Harborough Renewable Energy Assessment

Harborough District Council

Final report
Prepared by LUC
October 2024

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Introduction

1.1 LUC was commissioned by Harborough District Council in 2024 to prepare a renewable and low carbon energy study to assist with the preparation of the Local Plan update. It identifies the potential for different renewable and low carbon energy technologies at all scales within the District and where they are most suitable for development This study seeks to provide a robust evidence base to underpin planning policies relating to renewable and low carbon energy generation and low carbon development within the Local Plan update. This will assist the determination of planning applications for renewable and low carbon technology developments within the District.

Renewable energy refers to sources of energy that are not depleted when used, for example, wind and solar.

Low-carbon energy sources are technologies that produce power with substantially lower amounts of carbon dioxide emissions than are emitted from conventional fossil fuel power generation. An example of this is a heat pump. Whilst the heat from the ground is free and renewable, it still requires an electric pump to operate the system.

1.2 The evidence base and the recommended policies meet the requirements of the National Planning Policy Framework (NPPF) and Planning Policy Guidance (PPG) and take into account the guidance and considerations set out in relevant national policy statements.

1.3 In summary, the key objectives of the study were to:

- Review the technical potential for renewable and low carbon energy within the District and summarise the key factors that may affect the extent to which these technologies can be deployed – i.e. grid connection, planning, finance etc; and

- Provide recommendations or appropriate policy options to include in the revised Local Plan regarding renewable and low carbon energy – including areas of potential technical suitability for wind, solar and other technologies.

It is noted that while the study identifies areas which are potentially technically suitable for wind and solar, more detailed site assessments (i.e. as required for a planning application) would be required to determine if specific sites are suitable for development in planning terms.

Report structure

1.4 The remainder of this report is structured as follows:

- Chapter 2 provides a review of the policy context in relation to renewable and low carbon energy;
- Chapter 3 outlines the existing renewable and low carbon energy generation in Harborough;
- Chapter 4 presents the findings of the assessment of 'technical' potential for renewable and low carbon energy and the factors that may affect the deployment of these technologies;
- Chapter 5 outlines the potential planning policies options for the Local Plan update; and
- Chapter 6 sets out the summary and study conclusions.

Chapter 2

Renewable and low carbon policy context

2.1 The following chapter provides a summary of the national and local legislative and policy context for the development of renewables and low carbon energy within Harborough.

National climate change and renewable energy legislation and policy

2.2 The profile of climate change on the world's stage has never been higher. The risks of failing to limit a global average temperature increase to 1.5°C are clearly set out in the IPCC Special Report 'Global Warming of 1.5°C' **[See reference 1]** and have recently been reiterated in COP26. In response to this and the 2016 Paris Agreement, the UK's Committee on Climate Change (CCC) in its Sixth Carbon Budget recommended in December 2020 a new emissions target for the UK: reduction by 78% by 2035 relative to 1990 and net zero greenhouse gases by 2050 **[See reference 2]**. It also advised that current carbon reduction targets submitted under the Paris Agreement are predicted to lead to global average temperatures rising around 3 degrees Celsius by 2100 compared to pre-industrial levels.

Climate Change Act 2008

2.3 The UK's legally binding emission reduction targets were first set by the Climate Change Act 2008 and included a reduction of at least 80% by 2050 against the 1990 baseline **[See reference 3]**. However, on 1st May 2019, Parliament declared a formal climate and environment emergency, and on 12th

June 2019 the Government amended the Climate Change Act to target full net carbon neutrality (a 100% reduction of greenhouse gas emissions) in the UK by 2050 **[See reference** 4**]**.

2.4 In response to its obligations to prepare policies to meet climate targets, the UK Government has also produced various sector-specific policies and strategies. These include Powering Up Britain (2023), British Energy Security Strategy (2022), Net Zero Strategy (2021), Ten Point Plan for a Green Industrial Revolution (2020), UK National Energy & Climate Plan (2019), the Clean Growth Strategy (2017) and the Industrial Strategy White Paper (2017) (further details below). In addition, in December 2020, the Department for Business Energy and Industrial Strategy (BEIS) now known as the Department for Energy Security & Net Zero (DESNZ) published the Energy White Paper which sets out how the UK will clean up its energy system and reach net zero emissions by 2050.

Powering Up Britain

2.5 This policy paper **[See reference** 5**]** sets out how the government will enhance the UK's energy security, seize the economic opportunities of the transition, and deliver on the net zero commitments. One of the main aims is to accelerate the deployment of renewables with the goal of developing up to 50GW of offshore wind by 2030 and to quintuple solar power by 2035.

British Energy Security Strategy

2.6 In response to the rising costs of oil and gas on the global energy market, the UK government has set out its plan to reduce the UK's dependence on imported oil and gas. A key part of this strategy (2022) is accelerating the UK's transition towards renewable sources. In regard to renewables, the strategy proposes to:

- Aim to cut the development and deployment of offshore wind projects by half through a streamlined planning process, including reducing consent time from up to four years down to one year and establishing a fast track consenting route for priority cases where quality standards are met;

- Consult on developing local partnerships for communities who wish to host new onshore wind infrastructure; and
- Consult on amending planning rules to favour development of solar projects on non-protected land and support projects that are co-located with other functions.

Net Zero Strategy

2.7 The Net Zero Strategy (Oct 2021) sets out the UK's policies and proposals to meet its allocated carbon budgets and Nationally Determined Contributions (NDC's) alongside the long term vision of decarbonising the economy by 2050. The strategy sets out a delivery pathway showing indicative emissions reductions across sectors to meet the UK's targets up to the sixth carbon budget (2033-2037). This builds on the proposals set out in the Ten Point Plan for a Green Industrial Revolution. Key policies in the strategy include:

- By 2035 the UK will be powered entirely by clean electricity, subject to security of supply.
- 40GW of offshore wind by 2030 and further development of onshore wind and solar projects. Ensuring that new renewable projects incorporate generation and demand in the most efficient way – taking into account the needs of local communities.

2.8 The strategy also outlines key commitments in Local Climate Action, including:

- Setting clearer expectations on how central and local government interact in the delivery of net zero;
- Establishing a Local Net Zero Forum, chaired by BEIS now DESNZ, to bring together national and local government officials to discuss policy and delivery on net zero; and

- Continuing the Local Net Zero Programme to support local areas with their capability and capacity to meet net zero.

Energy White Paper – Powering Our Net Zero Future

2.9 This white paper (2020) is based on the Ten Point Plan and sets out the specific energy-related measures that will be implemented in line with the UK's 2050 net zero target. The paper emphasises the UK government's commitment to ensuring that the cost of the transition is fair and affordable for consumers. Key commitments in the paper include:

- Targeting 40GW of offshore wind generation by 2030, including 1GW of floating wind generation. This is alongside the expansion of other renewable technologies.
- Supporting the development of CCUS in four industrial clusters.
- Consulting on whether to stop gas grid connections to new homes being built from 2025.
- Increasing the installation of electric heat pumps from 30,000 per year to 600,000 per year by 2028.
- Aim to develop 5GW of low-carbon hydrogen production capacity by 2030.

The Ten Point Plan for a Green Industrial Revolution

2.10 This plan (published in 2020) puts forward the ten main areas where the UK wishes to scale up decarbonisation, mobilising £12 billion of government investment. The outlined areas in the plan will be continually built upon by further legislation and policy, such as the Net Zero Strategy (2021) and Energy White Paper (2020).

UK Integrated National Energy and Climate Plan

2.11 The UK National Energy and Climate Plan (2020) sets out the UK's approach to meeting the five objectives of the EU's Energy Union: energy security; energy efficiency; decarbonisation; the internal energy market; and research, innovation and competitiveness **[See reference 6]**.

2.12 The Plan describes the current state of the energy sector in the UK, outlining the government's current approach to climate change mitigation through policy, and how this is expected to affect the five objectives of the Energy Union in future. This is supported by a summary table containing all the relevant UK policies that contribute to achieving the UK's climate goals, taken from the UK's National Communication with the United Nations Framework Convention on Climate Change (UNFCCC).

2.13 The report also includes scenario testing on the UK's projected emissions to 2035, with business as usual, all current measures and all current and planned measure scenarios. It demonstrates that the government's current measures have the potential to reduce baseline emissions by approximately 20% over the current baseline, with a further 10% reduction through implementation of planned measures.

Clean Growth Strategy

2.14 In the context of the UK's legal requirements under the Climate Change Act, the UK's approach to reducing emissions, as set out in the Clean Growth Strategy (2017), has two guiding objectives:

- To meet domestic commitments at the lowest possible net cost to UK taxpayers, consumers and businesses; and
- To maximise the social and economic benefits for the UK from this transition.

2.15 The Clean Growth Strategy sets out three possible pathways to decarbonise the UK's economy by 2050:

- Electric: Including full deployment of electric vehicles (EVs), electric space heating, and industry moves to 'clean fuels'.
- Hydrogen: Including heating homes and buildings, fuelling many vehicles and the power industry.
- Emissions removal: Including construction of sustainable biomass power stations with carbon capture and storage technology.

2.16 The Strategy also encourages local authorities to actively pursue a low carbon economy:

> "Local areas are best placed to drive emission reductions through their unique position of managing policy on land, buildings, water, waste and transport. They can embed low carbon measures in strategic plans across areas such as health and social care, transport, and housing." [pg 118]

2.17 The strategy also announced up to £557 million in further 'Pot 2' (less established renewables) funding for Contracts for Difference (CfD) – a 15-year contract that offers low-carbon electricity generators payments for the electricity they produce. This opened in May 2019.The most recent allocation round (sixth) opened in 2024.

Green Finance Taskforce and the Green Finance Strategy

2.18 One of the key proposals within the Clean Growth Strategy is to develop world leading Green Finance capabilities by setting up a Green Finance Taskforce, the aim of which is to "provide recommendations for delivery of the public and private investment we need to meet our carbon budgets and maximise the UK's share of the global green finance market".

2.19 Building on the important work of the Green Finance Taskforce, the first Green Finance Strategy was produced in July 2019 and recently updated in 2023. This seeks to reinforce and expand the UK's position as a world leader on green finance and investment, delivering five key objectives:

- UK financial services growth and competitiveness;
- Investment in the green economy;
- Financial stability;
- Incorporation of nature and adaptation; and
- Alignment of global financial flows with climate and nature objectives.

2.20 The Strategy notes the importance of local key players in directing potential investors towards opportunities that meet local priorities and so are more likely to secure local community support.

Industrial Strategy White Paper

2.21 Achieving 'Clean Growth' is one of the future challenges the Government outlines as part of its Industrial Strategy. In order to maximise the advantages of the global shift to clean growth for the UK, the strategy proposes to:

- Develop smart systems for cheap and clean energy across power, heating and transport;
- Transform construction techniques to dramatically improve efficiency;
- Make our energy intensive industries competitive in the clean economy;
- Put the UK at the forefront of the global move to high efficiency agriculture;
- Make the UK the global standard setter for finance that supports clean growth; and

- Support key areas of innovation, investing £725m over 4 years.

UK Ban of New Petrol and Diesel Cars by 2030

2.22 The zero emission vehicle (ZEV) mandate sets out the percentage of new zero emission cars and vans manufacturers will be required to produce each year up to 2030. 80% of new cars and 70% of new vans sold in Great Britain must be zero emission by 2030, increasing to 100% by 2035 (prior to 2024, the target was 100% by 2030) **[See reference** 7**]**.

2.23 This means that the uptake of Battery Electric vehicles (BEV) is likely to significantly increase in Harborough and this will increase the demand for electricity in the area. This provides an opportunity to reduce carbon emissions if the increased demand can be met from renewable or low-carbon electricity generation.

UK Heating System Target

2.24 The UK has a target for all new heating systems installed in UK homes from 2035 to be using low-carbon technologies, such as electric heat pumps. This will also increase the electricity demand in Harborough, increasing the need for renewable electricity generation **[See reference** 8**]**.

UK Power System Decarbonisation

2.25 The UK has committed to decarbonise the electricity system by 2035. This brings forward the 2050 commitment set out in the Energy White Paper by 15 years. This will be achieved by focusing on offshore wind, onshore wind, solar, nuclear and hydrogen **[See reference** 9**]**.

Great British Energy

2.26 The new Labour Government is setting up Great British Energy, a publicly-owned company headquartered in Scotland to invest in clean, home-grown energy and has introduced the Great British Energy Bill to Parliament. Great British Energy's mission will be to drive clean energy deployment to create jobs, boost energy independence, and ensure UK taxpayers, billpayers and communities reap the benefits of clean, secure, home-grown energy. This mission will be delivered through the following 5 functions:

- Project investment and ownership;
- Project development;
- Local Power Plan;
- Supply chain; and
- Great British Nuclear **[See reference** 10**]**.

National planning legislation

Planning and Compulsory Purchase Act

2.27 The Planning and Compulsory Purchase Act (2004) sets out the structure of the local planning framework for England, including the duty on plan-making authorities to mitigate and adapt to climate change. In other words, local planning authorities must make positive and proactive policies and decisions which contribute to the mitigation of, and adaptation to, climate change – polices and decisions that make measurable, ongoing reductions in carbon emissions reported in Council's annual monitoring reports. This legislation is supported by national planning policy and guidance set out below.

2.28 Section 19(1A) of the Planning and Compulsory Purchase Act 2004 requires that climate change is addressed through development plan documents and that obligations regarding annual monitoring of any targets or indicators are fulfilled:

> "Development plan documents must (taken as a whole) include policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change." [Section 19(1A)]
>
> "Every local planning authority must prepare reports containing such information as is prescribed as to… the extent to which the policies set out in the local development documents are being achieved." [Section 35(2)]

2.29 This means that local plans must consider how policies can deliver on these requirements, including having regard to the objectives and trajectories for reducing emissions set out within the Climate Change Act (2008).

Planning Act and National Policy Statements

2.30 The Planning Act (2008) introduced a new planning regime for nationally significant infrastructure projects (NSIPs), including energy generation plants of capacity greater than 50 megawatts (50MW). In 2011, six National Policy Statements (NPSs) for Energy were published and subsequently updated in 2024. The energy NPSs are designed to ensure that major energy planning decisions are transparent and are considered against a clear policy framework. They set out national policy against which proposals for major energy projects will be determined by the National Infrastructure Directorate (NID) (formerly the Infrastructure Planning Commission or IPC).

2.31 The Overarching National Policy Statement for Energy (EN-1) sets out national policy for energy infrastructure and describes the need for new nationally significant energy infrastructure projects. EN-3 (NPS for Renewable

Energy Infrastructure) provides the primary basis for decisions by the NID on applications it receives for nationally significant renewable energy infrastructure. It provides guidance on various technologies and their potential for significant effects. In 2016, onshore wind installations above 50MW were removed from the NSIP regime; as such, these applications are now dealt with by local planning authorities, based on the NPPF. The NPSs were consulted on in 2021 and officially updated in 2024 to:

- Reflect the current regulatory framework and contain new transitional provisions applicable during and following a review;
- Update the Government's greenhouse gas emission reductions target from "at least 80%" by 2050 to net zero by 2050, and 78% by 2035 compared to 1990 levels;
- Add flexibility for the applicability of the NPS to new and developing types of energy infrastructure, such as carbon capture and storage and hydrogen infrastructure;
- Confirm future energy generation would come from a range of sources including renewables, nuclear, low carbon hydrogen, with "residual use of unabated natural gas and crude oil fuels" for heat, electricity, transport, and industrial applications; and
- Remove reference to the need for new coal and large-scale oil-fired electricity generation and update references to the need for other infrastructure.

2.32 Since the 2021 update, the British Energy Security Strategy (2022) was published and as such set out some commitments relating to planning reform. Therefore, various changes were made to the draft energy NPS and were consulted on until the end of May 2023. The amended NPSs are likely to strengthen the process for delivering major new energy infrastructure in England and Wales, reinforcing the country's national priority of delivering on net zero. The updates are also expected to speed up the planning process so that low-carbon generation can be developed at the right time and place whilst protecting and enhancing the national and historic environments and landscape.

Planning and Energy Act

2.33 The Planning and Energy Act (2008) enables local planning authorities to set requirements for energy use and energy efficiency in local plans, including a proportion of energy used in development to be generated from renewable and low carbon sources in the locality of the development. Such requirements can relate to specific types and scales of development but also broad areas within a local planning authority's area of influence, such as areas with optimal conditions for decentralised heat networks.

2.34 The Act also enables local authorities to require standards for energy efficiency in new buildings beyond those in the Building Regulations. In 2015 the energy efficiency requirements were proposed to be repealed, to effectively make the Building Regulations the sole authority regarding energy efficiency standards for residential development and removing the ability for local planning authorities to set their own energy efficiency standards. However, while the power was removed in principle and consultation on new Building Regulation has been undertaken, the Government has not yet produced a commencement date for repealing these powers, which therefore remain in place. More details on Part L of the Building Regulations are set out below.

National planning policy

National Planning Policy Framework (NPPF)

2.35 The NPPF was first published on 27th March 2012 and updated on 24th July 2018, 19th February 2019, 20th July 2021, 5th September 2023, and 19th December 2023. This sets out the government's planning policies for England and how these are expected to be applied.

2.36 Central to the NPPF policies is a presumption in favour of sustainable development, that development should be planned for positively and individual proposals should be approved wherever possible. One of the overarching objectives that underpins the NPPF is set out in Paragraph 8: "an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including… mitigating and adapting to climate change, including moving to a low carbon economy".

2.37 The revised NPPF supports the contents of the Neighbourhood Planning Act (2017) by making explicit reference to the need for local planning authorities to work with duty to cooperate partners on strategic priorities (paragraph 24) and defined strategic policies that make sufficient provision for climate change mitigation and adaptation (paragraph 20). These amendments provide a clear policy framework for local planning authorities to work collaboratively with partners and neighbours to tackle climate change mitigation and adaptation at a strategic scale and over the longer term.

2.38 Paragraph 158 of the NPPF states:

> "Plans should take a proactive approach to mitigating and adapting to climate change taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures."

2.39 Paragraph 160 states that:

> "To help increase the use and supply of renewable and low carbon energy and heat, plans should:
>
> - a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

- b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
- c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."

2.40 Paragraph 161 states that:

"Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning."

2.41 The NPPF goes on to state at paragraph 163 that:

"When determining planning applications for renewable and low carbon development, local planning authorities should:

- a. not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions;
- b. approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas; and
- c. in the case of applications for the repowering and life-extension of existing renewable sites, give significant weight to the benefits of

> utilising an established site, and approve the proposal if its impacts are or can be made acceptable."

2.42 The December 2023 version of the NPPF contained the following footnotes to paragraph 163:

> Footnote 57: "Wind energy development involving one or more turbines can also be permitted through Local Development Orders, Neighbourhood Development Orders and Community Right to Build Orders. In the case of Local Development Orders, it should be demonstrated that the planning impacts identified by the affected local community have been appropriately addressed and the proposal has community support."
>
> Footnote 58: "Except for applications for the repowering and life-extension of existing wind turbines, a planning application for wind energy development involving one or more turbines should not be considered acceptable unless it is in an area identified as suitable for wind energy development in the development plan or a supplementary planning document; and, following consultation, it can be demonstrated that the planning impacts identified by the affected local community have been appropriately addressed and the proposal has community support."

2.43 These footnotes have been characterised (and earlier, similar versions) have been characterised as creating a de-facto ban on the development of onshore wind and very few wind energy applications have been submitted for planning approval in England since the policy regime was originally introduced in 2015 **[See reference 11]**.

2.44 However, the new Labour Government issued a policy statement on 8th July 2024 deleting the tests set out in Footnotes 57 and 58 with immediate effect. These changes are reflected in the proposed reforms to the NPPF that the Government is consulting on from 30th July 2024 **[See reference** 12**]**. These proposed reforms to the NPPF also include wider changes to support locally consented renewable energy development, including:

- Amendments to existing paragraph 163 to direct decision makers to give significant weight to the benefits associated with renewable and low carbon energy generation, and proposals' contribution to meeting a net zero future;
- Further amendments to paragraph 160 to set a stronger expectation that authorities proactively identify sites for renewable and low carbon development when producing plans, where it is likely that in allocating a site, it would help secure development; and
- Development of renewables may be proposed in sensitive areas which may include valuable habitats.

2.45 The consultation also proposes bringing large onshore wind proposals back into the Nationally Significant Infrastructure Project regime, to support quick determination, followed by a revised National Policy Statement.

2.46 The Government has also signalled an intention to empower local communities to participate in decisions on local infrastructure and to benefit from hosting local renewable energy infrastructure and will shortly publish an update to the Community Benefits Protocol for Onshore Wind in England **[See reference** 13**]**.

National Planning Practice Guidance (PPG)

2.47 The online National Planning Practice Guidance (PPG) resource, published by the Department for Levelling Up, Housing and Communities (DLUHC) and Ministry of Housing, Communities and Local Government (MHCLG) provides further interpretation of national planning policy for the benefit of local planning authorities and planning practitioners. Although the section on climate change has not been updated following the changes to the Climate Change Act and the UK Climate Emergency Declaration, it strongly asserts the importance of climate change within the planning system and the need for adequate policies if Local Plans are to be found sound **[See reference 14]**:

> "Addressing climate change is one of the core land use planning principles which the National Planning Policy Framework expects to underpin both plan-making and decision-taking. To be found sound, local plans will need to reflect this principle and enable the delivery of sustainable development in accordance with the policies in the National Planning Policy Framework. These include the requirements for local authorities to adopt proactive strategies to mitigate and adapt to climate change in line with the provisions and objectives of the Climate Change Act 2008, and co-operate to deliver strategic priorities which include climate change." [Paragraph 1]

2.48 In respect of the approach to identifying climate mitigation measures for new development, the PPG also states:

> "Every area will have different challenges and opportunities for reducing carbon emissions from new development such as homes, businesses, energy, transport and agricultural related development. Robust evaluation of future emissions will require consideration of different emission sources, likely trends taking into account requirements set in national legislation, and a range of development scenarios." [Paragraph 7]

2.49 The PPG also makes it clear with regards to renewable energy that:

> "When drawing up a Local Plan local planning authorities should first consider what the local potential is for renewable and low carbon energy

> generation. In considering that potential, the matters local planning authorities should think about include:
>
> - The range of technologies that could be accommodated and the policies needed to encourage their development in the right places;
> - The costs of many renewable energy technologies are falling, potentially increasing their attractiveness and the number of proposals; and
> - Different technologies have different impacts and the impacts can vary by place.
>
> The UK has legal commitments to cut greenhouse gases and meet increased energy demand from renewable sources. Whilst local authorities should design their policies to maximise renewable and low carbon energy development, there is no quota which the Local Plan has to deliver."
> [Paragraph 3]

2.50 The role community-led renewable energy initiatives have is outlined and states that they:

> "are likely to play an increasingly important role and should be encouraged as a way of providing positive local benefit from renewable energy development… Local planning authorities may wish to establish policies which give positive weight to renewable and low carbon energy initiatives which have clear evidence of local community involvement and leadership."
> [Paragraph 4]

2.51 In terms of identifying suitable locations for renewable energy development, such as wind power, the PPG section on 'Renewable and Low Carbon Energy' states:

> "There are no hard and fast rules about how suitable areas for renewable energy should be identified, but in considering locations, local planning authorities will need to ensure they take into account the requirements of the technology and, critically, the potential impacts on the local environment, including from cumulative impacts. The views of local communities likely to be affected should be listened to.
>
> When identifying suitable areas it is also important to set out the factors that will be taken into account when considering individual proposals in these areas. These factors may be dependent on the investigatory work underpinning the identified area.
>
> There is a methodology available from the Department for Energy and Net Zero's website on assessing the capacity for renewable energy development which can be used and there may be existing local assessments. However, the impact of some types of technologies may have changed since assessments were drawn up (e.g. the size of wind turbines has been increasing). In considering impacts, assessments can use tools to identify where impacts are likely to be acceptable. For example, landscape character areas could form the basis for considering which technologies at which scale may be appropriate in different types of location." [Paragraph 5]

2.52 It also goes on to state that:

> "Local planning authorities should not rule out otherwise acceptable renewable energy developments through inflexible rules on buffer zones or separation distances. Other than when dealing with setback distances for safety, distance of itself does not necessarily determine whether the impact of a proposal is unacceptable." [Paragraph 8]

Neighbourhood Development Plans

2.53 Neighbourhood planning offers local communities an opportunity to produce positive and ambitious sustainable energy plans for their local area. The PPG on Renewable and Low Carbon Energy states that:

> “Local and neighbourhood plans are the key to delivering development that has the backing of local communities.” [Paragraph 3]

2.54 Across the country, the large majority of the numerous plans adopted so far, show little evidence of having considered the issue of climate change and energy to the level that is required to have meaningful impact **[See reference 15]**.

2.55 However, given the right support, Neighbourhood Development Plan (NDP) groups can serve to convene and inform local communities and stimulate bottom-up renewable energy policies and development.

Building Regulations – Part L

2.56 National standards for energy use and emissions within new developments are set by Part L1A and Part L2A of the Building Regulations, which concern the conservation of fuel and power in new dwellings and new buildings other than dwellings respectively. The current regulations came into operation in 2010 but were re-issued in 2013 and amended in 2016. The regulations apply a cap to a building’s emissions through the use of a nominal Target Emissions Rate (TER) measured in $kgCO_2/m^2$/year, which for dwellings must not be exceeded by the Dwelling Emissions Rate (DER) as calculated according to the Standard Assessment Procedure (SAP) methodology.

2.57 In October 2019 the Government launched a consultation on the next revision of the Building Regulations and proposed a new 'Future Homes Standard' with the message that "We must ensure that new homes are future-proofed to facilitate the installation of low-carbon heat, avoiding the need to be retrofitted later, and that home builders and supply chains are in a position to build to the Future Homes Standard by 2025".

2.58 The consultation considered two levels of emission reductions for new dwellings from 2020: either 20% or 31% over current 2013 Part L standards, and for the 2025 Future Homes Standard a 75-80% reduction together with low carbon heating systems. These standards aim to reduce or remove the dependency on fossil fuels and encourage the use of heat pumps, heat networks or in some circumstances direct electric heating in the context of a rapidly decarbonising UK electricity supply. The 2020 31% target ('Fabric plus technology') is stated as being the Government's preferred option and would most likely comprise energy efficiency measures with onsite low carbon generation, whereas the 20% option ('Future Homes Fabric') would require higher levels of fabric energy efficiency.

2.59 The consultation also proposed that from 2020 the energy efficiency of new dwellings should be assessed in terms of 'primary energy' as the basis for the Part L performance target (alongside emission targets), and that from 2020, homes should be future-proofed for low carbon heating. This is likely to mean that, if not already fitted, homes should have a low temperature heat distribution system so that they will be compatible with heat pumps. Additionally, in order to counteract existing variations in local authority-set performance standards, the consultation also proposed to remove the powers from local authorities to set their own standards above Part L (as granted under the Planning and Energy Act).

2.60 In January 2021 the Government launched a consultation on the second stage of the 2-part consultation on proposed changes to Part L (Conservation of fuel and power) and Part F (ventilation) of Building Regulations. It confirmed that the Planning and Energy Act 2008 will not be amended, which means that local authorities will retain powers to set local energy efficiency standards for new homes. It also built on the Future Homes Standard consultation by setting out energy and ventilation standards for non-domestic buildings, existing homes and included proposals to mitigate against overheating in residential buildings.

2.61 This consultation considered two ambitious options to uplift energy efficiency and ventilation standards for new non-domestic buildings including: introduction of overheating standards for new residential buildings in 2021 and a 2021 uplift of energy and ventilation standards (Part L and Part F) for homes. The Government responded in December 2021 to the consultation **[See reference** 16**]**, the responses are summarised below:

- Starting from 2025, the Future Building Standard will produce highly efficient new non-domestic buildings;
- A new full technical consultation on the Future Buildings Standard commencing December 2023 (see below);
- Employment of the performance metrics set out in the consultation will be undertaken: a new primary energy target, a CO_2 emissions target and minimum standards for fabric and fixed building services; and
- The interim uplift will also make sure that construction professionals and supply chains are working to higher specifications in readiness for the introduction of the Future Buildings Standard from 2025.

2.62 Alongside, the publication of the Government's response, the 2021 uplift has been implemented, therefore as of 15th June 2022, all new build homes and commercial buildings must reduce their carbon emissions by 31% and 27% respectively, according to the updated Building Regulations. A further, more detailed, consultation began in December 2023 and ran until March 2024. The Heat and Buildings Strategy outlines the need to eliminate virtually all emissions arising from heating, cooling and energy use in our buildings. As such, the 2025 Future Homes and Buildings Standards aim to build on the 2021 Part L uplift and set more ambitious requirements for energy efficiency and heating for new homes and non-domestic buildings. These standards are set to be in line with meeting the 2050 net zero target. The main proposals being consulted on include: performance requirements for new building, retaining existing metrics, improvements to standards for fixed building services and on-site electricity generation, improved standards for dwellings created through material change of use, expanding cleaner heat networks, changes to the regulations permitting local authorities to relax or dispense the energy efficiency requirements, gathering evidence on two proposed measures to improve building performance in new homes against expected energy use and reviewing approach to setting standards and transitional arrangements.

Local policy and guidance

Harborough Local Plan 2011-2031

2.63 The existing local plan presents HDC's current approach for renewable and low carbon energy in Policy CC2 Renewable energy generation. Part 1 sets out a criteria based policy for where renewable and low carbon regeneration will be acceptable. Part 2 identifies areas where developments of one or more wind turbines will not be acceptable. The full text of this policy is reproduced in the 'Policy options for renewable and low carbon energy in Harborough District' chapter, later in this report.

Harborough District Climate Emergency Plan 2021

2.64 Harborough District Council declared a Climate Emergency in July 2019. This followed on from many years working on action plans devised as part of the Local Government Association initiative; "Climate Local", which Harborough District Council committed to in 2013. Council has adopted a Climate Emergency Action Plan and agreed that it should form part of the Corporate Plan.

2.65 The six key climate emergency commitments in the plan where the Council has the opportunity to act are:

1. The Council commits to demonstrate political and corporate leadership in acting on climate change;

2. The Council commits to managing its own assets and services, with the aim of reducing carbon emission to net zero by 2030, as far as practical;

3. The Council commits to working with residents and communities to support their actions in reducing emissions and help them increase their resilience to the impacts of climate change;

4. The Council commits to working with businesses to support their actions in reducing emissions and help them increase their resilience to the impacts of climate change;

5. The Council commits to ensuring that new development is designed to mitigate emissions and be resilient to the impacts of climate change; and

6. The Council commits to working in partnership to promote resilient natural systems that will help to reduce the impacts of climate change.

Chapter 3

Existing renewable and low carbon energy generation

Introduction

3.1 This chapter sets out information on existing renewable and low carbon energy generation within Harborough.

3.2 It is not possible to identify an exact figure for the amount of existing renewable energy generation across the District, however estimates for installed electricity generation capacity and output are set out in Table 3.1. This draws on:

- Sub-regional data from the Government's Feed-in Tariff (FiT) scheme **[See reference** 17**]**; and
- The Government's Renewable Energy Planning Database (REPD) **[See reference** 18**]**, which lists all renewable electricity projects over 150kW.

3.3 Figure 3.1 to Figure 3.3 only include those projects that were registered as operational and consented at the time of preparing this report.

Figure 3.1: Existing operational and consented renewable energy generation: capacity

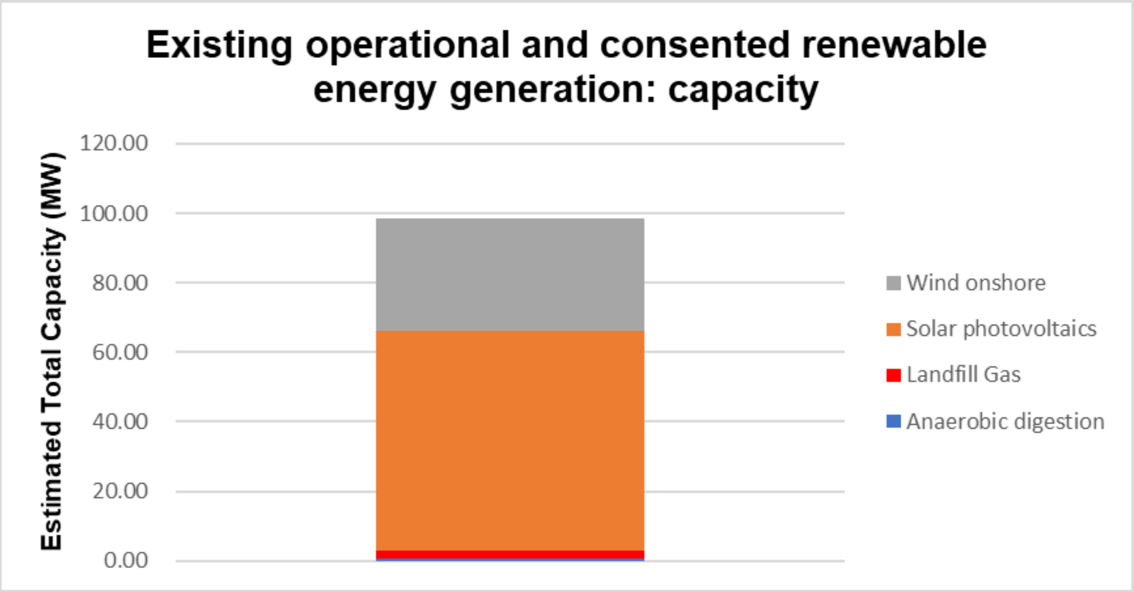


Figure 3.2: Existing operational and consented renewable energy generation: electricity output

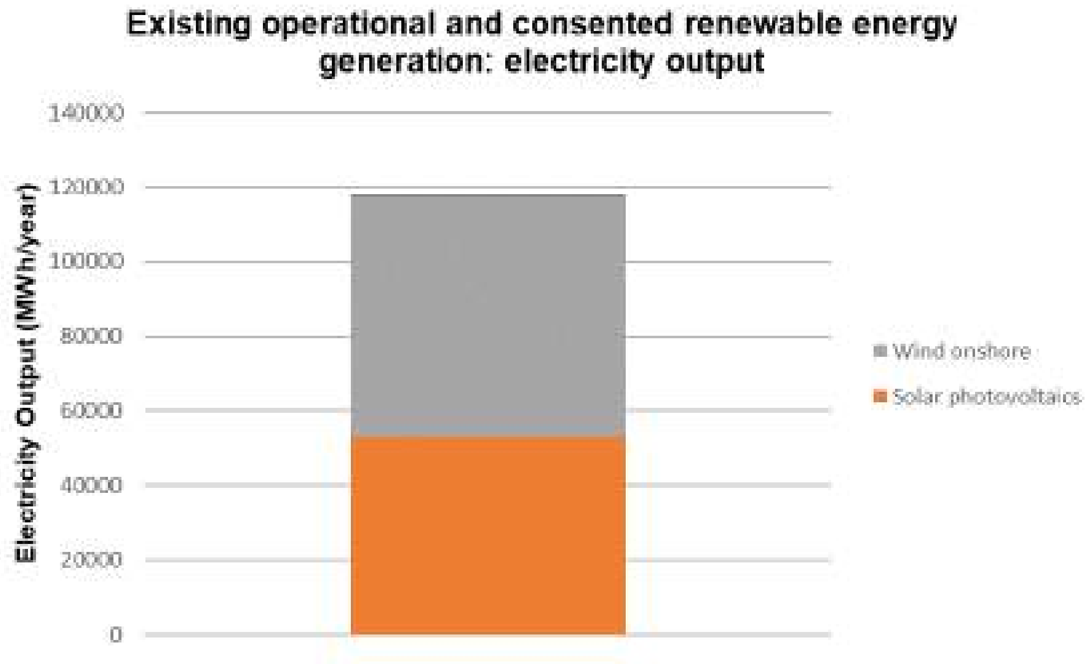
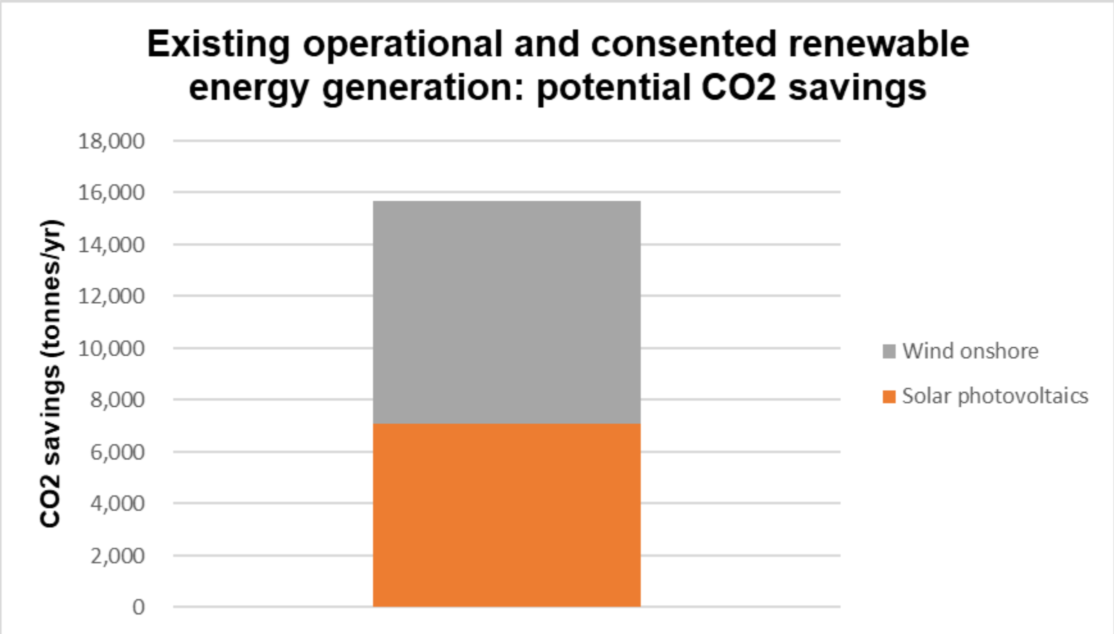


Figure 3.3: Existing operational and consented renewable energy generation: potential CO_2 savings



3.4 The locations for existing and consented installations across Harborough, as currently listed in the Renewable Energy Planning Database are shown in Figure 3.4 below.

3.5 Figure 3.4 shows that the renewable energy installations are widely distributed across Harborough, with the exception of the south-east of the District. Most of these are solar photovoltaics.

3.6 As outlined in Table 3.1, there is currently 98.4MW of operational renewable electricity generation capacity across Harborough, providing annual emission savings of over 16,000tCO_2.

3.7 Table 3.1 shows that solar photovoltaics and onshore wind are the main sources of renewable energy generation in Harborough.

