

Note on the assessment of options for the connection of the Nautilus and Eurolink interconnectors to the National Grid network

1 Introduction

1.1 This note has been prepared by National Grid as electricity System Operator (SO) to explain why the National Grid Ventures Nautilus and Eurolink interconnectors are proposing to connect to the national electricity transmission system (NETS) in the Sizewell/Leiston area.

1.2 The note reflects the outcome of a comparative assessment of connection options undertaken in 2017. That assessment, led by the SO as operator of the electricity transmission system across Great Britain, includes input from National Grid Ventures and from the Transmission Owner (TO) part of National Grid, which owns the onshore electricity transmission network in England and Wales.

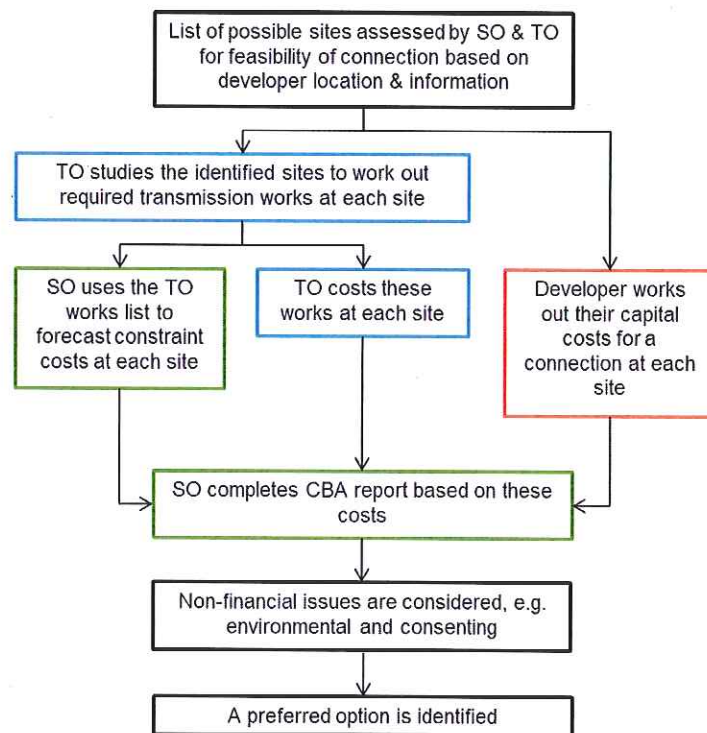
2 How the comparative assessment of options is undertaken

2.1 Developers wishing to connect new electricity generation to the NETS must make a connection application. A modification application is also required when developer's proposals change significantly. When the proposed development is an offshore wind farm or an interconnector project, the connection options are comparatively assessed to identify the most appropriate connection location.

2.2 A guidance note on the National Grid website explains how the assessment is carried out¹. The process looks at technical, commercial, regulatory, environmental, planning and deliverability aspects to identify the preferable connection for the consumer. The Electricity Act 1989 requires National Grid when formulating proposals, to be efficient, co-ordinated and economical whilst also having regard to the environment. When the development being connected is offshore, be that a wind farm or an interconnector, the offshore aspects need to be considered in that evaluation too. The assessment process therefore looks to minimise the total capital and operational cost whilst taking into account other key considerations as set out above.

2.3 The total cost of connecting to each location is worked out based on Transmission Capital Costs + Developer Capital Costs + System Operator Constraint Costs. Constraint Costs are the costs of increasing generation from some power stations and decreasing it at others to balance the system. It then considers how the various options compare in cost terms against a range of future energy scenarios, which is known as the cost benefit analysis (CBA) process. Through the CBA assessment a recommended option is identified in economic terms. The cost of the options is then evaluated against the other key considerations to determine the preferred option, which can change as more detailed information is obtained. The diagram below illustrates the process.

