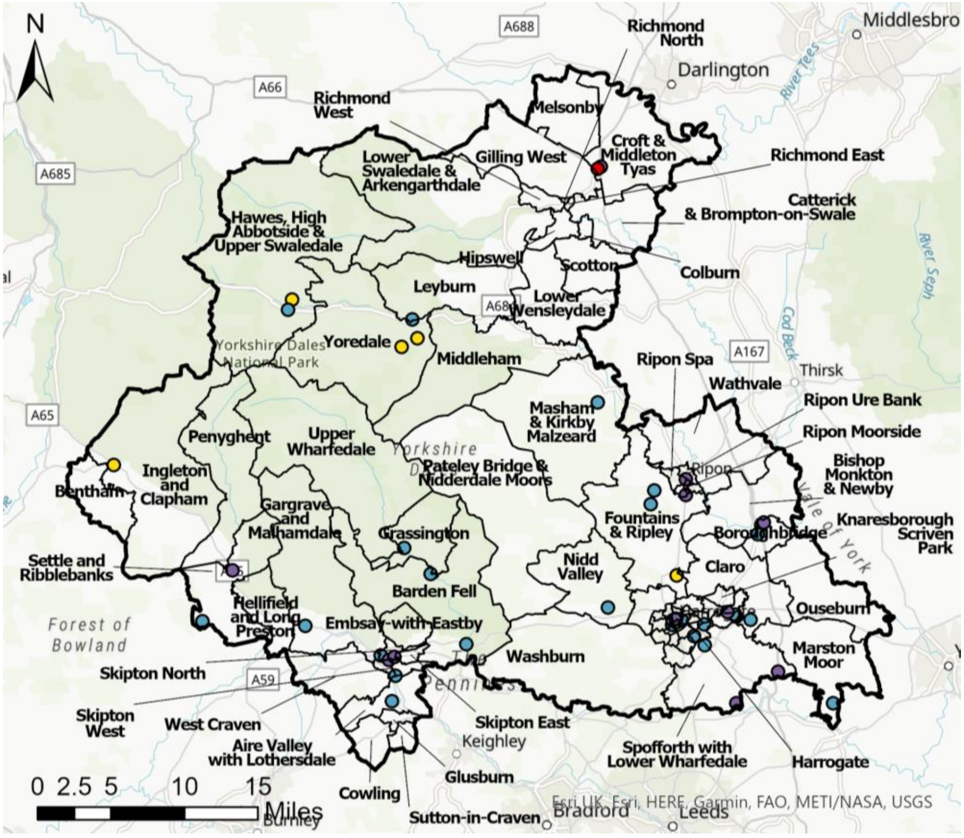
Combined capacity of these dwellings: 870kW

Figure 95: Dwellings identified as suitable for rooftop PV panels. (Location: Central Harrogate)

In total these three areas alone have a total potential solar PV capacity of 3.197 MW.

2.3.5. Domestic & Public EV Charging

Data from the Zap-Map®[28] has been used to identify the locations and power outputs of public Electric Vehicle (EV) chargepoints across the West North Yorkshire sub-region. The locations and the speed of the chargepoints are shown in Figure 96. In total there are 143 public chargepoints with a combined capacity of 4,938kW.



Speed of Chargepoint
- Ultra Rapid (100kW+)
- Rapid (25-99kW)
- Fast (7-25kW)
- Slow (3-6kW)

Figure 96: Location of public chargepoints according to Zap-Map® (December 2020)

Chargepoint data provided by Zap-Map®

The Driver and Vehicle Licensing Authority (DVLA) publishes data on the numbers and types of different vehicles registered within different Local Authority Areas. This gives an indication of the number of EVs that might be registered within the sub-region as shown in Table 29.

It should be noted that leased vehicles will be registered to the leasing company which may not be based within the project area.

[28] https://www.zap-map.com/

Using National Travel Survey data representative charge profiles have been generated for both public and domestic charge points. The estimated peak demands for domestic chargepoints are shown in Table 29.

Table 29: Summary of plug-in vehicles[29] registered in the West North Yorkshire sub-region according to data from DfT

Number of Plug-in Vehicles	Percentage of Total Vehicles	Estimated Peak Demand [kW]
1,209	1.08%	2,469

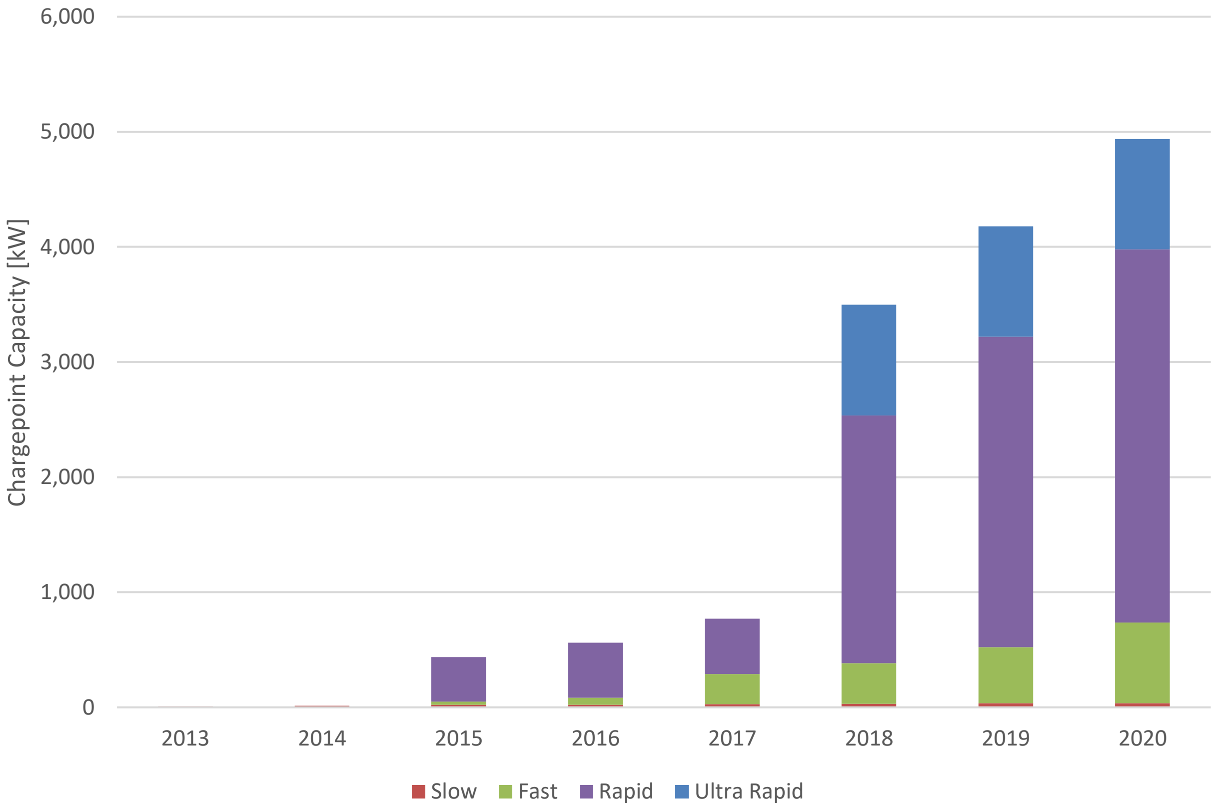


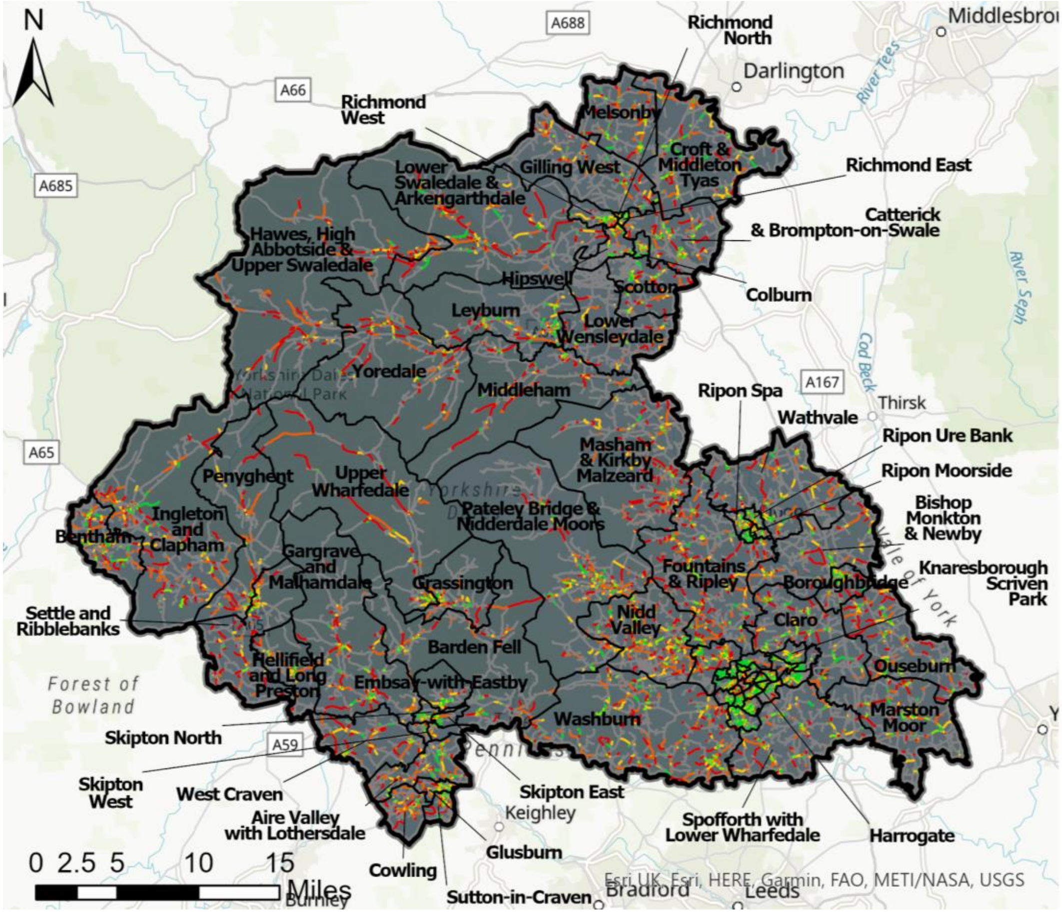
Figure 97: Chargepoint connector total capacity (kW) within the West North Yorkshire sub-region over time.

Using the date that each chargepoint was added to the Zap-Map database the uptake of chargepoints in the area can be analysed. Figure 97 shows this uptake in total kW rating of connectors within the West North Yorkshire sub-region by charger type.

