Swindon Carbon Inventory - 2025

NEW LOCAL PLAN 2023-2043 BACKGROUND PAPER

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Swindon Borough Council

Note: Planning Policy Team, Inclusive Economy and Sustainability

Purpose of the Document:

This background paper supports local climate policy development by presenting an overview of the Swindon's carbon emissions profile and exploring the scale and nature of interventions required to meet the UK's legally binding target of net zero greenhouse gas emissions by 2050, as set out in the Climate Change Act 2008.

The document establishes a local carbon inventory baseline using the most up-to-date emissions data and applies the SCATTER (Setting City Area Targets and Trajectories for Emissions Reduction) tool to model potential emission reduction pathways.

While not a statutory carbon budget, this process mirrors national carbon budgeting principles by identifying priority sectors for decarbonisation and quantifying the level of ambition needed across various scenarios. It provides an evidence base for setting local targets, informing climate action plans, and integrating climate objectives into the Local Plan and wider policy frameworks.

Policy Analysis:

In 2008 UK Parliament passed the Climate Change Act aiming to reduce GHG emissions by 80% till 2050 compared to 1990 levels and later in 2019 it was amended original act to set new targets of reduction of UK's net emissions of GHGs by 100% relative to 1990 levels by 2050.

The 2024 National Planning Policy Framework (NPPF) explicitly mandates that "the planning system should support the transition to net zero by 2050 and take full account of all climate impacts" including overheating, water scarcity, storm and flood risk. To operationalise this requirement at the borough level, Swindon has develop a robust carbon inventory—a comprehensive, sector-based quantification of current emissions—and implement carbon budgets aligned to projections. A baseline inventory enables tracking of emissions reductions over time, whilst interim budgets demonstrate the borough's trajectory toward net-zero, ensuring local decision-making supports radical reductions in greenhouse gas emissions and addresses emerging climate impacts.

In addition, NPPF paragraph 163 asserts that "the need to mitigate and adapt to climate change should also be considered in preparing and assessing planning applications, taking into account the full range of potential climate change impacts". A defined carbon inventory equips applicants and authorities with evidence of current emissions to assess both operational and embodied carbon impacts of developments. Meanwhile, a clear carbon budget structure offers a framework against which planning decisions can judge whether proposals are consistent with borough-wide emissions trajectories and climate mitigation goals.

Introduction:

This report illustrates a comprehensive analysis of carbon emissions through a carbon inventory and projects future emission trajectories. The report provides a pragmatic approach to quantifying carbon emissions and delineates their distribution across various sectors responsible for emissions. By examining current emissions and projecting future trajectories, the report lays the groundwork for informed policy development and strategic planning to address climate change mitigation and adaptation. Furthermore, it aligns with national policies such as the Climate Change Act 2008 and its amendments, as well as global agreements like the Paris Agreement, by setting potential ambitions and targets to set directions for climate responsive policies in Local Plan with the aim of reducing greenhouse gas emissions. Specifically, it underscores Swindon's commitment to achieving net-zero emissions, both within the Council's organizational framework and across the broader community, in alignment with UK-wide targets set by the government. This comparative analysis serves as a crucial tool for informing policy decisions and guiding actions to transition towards a sustainable, low-carbon future.

Greenhouse Gas Emissions Accounting Framework

The accurate quantification of greenhouse gas (GHG) emissions across all sectors within an urban jurisdiction is fundamental for informed climate action planning. The **Global Covenant of Mayors for Climate & Energy (GCoM)** provides a standardised methodology for local authorities to develop GHG emissions inventories using the **Common Reporting Framework (CRF)**. The CRF enables cities to structure their emissions inventories around five core sectors—**Stationary Energy**, **Transportation**, **Waste**, **Industrial Processes and Product Use (IPPU)**, and **Agriculture, Forestry, and Other Land Use (AFOLU)**—with further disaggregation into subsectors to enhance the granularity and traceability of emission sources.

To provide a consistent approach to emissions attribution, the CRF adopts a **scope-based system of categorisation**, which distinguishes between **direct** and **indirect** emissions based on the origin of emissions relative to the city's geographic boundary. This distinction reflects methodologies aligned with both the **Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories** and the **Greenhouse Gas Protocol for Cities (GPC)**, jointly developed by the World Resources Institute (WRI), C40 Cities, and ICLEI

Sector and Subsectors
Stationary Energy
Residential Buildings
Commercial building and facilities
Institutional building and facilities
Industrial building and facilities
Agriculture
Fugitive emission
Transport
On-Road
Rail
Waterborne navigation
Aviation
Off-Road
Waste
Solid waste disposal
Biological treatment
Incineration and open burning
Wastewater treatment and discharge
All IPPU
All AFOLU
Energy generation
Electricity only generation
CHP generation
Heat/cold generation
Local renewable generation

Table 1: Common Reporting Framework (CRF)

Tyndall Centre Carbon Budget Aligned Pathway

The SCATTER Pathway has added in an indicative pathway which is aligned with The Tyndall Carbon Budget Tool. A Carbon Budget is defined as the allowed cumulative total of emissions over a period of years which ensures temperature change remains below dangerous level. This allows Local Authorities to understand the reductions required to stay aligned with the Paris Agreement and is often referred to as a science-based pathway.

Tyndall Carbon Budget Reports present recommended climate change commitments for UK local authority areas that are aligned with the commitments in the United Nations Paris Agreement, informed by the latest science on climate change and defined by science based carbon budget setting.

According to this report, the following recommendation should be adopted to meet net zero targets. However, the report only considers CO2 emissions and project of future implication till 2100.

1. stay within maximum cumulative CO2 emission budget of 6.8 MtCO2 for the period of 2020-2100
2. Enshrine interventions as immediate programme to achieve 13.2% reduction rate per year in carbon emission to deliver a Paris aligned carbon budget.
3. Achieve zero or near zero carbon target till 2042. At 2042 5% of the budget remains. This represents very low levels of residual CO_2 emissions by this time, or the Authority may opt to forgo these residual emissions and cut emissions to zero at this point.

SCATTER Pathway Methodology

SCATTER pathway provides scenario modelling with pre-loaded interventions varying with different model styles. Considering the framework provided by GCoM, it helps to understand the trajectories of emission till 2050 according to selected pathway and deliver a roadmap to visualise the comparison of required interventions and its impact with recommendations mentioned by Tyndall Centre Carbon Budget Aligned Pathway. There are five various pathways the SCATTER offers which are mentioned below,

1. Business As Usual (BAU)
2. Reduce Fuel Consumption (RFC)
3. Shifting Fuel
4. Renewable Supply
5. Higher Ambition

To deliver trajectory, the model provides 32 interventions with 4 levels varying according to the selected pathway. This report reflects the results of BAU and Higher ambition pathway to understand the basic and highest interventions required to achieve the target. Based on the results and recommended interventions for both pathways, policy recommendation will be derived.

In this analysis, only the Business As Usual (BAU) and Higher Ambition pathways from the SCATTER model have been included. The BAU pathway provides a baseline scenario against which future interventions can be assessed, while the Higher Ambition pathway illustrates the maximum potential impact of extensive policy action. Other pathways—such as Reduce Fuel Consumption, Shifting Fuel, and Renewable Supply—have not been individually assessed, as those are aiming only specific carbon reduction strategy and their interventions are largely embedded within the broader assumptions of the Higher Ambition scenario. This approach allows for a more streamlined comparison between the current trajectory and the most aspirational route toward emissions reduction.

Carbon Inventory:

Figure 01 presents an overview of borough-wide greenhouse gas (GHG) emissions between 2017 and 2020. Over this period, the stationary energy and transport sectors consistently accounted for the largest share of emissions. Notably, both sectors exhibit a marginal decline in emissions by 2020 compared to 2017, likely reflecting behavioural and operational changes during the COVID-19 pandemic. In particular, the decrease in transport-related emissions may be attributed to restricted mobility during lockdowns, while the corresponding increase in emissions from residential buildings in 2020 is indicative of heightened domestic energy demand during the same period.

The data further reveals a strong reliance on motorised road transport, which is responsible for over 90% of the transport sector's emissions and contributes approximately 31.8% of total borough-wide emissions. In contrast, emissions from waste, AFOLU, and energy generation remained relatively stable over the assessment period. The IPPU sector, however, exhibited a notable upward trend, reaching nearly 100,000 tonnes of CO_2 equivalent by 2020.

In total, the stationary energy sector contributes over 50% of the borough's emissions, highlighting the significance of both operational and embodied carbon in buildings and infrastructure.

Figure 1: Sector-wise Carbon Inventory of Swindon

SCATTER Scenario Pathways

BAU (Business as Usual)

The BAU model style provides a useful tool for policymakers and planners to understand the potential trajectory of GHG emissions in a city if no action is taken to mitigate climate change. It helps highlight the urgency of implementing emission reduction measures and informs decision-making on climate policy and planning.

The interventions across all sectors stay at the minimum ambition level which means emission reduction comes through some nationally- led policies and continued grid decarbonisation. To evaluate the effectiveness of different strategies in achieving emission reduction targets, The BAU pathway helps to establish baseline against which the potential impact of emission reduction policies and interventions can be assessed.

Modelled Interventions and Ambition Levels

As mentioned in figure 01, BAU intervention plan aimed at achieving emission reduction targets, several strategies across various sectors are outlined to influence the trajectory of greenhouse gas emissions over time. By 2030, efforts are directed towards increasing forest cover by 5%, while simultaneously decreasing grassland by 2% and increasing cropland by 5%. Additionally, a 13% expansion in the coverage of settled land is targeted.