¹ The Connection and Infrastructure Options Note (CION) Process Guidance Note Issue 3
<https://www.nationalgrid.com/uk/electricity/connections/applying-connection>

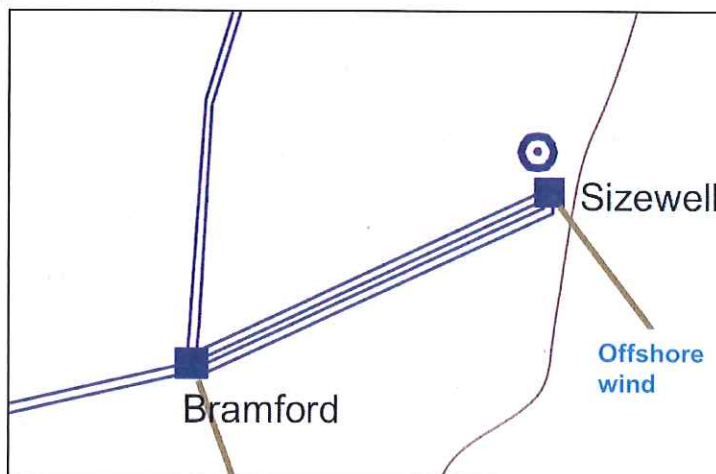


3 Existing generation connected in the Sizewell/Leiston area

3.1 Three electricity generators are currently connected to the NETS at Sizewell and Leiston:

- Sizewell B nuclear power station (EDF) – 1216 MW (megawatts)
- Greater Gabbard offshore wind farm (SSE) – 500 MW
- Galloper offshore wind farm (Innogy) – 350 MW

3.2 The electricity these produce is transported on two existing National Grid transmission lines which form part of the NETS. Each of those existing overhead lines carries two electrical circuits (one on each side of the pylons). In total therefore, there are four existing electrical circuits connecting the Sizewell/Leiston area.



3.3 Four electrical circuits were originally built there to provide a secure connection to the Sizewell A (Magnox) and Sizewell B nuclear power stations, rather than four being needed for power carrying capacity reasons.

3.4 Sizewell A stopped generating in 2006 and there is spare capacity to connect additional generation in the four electrical circuits from Sizewell/Leiston. Sizewell B is also currently expected to close in 2035.

4 Proposed new generation in the Sizewell/Leiston area

4.1 EDF are developing plans and have been consulting for a number of years on their proposals for the new Sizewell C nuclear power station. Contractually when Sizewell C is expected to connect to the NETS has changed over time. Getting everything in place to construct EDF's first new nuclear power station in the UK at Hinkley Point C in Somerset has taken longer than originally anticipated and they have been developing and consulting on their plans for Sizewell C. Whilst there isn't a confirmed date yet therefore for when Sizewell C is likely to start generating, it is widely expected to be around the 2030's².

4.2 More recently, Scottish Power Renewables have re-configured some of their East Anglia offshore wind farm projects. What was East Anglia Four and Two have been re-configured with some residual capacity from East Anglia One, to form East Anglia One North and East Anglia Two. With the reconfiguration of their offshore zones, Scottish Power requested a review of connection locations. Following a comparative assessment of options using the process outlined in Section 2, the Leiston area was identified as the most appropriate location to connect East Anglia One North and East Anglia Two.

4.3 More recently again, applications to connect to the NETS have also been made by National Grid Ventures³ for two proposed electricity interconnectors with continental Europe. The Nautilus Interconnector is proposed between the UK and Belgium and the Eurolink interconnector is proposed between the UK and the Netherlands. The reasons why the Leiston area is also the preferred connection location for those connections and the alternatives considered are explained in section 6.

4.4 There are therefore a number of new sources of electricity proposing to connect in the Sizewell/Leiston area in addition to the existing Sizewell B, Greater Gabbard and Galloper generation that is already connected:

- Sizewell C (EDF) – 3340 MW – contracted to connect in 2020 but likely to be in the 2030's
- East Anglia One North (SPR) – 860 MW – connecting in 2027
- East Anglia Two (SPR) – 860 MW – connecting in 2026
- Nautilus (NGV) – 1500 MW – contracted to connect in 2025 but likely to change to 2027 to align with consenting timescales in Belgium
- Eurolink (NGV) – 1600 MW – connecting in 2025

² <https://www.thetimes.co.uk/article/sizewell-c-nuclear-power-to-come-on-stream-in-2031-35nw6wwsv>

³ <https://www.nationalgrid.com/group/about-us/what-we-do/national-grid-ventures>

5 National Grid works required to connect the proposed generation

5.1 Under normal operating circumstances with all four electricity transmission circuits in operation, the existing and proposed generation can be accommodated without building new transmission lines. Based on current contracted dates, the conductors (wires) on the four transmission circuits between Sizewell/Leiston and Bramford will need replacing with larger current carrying capacity conductors by around 2027 in order to accommodate the planned generation.