Since the Zap-Map data was retrieved, the Yorkshire Dales National Park have added a 7kW chargepoint (with 2 charging sockets) in seven of their car parks across the West North Yorkshire sub-region (Aysgarth, Kettlewell, Buckden, Horton in Ribblesdale, Stainforth, Clapham and Malham).

Ordnance Survey Mastermap Topography and Land Registry INSPIRE polygons have been used to identify houses which have space for off-street parking. This is done by attempting to fit a standard UK parking space of 4.8m x 2.4m in the owned area between the house and its nearest road. This helps identify homes that may be able to charge an EV on a driveway, and areas that will require alternative charging solutions for on-street parking. Figure 98 shows the results of this analysis aggregated by road.

[29] Plug-in vehicles are all models identified as being fully electric or plug-in hybrid.



Percentage of dwellings
on road with potential
for off-street parking
- 0% - 20%
- 20% - 40%
- 40% - 60%
- 60% - 80%
- 80% - 100%
- N/A

Figure 98: Percentage of dwellings with off-street parking on each road within the West North Yorkshire sub-region.

As a purely spatial exercise this analysis does not consider local planning constraints and should not be used as a replacement for a detailed feasibility study.

2.3.6. Social Data

National data have been used to provide an indication of fuel poverty (Figure 99) and multiple deprivation (Figure 100) across the West North Yorkshire sub-region.

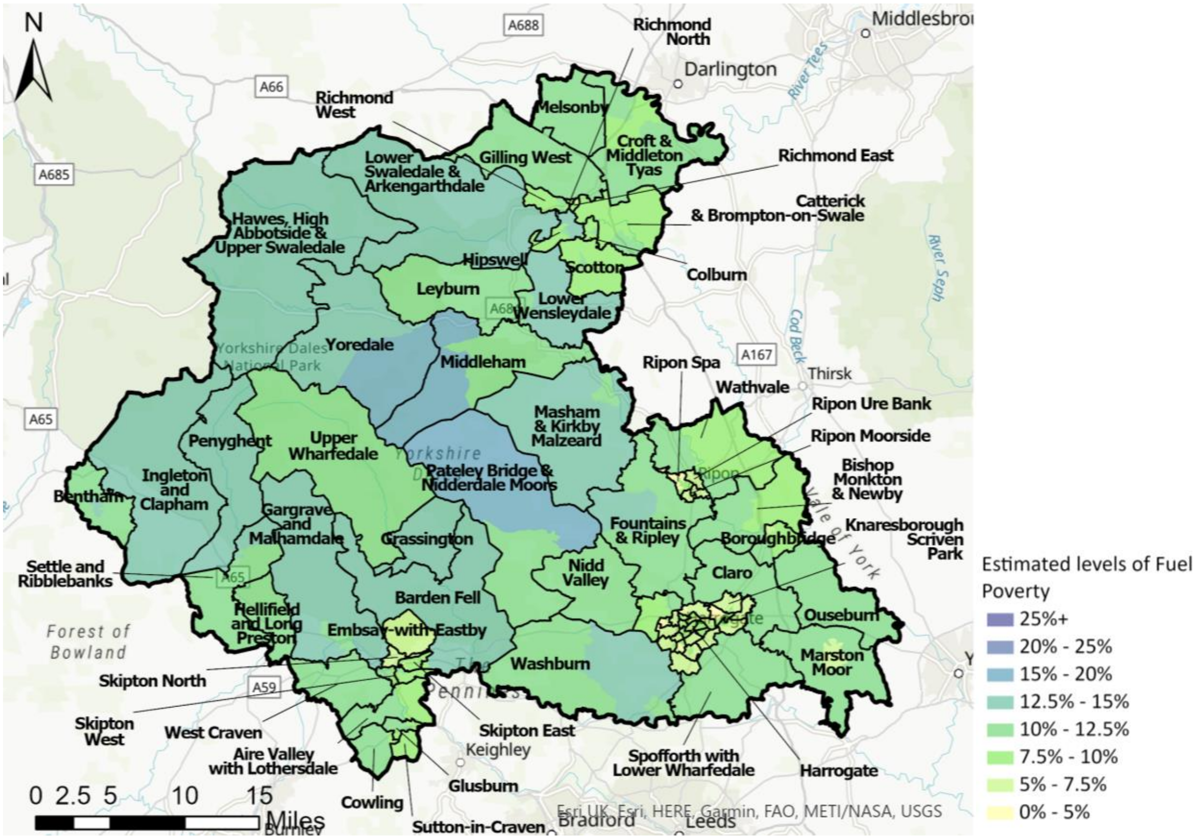


Figure 99: Estimated levels of fuel poverty according to 2020 BEIS data

Using the ranked Index of Multiple Deprivation[30] data published by The Department for Communities and Local Government (DCLG) at LSOA level it is possible to compare localised levels of deprivation within the West North Yorkshire sub-region against the rest of England. For mapping purposes these are shown by octile, with values falling in octile 1 being within the most deprived 1/8th of the country and values falling in octile 8 being within the least deprived 1/8th of the country.

[30] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015
For descriptions of the underlying indicators used in the indices of deprivation please refer to this document: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/467775/File_8_ID_2015_Underlying_indicators.xlsx

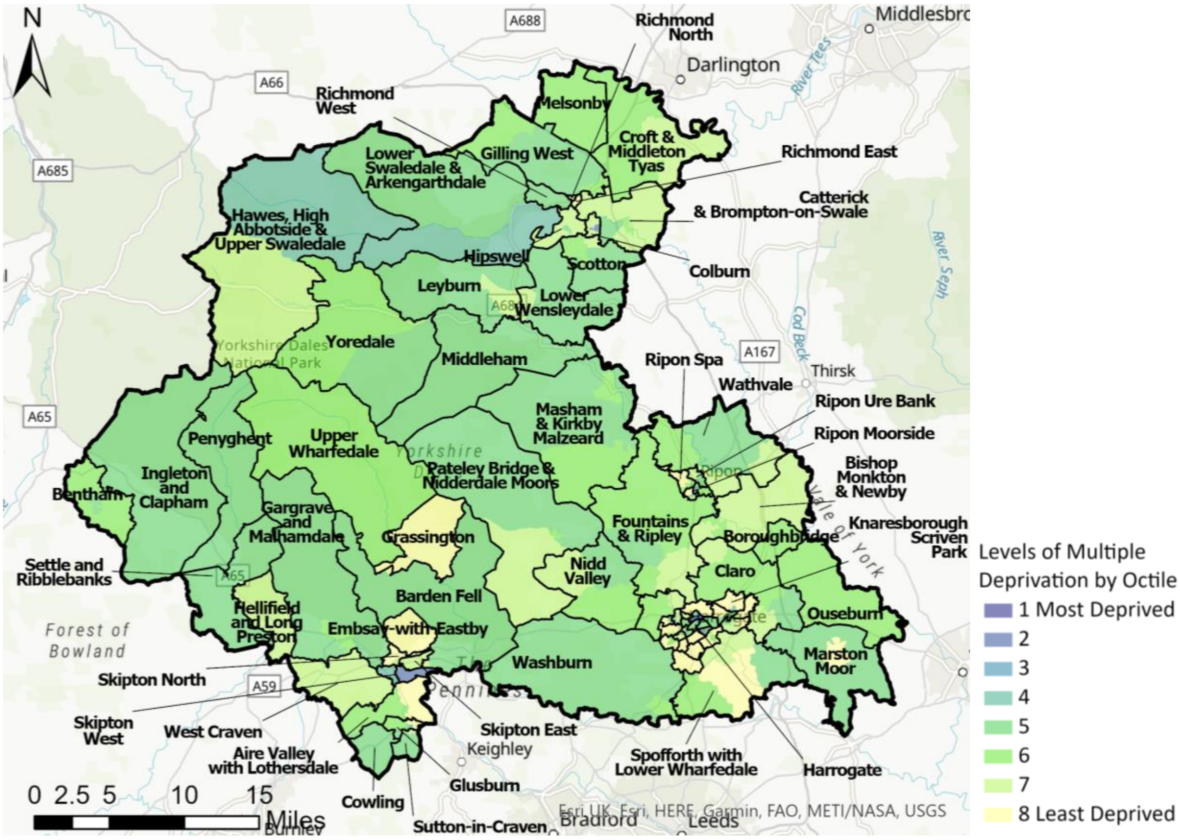


Figure 100: Ranking of English indices of deprivation 2020

The multiple indices that make up the IMD can be found in the accompanying data/maps to this report.

3. Local Insights

This section will use maps at the local authority level, rather than the sub-regional level, to provide some insights into what the data are, or could be, showing. Due to the amount of data and maps, comparisons between each permutation cannot be provided, however the commentary alongside the insights should allow users to replicate the steps to come to their own conclusions. Local knowledge is invaluable in this process.

3.1. Craven

Figure 101 shows the total annual gas demand in Craven. The highest demand is in the centre of the local authority area with a demand of c.50,000 MWh per year. The LSOA is comparatively large, in terms of land area, but the buildings are located mainly in the south of the Gargrave & Malhamdale electoral ward (Figure 101) meaning that this is the likely source of the high gas usage.

