

Offshore Phase 1 Projects

Grid Connections Assessment

March 2021



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Executive Summary

On January 31st 2020, the Commission for Regulation of Utilities (CRU) directed EirGrid (D/20/2760)¹ to “commence processing any such applications from projects which may be deemed to meet the definition of Relevant Projects”. The CRU also wrote to EirGrid on the 28th April 2020, ref D/20/8558, to clarify the treatment of Arklow Bank Wind Park in this regard. The term “Relevant Projects” was subsequently replaced with the term “Phase 1 projects”. Recognising the “detailed and complex considerations” the CRU requested EirGrid to revert to the CRU once “further details on the onshore network reinforcements” were available. The purpose of this report is to fulfil that direction by providing further details on the onshore network reinforcements and associated matters.

The offshore Phase 1 project applications, submitted to EirGrid in September 2020 are as follows:

Table 1

East Coast Projects	MEC Range
Oriel Windfarm	370 – 400 MW
North Irish Sea Area (NISA)	500 MW
Dublin Array – (Bray and Kish)	600 – 900 MW
Codling Wind Park 1 and 2 ²	0.9 - 1.5 GW
Arklow Bank Wind Park Phase 2 ³	520 – 800 MW
Total MEC Range	2.9 – 4.1 GW

Table 2

West Coast project	MEC Range
Skerd Rocks Wind Farm	350 - 450 MW

¹ <https://www.cru.ie/wp-content/uploads/2020/02/CRU20020-Offshore-Wind-Grid-Delivery.pdf>

² Based on stakeholder engagements, the customer has indicated that their MEC range is likely to be between 900 – 1500 MW. This is covered in the range of scenarios considered.

³ Based on stakeholder engagements, the customer has indicated that they are likely to progress with a connection for 520 MW. For the purpose of this analysis, this connection has been assessed as a 520 MW fixed connection.



Figure 1: Site locations of East Coast Phase 1 projects

The objectives of this analysis were as follows:

- Assess connection method options for the Phase 1 applicants,
- Identify the level of additional network reinforcement needs necessary for the projects and
- Appraise the options based on overall cost, deliverability and risk.

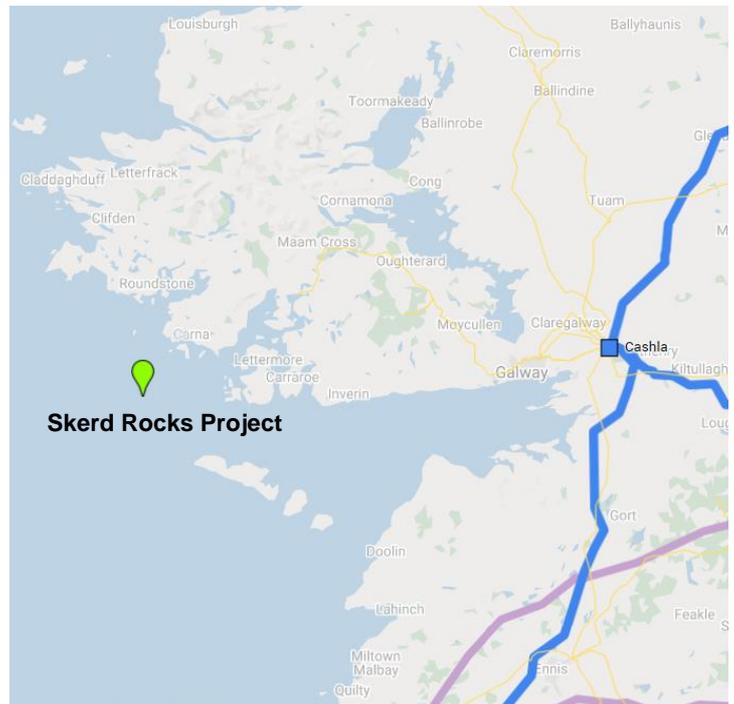


Figure 2: Site locations of West Coast Phase 1 project

EirGrid has carried out extensive analysis on the east and west coasts along with detailed engagement with the Phase 1 projects and key stakeholders. This report sets out these findings which can be summarised as:

- A number of ongoing infrastructure projects that are already in EirGrid's Framework for Grid Development⁴ will play a key role in the integration of offshore wind on the east coast.
- The connection methods for the Oriel, NISA and Arklow Bank Phase 2 projects are relatively clear due to their location and the proximity to existing 220 kV infrastructure.
- A range of connection methods exist for the Codling and Dublin Array projects within the Dublin network.
- Concentrating the highest portion of offshore capacity into the Poolbeg 220 kV substation was seen to minimise overall cost and reduce deliverability risk relative to the other options.
- Connecting the Skerd Rocks project (on the West Coast) into the 220 kV system, such as Cashla 220 kV substation, or the 400 kV system, such as Moneypoint 400 kV substation, was demonstrated as equally viable connection options.

In addition, it is worth noting that EirGrid is preparing for a future electricity system with at least 70% of our electricity coming from renewable sources by 2030. Offshore wind is a key enabler to Ireland in meeting 2030 target for 70% RES-E. EirGrid's *Shaping Our Electricity Future* consultation⁵ assumes that 4.5 GW of offshore wind capacity will connect to the east coast by 2030 as part of the "Generation-led" development approach. The analysis carried out for this report is consistent with this Pathway.

EirGrid has been proactively supporting this emerging industry in Ireland, as demonstrated by the work we have done on the East Coast Assessment⁶, the Navigant Report on *Offshore grid delivery models for Ireland*⁷, and the ongoing work on the preparation of functional specifications for offshore infrastructure and the Poolbeg Feasibility Study. EirGrid also recognise that there will be merit in further assessment in areas such as constraints, and facilitation of projects beyond Phase 1, etc. at the appropriate time. However we recognise that at this time there are a number of key enabling pieces of work in progress such as a decision on the Grid Delivery Model which will inform the associated Regulatory Framework and which are vital to informing next steps.

⁴ <http://www.eirgridgroup.com/the-grid/irelands-strategy/>

⁵ <https://consult.eirgrid.ie/consultation/public-consultation-shaping-our-electricity-future>

⁶ <http://www.eirgridgroup.com/site-files/library/EirGrid/East-Coast-Generation-Opportunity-Assessment.pdf>

⁷ <https://assets.gov.ie/75918/9659386d-7526-4ebe-8420-8854033250b6.pdf>

1 Objectives, Methodology and Assumptions

1.1 Study Objectives

The primary purpose of this analysis is to:

- Assess connection options for Offshore Phase 1 projects
- Identify network reinforcement impacts driven by the connection of the Offshore Phase 1 projects
- Complete a comparative assessment of each option on cost, deliverability and risk.