Table 3.1: Existing and consented renewable installations in Harborough

Technology	Estimated Total Capacity (MW)	Electricity Output (MWh/year)	Potential CO_2 Savings (tonnes/yr)
Anaerobic digestion	0.5	2,835	377
Landfill gas	2.3	N/A	N/A
Solar photovoltaics	63.3	53,191	7,074
Wind onshore	32.2	64,632	8,596
Total	98.4	120,658	16,047

Renewable heat

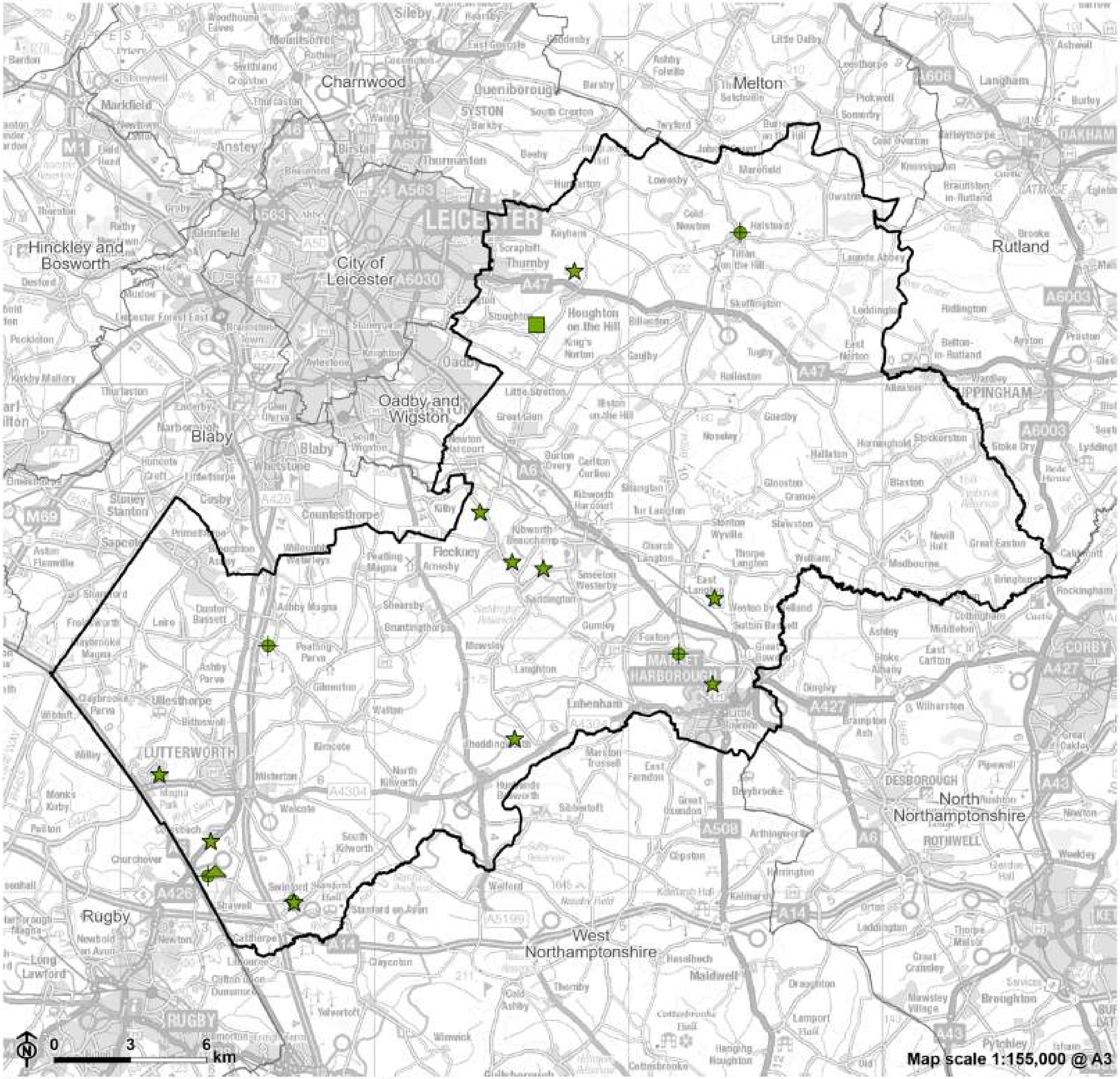
3.8 The amount of existing renewable heat generation in Harborough from biomass, solar water heating and heat pumps has been estimated using sub-national data within the Renewable Heat Incentive (RHI) statistics **[See reference** 19**]**. These statistics indicate that there are 1,812 (approx. 22.4MW) domestic accredited full applications for the Renewable Heat Incentive within Harborough. Technology breakdowns for domestic installations are given in Table 3.2. In addition, Table 3.1 indicates there is 2.3MW of operational landfill gas development.

Table 3.2: Existing domestic renewable heat installations

Technology	Number of Accredited Full Domestic Applications	Average System Capacity (kW)	Approx. Installed Capacity (MW)	Approx. Delivered Heat (MWh/year)	Approx. CO_2 Savings (tonnes/yr)
Air source heat pumps	1,238	10.20	12.6	20,354	3,534
Ground source heat pumps	273	15.00	4.1	6,529	1,152
Biomass systems – assuming heating only	202	26.50	5.4	20,473	4,311
Solar water heating	99	2.80	0.3	109	23

Renewable Energy Study
Harborough District

Figure 3.4: Existing and consented renewable energy installations within Harborough



Harborough District
Neighbouring Local Authority

Technology

Anaerobic Digestion
Landfill Gas
Solar Photovoltaics
Wind Onshore

12842_Other_Figure 09/09/2024 EB:shayler_h

Chapter 4

Renewable and low carbon energy opportunities

Introduction

4.1 This chapter provides the results of the assessment of the 'technical potential' for renewables within Harborough. It also includes a discussion of the issues that will affect what could be realistically delivered within the District – i.e. the 'deployable potential'. This includes the consideration of factors such as planning, economic viability and grid connection.

4.2 The technical potential is the total amount of renewable energy that could be delivered in the area based on a number of assumptions regarding the amount of resource available and the space available to harness this resource using current renewable energy technologies. The assessment of technical potential has been applied at a strategic scale across Harborough and as such it is only able to quantify the theoretical opportunity for renewable energy production in the District.

While some areas of opportunity and constraint have been mapped, the study does not identify locations that would be acceptable for renewable energy development in planning terms. More detailed site assessments (i.e. as required for a planning application) would be required to determine if specific sites are suitable in planning terms.

4.3 The assumptions used to calculate 'technical potential' for each renewable technology are provided in Appendix A.

Assessment of potential for renewables

4.4 Broadly, the assessment of technical potential for each form of renewable energy and low carbon technology considers:

- The availability of the naturally occurring energy resource in the District;
- The potential to convert this into usable energy in light of the technical limitations of existing renewable energy technologies; and
- The maximum theoretical space available to accommodate the technology, in light of the physical characteristics of the technology and key environmental conditions and constraints present in the District.

4.5 The following section summarises the assessment of technical potential for each form of renewable and low carbon technology. For each resource, where relevant it includes the following information:

- Description of the technology;
- Summary of existing deployment within Harborough;
- Assumptions used to calculate technical potential;
- Results of assessment of technical potential; and
- Summary of issues affecting deployment.

4.6 The assessment approach is based on the former Department of Energy and Climate Change (DECC) Renewable and Low-Carbon Energy Capacity Methodology: Methodology for the English Regions (2010) **[See reference** 20**]** as referenced in the PPG. This has been updated and refined to take account of local circumstances within Harborough where appropriate.

4.7 In addition, the potential carbon savings as a result of generation via the identified potential from each renewable technology was calculated by considering the “emissions factor” of energy sources. An emissions factor provides the annual average carbon intensity of energy used and is used to calculate the potential carbon savings of replacing national grid-sourced electricity, mains gas and heating oil, with that from renewables, which have negligible carbon emissions.

4.8 The emissions factors for mains gas and heating oil used in this assessment were 0.210kgCO2e/kWh and 0.298kgCO2e/kWh respectively, and were sourced from SAP10.2 **[See reference** 21**]**. These sources of energy remain consistent and as such their emissions factor does not change over time **[See reference** 22**]**.

4.9 However, the sources of electricity feeding the national grid can change and its carbon intensity is decreasing over time as more of the UK's grid electricity is sourced from renewables. As such, the carbon savings from deploying renewables is also decreasing over time. The national grid electricity emission factor used within this assessment was 0.133kgCO2e/kWh. This is sourced from the National Grid (2024) Future Energy Scenarios: FES 2024 Data workbook **[See reference** 23**]** and provides the annual average carbon intensity of electricity based on a five-year forecast from 2023. This was used as this is the most up to date forecast available, and so the most accurate value to use to calculate the potential carbon savings of using renewable energy in the future.

Wind

Description of technology

4.10 Onshore wind power is an established and proven technology with thousands of installations currently deployed across many countries throughout the world. The UK has the largest wind energy resource in Europe.

4.11 Turbine scales do not fall intrinsically into clear and unchanging size categories. At the largest scale, turbine dimensions and capacities are evolving quite rapidly with the largest turbines in Scotland now reaching 250m to blade tip. The deployment of turbines at particular 'typical' scales in the past has also been influenced by changing factors which include the availability of various subsidies. As defined scales need to be applied for the purpose of the resource assessment, the assessment used five size categories based on consideration of current and historically ‘typical’ turbine models:

- Very large (150-220m tip height);
- Large (100-150m tip height);
- Medium (60-100m tip height);
- Small (25-60m tip height); and
- Very small (<25m tip height).

4.12 An assessment of technical potential for very small wind (<25m height) was not undertaken as it is not possible to define areas of suitability for these using the same assessment criteria. Notional turbine sizes falling within the middle of each class size are used for the technical resource assessment as set out in Table 4.1.

Table 4.1: Notional turbines used for the resource assessment

Scale	Typical Turbine Installed Capacity	Typical Turbine Height (maximum to blade tip)
Very large	4MW	185m
Large	2.5MW	125m
Medium	0.5MW	80m
Small	0.05MW	45m

4.13 Most turbines above the smallest scales have a direct connection into the electricity network. Smaller turbines may provide electricity for a single premises via a ‘private wire’ (e.g. a farm or occasionally a large energy use such as a factory) or be connected to the grid directly for export. Typically, turbines will be developed in larger groups (wind farms) only at the larger scales. The amount of energy that turbines generate will depend primarily on wind speed but will be limited by the maximum output of the individual turbine (expressed as 'installed capacity' in Table 4.1).

4.14 A review of wind turbine developments across the UK found that tip heights range from less than 20m up to around 250m, with larger turbine models particularly in demand from commercial developers. This has been driven by the reduction in financial support from Government, product development by manufacturers, and trends from other European markets where turbines of this scale have been developed for some time. The majority of operational and planned turbines range between 80m and 250m, with the majority of new applications in Scotland and Wales currently being at the larger end of the scale.

4.15 For January to March 2024, the UK had 15,426MW of installed onshore wind capacity, providing 11,040GWh electricity during those months **[See reference** 24**]**. Since the removal of financial support and restrictive policy requirements in the 2015 Written Ministerial Statement and subsequently incorporated in the NPPF, onshore wind development activity has moved overwhelmingly away from England towards Scotland and Wales, where it is focusing particularly on sites with high wind speeds and the ability to accommodate large numbers of tall turbines. Very few onshore wind energy projects have been approved and built within England since 2015. However, this is likely to change since the removal of Footnotes 57 and 58 in the NPPF by the new Labour Government.

Existing development within Harborough

4.16 According to the most recent DESNZ Renewable Energy Data base **[See reference** 25**]** there are two operational wind developments within Harborough currently. Low Spinney Wind farm which has an installed capacity of 8MW (4 x 125m to tip wind turbines) and Swinford Wind Farm with an installed capacity of 22MW (11 x 125m to tip wind turbines). These were both approved in 2009 and became operational in 2011 and 2012 respectively. Three onshore wind applications have been refused in the District to date. Valley View Farm (1.3MW

– refused in 2010), Airfield Farm (7.5MW – refused in 2010) and Redland Roof Tiles (2MW – refused in 2014).

Assumptions used to identify land with technical potential

4.17 The assessment of technical potential for very large, large, medium and small turbines was undertaken using GIS (Geographical information Systems) involving spatial mapping of key constraints and opportunities. The assessment identified areas with suitable wind speeds (applying a reasonable but relatively generous assumption in this respect, bearing in mind that only the highest wind speeds are potentially viable at the present time) and the number of turbines that could theoretically be deployed within these areas. A series of constraints relating to physical features, such as environmental/heritage protection were then removed. The remaining areas have 'technical potential' for wind energy development.

4.18 The key constraints considered are set out in detail in Appendix A.

4.19 Unconstrained areas of land were excluded if they were below a minimum developable size of 40m width and an area that varied per turbine size:

- Very large: 0.8ha
- Large: 0.6ha
- Medium: 0.4ha
- Small: 0.2ha

4.20 Following this, the total area of land with 'technical potential' for wind energy development for each turbine size category was then calculated.

4.21 The calculation of potential wind capacity involved applying an assumption concerning development density. In practice, turbines are spaced within developments based on varying multiples of the rotor diameter length. Although turbine separation distances vary, a 5 by 3 rotor diameter oval spacing **[See reference** 26**]**, with the major axis of the oval oriented towards the prevailing wind direction, taken to be south-west as the 'default' assumption in the UK, was considered a reasonable assumption. In practice, site-specific factors such as prevailing wind direction and turbulence are taken into account by developers, in discussion with turbine manufacturers. Bearing in mind the strategic nature of the present study, the density calculation did not take into account the site shape, and a standardised density was used instead, as set out below:

- Very large: 4 turbines per km^2
- Large: 8 turbines per km^2
- Medium: 22 turbines per km^2
- Small: 167 turbines per km^2

4.22 The calculation of potential energy yield requires the application of a 'capacity factor'. The capacity factor is the average proportion of maximum turbine capacity that would be achieved in practice over a given period, i.e. the average proportion of the total energy that can be produced by a wind development over a year, in comparison to the amount of energy that would have been produced if the wind turbines were producing energy at full output for a whole year. With regards to wind generation, this most notably reflects the fact that wind turbines will not produce energy when the wind is not blowing. Capacity factors vary in practice in accordance with wind speed, terrain and turbine scale. It was not possible to find suitable local historic data on capacity factors, taking into account these kinds of variations in Harborough for the present study, and so a single capacity factor of 22.9% was used for all turbine scales, based on available regional data for the East Midlands **[See reference** 27**]**. This indicates that within the East Midlands, wind turbines will on average produce the equivalent amount of energy as the development working at full output for 22.9% of the year.

4.23 In addition, the potential carbon savings as a result of generation via the identified wind potential was calculated. This assumed that the electricity generated from the identified wind potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.133kgCO_2e/kWh **[See reference** 28**]**.This could either be via use of the electricity on-site, on-site following battery storage, or off-site via export.

Results

Technical potential

4.24 Figure 4.1 and Table 4.2 below provides a summary of the estimated technical potential for wind energy in Harborough. The analysis examined the potential for very large, large, medium and small turbines. Where potential exists for more than one size of turbine, it was assumed that the larger turbines would take precedence as, to ensure viability, developers usually seek to install the largest capacity turbines possible.

4.25 The assessment results indicate that there is a technical potential to deliver up to around 2,678MW of wind energy capacity in Harborough, equating to powering approximately 1.9 million homes a year **[See reference** 29**]** The associated potential annual CO_2 savings of 714,289 tonnes are equivalent to planting approximately 27.5 million trees a year **[See reference** 30**]**. The greatest technical potential is for small turbines (see Figure 4.1 and Table 4.2).

Figure 4.1: Onshore wind potential capacity and carbon savings within Harborough

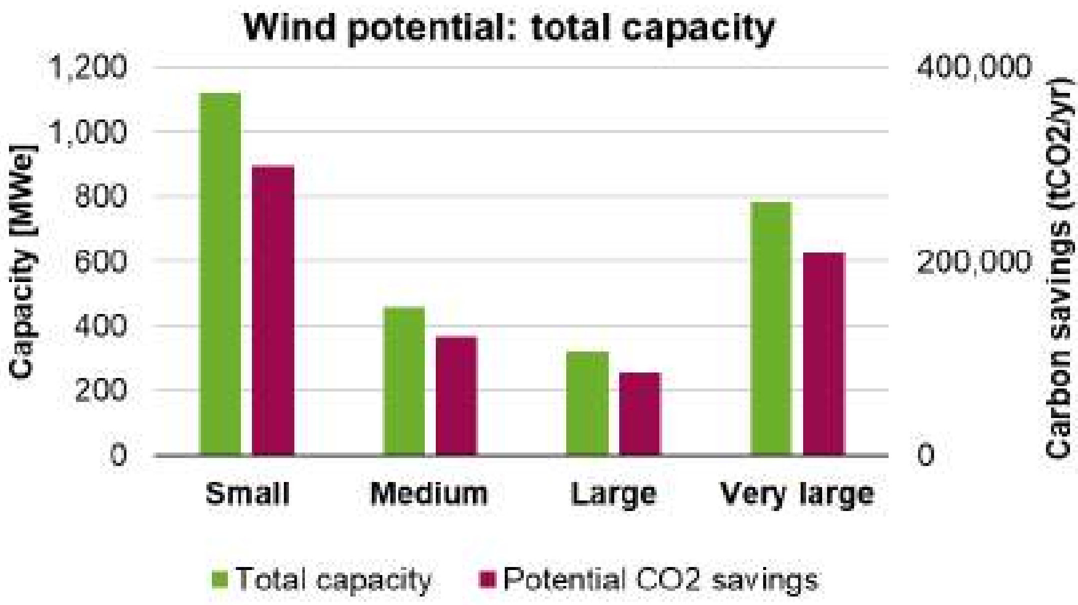


Table 4.2: Potential wind capacity and output

Development Scale	Estimated Total Capacity (MW)	Electricity Output (GWh/year)	Potential CO_2 Savings (tonnes/year)
Small	1,119	2,243	298,369
Medium	456	915	121,680
Large	322	645	85,743
Very large	782	1,568	208,497
Total	2,678	5,371	714,289

4.26 The maps included in Appendix B show the areas that have been identified via the GIS analysis to have technical potential for wind development at each turbine scale. These figures indicate that there are pockets of potential for very large scale wind development scattered across the District. Additionally, most of the District outside of the main built up areas (Broughton Astley, Bushby Thurnby, Fleckney, Kibworth Harcourt/Kibworth Beauchamp, Lutterworth, Market Harborough) contains significant areas with potential for wind generation at smaller scales.

4.27 In order to illustrate the GIS tool parameters, a series of opportunity and constraints maps was produced. Figure B.1 in Appendix B shows the wind speed within Harborough at 50m above ground level (agl). This shows that small areas with the highest winds speeds are found in the north-east of the District. Other mapped constraints that have influenced the assessment outcomes are included in Appendix B. Maps depicting the physical constraints are only included for small and very large turbines for illustrative purposes, showing the minimum and maximum buffer distances applied to physical features depending on turbine size.

4.28 An assessment of this nature will necessarily have certain limitations, including:

- Wind data – It is important to note that the macro-scale wind data which was used for this assessment can be inaccurate at the site-specific level and therefore can only be used to give a high level indication of potential capacity and output within Harborough. Developers will normally require wind speeds to be accurately monitored using anemometers for an extended period (typically at least one to two years) for commercial scale developments.
- Cumulative effects – Multiple wind turbine developments can have a variety of cumulative effects. Cumulative landscape and visual effects, in particular, would clearly occur if all the identified areas of wind development potential were to be realised. Cumulative effects, however, cannot be taken into account in a high-level assessment of this nature and must be considered on a site-by-site basis.
- Site-specific features and characteristics – In practice, developments outside protected areas may potentially have an impact on amenity and sensitive ‘receptors’ such as protected species. These impacts can only be assessed via site-specific surveys.

- Aviation – Although operational airports and airfields were considered to be constraints to wind development, airport safeguarding zones were only mapped for information. Aviation interests were not used to restrict potentially suitable areas as these impacts require site by site consideration and mitigation may be available to address any issues.

Issues affecting deployment

4.29 The technical wind development potential within Harborough, as estimated through application of reasonable constraints within a GIS tool, is not the same as the development capacity that may be expected to be deployed in practice.

4.30 Certain limitations of the resource assessment with respect to deployable wind potential have already been noted in the previous section. For example, cumulative impacts can only be considered fully when developments come forward in practice but would generally be expected to reduce the overall deployable capacity. However, there are four key factors that affect the deployable wind potential that merit individual consideration: landscape sensitivity, grid connection, development income and planning issues. These are discussed in turn below.

Landscape sensitivity

4.31 Landscape and Visual Impact (LVI) has historically often been a defining consenting consideration within the context of planning applications for wind developments, and has therefore been a particularly important influence on the choice of turbine scales and locations by developers.

4.32 As the degree of acceptable landscape and visual impact is generally a matter that needs to be considered within the context of an overall planning balance, no land was excluded from the GIS technical constraints assessment on landscape or visual grounds. Instead, a separate landscape sensitivity assessment (LSA) is recommended to be undertaken to consider all Landscape

Character Areas defined within the Harborough Landscape Character Assessments with technical potential for development. The LSA could be used alongside the output of this assessment of technical potential to help the Council identify which areas may be more or less suitable for onshore wind energy development within Harborough. It should be noted that site specific assessments (including landscape and visual impact and residential amenity assessments) would also be needed to verify the suitability of specific wind energy development proposals in landscape terms. Careful consideration of the potential landscape impacts versus the public benefits of renewable energy would need to be weighed through the planning application process.

Grid connection

4.33 Historically, it has been possible to connect a variety of wind energy development scales into the distribution network at a wide range of distances from the nearest connection point. This situation has changed dramatically over recent years due to two factors in combination:

- The distribution network, and even the transmission network **[See reference** 31**]**, have become increasingly congested, to the point at which connections in many cases cannot take place without expensive network reinforcement costs (which fall to the developer) being incurred, or generation being curtailed, or both; and
- The Government's cancelling of subsidies for onshore wind in 2016 has reduced wind development incomes to the point at which previously affordable reinforcement works would now render many developments unviable, particularly those of smaller scale.

4.34 Within Harborough, National Grid is now the distribution network operator, having bought out Western Power Distribution. Western Power Distribution prepared a Business Plan 2023-2028, which is still being used by National Grid, and this actively supports community renewable energy schemes **[See reference** 32**]**.

4.35 ESO (formerly known as the National Grid) is the overall electricity system operator for the UK and has included various recommendations within the Beyond 2030 plan **[See reference** 33**]**. For Leicestershire, the plan notes that upgrades are necessary to existing infrastructure in the region. For example, ESO has proposed increasing the voltage of the circuit, replacing the line conductors with higher capacity ones, or adding devices to better control how electricity flows along the line. These upgrades reduce the amount of new infrastructure needed.

4.36 Most of the upgrade projects are identified in the Beyond 2030 plan (published March 2024) as having reached level 2 maturity where level 1 is scoping and level 6 is construction. Therefore, although investment is being proposed it is likely that grid capacity will remain constrained for the immediate future. Grid could therefore be a significant constraint in the short-medium term in relation to the deployment of wind and all large-scale grid-connected renewable energy developments. As the local plan period extends past 2028, it is important that if Local Plan policy identifies suitable areas for wind energy, these do not preclude developments that may become less constrained later in the plan period. This is also reflected in the discussion of policy options in Chapter 5.

Development income

4.37 Financial support mechanisms in the form of Government subsidies such as the Renewables Obligation (RO) and Feed In Tariff (FiT) previously allowed onshore wind to be developed at a variety of scales and at a variety of wind speeds. The RO closed to all new generating capacity on 31st March 2017 and the FiT closed to new applicants from 1st April 2019.

4.38 The Contracts for Difference (CfD) scheme is now the Government's main mechanism for supporting low-carbon electricity generation **[See reference** 34**]**. The first auction included 'Pot 1' technologies; 'established' technologies, including onshore wind. The successful applicants of Round 1 auctions, as announced in February 2015, included onshore wind developments. Since then, Round 2 and Round 3 of the auctions in September 2017 and September 2019 excluded Pot 1 technologies, including onshore wind developments. As a result of the general decline in financial support for onshore wind, developers are predominantly interested in developing wind turbines in locations with high wind speeds, such as Scotland, Wales and northern England, to enable schemes to be financially viable.

4.39 Round 4 of CfD auctions opened in December 2021, Round 5 opened in March 2023, and Round 6 opened in March 2024, all of which now include Pot 1 technologies, such as onshore wind **[See reference** 35**]**. Following the budget uplift announced by the new Labour government in July 2024 **[See reference** 36**]**, Round 6 includes a budget increase compared to previous Rounds, although the majority of the budget is allocated to offshore wind. It remains unclear whether this will make schemes more financially viable for developers in England as much of the country, including Harborough, has relatively low wind speeds, and any potentially financially viable developments require a number of very large turbines to maximise the power output and make the scheme economic.

4.40 Various initiatives can in theory improve wind development viability beyond the provision of subsidy. These could include, for example, establishment of local supply companies that can 'capture' the uplift from wholesale to retail energy prices. The signing of Power Purchase Agreements (PPA), such as between a developer and the Council, agreeing that the developer will sell the electricity generated to the Council, could make individual turbines viable, for example on an industrial estate.

4.41 Between 2010 and 2022, solar and wind power experienced a large cost deflation. For onshore wind projects specifically, the global weighted-average cost of electricity fell by 69% **[See reference** 37**]**. Over the last decade, turbine prices have fallen globally despite the increases in rotor diameters, hub-heights and nameplate capacities.

4.42 In addition, the Smart Export Guarantee has been introduced since January 2020 **[See reference** 38**]**. This is an obligation set by the Government for licensed electricity suppliers to offer a tariff and make payment to small-scale, low-carbon generators for electricity exported to the National Grid, providing certain criteria are met **[See reference** 39**]**. Wind developments of up to 5MW capacity could benefit from this obligation. However, as mentioned above, the obligation does not provide equal financial benefits to the previous FiT scheme (which provided funding for smaller scale renewable energy developments), as it only provides payments for electricity export, not generation, and it does not provide a guaranteed price for exported electricity.

4.43 Overall, viability challenges, based on reduced income relative to capital costs, are a challenge for wind development at all scales unless sites have high wind speeds. Within England, the highest wind speeds are found within the north of England so it is likely that wind energy developers will look to develop sites here before pursuing less viable sites elsewhere.

Planning issues

4.44 In addition to the lack of financial support mechanisms, until July 2024, the NPPF stated that wind energy development may only be permitted within areas identified suitable for wind energy developments within the development plan or supplementary planning document and where the development has the support of the local community (Footnote 58 in the NPPF). As such, the uptake of wind energy in England was very minimal as it discouraged developers. However, since the removal of the footnote by the new Labour Government, there may be an increase in onshore wind in England in the coming years.

4.45 Securing consent for onshore wind turbines, particularly very large scale wind turbines which are the most economically viable, is likely to remain a challenge although setting out positive planning policies within the Local Plan can help with this.

Onshore wind – conclusion

Onshore wind has the second largest technical potential energy output in Harborough of all the renewable and low carbon energy sources considered by this study, after ground-mounted solar PV. There are pockets of technical potential for very large scale wind development scattered across the District. Additionally, most of the District outside of the main built up areas contains significant areas with potential for wind generation at smaller scales. Onshore wind was estimated to have the potential to contribute approximately 16% of Harborough's total technical potential energy output. Due to the recent change to the NPPF there is new potential for onshore wind to be consented in England and as such it may be a good future option in Harborough. The economic viability of onshore wind in England does, however, remain a challenge to deployment; despite the more favourable national planning policy, commercial renewable energy developers may prioritise schemes in the North of England, where wind speeds are higher. Grid capacity could also be a significant constraint in the short-medium term in relation to the deployment of onshore wind and all large-scale grid-connected renewable energy developments.

Solar PV (ground-mounted)

4.46 In addition to PV modules integrated on built development, there are a large number of ground-mounted solar PV arrays or solar farms within the UK. These consist of groups of panels (generally arranged in linear rows) mounted on a frame. Due to ground clearance and spacing between rows (and between rows and field boundary features) solar arrays do not cover a whole field and allow vegetation to continue to grow between and even underneath the panels.

4.47 Ground-mounted solar project sizes vary greatly across the UK. Although developers in a post-subsidy environment are increasingly focusing on large-scale development, with the largest currently consented scheme in England (Longfield Solar Farm in Essex) being up to 500MW **[See reference 40]**, three quarters of operational schemes in the East Midlands have a capacity of less than 10MW **[See reference 41]**. There is no established standard for land take per MW of installed capacity, although land requirements for solar are comparatively high compared with wind. For the present assessment, an approximate land requirement of 1.2 hectares per MW has been applied within this assessment based on past and recent development experience.

4.48 In the period January to March 2024, the UK had 16,695MW of installed solar PV capacity, with this providing 1,914GWh of electricity during those months **[See reference** 42**]**. These figures include all forms of solar PV – although according to the most recent available data, ground-mounted schemes account for 48.6% of overall solar capacity **[See reference** 43**]**. Falling capital costs mean solar PV is increasingly viable in a post-subsidy context, although as outlined above, at present developers are generally focusing on large developments in order to achieve economies of scale. Grid connection costs can also critically affect viability.

Existing development within Harborough

4.49 The data available from DESNZ **[See reference** 44**]** identifies there is 53.1MW of ground-mounted solar PV currently operational or under construction in Harborough. This capacity is provided by four schemes, with two near Lutterworth providing the majority of the capacity: Swinford Solar Park (20.0MW capacity occupying approximately 26ha **[See reference** 45**]**) and Northfield House Solar Farm (26.0MW capacity occupying approximately 55ha **[See reference** 46**]**).

Assumptions used to identify land with technical potential

4.50 A GIS assessment of technically suitable land for solar development was undertaken using a similar approach to that undertaken for wind development. The assessment identified areas with financially viable solar irradiance levels (amount of sunlight) for PV. A series of primary constraints relating to physical features and environmental/heritage protection were then removed. The remaining areas have ‘technical potential’ for ground-mounted solar energy development.

4.51 Solar development is more ‘modular’ than wind (development size is dictated by the number of panels, which themselves do not differ greatly in size) and constraints are not affected by project scale in the way that they are for wind (e.g. the identification of areas suitable for wind turbine development excludes buffer areas around features such as roads, railways and electricity lines and the size of these buffer areas is based on the height of the turbines). Therefore, the identification of available land for ground-mounted solar has not been broken down into discrete project sizes but rather any land technically suitable for development has been identified.

4.52 The key constraints considered are set out in Appendix A. The total area of land with ‘technical potential’ for ground-mounted solar energy development was calculated.

4.53 The calculation of potential solar capacity involved applying an assumption concerning development density. An assumption of 1MW per 1.2 hectares was applied, in line with guidance within the Draft National Policy Statement for Renewable Energy Infrastructure (EN-3).

4.54 The calculation of potential energy yield requires the application of a ‘capacity factor’. The capacity factor is the average proportion of maximum PV capacity that would be achieved in practice over a given period, i.e. the average proportion of the total energy that can be produced by a solar development over a year, in comparison to the amount of energy that would have been produced if the solar panels were producing energy at full output for a whole year. With regards to solar generation, this most notably reflects the fact that solar panels will not produce energy when the sun is not shining. Capacity factors vary in practice in accordance with solar irradiation, which in turn is affected by location, slope and aspect. It was not possible to find suitable historic data on capacity factors taking into account these kinds of factors within Harborough for the present study, and so a single capacity factor of 9.59% was used, based on regional data available for the East Midlands **[See reference 47]**. This indicates that within the East Midlands, solar developments will on average produce the equivalent amount of energy as the development working at full output for 9.59% of the year.

4.55 The potential carbon savings as a result of generation via the identified ground-mounted solar potential was also calculated. This assumed that the electricity generated from the identified ground-mounted solar potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.133kgCO_2e/kWh **[See reference** 48**]**.This could either be via use of the electricity on-site, on-site following battery storage, or off-site via export.

Results

Technical potential

4.56 Figure 4.2, Figure 4.3 and Table 4.3 below provide an overview of the estimated technical potential for ground-mounted solar PV within Harborough. The unconstrained area with technical potential covers much of the District. Assuming that a basket of different renewable technologies was developed, not all of this unconstrained area would be available for ground-mounted solar PV as it overlaps with unconstrained areas with technical potential for other technologies such as wind. As with the other technologies assessed in this report, the actual potential for energy generation from this resource would also be affected by a variety of issues affecting deployment, as discussed below. The generation capacity of utilising smaller proportions of this technical resource (1%, 3% or 5%) have therefore also been quantified to illustrate what might be achieved from more realistic scales of deployment. Adopting the 3% development scale would result in a total potential technical capacity from ground-mounted solar PV across Harborough of 897MW – this approximately equates to an area of 11km^2, powering 279,000 homes a year **[See reference** 49**],** with potential CO_2 savings equating to planting approximately 3.9 million trees a year **[See reference** 50**]**.

Figure 4.2: Ground mounted solar PV potential

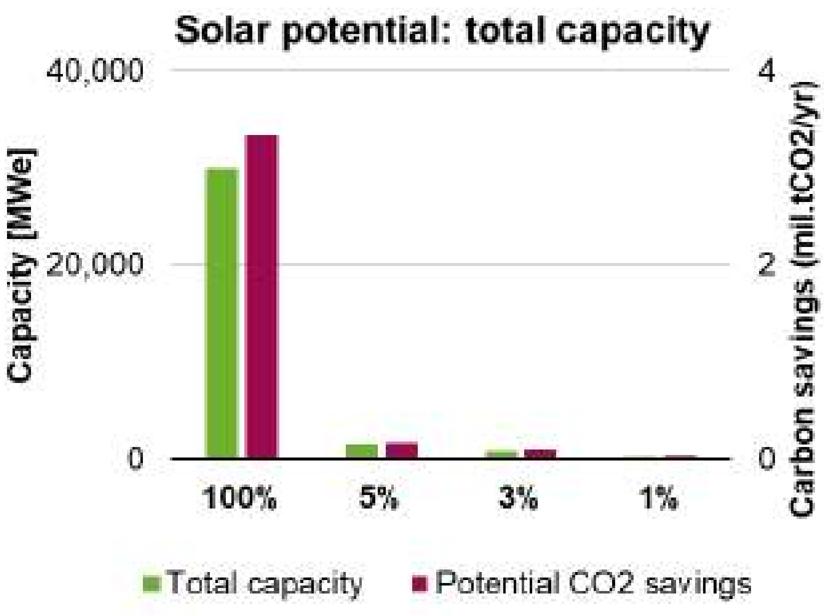


Figure 4.3: Ground-mounted solar PV potential: 1%, 3% and 5% only

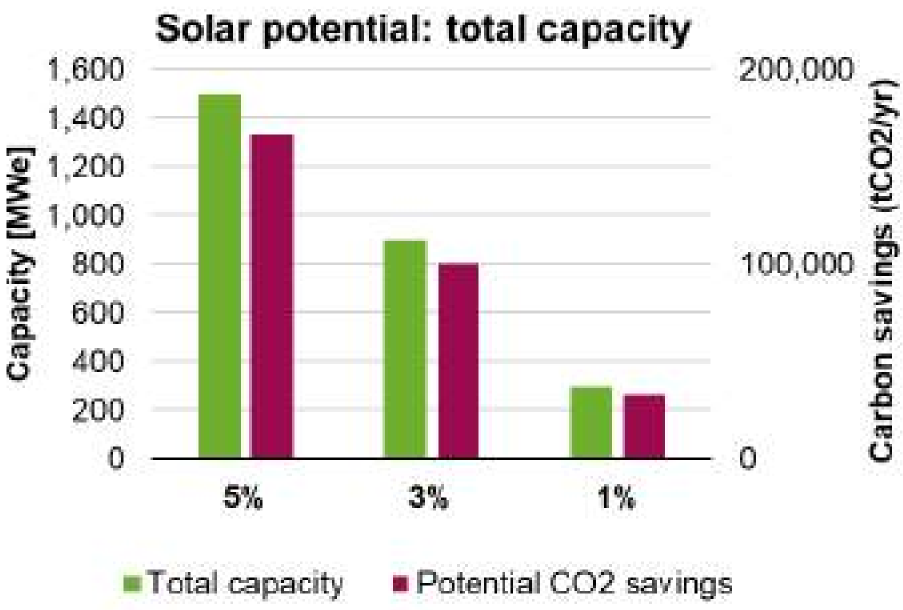


Table 4.3: Potential solar capacity and output

Development Scale	Potential Installed Capacity (MW)	Electricity Output (MWh/year)	Potential CO_2 Savings (tonnes/yr)
100% of technical resource	29,899	25,104,856	3,338,946
5% of technical resource	1,495	1,255,243	166,947
3% of technical resource	897	753,146	100,168
1% of technical resource	299	251,049	33,389

4.57 The key constraints and resulting potentially suitable land for solar development are presented in maps in Appendix C.

4.58 As with the wind resource assessment, the solar assessment has some key limitations. In particular, cumulative impacts are again a key consideration that the assessment cannot take into account but which would affect the suitability of planning applications in practice. A large area of land has been identified as technically suitable for ground mounted solar. This is due to the less constrained nature of solar relative to wind, in terms of the factors that can reasonably be considered within a high-level resource assessment. This includes the lack of Grade 1 agricultural land present within the District to constrain solar development, as well as the requirement for much larger safety buffers to be applied to buildings and infrastructure when identifying land for wind development. In practice, development of all or even the majority of such a large area of land with technical potential for ground-mounted solar PV would clearly not be appropriate.

Issues affecting deployment

4.59 Considerations, other than cumulative impact, that would reduce the deployable potential of ground-mounted solar PV in practice include landscape sensitivity, grid connection and development income. These are discussed in turn below.

Landscape sensitivity

4.60 Although the landscape and visual impacts of solar PV tends not to be as contentious as wind development, it is still often a key consenting issue, particularly for larger development scales. As the degree of acceptable landscape and visual impact is generally a matter that needs to be considered within the context of an overall planning balance, no land was excluded from the GIS technical constraints assessment on landscape or visual grounds. Instead, similar to wind, a separate landscape sensitivity assessment (LSA) is recommended to be undertaken to consider all Landscape Character Areas defined within the Harborough Landscape Character Assessments with technical potential for development. The LSA could be used alongside the output of this assessment of technical potential to help the Council identify which areas may be more or less suitable for ground mounted solar development within Harborough. Careful consideration of the potential landscape impacts versus the public benefits of renewable energy would need to be weighed through the planning application process.

Grid connection

4.61 As with wind, a key consideration in relation to solar PV development viability is the interaction between development income and grid connection costs. As noted above, at the present time viable solar developments are generally larger scale. It is understood, however, that even larger scale solar developments will only generally be viable at present where a grid connection is available in relatively close proximity to the development site, and does not involve significant network reinforcement costs. Although connections can in principle be made either into existing substations or into power lines (a ‘tee in’ connection), proximity requirements alone would limit the deployable solar PV potential in much of Harborough at the present time.

Development income

4.62 Until recently, the lack of financial support for solar PV has constrained the deployable potential, particularly for smaller schemes and schemes at greater distances from potential grid connection points. The present assessment cannot, however, rule out the potential for such schemes, bearing in mind that the financial context for solar is changing – for example solar has been included in the latest round of the Contracts for Difference (CfD) auctions. Renewable generators located in the UK that meet the eligibility requirements can apply for a CfD by submitting what is a form of ‘sealed bid’. Round 6 of auctions opened in March 2024 with the budget revised upwards in July 2024 and includes Pot 1 technologies, such as solar PV >5MW and onshore wind >5MW. **[See reference** 51**]**.

4.63 Over recent years solar panel costs also have decreased significantly, and as such subsidy-free solar energy schemes in the right locations are financially viable at larger scales. Solar PV module prices have dropped in price by 89% since 2010. A Government report confirmed that solar farms offer the most cost-effective power generation method, with levelized costs projected to decrease significantly by 2040 **[See reference** 52**]**. It is noted however that at present, commercial ground mounted solar PV schemes are predominantly pursued at large scales to ensure viability via economies of scale.

