AECOM

Horsham Carbon Audit

District Wide Carbon Reduction Study & Carbon Audit of the Local Plan Review

Horsham District Council

November 2022

Delivering a better world

Quality information

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Executive Summary

Horsham District Council (HDC) has commissioned AECOM to provide technical support to develop an evidence base for new energy and sustainability policies within the forthcoming Horsham Local Plan. The report presents the existing energy use, carbon dioxide (CO_2) emissions and low and zero carbon (LZC) energy generation in Horsham. It discusses some of the anticipated changes that may arise from planned new development along with broader national trends and presents a variety of options for responding to these and delivering on the Council's climate emergency commitments through planning policy.

The study will form part of a technical evidence base to support the forthcoming Local Plan. It will also contribute towards the development of an Action Plan for achieving Net Zero carbon emissions. Local Plans require a robust body of evidence to justify any proposed policies and environmental targets, both to ensure smooth transition through the Examination in Public and to avoid challenges from developers. To this effect, the project brief lists the following outputs to be addressed in the study:

- Output A: Carbon Emissions Baseline Reporting
- Output B: Carbon Scenario Modelling

Stage 1 deliverables

- Output C: Policy Review
- Output D: Renewable Energy Assessment

Stage 2 deliverables

- Output E: Estimated Carbon Savings from Local Plan Policies — Stage 3 deliverable

A summary of each output is as follows.

Output A: Carbon Emissions Baseline Reporting

To provide context for the assessment of future low and zero carbon (LZC) opportunities the current baseline fuel consumption and CO_2 emissions for Horsham is presented. The reference data is sourced from the Department for Business, Energy & Industrial Strategy (BEIS). The current level of LZC deployment, ultra-low emission vehicles (ULEV) uptake and charge point provision across the District is also estimated.

The fuel consumption within Horsham was analysed by sector and type (Figure A). As Horsham is a rural District, where fuel consumption is dominated by road transport and resulting in relatively high transport emissions. Domestic fuel consumption is dominated by gas which is predominantly used for heating. Decarbonising transportation and heat are critical to decarbonising the District's emissions. as would be expected, highlighting the large opportunity for decarbonisation of heat.

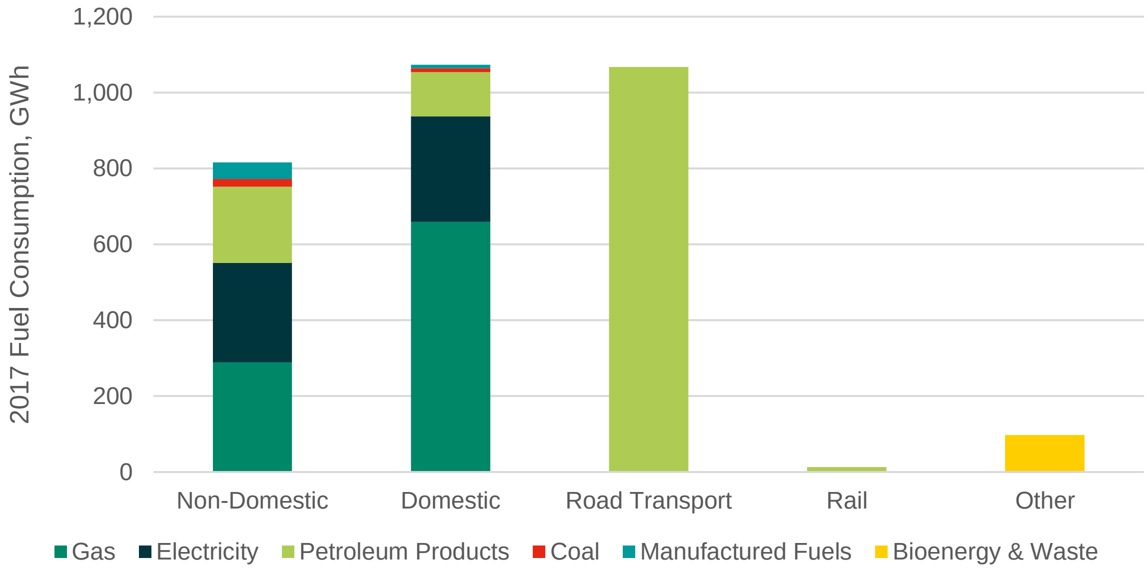

Figure A. 2017 Fuel consumption by sector and fuel type, BEIS data

As well as fuel consumption BEIS also provide an emissions breakdown and past trends data set for the Horsham District. This data is presented in Table A and Figure B. The data has been analysed to locate areas and identify opportunities for emissions reduction.

	Emissions – Non-Domestic ($ktCO_2$)	Emissions – Domestic ($ktCO_2$)	Emissions – Transport ($ktCO_2$)	Total ($ktCO_2$)	Total (Adjusted) ($ktCO_2$)
Gas	54.7	128.2	-	182.9	Land Use, Land Use Change and Forestry (LULUCF)* adjustment: -71.4
Electricity	61	64.8	-	125.8	
Large Industrial Installations	11.8	-	-	11.8	
Agriculture	14.0	-	-	14.0	
Road Transport	-	-	296.5	296.5	
Diesel Railways	-	-	3.4	3.4	
Other / Not Specified	49.7	34.8	1.6	86.1	
TOTAL	191.2	227.8	301.5	720.5	649.1
% of total emissions (excl. removals)	*26.5*	*31.6*	*41.9*	*100*	

Table A 2018 Emissions sources by fuel and Sector, BEIS data

There is a steady decline in emissions from 2005 to 2018 as illustrated in Figure B. Most of the reduction is from electricity and is not due to lessening consumption, but due to the decarbonisation of the National (electricity) Grid. Other emissions sources have reduced over the time but change is not as significant as that of electricity.

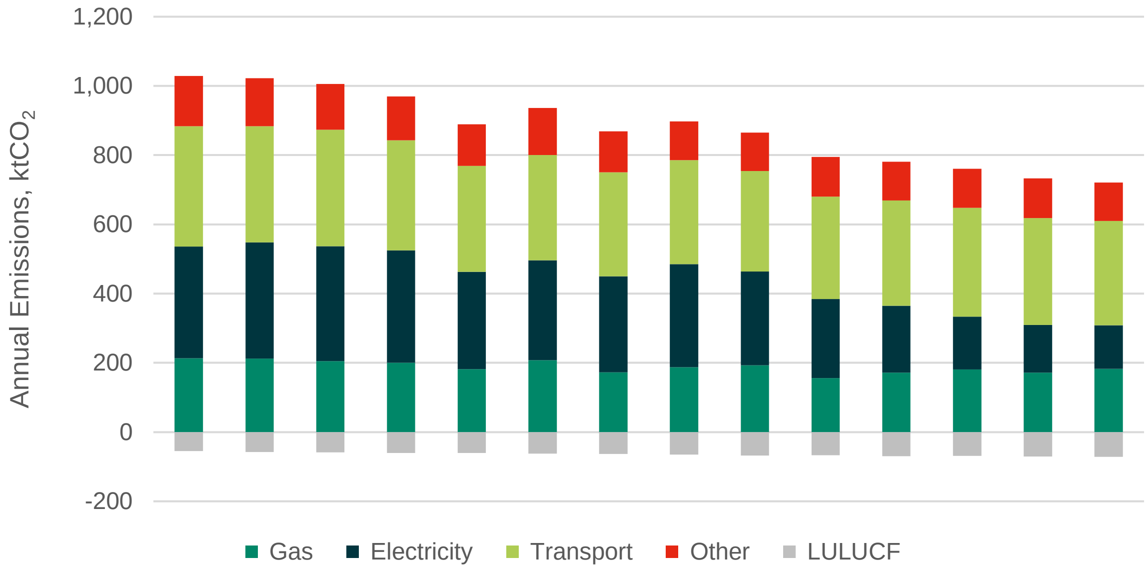

Figure B. Carbon Emissions trends from 2005 to 2018 in Horsham

Output B: Carbon Scenario Modelling

Using the baseline Horsham emissions data, a high-level CO_2 modelling exercise to assess the potential scale and direction of impacts from a range of anticipated future trends was completed. The range of future trends include:

- New housing and employment space to be constructed
- National electricity grid decarbonisation
- Energy demand reduction e.g. through energy efficiency measures and behaviour change
- Switching from the use of gas-fired heating to electric systems e.g. heat pumps
- Reducing demand for transport and increasing use of ULEVs; and
- Uptake of LZC technologies.

We have developed two scenario models, for the purpose of illustrating the importance of the decarbonisation of the grid. The key findings of the Scenario Modelling are shown in Table B. In terms of emissions reduction the most substantial change is achieved by switching the fuel used for heating and transportation.

By 2050…

Potential change in carbon emissions from these measures…	Without grid decarbonisation	With grid decarbonisation
New development		
New buildings constructed, no other changes	+9%	-13%
Demand reduction in buildings		
Reduce demand for electricity and heat…	-4%	-20%
… and switch to electric heating systems	-17%	-40%
Low carbon transport		
Mileage reduction, no other changes	-5%	-5%
… and switch to ULEVs (excludes HGVs)	-33%	-42%
Total reductions		
All measures implemented (excluding offsetting / renewables)	-38%	-82%
Residual emissions to be offset (ktCO_2 p.a.)	**413**	**121**

Table B. Key findings from AECOM's Carbon Scenario Models

Figure C and Figure D show historic emissions for Horsham, along with a hypothetical 'Business as Usual' trajectory – which includes the provision for new development as HDC have outlined in their Draft Local Plan. The other lines show the cumulative impact of sequentially adopting reduction measures that:

1. Include Government new energy efficiency Building Regulations yet to be implemented; and then
2. Reduce energy demands in buildings; and then
3. Switch from gas boilers to efficient electric heating systems; and then
4. Reduce vehicle mileage and switch from petrol and diesel vehicles to ULEV (electric or hydrogen) vehicles; and then
5. Install additional renewable energy technologies.

The measures are based on approximate changes and gradual role out of improvements. All are estimates based on unknown levels of change and adoption that will be different to that modelled but intended to illustrate the potential magnitude of the benefits that the measures can bring.

The Carbon Scenario Models project how emissions in the District will be affected by areas of policy and technology shifts, they are separated into **ignoring the decarbonisation of the grid** and **accounting for the decarbonisation of the grid.**

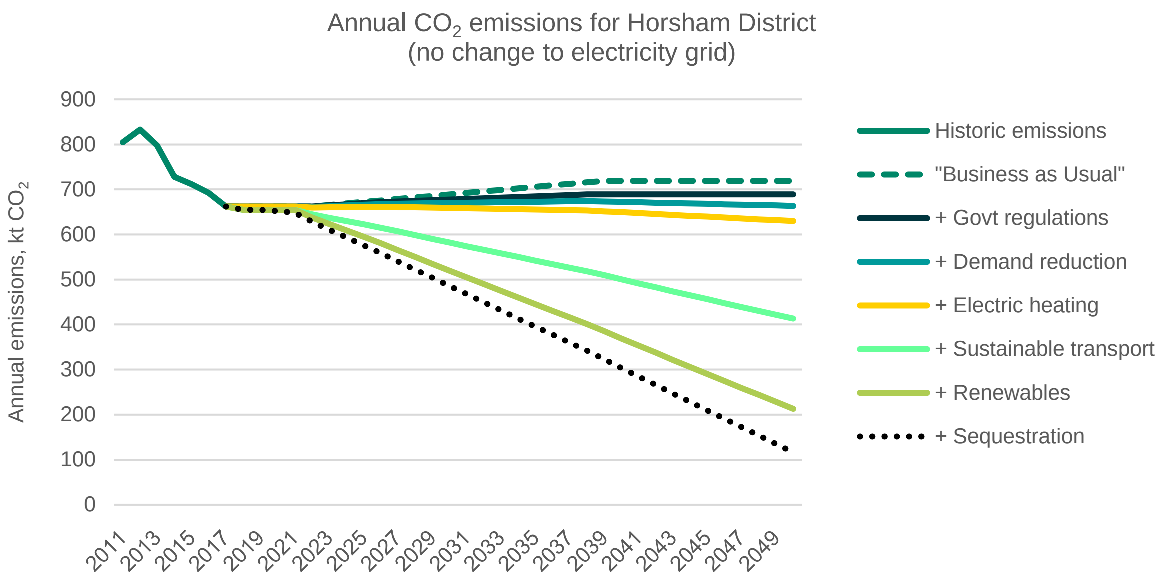

Figure C. Annual CO_2 emissions scenarios for Horsham District, no change in the electricity grid

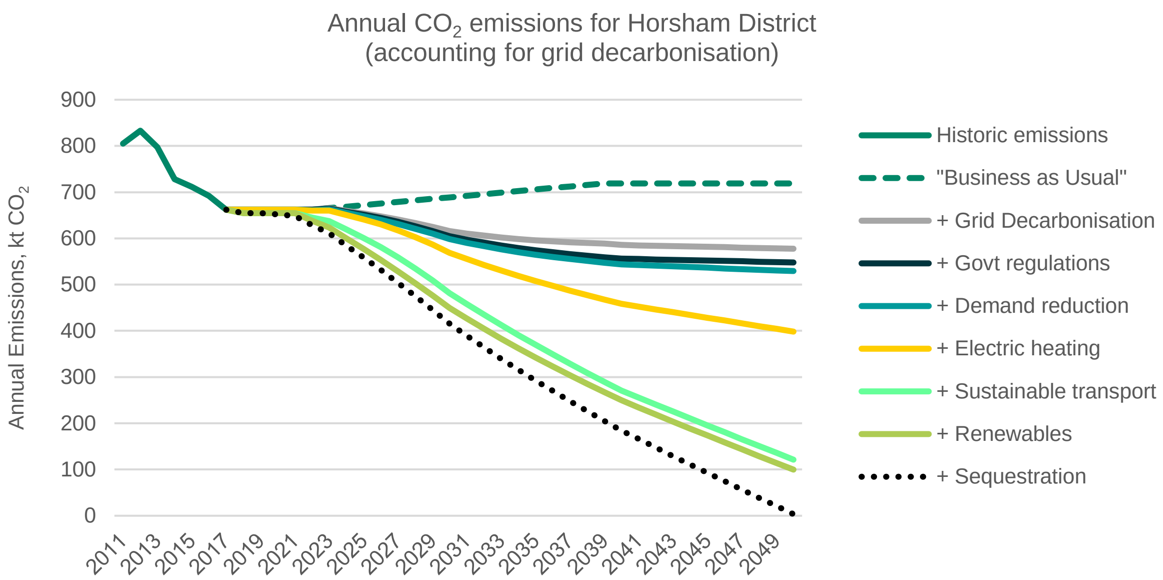

Figure D. Annual CO_2 emissions scenarios for Horsham District, accounting for grid decarbonisation

Output C: Policy Review

AECOM carried out a high-level review of the sustainability-related policies that HDC is considering for inclusion in the new Local Plan, recognising that more detailed policy options are being assessed by Centre for Sustainable Energy (CSE). A brief summary was made of the policy implications of the evidence presented in previous sections, and then outlines a range of suggestions for ways that HDC could potentially leverage its role as the local planning authority to deliver further benefits, whether through policy, a Supplementary Planning Document (SPD) on sustainability, or other means.

The policies assessed by AECOM were as follows:

- Strategic Policy 36 – Climate change
- Policy 37 – Appropriate Energy Use
- Strategic Policy 38 – Sustainable Design and Construction
- Strategic Policy 41 – Sustainable Transport
- Policy 42 – Parking

Having assessed the key policies within Horsham's draft Local Plan 2021-2038 AECOM has identified the ones which will have a direct effect on reducing the carbon emission within the district. These are set out in Section 7 (Output E). Horsham District Council has taken on the AECOM recommendation that Energy and Sustainability Statements are required; this will encourage good practice to be applied to new developments.

Whilst these policies are in line with the National effort to decarbonise the UK, AECOM believes there are further opportunities within the District to promote renewable technologies. More information can be found in the 'Output D'.

Output D: Renewable Energy Assessment

To assess future opportunities to deliver low and zero carbon (LZC) energy technologies in Horsham, AECOM undertook a review and validation of previous analytical work carried out by the CSE in 2009, the 'West Sussex Sustainable Energy Study'. Where relevant, the findings have been updated or supplemented to reflect changes that have taken place since 2009.

Our assessment has considered the following technologies:

- Wind turbines
- Solar photovoltaics (PV) roof-mounted and ground-mounted
- Ground, air and water source heat pumps (GSHPs, ASHPs and WSHPs) – *Note that, although these do not generate renewable electricity or fuel, they can reduce CO_2 emissions by lowering primary energy demands and facilitating a switch towards less carbon-intensive fuels.*
- Hydroelectric power
- Energy from waste (EfW)
- Biogas (landfill and sewage gas)
- Biomass
- Heat networks – *As with heat pumps, this technology does not necessarily provide renewable electricity or heat but can offer greater efficiencies and facilitate a shift towards LZC heat sources where available.*

Technologies that are not relevant to the geographic context of Horsham, such as tidal power, have been excluded from this analysis. Emerging technologies such as hydrogen fuel cells and battery storage has been discussed at a qualitative level in more detail in the main body of the report.

Technology	Theoretical future added capacity (MW)	Theoretical future added generation (MWh p.a.)
Large- and medium -scale wind	Up to 266	Up to 541,000
Small-scale wind	Up to 25	Up to 21,600
Building-mounted PV	72.8	73,304
Domestic buildings	31.5	31,712
Commercial buildings	9.0	9,080
Industrial buildings	8.3	8,305
New dwellings	24.0	24,177
Large-scale PV	Up to 970	Up to 976,000
ASHPs	Potential to retrofit most existing buildings and all new buildings	n/a
GSHPs		
Energy from Waste	21	Unknown
Biogas (Landfill and Sewage), District Heat Networks, Hydrogen and Battery Storage	Not quantified	Not quantified

Table C. Potential future provision of renewables in Horsham District

Output E: Estimated Carbon Savings from Local Plan Policies

Draft Policy from the Regulation 19 Proposed Submission Local Plan was considered, which AECOM reviewed in order to comment how they further Horsham's commitment to reducing the emissions produced within the District Boundaries.

Strategic Policy 38 – sustainable design and construction

This draft strategic policy targeted 35% reduction in emissions from the baseline rate determined by Part L 2013, with a minimum 10% reduction arising from energy demand reduction measures. New non-domestic developments must target BREEAM 'excellent' rating, unless demonstrated the target deems the development unviable. These quantitative targets have been measured against Business as Usual (BAU) and newly published Government policy which will also steer the direction of building performance in the future. The results can be seen in Table D.

	Future Homes Standard 2025 75% reduction enacted				Future Homes Standard 2025 75% reduction not enacted			
Projected Saving	No grid decarbonisation		Grid decarbonisation		No grid decarbonisation		Grid decarbonisation	
HDC policy vs:	BAU	Govt regulations	BAU	Govt regulations	BAU	Govt regulations	BAU	Govt regulations
$ktCO_2$/year saved in 2050	29.9	0.1	29.7	0.0	15.2	0.3	10.9	0.6
Total $ktCO_2$ saved by 2050	562	2	561	1	304	7	232	2

Table D. Matrix of carbon savings from proposed Local Plan policy

Policy 38 of the draft Local Plan only addresses a small portion of the emissions associated with Horsham; however, new build is one of the Council's main areas of influence within the context of planning policy. Therefore, it is a step in the right direction and a demonstration of the intentions Horsham Council have to decarbonise the District.

There is a much larger portion of emissions arising from transport in Horsham. As noted by the Council in their draft Local Plan, it being a rural district there will be a need for private cars. The promotion of electric vehicles, in policies 41 and 42 of the draft Local Plan, will help to reduce the emissions of vehicles – however it is not possible to quantify the reduction associated specifically with the policies as there are no figures on how many vehicles will switch to electric. Promoting electric vehicle usage is a critical part of the pathway to Net Zero Carbon.

Next Steps

Horsham District Council is expecting to publish the draft Local Plan by year end 2021, it should look to enforce its policy at the point the Plan assumes material weight for decision making. By reducing carbon emissions sooner in new developments, there is less reliance on making substantial savings in other harder to reach sectors.

Horsham should consider developing its renewable energy capacity, protecting its residents from market price inflation of electricity whilst also playing its part in decarbonising the National Gird. Funding and supporting renewable installation both small-scale and large-scale will help reduce the District's emissions in the short-term, whilst rewilding, afforestation and general landscape maintenance will provide a long-term carbon sink within Horsham's boundaries.

Horsham being a southerly District with plenty of open space lends itself to large-scale solar farms for example or afforestation which are just some of the solutions being implemented in other Southern areas, the need for publicly owned land is of paramount importance – therefore it is recommended that the acquisition of land for future use should also be considered.

Developing a Horsham specific Action Plan is an effect way of collating the key next steps in a cohesive way to allow progress to be judged and identify discreet projects that align with the goals of targeting Net Zero Carbon.

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1. Introduction

1.1 Horsham District Council (HDC) has commissioned AECOM to provide technical support to develop an evidence base for new energy and sustainability policies within the forthcoming Horsham Local Plan. This report presents the existing energy use, carbon dioxide (CO_2) emissions and low and zero carbon (LZC) energy generation in Horsham. It discusses some of the anticipated changes that may arise from new development along with broader national trends and presents a variety of options for responding to these and delivering on the Council's climate emergency commitments through planning policy.

Purpose of this report

1.2 The Council is looking for technical support to undertake carbon emissions analysis and scenario modelling, and to assess renewable and low carbon energy opportunities across the District. Building on previous analytical work such as the Renewable Energy Study undertaken in 2009, and local targets and commitments such as those laid out in the Council's Corporate Plan 2019-2023, this study will form part of a technical evidence base to support the forthcoming Local Plan. It will also contribute towards the development of an Action Plan for achieving Net Zero carbon emissions. Local Plans require a robust body of evidence to justify any proposed policies and environmental targets, both to ensure smooth transition through the Examination in Public and to avoid challenges from developers. To this effect, the project brief lists the following outputs to be addressed in the study:

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(Stage 1 deliverables)

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(Stage 2 deliverables)

- Output E: Estimated Carbon Savings from Local Plan Policies — Stage 3 deliverable

1.3 We are keen for our work to be tangible and practical for our clients, and therefore will seek to produce outputs that not only support the revised Local Plan and carbon neutral ambitions of the District, but also identify projects that can be taken forward to deliver on these goals.

Structure of this report

1.4 The report is structured as follows:

- **Section 2** – Provides an overview of the key drivers for achieving net zero emissions, including an overview of the current regulatory context, with a focus on buildings and transport.
- **Section 3** – Describes the current (baseline) fuel consumption and CO_2 emissions in Horsham, along with recent trends. It also sets out the existing low and zero carbon (LZC) energy generation technologies in Horsham.
- **Section 4** –Discusses the potential changes in CO_2 emissions that could occur in the coming decade, with consideration given to trends such as new development, electricity grid decarbonisation, energy efficiency standards for buildings, switching to electric heating systems, and uptake of ultra-low emission vehicles (ULEVs) and LZCs. This is then used to provide high-level policy recommendations.
- **Section 5** – This section presents an estimate of the additional LZC energy capacity, with consideration given to the available resources in the District, as well as the current policy context.

- **Section 6 and 7** – Presents a carbon audit of the draft Local Plan policies, drawing on the results of the preceding sections, along with a list of further opportunities for consideration.
- **Section 8** – Conclusions and next steps.

1.5 Supporting information is provided in the **Appendices** as relevant.

2. Background and Context

2.1 This section of the report summarises the key scientific consensus that is driving climate targets and the current and emerging climate policy context applicable to development across the District of Horsham. A selection of targets, policies and initiatives aimed at reducing CO_2 emissions are described below, particularly those related to decarbonising heat, energy and transportation in Horsham.

2.2 Although it is not possible to fully capture the wide range of environmental, social, and economic drivers for taking action to address the threat of climate change, these are some of the key drivers that have been used to inform the analysis presented in this report.

International Context

2.3 Climate change is one of the key challenges faced today, with its impact observed at global and local levels. Climate experts indicate that global temperature rise must be limited to 1.5°C in order that the effects identified as a result of climate change are not irreparable. With the rise in average global temperatures already recorded at 1.1°C, a united global response is required to combat the causes of climate change and mitigate its ongoing effects.

UNFCCC

2.4 Over the past 20 years the need to reduce the growth in global greenhouse gas emissions has been gaining momentum on the international political agenda. The main vehicle for international cooperation on climate change mitigation is the United Nations Framework Convention on Climate Change (UNFCCC), particularly in being responsible for negotiations under the Kyoto Protocol and the Paris Agreement.

2.5 Most countries have been setting targets for national carbon emissions reductions and this is expected to continue following international agreements at the 25th Conference of the Parties to the UNFCCC in December 2019. The UK is expected to host the 26th Conference of the Parties (COP26) to the UNFCCC.

The Paris Climate Agreement

2.6 On 12 December 2015, UNFCCC members, including the United Kingdom, reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The UK ratified the Paris Climate Change Agreement in November 2016. The Agreement's central aim *'is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C'.*[1]

2.7 For context, a study produced by the Tyndall Centre for Climate Change Research[2] calculated that the total carbon budget for Horsham to be compatible with the Paris Agreement targets would be a maximum cumulative sum of 4.5 million tonnes ($MtCO_2$) for the period 2020 to

[1] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[2] https://carbonbudget.manchester.ac.uk/reports/E07000227/

2100. Analysis found that, *'at 2017 CO_2 emission levels, Horsham would use this entire budget within 7 years from 2020'.*

Intergovernmental Panel on Climate Change

2.8 The Intergovernmental Panel on Climate Change (IPCC) has explored the pathways needed to limit the global temperature rise as a result of climate change to no more than 1.5°C. These would require average global emissions to be reduced to -0.4 to 1.7 tonnes CO_2 equivalent (tCO_2e) per person per year. The Climate Change Committee (CCC) advised Government that achieving Net Zero by 2050 would be the equitable role the UK would need to play in global efforts to limit average global emissions to 1.7 tCO_2e per person.[3]

Energy Performance of Buildings Directive

2.9 The European Energy Performance of Buildings Directive (EPBD) addresses the issue of climate change through energy performance improvement. It requires that by 31 December 2020, all new buildings should be 'nearly zero-energy buildings.' EU Directives are met by member states transposing the requirements into national legislation. The UK Government has previously met EPBD requirements for new buildings by transposing the requirements into Part L of the Building Regulations. It is set out that buildings which meet the standards set out in the consultation version of Part L 2020 will fulfil the requirement of nearly zero-energy buildings. Implementation of this condition is remains subject to the UK's exit from the EU.

National Context

UK Climate Change Act: 2050 Target Amendment Order (2019)

2.10 In 2019, the UK became the first country to declare a Climate Emergency, and subsequently, by amending the Climate Change Act (2008), legally committed to achieving Net Zero greenhouse gas emissions by 2050. In taking these actions, the UK has demonstrated international leadership with regards to its obligations under the Paris Agreement.

2.11 This policy legally commits the UK Government to reducing emissions by 100% by the year 2050, compared with a 1990 baseline.[4] As described by the UK Committee on Climate Change (CCC), *'The Act provides the UK with a legal framework including a 2050 target for emissions reductions, five-yearly 'carbon budgets' (limits on emissions over a set time period which act as stepping stones towards the 2050 target), and the development of a climate change adaptation plan.'*[5]

2.12 As noted in the CCC report *'Net Zero: The UK's contribution to stopping global warming'* (2019), this level of carbon reduction is achievable using known technologies and techniques,[6] such as:

- Reducing demand through resource and energy efficiency;
- Societal choices e.g. reducing meat consumption;
- Electrification of transport and heating;
- Development of hydrogen gas and carbon capture and storage (CCS) technologies; and
- Land use changes that promote carbon sequestration and biomass production.

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[3] Net Zero – The UK's contribution to stopping global warming. Climate Change Committee. May 2019.
[4] The original (2008) target of 80% was amended through subsequent legislation in 2019. *See 'The Climate Change Act 2008 (2050 Target Amendment) Order 2019'*: http://www.legislation.gov.uk/uksi/2019/1056/contents/made
[5] https://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/
[6] Available at: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

2.13 The CCC's recent *'2020 Progress Report to Parliament'* assesses the progress in reducing carbon emissions in the UK over the past year. The report concludes that whilst steps have been made to approach climate change mitigation targets there remains much to be addressed if the UK is to meet its net zero carbon commitment by 2050. The Committee sets out recommendations to the Government, ongoing strategic priorities are defined as:

6. Low-carbon retrofits and buildings that are fit for the future;
7. Tree planting, peatland restoration, and green infrastructure;
8. Energy networks must be strengthened;
9. Infrastructure to make it easy for people to walk, cycle, and work remotely; and
10. Moving towards a circular economy.

