Renewable Energy Study

Solar PV and Wind Turbine Potential

Eastbourne Borough Council

29 March 2023

Quality information

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1. Introduction

In July 2019 Eastbourne Borough Council (EBC) declared a climate emergency and committed to reduce carbon emissions to net zero over a ten year period[1]. To support the net zero carbon 2030 transition EBC have instructed AECOM to quantify renewable energy potential within the Council boundary. This study is intended to help inform the new Eastbourne Local Plan, which is an opportunity to shape policies to meet the ambitious decarbonisation target. Technologies investigated include solar photovoltaics (PV) and wind turbines. The aim of the study is to identify areas of opportunity for potential developments following a constraints based approach.

The Eastbourne Borough includes parts of the South Downs National Park (SDNP). However, these are not included in the local plan area. Therefore, the focus of this study is on the Borough, outside of the SDNP area. Analysis of wind energy potential in the SDNP are presented in this report as a separate opportunity.

This study is desktop based and no site visits have been carried out to test the feasibility of any of the opportunities discussed.

1.1 Energy consumption

To contextualise the renewable generation yield figures discussed herein, details of energy consumption in Eastbourne is provided in Figure 1. In 2019, the total consumption of all fuels (including gas, electricity, coal, petroleum, bioenergy, manufactured fuels) in Eastbourne equated to 1,387 GWh, of that 340 GWh was delivered as electrical power. It can be assumed that the latter figure will increase as sectors including heating and transport are electrified.

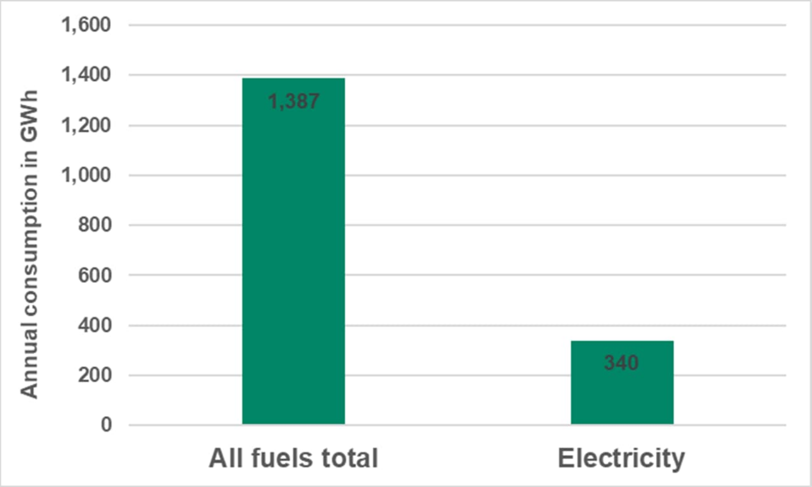

Figure 1: Eastbourne total fuel and electricity consumption 2019[2]

1.2 Methodology

The renewable energy study was conducted to the following methodology:

- Definition of mapping criteria used to build the GIS model. The GIS model was developed using Esri ArcGIS desktop. Datasets were compiled into a file geodatabase, supplied with appropriate metadata. Layers of spatial data include:
  - Planning and environmental constraints
  - Existing infrastructure (buildings, roads, overhead power lines, railways etc.)

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[1] https://www.lewes-eastbourne.gov.uk/eastbourne-borough-council-news/council-approves-plan-for-a-carbon-neutral-eastbourne/

[2] https://www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019

  - Watercourses and flood risk
  - Topography
  - Mean wind speed
  - Irradiance as Global Horizontal Index (GHI)
- The GIS model was then used to identify areas of constraint and allowed measurement of land areas with opportunity for development of solar PV or wind turbines.
- A high-level assessment of generation capacity was carried out for the land areas identified. Solar PV yield was calculated using PV GIS and wind energy yield was simulated using the software HOMER.
- Available grid capacity was assessed at a high-level.

The methodology above identified the opportunities for renewable energy in Eastbourne and provided the estimation of their scale in terms of capacity and energy yield.

The methodology aligns with criteria set out on planning practice guidance[3] where relevant.

1.3 Constraints overview

This section provides an overview of the EBC boundary area and the main limitations to developing renewable energy. Development of large-scale renewables generally requires extensive open land areas. Figure 2 highlights that the majority of land area is taken up by the town of Eastbourne and its suburbs. The remaining land is mostly constrained by factors including flood risk and environmental designations.

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[3] https://www.gov.uk/guidance/renewable-and-low-carbon-energy

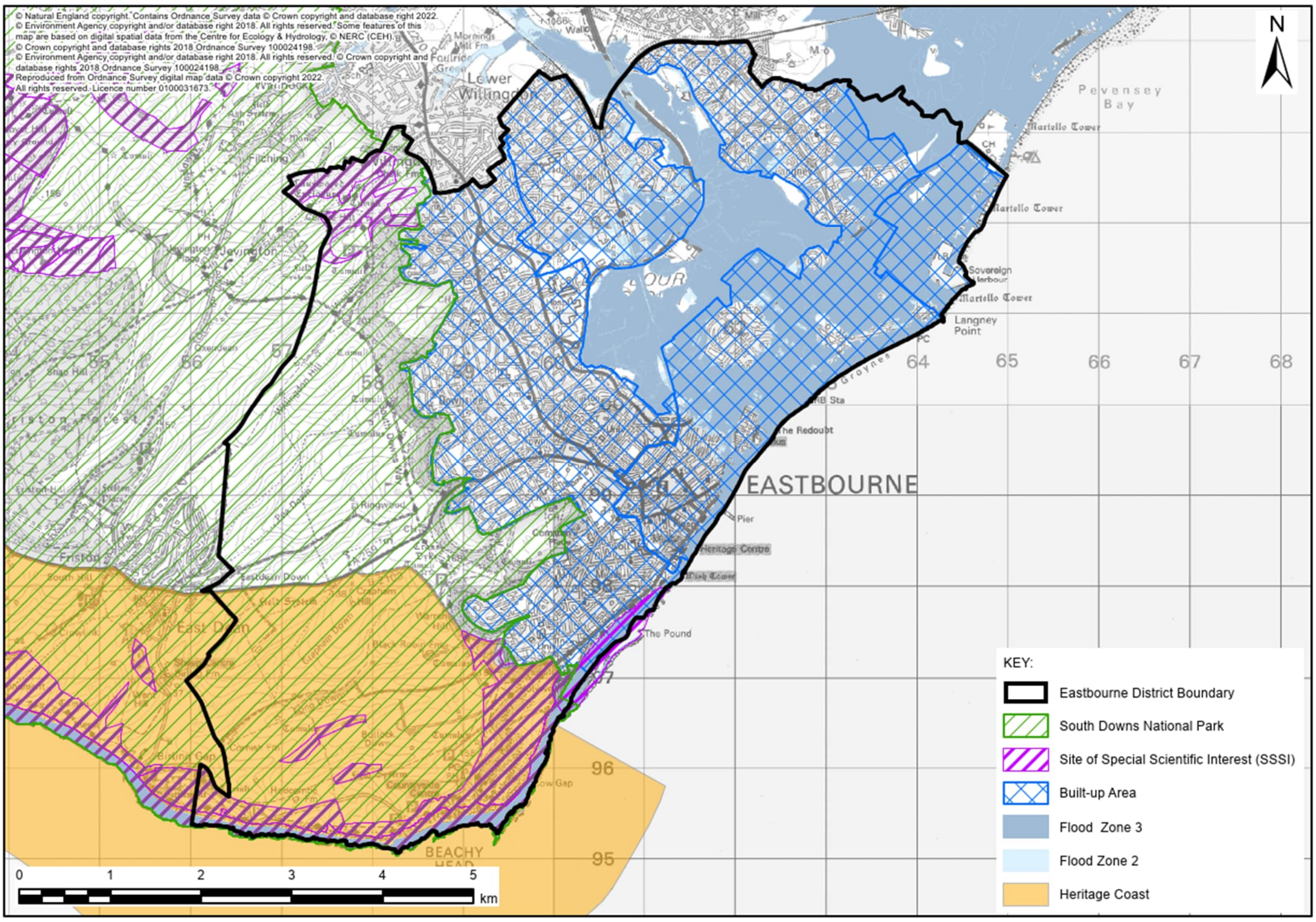
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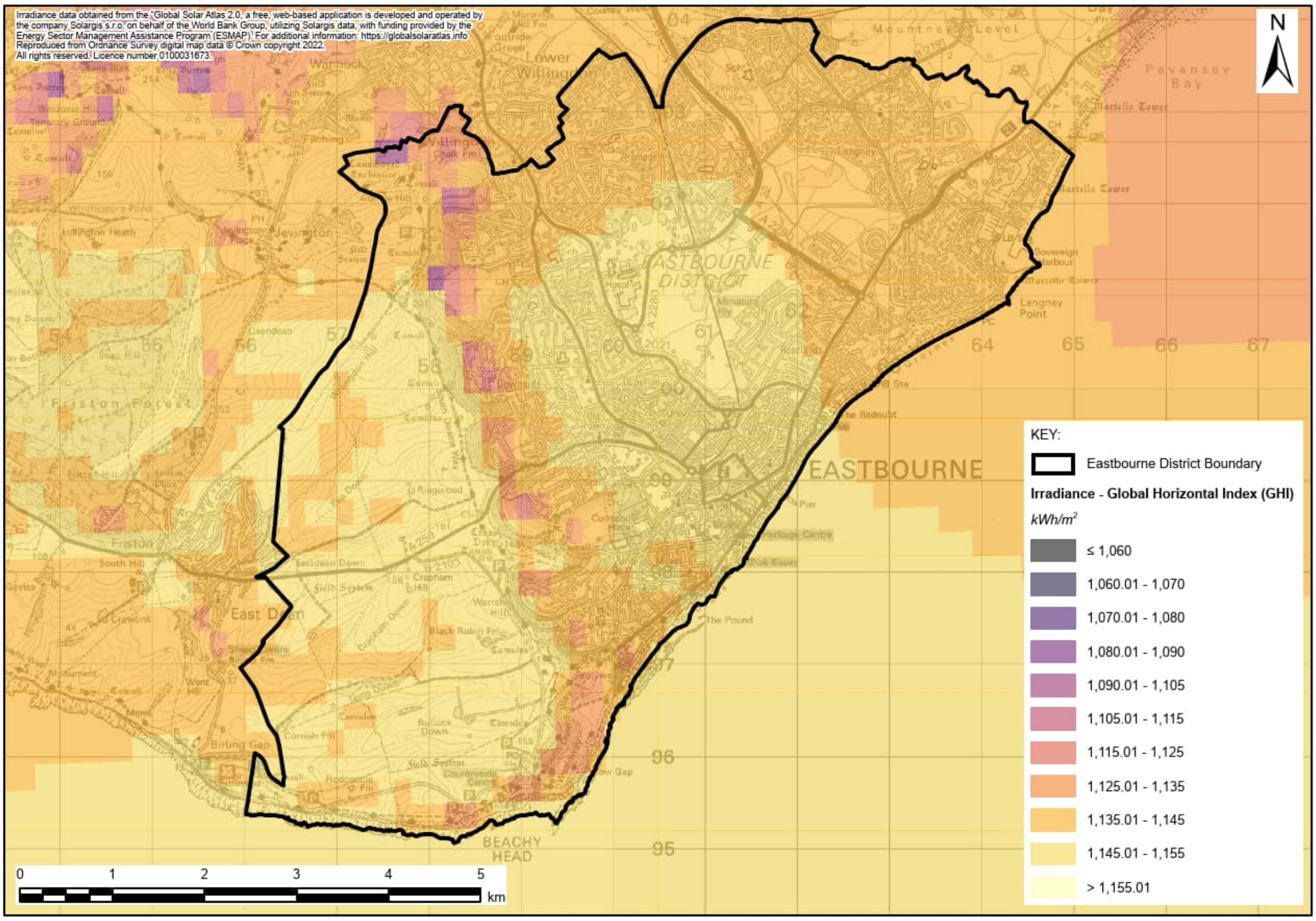
Figure 2: Overview of constraints on renewable energy development in Eastbourne