Interventions modelled and underlying ambition levels

No	Ambition*	Description
1	1	5% increase in forest cover by 2030.
2	1	By 2050, 2% decrease in grassland. Cropland increases 5%. 13% increase in the coverage of settled land.
3	1	0.2% annual growth in dairy cows & livestock.
4	1	Domestic lighting and appliance total energy demand decreases to 80% by 2050.
5	1	Small reductions in energy demand from domestic cooking; no change in heat source.
6	1	Hot water demand per household grows 5% every 5 years.
7	1	All new houses are built to 2013 building regulations (no change).
8	1	All current households remain at weighted average heat loss.
9	1	No change to current technology mix for home heating.
10	1	Onshore wind grows by 50% by 2030, doubling by 2050.
11	1	No change to small-scale onshore wind.
12	1	Offshore wind triples by 2030, and increases steadily to 2050.
13	1	180% increase in large-scale solar PV generation by 2030; 320% increase by 2050.
14	1	180% increase in small solar PV by 2030; 320% increase by 2050.
15	1	By 2050, hydroelectric power generation increases by 12%.
16	1	No change to current levels.
17	1	No change in solid fuel power generation.
18	1	In 2050, commercial heating, cooling and hot water demand is 103% of current levels.
19	1	No change to current technology mix for commercial heating and cooling.
20	1	Commercial lighting & appliance energy demand increases 28% by 2050.
21	1	Share of commercial cooking which is electric is at current levels.
22	1	Industry moves to higher natural gas consumption, with electricity consumption falling before 2035 then remaining constant.
23	1	Other industry process emissions are reduced at a rate of 2.6% per year.
24	1	By 2050, 47% increase in distance travelled by road freight; 40% increase in efficiency. In waterborne transportation, 15% decrease in use of waterborne transport.
25	1	No change to total travel demand per person.
26	1	No change to current national average modal split by total miles: 74% transportation by cars, vans and motorcycles.
27	1	Cars and buses are 100% electric by 2050. Slight increase in average train occupancy.
28	1	Department for Transport "central" forecast for aviation. The "Central" forecast represents the DfT base-case. For reference see Pathways Methodology on the SCATTER website.
29	1	By 2050, 48% increase in fuel use at UK ports.
30	1	65% recycling, 10% landfill, 25% incineration by 2040; remaining constant to 2050.
31	1	Total volume of waste is 124% of 2017 levels by 2040.

KEY
Most Ambitious
Medium Ambition
Less Ambition
Minimum Ambition/BAU
Different technology mixes (rather than ambitions)

**Please note that heating and cooling technologies for both Domestic buildings and Commercial & Institutional buildings are modelled as a range of technology mix scenarios, rather than an increasing ambition level and so are shown in grey.*
*** Measures 10 to 14 will sometimes appear as duplicates as users are not asked to break down their generation/capacity targets into small and large scale for the given energy technology. It is worth noting that this does not mean double savings and the generation/capacity target can have a mix of small and large scale or one or the other.*

Table 2: BAU Ambition Pathway Policy Interventions

The pathway also entails a modest annual growth of 0.2% in dairy cows and livestock, alongside a strategic reduction in domestic lighting and appliance energy demand to 80% by 2050. Hot water demand

per household is projected to grow steadily, while onshore and offshore wind energy capacities are set to significantly increase, complemented by substantial boosts in solar PV and hydroelectric power generation.

Commercial sectors are expected to witness a rise in heating, cooling, and hot water demand, with corresponding increases in lighting and appliance energy consumption. Industry shifts towards higher natural gas consumption, with a focus on reducing process emissions. Transportation strategies involve increasing road freight distance travelled, albeit with improved efficiency, while promoting electric vehicles and slightly increasing train occupancy.

Waste management initiatives aim for higher rates of recycling and reduced landfill usage. Overall, these interventions aim to steer the trajectory of emissions towards a more sustainable pathway, albeit without radical departures from current trends or technologies.

Although some of the interventions are not applicable in the case of Swindon. As instance, non-existence of any natural water resources, hydroelectric power generation and waterborne transport policies are unlikely to consider in new carbon emission reduction strategy.

Results of BAU Scenario:

The Business-As-Usual (BAU) modelling results indicate that, without significant changes to current policy and action, Swindon's carbon emissions will decline only gradually and will fall far short of the reductions required to achieve net zero by 2050. Despite some anticipated improvements in the transport and industrial sectors, overall emissions plateau mid-century, leaving a substantial gap between projected emissions and climate-aligned targets.

Sectoral breakdowns further reveal that while transport emissions are expected to fall sharply, this progress is offset by persistently high or even increasing emissions in the domestic sector. By 2050, domestic buildings are projected to become the dominant source of local emissions—highlighting a critical need for intervention in housing energy efficiency, heating systems, and retrofit programmes.

Overall, the BAU pathway illustrates a trajectory of insufficient systemic change, relying on marginal gains rather than transformative action. This modelling reinforces the importance of establishing a robust carbon inventory and using tools like SCATTER to model alternative, more ambitious scenarios. Doing so provides the evidence base needed to identify sector-specific interventions and ensure local policy aligns with science-based targets for carbon reduction.

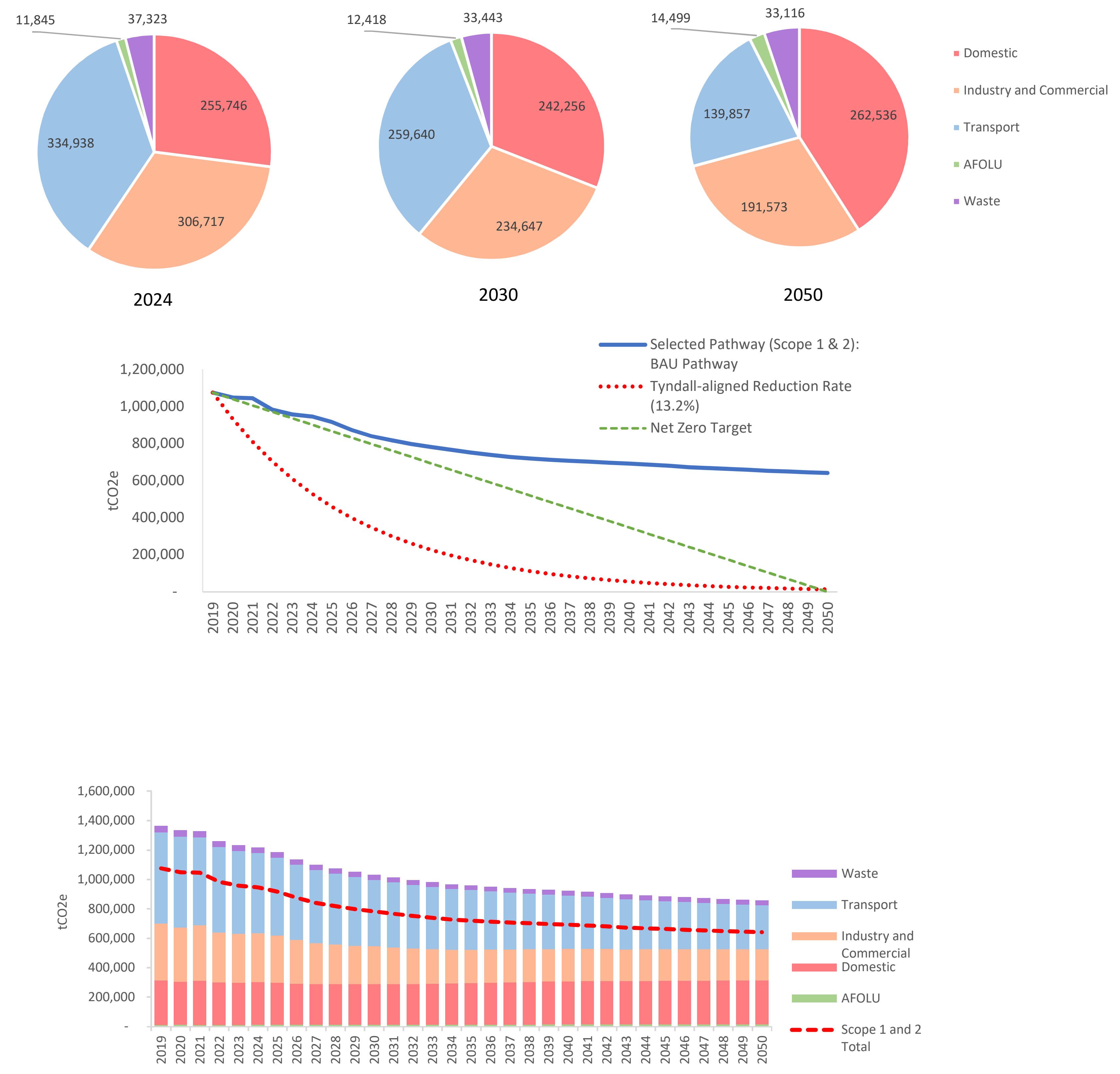


Figure 2: BAU Pathway Model Results

Higher Ambition Pathway:

The Higher Ambition model style for projecting GHG emissions involves setting more ambitious goals and implementing proactive measures to achieve significant emission reductions beyond the BAU scenario. By establishing these ambitions, the maximum level of policy interventions for emission reduction can be identified. It can help decision making to understand the dichotomy of essential policy interventions to meet net zero target by 2050 and associated emission trajectory.

The Higher Ambition interventions outlined for emission reduction represent a proactive and transformative approach aimed at achieving significant reductions in GHG emissions for Swindon. In contrast to the BAU interventions, these measures set more ambitious targets and implement a wide range of actions across various sectors to drive emission reductions further.

By 2030, the Pathway targets a substantial 24% increase in forest cover, coupled with a 7% decrease in grassland and a 1% reduction in cropland, emphasizing land use changes to enhance carbon sequestration. Additionally, aggressive measures are proposed to reduce livestock numbers by 0.5% annually and significantly decrease domestic lighting and appliance energy demand to 27% by 2050, alongside transitioning cooking to 100% electric by the same year.

