Grid connection point

This representation follows on directly from a previous submission on the same issue for Deadline 2 (REP2-072, EN010109-001068) and should be read in conjunction with that document.

The consideration of alternative grid connection points is described in the examination libraries for Vanguard, Boreas and Hornsea Three, and diagrams from the relevant documents are attached. Grid connection offers for these three projects were apparently made and accepted concurrently in 2016.

In the case of Hornsea Three, written questions were issued by the Examining Authority at an early stage, and the response submitted to the examination by National Grid is reproduced below in full from document EN010080-001080 (Hornsea Three examination library, REP1-070).

Question Ref	Topic	Examining Authority's Question
Q1.1.11	Alternatives and design flexibility	The ES describes the locations considered for connecting the project to the national grid [APP-092] (paragraph 2.2.1.1). It states that NGET's decision making took into account technical, commercial, regulatory, environmental, and socio-economic aspects. Please provide an explanation of NGET's reasons for selecting the connection point at Norwich Main.
NGET Response		
When a wind farm developer wishes to connect to the national transmission network, there is a joint assessment to identify a cost-effective connection point. The regulatory framework requires the wind farm developer, acting as Offshore Transmission Owner, to work with National Grid to find an economic and efficient connection option. The wind farm developers look at offshore and onshore routeing considerations for the wind farm cables and National Grid as System Operator looks at the network reinforcements that may be needed, taking account of the capacity sought and timing of the connection. These assessments are carried out in line with the framework set by government and the Regulator. The assessment for the Ørsted Hornsea Three project concluded that the wind farm developer would cable below ground to the National Grid network, rather than National Grid extending its network of overhead lines across Norfolk to the coast. When Ørsted applied for the Hornsea Three connection, National Grid (as System Operator and the Transmission Owner) and Ørsted (the Developer) reviewed all feasible sites available for the connection between Bicker Fen and Eye. Please see Figure 2.1, Grid Connection and Indicative Route Options, in Ørsted's Environmental Statement Volume 4 Annex 4.1 for the sites considered at Bicker Fen, Weston Marsh, Walpole, Necton, Norwich Main and Eye. We then looked at the effect on the electricity network of connecting Hornsea 3 on the various locations to identify the extent of works required. The assessment looks at technical, commercial, regulatory, environmental, planning and deliverability aspects. These were considered for each individual option and then compared between the options. In addition to that, we also compared the overall cost between the options. Necton was discounted because when the assessment was made, Necton had been contracted as the connection point for a total of approximately 5.3GW. Connecting Hornsea Three to Necton would overload the current capacity there, requiring at least a further 5 bays extension and a new 400kV line. Taking into consideration all the above, Norwich Main was chosen as the preferred option due to it having the overall shortest export cable route, lower flood risk and lowest environmental risk.	

Q1.1.12	Alternatives and design flexibility	A relevant representation [RR-106] has suggested that Hornsea Project Three, rather than Norfolk Vanguard, should be connected to the national grid at Necton. The ES states that, during NGET's offer preparation for Hornsea Project Three, a connection offer made to another developer meant that the connection point at Necton reached capacity. The Necton option was therefore discounted from further consideration. Was NGET in the position of considering connection requests at Necton from more than one developer at the same time? If so, was NGET's assessment of the technical, commercial, regulatory, environmental, and socio-economic aspects carried out on a comparative basis? What were the reasons for offering a connection to another developer rather than Hornsea Project Three?
NGET Response		
Multiple connection applications will be assessed at the same time if the timing of the applications coincide with each other. This was not done for Ørsted Hornsea 3 and Vattenfall Norfolk Vanguard/Boreas because Ørsted applied after Vattenfall. For the above reason, there was no comparative assessment. When Ørsted Hornsea Three's application was received, we were finalising the Vattenfall Norfolk Vanguard and Boreas connections. Hence Hornsea Three was assessed behind Norfolk Vanguard.		

For Hornsea Three, an existing grid connection agreement was moved from Walpole to Norwich Main at the instigation of the applicant; whereas for Vanguard and Boreas, existing grid connection agreements were withdrawn by National Grid, leading to new grid connection offers at Necton. The history of these grid connection agreements is described in the relevant examination libraries.

For Triton Knoll, the offshore generation elements were consented separately from the export cable and onshore substation, and alternative grid connections were considered. This provides a precedent for a 'Split DCO' approach in which the offshore and onshore elements are consented separately. In the case of the Aquind interconnector, the grid connection point was central to the refusal of consent by the Secretary of State and, after Judicial Review, the project is now undergoing re-determination.

The reports of the Examining Authorities for each of these two projects can be found in the relevant examination libraries (Triton Knoll EN020019-004772; Aquind Interconnector EN020022-004425).

Observations

The following observations can be made:

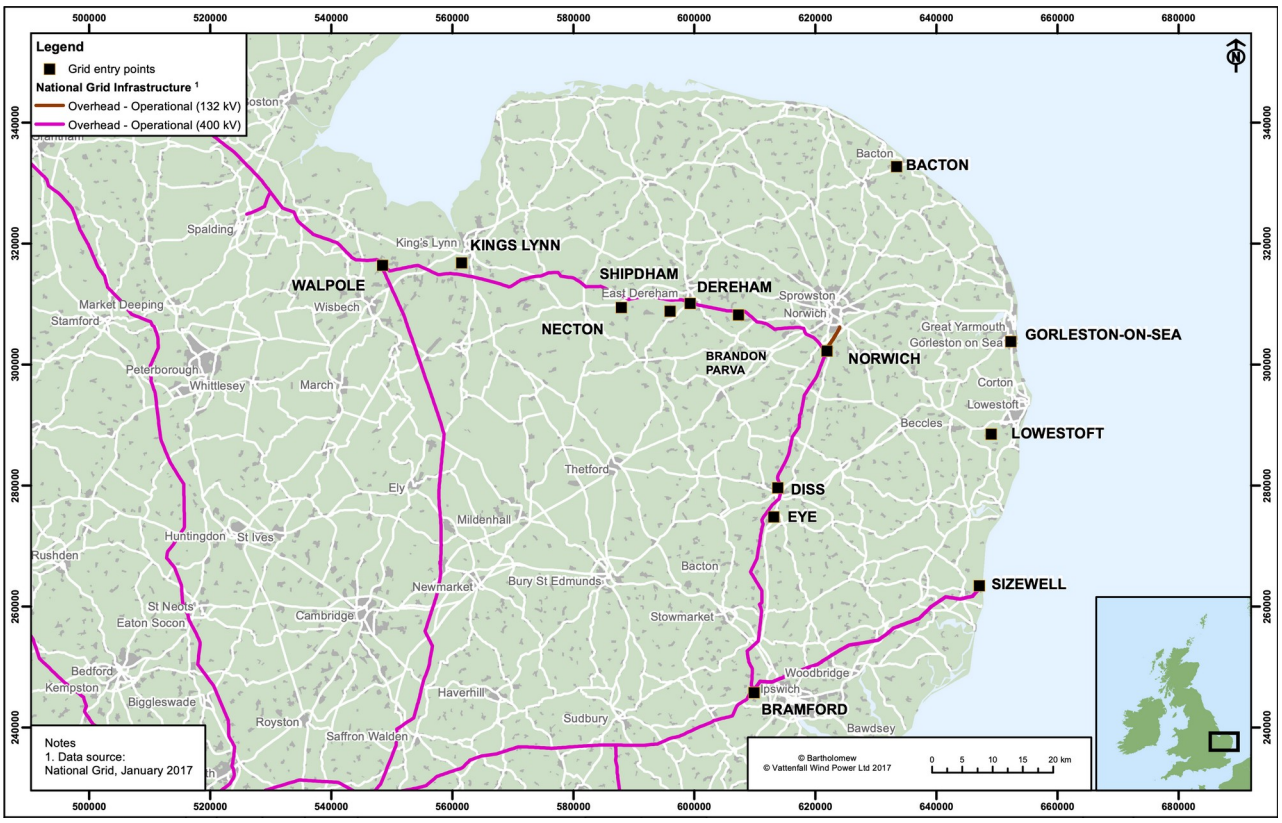
(a) It is normal practice to consider and describe alternative grid connection points.

(b) The issue of alternative grid connection points may influence the Secretary of State's decision.