1.4 Renewable Resource overview

Initial review shows that Eastbourne has significant renewable energy resource. Figure 3 illustrates that GHI (explained further below) is fairly evenly spread across the area with little variation and annual insolation exceeds 1100kW/m^2 in most areas (this does not apply to areas where the path of sunlight is blocked by shading objects). For comparison, Sheffield is the town deemed to represent the average solar resource in the UK with approximately 950 kWh/m^2.

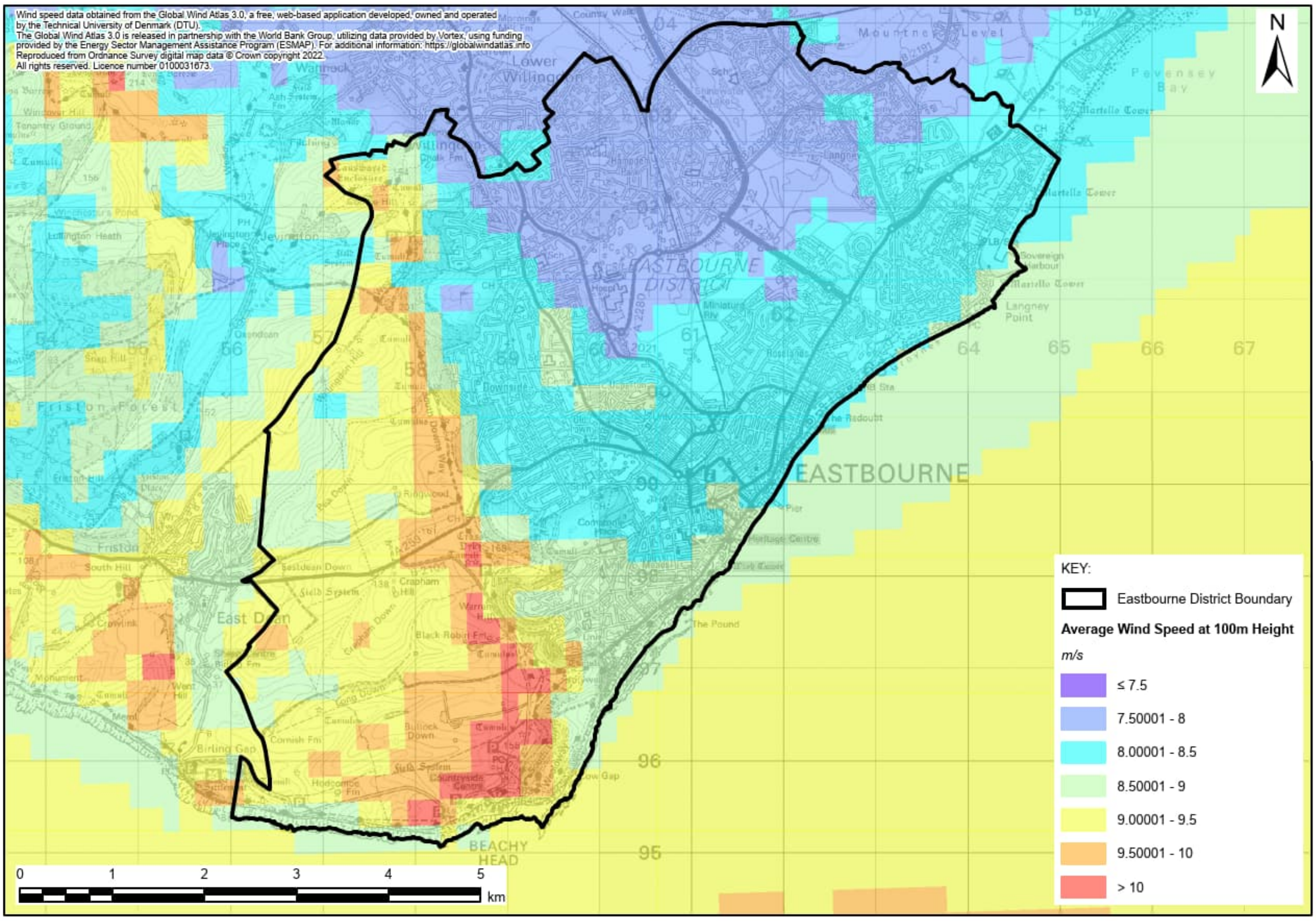
GHI is the total solar energy (direct beam and diffuse irradiation) received on a unit area of a horizontal surface. The yearly sum of the GHI is of particular relevance for PV power plants, which are able to make use of both the diffuse and beam components of solar irradiation. The level of resource available directly impacts the generation potential per unit area. In a UK context, the EBC area is fortunate to have relatively high wind and solar resource.



Irradiance data obtained from the "Global Solar Atlas 2.0, a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info Reproduced from Ordnance Survey digital map data © Crown copyright 2022. All rights reserved. Licence number 0100031673.

Figure 3: Solar resource across Eastbourne. GHI measured in kWh/m^2.

Figure 4 illustrates mean wind speed at 100 m above ground. 100m height is used as this would likely be close to the height of a large onshore wind turbine. Areas to the east receive windspeeds exceeding 7.5 m/s. Areas to the west have significantly more wind resource due to their elevated position and receive mean windspeeds up to 10 m/s. As a rule of thumb 6 m/s is a minimum requirement for economically viable wind turbine development.



Wind speed data obtained from the 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
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Figure 4: Wind resource across Eastbourne. Mean wind speed at 100m above ground in m/s.

2. Renewable Energy Technology Type

Within the scope of this study the renewable energy technologies include solar PV and wind turbines. Options investigated are tailored specifically to the opportunities within EBC boundary and include ground-mounted PV, floating PV, carport PV, roof-mounted PV and horizontal axis wind turbines.

