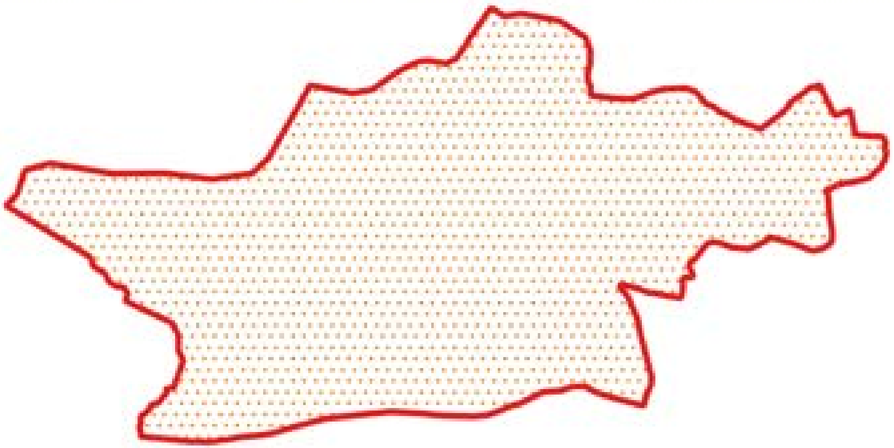
Georgeham Community Energy Opportunities Study



Renewable Georgeham – Today

How much wind and solar would be needed to meet Georgeham's current electricity needs?

We have estimated Georgeham's current electricity demand based on an average domestic energy demand profile for the UK*, and government data for the Parish's consumption in 2020. This analysis only considers residential electricity demand.

The resulting profile (Orange) can be used to determine how much PV or wind would be needed to meet the electricity demands of the parish.

Solar

Using satellite irradiance (sunlight) records to estimate solar generation, around 1.5MW of solar would be well suited to the energy demand of the parish.

Approximately **85%** of the power would be consumed locally, and **15%** would be exported. The solar PV plant would provide around **25%** of the parish's power over a year.

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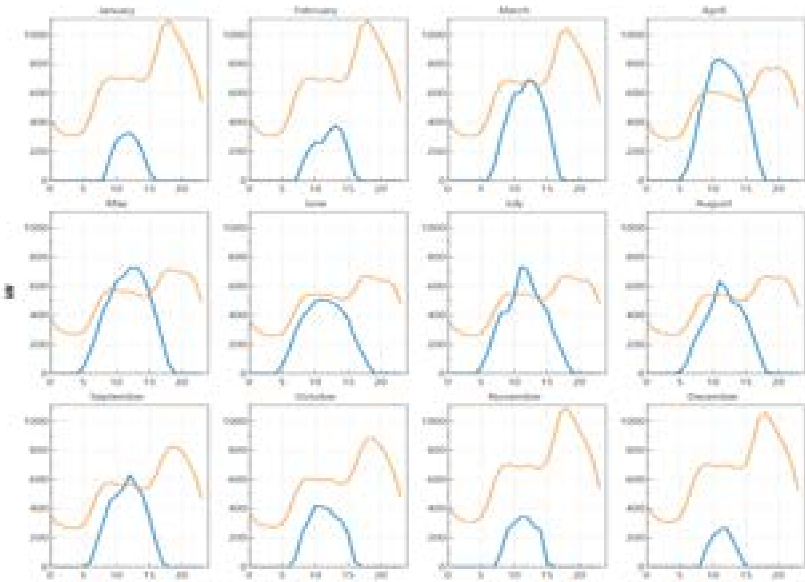
*Assumed domestic energy demand profile is winter focussed, this may not be true for Georgeham if there are many holiday homes

Assumed current domestic electricity demand for Georgeham

Estimated electricity demand: (MWh)	
LSOA electricity demand 2020	5,000



Georgeham's current average electricity demand profile for each month of the year (Orange) vs. Generation from a 1.5MW solar farm (Blue)

Renewable Georgeham – Today

Wind

A single 900kW wind turbine* would generate the equivalent of around 50% of Georgeham's electricity demand, and would export approximately 10% of its annual generation.

Wind turbines are typically a better fit for domestic energy demand as they generate during the evening and night, and generate more in winter months than summer months.

Greater 'self sufficiency' of renewable energy in the locality can be achieved by:

- **Oversizing renewables relative to local demand**
- **Combining Solar and Wind**
- **Energy storage solutions such as batteries**

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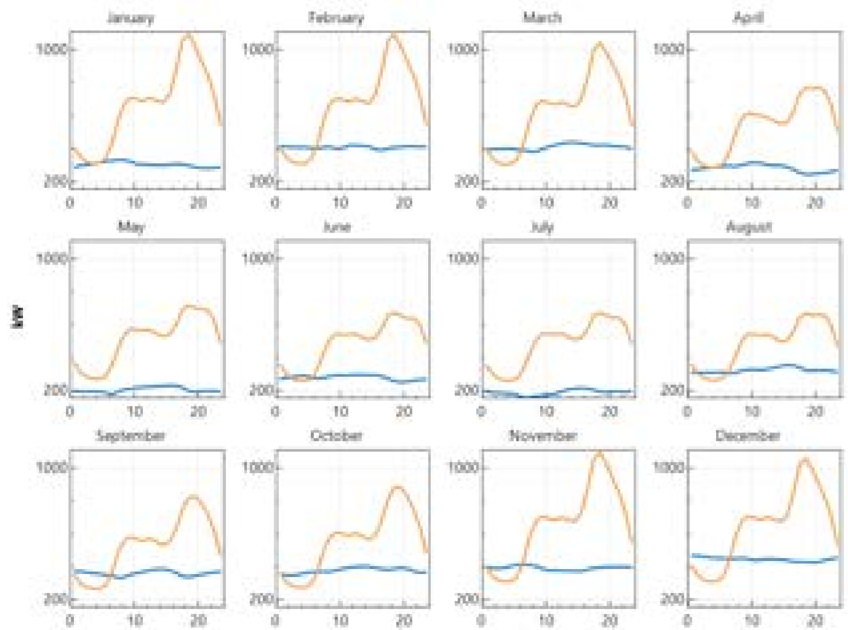
* 5 smaller 225kW wind turbines would be required to deliver an amount of power comparable to one 900kW model.

Assumed current domestic electricity demand for Georgeham

Estimated electricity demand: (MWh)	
LSOA electricity demand 2020	5,000
Domestic energy demand post retrofit	14,000



Georgeham's current average energy demand profile for each month of the year (Orange) vs. Generation from a 900kW/ 0.9MW wind turbine (Blue)

Renewable Georgeham – Future

How much wind and solar would be needed to meet Georgeham's future electricity needs?

With the conversion of Georgeham's existing (predominantly oil fired) central heating to heat pumps (ground or air source), and half of Georgeham's cars to electric vehicles, Georgeham's electricity demand will increase by around 400%.