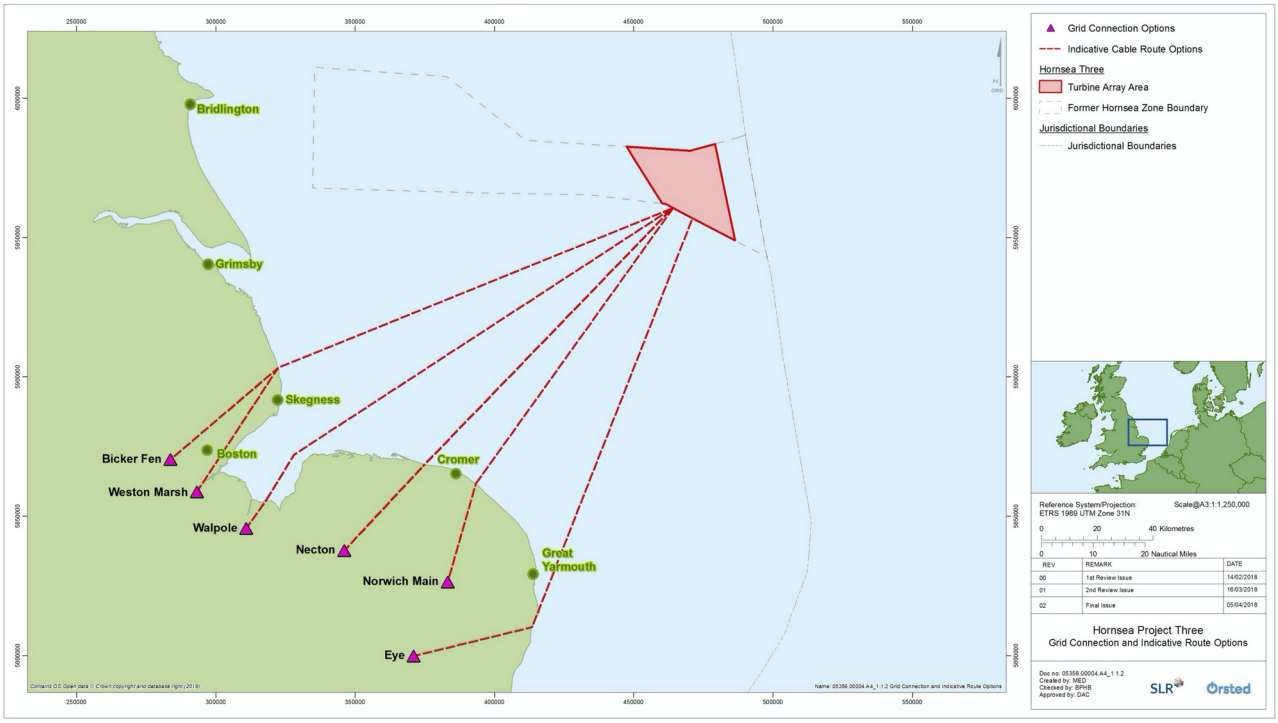
(c) The onward grid transmission capacity towards the main centre of demand is a relevant factor.

(d) Onward grid transmission capacity is effectively pre-booked by the first project in the queue.

(e) Consideration of the grid connection point may lead to a 'Split DCO', or refusal of consent.



Alternative onshore grid connection points for Norfolk Vanguard and Boreas



Alternative onshore grid connection points for Hornsea Project Three

Climate Change and Life Cycle Analysis

Summary

This representation further challenges the validity of the applicant's life cycle analysis as submitted to the examination in document APP-179 (EN010109-000408), in the context of the grid connection point, the available onward grid transmission capacity, and the question of the planning balance.

Discussion

This issue was raised in a written representation at Deadline 1 (REP1-174, EN010109-000790).

The applicant responded to this and other related points in Section 2.18 of its Comments on Written Representations, and also provided new information on the maximum project capacity (REP2-017, EN010109-001106, pages 144 to 161). The fulness and transparency of the response is appreciated.

The applicant makes clear that the existing grid connection offer is up to 720MW at Norwich Main. An increase of generation output up to 900MW is technically feasible, but cannot be accommodated at Norwich Main within the constraint of the existing grid transmission capacity towards London.

The output of the existing Dudgeon and Sheringham Shoal offshore wind farms is 720MW. The two Extension projects would increase this to either 720 + 720 = 1440MW, or 720 + 900 = 1620MW.

The applicant's response is consistent with the existing onward grid capacity from Norwich Main towards London of two circuits of 1500MW each, either of which may be unavailable at any time.

It would appear, however, that in the event of Vanguard, Boreas and Hornsea Three taking up a total of 6000MW at Necton and Norwich Main, there will be no onward grid capacity available for the Proposed Development. This view is supported by National Grid's explanation of the CION process for the connection of Hornsea Three at Norwich Main in that examination (EN010080-001080).

The applicant's response does not address the two further points raised in the earlier representation, namely an appropriate allowance for curtailment and constraint, and the use of life cycle analysis as a method for the comparison of alternatives. The life cycle analysis as submitted appears to be valid only in the event that Vanguard, Boreas and Hornsea Three do not take up their grid connections, or the Proposed Development is connected to the grid at a location where greater capacity is available.

The applicant has also identified the Planning Statement, which summarises the background to the planning balance, including recent climate change legislation (APP-285, EN010109-000213, p.52).

The references provided in the Planning Statement confirm that, in weighing the adverse impacts against the benefits, the Secretary of State should take account of the project's '*actual contribution*' to meeting the need for renewable energy infrastructure. (APP-285, EN010109-000213, p.34).

The 'actual contribution' of the Proposed Development will necessarily depend upon the available grid transmission capacity from Norwich Main towards the main centre of demand in London. If there is no grid capacity available, there can be no contribution to the need for energy infrastructure.

Under these circumstances, however, it appears that Contract for Difference payments and network constraint payments would still arise, leading to higher costs for the electricity consumer.

These comments are equally applicable to Vanguard, Boreas and Hornsea Three.

Onshore substation - Design

Design context

The onshore substation site is not far from an area of mature woodland known as Dunston Woods, where a general Tree Protection Order applies. Faden's map of Norfolk, surveyed between 1790 and 1794, suggests that this area was originally part of the estate of Dunston Hall, and prior to that time, Dunston Manor. There are clear views from the grounds of Dunston Hall towards the proposed site. Part of the village of Swainsthorpe lies to the south of the proposed substation site. Depending upon the height of the substation buildings, it is likely that the proposed substation will be clearly visible.

The overall height of the substation building should therefore be reduced as much as possible.

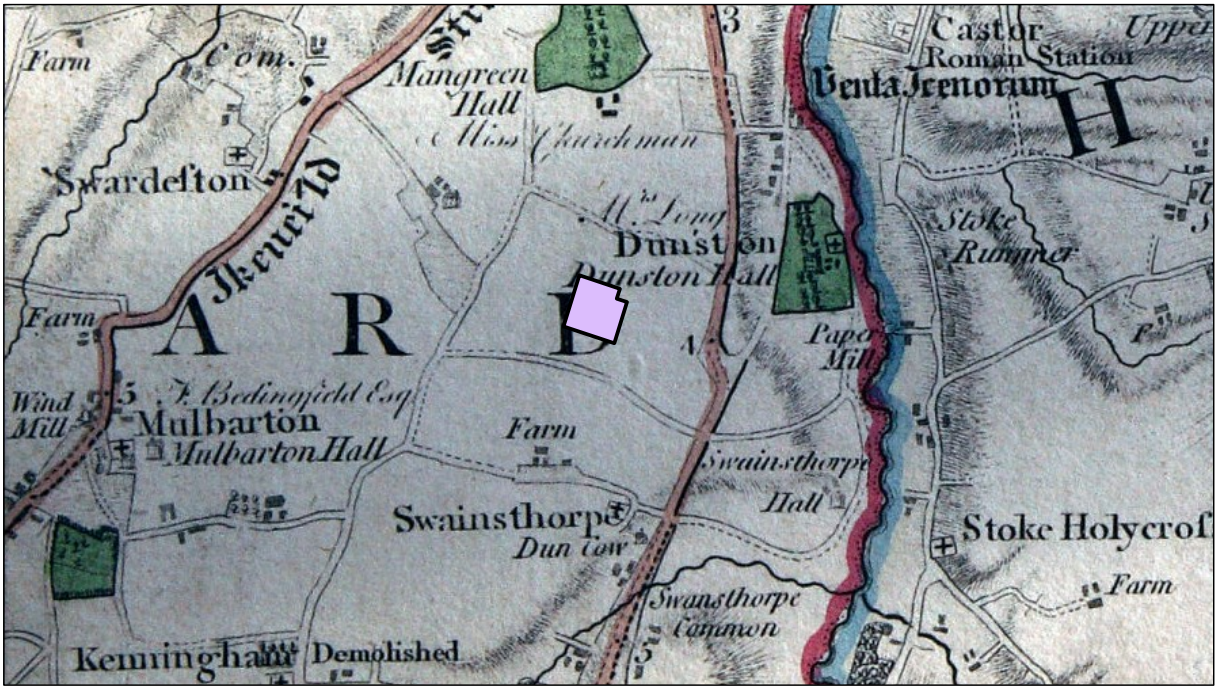
These local connections also provide a design context for the proposed onshore substation. Dunston Manor lies to the north-east of the National Grid substation. It is a brick structure forming part of a range of related buildings dating from the early 1700s. Dunston Hall lies to the east of the proposed onshore substation. It is a large red-brick structure in Elizabethan style, built in the 1860s. The area known locally as Dunston Park covers approximately 200 acres. It extends to the south of Dunston Hall and also lies directly to the east of the proposed onshore substation site.

A red brick structure with traditional detailing would emphasise these local connections.

Other local references

Gowthorpe Manor is an important medieval building in the area dating primarily from around 1520 and situated some distance to the west of the National Grid substation site.

Mangreen Hall, which dates from around 1700, sits to the north of the proposed substation site and is separated by the intervening National Grid substation. The Glebe Farmhouse in Swainsthorpe dates from the early 1600s. Details of all of the listed buildings in the area can be found at Historic England and in the Norfolk Heritage Explorer.



Source: Faden's Map of Norfolk, 1790–1794, with onshore substation added.