The plan includes ambitious targets for building standards, with all new-build properties required to meet passivhaus standards from 2021, and significant proportions of existing housing stock undergoing deep retrofitting by 2050. Renewable energy deployment is dramatically accelerated, with substantial increases in onshore and offshore wind, solar PV, hydroelectric, and wave/tidal power generation capacities. Transitioning to electric vehicles and increasing public transportation efficiency are key components of transportation strategies, along with significant reductions in distance travelled per individual and modal shifts away from car usage.

Aggressive targets for waste management, including recycling rates reaching 85% by 2050, further contribute to emission reduction efforts. Overall, the Higher Ambition interventions demonstrate a holistic and ambitious approach towards achieving emission reduction targets, emphasizing sustainable land use, energy efficiency, renewable energy deployment, low-carbon transportation, and waste management strategies. Compared to the BAU interventions, the Higher Ambition pathway sets more aggressive targets and implements a wider range of measures across multiple sectors to drive emissions down further, aiming for a more sustainable and resilient future for Swindon.

No	Ambition*	Description
1	4	24% increase in forest cover by 2030.
2	4	By 2050, 7% decrease in grassland. Cropland decreases 1%. 13% increase in the coverage of settled land as in BAU.
3	4	0.5% annual reduction in livestock numbers.
4	4	Domestic lighting and appliance total energy demand decreases to 27% by 2050.
5	2	Small reductions in efficiency of domestic cooking. Proportion of cooking which is electric increases to 100% in 2050.
6	4	Hot water demand per household reduces by 8% every 5 years.
7	4	From 2021, 100% new-build properties are built to passivhaus standard.
8	4	By 2050, 10% of current housing stock is retrofitted to a medium level; 80% deep retrofit.
9	12	By 2050, 10% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps for domestic space heating and hot water.
10	4	Onshore wind generation is 2.4 times bigger by 2030, tripling by 2050.
11	4	Onshore wind generation is 2.4 times bigger by 2030, tripling by 2050.
12	4	By 2030, offshore wind electricity generation is six times bigger than current levels, dropping slightly by 2050.
13	4	610% increase in large-scale solar PV generation by 2030; 1250% increase by 2050.
14	4	610% increase in small solar PV by 2030; 1250% increase by 2050.
15	4	By 2030, hydroelectric power generation increases by 90%; by 2050 generation is 230% of current levels.
16	4	For areas with wave / tidal power, 320-fold increase by 2030, 1300-fold increase by 2050.
17	4	Solid biomass generation quadruples in 2025, dropping off after that; Coal phase-out follows trajectories from the National Grid's Two Degrees scenario.
18	4	In 2050, commercial heating, cooling and hot water demand is 60% of current levels.
19	10	By 2050, 50% of heating is from air-source heat pumps; 30% from ground-source heat pumps and the rest comes from community-scale CHP for commercial heating and cooling.
20	4	Commercial lighting & appliance energy demand decreases 25% by 2050.
21	2	By 2050, 100% of commercial cooking is electrified.
22	4	Industrial electricity consumption is 50% of total energy consumption by 2035; 65% by 2050. Output falls by 2% every year for non-heavy industry.
23	3	Reductions in process emissions from all industry: general industry reduces process emissions at a rate of 4.5% per year. Chemicals emissions reduce 1% per year; metals 0.7% per year, and minerals 0.8% per year.
24	4	By 2050, 22% decrease in distance travelled by road freight; 75% increase in efficiency. In waterborne transportation, 28% increase in use of waterborne transport.
25	4	25% reduction in total distance travelled per individual per year by 2030, staying constant at this level until 2050.
26	4	Average modal share of cars, vans and motorbikes decreases from current national average 74% total miles to 38% in 2050.
27	4	Cars and buses are 100% electric by 2035. Average occupancies increase to 18 people per bus km (from 12), 1.65 people per car-km (up from 1.56), and 0.42 people per rail-km (from 0.32).
28	3	Department for Transport "Low" forecast for aviation. The "Low" forecast encapsulates 'lower economic growth worldwide with restricted trade, coupled with higher oil prices and failure to agree a global carbon emissions trading scheme. For reference see Pathways Methodology on the SCATTER website.
29	4	By 2050, 28% decrease in fuel use at UK ports.
30	4	65% recycling, 10% landfill, 25% incineration achieved by 2035, recycling rates increasing to 85% by 2050.
31	4	Total volume of waste is 61% of 2017 levels by 2040.

**Please note that heating and cooling technologies for both Domestic buildings and Commercial & Institutional buildings are modelled as a range of technology mix scenarios, rather than an increasing ambition level and so are shown in grey.*
*** Measures 10 to 14 will sometimes appear as duplicates as users are not asked to break down their generation/capacity targets into small and large scale for the given energy technology. It is worth noting that this does not mean double savings and the generation/capacity target can have a mix of small and large scale or one or the other.*

Table 3: Higher Ambition Pathway Policy Interventions

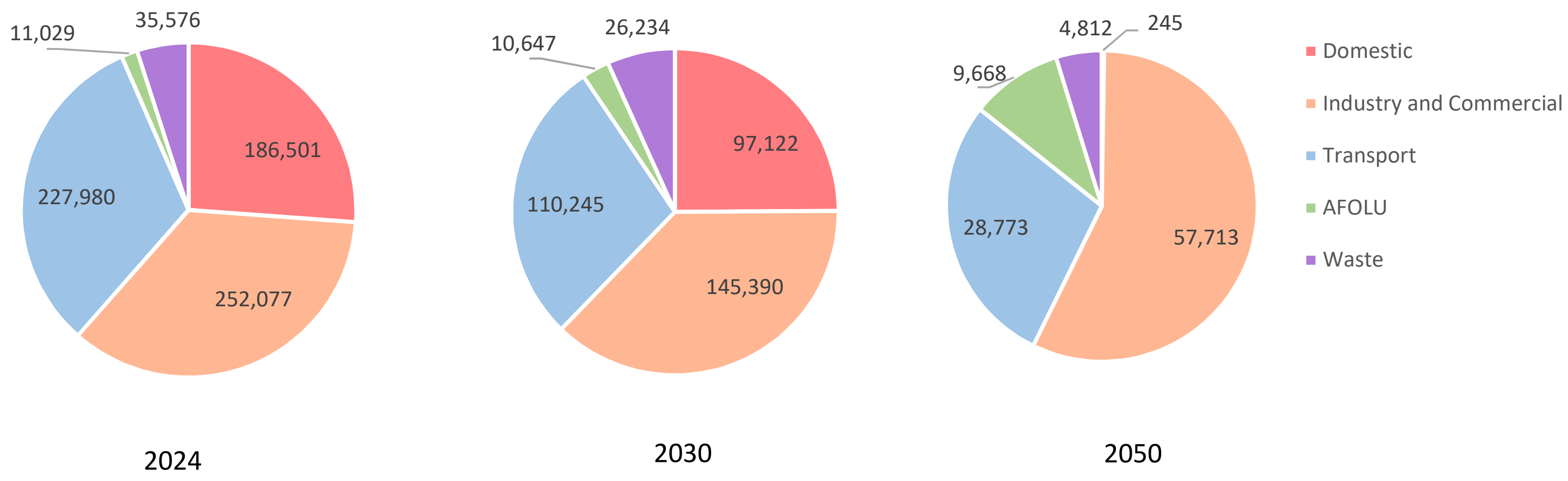
Results:

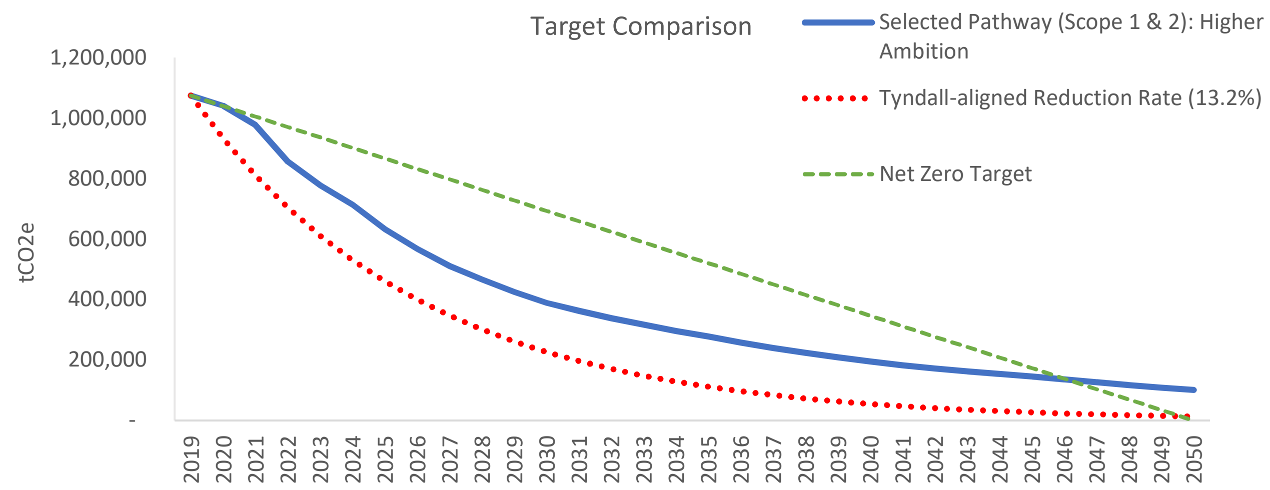
The Higher Ambition modelling shows that, with accelerated local action and supportive national policy, Swindon can achieve deep and sustained reductions in carbon emissions across all major sectors. Emissions fall rapidly in the first decade, with a strong downward trend continuing through to 2050. By mid-century, territorial emissions are reduced to a small fraction of their 2019 levels, approaching net zero and demonstrating what is possible under a scenario of proactive, coordinated decarbonisation.