2.14 It is expected that the Government's planned 2020 Heat Roadmap will respond to these areas in establishing an approach that will lead to the full decarbonisation of buildings by 2050.

UK Clean Growth Strategy and Industrial Strategy (2017)

2.15 The UK Clean Growth Strategy[7] (CGS) was published in October 2017 and sets out the Government's vision for decoupling economic growth from carbon emissions.

2.16 It includes objectives for increasing the generation of energy from renewable sources, increasing the delivery of clean, smart and flexible power, and accelerating the shift to low carbon transport, smart grids and energy storage. The delivery of low carbon heating is identified as a priority, indicating that heat pumps, district heating networks and a hydrogen gas grid could all support the scale of change required, while acknowledging the significant technical and financial obstacles.

2.17 The Clean Growth Strategy also discusses the need to improve energy efficiency in buildings, particularly the existing stock. This includes a strategy of progressively increasing the minimum Energy Performance Certificate (EPC) ratings that will be considered permissible in order to allow the sale or rental of buildings, as required by the Minimum Energy Efficiency Standards (MEES) regulations. [8]

2.18 The UK Industrial Strategy,[9] published in November 2017, emphasises the themes of the CGS and describes a 'Grand Challenge' for maximising the advantages that the UK can gain from the global shift to a low carbon economy. Both documents note the potential for low carbon industries to deliver a high level of GDP growth compared with the current forecast.

National Planning Policy Framework

2.19 The National Planning Policy Framework (NPPF) sets out Government planning policy for England. It states that, *'the purpose of the planning system is to contribute to the achievement of sustainable development.'* It provides guidance for local planning authorities drawing up local plans and is a material consideration for those determining applications.

[7]HM Government *'Clean Growth Strategy'* (2017). Available at: https://www.gov.uk/government/publications/clean-growth-strategy

[8] The *'Energy Efficiency (Private Rented Property) (England and Wales)'* Regulations 2015 introduced the Minimum Energy Efficiency Standard (MEES) for buildings across the UK. For further information, see https://www.gov.uk/government/publications/the-private-rented-property-minimum-standard-landlord-guidance-documents

[9] HM Government, *'Industrial Strategy: Building a Britain Fit for the Future'* (2017). Available at: https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

2.20 The NPPF further states, *'at the heart of the [National Planning Policy] Framework is a presumption in favour of sustainable development.'* It addresses topics that are relevant to the economic, environmental and social sustainability of development proposals, including but not limited to:

- Promoting sustainable transport;
- Making effective use of land;
- Achieving well-designed places;
- Protecting Green Belt land;
- Meeting the challenge of climate change, flooding and coastal change; and
- Conserving and enhancing the natural environment.

Building Regulations (Part L)

2.21 Part L of Building Regulations is the key mechanism that prescribes standards for the conservation of fuel and power in buildings in the UK, based on metrics such as the estimated level of energy demands and CO_2 emissions.

2.22 At the time of writing, the Ministry of Housing, Communities and Local Government (MHCLG) has recently released a consultation on proposed future standards (see box below) that would significantly reduce emissions from new domestic buildings in the UK. The consultation also states that the Government will make further improvements to Building Regulations requirements for existing domestic buildings as well as new and existing non-domestic buildings. [10]

The Future Homes Standard

Under the Future Homes Standard, new buildings would be required to meet significantly higher targets for energy efficiency and carbon savings. The Government states that, *'As part of the journey to 2050 we have committed to introducing the Future Homes Standard in 2025. This consultation sets out what we think a home built to the Future Homes Standard will be like. We expect that an average home built to it will have 75- 80% less carbon emissions than one built to current energy efficiency requirements (Approved Document L 2013). We expect this will be achieved through very high fabric standards and a low carbon heating system. This means a new home built to the Future Homes Standard might have a heat pump, triple glazing and standards for walls, floors and roofs that significantly limit any heat loss.'*

- BEIS, *'The Future Homes Standard Consultation'* (2019)

The Road to Zero (2018)

2.23 The Road to Zero report[11], published in July 2018 sets out the Government's core mission; 'to put the UK at the forefront of the design and manufacturing of zero emissions vehicles and for all new cars and vans to effectively be zero emission by 2040.' The strategy furthers the ambitions of the Air Quality Plan for NO_2[12] and Clean Growth Strategy (see following section) in defining key policies with a primary focus on the introduction of low and zero emission vehicles, with the aim that *'at least 50%, and as many as 70%, of new car sales and up to 40% new van*

[10] BEIS, *'The Future Homes Standard Consultation'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/843757/Future_Homes_Standard_Consultation_Oct_2019.pdf

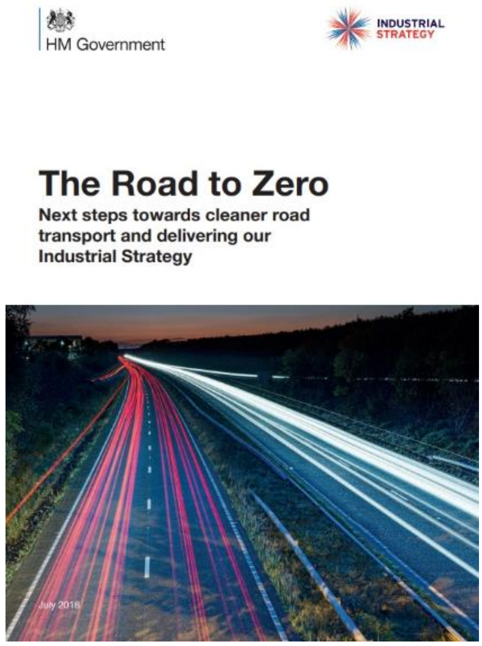
[11] HM Government, *'The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy'* (2018) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

[12] Air quality plan for nitrogen dioxide (NO2) in UK (2017) https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

sales being ultra-low emission by 2030. By 2050 we want almost every car and van to be zero emission.'

2.24 In supporting these longer-term ambitions, the strategy outlines supporting policy action toward the fulfilment of these broader goals, including:

- Reducing emissions from existing vehicles on the road;
- Extension of the Clean Vehicle Retrofit Accreditation Scheme (CVRAS) beyond its current scope to include both vans and black cabs; and
- Developing a strategy to tackle HGV and freight-related emissions through Highways England research.



2.25 The Government has stated that local action will be supported through new policies, including the provision of funding to extend ultra-low emission bus schemes and taxi charging infrastructure. Ongoing goals to encourage the uptake of clean new vehicles will be backed by developing electric vehicle infrastructure, offering funds and grants for provision of electric charge points.

Written Ministerial Statement on Wind (2015)

2.26 The Written Ministerial Statement on Wind (HCWS42, 2015) states that, when determining planning applications for wind energy development, planning authorities should only grant permission if:

- the development site is in an area identified as suitable for wind energy development in a Local or Neighbourhood plan; and
- following consultation, it can be demonstrated that the planning impacts identified by affected local communities have been fully addressed and therefore the proposal has their backing.[13]

2.27 The statement goes on to explain:

> *'In applying these new considerations, suitable areas for wind energy development will need to have been allocated clearly in a Local or Neighbourhood Plan. Maps showing the wind resource as favourable to wind turbines, or similar, will not be sufficient.'*

2.28 In practical terms, the effect of HCWS42 has been to significantly limit the amount of onshore wind development in the UK, recognising that most Local Authorities have few, if any, site allocations for wind energy – although it is anticipated[14] that the Government will relax its position in future. Horsham has had a map produced in 2009, as part of the West Sussex Sustainable Energy Study[16], showing potentially acceptable locations for wind energy development which will inform our analysis of future renewable energy opportunities.

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[13] https://www.parliament.uk/documents/commons-vote-office/June%202015/18%20June/1-DCLG-Planning.pdf

[14] In March 2020, BEIS announced that onshore wind farms would be eligible to join the Contracts for Difference (CfD) scheme, reversing an earlier prohibition on subsidies for onshore wind, but as of June 2020, no changes have been announced that would lift the planning policy restrictions set by HCWS42. See BEIS, *'Contracts for Difference for Low Carbon Electricity Generation'* (2020). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/885248/cfd-ar4-proposed-amendments-consultation.pdf

‘Planning for the Future’ White Paper (2020)

2.29 The Planning for the Future consultation White Paper was published by the Ministry of Housing, Communities and Local Government on 6th August 2020. This consultation sets out a package of proposed measures that, if implemented, would comprehensively transform the current planning system in England. The stated aim is to streamline and modernise the planning process, including to improve design and sustainability outcomes.

2.30 The Consultation proposes the role of Local Plans to be simplified, with less repetition of national policy. Local Plans will instead focus on setting out clear rules limited to a core set of standards and requirements for development, including site-specific and area-specific requirements. It is also proposed that a National Model Design Code be introduced following the publication of the National Design Guide in October 2019, to be supplemented by local design guides and codes, although it is not clear what topics would be delegated to the latter.

2.31 Some of the proposed key changes in the consultation relevant to this study are outlined below.

- Local Plans would be significantly reduced in scope to include fewer policies. The majority of policies would be set nationally while Local Plans would primarily address development site allocations.
- Specifically, Local Plans would designate land as falling into the category of either ‘protection’, ‘renewal’ or ‘growth’. Outline planning permission may automatically be granted for ‘growth’ areas and restricted in ‘protection’ areas, while areas suitable for ‘renewal’ would accommodate some forms of development such as infill / densification.
- Proposals would still need to adhere to locally specific Design Codes that set out more detailed requirements. The process for developing these would require significant community engagement and support, an issue that is strongly emphasised throughout the consultation document.
- The planning application system would be streamlined and digitised; in particular, the number of supporting application documents would be reduced.
- The current system of S106 contributions and the Community Infrastructure Levy would be replaced with a nationally standardised, flat-rate infrastructure levy based on development and land values.

2.32 The ‘Planning for the Future’ consultation closes on the 29th October 2020. It is not clear when the government is intending to respond to the consultation or the timeline for implementation. Nonetheless, it should be borne in mind when considering the policy recommendations set out in this report.

Regional context

South2East Local Energy Strategy (2018)

2.33 The South2East Energy Strategy[15] is intended to support a group of Local Enterprise Partnerships (LEPs) to deliver decarbonisation and clean growth across the heat, power and transport sectors, in line with the nationwide Industrial Strategy (2017). The Strategy outlines a vision for achieving clean growth through to the year 2050, with a focus on the power, heat and transportation sectors. It highlights several key opportunities for the region, including:

- Renewable energy potential, especially solar, wind, energy from waste and landfill gas;
- Rich natural assets (including a high proportion of woodland); and
- Large amounts of planned new development within the region, offering opportunities for deployment of smart, integrated, sustainable energy system models.

2.34 The South2East Local Energy Strategy considers strategic regional opportunities in the south-eastern UK and seeks to identify project models suitable for investment and targeted intervention. The report lists a variety of immediate priority actions that could be taken, such as:

- Moving households and businesses to low carbon heat sources e.g. district heat networks (DHNs);
- Deployment of renewables e.g. solar photovoltaics (PV) on disused landfill sites;
- Energy efficiency programmes across industrial, commercial and domestic sectors;
- Utilisation of smart technologies e.g. microgrids; and
- Supporting low carbon transport e.g. through provision of electric vehicle (EV) charging and hydrogen refuelling points.

2.35 Overall, it is estimated that over £14 billion in investment would be required to meet the area's fair share of the 2032 carbon emission reduction target, with the potential to create over 75,000 jobs.

West Sussex Sustainable Energy Study (2009)

2.36 An area-wide renewable energy study for West Sussex was undertaken by the Centre for Sustainable Energy (CSE) in 2009[16]. The study was intended as an evidence base to support the Local Development Frameworks and spatial planning considerations for a consortium of five Local Authorities: Horsham District Council, Mid Sussex District Council, Arun District Council, Worthing Borough Council and Chichester District Council. Although it predominantly focused on opportunities for delivering more LZC energy technologies in the area, it also put forth evidence and policy recommendations relating to sustainable building design standards.

2.37 Key recommendations from the study included, but were not limited to:

- Undertaking further analysis to assess whether local conditions and local in-house capacity could accommodate setting a target for all new homes to reach Code for Sustainable Homes Level 5 (100% reduction in regulated CO_2 emissions) from 2013 onwards.

[15] Energy South2East, *'South2East Local Energy Strategy'* (2018). Available at: https://www.southeastlep.com/app/uploads/2019/03/Local-Energy-Strategy-FINAL.pdf
[16] https://www.horsham.gov.uk/__data/assets/pdf_file/0004/88438/west_sussex_sustainable_energy_study.pdf

- Use of BREEAM for non-residential development (i.e. setting a target rating of 'Very Good' with a view towards increasing the level of ambition over time).
- Consider setting higher targets in areas where there are specific opportunities to achieve greater carbon savings.
- Require planning applicants to develop Energy Strategies in line with an energy hierarchy and a heating / cooling hierarchy.

2.38 These recommendations informed the subsequent development of Horsham planning policy as described below. As part of the present study we will provide a technical review, validation and update of the West Sussex Sustainable Energy Study (2009) study[16]. Further details are provided in Section 6.

Local Policies and Drivers

2.39 Since 2019, Local Authorities across the country have been supporting the action on climate change by formally passing 'Climate Emergency Declarations.' Horsham District Council made and passed a climate emergency motion on June 27th 2019 but failed to declare a climate emergency.

Horsham District Planning Framework, 2015 and Draft Horsham District Local Plan 2021-2038

2.40 The current adopted Local Plan for Horsham District Council is entitled the '*Horsham District Planning Framework*' (2015). At the time of writing, the Local Plan is being updated and a public consultation[17] was completed on the '*Draft Horsham District Local Plan 2021-2038*' between 17th February and 30th March 2020. It is planned to be adopted in 2022. Note that, when discussing policy options, this report will provide recommendations and feedback relating to the draft Local Plan policy proposals.

2.41 The consultation version of the Draft District Plan[18] contains the following policies relevant to sustainability:

- Strategic Policy 1 – Sustainable Development
- Policy 25 – Strategic Policy: Environmental Protection
- Policy 26 – Air Quality
- Strategic Policy 27 – The Natural Environment and Landscape Character
- Strategic Policy 28: Countryside Protection
- Policy 31 – Strategic Policy: Green Infrastructure and Biodiversity
- Policy 32 – Local Green Space
- Strategic Policy 37 – Climate Change
- Strategic Policy 38 – Appropriate Energy Use
- Policy 39 – Sustainable Design and Construction
- Strategic Policy 40 – Flooding

2.42 Further details can be found in Section 5.

[17] https://www.horsham.gov.uk/planning/local-plan/regulation-18-consultation
[18] https://strategicplanning.horsham.gov.uk/consult.ti/LocalPlanReview/viewCompoundDoc?docid=10336756&sessionid=&voteid=&partId=10339124

3. Establishing the Baseline

3.1 In order to provide context for our assessment of future low and zero carbon (LZC) opportunities that will be presented in Section 6, this section summarises the current baseline fuel consumption and CO_2 emissions for Horsham. It also provides an estimate of the current level of LZC deployment, ultra-low emission vehicles (ULEV) uptake and charge point provision across the District.

Fuel Consumption

3.2 Fuel consumption figures are taken from the BEIS publication *'Sub-national total final energy consumption statistics: 2005-2017'* (published in 2019).[19] The dataset includes a breakdown of emissions by sector and fuel type where data is available and can be meaningfully disaggregated to a Local Authority level, i.e. it does not include aviation or national navigation. 2017 is the most recent year for which data is available. Further details of the methodology used to calculate these figures can be found in the *'Sub-national methodology and guidance booklet'* (BEIS, December 2018).[20] Results are shown in the table below.

Fuel	Non-domestic (GWh)	Domestic (GWh)	Road transport (GWh)	Diesel Rail (GWh)	Bioenergy & waste (GWh)	Total (GWh)	*% of total*
Gas	288.5	659.6	-	-	-	948	*30.9*
Electricity	263.1	277.7	-	-	-	550	*17.6*
Petroleum Products	200.6	116.7	1,067.4	13.2	-	1,398	*45.6*
Coal	19.9	10.3	-	-	-	30	*1.0*
Manufactured fuels	43.7	9.0	-	-	-	53	*1.7*
Bioenergy & waste	-	-	-	-	96.2	96	*3.1*
Total by sector	815.8	1,073.2	1,067.4	13.2	96.2	3,066	*100*
% of total	*26.6*	*35.0*	*35.0*	*35.2*	*3.1*	*100*	

Table 3-1. Fuel Consumption (2017 data)

3.3 Petroleum products represent the majority (45.6%) of fuel use in the District, the majority of this is used for road transportation although a significant portion is also used in non-domestic buildings and facilities, with a smaller amount used for domestic heating and rail. Gas and electricity use in buildings represent 30.9% and 17.6% of the total fuel use respectively, whilst the other fuels collectively account for 5.7%.

3.4 Interesting to note is the usage of petroleum products in non-domestic and domestic buildings. In the domestic stock, this is likely attributed to the use of oil boilers; only 73% of homes are supplied with gas heating (Figure 3-1) while 27% utilise other systems. In the non-domestic sector this is likely a combination of petroleum products used for heat, but also those used for industrial and manufacturing processes.

[19] https://www.gov.uk/government/statistical-data-sets/total-final-energy-consumption-at-regional-and-local-authority-level
[20] For the purpose of this report, BEIS statistics for 'industrial & commercial', 'public sector' and 'agriculture' fuel consumption are collectively referred to as 'non-domestic' uses. 'Bioenergy & waste' is not reported by sector. Electricity used for transport, (i.e. rail or ULEVs) is incorporated into the total figures for electricity. For further information see: here

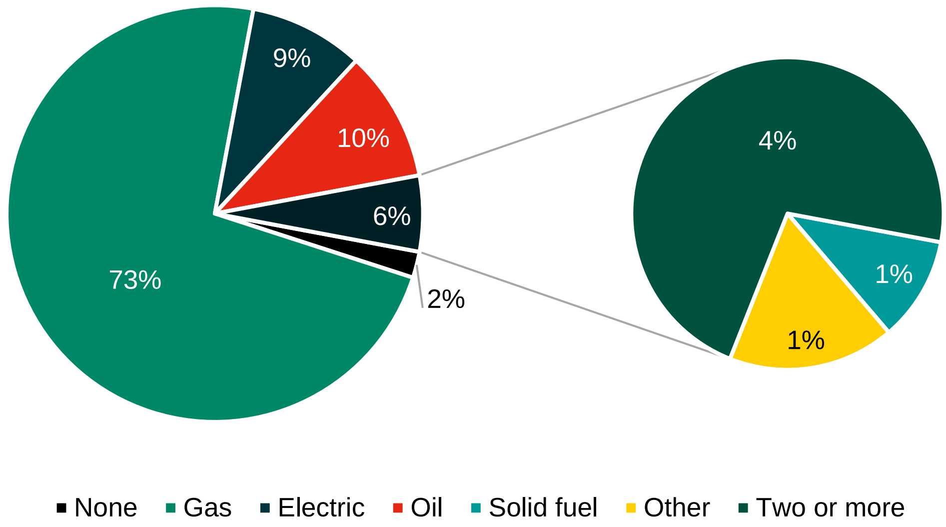

Figure 3-1. Split by central heating system

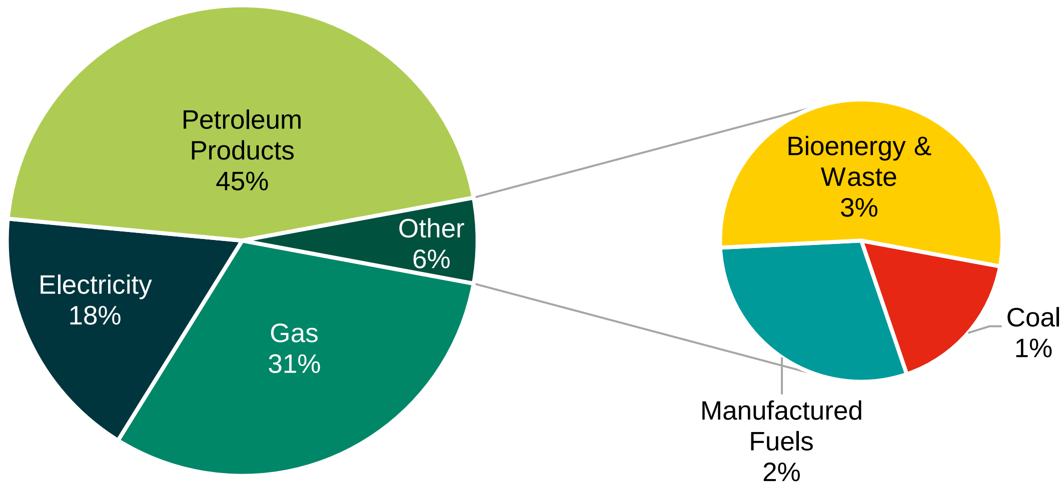

Figure 3-2. Split of Fuel Consumption by Fuel Type (2017 data)

3.5 Figure 3-3 shows a more detailed breakdown of fuel use by sector. The domestic and road transportation sectors represent the highest portion of fuel consumption (c. 35% each). Gas and electricity dominate usage in the domestic sector, whereas petroleum products are mostly used for road transport. Diesel rail accounts for less than 0.5% of total fuel consumption. Note that it is not possible to differentiate between electricity use in buildings and electricity used for charging vehicles or public transport (such as rail), as the public datasets do not capture this information. Nonetheless, this provides a good insight as to where switching fuels to take advantage of lower carbon electricity will be beneficial, i.e. electrification of vehicles and heating.

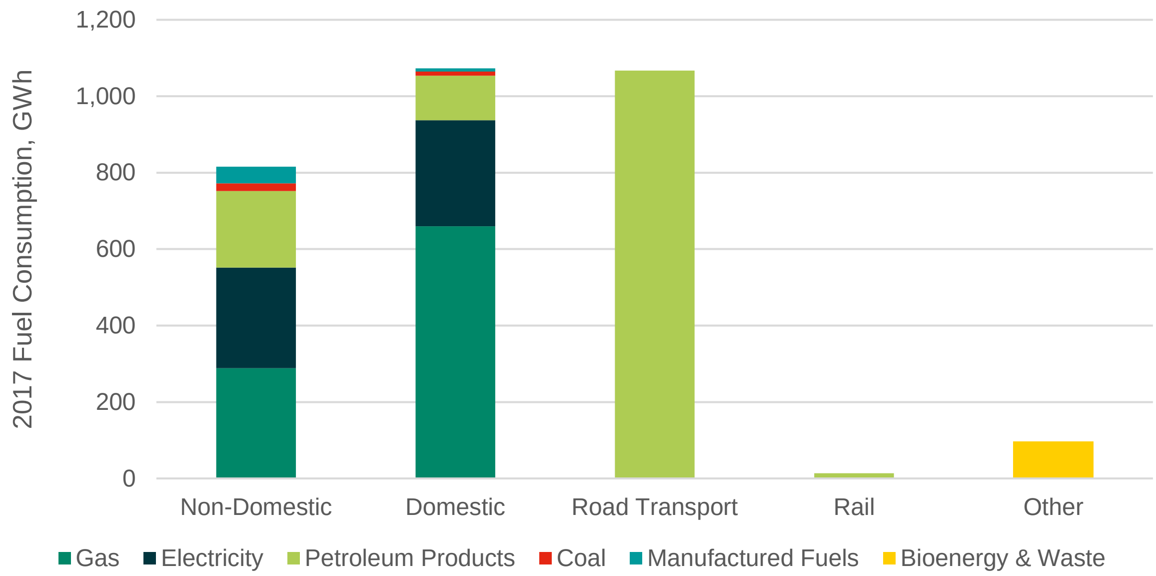

Figure 3-3. Fuel Consumption by Sector and Fuel Type (2017 data)

3.6 Considering road transportation in more detail, the majority of fuel use is for petrol and diesel cars, which represents 68% of the total. Nearly a further third is used in heavy goods vehicles (HGVs) and light goods vehicles (LGVs); (29%), while the rest is used for buses and motorcycles (2% and 1% respectively).

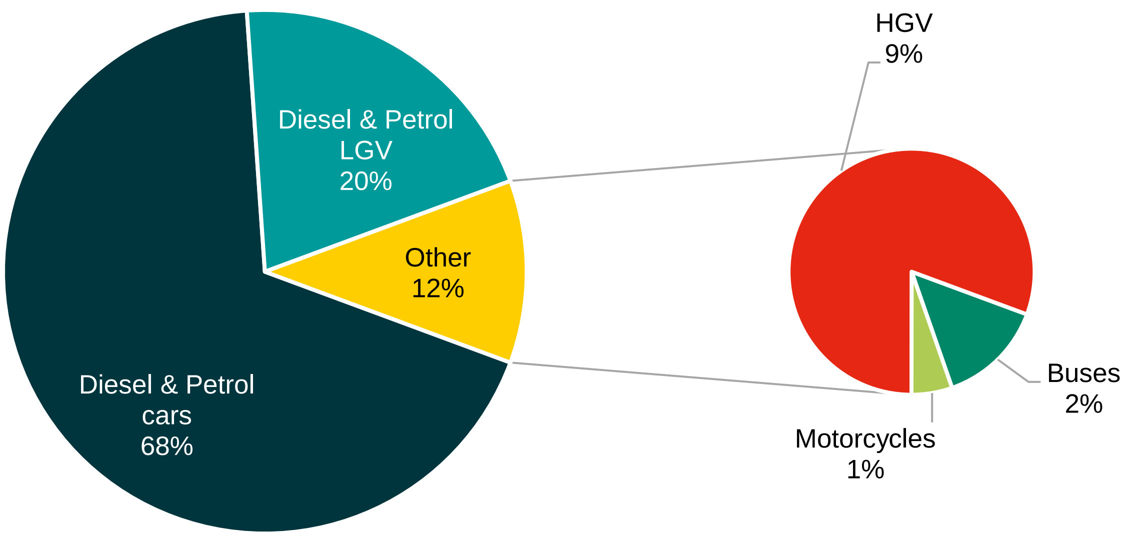

Figure 3-4. Use of Petroleum Products in Road Transportation (2018 data)

3.7 Figure 3-5 below shows trends in fuel consumption by sector since 2005. Total fuel use has generally declined from 2005-2013 and has remained largely stable since then. There has been an 11% decrease in road transport fuel use, an 18% decrease in the use of natural gas, a 13% decrease in the use of electricity. Although encouraging, these results should be interpreted with some caution because they are likely due to a wide range of factors, which could include positive changes in energy efficiency and consumer behaviour but could also be linked to weather, energy prices, and so on.

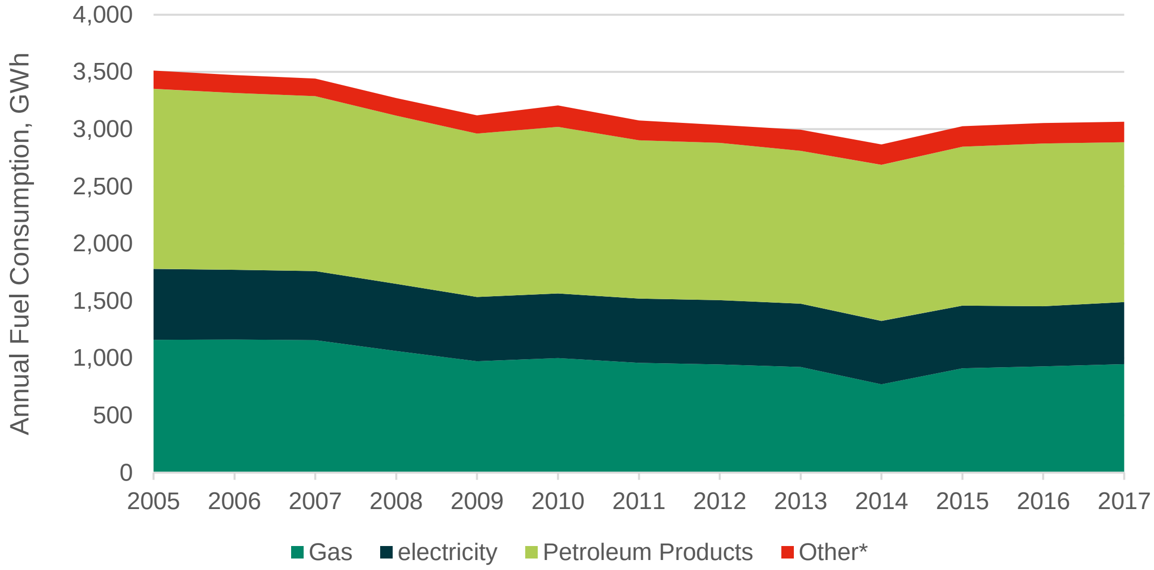

Figure 3-5. Trends in Fuel Consumption (2005-2017)

** Includes coal, manufactured fuels, bioenergy & waste, and petroleum products used for rail. These categories have been consolidated for clarity as they make up a small proportion (4-6%) of the total.*

CO_2 emissions

Note: Scope of the Greenhouse Gas Emissions Reporting

For the purpose of greenhouse gas (GHG) reporting, emissions are divided into three categories:

- Scope 1 – Direct emissions that arise from burning fuels in Horsham. This primarily includes fuel used in boilers to provide heating and hot water, fuel used in any vehicles while they are driving within District boundaries, and fuels (other than electricity) used for cooking.
- Scope 2 – Indirect emissions associated with the use of electricity in Horsham.
- Scope 3 – Indirect emissions that result from other activities outside the border of Horsham, but that take place as a result of the actions of people or organisations within Horsham, e.g. emissions from commuting, shipping, or aviation.

