Partners in UK offshore wind

EnBW and bp joint response to Ofgem "Minded-to Decision and further consultation on Pathway to 2030"

Executive Summary

We welcome the minded-to decision delivery model for radial design Pathway to 2030 projects 'Option 6 – Developer design and build with OFTO operate.'

In principle we also support such a delivery model for more complex meshed, multi-use solutions such as on the East Coast and support the proposal in the Holistic Network Design (HND) publication recommendation – that there is multi-party dialogue over summer 2022 – as to how such infrastructure can be successfully progressed to enable its delivery in a cost effective, efficient and timely manner.

In our more detailed feedback, we propose solutions to simplify deliverability of complex offshore transmission infrastructure, including:

1) Further integration through collaboration between Ofgem, affected Developers, Transmission Operators (TOs) and NG ESO in the near term and in advance of updated Bilateral Connection Agreement (BCA) offers, with an aim of establishing clear principles on:
   a. Delivery accountability for individual elements of the offshore network (with clear sub-system boundaries and scope);
   b. How costs and delivery risks will be borne and by which party(s), what guarantees may be required and any associated liability regime; and
   c. Further refinement of the Gateway Assessment process into sub-gates that correspond to the specific sub-systems to be delivered and their respective OFTO tenders (which may be on different timelines).
2) Clarity and certainty around anticipated TNUoS charges for offshore wind project business cases, to avoid any negative cost and schedule impact for project financing that may unnecessarily increase the cost to the end consumer.

As a general principle we suggest that infrastructure with transmission as its sole purpose[1] should be delivered by a third party TO under a separate delivery model, but aligned to the delivery schedule of the relevant generators. In respect of any dual use infrastructure also required for the TO, where such infrastructure is expected to be delivered by a developer, the above points 1a, 1b and 1c need to be defined to enable developers to obtain relevant corporate approvals to enter into any updated Bilateral Connection Agreement offer.

If an offshore windfarm developer is being asked to deliver transmission infrastructure that serves more than one offshore wind farm or facilitates the development of the parts of the HND to be provided by a third party TO (as described above)[2], it will be important to understand how risks relating to schedule and cost are to be equitably borne (with the TO and other developers), how the

[1] e.g. the HVDC connection from SWE1a to R41 and other relevant infrastructure downstream shown in Figure 1 HND recommendations for Scotland East Coast.

[2] e.g. joint connection infrastructure at SWE1a to be shared with SWE1b for onward transmission through HVDC.

TO is envisaged to provide its share of the funding including for any Anticipatory Investment, and what compensation will be provided for project managing delivery of such dual use infrastructure. Parties will need to work together to establish viable commercial structures that enable cost effective and timely project financing.

Where there is the complexity of more than one developer connecting to the offshore transmission network and needing to progress the required offshore network together, multi-party agreement(s) between project developers and the TO will need to be reached.

We look forward to working with the Ofgem team and wider stakeholders to enable these more complex elements of HND delivery to happen successfully and stand ready to start this important next stage of the dialogue as soon as possible.

Specific consultation questions

1 Do you agree with the findings of the draft impact assessment published alongside this document?

EnBW and bp are broadly aligned with the findings of the impact assessment. We welcome the opportunity to ensure timely delivery of our radially and non-radially connected windfarms in alignment with our 2030 targets through the proposed 'very late competition generator build' model (Model 6, Figure 2). However, we have concerns that the blanket approach to classifications would lead to undue financial risk being placed on developers in instances where assets can be classified as "wider works" and therefore our view is that the development and construction of section of the transmission works outline in the NG ESO HND would be better placed with third party TOs under a different delivery model strategy.

We note the limited consideration of the supply chain within the impact assessment and the Minded-to decision overall. This is of particular concern for the supply of HVDC main equipment where the market currently has very few established suppliers with experience of providing HVDC offshore substations.

The HND has identified a requirement for 7 offshore and 8 onshore converter stations, in addition to the 5 subsea HVDC "bootstrap" projects identified for network strengthening projects. Overall, 25 converters are required prior to 2030, placing significant pressures on the supply chain in the UK alone.

Furthermore we are encountering instances whereby the HVDC electrical equipment suppliers are declining opportunities to submit tenders on a competitive basis due to the combination of severely limited capacity, high levels of demand as noted above, and the wider demands in the global supply chain for HVDC services.

While these impacts may be common to the delivery models presented, it is particularly concerning for the developer-led model as there is no clear mechanism or assurance in the current OFTO divestment process to account for alternative "single source" procurement approaches. These are currently being demanded by the supply chain to secure manufacturing capacity without undertaking a competitive tendering process, resulting in increased schedule pressure being placed upon developers.

2 Where you disagree with the draft impact assessment, does this raise any issues with our minded-to decisions?

EnBW and bp are concerned that Ofgem is expecting developers to commence Detailed Network Design (DND) and pre-consenting work immediately after summer 2022 without the proper alignment and integration of the HND, Anticipatory Investment (AI) and delivery model initiatives for the same infrastructure.

We suggest that an aligned and integrated process map is developed for HND, AI and delivery model.

We have identified two key observations for consideration:

HND output due diligence

EnBW and bp have made recommendations to National Grid ESO as part of the HND review process (included as appendix 1) where we believe that the solution proposed by NG ESO creates significant potential risk to project delivery and for excessive price escalation. As an example, the selection by NGESO of HVDC voltage and rating places considerable risk on developers to implement designs that require wind generation developers to deploy technology less proven in offshore settings than the more traditional HVAC approach. At present there is no stage assessment between HND output and final agreement of the Gateway Assessment which would allow for alternatives to be considered. As a result, developers are required to proceed at risk with alternative solutions until the Gateway Assessment process is undertaken, leading to significant uncertainty.

Delivery agreements and scope split

EnBW and bp believe the level and split of AI should be defined and integrated within the Gateway Assessment to ensure the correct level of investment, risk management and environmental impact as noted in our response to the AI Minded-to consultation.

The Minded-to text refers to a 'plug and play' for future connections (paragraph 3.15). HND Phase 1 has included varying levels of complexity and overall transmission system size from simple radial designs through to coordinated designs involving multiple point of entry (POI) locations, offshore wind generators and transmission operators as detailed in the East Coast non-radial design.

With non-radial transmission systems growing in complexity combined with a requirement to be mindful of HND Phase 2, the ability to undertake anticipatory investment with a blanket "Plug and Play" approach is prohibitive without placing excessive stranded assets risk on the end consumer. As a general principle, the developer should be compensated / ultimately not be liable for the additional cost and risk it takes in procuring oversized or unrelated infrastructure to the wind farm development – dialogue is needed to determine the liabilities and risks and then agree commercially with NG ESO and Ofgem how those risks should be borne during the development phase.

3 Do you agree with the proposed introduction of a new Tender Entry Condition in the Tender Regulations requiring the confirmation of the offshore transmission system as 'economic, efficient and coordinated'?

We can agree to the underlying principle of this if a reasonable amount of AI is added to the Developer's scope for offshore platforms. In our case this would currently mean adding significant scope to our project and accepting this through the Tender Entry Condition without prior alignment and discussion. To mitigate, we propose a refinement of the Gateway Assessment process as set out under consultation question 4 below.

EnBW and bp note that the requirement for an economic, efficient and coordinated design lies with NG ESO as part of the HND function taking account of the entire network considering future demand, onshore constraints and economics in comparison to alternative offshore solutions in meeting a social, environmental, deliverable and economic design.

As developer(s) working within the HND framework as presented, we are only able to confirm how our proposed project delivery structures will maintain the objectives of HND including economics, efficiency and coordination.

The new Tender Entry Condition could possibly work for simple coordinated offshore transmission systems, however for the complex, meshed HVDC system proposed by HND round 1 for our Morven project (SW E1a) it raises concern.

The intent of the new Tender Entry Condition is for developers to not "*solely prioritise their own assets and be incentivised to take on additional risk stemming from coordination"* (paragraph 4.1).

We include the below figure from the final HND announcement to elaborate our concern.

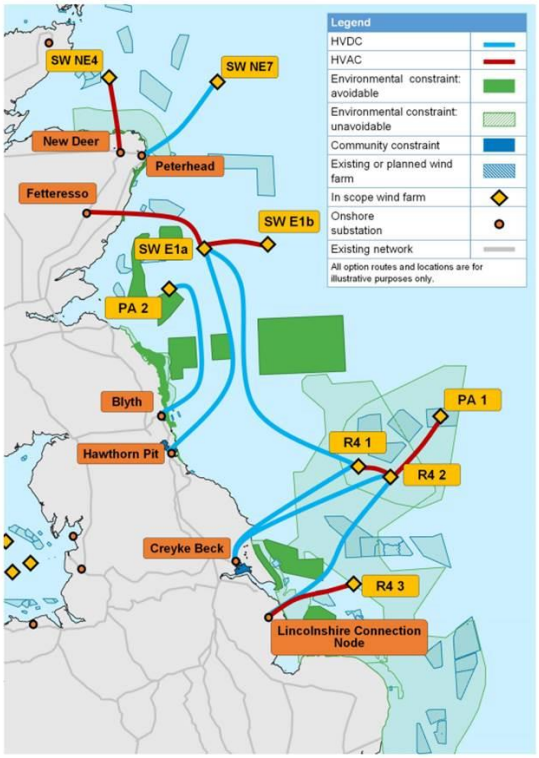


Figure 1 HND recommendations for Scotland East Coast

In the simplest reading of the proposal from the developer point of view, we would require one HVDC 1.5GW link from our Morven project (SW E1a) to Hawthorn Pit, with additional AI to connect to the HVAC system (which would not be for our use). However, the new Tender Entry Condition model bears the risk for the developer to build significantly more infrastructure than simply needed to connect our windfarm to the grid.

For our Morven project alone, the HND output appears to place the responsibility of two 1.8GW HVDC transmission systems (combined route length greater than 750km), one containing a multi-terminal HVDC interlink to the Dogger Bank projects and one 2GW HVAC network (route length greater than 150km) linking Fetteresso with our project and the adjacent SW E1b project.

This would increase the investment level for the transmission part of the project far beyond the investment level for the windfarm itself.

In our HND response to National Grid ESO (see Appendix 1 – EnBW and bp response to National Grid ESO HND consultation) we provided a modular approach to improve deliverability and cost effectiveness for the East Coast system which provided equivalence for social and environmental impacts. Unfortunately, these recommendations have not been incorporated and now represent a significant deliverability challenge to the transmission system for all developers. For that reason we recommend the inclusion of a HND due diligence stage as set out in our proposal under question 4 below.

4 Do you agree with the introduction of the proposed gateway stage assessment process?

EnBW and bp agree with the proposed Gateway Assessment process as a process in enabling certainty on the approach to non-radial design delivery as developers move forward with their projects.

There are several concerns around the process including the level of information required, commercial certainty and timing of the process as highlighted throughout our consultation response.

EnBW and bp suggest a clear expectation should be established of collaboration between relevant parties including the associated developers, NG ESO and the associated TOs throughout the Gateway Assessment process. This needs to start as soon as possible after HND (phase 1) disclosure and could include Ofgem as a mediating authority.

We propose a refinement and subdivision of the Gateway Assessment (GA) process for complex, coordinated offshore transmission systems into four consecutive stages. Each of the GA need to be signed off by Ofgem before moving to the next stage:

- GA1 (immediately following HND output): design follow up with further optimization and additional developer input
- GA2: Agreement on system split of all network assets (delivery boundaries) and their classification
- GA3: Anticipatory Investment assessment
- GA4: DND and start of consenting for agreed scope

5 Do you think the information sought as part of the Gateway Assessment process is appropriate and proportionate? Is anything missing?

In our view, the information sought as part of the GA process is insufficient. Expanding our response to question 4 above, the following provides a brief overview of the information we consider necessary at each step of the Gateway Assessment process.

GA1: Design follow up with further optimization and additional developer input

The HND output as published has presented instances where the level of deliverability of offshore assets is not possible without significantly increased risk[3] and financial support, where key HND feedback has not been incorporated or considered by National Grid ESO.

This stage of the Gateway Assessment is considered necessary for the involved parties to critique the HND output, make alternative recommendations as required and gain endorsement. The information sought would be a full evaluation of the presented HND design against financial, deliverability, environmental and economic categories including alternatives considered.