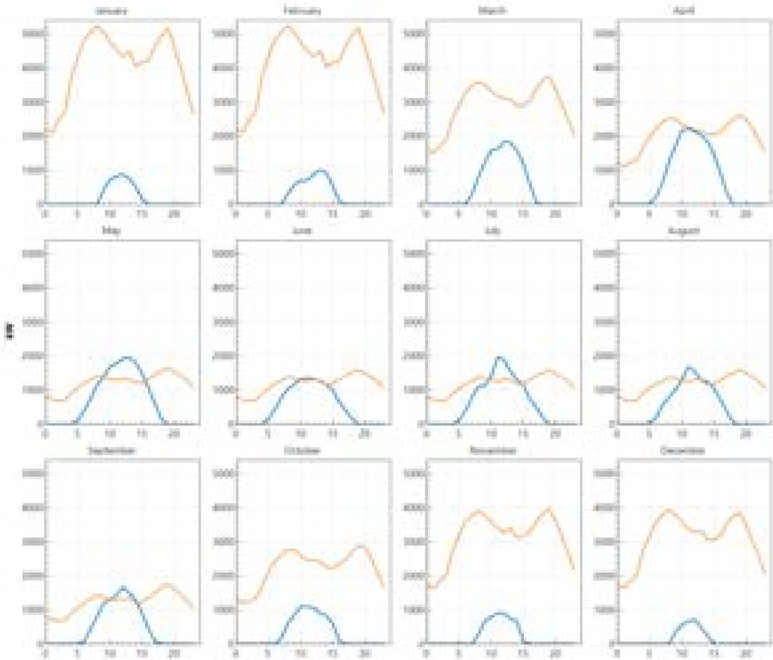
Solar

4MW of solar PV would supply approximately 15% of the parish's future increased power needs, with approx. 75% of the solar generation consumed locally.

The introduction of heat pumps significantly increases the winter electricity demand of the parish. The ability of solar to offset the parish's energy demand has reduced, as solar PV generation is predominantly in the summer months.

Table of assumed domestic energy demand for Georgeham in the future as vehicles and heating systems are electrified

Estimated electricity demand: (MWh)	
LSOA electricity demand 2020	5,000
Domestic energy demand post retrofit	14,000
Electricity demand for 50% change to EVs	1,000
Total domestic electricity demand	20,000



Georgeham's current average energy demand profile for each month of the year (Orange) vs. Generation from a 4MW solar farm (Blue)

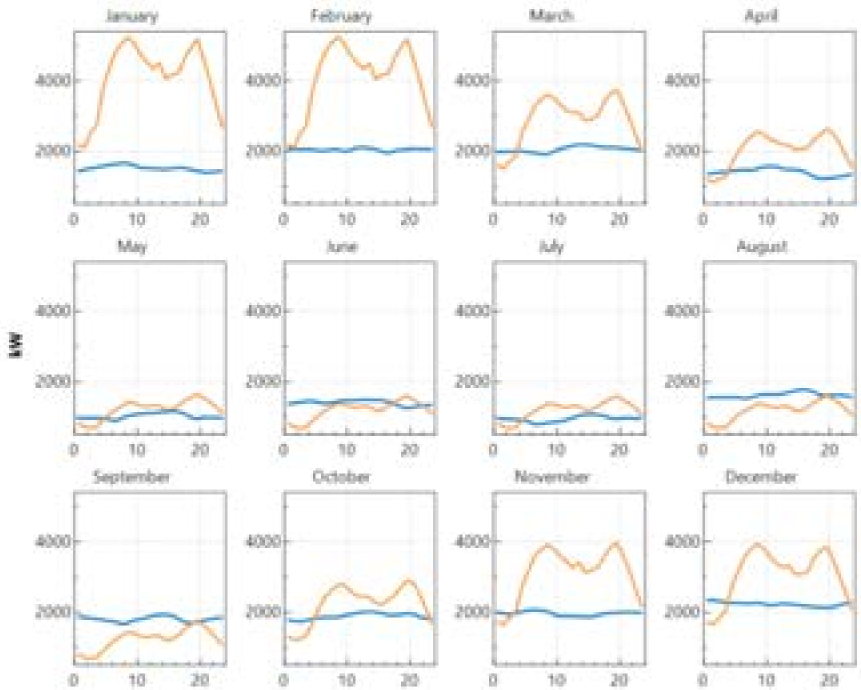
Renewable Georgeham – Future

Wind

Wind is a better fit to a heat-pump driven energy demand. Five 900kW wind turbines or twenty-four 225kW turbines would provide approximately **55%** of Georgeham's energy demand. **80%** of power generated would be consumed locally.

Table of assumed domestic energy demand for Georgeham in the future as vehicles and heating systems are electrified

Estimated electricity demand: (MWh)	
LSOA electricity demand 2020	5,000
Domestic energy demand post retrofit	14,000
Electricity demand for 50% change to EVs	1,000
Total domestic electricity demand	20,000



Georgeham's current average energy demand profile for each month of the year (Orange) vs. Generation from five 900kW wind turbines (Blue)

Scale illustration

1.5 MW of Solar – 5 acres

4 MW of Solar – 12 acres

EWT DW52 900kW Turbine - Hub height: 40-50 m

Distribution network constraints in North Devon

The most challenging factor in developing new renewable generation in the South-West is securing a viable grid connection with the Distribution Network Operator (DNO), NGED (National Grid Energy Distribution, formerly called Western Power Distribution).

Due to bottlenecks in the electricity network, severe limitations are being imposed on new solar PV connections to prevent operational limits being exceeded. We have been informed that new solar PV connections in North-Devon would be subject to curtailment levels of between 50-70% until the network is upgraded. We have been told that upgrades may happen as late as 2036.

Connections under 500kW are exempt from transmission-level constraints but are subject to distribution level constraints, the level of curtailment from which is likely to be driven by the amount of solar PV connected in a specific circuit

NGED do not curtail connections under 250kW as they are deemed too small to impact the network.

Transmission level grid constraints may be eased by network reform measures over the next few years including:

- A connections amnesty due in early 2023 to encourage developers to give up transmission connection offers they are incurring liabilities on but are unlikely to be able to use, as they do not have a viable site.
- Tougher milestones to retract connection offers from developments which are not progressing.
- Revisions to how batteries are considered in grid constraint modelling.
- Strategic planning and upgrades.

Possible solutions to grid constraints

Upgrades to the transmission network are critical to remove bottlenecks and enable new community energy projects in the South West. However, we have provided some information on potential alternative solutions below.

Co-locating solar farms with demand (Private Wire connections)

- Connecting new renewable energy projects to the grid in the same place as large energy users presents a partial solution to the large levels of curtailment on the grid, as only power exported to the grid is subject to curtailment.
- Generation must be connected 'behind-the-meter' via a 'private-wire' meaning an energy user must share a grid connection with a generator. This ensures that renewable energy is used locally before being exported.
- Holiday parks could be a good option for solar private wire connections in the Georgeham parish, as they have a large energy demand in the summer.
- Private wire solar projects must be close to both the source of demand, and the grid connection to minimise cabling costs.