The analysis took into account the range of Maximum Export Capacities (MEC's) applied for by the projects, with a total combined capacity in line with the Government's 2019 Climate Action Plan target of at least 3.5 GW⁸.

While this assessment takes account of the applications made by the Offshore Phase 1 projects a total offshore wind capacity of up to 4.5 GW is assessed on the east coast by 2030 as part of the "Generation-led" development approach, in EirGrid's *Shaping Our Electricity Future* consultation.

1.2 Standards and Policies

In accordance with the Transmission System Security and Planning Standards (TSSPS)⁹ and other standard planning procedures and methodologies, single (N-1) contingencies were investigated for the specified year, seasons and dispatch scenarios, in order to identify if any network reinforcements are required. Solution optioneering has not been considered for planned maintenance or overlapping single trip generator outages.

While the analysis in this document focuses on the available transmission capacity, there may be other technical limitations that restrict the amount of generation that can be connected. This could include factors like system stability considerations, power quality, short circuit limitations and factors associated with the loss of a very large single infeed of generation. These studies are complex and require accurate data from the connecting party, and are therefore normally done after offer acceptance.

⁸ <https://assets.gov.ie/10206/d042e174c1654c6ca14f39242fb07d22.pdf>

⁹ <https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016-APPROVED.pdf>

1.3 Methodology Overview

The studies carried out as part of this assessment considered a range of seasonal peak, valley and intermediate load conditions. This was considered for a range of connection options for the offshore wind projects. Contingency analysis was carried out to identify areas on the system which have need for mitigating solutions.

This assessment aligns with the “Generation Led” development approach in EirGrid’s Shaping Our Electricity Future consultation. Detail on this consultation can be found on the EirGrid consultation webpage¹⁰.

The connection options for this analysis were initially studied on an existing grid. Following this, network reinforcements which are already in EirGrid’s Framework for Grid Development, were assessed to determine their benefit in facilitating the offshore wind projects. Finally, additional needs were identified and plausible solutions were assessed.

1.4 Study Year

A 2030 study year has been chosen for this analysis. It is noted that some or all of the Offshore Phase 1 projects may connect in advance of 2030, but 2030 has been deemed as an appropriate study year to assess the long term impacts of the offshore wind grid connections.

¹⁰ <https://consult.eirgrid.ie/consultation/public-consultation-shaping-our-electricity-future>

1.5 Solution Optioneering

1.5.1 EirGrid Framework for Grid Development

This assessment is not covered by EirGrid’s six-step approach to developing the electricity grid, known as the *Framework for Grid Development*. Through the grid development framework, a need is typically identified in Step 1, to progress to a solution optioneering stage.

Solutions suggested in this report are for the purpose of providing the CRU with an indication of the conceivable scale of transmission reinforcements that may be required, but each solution is subject to the optioneering process set out in the grid delivery framework.

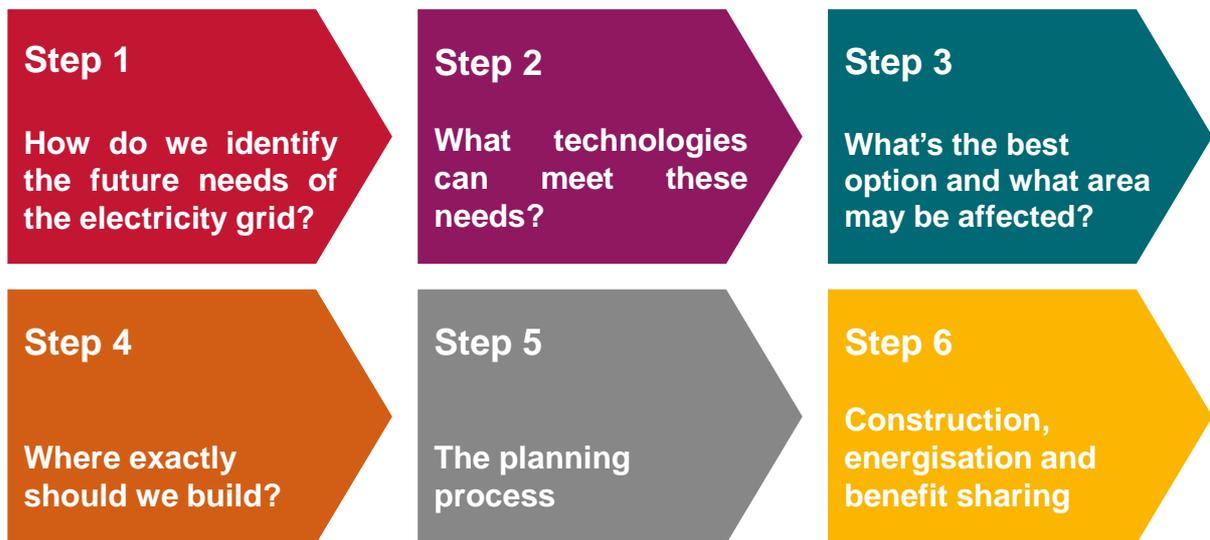


Figure 3: Six step process - EirGrid Framework for grid delivery

Figure 3¹¹ summarises the steps within the Framework for Grid Development. Detailed analysis of the potential transmission network solutions has not been undertaken as part of this analysis. It is worth noting that transmission network reinforcements may have multiple drivers. Each reinforcement undergoes a detailed technical and economic assessment to determine if there is a substantive need for the reinforcement. The reinforcements suggested in this report would be subject to further detailed technical, economic, environmental, deliverability and social impact assessment along with public and stakeholder engagement to determine the best performing solutions for any particular need.

Conceivable solutions were developed in accordance with one of EirGrid’s objectives set out in our Grid Development Strategy¹² to “minimise the addition of new infrastructure”.

¹¹ http://www.eirgridgroup.com/__uuid/7d658280-91a2-4dbb-b438-ef005a857761/EirGrid-Have-Your-Say_May-2017.pdf

¹² <https://www.eirgridgroup.com/the-grid/irelands-strategy/>

Solutions are suggested in such a way that the existing grid is maximised before development of new circuits or equipment is considered.

2 Connection Options

EirGrid has engaged with the Phase 1 projects and key stakeholders including the CRU, the Department of the Environment, Climate and Communications and ESB Networks both collectively and on a bi-lateral basis. This engagement has taken place at key points in this study prior to accepting applications and following the presentation of emerging findings. Further information on the engagement process is set out in [Appendix A](#).