4.64 With regards to smaller scale solar developments, the Smart Export Guarantee has been introduced since January 2020 **[See reference** 53**]**. This is an obligation set by the Government for licensed electricity suppliers to offer a tariff and make payment to small-scale low-carbon generators for electricity exported to the National Grid, providing certain criteria are met. This could help to increase the financial viability of solar energy developments of up to 5MW capacity. However, the obligation does not provide financial benefits equal to the previous FiT scheme, as it only provides payments for electricity export, not generation, and it does not provide a guaranteed price for exported electricity. In its first year of operation, several new tariffs were launched, up to a peak of 11p/kWh, and the scheme is running smoothly, and enables customers to shop around for the best tariff, incentivising suppliers to increase their prices to compete **[See reference** 54**]**. However, in April 2021 the Environmental Audit Committee wrote a letter to the Business Secretary raising concern about the lack of clarity from the Government on the role of community energy in decarbonising the energy sector and called for the introduction of a floor price above zero for the Smart Export Guarantee to help support such community energy **[See reference** 55**]**. It may therefore be that future changes to the Smart Export Guarantee or introduction of additional schemes may increase the potential developer income on future solar PV developments.

Ground-mounted solar PV – conclusion

Ground-mounted solar PV has the largest technical potential energy output in Harborough of all the renewable and low carbon energy sources considered by this study. The economic viability of ground-mounted solar PV in England is good as the costs have decreased significantly in recent years. Although Harborough has a good amount of technical potential for ground-mounted solar, there is uncertainty surrounding the capacity of the grid and the costs of connecting to it.

Solar PV (rooftop)

Description of technology

4.65 Rooftop solar photovoltaic (PV) panels capture the sun's energy and convert it into electricity to use locally, with the potential to sell excess electricity generated back to the grid or store it in a battery for later use. Solar water heating (aka solar thermal) systems use energy from the sun to warm water for storage in a hot water cylinder or thermal store. Both rooftop solar PV and rooftop solar water heating are well-established technologies in the UK, with uptake having been significantly boosted through the Feed-in Tariff (FiT) and the Renewable Heat Incentive (RHI) schemes. Installations are largely confined to southwest to south-east facing roofs, pitched between 20-60º, and which have minimal shading. These may be installed upon existing roofs or can be roof-integrated. Roof-integrated systems, such as PV tiles, shingles and semi-transparent PV panels, form part of the roof itself and can offset some of the cost of conventional roofing materials.

4.66 On flat roofs, commonly found on flats and on-domestic properties, the orientation of the roof is less critical to the viability of solar technologies. However, on these roofs, the panels will instead need to be pitched on tilted frames and spaced appropriately to limit self-shading.

4.67 On pitched roofs, approximately 7.5m^2 of roof space per kW of high efficiency (e.g. monocrystalline silicon) solar PV panel is required. These PV systems can also be connected to export power to the grid at times when there is insufficient energy use or storage capabilities within the property. In comparison, the rooftop size requirements for the installation of solar water heating systems is limited to the usage of hot water within the property itself. On residential properties, solar water heating systems therefore typically occupy 1.5m^2 of flat panel per resident, and properties require sufficient space to accommodate a hot water storage tank.

4.68 Standard installations of solar panels are considered to be 'permitted development' **[See reference** 56**]** and therefore do not normally require planning consent. However, installations on listed buildings, or on buildings in designated areas (e.g. on the site of a scheduled monument or in a conservation area) are restricted in certain situations and may require planning consent.

Other emerging Solar PV technologies considered but not assessed

4.69 The breadth of uses for solar PV technology is vast and spans many diverse applications such as solar phone chargers, roof or ground-mounted power stations and solar streetlamps. There is also a new design for a solar PV integrated motorway noise barrier that is being considered for use by Highways England, and a trial of track-side solar panels being used to power trains by Imperial College. Solar car park canopies also offer potential, as demonstrated by the 2.7MW system installed by FlexiSolar at large manufacturing site in England **[See reference** 57**]**.

4.70 Emerging solar PV technologies include ‘floatovoltaics’, whereby PV systems float on waterbodies such as reservoirs and lakes, often floating on rafts and anchored to the side of the water body. For example, a 6.3MW 23,046 panel scheme has been developed on Queen Elizabeth II Reservoir, near Heathrow airport **[See reference** 58**]**, and a 3MW 12,000 panel scheme has been installed on Godley Reservoir near Manchester **[See reference** 59**]**. These schemes generally occupy only a small area of the water bodies and are beneficial in reducing evaporation over the summer. As such, there may be potential to utilise the water bodies within Harborough for ‘floatovoltaics’, for example Eye Brook Reservoir that spans the District’s eastern boundary and Saddington Reservoir in the middle of the District.

4.71 However, if such ‘floatavoltaic’ systems were installed on more natural water bodies as opposed to reservoirs, their installation could risk impacting the ecosystems of water bodies by creating too much shading beneath the panels. This would require more investigation if proposals for such ‘floatavoltaic’ systems are proposed on sensitive or protected water bodies.

Existing development within Harborough

4.72 Harborough saw 8,839kW of solar PV capacity installed from January 2019 to March 2019 via the Feed In Tariff (when it closed), with 6,350kW deployed on domestic properties and 2,489kW on non-domestic properties **[See reference** 60**]**. The data from DESNZ **[See reference** 61**]** identifies there is 1.41MW of roof-mounted solar PV currently consented and awaiting construction in Harborough at three commercial properties. Accredited domestic installations of solar water heating systems under the Renewable Heat Incentive (RHI) scheme in January 2022 totalled 99 accredited full applications **[See reference** 62**]**.

Assumptions used to calculate technical potential

4.73 A high-level assessment of solar rooftop potential was undertaken, considering the number of buildings and types of building within Harborough. The total number of domestic and non-domestic properties within Harborough were considered within this assessment and were calculated based on OS Address data. The total potential capacity of roof mounted solar was estimated based on typical system sizes:

- Solar PV:
  - Domestic: 1.7-5.2kW, depending on type of house
  - Non-domestic: 28.61kW
- Solar water heating:
  - Domestic: 2.8kW
  - Non-domestic: 18.83kW

4.74 And the estimated proportion of properties with suitable roofs (40% of dwellings; 75% of non-domestic properties) within the study area. Justification for these assumptions are set out in Appendix A.

4.75 Roofs that have potential to deliver solar PV also have the potential to deliver solar water heating generation. However, this was treated as being mutually exclusive with solar PV potential, i.e. the same roof space can only be utilised for one of the technologies.

4.76 The total potential capacity of solar PV and solar water heating was calculated along with the generation potential. The calculation of potential energy yield requires the application of a 'capacity factor'. The capacity factor is the average proportion of maximum solar PV or solar water heating system capacity that would be achieved in practice over a given period, i.e. the average proportion of the total energy that can be produced by a solar rooftop development over a year, in comparison to the amount of energy that would have been produced if the solar panels were producing energy at full output for a whole year. With regards to solar generation, this most notably reflects the fact that solar panels will not produce energy when the sun is not shining, and this varies between electricity (solar PV) and heating (solar water heating) technologies. A capacity factor of 9.6% was used for Solar PV, based on regional data available for the East Midlands **[See reference 63]**, and a capacity factor of 4.5% was used for solar water heating, based on available national scale DESNZ data **[See reference 64]**. This indicates that rooftop solar PV developments will on average produce the equivalent amount of energy as the development working at full output for 9.6% of the year, and that rooftop solar water heating developments will on average produce the equivalent amount of energy as the development working at full output for 4.5% of the year.

4.77 The potential carbon savings as a result of generation via the identified roof-mounted solar potential was also calculated. This assumed that the electricity generated from the identified solar PV potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.133kgCO_2e/kWh **[See reference 65]**. This could either be via use of the electricity on-site, on-site following battery storage, or off-site via export. Similarly, this assumed that the heat generated from the identified solar water heating potential would result in negligible carbon emissions and would replace that currently provided by the mains gas (emission factor of 0.210kgCO_2e/kWh **[See reference** 66**]**), or either heating oil (emission factor of 0.298kgCO_2e/kWh **[See reference** 67**]**) or national grid electricity (emission factor of 0.133kgCO_2e/kWh **[See reference** 68**]**) for properties located 'off-gas' – see Appendix A.

Results

Technical potential

4.78 Figure 4.4 and Table 4.4 below provide a summary estimate of the technical potential for roof-mounted solar PV and Figure 4.5 and Table 4.5 below provide a summary estimate of the technical potential for roof-mounted solar water heating within Harborough.

Figure 4.4: Total capacity of rooftop solar PV potential and carbon savings

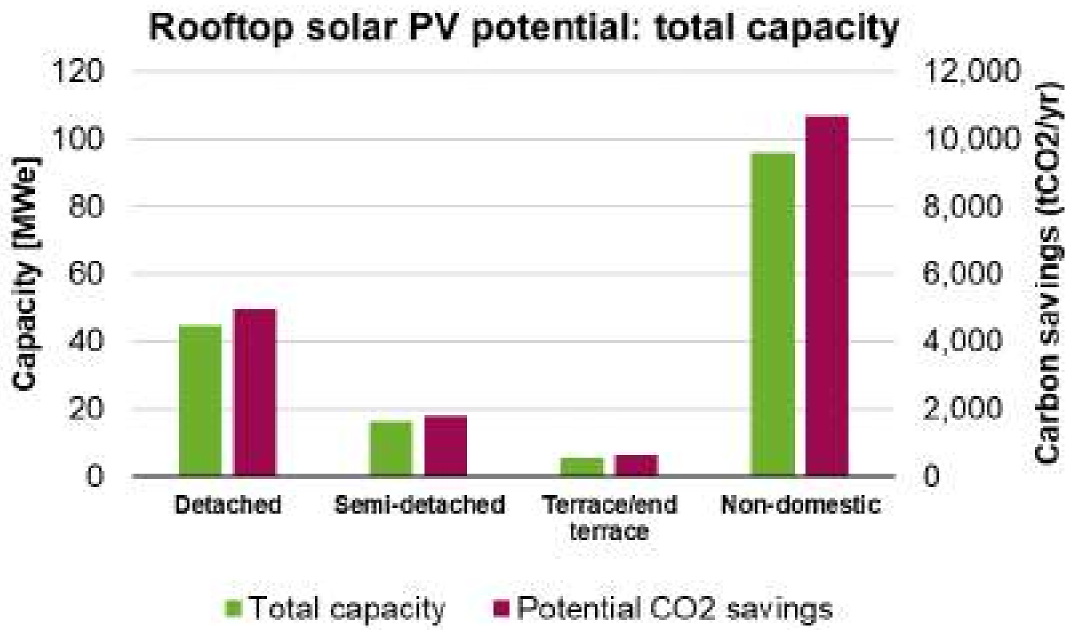


Table 4.4: Assessment of rooftop solar PV

Building Category	Estimated Capacity (MW)	Electricity Output (MWh/year)	Potential CO_2 Savings (tonnes/year)
Detached	45	37,483	4,985
Semi-detached	16	13,650	1,815
Terrace/end terrace	5	4,612	613
Non-domestic	96	80,206	10,667
Total	117	135,951	18,081

Figure 4.5: Rooftop solar water heating potential capacity and savings

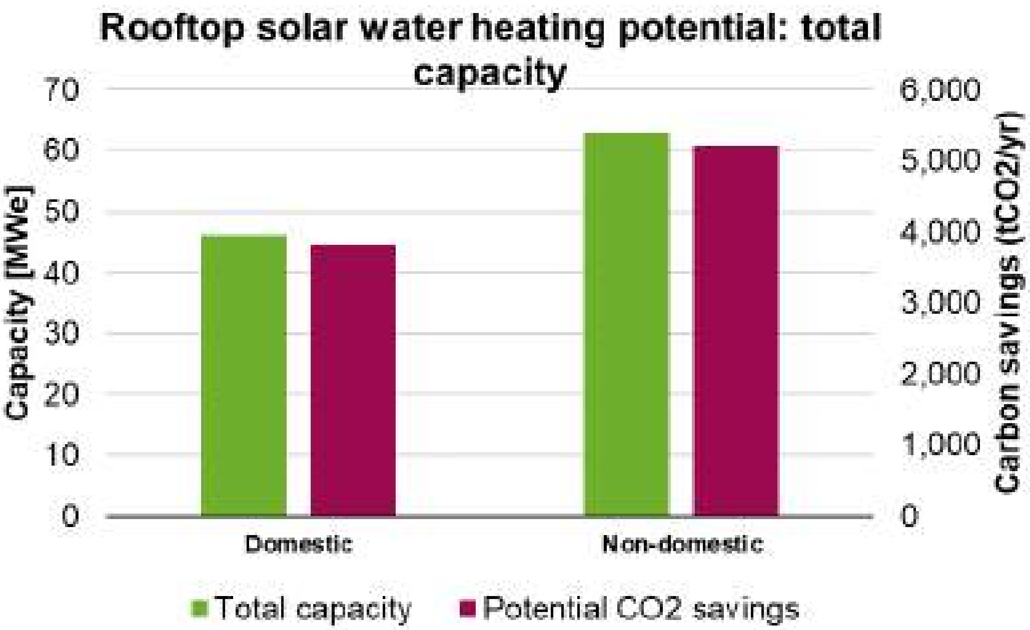


Table 4.5: Assessment of rooftop solar water heating

Building Category	Estimated Capacity (MW)	Delivered Heat (MWh/yr)	Potential CO_2 Savings (tonnes/yr)
Domestic	46	18,169	3,826
Non-domestic	63	24,786	5,219
Total	109	42,955	9,045

Issues affecting deployment

Grid decarbonisation

4.79 Rooftop solar PV is proving to be attractive to developers as an easily deployed renewable energy generation technology that offsets high-carbon mains electricity usage, thereby helping to meet tightening buildings emission standards. However, the 'value' of this offsetting will continue to drop as the mains grid electricity gradually decarbonises.

4.80 Nonetheless, for those already receiving a proportion of free electricity from onsite solar PV, the financial benefits of reduced bills from mains electricity usage will continue. Over the past decade, the cost of solar PV has reduced significantly, and this fall in cost is likely to continue in conjunction with UK grid parity (generation of power at or below the cost of mains power) expected in 1 to 3 years, without the need of subsidies.

4.81 In addition, recent advances in smart power management controls and energy storage systems have benefited solar PV. The dual deployment of these technologies with rooftop solar PV, for example through time-of-use electricity tariffs, could automate and optimise the generation and storage of power, determining whether power is used directly on site, stored for later use, or exported immediately directly to the grid. Furthermore, the integration of solar PV into 'whole house' systems, which could also incorporate electric vehicle charging, could further incentivise uptake of rooftop solar PV technologies.

Lack of financial incentives

4.82 The FiT scheme, which enabled properties to gain payments for energy generation and export from small-scale renewable installations, closed to new applicants in March 2019. Following this, the Government introduced the Smart Export Guarantee scheme in January 2020. This scheme requires that licenced electricity suppliers offer a tariff to pay small-scale (>5MW) low carbon electricity generators to export electricity to the grid. However, this scheme is generally less beneficial than the FiT as the payments are only related to the exported electricity, rather than the total amount of electricity generated. However, as part of the Spring Statement 2022, the Chancellor made the announcement that from 1st April 2022 until 31st March 2027 VAT on installing energy-saving materials (ESMs), which includes solar thermal and PV systems, in residential properties will be 0% in Great Britain. The measure is intended to incentivise the take-up of ESMs in line with the government's net zero objectives and making schemes potentially more financially viable for most users **[See reference** 69**]**.

4.83 Compared to solar PV, solar water heating installations are less common, as preference was previously given to PV installations during the more profitable FiT period. This is with the exception of solar water heating installations on properties that are located off the gas grid. For off-gas properties, the installation of roof-mounted solar water heating panels are often more financially beneficial, due to the higher cost of heating fuels like electricity and oil in comparison to mains gas.

4.84 With regards to non-domestic properties, the installation of roof-mounted solar water heating technologies is more limited than on domestic properties, as the viability of these installations is dependent on hot water demand, as well as competition with point-of-use hot water heating. This technology is less likely to play a significant role in the decarbonisation of heat in comparison to heat pumps, particularly as grid electricity continues to decarbonise in pursuit of the Government's goal of a fully decarbonised electricity system by 2035 **[See reference** 70**]**. It should be noted, however, that the Environmental Audit Committee has said "This is one of the most challenging undertakings faced by any government in peacetime, with some of the most ambitious timescales" and has made a variety of recommendations to address the fact that the necessary deployment of renewable energy generation projects is being held back by slow grid connections, limited grid capacity, inappropriate planning regulations and market uncertainty **[See reference** 71**]**.

4.85 It is noted that in certain circumstances, rooftop solar PV and solar water heating installations can be considered to be permitted development **[See**

reference 72] and therefore may not need planning permission, potentially encouraging uptake.

Roof-mounted solar – conclusion

Roof-mounted solar PV and solar water heating has a very small technical potential energy output in Harborough (less than 1%) of all the renewable and low carbon energy sources considered by this study. The technology is currently attractive to developers as the cost of solar PV has reduced significantly in the last decade and depending on the size and location of the installation it could be considered through permitted development. It is an easily deployed renewable energy generation technology that offsets high-carbon mains electricity usage.

Hydropower

Description of technology

4.86 The generation of energy via hydropower involves using water flowing from a higher to a lower level to power a turbine that is connected to an electrical generator. The resultant energy generation is therefore directly proportional to the height difference (the head) of the water flowing and the volume of water flowing.

4.87 Hydropower is a proven well-established technology. There are few technological constraints to its use, with the exception of ensuring:

- The water course has sufficient flow rates and heads (height difference) throughout the year;
- The electricity generates can be transmitted to the end user; and
- The site is accessible and can accommodate the required equipment.

4.88 Based on these few constraints, the energy yields of potential installations can be accurately estimated and the economic viability of installations determined relatively easily.

4.89 However, due to the environmental constraints on large-scale multi-MW installations, the most potential for hydropower exists mainly from small or micro-scale schemes. In the UK, micro scale (typically under 100kW) hydropower installations can include schemes that provide power to individual homes, whilst small-scale schemes can reach up to a few hundred kW in size and export electricity directly to the grid. These small schemes commonly incorporate dams, weirs, leats, turbine houses and power lines, which have the potential to visually impact the landscape. However, suitable siting and design of these installations can commonly mitigate these impacts. For 'low head run of river' developments, typically for schemes located in lowland areas, these can often be located on the site of old mills and utilise existing channel systems and weirs or dams. In comparison, in 'high head run of river' schemes, that are typically found in upland steeper areas, the water flow is often diverted via enclosed penstocks (pipelines) to the turbines.

4.90 In addition to potential landscape and visual impacts, impacts on hydrology and river ecology require consideration in determining the suitability of sites for hydropower developments. For example, aquatic plants may impact the performance of a hydropower scheme by impacting the water flows and waterfalls. Moreover, river fish populations may be sensitive to changes in water flows, as well as risk physical harm from the hydropower equipment installed. However, mitigation measures including the incorporation of 'fish passes' are often included within schemes to limit such impacts.

4.91 Potential impacts of hydropower developments upon the status indicators of a water body, as set out in the Water Framework Directive, may require abstraction licences, discharge permits and flood defence consent from the Environment Agency. As well as the assessment of potential impacts from individual hydropower installations upon waterways, the cumulative impacts of hydropower and any other water abstraction activities along a waterway on the protected rights of other river users will require assessment. Moreover, as permissions on use of waterways for hydropower are commonly issued with a time limit on the permitted abstraction period, this must also be considered. Unless such time periods are sufficiently long, the long-term viability of hydropower developments may be at risk if these permissions are not renewed in the future.

Existing development within Harborough

4.92 FiT **[See reference 73]** data indicates there are currently no known hydropower installations located within Harborough.

Results

Technical potential

4.93 It has not been possible within the scope of this study to undertake a new assessment of the potential hydropower resource within Harborough, as this would require an additional, specialist study. However, in 2010 the Environment Agency published the findings of a study identifying hydropower opportunities within England and Wales **[See reference 74]**. This study has not been updated since, but it was produced to provide an overview at national and regional scales of the potential hydropower opportunities available, as well as the relative environmental sensitivity of identified potential sites to development. It is noted that this data is indicative and that further site-specific study would be required in order to determine the technical potential and suitability of sites for hydropower developments.

4.94 The study included identifying ‘heavily modified water bodies’ that are identified as being at significant risk of failing to achieve good ecological status because of modifications to their hydromorphological characteristics resulting from past engineering works, including impounding works. Due to these characteristics, such waterbodies were identified as having the potential to create hydropower barriers that would also be beneficial to the passage of fish upstream. These were overlayed with identified locations where suitable yearly flow characteristics are present and could feasibly support hydropower sites. The resultant identified sites were classified as 'win-win' opportunities where hydropower developments could potentially be installed whilst also improving the ecological status of waterways. The study shows that no sites were identified within Harborough.

Hydropower – conclusion

It was not possible within the scope of this study to undertake an assessment of the technical potential for hydropower within Harborough. However, the lack of existing hydropower installations together with the failure of a historic, national study to identify any such potential suggest that hydropower is unlikely to represent a meaningful renewable and low carbon energy resource for Harborough.

Heat pumps

Air source heat pumps

Description of technology

4.95 An air source heat pump transfers heat from the air outside a building to water that is used to heats rooms inside the building via radiators or underfloor heating. It can also heat water stored in a hot water cylinder to help supply hot taps, showers, and baths. Heat is transferred via a process known as a refrigeration cycle, similar to that used by a fridge to move heat from its interior to its exterior.

Assumptions used to calculate technical potential

4.96 A high-level assessment of air source heat pumps was undertaken, considering the number of buildings and types of building within Harborough. The total number of domestic and non-domestic properties within Harborough were considered within this assessment and were calculated based on OS Address data. The total potential capacity of air source heat pumps was estimated based on typical system sizes:

- Domestic: 10.2kW
- Non-domestic: 46.5kW

4.97 Almost any building theoretically has the potential for an air source heat pump to be installed. Therefore, the assessment considered the potential for air source heat pumps to be delivered in all dwellings and non domestic properties within Harborough. Justification for these assumptions are set out in Appendix A.

4.98 The calculation of potential energy yield requires the application of a 'capacity factor'. The capacity factor is the average proportion of air source heat pump capacity that would be achieved in practice over a given period, i.e. the average proportion of the total energy that can be produced by a heat pump over a year, in comparison to the amount of energy that would have been produced if the heat pump was producing energy at full output for a whole year. Capacity factors vary in practice in accordance with location and climate. It was not possible to find suitable historic data on capacity factors taking into account these kinds of factors within Harborough for the present study, and so a single capacity factor of 18.4% was used, based on available national scale DESNZ data **[See reference 75]**. This indicates that air source heat pumps will on average produce the equivalent amount of energy as the heat pump working at full output for 18.4% of the year.

4.99 In addition, as the performance of air source heat pumps vary with air temperature, their performance varies with season. As such the calculation of potential energy yield also requires the application of a 'seasonal performance factor' (SPF) i.e. the ratio of the total heat supplied to a building to the electricity used by the heat pump to run it. A value of 3.6 was used, as based on national scale DESNZ data **[See reference** 76**]**.

4.100 The potential carbon savings as a result of generation via the identified air source heat pump potential was also calculated. This assumed that the heat generated from the identified solar water heating potential would result in negligible carbon emissions and would replace that currently provided by the mains gas (emission factor of 0.210kgCO_2e/kWh **[See reference** 77**]**), or either heating oil (emission factor of 0.298kgCO_2e/kWh **[See reference** 78**]**) or national grid electricity (emission factor of 0.133kgCO_2e/kWh **[See reference** 79**]**) for properties located 'off-gas' – see Appendix A.

Results

4.101 Figure 4.6 and Table 4.6 below provide a summary estimate of the technical potential for air source heat pumps within Harborough.

Figure 4.6: Air source heat pump potential capacity and savings for domestic and non-domestic

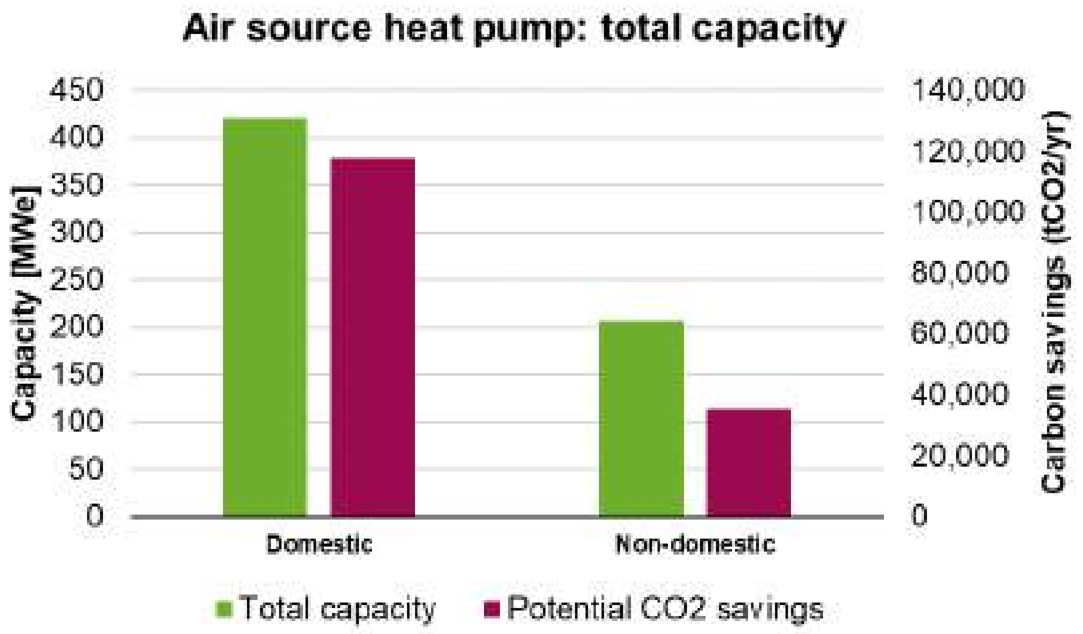


Table 4.6: Assessment of air source heat pumps

Building Category	Estimated Capacity (MW)	Delivered Heat (MWh/yr)	Potential CO_2 Savings (tonnes/yr)
Domestic	420	676,570	117,476
Non-domestic	207	333,834	35,223
Total	627	1,010,404	152,699

Ground and water source heat pumps

Ground source heat pumps

4.102 Ground source heat pumps work along the same principles as the air source heat pumps described above but they transfer heat from the ground rather than from the surrounding air to heat a building and its hot water supply. Ground source heat pumps require more space than air source, requiring pipes to be buried vertically in a deeper system or horizontally in a shallow wider system. While ground source heat pumps tend to be more efficient than air source, they are also more expensive to install, particularly if a borehole rather than a trench is used to bury the ground loop **[See reference** 80**]**.

4.103 Ground source heat pumps fall into two main categories – open loop or closed loop. This refers to the design of the loop that is buried in and extracts heat from the ground. A closed loop system is the most common, using a sealed ground loop containing a water and antifreeze mixture. An open loop system uses water from the ground surrounding the ground loop but this needs to meet certain requirements such as being low in chlorine. **[See reference** 81**]** The British Geological Survey has produced a map identifying the potential viability of open-loop ground source heat pumps across England and Wales, considering hydrogeological and economic factors **[See reference** 82**]**. This indicates that land within Harborough is less favourable for open-loop ground source heat pumps, with closed-loop systems more likely to be appropriate. However, the British Geological Survey states that this is an initial screening assessment only. Detailed environmental assessments of proposed sites would be required, considering local variations in environmental conditions and factors such as the availability of water (i.e. the amount of water that is available for licensing by the Environment Agency) and discharge of water from a scheme **[See reference** 83**]**.

4.104 Due to the significant space requirements, this study did not estimate the potential annual energy generation capacity and carbon savings of ground source heat pumps across the study area for the following reasons:

- It was not possible to estimate how many properties have access to the required, significant space to bury a ground loop; and
- The limitations of the British Geological Survey data re. ground suitability for open loop systems.

4.105 Average system sizes of domestic pumps were derived, however, from DESNZ data, which indicated that typical domestic ground source heat pumps in the UK are 15kW **[See reference** 84**]**.

Water source heat pumps

4.106 Water source heat pumps work in the same way but extract heat from a nearby lake or other large water body rather than the ground. The DECC 2014 water source heat map identified, at a high level, opportunities for water source heat pump technologies **[See reference** 85**]**. Less is known about the potential for water source heat pumps. In the right locations, they have been shown to have the potential to provide efficient low carbon heating or cooling at scale as long as the buildings to be served are in close vicinity to the water body, as demonstrated by the Kingston Heights installation by the River Thames **[See reference** 86**]**. This incorporates a 2.3MW water source heat pump for space and water heating of a mixed development. In addition, the Grade I listed house Kelmarsh Hall installed a water source heat pump to obtain heat from the estate's lake and reduce the site's carbon footprint by 50% **[See reference** 87**]**.

4.107 Although it has not been possible within the scope of this study to assess the potential for water source heat pumps, the sensitivity analysis included in the 2014 DECC water source heat map **[See reference** 88**]** identified the River Soar, which passes through Harborough, as having a heat capacity of 13MW, and is therefore classified as having the "highest potential for water source heat pump deployment in areas of high heat demand". Viability would largely depend on having a sufficiently high heat-use demand in proximity to the potential heat pump location.

Heat pumps – conclusion

It was not possible within the scope of this study to undertake an assessment of the technical potential for ground source or water source heat pumps within Harborough. Air source heat pumps have a relatively small technical potential energy output in Harborough (approximately 3%) of all the renewable and low carbon energy sources considered by this study. They do, however, benefit from the fact that almost any building theoretically has the potential for an air source heat pump to be installed.

Biomass and waste

Description of resource

4.108 Biomass is defined generally as material of recent biological origin that is derived from plant or animal matter. 'Dry' biomass is commonly combusted to produce electricity or generate heat. 'Wet' biomass is commonly used to produce biogas via anaerobic digestion. This can be used as 'green' gas on the grid or used to produce 'biofuel' for transport.

4.109 In many countries, dry biomass materials such as wood are commonly used as a fuel for modern heating systems. These modern technologies can be used to heat a variety of building sizes and can be utilised within individual boilers or district heating systems.

4.110 In addition, organic wastes can be considered a source of low-carbon energy production if their use in generation prevents them from otherwise decomposing and potentially releasing methane, contributing to greenhouse gas levels in the atmosphere.

4.111 Biomass can also be used to generate electricity, fuelling electricity plants or combined heat and power (CHP) plants. This is becoming increasingly common due to the low carbon emissions of its use. However, to ensure the technology is low-carbon, consideration must be given to ensuring the biomass feedstocks are sustainably sourced with minimal carbon emissions associated with any required processing and transportation. Except for landfill gas, energy supply from most bioenergy sources has grown since 2010 with the largest upturn from plant biomass (imported and domestic).

4.112 The most common types of biomass feedstocks for energy production include:

- Virgin woodfuel: Including that sourced via forestry and woodland residues, and energy crops (crops planted specifically to be used in the production of heat and electricity, as further described below).
- Waste residues: Including municipal and commercial solid waste, recycled wood waste, agricultural residues and sewage.

4.113 It is noted that there is some overlap between virgin woodfuel and waste biomass sources as virgin wood enters certain waste streams, however this is difficult to extract from contaminated non-virgin wood. As such, virgin woodfuel within waste streams is not considered within this part of the assessment.

Virgin woodfuel

Description of technology

4.114 The virgin woodfuel considered within this study comprises:

- Untreated wood residues (from forestry, woodlands, arboriculture, tree surgery, etc); and
- The energy crops Miscanthus and Short Rotation Coppice (SRC).

4.115 It is necessary to separately consider virgin and non-virgin woodfuel resources as different legislation will apply to its usage for energy generation regarding emission permits. Virgin woodfuel is considered to be clean and safer than non-virgin woodfuel, which may be contaminated for example by paint or preservatives. As such the use of non-virgin woodfuel for energy generation would fall under stricter emission and pollution controls.

4.116 Provided that virgin woodfuel is sustainably sourced, such as via sustainable woodland management through re-growth and low emissions from processing and transportation, it can be considered a sustainable fuel. The carbon emissions released from the combustion of the wood are theoretically balanced by the regrowth of replacement woodland and energy crops, provided the carbon emissions released in growing and transporting the woodfuel are mitigated. For example, logs and woodchip are considered to be less sustainable due to their 'bulky' nature, and as such should be sourced locally to limit greater transport emissions.

4.117 Woodfuel biomass is commonly produced as logs, woodchips, pellets and briquettes, and there are several processes that are required to prepare the woodfuel to reach these usable states. Processing influences the moisture content, size and form of the biomass fuels and the quality control of these factors is necessary to ensure the biomass is usable within specific boilers and thermal conversion processes.

4.118 Virgin woodfuel biomass can be utilised for both heat-only generation as well as CHP, and a variety of energy conversion technologies can be used, such as direct combustion, gasification and pyrolysis.

4.119 Miscanthus and Short Rotation Coppice (SRC) are the two main virgin woodfuel energy crops used within biomass and considered within this study. Such crops are commonly planted specifically to be used in the production of heat and electricity, whilst other 'biofuel' crops, including sugar cane, maize and oilseed rape, are more commonly planted to be used as transport fuels.

4.120 The benefits of Miscanthus cultivation relative to SRC are:

- It utilises existing machinery (SRC requires specialist equipment to be cultivated);
- It is higher yielding;
- It is annually harvested (SRC is harvested only once every three years); and
- It is a relatively dry fuel product when cut (SRC requires drying once cut, prior to use).

4.121 The benefits of SRC cultivation relative to Miscanthus are:

- It is easier and cheaper to establish;
- It is better for biodiversity; and
- It is suitable for a wider range of boilers.

4.122 Although both crops have similar lead-in times of approximately four years until they are able to produce commercial harvests, Miscanthus will reach its peak yield in the fifth year and SRC in the seventh year, after its second rotation.

Existing development within Harborough

4.123 The data available from DESNZ **[See reference** 89**]** identifies one 2MW anaerobic digestion facility in Harborough, at Houghton Lodge Farm, but it has been abandoned, and one 0.5MW non-domestic anaerobic digestion installation, as recorded on the Feed In Tariff scheme. In addition, Renewable Heat Incentive (RHI) scheme data **[See reference** 90**]** indicates that 334 domestic properties (0.8% of the dwelling stock) have small-scale biomass and 51 non-domestic properties (1.1% of commercial properties) have small-scale biomass within Harborough.

4.124 No further data was identified on use of woodfuel within the area, although there will be significant amounts used domestically in open fires, stoves and wood burners, for example the Harborough Innovation Centre is understood to have a biomass boiler. There are several firewood suppliers within Harborough, for example Leicestershire Logs and Swift Solid Fuels.

Forestry and woodland resource

Assumptions used to calculate technical potential

4.125 To determine the potential for biomass generation from farming existing forestry and woodland for fuel, suitable woodland within the study area was identified using the Forestry Commission's National Forest Inventory (NFI). Only woodland categories that were considered to be mature **[See reference 91]** and able to provide a sustainable yield of woodfuel (i.e. the annual harvest of woodfuel that can be maintained indefinitely) of two odt/ha/yr (oven-dried tonnes/ha/year) **[See reference 92]**, and that were not protected ancient woodland or a designated biodiversity or heritage site, were considered (see Appendix A). It should be noted that while important local woodland sites were included within this assessment, they are essential to the character of Harborough and are protected locally, and would require consideration but further site-specific study.

4.126 Figure 4.7 shows the existing woodland opportunities and constraints to woodland exploitation for biomass considered within this assessment.

4.127 The total area of suitable woodland was then calculated. To calculate the total potential energy generation from this area of woodland, this area of suitable woodland was multiplied by the energy generation of woodland per hectare per year as based on Forestry Research **[See reference 93]**: 10.3MWh/ha/year.

4.128 Both the potential for heating and for combined heat and power were calculated. Therefore, the calculation of potential energy yield required the consideration of the efficiency of boilers (77%) **[See reference 94]** and CHP units (50% heating and 30% electricity) **[See reference** 95**]** (i.e. the ratio of total energy output to the total energy input to the boiler/CHP unit).

4.129 The potential carbon savings as a result of generation via the identified biomass potential was also calculated. This assumed that the electricity generated from the identified biomass CHP potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.133kgCO_2e/kWh **[See reference** 96**]**. This could either be via use of the electricity on-site, on-site following battery storage, or off-site via export. Similarly, this assumed that the heat generated from the identified biomass boiler and CHP potential would result in negligible carbon emissions and would replace that currently provided by the mains gas (emission factor of 0.210kgCO_2e/kWh **[See reference** 97**]**), or either heating oil (emission factor of 0.298kgCO_2e/kWh **[See reference** 98**]**) or national grid electricity (emission factor of 0.133kgCO_2e/kWh **[See reference** 99**]**) for properties located ‘off-gas’ – see Appendix A.

Renewable Energy Study
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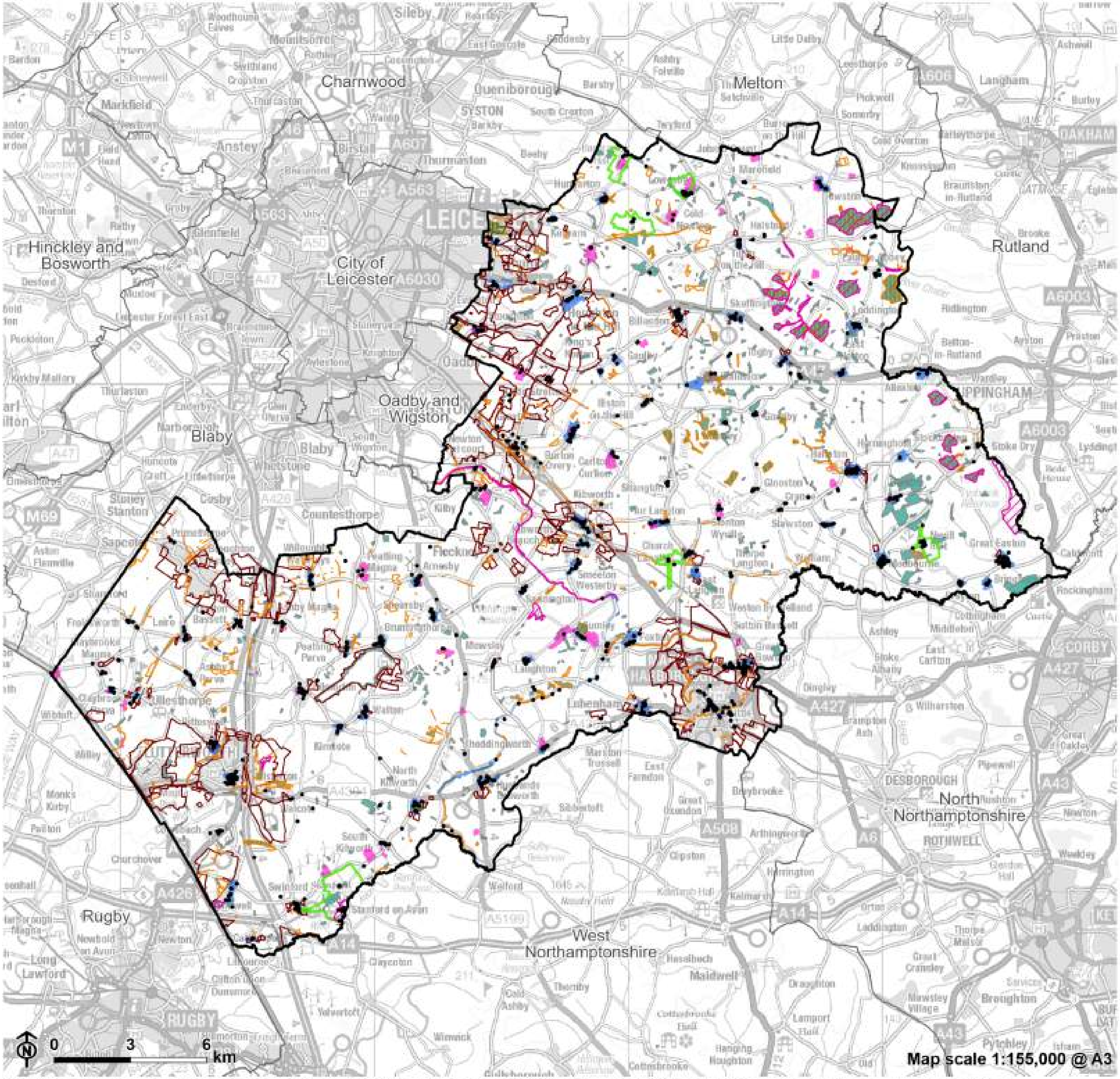
Figure 4.7: Opportunities and constraints - Biomass - Virgin Woodfuel - Forestry and Woodland



- Harborough District
- Neighbouring Local Authority

Opportunities

- National Forest Inventory

Constraints

- Site of Special Scientific Interest
- Registered Parks and Gardens
- Scheduled monument
- Conservation area
- Ancient woodland
- Future development, safeguarded land and employment site
- Local Nature Reserve
- Local Wildlife Site
- Locally Listed Building
- Listed building

Notes:

MOD land is not shown in the figure but was included as a constraint in the assessment.