2.1 Ground Mounted Solar PV

To site ground-mounted PV installations typically large areas of relatively flat open land is required, with few obstructions from trees and manmade structures. PV modules are attached to array tables which are fixed to the ground either with a screw or pile foundation, or ballast where ground conditions do not allow the former option. The layout can be tailored to maximise capacity from individual shapes of land and the approach is modular so can be scaled to almost any size. A clear and preferably short route should be available to connect the PV plant either to the grid or to a local off-taker such as a hospital or industrial site.

2.1.1 Potential Ground Mounted PV locations

The majority of open land areas with in the EBC boundary are either designated national park or flood zone 3. Figure 5 shows six areas with PV potential within Eastbourne park that are not constrained by those two factors.

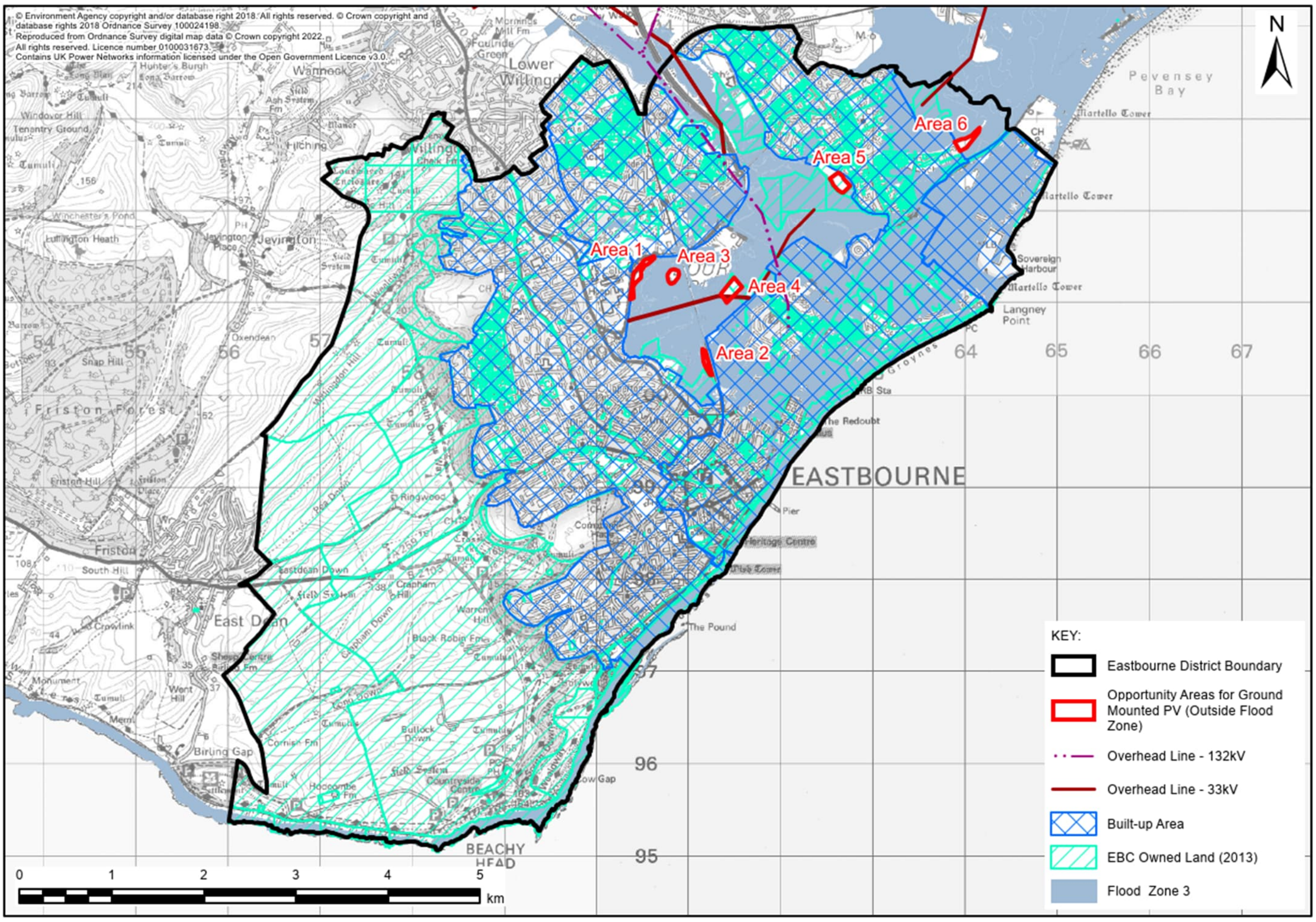

Figure 5: Ground-mounted PV opportunities outside flood zone 3

Technically it is possible to develop renewable energy sytems (wind / solar) in flood zone 3 areas with suitable engineering solutions, subject to planning approvals . Although the data available to this project does not have this level of granularity, the flood zone 3 classification is split into 3a and 3b[4] classification:

- Zone 3a High Probability - Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea.
  - In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.
- Zone 3b The Functional Floodplain - This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. Functional floodplain will normally comprise:
  - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
  - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).
    - In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:
    - remain operational and safe for users in times of flood;
    - result in no net loss of floodplain storage;
    - not impede water flows and not increase flood risk elsewhere.

Development in category Flood Zone 2 and above may be subject to an ‘Exception Test’, depending on the technologies vulnaribilty in flood conditions. This requires that[5]:

- development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh flood risk; and
- the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The text above describes that renewable energy schemes must be safe if subject to flood conditions, not have a negative effect on the floodplains capability to store floodwater or increase flood risk elsewhere. To address this challenge a number of design solutions can be incorporated:

- Solar array tables can be sited on higher mounting structures and electrical equipment and connections raised and designed with appropriate water ingress protection.
- Equipment such as transformers, inverters substations should be sighted on raised ground or structures.
- Increase in impermeable surfaces should be kept to a minimum.
- Interuption to the conveyance of flood waters freely across the site (e.g. by panels, fencing) should be kept to a minimum
- Land raising and civil works should not reduce the flood water storage capacity of the site.
- The solar PV development is likely to increase surface-water runoff. Additional flood water storage capacity may need to be created to mitigate against increased flood risk elsewhere.

Assuming that these engineering and planning challenges can be overcome, the area available for potential ground mounted PV is greatly increased. Figure 6 shows the potential opportunities in Eastbourne Park and the Langney Levels which are in flood zone 3 areas.

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[4] https://www.gov.uk/guidance/flood-risk-and-coastal-change#para77
[5] https://www.gov.uk/guidance/flood-risk-and-coastal-change#the-exception-test

