Summary of the National Grid Electricity Transmission (NGET) response to questions raised by Offshore Electricity Grid Task Force (OffSET) at the meeting of Monday 18 July 2022 (chair Sir Bernard Jenkin) in regard to the East Anglia Green Energy Enablement Project (East Anglia GREEN):

INTRODUCTION AND BACKGROUND

The following is a brief introduction to the National Grid's (NG) proposed development to bring ashore wind generated electricity from windfarms in the North Sea.

1. This section outlines NG's proposed favoured solution which is via overhead cabling which requires the construction of a series of pylons over some 180 kms. It is clear that NG have, under sufferance, prepared details of an alternative to bring the energy on shore by way of an under-sea cable details of which are appended below, but it is clear that their favoured route is overhead via the pylons. I suspect that this is for two reasons, the first being cost and the second being that some of the overhead route is already in existence.

   East Anglia's 400 kV electricity transmission network was built in the 1960s. It was built to supply regional demand, centred around Norwich and Ipswich. With the growth in new energy generation from offshore wind, nuclear power and interconnection with other countries, there will be more electricity connected in East Anglia than the network can currently accommodate.

   The existing network in East Anglia currently carries around 3,200 megawatts (MW) of electricity generation. Over the next decade we expect more than 15,000 MW of new generation and 4,500 MW of new interconnection to connect in the region.

   National Grid is proposing to reinforce the transmission network between the existing substations at Norwich Main in Norfolk, Bramford in Suffolk, Tilbury in Essex as well as connect new offshore wind generation. This would be achieved by the construction and operation of a new 400 kV electricity transmission line over a distance of approximately 180km and a new 400 kV connection substation.

   The reinforcement would comprise mostly overhead line (including pylons and conductors – the 'line' part) and underground cabling through the Dedham Vale Area of Outstanding Natural Beauty (AONB) and a new 400 kV connection substation in the Tendring district:

   - temporary land for construction activities including working areas for construction equipment and machinery, site offices, welfare, storage and access; and
   - land required for mitigation, compensation and enhancement of the environment as a result of the environmental assessment process and Biodiversity Net Gain.

2. **It is important to note that the energy from wind farms arrives onshore as a Direct Current (DC) and needs to be converted to Alternating Current (AC) before it can be fed into the National Grid.** This requires the construction of considerable new infrastructure, the details of which are listed as follows:
   - Extensions at existing substations at Norwich Main and Tilbury
   - HVDC options require a convertor station at each end similar in size to a large DIY warehouse. For 4GW, 2 convertor stations are required at each end and for 6GW, 3 convertor stations are required at each end
   - It was anticipated that convertor stations would be sited in the locality of the existing substations depending on suitable site availability
   - Connections would be required from the substations to the convertor stations and then on to the coast (routes/landfall would need to take account of environmental considerations)

   HVDC offshore options would be limited by the largest technology available for submarine DC cables currently being developed at 2000MW (2GW). Each convertor would require 2 cables to be installed between each convertor with land installation to coastal landing points and submarine cabling, crossing many other services and needing to be carefully routed to avoid marine designations. The convertor stations can have a large visual impact on local communities, the circuit itself is not visible

and does not have the visual impact that overhead lines have. HVDC links are controllable and use a control system to respond to system conditions which has advantages in controllability, however response to very fast transient faults can lag that of an AC system.

In addition to the above NG outline some of the environmental factors to be included in the equation and these are as follows.