5.2 With up to two of those circuits out of operation for unplanned reasons, those re-conducted lines would still likely be able to accommodate the anticipated output from the existing and planned generation based on realistically credible output scenarios.

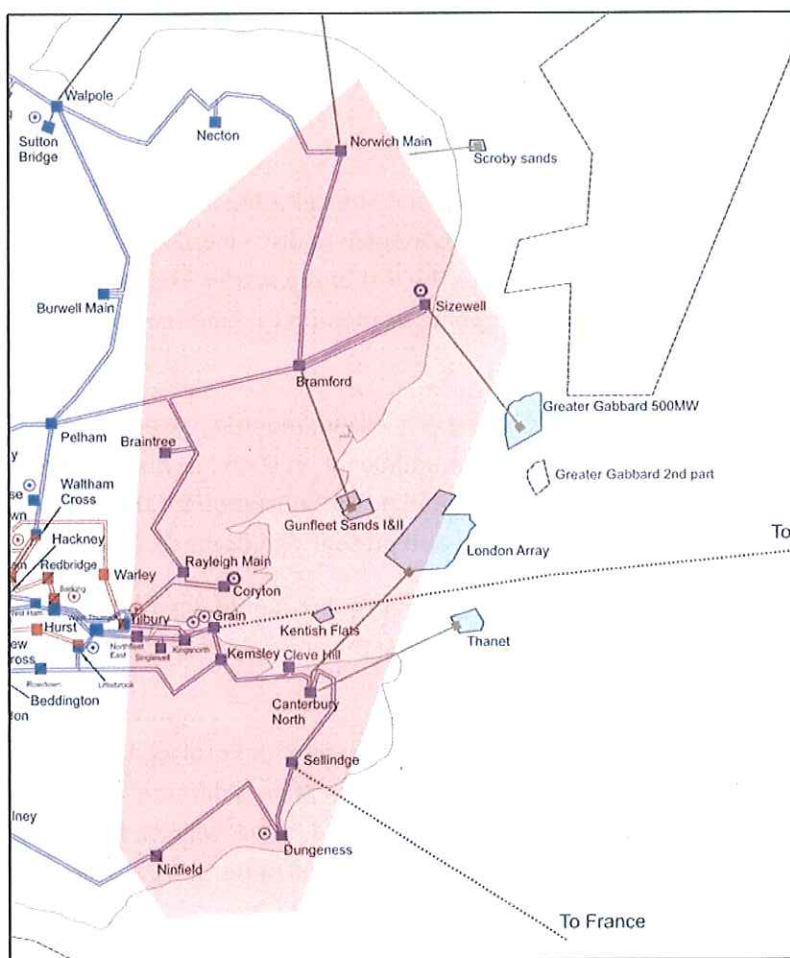
5.3 When looking to take transmission circuits out of service temporarily for planned maintenance, National Grid works closely with the generators connected to those circuits to look wherever possible, to align those works with periods when the generators themselves are planning not to generate or reduce the amount of electricity they're generating while they carry out their own maintenance activities. Additional system control measures are also available to manage the transmission system during temporary abnormal conditions, such as intertrips and pre-fault constraints.

5.4 The proposals for the new Sizewell C nuclear power station will include a new National Grid 400kV substation at Sizewell, which is located adjacent to the existing National Grid substation connecting the Sizewell B power station. With spatial and environmental constraints at both the existing and new Sizewell site, it would not be possible to connect any single one of the East Anglia One North, East Anglia Two, Nautilus and Eurolink projects there. A new National Grid 400kV substation will therefore be required somewhere in the Leiston area, beyond the Sizewell site, to connect the two proposed wind farms and the two proposed interconnectors.

5.5 National Grid is proposing a single new 400kV substation which, subject to consent being granted, would connect all of these new sources of generation to the NETS. The wind farms and interconnectors would each have buried cables connecting their individual developments into that new 400kV substation.

6 Comparative assessment of connection options for Nautilus and Eurolink

6.1 The map below shows the location of the National Grid network in the South East and the connection locations considered in the review of options for Nautilus and Eurolink to connect to the NETS. In electrical terms certain areas of the network can be grouped together, as a connection to any site in that area will trigger very similar constraint costs and system reinforcement. It is therefore generally preferred to study options from separate areas, rather than study multiple sites in the same area. If an area is subsequently preferred, but a connection to the studied substation proves unviable, another substation or a new substation in the area may become the preferred solution. For the purpose of the assessment, therefore, the map below can, electrically speaking, be divided into the South Coast Ring, Thames Estuary and North of Thames Estuary. Paragraphs 6.2 to 6.8 below explain which options from those areas were taken forward in the comparative assessment.