GA2: Agreement on system split of all network assets (delivery boundaries) and their classification

This stage is critical in dividing the non-radial transmission system into multiple projects. This will inform the Scope of Works for individual developers, consortia, TOs or otherwise in delivering the overall collective transmission system and setting any supporting roles and responsibilities.

Project divisions within the overall program will also represent segregation of OFTO (or other asset classification) into individual elements for the auction and operational phases post construction.

In support of the above, several key observations have been identified based on the HND output and the East Coast non-radial transmission system particularly:

- The East Coast non-radial transmission system presented in HND represents a significant development in excess of any one developer's investment in their associated Wind Farm Generating facilities and much larger than any OFTO facility within UK waters to date. By including a stage to divide the program of works into individual projects with agreement between developers and TOs, excessive financial risk is avoided for any one developer or TO. This will enable developments to proceed with commitments to build projects which are not financially prohibitive.
- The East Coast non-radial design is a substantial investment, larger than any OFTO auction in the UK to date. This may limit the pool of bidders able to enter the OFTO auction process due to financing size, potentially reducing competition compared to multiple individually auctioned projects within the same non-radial transmission system.
- EnBW and bp also believe that subdivision of the non-radial transmission system would provide diversity of transmission routes for Wind Farm Power generation.
- Smaller projects within the overall program will further support supply chain diversity.

[3] Including limited choice of suitable vessels to move and install the large-scale topside platforms. Our HND proposal also helps minimise the cost of plug and play AI, thereby reducing the risk of stranded AI assets and ultimately the costs borne by consumers.

Instances of wider works provide no benefit to developers and their access to the onshore transmission network. An example is included in the East Coast non-radial design where a HVAC line interconnects Fetteresso, SW E1a (Morven) and the adjacent SW E1b windfarm. We therefore recommend that a TO deliver such infrastructure as it is for TO sole use.

This link provides additional transmission capacity for the onshore network via the two HVDC OFTO links to Hawthorn Pit and Creyke Beck, which benefits other developments in the ScotWind leasing round. On the basis that the offshore wind developer is required to deliver such dual use elements that are not for their sole use, this would require considerable resource and financial investment, representing commercial risk considerably above that of the associated wind farm investment. Management of associated costs and risks will require multi-party agreement including with the TO.

GA3: Anticipatory Investment assessment

The Anticipatory Investment scheme needs to be integrated fully into the GA process. Please refer to our previous Ofgem consultation response on Minded-to Decision on Anticipatory Investment and Implementation of Policy Changes, and our response under question 2 above.

GA4: DND and start of consenting for agreed scope

Sufficiently developed design is needed to begin consenting individual projects within the HND. This is envisaged to include the number and approximate size of all substation sites, cable routes and ratings for the overall transmission system. Boundaries of ownership, interface, and anticipatory investment amongst all developers and TOs will need to be clearly identified in alignment with the principles of the previous stages.

Financial arrangements will be required for projects included in the transmission system, including elements relating to TNuOS charges and the OFTO auction procedure. Since the complexity and novelty of the proposed East Coast HND will require the development of "first of a kind" facilities, the process relating to cost benchmarking and cost assessment procedure to be applied should be identified at this stage.

All aspects of the project which are considered mandatory should be agreed during this stage to provide a basis on which change management can be actioned as well as the process to be followed.

6 Do you have any views on the timing of the Gateway Assessment process?

In line with process steps described laid out in questions 4 and 5 above, EnBW and bp believe that the gateway process should have the following timing:

- GA1 – immediately after HND final announcement (July 2022 for Phase 1)
- GA2 – September 2022
- GA3 – October 2022
- GA4 – December 2023

The above timeline is specific for HND Phase 1, however the principles can be replicated for later phases.

7 Is there any other information which you believe should be included in the confirmation to developers?

The Gateway Assessment process should provide clarity on the commercial and financial implications of the works undertaken by each developer and TO where appropriate.

All Gateway Assessments should be completed prior to BCA agreements being signed due to the financial implications of the BCA signing within the overall project with full clarity over the TNUoS charges to be applied to the project. In addition, the following should all be fully agreed and clarified as part of the GA confirmations:

GA1

- Identification of any mandatory requirements arising from the HND including schedule milestones, and commercial, technical, environment and social factors.
- Agreement on variations to the original HND design.

GA2

- Clear statement of delivery boundaries and asset classification of each sub-system (e.g. OFTO, Offshore Transmission, MPI).

GA3

- Endorsement (or otherwise) of AI method and schedules.

GA4

- Endorsement (or otherwise) of developer(s) and TO structures within the overall program of non-radial transmission system including:
    - Detailed Network Design
    - Construction responsibility
    - Consenting scope
- TNUoS charges for the offshore wind farm.
- Specific for East Coast HND round 1: Confirmation that the Fetteresso HVAC link is for transmission purposes only and not as a POI for Morven (therefore no TNUoS charging for Fetteresso Zone)
- Changes to GA1 agreed design arising from DND (Management of Change)

8 Do you think changes are required to the current process to facilitate a very late competition model for non-radial assets?

As noted in our responses throughout, EnBW and bp are of the opinion that non-radial transmission designs should be delivered in individual projects where the overall transmission development is intended to serve multiple wind farms across the network. This has the benefit of maintaining competition between different projects within the program of non-radial transmission works, allows flexibility around staggered developer construction schedules and enables more competitors to enter the OFTO auction process.

Splitting the program of non-radial transmission works into separate packages will enable individual developers to focus on delivering parts of the system that enable their projects to meet their commercial operation dates. This serves to limit or eliminate instances where interdependencies

between developments exist, allowing developers and Ofgem to manage the OFTO auction process within the existing structure and timelines.

If the entire East Coast non-radial design is procured by multiple parties and then placed in one OFTO auction (once fully completed), there would be significant and potentially prohibitive financial risk placed on each individual developer due to uncertainty over the delivery undertaken by the other developers. If the first developer met their schedule targets while the second developer was running several years late or were unable to complete, the auction process could not begin. This would leave the first developer's financial investment stranded for an unlimited period resulting in significant financial penalties. In our view, no third party finance provider to a wind farm project would bear this risk without government support.

If non-radial transmission systems are sub-divided into individual independent packages as outlined above, EnBW and bp believe the existing tendering process will remain fit for purpose.

9 Do you think changes are required to the current package of OFTO obligations and incentives due to the introduction of non-radial offshore transmission assets?

EnBW and bp believe the current incentives and obligations can remain fit for purpose, subject to the proviso detailed in question 8 above.

It is noted that competition in operation between OFTOs would be enhanced where large non-radial transmission systems are sub-divided into competing OFTO elements within the East Coast system.

Higher diversity of OFTOs and transmission routes is considered beneficial to both generators and customers as OFTOs seek to provide the most effective service instead of holding a large single monopoly of an entire system.

However, it is critical to implement an operational liabilities and penalty framework for the case of diverse OFTOs operating together in a non-radial design with impact on multiple developers. If liabilities and reimbursements are not clearly defined or insufficient, the risk of a single OFTO not performing might outweigh the benefit of competition in the system.

10 Do you think changes are required to other aspects of the OFTO regime, eg asset life or duration of the revenue stream?

Timespans under the current OFTO regime are not aligned with the most recent windfarm sizes and lease spans, with recent leases being more than 50 years. The expectations of the lease period and the OFTO regime should be aligned to enable long-term and long-life engineering enhancements.

Appendix 1 – EnBW and bp response to National Grid ESO HND consultation

Executive Summary – 04 - Coordinated Design East Region

bp/EnBW are grateful to NG ESO for their commitment to the HND process and providing the opportunity for feedback on the recommendations presented.

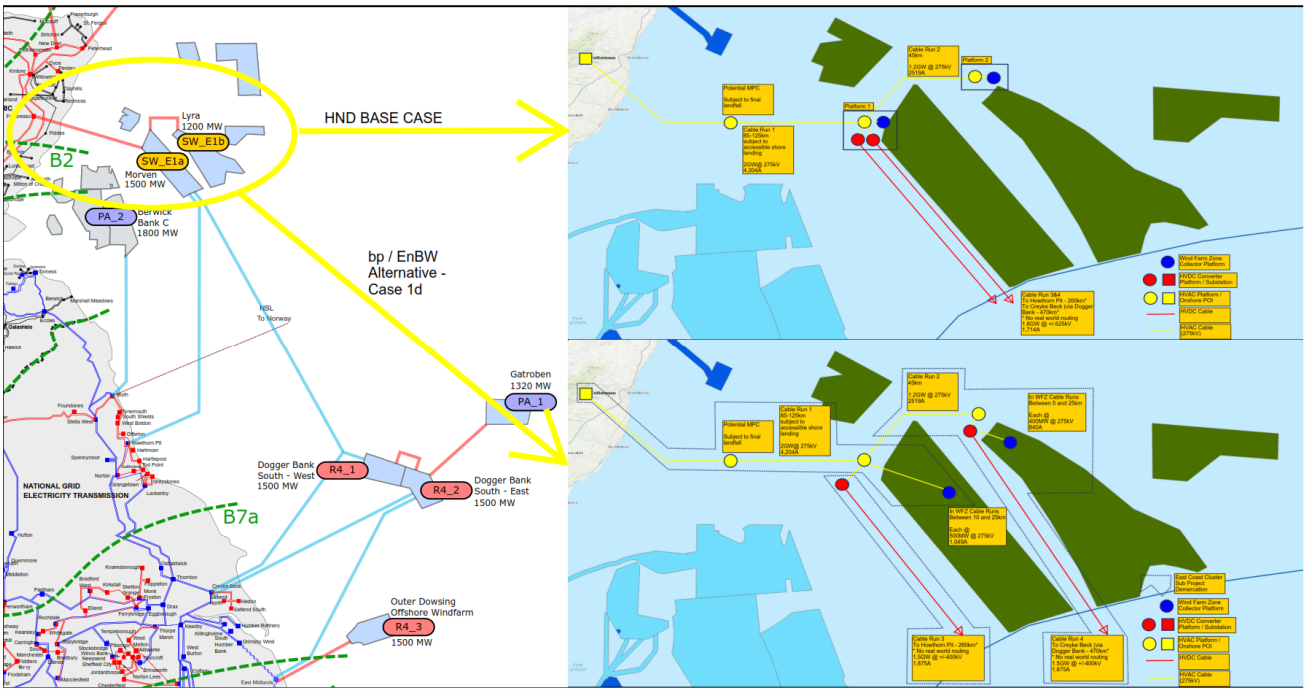
For ease, we have created an executive summary which outlines the key points from our response.

bp/EnBW would like to reiterate our open invitation to collaborate with the HND team and objectives. We believe constructive discussions in support of NG ESO strategic thinking in network development are key to success of the offshore wind industry.

Our commentary will focus on the practicalities of the recommended design structure and ways to increase deliverability within the timeframes and the key barriers which must be overcome. To this end, bp/EnBW have developed a detailed response in the ESO OAST feedback template along with an attached package of information.

Our analysis suggests the preferred coordinated proposal (option A) creates several delivery constraints and interdependencies between developers. Weight and size constraints also prohibit the feasibility of a single offshore substation platform approach.

As part of our response, we would like to introduce an optimised coordinated design (see diagram below) that focuses on improving the deliverability, likelihood of meeting the 2030 target and provides flexibility to include future strategic network development.



bp/EnBW generally support the proposed coordinated design but are concerned by several factors in the design criteria which we have accounted for in the optimised coordinated design as depicted above. However, we would like to highlight at the outset one area of concern and potential significant political challenge for our project where the concept exports all the Transmission Export Capacity (TEC) from Morven - as well as other eastern ScotWind projects - to England, bypassing Scotland. Given the potential political impact, we ask that NG ESO develops a clear communications and engagement plan which outlines how communications will be made to both Scottish & UK Governments and other interested parties and outline expected timings for engagement ahead of the decision announcement. We would be grateful to review this plan and offer input in advance of any announcement or engagement.

Furthermore, the following benefits of our proposed optimised design have been identified and presented within the four HND objectives:

Objective 1: Economic and efficient

- A key efficiency benefit is that the overall offshore coordinated design as proposed above can be split into three distinct elements of delivery without any interdependency on each other from a project perspective to achieve initial COD for the two windfarm projects Morven and SW_E1b.