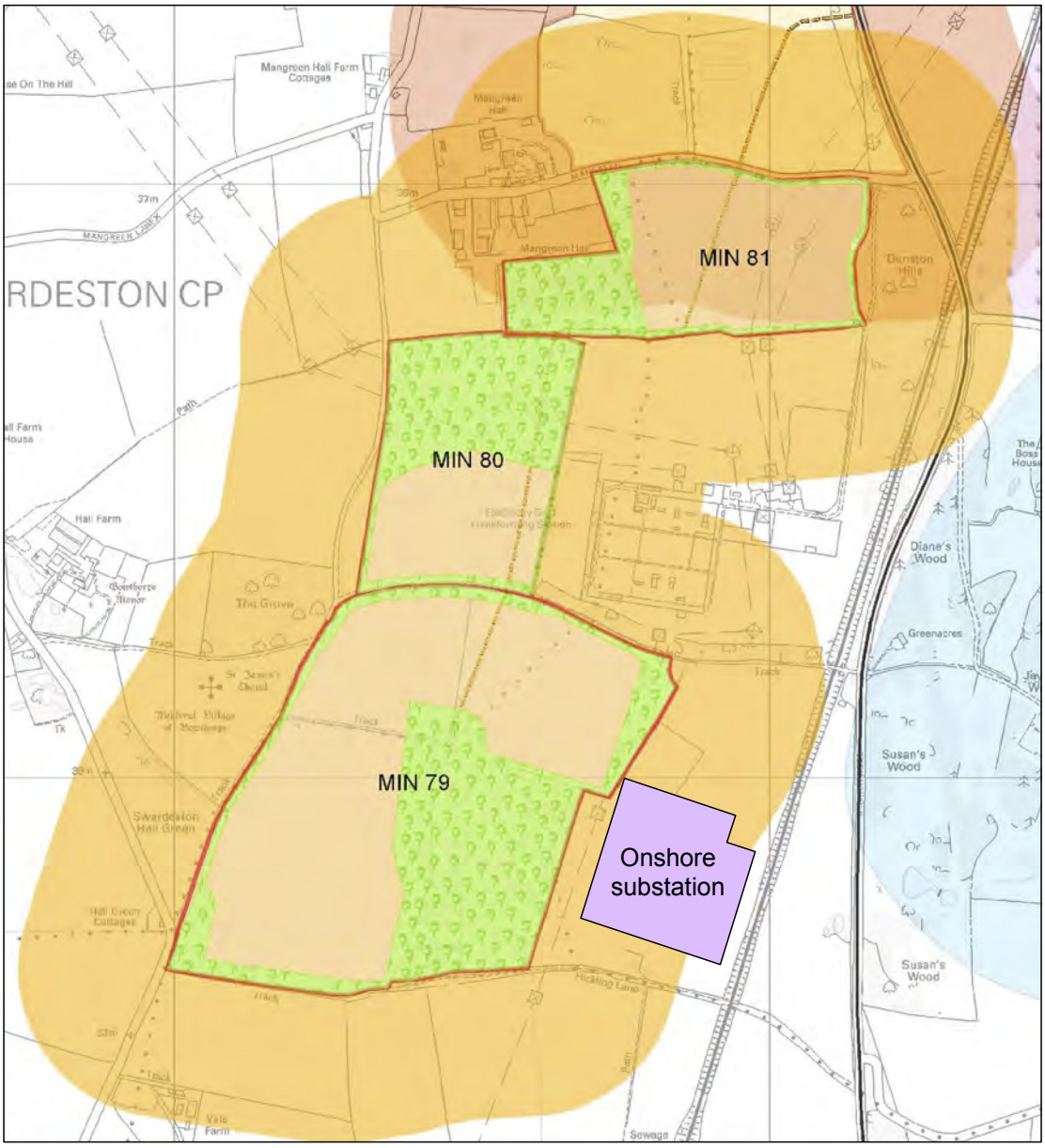
Onshore substation - Platform level

On Friday 24th March 2023 the second Accompanied Site Inspection (ASI 2) visited the site of the proposed onshore substation just to the south of the existing National Grid substation at Mangreen.

This site benefits from an existing access to the A140 trunk road, designed to accommodate regular HGV traffic in and out of the former Mangreen Quarry gravel pit. At its peak, the expected traffic volume was up to 76 vehicle movements per day. Mineral extraction has now ceased and restoration of the landform has been taking place for some years. Plans for expansion using mineral allocations MIN 79 and MIN 80, shown below, were abandoned in December 2018.

The proposed onshore substation site is very much smaller than the former gravel extraction areas.

The overall height of the substation should therefore be reduced by sending surplus material off site, in preference to raising the platform level and building height by the use of 'cut and fill' techniques.



Source: Norfolk County Council mineral allocations map, with onshore substation added.

Onshore substation - Cumulative effects

The diagram below shows the proposed layout of the Hornsea Three substation site at Swardeston. It is reproduced from the final version of the Statement of Common Ground between Hornsea Three and South Norfolk Council. The maximum height of the proposed development is 25m excluding lightning protection masts and it may or may not include industrial scale battery storage.

The cumulative effects of the onshore substation have not been agreed in the Statement of Common Ground between the applicant and South Norfolk Council (REP1-041, EN010109-000990, p.37).

Objection

1. The cumulative impact of the onshore substation for the Proposed Development in conjunction with the Hornsea Three site is unacceptable in terms of the following permanent effects:

(a) Change of landscape character

(b) Landscape and visual impact

(c) Noise during operation

(d) External lighting

2. In the event that industrial scale battery storage is constructed on the Hornsea Three site, there may be an additional indeterminate risk to human health and safety. There may also be a significant risk of contaminated groundwater from the Hornsea Three site passing through a gravel substratum under the onshore substation of the Proposed Development and reaching the protected groundwater catchment area that lies beneath Dunston Hall. Groundwater may also flow through the back-filled cable trenches from the Hornsea Three site towards the National Grid substation at Mangreen.

Source: Hornsea Three examination library, EN010080-001499, p.39.

Connection at Sutton Bridge

Summary

This representation describes an alternative grid connection at Sutton Bridge.

To avoid submitting information already before the examination, only significant differences from the original proposal are set out. These are described in as much detail as possible in order to clarify to what extent this alternative can deliver the same or greater benefits in the same timescale with lesser environmental impacts, and whether or not it is physically and commercially viable.

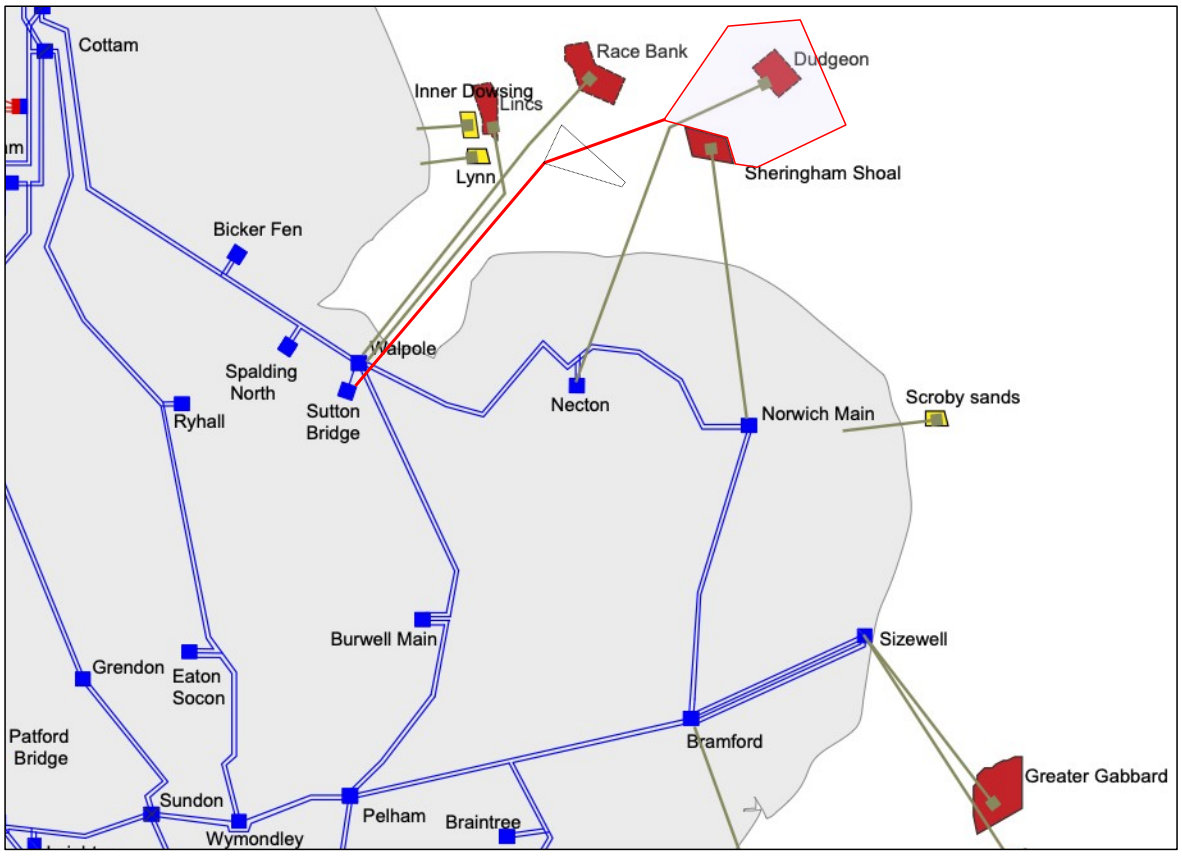
Design assumptions

The alternative grid connection is shown in outline below.

The applicant has explained that an output of 900MW is feasible and may be adopted post-consent without a material amendment of the DCO. Recognising the urgent need for renewable energy, this increased output level is therefore assumed. There are no other changes to the wind turbine arrays or the connection between the extension zones. One offshore platform may need to be re-positioned.

The export cable route extends westward towards Docking Shoal for a distance of about 35km and then turns south-west for a distance of about 50km to the onshore substation at Sutton Bridge. An existing pylon route is then used for the final connection to the National Grid substation at Walpole.

The 60km onshore cable route is practically eliminated. This removes nearly all the concerns raised by interested parties in relation to onshore impacts. A single-stage concurrent development scenario is also assumed, although the adoption of other multi-stage scenarios would have little or no impact.



Source: Electricity Ten Year Statement 2022, with Dudgeon and Sheringham Shoal Extension projects added.