Co-locating Batteries with Solar Connections

- Batteries can help avoid export curtailment by charging the solar energy during peak periods and discharging this later in the day.
- Batteries would be best used in conjunction with a private wire customer to maximise the solar PV used locally.
- Batteries represent a substantial additional capital cost, and the economics are still challenging for community-scale projects.

Potential Solar Sites - Search Criteria

The following criteria were used to identify potential sites for solar:

Grid Connection
Within 500m of an 11kV network line, to ensure that cabling costs are minimised

Land Suitability
Suitable land gradient and aspect (direction)
Agricultural land grading 3 or above
Outside of flood risk zone 3

Designations
*Outside of Areas of Outstanding Natural Beauty (AONB)**
Outside of designated areas of ecological importance
Outside areas of cultural heritage

The following slides show the progressive application of these criteria to arrive at potential sites. (The final designation of specific fields for solar have been excluded to preserve the privacy of the landowners.The criteria have been applied using publicly available data. No site visits have been made.)

*There are precedents for solar PV within AONB areas but Georgeham has sufficient land outside the AONB.

The North Devon Coast AONB has been excluded, although there are planning precedents for well screened sites within an AONB.

Areas of grade 2 land have been excluded. Note, land grade maps are indicative only; the actual land grade of a site may differ. Areas within flood risk zone 3 have been excluded.

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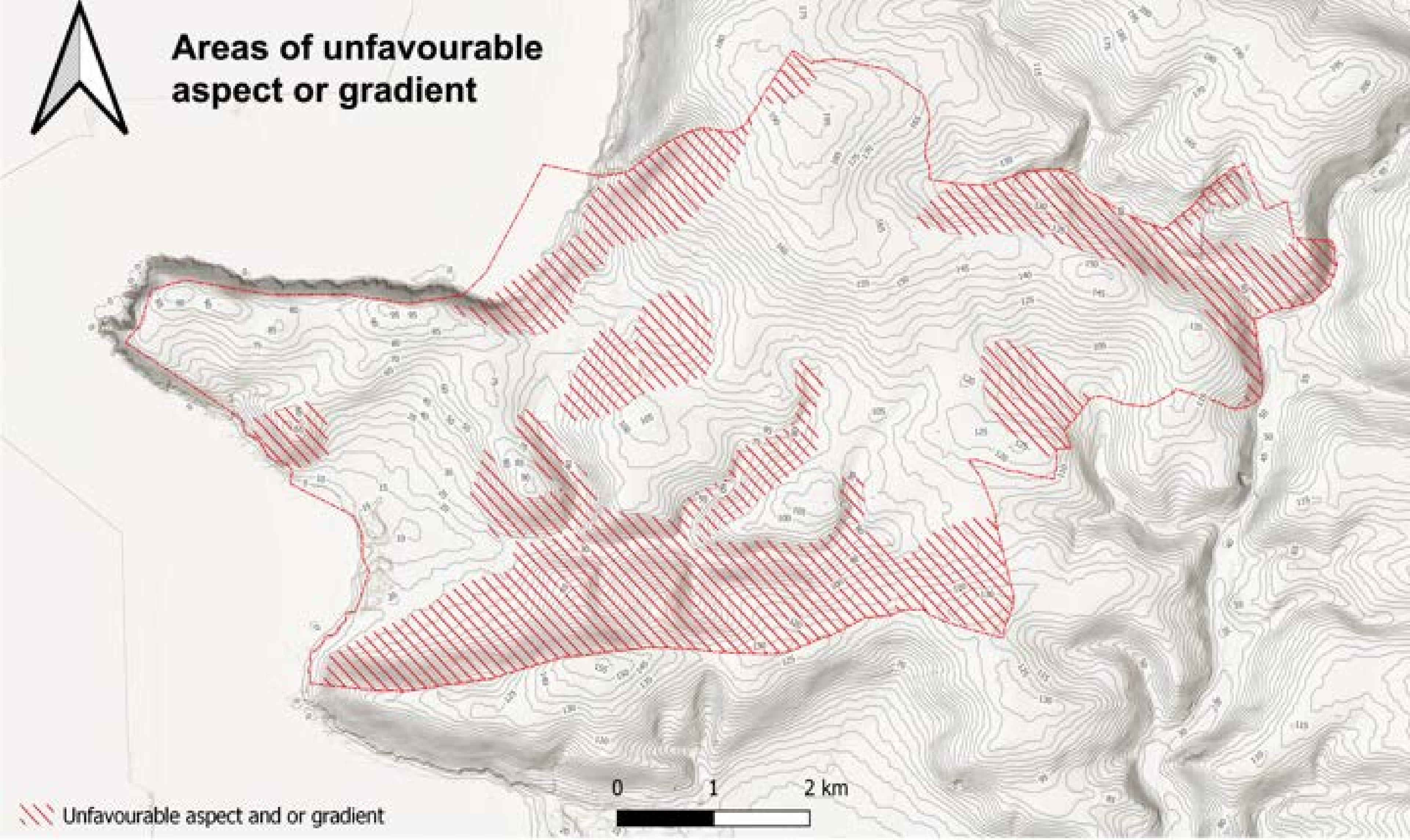
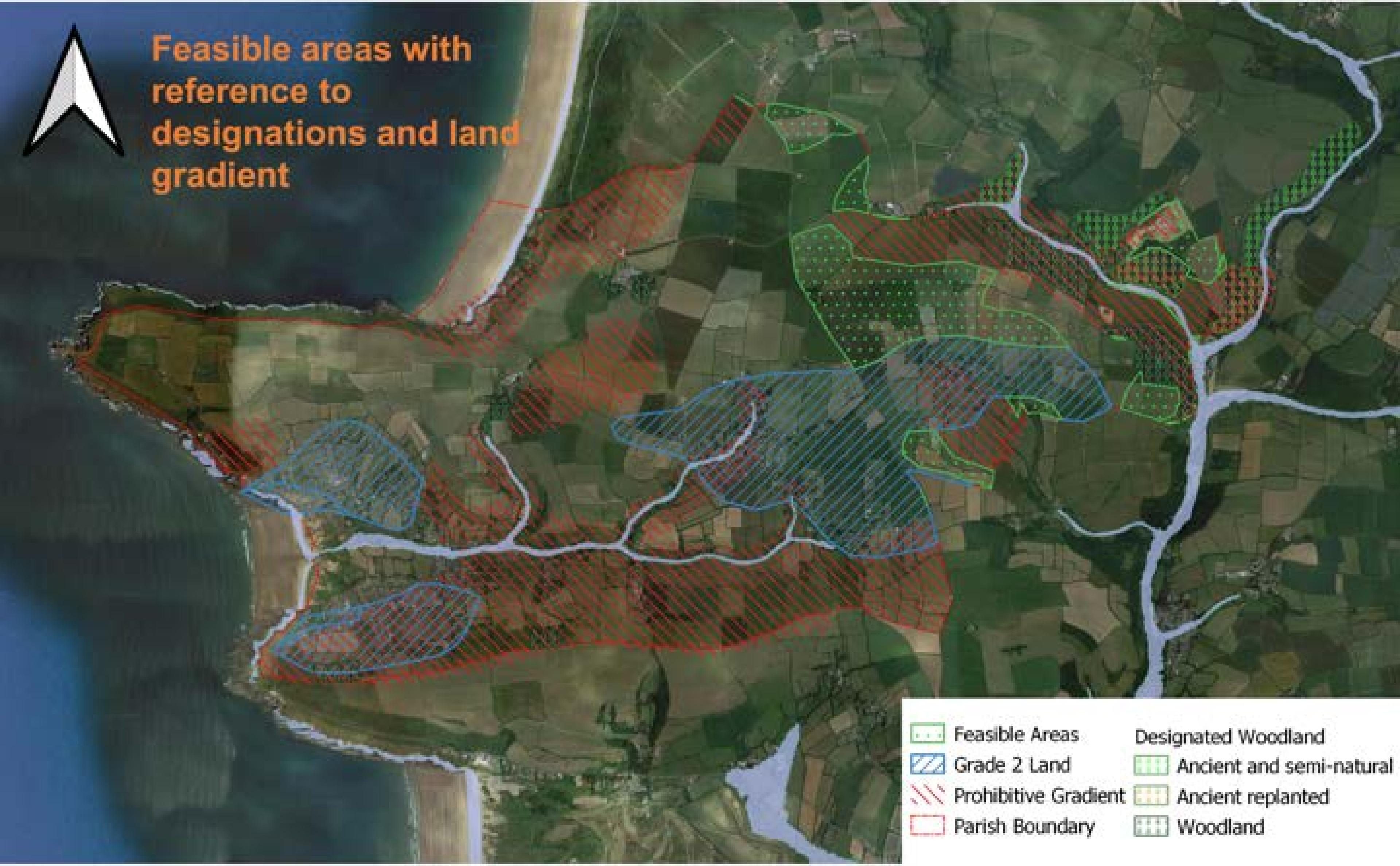