Projects with known or well-understood connection methods, which do not have a material interaction with other connections in terms of network reinforcement, have been considered as fixed for the purposes of this analysis. These are as follows:

2.1.1 Oriel Offshore Wind Farm

The Oriel wind farm has an existing connection agreement in place for 210 MW at a proposed new Oriel 220 kV substation, looping into the existing Louth – Woodland 220 kV overhead line. For the purpose of this analysis, in all simulations Oriel wind farm is assumed as a loop-in to the existing Louth – Woodland 220 kV circuit.

2.1.2 NISA Offshore Wind Farm

The NISA wind farm received a connection offer for 500 MW, via a tailed connection into the Belcamp 220 kV substation.

2.1.3 Arklow Banks Phase II Offshore Wind Farm

The Arklow Banks Phase II wind farm is expected to be a 220 kV connection in the vicinity of Arklow 220 kV substation. Sensitivity analysis has shown that some variance around the specific connection (north or south of Arklow) is unlikely to have a material impact on the system impact assessment. For this reason the connection method has been assumed as a new 220 kV substation in close proximity to Arklow 220kV substation.

2.2 Varied Connection Options

2.2.1 East Coast

Within the Dublin region, the connection method options considered for the Codling Banks and Dublin Array projects are shown in table 3. For these two projects, a total of 2.15 GW of their total combined applications has been assessed at different nodes to assess the impact on the overall suite of reinforcements required.

Table 3

Option 1: Favouring Carrickmines		
Combined Dublin Array and Codling Total	Node	MW
	Poolbeg	700
	Carrickmines	1450
	Belcamp	0
Option 2: Favouring Poolbeg		
Combined Dublin Array and Codling Total	Node	MW
	Poolbeg	1450
	Carrickmines	700
	Belcamp	0
Option 3: Favouring Belcamp		
Combined Dublin Array and Codling Total	Node	MW
	Poolbeg	700
	Carrickmines	1450
	Belcamp	700
Option 4: Load Centres		
Combined Dublin Array and Codling Total	Node	MW
	Poolbeg	700
	Carrickmines	350
	Belcamp	0
	Inchicore	350
	Castlebagot	350
	Corduff	350

As mentioned above, the following connections remain as fixed throughout this study.

Table 4

Assumed Connections		
Project	Node	MW
Oriel WF	Oriel	370
NISA WF	Belcamp	500
Arklow Banks Phase II	Arklow	520

2.2.2 West Coast

There have been a number of historical challenges associated with the network capacity for major wind connections in the west of the country. These are associated with power transfer issues in moving power from the west to the east, as well as local issues driven by the 110 kV network capacity limitations.

In particular the 110 kV network between Cashla, Galway and Knockranny is considered almost at capacity. This effectively rules out any local 110 kV connection options for the Skerd Rocks project. The connection methods we have assessed have targeted more strategic connections at high capacity 220 kV and 400 KV nodes on the system. These connection methods are as follows:

Table 5

Skerd Rocks Connection Method	MW
Cashla 220 kV station	392
Moneypoint 400 kV station	392

2.2.3 Assumed Connection Capacity

Based on feedback from the applications and a review of high voltage AC connections internationally, 350 MW has been assumed as the thermal capacity capability of customer export cables for the purpose of this study. This limit has influenced our approach for defining options to assess. Every 350 MW of capacity is treated as an individual connection and hence would require a separate bay connection onto the meshed transmission system.

EirGrid will work with customers in terms of individual connection sizing as part of the connection offer process. This analysis to date is robust to variations in the 350 MW capacity assumption.

For clarity, reference to shallow connection works throughout this report refers to bay requirements for individual connections at onshore substations as well as the onshore and offshore export cables out as far as, but not including, the offshore substation platforms.

3 Results: Reinforcement needs

The studies carried out as part of this analysis identified a number of key themes. The results in this section have been structured on these themes:

1. In terms of system reinforcement needs, the Phase 1 offshore applications on the East coast do not interact with the Skerd Rocks project and can therefore be considered separately.
2. A number of existing/planned reinforcement projects are critical to integrating offshore wind on the east coast (regardless of the specific connection methods chosen for the projects).
3. In addition to these planned reinforcements, a number of additional reinforcements will also be required (regardless of the specific connection methods chosen for the projects).
4. Independent of the specific connection methods for all other projects, the Dublin Array and Codling projects have a direct interaction in terms of network reinforcement needs. The specific connection methods chosen will have a direct impact on the level of reinforcements required in the Dublin region. As such, a bespoke assessment of the reinforcement needs for these variable connection methods has been completed.

3.1 Dependency on planned reinforcements

The following infrastructure projects, which are already in EirGrid's Framework for Grid Development, are critical to facilitating the integration of offshore wind:

- 1) Dublin cable replacement projects, these include:
 - a. Carrickmines – Poolbeg 220 kV cable
 - b. Inchicore – Poolbeg 220 kV cable 1
 - c. Inchicore – Poolbeg 220 kV cable 2
 - d. North Wall – Poolbeg 220 kV cable
 - e. Finglas – North Wall 220 kV cable

Additional to the above, three other network reinforcement projects add significant benefit in facilitating offshore connections:

- 1) CP1021 – The East Meath –North Dublin reinforcement project
- 2) CP0966 – The Kildare – Meath upgrade project
- 3) The North – South interconnector

3.2 Common Needs for all options

Based on the assessment of the fixed and varied connection methods for the Offshore Phase 1 projects, there are a number of reinforcement needs which are common to all options. These are newly identified projects, additional to those which are already in the *Framework for Grid Development*.

3.2.1 New substation at Poolbeg

3.2.1.1 The need

A need has been identified for a substation solution at the Poolbeg node as the existing Poolbeg 220 kV substation does not have sufficient bay capacity to accommodate multiple offshore connections.

3.2.1.2 Solution option

To accommodate future offshore connections, and future system reinforcements, a new 220 kV station will be required.

3.2.2 New South East 220 kV substation

3.2.2.1 The need

A need has been identified for a solution to mitigate against overloads occurring on the underlying 110 kV network between Arklow and Carrickmines.

The existing Arklow – Ballybeg – Carrickmines 110 kV corridor is strung on a double circuit tower with the Arklow – Carrickmines 220 kV circuit. The Ballybeg 110 kV substation supplies distribution load for Wicklow town. Although the Arklow – Ballybeg - Carrickmines corridor is operated at 110 kV, it is capable of being operated at a 220 kV voltage level.