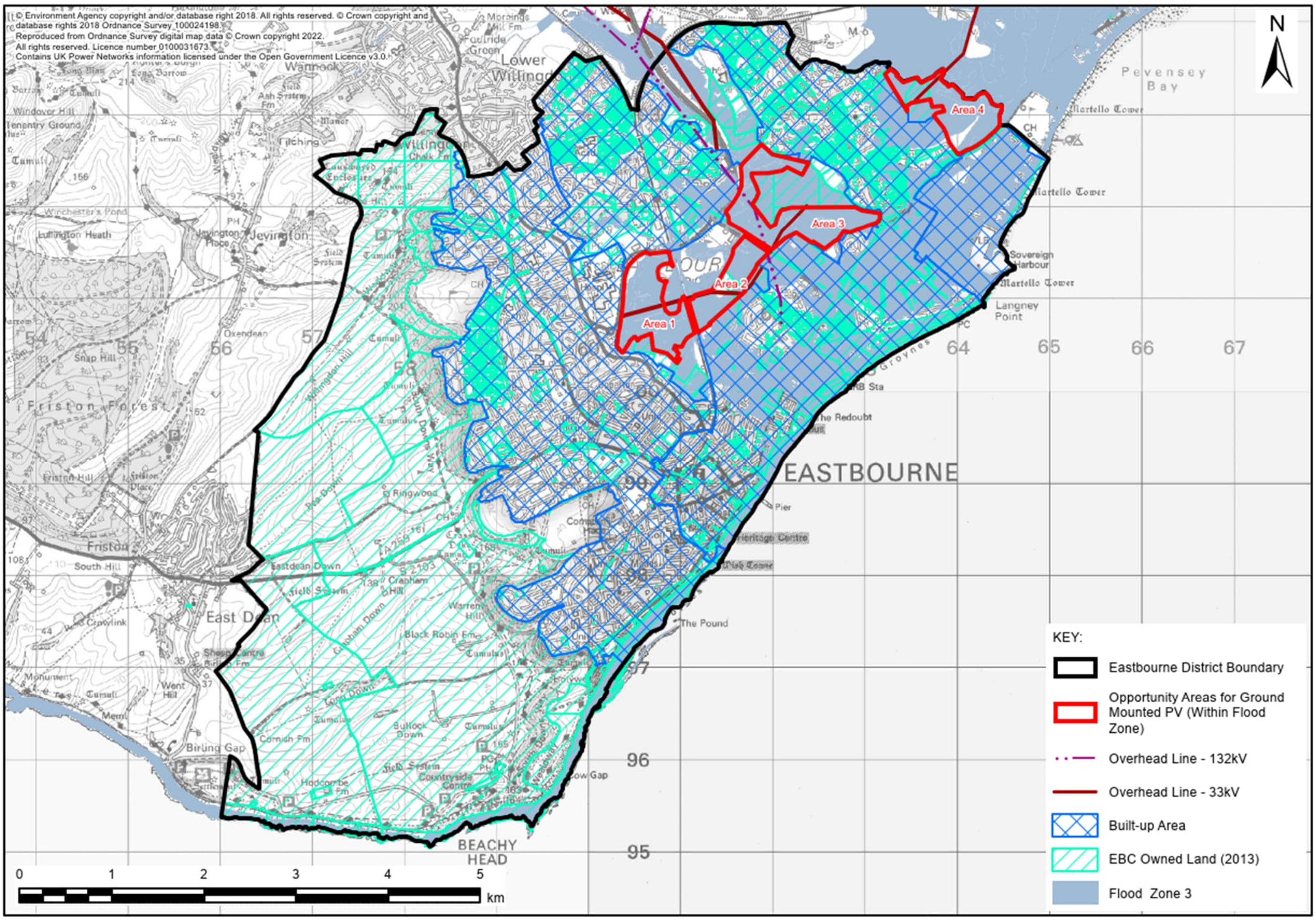

Figure 6: Ground-mount PV opportunities inside flood zone 3

There are multiple local policy constraints that likely affect the feasibility of gaining planning consent for development on the areas selected here; to include local wildlife sites, landscape, biodiversity, agricultural land class 3. These have been discounted for the purposes of analysis here to arrive at an approximation of technical potential. AECOM understands that in light of the climate emergency consideration may be given to revising local policy to allow for more development of renewable energy generation. There are options to mitigate undesired impacts such as visual screening with treelines and wildflower growing to increase biodiversity.

Also shown in the figures above are the land areas that are owned by EBC (accurate in 2013). Here the Council has greater opportunity to progress development of renewables via suitable delivery models (council owned, community owned, or land lease to a commercial developer and operator).

2.2.2 Estimated Ground Mounted PV generation

Generation potential for the ground-mounted PV category has been broken down into areas that are flood zone 2 or below and areas that are designated flood zone 3 land.

Flood Zone 2 and below
Table 1 shows that the total size of the six areas identified in Figure 5 is 10.3 Ha. Assuming a PV density of 0.5 MWp/Ha and a land usability factor of 0.8; to account for hedgerows, shading and access roads; the estimated PV capacity is 4.1 MWp. The year one yield was simulated in PV GIS which resulted in an expected annual generation of 4.6 GWh. Lifetime yield includes expected module degradation over a 30 year period.

Table 1: Generation potential from ground mounted PV in Flood Zone 2 or below

Total Area (Ha)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30 year lifespan (MWh)
10.3	4.1	4,633	131,216

Flood Zone 3

In Table 2 we can see that the area with potential for PV development in flood zone 3 areas is 200 Ha. This includes all areas highlighted in Figure 6. The total technical potential PV capacity from this land area is 80.8 MWp, which has a simulated year 1 yield of 90.4 GWh.

Table 2 Generation potential from Flood Zone 3

Total Area (Ha)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30 year lifespan (MWh)
200.2	80.8	90,371	2,559,596

The following assumptions were made in calculating generation potential from ground mounted PV:

- 20 degree module inclination
- 0 degree module orientation
- 0.4% annual module degradation
- No shading losses were modelled
- 0.5 MW PV capacity / hectare
- 14% system losses (due to cell temperature rise, electrical losses, etc.)
- 20% reduction on Deployable Land / Hectares
- 30 year lifespan of PV modules

2.2 Floating Solar PV

Floating solar can be sited on calm shorelines, lagoons or natural lakes, or provide an additional use from manmade waterbodies such as decommissioned coal mines and reservoirs. PV modules are mounted on structures that float on the water’s surface (Figure 7). Several rows of modules connect to form solar boats, where DC cables are typically fed to central inverters. These structures are anchored to the ground and moored at the shore to stay in position. Required tolerance is incorporated into designs to deal with fluctuations in water levels. An AC power cable connects to the load or electricity network on shore. An added benefit is that the cooling effect of the water reduces efficiency losses through overheating of PV cells. The cost of floating PV is approximately on par with ground-mounted PV.

Figure 7. An example of floating solar PV

2.2.1 Potential FSPV locations

There are a large number of lakes and ponds in Eastbourne, however most are either quite small, or located within country parks or areas for leisure, where it was perceived more challenging to obtain planning consent. Out of a total of six waterbodies with potential in terms of size, three were selected as being potentially suitable for floating solar PV in the Eastbourne Park area (Figure 8), it is worth noting that areas labelled 1 and 2 are under EBC ownership. Shinewater Lake, Hydneye Lake and Sovereign Harbour were excluded for practicality reasons and due to their leisure area usages.

As some of the water bodies in question have a purpose of storing flood water it is likely that their water levels may change. Therefore, the tolerance levels of any solar boat fixing design are an important consideration.

Floating solar PV has environmental impacts on the water bodies where they are sited. The two main elements to this are light and gas exchange. Light is the primary energy source for organisms at the base of the trophic chain and is a cue for daily ad seasonal physiological patterns. It also influences temperature which is an important factor for any ecosystem. Gas exchange takes place at the water-air boundary. Oxygen is a basic requirement for aerobic organisms and carbon dioxide, as well as light, are indispensable for photosynthesis. It must be considered that the PV modules will cause shading over the water body and the floating structures they are mounted on reduce available surface area for gas exchange. Impacts can also be positive as shading form PV modules can reduce evaporation, which can be a problem in drought areas. The shade provided can also help reduce the presence of algal blooms. In general, it can be said that the greater the percentage coverage of PV to surface area, the greater the environmental impacts. Investigation of environmental impacts of floating solar at any specific location is recommended prior to installation.

Since the majority of open land in the Eastbourne Park is designated Flood Zone 3, developing floating PV on its permanent waterbodies may be an appropriate option.

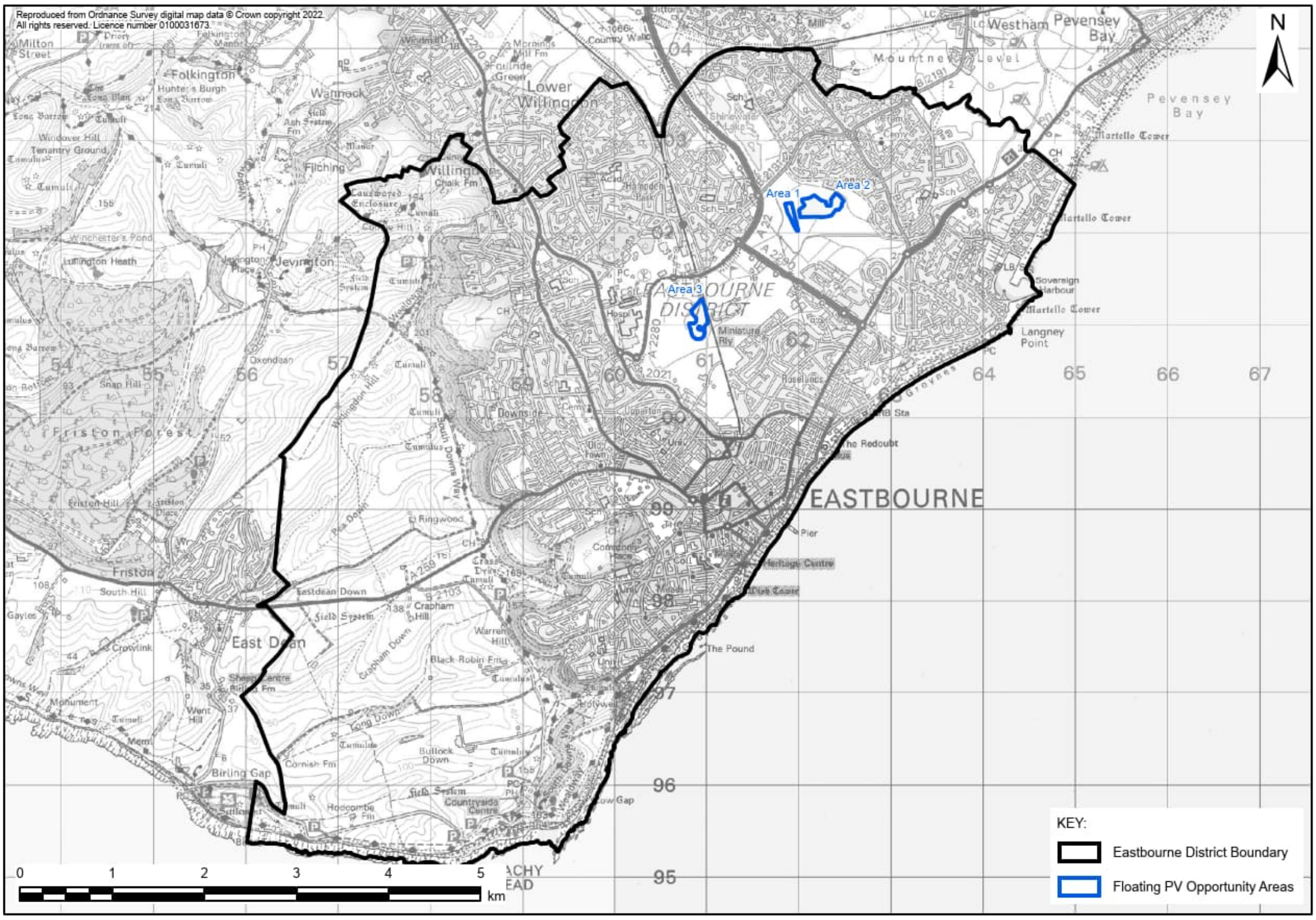
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Figure 8: Opportunities for floating PV in Eastbourne Park