Areas with an aspect unfavourable to solar and wind and areas that would be too steep for development have been excluded.

500m Buffering on
11kV overhead lines
Feasible Area
11kV Lines
Parish Boundary


Feasible areas with reference to AONB and access to 11kv lines.
Feasible areas
AONB
Parish Boundary



Feasible areas with reference to designations and land gradient
Feasible Areas
Grade 2 Land
Prohibitive Gradient
Parish Boundary
Designated Woodland
Ancient and semi-natural
Ancient replanted
Woodland

Solar Car Parks

Selection Criteria

- Public car park
- Appropriate space
- Large customer base
- Minimal to no shading

Car Park	Ownership	Available Bays*
Putsborough	Putsborough Sands Ltd	70
Baggy Point	National Trust	60
Croyde Beach	Unknown	55
Down End	Downend Car Park Ltd	35

*Approximate Bays observed to be feasible for development

Solar car park installations are expensive and their viability will be dependent on high on-site consumption, e.g. from future EV charger demand.

- Solar carports are generally built for a minimum of six parking bays, with 1-2kW installed per parking bay.
- Solar carports cost £1,900 - £2,500 per kW installed.

Wind Site Search Criteria

The following criteria were used to identify sites for wind turbines:

Grid Connection

Within 500m of 11kV, to ensure that cabling costs are minimised

Land Suitability

>500m away from any housing
>60 meters away from hedgerows and trees
Suitable land gradient and aspect (direction)
Outside of flood risk zone 3

Designations

Outside of Areas of Outstanding Natural Beauty (AONB)
Outside of designated areas of ecological importance
Outside areas of cultural heritage

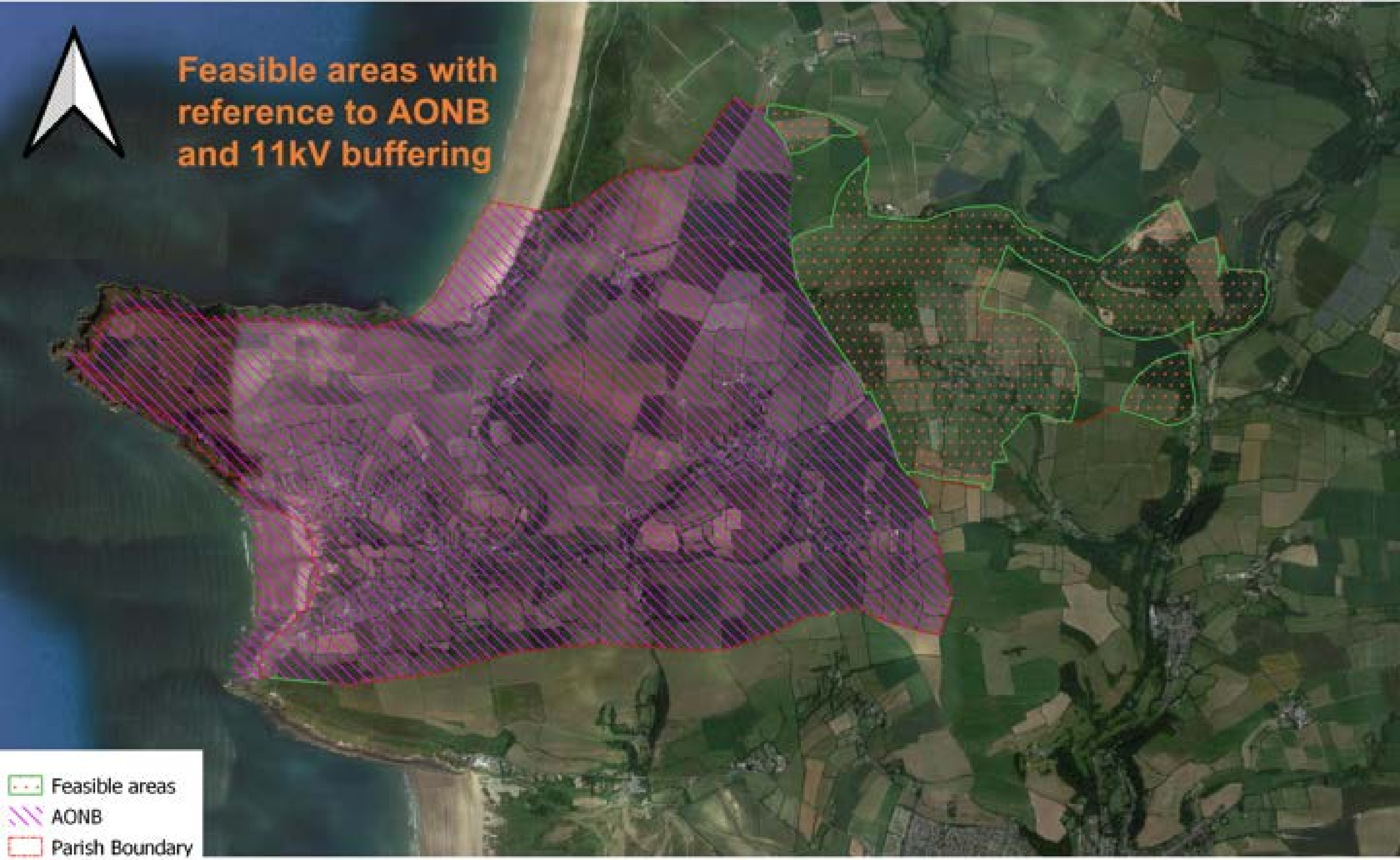
The following slides show the progressive application of these criteria to arrive at potential sites. (The final designation of specific sites for wind turbines have been excluded to preserve the privacy of the landowners.The criteria have been applied using publicly available data. No site visits have been made.)