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Results

4.130 The calculated woodland and forestry biomass resource was calculated in line with the assumptions outlined in Appendix A. The technical potential findings are presented in Table 4.7, considering the biomass resource is used for heating only, and in Table 4.8 considering the biomass resource is used for heat and electricity generation via CHP. This only assumed the use of woodfuel from woodland within Harborough District.

Table 4.7: Woodfuel: Assessment of forestry and woodland resource – use for heating only

Woodland Type	Estimated Capacity (MW)	Delivered Heat (MWh/year)	Potential CO_2 Savings (tonnes/year)
Assumed woodland	0.4	1,712	360
Broadleaved	1.8	7,045	1,483
Conifer	0.3	1,087	229
Coppice	0	0	0
Mixed mainly broadleaved	0.1	213	45
Mixed mainly conifer	0.1	301	63
Total	2.7	10,358	2,181

Table 4.8: Woodfuel: Assessment of forestry and woodland resource – use for CHP

Woodland Type	Estimated Capacity (MW)	Delivered Electricity (MWh/year)	Delivered Heat (MWh/year)	Potential CO_2 Savings (tonnes/yr)
Assumed woodland	0.4	667	1,112	323
Broadleaved	1.8	2,745	4,574	1,328
Conifer	0.3	424	706	205
Coppice	0	0	0	0
Mixed mainly broadleaved	0.1	83	138	40
Mixed mainly conifer	0.1	117	196	57
Total	2.7	4,035	6,726	1,953

4.131 In addition to the calculated potential woodland and forestry biomass resource within Harborough, surplus woodfuel could potentially also be sourced from neighbouring authorities, provided the cost and transportation sustainability were viable. Furthermore, the cutting of hedgerows could additionally provide a source of woodfuel, however due to the lack of data regarding hedgerow yields, it has not been possible to factor this into the assessment. Woodfuel could be used from neighbouring areas but as stated above, this assessment only focuses the technical potential for wood fuel grown within the District.

Technical potential of energy crops

Assumptions used to calculate technical potential

4.132 A GIS assessment of technically suitable land for energy crop planting was undertaken using a similar approach to that undertaken for wind and solar development. In order to protect the best and most versatile agricultural land for food crops, it was assumed that neither energy crop should be planted on Grade 1 or 2 agricultural land within Harborough. It was assumed that both crops have the ability to successfully grow on Grade 3 and 4 agricultural land. It was also assumed that SRC has the potential to grow on Grade 5 agricultural land. However, there is no Grade 1 or Grade 5 agricultural land in Harborough.

4.133 Cultural heritage, natural heritage and physical constraints were also considered to prevent the growing of the crops and were removed from the identified Grade 3 and 4 land. The constraints to energy crop planting are presented in Figure 4.8 to Figure 4.11 and in Appendix A.

4.134 The remaining areas have 'technical potential' for energy crop planting. The total area of land with 'technical potential' for energy crop planting development was calculated.

4.135 To calculate the total potential energy generation from this area for crop planting, this area was multiplied by the energy generation of the crops per hectare per year as based on Forestry Research data **[See reference** 100**]**:

- Miscanthus: 46MWh/ha/year
- SRC: 63MWh/ha/year

4.136 Both the potential for heating and for combined heat and power were calculated. Therefore, the calculation of potential energy yield required the consideration of the efficiency of boilers (77%) **[See reference** 101**]** and CHP units (50% heating and 30% electricity) **[See reference** 102**]** (i.e. the ratio of total energy output to the total energy input to sun the boiler/CHP unit).

4.137 The potential carbon savings as a result of generation via the identified biomass potential was also calculated. This assumed that the electricity generated from the identified biomass CHP potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.133kgCO_2e/kWh **[See reference** 103**]**. This could either be via use of the electricity on-site, on-site following battery storage, or off-site via export. Similarly, this assumed that the heat generated from the identified biomass boiler and CHP potential would result in negligible carbon emissions and would replace that currently provided by the mains gas (emission factor of 0.210kgCO_2e/kWh **[See reference** 104**]**), or either heating oil (emission factor of 0.298kgCO_2e/kWh **[See reference** 105**]**) or national grid electricity (emission factor of 0.133kgCO_2e/kWh **[See reference** 106**]**) for properties located 'off-gas' – see Appendix A.

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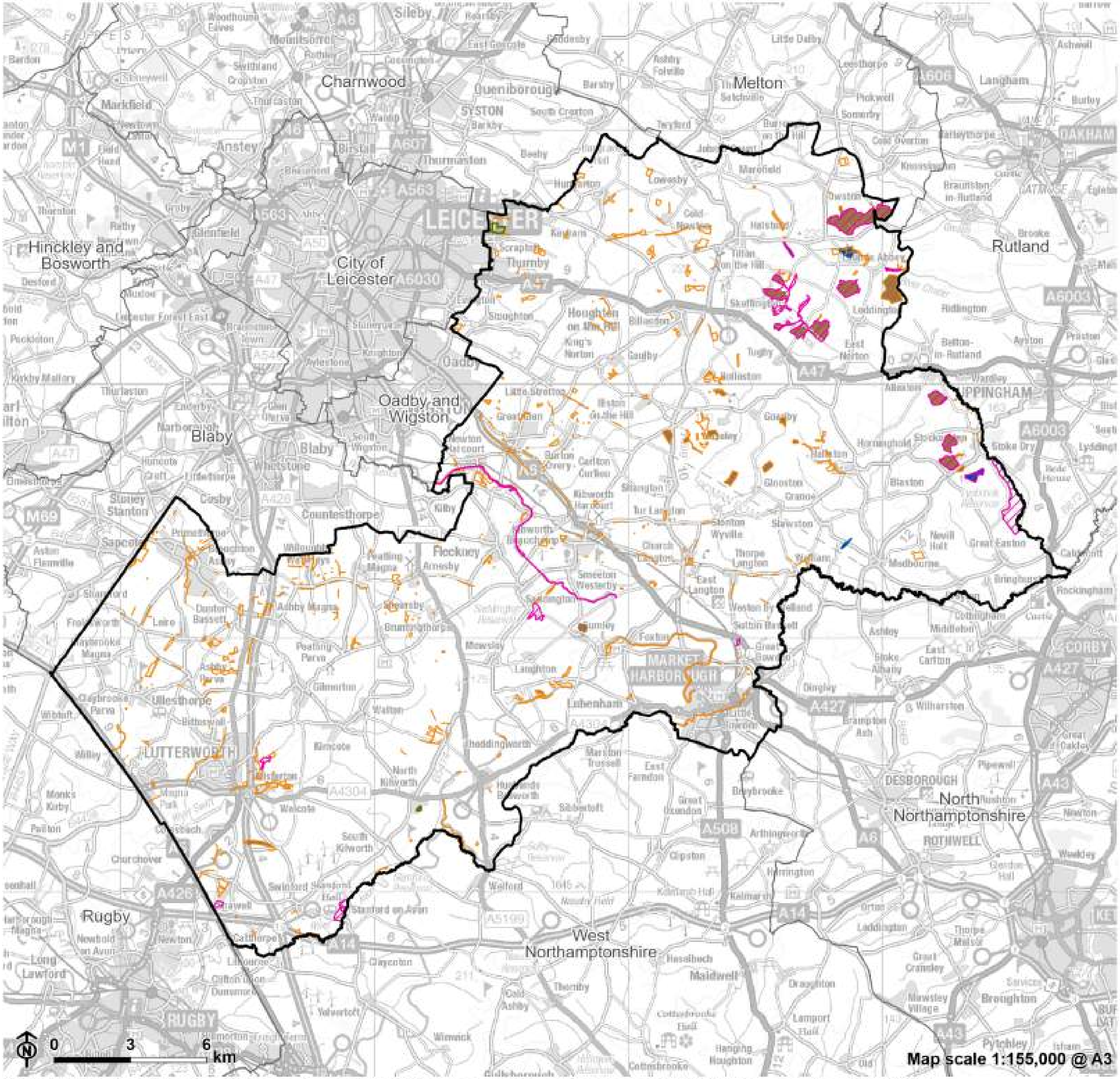
Figure 4.8: Constraints - Biomass - Virgin Woodfuel - Energy Crops - Natural Heritage



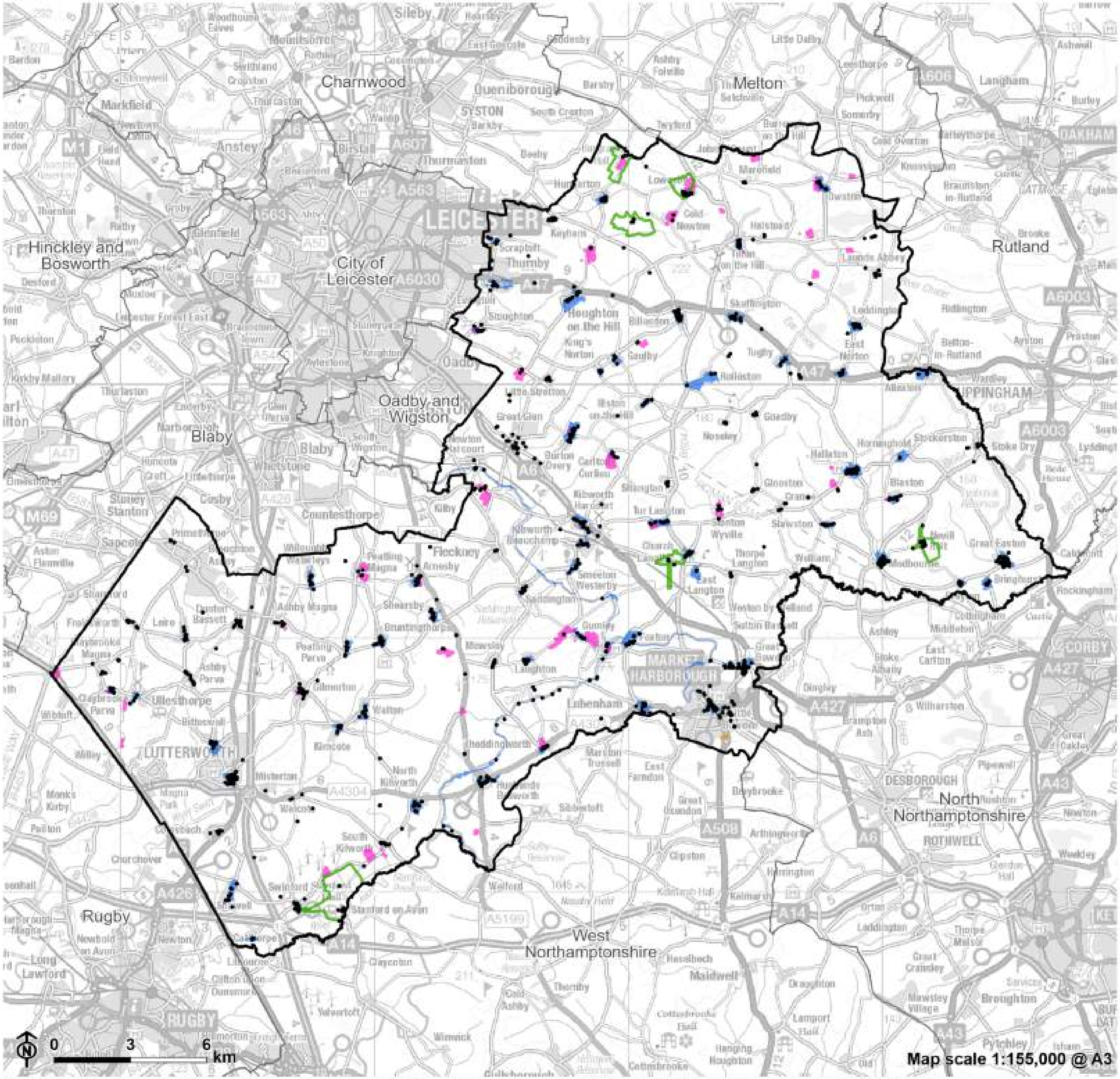
- Harborough District
- Neighbouring Local Authority
- Site of Special Scientific Interest
- Ancient woodland
- Local Nature Reserve
- Local Wildlife Site
- Local Geological Site

Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Renewable Energy Study
Harborough District

Figure 4.9: Constraints - Biomass - Virgin Woodfuel - Energy Crops - Cultural Heritage



- Harborough District
- Neighbouring Local Authority
- Registered Parks and Gardens
- Scheduled monument
- Conservation area
- Locally listed building
- Listed building

Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Renewable Energy Study
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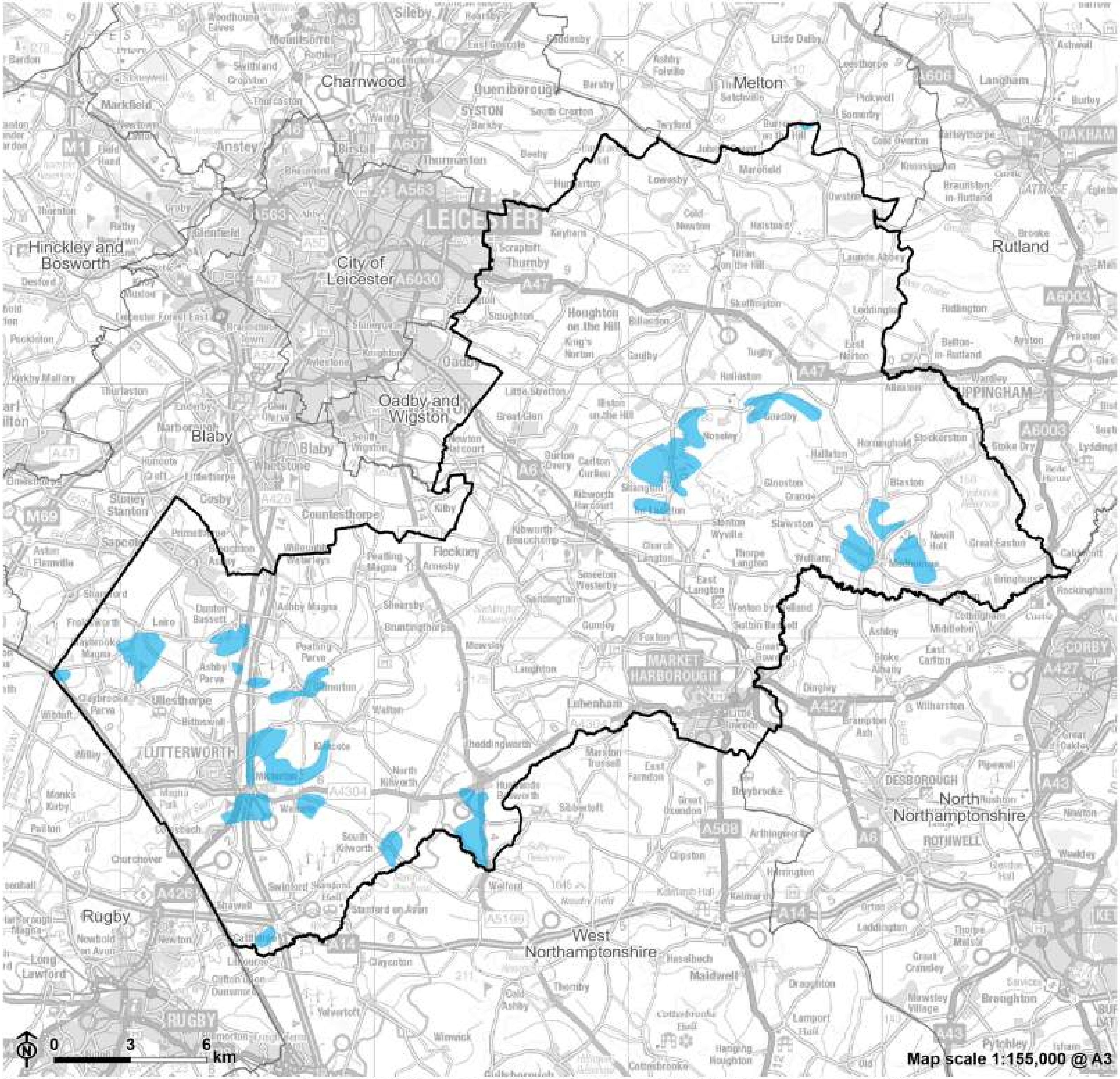
Figure 4.10: Constraints - Biomass - Virgin Woodfuel - Energy Crops - Agricultural



- Harborough District
- Neighbouring Local Authority
- Grade 2 agricultural land

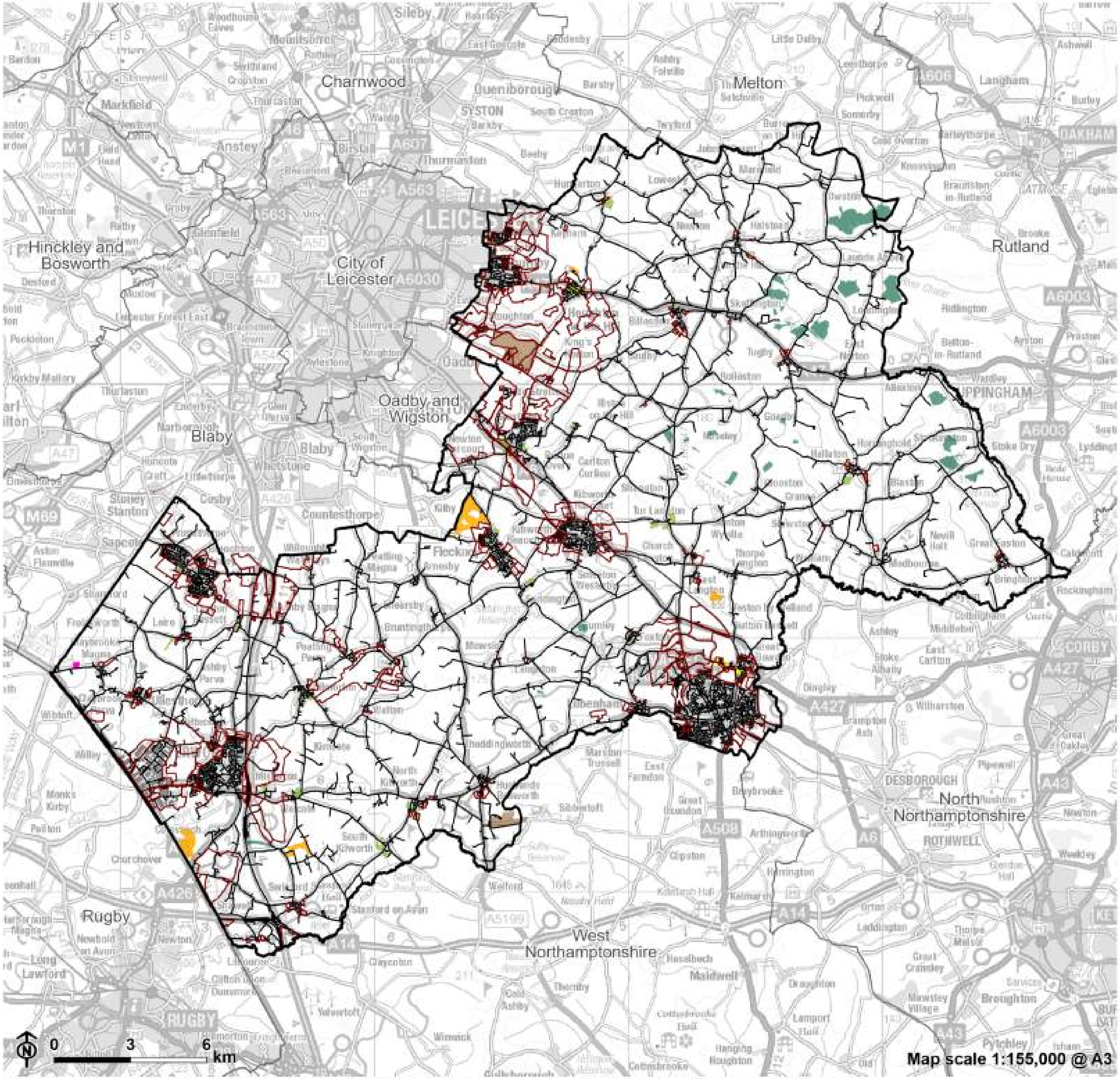
Notes:

No land was classified as Grade 1 and Grade 5.

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Renewable Energy Study
Harborough District

Figure 4.11: Constraints - Biomass - Virgin Woodfuel - Energy Crops - Physical



- Harborough District
- Neighbouring Local Authority
- Roads and railways
- Building
- Airports and airfield
- Watercourses and water bodies
- Woodland
- Existing solar farm
- Common land
- Open space
- Greenspace
- Future developments, safeguarded land and employment sites

Notes:

MOD land is not shown in the figure but was included as a constraint in the assessment.

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Results

4.139 Table 4.9 presents the findings of the technical assessment, assuming that the energy crops would be used for heating only, and Table 4.10 presents the findings assuming that the energy crops were used to produce electricity and heat via CHP. A total area of 43,082 hectares was identified to have technical potential for energy crop growth.

Table 4.9: Woodfuel: Assessment of energy crops – use for heating only

Woodland Type	Estimated Capacity (MW)	Delivered Heat (MWh/year)	Potential CO_2 Savings (tonnes/yr)
Miscanthus	437	1,671,918	352,072
SRC	80	305,191	64,267
Total	517	1,977,109	416,339

Table 4.10: Woodfuel: Assessment of energy crops – use for CHP

Woodland Type	Estimated Capacity (MW)	Delivered Electricity (MWh/year)	Delivered Heat (MWh/year)	Potential CO_2 Savings (tonnes/yr)
Miscanthus	437	651,396	1,085,661	315,254
SRC	80	118,906	198,176	57,436
Total	517	770,302	1,283,837	372,800

Issues affecting deployment

4.140 The quantity of production of virgin woodfuel for biomass from forestry and woodland will depend on the quantity of woodland that can be actively managed and the incentives available for landowners to extract and process the woodfuel. At present, the demand for domestic log-burners dominates the virgin woodfuel market. The demand for woodchip stoves and pellet boilers is less than that for log-burners, however the economic viability of these installations is greater for off-gas properties, due to the higher costs of heating fuels such as oil and electricity, and due to the benefits offered by the Renewable Heat Incentive scheme. However, heat pump deployment is anticipated to significantly increase in the UK as the electricity grid decarbonises and the electrification of heat increases. The viability of biomass installations will need to compete with the costs of heat pumps, as well as additional constraints such as space for fuel storage, solid fuel flue regulations and maintenance requirements.

4.141 The deployment of energy crops, and to a lesser degree the management of woodland for woodfuel, will be influenced by:

- Economic viability;
- End-use/market;
- Land ownership;
- Existing farming activities;
- Potential biodiversity impacts;
- Protected landscapes; and
- The presence of water-stressed areas.

4.142 Notably, the conflict between land use for food production or for energy crops will require consideration with regards to the potential scale of energy crop potential within Harborough.

4.143 The availability of incentives for landowners and farmers to grow and harvest crops will impact energy crop production. Often, longer-term supply contracts with end users will need to be arranged in advance. In addition, the establishment of supply-chains and logistics of fuel processing may initially limit the widespread uptake of energy crop resource. Other issues that may limit the exploitation of Harborough's energy crop resource include the requirement for an Environmental Impact Assessment (EIA) of energy crop projects, the planning and permitting of energy generating plants and the question of alternative markets for Miscanthus and SRC other than energy use.

4.144 There is ambition at national level for biomass to play an important role in decarbonising the UK's energy generation. The Government's Clean Growth Strategy (2017) and the Committee on Climate Change's 'Net Zero – the UK's contribution to stopping global warming' report (2019) both acknowledge the significant opportunities offered by biomass, notably if it is used in conjunction with carbon capture and storage technology to both sequester carbon from the atmosphere via plant growth and capture that subsequently released in bioenergy conversion processes. The Committee on Climate Change has also reviewed the carbon and wider sustainability impacts of biomass production and use and concluded that sustainable, low-carbon bioenergy is possible but only if:

- Rules governing the supply of sustainable sources of biomass for energy are improved; and
- The use of harvested biomass is carefully managed to maximise the removal and minimise the release of carbon into the atmosphere **[See reference** 107**]**.

4.145 Subsequently, the Government has restated its firm commitment to biomass sustainability via its Biomass Strategy **[See reference** 108**]**.

4.146 Since the 1960s, agricultural subsidies under the EU's Common Agricultural Policy (CAP) have significantly shaped farming practices in the UK, including the extent to which bioenergy initiatives have been deployed. The UK's 25-year Environment Plan and phased exit from CAP-based subsidies now provide a new context for policies and strategies to scale up sustainable biomass production. The Government's new Environmental Land Management (ELM) scheme, which will pay farmers to deliver beneficial outcomes. For example, the Sustainable Farming Incentive (SFI – part of the ELM scheme) pays farmers and land managers to take up or maintain sustainable farming and land management practices (known as 'SFI actions') that protect and benefit the environment, support food production or improve productivity. Land use types eligible for support of SFI actions include Miscanthus and SRC energy crops **[See reference** 109**]**.

Energy from waste

Description of technology

4.147 Generally referred to as 'Energy from Waste', this technology involves extracting energy using a process undertaken on the non-recyclable residual elements of waste stream. Solid dry materials can be processed into Refuse-Derived Fuel (RDF) and are usually incinerated to produce heat and/or electricity. A proportion of this fuel (usually up to 50% of the residual waste prior to being processed) could be considered as 'renewable' depending on its organic, non-fossil fuel content, for example as set out by Ofgem for the purposes of the Renewables Obligation **[See reference** 110**]**. However, the RDF itself remains a significant source of carbon emissions, particularly from the plastic content of the waste stream, so there is some debate whether it should be classed as a renewable or even a partially renewable fuel. Residual waste arisings should therefore be minimised at source as far as possible in order to reduce their impact on emissions.

4.148 Another form of energy from waste technology uses anaerobic digestion to process food waste. One of the by-products of the process is biogas which is then either combusted to generate electricity or processed into biomethane and injected directly into the gas grid. Due to lack of data available on local waste streams and the energy content of such waste streams, the technical potential of such biogas energy is not included within this assessment. Further detailed study would be required to make consideration of this.

Existing development within Harborough

4.149 Waste disposal is dealt with at County level and there is only one energy recovery treatment plant serving the County, Newhurst ERF, which is located outside of the District, near Shepshed.

Results

Technical potential

4.150 Harborough's technical resource for municipal and commercial waste, as a sustainable energy generating technology, is directly related to the amount of residual waste that is generated and collected within the District, and whether all this can be treated using energy recovery processes. Consideration of this is complicated by the fact that, as noted above, waste disposal is dealt with at County level and there is no energy recovery treatment plant within the District.

4.151 The Leicestershire Minerals and Waste Local Plan (LMWLP) was adopted on the 25th of September 2019, replacing the Leicestershire Minerals Development Framework and Leicestershire Waste Development Framework. The Local Plan addresses the need to provide protection to the environment and the amenity of local residents, while ensuring the provision of waste management facilities in accordance with Government policy and society's needs. It aims to maximise the use of alternative materials in order to reduce the reliance on primary-won minerals, and to significantly increase levels of reuse and recovery of waste and move away from landfill as a means of disposal, having regard to sustainability objectives.

4.152 Leicestershire County Council's approach to waste management is to tackle the growth in waste through the use of the waste hierarchy which seeks to prioritise the prevention of waste at source, followed by reuse, recycling, recovery including energy recovery and as a last option, safe disposal. The spatial strategy set out in the adopted LMWLP aims to locate the largest waste management recycling and recovery facilities in close proximity to the largest arisings, i.e. urban concentrations with populations above 30,000 around Leicester, and in and around Loughborough/Shepshed, Hinckley/Burbage, and Coalville. Smaller, non-strategic waste facilities will be sought in the first instance within the Broad Locations for strategic waste facilities but also in other key urban areas within the County – Melton Mowbray and Market Harborough. The LMWLP identifies a shortfall in the capacity of facilities for the recovery (by a variety of methods including anaerobic digestion, mechanical-biological treatment and some form of thermal treatment) of local authority collected waste and commercial and industrial waste in the plan period up to 2031. It notes, however, that planning permission has been granted for two waste recovery sites that would accommodate the shortfall. These are for the now-operational Newhurst ERF and a smaller proposal for an anaerobic digestion facility at Sutton Lodge Farm in Harborough.

4.153 Department for Environment, Food and Rural Affairs (DEFRA) figures show 35,850 tonnes of waste were collected and disposed by Harborough District Council in the year to March 2023. Of this, 15,623 tonnes were sent for reuse, recycling or composting – meaning the district had a recycling rate of 43.5% **[See reference 111]**. At the time of writing detailed data on commercial waste arisings in Harborough had not been identified.

Issues affecting deployment

4.154 As discussed above, 'deployment' of this technology is related to levels of residual waste arisings within the District and County. These levels are likely to decrease in the future as waste minimisation and recycling initiatives increase to comply with tightening regulations. Additionally, biomaterials (e.g. wood products, pulp, paper, fibre, etc) are a key input to several sectors of the economy – and are likely to increase in importance. Given that competition for renewable materials is likely to increase in the coming decades, it will become increasingly essential to prioritise the recycling and reuse of biomaterials – and not for energy recovery.

Waste residues – agricultural residues

Description of technology

4.155 Agricultural waste also represents a potential renewable energy resource, particularly from using livestock slurry as a feedstock for the anaerobic digestion (AD) process. This describes the process by which organic matter is broken down by microbes in the absence of oxygen to produce methane-based biogas for heat and/or power generation, and a liquid or solid digestate residue, which can often safely be used as a fertiliser. This potential resource is considered below.

4.156 Biogas generation from the anaerobic digestion of sewage is also classed as a renewable form of energy, with most large plant generating heat and/or electricity for the site's own needs and exporting excess power to the local grid. Biogas can also be upgraded to biomethane and injected directly into the gas grid. Heat recovery systems can also be used with sewage or wastewater infrastructure to provide heat to local users, although this application is not yet widespread. Due to lack of data available on local waste streams and the energy content of such waste streams, the technical potential of such biogas energy is not included within this assessment. Further detailed study would be required to make consideration of this.

Existing development within Harborough

4.157 Agricultural waste is mostly animal matter and plant waste which is dealt with on site. The data available from DESNZ **[See reference** 112**]** notes that there was an application for a 2MW anaerobic digestion plant at Houghton Lodge Farm but has been abandoned, and one 0.5MW non-domestic anaerobic digestion installation, as recorded on the Feed In Tariff scheme.

Assumptions used to calculate technical potential

4.158 As Harborough is predominantly rural, agricultural waste is a potential renewable energy resource, particularly from using livestock slurry as a feedstock for the anaerobic digestion process. Using estimates from Defra statistics on animal numbers for 2024, the total number of livestock that can produce waste for biogas (cattle, pigs and poultry) within Harborough was calculated **[See reference 113]**.

4.159 The total potential slurry produced by livestock and subsequent potential biogas yield via anaerobic digestion were then calculated based on these total livestock numbers by considering:

- The number of animals required to produce 1 tonne of slurry per day;
- The biogas yield from 1 tonne of slurry from each animal type; and
- The energy content of biogas.

4.160 Details of these calculations are included in Appendix A.

4.161 The potential for combined heat and power using the anaerobic digestion produced via the anaerobic digestion of livestock slurry was calculated. The calculation of potential energy yield required the application of a 'capacity factor'. The capacity factor is the average proportion of maximum anaerobic digestion capacity that would be achieved in practice over a given period, i.e. the average proportion of the total energy that can be produced by a anaerobic digestion development whilst it is running over a given time, in comparison to the amount of energy that would have been produced if the anaerobic digestion development was producing energy at full output for the entire time. A capacity factor of 64.9% was used, based on available national scale DESNZ data **[See reference 114]**. This indicates that anaerobic digestion developments will on average produce the equivalent amount of energy as the development working at full output for 64.9% of the total time it is running. The calculation of potential energy yield also required the consideration of the efficiency of CHP units (50%

heating and 30% electricity) **[See reference** 115**]** (i.e. the ratio of total energy output to the total energy input to the boiler/CHP unit).

4.162 The potential carbon savings as a result of generation via the identified biogas was also calculated. This assumed that the electricity generated from the identified biogas CHP potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.133kgCO_2e/kWh **[See reference** 116**]**. This could either be via use of the electricity on-site, on-site following battery storage, or off-site via export. Similarly, this assumed that the heat generated from the identified biogas CHP potential would result in negligible carbon emissions and would replace that currently provided by the mains gas (emission factor of 0.210kgCO_2e/kWh **[See reference** 117**]**), or either heating oil (emission factor of 0.298kgCO_2e/kWh **[See reference** 118**]**) or national grid electricity (emission factor of 0.133kgCO_2e/kWh **[See reference** 119**]**) for properties located 'off-gas' – see Appendix A.

Results

Technical potential

4.163 The technical potential findings are presented in Table 4.11.

Table 4.11: Biomass: Assessment of slurry – use for electricity CHP

Livestock	Estimated Capacity (MW)	Delivered Electricity (MWh/yr)	Delivered Heat (MWh/year)	Potential CO_2 Savings (tonnes/yr)
Cattle	10	17,423	29,039	8,432
Pigs	0.4	703	1,171	340

Livestock	Estimated Capacity (MW)	Delivered Electricity (MWh/yr)	Delivered Heat (MWh/year)	Potential CO_2 Savings (tonnes/yr)
Poultry	2	3,379	5,632	1,635
Total	**13**	**21,505**	**35,842**	**10,408**

Issues affecting deployment

4.164 Larger AD (or biomass) plants can cause landscape impacts, with the presence of features such as storage tanks, lighting and ground disturbances having the potential to impact the landscape of the site itself and the landscape character of the surrounding area. The presence of the storage tanks and industrial buildings within AD plants could also impact views from key viewpoints and settlements, and multiple AD plants could have cumulative impacts on landscape character. AD plants can also cause local nuisance issues due to release of bioaerosols and odour.

Biomass and waste – conclusion

This section of the study estimated the technical potential in Harborough for energy from virgin woodfuel (untreated wood residues from forestry/woodland and from energy crops) and from agricultural slurry. It was not possible within the scope of the study to estimate potential from other waste residues such as food waste or sewage waste. While much smaller than the technical potential from ground-mounted solar PV or from onshore wind, the combined technical potential (for electricity and heating) of virgin woodfuel and agricultural slurry is nevertheless potentially significant in Harborough, representing approximately 6% of the total technical potential energy output of all the renewable and low carbon energy sources considered by this study. Deployment of virgin woodfuel as an energy source will be influenced by a wide variety of factors affecting the quantity of land that is managed as woodland or for energy crops, incentives available for landowners to extract and process the woodfuel, as well as economic viability. Deployment of agricultural slurry as an energy source will be affected by the potential environmental effects of larger anaerobic digestion plants such as landscape impacts and odour.

Chapter 5

Policy options for renewable and low carbon energy in Harborough District

5.1 In order to have a realistic chance of meeting net zero targets, local planning authorities need to adopt a presumption in favour of renewable energy projects, provided they are not subject to technical, environmental or safety concerns. Increasing the amount of energy produced from renewable and low carbon technologies will help to make sure the UK has a secure energy supply, reduce greenhouse gas emissions to slow down climate change and stimulate investment in new jobs and businesses. Planning has an important role in the delivery of new renewable and low carbon energy infrastructure in locations where the local environmental impact is acceptable **[See reference** 120**]**.

5.2 The key consideration for HDC is therefore whether more can be done to promote renewable and low carbon energy in the District. This section provides an overview of some of the key policy approaches the Council may wish to consider as part of the preparation of the Local Plan update and other local planning guidance or documents. It also provides some examples of relevant policy wording used by other local planning authorities in recent Local Plans, which HDC may wish to draw from when drafting the new Harborough Local Plan.

Existing policy in Harborough Local Plan

5.3 The existing local plan presents HDC’s current approach for renewable and low carbon energy. Policy CC2 Renewable energy generation of the local plan states that:

1. Development for renewable and low carbon energy generation will be permitted where:

- a. it is an appropriate technology for the site;
- b. it does not create a significant noise intrusion for existing dwellings;
- c. it includes measures to mitigate against any adverse impacts on the built and natural environment resulting from the construction, operation and decommissioning of any equipment/infrastructure;
- d. it does not contribute towards an unacceptable cumulative visual impact from renewable energy developments when considered in conjunction with nearby developments and permitted proposals within the District or adjoining local authority areas; and
- e. adequate conditions are imposed and/or a legal agreement is entered into ensuring that once the use ceases operating permanently, it is fully decommissioned and the site appropriately restored.

2. Wind energy development involving one or more turbines will not be permitted except as follows:

- a. in the High Leicestershire and Laughton Hills Landscape Character Areas, where the height does not exceed 30 metres and no more than three turbines are proposed;
- b. in the Welland Valley Landscape Character Area, where the height does not exceed 65 metres and no more than three turbines are proposed; and
- c. in the Lutterworth Lowlands and Upper Soar Landscape Character Areas, where the height does not exceed 125 metres. In all cases, proposals will be considered against the above criteria 1.a to e.

Alternative policy approaches considered

5.4 The Harborough Local Plan already includes a criteria-based policy in relation to renewable and low carbon energy projects that ensure that the adverse impact of renewable and low carbon energy development are addressed satisfactorily, including cumulative impacts. The following alternative policy approaches for renewable and low carbon energy have been considered:

- Maintain (and update) existing Policy CC2.
- Identification of 'suitable areas for wind energy' that take into account the requirements of the technology (as mapped in this study), as well as the potential impacts on the local environment, including from cumulative impacts and views of affected local communities.
- Development of 'energy opportunity maps' to identify suitable areas for renewable and low carbon energy sources, and supporting infrastructure. These would expand on the above-mentioned identification of 'suitable areas for wind energy' by mapping opportunities for other renewable and low carbon technologies, such as solar, and could include mapping the proximity to necessary infrastructure including sub-stations and overhead lines. Developing energy opportunity maps could include the mapping of technical potential produced within this study, but adding further analysis, which takes into account the potential impacts on the local environment (e.g. landscape sensitivity).
- Allocation of sites for standalone renewable and low carbon energy developments.
- Encouraging community renewables by supporting community-led initiatives for renewable and low carbon energy, including developments being taken forward through neighbourhood planning.
- An additional guidance document to provide further guidance for new development on renewable energy technologies, requirements for planning submission documents (e.g. Energy and Climate Statements, Landscape Sensitivity Assessments, etc.) and climate change adaptation.