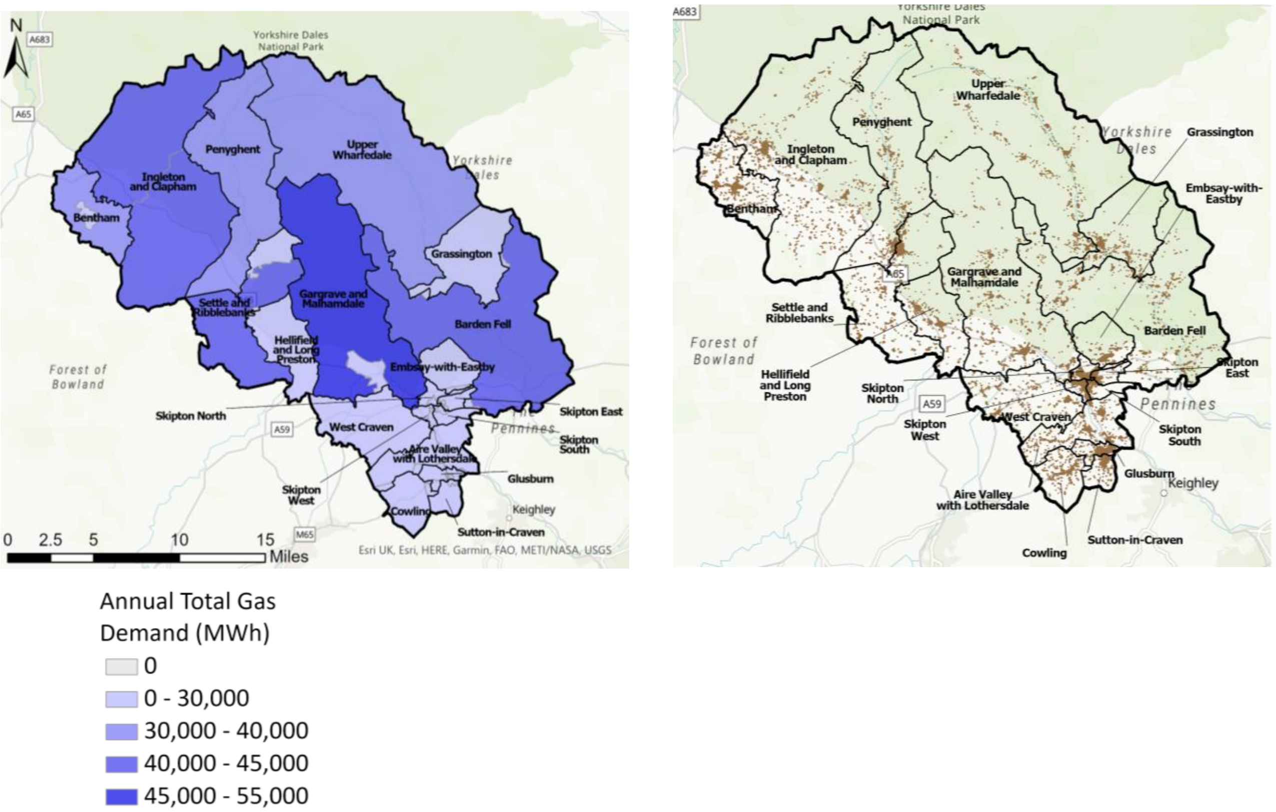


Figure 101: Total annual gas usage (left) and distribution of buildings in Craven (right).

To further narrow down the high gas user(s) the off-gas grid map can be used to limit the search area (Figure 102). The off-gas grid map clearly shows that most of the area is not on the gas network therefore validating the assumption that the high gas use is due to the user(s) in the south of the area.

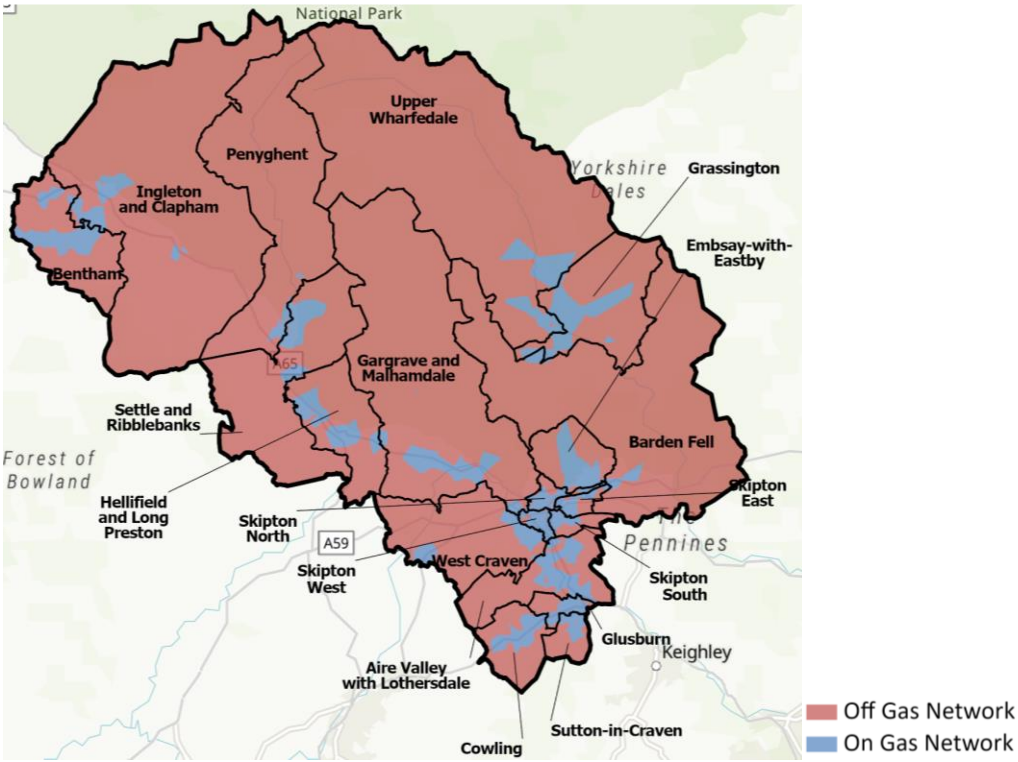


Figure 102: On- and off-gas network locations in Craven.

The two images in Figure 103 can then be used to ascertain whether the use is more likely to be domestic or non-domestic. Comparing the two images in Figure 103, it's clear to see that the gas usage is being driven by non-domestic users which accounts for over 73% of the gas usage.

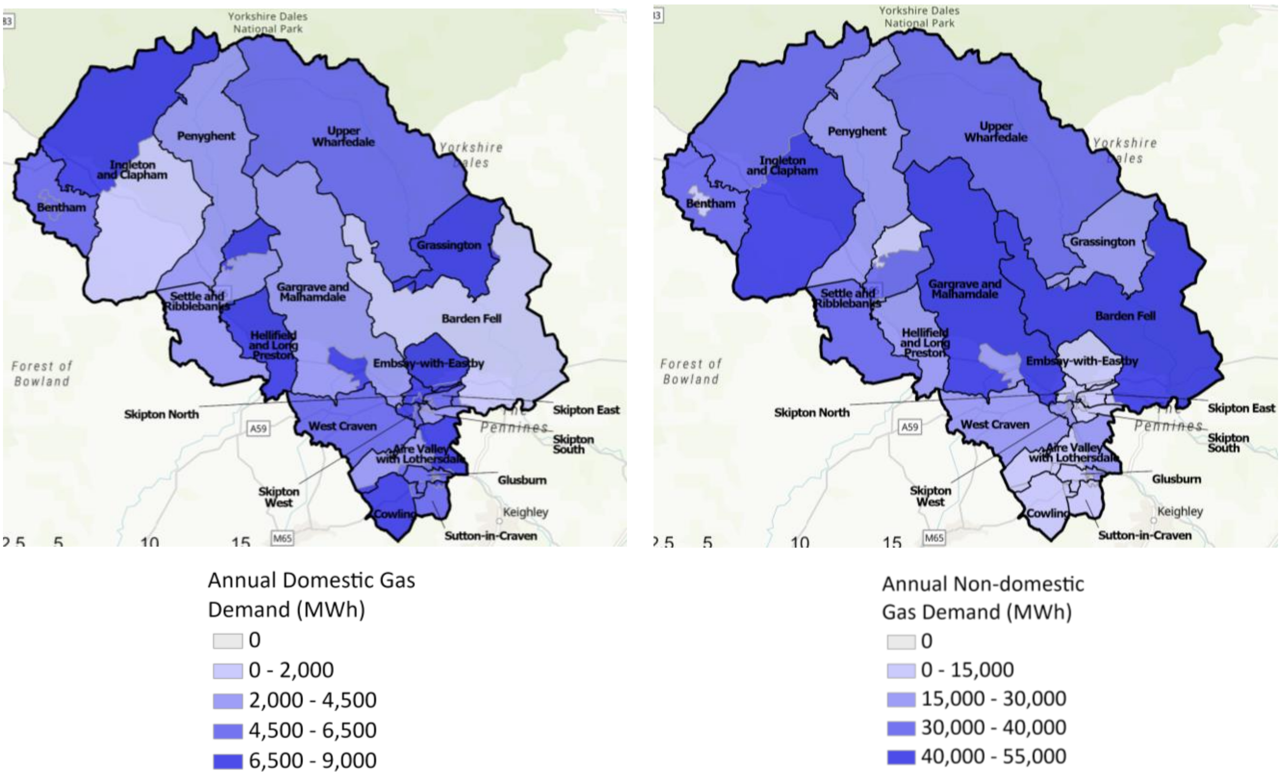


Figure 103: Domestic (left) and non-domestic (right) gas demands in Craven.

Using Google Maps to focus on the identified area (the large village of Gargrave) a large industrial site was immediately apparent – shown in the top right corner of Figure 104 – and was identified as 'Systagenix Wound Management Manufacturing Limited'. Although a number of other non-domestic sites were also found, this was the largest and most obviously non-agricultural. The site is also shown on the map of NAEI point-source emitters of VOCs (Figure 105); although, this does not necessarily mean that they are a gas user.

Figure 104: Aerial image from Google Maps of Gargrave village in Craven.

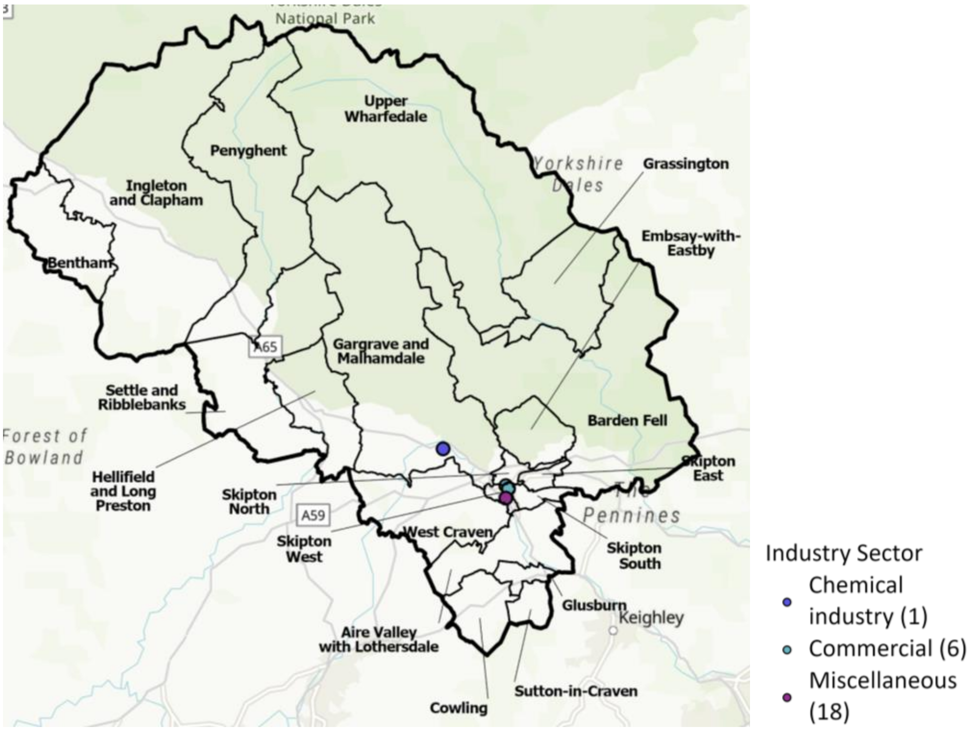


Figure 105: Individual emission sources identified by the National Atmospheric Emissions Inventory (NAEI) in Craven.