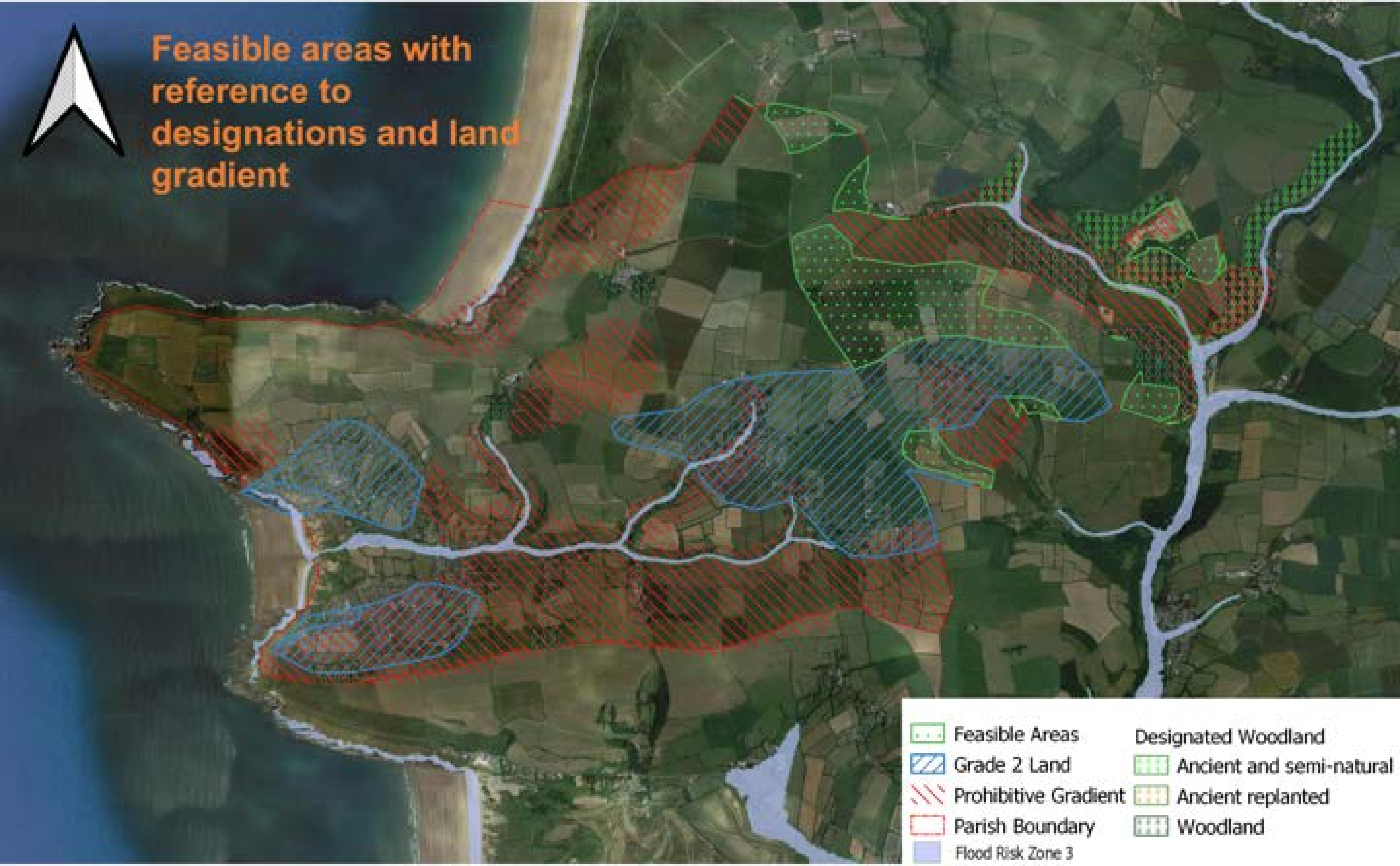
Wind Site Planning Permission

Obtaining planning permission for an onshore wind turbines is currently very difficult. With an effective ban in place since 2016. However in December the Government announced a consultation to relax the restrictions. Wind proposals will still need to be supported by the local community:

"Permission is predicated on satisfactorily addressing the planning impacts of onshore wind projects as identified by local communities, and on demonstrable local support for the scheme, learning from best practice and using new digital engagement techniques."


500m Buffering on
11kV overhead lines
Feasible Area
11kV Lines
Parish Boundary


Feasible areas with reference to AONB and 11kV buffering
Feasible areas
AONB
Parish Boundary


Feasible areas with reference to designations and land gradient
Feasible Areas
Grade 2 Land
Prohibitive Gradient
Parish Boundary
Flood Risk Zone 3
Designated Woodland
Ancient and semi-natural
Ancient replanted
Woodland

Braunton Aggregates Hedgerow Buffering

Following hedgerow and treeline buffering, no viable areas remain here. The site would have also been constrained in its wind resource due to the trees to the west

Application of site search criteria

It is clear from the previous slides that the suitable sites which meet all the search criteria for Solar PV and wind turbines lie in the area of the parish to the north of North Buckland village.

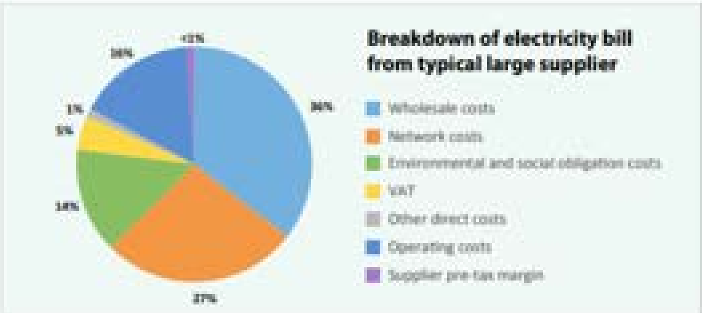
Specific fields for solar PV and sites for wind turbines have been excluded from this report to protect the privacy of landowners.