Maintain (and update) existing Policy CC2

5.5 The NPPF states that local authorities should design their policies to maximise renewable and low carbon energy development while ensuring that adverse impacts are addressed satisfactorily. While the Harborough Local Plan already includes a criteria-based policy in relation to renewable and low carbon energy, it could be updated to reflect the most recent national guidance. The PPG provides helpful guidance for local authorities on how to develop robust criteria-based policies in relation to renewable and low carbon energy projects. Key points include:

- The criteria should be expressed positively (i.e. that proposals will be accepted where the impact is or can be made acceptable – see Lancaster example provided below).
- Should consider the criteria in the National Policy Statements as these set out the impacts particular technologies can give rise to and how these should be addressed.
- Cumulative impacts require particular attention, especially the increasing impact that wind turbines and large-scale solar farms can have on landscape and local amenity as the number of turbines and solar arrays in an area increases.
- Local topography is an important factor in assessing whether wind turbines and large-scale solar farms could have a damaging effect on landscape. Recognise that the impact can be as great in predominantly flat landscapes as in hilly areas.
- Care should be taken to ensure heritage assets are conserved in a manner appropriate to their significance, including the impact of proposals on views important to their setting.
- Protecting local and residential amenity is an important consideration which should be given proper weight in planning decisions.

5.6 Drawing on the guidance outlined in the PPG, after expressing positive support in principle for renewable and low carbon energy development, Local

Plans should list the issues that will be taken into account in considering specific applications. This should not be a long negative list of constraints but it should set out the range of safeguards that seek to protect the environment – including landscape and townscape. Other key considerations may include residential amenity, aviation, heritage, tranquillity, etc.

5.7 For example, the **Lancaster Regulation 19 Partial Review Local Plan Part 2** **[See reference** 121**]** includes a renewable energy criteria-based policy that is positively worded and goes further than many Local Plan policies as it sets out criteria for onshore wind, hydro, solar, other renewable and low carbon technologies, heating and cooling networks and energy storage. Useful parts of the policy that HDC could consider including have been presented in the box below:

Lancaster Local Plan Policy DM53: Renewable and Low Carbon Energy Generation

The Council is committed to supporting the transition to a lower carbon future as a matter of urgency and will seek to maximise the renewable and low carbon energy (electricity and thermal) generated in the district where this energy generation is compatible with other sustainability objectives. *[This is a good example of demonstrating a strong commitment to trying achieve net zero. HDC could also refer to the climate emergency declaration the Council has signed.]*

The Council will support proposals for renewable and low carbon energy schemes, including ancillary development, where the direct, indirect, individual and cumulative impacts on the following considerations are, or will be made, acceptable (unless material considerations indicate otherwise): *[Again, this is more positively worded than the existing Harborough policy.]*

- I. As a result of its scale, siting or design impacts on the landscape character, visual amenity, impact on the setting of nationally designated landscapes, biodiversity, geodiversity, water quality, flood risk, townscape and historic assets of the district, highway safety, aviation and defence navigation system/communications are satisfactorily addressed;
- II. Impacts on the amenities of sensitive neighbouring uses and local residents are minimised *[‘as far as practicable’ – note LUC recommends including this phrase]* (including by virtue of noise, dust odour, shadow flicker, air quality or traffic).

[The policy goes on to set out specific requirements for proposals for hydro energy generation, solar energy generation, other renewable and low carbon technologies, thermal energy distribution (heating and cooling networks) and energy storage. It ends with the general requirement:]

The requirements of this policy are to be evidenced in a Sustainable Design Statement to be submitted with the planning application.

5.8 It would also be useful to recognise the potential opportunities for renewable energy developments to achieve positive impacts such as biodiversity enhancements (e.g. for ground-mounted solar farms, less than 2% of the land is disturbed by infrastructure, so the remainder of the site can be set aside for grassland and wildflower meadows and/or for sheep grazing, ensuring the land continues to contribute to food production) **[See reference** 122**]**. There is also the mandatory biodiversity net gain standard that needs to be met for all new development proposals.

It is therefore recommended that a criterion be added into the general renewable and low carbon energy development policy along the lines of:

- Renewable and low carbon energy developments should meet current best practice guidelines and standards on enhancement of biodiversity.

5.9 It is important that policy does not preclude the development of specific technologies other than in the most exceptional circumstances and does not merely repeat national policy but is relevant to the process of decision-making at the local level, focusing on locally distinctive criteria related to local assets, characteristics and sensitivities. It may also be appropriate for more detailed issues and guidance to be published in an additional guidance document on renewables (see 'additional guidance document' alternative policy approach below).

5.10 For example, the Inspector's report which accompanied the Blackburn with Darwen Borough Council **[See reference 123]** Site Allocations and Development Management Policies Plan (adopted in 2015) noted that in order for the Plan to be found sound, the Borough's criteria-based policies would need to be supported by an SPD which identified suitable areas. It is therefore recommended that any criteria-based policy designed to manage the development of renewable and low carbon technologies should also be supported by guidance on the most suitable locations (see appropriate sections relating to suitable areas, energy opportunities and allocations below), either within the Local Plan, an accompanying SPD (or Local Guidance document if SPDs are no longer able to be prepared – see 'additional guidance document' alternative policy approach below).

5.11 The benefits and limitations of adopting positively worded, criteria-based policies are summarised below:

Benefits:

- Creates greater policy certainty for developers.
- Allows the Council to clearly set out the circumstances in which renewable energy proposals will be permitted.
- Shows Council's commitment to addressing the climate emergency.

Limitations:

- May be perceived to be overly restrictive by certain stakeholders.

Identification of 'Suitable Areas for Wind Energy'

5.12 Given the 8th July 2024 deletion of Footnotes 57 and 58 to the NPPF and the proposed strengthening of paragraph 160 of the NPPF being consulted on from 30th July 2024 (see Chapter 2 of this report for further detail), HDC may wish to consider a policy that identifies suitable areas for wind energy in the Local Plan.

5.13 When identifying suitable areas for wind, the PPG does not dictate how suitable areas for renewable energy should be identified, but in considering locations, local planning authorities will need to ensure they take into account the requirements of the technology (e.g. scale of turbine, grid connections needed) and, critically, the potential impacts on the local environment, including from cumulative impacts and views of affected local communities. It also makes reference to the former Department of Energy and Climate Change's (now part of the Department for Business, Energy and Industrial Strategy) methodology on assessing the capacity for renewable energy development. LUC was involved in the preparation of this guidance. The guidance notes the value of landscape character assessments in identifying which technologies are appropriate in different locations, including the appropriate scale of development.

5.14 The assessment of technical potential as set out in Chapter 4 is based on a refinement of the methodology and identifies those areas which are technically viable for wind energy – i.e. they are broadly not constrained by infrastructure, environmental or heritage constraints (see Appendix A for the list of infrastructure types, and national and local biodiversity, geodiversity and heritage designations included as constraints).

5.15 HDC could choose to include the maps produced from this study in Appendix B in the new Local Plan as their 'suitable areas for wind energy', as these maps show the areas that have been identified via the GIS analysis to have technical potential for wind development at each turbine scale. Stroud Local Plan **[See reference** 124**]** has taken this approach. However, these maps do not take into account landscape sensitivity and were not able to factor in local residential amenity or cumulative impacts. The accompanying policy would need to:

- State that wind developments are more likely to be supported in the areas identified as suitable in principle but that proposals outside of these areas will also be considered where the suitability of the area is clearly justified;
- Include supporting text that explains that the location of a proposal for wind within a 'suitable area', as identified in the policies map, does not preclude the need for a site-specific investigation of the proposed site in relation the criteria set out in the renewables policy (see above), noting that the Renewable Energy Assessment study deliberately drew broad areas of technical potential so as to avoid excluding areas that site-specific investigation might find to be suitable for development; and
- If a more detailed Landscape Sensitivity Assessment is undertaken (see below), then the policy should also state that wind developments are more likely to be supported if they fall within landscape character areas of lower sensitivity to the relevant development scale.

5.16 One of the key factors determining the acceptability or otherwise of wind turbines is their potential impacts on the local landscape – this is due to their height and the movement they introduce into the landscape (i.e. rotating blades). Different landscapes present different opportunities for renewable energy, and landscape sensitivity studies can assist both planners and developers in identifying what scale of development may be appropriate in which areas. This approach is endorsed by the PPG which states that "landscape character areas could form the basis for considering which technologies at which scale may be appropriate in different types of location".

5.17 Therefore, it is recommended that a separate landscape sensitivity assessment is undertaken and overlaid with the maps showing just technical potential (in Appendix B of this report), in order to identify areas which are less sensitive to the different scales of wind turbines and hence identify more refined areas and/or provide additional guidance relating to where wind development proposals are more likely to be supported.

5.18 It is important to emphasise that if areas of suitability are identified in the Harborough Local Plan or Neighbourhood Plans (whether they are simply the technical potential maps, or have landscape sensitivity factored in as well), they would be broad designations rather than specific site allocations and would not therefore provide a definitive statement of the suitability of particular location for wind energy. In identifying these areas, the plan should avoid precluding developments which may not be viable now but may be in the future, for example because grid capacity becomes less constrained or renewable technologies improve to in relation to required wind speed. Site specific assessment and design would still be required as noted above, and all applications would still be assessed on their individual merits. It is also not possible at a strategic level, to take into account cumulative effects when identifying areas of suitability. Residential amenity, the setting of heritage assets, telecommunications, ecology, air traffic safety and other issues would also need to be carefully considered at a site level (and these should be included in the overarching criteria-based renewables policy as discussed above).

5.19 Examples of where identification of 'suitable areas for wind energy' has been included in local plans include Eden, Hull and Exmoor National Park – note that these are not necessarily examples of best practice but serve to illustrate different approaches taken. The Redcar and Cleveland Local Plan **[See reference** 125**]** adopted in May 2018 includes Renewable and Low Carbon Energy Policy SD 6 which identifies areas with potential for wind and solar technologies in the Proposal Map accompanying the Local Plan. These areas were identified by undertaking a technical assessment of wind and solar potential overlaid with the findings of a landscape sensitivity assessment.

5.20 The benefits and limitations of adopting identified 'suitable areas for wind energy' are summarised below:

Benefits:

- Enables planners to have informed discussions with developers and communities about potential opportunities for wind – i.e. proactive rather than reactive planning.
- Meets NPPF, PPG and Ministerial statement that LPAs should identify suitable areas for renewable and low carbon energy sources and supporting infrastructure.
- Can act as a useful tool for neighbourhood planning.

Limitations:

- There may be concern that it will lead to multiple wind energy applications within the areas identified as being suitable for wind. However, all applications would still need to be assessed on their own merits against the criteria-based policy, in isolation and in combination with existing developments, and the suitable areas identified in the Local Plan would not be a replacement for detailed site-specific studies.
- It does not provide a definitive statement on the suitability of a certain location for wind turbine development – each application must be assessed on its own merits.
- May identify potential areas for wind development that are unpopular.

Development of ‘Energy Opportunities Maps’

5.21 The consultation version of the NPPF (published in July 2024) encourages local planning authorities to “identify suitable areas for renewable and low carbon energy sources, and supporting infrastructure”. This is a strengthening of the current NPPF policy wording which encourages local planning authorities to “consider” identifying suitable areas. The Council should therefore seek to identify suitable areas for other forms of renewable and low carbon energy sources (in addition to wind, such as ground mounted solar discussed above), and supporting infrastructure, where this would help secure the development of such sources.

5.22 Clearly identifying and mapping an area's opportunities for renewable and low carbon sources of energy represents a positive and proactive way to spatially plan for renewable and low carbon energy generation. With a spatial map illustrating energy opportunities it is easier for local authorities to work with local communities and developers to identify the areas that would be most appropriate for development in strategic terms, accelerating the planning and development processes and avoiding conflict.

5.23 Energy opportunities maps can provide a spatial summary of the key opportunity areas (in terms of their technical potential) for various forms of renewable energy. These can be used to inform development decisions and discussions and guide development towards the most suitable areas.

5.24 At the scale of neighbourhood planning, energy opportunities maps can provide a useful tool for communities and other stakeholders to identify the key opportunities for renewables within their area. It is important to note, however, that it is not possible to identify potentially suitable locations for all types of renewable energy, as many technologies such as building integrated solar, heat pumps, farm-scale anaerobic digestion, and small-scale biomass can be located in nearly all areas.

5.25 The benefits and limitations of adopting 'Energy Opportunities Maps' are summarised below:

Benefits:

- Enables planners to have informed discussions with developers and communities about potential opportunities for renewable and low carbon energy technologies – i.e. proactive rather than reactive planning.

- Meets NPPF, PPG and Ministerial statement that LPAs should consider identifying suitable areas for renewable and low carbon energy sources and supporting infrastructure.
- Can act as a useful tool for neighbourhood planning.

Limitations:

- Not possible to identify locations for all types of renewable energy technologies.
- It does not provide a definitive statement on the suitability of a certain location for a particular development – each application must be assessed on its own merits. It is not a replacement for detailed site studies.
- May identify potential areas for renewable energy development that are unpopular.

Allocating sites for standalone renewable and low carbon energy schemes

5.26 The Harborough Local Plan could go even further than identifying potentially suitable areas (as discussed above) and instead allocate specific sites for standalone renewable developments. This policy option could provide very clear direction to the siting of renewables for developers, investors, the local authority, statutory stakeholders and communities. It may be possible to allocate sites which have the greatest potential for sustainable energy and carbon reduction or sites that could potentially be developed for other purposes (e.g. resulting in the sterilisation of potential sites).

5.27 If sites exist that have potential for standalone renewable or low carbon energy use but are constrained in a way that would make them less attractive to commercial developers, then allocating the site is a way of promoting that site for renewable/low carbon development to a wider audience such as landowners or co-operatives. Alternatively, or in addition, the Council could undertake a 'call for sites' exercise for renewable and low carbon development and consider the merits of promoted sites in isolation, or in combination with other planned types of development. It should however be noted that such call for sites exercises tend to generate a relatively poor level of response.

5.28 Again, it would be important that site allocations only highlight appropriate schemes/areas; site developers and communities would still be required to undertake detailed site-based assessment work to support individual development planning applications and if required Environmental Impact Assessments. Furthermore, site allocations should be framed such that they do not preclude renewable energy development proposals in other locations.

5.29 The benefits and limitations of allocating sites for standalone renewable and low carbon energy schemes are summarised below:

Benefits:

- Provide clear direction to the siting of renewables.
- Ensure sites with the greatest potential for delivery are identified.
- May promote sites to a wider audience such as co-operatives.

Limitations:

- Very resource intensive for the Council to gather the necessary evidence to justify each site allocation for renewable or low carbon energy use.
- Would be desirable to secure agreement of landowner which may be resource intensive.
- May identify potential sites for renewable energy development that are unpopular.

Encouraging community renewables

5.30 The NPPF states that local authorities should support community-led initiatives for renewable and low carbon energy, including developments being taken forward through neighbourhood planning. Community-led renewable energy projects are increasingly being seen as an attractive option for local communities wishing to contribute to local/national climate change targets and as a way to generate local revenue to directly benefit the community. For example, the Westmill Wind Farm Co-operative **[See reference** 126**]** in Swindon was the first 100% community owned wind farm to be built in the south of England.

5.31 There are many ways in which community-led schemes can be brought forward for development such as via grants, crowdfunding, share raising and institutional investments. Some key information sources from organisations closely involved in the development of community renewable initiatives include:

- Community for renewables;
- CSE; and
- Regen.

5.32 Community groups can face considerable challenges in the pre-planning stage and there are a number of opportunities for local authorities to provide advice and guidance at this stage, including the provision of early advice on planning requirements and lending support to consultation activities within the community. Engaging communities in the earliest stages of plan-making and providing clear information on local issues and the decision making process can aid the development of community renewable energy projects.

5.33 Examples of plans that include policies to support community renewable energy schemes include the adopted Bath and North East Somerset Local Plan **[See reference** 127**]**, and this policy in the Cotswolds Local Plan Regulation 18 consultation **[See reference** 128**]**:

Policy CC2d Community Renewable Energy Schemes

Significant weight will be given to community led energy schemes where evidence of community support can be demonstrated, with administrative and financial structures in place to deliver/manage/own the project and any income from it. Encouragement will be given to schemes to provide for a community benefit in terms of profit sharing or proportion of community ownership and delivery of local social and community benefits.

5.34 The Council's emerging Local Plan could broaden its support for community renewable schemes by stating that the Council would actively support community renewable energy schemes which are led by or meet the needs of local communities. Such developments would normally be conceived and/or promoted by the community within which the renewable development will be undertaken, delivering economic, social and/or environmental benefits to the community. Neighbourhood plans provide a particular opportunity to define detailed local site allocation policies for renewable and low carbon technologies.

5.35 The benefits and limitations of encouraging community renewable schemes are summarised below:

Benefits:

- Provides support to local communities to develop renewables and low carbon energy.
- Generates local revenue to directly benefit the local community.
- Can secure a broad base of local support for renewable energy schemes.

Limitations:

- Care may need to be taken not to prescribe the process of community ownership (i.e. shared ownership etc.) as it is not the role of the planning system to do this.

Additional guidance document

5.36 The Levelling Up and Regeneration Act (LURA) 2023 provides for the creation of new planning policy documents called Supplementary Plans (SPs). The intention is (as set out in the Government's consultation) that SPs replace Supplementary Planning Documents (SPDs) and Area Action Plans (AAPs) once the regulations are in place for the reformed plan-making system sometime later in 2024. That said, SPs will be different to SPDs in relation to what content they can cover.

5.37 The plan making reforms, once brought in to force, will remove the legal powers that enable the preparation of Supplementary Planning Documents (SPDs). Government expects Local Planning Authorities (LPAs) to review the content of all existing SPDs. LPAs should review their SPDs and decide whether the information they contain should go into the local plan or whether it can become 'Local Guidance'.

5.38 At the time of writing, the new Labour Government had not signalled whether it intends to continue with this aspect of plan making reform. If it does not and where there is no scope to include the relevant level of guidance within the Local Plan, this could be set out in an accompanying Supplementary Planning Document or Local Guidance document. This could include further guidance on the various renewable energy technologies (including battery storage), what is required in an Energy & Climate Statement, the findings of a Landscape Sensitivity Assessment (if undertaken) and how this should be interpreted and/or further development management guidance on how applications will be considered. This information could potentially be added to the Council's existing Development Management SPD or form its own separate Renewable and Low Carbon Energy guidance document.

Policy examples

5.39 In addition to some of the specific examples referred to above, Section 3 of the TCPA/RTPI Climate Change Planning Guidance (2023) **[See reference 129]** provides various model approaches for renewable energy and low carbon policy options that can be referred to as examples for local authority plan making.

Chapter 6

Summary and conclusions

Summary

6.1 This study has sought to provide the Council with evidence of the technical potential for renewable and low carbon energy technologies within the District and how renewable and local issues could be embedded within the Council's emerging Local Plan.

6.2 There is currently 98MW of operational renewable electricity generation capacity across Harborough, with annual emission savings of over 16,000tCO_2, equating to powering approximately 45,000 homes a year **[See reference** 130**]**, equating to planting approximately 618,000 trees a year **[See reference** 131**]**. The findings of this study show that there is significant technical potential for renewable and low carbon energy within the District. As summarised in Table 6.1 below, if all of this electricity and heat generation potential could be realised, it would have a total illustrative capacity of 33,827MW, outputting 33,697,557MWh of energy per year, equating to powering approximately 11.6 million homes with electricity and 205,000 homes with heat a year **[See reference** 132**]**, and saving 4,604,658tCO_2 emissions annually, equating to planting approximately 177 million trees a year **[See reference** 133**]**. However, the deployable potential will be much lower, one reason being that technologies would require the same areas of land to be developed **[See reference** 134**]** and due to the many issues affecting deployment described in this study. The greatest technical potential lies in the opportunity to use the power of the sun in the form of ground-mounted solar PV. Onshore wind also has significant technical potential, particularly if economic viability improves, although developers may prioritise opportunities in the North of England where windspeeds tend to be higher.

Table 6.1: Summary of illustrative technical potential by technology

Technology	Estimated Total Capacity (MW)	Energy Output – Electricity (MWh/yr)	Energy Output – Heat (MWh/yr)	Energy Output – Total (MWh/yr)	Potential CO_2 Savings (tonnes/yr)
Wind	2,678	5,370,597	-	5,370,597	714,289
Ground-mounted solar	29,899	25,104,856	-	25,104,856	3,338,946
Rooftop solar PV/heating	113	67,975	21,477	89,453	13,563
Hydro	-	-	-	-	-
Air source heat pumps	627	-	1,010,404	1,010,404	152,699
Biomass – livestock slurry (CHP)	13	21,505	35,842	57,347	10,408
Biomass – woodfuel (CHP)	3	4,035	6,726	10,761	1,953
Biomass – energy crops – miscanthus only (CHP)	437	651,396	1,085,661	1,737,057	315,254

Technology	Estimated Total Capacity (MW)	Energy Output – Electricity (MWh/yr)	Energy Output – Heat (MWh/yr)	Energy Output – Total (MWh/yr)	Potential CO_2 Savings (tonnes/yr)
Biomass – energy crops – SRC only (CHP)	80	118,906	198,176	317,082	57,546
Total illustrative technical potential	**33,850**	**31,339,271**	**2,358,286**	**33,697,557**	**4,604,658**

6.3 One of the difficulties for local authorities in setting District-wide carbon targets is the co-dependency on national policy measures, such as those which will contribute to decarbonising both the electricity grid and heat supplies. Such measures are likely to be achieved through a mix of technologies, including some which most local authorities have little or no influence over such as offshore wind power and the development of hydrogen infrastructure. The rate at which grid decarbonisation occurs will be dependent on national policies and local authorities will in turn be largely dependent on a decarbonised grid to fulfil their own policy commitments.

6.4 New developments do, however, have the potential to make a significant contribution towards low and zero carbon energy generation capacity within the District, particularly if a rapid trajectory towards operational net zero carbon is adopted for new buildings – aided by the Future Homes Standard when this is implemented. It is difficult to quantify their impact as the mix of technologies used will depend on costs, onsite emission targets and applied emission factors, but it is likely that developers will focus on heat technologies such as heat pumps and rooftop solar. However, the additional capacity will not decrease overall emissions; it will instead limit the additional emissions resulting from the new development.

Conclusions

6.5 Achieving net zero is hugely challenging considering the radical changes that are needed to enact the necessary innovative transformative action across all sectors. However, in their 'Net Zero' report, the Committee on Climate Change view the UK-wide target as being "achievable with known technologies, alongside improvements in people's lives… However, this is only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay" **[See reference** 135**]**.

6.6 As such, this document focussed on the potential interventions through local planning for renewable energy development. With Harborough District Council in the process of preparing its next Local Plan, there is a clear window of opportunity to ensure that the new Local Plan sets out a step change in the support given to the development of renewable and local carbon energy projects.

6.7 To support the deployment of renewable energy in the District, it is recommended that stronger polices should be put in place supporting:

- Onsite renewable and low carbon energy generation via supportive and positively worded criteria-based policies (as illustrated by the Lancaster Local Plan example provided in Chapter 5);
- Stand-alone renewable and low carbon energy schemes, including specific policies on solar PV and wind energy identifying areas of suitability for these technologies and recognising that some landscape change will be required (how this could be achieved is discussed further in Chapter 5, including the recommendation for an additional landscape sensitivity assessment to help inform the areas of suitability to be identified in the Local Plan); and
- Community-led renewable and low carbon energy schemes (see examples provided in Chapter 5).

6.8 Additional guidance may need to be provided within supporting text to the policies, or in an additional guidance document. Careful monitoring of the success of the policies should also be established to measure the District's progress towards its ultimate goal of becoming net zero by 2030. Additionally, monitoring can also help address unintended consequences on future occupants such as badly installed heat pumps or higher costs to run the technology.

6.9 The delivery of renewable and low carbon projects will also require changes not just to planning policy but also to the implementation of policy. It will be imperative that due weight and consideration is given to the importance of addressing climate change in development management decisions. This should include providing appropriate training and checklists for development management officers and planning committees to ensure that the policies are implemented as intended and that due weight is given to Climate Change issues in all planning decisions.

Appendix A

Resource assessment assumptions

Appendix A

Key Assumptions to be Applied in the Assessment of Renewable and Low Carbon Energy Resource

Introduction

A.1 This appendix sets out the key assumptions that were used within the assessments of technical potential. Assumptions relevant to multiple renewable energy technologies are described first, followed by those specific to individual technologies as follows:

- Existing property statistics
- Emission factors
- UK capacity factors
- Wind
- Ground-mounted solar
- Rooftop solar
- Hydropower
- Heat pumps
- Biomass (including forestry and woodland residues; energy crops; recycled wood waste; agricultural residues, including anaerobic digestion; and sewage)

Existing Property Statistics for Harborough

A.2 The existing stock of domestic dwellings and non-domestic properties within Harborough was derived from Local Land and Property Gazetteer (LLPG) address data.

A.3 The overall proportion of 'off-gas' properties (those not connected to the gas network) was derived from the 2024 Department for Energy Security & Net Zero (DESNZ) Lower layer Super Output Areas (LSOA) estimates[1].

[1] DESNZ (2024) LSOA estimates of properties not connected to the gas network 2015 to 2022. Available at: https://www.gov.uk/government/statistics/lsoa-estimates-of-households-not-connected-to-the-gas-network

Table A - 1: Properties in Harborough

Property type	Number of properties within Harborough
Detached dwelling	*21,462*
Semi-detached dwelling	*11,612*
Terraced dwelling	*8,078*
Flat[2]	*3,061*
Other dwelling[3]	*586*
Total dwellings considered in the rooftop solar and air source heat pump assessments	***41,152***
Properties other than dwellings[4]	*4,452*
Total properties considered in the rooftop solar and air source heat pump assessments	***45,604***

Source: OS Address data

Emission Factors

A.4 To determine the potential CO_2 savings from the identified potential renewable resources, the identified potential electricity/heating output was multiplied by the emissions factors at present of the fuels the renewable energy generation would replace:

- Grid electricity: 0.133 $kgCO_2e/kWh$[5]
- Mains gas: 0.210 $kgCO_2e/kWh$[6]
- Heating oil: 0.298 $kgCO_2e/kWh$[7]
- Wood fuel: 0.011 $kgCO_2e/kWh$[8]

A.5 The actual proportions of electricity and oil usage by off-gas properties for heating is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

UK Capacity Factors

A.6 Regional capacity factors[9], where available, were used when calculating technical potential within Harborough. Where unavailable, national DESNZ and RHI data on annual load factors were used when calculating technical potential.

[2] Flats could not be considered in in the rooftop solar and air source heat pump assessments as data was not available to determine if all flats were suitable.
[3] Excluding ancillary buildings, car parking, garages, house boats, caravans and chalets. Other dwellings could not be considered in in the rooftop solar and air source heat pump assessments as data was not available to determine if all properties were suitable.
[4] Commercial properties excluding land, ancillary buildings, military buildings, objects of interest, parent shells, waste sites, minerals sites, ancillary buildings, parking, and other inappropriate locations including fisheries, telephone boxes, lighthouses, beach huts; ATMs, cemeteries; and utilities.
[5] National Grid (2024) Future Energy Scenarios: FES 2024 Data workbook – Key Stats: Annual average carbon intensity of electricity (five year forecast from 2023). Available at: https://www.nationalgrideso.com/future-energy/future-energy-scenarios-fes.
[6] BRE (2024) Standard Assessment Procedure: RdSAP10 Specification. Available at: https://bregroup.com/sap/sap10
[7] BRE (2024) Standard Assessment Procedure: RdSAP10 Specification. Available at: https://bregroup.com/sap/sap10
[8]BEIS and DESNZ (2022) Greenhouse gas reporting: conversion factors 2022. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022. Wood logs/chips/pellets.
[9] The ratio of the actual energy generated over a year, compared to the amount of energy the development could have generated if it had operated at full capacity the entire time.

Table A - 2: UK renewable capacity factors

Technology	UK-level Capacity Factor
Anaerobic Digestion[10]	64.9%
Hydro[11]	38.2%
Micro CHP[12]	12.6%
Solar PV[13]	9.6%[14]
Wind[15]	24.5%[16]
Solar Water Heating[17]	4.5%
Air Source Heat Pumps[18]	18.4%
Ground Source Heat Pumps[19]	18.2%
Biomass (plant-based)[20]	56.7%
Sewage Sludge Digestion[21]	43.8%

Wind Resource Assessment Parameters

A.7 The potential wind development resource within Harborough was assessed using a Geographical Information Systems (GIS) approach. This involved mapping a variety of technical and environmental parameters (see below) to identify parts of the district which are constrained with respect to wind development at various scales. The remaining land was then identified as having 'technical potential' (subject to further site-specific assessment at application stage)[22]. The parameters of the GIS tool are set out in **Table A - 3**.

A.8 The maximum theoretical wind generation capacity of the areas of technical potential was estimated using:

[10] BEIS and DESNZ (2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[11] BEIS and DESNZ (2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[12] BEIS and DESNZ (2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[13] BEIS and DESNZ(2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[14] The average of all the available load factors for the East Midlands was used for the technical potential assessment for solar (9.59%) – see footnote 30.
[15] BEIS and DESNZ(2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[16] The average of all the available load factors for the East Midlands was used for the technical potential assessment for wind (22.9%) – see footnote 23.
[17] BEIS and DESNZ (2023) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps. Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments
[18] BEIS and DESNZ(2023) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps. Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments
[19] BEIS and DESNZ(2023) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps. Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments
[20] DESNZ(2023) Load factors for renewable electricity generation (DUKES 6.3). Available at: https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes
[21] Statista (2024) Load factor of electricity from sewage sludge digestion in the United Kingdom (UK) from 2010 to 2022. Available at: https://www.statista.com/statistics/555718/sewage-sludge-digestion-electricity-load-factor-uk/
[22] The area of unconstrained land is treated as a single block of land which may not be the case in reality. This singular block is created from merging many polygons, which are not simple shapes of equal width. This means some slivers, or areas smaller than the required width, may be present in the results as they adjoin suitably sized areas of land.

- Standardised turbine densities and assumed turbine maximum generation capacities (the latter expressed in Megawatts (MW));
- One or more assumed capacity factors based on historic data broken down at least to regional level (using data from the Department for Business, Energy and Industrial Strategy (BEIS, now DESNZ) relating to Feed in Tariff (FiT) installations)[23]; and
- The assumption that, where land has technical potential for multiple turbine scales, the largest scale will be developed in preference to smaller scales.

Table A - 3: Proposed assumptions to be used for assessment of technical potential for onshore wind – Constraints

Parameter	Assumption	Data Source	Justification and Notes
Wind Turbine Size	Five turbine sizes were considered: ■ Very large (150-220m tip height) ■ Large (100-150m tip height) ■ Medium (60-100m tip height) ■ Small (25-60m tip height) ■ Very small (<25m tip height) Assessment was based on notional turbine sizes, approximately intermediate within each class size i.e.: ■ Very large: 185m tip height, 4MW capacity ■ Large: 125m tip height, 2.5MW capacity ■ Medium: 80m tip height, 0.5MW capacity ■ Small: 45m tip height, 0.05MW capacity	■ LUC ■ Research into turbine manufacturers ■ BEIS (now DESNZ) renewable energy planning database and other databases containing information on wind turbine applications.	There are no standard categories for wind turbine sizes. The categories chosen are based on consideration of currently and historically 'typical' turbine models at various different scales. The approach is intended to be flexible in the light of uncertainty regarding future financial support for renewable energy. A review of wind turbine applications across the UK showed tip heights ranging from less than 25m up to around 220m, with larger turbine models in demand from developers following the reduction in financial support from Government and driven by the manufacturers and trends from other European markets where turbines of this scale have been developed for some time[24]. Due to the structure of the financial support system in the past, smaller turbines (those in the medium to small categories) have tended to be deployed as 1-2 turbine developments. As this is a strategic scale study, notional turbine sizes, approximately intermediate within each class size, were used to represent each scale of turbine within this assessment. No mapped-based assessment of 'very small' turbines was undertaken. The type of buffers applied to constraints for the assessment of other turbine size categories in many cases do not reasonably apply to very small turbines. Equally, mapping a strategic district-wide 'resource' for very small turbines (which are generally developed individually in association with particular farm or other buildings) is not

[23] An energy generator's 'capacity factor' can be defined as the actual energy yield produced over a period of time expressed as a proportion of the energy yield that would have been produced if the generator had operated at its full generation capacity continuously over the same period. This was averaged at 22.9% for the East Midlands over the past 12 years. BEIS and DESNZ (2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors.

[24] LUC review in February 2024.

Parameter	Assumption	Data Source	Justification and Notes
			particularly meaningful. Instead, it is recommended that policy references the entire plan area as being potentially suitable for very small wind in principle (subject to site-specific assessment).
Roads	Exclude: ■ Roads (excl. restricted access tracks) with a buffer of the height of the turbine (to blade tip height) +10%.	■ Ordnance Survey OpenRoads	These buffers were applied as a safety consideration. The proposed buffer distance is based on standard safety distances used by wind turbine developers and the DECC Renewable and Low-carbon Energy Capacity Methodology[25]. Restricted access tracks were excluded from consideration as these predominantly comprise of forestry and other tracks which could be more easily diverted than standards roads.
Railways	Exclude: ■ Railways with a buffer of the height of the turbine (to blade tip height) +10%.	■ Ordnance Survey VectorMap District	This buffer was applied as a safety consideration, based on the same principles as used for roads.
Electricity Lines	Exclude: ■ Major transmission lines (132kV minimum) with a buffer of the height of the turbine (to blade tip height) +10%.	■ Ordnance Survey OpenMap ■ National Grid	This buffer was applied as a safety consideration. It is derived from guidance by the Energy Networks Association (Engineering Recommendation L44) and National Grid (Technical Advice Note 287). It is noted that this guidance also states that a buffer of 3x the rotor diameter should be applied to account for turbine wake downwind of a turbine impacting the weathering of electricity lines. However, this also states that this impact is variable depending on factors including turbine positioning. This would require site-level study and consultation with the relevant DNO. As such, this buffer distance was not applied as a constraint. Further study would be required to make consideration of transmission lines operated by the local DNO National Grid (Formerly Western Power Distribution).
Gas pipelines	Exclude: ■ Gas pipelines with a 1.5x hub height buffer.	■ National Grid	This buffer was applied as a safety consideration. It is derived from guidance by the United Kingdom Onshore Pipeline Operators' Association (UKOPA/GP/013 Edition 1).

[25] DECC (2010) Renewable and Low-carbon Energy Capacity Methodology. Available at: https://www.gov.uk/government/news/decc-publishes-methodology-for-renewable-and-low-carbon-capacity-assessment

Parameter	Assumption	Data Source	Justification and Notes
			For security reasons National Grid do not provide the exact locations of the pipelines but a buffered dataset of approximately 25m in width. The 1.5x hub height buffer was therefore applied in addition to this current buffer. Moreover, it is noted that only National Grid open data was available for use within this study. Further site-specific study would be required to consider any other buried pipelines not contained within this dataset.
Airports and Airfields	Exclude: ■ Operational airports and airfields.	■ Ordnance Survey OpenMap Local Functional Site layer with the theme 'Air Transport'	OS OpenMap Local Functional Site data with the theme Air Transport was used in the assessment. It is noted that land within consultation zones surrounding airports and airfields may also be unsuitable for wind turbine development, and further consultation between potential developers and airport and airfields is required to determine if there is any impact from a proposed development.
Noise	Exclude: ■ Sensitive[26] and non-sensitive receptor[27] buffer zones based on turbine size: – Very large scale: 500m for residential/other sensitive receptors, 250m for non-residential. – Large scale: 480m for residential/other sensitive receptors, 230m for non-residential. – Medium scale: 400m for residential/other sensitive receptors, 180m for non-residential. – Small scale: 180m for residential/other sensitive receptors, 80m for non-residential.	■ OS Addressbase ■ OS OpenMap	Wind turbines generate sound during their operation, and their noise impacts upon nearby properties must be limited to appropriate levels, defined in particular by the 'ETSU' Guidance – The Assessment and Rating of Noise from Wind Farms (1995) (as supplemented by the Institute of Acoustics). The relationship between turbine size and the separation distance from properties at which acceptable noise levels will be achieved is in practice quite complex and variable. However, the present assessment has applied specialist acoustic advice to define minimum distances below which it is generally unlikely that the required noise levels under ETSU-R-97 will be achievable. The buffer for a noise level of 35dB LA90 for small-medium turbines and 38dB LA90 for large-very large turbines was used as the minimum limit applied to sensitive receptors in a typical rural location. The approach taken necessarily involves applying various assumptions, including: ■ An assumed single turbine development in all cases (rather than multiple turbines); and ■ The assumption that no properties will be 'financially involved' in the wind development or are located in an existing nosier area (financial involvement

[26] Sensitive receptors include residential properties, schools, hospitals and care homes. These were identified via the LLPG data.
[27] Non-relevant addresses that have no applicable noise receptors were excluded, identified via the LLPG data, including: ancillary buildings, car parking, garages, non-buildings.

Parameter	Assumption	Data Source	Justification and Notes
	For properties outside (but close to) the authority boundary, indicative buffers were applied to the available property/buildings data from OS OpenMap. As this data does not distinguish commercial and residential properties, and it was not possible to verify uses by other means, non-residential buffers were used throughout.		and existing elevated baseline noise levels may allow higher noise levels to be accepted in individual cases). The limitations associated with such assumptions are considered preferable to avoiding the use of noise-related separation distances for the assessment, bearing in mind that noise is a key factor that influences the acceptable siting of turbines in practice. The assessment defines the minimum distances below which adherence to the Industry standard (ETSU-R-97) noise guidance would not be possible and it should not be inferred that the proposed distances represent acceptance of any given proposal within the areas of identified suitable potential as site based noise monitoring and assessments would still be required. Note: Due to lack of address data outside of Harborough, buildings outside of the Authority were identified by OS OpenMap data and assumed to be of non-sensitive use. This was to ensure that land was not unnecessarily ruled as being constrained to wind development, as a result of non-sensitive buildings being mistakenly assessed as being sensitive. It is noted further site specific study would be required to determine the necessary buffer distance between specific buildings and proposed turbines.
Buildings	Exclude: ▪ Buildings with a buffer of the height of the turbine (to blade tip height) +10%.	▪ OS OpenMap	National Planning Practice Guidance notes that the topple distance + 10% is a safe separation distance between turbines and buildings.
Future Developments, Safeguarded Land and Employment Sites	Exclude: ▪ Site allocations from Harborough's Plan: – BE1 Business and employment commitments and allocations – BE2 Magna Park – BE5 Leicester Airport – BE4 Bruntingthorpe Proving Ground	▪ Harborough District Council	Generally unsuitable for wind turbine development, unless allocations contain relatively large undeveloped portions. Identification of suitable land for wind within specific allocation boundaries would require a separate site-specific study. It is assumed that opportunities for renewables within such sites will potentially be considered as part of their design. It is noted that developers would need to make consideration of other allocations, such as those within neighbourhood plans, as part of further site feasibility study.