2.2.2 Estimated FSPV generation

The three selected waterbodies have a total area of 14.5 Ha. A PV coverage factor of 0.6 is applied as the solar boat structures tend to be large and less adaptable to fit contours of land parcels than e.g. ground mounted PV. The total estimated capacity is 4.3 MWp resulting in an energy yield of 4.9 GWh in the first year of operation (3).

Table 3: Generation potential from floating PV

Waterbody	Area (Ha)	Capacity (MWp)	Year 1 yield from floating solar PV (MWh)	Yield estimate over 30 year lifespan (MWh)
1	5.1	1.5	1,716	48,603
2	1.6	0.5	572	16,201
3	7.8	2.3	2,631	74,524
Total	14.5	4.3	4,919	139,328

The following assumptions were made in calculating generation potential from floating PV:

- 20 degree module inclination
- 0 degree module orientation
- 0.4% annual module degradation

- No shading losses
- 0.5 MW PV capacity / hectares
- 14% system losses
- 20% reduction on Deployable surface / Hectares
- 30 year lifespan
- PV Coverage factor of 0.6

2.3 Carport Solar PV

A solar carport is a shelter for one or more cars that incorporates solar PV modules. The roof cover material of these structures consists of PV modules (if integrated), mounted onto steel or wooden structures as seen in Figure 9. Wood has the advantage of being a lower embodied carbon building material than steel (depending on lifecycle), although this type of frame is more commonly seen in smaller installations. The foundations tend to be screw piles, concrete piles or concrete pads. Carport PV is a more costly method for installing PV (approximate 30% to 40% uplift in CAPEX compared to similar size ground mounted system), but on balance of the space constraints within the EBC boundary, it appears to be a good opportunity to get additional land use from these areas.

Carport PV presents opportunities to sell generated power directly through EV charging, without the use of the grid and associated cost. EBC may wish to consider this in more detail at a later stage.

Figure 9: Example of a solar PV carport with steel support structure

2.3.1 Potential Carport PV locations

Car park size and location data was provided by EBC. AECOM understands that this data may not be exhaustive of all car parks in the EBC boundary, but the 33 detailed areas provide suitable basis for analysis for this report. Out of the 33 listed locations EBC owns 10 (2.3 Ha out of 21.5 Ha total) and therefore has some direct control over increasing renewable capacity of this type.

To be noted is that a planning application for carport sola PV was granted at the Eastbourne District General Hospital[6].

Figure 10 shows locations of large surface car parks assessed.

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[6] ref: 220618

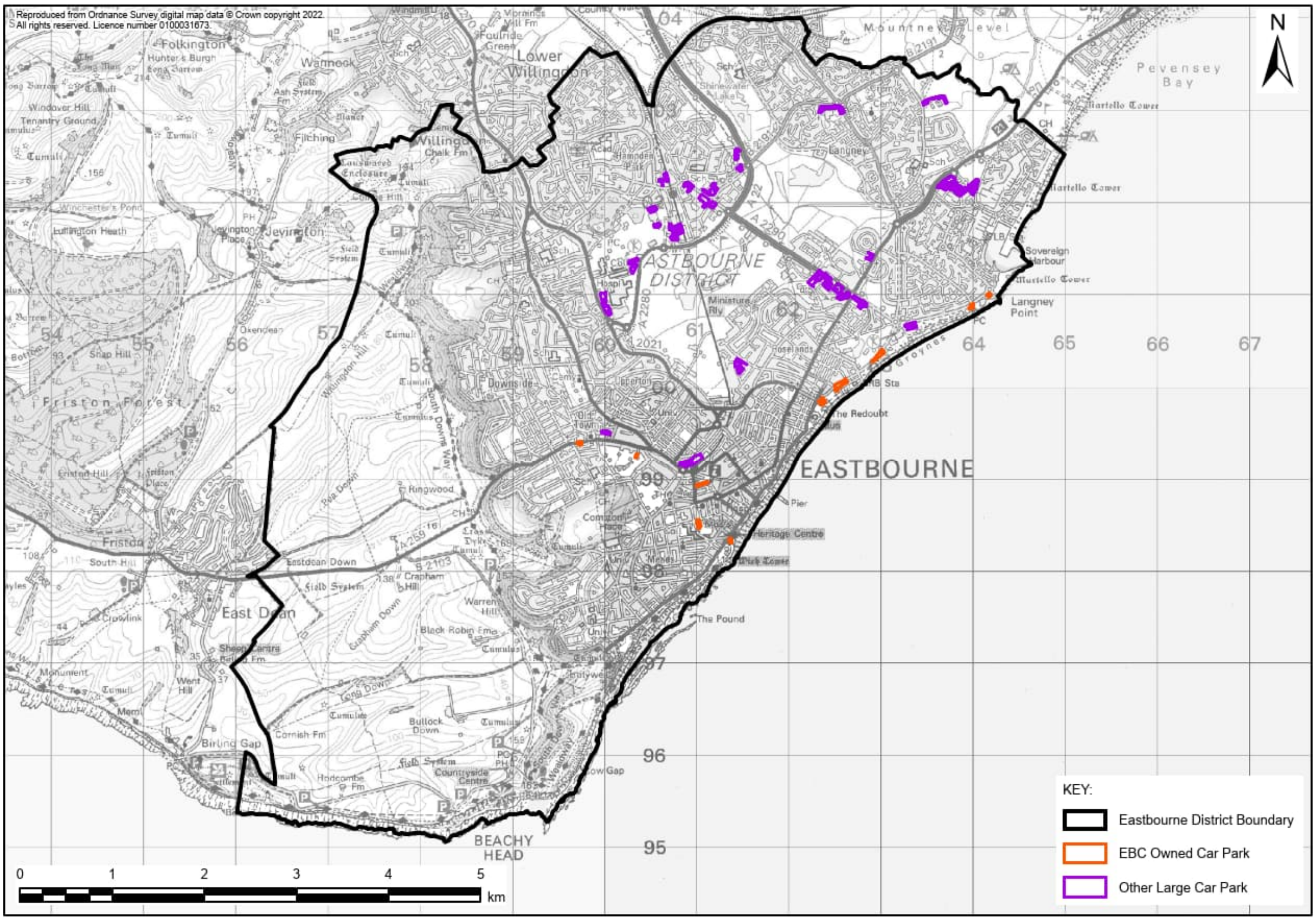

Figure 10: Carport PV opportunities in Eastbourne

2.3.2 Estimated Carport PV generation

Table 4 shows that estimated total carport PV capacity within the EBC boundary is 20.4 MWp. Coincidently this roughly equates to the total connection capacity currently available on the local distribution network (Section 3). EBC can directly influence the progress of 2.2 MWp of carport PV capacity on land under its ownership, with estimated total annual generation of 2,374 MWh. The total annual generation from carport PV is 22,492 MWh.

Table 4. Generation potential from carport PV

	EBC boundary total	EBC owned
Car park area (Ha)	21.5	2.3
Capacity estimate (MWp)	20.4	2.2
Yield estimate year 1 (MWh)	22,492	2,374
Yield estimate over 30 year lifespan (MWh)	637,072	67,228

The following assumptions were made in calculating generation potential from carport PV:

- 25 degree inclination of PV modules
- 45 degree average orientation of PV modules
- 0.4% annual degradation of PV modules
- No shading losses were calculated
- 950 kWp installed per Hectare (calculation shown in Appendix A)
- 14% system energy losses
- 30 year expected system lifespan

It should be noted that while the density of installed capacity (kWp/ha) of solar can be higher than that of ground mounted the generation density (kWh/ha/yr) of carports is likely to be lower due to higher shading losses, limitations on orientation (relative to the south) and sub-optimal tilt angels.