Research into the manufacturer however (Figure 106) showed that they are a user of gas on their manufacturing site.

Energy Efficiency

The new activities use electricity and natural gas supplied by the national grid. As the operations are being transferred from one site (Dunstable) to another (Gargrave) there is not expected to be an overall increase in contribution of greenhouse gas emissions from the sector/UK as a result of the proposed activities.

The energy performance of the site is routinely monitored, recorded and evaluated both under a Climate Change Agreement and in accordance with the existing environmental permit; energy audits are completed where appropriate. This will include the new activities. Energy efficiency will continue to be reviewed at least every 4 years and as per the existing permit.

Figure 106: Extract from the Environment Agency's Decision Document[31] regarding Systagenix Wound Management Manufacturing Limited

In summary, there is a high gas demand in central Craven which may be attributed to a manufacturer in Gargrave. This highlights a potential opportunity to work alongside the manufacturer to reduce their energy consumption and, in turn, to meet the conditions of their agreement with the Environment Agency.

[31] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/878981/Decision_Document.pdf [Accessed: 10/06/2021].

3.2. Harrogate

The off-street parking potential maps provided as part of this research show the possibility for a street to have off-street at-home EV charging. Roads highlighted in green have a higher proportion of the dwellings who could potentially charge at-home, those in red have a lower proportion. By looking at the distribution on the map, it is possible to make assumptions about where public charging infrastructure may be required to facilitate the transition to EV car ownership. The map for Harrogate (Figure 107) shows that the greatest potential for off-street EV charging is in the suburbs around the urban centre, although the urban centre itself has a low potential.

This is unsurprising, given the space premium in urban centres, many homes do not have driveways or front gardens that could allow off-street at-home charging. Figure 108 shows that the predominant dwelling type in Harrogate's urban centre is flats which exacerbates the issue. However, in the suburban areas where semi-detached dwellings are most common, there is a high potential for off-street EV charging.

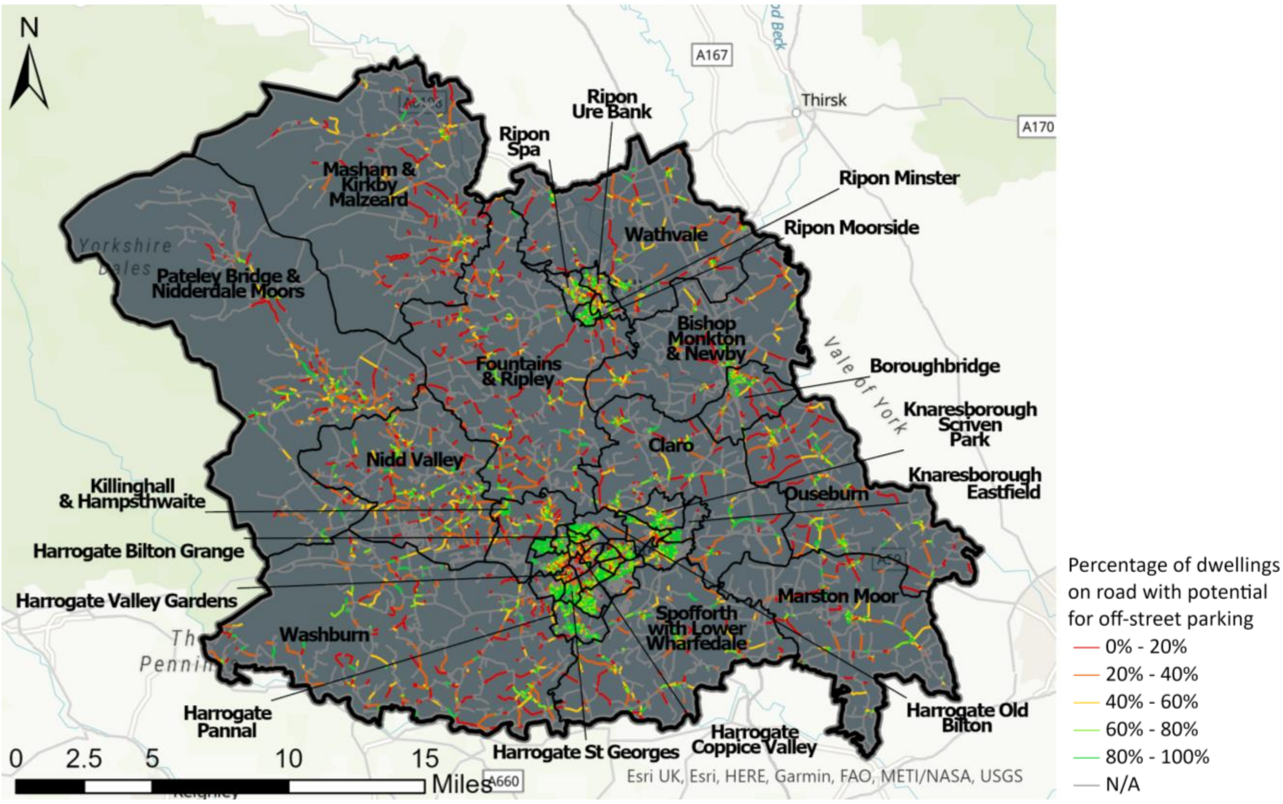


Figure 107: Off-street parking potential in Harrogate.

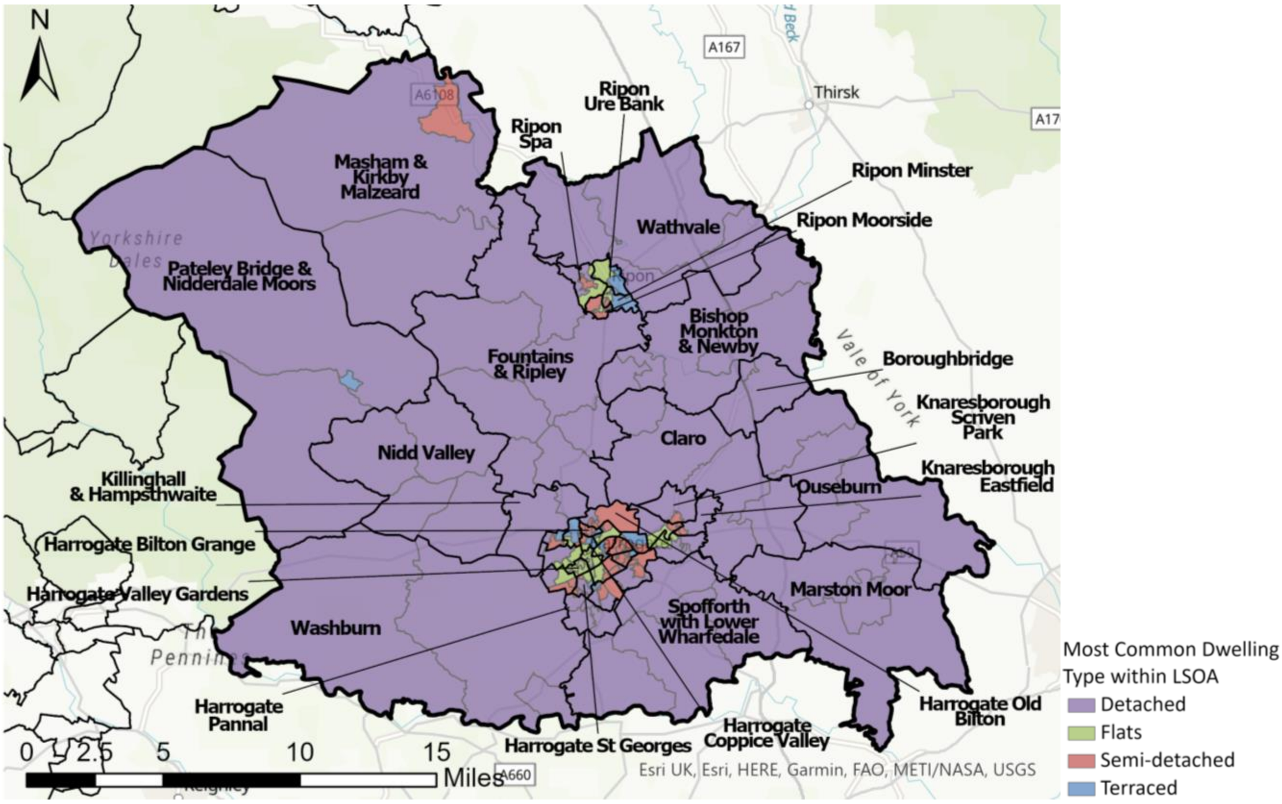


Figure 108: Predominance of dwelling type in each LSOA in Harrogate.

Moving out into the more rural areas where the predominant house type is detached, it would be assumed that this would mean an increased land ownership and therefore more space for off-street parking/charging. However, this is not always the case. Using the example of Lofthouse, in older areas many of the dwellings have a small front land area, and large back (Figure 109). Other areas such as Sawley, use small communal parking areas which are good candidates for small charging hubs (Figure 110)

Figure 109: Image taken from Google Street View of Lofthouse, Harrogate showing the lack of off-street parking.

Figure 110: Image taken from Google Street View of Sawley showing lack of off-street parking with a small communal parking area.

It can be seen from the map of public EV charging locations in Harrogate (Figure 111) that these locations are often focussed on destination charging i.e. where an EV owner would be able to charge their vehicle while visiting the supermarket, leisure centre, Fountain's Abbey, etc. However there is also a case to provide slow/trickle charging in the locations with poor off-street parking access to allow a greater number of people to access the EV market and help to reduce the 32% of emissions in Harrogate attributed to transport.