This report only quantifies Scope 1 and 2 CO_2 emissions, as these are the categories reported within publicly available datasets produced by BEIS. This covers a range of sectors and fuel types but does not cover *all* potential sources of GHG emissions within the Local Authority area.[21] For example, considering air conditioning units, the dataset includes the CO_2 emissions from the electricity used, but excludes other greenhouse gases emitted by refrigerants (e.g. hydrofluorocarbons). At the time of writing such information is not published by BEIS at a Local Authority level.

For further information, see *'Technical Report: Local and Regional Carbon Dioxide Emissions Estimates for 2005-2018 for the UK'* (BEIS, June 2019).[22]

3.8 The 2018 CO_2 emissions data breakdown for Horsham based on the BEIS dataset is shown in Table 3-2 and is further illustrated in Figure 3-6. Note that the CO_2 emissions data is reported

[21] The Kyoto Protocol covers six GHGs: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur hexafluoride (SF_6).
[22] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/812146/Local_authority_CO2_technical_report_2017.pdf

using slightly different categories than the fuel consumption data presented earlier, and fuel consumption data for 2018 is not yet available, so it is not possible to make a direct comparison, but the fuel consumption figures nonetheless provide useful context.

	Emissions – Non-Domestic ($ktCO_2$)	Emissions – Domestic ($ktCO_2$)	Emissions – Transport ($ktCO_2$)	Total ($ktCO_2$)	Total (Adjusted) ($ktCO_2$)
Gas	54.7	128.2	-	182.9	Land Use, Land Use Change and Forestry (LULUCF)* adjustment: -71.4
Electricity	61	64.8	-	125.8	
Large Industrial Installations	11.8	-	-	11.8	
Agriculture	14.0	-	-	14.0	
Road Transport	-	-	296.5	296.5	
Diesel Railways	-	-	3.4	3.4	
Other / Not Specified	49.7	34.8	1.6	86.1	
TOTAL	191.2	227.8	301.5	720.5	649.1
% of total emissions (excl. removals)	*26.5*	*31.6*	*41.9*	*100*	

Table 3-2. CO_2 Emissions (2018 data)

** Note: The adjustment for Land Use, Land Use Change and Forestry (LULUCF) reflects the fact that certain land use activities, such as cutting down or planting trees, result in CO_2 being added or removed from the atmosphere. In Horsham the net emissions from LULUCF are negative, i.e. more CO_2 is removed from the atmosphere than is emitted from these activities.*

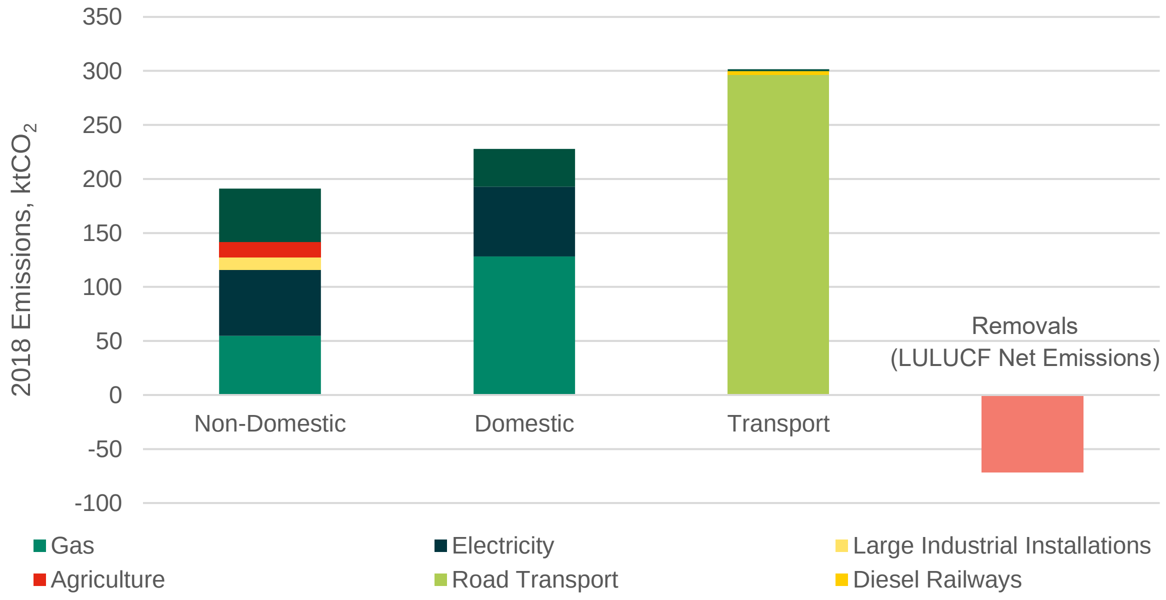

Figure 3-6. CO_2 emissions in Horsham by Sector and Source / Fuel Type (2018 data)

3.9 Among the sectors reported, the transport sector accounts for the largest proportion of CO_2 emissions (46.4%). This is almost all dominated by petroleum products as shown previously in Figure 3-3. 68% of CO_2 emissions from road transport are associated diesel and petrol cars and given that there is a national trend towards uptake of ULEVs, Horsham should see these emissions reduce in time subject to adequate infrastructure and incentives to facilitate change. As expected, domestic CO_2 emissions are larger than non-domestic (35.1% to 29.5% respectively). With heating accounting for a large proportion of total emissions, switching to electric heating systems such as heat pumps and retrofitting energy efficiency improvements would be expected to result in a significant reduction in these emissions. Overall CO_2 removals (i.e. sequestration, the LULUCF category shown above) are relatively high when compared to the national average and should be encouraged to increase where feasible. The relatively high rate may be due, in part, to the areas of the South Downs National Park and High Weald AONB (Area of Outstanding Natural Beauty) within the District's boundary although further work would be required to understand the potential cause. Figure 3-7 shows how Horsham has a higher ratio of carbon emissions to carbon removals compared to West Sussex, the South East and nationally.

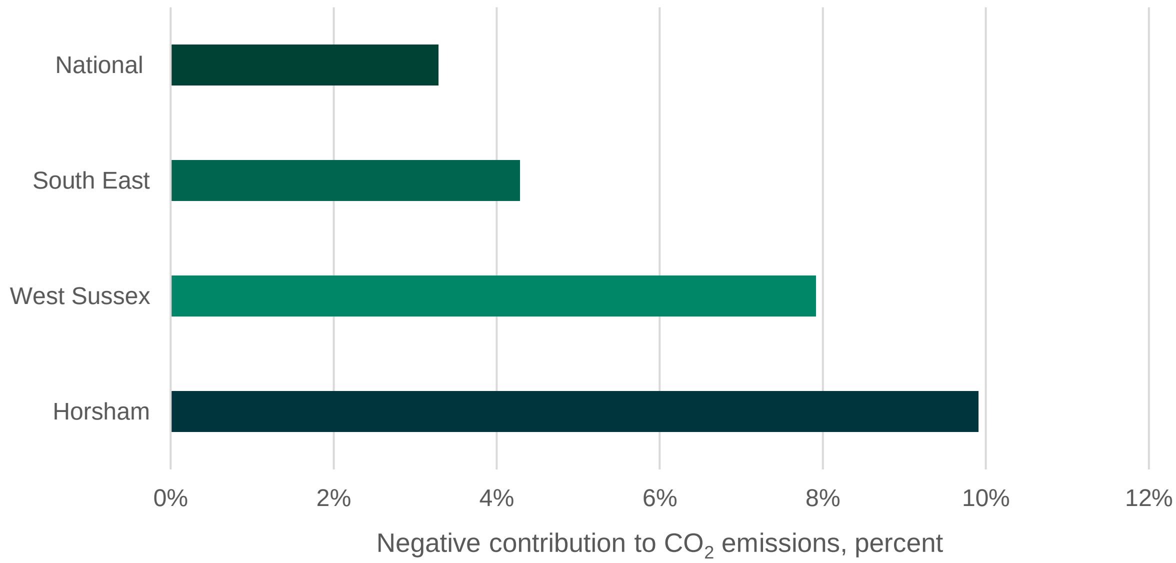

Figure 3-7. Comparison of percentage decrease in CO_2 emissions in each region from sequestration

3.11 Below, Figure 3-8 shows the recent trends in CO_2 emissions by sector and fuel type as reported by BEIS. Since 2005 there has been an overall 33% decrease in emissions, which is lower than the UK average (which saw a 35% decrease) but higher the regional average of West Sussex (31%). There has been a steady decrease in emissions in the District since 2005. It can be seen that the change in CO_2 emissions is disproportionate to the change in fuel use, and it should be noted that most of this decrease is associated with decarbonisation of the electricity supply.

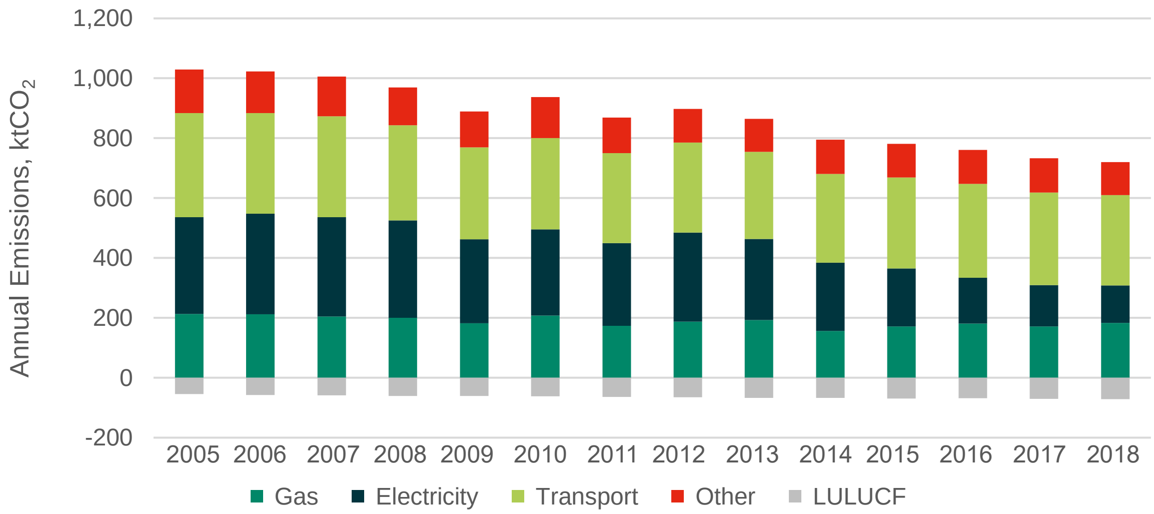

Figure 3-8. Trends in CO_2 Emissions in Horsham (2005-2018)

Electric Vehicles

Data Sources

3.12 Estimates for the current number of vehicles (including ULEVs) in Horsham are taken from *'VEH0105: Licensed vehicles by body type and local authority'* and *'VEH0132: Licensed ultra-low emission vehicles by local authority'* (2020 which are published by the Department for Transport (DfT). [23,24] These datasets record the number of vehicle registrations in each Local Authority from 2011 onwards. The DfT also publishes an online map of public electric vehicle charging points in each Local Authority which has been used to estimate the current number in Horsham. [25]

3.13 Note: For the purpose of this report, we have used the DfT definition of 'ultra-low emission vehicle' which refers to 'vehicles that emit less than 75g of carbon dioxide (CO_2) from the tailpipe for every kilometre travelled. In practice, the term typically refers to battery electric, plug-in hybrid electric and fuel cell electric vehicles.'

Current Baseline and Recent Trends

3.14 Table 3-3 shows the estimated number of ULEVs that are currently registered in Horsham, along with the number of public EV charge points in the District.

Description	Baseline Estimate
Number of licensed ULEVs (as of Q1 2020)	712
ULEVs as % of total vehicles (at end of 2019)	<0.7%
Total public charging devices	21
Total public rapid* charging devices	4
Charging devices per 100,000 population	15

** DfT statistics classify charge points of 43kW and above as 'rapid'.*

Table 3-3. Uptake of ULEVs and estimated number of public charging points in Horsham

[23] Department for Transport, *'VEH0105: Licensed vehicles by body type and local authority'* (April 2020). Available at: https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#licensed-vehicles
[24] Department for Transport, *'VEH0132: Licensed ultra low emission vehicles by local authority'* (June 2020). Available at: https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#licensed-vehicles
[25] Department for Transport, *'Table 1: Publicly available electric vehicle charging devices by local authority'* (July 2020). Available at: http://maps.dft.gov.uk/ev-charging-map/

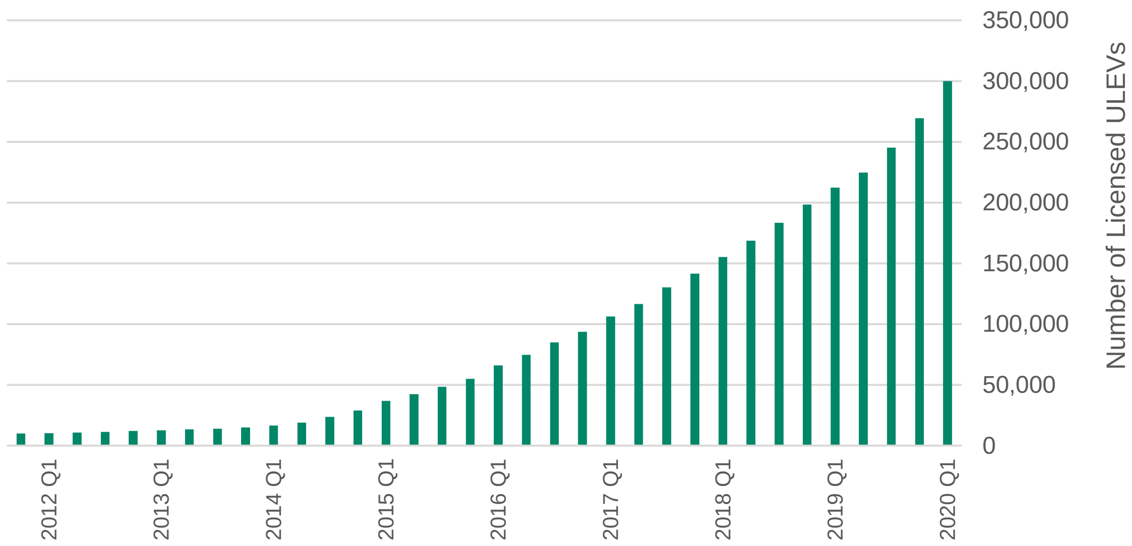

Figure 3-9. Ultra-low emission vehicle (ULEV) registrations in Horsham, 2011-2020

3.15 As shown in Figure 3-9, there was a nearly sixty-fold increase in the number of ULEVs registered in Horsham between 2011 and 2020, with 712 as of Q1 2020. Nonetheless, these represent a very small portion (<0.7%) of the more than 105,800 total vehicles licensed in the District.

Renewable and Low Carbon Energy

Data Sources

3.16 The total number and type of electricity-generating LZC technologies within Horsham is recorded in *'Regional Renewable Statistics: Renewable energy by local authority'* (henceforth referred to as RRS).[26] This was cross-checked against the Renewable Energy Planning Database[27] (REPD) which provides a quarterly record of all operational or planned LZC energy schemes that have been submitted for planning approval in the UK.

3.17 Regarding LZC technologies that generate only heat, there is less publicly available information. In order to provide an estimate of the number and type of these technologies, data was retrieved from the Renewable Heat Incentive (RHI) database.[28] It should be noted that these figures primarily focus on the total *number* of accredited installations; the figures are not disaggregated by technology type and figures for installed capacity are estimates based on nation-wide totals.

Limitations

3.18 Note that the amount of publicly available information varies depending on the technology in question, and therefore this information represents a 'best estimate' rather than a definitive list of every renewable energy installation in the District.

3.19 Most of the data relating to renewable energy technologies is based on records of installations that have been registered under an accreditation scheme or similar measure. Technologies that are not supported by such schemes or that are not registered for some other reason are therefore likely to be underrepresented in this analysis. This includes renewable heat technologies that are not RHI accredited, and small-scale electricity generating technologies (particularly PV) that would previously have been registered under the Feed-in Tariff incentive scheme, which closed to new registrations in 2019.

Existing and Planned Provision

3.20 The total installed capacity of LZC electricity technologies as at the end of 2018 was approximately 70.4 MWe, offering the potential to generate almost 109 GWh of electricity per year. According to the REPD (accessed August 2020), planning permission has been granted for a further 20 MW of ground-mounted PV, 4 MW of roof-mounted PV, and one additional large-scale battery storage installation.

	PV	Onshore Wind	Anaerobic Digestion	Landfill Gas	Total
Number of sites (#)	2,088	2	2	5	2,097
Installed capacity (MW)	53.8	<0.01	5.0	9.5	70.4
Electricity generation (MWh/yr)	54,129	15	13,629	40,671	108,444

Table 3-4. LZC electricity installations in Horsham, as at end of 2018

3.21 These results show that the largest number of installations are PV panels. It is likely that the majority of PV installations are small-scale domestic roof-mounted systems, but most of the capacity is attributed to large-scale ground-mounted PV farms. The REPD contains a record of no wind farm which suggests that the wind energy capacity listed in the RRS is likely to

[26] Available at: https://www.gov.uk/government/statistics/regional-renewable-statistics
[27] Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract
[28] For non-domestic see *'Table 1.1 – no. of applications and total capacity by technology type'* and *'Table 1.4 – no. of accredited applications and installed capacity by local authority'*. For domestic, see *'Table 2.1 – no. of applications and accreditations by technology type'* and *'Table 2.4 – no. of accreditations by local authority'*. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-february-2020

comprise smaller turbines. There are also two anaerobic digestion (AD) plants and five landfill (LFG) gas plants installed. Overall, the figures suggest that these generate almost 109 GWh of renewable electricity per year, with the largest contribution from PV. Figure 3-10 shows the rate of increase in renewable generation from 2015, it shows a slowing of uptake in renewable deployment after 2017; which, if following the previous trend could have been a very positive step for Horsham.

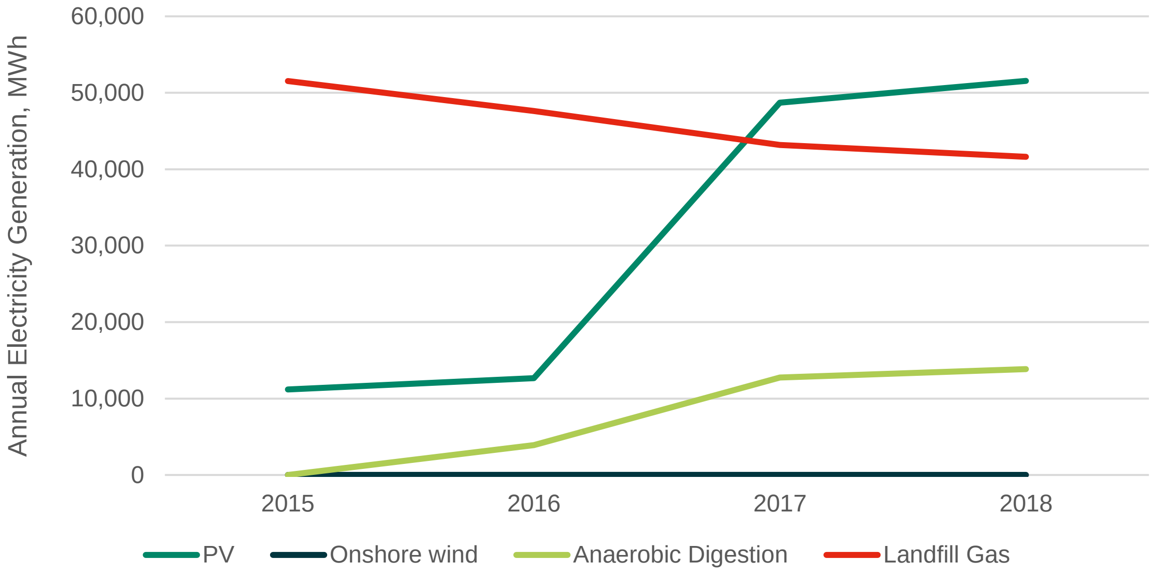

Figure 3-10. Rate of renewable generation per year

3.22 Due to EU directives, most landfill gas sites are shut due to resources depletion over time, hence the negative line[29]. Slowly this source of renewable energy will no longer be a viable option, therefore increasing the generation from renewables is imperative to compensate for the loss of generation from landfill gas and the increasing demand from the District itself.

3.23 Figure 3-11 shows the estimated capacity of operational LZC electricity generation and storage technologies in Horsham. There are two other installations that have been granted planning permission: 21.0MW of Energy from Waste (EfW) and 0.2MW of solar PV, based on our review of the RRS and REPD records.

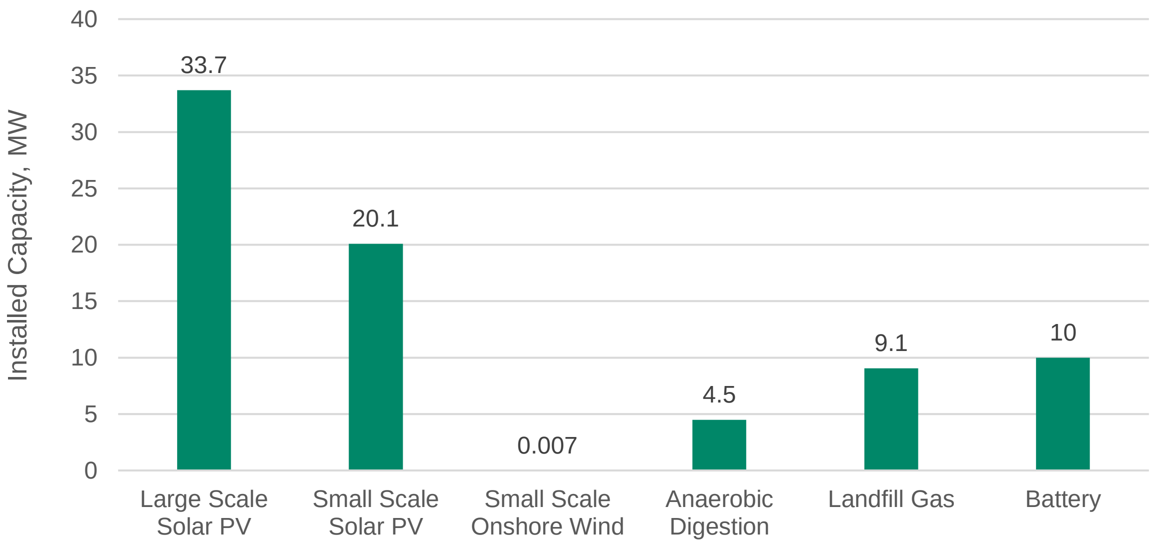

Figure 3-11. Operational and potential LZC electricity generation and storage capacity in Horsham

[29] https://ec.europa.eu/environment/waste/landfill/pdf/guidance%20on%20landfill%20gas.pdf

3.24 In addition to the renewable *electricity* technologies described above, the Renewable Heat Incentive (RHI) Database indicates that there are 47 accredited non-domestic RHI installations in Horsham with a capacity of roughly 7 MW, and 274 domestic RHI installations. These may include heat pumps, solar thermal technologies, and technologies utilising biomass or biogas, but further details are not publicly available.[30] The RHI database does not provide a breakdown of installations for each Local Authority by technology type and installed capacity. However, by looking at the RHI data for the UK as a whole, in general terms it is observed that:

- The majority of non-domestic accredited installations are biomass boilers; a quarter use biomethane, and the remainder comprises a mixture of technologies, most notably combined heat and power (CHP) or ground source heat pumps.
- The majority of domestic accredited installations are air source heat pumps, with the remainder primarily split between ground source heat pumps, biomass boilers and solar thermal technologies.

3.25 Finally, our review found a water source heat pump (WSHP) installed in the District in 2013. An estate near Buckshead Hill installed a submerged 86 kW capacity WSHP to provide both heating and domestic hot water. The closed loop system draws heat from the lake situated on the grounds of the estate which feeds into five separate heat pumps to minimise cost of expensive insulated pipework. The system achieved a coefficient of performance (COP) of above 4 since being operational and exceeded predicted savings and RHI income.[31]

Large LZC Installations in Horsham

3.26 Table 3-5 lists the large-scale LZC installations recorded in the REPD (accessed September 2020).

Type		Site Name	MW	Status
Landfill Gas		Brookhurst Wood Gas to Energy	5.1	Operational
		Horton Landfill Site	2.0	Operational
		Broockhurst Wood	2.0	Operational
Aerobic Digestion		Brookhurst Wood (Waste AD)	4.5	Operational
Solar PV	Ground-mounted	Ford Farm (Ashurst)	10.0	Operational
		Priors Byne Farm	7.6	Operational
		Five Oaks Solar Farm	5.0	Operational
		Land at Five Oaks Farm	5.0	Operational
		Land at Christ's Hospital School	1.1	Operational
		Land off Hooklands Lane	5.0	Operational
		Brinsbury Campus Stane	0.2	Awaiting Construction
Energy from Waste (EfW)		Britania Crest Recycling	21.0	Awaiting Construction
Battery		King Barn Farm - Energy Barn	10.0	Operational

Table 3-5. Existing large scale LZC installations in Horsham. Source: REPD

[30] Source: BEIS Renewable Heat Incentive Monthly Deployment Statistics (June 2020), *'Table 2.4 - Number of accreditations by local authority'* and '*Table 2.6 - Average capacity and design SPF values'*.
[31] CIBSE, *'CP2: Surface Water Source Heat Pumps: Code of Practice for the UK'* (2016). Available at: https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q200000090NmPAAU

4. Potential Future Carbon Scenarios

4.1 This section provides an overview of our approach to carbon scenario modelling. Then, it presents an overview of the types of changes that might be expected to occur in coming years and that would have a significant impact on CO_2 emissions. The cumulative, quantitative impacts are then summarised in later in this section.

Modelling Approach

4.2 AECOM has carried out a high-level CO_2 modelling exercise to assess the potential scale and direction of impacts from a range of anticipated future trends. These include:

- New housing and employment space to be constructed
- National electricity grid decarbonisation
- Energy demand reduction e.g. through energy efficiency measures and behaviour change
- Switching from the use of gas-fired heating to electric systems e.g. heat pumps
- Reducing demand for transport and increasing use of ULEVs; and
- Uptake of LZC technologies.

4.3 The model assumes that, in a hypothetical 'Business as Usual' ('BAU') scenario, no actions are taken to reduce emissions, fuel consumption remains steady, and the only change in emissions is due to the increased energy use in new development. This is used as a baseline for understanding which future trends are likely to have the greatest impact. Based on information provided by HDC, we have modelled the consumption for 15,002 new dwellings, and a total increase in employment floorspace of 103,700 m^2 over the Local Plan period. The energy consumption and carbon emissions are distributed across the Local Plan period.

4.4 This assessment also provides an indication of the *residual* CO_2 emissions after all measures are adopted, which can be used to understand the scale of additional renewable energy generation, carbon offsetting or sequestration that would be required to meet the decarbonisation target.

4.5 It is important to note that these scenarios are *not* intended to predict actual fuel consumption or CO_2 emissions. However, the analysis is useful in as much as it highlights the potential scale and direction of different trends, which provides insight into key priorities and risks when considering pathways and component actions required to deliver the decarbonisation target.

4.6 Appendix A offers a more in-depth methodology of how the modelling was completed, including key inputs.

Overview of Future Trends

4.7 Note that this section discusses the impacts of different trends separately; cumulative impacts are described in Paragraph 4.30.