For the tripping of the existing Arklow-Carrickmines 220 kV circuit, the parallel 110 kV circuits become overloaded.

3.2.2.2 Solution option

A new 220 kV substation would address this need and facilitate 220 kV operation along the corridor. The new 220 kV substation would provide transformer connections to a 110 kV busbar to maintain supply to the distribution load.

As noted in [1.5.1](#) a detailed analysis of the solution options has not been undertaken as part of this analysis. A high-level desktop assessment of a conceivable solution was undertaken.

3.2.3 South East Network upgrading

3.2.3.1 The Need

There are overloads seen on the network in the South East of the country, between Arklow and Great Island. For the tripping of the 220 kV circuits in the area, overloads are seen on the underlying 110 kV network.

3.2.3.2 Solution option

Overhead line conductor upgrading is considered for the network in the South East of the country.

As noted in [1.5.1](#) a detailed analysis of the solution options has not been undertaken as part of this analysis. A high-level desktop assessment of a conceivable solution was undertaken.

3.3 Dublin region reinforcement needs for variable connection options

A range of connection method options have been assessed for the Dublin Array and Codling Banks projects. Their connections cause challenges on an existing grid, especially with an overall capacity of c.3 – 4 GW on the east coast per the applications assessed in this study, serving the large Dublin load centres.



Figure 4: Dublin region 220 kV network - geographical overlay

Within the Dublin area, as can be seen in Figure 4, the Carrickmines and Belcamp nodes have a limited number of circuits connecting them to load centres, compared to the more central Poolbeg node which is better connected to critical nodes. The connection options vary the power concentrations across each of these three nodes in Dublin, and it is anticipated that each of these nodes will have a significant offshore connection across all options assessed.

3.3.1 Favouring Carrickmines

The Favouring Carrickmines option concentrates the majority of power (1450 MW) from the Codling Banks and Dublin Array projects at Carrickmines, with the remainder (700 MW) located at Poolbeg. The other connections remain as fixed throughout the assessment. See offshore capacities at key nodes on the transmission system in the following table.

Table 6

Node	MW Capacity
Arklow	520
Oriel	370
Belcamp	500
Carrickmines	1450
Poolbeg	700



Figure 5: Favouring Carrickmines Connections

3.3.1.1 The need

As can be seen from figure 5, the Carrickmines node only has two circuits connecting it to the major Dublin load centres. Connection of 1450 MW of offshore wind capacity at Carrickmines causes network issues as there aren't enough circuits to carry power into the load centres in the city, where there is a demand for the power.

Following the completion of the planned reinforcements, as identified in section [3.1](#), significant thermal violations are still present for this connection option.

During contingency analysis, a number of critical thermal overload issues observed on the following circuits as a result of interacting contingencies of a corresponding circuit on this list:

- Carrickmines – Irishtown 220 kV circuit,
- Inchicore – Irishtown 220 kV circuit,
- Carrickmines – Poolbeg 220 kV circuit,
- Carrickmines Phase Shifting Transformer (PST),
- Carrickmines –Dunstown 220 kV circuit,

To ensure compliance within the transmission network equipment ratings, while adding 1450 MW of generation at Carrickmines, requires additional network reinforcement. Also, a need has been identified for additional bay capacity at Carrickmines to accommodate the four individual physical offshore connections at the Carrickmines node.

3.3.1.2 Solution option

Two additional 220 KV cross city transmission circuits would be required for option 1 to ensure TSSPS compliance for this connection option.

There would be a need for an additional 220 kV transmission substation in the Carrickmines area to accommodate the offshore generating units and connect the transmission reinforcements onto the transmission system.

Table 7

Favouring Carrickmines
Additional Reinforcement Needs
2 x New Cross City Transmission circuits
1 x New Carrickmines 2 Station

For the purpose of this assessment, two circuits from Carrickmines to the city centre were identified as solution options, due to the limited connectivity at the node. As noted in [1.5.1](#) though, a detailed analysis of the solution options has not been undertaken as part of this analysis. A high-level desktop assessment of a conceivable solution was undertaken.

3.3.2 Favouring Poolbeg

The Poolbeg region has seven circuits connecting it to the major Dublin load centres. This option considers the impact of concentrating the majority of power (1450 MW) from the Codling Banks and Dublin Array applications at Poolbeg, with the remainder (700 MW) located at Carrickmines. The other project connections remain as fixed throughout the analysis. See offshore capacities at key nodes on the transmission system in the following table.