Environmental considerations summary for the offshore option:

- Two nationally designated landscapes (Broads National Park and Suffolk Coasts and Heaths AONB). Impacts both direct and on setting from buried cables (both temporary and permanent) and convertor stations.
- Scheduled monuments distributed throughout the study area which includes sites dating from prehistoric period onwards.
- European and national designated sites unlikely to be avoidable particularly at landfalls.
- Six Country Parks - four through the northern area and two to the south.
- Significant amount of infrastructure including numerous existing/proposed subsea cables/pipelines and offshore wind farms with associated substations and cables.
- Thames Estuary - large volumes of sediment deposited during glacial times and subsequent movement by sea has created large features (sand banks/sand wave fields) which have direct impact on bathymetry profile of Estuary. Continuing shifting/migration of the sand banks and channels.
- Crossing offshore infrastructure may lead to unacceptable reduction in water depth presenting a hazard to vessels in areas of shallow water.
- Thames is a key navigation route for both freight and passenger shipping. Over 10,000 ships per year are recorded to be transiting the Thames.
- A number of channels are dredged for navigation to maintain an appropriate safe depth of water. Dredging would both pose a risk to cable and safety concern for the dredging works.

3. Costings

Listed below are the **capital costs** of the various options considered:

a) AC onshore option (Norwich/Bramford/Tilbury) at 6.9GW: £793.5m
b) HVDC offshore (Norwich/Tilbury) at 4GW: £2,028.2m
c) HVDC offshore (Norwich/Tilbury) at 6GW: £3,104.9m
d) HVDC offshore (Norwich/Bramford/Tilbury) at 6GW: £4,168.4m

With **lifetime** costs as follows.

a) AC onshore option (Norwich/Bramford/Tilbury) at 6.9GW: £1,136.m
b) HVDC offshore (Norwich/Tilbury) at 4GW: £3,769.m
c) HVDC offshore (Norwich /Tilbury) at 6GW: £5,654.m
d) HVDC offshore (Norwich/Bramford/Tilbury) at 6GW: £7,332.1m

Given all the foregoing, it is easy to see why the overhead route is the favoured NG choice of route. However, we have no way of being able to verify these figures or to verify any of the other information given herein, most of which was lifted verbatim from NG publications and/or relevant legislation

Summary by WBPC Cllr David Short 16/10/22

Acknowledgements to National Grid for the material used herein.

APENDIX 1

Here are further considerations used by NG in support of their choice of route:

"Summarised below are a number of important factors that we took into account as part of our evaluation to identify a potential offshore strategic option:

- HVDC meets current need (4GW) for current connections, with capital cost £2,028.20m and lifetime cost of £3,769.00m. Future connections require the higher HVDC cost with additional 2GW (6GW overall) with capital cost £3,104.9m and lifetime cost of £5,654m, to match the capacity available on the AC onshore option
- For full like for like with the AC onshore option, the HVDC solution would need to be a multi-terminal design (three additional 2GW convertors located at Bramford and cabling 50km from offshore). Additional capital cost of £1,063.5m (3 x 2GW convertors + 3x50km DC cable pairs) on top of the 6GW solution cost of £3,104.9m, a total capital cost of £4,168.4m and total lifetime cost of £7,332.10m.
- The additional flexibility provided by the AC solution - at a cost of £10s of millions connecting to Bramford, can be justified by the system benefits gained. However, the Direct Current (DC) alternative could not justify such costs and therefore DC circuits would only be directly connected to Tilbury, with the loss of additional flexibility and benefit of connections at Bramford.
- Offshore HVDC option does not enable connection of North Falls and Five Estuaries Wind Farms (2GW). To make an offshore connection, the link would require the additional cost of HVDC convertor station, AC substation, offshore HVDC platform, Offshore AC platform with an additional capital cost of > £500m
- The onshore option best supports the regulatory, legislative and policy framework within which we are required to operate
- The onshore option for East Anglia GREEN is the most economical solution whilst also supporting the connections for Sizewell, North Falls and Fives Estuaries
- North Falls and Five Estuaries have signed agreements to connect into the new substation near Lawford, Essex. If the connection location for this low carbon generation changes, we will backcheck and review the proposed substation site and route

The option that currently best meets NGET obligations under Section 9 of the Act and aligned with EN-1 and EN-5 is:

- AENC – OHL Norwich Main to Bramford with capital cost £312.3m and lifetime cost of £505m; plus
- ATNC – OHL Bramford via a new substation to Tilbury with a capital cost £481.2m and lifetime cost of £631m.

Total Capital Cost of £793.5m and lifetime cost of £1,136m"