Impact of grid decarbonisation

4.8 Although the level of grid decarbonisation is uncertain, it is one of the most important variables that will determine whether the net zero target is achieved. This has both positive and negative implications. On one hand, if the BEIS decarbonisation scenario were to occur, District-wide emissions could decrease by up to 21% by 2050, compared with 2017 emissions, even if no other actions were taken. On the other hand, this presents a key risk, because it means that much of the reliance on achieving the net zero target will rely on factors outside of the Council's ability to influence.

4.9 To address and mitigate this risk, consideration must be given to how the Council can best facilitate the government's objectives in decarbonising the grid as well as what measures it can take to best insulate itself from the eventuality that grid decarbonisation does not happen as quickly and/or as deeply as the Government intends.[32]

Impacts of new development

4.10 If new development in Horsham between now and 2038 uses roughly the same amount of gas and electricity as existing buildings, if all other variables hold constant, this would result in a approximately 9% *increase* in District-wide CO_2 emissions over the Local Plan period (this trend would continue assuming that further housing and employment space is built up to 2050). Even if the new developments were built to meet the proposed Future Homes Standard, there would still be a small increase. Therefore, it will be vital to ensure that any new buildings are constructed or retrofitted to be capable of becoming net zero in operation[33] and incorporate low and zero carbon technologies as standard.

4.11 Note: This estimate is based on the amount of new development as set out in the Draft Local Plan and the Northern West Sussex EGA Update Final Report.[34] It is understood that these figures are subject to revision. However, the key point is that new development has a relatively small impact when compared to the scale of total emissions.

Reducing demands for electricity and heating

4.12 The demand reduction measures modelled in this report have relatively little impact when considered on their own, offering CO_2 emissions savings of approximately 4% compared with 2018 levels. In principle, it would be possible to achieve a greater reduction through a large-scale deep energy retrofitting initiative. Although this is a conservative estimate of the reduction in demand that could be achieved from a technical standpoint, the timescale and cost implications are extremely challenging and would require an ambitious programme of energy efficiency improvements.

4.13 One of the key obstacles would likely be the absence of a policy driver that requires energy efficiency upgrades to existing buildings. The Minimum Energy Efficiency Standards (MEES) regulations are intended to drive progressive improvements in the existing stock but the impact this will have is not yet clear. Therefore, it will be important to identify any potential sources of funding to implement this measure. Horsham District Council could also consider lobbying the Government to promote additional regulations in this area.

4.14 An important aspect to note is that within the model, conservative estimates of 10% heat demand and 5% electricity demand reductions respectively have been used for existing buildings. This is in line with reports[35] and research[36] projecting the likely reductions possible within the UK. If Horsham as a District is committed to reducing demand significantly, then the likelihood is that heat demand within existing buildings could be reduced by up to 75%[37]. This could be done through an effective and wide-ranging rollout of retrofitting the housing stock in Horsham.

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[32] Although there has been significant progress in this area in recent years, future decarbonisation is anticipated to be much more difficult to achieve. To date, this has been primarily achieved through the significant reduction in the use of coal fired power stations and the increase in the use of renewable technologies, particularly large-scale wind and biomass (where it is used for co-firing in power stations). However, the use of gas remains a significant component of the generation mix, and the timely replacement of the existing nuclear fleet is already proving to be challenging. Furthermore, significant additional pressures from the use of electricity to provide heating and power vehicles may incentivise power generation from fossil fuel sources to deal with greater peaks in demand.

[33] For more information, see https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings

[34] https://www.horsham.gov.uk/__data/assets/pdf_file/0007/79261/Northern-West-Sussex-Economic-Growth-Assessment-24.01.20.pdf

[35] NEED 2019 Report, Table 3. Typical savings following multiple energy efficiency measures suggests 12% reduction in heating is possible

[36] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48123/2135-behaviour-change-and-energy-use.pdf

[37] In line with EnerPhit Standards, a Passivhaus standard of retrofit

4.15 Electricity demand reduction would remain at 5% before taking into account fuel switching as the efficiencies of appliances improve.

Minimum Energy Efficiency Standards

Under the MEES regulations, as of 1st April 2018, any properties newly rented out in the private sector must have a minimum Energy Performance Certificate (EPC) rating of E (some exceptions apply). Fines will be applied for non-compliance.

Owners of buildings with a lower EPC rating will be required to implement energy efficiency measures, though consideration will be given to financial viability, the anticipated payback time and impacts on property value.

Over time, the Government intends to progressively increase the minimum EPC rating, meaning that buildings must become more efficient in order to be sold or rented. A recently published consultation covering non-domestic buildings proposed that the minimum rating should be raised to B by 2030, subject to actions meeting a seven-year payback test.

- BEIS, *'The Non-Domestic Private Sector Minimum Energy Efficiency Standards: The Future Trajectory to 2030'* (2019)

4.16 It is worth noting that there are important reasons other than CO_2 savings which support refurbishing the existing stock. Fabric and building services efficiency improvements can help to protect consumers against changes in fuel prices, mitigate fuel poverty and improve health, wellbeing and comfort, all of which are highly significant.

Phasing out natural gas

4.17 Unlike electricity, which can be generated from a range of renewable technologies, natural gas is a fossil fuel which unavoidably emits CO_2 during combustion. In order to meet the net zero target, it will therefore be crucial to phase out the use of gas, because the scale of investment that would be required to offset these emissions would be significant.

4.18 The two main options for achieving this, based on currently available technologies, are to (1) reduce the total demand for heat and (2) switch to using electric heating systems such as direct electric heating (DEH) or heat pumps[38]. Of these, heat pumps are the preferred option due to the lower running costs and smaller impact on the electrical grid.

4.19 This would have the effect of reducing the District's emissions by approximately 5%, depending on the technology used, assuming there is no change in the electricity grid emissions and, crucially, the homes that were using these technologies were energy efficient – i.e. there was a demand reduction. As the grid decarbonises, the savings would increase, so fuel switching (with necessary enabling works) could potentially result in up to a 20% decrease in emissions by 2038.

4.20 These new electric heating systems could be provided to individual buildings (which is standard) or as part of communal or district heat networks.[39] Our model assumes that a mix of technologies is used. Heat networks offer an opportunity to switch multiple buildings on to lower carbon heating systems and use larger and more complex technologies to deliver higher carbon savings with lower overall capital and operational costs than addressing each building separately. However, by virtue of being larger projects they can be more complex to deliver although the Government is providing technical support and funding through the Heat Network

[38] It may be possible to decarbonise the gas grid by injecting it with biomethane or hydrogen, but this would require a technological step-change and has therefore not been considered given the timeframe for the Councils to reach net zero.
[39] A heat network involves the centralised generation of heat to serve multiple buildings, which can enable the use of larger and more efficient equipment, thereby delivering higher carbon savings with lower capital and operational costs than solutions for each individual building. Although heat networks at present often utilise gas-fired Combined Heat and Power (CHP) systems, future heat networks will need to deliver low or zero carbon heat and therefore are likely to utilise large-scale heat pump technology or waste heat sources.

Delivery Unit and Heat Network Investment Programme to assist local authorities in delivering these projects.

Switching to ultra-low emission cars and vans

4.21 As mentioned in paragraph 3.15, there has been an increase in electric vehicle registrations in Horsham, and growth is expected to continue. It is estimated that the price of electric, hybrid and traditional fuel cars could converge within the next decade,[40] which would help to facilitate the shift towards sustainable transport. Switching to ULEVs would reduce total CO_2 emissions by approximately 31% if they were charged using current national grid electricity. The savings would increase as the electricity grid decarbonises, or if the vehicles were charged using 100% renewable energy – for instance, generated by PV on the roof of a Council-owned car park. In that instance, the savings could be up to 41% compared with 2018 CO_2 emissions.

4.22 Although switching to ULEVs will be an important part of reaching the decarbonisation target, even if this goal is achieved, it creates additional challenges. For instance, achieving the District-wide net zero target will depend more on the rate of national electricity grid decarbonisation. It will also present a broad-ranging challenge across all areas of electricity infrastructure.[41] Increasing LZC energy generation, the use of smart EV charging and, potentially, vehicle-to-grid systems could mitigate some of the effects on peak demand and help to alleviate some of this pressure.

4.23 A large-scale shift to the use of electric vehicles must also be accompanied by a significant modal shift towards walking, cycling, ridesharing, and an increase in the use of public transport. This is necessary to reduce electricity demand – with added benefits in terms of air quality and, potentially, improving people's health.

Reducing emissions from HGVs

4.24 At the time of writing, ultra-low emission HGVs are not widely commercially available and are not expected to become so in the next decade, barring a technological step-change. In the short-term the Government has suggested a target of reducing emissions from HGVs by 15% through efficiency measures such as driver training. Because HGVs represent a small portion of the total emissions in Horsham,[42] this would probably have a small (<1%) impact. (Note that conversion to hydrogen or electric HGVs is anticipated in the medium to long term.)

Increasing renewable electricity generation

4.25 As buildings and vehicles switch away from the use of fossil fuels and towards electricity, it becomes increasingly important to ensure that electricity is supplied from renewable sources. Reasons include:

- reducing pressure on grid infrastructure
- ensuring security of supply, and
- protecting consumers from rising electricity prices.

4.26 Section 6 describes potential opportunities for increasing the amount of LZC technologies in Horsham, considering key constraints, opportunities and challenges in more detail.

Offsetting residual emissions

4.27 At this stage, the scenario testing indicates that, even with the most optimistic assessment of grid decarbonisation, switching to low emission transport, and uptake of other efficiency measures and LZCs in buildings, there will be significant residual CO_2 emissions that would

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[40] Cambridge Econometrics and Element Energy, *'Fuelling Europe's Future: How the transition from oil strengthens the economy'* (2018). Available at: https://europeanclimate.org/wp-content/uploads/2018/02/FEF_transition.pdf
[41] National Grid, *'Future Energy Scenarios'* (2019). Available at: http://fes.nationalgrid.com/media/1409/fes-2019.pdf
[42] Although not reported separately in the BEIS CO_2 dataset, HGVs account for less than 10% of all fuel used for transportation. See BEIS, *'Sub-national road transport fuel consumption 2005-2017'* (published 2019). Available at: https://www.gov.uk/government/collections/road-transport-consumption-at-regional-and-local-level

require offsetting. To achieve net zero, it will become necessary to sequester, capture or store CO_2 in some form.

4.28 For context, to illustrate the scale of the challenge, offsetting just 5% of the District's 2018 CO_2 emissions would require the creation of roughly 80-85 km^2 of new woodland which would then have to be sustainable managed in the very long term (that is, hundreds of years) to ensure that the benefits are realised. This is clearly not feasible, which emphasises the need for a multi-pronged approach. Further work and consultation would be required to identify the most appropriate and cost-effective opportunities, but these might include tree planting or new woodland creation. The UK Woodland Carbon Code, for instance, provides a means of gaining certification for this type of project.[43]

Other opportunities to reduce emissions

4.29 The following technologies have not been included in the quantitative analysis above, but present further opportunities for Horsham to reach net zero emissions:

- **Smart energy management:** One of the key benefits of smart meters is by improving transparency and user access to their own energy data, making it easier to identify areas of waste. Although it is not clear to what extent this affects user behaviour in the long term, the improved data collection could also facilitate the introduction of demand side response, and on a broader scale, help to balance energy demand and supply, which is particularly important at peak times.[44] In principle, therefore, these have the potential to reduce energy consumption.
- **Battery storage:** There have been significant improvements in battery storage in recent years with implications for energy consumption across all sectors. Although batteries are likely to become crucial to future energy infrastructure, they do not offer CO_2e savings per se. Instead, they help to facilitate uptake of LZC technologies by moderating the intermittency of wind and solar energy generation. Combined with EV uptake and the introduction of vehicle-to-grid systems, this could have a transformative effect on the design of energy infrastructure and the built environment.
- **Carbon capture and storage:** At present, carbon capture and storage technologies have been deployed as pilot projects in the UK. Although these form part of the Government's *Clean Growth Strategy* (2017), at present there is insufficient evidence to provide a realistic estimate of their potential contribution towards the decarbonisation target.[45]

[43] https://www.woodlandcarboncode.org.uk/
[44] BEIS, 'Smart Meters and Demand Side Response' *https://www.gov.uk/government/publications/smart-meters-and-demand-side-response*
[45] For more information, see https://www.gov.uk/guidance/uk-carbon-capture-and-storage-government-funding-and-support

Potential Scale of Impact on CO_2 emissions

4.30 Figure 4-1 shows historic emissions for Horsham, along with a hypothetical 'Business as Usual' trajectory as described above. The other lines show the cumulative impact of sequentially adopting measures to:

1. Allowing Government building regulations to be implemented; and then
2. Reduce energy demands in buildings; and then
3. Switch from gas boilers to efficient electric heating systems; and then
4. Reduce vehicle mileage and switch from petrol and diesel vehicles to ULEV (electric or hydrogen) vehicles; and then
5. Install additional renewable energy technologies.

4.31 Cumulatively, these changes would, by 2050, result in approximately 68% less CO_2 emissions versus the 2018 baseline. For comparison, Figure 4-2 shows the same results, but this time also accounting for decarbonisation of the national electricity grid[46]. In this scenario, if all of the above measures were adopted, this would reduce total CO_2 emissions by up to 85% by 2050. This highlights how the impact of switching to electric heating systems and vehicles is highly dependent on whether or not they are supplied with low carbon, renewable electricity.

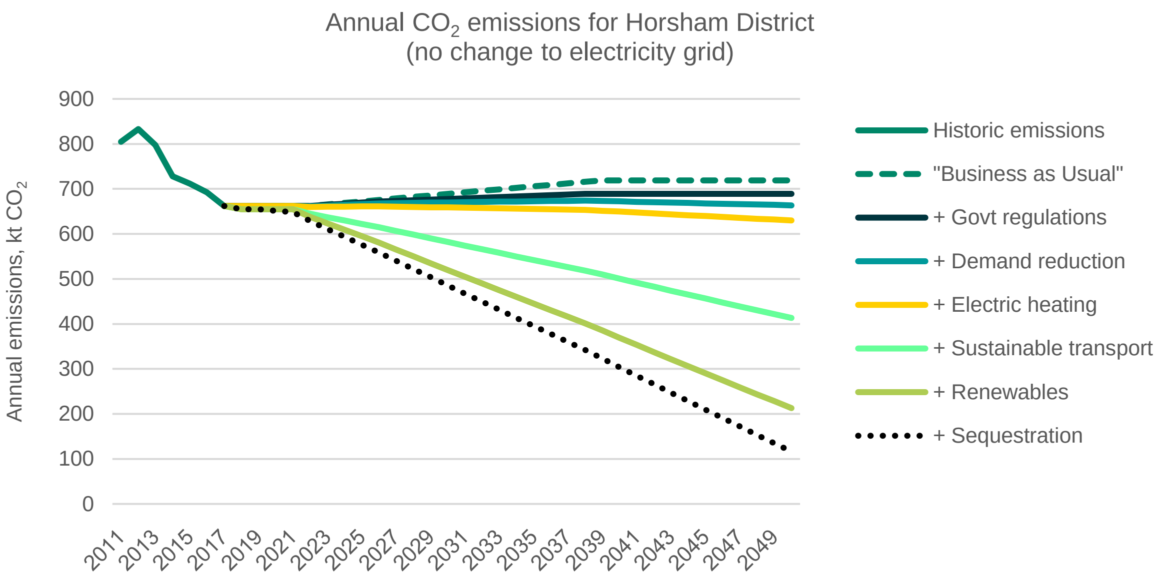


Figure 4-1. Annual CO_2 emissions scenarios for Horsham District, no change in the electricity grid

[46] *The decarbonisation of the Grid does not reflect any change in usage patterns within Horsham District, however from an emissions point of view, it helps with lowering the overall emissions of Horsham District. This is because for each kWh of electricity used within Horsham, far less $kgCO_2$ of emissions are being produced than the baseline $kgCO_2$ of previous electricity generation within the UK.*

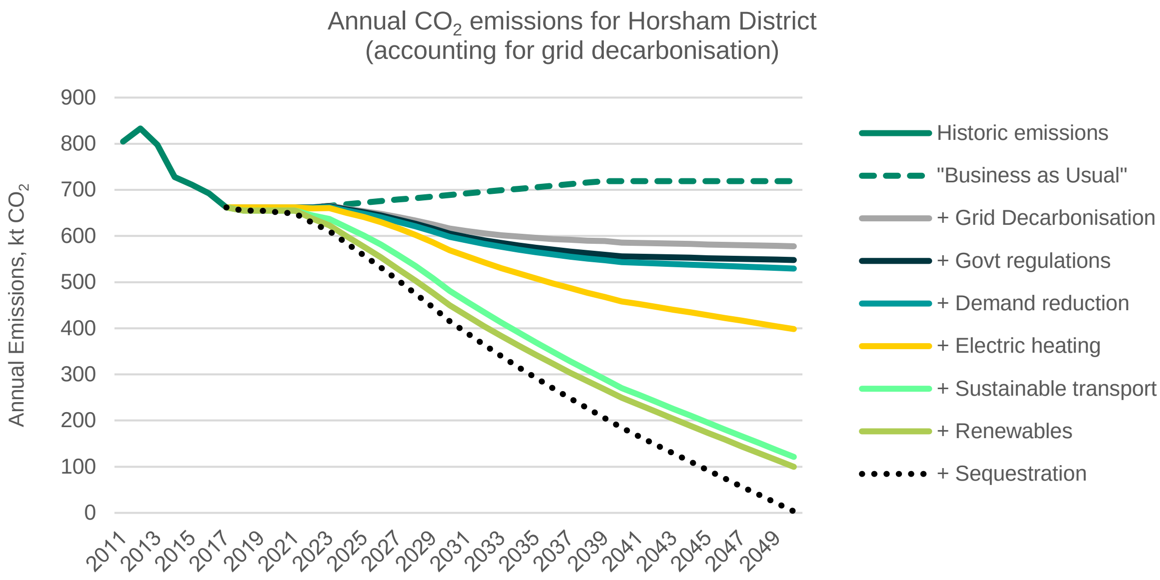


Figure 4-2. Annual CO_2 emissions scenarios for Horsham District, accounting for grid decarbonisation

4.32 In both scenarios, the residual emissions would need to be offset through additional measures such as provision of additional, local renewable energy, carbon sequestration via tree planting, and so on. However, as stated previously, the scale of offsetting required even in an optimistic scenario would require a significant amount of land and other resources and is clearly not practical. This emphasises the fact that demand reduction and energy efficiency measures must be prioritised.

4.33 The results of this analysis are summarised in Table 4-1.

By 2050…

Potential change in carbon emissions from these measures…	Without grid decarbonisation	With grid decarbonisation
New development		
New buildings constructed, no other changes	**+9%**	**-13%**
Demand reduction in buildings		
Reduce demand for electricity and heat…	**-4%**	**-20%**
… and switch to electric heating systems	**-17%**	**-40%**
Low carbon transport		
Mileage reduction, no other changes	**-5%**	**-5%**
… and switch to ULEVs (excludes HGVs)	**-33%**	**-42%**
Total reductions		
All measures implemented (excluding offsetting / renewables)	**-38%**	**-82%**
Residual emissions to be offset (ktCO_2 p.a.)	**413**	**121**

Table 4-1. Key findings of the CO_2 emissions scenario modelling

Key Points

4.34 Although CO_2 emissions have decreased in recent years, significant changes must take place across all sectors to achieve net zero emissions by 2050. Based on this analysis, the key priorities that should be addressed prior to offsetting or carbon sequestration are to:

1. Reduce the demand for heat *and* phase out the use of natural gas by switching to heat pumps; and
2. Reduce demand for transport *and* switch from petrol/diesel to ULEVs; and
3. Reduce all other energy demands, in part to minimise pressure on grid infrastructure; and
4. Meet any remaining energy demands with renewable electricity.

4.35 The decarbonisation of the Grid helps reduce the District's emissions overall by 44% provided that all the priorities (except for 4) above are fulfilled. This key factor is influenced heavily by the uptake in renewable energy generation across the UK, hence promoting and funding of renewables in Horsham, like other areas of the UK, is a critical part of reaching net-zero.

4.36 Sequestration is a last resort, as stated above, the scale of offsetting required even in an optimistic scenario would require a huge amount of land and other resources and is clearly not practical - emphasising the demand reduction and energy efficiency measures.

4.37 AECOM's model uses conservative estimates of 10% heat demand and 5% electricity demand reductions respectively have been used for existing buildings. Electricity demand reduction would remain low, prior to switching to electric heating systems, as efficiencies of appliances improve. However, If Horsham as a District is committed to reducing heat demand significantly through an effective retrofit scheme, emissions associated with existing buildings could be reduced significantly and this would help reduce the future increase in electricity demand associated with electric heating.

5. Policy Options

5.1 This section presents a high-level review of the sustainability-related policies that HDC is considering for inclusion in the new Local Plan, recognising that more detailed policy options are being assessed by CSE. It begins with a brief summary of the policy implications of the evidence presented in previous sections, and then outlines a range of suggestions for ways that HDC could potentially leverage its role as the local planning authority to deliver further benefits, whether through policy, a Supplementary Planning Document (SPD) on sustainability, or other means.

The Scale of the Challenge

5.2 To reach Net Zero emissions, it will be necessary to switch away from the use of fossil fuels such as natural gas, oil, coal and petrol, and instead utilise 100% renewable electricity wherever possible. Although it is understood that some energy will continue to be imported and exported, and that Horsham District will not be responsible for generating all of its own electricity locally, this would still require a step change in LZC energy deployment.

5.3 To understand the scale of this challenge, consider the following:

5.4 Annual electricity use in Horsham was 549.7 GWh in 2017. LZC technologies in the District currently generate approximately 108.4 GWh of renewable electricity annually, equivalent to 20% of electricity demand. Based on typical outputs for PV and onshore wind turbines,[47] meeting 100% of Horsham's net electricity 2017 demands using local renewable technologies[48] would require:

439 MW of PV, equivalent to solar farms totalling around 550 hectares (5.5 km^2) – just over 1% of the land area of Horsham or 219,500 2 kWp roofs installations at;

OR

204 MW of large-scale onshore wind, which could be delivered using 70-100 large turbines. Wind farms of this scale would require a land area of around 2,300 hectares (23 km^2), which is approximately 4% of the land area of Horsham, although they could be co-located with other agricultural uses.

5.5 On one hand, these figures are vast, but on the other hand our analysis has shown that there is theoretically enough resource within Horsham to deliver this scale of renewable electricity. Given that the UK has made a legal commitment to reaching Net Zero by 2050, the Council should assume that a significant shift will be inevitable and will need to account for this in target setting and policy development.

[47] BEIS, *'Digest of UK Energy Statistics (DUKES) 6.5: Load factors for renewable electricity generation'* (2019). Available at: https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

[48] Realistically, these figures under-estimate the amount of renewable electricity that will be needed; demand will increase over time due to factors such as the uptake of electric vehicles and electric heating systems. If accounting for fuel switching, the annual electricity usage in 2050 and beyond would be above 2 TWh. This would need approximately 1,650 MW of PV install (4% of land area in Horsham) or 990 MW of large-scale onshore wind (19% of land area in Horsham). This is only to illustrate the scale of energy usage within Horsham, in reality this would have to be generated outside the District.

5.6 On this basis, some of the key opportunities for HDC to respond to the climate emergency and do its part to mitigate climate change are to:

Set High Standards for Energy and CO_2 Performance in New and Existing Buildings

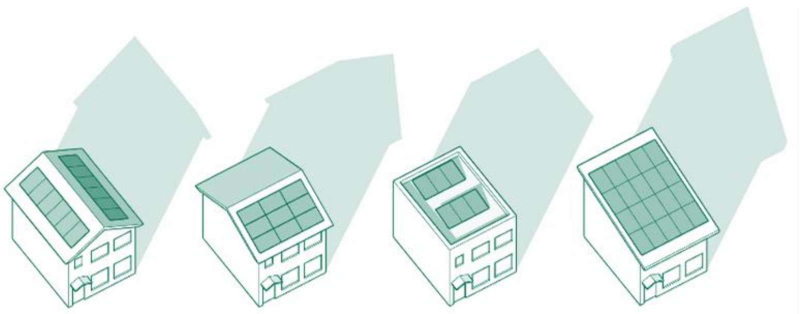
5.7 As demonstrated in Section 4, a switch towards renewable energy sources needs to be accompanied by a radical reduction in energy demands across all sectors in order for the UK to feasibly reach the 2050 target. Any increase in CO_2 emissions will make the target more difficult to achieve. Local planning authorities should therefore look to set the highest level of building performance standards for new buildings that can practically and viably be achieved and should do so as soon as possible. In addition, HDC will need to consider opportunities to improve the performance of the existing building stock, as this represents a high share of total emissions.

Require New Developments to Maximise Opportunities for Renewable Energy

5.8 A key step in being able to achieve Net Zero emissions across Horsham will be its ability to satisfy its heating, cooling and electricity needs through the use of renewable energy. In order to do this, it will be critical to increase the amount of decentralised and renewable energy technologies within the District. Providing on-site and decentralised energy systems can help to improve the resilience of the energy network and decrease pressures on grid infrastructure.

5.9 One way to do this, which has ample precedent within the UK planning system, would be to introduce a 'Merton Rule' that requires a certain proportion of energy demands to be met via renewable electricity generated onsite. (This is discussed more in the following section). If LZCs are not fitted at the outset, then inevitably they will need to be retrofitted, which is costly in terms of both money and CO_2 emissions. If this is unavoidable, then the development needs to be futureproofed to maximise opportunities in the future. The design and layout of new developments, and in particular the geometry and orientation of a building, can have a significant impact on the potential amount of renewable energy that can be generated on development sites. Therefore, guidance should be provided either within the Local Plan or SPD to advise applicants as to how they can achieve this.

The diagram below shows how the design of a building impacts both the amount of PV that can be installed (due to roof geometry) and the annual electricity that the PV can generate (due to orientation and tilt). In this *illustrative* example, the roof of House 4, which is designed to maximise PV output could generate nearly four times as much electricity per year as House 3, the worst-performing design.



	House 1	House 2	House 3	House 4
Description	Dual pitch	Dual pitch	Flat roof + parapet	Monopitch
Panel Orientation	East/West	South	South	South
Electricity (kWh p.a.)	2,190	1,910	1,150	4,080

How much of a building's energy demands can be met with PV?

Assuming that there will be roughly 103,700 m^2 of new employment space delivered in Horsham over the Local Plan period, it is possible to generate a rough estimate of the additional roof-mounted PV. If this was typically comprised of 4-storey offices, the building footprint would be around 10,000 m^2. Assuming that 3/8^{ths} of the roof area is suitable for PV, this would give 3,750 m^2 of roof space for PV, which could conservatively accommodate 375 kWp of PV. An array of this size could generate around 330-340 MWh of electricity per year. Best practice benchmarks for energy demand in commercial offices range from 50-100 kWh per m^2 of floorspace, so assuming energy demands of 2,250-4,500 MWh per year, the PV could feasibly deliver 10-15% of energy demands for new employment space. This would be higher if higher efficiency panels are used or if there is more space for panels, e.g. if the development is less dense or if PV canopies are added to car parks, or lower if the energy demands of the development exceed those benchmarks.

What percent of a building's energy demand can be met with roof-mounted PV?

		How many storeys?				
		1	2	3	4	5
Energy Efficiency	Typical practice	18%	9%	6%	5%	4%
	Good practice	25%	13%	8%	6%	5%
	Best practice	43%	21%	14%	11%	9%

Increase Support for Building-Integrated and Standalone LZC Developments that Meet Local Criteria for Acceptability, and Seek to Broaden those Criteria

5.10 Planning policy is one of the few ways that HDC can directly affect uptake of large-scale LZCs of the type that will be necessary in order to decarbonise the UK. In the long term, it may be appropriate to shift towards a presumption in favour of LZC developments that meet criteria for acceptability. In setting these criteria, HDC must carefully consider how to balance the decarbonisation agenda against the conservation agenda taking into account the unique character of the landscape.[49]

[49] It is worth noting that, while the authors of the 2009 LCA followed best practice guidance at the time, and acknowledged that, *'When considering the impact of renewable energy generation technologies on landscape character, it is important to recognise that climate change itself will result in changes to our landscapes,'* the report did not fully consider the potential impacts of climate change on the landscape. Therefore, the impact of visible renewable technologies was compared against a baseline situation where the landscape would otherwise remain the same. This is no longer considered realistic.