Local supply models – direct connection

Private Wire – a generator directly supplying a large energy user via a private wire

Private wire connections are mutually beneficial to generator and consumer as the power generated and used directly by the consumer is not subject to supply costs, which are typically 10-15p/kWh. This saving can be split between the generator and consumer.

Prior to the energy crisis, 2/3rds of the long-term average costs of an energy bill were associated with supply costs, which include levies for maintenance of the national and local electricity grid, the supplier's costs (metering, billing and margin), and government taxes and environmental levies.

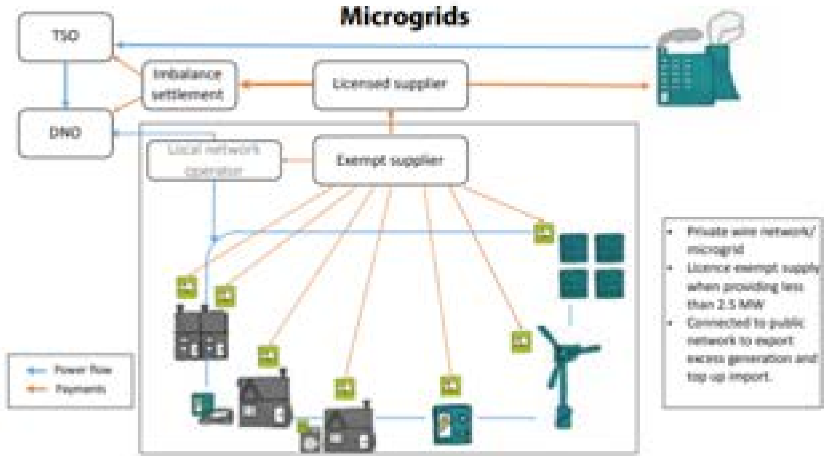


Source: Regen

Microgrid – a generator directly supplying a community via a private microgrid

A generator can supply up to 500 households with up to 2MW of power via a microgrid (a private wire network) and can be classed as a licence exempt supply. This makes it possible to cut out the standard use of system charges and other obligations that apply to licensed suppliers. As for the private wire project, this can mutually benefit generator and consumer.

This is only an option for new build developments, where the electricity distribution network is retained by the community.



DNO: Distribution Network Operator TSO: Transmission System Operator. Source: Regen

Local supply models – via the electricity network

The following local supply models are dependent on a connection to the electricity network and are therefore still restricted by grid constraints, although they could improve the economics of a small-scale community energy project whilst benefiting local consumers.

Local Generation Tariffs

Local generation tariffs enable local consumers to purchase power directly from a local generator via an electricity supplier. For example, the Energy Local 'energy club' model:

- Generator and consumer must be connected to the same sub-station
- Consumers require a smart meter and sign up to the Energy Local partner supplier (currently GEUK)
- Generation and consumption which is matched on a half hourly basis is supplied at the 'club rate' agreed between generator and consumer. Currently, supply costs are not charged on the matched supply which, like a private wire supply, creates a c.10-15p/kWh benefit which can be shared between the generator and the consumer
- Consumer top-up power is supplied on a time of use tariff basis
- Surplus generation is sold at market rates

Local supply models rely on a sufficient number of local consumers willing to sign up to consume the power generated.

Corporate PPA

A corporate power purchase agreement (CPPA) enables a generator to sell power to a large energy consumer (e.g. a local business or public sector body) via an electricity supplier.

The generator and consumer agree a 'wholesale' price for the power generated. The generator will be paid the wholesale price. The consumer will pay the wholesale price plus supply costs (c.10-15p/kWh), and possibly an additional charge for 'balancing and shaping' the differences between the generation and consumption profiles.

The generator will sell all the power generated to the consumer. The consumer will buy top up power from their electricity supplier.

The agreement gives both parties price certainty for the length of the PPA (e.g. 5 – 20 years).

Generic financial feasibility – power prices

- We have used the freely available GB Power Market Outlook Q4 2022 from energy consultants Cornwall Insight. The outlook is illustrative only and no reliance can be placed on it. Current and forward price projections are highly volatile.
- The projections show wholesale commodity prices.
- A generator will receive a discount to the wholesale price. The discount for solar may increase in future due to 'price cannibalisation' caused by a surplus of solar on the system.
- A consumer will pay the wholesale price + supply and non-commodity costs of c.£150/MWh (15p/kWh).
- For power supplied directly from a generator to a consumer via a sleeved PPA, the consumer will pay an additional £5-£15/MWh 'shaping and balancing' costs.


GB Power Market Outlook to 2030

This report provides an annual overview of trends for the GB Power Market out to 2030 using outputs from Cornwall Insight's latest Benchmark Power Curve (BPC) for the British Electricity Market covering England, Scotland and Wales. This publication is based on comprehensive market and asset-level power price modelling that delivers long-term power price forecasts, informed by industry-leading regulatory, market and policy expertise, and supplemented with direct access to trusted practitioners. All numbers/ figures are based on Cornwall Insight modelling except where explicitly referenced.

Figure 1: Power price forecasts - average price per fiscal year

Source: Cornwall Insight Benchmark Power Curve

Key Drivers

- High power prices in winter 2022 are due to significant risk premiums from uncertain Russian gas supply to the EU. This is further exacerbated by prolonged outages of French nuclear capacity.
- Prices drop in the 2020s as higher marginal cost coal-fired plants retire, and new offshore turbines are built to meet the government's 2030 wind generation target. The low marginal cost of wind turbines means that when they are generating, prices tend to fall.
- As we approach 2030, the deployment of low marginal cost generators is met by demand growth from the electrification of the economy, increasing production of green hydrogen and increased power exports to Europe, resulting in the levelling of prices above pre-pandemic levels.
  - Compared to our last report:
    - The whole gas forward curve has decreased, which makes periods of low renewable availability cheaper than the last report, lowering the power forward curve.
    - Lower prices also result from a decreased demand forecast as the macroeconomic outlook has changed.
  - For information up to 2050 and more in-depth analysis, our **GB Benchmark Power Curve Report** is available.

www.cornwall-insight.com

Illustrative sleeved PPA consumer price make-up

	Per MWh	Per kWh
Wholesale price paid to generator	£100	£0.10
Non-commodity costs	£150	£0.15
Balancing and shaping costs	£15	£0.02
Price paid by consumer	£265	£0.27

Generic solar financial feasibility – market background

From a low point in 2020, install costs for solar PV have been increasing due to a combination of factors, including:

- Component prices increasing due to supply chain shortages and commodity price increases.
- The pound dropping in value against the Euro and $.
- A shift in the UK market for solar farm construction. The larger UK solar EPC (engineer, procure and construct) firms are focussing on large-scale (30-50MW+) projects. Some of the key UK solar EPC firms have been acquired by solar funds and energy firms to be their in-house construction arm. Most of the European solar EPC firms have not returned to building in the UK post-Brexit. The smaller regional UK solar firms, for whom a 1MW ground mount scheme would be a big project, have full order books installing roof-top PV.