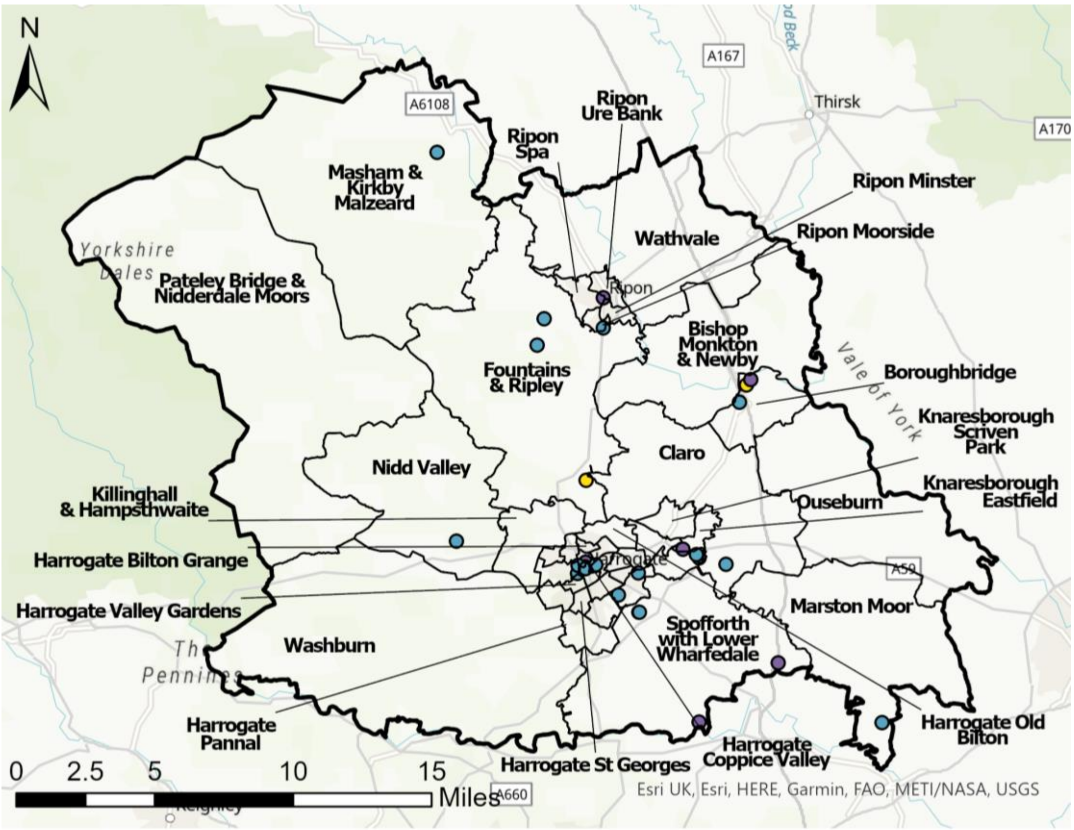


Figure 111: Location of public chargepoints in Harrogate according to Zap-Map® (December 2020)

3.3. Richmondshire

The decarbonisation of heat is one of the biggest challenges facing the UK on the road to net zero. There is also a need to ensure that the transition to net zero will not adversely affect the more vulnerable members of society, such as those already in fuel poverty. Richmondshire has a higher fuel poverty rate than the England average meaning increased care is required (the fuel poverty rates in Richmondshire by LSOA is shown in Figure 112).

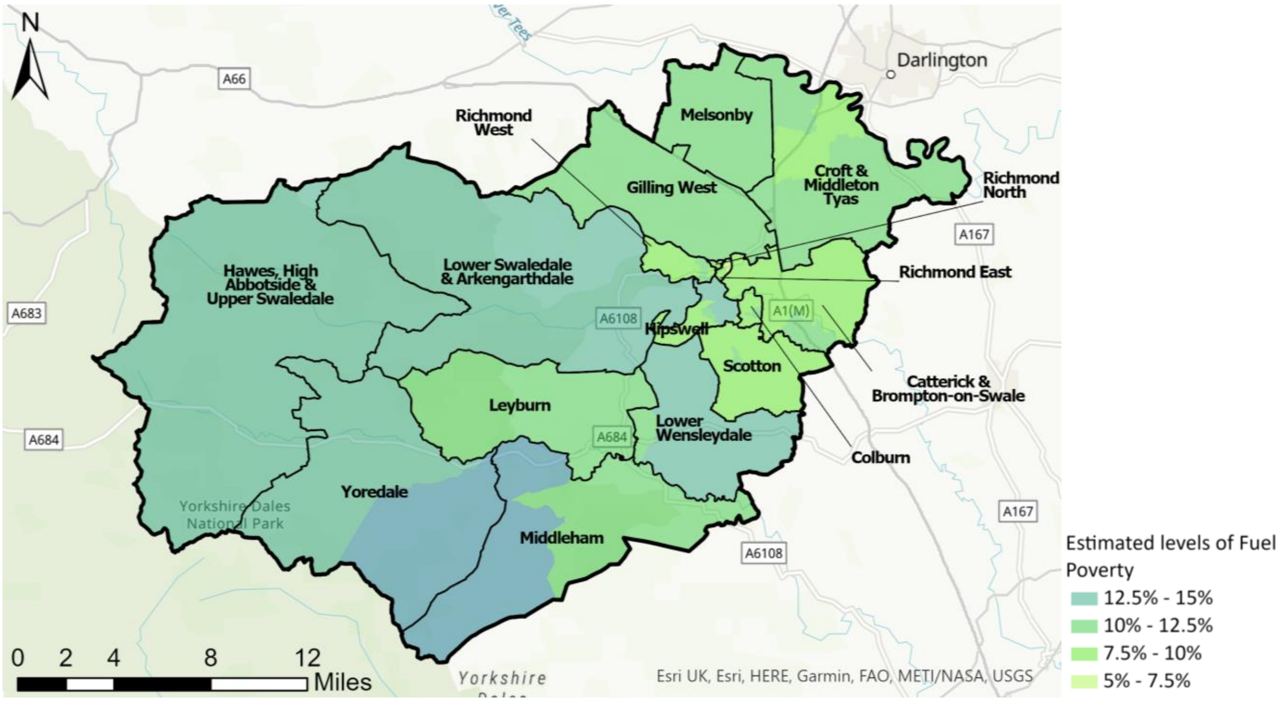


Figure 112: Fuel poverty by LSOA in Richmondshire.

The government is considering three future pathways to decarbonise heat: hydrogen, heat pumps and heat networks. A mass hydrogen boiler roll-out is still, at least, several years away and therefore may not be a viable short-to-medium-term option for those areas looking to decarbonise at a rate faster than that of the UK, including Richmondshire. Heat pumps are certainly a viable option, particularly in off-gas grid areas (Figure 113), but the capital and ongoing costs can be prohibitive to those already in fuel poverty. Heat networks require significant upfront investment into the infrastructure meaning that they're only viable in areas where there is a good density of buildings (Figure 114) that have a 'steady load' i.e. a mix of domestic and non-domestic where the amount of energy required is as consistent as possible over time. Heat networks also require a predictable heat source.

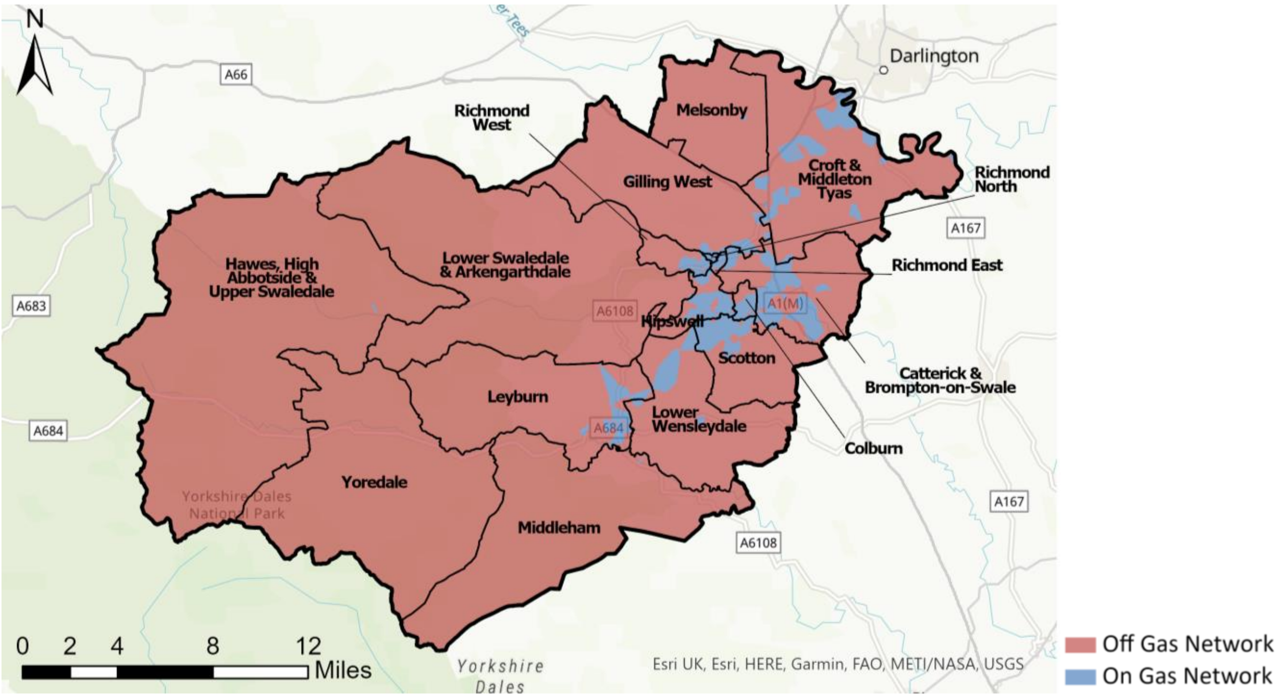


Figure 113: On- and off-gas network locations in Richmondshire.

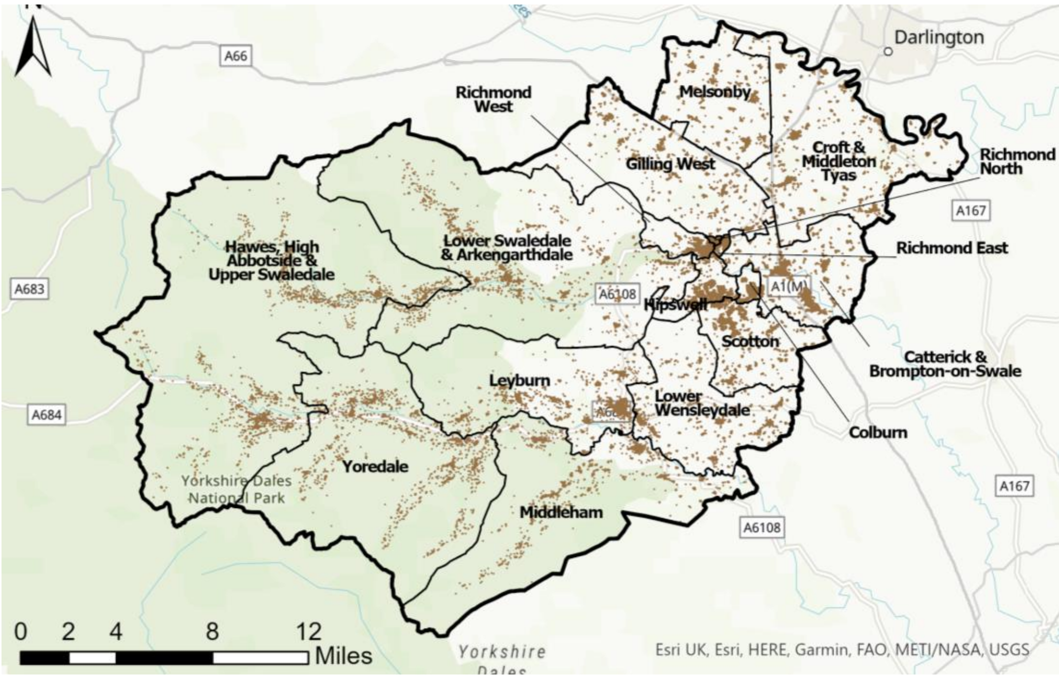


Figure 114: Distribution of buildings across Richmondshire.