Description

The export cable route from Sheringham Shoal to Docking Shoal is similar to earlier proposals for a Hornsea zone grid connection at Walpole and raises no new issues. The length of this first section is about 35km. Assuming offshore construction is approximately twice as expensive as underground construction onshore, the cost of this first section is broadly equivalent to the original 60km route from landfall at Weybourne to Norwich Main and does not affect physical or commercial viability.

From Docking Shoal, the export cable follows a route previously surveyed for the Race Bank and Docking Shoal offshore wind farms. This route was chosen after the comparison of several different alternatives and was found to be physically and commercially viable for the output of Race Bank.

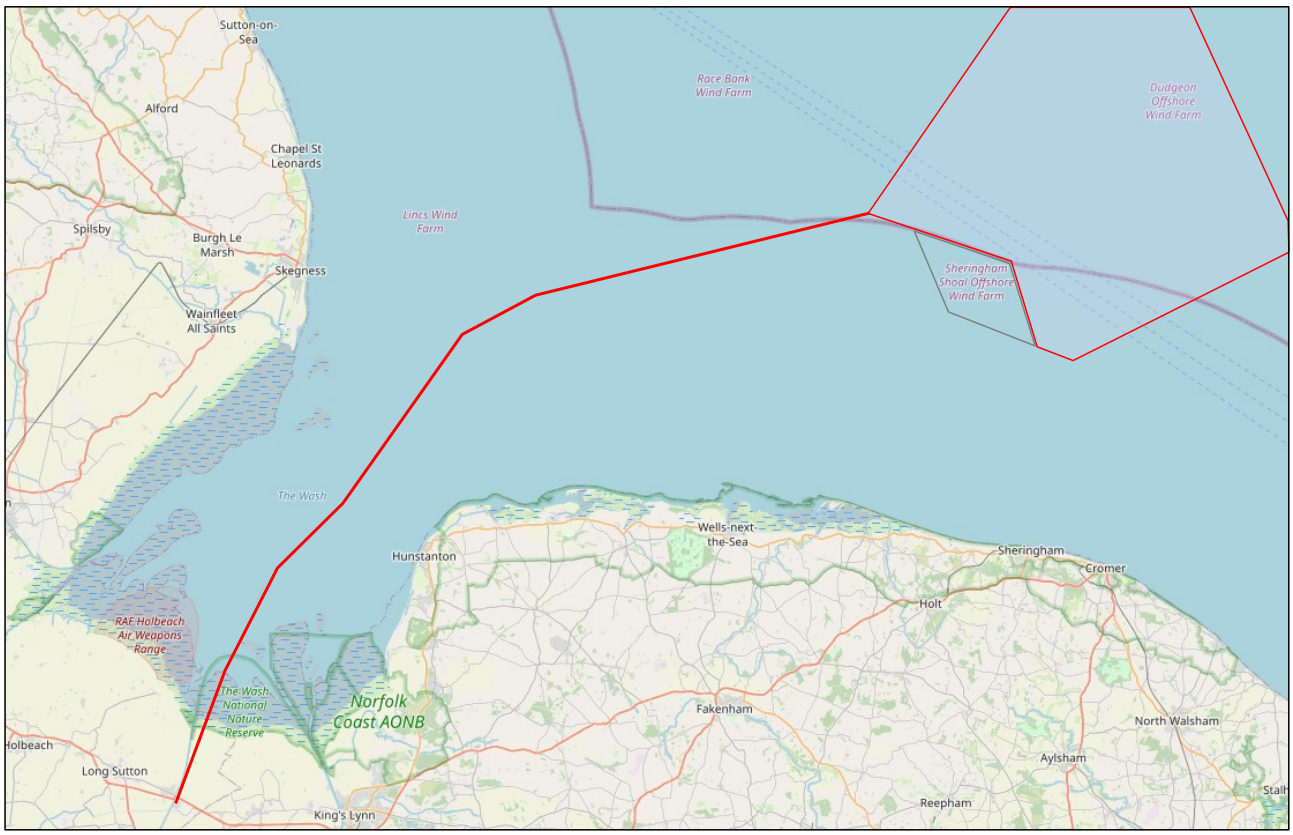
The cost and environmental challenge of a route through The Wash to the mouth of the River Nene may be no greater than the cost and environmental impact of the original 20km export cable route from Sheringham Shoal to Weybourne, which has additional onshore impacts near the landfall area.

Given the higher output level of 900MW, and previous experience of the installation and use of the export cables for the Lincs and Race Bank offshore wind farms, there is no reason to suppose that this second section of the export cable route is not physically or commercially viable. A final length of about 7km of underground onshore cable completes the route to Sutton Bridge as shown below.

The cost of the export cable is estimated to be broadly the same as for the application as submitted.

The onshore substation is constructed alongside the existing Sutton Bridge Power Station, which is currently mothballed. The successful construction of the power station building provides evidence of the feasibility of constructing the much smaller onshore substation on a directly adjoining site.

The capacity of the existing 3.85km pylon route from Sutton Bridge to the National Grid substation at Walpole is 1340MW. As an alternative to the use of the existing pylon route, a new underground cable could be installed from Sutton Bridge to Walpole following the route used for the Lincs and Race Bank offshore wind farms. This could allow the existing pylon route from Sutton Bridge to Walpole to be permanently removed, thus making a positive contribution to the local environment.



Onshore substation

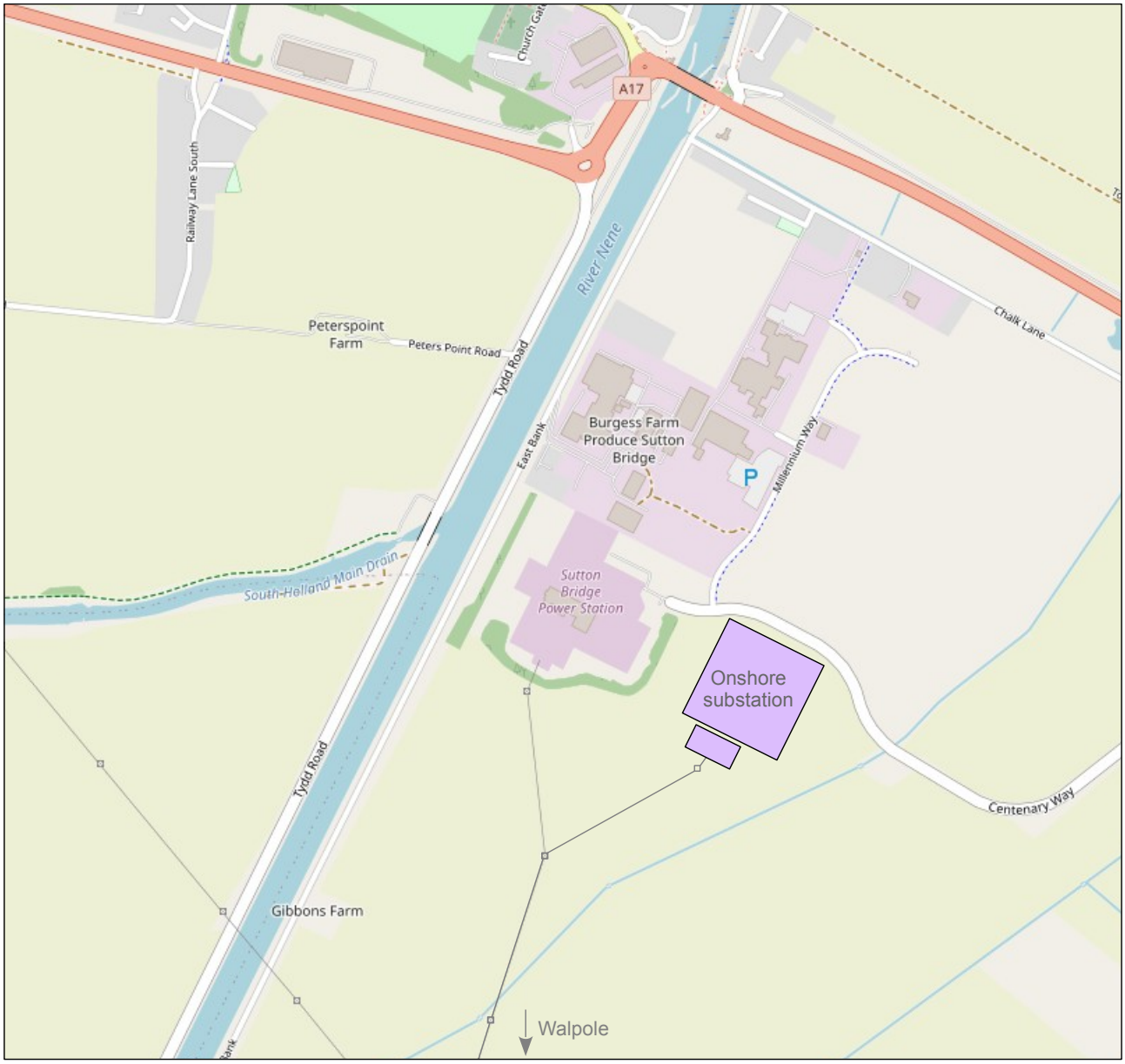
In the first instance, it is assumed that the existing 400kV pylon route would be upgraded to provide an independent path of at least 900MW to the National Grid substation at Walpole, as shown below.

Sutton Bridge power station was upgraded in 2016 to support intermittent renewable generation and flexible short term operation, and to work efficiently with the power market balancing mechanism.

It was the first power station of its kind in the UK to be upgraded to the latest specifications for the reduction of emissions, and can be regulated down to 35% of peak output. It can also be upgraded to use hydrogen. The power station is not currently in regular use and local employment is at risk.