Parameter	Assumption	Data Source	Justification and Notes
	– H1 Housing commitments and allocations – SC1 Scraptoft North Strategic Development Area – L1 East of Lutterworth Strategic Development Area		
Existing Renewable Energy Developments	Exclude: ▪ Land boundaries of consented and operational renewable energy installations.	▪ Harborough District Council ▪ BEIS (now DESNZ) ▪ Aerial imagery ▪ LUC windfarm database	The quarterly BEIS (DESNZ) Renewable Energy Planning Database, Harborough Council data and the LUC internal windfarm database was used to determine the locations of operational and consented renewable energy installations. To approximate the site boundary, land was excluded based on Harborough Council boundary data in combination with assessment of surrounding recent aerial imagery. For existing wind developments, it was assumed these were of notional medium scale tip height and occupied a 5 x 3 rotor diameter oval spacing[28], with the major axis of the oval oriented towards the prevailing wind direction, taken to be south-west (see turbine spacing below). Existing roof-mounded solar PV developments are building-integrated and therefore were excluded via the consideration of existing built development as a constraint. Additionally, existing landfill gas developments were not considered a constraint to wind developments, as there is potential that turbines could be incorporated onto such existing sites. Existing battery developments were not included as, due to their small scale, their exact location within a site was difficult to identify. Moreover, there is potential for battery and turbine developments to also be co-located.
Terrain	Exclude: ▪ Slopes greater than 15%.	▪ EA Lidar DTMs	This is a development/operational constraint. Developers have indicated that this is the maximum slope they would generally consider feasible for development. Although it is theoretically possible to develop on areas exceeding 15% slopes,

[28] To mitigate impacts on the productivity of wind turbines located close to one another caused by wind turbulence, it is standard practice for developers to maintain an oval of separation between turbines that is equal to 5 times the turbine rotor diameter (the cross sectional dimension of the circle swept by the rotating blades) on the long axis, and 3 times the rotor diameter on the short axis.

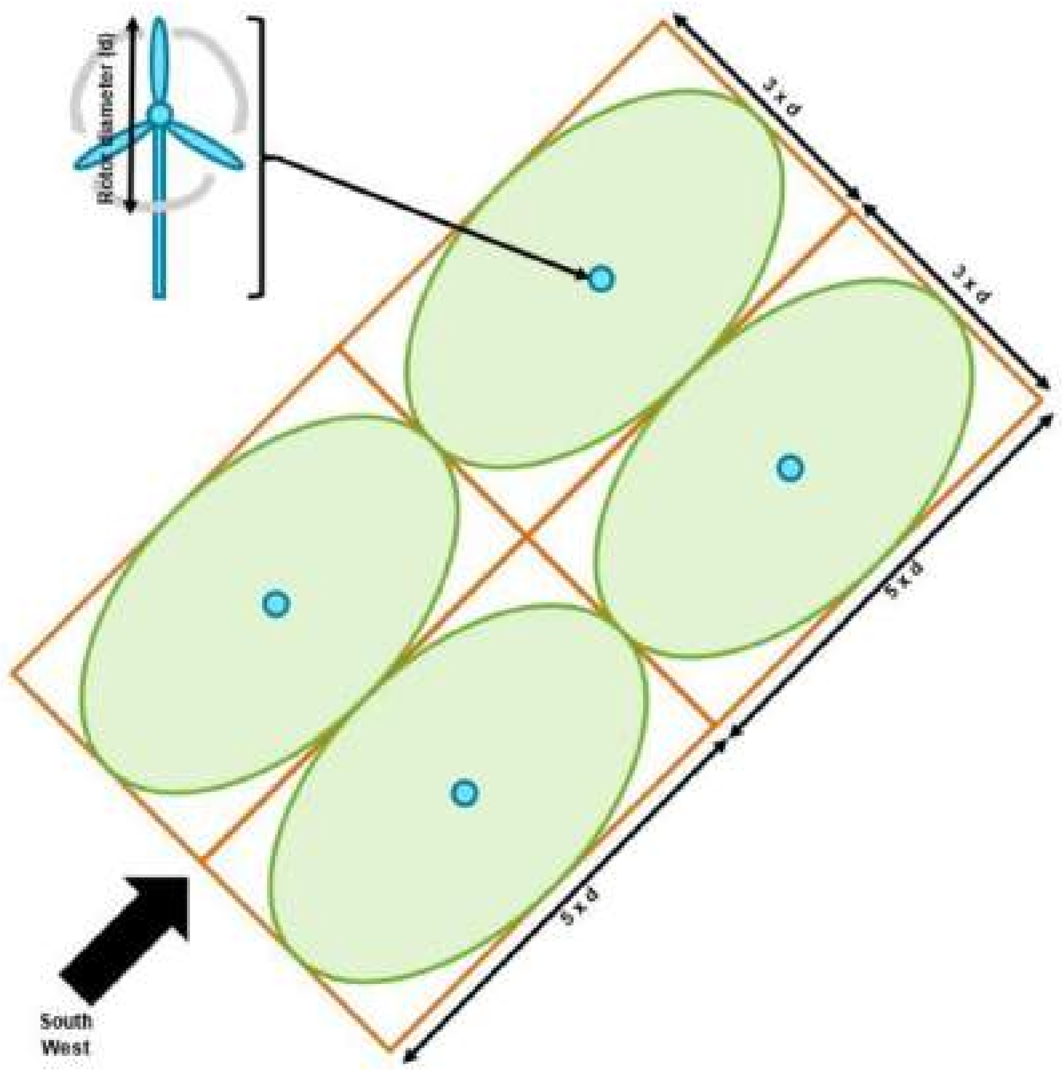
Parameter	Assumption	Data Source	Justification and Notes
			turbine manufacturers are considered unlikely to allow turbine component delivery to sites where this is exceeded.
Water Environment	Exclude: ■ Watercourses and waterbodies with a 50m buffer.	■ Ordnance Survey OpenMap Local	A 50m buffer was applied around all rivers and waterbodies to take account of good practice such as that relating to pollution control during construction. OS Survey OpenMap Local surface water area data includes waterways of approximately a minimum of 2m width. OpenMap Local surface water line data is line data, and so a 1m buffer was applied to approximate a footprint of smaller waterways.
Woodland	Exclude: ■ Ancient Woodland Inventory with a 50m buffer; and ■ Woodland as shown on the National Forest Inventory with a 50m buffer including: – Assumed woodland; – Broadleaved; – Conifer; – Coppice; – Coppice with standards; – Low density; – Mixed mainly broadleaved; – Mixed mainly conifer; and – Young trees.	■ Forestry Commission ■ Natural England	All areas of woodland were excluded with a +50m buffer to reduce risk of impact on bats. A 50m clearance distance of turbine blades from tree canopies and other habitat features is standard practice and endorsed by Natural England guidance set out in 'TIN051'. A 50m horizontal buffer from turbine masts is a reasonable proxy clearance for the purposes of a strategic study bearing in mind unknowns concerning tree height and turbine dimensions. In addition, a 50m buffer cannot be applied to all linear habitat features and individual trees due to a lack of data for a study of this scale. Further site specific study would therefore be required to accurately define buffer distances between turbines and adjacent woodland. The following National Forestry Inventory categories of woodland were considered non-permanent or non-woodland and therefore not excluded as wind turbine development may be suitable in these locations: ■ Cloud/shadow; ■ Failed; ■ Felled; ■ Group prep; ■ Shrub; ■ Uncertain; and ■ Windblown.

Parameter	Assumption	Data Source	Justification and Notes
Geological designations	Exclude: ■ Locally Important Geological Sites ■ Regionally Important Geological Sites	■ Harborough District Council	As protected by: ■ Town and Country Planning Act 1990 ■ Harborough's Local Plan to 2031 (Adopted April 2019)
Biodiversity (National Designations)	Exclude national designations: ■ Sites of Special Scientific Interest (SSSI)	■ Natural England	As protected by: ■ Wildlife and Countryside Act 1981 ■ Conservation of Habitats and Species Regulations 2017 (as amended) National Nature Reserves would also be considered constraints to wind development, however there are none located within the authority.
Biodiversity (Regional and Local Designations)	Exclude other designations: ■ Local Nature Reserves; and ■ Local Wildlife Sites (LWS).	■ Natural England ■ Harborough District Council	Generally, would not be suitable for renewables development based on law/policy/guidance including: ■ NPPF ■ Natural Environment and Rural Communities Act 2006 ■ Harborough's Local Plan to 2036 (Adopted May 2019) It is noted that further site-specific study would be required to consider non-designated features.
Cultural Heritage	Exclude: ■ Registered Parks and Gardens; ■ Scheduled Monuments; ■ Listed Buildings; ■ Conservation Areas; and ■ Locally Listed Buildings.	■ Historic England ■ Harborough District Council	As protected by: ■ NPPF ■ National Heritage Act 1983 ■ Ancient Monuments and Archaeological Areas Act of 1979 ■ Planning (Listed Buildings and Conservation Areas) Act 1990 ■ Harborough's Local Plan to 2031 (Adopted April 2019) Registered Battlefields and World Heritage Sites (core sites) would also be considered constraints to wind development, however there are none located within the authority.

Parameter	Assumption	Data Source	Justification and Notes
			It is noted that further site specific study would be required to determine if any unexpected archaeological remains or undesignated but nationally significant features are present that would require consideration, as well as the setting of historic features. Note: Listed building point data was buffered 5m to estimate building footprints where they did not intersect or have the same name as Harborough's listed building polygon data.
Minimum Development Size	Unconstrained areas of land were excluded if they were below a minimum developable size of 40m width and an area that varied per turbine size: ▪ Very large: 0.8ha ▪ Large: 0.6ha ▪ Medium: 0.4ha ▪ Small: 0.2ha	▪ N/A	The minimum development size was based on developer knowledge of recent wind turbine developments, and accounts for the estimated land take requirements for a single turbine base, the adjacent laydown area and other immediate infrastructure requirements adjacent to the turbine itself. However, further site specific study would be required in order to determine the land take requirements of individual turbines depending on factors such as their model and location.
Turbine Spacing	The following standardised turbine densities were considered when determining the overall potential for turbine development across Harborough: ▪ Very large: 4 per km^2 (assuming a rotor diameter of 130m) ▪ Large: 8 per km^2 (assuming a rotor diameter of 90m) ▪ Medium: 22 per km^2 (assuming a rotor diameter of 55m) ▪ Small: 167 per km^2 (assuming a rotor diameter of 20m)	▪ N/A	The calculation of potential wind capacity involved applying an assumption concerning development density. In practice, turbines are spaced within developments based on varying multiples of the rotor diameter length. Although turbine separation distances vary, a 5 x 3 rotor diameter oval spacing[29], with the major axis of the oval oriented towards the prevailing wind direction, taken to be south-west as the 'default' assumption in the UK, was considered a reasonable general assumption at the present time in this respect. This is based on industry knowledge of recent developer applications. In practice, site-specific factors such as prevailing wind direction, turbine model and varying rotor diameters, and turbulence are taken into account by developers, in discussion with turbine manufacturers. Bearing in mind the strategic nature of the present study, the density calculation did not take into account the site shape, and a standardised rectangular grid density based on a 5 x 3 rotor diameter was used instead (see image below).

[29] To mitigate impacts on the productivity of wind turbines located close to one another caused by wind turbulence, it is standard practice for developers to maintain an oval of separation between turbines that is equal to 5 times the turbine rotor diameter (the cross sectional dimension of the circle swept by the rotating blades) on the long axis, and 3 times the rotor diameter on the short axis.

Figure A - 1: Wind turbine spacing



A.9 The parameters below have not been used to exclude land for the purposes of this study. This does not mean that these constraints are not present or do not require consideration on a specific site.

Table A - 4: Proposed assumptions to be used for assessment of technical potential for onshore wind – Constraints considered but not used

Parameter	Assumption	Data Source	Justification and Notes
Wind speed	No land excluded on this basis.	▪ Global Wind Atlas/Vortex ▪ Industry practice	Wind speed requirements change with turbine scale and model. Some turbine manufacturers produce models which may operate at lower wind speeds and the configuration of certain turbine models can be altered to improve yield in lower wind speed environments. Future changes in government policy, such as the reintroduction of greater financial support for wind projects, and turbine technology could allow developments to be deliverable at lower wind speeds than are currently viable. A mean annual average wind speed <5m/s at 50m above ground level (agl) threshold was applied to take account of such changes. However, no areas of the District have average wind speeds that low. And as such no land was excluded on this basis.
Biodiversity (International Designations)	No land excluded on this basis.	▪ Natural England ▪ Wildlife Trust	The following designations would also be considered constraints however none are present within the study area: ▪ Special Protection Area (SPA) ▪ Special Areas of Conservation (SAC) ▪ Ramsar sites ▪ Potential SAC ▪ Potential SPA ▪ Proposed Ramsar sites In addition, Wildlife Trust reserve data was not available to use for this project. Further site specific study would be required to make consideration of these sites.
Electricity Grid	No land excluded on this basis.	▪ National Grid (Formerly Western Power Distribution)	General commentary was provided on the current state of grid capacity within Harborough to inform the assessment of deployment potential. However, as grid capacity is so variable with little certainty in advance of where there could be capacity for additional electricity generation to be connected, no land was excluded on this basis for the technical assessment. Further consultation would be

Parameter	Assumption	Data Source	Justification and Notes
			required with National Grid (Formerly Western Power Distribution)to determine the feasibility to connect specific sites to the electricity grid. Moreover, for larger wind turbine schemes, developers commonly deliver substations and additional grid infrastructure as required to support the additional generation capacity requirements of the development, limiting concerns regarding connecting to constrained parts of the existing grid.
NATS Safeguarding Areas	Guidance includes reference to the following safeguarding areas: ▪ 30km for aerodromes with a surveillance radar facility; ▪ 17km for non-radar equipped aerodromes with a runway of 1,100m or more, or 5km for those with a shorter runway; ▪ 4km for non-radar equipped unlicensed aerodrome with a runway of more than 800m or 3km with a shorter runway; ▪ 10km for the air-ground-air communication stations and navigation aids; and ▪ 15 nautical miles (nm) for secondary surveillance radar. These are indicative of potential constraints to wind development but cannot be used to definitely exclude land as unsuitable. They are generally presented as separate figures alongside the main assessment of technical potential.	▪ NATS	Further consultation between potential developers and NATS is required to determine if there is any impact from a proposed development. NATS safeguarding areas were therefore not excluded.
Shadow Flicker	No land excluded on this basis.	▪ N/A	Wind turbines may in some circumstances cause 'shadow flicker' within nearby properties. However, shadow flicker effects can be readily mitigated and so shadow flicker was not considered as a constraint for the purposes of this study.

Parameter	Assumption	Data Source	Justification and Notes
Residential Amenity	No land excluded on this basis.	▪ N/A	It is noted that it may be inappropriate to develop wind turbines in proximity to residential properties, due to impacts upon residential amenity. However, due to the potential for micro siting, property aspect and potential for mitigation, it would require further site specific study to determine whether wind turbines would be suitable in proximity to residential properties. Therefore, this factor would require consideration within a site specific residential and visual amenity assessment (RVAA).
Public Rights of Way and Cycle Paths	No land excluded on this basis.	▪ Harborough District Council ▪ SusTrans	Public Rights of Way and cycle paths can diverted if necessary to ensure they are safely distanced from wind turbines. Public Rights of Way and cycle paths were therefore not excluded.
MOD land	No land excluded on this basis.	▪ OpenStreetMap	MOD land may be considered unsuitable for wind turbine development, as this land is already in use for MOD activities. Further consultation with the MOD would be required to determine if there is any potential for wind turbine development to be delivered on this land. However, there is not MOD land present within the study area.
Blade oversail of biodiversity and cultural heritage designations	No land excluded on this basis.	▪ N/A	Depending on individual designated site characteristics, it may not be suitable for the blades of adjacent wind turbines to oversail the site. However, this is site dependent and would require further studies. As such, a blade oversail buffer was not excluded.
Flood zones	No land excluded on this basis.	▪ Environment Agency	It is feasible to deliver wind development within flood zones. As such, flood zones were not excluded.

Ground-Mounted Solar Resource Assessment Parameters

A.10 Harborough's technical potential for ground mounted solar PV development was assessed in a similar way to the potential for wind. The key GIS tool parameters are set out in **Table A - 5** below.

A.11 The maximum solar PV capacity of the area of technical potential was estimated using an assumed development density expressed as Megawatts (MW) per hectare; and regional capacity factor[30] (again, derived from historic data broken down to at least regional level).

A.12 As solar PV is essentially modular, the land with technical potential was not differentiated by project scale[31].

Table A - 5: Proposed assumptions to be used for assessment of technical potential for commercial/large scale ground-mounted solar – Constraints

Parameter	Assumption	Data Source	Justification and Notes
Development Size Categories	None.	■ N/A	Solar development is more 'modular' than wind (development size is dictated by the number of panels, which themselves do not differ greatly in size) and constraints are not affected by project scale in the way that they are for wind. Therefore, the identification of available land for ground-mounted solar has not been broken down into discrete project sizes but rather any land technically suitable for development has been identified.
Roads	Exclude: ■ Roads.	■ Ordnance Survey OpenRoads	Physical features preventing the development of ground-mounted solar PV were excluded. There is no requirement for safety buffers in relation to these with respect to ground-mounted solar PV. Restricted access tracks were excluded from consideration as these predominantly comprise of forestry and other tracks which could be more easily diverted than standards roads. Note: Only line data for roads was available and in order to create a footprint from the road centre, it was assumed that single carriageways are 10m in width, dual carriageways 20m and motorways 30m. This based it on professional judgment of what is the typical width of these roads.
Railways	Exclude: ■ Railways.	■ Ordnance Survey OpenMap	Physical features preventing the development of ground-mounted solar PV were excluded. There is no requirement for safety buffers in relation to these with respect to ground-mounted solar PV.

[30] An energy generator's 'capacity factor' can be defined as the actual energy yield produced over a period of time expressed as a proportion of the energy yield that would have been produced if the generator had operated at its full generation capacity continuously over the same period. This was averaged at 9.59% for the East Midlands over the past 12 years. BEIS and DESNZ(2023) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors.

[31] The area of unconstrained land is treated as a single block of land which may not be the case in reality.

Parameter	Assumption	Data Source	Justification and Notes
			Note: In order to create a footprint from the railway centrelines data, it was assumed that railways were 15m in width. This based it on professional judgment of what is the typical width of railways.
Planning/Land Use Other	Exclude: ■ Registered Common Land; ■ Open Access Land; and ■ Local public green/open space, including: – Open Space Sport recreation strategy sites. – Neighbourhood Development Plan Open Space – Neighbourhood Development Plan Local Green Spaces	■ Natural England ■ Harborough District Council	Due to land take requirements, these land uses/types were considered generally to constrain ground-mounted solar development, particularly at larger scales, although in some circumstances they may offer opportunities for smaller scale development collocated with their other facilities. They were excluded from the resource assessment but may be subject to bespoke policies with the Local Plan allowing development to take place in principle subject to defined criteria being satisfied. Country Parks would also be considered constraints to solar development, however there are none located within the authority.
Buildings	Exclude: ■ All buildings with a 10m buffer.	■ OS OpenMap Local data	Buildings were buffered by 10m to account for shading and impacts on solar output. It is noted that further site specific study considering building heights and orientation in relation to the site would be required to determine the exact buffers required to account for shading.
Future Developments, Safeguarded Land and Employment Sites	Exclude: ■ Site allocations from Harborough's Plan: – BE1 Business and employment commitments and allocations – BE2 Magna Park – BE5 Leicester Airport – BE4 Bruntingthorpe Proving Ground	■ Harborough District Council	Generally, these will be unsuitable for ground-mounted solar, although there may be some potential for installations on undeveloped land/open space within these areas. Identification of this potential would require a separate, site-specific study. In addition, it is assumed that opportunities for renewables within such sites may potentially be considered as part of the master planning activities for the allocations. It is noted that developers would need to make consideration of other allocations, such as those within neighbourhood plans, as part of further site feasibility study.

Parameter	Assumption	Data Source	Justification and Notes
	– GD7 Designated Green Wedges – H1 Housing commitments and allocations – SC1 Replacement Golf Course – SC1 Scraptoft North Strategic Development Area – L1 East of Lutterworth Strategic Development Area –		
Existing Renewable Energy Developments	Exclude: ■ Land boundaries of consented and operational renewable energy installations.	■ Harborough District Council ■ BEIS (now DESNZ) ■ Aerial imagery ■ LUC windfarm database	The quarterly BEIS (DESNZ) Renewable Energy Planning Database, Harborough Council data and the LUC internal windfarm database was used to determine the locations of operational and consented renewable energy installations. To approximate the site boundary, land was excluded based on Harborough Council boundary data in combination with assessment of surrounding recent aerial imagery. For existing wind developments, it was assumed these were of notional medium scale tip height and occupied a 5 x 3 rotor diameter oval spacing[32], with the major axis of the oval oriented towards the prevailing wind direction, taken to be south-west (see turbine spacing below). Existing roof-mounded solar PV developments are building-integrated and therefore were excluded via the consideration of existing built development as a constraint. Additionally, existing landfill gas developments were not considered a constraint to solar developments, as there is potential that solar developments could be incorporated onto such existing sites. Existing battery developments were not included as, due to their small scale, their exact location within a site was difficult to identify. Moreover, there is potential for battery and solar developments to also be co-located.

[32] To mitigate impacts on the productivity of wind turbines located close to one another caused by wind turbulence, it is standard practice for developers to maintain an oval of separation between turbines that is equal to 5 times the turbine rotor diameter (the cross sectional dimension of the circle swept by the rotating blades) on the long axis, and 3 times the rotor diameter on the short axis.

Parameter	Assumption	Data Source	Justification and Notes
Terrain	Exclude: ■ Areas with north-east to north-west aspect and inclinations greater than 7 degrees; and ■ All areas with inclinations greater than 15 degrees.	■ EA Lidar DTM	Although it is possible to develop Ground-mounted solar PV installations on slopes facing north-east to north-west, it would generally not be economically viable to do so. However, slopes that are north-east to north-west facing and below 7°, as well as all other land with inclinations less than 15°, are considered potentially suitable[33], as generation output will not be significantly affected.
Water Environment	Exclude: ■ Watercourses and waterbodies with a 50m buffer.	■ Ordnance Survey OpenMap Local	A 50m buffer was applied around all rivers and waterbodies to take account of good practice such as that relating to pollution control during construction. OS Survey OpenMap Local surface water area data includes waterways of approximately a minimum of 2m width. OpenMap Local surface water line data is line data, and so a 1m buffer was applied to approximate a footprint of smaller waterways.
Woodland	Exclude: ■ Ancient Woodland Inventory with a 20m buffer; and ■ Woodland as shown on the National Forest Inventory with a 20m buffer including: – Assumed woodland; – Broadleaved; – Conifer; – Coppice; – Coppice with standards; – Failed; – Felled; – Group prep;	■ Forestry Commission ■ Natural England	Forested areas were buffered by 20m to account for shading and impacts on solar output. It is noted that further site specific study considering woodland heights and orientation in relation to the site would be required to determine the exact buffers required to account for shading. The following National Forestry Inventory categories of woodland were considered non-permanent or non-woodland and therefore not excluded as ground mounted solar development may be suitable in these locations: ■ Cloud/shadow; ■ Uncertain; and ■ Windblown.

[33] Based on current standard developer practice.

Parameter	Assumption	Data Source	Justification and Notes
	– Low density; – Mixed mainly broadleaved; – Mixed mainly conifer; – Shrub; and – Young trees.		
Geological designations	Exclude: ▪ Locally Important Geological Sites ▪ Regionally Important Geological Sites	▪ Harborough District Council	As protected by: ▪ Town and Country Planning Act 1990 ▪ Harborough's Local Plan to 2031 (Adopted April 2019)
Biodiversity (National Designations)	Exclude national designations: ▪ Sites of Special Scientific Interest (SSSI)	▪ Natural England	As protected by: ▪ Wildlife and Countryside Act 1981 ▪ Conservation of Habitats and Species Regulations 2017 (as amended) National Nature Reserves would also be considered constraints to wind development, however there are none located within the authority.
Biodiversity (Regional and Local Designations)	Exclude other designations: ▪ Local Nature Reserves; and ▪ Local Wildlife Sites (LWS).	▪ Natural England ▪ Harborough District Council	Generally, would not be suitable for renewables development based on law/policy/guidance including: ▪ NPPF ▪ Natural Environment and Rural Communities Act 2006 ▪ Harborough's Local Plan to 2031 (Adopted April 2019) It is noted that further site-specific study would be required to consider non-designated features.
Cultural Heritage	Exclude: ▪ Registered Parks and Gardens; ▪ Scheduled Monuments; ▪ Listed Buildings;	▪ Historic England ▪ Harborough District Council	As protected by: ▪ NPPF ▪ National Heritage Act 1983 ▪ Ancient Monuments and Archaeological Areas Act of 1979

Parameter	Assumption	Data Source	Justification and Notes
	■ Conservation Areas; and ■ Locally Listed Buildings.		■ Planning (Listed Buildings and Conservation Areas) Act 1990 ■ Harborough's Local Plan to 2031 (Adopted April 2019) Registered Battlefields and World Heritage Sites (core sites) would also be considered constrains to solar development, however there are none located within the authority. It is noted that further site specific study would be required to determine if any unexpected archaeological remains or undesignated but nationally significant features are present that would require consideration, as well as the setting of historic features. Note: Listed building point data was buffered 5m to estimate building footprints where they did not intersect or have the same name as Harborough's listed building polygon data.
Minimum Development Size	Unconstrained areas of land were excluded if they were below a minimum developable size of 0.6ha.	■ N/A	A minimum development size of 0.6ha (0.5MW) was set in agreement with Harborough District Council.
Development Density	1.2 hectares per MW.	■ N/A	The Draft National Policy Statement for Renewable Energy Infrastructure (EN-3) states that, along with associated infrastructure, generally a solar farm requires between 2 to 4 acres for each MW of output. This equates to 0.8-1.6ha per MW. For this study, the average of 1.2ha per MW was used. It its noted that on sites where solar farms are co-located with wind turbines, the value of MW per ha may increase as infrastructure may be able to be shared between the technologies.

A.13 The parameters below have not been used for the purposes of this study. This does not mean that these constraints are not present or do not require consideration on a specific site.

Table A - 6: Proposed assumptions to be used for assessment of technical potential for commercial/large scale ground-mounted solar – Constraints considered but not used

Parameter	Assumption	Data Source	Justification and Notes
Agricultural Land Use	No land excluded on this basis.	▪ Natural England ▪ Harborough District Council	Grade 1 agricultural land would also be considered a constraint, however none is present within the study area. Agricultural Land Use is a consideration, with grades 1, 2 and 3a land being classed as *"the best and more versatile (BMV)"* land and having higher value for food production. Further investigation would be required of grade 3 land to determine whether it is grade 3a or b, as available data does not distinguish these. Ground-mounted Solar PV projects, over 50kWp, should ideally utilise previously developed land, brownfield land, contaminated land, industrial land or agricultural land preferably of classification 3b, 4, and 5. However, solar developments can be built on BMV land, if they have been deemed to pass the sequential test, whereby sites on lower grade a non-agricultural land are prioritised over BNM land. Within Harborough, the majority of land is grades 2, 3 or 4 agricultural land, and there are existing solar farms present on some of this. As such, only grade 1 (excellent quality) agricultural land would be treated as a constraint to solar development, and further site-specific study would be required to determine if sites on lower grade BMV would be suitable based on the sequential text.
Biodiversity (International Designations)	No land excluded on this basis.	▪ Natural England ▪ Wildlife Trust	The following designations would also be considered constraints however none are present within the study area: ▪ Special Protection Area (SPA) ▪ Special Areas of Conservation (SAC) ▪ Ramsar sites ▪ Potential SAC ▪ Potential SPA ▪ Proposed Ramsar sites

Parameter	Assumption	Data Source	Justification and Notes
			In addition, Wildlife Trust reserve data was not available to use for this project. Further site specific study would be required to make consideration of these sites.
Solar Irradiance	No land excluded on this basis.	■ Global Solar Atlas	Using modern solar panel technology, the vast majority of land within England is deemed suitable for solar panel development in terms of solar irradiance. Any land unsuitable due to slope and aspect which limit the total hours of direct daily sunlight within a location, were excluded from consideration as based on the above constraints table. Therefore, no land was excluded from this assessment based on this, and solar irradiance levels they were mapped for information only to indicate where the more productive sites may be located.
Electricity Grid	No land excluded on this basis.	■ National Grid (Formerly Western Power Distribution)	Grid connection is a key consideration for solar developments, as additional grid connections costs, such as long cable distances and additional substation requirements, can significantly hinder the economic viability of this technology. General commentary was provided on the current state of grid capacity within Harborough to inform the assessment of deployment potential. However, as grid capacity is so variable with little certainty in advance of where there could be capacity for additional electricity generation to be connected, no land was excluded on this basis for the technical assessment. Further consultation would be required with National Grid (Formerly Western Power Distribution)to determine the feasibility to connect specific sites to the electricity grid.
Gas pipelines	No land excluded on this basis.	■ National Grid	Although the presence of buried pipelines could impact the suitability of overlaying above-ground solar panels, mitigation and panel layout design can be applied to limit impacts. Further site-specific study would be required to consider this parameter. As such, no land was excluded on this basis.
Electricity lines	No land excluded on this basis.	■ Ordnance Survey OpenMap ■ National Grid	Although overhead lines have the potential to cause some limited shading of solar panels, and thereby impact on potential PV generation potential, panel layout design can limit impacts. Further site-specific study would be required to consider this parameter. As such, no land was excluded on this basis.

Parameter	Assumption	Data Source	Justification and Notes
		▪ National Grid (Formerly Western Power Distribution)	
Residential Amenity	No land excluded on this basis.	▪ N/A	It is noted that it may be inappropriate to develop solar farms in proximity to residential properties, due to impacts upon residential amenity. However, due to the potential for micro siting, property aspect and potential for mitigation, it would require further site specific study to determine whether solar developments would be suitable in proximity to residential properties. Therefore no land was excluded on this basis from the technical assessment.
Public Rights of Way/Cycle Paths	No land excluded on this basis.	▪ Harborough District Council ▪ DEFRA ▪ SusTrans	Public Rights of Way and cycle paths can be diverted if necessary around or safely through ground mounted solar developments, and these impacts are considered as part of the assumed development density. Public Rights of Way and cycle paths were therefore not excluded.
Airports and Airfields	No land excluded on this basis.	▪ Ordnance Survey OpenMap Local Functional Site layer with the theme 'Air Transport' ▪ Aerial imagery	Glint and glare caused by solar panels is a consideration for aviation safety. However, this is site dependent and scheme design can enable solar developments to be situated within airports and airfields themselves. As such, only the airport and airfield buildings and hardstanding should treated as constraints to solar development. Although airport buildings were treated as constraints to solar development, considered under *"Buildings"*, no spatial data was available to map runways and in-use airport hardstanding. Therefore, further site-specific study would be required to consider these.
MOD Land	No land excluded on this basis.	▪ OpenStreetMap	MOD land may be considered unsuitable for solar development, as this land is already in use for MOD activities. Further consultation with the MOD would be required to determine if there is any potential for solar development to be delivered on this land. However, there is no MOD land present within the study area.
Minerals Sites with a 250m buffer	No land excluded on this basis.	▪ Harborough District Council	The IAQM 2016 Guidance on the Assessment of Mineral Dust Impacts for Planning indicates that adverse dust impacts from sand and gravel sites are uncommon

Parameter	Assumption	Data Source	Justification and Notes
			beyond 250m and beyond 400m from hard rock quarries measured from the nearest dust generating activities. However, no GIS data was available for these sites. Therefore, further site-specific study would be required to consider these, making reference to the site details available on the council's website.
All operational waste Sites	No land excluded on this basis.	■ Harborough District Council	Waste sites will frequently be quite highly constrained with respect to ground-mounted solar development (e.g. areas of active landfill) but landfill sites equally may present opportunities in some circumstances, particularly when they are to be decommissioned/restored during a plan period. Waste sites would therefore be excluded from the identified ground-mounted solar resource but potentially subject to bespoke policy wording in the local plan. However, no GIS data was available for these sites. Therefore, further site-specific study would be required to consider these, making reference to the site details available on the council's website.
Flood zones	No land excluded on this basis.	■ Environment Agency	It is feasible to deliver solar development within flood zones. As such, flood zones were not excluded.

Rooftop Solar Resource Assessment

A.14 The total potential capacity of roof mounted solar was estimated based on typical system sizes and the estimated percentage of suitable roof space within the study area. Roofs that have potential to deliver solar PV also have the potential to deliver solar water heating generation. However, this was treated as being mutually exclusive with solar PV potential, i.e. the same roof space can only be utilised for one of the technologies. Generation potential was therefore calculated for each technology for separate comparison.

Table A - 7: Solar PV resource assessment assumptions

Parameter	Assumption	Data Source	Justification and Notes
System Size	Average size of system based on property type: ▪ Detached[34]: 5.2kW ▪ Semi-detached[34]: 3.5kW ▪ Terrace/end-terrace[29]: 1.7kW ▪ Non-domestic:28.61kW[35]	▪ BEIS (now DESNZ)	Typical system sizes for dwellings were estimated based on Energy Saving Trust and Jinko solar Data[36]. Due to lack of appropriate data on typical system sizes and suitability of roofs, dwellings classed as 'flats' and those classed as 'other dwellings' were not included within the assessment. Average sized solar PV systems in Harborough for non-domestic installations recorded on the FiT Register up to March 2019 was 28.61kW.
Suitable Roofs	Proportion of properties with suitable roofs (estimate): ▪ 40% of dwellings[37]; and ▪ 75% of non-domestic properties[38].	▪ OS Addressbase ▪ OS OpenMap	Proportions estimated from prior research undertaken by CSE, which considered suitable type and orientation of roof, and space availability[39]. Conservation areas and listed buildings were not treated as constraints to rooftop solar generation. Permitted development rights in England allow solar to be installed within conservation areas provided this is not on walls fronting a highway. In addition, rooftops solar generation has the potential to be installed in this circumstance and on any listed buildings through the granting of planning permission.

[34] Energy Saving Trust (2024) Solar panel calculator. Available at: https://energysavingtrust.org.uk/tool/solar-energy-calculator/. Assumption of a sloping roof. The calculator advises on average you can have up to 12 panels on a detached house, 8 panels on a semi-detached house, and 4 panels on a terraced house. Jinko Solar (2024) Tiger Neo. Available at: https://www.jinkosolar.com/en/site/tigerneo. Assumption of 430w solar panel modules being used.
[35] BEIS and DESNZ (2020) Sub-regional Feed-in Tariffs statistics: March 2019. Available at: https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics
[36] Energy Saving Trust (2024) Solar panel calculator. Available at: https://energysavingtrust.org.uk/tool/solar-energy-calculator/. Assumption of a sloping roof. The calculator advises on average you can have up to 12 panels on a detached house, 8 panels on a semi-detached house, and 4 panels on a terraced house. Jinko Solar (2024) Tiger Neo. Available at: https://www.jinkosolar.com/en/site/tigerneo. Assumption of 430w solar panel modules being used.
[37] Detached, semi-detached and terrace/end terrace.
[38] Excluding land, car parking, utilities, marina and moorings, and objects of interest.
[39] LUC and CSE (2020) Test Valley Renewable and Low Carbon Energy Study. Available at: https://www.testvalley.gov.uk/planning-and-building/planningpolicy/evidence-base/evidence-base-environment

Parameter	Assumption	Data Source	Justification and Notes
			Properties were included in the assessment based on Harborough LLPG Address data (see **Table A - 1**). Allocated sites were not considered, it is assumed that opportunities for renewables within such sites will potentially be considered as part of their design. Note: Where OS OpenMap buildings did not overlay address points data, these buildings were assumed to be of commercial use, most often forming outbuildings to properties such as agricultural buildings.

Table A - 8: Solar water heating resource assessment assumptions

Parameter	Assumption	Data Source	Justification and Notes
System Size	Average size of system based on property type: ■ Domestic: 2.8kW ■ Non-domestic: 18.83kW	■ BEIS (now DESNZ)	Average sizes for solar water heating systems obtained from RHI deployment data[40]. Due to lack of appropriate data on typical system sizes and suitability of roofs, dwellings classed as 'flats' and those classed as 'other dwellings' were not included within the assessment.
Suitable Roofs	See above – the same as for roof-mounted solar PV.	■ See above – the same as for roof-mounted solar PV.	See above – the same as for roof-mounted solar PV.
Heating Fuel Offset	Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ BEIS (now DESNZ)	The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

[40] DESNZ (2023) RHI monthly deployment data: March 2023 (Quarterly edition). Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-march-2023-quarterly-edition

Hydropower

A.15 It has not been possible within the scope of this study to undertake a new assessment of the potential hydropower resource within Harborough.

A.16 However, in 2010 the Environment Agency published the findings of a study identifying hydropower opportunities within England and Wales. This was produced to provide an overview at national and regional scales of the potential hydropower opportunities available, as well as the relative environmental sensitivity of identified potential sites to development. These findings will be reviewed as part of this study. It is noted that this data is indicative and that further site specific study would be required in order to determine the technical potential and suitability of sites for hydropower developments.

A.17 The study included identifying 'heavily modified water bodies' that are identified as being at significant risk of failing to achieve good ecological status because of modifications to their hydromorphological characteristics resulting from past engineering works, including impounding works. Due to these characteristics, such waterbodies were identified as having the potential to create hydropower barriers that would also be beneficial to the passage of fish upstream. These were overlayed with identified locations where suitable yearly flow characteristics are present and could feasibly support hydropower sites. The resultant identified sites were classified as 'win-win' opportunities where hydropower developments could potentially be installed whilst also improving the ecological status of waterways.

Heat Pumps

Air Source Heat Pumps

A.18 Almost any building theoretically has the potential for an air source heat pump to be installed. Therefore, the assessment considered the potential for air source heat pumps to be delivered in all buildings.

Table A - 9: Air source heat pump resource assessment assumptions

Parameter	Assumption	Data Source	Justification and Notes
System Size	Average size of system based on property type: ■ Domestic: 10.20kW ■ Non-domestic: 46.52kW	■ BEIS (now DESNZ) ■ OS Addressbase ■ OS OpenMap	Average sizes for air source heat pump systems obtained from RHI deployment data[41]. Due to lack of appropriate data on typical system sizes and suitability of individual properties, dwellings classed as 'flats' and those classed as 'other dwellings' were not included within the assessment.
Heating Fuel Offset	SPF: 3.6 (efficiency of 72%). Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ BEIS (now DESNZ)	SPF derived from BEIS (now DESNZ) Renewable Heat Incentive data: 3.6[42]. For every 3.6kW of heat generated, offsetting CO_2 from the existing heating fuel (gas/oil/electricity), 1kW of energy is consumed, contributing to CO_2 generated by consuming electricity. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

[41] DESNZ (2024) RHI monthly deployment data: March 2024 (Annual edition). Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-march-2024-annual-edition
[42] DESNZ (2024) RHI monthly deployment data: March 2024 (Annual edition). Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-march-2024-annual-edition

Ground Source Heat Pumps

A.19 Ground source heat pumps require more space than air source, requiring pipes to be buried vertically in a deeper system or horizontally in a shallow wider system. Due to these significant space constraints, this study did not estimate the potential capacity of ground source heat pumps across the study area, as it was not possible to estimate how many properties have access to the required space.