A predictable heat source could include the Colburn Waste Water Treatment Works (WWTW) which lies to the north of a well-populated area (Figure 115) with a mix of domestic and non-domestic buildings. Local knowledge and further investigation will be needed to ascertain whether these will be able to provide a stable base load of heating need, and whether the waste heat from Colburn WWTW is adequate for the use.

Figure 115: Aerial image taken from Google Maps of Colburn Waste Water Treatment Works and the surrounding area.

3.4. Scarborough[32]

One of the biggest challenges to reach net zero emissions is the decarbonisation of the housing stock which is responsible for 35% of end-use CO_2 emissions in Scarborough (Table 2). However, the cost of decarbonising a dwelling is prohibitive for many homeowners and landlords meaning that financial assistance will be required from the public purse. The UK Government have recognised this and are making billions of pounds available to local authorities, Energy Hubs, and others to upgrade energy inefficient dwellings. At the time of writing, a £350m Sustainable Warmth Competition is accepting applications from local authorities. The funds are split into two sub-schemes: £200m Local Authority Delivery Phase 3 ('LAD3') and the £150m Home Upgrade Grant ('HUG1').

The focus of both the LAD3 and HUG1 schemes is on poorly-insulated, owner occupied or private rented dwellings with low-income occupants. There are a few differences between the schemes with the main one being that LAD3 is aimed at on-gas dwellings, and HUG1 aimed at off-gas.

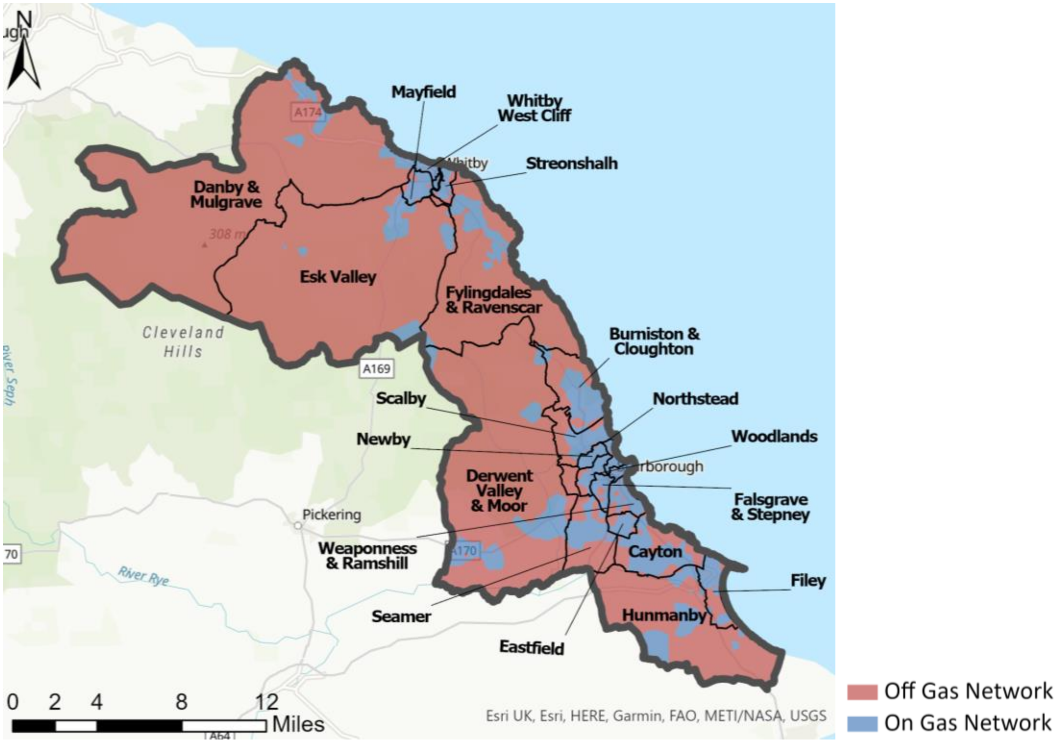


Figure 116: On- and off-gas grid locations within the Scarborough local authority area.

Figure 116 shows the areas of focus for the LAD3 scheme (blue) and HUG1 scheme (red).

The tenancy and energy efficiency are unknown at a level granular enough to feed into this assessment, however, using the income deprivation map (Figure 117) and ONS household income data can help to narrow the search areas.

[32] Please note: This analysis should not be used as the basis for a funding bid; it is solely intended to highlight areas for further investigation.

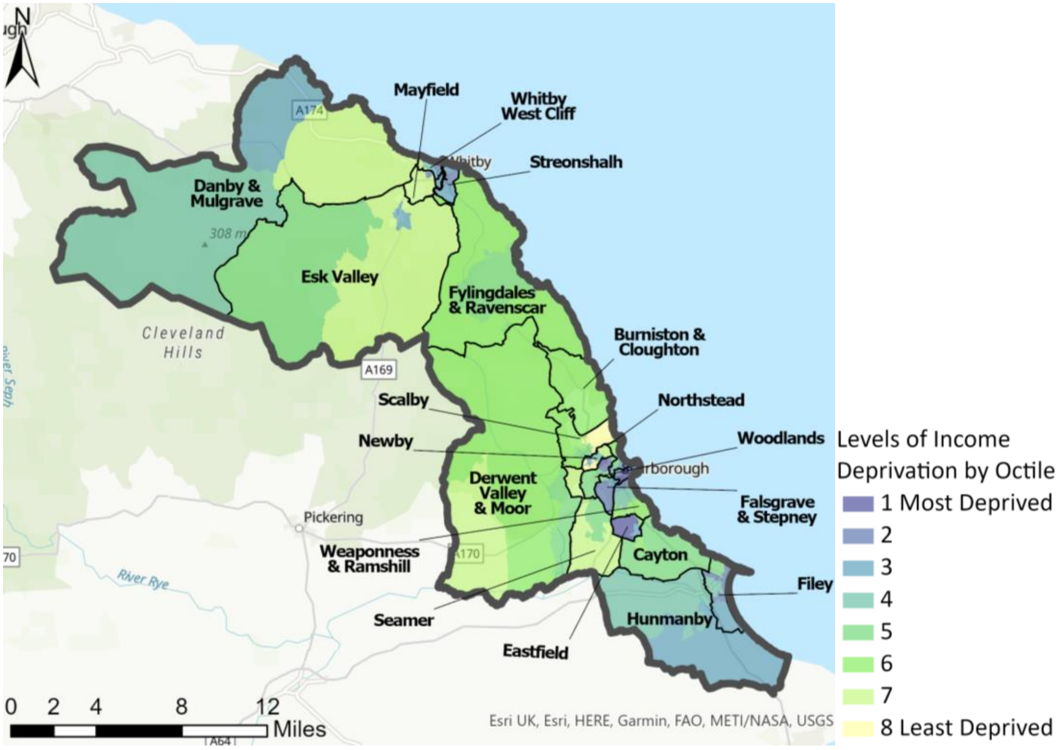


Figure 117: Income deprivation across the Scarborough local authority area.

Figure 117 shows clearly that the areas with the most income deprivation are those in the urban areas which are also typically on-gas (Figure 116).

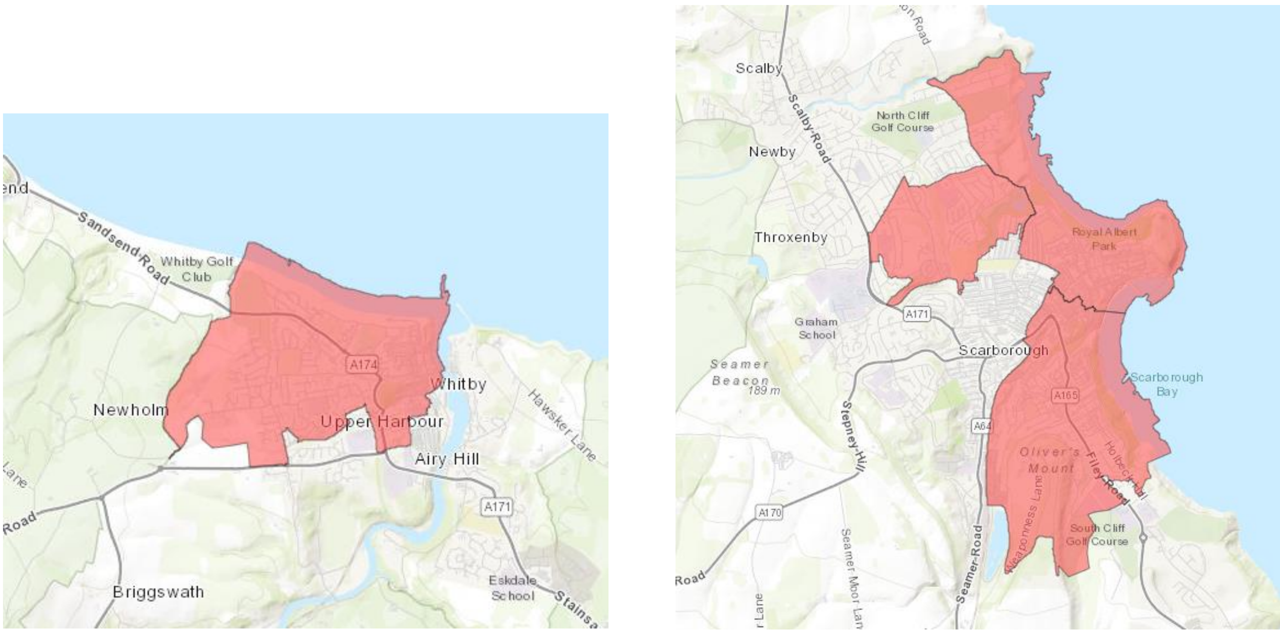


Figure 118: Low income MSOAs across the Scarborough local authority area[33].