- A standardised approach of interconnected 275kV hub platforms paired with an offshore HVDC platform for export to England (or Europe) which can be replicated multiple times. This enables:
    - Timely connection to the HVAC infrastructure.
    - Flexibility in relation to delivery model.
    - Reduced rating of HND phase I due to 1.5GW HVDC technology readiness can be grown through HND phase II as and when required.
    - Ultimately interconnect with an offshore HVDC MPIs grid.

Objective 2: Deliverable and operable

- We have increased deliverability by moving one HVDC converter station to the adjacent project, SW_E1b, reducing construction activities in one development zone and dependencies between projects within the Cluster.
- Our design segregates the two platforms presented in HND for the East Coast Cluster into multiple platforms within the capabilities of offshore lift vessels and allows for three individual connection projects (boundaries indicated in diagram above) to be created under the overall East Coast Cluster Programme.
- The HVDC converter platform with a reduced rating to 1.5GW ensuring a constructable weight and realistic technology readiness for an offshore application. Following detailed consultation with the major OEMs, the proposed 1.8GW HVDC converter platforms would require multiple lift (modular) platforms design involving significant offshore hook-up scope. We specifically highlight the overall weight would be more than 15k tonnes, greatly constraining the UK content options and the offshore construction / hook-up market competition. The primary benefit of our approach is to ensure each platform is individually liftable in a single lift, while reducing offshore hook-up and interactions between platforms / developers as far as practical. The reduced lifting weight also introduces greater market competition and associated cost reductions whilst reducing project risk associated with extreme offshore lift requirements.
- The modular design approach presented, using 1.5GW building blocks allows for full East Coast Cluster development during HND phase I and II. A short term HND phase I transmission capacity shortfall is identified of 600MW because of 1.5GW HVDC building blocks. In the event the full transmission capacity is required in phase I, our proposed modular design can be amended to three 1.2GW HVDC links, although at a higher cost than the optimised modular approach.

Objective 3: **Minimise environmental impact**

- The optimised modular approach recommended by bp/EnBW provides a known and predictable methodology for coordinating cable routing / impact of multiple projects directly to the point of interconnection (POI) in the UK or Europe of multiple projects.
- bp/EnBW have undertaken initial route consenting studies to Fetteresso and identified a very challenging landfall access due to steep cliffs and seabed, a small number of landing points have been identified which result in long cable routes onshore.
- bp/EnBW would seek to work with existing projects including both Wind Energy and Bootstraps to minimise cumulative impact to environmental for all cable routes associated with the East Coast Cluster programme.
- Shared transmission facilities and cable locations are constrained by Marine Protection Areas in the area around the Firth of Forth area and must be carefully selected to avoid environmental impacts.

Objective 4: Minimise local community impact

- The proposed modular design concept enables forthcoming development phases, (including routing and consenting), to be planned and coordinated in collaboration with future developments, thereby minimising community impacts resulting from disruption during the construction phase.

Attachments – Morven HND Response Information Pack.

The attachment provides a broad overview of the options reviewed by bp/EnBW in arriving at our optimised Coordinated Design to further enhance the HND Preferred Coordinated solutions offered. bp / EnBW are available to provide further explanation as required. bp / EnBW have also undertaken a detailed review of all POI's associated with Morven and have developed a further information package which we are available to present to NG ESO as required.

Radial OASTs feedback

Feedback on the overview of the options

Section	Feedback
Option overview map (document 2)	03 - Radial Design Scotland East region
Option description	Option A and Option B SW_E1b to Blyth (1.5GW HVDC)
Other variations within this option	
Onshore Transmission Owner works	NGETO / SPT

Feedback on each of the objectives

Objective		Feedback
1. Economic and efficient	Cost differentials	**Capex** A HVDC connection to Blyth introduces significant CAPEX over a local HVAC POI connection. Fetteresso would offer a more economical solution for Morven from an individual project development perspective. bp/EnBW have a limited view of the overall system benefits offered by selecting Blyth over a local HVAC solution but appreciate that the optimiser stage of HND may have found the onshore reinforcements necessary to be prohibitive from cost, environmental and social perspectives. On the basis that the radial connection is developer led this would help package a single end-to-end project program (offshore transmission infrastructure together with offshore wind farm) for third party project financing, which would be seen as positive (from a management of risk perspective) by the banks.
2. Deliverable and operable	Construction/delivery technical issues	
	Deliverable by 2030	
	Design and supply chain consideration	HVDC supply chain will be under considerable pressure and securing equipment build and installation prior to 2030 is a major concern.
	Further technical and wider network considerations	
3. Minimise environmental impact	Commentary	**Offshore** • The OAST recognises route EE16 is heavily constrained. There are several protected sites located between SW_E1a and the proposed EE16 cable route landfall location at Blyth.

		Based on the information presented in the Draft OAST it is assumed these will be avoided except for the Berwick to St Mary's and Coquet to St Mary's MCZ, Northumberland Marine SPA and Northumberland Shore SSSI. • It is unclear where the exact landfall location is planned. The OAST notes potential constraints could be managed using standard construction mitigation measures. It is notable that the landfall option route analysis conducted for the North Sea Link selected a location at the north end of Cambois Beach. A location at the south end of Cambois Beach was excluded due to its proximity to residential areas and potential conflict with cables from the Blyth Offshore Wind Farm. It is understood additional cables for Phase 2 of the Blyth Offshore Wind Farm are also planned for this area. • It is understood that several HVDC cables are planned for the east coast between Scotland and England out to 2032, including E2DC (SEGL1 Torness to Hawthorn Pit), E4D3 (SEGL2 Peterhead to Drax), E4L5 (Peterhead to South Humber) and TGDC (Southeast Scotland to South Humber). There is potential for cumulative impacts on the marine environment to occur from these developments. The presence of all these cables may mean it is more challenging for additional cables (i.e. EE16) to avoid environmentally sensitive areas as the other cables will already have identified the routes of least potential environmental impact. **Onshore** It is understood a short (onshore) 1km length cable route to Blyth substation is planned. On this basis the following key environmental characteristics are relevant: • Access at the landfall would be required through the marine protected areas described above. • Onshore cable route would be short, potentially minimising impacts. A trenchless shore crossing method such as Horizonal Directional Drilling (HDD) could reduce potential impacts. • The existing substation is located in the Northumberland Energy Park (part of the Energy Central cluster). This area is predominately brownfield land meaning sensitivity levels are low and environmental impacts are likely to be minimal, (although no location is apparent for a new substation/convertor station and space could be constrained). • Cumulative impacts are likely to arise (e.g. noise, air quality, landscape and visual) in combination with the development of large factory units built out of Energy Central or developments currently in the planning process such as the proposed Gigaplant and subsea cable manufacturing facility. New onshore cables for Blyth Offshore Wind Farm Phase 2 are also planned to connect to the existing substation.
4. Minimise local community impact	Commentary	• The potential for impacts to fishing, shipping and navigation activities in the nearshore areas would require investigation. For example, the North Sea Link project excluded a possible landfall location at Sandy Beach as it was used intensively for fixed net fishing, and fishing activity would be significantly restricted during installation activities. • There are only a small number of residential receptors in the vicinity of the landfall, cable, and substation area. Although the number of receptors is relatively small, they will potentially experience prolonged periods of disturbance from the extensive development planned for the area in addition to the EE16 cable.

		• Early stakeholder engagement with the local community would be important to minimise community impacts and reduce opposition to the proposals.

Feedback on overall Recommendation

	Feedback
Overall recommendation	Where the concept exports all the Transmission Export Capacity (TEC) from Morven - as well as other eastern projects - to England, bypassing Scotland, we anticipate a significant political challenge for our project. Given the potential political impact, we recommend that NG ESO develops a clear communications and engagement plan which outlines how communications will be made to both Scottish & UK Governments and other interested parties and outline expected timings for engagement ahead of the decision announcement. We would be grateful to review this plan and offer input in advance of any announcement or engagement.

Coordinated OASTs feedback

Feedback on the overview of the options

Section	Feedback
Option overview map (document 2)	04 - Coordinated Design East region
Option description	The following narrative will focus on the HND presented Option A – Preferred coordination options unless explicitly stated.
Other variations within this option	
Onshore Transmission Owner works	SSEN (Fetteresso) NG EN (Hawthorn Pit & Creyke Beck)

Feedback on each of the objectives

Objective		Feedback
1. Economic and efficient	Cost differentials	**Capex** Due to the limited cost basis information provided by the HND we can offer only a high-level response. We request further detail on the costing model used by the HND for the offshore platforms to enable more detailed feedback. The design presented depicts two platforms in the East Coast Cluster: 1. E1a offshore Platform is shown as one overall platform including Windfarm array switchgear at 66kV, HVAC switchgear at 275kV and two 1.8GW AC to DC converter units. 2. E1b Offshore Platform is shown as one overall platform including Windfarm array switchgear at 66kV, HVAC switchgear at 275kV. The 275kV HVAC transmission voltage would require a dedicated platform at each Windfarm Zone weighing in excess of 10k tonne.

		nally, an arrangement of Windfarm Collector Platforms integrated into the Wind Park Zones would be required, with modest lift weights below 10k Tonne. We request a clarification to confirm that the two platforms shown in diagram 12 East SLD D1 are correctly factored to reflect actual delivery costs associated with this design. Considering the points raised above and the lower costs associated with onshore converter stations compared to offshore, it is clear that providing transmission capacity via an offshore networking using AC to DC conversion on a platform is considerably more CAPEX intensive than providing a dedicated onshore point to point link (boot strap) in support of onshore grid power flows. **Financing / Commercial** Prospective lenders to Morven phase 1 will see the proposed approach and likely view this as a riskier development vs. the proposed design scope we have made – this being potentially problematic for a mature project finance market at a time when a lot of UK projects will be coming to market to attract funding, competing for bank liquidity. The impact on project risk of not being in control of the first phase of the OTI assets will likely be a credit negative for lenders beyond a few basis points on the credit spread and may require bp and EnBW to concede terms we would otherwise wish not to, to get the financing done and manage the lenders' natural concerns on completion risk. Via our proposal we enable the connection of SW_E1a with minimal design impact and cost which would be seen more favourably by the banks. Request: bp/EnBW note that power can be diversly transmitted from the East Coast Cluster under HND plans for both current and future developments joining the 275kV interlocking hubs to different TNUoS zones. During HND phase 1 alone, there is potential to supply power into three different POI's, Fetteresso, Hawthorn Pit and Creyke Beck in varying quantities and hence different TNUoS. With the diversity in generators in the East Coast Cluster and POI's receiving power in varied TNUoS zones, it is evident that a potential conflict exists with regards to TNUoS charge applied to all developers. bp/EnBW request guidance on how TNUoS charges will be levied in a fair and balanced approach for users of the East Coast Cluster Transmission system?
2. Deliverable and operable	Construction/delivery technical issues	---Observation item 1--- Reference: SINGLE LINE DIAGRAM – EAST REGION OPTION A sheets 1&2 Based on bp/EnBWs interpretation of the supplied SLD, we derive: • E1a offshore Platform shown as one overall platform including Windfarm array switchgear at 66kV, HVAC switchgear at 275kV and two 1.8GW AC to DC converter units. • E1b Offshore Platform is shown as one overall platform including Windfarm array switchgear at 66kV, HVAC switchgear at 275kV. Our analysis suggests the concept creates several delivery constraints and dependencies between developers. Weight and size constraints also prohibit the feasibility of a single platform approach. In support of the HND objectives bp/EnBW have developed several detailed design concepts and analysed their merits against the HND assessment criteria. We have concluded that there are two optimised concepts that should be considered. 1. Relocation of a 1.8GW HVDC converter station onshore at Fetteresso with 'bootstrap' to England greatly improves design efficiency by minimising offshore scope

2. Rearrangement of the HND coordinated to greatly improve the deliverability, project financing and developer integration risk.

For optimised concept one, although we recommend the HND considers this option, as this introduces greater level of social / environmental impact onshore along with the congested coastline we consider this concept as lower priority.