2.4 Roof Mounted Solar PV

In a roof-mounted PV system, modules are fixed directly onto a roof using rails in the case of pitched roofs, or a ballasted mounting solution for flat roofs. This often makes good use of an otherwise empty space and PV modules are sited up high, away from most shading. As there is little mounting kit needed for pitched roof systems, large commercial pitched roofs tend to have the lowest cost for installation.

2.4.1 Potential Roof Mounted PV locations

Solar PV can be mounted on most roofs, subject to listed building consent or permissions in conservation areas, as well as technical constraints such as shading and structural integrity. A large proportion of the EBC boundary is built up area, most suited to rooftop PV. Commercial and public buildings (i.e. non-domestic) with a footprint exceeding 50 m^2 within Eastbourne were assessed as they are opportunities with substantial PV capacity across a smaller number of buildings. There are 12 conservation areas in Eastbourne. Even though solar PV installations are not permitted development on the front of properties in these areas (i.e. permission must be granted), after careful consideration it was decided not to exclude these areas from analysis in this study. However, it should be noted that this presents a further constraint to provision of roof mounted PV.

Figure 11 shows all commercial buildings in Eastbourne with footprint > 50 m^2. The analysis does not exclude roofs that may already be hosting some PV.

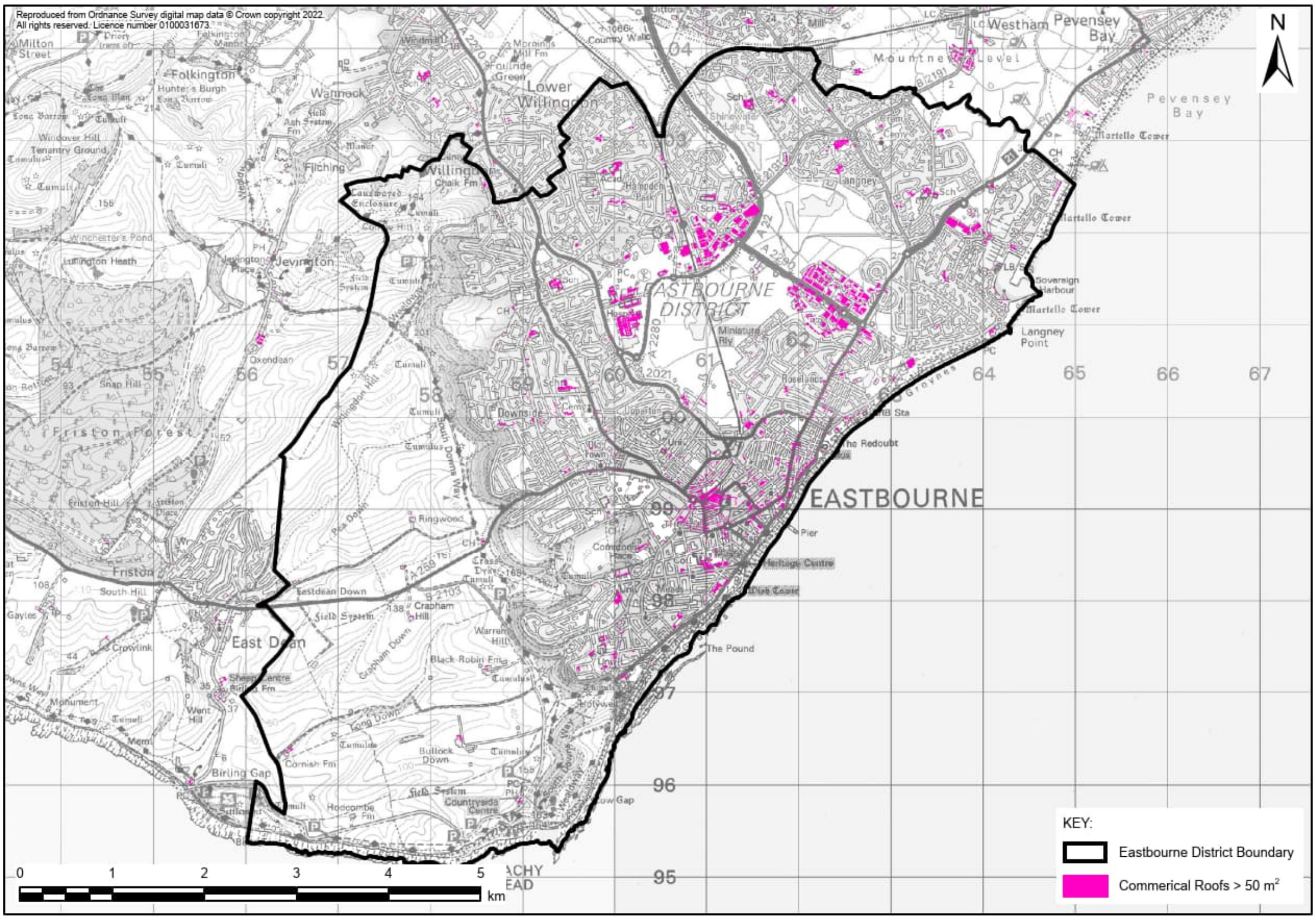

Figure 11: Roof-mounted PV opportunities on commercial buildings with footprint exceeding 50 m^2

2.4.2 Estimated Roof Mounted PV generation (non-domestic)

There are a total of 2,000 non-domestic buildings with a footprint exceeding 50 m^2 in Eastbourne. To approximate useable roof space, considering shading, unsuitable orientation, edge boundaries etc., a PV coverage factor of 0.3 was applied to the total footprint. Efficiency of PV modules varies, but 20% is commonly seen in the current marketplace. That level of efficiency provides 200 Wp/m^2, therefore a total capacity of 41.6 MWp across these selected commercial buildings. A yield calculation was performed in open source software PV GIS, resulting in a forecasted generation of 44.4 GWh in year 1 (Table 5).

Table 5. Generation potential from PV on non-domestic buildings

Total usable roof space (m^2)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30 year lifespan (MWh)
207,763	41.6	44,356	1,256,293

The following assumptions were made in calculating generation potential from roof-mounted PV:

- 25 degree inclination of PV modules
- 45 degree average orientation of PV modules
- 0.4% annual degradation of PV modules
- No shading losses were calculated
- 200 Wp capacity /m2
- 0.3 solar PV coverage factor
- 14% system energy losses
- 30 year expected system lifespan
- Minimum building footprint of 50 m^2

2.4.3 Estimated Roof Mounted PV generation - domestic

The calculation steps and assumptions from section 2.4.2 were extended to the domestic buildings within the EBC boundary. OS Mastermap lists 24,112 residential units in Eastbourne with footprint over 50 m^2. The estimated PV capacity for all of these buildings is 146 MWp, providing a yield of 156 GWh in the first year of operation.

Table 6. Generation potential from PV on domestic buildings

Total usable roof space (m^2)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30 year lifespan (MWh)
730,594	146	155,975	4,417,723

It is to be considered that most domestic properties have a single phase supply which can typically accommodate a maximum of 4 kWp PV capacity (3.6 kWac produced by inverter). That may lead to a reduction of the above estimated figures. If the detailed 24,112 properties can host 4kWp each that would give a capacity of 96 MWp with annual generation of 103 GWh. However, facilities such as care homes are included here which are an example of a building type likely to be capable of hosting larger PV systems.

Domestic solar PV has wider benefits in terms of local supply chain, reducing bills and engaging people in net zero transition. EBC could consider retrofitting PV onto social housing in its ownership. Another suggestion would be to create a bulk solar buying club, a scheme where many homeowners bundle their PV requirements together in order to achieve economy of scale and a reduced install price to each individual. Examples of these are active across the country[7]. AECOM understands that EBC has supported a similar scheme called ‘Solar together East Sussex’[8]; to date there has not been sufficient interest from the public to justify an auction round.

2.5 Wind Turbine Generators

Wind turbine Generators (WTG’s) exist in various forms and sizes. The two main types are horizontal axis – and vertical axis wind turbines, both of which can be installed at the domestic and commercial levels, or at grid-scale. The assessment of potential from domestic and commercial sites is outside the scope of this study, instead the focus is on large grid-scale deployment of horizontal axis WTG’s, illustrated in Figure 12. This turbine type is preferable due to higher energy conversion efficiencies.

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[7] https://solartogether.co.uk/wiltshire/home

[8] https://www.lewes-eastbourne.gov.uk/community/climate-change/solar-together/

Figure 12: Example of a wind farm consisting of horizontal axis wind turbine's

2.5.1 Potential Wind turbine locations

For development of WTG's land ideally should be flat or elevated terrain, however, many wind farms are built on undulating uplands. Preferably land should be free from obstructions to the wind flow. Obstructions cause the wind flow to become turbulent which increases the wear on the equipment. The main adverse effect on local residents is the sound created by air passing over the turbine blades. Therefore, a minimum distance of 500 m is required between WTG's and residential dwellings.