Of the fourteen MSOAs in the Scarborough local authority area, four of them have an estimated total annual household income of £30,500 or less and are therefore more likely to be eligible for the LAD3 scheme. These areas are all within on-gas grid areas and therefore are ineligible for HUG1. The areas

[33] Data from ONS: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/smallareaincomeestimatesformiddlelayersuperoutputareasenglandandwales [Accessed: 23/06/2021]

around Flixby and Reighton are the lowest household income off-gas grid areas (£32,900), followed by the Danby & Mulgrave ward (£38,100). These areas are therefore most likely to be eligible for HUG1 funding.

The criterion around tenure should not be an issue in Scarborough as only around 11.5% of dwellings are social rent[34]. Owned outright (42.0%), owned with mortgage (24.1%) and private rent (22.4%) make up most of the stock.

[34] Data from ONS: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/subnationaldwellingstockbytenureestimates [Accessed: 23/06/2021]

3.5. City of York

Figure 119 shows the top three areas in the City of York local authority area whose domestic housing stock have the highest suitability for solar PV.

Figure 119: Solar PV suitability in the City of York local authority area

Two of the three areas with the most suitability are in the Huntington & New Earswick ward with a combined potential of over 2.3MW across 846 domestic dwellings (Figure 60 & Figure 62). This ward has a low level of fuel poverty (see Figure 120) but a wide range of income levels (Figure 121).

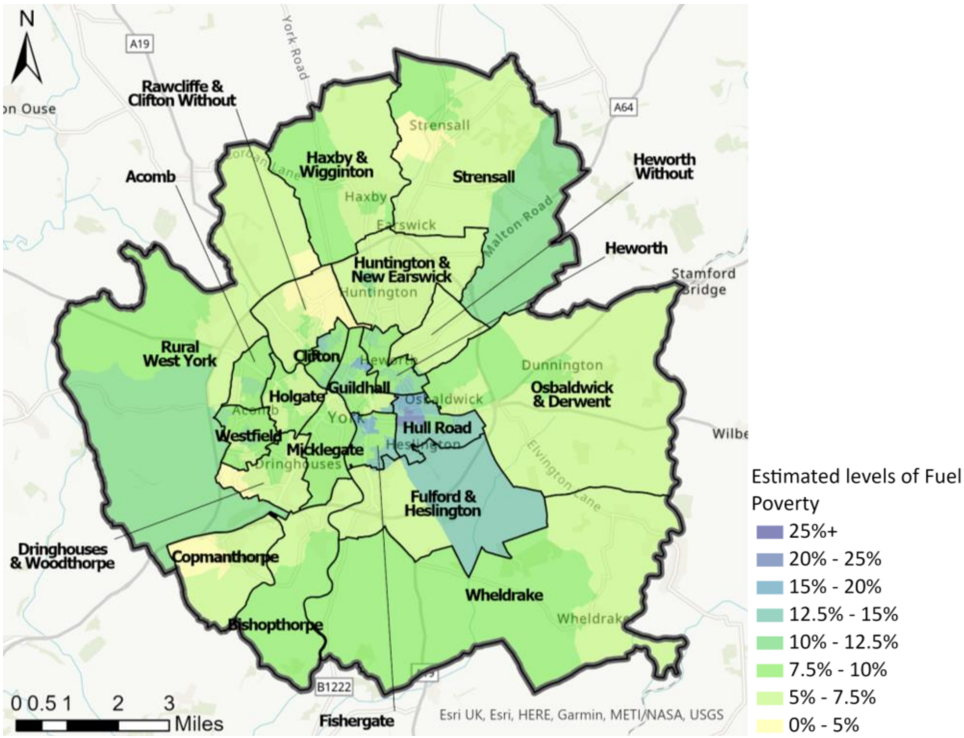


Figure 120: Estimated levels of fuel poverty across the City of York local authority area.

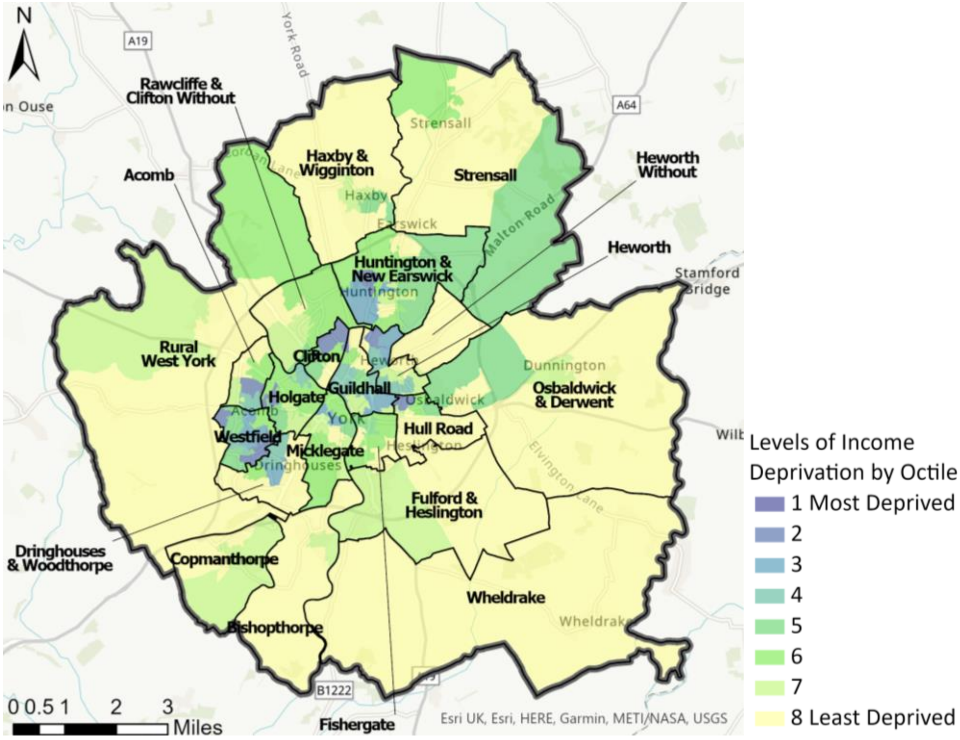


Figure 121: Income deprivation levels for the City of York.

The two areas highlighted as being of high suitability for solar PV deployment are both within the 'least deprived' octile for income and therefore the expectation would be that the houses are larger, and the occupants have more disposable income to spend on the installation of PV. This is confirmed by comparing to Figure 122 which shows the most common dwelling type within each LSOA.

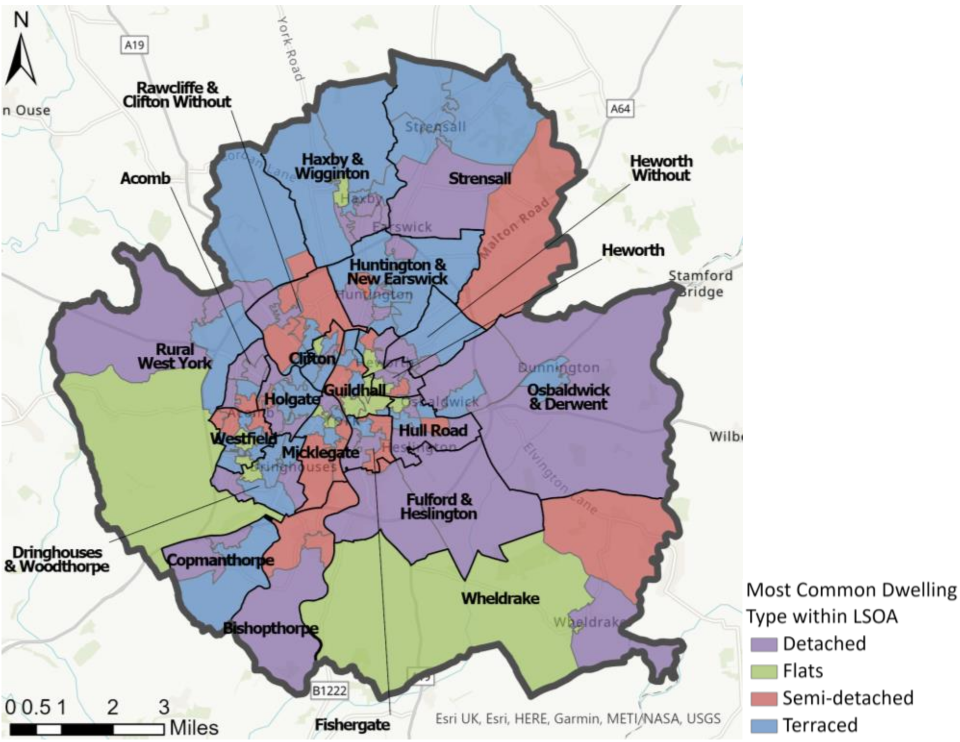


Figure 122: Most common dwelling type within each LSOA across the City of York local authority area.

By focussing in on the most suitable area for solar PV (Figure 123) it can be seen that the suitable dwellings in this area are mainly detached and semi-detached, and the roads running east-west mean that the dwellings are oriented towards the south making them ideal for solar irradiation.

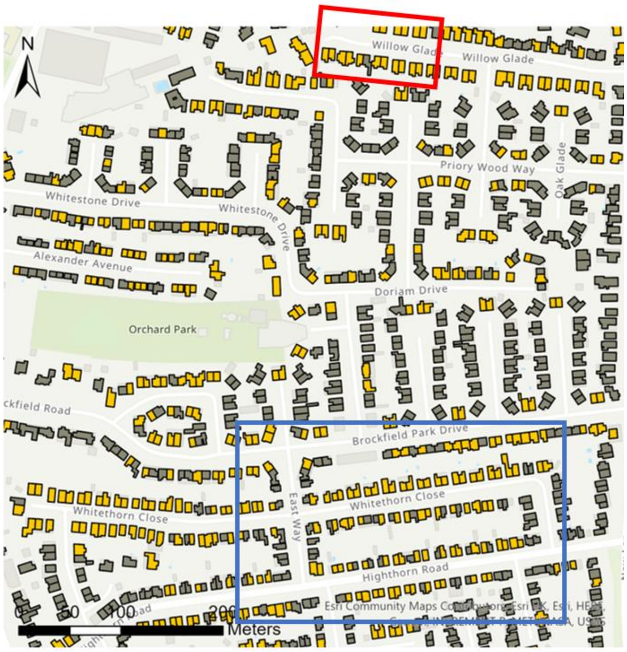


Figure 123: Replication of Figure 60 with two areas highlighted for further investigation.