Table 8

Node	MW Capacity
Arklow	520
Oriel	370
Belcamp	500
Carrickmines	700
Poolbeg	1450

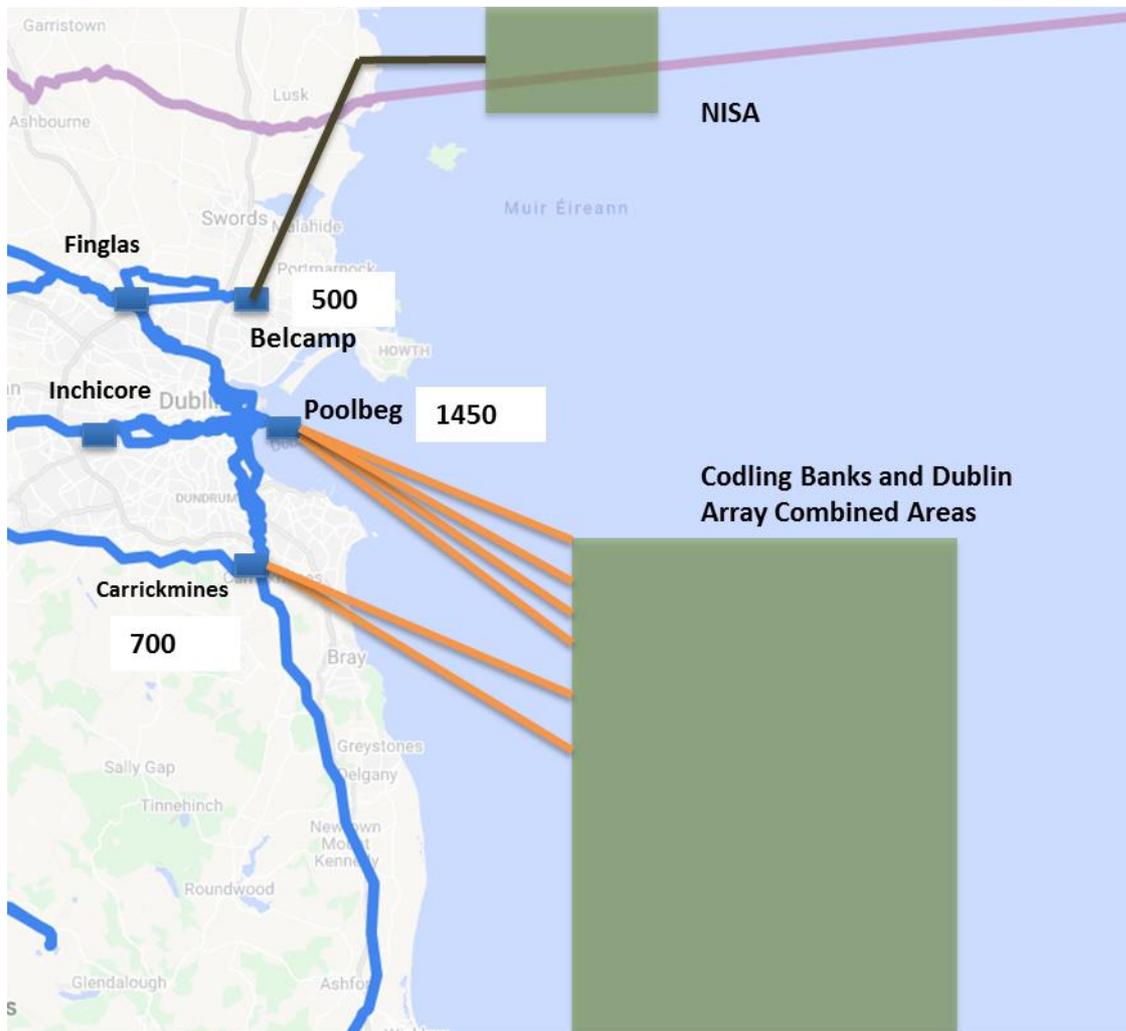


Figure 6: Favouring Poolbeg connections

3.3.2.1 The need

The concentration of more power at the Poolbeg node helps to minimise reinforcements due to the extent of the existing High Voltage infrastructure already in place at the node. However, even with the completion of the planned reinforcements, as identified in section [3.1](#), thermal violations are still present for this connection option. During contingency analysis, a number of critical thermal overload issues are observed on the following circuits:

- Inchicore – Irishtown 220 kV circuit,
- Carrickmines –Dunstown 220 kV circuit,
- Inchicore – Poolbeg 1 220 kV circuit and
- Inchicore – Poolbeg 2 220 kV circuit.

To ensure compliance with transmission network equipment ratings, while adding 1450 MW generation at Poolbeg requires additional network reinforcement.

3.3.2.2 Solution Options

One additional 220 KV cross city transmission circuit would be required for option 2 to ensure TSSPS compliance for this connection method.

Table 9

Favouring Poolbeg
Additional Reinforcement Need
1 x New Cross City Transmission circuit

For the purpose of this assessment, one circuit from Carrickmines to the city centre was identified as a solution option, due to the limited connectivity at the node. As noted in [1.5.1](#) though, a detailed analysis of the solution options has not been undertaken as part of this analysis. A high-level desktop assessment of a conceivable solution was undertaken.

3.3.3 Favouring Belcamp

The Favouring Belcamp option connects 750 MW of power from Dublin Array and Codling to Belcamp in addition to the fixed connection of 500 MW at this node across the option analysis. The remainder of the Dublin Array and Codling generation is split equally at Carrickmines (700 MW) and Poolbeg (700 MW). The other project connections remain as fixed throughout the analysis. See offshore capacities at key nodes on the transmission system in the following table.