Optimised concept two, this is focused on improving the deliverability and likelihood of meeting the 2030 offshore wind target. bp/EnBW recommend the platforms should be broken down into deliverable elements and costed appropriately. Following consultation with the major OEMs, the proposed 1.8GW HVDC converter platforms would require multiple lift (modular) platforms design involving significant offshore hook-up scope. We specifically highlight the overall weight would be more than 15k tonnes, constraining the UK content options and the offshore construction / hook-up market competition.

We have provided alternative SLDs to outline this approach of maximising deliverability via discreet elements of the offshore transmission design. For more information refer to the attached Morven HND Response information package.

The following key features are noted and the benefits to deliverability:

- Within the Morven Windfarm Zone (WFZ), up to three individual 500MW “WFZ Collector Platforms” are recommended to collect local power park modules at 66kV before stepping up to 275kV. This provides effective and efficient power collection within the WFZ and onward transmission at 275kV over one single cable connection per collector platform.
- The voltage step-up within the WFZ allows simplification of the 275kV hub platform designs. Minimising weights despite a large number of interconnecting circuits and ensuring a highly deliverable platform within the supply chain market capability.
- Interfaced to the 275kV hub platform, each HVDC converter platform is rated is reduced to 1.5GW ensuring a constructable weight and technology readiness in an offshore application.
- It is proposed that one HVDC platform is placed adjacent to the Morven field, while a second is placed adjacent to the SW_E1b field instead of both at the Morven field.
- 275kV hub platforms are proposed to be provided at Morven and SW_E1b to provide interconnection of the HVDC platforms and the 275kV transmission interconnection back to Fetteresso.

The primary benefit of the above is to ensure each platform is individually liftable elements while reducing offshore hook-up and interactions between platforms as far as practical.

A secondary benefit is the overall offshore coordinated design can be split into three distinct elements of delivery without any interdependency on each other to achieve initial COD for the two Windfarms (also refer to associated project financing risks in section 1.).

Furthermore, the HVAC cable connection between Morven and SW_E1b 275kV hub platforms can be reduced from 1200MW to 500MW as an option, subject to Anticipatory Investment for HND ‘Phase 2’.

A standardised building block can be formed by interconnecting each WFZ with a paired HVDC converter station and then to local 275kV hubs for deployment in each developer site. These standard

building blocks provide the overall cluster flexibility in expansion and schedule flexibility to meet both phase I and II of the HND requirements in the local Cluster area. Meeting developer needs, transmission capacity requirements and transmission diversity between final POI points in England (or Europe).
As a downside of recommendations and alignment of the HVDC converter size to 1.5GW instead of 1.8GW to suit technology readiness and offshore lift weights, a reduction of 600MW transmission capacity during HND phase I will be observed. This limitation may be overcome in subsequent phases as further wind farm developments are implemented with the same modular size building blocks are by using three 1.2GW HVDC converters within the building blocks during HND phase I.
As such the 275kV hub platform infrastructure improves availability as it grows through HND 'phase 2' and feature the option for further interconnection to the onshore grid as required.
Offshore Lift context
Lifting weights are critical in the design of offshore platforms. With UK Continental shelf historically limiting lift module sizes to less than 10k tonne in an effort to avoid the need for float over designs. This allows competition between two potential contracts / vessels, with weights below this introducing further completion and options. High lift weights place a considerable dependency on a very small number of offshore lift supply chain vessels and results in higher costs and schedule consents to secure lifting vessel availability.
Also, offshore lift weights in excess of 10kt will result in split modules and offshore hook-up requirements. This drives significant cost and schedule into the overall delivery of offshore installations and should be avoided.

---End item 1---

---Observation item 2---

The 275kV Coordinated design interconnecting Fetteresso, Morven and SW_E1b will be more than 260km considering 275kV cable connections to individual WFZ Collector platforms in each Windfarm as well.
A transmission system consisting entirely of cable over such long lengths is entirely unique and represents several unique risks to the overall East Cluster Programme.
While distributing HVDC converters at Morven and SW_E1b will provide dynamic stability of the 275kV cable link,
The cable length is unique with no known equivalent in operation either onshore or offshore. The solution represents a key risk. The following items are known to increase in risk as the cable length increases and these must be resolved prior to final technology section:

- TRV switching
- Compensated Cable Energisation
- Missing current zero crossings current energisation and fault events
- Energisation of radial end connections
- Energisation of transformers
- Energisation of reactors
- Energisation of filters
- Harmonic content and compliance
- Dynamic stability

While bp/EnBW support the requirement for HVAC within the East Coast Cluster to provide power sharing between developments and opportunities to provide North / South Transmission capabilities, the connection between the East Coast Cluster and Fetteresso should

		robustly eliminate all the issues identified in the above associated with a long AC connection or consider HVDC for this connection. ---End item 2--- ---Observation item 3--- Offshore cable route between Fetteresso and Morven Windfarm Zone / Platform 1, runs via a challenging landfall access zone and a Marine Protected Area. Onshore cable routing to access a suitable landfall point and offshore routing to avoid the Marine Protected Zone may result in a significantly longer cable route between Fetteresso and the 275kV Hub platform at Morven than anticipated as part of the HND review. This may result in a non-feasible HVAC design for this initial connection. Similarly, a suitable landfall for 4 HVAC cables along the Aberdeenshire Coastline may be prohibitive. As a result of the above, early engagement to identify suitable access points will be required. Options for HVDC to reduce the cable landing burden may be required. Mid-station compensation should be considered within the base case costing of cable runs between Fetteresso and Morven as a HVAC design. ---End item 3--- ---Observation item 4--- 525kV / 1.8GW Technology Readiness for application offshore. Following bp/EnBW's detailed engagement with OEMs, we wish to highlight that the current market position for offshore HVDC converter station is based around symmetrical monopole 320kV solutions with power outputs of 900MW, primarily in the German Sector. We are aware of several projects currently in development / construction, which push the overall capability to 1.2 – 1.3 GW at 320kV within a lift weight of less than 10k tonne. Transitioning directly to 525kV will increase weights and dimensions for equipment and associated clearances significantly – directly impacting constructability and transportation capabilities as weights increase over 15k tonne. Weights of over 10k tonne are anticipated to require multiple lifts and significant offshore hook-up scope. Such a step is considered to be outside of the technology readiness roadmap for offshore application and a more modest increase should be considered in this round of the HND, such as 400kV with rating of up to 1.5GW to stay within 10k tonne lift targets. Lower lift weights also reduce project risk exposure in a challenging environment. ---End item 4--- ---Observation item 5--- Multi-terminal HVDC approach between East Coast Cluster, Dogger Bank Southwest, and Creyke Beck. bp/EnBW understand from the market, a multi-terminal HVDC VSC concept featuring multiple converters contributing to the HVDC infeed is not considered Technology Ready for application offshore. We believe it represents a significant risk to delivery and operability, with only one known example in the planning stage currently, which is notably onshore (Shetland Link). Furthermore, we wish to raise concerns over both power flow management and fault conditions. We request a clarification should be provided over the operation of this system to ensure secure delivery of 2030 targets. ---End item 5---
	Deliverable by 2030	The co-ordinated design would result in a complex consenting regime requiring separate planning and marine license applications

		for the initial scope of Morven 1B grid application (1.5GW) of the project including: • Offshore windfarm area Section 36 application/s and Environmental Impact Assessment/s (EIA) submitted to Marine Scotland Licensing Operations Team (MS-LOT). • Separate Marine license applications and Environmental Appraisal Report/EIAs submitted to MS-LOT for the cable route (ESIn11) from landfall at Fetteresso to the offshore substation (SW_E1a); and offshore substation (SW_E1a) to Scottish/English waters boundary for both the Hawthorn Pit (EEIn12) and Creyke Beck (EEIn3) cables. • Separate Marine License applications to the Marine Management Organisation (MMO) from Scottish/English waters boundary to cable route landfall locations leading to Hawthorn Pit (EEIn12) and Creyke Beck (EEIn3 to R4_1 and EEIn1 from R4_1) substations. • Three town and country planning applications (TCPA) for each of the onshore cable routes and substations / convertor stations. There is potential for a Development Consent Order (DCO) application to be submitted covering the offshore and onshore cable route infrastructure in English waters / onshore England which may consolidate the consenting approach. However, whichever consenting strategy is adopted, it would be complex and unlikely to achieve the desired delivery of power by 2030. The extensive cable routes onshore and offshore will also require significant survey work and data processing, and there may be a requirement to undertake two years of intertidal bird surveys at the landfall locations, both of which will impact on overall consenting timescales. Opportunities to reduce the consenting timeline by integrating the power export requirements for SW_E1a into other existing or planned east coast bootstrap routes should be investigated. In addition, opportunities to expand environmental and other studies and surveys conducted for E2DC (SEGL1) and E4D3 (SEGL2) to cover SW_E1a should be identified. It is considered that a shorter direct export cable route to Fetteresso would be the option most likely to deliver power by 2030. HND Option B – Alterative Coordinated. This option has been dismissed as not technically viable due to the length of the AC connection between Morven and NE7, circa 170km plus.
	Design and supply chain consideration	HVDC and associated cable supply chain will be under considerable pressure and securing equipment manufacture window and installation prior to 2030 is a major concern.
	Further technical and wider network considerations	Request: we would like to understand the categorisation for the HVAC and HVDC part of the design considering Enabling vs Wider works. We are also looking for any further opportunity to quantify the non-firm HVAC connection to Fetteresso.
3. Minimise environmental impact	Commentary	**Offshore** • It is noted in the OAST that the offshore cable routes connected to SW_E1a (i.e. ESIN11, EEIn12 and EEIn3) can be routed to avoid key environmental constraints such as designated sites. However, the Firth of Forth Bank Complex Marine Protection Area abuts the north-west boundary of the Morven site, this will constrain the potential locations for siting the HVAC platform and HVDC Convertor station/s and is likely to result in both the Creyke Beck (ENIn3) and Hawthorn Pit (ENIn12) cables needing to run to the east of SW_E1a. In addition, it is noted in the Draft OAST that the cable routes EEIn3 and EEIn1, which enable SW_E1a to connect to Creyke Beck via R4_1, will need to pass through the Dogger Bank SAC.

- Regarding the potential landfall location for cable route ESIn11 for Fetteresso, initial constraints analysis conducted by bp/EnBW indicates limited suitable landfall locations in this area – potential areas identified include near Portlethen, just north of Stonehaven or north of Montrose in order to avoid steep sloping seabed and cliffs. Key sensitivities in these areas include fish spawning / nursery areas and passing in close proximity to a number of SPAs and SSSIs.
- It is unclear where the exact landfall location is planned for the EEIn12 cable route landfall near Hawthorn Pit. It is notable that the E2DC (SEGL1) project selected a landfall just north of Seaham as the option route analysis studies excluded potential sites further south nearer a direct route to Hawthorn Pit substation due to very complex topography and geology and potential disturbance to both operations at the port and potentially marine habitats. It is noted the OAST also recognises the landfall at Hawthorn Pit is challenging technically and that a number of alternatives may need to be considered in the detailed design.
- It is understood the EEIn1 route corridor from R4_1 will make landfall near Ulrome or Skipsea. It is noted that the Hornsea 4 offshore wind farm export cables are planned to make landfall just north of this location at Fraisthorpe while the Dogger Bank A & B offshore wind farm cables will make landfall at Ulrome. Therefore, there is potential for cumulative impacts to occur from a new cable landfall in this area.
- It is understood that several HVDC cables are planned for the east coast between Scotland and England out to 2032, including E2DC (SEGL1 Torness to Hawthorn Pit), E4D3 (SEGL2 Peterhead to Drax), E4L5 (Peterhead to South Humber) and TGDC (Southeast Scotland to South Humber). There is potential for cumulative impacts on the marine environment to occur from these developments and the presence of all these cables may mean it is more challenging for additional cables (i.e. EEIn12, EEIn3 and EEIn1) to avoid some environmentally sensitive areas as the other cables will already have identified the routes of least potential environmental impact.

Onshore

<u>Fetteresso</u>

- It is understood from the Draft OAST that an onshore cable approximately 18km in length will be constructed heading north from the proposed landfall location. This is relatively close to a landfall location north of Montrose which had initially been identified by bp/EnBW.
- Key constraints in the area include several SSSIs, areas at higher risk of coastal and surface water flooding and areas of ancient woodland to be avoided.