On top of this, many community energy projects face the additional challenge of being small scale.

IEA, Technology cost trends for solar PV modules, 2015-2021 [SOURCE]. Note the data is only for PV module prices which account for around 1/3 of the build cost of a solar array. Total build costs for small to medium-scale ground mount projects have increased as much as 50% over the last 2 years.

Generic solar financial feasibility – assumptions

	1MW AC / 1.2MW DC		500kW AC / 600kW DC	
	Current indicative	Poss future reduction	Current indicative	Poss future reduction
CAPEX				
Solar EPC / kWp	£850	£700	£900	£750
Solar EPC total	£1,020,000	£840,000	£540,000	£450,000
Customer sub-station	£140,000			
Grid connection	£100,000			
Ecological works	£25,000			
Dev and finance costs	£200,000	£192,000	£183,000	£180,000
Total	**£1,485,000**	**£1,297,000**	**£988,000**	**£895,000**
YIELD				
Yield kWh / KWp / year	1,071			
OPEX				
Scheduled and unscheduled O&M, metering and elec import	£14,920		£8,000	
Land rent	£4,150		£2,375	
Admin, accounts, asset management and insurance	£13,400		£12,500	
Total	**£32,470**		**£22,875**	
Other				
Inflation	2.50%			
Inverter replacement	£2,500/inverter replaced over years 7-20			
Community fund	£5,000			
Finance costs, assuming community share/bond with capital repaid over 20 years	6%	5%	6%	5%

- Assumptions are for a generic illustrative project.
- DC solar capacity is assumed to 20% higher than the AC grid capacity.
- Development and finance costs include £100k to cover land, planning, grid agreements and upfront finance raising costs. It also incudes a development finance cost of 50% of the 'at risk' investment, and a crowdfunding platform fee of 3% of capital raised.
- Current indicative build costs are based on discussions with EPC contractors with recent experience of building projects of this scale. However, we have seen firm quotes for larger projects significantly higher. Therefore, we consider the cost optimistic.
- Operating and finance costs are based on CfR benchmarks.

Generic solar financial feasibility – results

- The graph and tables show the 20 year Power Purchase Agreement (PPA) needed for a community energy project to break even – i.e. cover operating and finance costs and generate a community benefit surplus of £5,000/year.
- A 600kWp project, which is the scale required to avoid large transmission constraints, needs a significantly higher PPA than a 1MWp project.
- The PPA needed for both is below current market prices but well above the long-term price projections.
- The projects could be viable with a private wire/microgrid PPA, but there are no large energy consumers adjacent to the sites.
- The consumer price for a corporate PPA (or local supply model if supply charges are incurred) is too high for a long-term (10-20yr) PPA.
- Under optimistic assumptions, a project could possibly be viable under an Energy Local supply model if there was sufficient local demand for an Energy Club.

Source Cornwall Insight Benchmark Power Curve

Per kWh	Generator (wholesale) price	Supply costs	Consumer price
Private wire/microgrid	13-20p	NA	13-20p
Corporate PPA	13-20p	15p	28-35p
Local supply with supply costs	13-20p	15p	28-35p
Local supply without supply costs (e.g. Energy Local)	13-20p	NA	13-20p

AC (grid) capacity	DC (plant) capacity	EPC cost/kWp	Finance cost (20 yrs)	20 year PPA needed p/kWh
500kW	600kW stand alone	£900	6%	20p
500kW	600kW stand alone	£750	5%	18p
1000kW	1200kW stand alone	£850	6%	14.5p
1000kW	1200kW stand alone	£700	5%	13p

Generic wind financial feasibility

Two 'medium scale' wind turbine options have been used as the basis of the wind feasibility assessment:

1/ EWT 900kW turbine

- Tower height 40-50m
- Rotor diameter 54m
- Tip height 67-77m

2/ Refurbished Vestas V27/29 225kW or Endurance X29 225kW

- Tower height 30-40m
- Rotor diameter 27-29m
- Tip height 44-54m

EWT DW 54 / 900 kW Wind Turbine

Endurance X-29 225kW Wind Turbine

Generic wind financial feasibility – assumptions

	Endurance X29 225kW	EWT 900 kW
CAPEX		
Turbine supply and installation	£250,000	£920,000
Grid cost	£100,000	£100,000
Civil and elec BoP	Included in Turbine Supply	£500,000
Contingency	£35,000	£50,000
Development costs - pre consent	£100,000	£100,000
Owner's engineer	£20,000	£20,000
Development costs consent to construction finance (ex arrangement fees)	£100,000	£100,000
Community raise arrangement fee	£12,000	£63,000
Contingency and dev fee	£110,000	£220,000
Total	**£727,000**	**£2,070,000**
YIELD		
Assumed wind speed	7.5m/s	7.5m/s
Yield kWh / year	626,000	2,640,000
OPEX		
Import electricity	£270	£1,080
O&M Scheduled	£10,000	£26,000
Land rent	6% of revenue	6% of revenue
Audit and Accounts	£3,500	£3,500
Business Rates	-	£1,500
Insurance - asset	£3,375	£3,600
Investor admin	£2,000	£2,000
Management fees - SPV	£15,000	£25,000
Maintenance Reserve Amount	£10,000	£10,000
Total	**£44,000 + rent**	**£73,000 + rent**
Other		
Inflation	2.50%	2.50%
Community fund	£20,000	£20,000
Finance costs, assuming community share/bond with capital repaid over 20 years	7%	7%

- Assumptions are for a generic illustrative project.
- Wind speed is assumed to be 7.5m/s at hub height. NOABL database windspeeds for the area are 7.0 – 7.8m/s at 45m. Average wind speed has a significant impact on economics and needs to be confirmed through site-specific assessment.
- Development costs include a development finance cost of 50% of the 'at risk' investment, and a crowdfunding platform fee of 3% of capital raised.
- Indicative turbine supply and installation costs and O&M costs are based on discussions with turbine suppliers.
- Other operating costs and finance costs are based on CfR benchmarks.