Draft Policies Under Consideration

5.11 The policies have been considered from the Regulation 19 Proposed Submission Local Plan, which AECOM has reviewed in order to comment how they further Horsham's commitment to sustainability. Further details of AECOM's analysis on the efficacy of policy are given in Section 7.

Policy title and brief description	Comments	Relevant / similar policies
Strategic Policy 36 – Climate change Requires developments to include both mitigation and adaptation measures that will 'contribute to achieving zero carbon by 2050'.	This is an important policy that conveys the importance of designing in ways that respond to climate change. It is set out in three parts: Carbon reduction, Climate Change Adaptation and sustainability statement. *Carbon Reduction:* This section overlaps with other policies, particularly Policy 38, which could lead to some repetition. It lays out a range of measures that the Council will support but does not set specific requirements that developments *must* adhere to. Includes recommended text referring to the need to minimise embodied carbon emissions by avoiding 'demolish and rebuild' where possible. *Climate Change Adaptation:* This policy addresses some of the most significant topics related to climate change adaptation in a holistic manner, namely overheating, flood risk and water efficiency. It includes the suggestion of orientation to maximise passive heating and ventilation strategies, as well as the use of nature-based solutions and landscaping for shade and drainage design. *Sustainability Statement:* This section outlines that developments will be supported provided a Sustainability Statement is submitted – demonstrating the measures taken to mitigate and adapt to the effects of climate change. **Policy discussion** The policy could potentially be strengthened by introducing more specific requirements such as: • Technical assessments – e.g. overheating risk assessments or completion of an 'Overheating Checklist'. There is also a free overheating risk evaluation tool produced by the Good Homes Alliance that all applicants could be encouraged to use (e.g. within an SPD).	Rugby Borough Council Local Plan (2019) Policy SDC4: Sustainable Buildings [50]

[50] Rugby Borough Council (2019) *Local Plan 2011-2031.* [online] Available at: https://www.rugby.gov.uk/downloads/file/2319/local_plan_2011-31

	It is understood that viability and enforcement may present a challenge so this could potentially only apply for major developments to reduce the impact on development managers' time. This policy, or the supporting text, could also address design measures that are currently not in common use but that could be permitted as a climate change adaptation measure. Examples include: • Allowing buildings to be constructed on stilts if there is a risk of flooding.	
Policy 37 – Appropriate Energy Use Establishes an energy hierarchy that developments must follow.	In order to reach net zero emissions by 2050 it will be necessarily to radically increase uptake of LZC technologies, which is what this policy seeks to promote. The policy has four sections, Energy Hierarchy, Zero and Low Carbon Heating, Energy Statements and Renewable energy Schemes *Energy Hierarchy:* This section details the energy hierarchy cascade which developments should follow to be supported – Be Lean, Be Clean and Be green. *Zero and Low Carbon Heating:* Development proposals are required to demonstrate how they will provide zero and low carbon heating according to a hierarchy of: a) Connection to current/planned local DH network, with on-site renewables b) Maximisation of renewables on site c) Use LZC heat supply *Energy Statements:* This section outlines the requirement of an Energy Statement demonstrating the residential or commercial development achieves policy compliance. The Energy Statement may be incorporated into the Sustainability Statement (Required in Policy 36) *Renewable Energy Schemes:* This section describes how stand-alone renewable energy schemes will be supported where they do not conflict with other policies the Local Plan.	Arun District Council Local Plan (2018) Policy ECC SP2: Energy and climate change mitigation [51] Greater London Authority Draft London Plan (2020) Policy SI2: Minimising greenhouse gas emissions[52] Milton Keynes Plan:MK (2019) Policy SC2: Community Energy Networks and Large-Scale Renewables[60] Nuneaton & Bedworth Borough Plan (2019) Policy BE2: Renewable and Low Carbon Energy [53] Central Lincolnshire Local Plan (2017) Policy LP19: Renewable Energy Proposals [54] Arun District Council Local Plan (2018) Policy ECC SP2: Energy and climate change mitigation Melton Local Plan (2018) Policy EN10:

[51] Arun District Council (2018) Local Plan. [online] Available at: https://www.arun.gov.uk/download.cfm?doc=docm93jijm4n12561.pdf&ver=12579
[52] Greater London Authority (2019) *Draft London Plan – Intend to Publish version.* [online] Available at: https://www.london.gov.uk/sites/default/files/intend_to_publish_-_clean.pdf
[53] Nuneaton & Bedworth Borough Council (2019) *Borough Plan 2011-2031.* [online] Available at: https://nuneatonbedworthboroughcouncil.sharefile.eu/d-s56969f3fadf4b108
[54] Central Lincolnshire Joint Strategic Planning Committee (2017) *Central Lincolnshire Local Plan*. [online] Available at: https://www.n-kesteven.gov.uk/central-lincolnshire/local-plan/

	Policy discussion This policy has opted to not require a 10% renewable energy supply. Although there is precedent for Local Authorities to adopt a 10% rule (known as a 'Merton Rule') in planning policy. However, it is worth noting that there is a significant difference in the amount of LZC technologies that would need to be deployed depending on how this 10% rule is defined.	Energy generation from renewable and low carbon sources [55] Wyre Local Plan (2019) Policy EP12: Renewable Energy [56]
Strategic Policy 38 – Sustainable Design and Construction New domestic buildings must meet Building Regulations Pt L 2013 via energy efficiency alone and deliver an additional minimum 10% improvement on the TER. Whilst an overall 35% improvement of the TER is targeted. Non-domestic development must achieve BREEAM 'Excellent' unless it renders the scheme unviable. New development must limit water use to 100L/p/d. New non-domestic buildings to achieve maximum credits for BREEAM Wat 01.	This policy would set high standards for domestic and non-domestic development which reflects the Councils' environmental aspirations. The policy is divided into four points on New Build, Retrofit, Retrofit of historic buildings and Sustainability Statements. *New Build requirements:* The first point in this policy outlines key requirements new-build developments must meet; a summary is as follows: a) New-build homes to deliver 35% overall reduction on DER against TER based on Part L 2013 with 10% coming from energy efficiency measures alone, and the residual reduction to be achieved through on-site renewables or connection to a heat network. b) New non-domestic buildings to achieve BREEAM rating 'Excellent' unless demonstrated this would make the scheme unviable c) New residential development to achieve 100L/person/day water efficiency, and 80L/person/day in developments of over 200 homes by including site-wide measures. d) Non-domestic to achieve maximum credits in BREEAM Wat 01 category. e) Use Circular Economy principles – minimise construction and demolition waste, use recycled or low-impact materials and reduce biodegradable waste sent to landfill.	Milton Keynes Plan:MK (2019) Policy SC1: Sustainable Construction – Energy and Climate[60] South Downs Local Plan (2019) Strategic Policy SD48: Climate Change & Sustainable Use of Resources[61] Arun District Council Local Plan (2018) Policy ECC SP2: Energy and climate change mitigation[62] Brighton and Hove City Council CPP1 (2016) Policy CP15: Heritage [63]

[55] Melton Borough Council (2018) *Melton Local Plan 2011-2036.* [online] Available at: https://www.meltonplan.co.uk/adoptedplan

[56] Wyre Council (2019) *Wyre Local Plan 2011-2031.* [online] Available at: https://www.wyre.gov.uk/downloads/file/5592/adopted_wyre_local_plan_2011-2031

[60] Milton Keynes Council (2019) *Plan:MK.* [online] Available at: https://www.miltonkeynes.gov.uk/assets/attach/59718/PlanMK%20Adoption%20Version%20(March%202019).pdf

[61] South Downs National Park Authority (2019) *South Downs Local Plan.* [online] Available at: https://www.southdowns.gov.uk/wpcontent/uploads/2019/07/SD_LocalPlan_2019_17Wb.pdf

[62] Arun District Council (2018) Local Plan. [online] Available at: https://www.arun.gov.uk/download.cfm?doc=docm93jijm4n12561.pdf&ver=12579

[63] Brighton and Hove City Council (2016) *City Plan Part 1.* [online] Available at: https://www.brighton-hove.gov.uk/content/planning/planning-policy/city-plan-part-one

Retrofitting of an existing historic building (heritage asset) will be supported.	f) Also design for flexibility, future modification of use or layout and retrofit/ refurbishment. g) Include high-speed broadband and enable provision of future communication technologies. *Retrofit:* Horsham District Council will support retrofitting measures in principle. *Retrofit of historic buildings:* Retrofitting of historic buildings will be supported provided that: a) it does not result in detriment to the significance of the asset or damage to its fabric b) a whole building approach to improving energy efficiency is taken; c) Micro-renewables do not result in harm to the heritage asset or their settings; and d) Where the proposal involves major development, it is demonstrated that opportunities for the retention and retrofitting of existing historic buildings within the site boundary have been included *Sustainability Statements:* Proposals should be accompanied by Sustainability Statements to demonstrate how measures will be incorporated into the development's design in order to meet compliance. **Policy discussion** *Domestic development:* Government guidance published in March 2019 states that local planning authorities can set energy performance standards for dwelling 'only up to the equivalent of the Level 4 of the Code for Sustainable Homes', which is equivalent to a roughly 19-20% improvement on Part L 2013.[57] There is ample precedent for this target to be adopted in Local Plans,[58] but even though from a climate change perspective a more ambitious target would be preferable. (More information about the viability implications of these options can be found in the UK-GBC Policy Playbook and the Future Homes Standard Impact Assessment.)

[57] https://www.gov.uk/guidance/climate-change
[58] UK Green Building Council, *'The Policy Playbook'* (2020). Available at: https://www.ukgbc.org/wp-content/uploads/2020/03/The-Policy-Playbook-v.1.5-March-2020.pdf

A key challenge is also the fact that the target is set in relation to Part L 2013 which is due to be updated in the next year. HDC will therefore need to include wording that addresses this. For an example, see the GLA 'Intend to Publish – New London Plan'.

Non-Domestic Development:

The BREEAM framework is a useful way of addressing sustainability topics from a holistic perspective. As a third-party assessment procedure, it also minimises the resources required for the local planning authority to evaluate submissions.

Our team's experience of reading and responding to Local Plan documents suggests that, where BREEAM requirements are set, this is typically only a requirement for major development because of the costs of undertaking the assessment in the first place. The policy wording should potentially be updated to clarify that, if viability is an issue, developments may not be required to seek a rating.

BREEAM has developed a variety of resources aimed at planning practitioners to assist in setting appropriate Local Plan targets, including sample policy wording and information about which rating levels can be achieved.[59]

Water efficiency:

In general, the cost of water efficient sanitary fittings is similar to that of conventional ones so this target should be achievable. There may be an opportunity to promote additional water saving measures. Options could include:

- Requiring all development that includes a landscaping component to include rainwater collection for use in irrigation. At minimum this could include rainwater butts fitted to downpipes which are cheaply available.
- For development that includes standalone outdoor toilet facilities (e.g. parks), encouraging applicants to consider the use of composting / non-water toilets.

Other sustainability topics:

Where relevant, HDC could consider setting minimum credit requirements in BREEAM that address the other sustainability topic areas in points (e) through (g) of the draft policy wording.

[59] For more information, see https://www.breeam.com/engage/research-and-development/consultation-engagement/local-government/

Strategic Policy 41 – Sustainable Transport Home working is considered in design Maximise layout to safely and conveniently walk / cycle on a day-to-day basis Integrate pedestrian routes within the existing and wider network Requires a transport assessment or statement for major developments	This policy highlights the need to integrate and expand walking and cycling infrastructure within developments to promote healthier modes of transport. Horsham District Council are encouraging public transport links as a means of mass-transit, whilst looking to reduce private car mileage.	
Policy 42 – Parking Requires all development to incorporate charging infrastructure for ULEVs, including passive provision for connection in future. Requires safe overnight storage facilities for bicycles. 20% of communal off-street parking must have active charging facilities. Additional or replacement airport related parking will not be permitted.	Given that transport accounts for a high proportion of total emissions in Horsham, but is typically not within the remit of the local planning authority to address, this policy will help to ensure that new development facilitates the switch towards low emissions transport. The policy could potentially include some reference to the benefits of co-locating renewable electricity technologies and / or battery storage with charging facilities, e.g. encouraging the use of solar canopies above parking lots.	South Downs Local Plan (2019) Policy SD22: Parking Provision [61] Nuneaton & Bedworth Borough Plan (2019) Policy HS2:Strategic accessibility and sustainable transport[64]

[64] https://ftpes.nuneatonandbedworth.gov.uk/planning/BoroughPlanFINAL12619.pdf

Other Opportunities to Deliver Greater Benefits

Renewable Energy

5.12 In addition to updating Local Plan policies related to LZC provision, there are several ways that HDC could promote uptake. These include:

- Lobby and support Government to review Permitted Development rights regarding PV and other renewable technologies to assess whether restrictions can be loosened without compromising broader policy aims / requirements.
  - For smaller-scale or building-integrated installations, consider removing the need for a full planning application e.g. offering a self-certification route.
  - For larger-scale or standalone installations, consider issuing Local Development Orders (LDOs) that would extend permitted development rights for certain LZC technologies and / or certain sites, removing the need for a full planning application. This is the approach that has been taken by Swindon Borough Council (see case study[65]).
- Issuing a 'call for sites' for large-scale LZCs as for other development sites.
- Working with community groups (e.g. Solar Together Sussex) to deliver local energy projects e.g. on schools and public buildings.
- Reviewing any local fuel poverty initiatives or subsidy schemes, **particularly if there are any aimed at replacing gas boilers**, to ensure that these offer solutions that are compatible with the Net Zero target.
- Undertaking surveys to better understand opportunities to incorporate LZCs within existing built infrastructure, such as PV or wind turbines on industrial sites and car parks.
- Undertaking mapping to determine sites where wind turbines would be an acceptable development, fulfilling the requirement set by HCWS42[66] which states that wind turbines will only be granted planning permission if the site is within an area identified as suitable for wind energy development in a local plan.

Offsetting

5.13 As the rest of the UK looks to decarbonise their activities, Horsham District Council could investigate the efficacy of a carbon offsetting fund. This would involve setting a price per tCO_2 emitted by new development, the payment would be made to cover the remaining balance over a set lifetime of any development which fails to meet the Council's emissions reduction target. The Greater London Authority (GLA) has suggested a carbon price at £95/tCO_2 for a 30-year lifetime of new build be imposed by London councils.

5.14 With the funds accrued, Horsham District Council would be able to fund projects aimed at reducing the carbon emissions associated with the district. Examples of projects include:

- Afforestation
- rewilding
- funding renewable energy generation
- funding local retrofit schemes
- funding for cleaner transport modes.

Evaluation and monitoring

5.15 As with all targets being set, evaluation and monitoring of progress is vital to understand the success of a policy. The GLA provide a final level of their 'Energy Hierarchy' called 'Be Seen',

[65] https://www.swindon.gov.uk/info/20113/local_plan_and_planning_policy/648/local_development_orders/2
[66] https://www.parliament.uk/globalassets/documents/commons-vote-office/June-2015/18-June/1-DCLG-Planning.pdf

where a development commits to reporting their energy demands for a period of time post-completion. This could be done similarly in Horsham if the Council wants to measure how on-track the District is in reaching its emissions reduction target from new domestic and non-domestic property.

5.16 Monitoring energy demand in homes by smart meter is a requirement for new homes, this automatically collects data on fuel consumption for the household and their energy supplier. By allowing an interface with the occupant, a behavioural shift can also be encouraged – reducing energy bills and CO_2 emissions in the process.

Key Points

5.17 Having assessed the key policies within Horsham's draft Local Plan 2021-2038 AECOM has identified the ones which will have a direct effect on reducing the carbon emission within the district. These are set out in Section 7. Horsham District Council has taken on recommendations from AECOM for the inclusion of Energy and Sustainability Statements which will encourage good practice for new build.

5.18 Whilst these policies are in line with the National effort to decarbonise the UK, AECOM believes there are further opportunities within the District to promote renewable technologies – which have been listed for Horsham District Council's consideration.

6. Renewable Energy Assessment

Scope and Methodology

6.1 The Government acknowledges[67] that, *'there are no hard and fast rules about how suitable areas for renewable energy should be identified'* when developing an evidence base for local planning policies. To assess future opportunities to deliver low and zero carbon (LZC) energy technologies in Horsham, we have undertaken a review and validation of previous analytical work carried out by the Centre for Sustainable Energy (CSE) in 2009, the 'West Sussex Sustainable Energy Study'. Where relevant, we have sought to update or supplement those earlier findings to reflect changes that have taken place since 2009, including policy and technological developments.

6.2 Our assessment has considered the following technologies:

- Wind turbines
- Solar photovoltaics (PV) roof-mounted and ground-mounted
- Ground, air and water source heat pumps (GSHPs, ASHPs and WSHPs) – *Note that, although these do not generate renewable electricity or fuel, they can reduce CO_2 emissions by lowering primary energy demands and facilitating a switch towards less carbon-intensive fuels.*
- Hydroelectric power
- Energy from waste (EfW)
- Biogas (landfill and sewage gas)
- Biomass
- Heat networks – *As with heat pumps, this technology does not necessarily provide renewable electricity or heat but can offer greater efficiencies and facilitate a shift towards LZC heat sources where available.*

6.3 Technologies that are not relevant to the geographic context of Horsham, such as tidal power, have been excluded from this analysis. Emerging technologies such as hydrogen fuel cells are also excluded due to uncertainty associated with their performance and limited information about practical constraints; however, both hydrogen and battery technologies are discussed from a qualitative perspective.

[67] Department for Communities and Local Government, *'Planning practice guidance for renewable and low carbon energy'* (2013). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/225689/Planning_Practice_Guidance_for_Renewable_and_Low_Carbon_Energy.pdf

6.4 Our methodology broadly follows the 'Renewable and Low-Carbon Energy Capacity Methodology' published in 2010 by the former Department of Energy and Climate Change (DECC).[68] This involves estimating the total naturally available energy resource in a given geographic area, which is narrowed down sequentially based on technical constraints, physical constraints, and planning or regulatory constraints, as illustrated in Figure 6-1 below. For each technology, consideration has been given to the physical availability of renewable sources, along with technical and regulatory constraints and other practical considerations. Where possible, an indicative quantitative estimate of capacity is provided.

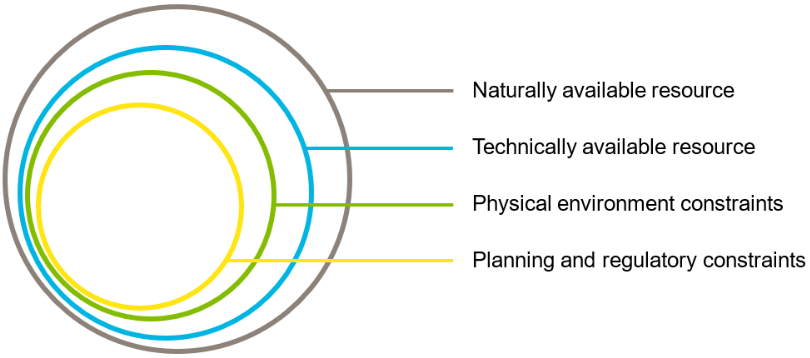


Figure 6-1. Sequential approach to assessing LZC opportunities, based on DECC (2010)

6.5 It is important to understand that not all opportunities will be captured using an area-wide assessment technique. In locations where constraints are identified, it may be possible to remove or mitigate these through careful design and planning. Conversely, there may be practical barriers or other reasons why LZC development would be difficult even in areas that are identified as being 'less constrained'.

Estimate of Future Provision

6.6 Table 6-1 summarises the theoretical future LZC opportunities in Horsham. Unless otherwise stated, results are reported in units of megawatts (MW) of electrical power capacity and megawatt hours (MWh) of energy.

6.7 Note that these estimates are based on the *current* technical performance of each technology and do not account for anticipated technological changes (e.g. efficiency improvements). These estimates also do not consider the available capacity of the electrical power network which could be a major barrier to deployment.

Technology	Theoretical future added capacity (MW)	Theoretical future added generation (MWh p.a.)	Reference
Large- and medium -scale wind	Up to 266	Up to 541,000	CSE (2009)
Small-scale wind	Up to 25	Up to 21,600	CSE (2009)
Building-mounted PV	72.8	73,304	AECOM estimate based on DECC methodology and satellite images; see Appendix B.2
Domestic buildings	31.5	31,712	
Commercial buildings	9.0	9,080	
Industrial buildings	8.3	8,305	
New dwellings	24.0	24,177	

[68] DECC, *'Renewable and low carbon energy capacity methodology'* (2010). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/226175/renewable_and_low_carbon_energy_capacity_methodology_jan2010.pdf

<table>
<tr><th>Technology</th><th>Theoretical future added capacity (MW)</th><th>Theoretical future added generation (MWh p.a.)</th><th>Reference</th></tr>
<tr><td>Large-scale PV</td><td>Up to 970
(see notes)</td><td>Up to 976,000
(see notes)</td><td>AECOM estimate based on unconstrained land areas set out in the CSE (2009) study</td></tr>
<tr><td>ASHPs</td><td rowspan="2">Potential to retrofit most existing buildings and all new buildings</td><td rowspan="2">n/a</td><td rowspan="3">AECOM estimate based on DECC methodology; see Appendix B.1</td></tr>
<tr><td>GSHPs</td></tr>
<tr><td>WSHPs</td><td>Not quantified</td><td>n/a</td></tr>
<tr><td>Hydro power</td><td>No sites identified</td><td>0</td><td>For details see later in section</td></tr>
<tr><td>Energy from Waste</td><td>21</td><td>Unknown</td><td>Renewable Energy Planning Database (REPD) records</td></tr>
<tr><td>Biogas (Landfill and Sewage), District Heat Networks, Hydrogen and Battery Storage</td><td>Not quantified</td><td>Not quantified</td><td>For details see later in section</td></tr>
</table>

Table 6-1. Potential future LZC opportunities in Horsham

6.8 Further details about the assumptions used to develop these estimates are provided in the following sections.

Wind

Large and Medium-Scale Wind Energy

6.9 From a purely technical perspective, there is considerable potential for wind energy across the District. The 2009 West Sussex Renewable Energy Study found that there could be up to 266 MW of large- and medium-scale[69] wind energy resource in Horsham District, which in combination could provide up to 541 GWh of electricity per year. For context, this would be equivalent to 98% of Horsham's total electricity consumption in 2017.

6.10 However, opportunities are significantly constrained by the presence of the High Weald AONB and South Downs National Park. In addition, large portions of the District are considered highly sensitive to large- and medium-scale turbines.[70] When these factors are taken into account, the 2009 study estimated that there would be as little as 1 MW of large-scale wind capacity (i.e. one large turbine) plus roughly 36 MW of medium-scale wind capacity.

6.11 Government guidance does not necessarily prohibit wind energy development in AONBs, National Parks, and other sensitive landscapes, but in practice such proposals are unlikely to receive support from either the local planning authority or the local community. The actual amount of wind energy development that is possible within Horsham District therefore depends on how they choose to balance these different environmental priorities, and how this is reflected in Local or Neighbourhood Plans.

6.12 Recognising the scale of the challenge that the UK faces if it is to achieve net zero emissions by 2050, these issues must be considered carefully going forward. Our assessment echoes that of the 2009 study authors who found that, *'Due to the potential impact on landscape character, a strategy to accept landscape character change in some areas may be needed if large/medium scale wind is to significantly contribute to renewable electricity generation in the study area.'*

[69] While definitions vary, the 2009 Renewable Energy Study was based on 'large-scale' turbines of approx. 2MW capacity and 80m hub height, 'medium-scale' turbines of approx. 300kW capacity and 44m hub height, and 'small-scale' turbines of approx. 15kW capacity and 15m hub height.
[70] Land Use Consultants Ltd., *'Landscape Sensitivity Analysis & Guidance for West Sussex Low Carbon Study'* (2009). Available at: https://www.midsussex.gov.uk/media/3243/ep51_landscapesensitivitylowcarbonstudy.pdf

6.13 Key constraints relevant to wind energy are listed below.

- **Wind speed:** In order to assess the technical wind resource on an area-wide basis, it is useful to establish a minimum threshold for average annual wind speed, which will vary depending on the size and type of turbine in question. As a general rule, DECC (2010) suggests a threshold of 5 m/s at 45m above ground level for large-scale wind turbines.[71]
- **Physical constraints:** Examples include roads, railways, waterways, built-up areas, airports, MOD training sites, etc. For safety reasons, a buffer should be applied around roads, railways, and buildings, although the size of the buffer depends on the size of the turbine. DECC (2010) indicates that a 600m buffer zone around built-up areas (not individual buildings) is appropriate.
- **Designated areas:** Nationally and internationally recognised landscape and nature conservation designations e.g. Areas of Outstanding Natural Beauty, National Parks, Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA), Special Areas of Conservation (SAC), and Ramsar wetland sites.
- **Other environmental constraints:** These include woodland, sites of historic interest (e.g. scheduled monuments), local or national nature reserves, parks and gardens.

6.14 From a practical perspective, there are other considerations such as gaining sufficient access to the site and the ability to connect to power infrastructure. Proximity to buildings needs to be taken into account to avoid the risk of visual or amenity disturbance which can occur due to shadow flicker and noise; however, these issues are highly dependent on site conditions (for instance, a building that falls within a ‘rule of thumb’ buffer zone could be shielded by nearby hedges or other landscape features.

6.15 Figure 6-2 shows key constraints to large- and medium-scale wind energy development for Horsham, based on the DECC (2010) methodology. As stated above, the majority of these are not considered ‘absolute’ constraints and it is recommended that HDC should adopt a policy approach that is relatively flexible to support wind energy proposals that meet certain criteria for acceptability.

[71] The 2009 study used a threshold of 6 m/s for large- and medium-scale turbines/ However, the NOABL Wind Map (which provides an estimate of wind speeds at a 1km grid resolution) indicates that there are few areas in Horsham with wind speeds below 5.8 m/s so this makes relatively little difference.

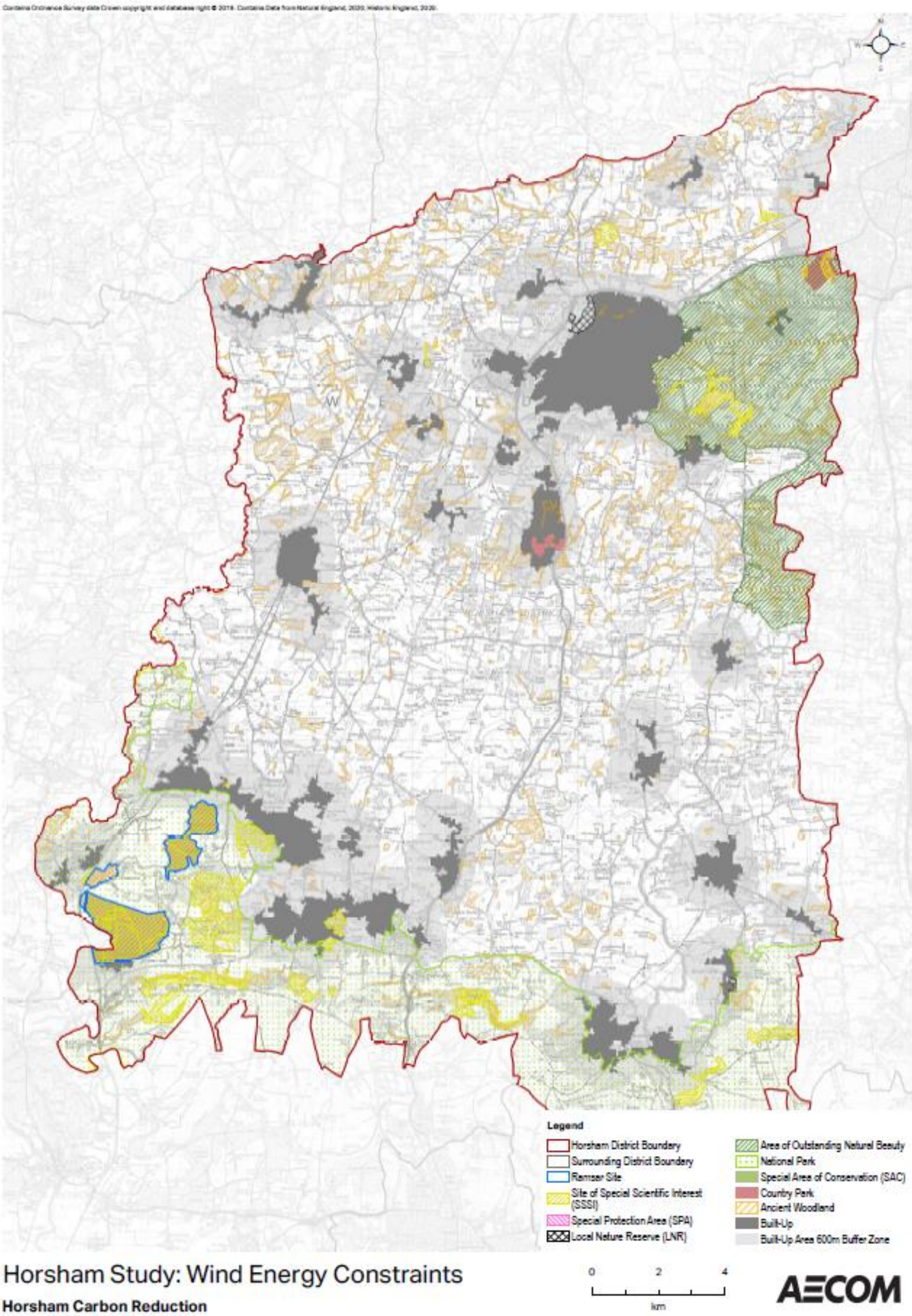


Figure 6-2. Wind Energy Constraints map

Small-Scale Wind Energy

6.16 Regarding small-scale wind turbines, in the 2009 Renewable Energy Study, *'no areas were identified as being highly sensitive to small scale wind development'*. These turbines can be installed on or near buildings, although they tend not to perform very well in urban areas where there is more disruption to wind flow.[72] Therefore, it is usually assumed that these will be more suitable for rural locations where there are fewer obstacles and wind speeds are higher. They may also be suitable for industrial sites and business parks where there is less concern about visual impact.