<u>Hawthorn Pit</u>

- Significant electrical infrastructure is already proposed to connect into Hawthorn Pit comprising E2DC (SEGL1) which runs from Torness to Hawthorn Pit and is due to be submitted for planning in Spring 2022. The scheme requires 2 x 10km onshore cables, new substation, and convertor station. The landfall is located north of Seaham in a gap between protected areas and a beach and the onshore route is mainly through agricultural land before approaching the Hawthorn Pit substation from the west.
- Potential ground contamination from former colliery workings is present around the existing substation which may limit development areas for new infrastructure.

		• An additional cable route to Hawthorn Pit substation would increase the environmental impacts in the area. The most beneficial approach to minimise impacts, would be to coordinate with the SEGL1 onshore cable corridor to reduce the onshore development footprint. <u>Creyke Beck</u> There are several new cable routes / convertor and substations which are either being constructed or planned for Creyke Beck: • *Dogger Bank A&B* – Under construction • *Hornsea 4* – DCO application in development • *Peterhead to Drax SEGL2* bootstrap • The cumulative environmental impacts of the proposed developments at Creyke Beck will be exacerbated by the additional cable corridor unless there is any opportunity for cable design / routes to be future proofed to accommodate additional cables. The landfall options will also be constrained due to the number of existing cables accessing this area and may result in a less favourable environmental option being selected *Humber Low Carbon Pipelines (HLCP) Project* National Grid Ventures (NGV) are developing the onshore part of a dual pipeline system to transport carbon dioxide and hydrogen between Drax in North Yorkshire to a landfall point on the Holderness coast in East Riding of Yorkshire. Seven potential landfall locations and onshore routing options were initially identified in constraints studies. This included potential landfalls at Ulrome Sands to Fraisthorpe Sands, which is being considered for route corridor EEIn1, and onshore routes in the vicinity of Beverley and Creyke Beck Substation. The HLCP routing study notes that land south of Beverley is heavily constrained due to common land and obtaining a land purchase agreement for the area of land around Creyke Beck Substation was also considered a potential risk. The final route selected for the HLCP project is not in the immediate vicinity of Creyke Beck Substation or the likely route of the new onshore HVDC cable associated with Morven, however National Grid will be able to utilise the previous route studies for future cable routing studies in this area.
4. Minimise local community impact	Commentary	• Based on the Draft OAST the onshore section of route EEIn1 to Creyke Beck will be at least 27km in length and is likely to pass in proximity to several residential areas and require road and rail crossings in numerous locations. • The main impacts on communities are likely to be disturbance from construction activities, (e.g. noise) landscape and visual impacts arising from the new infrastructure required. • As described above, the number of cables connecting into Creyke Beck and to a lesser extent Hawthorn Pit will inevitably lead to stakeholder fatigue with the number of developments being consulted on. This could be minimised by coordinating cable routes with existing developers and National Grid to reduce the amount of future disruption. • Additional new developments may lead to frustration for the local communities impacted and opposition to the proposals. Early stakeholder engagement with the local community would be important to minimise community impacts and reduce opposition to the proposals.

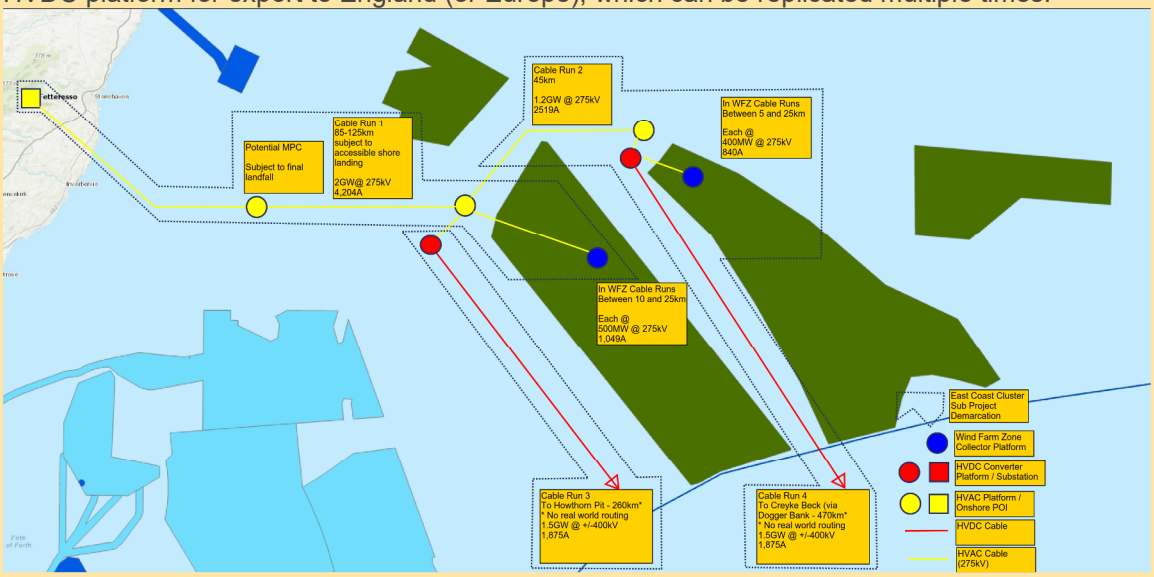
Feedback on overall Recommendation

Feedback

Overall recommendation

Following a high-level review of the benefits against the HND objectives and the perceived transmission requirements which ESO have put forward into the HND recommendation, bp/EnBW have developed an alternative option as presented below, ref option 1d (also detailed within the attached information package). This alternative addresses the concerns identified in the specific feedback sections to ensure deliverability of the East Coast Cluster Programme. The optimisation does not introduce any further social and environmental impact but does improve economics, operability and deliverability compared to the base case.

A key efficiency benefit is that the overall offshore coordinated design as proposed above can be split into three distinct elements of delivery, without any interdependency on each other from a project perspective to achieve initial COD for the two windfarm projects Morven and SW_E1b. Further, a standardised approach of interconnected 275kV hub platforms paired with an offshore HVDC platform for export to England (or Europe), which can be replicated multiple times.



The optimized coordinated design assumes that a level of non-firm TEC can be secured at Fetteresso. Hence, we are recommending a phased approach for the overall design. The first project to be delivered within the programme would be the Morven WFZ and connection to Fetteresso as HVAC. This provides the most schedule secure approach to meeting 2030 wind generation targets due to the shortened lead times associated with HVAC technology.

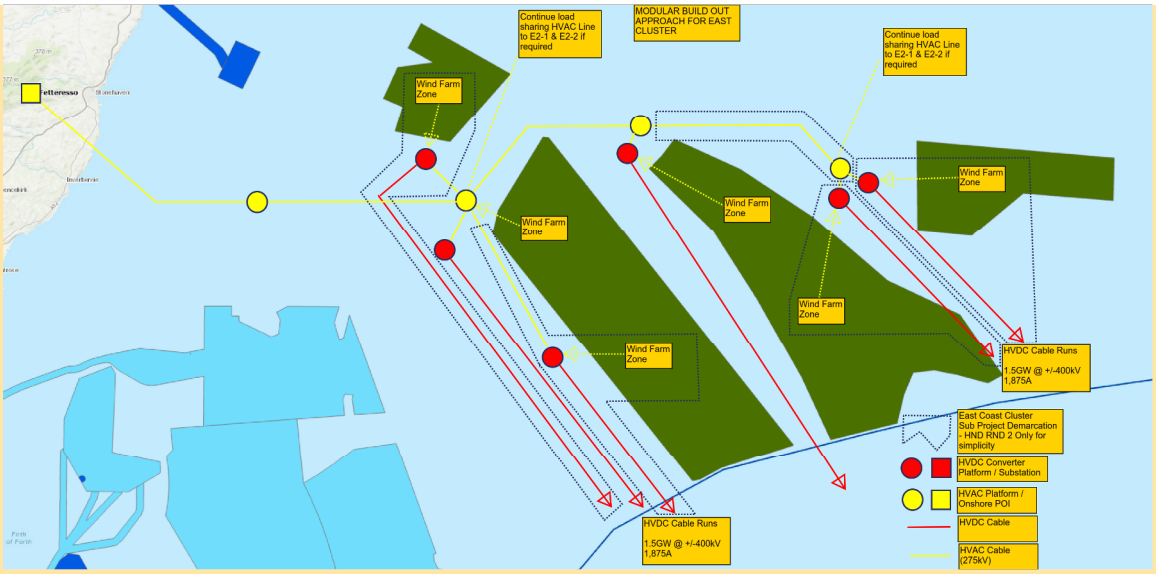
In parallel, the second project in the East Cluster will be developed, the HVDC link to Hawthorn Pit. Due to HVDC lead times and longer consenting periods associated with the longer cable run, this is anticipated to be operational by 2032. Once completed, the non-firm TEC entry at Fetteresso would be revoked and all power transferred to Hawthorn Pit over the HVDC link and consider as firm TEC.

This concept represents the modular approach for all future connection within the same cluster and optimise the driver and optimum point for the HVDC link to increase the capacity across the network.

Minimal additional Anticipatory Investment is required at the HVAC platform adjacent to the Morven area to provide connection options for HND round 2, please refer to our recommendation for round 2.

The approach supports several different delivery models.

Finally, a view towards HND round 2 has been included for ESO's consideration in their ongoing works. This includes three potential approaches for the East Coast Cluster which build upon the modular project approach adopted in the alternatives presented in the package. We consider this approach to be beneficial to the schedule and a phased build out of the offshore network while reducing Anticipatory Investment to the minimal possible amount. The approach is also considered to be in alignment with the European Interconnection Programme.



We note that infrastructure indicated to the west of Morven will need to be carefully sited to minimise impact on the Firth of Forth Banks Complex MPA or relocated to the east of Morven.

Morven Project

SLD options HND Round 1

Date: May 2022

Partners in UK offshore wind

SLD Options and Recommendation

Partners in UK offshore wind

Several options have been evaluated to increase deliverability, operability and cost efficiency of the presented design while maintaining the overall concept presented in HND.

Following a high-level review of the benefits against the HND key objectives and the perceived transmission requirements which ESO have designed into the HND recommendation, option 1d has been identified as the preferred modification to the design presented as part of HND. The design provides a balanced impact for social and environmental considerations while improving economics, operability and deliverability compared to the base case.

The design assumes that a level of non-firm TEC can be secured at Fetteresso. Hence, we are recommending phase approach for the overall design. The first project to be delivered within the programme would be the Morven WFZ and connection to Fetteresso as HVAC. This provides the most schedule secure approach to meeting 2030 Wind Generation Targets due to the shorted lead times associated with HVAC technology.

In parallel, the second project in the East Cluster will be developed. Due to HVDC lead times and longer consenting periods associated with the longer cable run, this is anticipated to be operational by 2032. Once completed, the non-firm TEC entry at Fetteresso would be consider as firm TEC after completion of HVDC link to Hawthorn Pit.

This concept represents the modular approach for all future connection within same cluster and optimise the driver and optimum point for the HVDC link to increase the capacity across the network.

Minimal additional Anticipatory Investment is required at the HVAC platform within the Morven area to provide connection options for HND round 2, please refer to our recommendation for round 2.

The approach supports a number of different delivery models.