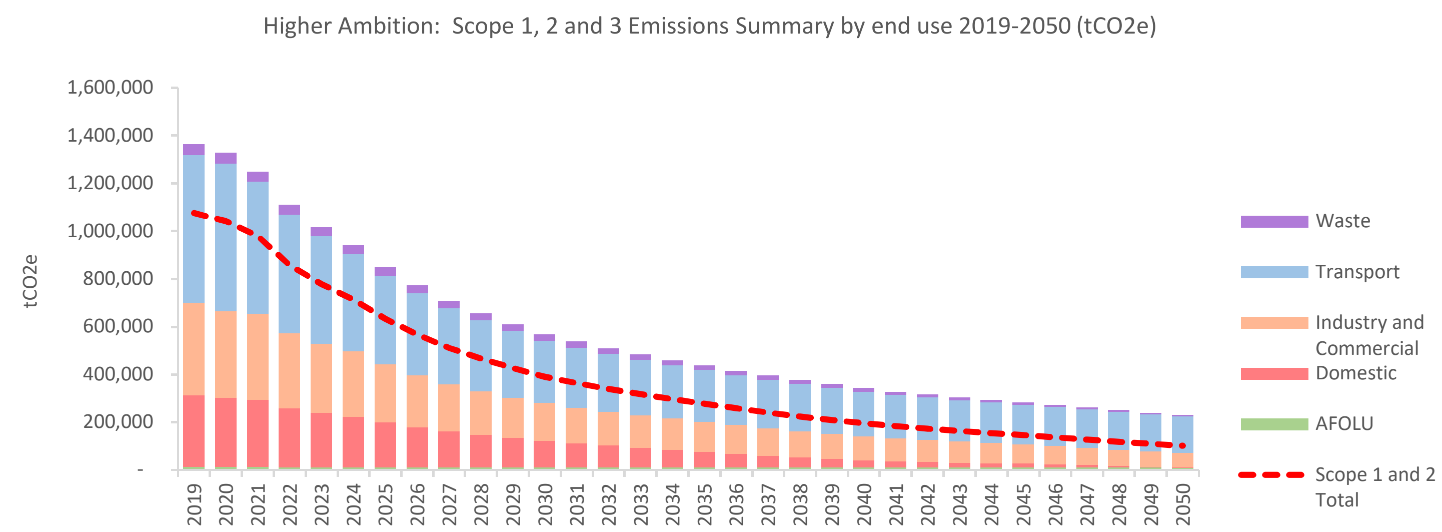
Sectoral breakdowns indicate that the most significant reductions occur in the transport, domestic, and industrial sectors. Emissions from road transport drop dramatically, reflecting widespread uptake of low-carbon vehicles and a shift toward more sustainable travel behaviour. Domestic emissions, while initially high, decline sharply due to assumed improvements in building efficiency and low-carbon heating. By 2050, the remaining emissions are concentrated in harder-to-decarbonise sectors, particularly commercial and industrial activity, with waste and land use playing a smaller but proportionally more prominent role in the residual emissions profile.

Compared to science-based targets, the Higher Ambition pathway closely tracks the necessary trajectory to meet long-term climate goals, though it falls slightly short of the aggressive early reductions recommended by Tyndall-aligned pathways. While cumulative emissions may exceed the tightest carbon budgets, this scenario demonstrates substantial alignment with the principles of front-loading action and driving system-wide transformation over the next decade.

Overall, the Higher Ambition modelling provides a compelling vision of what could be achieved through bold policy decisions, investment, and behaviour change. It highlights the importance of sustained action across all sectors, and reinforces the need for local authorities to use evidence-led tools like SCATTER to identify interventions, track progress, and embed climate action into spatial and economic planning.







Spatial Distribution of Energy Use and Low Carbon Transition Potential

As we have seen in carbon inventory section that stationary energy emission contributes 41.6% of total CO2 emission which is more than 350K tonnes CO2e, it is essential to understand existing spatial consumption demand, generation and renewable potential. This section shows geospatial analysis of mentioned three stages and clarify the potential of policy interventions which shows in BAU and Higher ambition Pathway. The table below shows all required policy interventions set by Higher Ambition Scenario to reduce carbon emission cause by stationary energy sector.

No.	Higher Ambition Policy Interventions for Stationary Energy reduction
1	Domestic lighting and appliance total energy demand decreases to 27% by 2050.
2	Small reductions in efficiency of domestic cooking. Proportion of cooking which is electric increases to 100% in 2050.
3	Hot water demand per household reduces by 8% every 5 years.
4	From 2021, 100% new-build properties are built to passivhaus standard.
5	By 2050, 10% of current housing stock is retrofitted to a medium level; 80% deep retrofit.
6	By 2050, 10% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps for domestic space heating and hot water.
7	Onshore wind generation is 2.4 times bigger by 2030, tripling by 2050.
8	By 2030, offshore wind electricity generation is six times bigger than current levels, dropping slightly by 2050.
9	610% increase in large-scale solar PV generation by 2030; 1250% increase by 2050.
10	610% increase in small solar PV by 2030; 1250% increase by 2050.
11	By 2030, hydroelectric power generation increases by 90%; by 2050 generation is 230% of current levels.
12	For areas with wave / tidal power, 320-fold increase by 2030, 1300-fold increase by 2050.
13	Solid biomass generation quadruples in 2025, dropping off after that; Coal phase-out follows trajectories from the National Grid's Two Degrees scenario.
14	In 2050, commercial heating, cooling and hot water demand is 60% of current levels.
15	By 2050, 50% of heating is from air-source heat pumps; 30% from ground-source heat pumps and the rest comes from community-scale CHP for commercial heating and cooling.
16	Commercial lighting & appliance energy demand decreases 25% by 2050.
17	By 2050, 100% of commercial cooking is electrified.

Energy Demand

Gas Consumption

According to figure 11, showing domestic gas consumption in all postcodes, there are significant neighbourhoods as instance town centre, Old town, Blunsdon and Highworth, are depended highly on gas as primary source of energy with highest consumption above 685k kWh annually which contributes 7.70% of total gas consumptions of Swindon. 22.4% of total gas demand is being consumed by the houses consume 270489-373535 kWh annually. Nearly 20% and 19% of contribution by houses consume 373535-502651 kWh/annum and 185600-270848 kWh/annum respectively.

Electrical Consumption

As illustrated in figure 12, Similar to gas consumption analysis, town centre, old town, Blunsdon and Highworth neighbourhoods are more inclined to use electrical energy use. 18.4% of total electrical demand has been used by the houses consume 129665-178296 kWh annually. Highest Domestic Electrical Consumption (DEC) of 1178297-270826 kWh annually shares around 10% of total electrical consumption of Swindon. Almost 40% of total consumption is contributed by houses which use 65740-95003 kWh and 95003-129664 kWh annually.

Heat Demand

As illustrated in figure 13, annual heat demand per sq.m. is almost same in major part of the Swindon. Only 17.6% houses using 0-150 kWh/sq.m., 66.2% houses are using 150-250 kWh/sq.m. and 16% of homes has demand of more than 250 kWh/sq.m. annually. Major part of town centre is using highest annual energy consumption per sq.m. annually.