A.20 It is noted however that the average system size of domestic pumps are 15kW.[43].

Open Loop Ground Source Heat Pumps

A.21 The British Geological Survey has produced a map identifying the potential viability of open-loop ground source heat pumps across England and Wales, considering hydrogeological and economic factors[44]. This was reviewed as part of this study.

A.22 However, the British Geological Survey states that this is an initial screening assessment only and that identified areas favourable for open-loop systems are not automatically suitable for this technology to be installed. Instead, detailed environmental assessment of proposed sites would be required, considering local variations in environmental conditions and factors such as the availability of water (i.e. the amount of water that is available for licensing by the Environment Agency) and discharge of water from a scheme[45]. Therefore, with the data available, it is not possible to determine the potential annual energy generation and carbon savings that could be produced by open loop ground source heat pumps within Harborough.

Water-Source Heat Pump

A.23 The DECC 2014 water source heat map identified, at a high level, opportunities for water source heat pump technologies[46]. This was reviewed as part of this study.

Biomass Resource Assessment

Virgin Woodfuel Thermal Conversion: Forestry and Woodland

A.24 To determine the potential for biomass generation from forestry and woodland, it was assumed that all woodland within the study area has a sustainable yield of two odt/yr (oven-dried tonnes/ha/year)[47] and assumptions (see **Table A - 10**) were applied. Both the potential for heating and for combined heat and power were calculated.

A.25 To identify existing suitable woodland within the study area, the Forestry Commission's National Forest Inventory (NFI) was used. The NFI records the location and extent of all forests and woodland above 0.5ha across the UK and it is noted that although a sample of forests and woodland are ground surveyed every 5 years, the inventory is updated annually using aerial photography, interpretation of satellite imagery and administrative records of newly planted areas covered by government grant schemes[48]. Therefore, there can be occasional errors due to misidentification of sites not ground-surveyed.

A.26 To calculate the total capacity of the resource in MW from the annual generation potential in MWh, a national capacity factor was applied, as based on national data for plant-sourced biomass[49].

[43] DESNZ (2024) RHI monthly deployment data: March 2024 (Annual edition). Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-march-2024-annual-edition
[44] British Geological Survey (2021) Open-loop ground source heat pump viability screening map. Available at: https://www.bgs.ac.uk/technologies/web-map-services-wms/open-loop-ground-source-heat-pump-viability-screening-map-wms/
[45] British Geological Survey (2012) Non-Technical Guide: A screening tool for open-loop ground source heat pump schemes (England and Wales). Available at: https://www.bgs.ac.uk/geology-projects/geothermal-energy/open-loop-gshp-screening-tool/
[46] DECC (2015) National Heat Map: Water source heat map layer. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416660/water_source_heat_map.PDF
[47] Forestry Research (2024) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-pa/. Data for Wood (forestry residues, SRW, thinnings, etc.).
[48] Forestry Commission (2019) About the NFI. Available at: https://www.forestresearch.gov.uk/tools-and-resources/national-forest-inventory/about-the-nfi/
[49] DESNZ (2023) Load factors for renewable electricity generation (DUKES 6.3). Available at: https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

Table A - 10: Proposed assumptions to be used for assessment of technical potential for virgin woodfuel thermal conversion: forestry and woodland

Parameter	Assumption	Data Source	Justification and Notes
Woodland Resource	The following National Forestry Inventory (NFI) woodland categories within the study area were included: ■ Broadleaved; ■ Conifer; ■ Coppice; ■ Coppice with standards; ■ Assumed woodland; ■ Mixed mainly conifer; and ■ Mixed mainly broadleaved. Energy generation per hectare per year: 10.3 MWh/ha/year	■ Forestry Commission	These woodland categories were included as they were assumed to be mature and able to provide a sustainable yield of woodfuel. The following woodland categories were not included as they were assumed to currently be unable to provide a sustainable yield of woodfuel: ■ Cloud\shadow; ■ Failed; ■ Felled; ■ Ground prep; ■ Low density; ■ Shrub; ■ Uncertain; ■ Windblow; and ■ Young trees. The non-woodland categories within the NFI were also not assessed as they do not provide woodfuel. The assumed energy generation per hectare per year is derived from Forestry Commission data[50].
Constraints	The following constrained areas of woodland were excluded from the assessment: ■ Ancient woodland; ■ Sites of Special Scientific Interest; ■ Local Nature Reserves; ■ Local Wildlife Sites (LWS);	■ Natural England ■ Historic England ■ Harborough District Council	As protected by: ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ Wildlife and Countryside Act 1981 ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ NPPF

[50] Forestry Research (2024) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-pa/. Data for Wood (forestry residues, SRW, thinnings, etc.).

Parameter	Assumption	Data Source	Justification and Notes
	■ Registered Parks and Gardens; ■ Scheduled Monuments; ■ Listed Buildings; ■ Conservation Areas; ■ Locally Listed Buildings; and ■ Future developments, safeguarded land and employment sites.		■ Natural Environment and Rural Communities Act 2006 ■ Harborough's Local Plan to 2031 (Adopted April 2019) The following designations would also be considered constraints however none are present within the study area: ■ Special Protection Areas (SPA) ■ Special Areas of Conservation (SAC) ■ Ramsar sites ■ Potential SAC ■ Potential SPA ■ Proposed Ramsar sites ■ National Nature Reserves ■ Registered Battlefields ■ World Heritage Sites (core sites) MOD land would be considered as a physical constraint however there is no MOD land present within the study area. It is noted that further site-specific study would be required to make consideration of non-designated biodiversity and cultural heritage features. Note: Listed building point data was buffered 5m to estimate building footprints where they did not intersect or have the same name as Harborough's listed building polygon data.
Heating Fuel Offset: Heating Only	Boiler efficiency assumed to be 77%[51]. Heating fuel assumed to be offset:	■ BEIS (now DESNZ)	Biomass boiler efficiency derived from research by BEIS (DESNZ)[52].

[51] BEIS and DESNZ (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance. As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the boiler efficiency was considered to calculate the overall energy generation potential, not the load factor for biomass boilers, which considered the percentage of time a boiler is operating at peak output annually.

[52] BEIS and DESNZ (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance. As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the boiler efficiency was considered to calculate the overall energy generation potential, not the load factor for biomass boilers, which considered the percentage of time a boiler is operating at peak output annually.

Parameter	Assumption	Data Source	Justification and Notes
	■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties		The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.
Fuel Offset: Combined Heat and Power (CHP)	CHP efficiency: ■ Electricity: 30% ■ Heating: 50% Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ CSE	Average CHP efficiencies estimated from prior research undertaken by CSE[53]. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

[53] LUC and CSE (2020) Test Valley Renewable and Low Carbon Energy Study. Available at: https://www.testvalley.gov.uk/planning-and-building/planningpolicy/evidence-base/evidence-base-environment

Virgin Woodfuel Thermal Conversion: Energy Crops

A.27 To determine the potential for biomass generation via thermal conversion (burning within a boiler) from the two main woodfuel energy crops Miscanthus and Short Rotation Coppice (SRC), the below assumptions (**Table A - 11**) were applied. Both the potential for heating and for combined heat and power were calculated.

A.28 To calculate the total capacity of the resource in MW from the annual generation potential in MWh, a national capacity factor was applied, as based on national data for plant-sourced biomass[54].

Table A - 11: Proposed assumptions to be used for assessment of technical potential for virgin woodfuel thermal conversion: energy crops

Parameter	Assumption	Data Source	Justification and Notes
Energy Crop Resource	Yields: ▪ Miscanthus: 13 odt/ha/year ▪ SRC: 9 odt/ha/year Ratio of crops per hectare: ▪ Miscanthus: 80% ▪ SRC: 20% Energy generation per hectare per year: ▪ Miscanthus: 63 MWh/ha/year ▪ SRC: 46 MWh/ha/year	▪ Forestry Commission	Miscanthus and SRC yields and assumed energy generation per hectare per year was derived from Forestry Commission data[55]. The average proportion of miscanthus and SRC grown in the UK was derived from Defra data[56]. The analysis assumed that of the land identified as suitable for energy crops, 4ha of Miscanthus would be delivered for every 1ha of SRC.
Constraints	Agricultural land constraints for miscanthus: ▪ Grade 1 ▪ Grade 2 ▪ Grade 5	▪ Aerial imagery ▪ BEIS (now DESNZ) ▪ Forestry Commission ▪ Natural England	The NNFCC energy crops report produced for DECC indicates that miscanthus planting should be restricted to good and moderate quality (Grade 3) and poor quality (Grade 4) agricultural land and that SRC can grow on this land as well as very poor (Grade 5) land[57].

[54] DESNZ (2023) Load factors for renewable electricity generation (DUKES 6.3). Available at: https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

[55] Forestry Research (2024) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-pa/.

[56] Defra (2021) Area of crops grown for bioenergy in England and the UK: 2008-2020: Section 2: Plant biomass: miscanthus, short rotation coppice and straw. Available at: https://www.gov.uk/government/statistics/area-of-crops-grown-for-bioenergy-in-england-and-the-uk-2008-2020/section-2-plant-biomass-miscanthus-short-rotation-coppice-and-straw

[57] NNFCC (2012) Domestic Energy Crops; Potential and Constraints Review. Available at: https://www.gov.uk/government/publications/domestic-energy-crops-potential-and-constraints-review

Parameter	Assumption	Data Source	Justification and Notes
	■ Non-agricultural land Agricultural land constraints for SRC: ■ Grade 1 ■ Grade 2 ■ Non-agricultural land Physical constraints: ■ Roads ■ Railways ■ Common Land ■ Local public green/open space ■ Buildings ■ Airports and airfields ■ Future developments, safeguarded land and employment sites ■ Existing solar farms ■ Watercourses and waterbodies ■ Woodland and ancient woodland Natural heritage constraints: ■ Sites of Special Scientific Interest ■ Local Nature Reserves ■ Local Wildlife Sites (LWS) Cultural heritage constraints: ■ Registered Parks and Gardens ■ Scheduled monuments ■ Listed Buildings ■ Locally Listed Buildings	■ Ordnance Survey OpenRivers ■ Ordnance Survey OpenMap ■ Ordnance Survey OpenRoads ■ Harborough District Council	Excellent quality (Grade 1) and very good quality (Grade 2) agricultural land has the potential to deliver the highest crop yields and as such it was assumed that food crops would be prioritised above energy crops on this land. Physical features preventing the planting of energy crops were excluded. With regards to existing renewable energy developments, only existing ground-mounted solar farms were excluded as their land take prevents crop planting. Wind turbines have a far smaller land-take and crops could in theory be planted beneath and surrounding turbines within a wind farm. In addition, designated sites were also excluded, as protected by: ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ Wildlife and Countryside Act 1981 ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ NPPF ■ Natural Environment and Rural Communities Act 2006 ■ The Convention Concerning the Protection of the World Cultural and Natural Heritage ■ National Heritage Act 1983 ■ Ancient Monuments and Archaeological Areas Act of 1979 ■ Planning (Listed Buildings and Conservation Areas) Act 1990 ■ Harborough's Local Plan to 2031 (Adopted April 2019) It is noted that further site-specific study would be required to make consideration of non-designated biodiversity and cultural heritage features. The following designations would also be considered constraints however none are present within the study area: ■ Special Protection Areas (SPA) ■ Special Areas of Conservation (SAC) ■ Ramsar sites ■ Potential SAC

Parameter	Assumption	Data Source	Justification and Notes
	■ Conservation Areas		■ Potential SPA ■ Proposed Ramsar sites ■ National Nature Reserves ■ Registered Battlefields ■ World Heritage Sites (core sites) MOD land would be considered as a physical constraint however there is no MOD land present within the study area. Note: Only line data for roads was available and in order to create a footprint from the road centre, it was assumed that single carriageways are 10m in width, dual carriageways 20m and motorways 30m. In order to create a footprint from the railway centrelines data, it was assumed that railways were 15m in width. Listed building point data was buffered 5m to estimate building footprints.
Heating Fuel Offset: Heating Only	Boiler efficiency assumed to be 77%[58]. Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ BEIS (now DESNZ)	Biomass boiler efficiency derived from research by BEIS (DESNZ)[59]. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.
Fuel Offset: Combined Heat and Power (CHP)	CHP efficiency: ■ Electricity: 30% ■ Heating: 50%	■ CSE	Average CHP efficiencies estimated from prior research undertaken by CSE[60].

[58] BEIS and DESNZ (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance. As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the boiler efficiency was considered to calculate the overall energy generation potential, not the load factor for biomass boilers, which considered the percentage of time a boiler is operating at peak output annually.

[59] BEIS and DESNZ (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance. As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the boiler efficiency was considered to calculate the overall energy generation potential, not the load factor for biomass boilers, which considered the percentage of time a boiler is operating at peak output annually.

[60] LUC and CSE (2020) Test Valley Renewable and Low Carbon Energy Study. Available at: https://www.testvalley.gov.uk/planning-and-building/planningpolicy/evidence-base/evidence-base-environment

Parameter	Assumption	Data Source	Justification and Notes
	Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties		

Biogas from Agricultural Residues

A.29 As Harborough is predominantly rural, agricultural waste is a potential renewable energy resource, particularly from using livestock slurry as a feedstock for the anaerobic digestion process. Using estimates from Defra statistics on animal numbers for 2024[61] and resulting slurry and biogas yields, an estimate has been made of the potential emissions savings.

Table A - 12: Slurry resource assessment assumptions

Parameter	Assumption	Data Source	Justification and Notes
Slurry Resource	Number of animals required to produce 1 tonne of slurry per day: ■ Cattle: 30 ■ Pigs: 275 ■ Poultry: 10,500 Biogas yield: ■ Cattle: 20m3/tonne ■ Pigs: 20m3/tonne ■ Poultry: 65m3/tonne Energy content of biogas: ■ 6.7kWh per m3	■ Shared Practice ■ The Andersons Centre	The number of animals required to produce 1 tonne of slurry per day was derived from the average of the figure brackets provided in the Shared Practice Anaerobic Digestion Good Practice Guidelines[63]: ■ Cattle: 20-40 ■ Pigs: 250-300 ■ Poultry: – Laying hen litter: 8,000-9,000 – Broiler manure: 10,000-15,000 Biogas yields derived from the average of the figure brackets provided in The Andersons Centre data[64]: ■ Cattle: 15-25 m3/tonne ■ Pigs: 15-25 m3/tonne ■ Poultry: 30-100 m3/tonne Energy content of biogas also derived from The Andersons Centre data.

A.30 To calculate the total capacity of the resource in MW from the annual generation potential in MWh, a capacity factor was applied, as based on national data for animal-sourced biomass[62].

[61] Defra (2022) Structure of the agricultural industry in England and the UK at June. Available at: https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june

[62] DESNZ (2023) Load factors for renewable electricity generation (DUKES 6.3). Available at: https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

[63] Shared Practice (1997) Good Practice Guidelines: Anaerobic Digestion of farm and food processing residues. Available at: http://www.sharedpractice.org.uk/Library/library.html

[64] The Andersons Centre (2010) A Detailed Economic Assessment of Anaerobic Digestion Technology and its Suitability to UK Farming and Waste Systems. Available at: https://theandersonscentre.co.uk/service/economic-analysis/

Parameter	Assumption	Data Source	Justification and Notes
Heating and Electricity Fuel Offset	CHP plant efficiency[65]: ▪ Heat: 50% ▪ Electricity: 30% Heating fuel assumed to be offset: ▪ Electricity: 50% of off-gas properties ▪ Oil: 50% of off-gas properties ▪ Gas: All on-gas properties	▪ The Andersons Centre	CHP plant efficiency derived from The Andersons Centre data[66]. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

Energy from Waste

A.31 Any data the council holds on Harborough waste streams, such as municipal and commercial solid waste, recycled wood waste or food waste, was used to assess the technical potential of energy generation from waste.

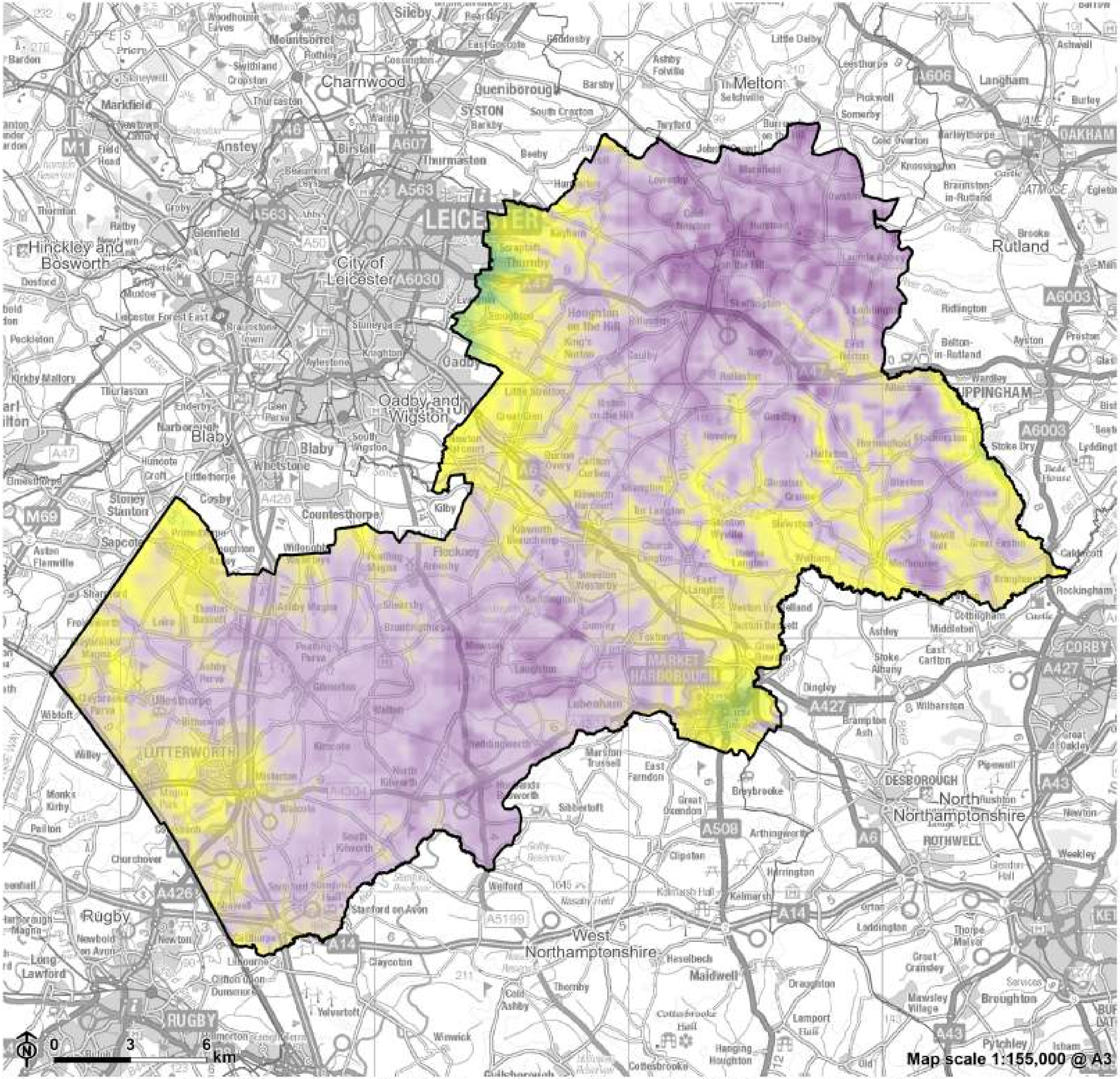
[65] As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the CHP efficiency was considered to calculate the overall energy generation potential, not the load factor for biogas CHP units, which considered the percentage of time a boiler is operating at peak output annually.
[66] The Andersons Centre (2010) A Detailed Economic Assessment of Anaerobic Digestion Technology and its Suitability to UK Farming and Waste Systems. Available at: https://theandersonscentre.co.uk/service/economic-analysis/

Appendix B

Wind maps

Renewable Energy Study
Harborough District

Figure B1: Wind Constraints - Wind speed at 50m above ground level



Harborough District

Neighbouring Local Authority

Wind speed at 50m above ground level

8.8 m/s

5.2 m/s

Notes:

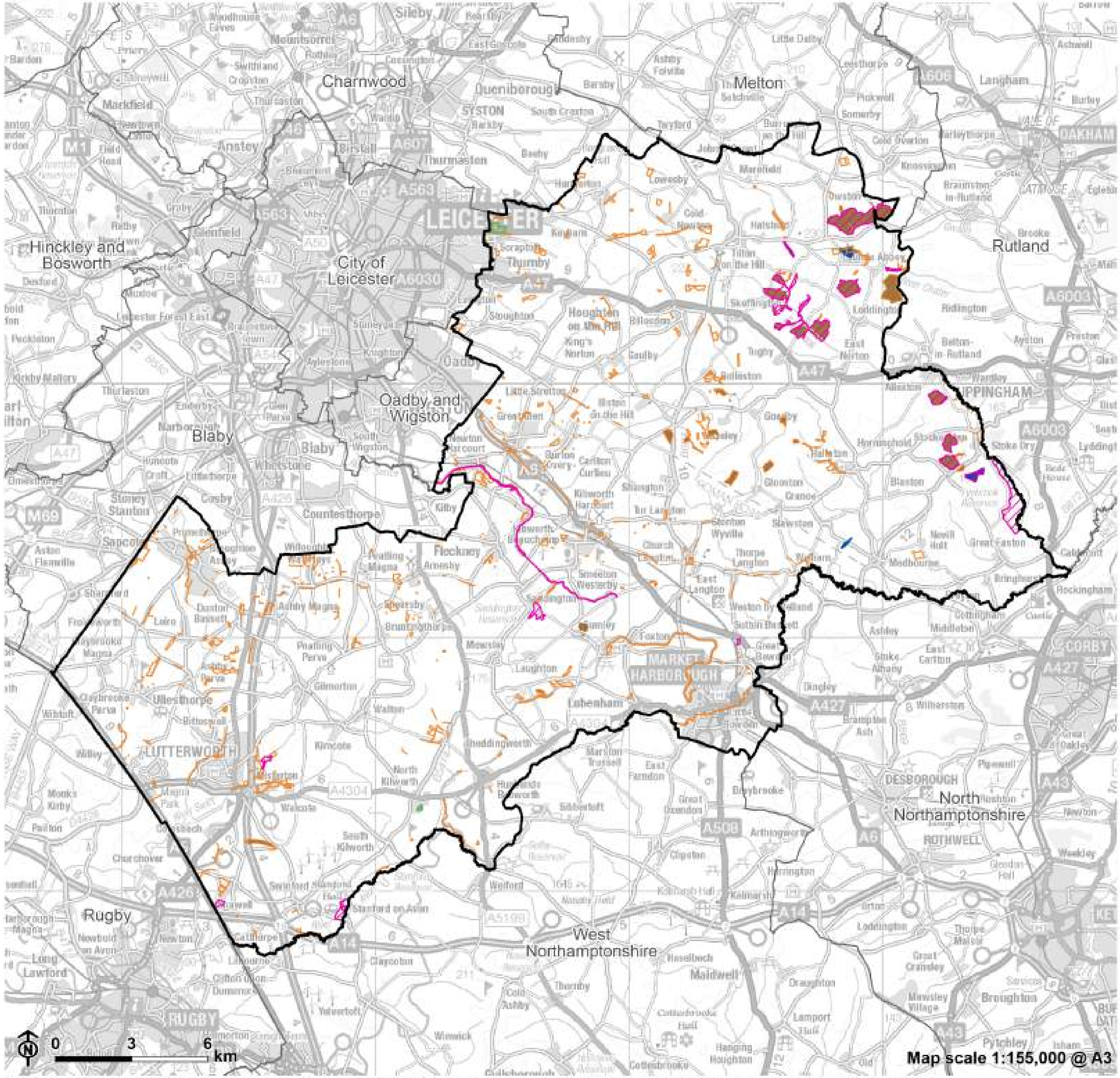
Global Wind Atlas 3.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU). The Global Wind Atlas 3.0 is released in partnership with the World Bank Group, utilizing data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalwindatlas.info.

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 09/09/2024 EB:shayler_h

Renewable Energy Study
Harborough District

Figure B2: Wind constraints - Natural heritage constraints



- Harborough District
- Neighbouring Local Authority
- Site of Special Scientific Interest
- Ancient woodland
- Local Nature Reserve
- Local Wildlife Site
- Local Geological Site

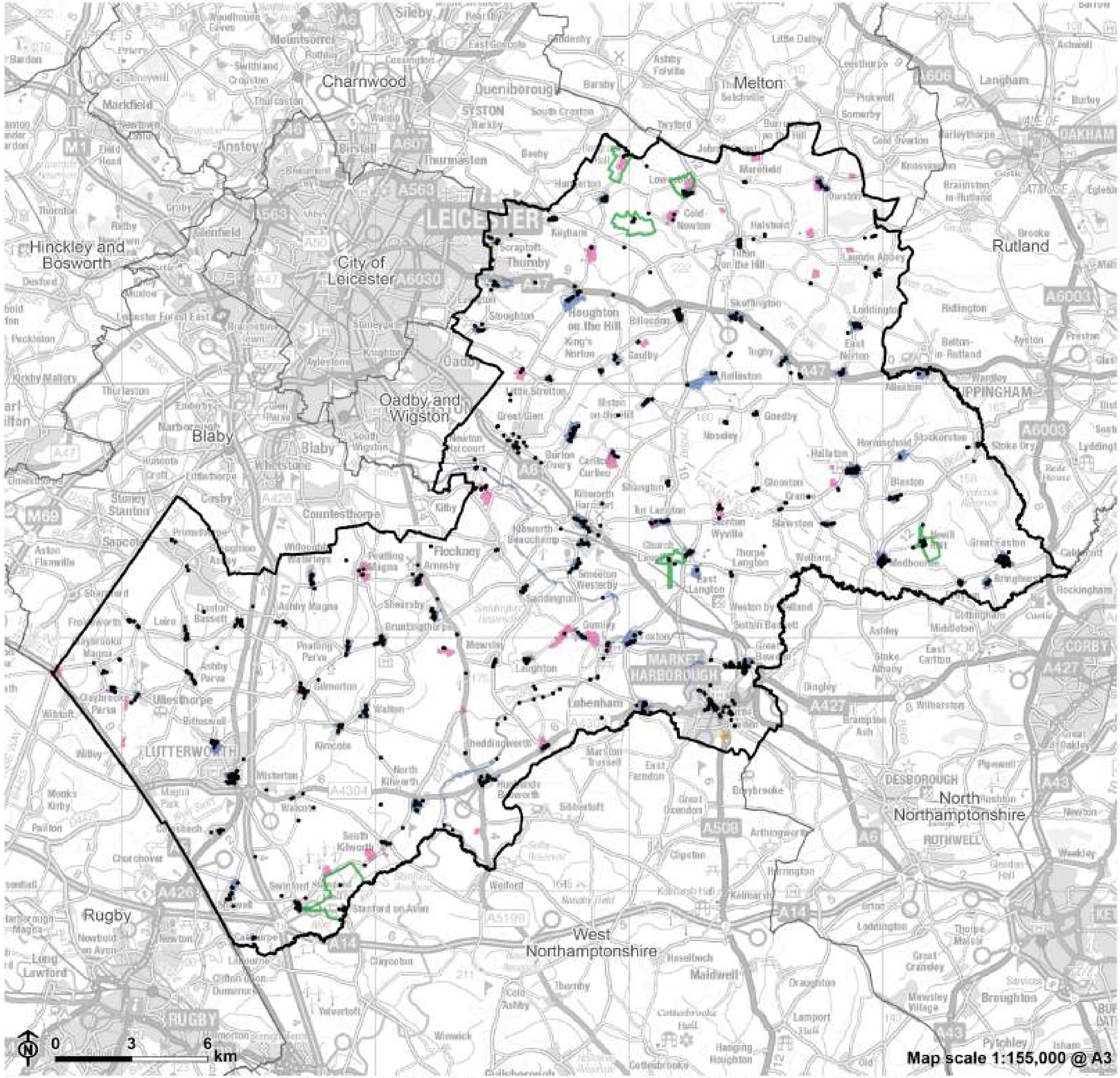
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 09/07/2024 EB:dhane_r

Renewable Energy Study
Harborough District

Figure B3: Wind constraints - Cultural heritage constraints



- Harborough District
- Neighbouring Local Authority
- Registered Parks and Gardens
- Scheduled monument
- Conservation area
- Locally listed building
- Listed building

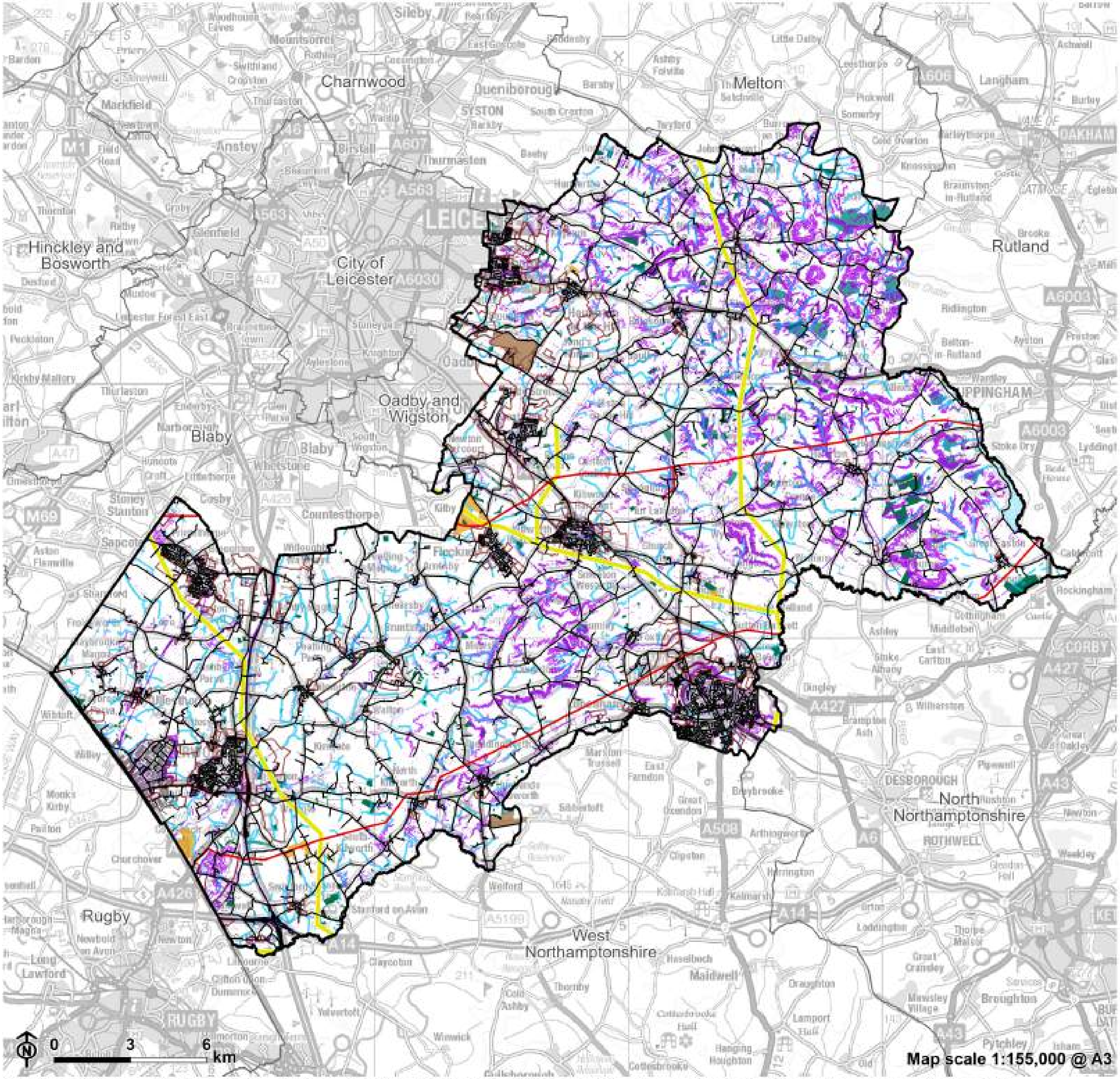
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 09/07/2024 EB:dhane_r

Renewable Energy Study
Harborough District

Figure B4: Wind constraints - Physical constraints



- Harborough District
- Neighbouring Local Authority
- Roads and railways
- Building
- Gas pipeline
- Electricity line
- Airports and airfield
- Watercourses and water bodies
- Woodland
- Existing renewable development
- Future developments, safeguarded land and employment sites
- Slope above 15%

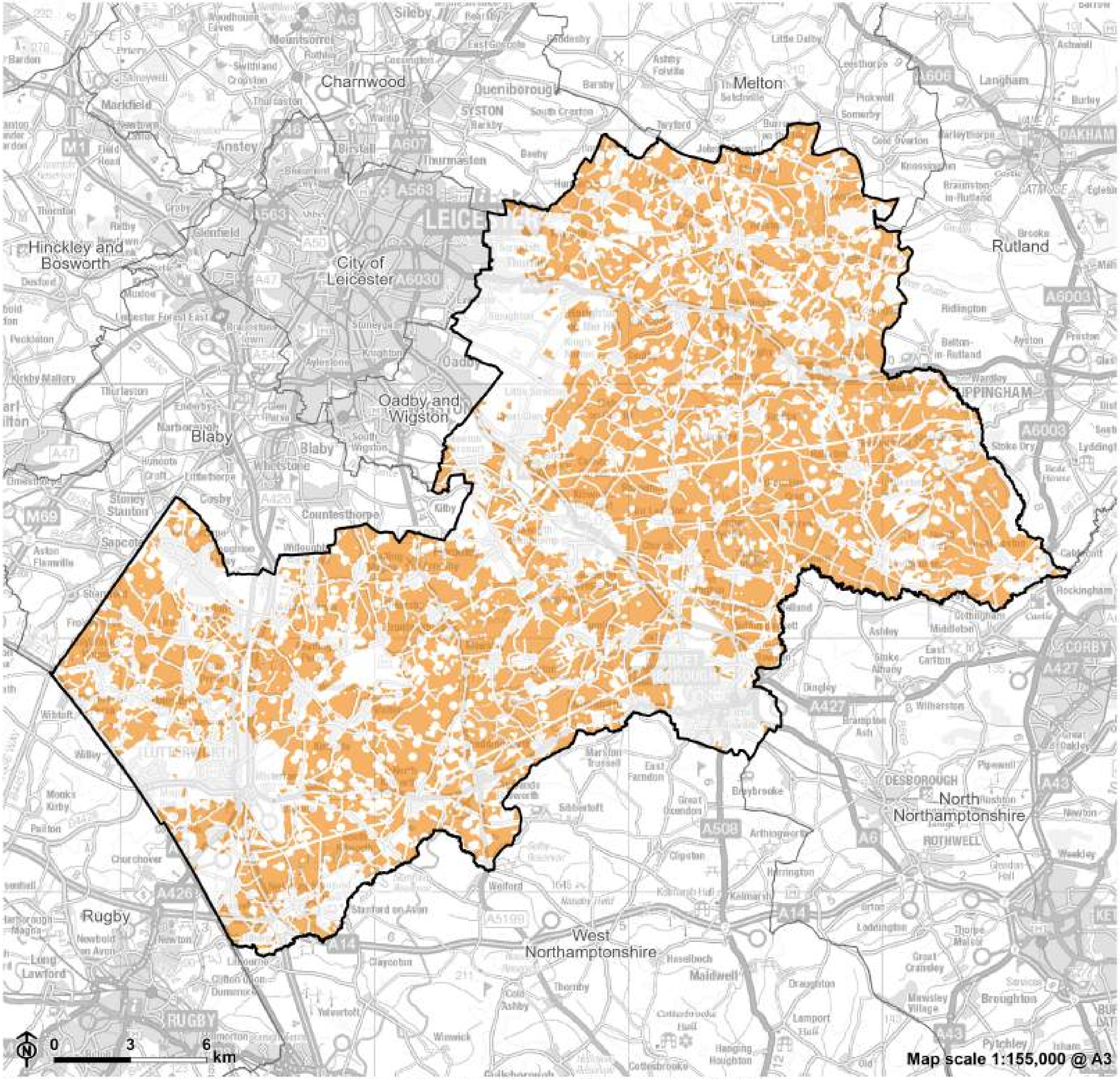
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 23/07/2024 EB:dhane_r

Renewable Energy Study
Harborough District

Figure B5: Opportunities and constraints: Small scale (25-60m tip height) wind development



- Harborough District
- Neighbouring Local Authority

Technical potential within Harborough

- Potentially technically suitable for small turbines (25-60m tip height) only
- Constrained area for small wind: no technical potential

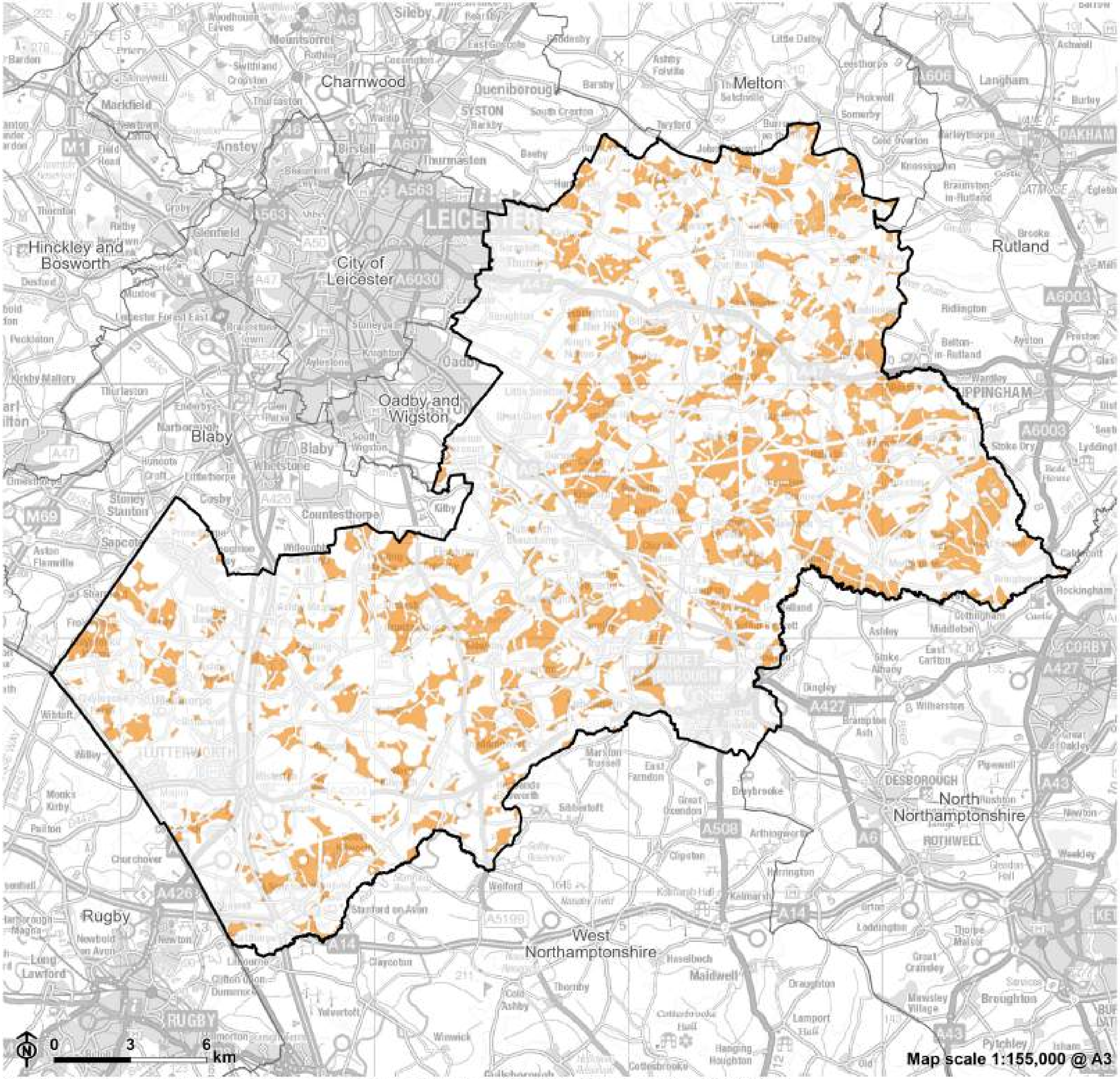
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Renewable Energy Study
Harborough District