SLD Option 1d – Preferred Recommendation

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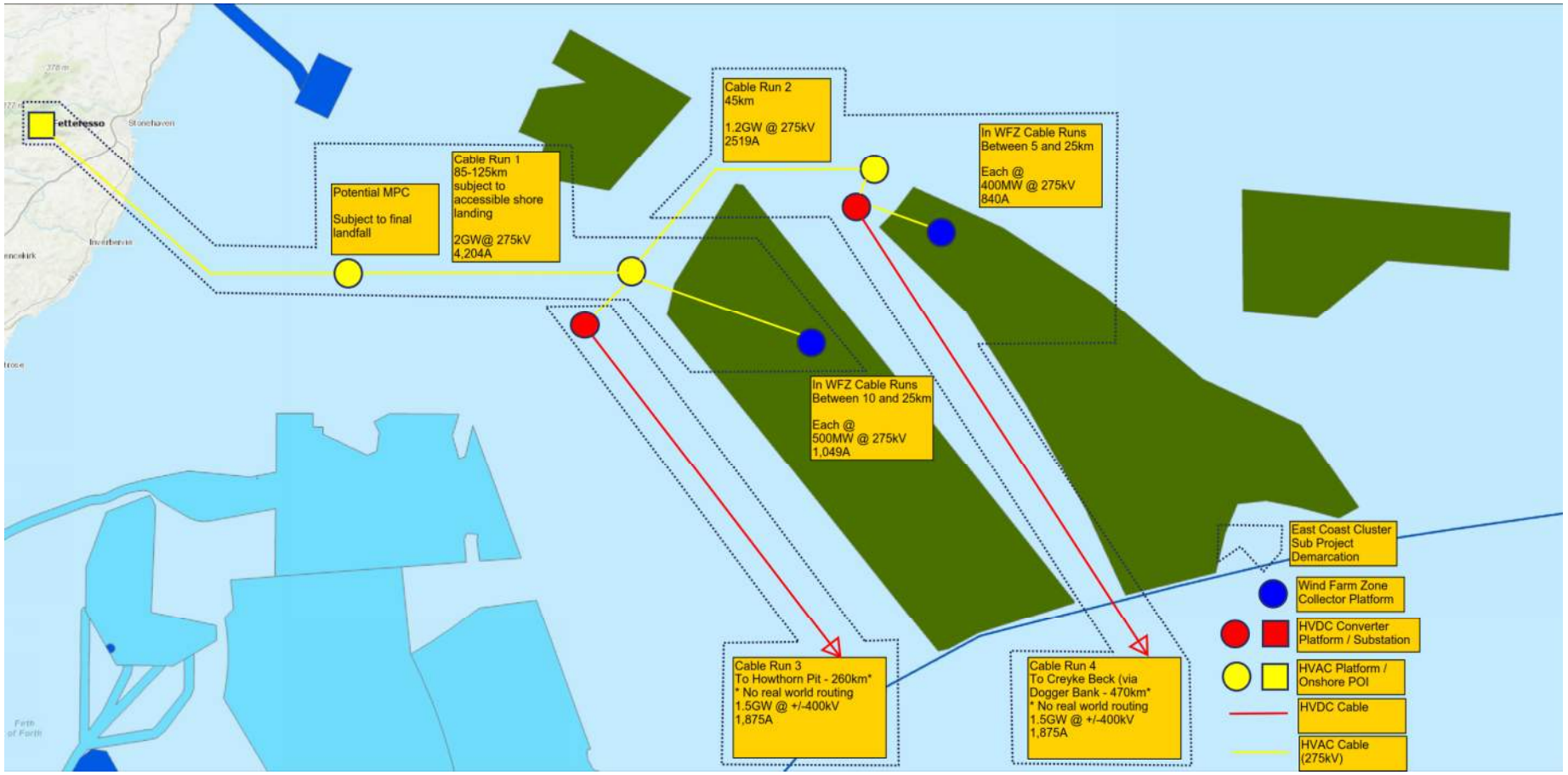

SLD Option 1d – Preferred Recommendation

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- We are recommending the phase approach for the overall design.
- This approach assumes a level of temporary TEC may be provided to Fetteresso to accommodate the Morven development via HVAC to ensure 2030 delivery.
- The Morven to Hawthorn HVDC link may be developed in parallel to accommodate long term incremental capacity from the East Coast Cluster to Hawthorn Pit with a predicted delivery of 2032.
- HVDC link between R4_1, SW_E1b and Creyke Beck provides the necessary works for further incremental capacity to accommodate SW_E1b WFZ generation.
- Moving HVDC platform to adjacent platform will significantly reduce the scheduling risk, technology readiness and provides more control over Deliverability.
- Similar concept may apply to all future development within this area (i.e. Phase 2 of SW_E1a & SW_E1b) as modular basis and connect through HVDC link to the most optimum POI.
- Furthermore, interconnection within HVAC platform will provide more coordination between all windfarm projects within the Cluster.
- With phase approach will provide opportunity to NGESO to optimise the Anticipatory Investment requirement considering the future need case.

SLD Option 1d Preferred Recommendation- Commentary

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HND Objective	
Economic and efficient	+ Breaking down the total deliverability in phases will increased competition as a result of reduced individual project size and a larger pool of contractors able to execute the works. +Modular HVDC boot strap will provide further opportunity in terms of expendability for future connection within same cluster. +More cost effective to optimise the size of HVDC modular design and optimum location considering the future requirement and technology readiness.
Deliverable and operable	+ Platforms can be delivered as single lifts with minimum offshore hook-up + Segregation of programme into smaller projects reduces overall project complexity and increases the number of contractors capable of delivering the project.
Minimise environmental impact	Equivalent
Minimise local community impact	Equivalent

SLD Option 1a

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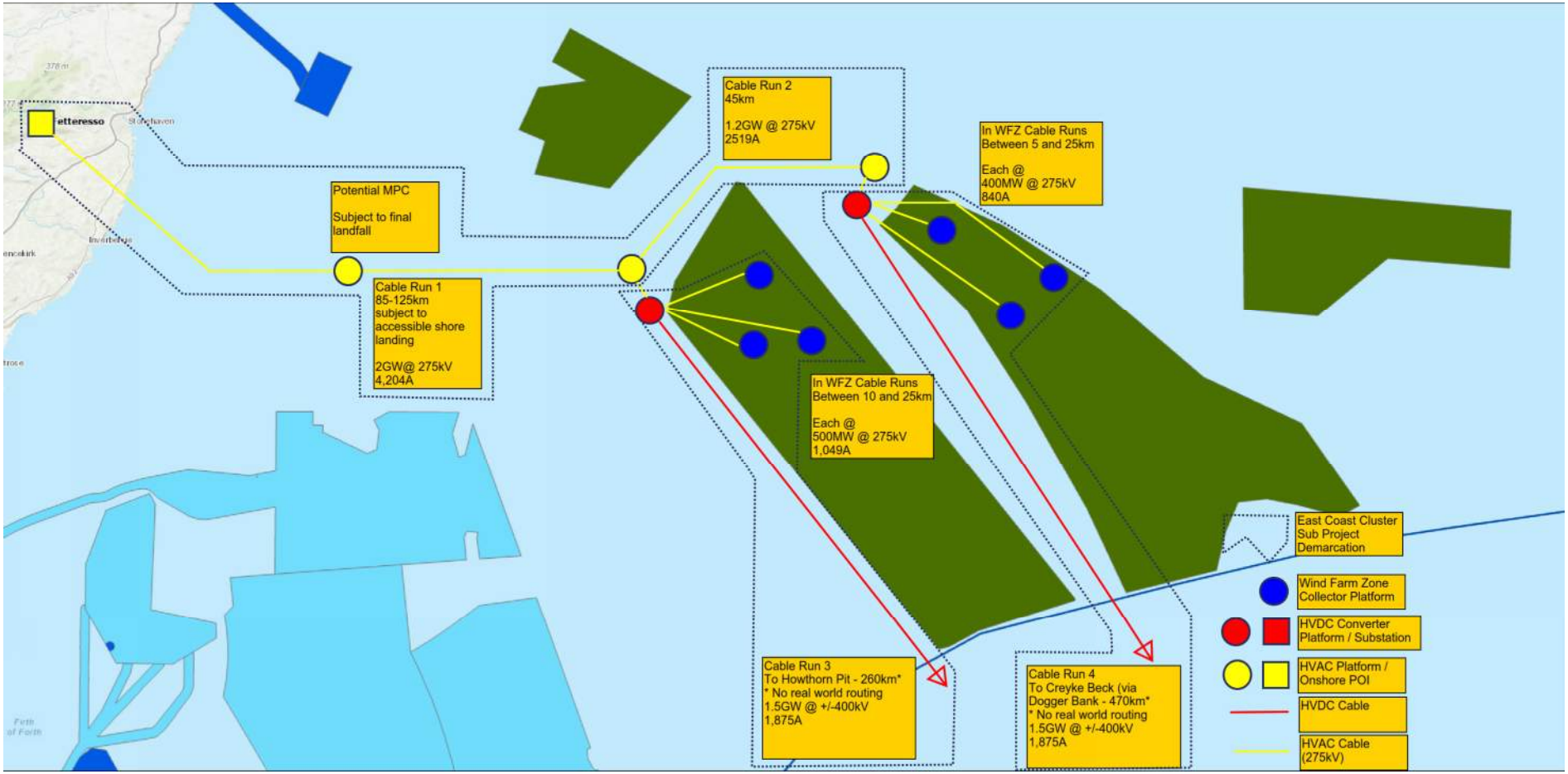

SLD Option 1a

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- This arrangement includes a maximum HVDC converter size of 1.5GW, as do all presented alternative. This is aligned with our concerns over 525kV voltage level technology readiness for HVDC in offshore environments considering lifting capacities in the UKCS North Sea.
- We are recommending the phase approach for the overall design.
- This approach assumes limited capacity at Fetteresso and HVAC link provides the incremental capacity to manage the power flow.
- The HVAC development may be built out independently of the WFZ projects to decouple interdependencies between projects within the overall programme as part of incremental capacity work requirement.
- HVDC link between Morven and Hawthorn Pit provides the necessary works to accommodate Morven generation to Hawthorn Pit.
- HVDC link between R4_1, SW_E1b and Creyke Beck provides the necessary works accommodate SW_E1b WFZ generation to Creyke Beck.
- Moving HVDC platform to adjacent platform will significantly reduce the scheduling risk, technology readiness and provides more control over deliverability. Similar concept may apply to all future development within this area as modular basis and connect through HVDC link to the most optimum POI.
- Furthermore, interconnection within HVAC platform will provide more coordination between all windfarm projects.
- Phased approach will provide opportunity to NGESO to optimise the Anticipatory Investment requirement considering the future need case.