6.17 It is worth noting that, due to their lower output, small-scale turbines are significantly more expensive than large-scale turbines in terms of cost per unit of electricity. Furthermore, it would take dozens of smaller turbines to match the output of a single large-scale turbine, which would result in cumulative impacts. For these reasons, if wind energy is planned within Horsham, it may be preferable to install fewer, larger turbines.

Solar technologies

Roof-Mounted PV and Solar Water Heating

6.18 Both building mounted solar PV and solar water heating (SWH) depend largely on two site-specific factors: available roof space, and the solar exposure of the roof area (which relates to orientation, pitch, overshading, etc). SWH systems are typically sized to meet a certain proportion of annual hot water demand, since the heat is used on site.[73] PV can be sized more flexibly, subject to the amount of available roof space, since electricity can be stored using batteries or exported to the grid.

6.19 From a planning perspective, the main considerations for roof-mounted solar technologies are due to the visual impacts and potential 'modernising effect' they may have. Therefore, their use is often restricted in sensitive locations such as Conservation Areas and Areas of Outstanding Natural Beauty (AONBs) – such as South Downs National Park and High Weald AONB. However, these are policy constraints rather than technical barriers, and the impact can be minimised depending on factors such as whether they can be seen from the street and the size of the installation relative to the roof area.

6.20 Although roof-mounted PV is not the cheapest way to generate renewable electricity, it should be understood as a key opportunity for Horsham District, both because it arguably has a smaller visual impact on the wider landscape than large-scale PV or wind turbines, and because the total amount of roof space, considered cumulatively, is relatively large. Our estimates suggest that it would be possible to install up to 49 MW of roof-mounted PV on existing buildings and an additional 24 MW on new dwellings projected to be built during the Local Plan period.

6.21 The following types of sites may provide better opportunities to deliver roof-mounted solar technologies:

- In general, greenfield and large new development sites may offer greater potential for solar energy generation; the relative lack of design constraints provides more opportunities to maximise sustainable design measures from the outset.
- Similarly, industrial sites may be more suited to solar technologies as they tend to have large roof areas and there is generally less concern about the visual impacts of solar panels.

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[72] DECC (2010) assumes that small scale turbines can in principle be located at any address point where the wind speed meets or exceeds 4.5 m/s at 10 m above ground level. In practice, site specific constraints vary considerably and include building height, roof shape, neighbouring buildings and other physical obstacles. These have a significant impact on viability because the power output varies cubically with relation to wind speed.

[73] For context, in domestic properties a typical SHW system size would be 4-5 m^2 according to the Energy Saving Trust; the system would not be compatible with combi boilers if there is no hot water tank. See https://energysavingtrust.org.uk/renewable-energy/heat/solar-water-heating

- Schools, hospitals, leisure centres and other public sector buildings are often relatively large and can be suitable for community energy projects; these may be easier for the Council to influence compared with private commercial and industrial buildings.
- Another key opportunity would be to install PV canopies on structures such as car parks. If co-located with battery storage and EV chargepoints, this would provide a local source of renewable electricity while also helping to decarbonise transport.

Large-Scale / Ground-mounted PV

6.22 In principle, PV can be delivered anywhere where there is a suitable surface with adequate solar access (i.e. minimal overshading and favourable orientation and pitch). Due to its southern location, the output from PV in Horsham is relatively high compared with higher latitudes in the UK (see Figure 6-3), which could make solar farms more financially attractive.

6.23 As with building-mounted PV, from a planning perspective, visual impact is generally the key issue with large-scale PV, so key constraints in Horsham would be the AONB and National Park. Solar farms also have significant spatial requirements, which raises the issue of competing land uses.[74] Therefore, the Government has recommended that priority should be given to installations on brownfield sites and lower grade agricultural land – or, alternatively, that PV should be incorporated into the existing built environment (e.g. on the roofs of commercial and industrial buildings).[75]

6.24 Another option would be to utilise land that would be unsuitable or challenging to use for either agriculture or new development, such as historic landfill sites or disused quarries.

6.25 DECC (2010) does not set out criteria for large-scale ground-mounted PV farms. However, the 2009 Renewable Energy Study provided estimates of the amount of land area (in hectares) that would be suitable for large- and medium-scale wind energy development, which accounted for landscape sensitivity. Using rules of thumb, it is possible to make an estimate of the potential capacity and output if these areas were used for PV farms instead.

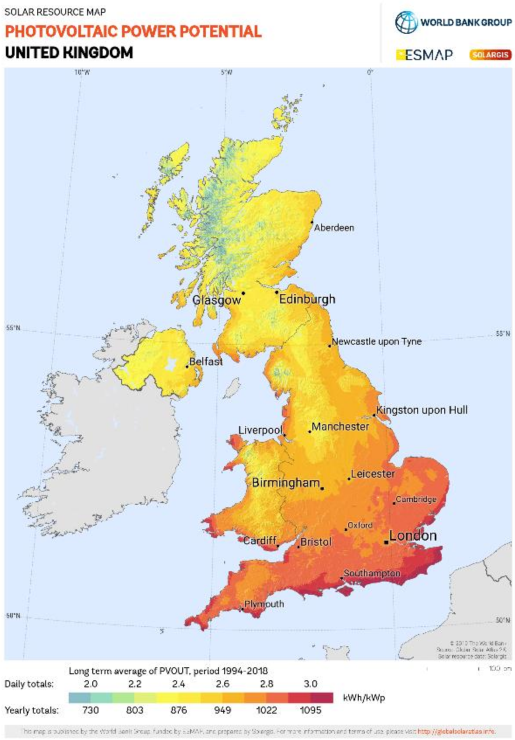

Figure 6-3. Long-term annual PV output in the UK. *Source: https://solargis.com/maps-and-gis-data/download/united-kingdom*

6.26 Across Horsham District there is roughly 12 km^2 of land that is unconstrained by proximity to urban areas, infrastructure, designated areas and areas of high landscape sensitivity. Although this is a small proportion of the total, if all of this was used for PV, it would be enough to deliver up to 970 MW of solar farm, with the potential to generate over 976 GWh of renewable electricity per year, equivalent to more than 178% of the District's 2017 electricity demands.[76]

6.27 In practice, not all of this would be delivered, and the infrastructure upgrades to support installations of this scale would be vast. However, it demonstrates that there is a considerable solar resource within Horsham District. Given that solar farms are among of the most cost-effective ways of generating renewable electricity, and can be installed more flexibly than many

[74] Empirical data suggests that c.0.8-1.0 MW of PV capacity can be accommodated per hectare of solar farm.
[75] In the Written Ministerial Statement HCWS488, published in 2015, the Government emphasises the need to protect the natural environment while avoiding competition for use of the 'best and most versatile agricultural land'. For further details, see https://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2015-03-25/HCWS488/
[76] Based on the PV farm spatial requirements listed previously, and typical output figures for Horsham taken from BEIS RRS.

other LZC technologies, this should be considered a key opportunity that can provide renewable energy for Horsham at a strategic scale.[77]

General Comments

6.28 Figure 6-4 shows key constraints for both roof- and ground-mounted solar technologies. Then, Figure 6-5 highlights some key opportunity areas for roof- and ground-mounted PV, which include (but are not limited to) built-up areas, industrial sites, and historic landfills.

[77] International Renewable Energy Agency, *'Renewable Power Generation Costs in 2018'* (2018). Available at: https://www.irena.org/publications/2019/May/Renewable-power-generation-costs-in-2018

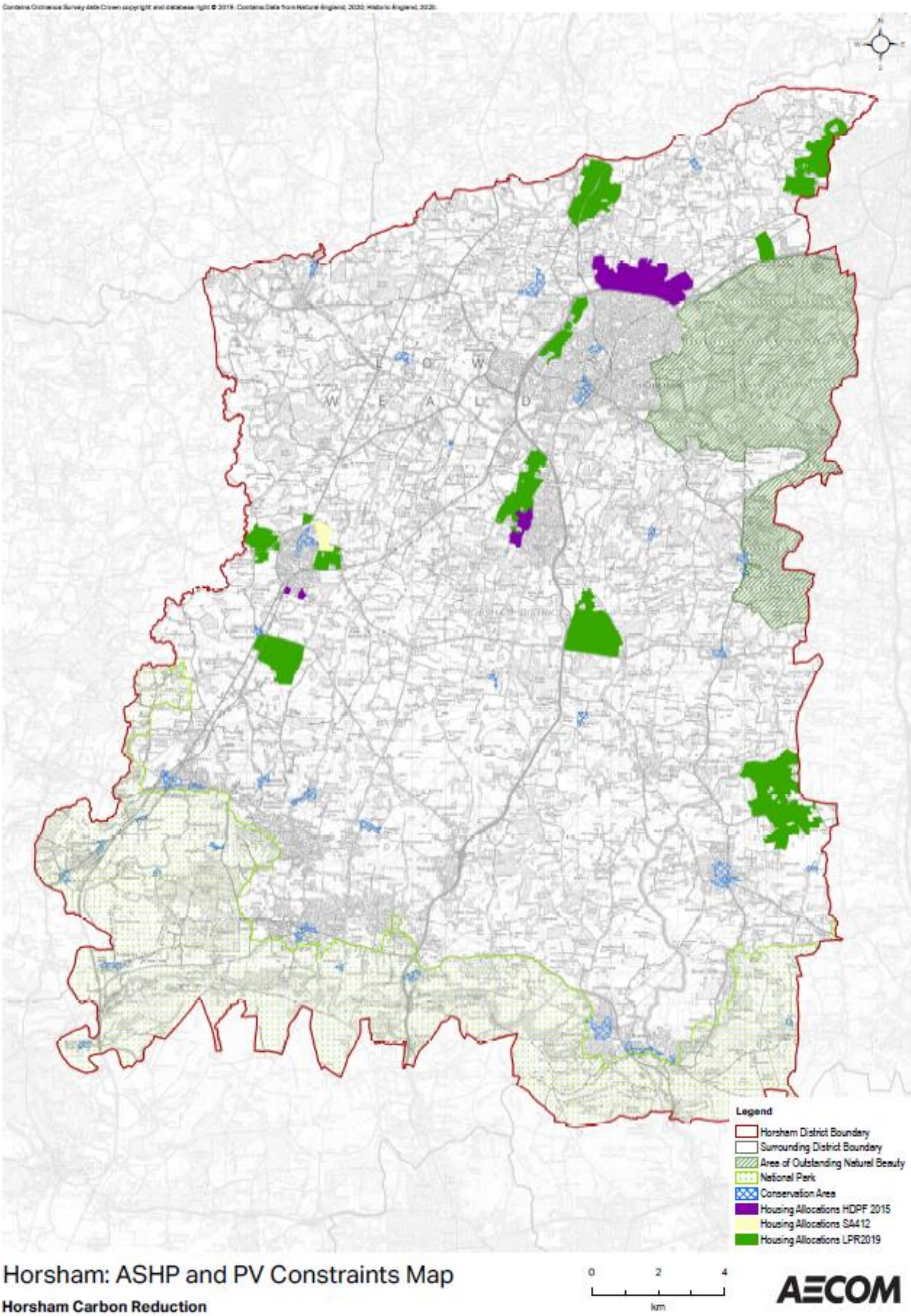

Figure 6-4. ASHP and PV Constraints map (also showing potential new development sites)

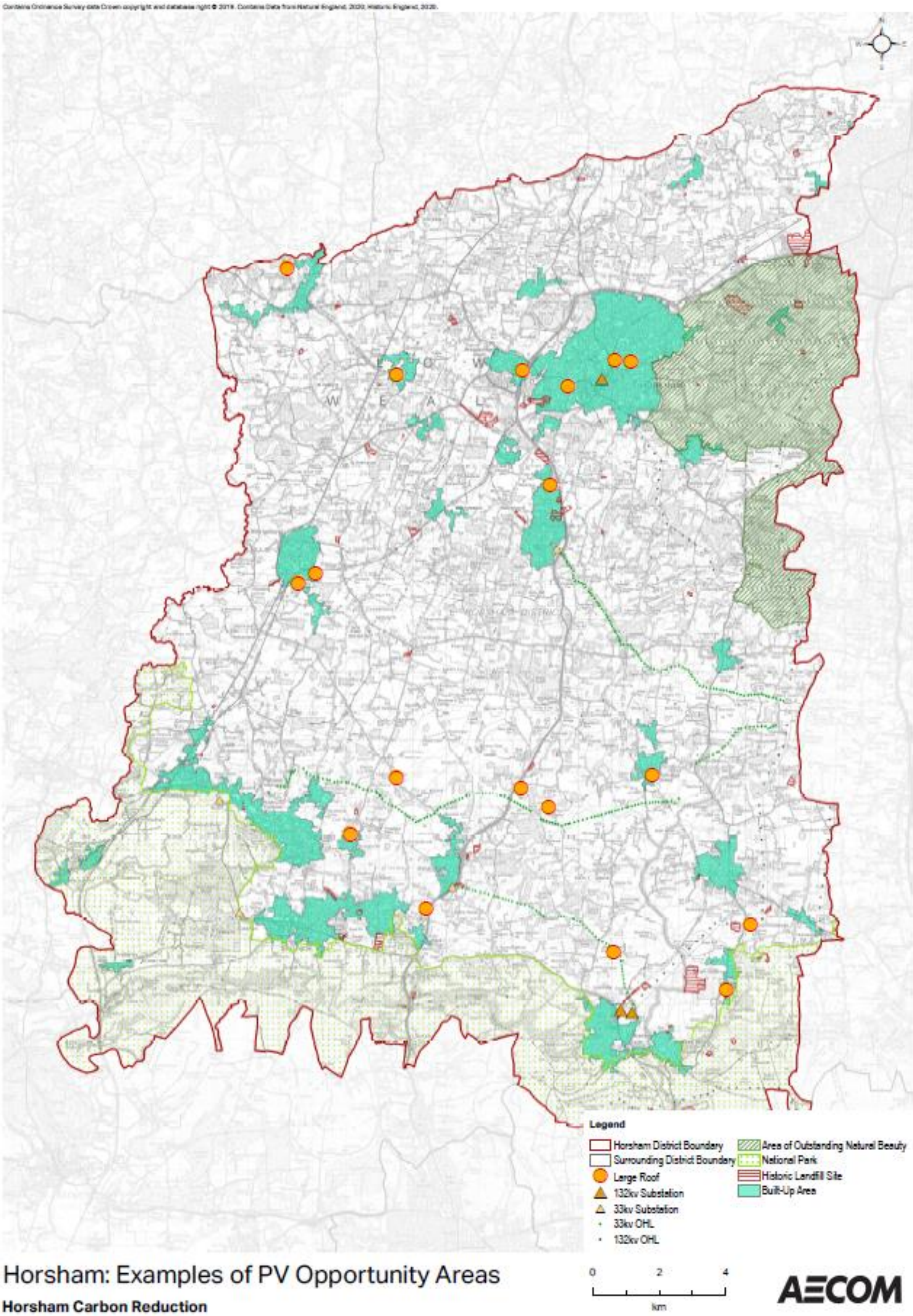

Figure 6-5. Examples of PV Opportunity Areas

Heat Pumps

6.29 DECC (2010) assumes that all buildings could, in principle, accommodate either a ground or air source heat pump (GSHP or ASHP). In practice, these tend to be more expensive to install than either gas boilers or direct electric heating (DEH), both due to the cost of the equipment itself and the need to upgrade the building fabric and services to ensure compatibility. At present, they are not commonly used, but, they are expected to become significantly more common in the coming decades if there is a move to greater use of electricity for heating to replace gas boilers. This shift will be influenced by regulatory factors (i.e. changes to UK Building Regulations) and wider market trends including the capacity for the electrical infrastructure to accommodate the scale of transition required.

6.30 In broad terms, while all heat pumps are considerably more efficient than either gas boilers or DEH systems, ground and water source heat pumps generally have a higher coefficient of performance (COP) than ASHPs. However, these are more expensive to install, and rely on detailed feasibility work being carried out to ensure that the site is suitable. Therefore, in practice, ASHPs are likely to be more common, both in new buildings and retrofitted into existing ones. For context, national domestic RHI data indicates that there are more than four times as many accredited ASHP installations as there are GSHP installations.[78]

Air Source Heat Pumps

6.31 Because ASHPs need to be located outside of the building, they could be considered to have a negative visual impact, which would be particularly relevant in Conservation Areas and within the High Weald AONB. The design and siting of ASHPs should also consider the potential noise or vibrations from fans, although this depends to some extent on the precise model of heat pump that is installed. Further design challenges include sourcing the electrical capacity to introduce these technologies at scale. Provided that these issues are adequately addressed, ASHPs can in principle be integrated into many types of new development or retrofitted into existing buildings.

6.32 For a map of ASHP constraints, refer to the PV constraints map (Figure 6-4).

Ground Source Heat Pumps

6.33 In order to determine whether it is possible to install a GSHP on a specific site, detailed analysis must be undertaken, which is beyond the scope of this report. Our assessment has therefore sought to map some of the major constraints on a District-wide basis, where GIS data was available.

6.34 Different constraints apply depending on the specific technology in question, i.e. whether the GSHP is horizontal or vertical, open or closed loop). In all cases, however, the most important considerations relate to excavations, drilling and ground conditions rather than visual impact.

6.35 According to the Environment Agency's *'Environmental good practice guide for ground source heating and cooling'* (2011), an environmental impact assessment should be carried out to assess whether the site is:

- Within a defined groundwater Source Protection Zone 1 (as per DEFRA's online mapping resource)[79]
- Within 50m from a well, spring or borehole used for potable water supply
- On land affected by contamination e.g. historic landfill sites[80]
- Close to a designated wetland site
- Within 10m of a watercourse

[78] https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/public-reports-and-data-domestic-rhi
[79] https://data.gov.uk/dataset/3d136e9a-78cf-4452-824d-39d715ba5b69/drinking-water-protected-areas-surface-water and https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/SourceProtectionZonesMerged&Mode=spatial
[80] Maps available at https://data.gov.uk/dataset/contaminated-land

- Close to other GSHP schemes (depending on uptake, proximity to other open-loop GSHPs could become a constraint due to the potential for thermal interference)
- Adjacent to a septic tank or cesspit

6.36 These factors would indicate that the location is potentially sensitive to a GSHP installation. Additional factors that need to be taken into account include:

- Location of buried infrastructure e.g. gas pipelines, sewers, cables
- Other site designations e.g. Archaeological Notification areas, Regionally Important Geological Sites, Sites of Special Scientific Interest, etc.

6.37 Figure 6-6 shows a map of some constraints impacting GSHPs. However, not all of the data listed above was available during this study, so this is only a partial assessment. No data on wells, springs, boreholes, septic tanks, cesspits and existing GSHP schemes was available at the time of writing. Additional feasibility studies would be required to determine whether a GSHP would be appropriate on a given site. Further guidance is available at: https://www.gov.uk/guidance/open-loop-heat-pump-systems-permits-consents-and-licences

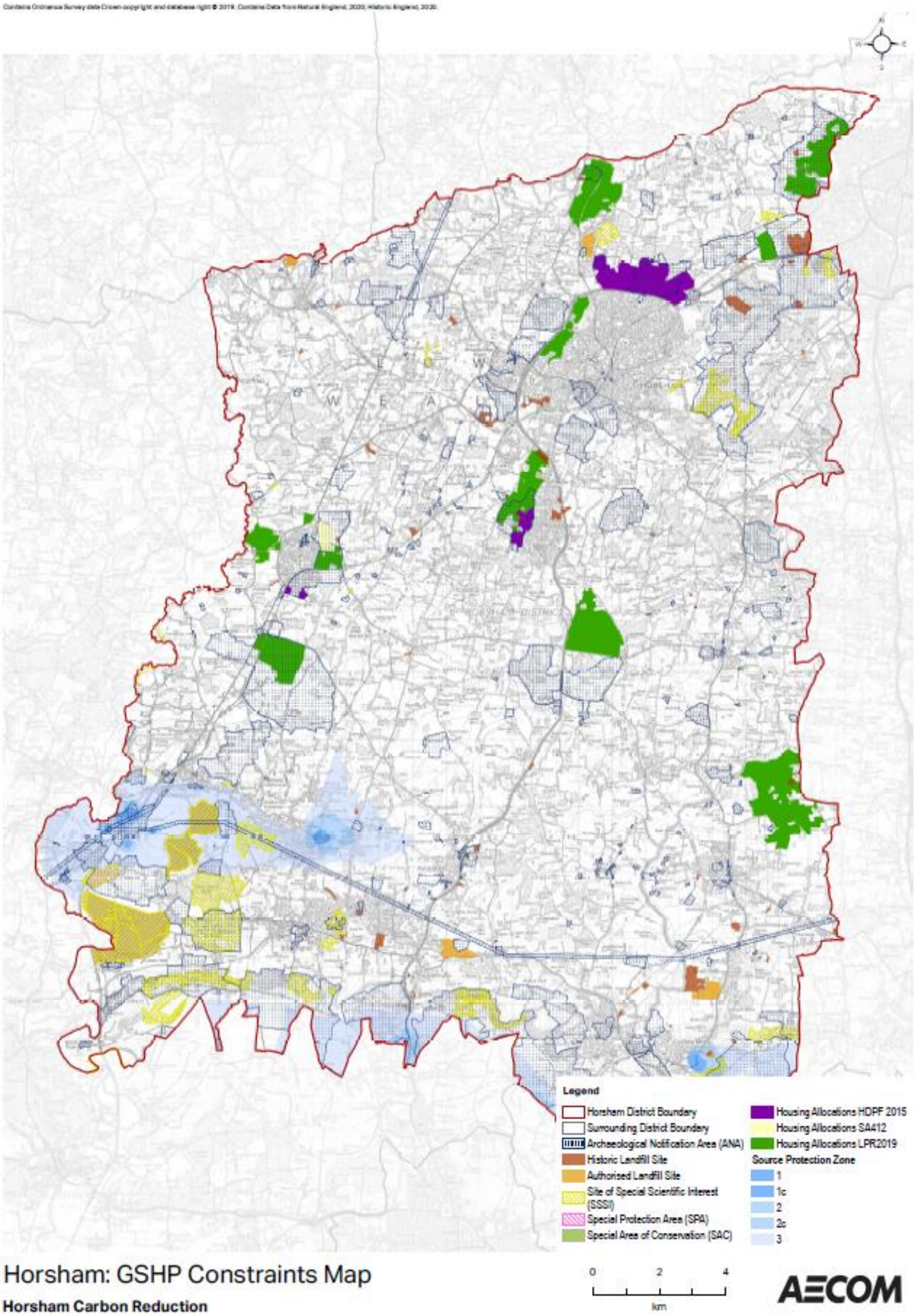

Figure 6-6. GSHP Constraints Map (also showing potential new development sites)

Water Source Heat Pumps

6.38 There are relatively few examples of water source heat pumps (WSHPs) in the UK. A report[81] published by DECC in 2015, which provided a high-level assessment of river heat capacity for all of England, suggests that the opportunities to utilise river source heat in Horsham are relatively low *on a national scale*.

6.39 Figure 6-7 below (extracted from the DECC 2015 report) highlights urban areas that are adjacent to potential sources of river heat, colour coded based on the estimated river heat capacity. The two areas highlighted within Horsham District (Horsham and Billinghurst) are shown to be in the '0-50MW' bracket (lowest).

6.40 However, as noted earlier, there is at least one precedent for a WSHP being installed in the District, which confirms that the technology can be successfully deployed if the site conditions are favourable.

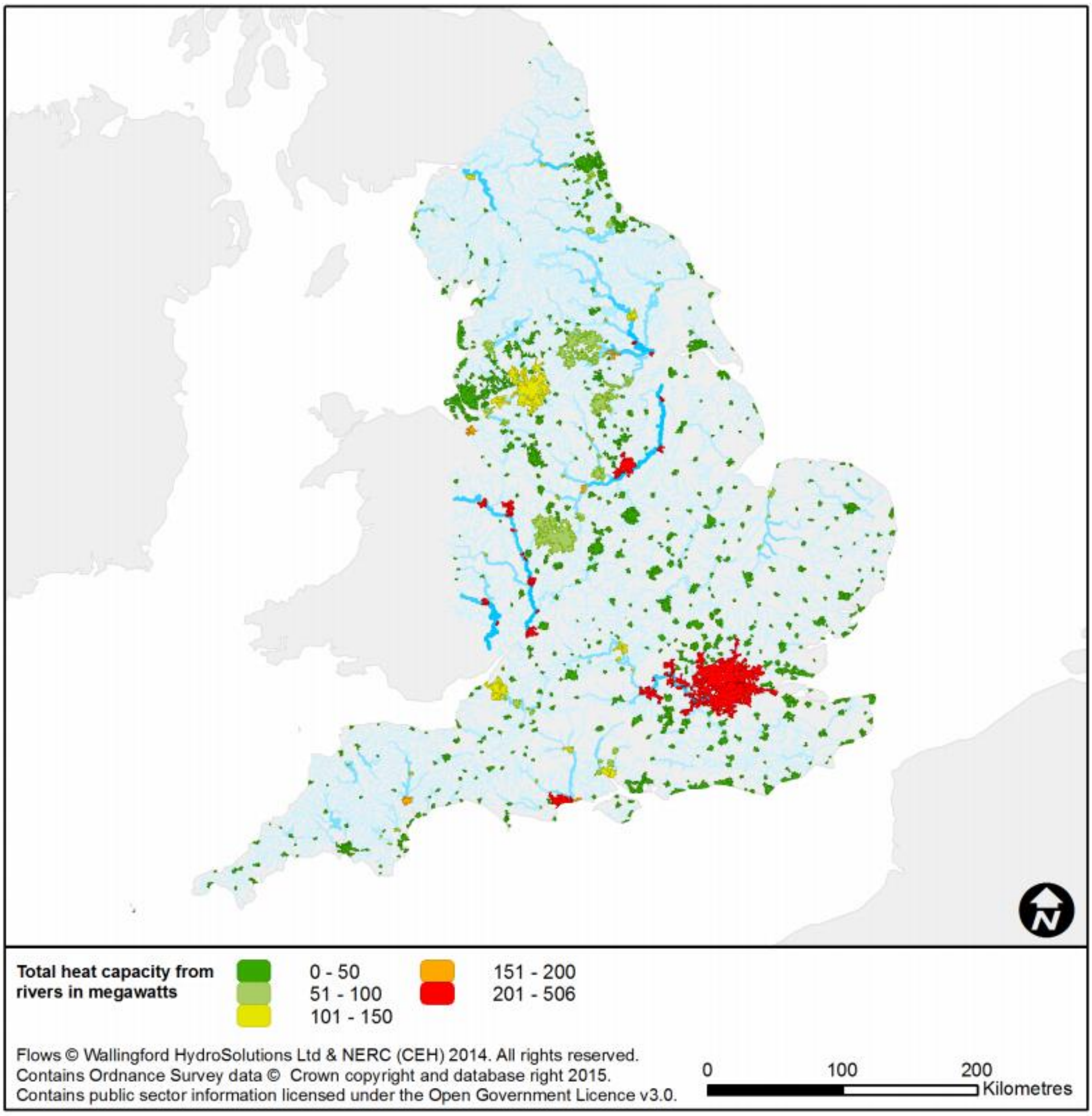

Figure 6-7. Total heat capacity from rivers in megawatts for urban areas. Source: DECC (2015)

[81] For more information, see DECC, *'National Heat Map: Water Source Heat Layer'* (2015). Available at: https://www.gov.uk/government/publications/water-source-heat-map-layer

6.41 As for GSHPs, detailed feasibility studies would be required to assess the potential for WSHPs on a given site, which would also require consultation with the Environment Agency. Environmental designations that could potentially act as constraints on the use of WSHPs include:

- Sites of Special Scientific Interest
- Special Protection Areas
- Special Areas of Conservation
- RAMSAR sites
- CAMS water resource status
- Freshwater fisheries status
- Water Framework Directive Waterbodies

Other opportunities

6.42 The above has highlighted the potential to utilise river courses as a source of heat. However, it may also be possible to deploy WSHPs in other resources. For example, wastewater treatment works (WWTWs) represent a large and renewable source of heat which could be used for a WSHP. No attempt has been made to quantify the potential capacity of WSHPs that source their heat from WWTWs, as this is beyond the scope of the current study, and the use of WWTWs for this purpose is still in its infancy. However, it is recommended that this is investigated in the future, particularly where there are large developments planned within the District, as it represents a key sustainable option for delivering low carbon heating to developments.