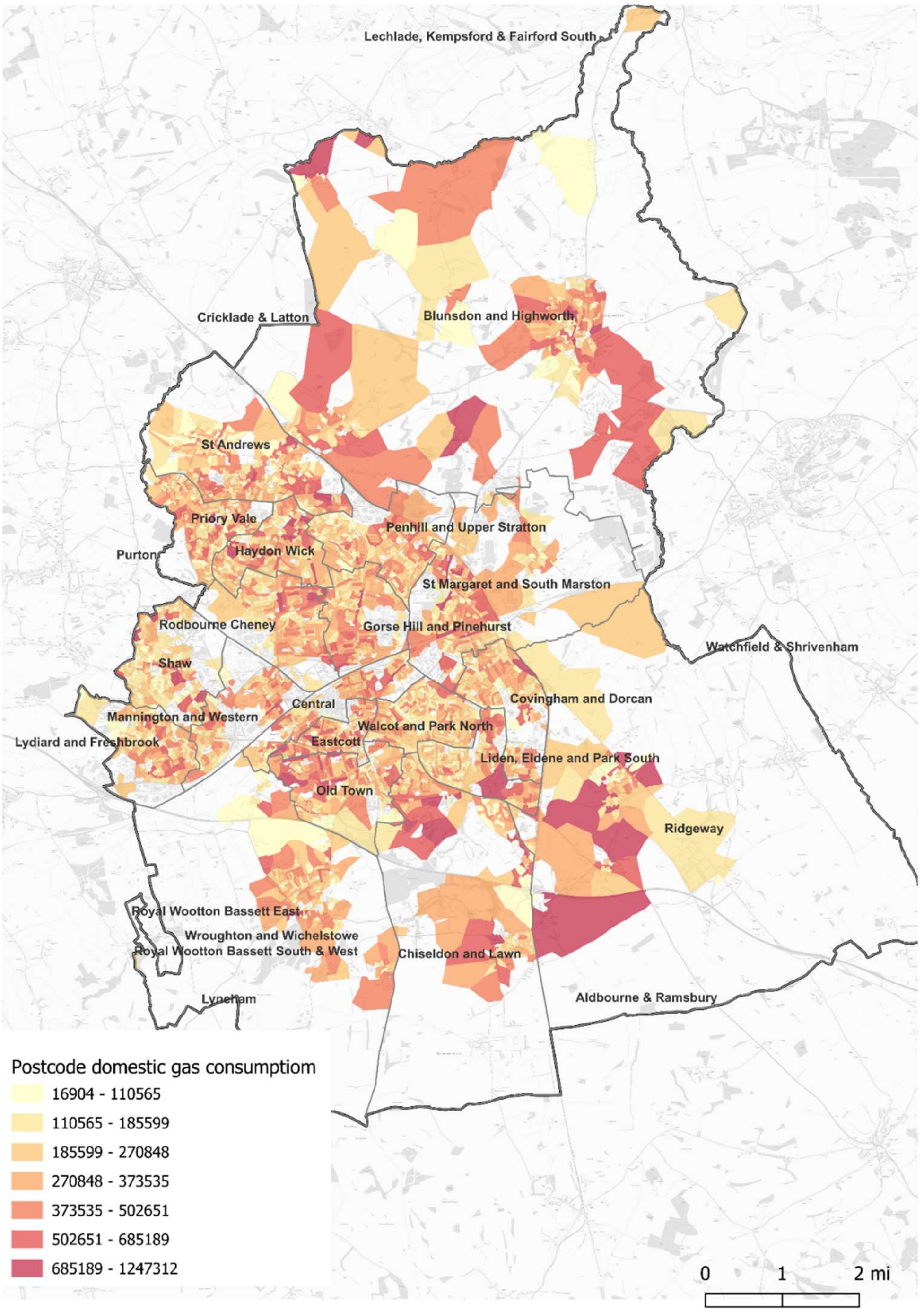


Figure 3: Postcode Domestic Gas Consumption in Swindon

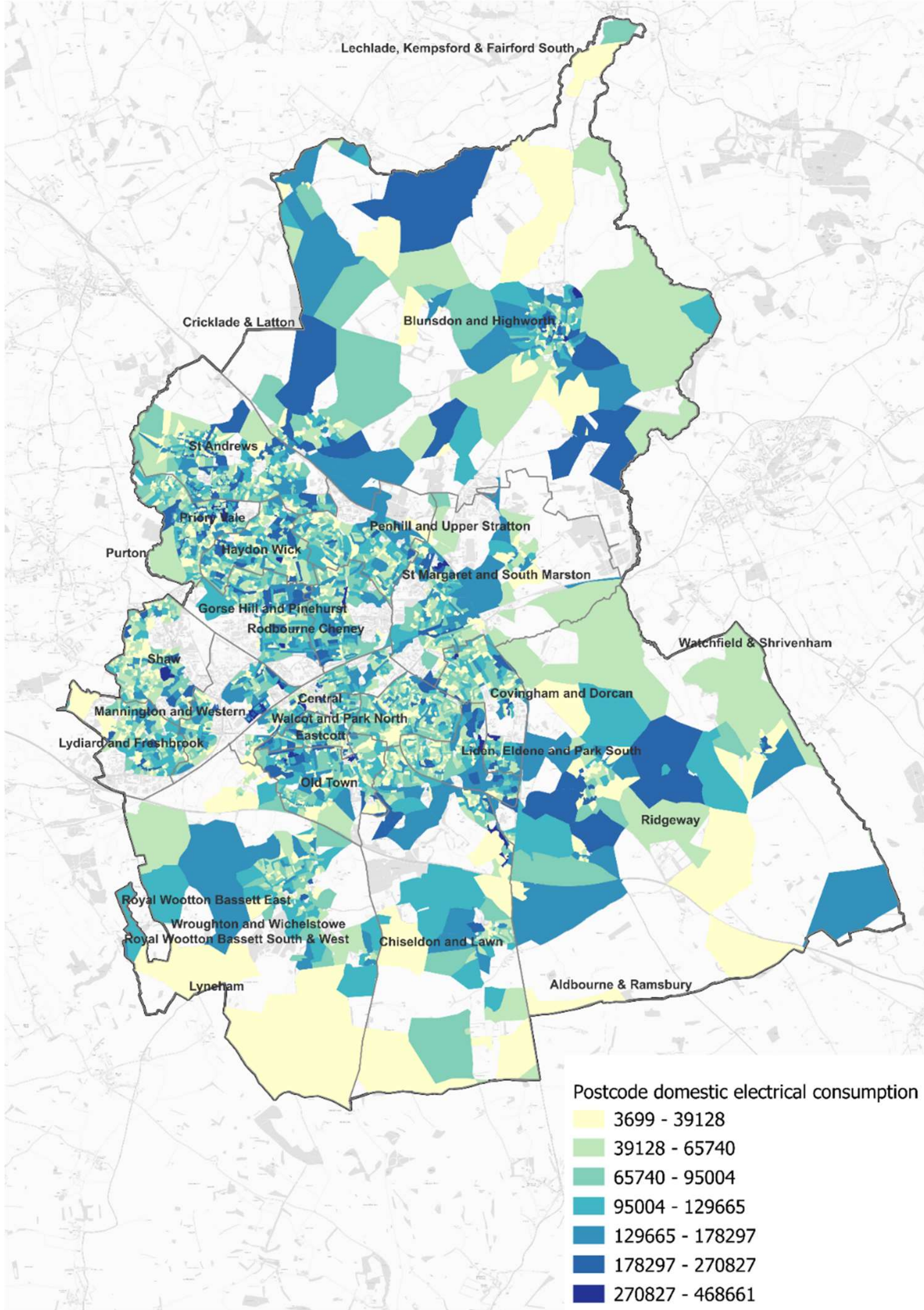


Figure 4: Postcode Domestic Electrical Consumption in Swindon

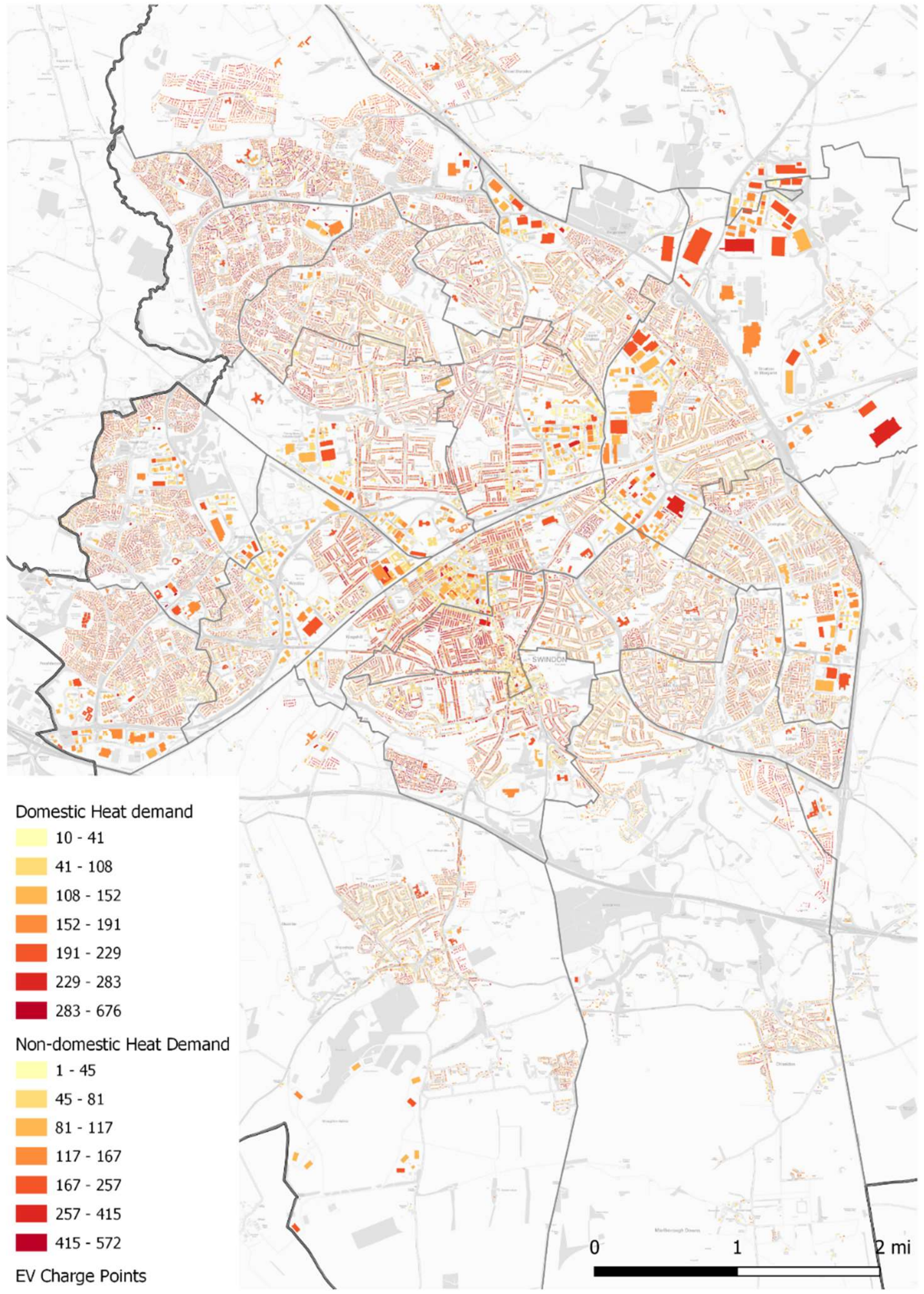


Figure 5: Domestic and Non-domestic Heat Demand in Swindon

Energy Generation in Swindon

Swindon has significant number of energy generation sources varying from solar photovoltaics, Anaerobic Digestion, Landfill Gas, Battery, Biomass, and Advanced Conversion Technologies. Total 43 various UK renewable electricity projects are either in operational condition or under construction with total installed capacity of more than 870 MWelec. Some of the biggest energy generation sources are Mannington Battery Storage Plant and Corner Copse Solar Farm generating 49.9 MWelec individually. Apart from these, Wroughton Airfield Solar Park contributing 41 MWelec generation, Catsbrain Farm and Battery Storage 60 MWelec and Pentylands Farms with the generation of 19 MWelec.