Table 10

Node	MW Capacity
Arklow	520
Oriel	370
Belcamp	1250
Carrickmines	700
Poolbeg	700

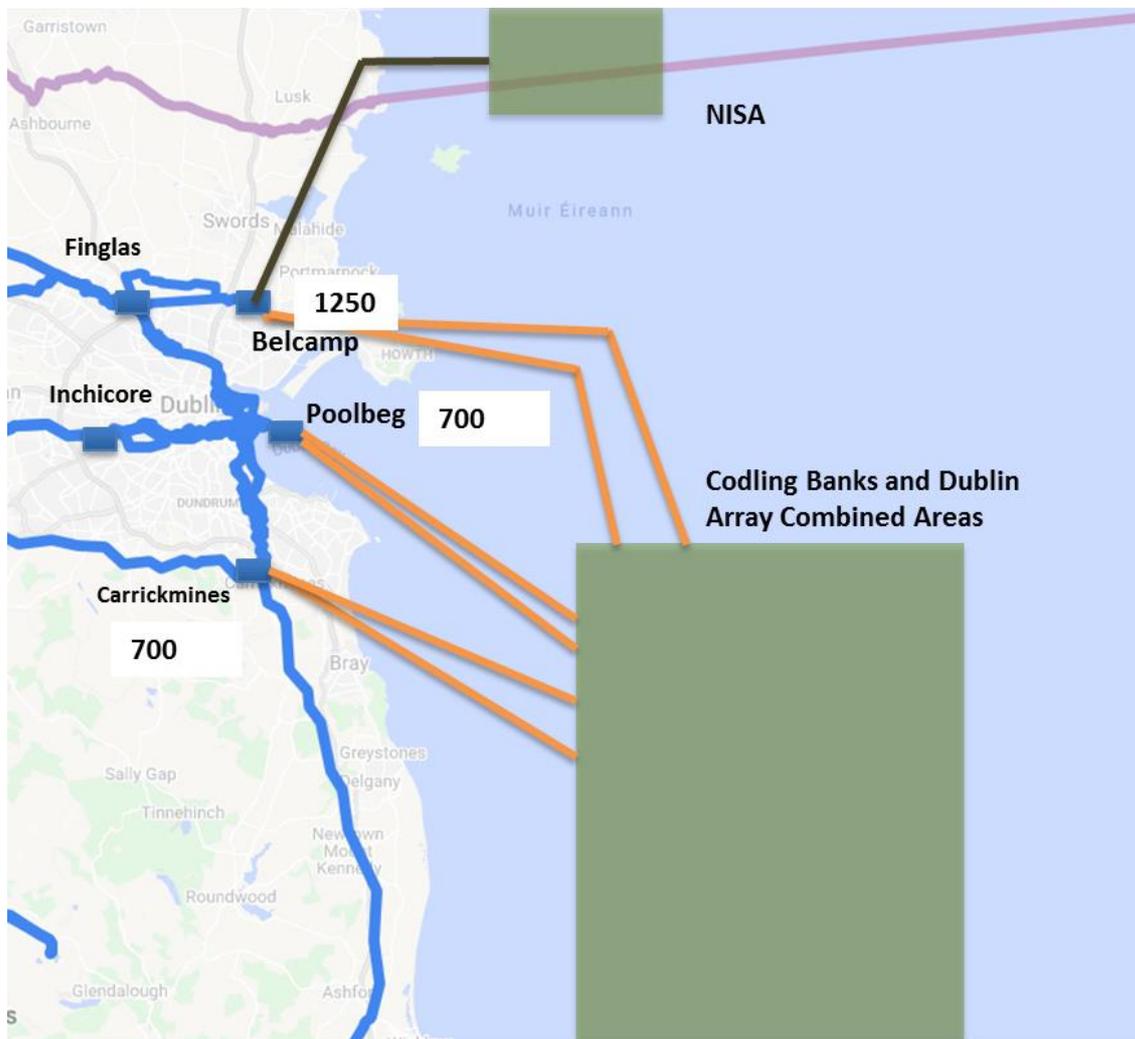


Figure 7: Favouring Belcamp connections

3.3.3.1 The need

Connecting more capacity at the Belcamp node brings more of the offshore connection capacity closer to large load substations in North Dublin. However, following the completion of the planned reinforcements, as identified in section [3.1](#), thermal violations are still present for this connection option.

For contingency analysis, overloads occur on the Corduff – Finglas 220 kV OHL double circuit and the Belcamp – Finglas 220 kV cable circuit due to a number of contingencies. To ensure compliance transmission network equipment ratings, while adding 1250 MW generation at Belcamp requires additional network reinforcement.

Also, a need has been identified for additional bay capacity at Belcamp to accommodate four individual physical offshore connections at the Belcamp node.

3.3.3.2 Solution options

A new transmission reinforcement would be required between the Belcamp and Corduff nodes to ensure TSSPS compliance for this connection option. Specific solution options would need to be assessed as part of future studies, if this connection option is progressed.

There would be a need for an additional 220 kV transmission substation in the Belcamp area to accommodate the offshore generating units and connect the transmission reinforcements onto the transmission system.

Table 11

Favouring Belcamp
Additional Reinforcements
1 x New Transmission Reinforcement (North Dublin)
1 x New Belcamp 2 Station

As noted in [1.5.1](#) a detailed analysis of the solution options has not been undertaken as part of this analysis. A high-level desktop assessment of a conceivable solution was undertaken.

3.3.4 Load Centres

The load centres option brings targeted connections from the offshore wind farms directly to the high load regions of Dublin city centre, West Dublin and North West Dublin. See offshore capacities at key nodes on the transmission system in the following table.

Table 12

Node	MW Capacity
Arklow	520
Oriel	370
Belcamp	500
Carrickmines	350
Poolbeg	700
Inchicore	350
Castlebagot	350
Corduff	350

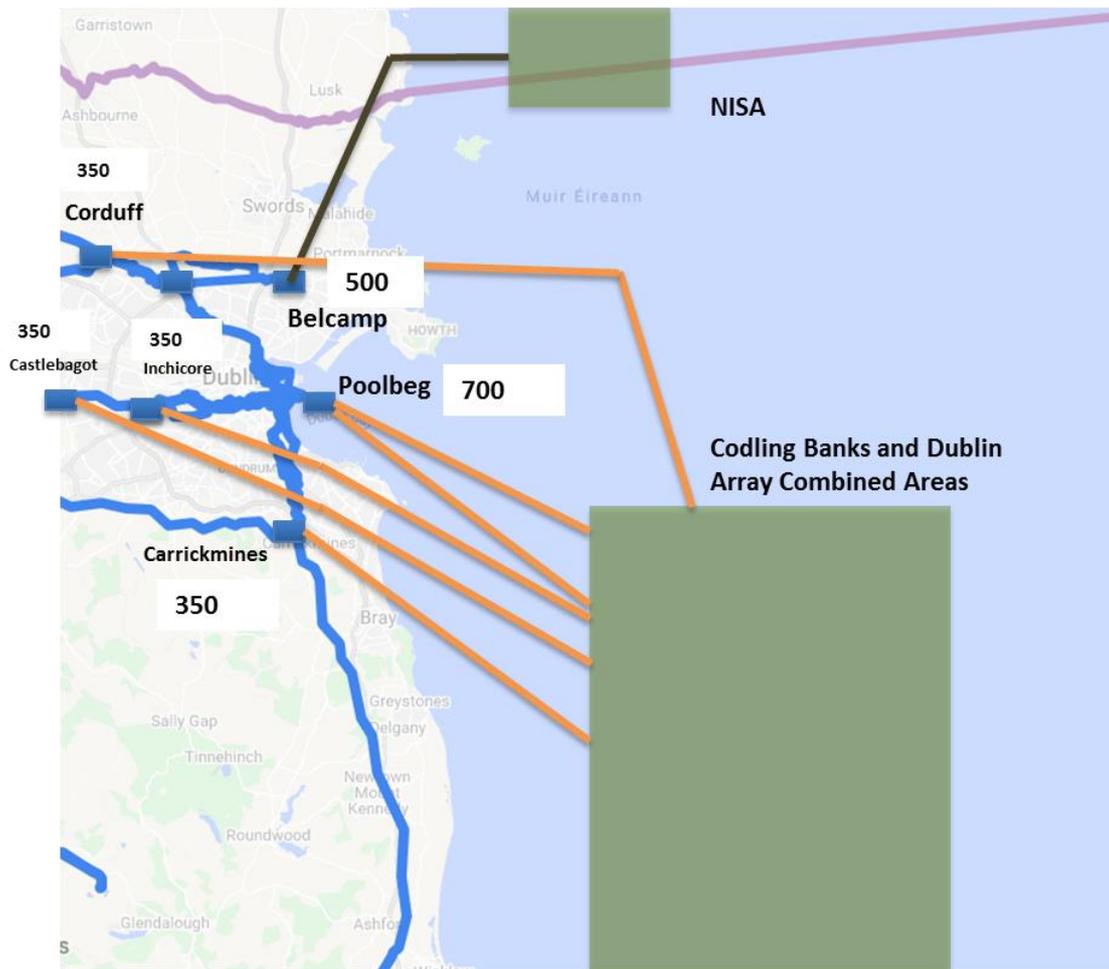


Figure 8: Load Centres connection

3.3.4.1 The need

Following the completion of the planned reinforcements outlined in section [3.1](#), there are no transmission network violations as a result of N-1 contingency analysis.