General comments

6.43 Retrofitting heat pumps incurs a variety of technical and practical challenges. For example:

- To ensure that the systems operate efficiently it is necessary to undertake energy efficiency upgrades to ensure that the building is well insulated and reasonably airtight.
- It may be necessary to upgrade the entire heating system to be compatible with a low temperature distribution system, which requires either larger radiators or underfloor heating, and the use of a hot water cylinder. (This presents a potential challenge particularly if there is no space for one.)
- In the case of GSHPs, the level of excavation or drilling work depends on the type of system that is installed, but it either requires boreholes or excavation of a large area if using horizontal trenches
- ASHPs need to be located outside, which has a visual impact and can result in noise due to the fans used. The appearance is similar to a typical external air conditioning unit.

6.44 In some cases, cost constraints in the short term may continue to see gas boilers as a preferred heat source for new homes. To ensure that new buildings are able to accommodate heat pumps easily in future, the following design measures should be strongly encouraged as part of either a Local Plan policy or SPD:

- The space heating system must be capable of delivering required heat load with a flow temperature ≤45°C (e.g. underfloor heating or large radiators);
- Individual houses must have space for a hot water cylinder (apartments with a communal heating system the flow temperature must be ≤60°C);
- Houses should not include gas for cooking and instead electric induction hobs and ovens are required;
- External space must be allocated for an air source heat pump capable of providing space heating and hot water load required by property; and

- Allocated space for air source heat pumps must be shown to meet the noise planning requirements for neighbouring new and existing properties (this applies to new properties that are proposing to install new air source heat pumps).

6.45 It is important to understand that even if new buildings are constructed with gas boilers and then retrofitted with heat pumps, the environmental and financial cost of delay is significant, even if standards are increased progressively over time. For example, a study conducted on behalf of the Committee on Climate Change found that the lifetime carbon emissions (over 60 years) of a house built with a gas boiler (G) in 2020 and then retrofitted with a heat pump in 2030 would be approximately three times higher than if a heat pump (ASHP) was fitted at the outset.[82] This is illustrated in Figure 6-8 (source: Figure E.1 of the CCC report). At a national level, *'each year of delay in adopting lower-carbon heat technologies could result in several million tonnes of avoidable carbon emissions.'*

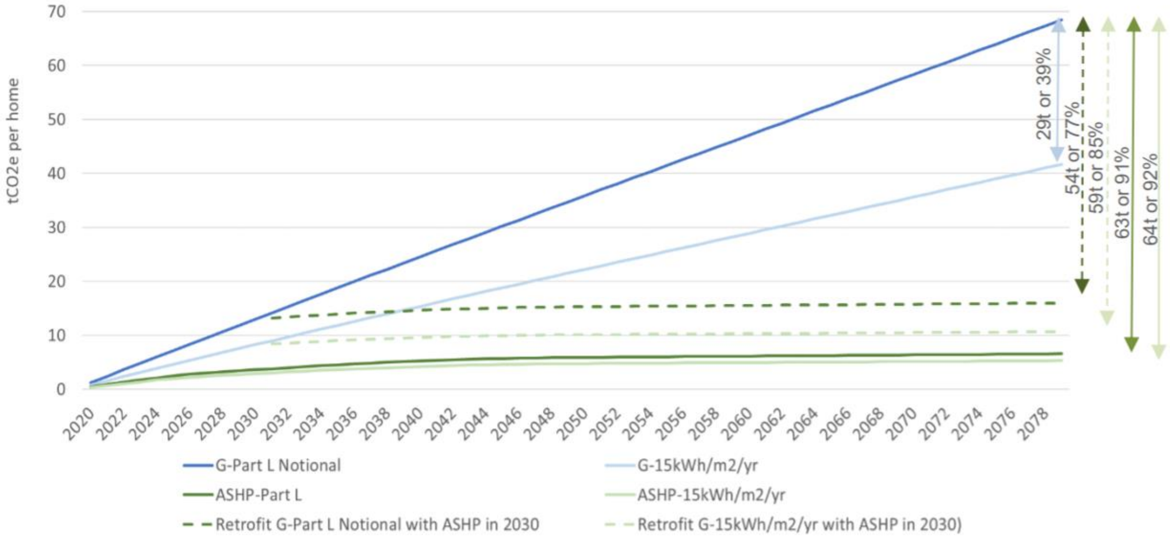

Figure 6-8. Comparison of cumulative CO_2 emissions from a house built to different energy performance standards. Source: CCC (2019)

Hydroelectric power

6.46 Hydro power is generated by water flow through a turbine and depends on the volumetric flow rate and available head (i.e. the vertical distance of the water surface above the turbine).

6.47 Our review of existing LZC installations in Horsham (Section 3) found no operational or planned hydroelectric power installations. It is assumed that the Environment Agency would be averse to any additional barriers being created which would limit the availability of new sites.

6.48 Considering the relatively high cost of the technology, and the need to carry out more detailed environmental assessment work compared with other types of LZCs, in practice it is likely that future uptake will be limited.

Energy from Waste (EfW)

6.49 'Waste' covers municipal solid waste (MSW) and commercial and industrial (C&I) waste. Both can be diverted from landfill to EfW facilities and used to derive power via combustion, pyrolysis, gasification or anaerobic digestion.

6.50 The 2009 Renewable Energy Study estimated that there could be up to 6.3 MW of capacity for EfW technologies in Horsham, which could provide 176 GWh of electricity per year. In January 2020, planning permission was granted for a new 21 MW incinerator at the site of the former Wealden Brickworks which would be expected to generate a large amount of electricity, and in

[82] Currie Brown and AECOM on behalf of the Committee on Climate Change, *'The costs and benefits of tighter standards for new buildings'* (2019). Available at: https://www.theccc.org.uk/wp-content/uploads/2019/07/The-costs-and-benefits-of-tighter-standards-for-new-buildings-Currie-Brown-and-AECOM.pdf

this study we have assumed that this would be the maximum additional EfW capacity for the District.

6.51 In line with waste reduction principles, it is considered preferable for this resource to diminish rather than increase. There are additional concerns related to air quality impacts if waste streams are disposed of through combustion. Therefore, this technology is not recommended for widespread adoption in Horsham. However, if there are incinerator facilities planned in future, EfW should be considered in preference to letting the heat go to waste, if it can be used to displace a more carbon-intensive fuel.

6.52 The aim is typically to maximise the generation of electrical power; however, it is in practice impossible to convert all available energy into electricity. There is much waste heat from such a facility that must be discharged to the environment. Although the environmental impact of the heat is minimal it does offer a significant opportunity to reduce fuel consumption for heating in buildings and homes. Opportunities to utilise this heat should be considered and prioritised to maximise carbon reduction.

Biogas (Sewage and Landfill Gas)

6.53 DECC (2010) provides a method for estimating the potential availability of both sewage and landfill gas, which can be used to generate either electricity or heat. Sites that could theoretically provide opportunities for biogas include:

- Material recovery facilities
- Landfill sites
- Waste transfer stations
- Sewage systems

6.54 However, the guidance states that most of the available resource is already captured and utilised. In the case of sewage gas, 'It is generally thought in the literature that the potential for expanding this resource is limited [...] New resource will be highly dependent on projections for the expansion of water treatment as a result of population growth.' Meanwhile, landfill gas naturally diminishes over time as the organic portion of the waste biodegrades. DECC (2010) states: 'Current landfill sites have a limited useful lifetime as sources of bio-gas and will be exhausted by around 2020. There is unlikely to be much new landfill gas resource due to the EU Landfill Directive which caps landfill, especially post-2014, and due to policies to promote other waste management processes such as anaerobic digestion, composting and recycling, which will reduce significantly the biodegradable fraction of landfill waste.'

6.55 Therefore, sewage and landfill gas are not expected to provide significant additional renewable electricity generation for Horsham going forward.

Biomass

6.56 Biomass covers a diverse range of fuels derived from plants, animals or human activity. Biomass is usually converted to energy via combustion, pyrolysis, gasification or anaerobic digestion. The 2009 Renewable Energy Study, which focused on energy crops and local woodland residues, found that there was significant potential for biomass to provide both heat and electricity in Horsham if suitable markets for those fuels could be created.[83] The key variables affecting those estimates are unlikely to have changed significantly in the last decade – for instance, recognising that the utilisation rate of agricultural land has remained stable.

6.57 However, it is difficult to quantify the overall environmental benefits of biomass energy using a broad-brush approach, in part because of questions about how the biomass is produced and whether there is a more suitable end use for the material. A 2018 report by the Committee on

[83] DEFRA records show that there were a small number of sites producing Short Rotation Coppice (an energy crop) within the last decade. Realistically, it is not likely that the use of energy crops will increase without significant Government incentives; the Energy Crops Scheme, which was aimed at increasing energy crop production, was cancelled in 2013 following low uptake.

Climate Change considered the role of biomass in supporting the UK's decarbonisation targets, and found that:[84]

6.58 *'Biomass can be produced and used in ways that are both low-carbon and sustainable. However, improved governance will be essential to ensure this happens in practice. If this is achieved, biomass can make a significant contribution to tackling climate change. If this is not achieved, there are risks that biomass production and use could in some circumstances be worse for the climate than using fossil fuels.'* The same report found that, to provide the greatest reduction in GHG emissions, *'the greatest levels of GHG abatement from biomass currently occur when wood is used as a construction material in buildings to both store carbon and displace high carbon cement, brick and steel.'*

6.59 If and when carbon capture and storage technologies become widely available, these could be used in conjunction with bioenergy to provide further benefits (via bioenergy carbon capture and storage (BECCS)). The CCC found that, as a final option, *'the remaining [biomass] resource would be best used to displace residual fossil fuel emissions where other low-carbon alternatives do not exist (e.g. in aviation).'* In other words, based on the present state of technologies, biomass energy is not a preferred option for heat or electricity generation for most applications.

6.60 There are additional issues related to air quality impacts. Direct combustion (burning) to produce electricity or heat is often the most viable approach to energy conversion from a technical and economic standpoint. However, biomass burning emits particulate matter (PMx) and therefore DEFRA's position is to not encourage this practice in or near urban areas or Air Quality Management Areas (AQMAs) due to air quality concerns.[85] A report[86] by the European Environment Agency found that, *'Particulate matter (PM) directly released into the air and emissions of volatile organic compounds (VOCs) increased because of the growth in biomass burning since 2005. $PM_{2.5}$ increased by 11%, PM_{10} by 7% and VOCs by 4%'* which the authors characterised as a 'strong increase' although it is acknowledged that modern combustion technologies meet stricter standards for air quality than traditional solid fuel burners,

6.61 With this in mind, biomass combustion technologies are not recommended for widespread adoption in Horsham; instead, as noted by the CCC, the best opportunity from a carbon reduction perspective may be to use biomass in construction as a carbon sink.

6.62 The most appropriate use of biomass as fuel is likely to be where there is an existing source of sustainably and locally sourced waste biomass – provided that waste reduction measures are also in place. This could include, for example, anaerobic digestion plants that are co-located with agricultural facilities that have a high energy demand. However, as these processes become more efficient, the opportunities around biomass for Horsham may change.

District Heat Networks

6.63 The delivery and expansion of heat networks relies upon the connectivity of potential heat loads. In general, suitable developments will be those of mixed usage types and those with a sufficiently high density of heat demand. A common rule of thumb is that Combined Heat and Power (CHP) DHN schemes are likely to be economically feasible for developments above 50 dwellings per hectare.[87] Other key opportunity areas may arise in built-up urban areas, or in proximity to hospitals, prisons, leisure centres, crematoria, and other high energy users.

6.64 New development can facilitate the creation of heat networks if buildings are designed to connect to an existing network or with the ability to connect to it in the future. Depending on the location of the new development the potential for the scheme to facilitate the decarbonisation of

[84] Committee on Climate Change, *'Biomass in a Low Carbon Economy'* (2018). Available at: https://www.theccc.org.uk/wp-content/uploads/2018/11/Biomass-in-a-low-carbon-economy-CCC-2018.pdf
[85] DEFRA, '*The Potential Air Quality Impacts from Biomass Combustion'* (July 2017). Available at: https://uk-air.defra.gov.uk/library/reports?report_id=935
[86] European Environment Agency, *'Renewable energy in Europe 2019 - Recent growth and knock-on effects'* (2019). Available at: https://www.eionet.europa.eu/etcs/etc-cme/products/etc-cme-reports/renewable-energy-in-europe-2019-recent-growth-and-knock-on-effects
[87] See, for example, Energy Saving Trust (2014) *CE299: The applicability of district heating for new dwellings.*

adjacent heat loads is worth considering. This is usually the case where there is a cluster of large existing loads near to a new development providing the opportunity to omit or reduce the existing fossil fuel consumption.

6.65 For commercial buildings, the costs associated with ensuring designs can facilitate their connection to a heat network in the future should be no greater than the alternative approach. Design considerations are likely to include the location of the plant room, the provision of space within the plant room for a heat exchanger, provision of capped off connections to the flow and return pipework, lower temperature heating systems and the choice of control systems. For residential buildings, there could be additional construction costs associated with the communal heating network within blocks of flats if compared to individual heating systems although whole life cycle cost of individual systems may be greater.

Future Low Carbon Technologies

Hydrogen

6.66 As discussed earlier in relation to EVs, hydrogen is considered to potentially have a significant role to play in decarbonisation efforts in the UK. While hydrogen can be used as a fuel for transportation, there are also significant opportunities for utilising renewably-sourced and low carbon hydrogen as a replacement fuel in systems that currently rely on natural gas.

6.67 Whilst the expansion of renewable electricity capacity is expected to reduce the UK's reliance on natural gas as a means of producing electricity, and in doing so aid the decarbonisation of grid electricity, the displacement of natural gas from other uses is expected to be more challenging. Much of the gas is transported via the gas grid, with high pressure transmission pipelines feeding into medium and low pressure distribution networks. In principle, hydrogen can be injected into the gas grid, so that the gas received by customers is a blend of natural gas and hydrogen. Since hydrogen was a major component in 'town gas' (which was created from coal and used extensively throughout the UK before the discovery of natural gas and oil reserves in the North Sea in the 1960s), it is considered technically feasible for hydrogen to become a major component in the gas network in the future.

6.68 The principle of blending gases also applies to the injection of biogases into the gas grid. These are synthetic hydrocarbon gases produced in facilities such as anaerobic digesters, and which, because of the short carbon cycle associated with their production, help to reduce net carbon emissions to the atmosphere.

6.69 Customers' appliances can, in many cases, run on blends of gas with a high hydrogen content, and the Government is working with the heating industry to trial the rollout of hydrogen in the gas network. For example, Keele University in Staffordshire is testing the viability of using a blended gas of 20% hydrogen : 80% natural gas in a project called HyDeploy.[88] At this blend ratio, no changes are expected to be required to the majority of boilers in the UK. The potential to run a 100% hydrogen network is being explored in a project called Hy4Heat, where positive results have been achieved to date.[89] Boiler manufacturers would need to ensure that boilers can operate safely with 100% hydrogen, though the major manufacturers are working on prototypes which can be switched to hydrogen-only fuels relatively simply.

6.70 The main challenges associated with delivering a hydrogen gas grid will be upscaling commercially viable hydrogen production capacity, and the upgrading of the gas distribution infrastructure. Current hydrogen production capacity in the UK is low and is considered uneconomic in the current environment. This is mainly due to the relatively high cost of the electricity needed to produce hydrogen via electrolysis. This process, which is referred to as 'green' hydrogen if the electricity is renewable, is expected to become more commercially viable once the capacity of renewable electricity generation is expanded to a point where there are large surpluses in grid generation for significant periods of time. Surplus generation results in very low real-time wholesale power prices, which potentially can be used to power the production of large quantities of commercially viable green hydrogen. This has the added

[88] https://hydeploy.co.uk/
[89] https://www.hy4heat.info/

benefit of ensuring demand for renewable electricity during periods when generation exceeds demand.

6.71 The gas distribution network is likely to require significant investment before hydrogen can be distributed in large volumes. New hydrogen meters and sensors would need to be fitted for each customer, which is likely to require significant administrative and organisational resources to deliver. The network itself may require some upgrades to reduce the incidence of leakage from and the failure of pipework. Any upgrades of the network would likely need to be led by SGN.

6.72 It is recommended that HDC should note the development of trials aimed at establishing the feasibility of hydrogen networks, such as the HyDeploy trials underway at Keele University.

Batteries

6.73 Batteries are expected to play a key role in the transition to a grid which is dominated in the future by renewable sources of electricity generation. By their nature, most renewable energy sources (particularly those which are most relevant to Horsham, i.e. PV and wind) are intermittent, due to their being dominated by local weather conditions. This means that, with evermore renewable capacity coming online, the real-time generation of electricity may at times dip below the real-time demand. This could lead to brown-outs, where certain loads need to be dropped (i.e. the supply needs to be cut to loads which are deemed less critical) in order to preserve supply capacity for the most critical loads (e.g. hospitals and residential customers). In severe cases, black-outs may occur, where the supply is significantly below demand, causing the whole local network to shut down.

6.74 Large 'grid-scale' or 'utility-scale' batteries (MW+), and other forms of energy storage, enable a surplus of supply to be stored during periods when generation exceeds demand. This surplus energy is released onto the grid when demand exceeds real-time generation. Hydroelectric generators have provided this kind of 'grid balancing' service for many years, and there are new concepts coming forward for innovative storage facilities, such as deploying weights within abandoned mine shafts that rise and fall when grid conditions result in oversupply or excess demand on the grid respectively. However, with the increasing penetration of renewables onto the grid, and the reduction in fossil fuel-based generation capacity (which are able to act as modulating generation in order to 'top up' the supply in response to demand levels), storage assets are expected to become an essential part of the energy balance in the future. Applications for large batteries are increasingly coming forward, as the market and the regulatory environment matures.

6.75 Units typically come in self-contained 'modular units', which means that capacity can be increased with relative ease, with additional units being delivered and integrated into existing facilities if required. Each MW unit is approximately the size of a shipping container. The capacity of upstream grid infrastructure (e.g. substations, incoming cables, etc.) needs to be assessed and potentially upgraded in order to facilitate connection. It is recommended that HDC note the development of large-scale battery systems and engage with DNOs regarding applications for new large-scale batteries in the District.

Key Points

6.76 The following are the key points when considering the future of renewable and low carbon technologies:

- The major strategic opportunities for increasing renewable electricity generation in Horsham are large-scale solar and wind energy projects. These are both well-established technologies that currently represent the most cost-effective solutions for generating renewable electricity in the UK.[77] However, delivering large-scale renewable energy developments is likely to be a challenge due to the sensitivity of the existing landscape and the presence of designated areas such as the AONB and National Park.

- Roof-mounted and building-integrated PV will offer additional resource. Although this is more expensive than large-scale wind or solar farms, the benefit is that it does not compete with other land uses and has less visual impact on the natural environment.
- Recognising that there are plans to increase EV charging provision across the District, HDC could also consider promoting PV and battery storage systems that are co-located with chargepoints.
- At present, heat pumps offer the best opportunity to decarbonise the heat supply in Horsham; most new and existing buildings can, in principle, accommodate either an air or ground source heat pump. Due to the efficiency of these technologies, their use can also help to mitigate against electricity price increases when compared with direct electric heating.
- Hydrogen gas offers the potential to help decarbonise the gas supply. Although this is currently not widely available, HDC should keep informed of technological advances in this area.
- HDC should continue to assess opportunities to deliver district heat networks in locations where there is sufficient energy demand and / or an accessible source of low carbon heat. This could include the Horsham town centre and, potentially, higher density new developments.
- Switching to the use of renewable electricity in buildings and vehicles will increase demand and therefore put pressure on existing grid infrastructure. HDC will need to work with the DNOs where relevant to plan for upgrade work. It also makes it all the more important to reduce demand through energy efficiency measures.

6.77 Table 6-2 summarises the key areas of applicability for the LZC technologies that have been assessed as being most suitable for Horsham. **All these technologies would require a site-specific feasibility study.**

Technology	Key considerations[90]	Potential applicability
Large scale wind	Visual impact Cumulative impacts Historic environment Local infrastructure constraints Noise, flicker and shadow	Constraints vary depending on location, height and number of turbines. Technically suitable for areas with adequate wind resource e.g. exposed hills, rural areas without nearby obstructions. At a strategic level, the entire District has wind speeds that could potentially support wind energy developments.
Small scale / urban wind	As for large wind, but effects likely to be smaller due to difference in size of turbines	
Small scale / building-mounted PV and SWH	Visual impact Cumulative impacts Historic environment Constraints associated with the local electricity network	Technically suitable for most building types subject to orientation and overshading, particularly for new developments which can be designed to maximise opportunities (e.g. orientation, roof geometry). May be particularly suitable for industrial buildings because of the large roof areas and character of industrial zones. Especially suitable as solar car ports. From a policy perspective, application is often limited for historic assets, listed buildings, Conservation Areas, etc. and installations in

[90] For more information, see https://www.gov.uk/guidance/renewable-and-low-carbon-energy#particular-planning-considerations-for-hydropower-active-solar-technology-solar-farms-and-wind-turbines

Technology	Key considerations[90]	Potential applicability
		high value landscape areas such as AONBs. However, these should not be ruled out automatically.
Large scale / ground-mounted PV	Visual impact Cumulative impacts Constraints associated with the local electricity network	Most suitable for lower grade agricultural land, historic landfill sites or as temporary installations on brownfield because of competing land uses. However, this technology is relatively flexible and could be installed at scale across the District.
ASHPs	As for building-mounted PV Potential noise concerns	Can be installed new or retrofitted into most building types but may require energy efficiency upgrades and replacement of heating system for compatibility. Visual and noise impacts can be reduced depending on placement.
GSHPs	Depends on design but groundworks can affect soil, water quality, aquifers, archaeology, etc.	Requires site-specific feasibility study and EA consultation. Not generally suitable for existing buildings unless using boreholes or undertaking significant insulation upgrades.

Table 6-2. Most suitable LZC technologies for Horsham

7. Carbon Audit of Draft Local Plan Policies

7.1 The policies have been considered from the Regulation 19 Proposed Submission Local Plan, which AECOM has reviewed in order to comment how they further Horsham's commitment to reducing the emissions produced within the District Boundaries.

Policies assessed

Strategic Policy 38 – sustainable design and construction

7.2 This draft strategic policy aims to deliver a higher standard of energy efficiency for all new domestic and non-domestic development in Horsham. For new domestic developments, a targeted 35% reduction in emissions from the baseline rate determined by Part L 2013 is proposed, with a minimum 10% reduction arising from energy demand reduction measures. New non-domestic developments must target BREEAM 'excellent' rating, unless demonstrated the target deems the development unviable.

7.3 As well as targeting new buildings' energy performance, Horsham also plans to target a limit of 100L / person / day of domestic water consumption. The current[91] water consumption target per person per household is 125L / person / day. This is therefore a 20% reduction - which will reduce the demand for domestic hot water (DHW), thereby reducing heating fuel consumption.

7.4 A more ambitious target of 80L / person / day is being proposed for strategic developments above 200 homes, this will likely include the installation of grey water recycling systems. Whilst conserving water resources will be key to improving the District's climate resilience, this policy will have a relatively small impact on the District's reported carbon emissions.

Other policy drivers

7.5 Some of the other ways that the Council are promoting carbon emissions reductions via the Local Plan include:

- Introducing policies that support holistic sustainable design measures that would have the effect of reducing energy demand, i.e. designing buildings, urban landscapes and communities to minimise demand for heating, reduce the risk of overheating, reduce waste, and use resources efficiently.
- Exploring avenues for improving the efficiency and reducing CO_2 emissions from the existing building stock. Among other issues, supporting appropriate retrofitting of historic buildings. This will be done in a way that is sensitive to their heritage value and avoids unintended damages.
- Policies aimed at increasing the provision of high-quality cycle and pedestrian routes, EV infrastructure and other interventions aimed at modal shift – reinforced via an approach to spatial planning that ensures that new development is located in areas with good provision of sustainable transport links.

Estimate of potential impacts

7.6 The following tables and graphs show the effects of Strategic Policy 38 from the draft Local Plan – the variation lies within whether the Future Homes Standard target of 75% reduction in regulated emissions will be enacted from 2025 onwards and whether accounting for grid decarbonisation or not.

[91]Current water consumption data, available at: https://www.statista.com/statistics/827278/liters-per-day-household-water-usage-united-kingdom-uk/

7.7 Business As Usual (BAU) presumes all new buildings proposed in the draft local plan (to 2038) consume a similar level of energy as that of current new buildings. It is anticipated given the UK Government's commitments to reducing carbon emissions and publication of the Future Homes Standard that new buildings will be required to meet or exceed carbon reduction levels far greater than those seen today. The HDC policy potential is compared not only to BAU but a projection that includes the Government's aspirations as presented in their Future Homes Standard.