As illustrated in figure 14, total 9 embedded capacity register sources (Export or import capacity of under 1MW) are in operation generating total 0.854 MWA of electricity by photovoltaics and 29 embedded capacity register sources (Export or import capacity of 1MW or above) are in operation/construction generating/aiming to generate total 170.291 MWA of electricity by solar photovoltaics.

No.	Site Name	Technology Type	Installed Capacity (MWelec)	Development Status
1	Building ONE	Solar Photovoltaics	1.2	Under Construction
2	Wroughton Airfield Solar Park	Solar Photovoltaics	41	Operational
3	Lower Basset Down Farm	Solar Photovoltaics	10.5	Operational
4	Wood Farm, Swindon Road - Solar Panels	Solar Photovoltaics	0.18	Planning Permission Granted
5	Berkeley Farm Dairy, Swindon Road - Solar Panels	Solar Photovoltaics	0.6	Planning Permission Granted
6	Common Farm	Solar Photovoltaics	4.8	Operational
7	Mannington Battery Storage Plant	Battery	49.9	Operational
8	Unit O, Penzance Drive - Solar Panels	Solar Photovoltaics	1.96	Planning Application Submitted
9	Newcome Drive - Solar Panels	Solar Photovoltaics	-123456	Planning Permission Granted
10	Swindon Sewerage Treatment Works	Anaerobic Digestion	1.2	Operational
11	Big Yellow Self Storage, Drakes Way - Solar Panels	Solar Photovoltaics	0.16	Planning Permission Granted
12	Rivermead Drive, Rivermead Industrial Estate - Solar Panels	Solar Photovoltaics	0.23	Planning Permission Granted
13	Barnfield Solar Park	Solar Photovoltaics	2.5	Operational
14	Brindley Close (Extension)	Battery	6	Under Construction
15	Cheney Manor EfW	EfW Incineration	2	Planning Application Withdrawn
16	Amazon, Symmetry Park - Solar Panels	Solar Photovoltaics	3.26	Planning Permission Granted
17	Keypoint Industrial Estate	Advanced Conversion Technologies	14.5	Planning Permission Granted
18	Parsonage Road, Stratton St Margaret - Solar Panels	Solar Photovoltaics	0.52	Planning Permission Granted
19	Alpha Building Europa Park, Stratton St Margaret - Solar panels	Solar Photovoltaics	-123456	Planning Permission Granted
20	Keypoint, South Marston - Solar panels	Solar Photovoltaics	1.09	Planning Application Submitted
21	Keypoint, South Marston - Solar panels	Solar Photovoltaics	1.09	Planning Application Submitted
22	Honda wind Farm	Wind Onshore	6.9	Planning Permission Refused
23	Honda Energy Centre (biomass)	Advanced Conversion Technologies	4.5	Abandoned
24	Sevor Farm	Solar Photovoltaics	9.3	Operational
25	Roves Farm (Solar)	Solar Photovoltaics	12.7	Operational
26	Arkwright Road, Groundwell Industrial Estate - Solar Panels	Solar Photovoltaics	0.91	Under Construction
27	Roves Farm (Solar)	Solar Photovoltaics	5	Revised
28	B and Q Distribution Centre Highworth Road	Battery	-123456	Operational
29	B&Q Swindon DC	Solar Photovoltaics	2.5	Operational
30	Catsbrain Farm	Battery	30	Revised
31	Catsbrain Farm - Battery Storage	Battery	30	Planning Permission Granted
32	David Lloyd, Latham Road, Abbey Meads - Solar Panels	Solar Photovoltaics	-123456	Planning Permission Granted
33	Land at Beech Farm	Solar Photovoltaics	4.6	Operational
34	Roves Farm	Biomass (dedicated)	2	Abandoned
35	Chapel Farm	Solar Photovoltaics	5	Operational
36	Corner Copse Solar Farm	Solar Photovoltaics	49.9	Planning Permission Granted
37	Corner Copse Solar Farm	Battery	-123456	Planning Permission Granted
38	Chapel Farm Landfill	Landfill Gas	3	Operational
39	Stanton solar park	Solar Photovoltaics	5	Operational
40	Castle Eaton Farm	Solar Photovoltaics	17.8	Operational
41	Pentylands Farm	Solar Photovoltaics	19	Operational
42	Castle Eaton Anaerobic Digestion Plant	Anaerobic Digestion	-123456	Planning Application Submitted
43	Lynt Farm	Solar Photovoltaics	27	Operational

Table 4: List of Electricity Generation and Storage Projects within Swindon

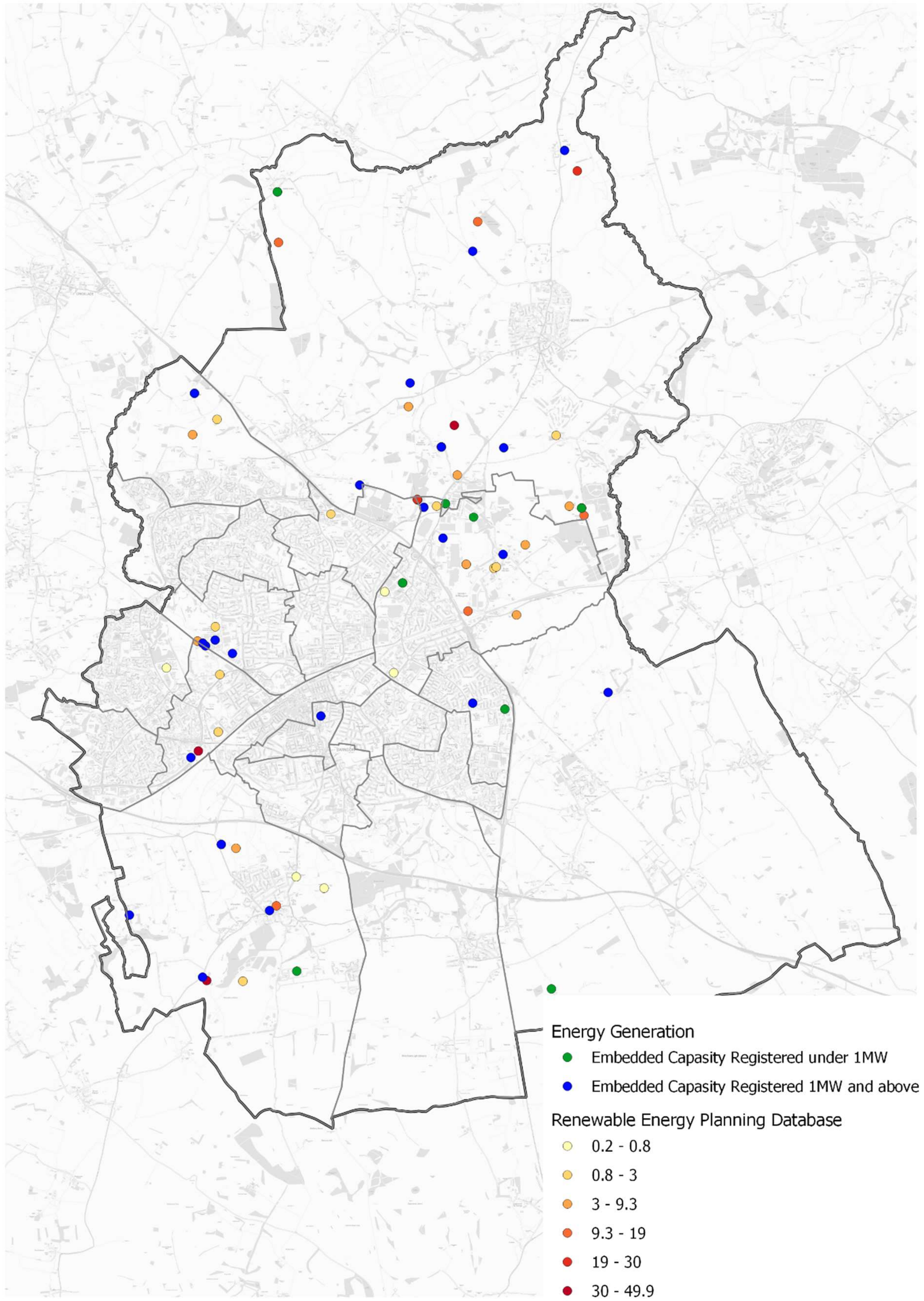


Figure 6: Energy Generation and Storage sites in Swindon

Technological Tranformation Potential in Swindon

As Swindon has significant difference between energy consumption and generation, it is essential to explore the possibilities of renewable and technological transformation potentials. In order to achieve long term target of reducing carbon emission to nearly zero, three possible solutions can quantify the possibilities. The **RTG** approach (Reduce, Technological Transform, and energy Generation) covers major possibilities of carbon reduction caused by stationary energy focusing prominently on suitability for reduction in energy demand, Technological transformation to provide energy efficiency of heating system and potential renewable energy generation to overcome energy demand rises after reduction and technological transformation.

1. **Reducing** need of heating and lighting (Retrofitting)
2. Exploring solutions of **Technological transformation** in heating and lighting demand (heating system advancement)
3. Examining possibility of domestic and non-domestic power **Generation** (Photovoltaics)

Domestic Insulation Potential

The first approach of reduction in terms of energy consumption can be delivered by retrofitting existing dwellings and commercial services. As **Error! Reference source not found.** necessitate deep retrofitting of 80% homes by 2050 as part of higher ambitions, it is essential to examine the potential of retrofit. Figure 07 shows opportunity to conduct retrofitting within town centre and old town. On the other side major part of the Swindon is either not applicable or unknown to perform the task. Domestic EPC certificates are combined with geospatial data from OS (OS MasterMap Topography and OS MasterMap Building Heights) to determine the existing energy efficiency and geometry of the property. Descriptions of the building envelope from its EPC have been simplified to include whether an element is currently insulated (Insulated/uninsulated), not suitable for insulation (Not applicable) or currently unknown (Unknown).