A need has been identified for a solution to accommodate the individual offshore connections onto the Transmission system in Dublin city centre and Dublin west.

3.3.4.2 Solution Option

This connection option requires an additional 220 kV substation to accommodate the cable connections near the load centres in the city. Although this option does mitigate the need for circuit reinforcements, it provides customers with very challenging and expensive connection methods.

Table 13

Load Centres
Additional Reinforcements
1 x New Transmission Station

3.3.5 Comparison of Options

Four options to connect power from the Dublin Array and Codling offshore wind farms onto the transmission system in Dublin have been assessed. The first three options involve connections to each of the Carrickmines, Poolbeg and Belcamp nodes with varying levels of connection at these nodes. The fourth option considers connection at these three nodes in addition to connections directly to load centres across the city. This section of the report compares the performance of each of the four options.

3.3.5.1 Assumptions

When completing the comparison of the connection options the following assumptions were made:

- The costing assessment was completed on a ranked basis – i.e. each option is assessed relative to the cost difference with the overall lowest cost option.
- The overall cost assessment is based on additional infrastructure beyond the projects which are already progressing through *Framework for Grid Development*.
- A high level “desktop” assessment of deliverability of each option has been carried out.

3.3.5.2 High level costing

A high level costing assessment was carried out to determine the network reinforcement costs of each solution, while taking into account the potential additional shallow customer connection costs for each option.

Onshore network reinforcement costs were accounted for based on the Transmission Standard Development Costs (TSDC’s), while a range of costs were assessed when comparing the shallow cost difference for the onshore and offshore export cables. Cost references were taken from a range of export cable per km costs provided in the offshore grid delivery model report¹³.

Table 14

Costing	
Option	Overall Cost Difference
Favouring Poolbeg	Cheapest Overall Connection
Favouring Carrickmines	0.5 - 3% additional cost
Favouring Belcamp	2 - 3% additional cost

¹³ <https://assets.gov.ie/75918/9659386d-7526-4ebe-8420-8854033250b6.pdf>

Load Centres	9.5-10% additional cost
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3.3.5.3 Comparing options based on cost, deliverability and risk assessment

The table presented is a comparison of the four options that have been assessed. The colour coding of each box goes from Cream (best performing), to Dark Blue (worst performing). The first column “Delivery Assessment” compares the connection options against each other in terms of the overall deliverability challenge, including the delivery of both specific shallow connections and the additional network reinforcements. The second column “Risk Assessment” compares the options against each other in terms of how sensitive each option is to delays in the development of new projects. The final column compares the options based on their overall cost.

Table 15

	Delivery Assessment	Risk Assessment	Overall Cost Performance
Option 1: Favouring Carrickmines	3 Major reinforcements Shortest Shallow cable works	Complex deep infrastructure delivery Large portion of capacity dependent on reinforcements	
Option 2: Favouring Poolbeg	1 Major reinforcement 12 km of Additional Shallow cable works	Most Deliverable Shallow & Deep works Capacity becomes available "sooner"	Cheapest overall cost
Option 3: Favouring Belcamp	2 Major reinforcements 26 km of Additional Shallow cable works	Challenging Shallow delivery Large portion of capacity dependent on reinforcements	
Option 4: Load Centres	1 Major reinforcement 55 km of Additional Shallow cable works	Difficult and Challenging Shallow Delivery	Most Expensive Option

More significant/difficult Less significant/difficult



Option 2 is the best performing option across the three metrics presented in table 15. Due to option 2’s combination of shallow connection works and minimised network reinforcements it is the best performing from a deliverability perspective. For example, the Dark Blue scoring for the Delivery Assessment of Favouring Carrickmines is due to the requirement of three major reinforcements to support that option, compared to one major reinforcement for the Favouring Poolbeg option.

Option 3 doesn’t perform as well due to additional challenges of getting power from Codling / Dublin Array to Belcamp. Finally, the Load Centres option results in difficult and expensive customer connections to deliver.

The risk assessment metric aims to capture the sensitivity of each option to specific delays in developing some of the new projects. As option 2 is only driving the need for one additional reinforcement, it performs better compared to the option 1. A significant

portion of the capacity at Carrickmines would be dependent on the completion of the new network reinforcements originating at Carrickmines.

3.4 West Coast project assessment

Two connection methods were considered on the west coast, for the Skerd Rocks project. The Skerd Rocks project has been assessed for a MW capacity of 392 MW.