In the future, it may be beneficial to re-start the use of Sutton Bridge power station. The latest report from the Climate Change Committee, issued in March 2023, confirms the need to provide for 'low wind years' and in particular increasing occurrences of 'wind drought' – extended periods of several weeks when low offshore wind generation coincides with high seasonal demand. If an underground cable is used for the final connection from the onshore substation to Walpole, additional ducts could be laid at the same time for the future use of the Sutton Bridge power station. This would allow the power station to be brought back into use, and the existing pylon route removed, at some later date.

A further alternative would be to cross-connect the two sites locally at the 400kV voltage level.



Transmission capacity

Circuit capacities are shown in Appendix B of the Electricity Ten Year Statement for 2020. The substation code for Sutton Bridge is SUTB and the substation code for Walpole is WALP. Row 551 of Appendix B, Section B-2-1c, shows the capacity of the existing single-circuit pylon route:

Node 1	Node 2	Length (km)	Winter Rating	Spring Rating	Summer Rating	Autumn Rating
SUTB41	WALP41	3.85	1340	1340	1150	1340

Existing grid connection agreements are shown in the TEC Register, issued at regular intervals by National Grid. At 24th March 2023 the TEC Register shows the following entry at Row 951:

Project Name	Customer Name	MW Connected	Plant Type
Sutton Bridge	Sutton Bridge Power Generation	850	CCGT (Combined Cycle Gas Turbine)

Until late 2016, the Hornsea Three project held a grid connection agreement for 2000MW directly at Walpole using an underground cable connection from its landfall point. This information shows that a grid connection agreement of at least 900MW at either Sutton Bridge or Walpole is feasible.

Environmental impacts

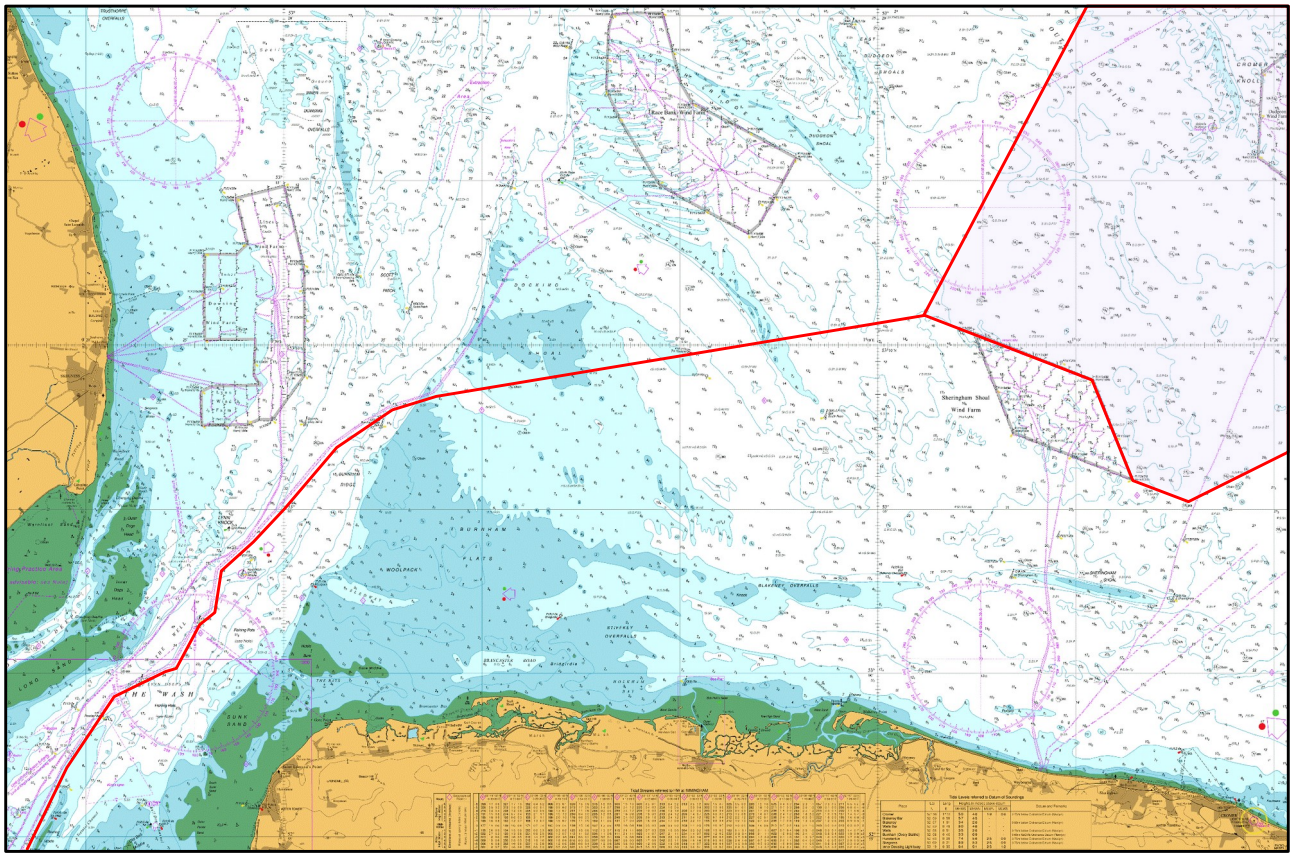
The onshore substation is significantly smaller than the existing Sutton Bridge power station, shown below, and could use similar external treatment. This would be the main long term onshore impact.

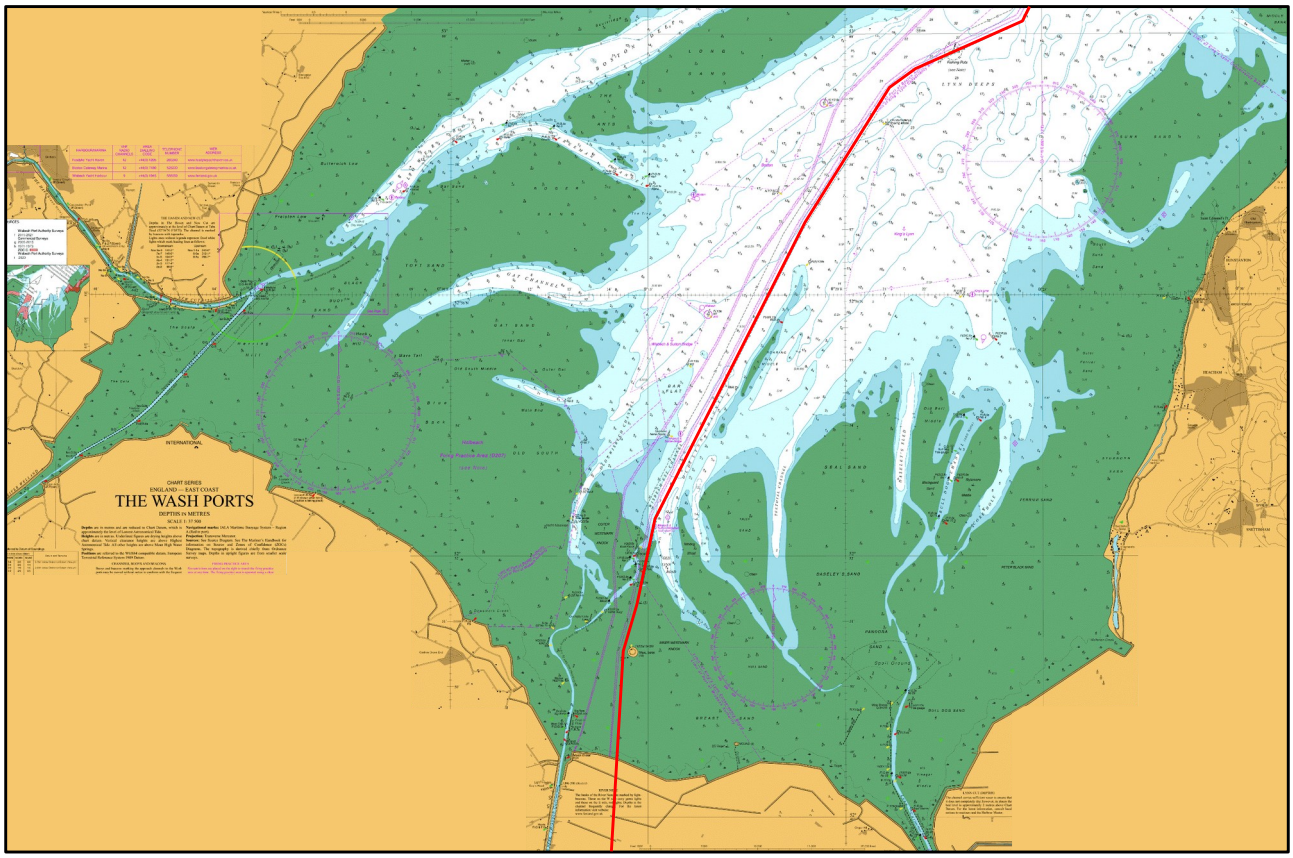
With the removal of the 60km onshore cable route, the remaining environmental impacts are mostly offshore. Impacts on the Cromer Shoal Chalk Beds MCZ are practically all removed, and charts are included overleaf so that the remaining offshore environmental impacts can be fully evaluated.

Conclusion

Offshore construction is generally considered to be quicker than onshore, and the dependency upon a new 180km pylon route from Norwich to London to deliver the full energy output is removed. It would appear, therefore, that an alternative proposal can deliver the same or greater benefits in the same timescale with lesser environmental impacts and is both physically and commercially feasible.