The red box in Figure 123 is focussed on Willow Glade, a residential street with a high density of suitable dwellings. Figure 124 shows that the dwellings that have been selected by the model are south-facing with clear unobstructed roofs. One of the dwellings in the image (Figure 124) has already installed sixteen solar PV panels giving it a likely capacity of ~$4kW_p$[35]. Dwellings on the north side of the street would have an easier installation and therefore likely a lower cost to install due to the scaffolding not needing to avoid additional structures e.g. conservatories.

Figure 124: Aerial image taken from Google Maps of Willow Glade, Huntington, York as shown in the red box in Figure 123.

[35] Often $4kW_p$ of solar PV capacity is installed with a $3.68kW_p$ inverter to stay within the G83 electrical regulations of 16A/phase. For more information: https://www.ena-eng.org/ENA-Docs/Index?Action=ViewDetail&EID=99837&tab=introduction [Accessed: 23/06/2021].

One of the dwellings also has a rear extension which cuts into the available roof space. This has been picked up by the model and can be seen shaded out in Figure 123.

The blue box in Figure 123 highlights the area around Whitethorn Close and Highthorn Road. These streets have a high-level of homogeneity across the housing stock and a reasonable proportion with solar PV already installed which could show good awareness and acceptability of the technology.

The tenure of these dwellings is unknown but assuming that they are privately owned a community scheme could be developed to encourage the uptake of solar PV, reduce installation costs through mass purchase, and if facilitated by the local authority could leverage additional savings through existing contractual arrangements (e.g. scaffolders).

Figure 125: Aerial image taken from Google Maps of Highthorn Road, Huntington, York and surrounding area as shown in the blue box in Figure 123.

4. Data Metrics

Using comparisons between different data sets and considering the completeness of individual data sets it is possible to get an indication of the quality, accuracy and completeness of this local energy system representation. The following table shows a selection of data metrics which provide these indications for different aspects of this representation.

Based on a number of local area energy system representations, a RAG rating has been developed for comparison of each data metric against other project areas and the national average. This provides specific indicators for which categories of national data may require additional local knowledge under a full detailed Local Area Energy Plan.

4.1. Map Data Quality and Accuracy

Data Metric	Description	Value
Basic Land and Property Unit (BLPU) completeness (%)	Percentage of buildings that have a BLPU status code. This code shows the current status of a building including whether it is live or inactive. Subsequently this infers whether it would have an energy demand. For example, a value of 40% signifies that for this many properties in the area it is known whether they are live or no longer active. This will not be known for the remaining 60%, and therefore energy demands, and energy networks may lose accuracy.	73.41%
Classification code completeness (%)	Percentage of buildings with a classification code that indicates their use. If a high number of buildings are unclassified this indicates poor quality, or badly maintained map data. Since the local area representation is built on the map poor quality raises concerns around the quality of that representation. In addition, low levels of completeness mean that building use is likely to be mis-classified leading to poor representation of buildings, energy demands and energy networks.	100%
Active buildings (%)	Percentage of records with a BLPU code that is not inactive or unoccupied buildings. If high numbers of buildings are classified as active this increases confidence on estimates of local energy demand.	67.49%
Commercial classification code (%)	Percentage of buildings with a commercial classification code. Due to large variability in non-domestic building construction methods and uses estimating energy demand for these buildings is inherently more uncertain than for domestic buildings. If most buildings in the project area have a domestic classification, then energy demand estimates are expected to be better than if most buildings are non-domestic.	10.19%
Land classification code (%)	Percentage of buildings with a "land" classification code. In theory this should be zero. If a high number of buildings are classified as land this indicates poor quality, or badly maintained data. Since the local area representation is built on the map poor quality data raises concerns around the quality of that representation.	5.24%
"Other" classification code (%)	Percentage of buildings with a classification code of "other". If a high number of buildings are classified as other this indicates poor quality, or badly maintained data. Since the local area representation is built on the map poor quality data raises concerns around the quality of that representation.	1.18%
Parent shell classification code (%)	Percentage of buildings with a "parent shell" classification code. In these cases, cross references are not available within the OS data meaning that it is not possible to associate the map data with other data sources such as the Valuation Office Agency. This means that there is less confidence in the quality of data associated with these buildings resulting in less confidence that local building stock is correctly represented and that estimates of energy use and network capacity are accurate.	6.84%
Residential classification code (%)	Percentage of buildings with a residential classification code. Due to large variability in non-domestic building construction methods and uses estimating energy demand for these buildings is inherently more uncertain than for domestic buildings. If most buildings in the project area have a domestic classification, then energy demand estimates are expected to be better than if most buildings are non-domestic.	74.22%

Unclassified code (%)	Percentage of buildings with a classification code of “Unclassified”. If many buildings are unclassified this indicates poor quality, or badly maintained data. Since the local area representation is built on the map poor quality data raises concerns around the quality of that representation. In addition, if use cannot be identified with certainty this will lead to poor understanding of the local building stock and poor-quality energy demand estimates.	1.41%
Dual use classification code (%)	Percentage of buildings with a dual use classification code. It is more difficult to correctly estimate the energy use of dual use buildings as the floor area used for different purposes may not be known. If many buildings are dual use, then understanding of local building stock will be less good and energy demand estimates will be of lower quality.	0.43%
Non-domestic addresses with Valuation Office Agency mappings (%)	Percentage of buildings with a commercial classification code that can be linked with Valuation Office Agency data. The Valuation Office Agency data provides information on buildings that pay business rates. It categorises how a building is used and the floor area within a building that is used for different purposes. When most non-domestic buildings can be mapped to an entry in the Valuation Office Agency data this allows a better understanding of the local stock and better-quality estimates of energy use.	52.46%
Building points correctly assigned to building Toids (%)	Percentage of Building Points[36] correctly assigned Building Toids. Where building points exist but are not contained within Building Toids[37] this can indicate poor quality, or badly maintained map data. Since the local area representation is built on the map data poor quality data raises concerns around the quality of that representation. Furthermore, it is likely that buildings will be mis-classified or omitted from the analysis in these cases resulting in reduced understanding of the local building stock and associated energy demand and network capacity analyses. In addition, if a Building Point is assigned to a non-building Toid then the information associated with that Building Point cannot be used as the size of the building is not known. This means that understanding of local building stock and energy demand estimates will be of lower quality.	82.96%
Buildings with height data (%)	Percentage of buildings with height data. Height data is used to understand the number of storeys in a building and so the total building floor area. If height data is missing from a building, then the number of storeys will be estimated using LIDAR data and the quality of the energy use may be less accurate.	75.95%

[36] Within the OS data all buildings that have an address should be represented by a building point as well as some geometry that shows the building’s footprint (the associated Building Toid).
[37] Within the OS data all buildings should be represented by some geometry that shows their footprint. This is the Building Toid.

4.2. Building Data Completeness and Quality

Data Metric	Description	Value
Proportion of domestic buildings with Energy Performance Certificate (%)	Energy Performance Certificates provide information on a variety of factors that are important when estimating the energy consumption of a house such as whether there is wall insulation. If Energy Performance Certificates are available for a large proportion of domestic buildings, then this provides a better understanding of local building stock and improves energy demand estimates.	48.75%
Proportion of domestic buildings where building type from analysis of map data matches building type from Energy Performance Certificates (%)	Domestic building type can be identified by analysing the map geometry for each Building Toid. Where this matches the building type given by the Energy Performance Certificate there is high confidence that the building has been correctly categorised. This indicates that there is a good understanding of local building stock and that energy use estimates will be of better quality.	84.08%
Percentage difference between domestic building ages and London Datastore data	London Datastore data provides information on housing age aggregated to Lower Super Output Area level. If the percentage difference between the proportions of different domestic building ages and the London Datastore data is low, then this gives high confidence in the building age predictions used in the project and that energy use estimates will be of better quality.	15.79%
Percentage difference between local building types and Office of National Statistics census data	National census data provides information on housing type aggregated to Lower Super Output Area level. If the percentage difference between the proportions of different house types in the project area and the ONS data is low, then this gives high confidence that there is a good understanding of local building stock and that energy use estimates will be of better quality.	16.52%
Comparison of Non-domestic use category between Valuation Office Agency and Ordnance Survey	The use category of non-domestic buildings is provided in the Ordnance Survey data with a commercial classification code and in the Valuation Office Agency data. Where these use categories agree this gives confidence that the use of the building has been correctly identified and reduces uncertainty associated with estimates of energy use.	97.89%

4.3. Other Data Comparisons

Data Metric	Description	Value
Social Data Scaling (%)	Social data is provided by the Office for National Statistics at Lower Super Output Area Level[38]. In cases where the project boundary cuts across a Lower Super Output Area the social data is calculated by proportioning the data based on the number of buildings contained in both the project area and the Lower Super Output Area compared to those in the whole Lower Super Output Area. For projects where this apportionment has been performed for a large number of Lower Super Output Areas it is likely that social metrics produced will be less accurate than in cases where little or no data points have been apportioned. This metric shows the percentage of buildings within the project area that belong to a proportioned LSOA.	0%
Annual gas demand comparison to BEIS data (%, LEAR/BEIS)	Total annual gas demand is published by BEIS at Medium Super Output Area level. This can be used to give an estimate of demand within the project area. Where this value compares closely with the demand estimate calculated for this work then there is good confidence in the value. Where there is a significant difference then confidence in the demand estimate is reduced. A number less than 100% means the demand modelled in LEAR is lower than BEIS reported demand. A number greater than 100% means the demand modelled in LEAR is higher than BEIS reported demand. It should be noted that the way buildings are categorised in the BEIS data, and the associated modelling used to calculate aggregate demand is different to the approach adopted here and is also likely to contain sources of error. This comparison gives an indication of confidence but should not be used to assess whether either number is a better estimate.	144%
Annual electricity demand comparison to BEIS data (%, LEAR/BEIS)	Total annual electricity demand is published by BEIS at Medium Super Output Area level. This can be used to give an estimate of demand within the project area. Where this value compares closely with the demand estimate calculated for this work then there is good confidence in the value. Where there is a significant difference then confidence in the demand estimate is reduced. A number less than 100% means the demand modelled in LEAR is lower than BEIS reported demand. A number greater than 100% means the demand modelled in LEAR is higher than BEIS reported demand. It should be noted that the way buildings are categorised in the BEIS data, and the associated modelling used to calculate aggregate demand is different to the approach adopted here and is also likely to contain sources of error. This comparison gives an indication of confidence but should not be used to assess whether either number is a better estimate.	197%

[38] Lower Super Output Areas are used by the Office for National Statistics to report national census data. Each Lower Super Output Area has a population of less than 3,000 people or 1,200 households.

Appendix A: Accompanying Data

The accompanying Excel workbooks contains all the data that sits behind the graphs and maps in this document. The summary tab can be used to navigate to the data of interest.

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