3.4.1 Skerd Rocks Connection at Cashla

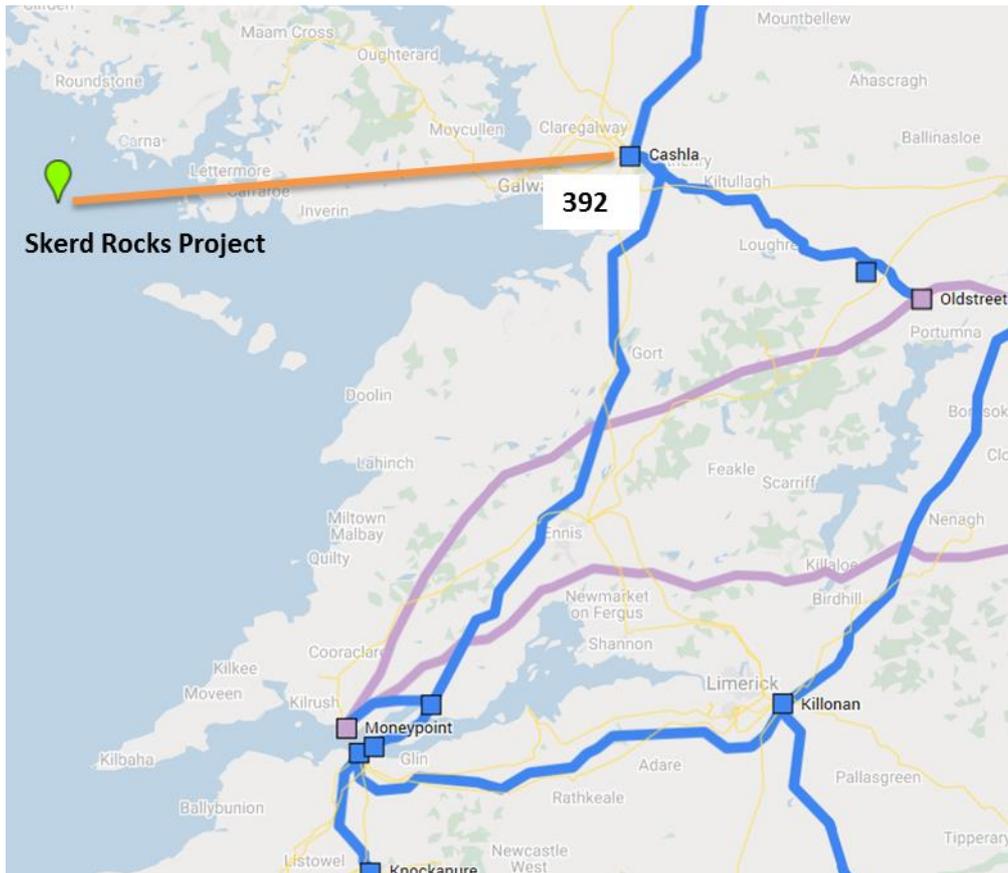


Figure 9: Skerd Rocks – Cashla 220 kV connection method

The contingency analysis carried out for this connection method did not indicate any additional reinforcement requirements for a connection into the Cashla 220 kV substation.

As would be expected, given the concentration of renewable generation in this area, analysis during summer conditions did result in high power flows on the Oldstreet – Tynagh circuit. However, the flows do not breach the emergency overload limits. This assumption is based on the planned Operational rules of high System Non-synchronous Penetration (SNSP) limits and low conventional must-run requirements at times of high renewables.

3.4.2 Skerd Rocks Connection at Moneypoint

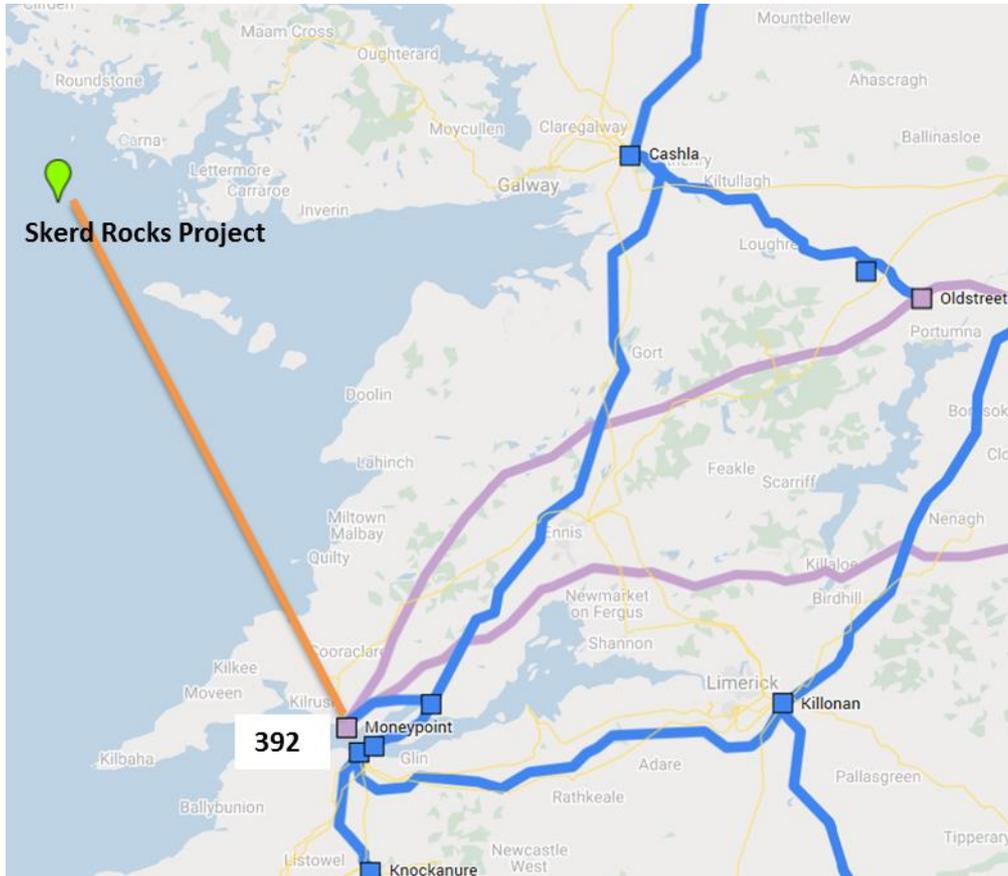


Figure 10: Skerd Rocks – Moneypoint 400 kV connection method

The contingency analysis carried out for this connection method did not indicate any additional reinforcement requirements for a connection into the Moneypoint 400 kV substation.

3.4.3 Comparing the Options

Comparing the options based on relative cost and deliverability:

- Both options result in relatively similar distances of offshore and onshore cable, required to get from the customer’s offshore site. There are no deep reinforcement costs to be accounted for in either option.
- Similarly, based on a high level deliverability assessment, both options present relatively equal deliverability challenges when compared to one another.

Two connection method options were assessed for the Skerd Rocks project on the West Coast. Although the assessment indicated no benefit of one connection over another, there are a number of caveats to be considered:

There are existing, known problems with west to east power transfers due to the high concentration of wind in the area, supplying the Dublin load.

There are projects underway to mitigate these issues which include the 400 kV series compensation projects and the Kildare Meath Grid Upgrade project.

This assessment aligns with the “Generation Led” development approach in EirGrid’s *Shaping Our Electricity Future* consultation. This assumes high offshore wind capacities on the East Coast. This capacity mitigates some of the existing power transfer issues from west to east.

On the assumption that this development approach is realised, and this connection does not have further competition from future large renewables in the area, it can be assumed that this connection, for either option, wouldn’t result in the need for any further reinforcements.

Appendix A: Summary of Stakeholder Engagement

EirGrid has undertaken a large number of engagements in relation to this assessment work which include:

Engagement	Date
Phase 1 projects workshop	July 2020
Bi-lateral meetings with Phase 1 Projects	July - August 2020
Phase 1 Projects applications received	September 2020
Presentation of emerging findings from grid connection studies to CRU	December 2020
Presentation of emerging findings from grid connection studies to ESB Networks	December 2020
Presentation of emerging findings from grid connection studies to Phase 1 projects workshop	January 2021
Presentation of emerging findings from grid connection studies to DECC	January 2021
Bi-lateral meetings with Phase 1 Projects	January 2021

The above table is in addition to various bilateral engagements with customers and Wind Energy Ireland (WEI) over the last year and monthly update meetings with the CRU.