Offshore charts





Connection at Norwich Main

Summary

This representation objects to the proposed grid connection at Norwich Main on the grounds that, even if Vanguard, Boreas and Hornsea Three do not proceed with their grid connection offers at Necton and Norwich Main, a much better alternative is available at Walpole or Sutton Bridge.

In the event that Vanguard, Boreas and Hornsea Three do proceed with their grid connection offers at Necton and Norwich Main, then additional objections arise, which are not covered here.

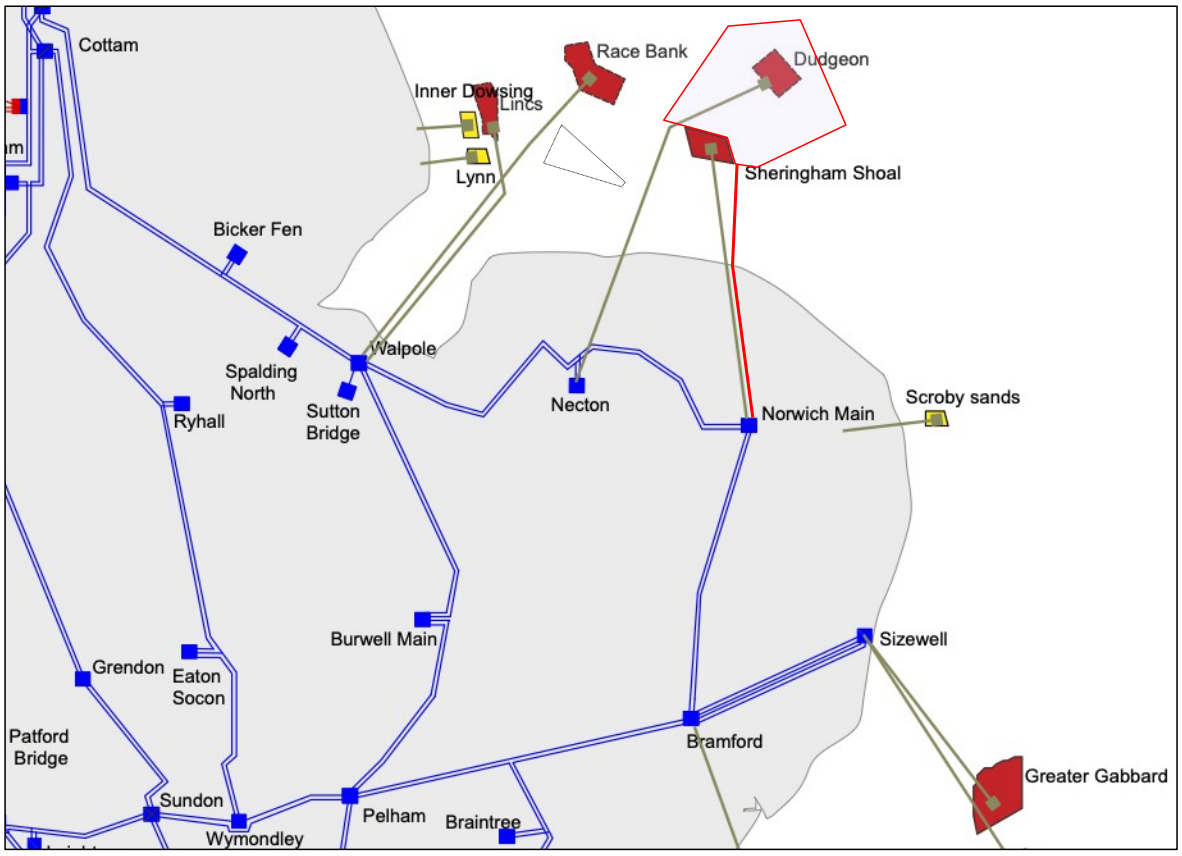
Description

The applicant's proposed grid connection at Norwich Main is shown in outline below.

The applicant has explained that an output of 900MW is feasible and may be adopted post-consent without a material amendment of the DCO. Recognising the urgent need for renewable energy, this increased output level is therefore assumed when considering the proposed grid connection point.

The export cable route runs south towards Weybourne for a distance of about 20km, makes landfall, and then continues south for about 60km to the onshore substation at Norwich Main. The existing double-circuit pylon route from Norwich Main to Bramford is used to convey the output to the main centres of demand in London and the south east, after allowing for local demand at Norwich Main.

Even without Vanguard, Boreas and Hornsea Three, and their associated developments of industrial scale battery storage and a new 180km onshore pylon route from Norwich Main to London, serious difficulties arise from the multi-stage development scenario needed for the Proposed Development.



Source: Electricity Ten Year Statement 2022, with Dudgeon and Sheringham Shoal Extension projects added.

Climate change

The maximum output available from the existing Dudgeon and Sheringham Shoal offshore wind farm projects is 720MW. Assuming that the output from the Extension projects is 900MW, then the onward transmission capacity required for a radial grid connection, using the existing pylon route from Norwich Main to Bramford and with onward transmission to London, is a total of 1620MW.

The existing pylon route from Norwich Main to Bramford is a double circuit with a minimum rating of 1500MW per circuit and a total capacity of 3000MW. This capacity will only be a constraint if peak wind farm output coincides with one circuit being out of action. Due to the rarity of peak wind speeds, such an event is statistically unlikely and would not justify upgrading of the pylon route.

The forecast peak winter demand at Norwich Main, which is limited by local distribution network capacity, is in the region of 300MW. In addition, there are several battery storage projects already approved for construction and clustered around the Norwich Main substation. In the absence of a Hornsea Three grid connection, these projects would probably not be economically viable, but they would further reduce the probability of a new pylon route being justified for the Extension projects.

Under these assumptions, there would be little or no prospect of curtailment or constraint arising between Norwich Main and Bramford. At Bramford, however, severe constraints are expected due to the planned introduction of renewable energy from East Anglia One, One North, Two and Three (a total of 3800MW), and the recently consented Sizewell C (3200MW). The proposed Bramford to Twinstead Tee upgrade, due to be submitted to the Planning Inspectorate this month under reference EN020002, would not eliminate this difficulty, and the DCO application has yet to be examined.

This picture is supported by the Offshore Constraints Study issued by National Grid for The Crown Estate in February 2018, in the context of the Round 2 extension projects, including the Dudgeon and Sheringham Shoal extensions. Figure 1c from that report, reproduced below, confirms that the use of Norwich Main would result in a relatively high connection cost compared with other options, and this higher grid connection cost would ultimately be passed on to the final electricity consumer.

Given these network constraints and higher costs, it is unlikely that a connection at Norwich Main would allow the Proposed Development to reduce emissions and increase the supply of renewable energy at least cost to the consumer, even in the absence of Vanguard, Boreas and Hornsea Three.

Circuit capacities and the forecast of demand at Norwich Main as shown in the Electricity Ten Year Statement have already been submitted and are included again below for ease of reference.

Environmental impacts

For the proposed grid connection at Norwich Main, and its associated landfall, the negative impacts on the Cromer Shoal Chalk Beds MCZ, at Weybourne and other onshore locations, and for tourism, agriculture and leisure have been identified by other Interested Parties, and these are exacerbated by the proposed multi-stage development scenarios throughout the 60km onshore export cable route.

Even in the absence of Vanguard, Boreas and Hornsea Three, cumulative impacts arising from the interaction with other local projects, including highways schemes, are also a material consideration.

The National Policy Statements require that consideration is given to wider legacy benefits, such as long term employment, and improvements to the visual and environmental experience (EN-1 4.1.3, 4.1.4, 5.1.2.8 and 5.1.2.9). Since the onshore substation is unattended, no long term employment benefits arise from this choice of grid connection. Despite the use of horizontal directional drilling, and the siting of the onshore substation in a hollow rather than on high ground, there is no overall contribution to the visual and environmental experience, and the long term negative impacts on the landscape and visual character of the area around the onshore substation would not be mitigated.

These negative environmental impacts can be avoided by the use of an alternative grid connection.