	Future Homes Standard 2025 75% reduction enacted				Future Homes Standard 2025 75% reduction not enacted			
Projected Saving	No grid decarbonisation		Grid decarbonisation		No grid decarbonisation		Grid decarbonisation	
HDC policy vs:	BAU	Govt regulations	BAU	Govt regulations	BAU	Govt regulations	BAU	Govt regulations
$ktCO_2$/year saved in 2050	29.9	0.1	29.7	0.0	15.2	0.3	10.9	0.0
Total $ktCO_2$ saved by 2050	562	2	561	1	304	7	232	2

Table 7-1. Matrix of carbon savings from proposed Local Plan policy

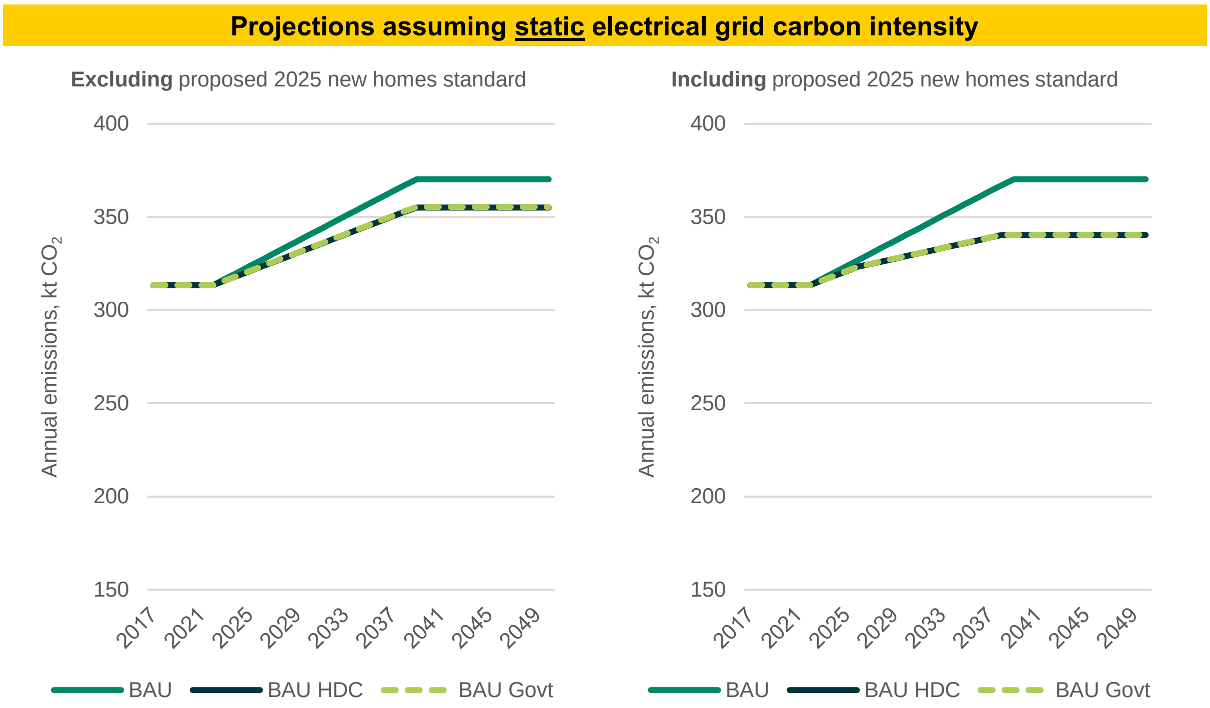

Figure 7-1. Emissions projections from only buildings, (no electrical grid decarbonisation)

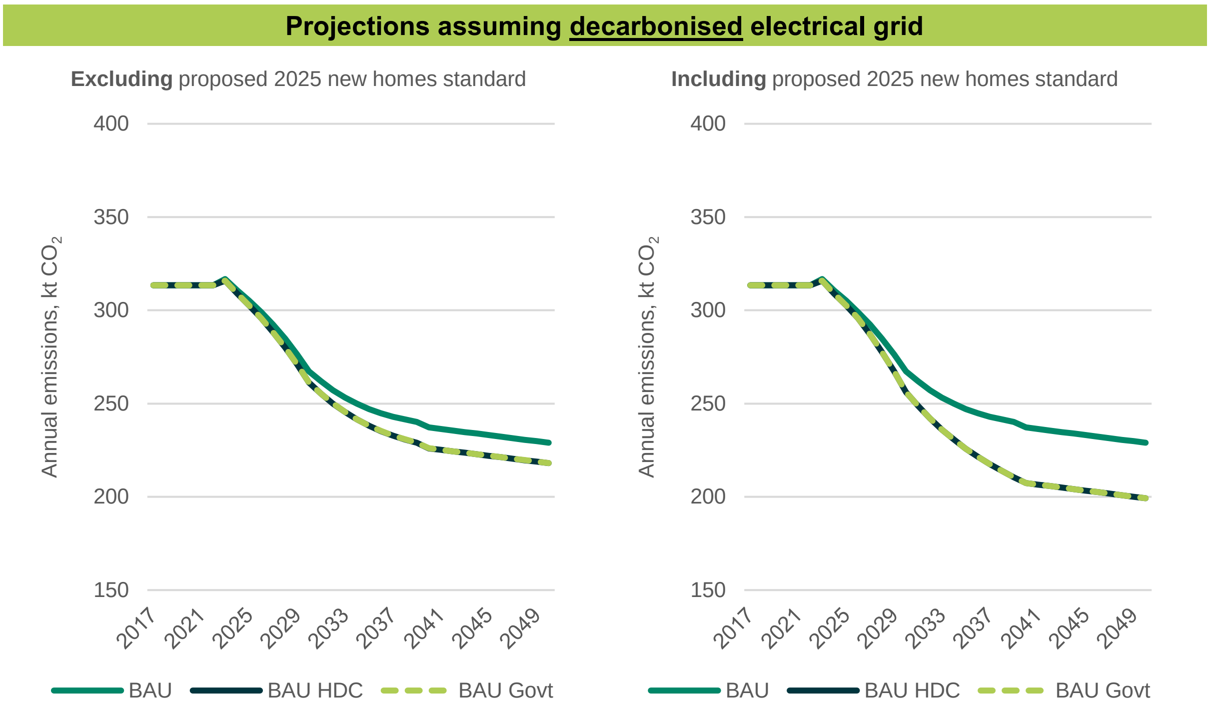

Figure 7-2. Emissions projections from only buildings (decarbonised electrical grid)

7.8 As expected, and per previous sections in this report, grid decarbonisation is projected to have a significant impact on the annual emissions by 2050 compensating for the increased number of buildings in the District. Accounting for the proposed policy change will reduce the potential carbon emissions compared to a projection that includes no improvement to the emissions from new buildings (BAU). The saving is substantially curtailed if it is projected that new buildings will meet new building standards both with and without the aspirational levels proposed for 2025.

7.9 Other targets in Strategic Policy 38 included a targets for all new developments to aim for <100L/person/day water consumption, with strategic sites having a more ambitious target of <80L/person/day. These targets, whilst very pertinent to the topic of water efficiency being that Horsham District is located in the South East of the UK, have not been included in the estimations of carbon savings. This is due to the relatively small difference to HDC reported emissions that can be attributed due to reduced water consumption.

Key Points

7.10 Reductions can be made to regulated energy demands in both domestic and non-domestic buildings, however, there is still a large proportion of emissions stemming from unregulated energy. This energy use cannot be curtailed by policy intervention, but rather public awareness on utilising energy. Smart meters being used in homes is a way for the general public to be more energy conscious – meaning they are likely to use less unregulated energy.

7.11 Policy 38 of the draft Local Plan only addresses a small portion of the emissions associated with Horsham; however, the section of new build is one of the Council's main area of influence within the context of planning policy. Therefore, it is a step in the right direction and a demonstration of the intentions Horsham Council have to decarbonise the District. The effects of the policy can be seen in Figure 7-2 and Figure 7-1; when presented alongside new development adopting a similar set of efficiency standards seen today. Set against proposed future standards the effect of adopting the draft Strategic Policy 38 is much less noticeable.

7.12 There is a much larger portion of emissions arising from transport in Horsham. As noted by the Council in their draft Local Plan, it being a rural district there will be a need for private cars. The promotion of electric vehicles, in policies 41 and 42 of the draft Local Plan, will help to reduce the emissions of vehicles – however it is not possible to quantify the reduction associated specifically with the policies as there are no figures on how many vehicles will switch to electric. Therefore, these policies aren't mentioned in this section but are recognised by AECOM as likely to have a positive influence on promoting electric vehicle usage.

Conclusion

7.13 Horsham District Council's new draft Local Plan has many positive stances on addressing the Climate Emergency. From the quantifiable policies, draft Strategic Policy 38, we have made modelling assumptions and estimated a potential carbon emissions reduction of 13% by 2050 compared to 2018 levels when compared to new buildings constructed to the same standards as today and the electricity grid is decarbonised in line with the Government's strategy. The emissions reduction delivered by Policy 38 are projected to be negligible should the Government succeed in delivering the higher energy efficiency standards proposed in their Future Homes Standard.

7.14 The quantitative targets set out in draft Strategic Policy 38 – *Sustainable design and construction* will have a positive, albeit small, effect on reducing the District's carbon emissions which have been quantified in Table 7-1. The principles conveyed are relevant as are the other policies that seek to promote uptake of EV and although not possible to model the direct impact it is clear from the baselining analysis that making changes to the transport sector in the District will be crucial to reaching zero carbon.

8. Horsham District Council Action

8.1 Separate to the policy options already included in the Local Plan, the Council could investigate adopting the following approaches to implementing policies and decisions:

- Greater weight on CO_2 and energy demand reduction in planning determinations – stronger checks on applications and pushing developers.
- Establish a carbon offset scheme to enable developments that cannot meet the carbon reduction policy on-site to achieve compliance.
- Review the mechanism for MEES enforcement to determine the Council's level of influence on energy efficiency in existing properties.
- Extend Permitted Development rights to encourage energy efficiency measures and LZC uptake in existing buildings, e.g. through issuing Local Development Orders and/or making more types of projects eligible to submit a self-certification form rather than a full planning application.
- Lobby the Government to promote stronger policies in this area – working with other organisations and Local Authorities where appropriate.
- Actively encourage increased uptake of standalone and building integrated LZC energy technologies that meet criteria for acceptability, including large-scale schemes such as PV and wind farms.
- Identify opportunities to deliver low carbon heat networks particularly where there is a high density of heat demand and hard to decarbonise loads such as existing city/town centres
- Ensure that new development is, at the very least, 'zero carbon ready' i.e. designed with high levels of fabric efficiency, and optimised to maximise opportunities for LZC technologies such as heat pumps, roof-mounted PV and battery storage, to support the transition to net zero.
- Encourage Lifecycle Carbon Assessments (particularly for larger developments) to minimise the embodied energy of proposed schemes.
- Introduce requirements relating to Circular Economy measures, which would have the effect of reducing embodied energy in the built environment by minimising demand for resources while also minimising the CO_2 emissions associated with the production and management of waste.
- Require major development applications to include a commitment to report energy consumption and compare this to estimated consumption at time of submission for a period of for example 5 years post occupancy.
- The Council can lead by example through any new developments/refurbishments the Council is doing and driving low energy and carbon retrofit project in their buildings.
- The up and downstream supply chain for the Council will be the largest contributor to GHG emissions and a sizable proportion will be accounted for in the District – there is therefore significant value in changing procurement practices to A) target local supply chains, C) require suppliers to declare GHG emissions resulting from services and goods provided and B) prioritise low GHG emission practises in tendering process

Next steps

8.2 Horsham District Council is expecting to publish the draft Local Plan by year end 2021, it should look to enforce its policy at the point the Plan assumes material weight for decision making. By reducing carbon emissions sooner in new developments, there is less reliance on making substantial savings in other harder to reach sectors.

8.3 Horsham should consider developing its renewable energy capacity, protecting its residents from market price inflation of electricity whilst also playing its part in decarbonising the National Grid. Funding and supporting renewable installation both small-scale and large-scale will help reduce the District's emissions in the short-term, whilst rewilding, afforestation and general landscape maintenance will provide a long-term carbon sink within Horsham's boundaries.

8.4 Horsham being a southerly District with plenty of open space lends itself to large-scale solar farms for example or afforestation which are just some of the solutions being implemented in other Southern areas, the need for publicly owned land is of paramount importance – therefore it is recommended that the acquisition of land for future use should also be considered.

8.5 Developing a Horsham specific Action Plan is an effect way of collating the key next steps in a cohesive way to allow progress to be judged and identify discreet projects that align with the goals of targeting Net Zero Carbon.

Appendix A – Carbon projection modelling methodology

A.1 Scope of the analysis

For the purpose of greenhouse gas reporting, CO_2 emissions are divided into three categories:

- **Scope 1** – Direct emissions that arise from burning fuels in Horsham. This primarily includes fuel used in boilers to provide heating and hot water, fuel used in any vehicles while they are driving within Borough boundaries, and fuels (other than electricity) used for cooking.
- **Scope 2** – Indirect emissions associated with the use of electricity in Horsham.
- **Scope 3** – Indirect emissions that result from other activities outside the border of Horsham, but that take place as a result of the actions of people or organisations within Horsham, e.g. emissions from commuting, shipping, or aviation.

This report only quantifies Scope 1 and 2 emissions, based on publicly available datasets produced by the Department of Business, Energy and Industrial Strategy (BEIS). This covers a range of sectors and fuel types but does not cover *all* potential sources of greenhouse gas emissions within the Local Authority. At the time of writing it is understood that such information is not published by BEIS at a Local Authority level.

The table below shows the categories of emissions reported in the BEIS dataset. In this report, some of the categories representing a small proportion (<1%) of total emissions have been consolidated in order to align the emissions baseline with the fuel consumption figures as much as possible.

Category	Sub-categories as listed by BEIS	Sub-categories as listed in this report
Industrial & commercial (Note: This includes public sector and agricultural fuel consumption and is referred to as 'Non-domestic' in this report)	• Electricity • Gas • Large industrial installations • Other fuels • Agriculture (Note: Fuel not specified)	• Electricity • Gas • Other fuels • Agriculture (all fuels)
Domestic	• Gas • Electricity • Other fuels	• Gas • Electricity • Other fuels
Transport	• Road transport (A roads, motorways and minor roads) • Diesel railways • Other	• Transport (all fuels)

The methodology used by BEIS to estimate carbon emissions varies depending on the source of emissions under consideration. For example, for gas and electricity, a carbon emission factor is developed for each fuel and applied to the sub-national fuel consumption data to provide an estimate of the CO_2e emissions associated with the use of that fuel. In the case of transport, emissions are estimated based on the types of vehicles and vehicle movements that take place on each stretch of road within the UK, and these are allocated to a Local Authority dataset based on geographic boundaries. Total emissions may also include point-source estimates for certain consumers, and therefore it is not possible to directly align the fuel consumption data with the emissions data.

For further information, see the *'Technical Report: Local and Regional Carbon Dioxide Emissions Estimates for 2005-2017 for the UK'* (BEIS, 2019).

A.2 Summary of key inputs

The following assumptions have been applied to the carbon modelling scenarios:

Topic	Model input	Explanation
Demand Reduction		
Potential reduction in demand for heating in existing buildings by 2050	10%	NEED 2019 Report, *'Table 3: Typical savings following multiple energy efficiency measures'* suggests a 12% reduction in heating is possible; 10% has been used as a conservative estimate. This would represent the average improvement across the entire building stock.
Potential reduction in demand for heating in new buildings by 2050	75%	This reduction is in line with the levels indicated by the Future Homes Standard consultation.
Potential reduction in demand for electricity for appliances and lighting by 2050	5%	Assumes that appliance use will increase but a small reduction could be achieved through behaviour change. Research indicates up to 10% is possible – 5% has been used as a low / conservative estimate.
Fuel Switching		
Proportion of existing buildings that switch to electric heating by 2050	90%	Assumes that, in the next 10 years, it will become a requirement to switch when otherwise replacing boilers. Based on a 15-year replacement cycle, this means that the majority of boilers would be replaced by 2050. 90% is used as a conservative estimate assuming that some heating systems cannot be replaced
New buildings that are built with electric heating	100%	Assumes all new builds will be required to use electric heating.
Proportion of existing building electric heating systems that are heat pumps	50%	Estimate. The remainder are assumed to be direct electric systems where it is not feasible to install heat pumps.
Proportion of new building electric heating systems that are heat pumps	90%	Estimate. The remainder are assumed to be direct electric systems where it is not feasible to install heat pumps.
System Efficiencies		
Typical gas boiler	80%	Typical boiler efficiency
Heat pump	250%	This is used as a low / conservative estimate which could represent a mix of air and ground source heat pumps, either individual or as part of a communal / district heat network system.
Direct electric heating	100%	1:1 conversion is normal
Transport		
Reduction in mileage by 2050	10%	Estimate.
Vehicles that switch to zero emission over time by 2050	91%	Assumes that HGVs (which represent 8% of the total transport fuel use) do not switch due to technological constraints.

A.3 Modelling Assumptions

Built environment

Existing buildings

The modelling assumes that existing buildings will continue to have the same gas and electricity consumption in a 'BAU' scenario. Reductions to fuel consumption are then applied to test the relative impact of different intervention measures (described below) as part of the carbon projection modelling.

New buildings

Based on discussions with HDC and review of the draft Reg 19 Plan, we have input the yearly housing trajectory proposed, totalling 15,002 new homes, and a total increase in employment floorspace of 103,700 m^2 over the Local Plan period.

The amount of proposed new development (number of dwellings and m^2 of employment floorspace) is multiplied by benchmarks to provide an estimate of energy demand.

In order to estimate the impact of new construction / development within the District as a whole, benchmarks were used to estimate the fuel consumption of new buildings. For domestic buildings, benchmarks were derived from median consumption figures for Horsham as reported in NEED. For non-domestic buildings, CIBSE Guide F benchmarks were used to estimate gas and electricity demand. In both cases, the heat / gas demand figures were reduced by 10% to reflect higher fabric performance standards set by policy 39 of the draft Local Plan. The level of heating demand reduction was informed by the recently published consultation documents related to Parts L and F of the Building Regulations, and the introduction of a Future Homes Standard.

Grid decarbonisation pathway

Carbon emission factors (CEFs) for electricity were taken from HM Treasury/BEIS *'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1'* (2019) which is intended for use by organisations reporting on their greenhouse gas emissions. Note that this trajectory reflects the level of decarbonisation that would be necessary for the UK to meet its current decarbonisation targets. It is not a projection of the likely emissions from grid electricity.

Electricity demand reduction

Evidence suggests that reductions of around 5% can be achieved through measures such as behavioural changes, smart metering, and zone lighting. Case studies suggest that greater reductions are possible for some organisations. However, in recognition of the fact that electricity use has increased in the past decade due to factors such as increasing use of electronic appliances, 5% has been used as a conservative estimate.

The model assumes that total electricity consumption will decrease linearly through to the year 2030, at which point this reduction will be achieved.

Heating demand reduction from energy efficiency measures

Evidence from NEED indicates that installing multiple energy saving measures (such as cavity wall or loft insulation) can reduce heating bills by around 5-12%. From a technical standpoint, higher savings (over 75% in some properties) could be achieved with more ambitious retrofitting strategies,[92] but 10% has been used as a conservative estimate.

This would not necessarily require all buildings to undergo a retrofit – it represents an average across the entire stock. In other words, some buildings could be retrofitted to a higher standard, while others (such as Listed buildings) receive no upgrades.

The model assumes that total gas consumption will decrease linearly through to the year 2050, at which point this reduction will be achieved.

[92] See https://passipedia.org/certification/enerphit

Gas demand reduction modelled is 12% for existing and 75% for new dwellings.

Impact of fuel switching

This calculation assumes that the metered gas consumption is delivered by individual gas boilers (80% efficiency). The total metered gas consumption data is used to provide a rough estimate of the amount of electricity that would be required if this level of demand was instead met using direct electric heating (DEH) with 100% efficiency or heat pumps with COP of 2.5 (this is intended as a conservative estimate that reflects the performance of air source heat pumps (ASHPs) in situ).

The model assumes that 90% of existing buildings will switch to an electric heating system by 2050. This would require an ambitious programme of heating system replacement with significant cost implications. Therefore, the calculation also assumes that 50% of the new heating systems will be DEH and 50% will be ASHP as an illustrative scenario, in recognition of the fact that DEH may be cheaper and more practical to install. Additional carbon reductions could potentially be achieved if more systems were replaced with ASHPs.

The model assumes that gas heating systems will be replaced with electric heating systems at a consistent rate (i.e. linearly) to 2050.

Vehicle mileage reduction

In the baseline scenario, it is assumed that demand for transport remains stable. This will likely tend to increase over time due to factors such as population growth. A stable trajectory would imply that measures are being implemented to mitigate this demand through encouraging other forms of travel such as walking, cycling or public transport.

According to the 'Road to Zero' report: *'Evidence from 60,000 fleet drivers receiving training through the Energy Saving Trust (EST), a key partner supporting the efficient motoring agenda, gave an average 15% saving of fuel and CO_2 […] Organisations that have incorporated a wider package of behavioural and procedural measures in managing their fleets (see the case study below) have delivered typical emission savings of between 10-30%.'*

The model assumes that a 10% reduction in either journeys, vehicles, or miles travelled will result in a 10% reduction in CO_2e emissions from those vehicles. A travel strategy aimed at reducing emissions would likely seek to target certain types of trips, vehicles, or users, so this approach should be understood as an estimate. However, for the purpose of this analysis, it is considered enough to show a simple proportional reduction to highlight the relative scale of impact such a measure could have, relative to other interventions.

The model assumes that total mileage will decrease linearly through to the year 2050, at which point this reduction will be achieved.

Impact of switching to Ultra Low Emission Vehicles (ULEVs)

Based on the estimated mileage for each vehicle type, we have re-calculated CO_2e emissions using BEIS Green Guide figures for electric vehicles.

Carbon savings from Low or Zero Carbon (LZC) technology energy generation

Carbon savings from Low or Zero Carbon (LZC) energy generation are based on the amount of National Grid electricity that would be offset by renewable electricity. A total figure for the amount of LZC capacity that will be installed by 2050 is inputted into the model, and the model assumes that the total savings will increase linearly up to that point.

An estimate is then made of the potential amount of renewable electricity that could be generated by those technologies (large-scale PV or wind). The electricity generation figure is multiplied by the CEF for a given year to provide an estimate of the total CO_2e savings in a given year.

- Large-scale PV: Assumed output of 827 kWh/kWp based on typical performance in the UK

- Large-scale onshore wind: Capacity factor of 2,081 kWh/kWp

Note that, as the electricity grid decarbonises, more LZC energy generation is required to offset any residual emissions. Therefore, although the amount of LZC capacity is assumed to increase linearly, the savings per MW decrease as the grid decarbonises over time.

Carbon reductions from woodland creation and tree planting

Based on nation-wide statistics from the Woodland Carbon Code, new woodlands created from low-grade agricultural land have the potential to sequester around 386 tCO_2e per hectare over 100 years, or 3.86 tCO_2e per hectare per year on average. In practice, this depends heavily on the type of woodland and its maturity level.

The scale of offsetting has been input in order to target net zero carbon by 2050 assuming all previous measures and changes in market come to pass. This allows HBC to understand the approximate scale of investment in offsetting required to overcome the likely gap shown by our projection modelling. Proposals would need to be backed up with detailed modelling / evidence and supported by a long-term management plan. Therefore, these figures are intended only to provide a rough sense of scale.

A.4 Limitations

As stated previously, this study has only considered sources of CO_2e emissions that are listed for Horsham District within the published BEIS dataset. Due to lack of information about other GHG emissions at a Local Authority level, therefore, the baseline presented in this report is likely to be an underestimate of the total.

A key overarching limitation of this approach is that any changes modelled would need to be backed up by policies, funding, changes in technology, and user / consumer behaviour which are uncertain.

The analysis does not account for other changes e.g. population growth, energy prices, weather, economic growth, and the many other trends that would impact energy demand – it is primarily focused on built environment measures with consideration given to changes in transportation technology.

Appendix B – Methodology for assessing the additional LZC capacity

B.1 Air and Ground Source Heat Pumps

The DECC Methodology (2010) states*: 'The regional assessment of the potential for heat pumps is […] based on the premise that most buildings (existing stock and new build) are suitable for the deployment of at least one of the heat pump options.'* – Paragraph 3.25

The suggested parameters for estimating potential heat pump installations at regional scale are shown below:

Table 3-9: Detailed assessment of opportunities and constraints for heat pumps

No	Parameter	Description	Assessment requirement	Where to source data from
Opportunity assessment - natural and technically accessible resource				
1	Existing building stock	Number of buildings suitable for heat pumps	Domestic - 100% of all of-grid properties; for the remaining stock - 75% of detached and semi-detached properties, 50% of terraced properties and 25% of flats Commercial -	CLG Statistics English Housing Survey (EHS) ONS data
2	New developments	Number of new buildings suitable for heat pumps	50% of all new build domestic properties	RSS new housing provisions
3	System capacity	Average generation capacity of an individual system kW	Domestic - 5kW Commercial - 100kW	no data required
Constraints assessment - physically accessible and practically viable resource				
	n/a		No significant specific parameters have been defined as most constraints have already been taken into account in the assumptions applied for the parameters above.	no data required

Source: SQW Energy and Land Use Consultants

The table below shows the estimated potential number and capacity of domestic heat pumps in Horsham, based on the above methodology.

Dwelling type	No. units	Percentage (%) of buildings suitable for heat pumps	Potential number of buildings suitable for heat pumps	Total potential capacity (kW)*
Off gas grid	11,572	100%	11,572	57,858
Detached house	20,171	75%	15,128	75,640
Semi-detached house	13,921	75%	10,441	52,203
Terraced house	8,890	50%	4,445	22,225
Flat, maisonette or apartment	8,624	25%	2,156	9,333
Other domestic (e.g. caravans)	768	*Not in DECC methodology; excluded from analysis*	-	-
All domestic	62,532	-	43,741	218,706
All non-domestic	4,850	60%	2,706	270,601
TOTAL	**68,794**		**46,447**	**489,306**

**Note: Average domestic system capacity of 5 kW and non-domestic system capacity of 100 kW.*

It should be noted that this methodology focuses on developing a universal approach to ASHPs assessments at local authority level. This means that these assumptions are broad and do not take into consideration local constraints for heat pump deployment.

B.2 Solar PV and hot water systems

Our estimate of the potential for roof-mounted PV and SWH on domestic and commercial buildings is based on rules of thumb set out in the DECC (2010) guidance document, which describes the percentage of different buildings assumed to be suitable for solar energy systems, along with average capacity of domestic systems (2 kW) and non-domestic systems (5 kW). For industrial buildings, AECOM has used satellite imagery to measure the roof area of 22no. existing industrial sites in the District and used a rule of thumb to determine the potential amount of roof area available for PV.[93]

The DECC (2010) suggested parameters for estimating potential solar PV and hot water installations at regional scale are shown below:

Table 3-8: Detailed assessment of opportunities and constraints for solar energy

No	Parameter	Description	Assessment requirement	Where to source data from
Opportunity assessment - natural and technically accessible resource				
1	Existing roof space	Number of roofs suitable for solar systems	Apply the following assumptions for number of suitable roofs: • Domestic properties - 25% of all properties (including flats) • Commercial properties - 40% of all hereditaments • Industrial buildings - 80% of the stock	CLG Statistics English Housing Survey (EHS) ONS data
2	New developments	Number of new roofs suitable for solar systems	Assume that 50% of all new domestic roofs will be suitable for solar systems	RSS new housing provisions
3	System capacity	Average generation capacity of an individual system kW	Apply the following assumptions for average system capacity: • Domestic - 2kW (thermal or electric) • Commercial - 5kW (electric only) • Industrial - each region use their own assumption	no data required
Constraints assessment - physically accessible and practically viable resource				
	n/a		No specific parameters have been defined as most constraints have already been taken into account in the assumptions applied for the parameters above.	no data required

Source: SQW Energy and Land Use Consultants

[93] Assuming that 3/8ths of roofs have an orientation of SE, S or SW, and that 10 m^2 of roof area is required per kWp of PV, we found that on average, industrial sites could accommodate approximately 375 kWp of PV in total.

The following table shows the calculation used to estimate the potential number and capacity of roof-mounted solar systems in Horsham District.

Dwelling type	No. units	Percentage (%) of roofs suitable for solar systems	Number of suitable roofs	Total potential capacity (kW)*
Detached house	24,627	25%	6,157	12,314
Semi-detached house	16,996	25%	4,249	8,498
Terraced house	10,854	25%	2,714	5,427
Flat, maisonette or apartment	10,529	25%	2,632	5,265
Other domestic (e.g. caravans)	937	*Not in DECC methodology; excluded from analysis*	-	-
All domestic	63,943	-	15,752	31,504
Commercial	4,510	40%	1,804	9,020
Industrial		*(Calculated separately)*		8,250
TOTAL – Existing buildings	**-**	**-**	**-**	**48,774**
New dwellings	15,003	80%	12,002	24,003
TOTAL – New and existing	**-**	**-**	**-**	**72,777**

**Average domestic system capacity of 2kW and average non-domestic system capacity of 5kW.*

On this basis, we have found that there could be approximately 81 MW of roof-mounted PV capacity, with the potential to generate approximately 81 MWh of electricity per year, 0.03% of the 2017 domestic electricity demand for Horsham.[94] Considering that currently there is approximately 20.1 MW of roof-mounted PV installed capacity in the District, installing this level of additional roof-mounted PV would require a large increase in uptake from the general public. That said, it is noted that the cost of PV has reduced significantly in recent years[95] while uptake has risen sharply, despite uncertainty surrounding government incentive schemes. This suggests that the technology is viable in practice and it is commonly used by developers to meet carbon emission reduction targets. Furthermore, the advance of battery storage technologies may help to further drive uptake by allowing users to store surplus power, helping to facilitate greater use of the generated energy on-site.

As for solar water heating (SWH), this calculation has focused on SWH potential in domestic properties. The dependant factors are:

- Available roof space;
- Orientation and exposure of the roof; and
- Hot water demand onsite.

Assuming that:

- The SWH system is sized to meet 50% of hot water demand;
- For domestic properties, the ratio of gas consumption for heating : hot water is 3.833 : 1 (based on BEIS figures[96]) therefore domestic hot water demand in 2017 was approximately 247.32 GWh;
- SHW generation possibility = 3/8 x 0.5 x 247,320 = 46,373 MWh

[94] This is significantly higher than the estimate presented in the 2009 Renewable Energy Study. The difference is primarily attributed to a change in the number of buildings during that time, and because the previous study did not consider opportunities on large industrial roofs in detail.
[95] International Renewable Energy Agency IRENA, '*Renewable Power Generation Costs in 2019*' (2020). Available at: https://irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019#:~:text=Electricity%20costs%20from%20utility%2Dscale,respectively%2C%20for%20newly%20commissioned%20projects.
[96] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/386858/Estimates_of_heat_use.pdf

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