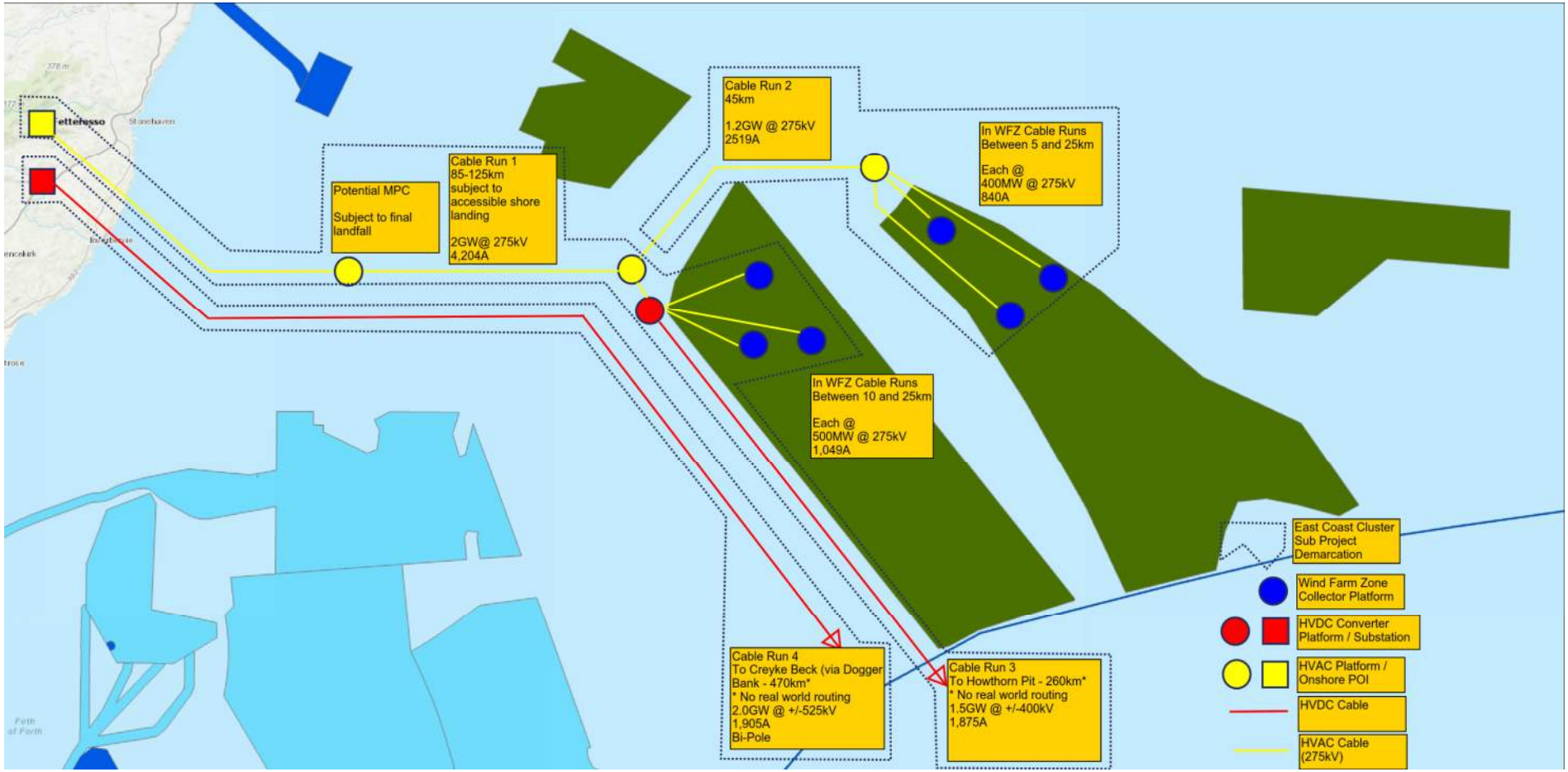
SLD Option 1a - Commentary

Partners in UK offshore wind

HND Objective	
Economic and efficient	+ Breaking down the total deliverability in phases will increased competition as a result of reduced individual project size and a larger pool of contractors able to execute the works.
Deliverable and operable	+ Platforms can be delivered as single lifts with minimum offshore hook-up + Segregation of programme into smaller projects reduces overall project complexity and increases the number of contractors capable of delivering the project.
Minimise environmental impact	Equivalent
Minimise local community impact	Equivalent

SLD Option 1b

Partners in UK offshore wind



SLD Option 1b

Partners in UK offshore wind

- We are recommending the phase approach for the overall design.
- This approach assumes HVAC link between Fetteresso, Morven and SW_E1b provides capacity for SW_E1b to Fetteresso Bootstrap.
- HVDC link between Morven and Hawthorn Pit provides the necessary works to accommodate Morven generation.
- HVDC link between Fetteresso, R4_1 and onshore Scottish network to Creyke Beck (via Dogger Bank) provides the necessary works for further incremental capacity to accommodate SW_E1b WFZ generation.
- This option provides significant cost benefits of the HND base case as the significant cost associated with an offshore platform is moved onshore, but at the requirement of additional cable runs in a complex cable land fall zone. Requires additional land substation zones to accommodate the HVDC converter station.
- One residual benefit is the onshore HVDC bootstrap can be sized to 2GW inline with other Easter Link onshore to onshore bootstraps.
- Interconnection within HVAC platform will provide more coordination between all windfarm projects.
- With phase approach will provide opportunity to NGESO to optimise the Anticipatory Investment requirement considering the future need case. To accommodate SW_E1b

SLD Option 1b - Commentary

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HND Objective	
Economic and efficient	+ Significant cost reduction as a result of AC to DC conversion take place onshore
Deliverable and operable	+ As per option 1A + Greater onshore scope content ensures higher deliverability compared to offshore - Very challenging landfall may make additional cable content non-feasible
Minimise environmental impact	- Increase onshore substation size - Increase cable corridor
Minimise local community impact	- Increase onshore substation size - Increase cable corridor

SLD Option 1c

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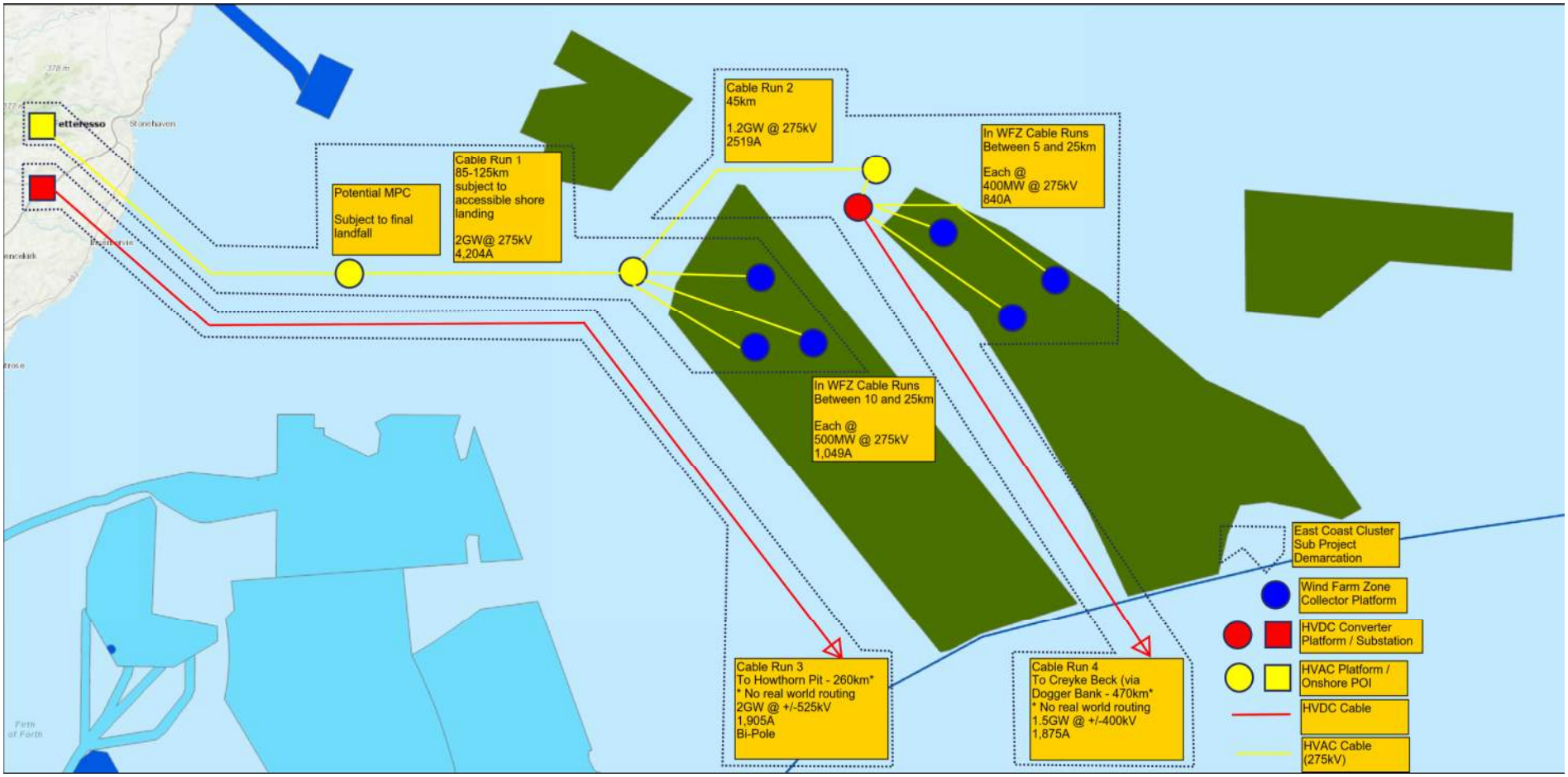

SLD Option 1c

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- We are recommending the phase approach for the overall design.
- This approach assumes HVAC link between Fetteresso, Morven and SW_E1b provides capacity for Morven to Fetteresso Bootstrap.
- HVDC link between Fetteresso and Hawthorn Pit provides the necessary works for further incremental capacity to accommodate Morven generation.
- HVDC link between SW_E1b, R4_1 and Creyke Beck provides the necessary works for further incremental capacity to accommodate SW_E1b WFZ generation.
- Moving HVDC platform to adjacent platform will significantly reduce the scheduling risk, technology readiness and provides more control over Deliverability. Similar concept may apply to all future development within this area as modular basis and connect through HVDC link to the most optimum POI.
- Furthermore, interconnection within HVAC platform will provide more coordination between all windfarm projects.
- With phase approach will provide opportunity to NGESO to optimise the Anticipatory Investment requirement considering the future need case.
- This design relies upon temporary TEC at Fetteresso to secure a level of power entry while the Bootstrap Construction is completed.

SLD Option 1c - Commentary

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HND Objective	
Economic and efficient	+ Significant cost reduction as a result of AC to DC conversion take place onshore
Deliverable and operable	+ Platforms can be delivered as single lifts with minimum offshore hook-up + Segregation of programme into smaller projects reduces overall project complexity and dependencies. +Greater onshore scope content ensures higher deliverability compared to offshore - Very challenging landfall may make additional cable content non-feasible. (This can be mitigated by assessing optimum POI for onshore HVDC landing or can be consider as offshore extension to HVDC as Phase 2)
Minimise environmental impact	- Increase onshore substation size - Increase cable corridor
Minimise local community impact	- Increase onshore substation size - Increase cable corridor

Variation to design is to consider the offshore HVDC platform as phase 2 development to mitigate the Environmental and Local Community impact.

SLD Option 2

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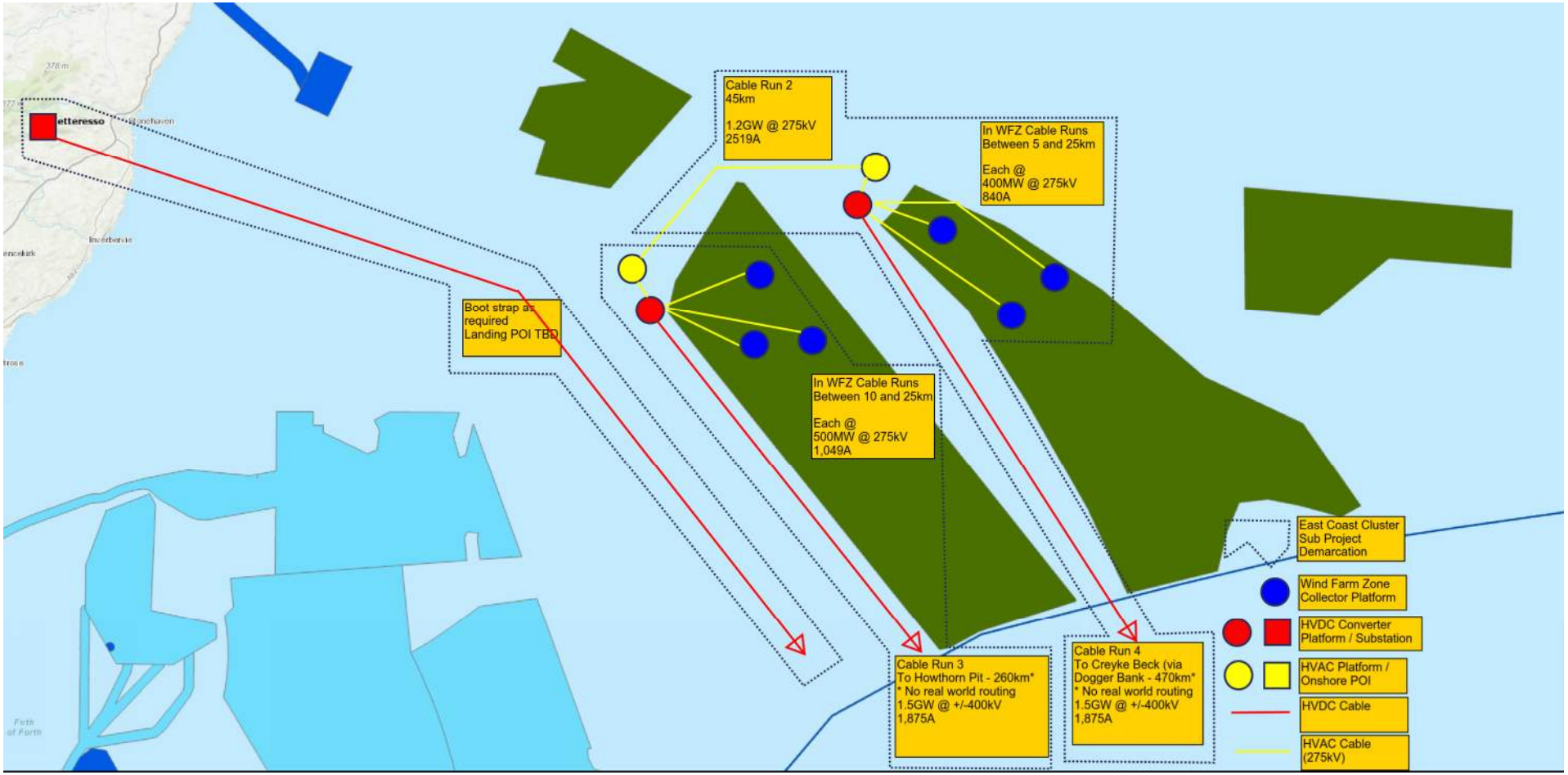