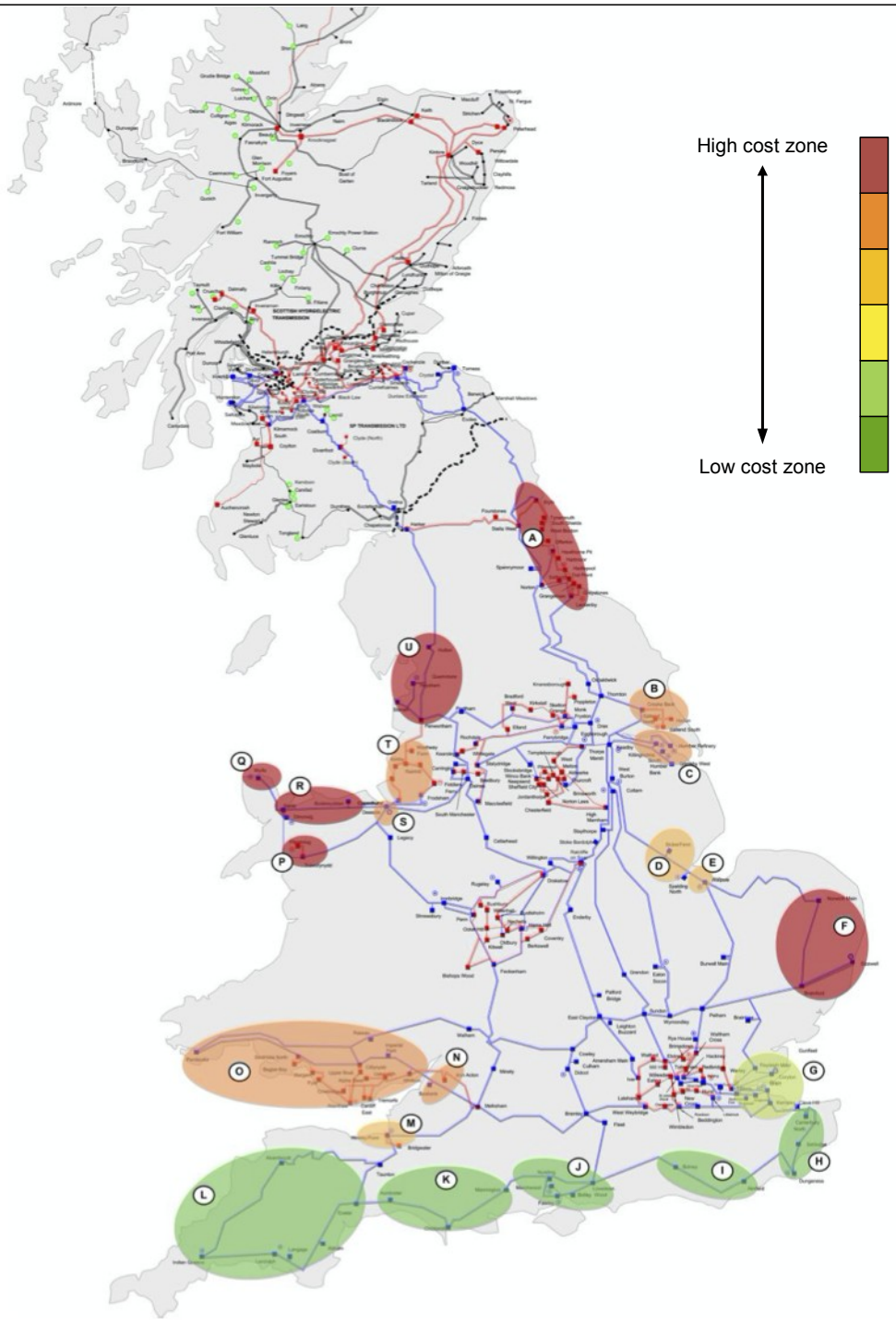


Figure 1c: Network cost impact of new 1500MW offshore wind in 2030

Source: Offshore Wind Constraints Study, National Grid SO (for The Crown Estate), February 2018, p.14.

Transmission capacity

Circuit capacities are published in Appendix B of the Electricity Ten Year Statement. The substation code for Norwich Main is NORM and the substation code for Bramford is BRFO. Rows 81 and 82 of Appendix B, Section B-2-1c, of the Electricity Ten Year Statement show the following:

Node 1	Node 2	Length (km)	Winter Rating	Spring Rating	Summer Rating	Autumn Rating
BRFO41	NORM41	61.576	1590	1500	1346	1500
BRFO41	NORM41	61.576	1590	1500	1346	1500

Forecast of demand

The forecast of peak winter demand at each Grid Supply Point is published in Appendix G of the Electricity Ten Year Statement. For Norwich Main, Row 676 of Appendix G shows the following:

Node	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
NORM40	289	288	289	291	299	307	324	341

Vanguard, Boreas and Hornsea Three

On 3rd March 2023 reports appeared in the national press (e.g. *The Times*) in which the developer of Hornsea Three stated, in effect, that the project was no longer economically viable at the agreed Contract for Difference subsidy price of £37.35/MWh (£45/MWh when adjusted for inflation), and that it had delayed a final investment decision after concluding that it could not proceed on present terms. The developer of Vanguard and Boreas apparently holds the same view. Pre-commencement work at the Hornsea Three onshore substation site apparently ceased at the end of March 2023.

Grid connection offers

The applicant has explained that National Grid ESO offered a grid connection at Norwich Main in April 2019. This was accepted in May 2019, prior to the DCO consent decisions for Hornsea Three (31st December 2020), Boreas (10th December 2021), and Vanguard (11th February 2022). Since then, the applicant has requested an increase in grid connection capacity from 720MW to 900MW.

National Grid has apparently said that this increase would require a new pylon route from Norwich to Tilbury at a cost to the consumer in the region of £1,000m. In the absence of Vanguard, Boreas and Hornsea Three, such a proposal would not satisfy the requirements of economic justification and deliverability. Furthermore, National Grid guidelines also suggest that the cost per km of laying a cable offshore may be less than the cost per km of onshore construction using undergrounding, and that the overall length of the export cable route is not necessarily the determining factor. These points further strengthen the economic case for a grid connection at Walpole or Sutton Bridge.

Conclusion

Even in the absence of Vanguard, Boreas and Hornsea Three, it would appear that little confidence can be placed in the process of grid connection offers. A consideration of the reasonable alternatives is an important part of the planning process for nationally significant infrastructure, and does not seem to have been addressed to an appropriate standard, either by the applicant or by National Grid.

It would appear that an alternative grid connection point at either Walpole or Sutton Bridge offers much greater certainty of the Proposed Development achieving its stated objectives, with reduced curtailment of renewable energy, reduced environmental impacts, lasting local benefits, and lower costs to the final electricity consumer. The application as submitted is therefore unacceptable.

Cumulative impacts with Vanguard, Boreas and Hornsea Three

Summary

The present examination is considering the Dudgeon and Sheringham Shoal Extension projects (the Proposed Development) in combination with Vanguard, Boreas and Hornsea Three.

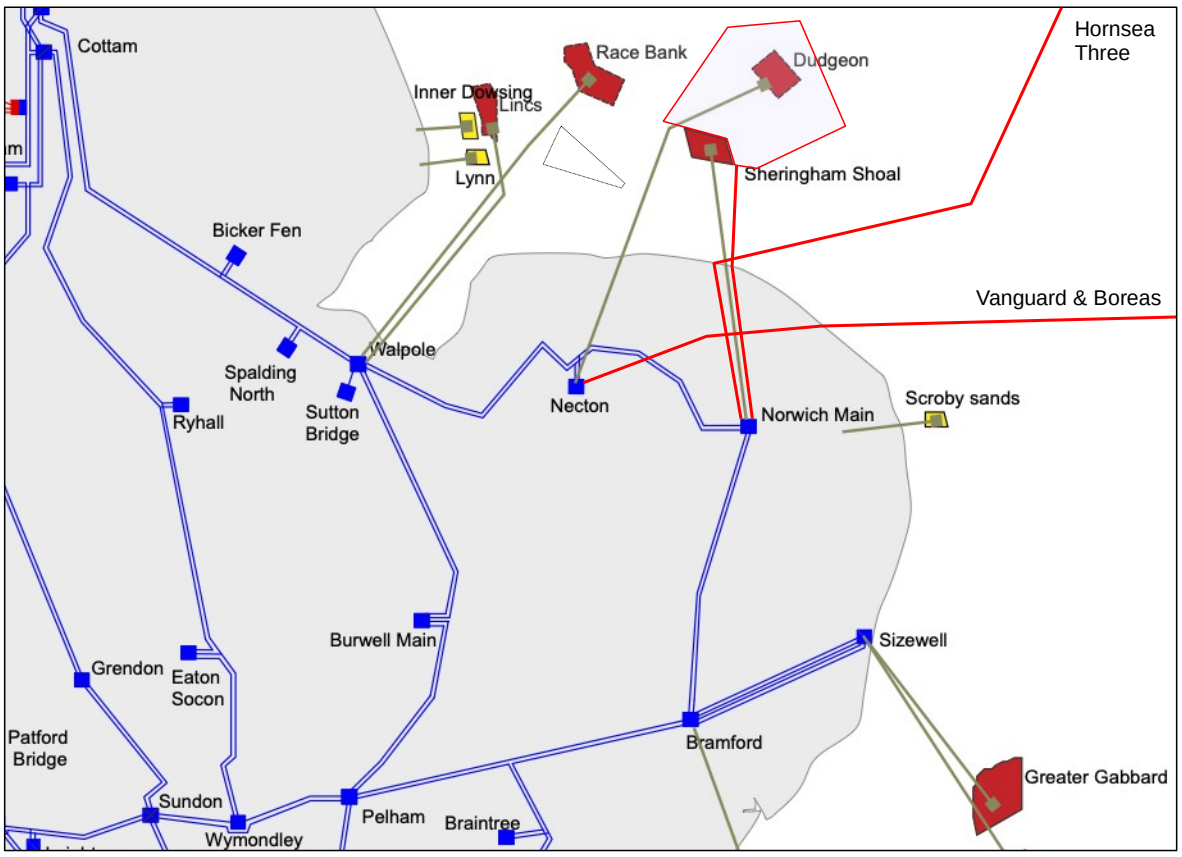
This representation objects to the cumulative impacts of the Proposed Development in combination with Vanguard, Boreas and Hornsea Three, and the proposed industrial scale battery storage at the Hornsea Three onshore substation, the proposed 180km pylon route from Norwich Main to Tilbury, and the grid connection offers from which these cumulative impacts would arise.

Development scenario

The applicant's proposed grid connection at Norwich Main, together with the proposed connections for Vanguard, Boreas and Hornsea Three, is shown in outline below. Vanguard, Boreas and Hornsea Three have announced increases in their offshore generation capacity post DCO consent, but have not described any capacity increases for their export cables and onshore substations. The nominal capacities of these projects are therefore assumed to be 3600MW for Vanguard and Boreas, and 2400MW for Hornsea Three, with a total requirement for out-of-region onward grid transmission capacity towards London of 6000MW prior to the construction of the Proposed Development.

The long term forecast of peak winter demand at Norwich Main is approximately 300MW and the existing pylon route capacity from Norwich Main towards Bramford is two circuits of 1500MW.

The assumed generation capacity of the Dudgeon and Sheringham Shoal Extensions is 900MW.