As previously discussed, most of the open land in the Eastbourne area is constrained and in terms of planning constraints there are no *ideal* locations to deploy WTG's. The Eastbourne Park and Langney Levels areas may be technically feasible areas for WTG's, including engineering solutions for flood risk but it may be challenging to obtain planning permission for construction on these flood zone 3 areas, as per the detail provided in section 2.1 Ground Mounted Solar PV.

Figure 13 illustrates four locations in Eastbourne Park and one in the Langney Levels which may be suitable. The locations are marked by red circles with radius of 500 m each to demonstrate appropriate distance from domestic dwellings. A minimum distance of 500 m is kept between WTG locations to reduce yield loss from wake effects (blocking of wind flow by upstream WTG's).

From a technical perspective the most suitable area for wind energy generation in Eastbourne is in the South Downs national park area on the western side, although this is outside of the local planning authority area for Eastbourne Borough Council. Figure 14 shows that the mean wind speed there is significantly greater than other areas. The prevailing wind direction is from the southwest so turbines placed here would mostly be free from wind flow obstruction (depending on height), due to proximity to the coast. Other locations are more likely to experience obstructed wind flow and turbulence caused by the buildings of the town. There are examples of existing WTG's in UK national parks[9].

Figure 13 shows 13 potential locations for wind turbines inside the national park, that avoid areas additionally constrained by Site of Special Scientific Interest (SSSI) and Heritage coast designations.

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[9] https://cairngorms.co.uk/wind-turbine-approved-in-the-national-park/

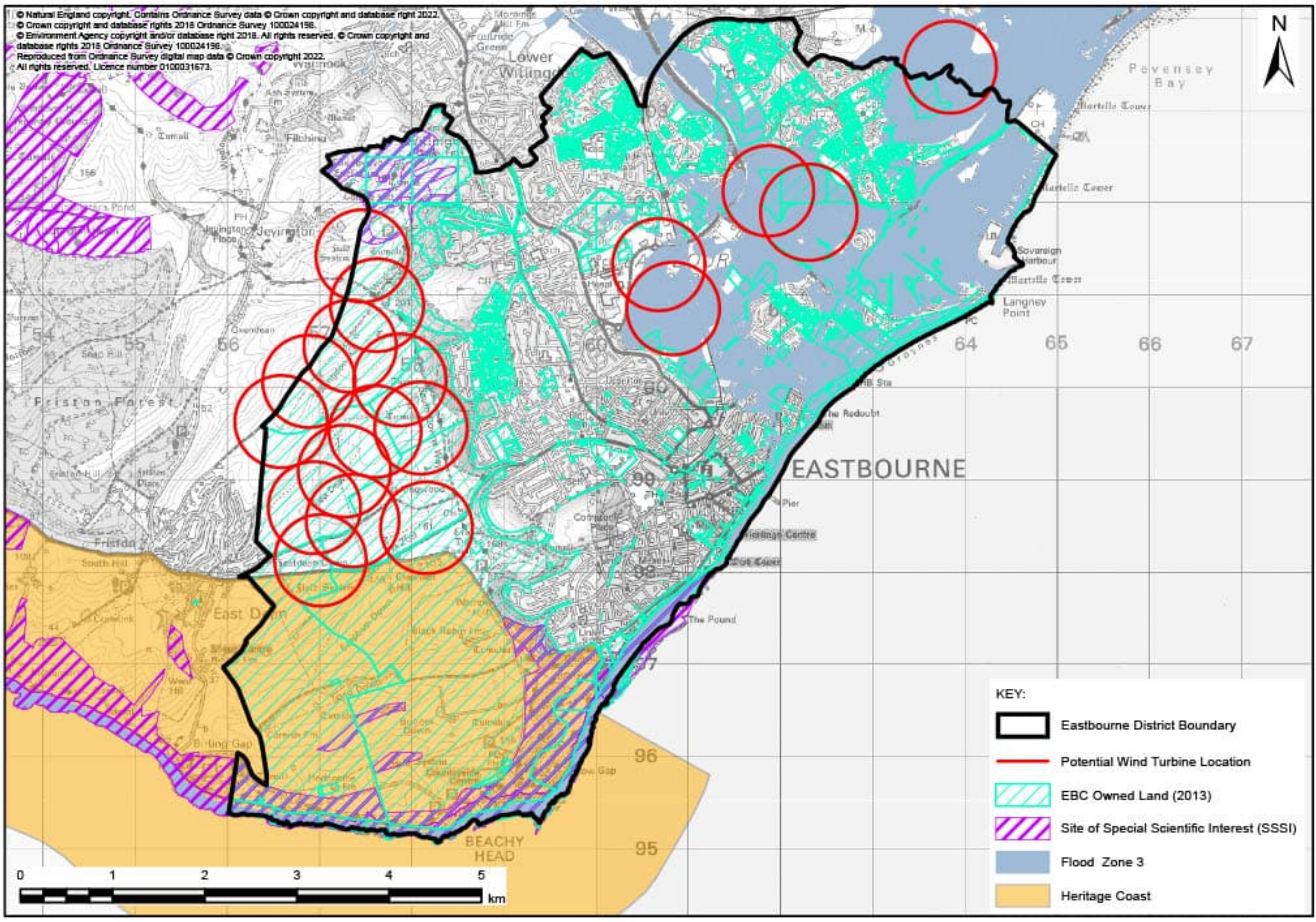
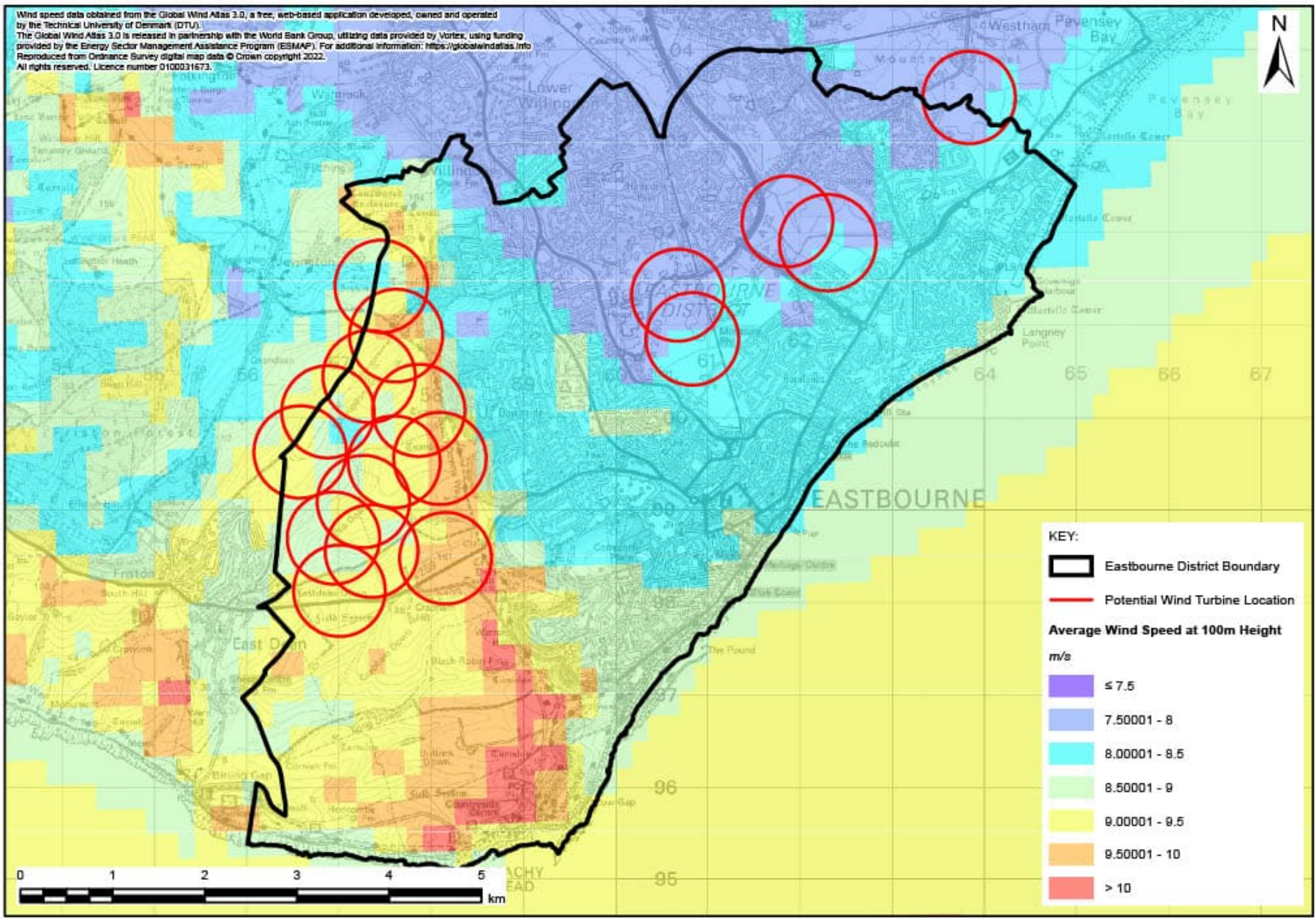


Figure 13: Potential locations for wind turbines. The red circles have a 500 m radius and illustrate minimum distance between turbine and residential areas.