South Coast Ring

6.2 Connecting at a substation on the 'South Coast ring' from Cleve Hill through to Ninfield would all require a significant new overhead line reinforcement from the south coast to the outskirts of London. The differentiating factors between connection options there are therefore the local works and constraints at each location.

6.3 Ninfield was considered to be less optimal as its distance from Belgium would require significant additional offshore cabling compared with other options. Cleve Hill would require an additional circuit turn-in or additional new circuit. The existing Canterbury North substation is in a constrained urban area with no room for expansion and consents for a new separate substation would be required. For this reason Dungeness and Sellindge were considered the locations with the most potential in this area. Sellindge, being the nearest of the two locations to Belgium, was taken forward in the full cost benefit assessment, though only for Nautilus, as this was considered too far from The Netherlands to make it an economical proposition for Eurolink.

Thames Estuary

6.4 Around the Thames estuary, Grain was considered in the full cost benefit analysis for both Nautilus and Eurolink. Other sites in the area were further from the originating countries with little-to-no benefit over Grain to justify the extra cable length. Kemsley, despite being a similar distance to Grain, was discounted due to previous experience showing major planning and environmental constraints to routeing any new connections in this area.

North of the Thames Estuary

6.5 Of the sites further north, Rayleigh Main and Sizewell were initially considered for the full cost benefit analysis for both interconnectors. Coryton was discounted as it would require a new double circuit to Rayleigh Main to connect it to the rest of the system because of the amount of generation that would be connected at that point, in addition to reinforcements required for Rayleigh Main.

6.6 Braintree and Bramford are both a long way inland, requiring extensive cabling from the coast to the sites both of which would generate additional cost and environmental effects when compared with other options. At Bramford, extending the substation for the connection and managing operational complexity issues would also present significant challenges.

6.7 Connecting at Rayleigh Main was also ultimately discounted due to the high density of existing infrastructure and residential development in the area which would limit onshore cable routeing options.

6.8 Norwich Main was considered as a connection option for Eurolink, but not for Nautilus, due to its distance from Belgium. In power flow terms Norwich Main is different from other options in that whilst much of the power will likely flow into Bramford, some will head to Walpole and then Pelham, differentiating it from the Bramford/Leiston/Sizewell options. As such Norwich Main was taken into the comparative assessment for Eurolink.

Cost Benefit Analysis

6.9 As a consequence of this early appraisal it was determined that a cost benefit analysis would be undertaken for Sellindge, Grain, and Sizewell for the Nautilus connection, and Grain, Sizewell and Norwich Main for the Eurolink connection.

6.10 The cost benefit analysis considered developer capital costs, transmission capital costs, and forecast power balancing costs and hence total cost of each connection option to the UK consumer.

through this appraisal, a connection at Sizewell performed better than any of the other options. Connecting at Grain or Sellindge would involve significant additional costs, to the region of several hundred million pounds. The connection at Norwich had the same power balancing costs as Sizewell, but the extensive additional onshore cables routeing that this option would necessitate as a result of its inshore location and need to avoid the challenging terrain of the Norfolk and Suffolk Broads meant the cost of this option would be significantly greater. The most efficient, co-ordinated and economical solution for the GB consumer is therefore considered to be a connection in the Sizewell area.

6.11 The assessment initially indicated that connecting at Sizewell is the preferred option. This would have required the extension of the existing substation. However this substation is within the nuclear security perimeter zone, requiring the option to be under the rules of Civil Nuclear Constabulary. There is limited land availability and nuclear site licencing constraints in that location.

6.12 Connecting in the Leiston area is considered to offer very similar significant economic benefit to the GB consumer compared to the other options. Whilst there are potential siting and environmental challenges with environmental constraints and other proposed connections, the assessment concluded that a connection in the Leiston area could not be discounted without further detailed consideration of local siting options.

6.13 For these reasons, the Leiston area compares more favourably than other connection options and forms the basis of the connection offers for the Nautilus and Eurolink projects.