Source: Electricity Ten Year Statement 2022, with Dudgeon and Sheringham Shoal Extension projects added, together with the proposed export cables and grid connection points for Vanguard, Boreas and Hornsea Three.

Environmental impacts

Hornsea Three is located off the East Yorkshire coast. The proposed export cable impinges upon the Cromer Shoal Chalk Beds MCZ, makes its landfall at Weybourne, and then continues onshore to a grid connection point at Norwich Main. With a total estimated length of 163km offshore and 62km onshore, this would be one of the longest offshore wind export cables ever proposed. At an output level of 2400MW, significant transmission losses are to be expected over its total length of 225km.

To achieve its climate change objectives, the output from Vanguard and Boreas is urgently required in London and the south-east. This suggests a southwards orientation of the export cable. Instead, it extends westward for a distance of about 90km to make landfall at Happisburgh, and then continues for another 60km across Norfolk to Necton. At an output level of 3600MW, significant transmission losses are again expected over its total proposed length of 150km.

If also connected at Norwich Main, the export cable route for the Dudgeon and Sheringham Shoal Extensions would extend south for 20km and once more cross the Cromer Shoal Chalk Beds MCZ to make landfall at Weybourne, and then continue 63km onshore to the grid connection point. With an output of 900MW, transmission losses may not be as significant over this total distance of 83km.

In total, this grid connection scheme requires about 275km of offshore transmission and 185km of underground export cable construction within the county of Norfolk. All projects may use multi-stage construction scenarios, and it is estimated that more than 2,500 acres of land will be affected, with more than 1,500 acres permanently affected. Construction would continue for many years.

Cost-benefit analysis

A review of the power flow snapshots presented in the Electricity Ten Year Statement indicates that, in all cases, the output from Vanguard, Boreas and Hornsea Three is expected to be transmitted via Norwich Main towards Bramford. In view of the strictly limited onward grid transmission capacity available, the most likely outcome of the proposed grid connections of these projects is a very high level of renewable energy curtailment and very high network constraint costs. A typical example of such a power flow diagram, based on the Electricity Ten Year Statement, is shown in Attachment 1.

The published cost of the Hornsea Three project is £8bn (stated in *The Times*, 3rd March 2023). At a rough estimate, the cost of the Hornsea Three export cable route may be as high as £2bn, or 25% of the total project cost. A similar cost estimate may also apply to Vanguard and Boreas. The very high construction costs of these offshore and onshore export cable routes, all using HVDC transmission, would be reflected in a need for higher Contract for Difference subsidy awards. All of these costs, including network constraint costs, would ultimately be passed on to the final electricity consumer.

At the time of writing, Hornsea Three holds a Contract for Difference award for 2852MW (metered offshore) and, in the absence of an increase in the size of the export cable and onshore substation, this will tend to increase the average annual load factor. Similarly, in December 2022, Vanguard and Boreas announced an increase of their planned generation capacity to 'more than 4200MW'. These changes will tend to increase the level of curtailment and constraint for the Proposed Development.

The environmental impacts of 185km of onshore undergrounding over many years are unlikely to be effectively mitigated. The onshore substations would require approximately 37 acres of industrial development at Necton, and 63 acres of industrial development at Norwich Main. In addition, both Vanguard and Boreas, and Hornsea Three, propose to site their onshore substations on high ground, contrary to the generally accepted Holford and Horlock principles. The resulting permanent change to the landscape character is unlikely to be effectively mitigated. In the case of Hornsea Three, the Examining Authority seems not to have considered the available grid capacity or a carbon footprint life cycle analysis, and did not attempt to determine the overall planning balance of the project.

The proposed battery storage installation and pylon route to Tilbury were not identified in the DCO applications for these projects, and would increase both the cost and the environmental impact.

It is unlikely that the combination of projects as currently proposed will make a contribution to their climate change objectives that justifies the environmental impacts and the cost to the consumer.

In the event that Vanguard, Boreas and Hornsea Three do not proceed, or are connected offshore, then two thirds of the onshore undergrounding and practically all of the onshore substation impacts would be eliminated. Under these conditions, the existing transmission capacity would be adequate, and the Dudgeon and Sheringham Shoal Extensions, with a shorter export cable route using HVAC transmission only, could immediately offer the higher output of 900MW and a lower cost per unit of generation. This would be reflected in a reduced requirement for a Contract for Difference subsidy.

If the Dudgeon and Sheringham Shoal Extensions connect to the grid at Walpole or Sutton Bridge, approximately one third of the onshore undergrounding would be removed. The planned increase in capacity from 720MW to 900MW could be made available four years earlier than at Norwich Main, with a lower risk of renewable energy curtailment and constraint. This would advance the delivery of climate change benefits whilst reducing the cost per unit of energy supplied, the likely amount of the Contract for Difference subsidy, and the cost to the final electricity consumer.

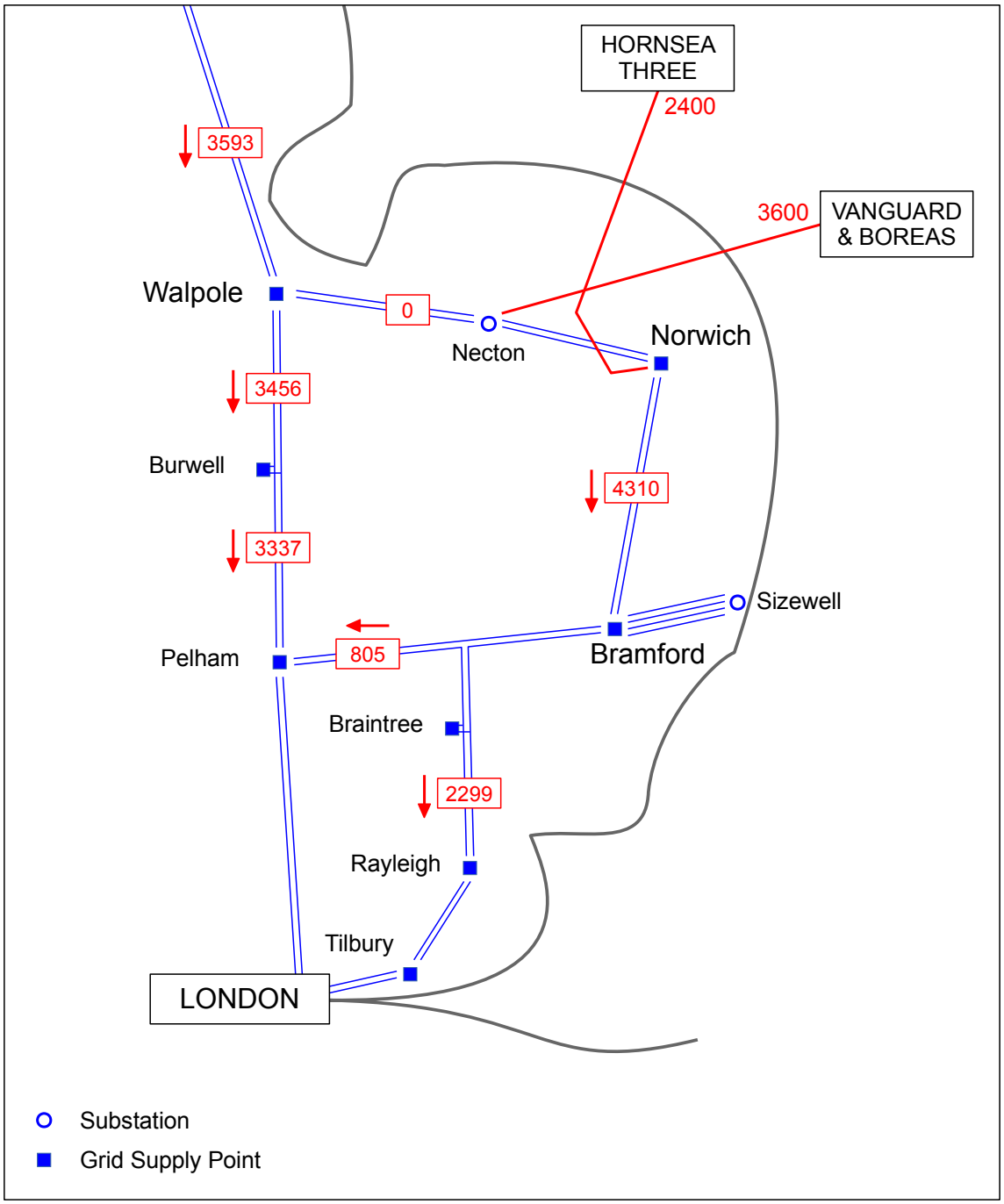
Conclusion

The cumulative impacts of the Proposed Development in combination with Vanguard, Boreas and Hornsea Three are not justified by the contribution which the projects are likely to make to the need for renewable energy. The application as submitted is therefore unacceptable.

Power flow diagram

Snapshots of power flows across the transmission network have been published by National Grid each year since 2012 in Appendix C of the Electricity Ten Year Statement. A typical example is shown below for the year 2030/31. It is based on one of four scenarios, called Leading The Way, and reflects the grid connection agreements listed in the TEC Register. At the time of publication in November 2021, this did not include the Dudgeon and Sheringham Shoal Extension projects.

On a consistent basis, power flow diagrams published since 2012 do not show any significant flow westward from Norwich towards Necton, or from Necton to Walpole. In the example shown below, the expected peak winter output from the Vanguard, Boreas and Hornsea Three projects exceeds the currently available onward grid transmission capacity from Norwich Main towards Bramford.



Source: Electricity Ten Year Statement 2021, Appendix C, Power Flow Diagrams, 2030/2031, p.6 with the Bramford to Twinstead Tee upgrade, due to be examined under reference EN020002, omitted for clarity.