Properties which don't have an EPC, or where the current level of insulation cannot be determined from the EPC default to unknown. Figure 07 shows potential of retrofitting for external walls for overall properties within Swindon. Around 45.5% of total properties are identified as unknown because of not determined EPC rating or current level of insulation. Only 7.5% of total buildings are uninsulated which shows smaller possibility for retrofitting. However, the assurance of smaller potential is there, unknown status of 45.5% property shows potential to increase retrofitting.

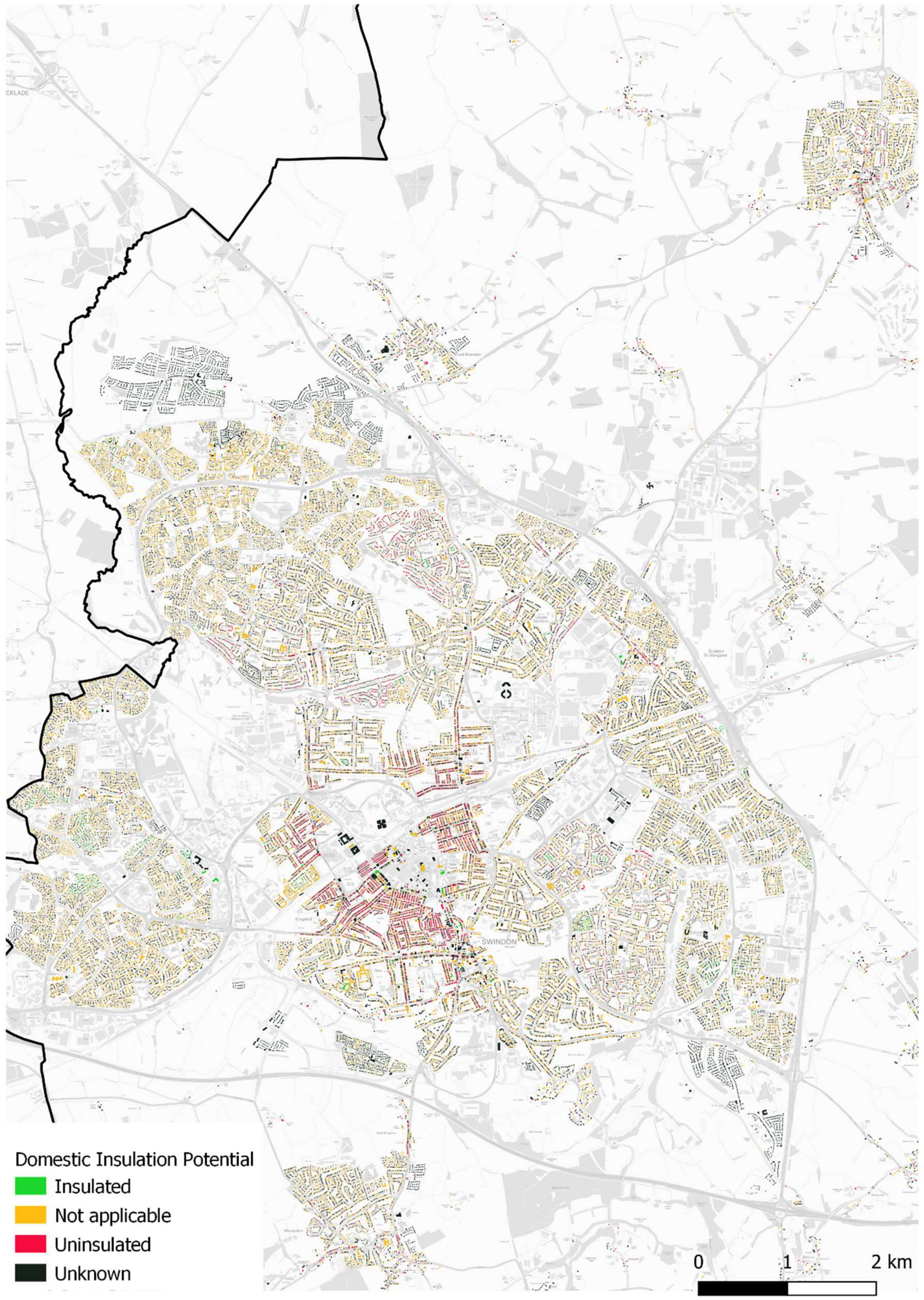


Figure 7: Domestic Insulation Potential within Swindon

Heat Pump Potential
Ground and air source heat pump are the two major solutions bring opportunity to provide efficient heating system. Uncertain pragmatic status of electrolysis energy generation brings sceptical perception of its wider usage although the technological advancement helps to keep the option available. Examining the heat pump potential provides clarification of suitability to reduce the energy consumption by providing more efficient heating solution.

The potential of Ground Source Heat Pump (GSHP) can be determined based on size of garden and building. Property would be suitable only if the garden to building size ration is greater than 2:1. The building data and land parcel data is combined to calculate the garden size, which is used to determine the suitability of the building for an Air Source Heat Pump (ASHP), with gardens over 25m2 being deemed suitable. Which shows possible explanation of suitability in Swindon except from town centre. Figure 08 emphasize, significantly less potential of GSHP then ASHP. Only **15% properties are suitable for GSHP** where in terms of **ASHP 42.5% are eligible** to adapt technological transformation. In case of GSHP the eligible properties are scattered all around the city, contrary Figure 08 states higher potential outside town centre.

Rooftop PV
Rooftop PV provides strong viability for domestic energy generation to overcome daily energy consumption against other source of generation. Hence, it is crucial to examine the potential of PV for each property within Swindon. A property is considered suitable if the roof has enough space to support a minimum of a 1.5 kWp capacity system (or 6 PV panels) and has an orientation of between 120º and 240º or is a flat roof (i.e., having an incline slope of less than 5°). Figure 09 states highest potential of suitability amongst all technological transformation which is **70% suitability overall**.