LUC

Figure B6: Opportunities and constraints: Medium scale (60-100m tip height) wind development



- Harborough District
- Neighbouring Local Authority

Technical potential within Harborough

- Potentially technically suitable for small to medium turbines (25-100m tip height) only
- Constrained area for medium wind: no technical potential

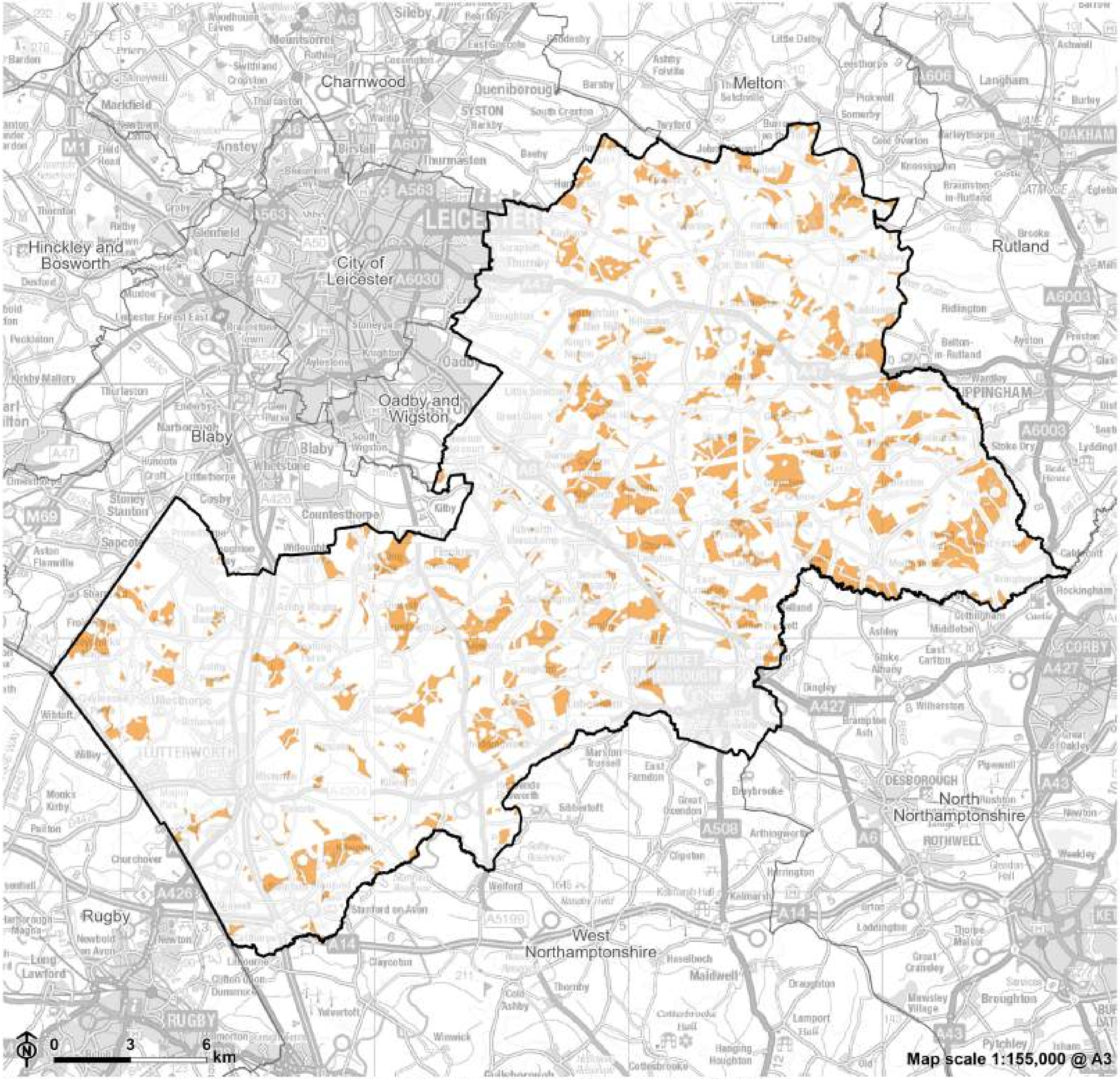
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 23/10/2024 EB:Sullivan_N

Renewable Energy Study
Harborough District

Figure B7: Opportunities and constraints: Large scale (100-150m tip height) wind development



Harborough District

Neighbouring Local Authority

Technical potential within Harborough

Potentially technically suitable for small to large turbines (25-150m tip height) only

Constrained area for large wind: no technical potential

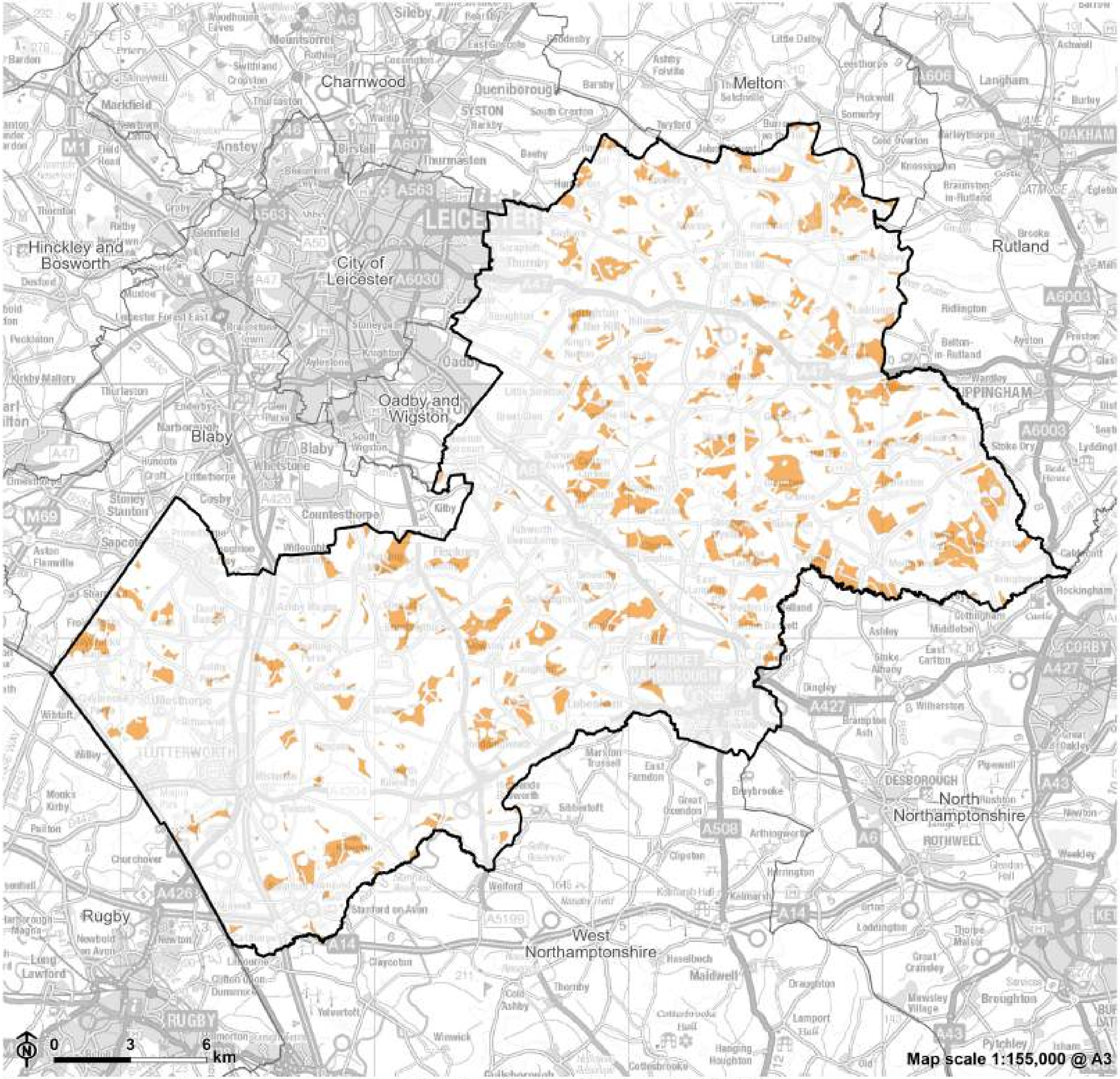
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 23/10/2024 EB:Sullivan_N

Renewable Energy Study
Harborough District

Figure B8: Opportunities and constraints: Very large scale wind development



- Harborough District
- Neighbouring Local Authority

Technical potential within Harborough

- Potentially technically suitable for all turbine scales (25-220m tip height)
- Constrained area for very large wind: no technical potential

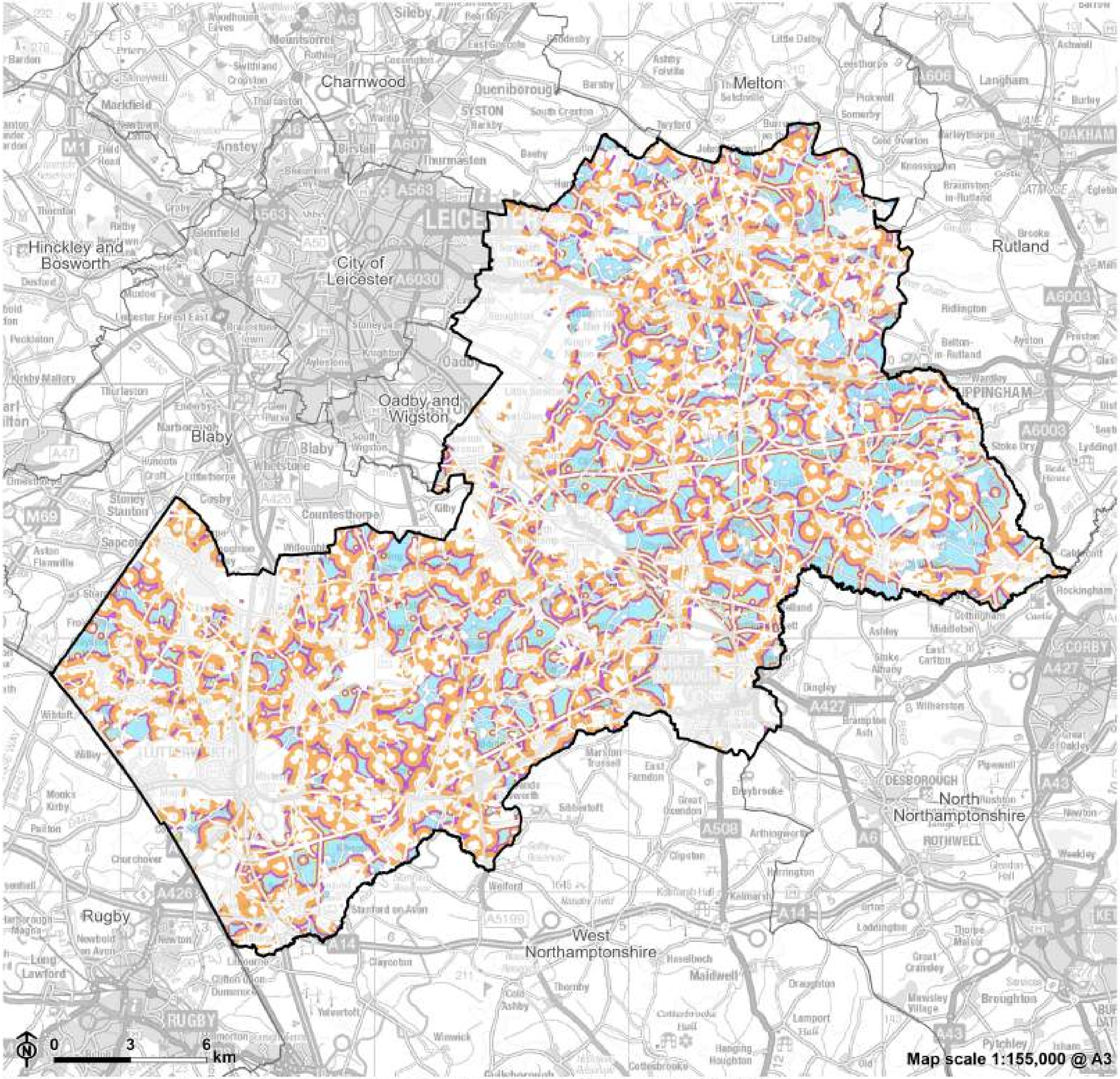
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 23/10/2024 EB:Sullivan_N

Renewable Energy Study
Harborough District

Figure B9: Opportunities and constraints: All scales of wind development



- Harborough District
- Neighbouring Local Authority

Technical potential within Harborough

- Potentially technically suitable for all turbine scales (25-220m tip height)
- Potentially technically suitable for small to large turbines (25-150m tip height) only
- Potentially technically suitable for small to medium turbines (25-100m tip height) only
- Potentially technically suitable for small turbines (25-60m tip height) only
- No technical potential

Notes:

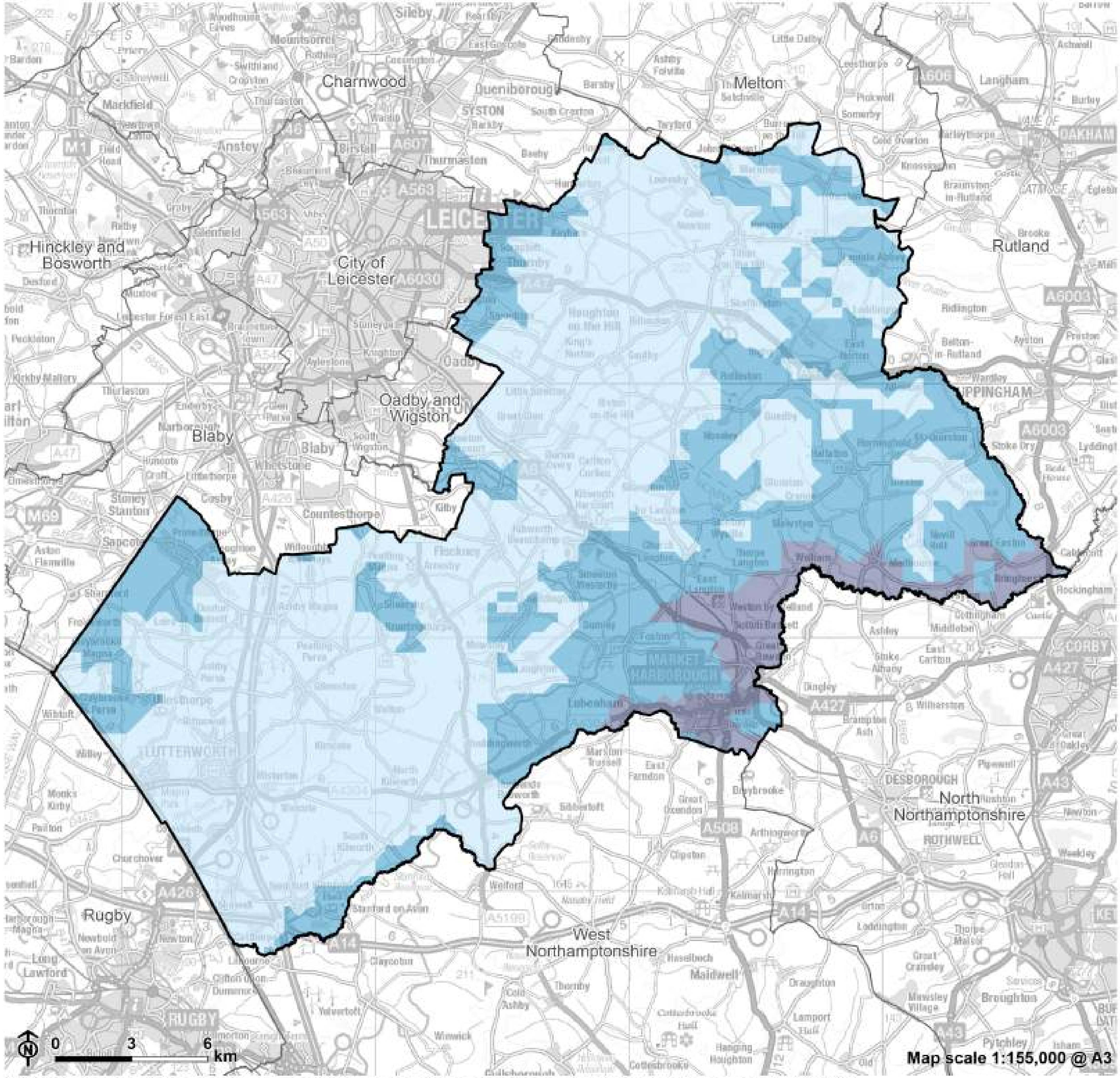
Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Wind_Figure 23/10/2024 EB:Sullivan_N

Renewable Energy Study
Harborough District

LUC

Figure B10: NATS Safeguarding Areas



Harborough District
Neighbouring Local Authority

NATS Safeguarding Area

20m turbine height
80m turbine height
140m and 200m turbine height

Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

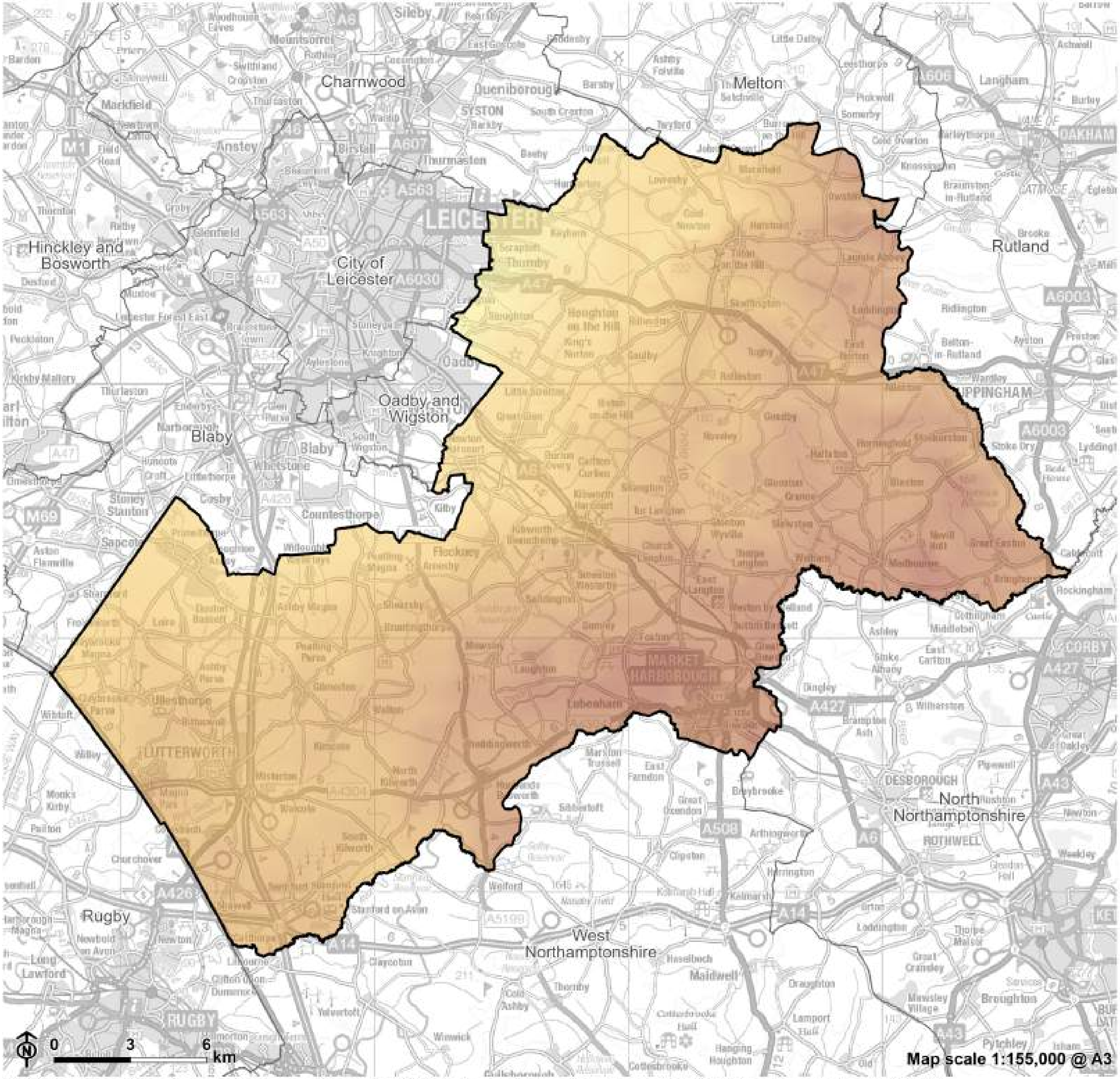
Appendix C

Ground mounted solar PV maps

Renewable Energy Study
Harborough District

LUC

Figure C1: Annual solar irradiance



Harborough District
Neighbouring Local Authority

Annual solar irradiance

1015 kWh/kWp

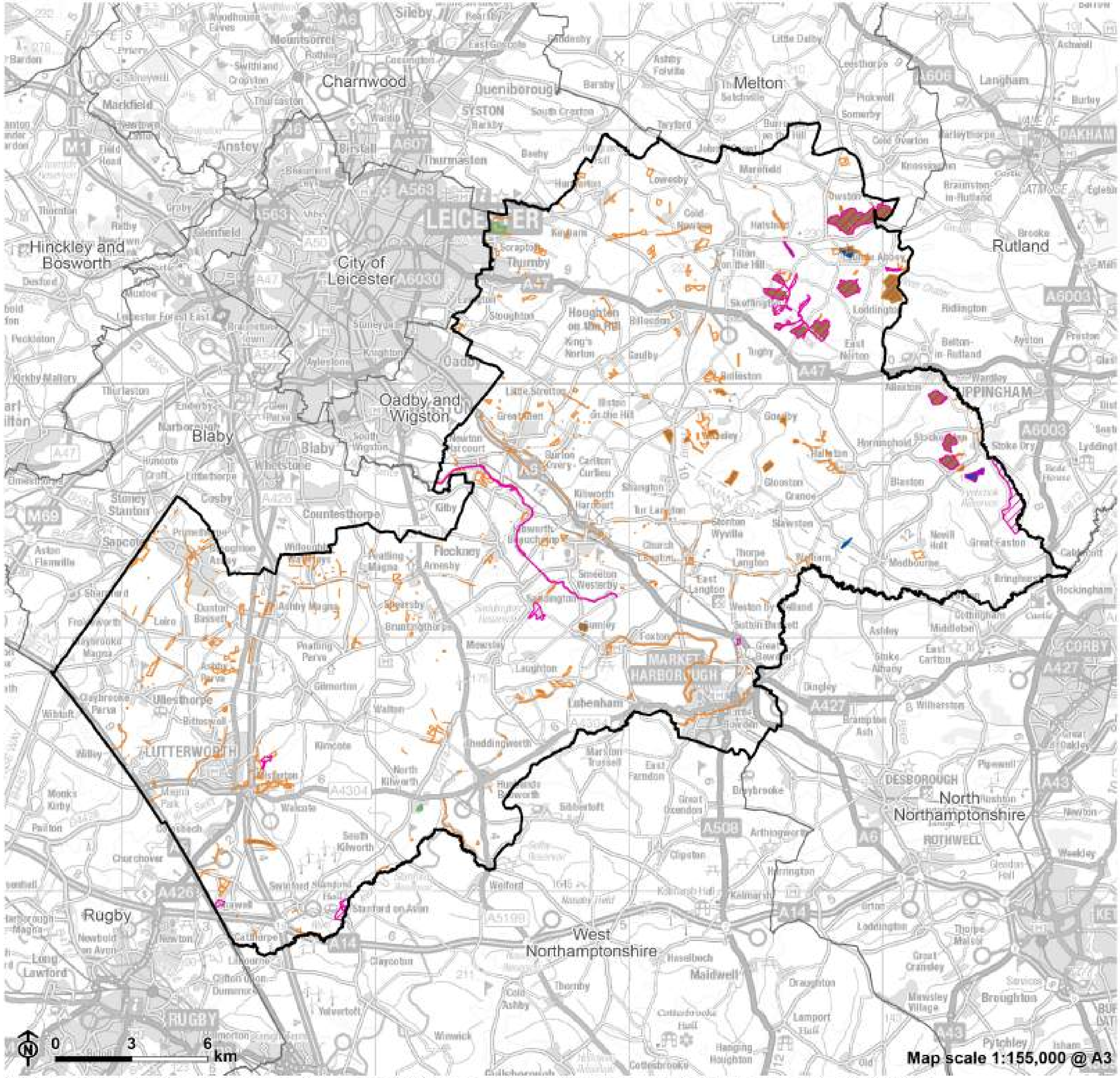
963 kWh/kWp

Notes:
Global Solar Atlas 2.0 is a free, web-based application, developed and operated by the company Solargis s.r.o on behalf of the World Bank Group, utilising Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info.

Renewable Energy Study
Harborough District

Figure C2: Solar constraints - Natural heritage constraints

- Harborough District
- Neighbouring Local Authority
- Site of Special Scientific Interest
- Ancient woodland
- Local Nature Reserve
- Local Wildlife Site
- Local Geological Site



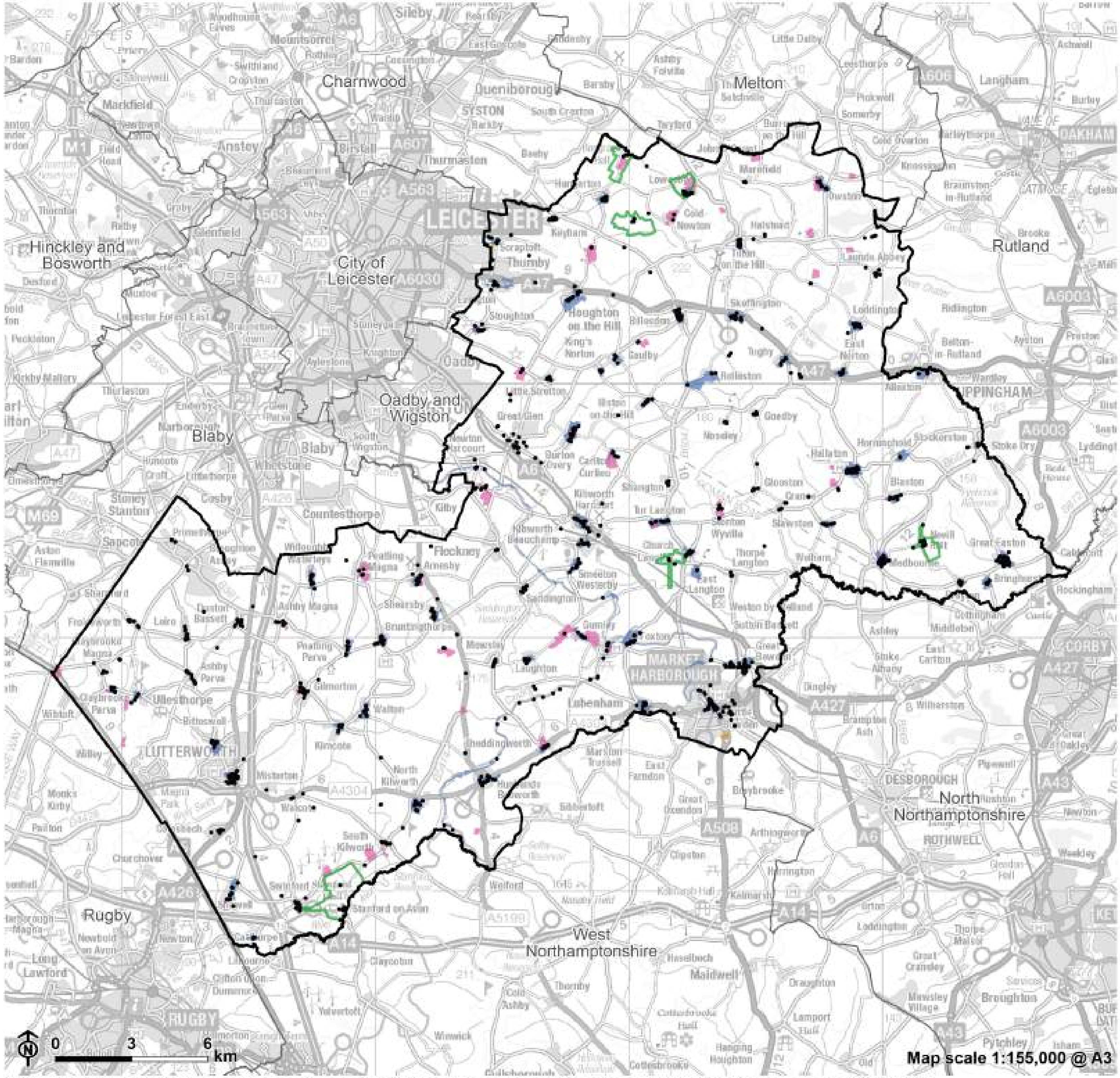
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Solar_figures 09/07/2024 EB:dhane_r

Renewable Energy Study
Harborough District

Figure C3: Solar constraints - Cultural heritage constraints



- Harborough District
- Neighbouring Local Authority
- Registered Parks and Gardens
- Scheduled monument
- Conservation area
- Locally listed building
- Listed building

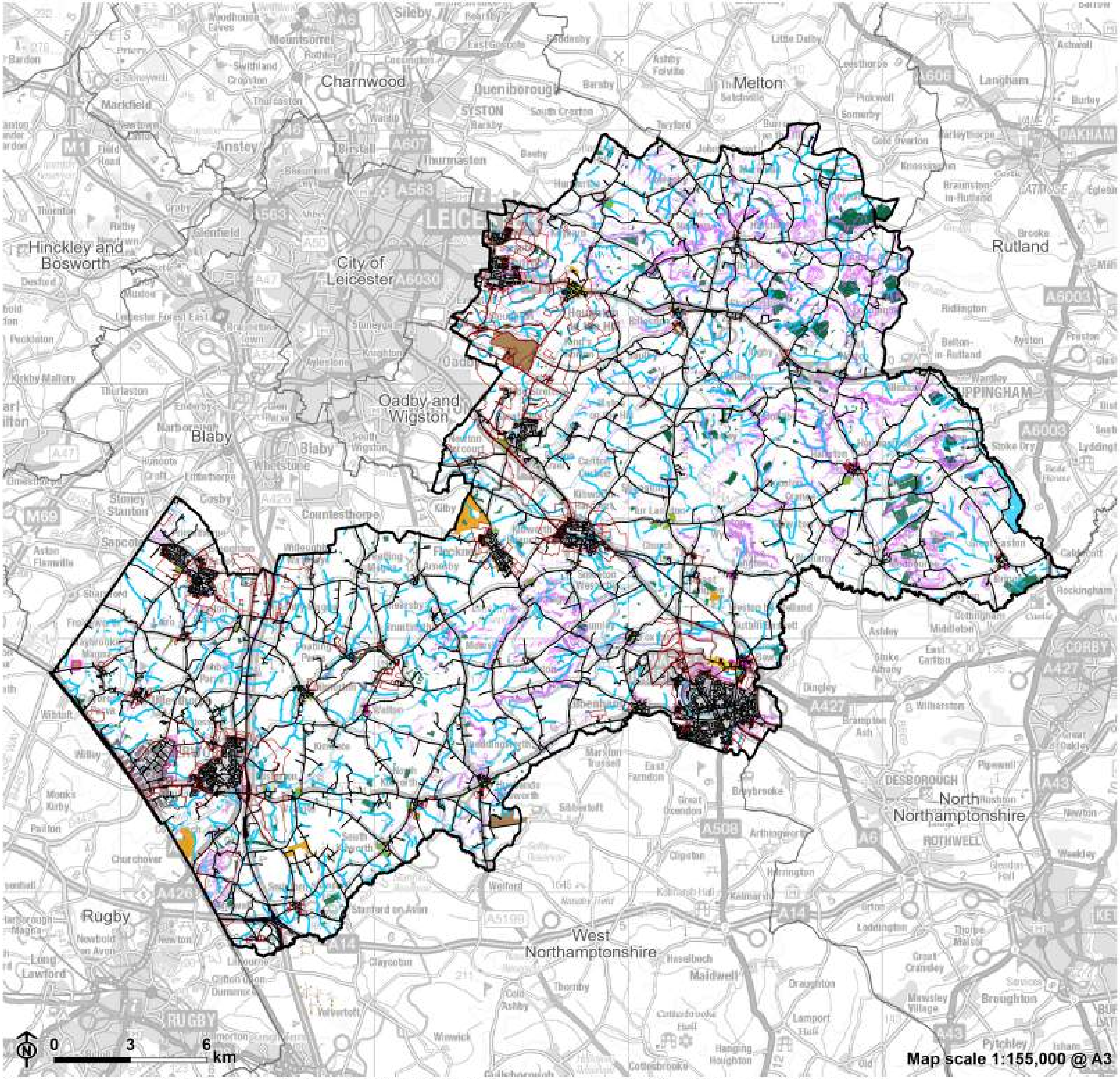
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

Renewable Energy Study
Harborough District

LUC

Figure C4: Solar constraints - Physical, land use and infrastructure



- Harborough District
- Neighbouring Local Authority
- Roads and railways
- Building
- Watercourses and water bodies
- Woodland
- Existing renewable development
- Greenspace
- Common land
- Open space
- Future developments, safeguarded land and employment sites
- Slope above 15° or slope above 7° and north-east to north-west aspect

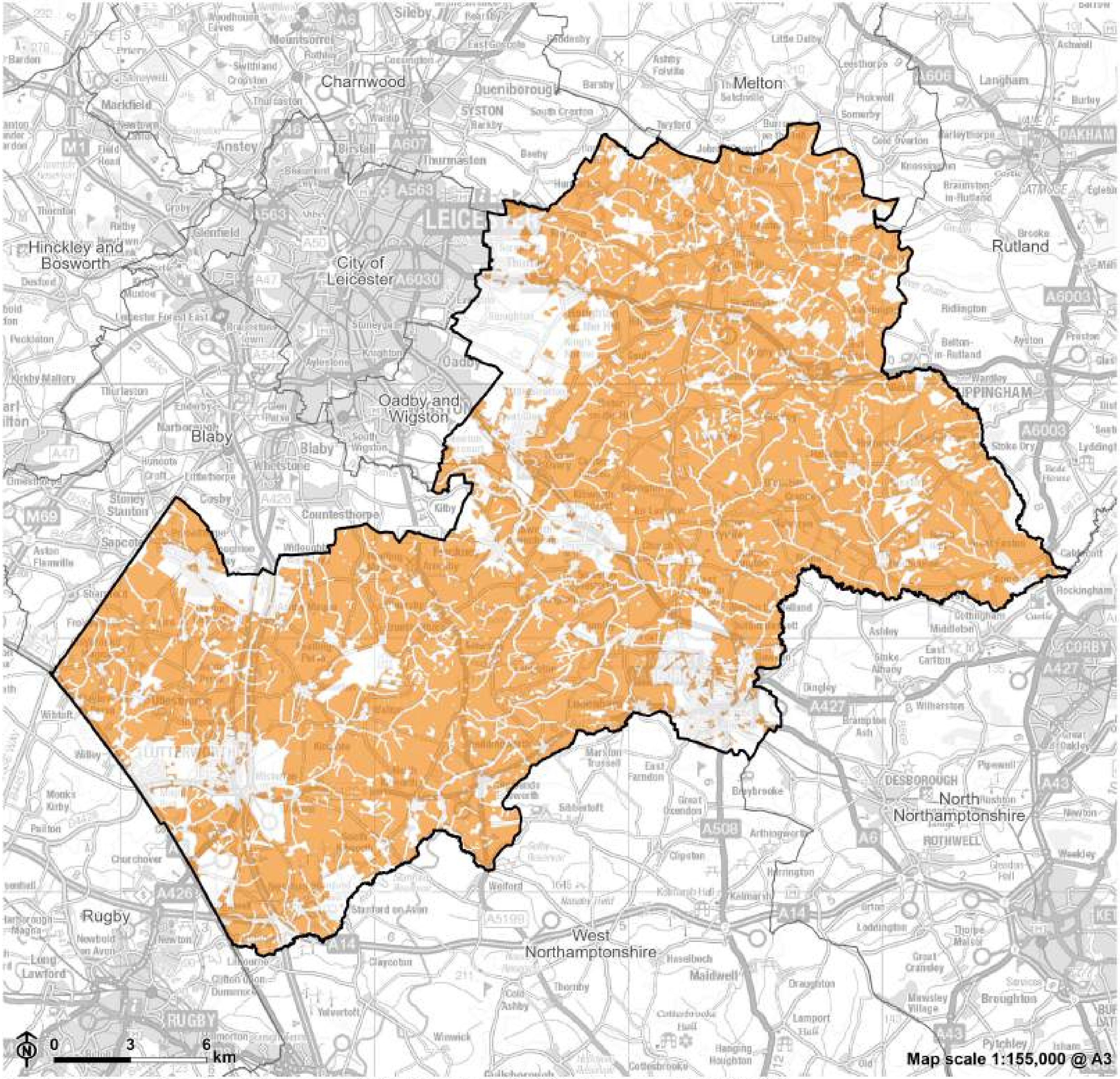
Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Solar_figures 23/07/2024 EB:dhane_r

Renewable Energy Study
Harborough District

Figure C5: Opportunities and constraints: Solar development



- Harborough District
- Neighbouring Local Authority

Technical potential within Harborough

- Potentially technically suitable for solar development
- Constrained area for solar development: no technical potential

Notes:

Please refer to this map in conjunction with the assessment assumptions detailed in Appendix A.

12842_Solar_figures 23/10/2024 EB:Sullivan_N

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2 Climate Change Committee (2020) The Sixth Carbon Budget: The UK's path to Net Zero

3 HM Government (2008) Climate Change Act 2008, c.27

4 HM Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019

5 Department for Energy Security and Net Zero (2023) Powering up Britain

6 The EU Energy Union is a project of the European Commission to coordinate the transformation of European energy supply. On 31st January 2020, the UK left the EU and is no longer part of the Energy Union. However, there are still UK policies and measures in force relating to the five dimensions of the EU's Energy Union.

7 Department for Transport, Office for Zero Emission Vehicles and Anthony Browne (2024) Pathway for zero emission vehicle transition by 2035 becomes law

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