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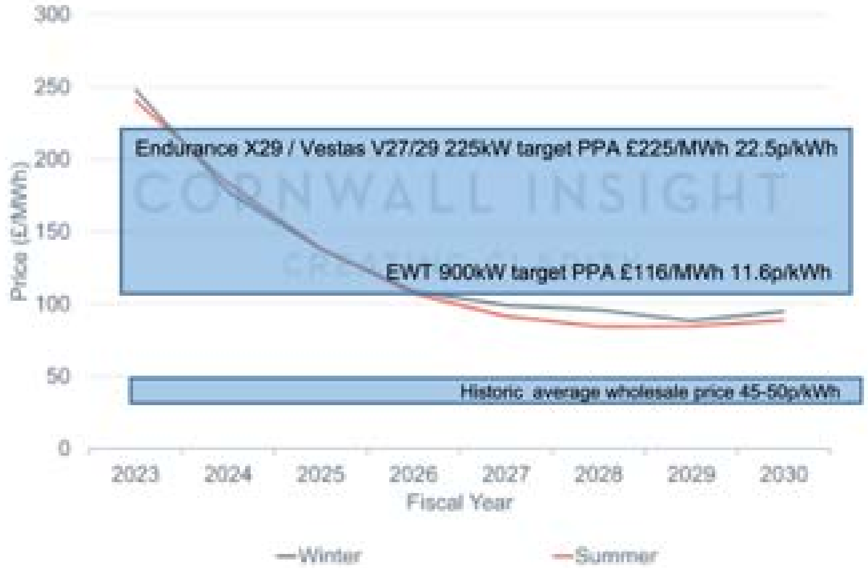
Generic wind financial feasibility – results

- The graph and table below shows the 20 year Power Purchase Agreement (PPA) needed for a community energy project to break even – i.e. cover operating and finance costs and generate a community benefit surplus of £20,000 per year.
- The turbine scenarios modelled require a PPA of £116 - £225 per MWh for 20 years in order to cover operating and finance costs and pay back capital.
- This is well above the long-term price projections but below current prices.
- At the lower end, the price could be viable for a 10-20yr corporate PPA (or local supply charges are incurred) in the current market.
- The PPA range needed could be low enough attract consumers to a be viable under an Energy Local supply model.
- The projects would be viable with a private wire/microgrid PPA, but there are no large energy consumers adjacent to the sites.



Source Cornwall Insight Benchmark Power Curve

Per kWh	Generator (wholesale) price	Supply costs	Consumer price
Private wire/microgrid	12-23p	NA	12-23p
Corporate PPA	12-23p	15p	27-38p
Local supply with supply costs	12-23p	15p	27-38p
Local supply without supply costs (e.g. Energy Local)	12-23p	NA	12-23p

Conclusions

- Georgeham's electricity demand is likely to increase from around 5,000MWh per year to around 20,000MWh per year with the shift to electricity for heating and transport.

- 4MW of PV could supply around 15% of Georgeham's increased future electricity consumption. There are sufficient suitable sites in the parish to accommodate this amount of PV. Several sites have been identified for solar PV that meet technical and planning requirements, and are in close proximity to 11kV lines. The best of the sites are 1C and 2C, on North Buckland Hill. However, grid constraints are currently a major challenge and limit the size of the project that can be developed to 500kW.

- Economics are challenging for 500kW – 1MW scale solar projects. They are only likely to be viable under a local supply model, such as Energy Local, if there was sufficient demand for an Energy Club.

- Wind is a better match to domestic energy demand. 5 x 900kW turbines or 24 x 225kW turbines could supply around 60% of Georgeham's increased future needs. There is not enough suitable land in the parish to accommodate this number of wind turbines. The wind constraints mapping illustrates the parish is largely constrained. Planning for the sites identified will be challenging even for a single turbine due to proximity to housing and visibility from the AONB . Access constraints have not been assessed. Access is likely be viable for the 225kW turbine but may not be for a 900kW turbine.

- A single wind turbine wind project could be economically viable, if planning and grid could be secured.

- There are a number of car parks within the Parish that are in close proximity to the distribution network, and could be considered for solar canopies. EV chargers will improve the economics of a solar car park but require high volumes of traffic in the summer.

Contact

Jake Burnyeat

Director, CfR CIC

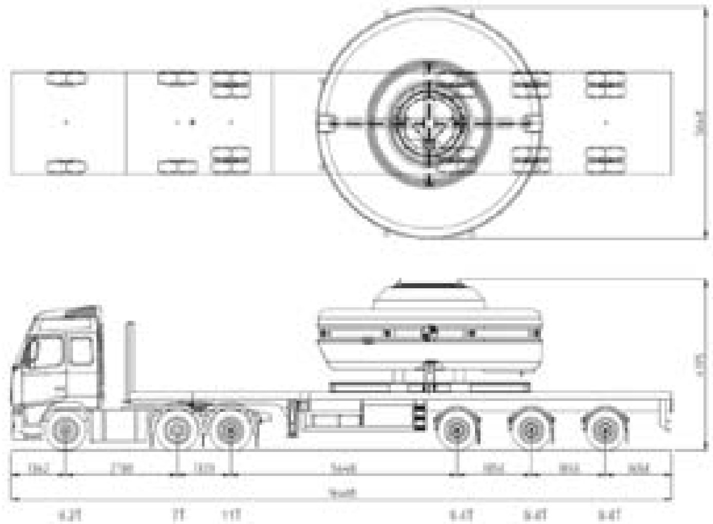
e. jake@cfrcic.co.uk
t. 01209 705 423

www.cfrcic.co.uk

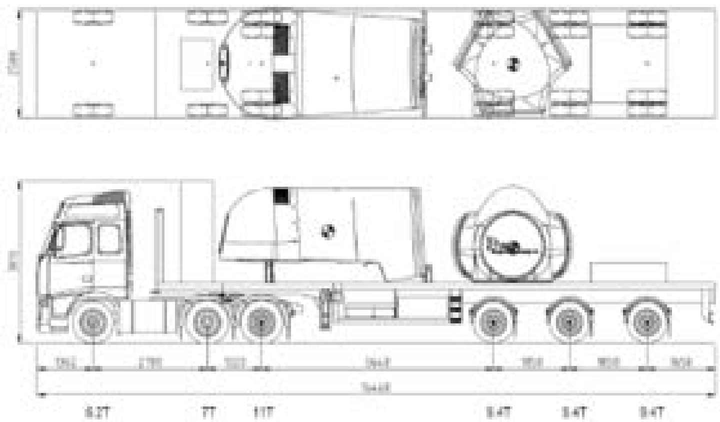
Appendix 1: Turbine Access

An access survey has not been performed for a small scale wind turbines delivery to the identified sites.

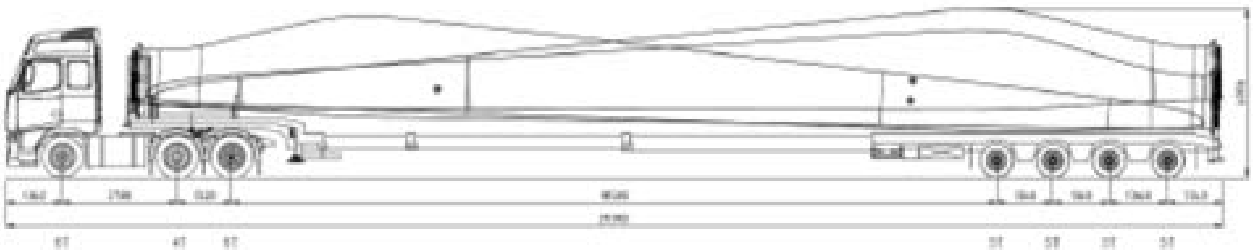
This is an important variable and would need to be considered if there were to be any further development. Please find below typical sizing of a small (<1MW) EWT turbine's components:



Generator



Nacelle and Hub



Turbine Blade (~25m)