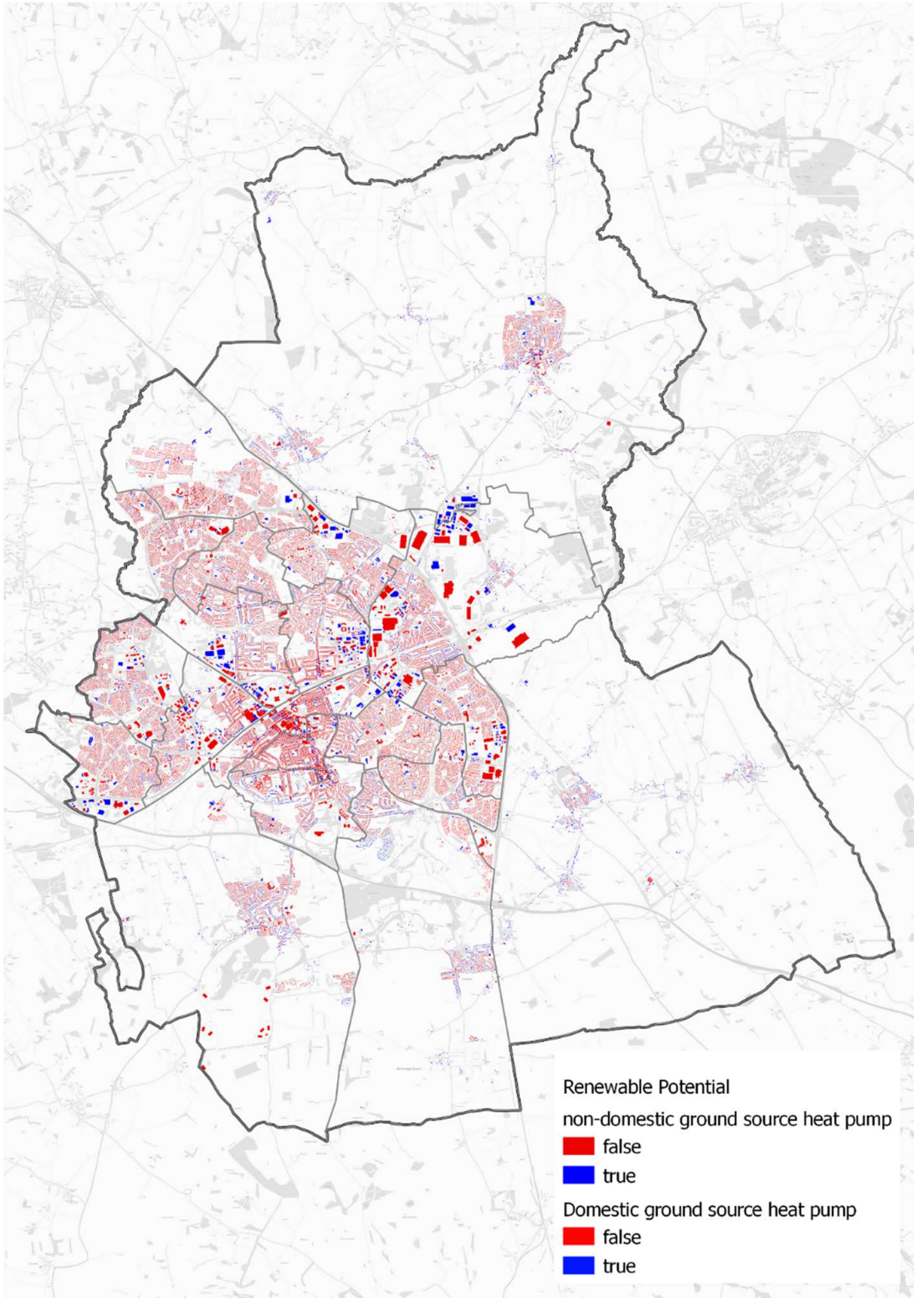


Figure 8: Heat Pump Potential in Swindon

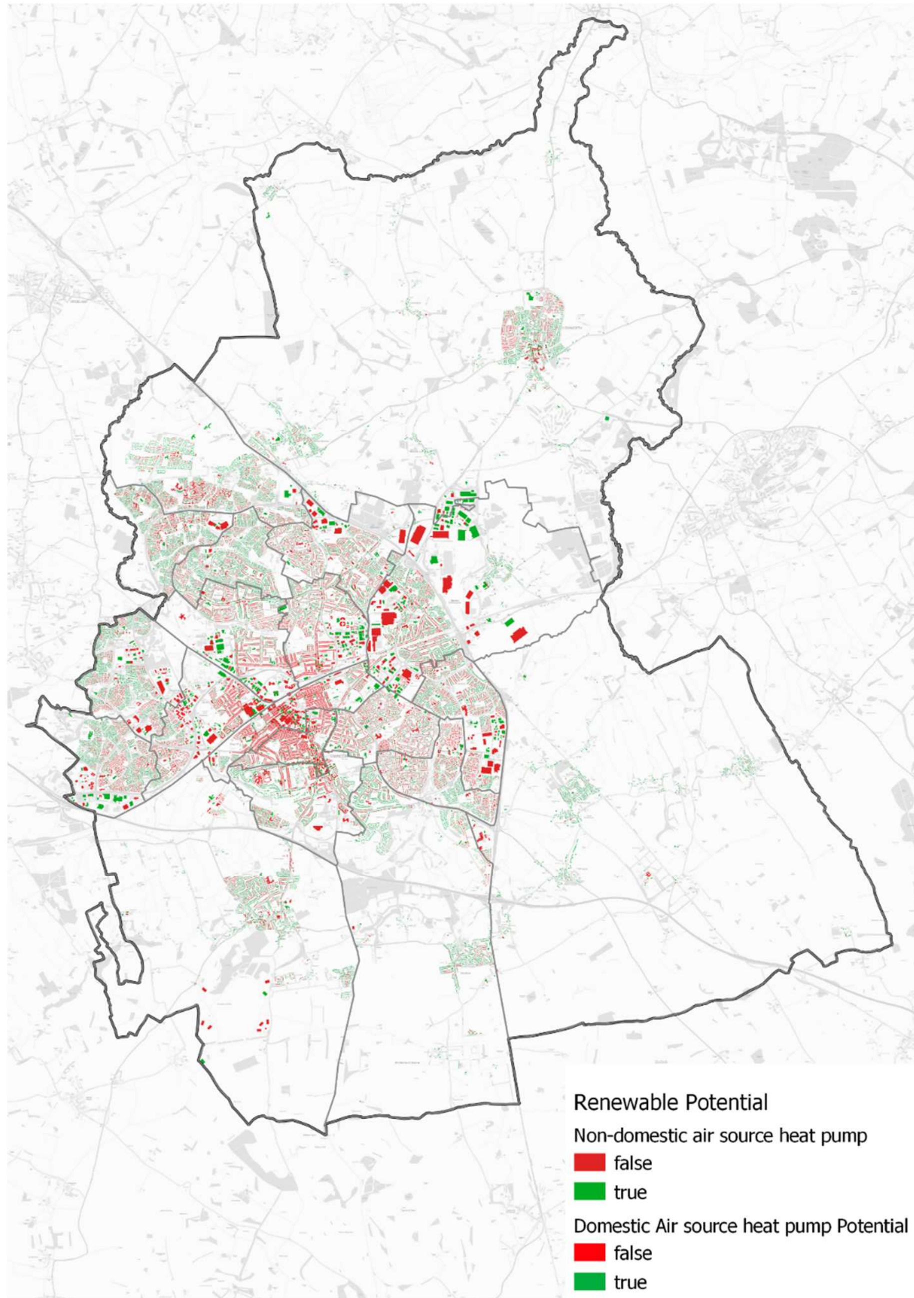


Figure 9: Solar PV potential in Swindon

Conclusion:

As evidenced in the carbon inventory, the stationary energy and transportation sectors are the predominant contributors to Swindon's greenhouse gas emissions. This underscores the urgent need for targeted and ambitious policy interventions to facilitate substantial carbon reductions across these sectors. The SCATTER model's Higher Ambition Pathway provides a strategic framework for this, highlighting the scale and intensity of change required—particularly in tackling operational and embodied energy consumption and reducing emissions from on-road transport.

Swindon's energy profile, as discussed in the Spatial Distribution of Energy Use, reveals a high dependency on fossil fuel-based energy. This imbalance between energy consumption and local energy generation significantly drives up emissions from stationary energy sources, which consistently account for more than half of the borough's total emissions. In response, the Higher Ambition Pathway identifies a need to support the construction of energy-efficient new buildings and implement policies that reduce borough-wide energy demand.

Although deep retrofitting of the existing building stock is frequently proposed as a decarbonisation measure, it may not be feasible at scale in Swindon due to technological and structural limitations, as illustrated in Figure 07. The data suggests that even substantial retrofitting may only yield limited emissions reductions. Therefore, borough-wide adoption of other technological innovations aimed at demand reduction—such as low-carbon heating systems, smart energy management, and passive design principles—may offer more practical and impactful solutions.

The analysis also reinforces the critical need for a sustainable transport transformation. Emissions data reveal a significant reliance on motorised transport, particularly private vehicles. A shift in travel behaviour, supported by spatial planning and infrastructure investment, should be central to transport policy. Reducing this reliance through mode shift—towards public transport, walking, and cycling—not only supports carbon objectives but also yields co-benefits in air quality and public health.

Challenges and Limitations:

While the implementation of more ambitious policy assumptions may indicate the potential to achieve a near-zero emissions target, it is important to recognise that such assumptions should not be adopted solely based on their projected outcomes, without critically assessing their practical feasibility and deliverability.

For instance, the higher ambition pathway assumes that 80% of properties will undergo deep retrofit, with an additional 10% achieving medium-level retrofit. However, Figure 00 indicates that not all of properties in Swindon physically or economically suitable for deep retrofit interventions. Given that stationary energy accounts for over 50% of the borough's total emissions—and residential buildings alone contribute approximately 28%, as shown in the carbon inventory—the level of reduction projected under the higher ambition pathway results may not be practically achievable within the existing building stock constraints.

While the higher ambition pathway outlines significant increases in renewable energy generation—such as a 610–1250% rise in solar PV, a tripling of onshore wind, and substantial expansion in hydroelectric, offshore, and tidal power—these projections present clear challenges within the specific context of Swindon. As a landlocked borough with no coastline or major rivers, Swindon is inherently constrained in its ability to contribute to tidal, wave, offshore wind, or hydroelectric generation, limiting the local applicability of these assumptions. Onshore wind deployment also faces practical limitations due to landscape sensitivity, planning constraints, and relatively low wind yield. Nevertheless, the borough has notable potential for solar PV expansion, particularly through rooftop installations and the strategic use of underutilised or brownfield land. To support this, investment in grid capacity, planning policy alignment, and local incentive mechanisms will be essential. Therefore, while the higher ambition pathway sets an important directional goal, a locally grounded strategy must prioritise technologies most suited to Swindon's geography and built environment, ensuring realism and deliverability within broader decarbonisation efforts.

Taken together, these considerations suggest that while the higher ambition pathway offers a valuable strategic direction, its outcomes may be challenging to achieve in full due to the ambitious nature of the underlying policy assumptions and their limited applicability in Swindon's context. Nevertheless, the pathway remains a useful tool for highlighting the range of policy levers and interventions available to support emissions reduction. It reinforces the importance of aligning local action with broader climate objectives, even if the pace and scale of change must be adapted to reflect local constraints and capacities.

Key focus areas to achieve Net Zero Target:

Based on this analysis, the following strategic policy themes emerge as essential to delivering the borough's net zero ambition:

Expanding Green Infrastructure and Carbon Sequestration

Investment in green infrastructure—such as urban forests, wetlands, and green roofs—enhances natural carbon sinks, contributes to biodiversity, mitigates urban heat island effects, and improves resilience to climate impacts. Enhancing the role of nature in the built environment is crucial for offsetting residual emissions.

Energy-Efficient and Low-Carbon Buildings

Policies should prioritise high-performance standards for new developments, including Passivhaus principles or similar, and encourage adaptive reuse of buildings where feasible. Whole-life carbon assessments should guide planning decisions to minimise both operational and embodied emissions.

Transition to Renewable Energy and Decentralisation of the Energy System

Increasing the deployment of renewable technologies—such as rooftop solar, wind, and ground source heat pumps—at the building and neighbourhood scale will reduce dependency on carbon-intensive grid electricity. Encouraging localised energy generation and storage can also increase energy security and community ownership.

Sustainable Transport and Mobility Shift

A coherent and inclusive transport strategy should be implemented to support modal shift and reduce car dependency. This includes investment in active travel networks, improved public transport connectivity, and infrastructure for electric vehicles. Land-use planning should be aligned to reduce travel distances and promote 15-minute neighbourhoods.

Sustainable Waste Management and Circular Economy

Reducing waste generation and maximising resource recovery are vital to cutting emissions from landfill and incineration. Planning policy can promote the circular economy by supporting re-use, repair, and material recovery infrastructure, particularly within employment and industrial land allocations.

Demand Reduction and Resource Efficiency

Beyond technological fixes, managing consumption patterns—through behavioural change, public awareness, and pricing mechanisms—will be necessary to reduce overall resource demand. This includes reducing energy and water consumption, shifting dietary habits, and encouraging low-impact lifestyles.