Wind speed data obtained from the 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
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Figure 14: Potential wind turbine locations in relation to local wind resource at 100 m above ground

2.5.2 Estimated Generation from Wind Turbines

Potential wind energy yield was simulated in the energy modelling software HOMER. For this exercise a single Siemens 3.6 MW turbine with hub height of 120 m was selected. The wind climate and temperature were based on the NASA Prediction of Worldwide Energy Resource (POWER) database, monthly average wind speed at 50 m above earth's surface, spanning a 30-year period. An industry standard power law equation was applied to scale up the wind speeds realised at 120 m. Availability of wind data to this project is limited. The location of the best available data source is latitude 50.75, longitude 0.25, which is within the 'red' wind resource zone approximately 2 km southeast of the most southern wind turbine locations in Figure 14. Therefore, the resulting yield is most accurate for the turbines in the national park area and it should be considered that yields in other locations may be lower, or higher towers may be required to reach equivalent wind resource.

Table 7 shows the yield estimates for a single 3.6 MW turbine and scaled up to the 5 which could potentially be sited within the area considered in the EBC local plan . There is potential for a further 13 WTG's in the part of the South Downs National Park within the EBC area boundary. It is assumed that the WTG's would derate in capacity by 0.3% per year and have a lifespan of 20 years. The estimated capacity factor is 42.6%, which is above average for existing onshore wind turbines in southern England. The result is due to the high recorded resource data on which the simulation was based. The annual maximum annual yield from WTG's in Eastbourne is estimated to be 242 GWh.

Table 7: Generation potential from wind turbines

Wind turbines	Total Capacity (MW)	Year 1 yield (MWh)	Yield estimate over 20 year lifespan (MWh)
1	3.6	13,421	260,906
5 (EBC policy area)	18	67,105	1,304,529
13 (SDNP)	47	174,473	3,391,777
18 (Total potential)	65	241,578	4,696,308

The following assumptions were made in calculating generation potential from wind turbines:

- 120 m hub height
- 500 m min distance to domestic buildings – this will depend on specific turbine chosen and site-specific background noise
- 500 m min distance between individual wind turbines – this will depend on more detailed site analysis, the prevailing wind direction and the size (rotor diameter) of the wind turbines
- Weibull k factor of 2.0
- Power law exponent 0.14
- 0.3% annual derating of capacity
- No wake losses were modelled
- 20-year wind turbine lifespan

3. Grid connection capacity

In order to connect any type of renewable generator, a connection agreement must first be secured with the distribution network operator (DNO). An initial assessment of available grid connection capacity was undertaken by review of information available on the website of the DNO, UK Power Networks. It was found that the Eastbourne area is currently without major constraints for inverter based generation (solar PV) and synchronous generation (wind turbines). The total available 'Headroom' on the distribution network is currently 20.18 MW[10]. This means that availability of grid connections will likely not be a barrier to renewable energy installations up to that total capacity. To be noted is that availability of connection capacity is dynamic, it changes as new connections are agreed or grid upgrades are carried out.

At feasibility stage grid connection should be assessed on a site by site basis, through a grid study by the DNO, as the electrical infrastructure local to the generating equipment must be capable of handling the additional power. Where this is not the case the installation project bears the required upgrade costs. Grid connection costs can vary vastly depending on the effects that the generator may or may not have on the DNO's equipment. Early engagement with the DNO is recommended for any renewable energy project.

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[10] https://ukpowernetworks.opendatasoft.com/explore/dataset/dfes-network-headroom-report/custom/?q=Eastbourne&location=13,50.77463,0.26436&basemap=jawg.light

4. Summary

An assessment of renewable energy potential in Eastbourne has been carried out. The technologies assessed were solar PV and wind turbines. A GIS model was constructed and used to find and measure areas of opportunity. A summary of these opportunities is shown in Table 8. It highlights that the largest opportunity is wind turbines with a yearly generation potential of 242 GWh. This figure includes WTG's in the SDNP area which is outside of the EBC policy area.

Installation of utility-scale wind turbines in Eastbourne has potential to be controversial, however the energy yields are of significant scale in relation to local electricity consumption and it could be reasoned that it is an appropriate mitigation to the climate emergency. When viewing these figures, it should also be considered that wind energy has a different seasonal profile to solar PV with winter months typically being the strongest and generation also at night-time. The energy transition requires a mix of technologies and resources to reduce strain on the electricity networks and decrease required energy storage capacities.

The second largest opportunity is from roof-top PV when both domestic and non-domestic are considered with an annual yield potential of 200 GWh. It should be considered that this is a challenging area to achieve a mass roll out since there are a vast number of stakeholders.

Table 8: Generation potential from all identified opportunities

Technology type	Total Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over lifespan (MWh)
Ground-mounted solar PV, total of inside and outside flood zone 3	84.9 (4.1 outside flood zone 3)	95,004 (4,633 outside flood zone 3)	2,690,812 (131,216 outside flood zone 3)
Floating solar PV	4.3	4,919	139,328
Carport solar PV	20.4	22,492	637,072
Roof-mounted solar PV, total of non-domestic and domestic	660.6 (41.6 non-domestic)	705,579 (44,356 non-domestic)	19,984,280 (1,256,293 non-domestic)
Wind Turbines, total in EBC policy area including SDNP	65 (18 outside SDNP)	241,578 (67,105 outside SDNP)	4,696,308 (1,304,530 outside SDNP)
Total	835.2	1,069,572	28,420,800

A comparison can be drawn between the energy consumption figures shown in section 1 and the estimated renewable energy generation potential. The total demand for all fuels in 2019 was 1,387 GWh[11], which is of the same order of magnitude as the total yearly renewables yield of 1,070 GWh. That is not to say that Eastbourne should aim to become energy independent, but it does highlight the scale of deployment required to meet energy demand.

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[11] https://www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019

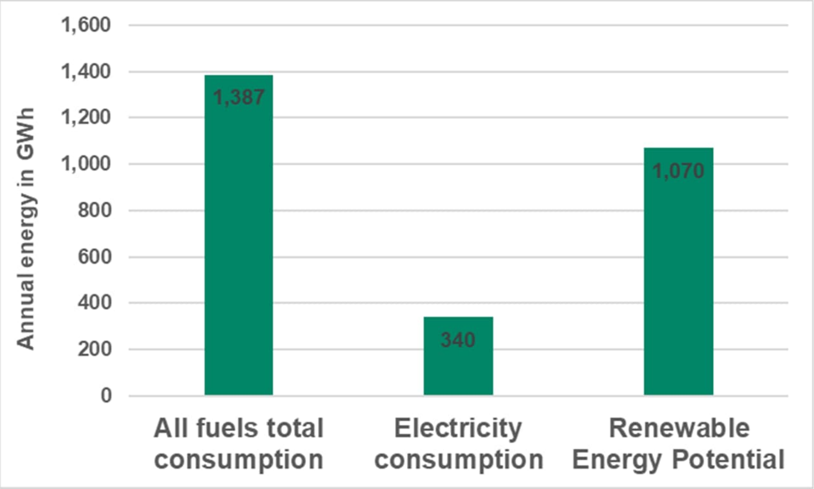

Figure 15: Eastbourne total fuel and electricity consumption in 2019 against estimated renewable energy potential

A high-level review of the available grid connection capacity showed that currently the area is unconstrained with 20.18 MW available on the distribution network. This allows for connection of renewable energy systems of significant size, but not the total of the opportunities discussed.

There are important details that the figures presented here do not take into account. For example, on-shore wind is currently the cheapest form of renewable generation and domestic solar PV is the most expensive to install of the PV applications tested. There is also no analysis into time of generation against demand, which becomes an important factor in net zero carbon scenarios, as any mismatch must be levelled via energy storage or offset.

It is recommended that EBC develop a renewable energy strategy to map out how the required renewable energy can be deployed in the available timeframe. Individual opportunities could be further developed and ranked. The Council could then directly or indirectly progress installation of ‘cherry picked’ schemes, such as ground-mounted PV connected by private-wire to the hospital.

Appendix A Carport PV footprint

The indicative layout drawing below shows how the PV density for carport PV of 950 kWp/Ha was arrived at. A Density ratio of 94.7 Wp/m^2 approximately equates to 950 kWp/Ha.

Red Line Boundary Area = 6458 m^2
Total No. of 400W panels = 1530
Total kWp = 612 kWp
Density Ratio = 94.7 Wp / m^2

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