SLD Option 2

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- One of the key technical concerns over the HND base case is the overall cable length associated with the HVAC element of the programme between Fetteresso and the Windfarm Zones. This is further compounded by the technical challenges and limited landfall access along the Aberdeenshire Coastal line, where there are very few cable landing points available and moving from a HVAC solution to DC provides a significant reduction in cable way requirements.
- HVDC bootstrap from Fetteresso implemented to England POI to increase North South incremental capacity as required.
- HVDC link between Morven and Hawthorn Pit provides the necessary works for further incremental capacity to accommodate Morven generation.
- HVDC link between SW_E1b, R4_1 and Creyke Beck provides the necessary works for further incremental capacity to accommodate SW_E1b WFZ generation.
- In this case HVAC platform and HVDC link from each development will be classified as enabling works.
- This means all windfarm directly connects to England Network and need case for the onshore HVDC link can be justified by future requirement to increase capacity across the network. Hence, can be classified as wider works.
- Furthermore, interconnection within HVAC platform will provide more coordination between all windfarm projects.

SLD Option 2 - Commentary

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HND Objective	
Economic and efficient	- Increased overall programme cost as the onshore element is converted to HVDC and a further converter station is required to complete the bootstrap. - Longer HVDC cable connection compared to HVAC
Deliverable and operable	+ As per option 1A + Long line HVAC risk is eliminated + Reduced Cable access challenge along Aberdeenshire Coast
Minimise environmental impact	+ Reduced cable landfall and cable Corridor to Fetteresso - Increase onshore substation size at Fetteresso - Additional HVDC converter station required
Minimise local community impact	+ Reduced cable landfall and cable Corridor to Fetteresso - Increase onshore substation size at Fetteresso - Additional HVDC converter station required

SLD Option 3

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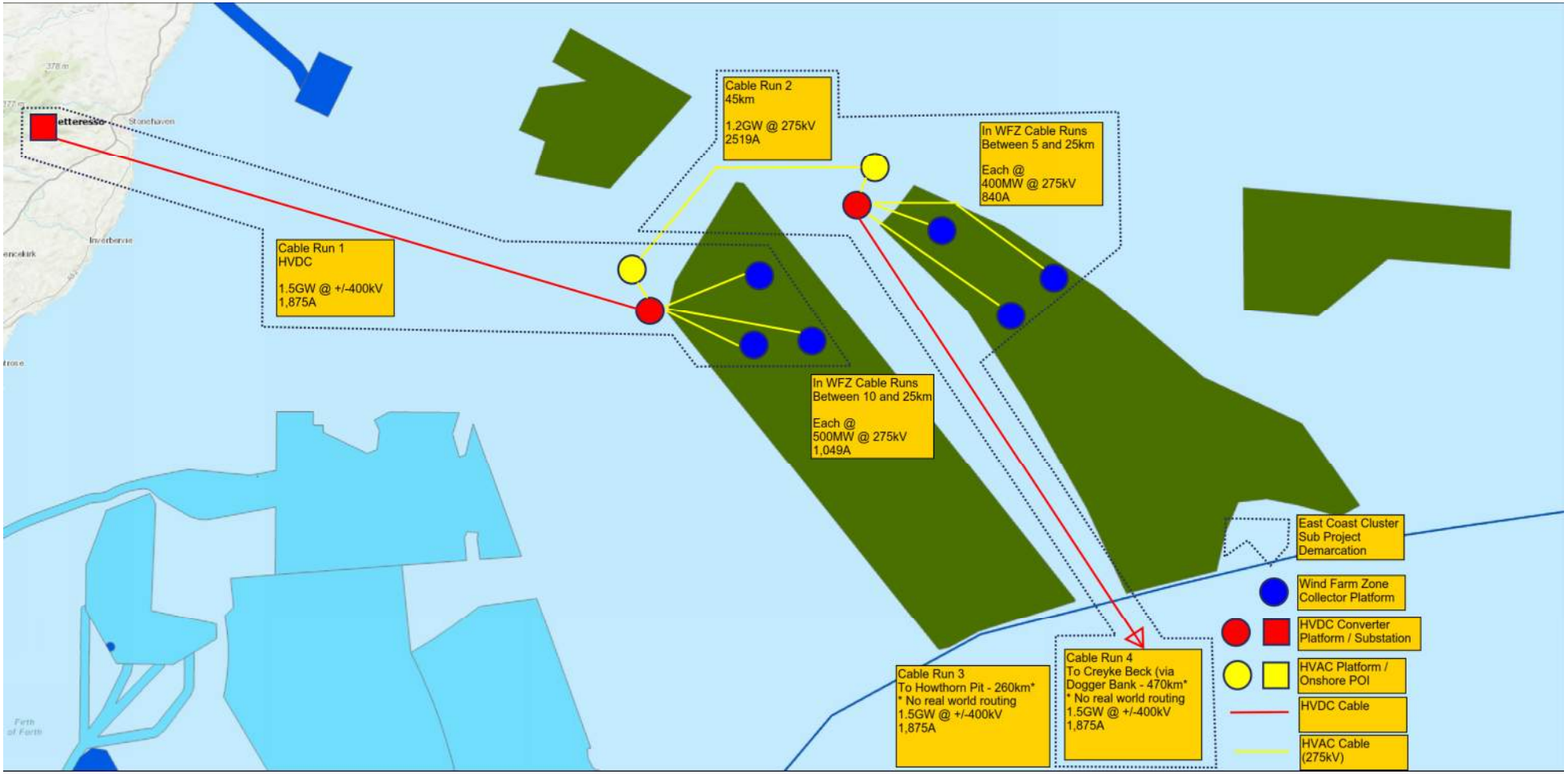

SLD Option 3

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- As per option 2, but enables bi-direction power flow into the offshore hub directly from Fetteresso. Allowing Fetteresso to act as an entry point initially for HND round 1.
- This approach assumes a level of temporary TEC may be provided to Fetteresso to accommodate the Morven development via HVDC to ensure 2030 delivery.
- HVDC link between SW_E1b, R4_1 and Creyke Beck provides the necessary works for further incremental capacity to accommodate SW_E1b WFZ generation.
- Further HVDC links added during HND phase 2 to increase incremental capacity and POI diversity as required.
- Furthermore, interconnection within HVAC platform will provide more coordination between all windfarm projects.

SLD Option 3 - Commentary

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HND Objective	
Economic and efficient	- Balanced
Deliverable and operable	+ As per option 1A + Long line HVAC risk is eliminated + Reduced Cable access challenge along Aberdeenshire Coast
Minimise environmental impact	+ Reduced cable landfall and cable Corridor to Fetteresso - Increase onshore substation size at Fetteresso
Minimise local community impact	+ Reduced cable landfall and cable Corridor to Fetteresso - Increase onshore substation size at Fetteresso

Morven Project

SLD options HND Round 2

Date: May 2022

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SLD Option 21d – Preferred Recommendation – Modular Approach for future connection

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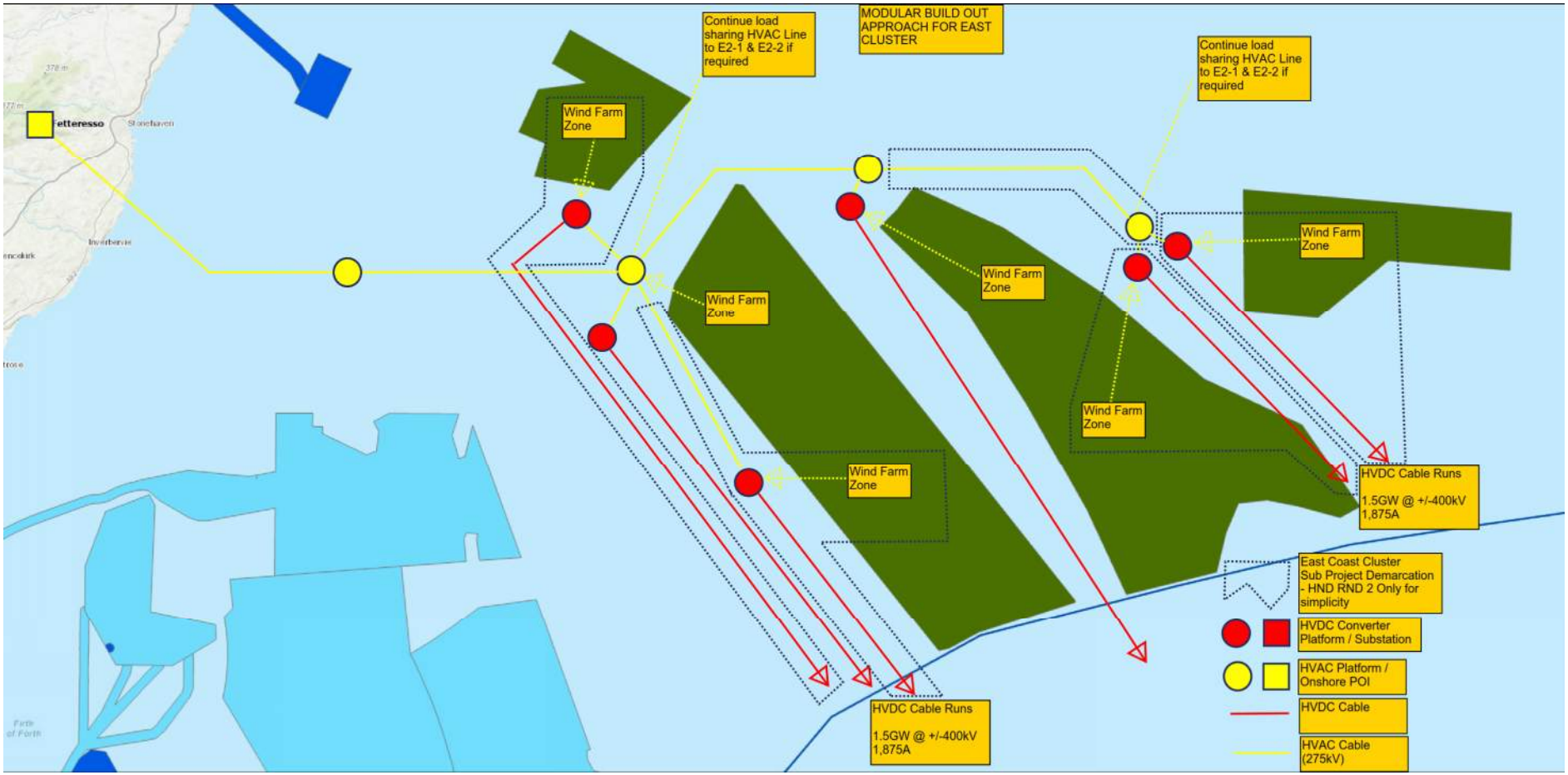

SLD Option 21d – Preferred Recommendation – Modular Approach for future connection

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- This design will provide more flexibility as it can be delivered as modular approach for the overall East Cluster Programme.
- Provide more certainty in identifying the driver for HVDC link to increase network capacity and at the same time provide opportunities to optimise the interconnection between different development site to reduce the further wider network investment.
- With modular phase approach will provide more opportunity to NGESO to optimise the Anticipatory Investment requirement considering the future need case.
- This will result in minimising the impact of all key categories considered under HND.