Constraint Forecast Analysis Reports for Electricity Connection Policy (ECP)-GSS-1

Results Summary for Ireland

Version 1.0

2026 Q3

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Executive summary

The constraints forecast studies report for ECP-GSS-1 presents an estimate of the reduction in available solar and wind generation for the set of study scenarios listed in Table 1-1. For more information on the methodologies and assumptions used in this study, please see the Assumptions document[1] and Methodology Statement [2] on the ECP webpage. Further details on model inputs and results can be found in the accompanying published Excel document.

Section 1 presents the overall Ireland results (IE only), comparing Total Dispatch Down across the study scenarios and analysing how renewable portfolio size, offshore wind additions, future grid assumptions, and battery capacity potentially could influence surplus, curtailment, and constraint outcomes.

Section 2 provides an area-by-area summary of installed renewable capacity, dispatch down trends, dominant power-flow patterns, and key network bottlenecks, highlighting that results vary significantly by location, technology type, priority status, and interaction with wider system flows.

Section 3 assesses the maintenance sensitivity study by comparing selected scenarios with and without a representative transmission maintenance programme, demonstrating that planned outages can increase constraint dispatch down in some subgroups.

Following the Judicial decision on the SEM-22-009 Decision Paper on Dispatch, Redispatch and Compensation Pursuant to Regulation EU 2019/943, the detailed design for implementing Articles 12 and 13 is yet to be determined and may differ from the implementation for Total Dispatch Down used in this study. Therefore, an assumed interpretation will be used for this report that applies a grandfathering[3] approach to resolving Surplus and Constraint conditions. However, all scenarios were also analysed using a pro-rata allocation of constraints. The results of these studies are available in the Excel document accompanying this report.

This report uses the term “Total Dispatch Down” to refer to the total reduction in available solar and wind generation i.e. the sum of surplus, curtailment, and constraint, and is considered the key indicator for the results.

The results presented in this report are based on the simulation and modelling assumptions described which are correct as of 27/03/2026 (the data freeze date). The findings are indicative only and this report should in no way be read as a guarantee as to future levels of surplus, curtailment, and constraint.

[1] https://cms.eirgrid.ie/sites/default/files/publications/ECP-GSS-1-Assumptions-Document.pdf

[2] https://cms.eirgrid.ie/sites/default/files/publications/Constraint-Forecast-Studies-for-ECP-Methodology.pdf

[3] As outlined in SEM decision paper SEM-22-009 ‘grandfathering’ of constraints results in non-priority wind and solar generation being constrained down before priority generators. The grandfathering of constraints will apply pro-rata to the non-priority units within a subgroup/area first, and then if the constraint is still not satisfied, the priority units within that subgroup/area will be constrained. However, in addition to the core constraint forecast studies, a set of sensitivity studies can also be included in the study scenarios which employs pro-rata allocation of constraints.

1 Results Summary for Ireland

This section provides estimated Renewable Dispatch Down for surplus, curtailment and constraint results for Ireland (IE) only. There is a total of nine ECP-GSS-1 studies presented in this report.

The below figures provide an overview of Total Dispatch Down and category:

- Percentage levels for IE.
- Generated energy levels in TWh.
- Total Dispatch Down percentage levels per area level

In general, a reduction in Total Dispatch Down levels is seen in later study years, for the same generation portfolio, due to the benefits of network reinforcements, future interconnection, relaxation of operational constraints and increased demand levels. While a similar generation portfolio sometimes shows an increase in constraint dispatch down in a later study year (e.g. 2030 100% ECP vs 2035 100% ECP), this may be attributed to the sequential nature of the modelling as described in the methodology. Due to the reduction in surplus and curtailment dispatch down, the available energy in the constraint study is significantly higher in the later study year, which can cause an increase in constraint dispatch down while total dispatch down decreases.

For a given forecast year, Total Dispatch Down tends to increase as the generation portfolio increases due to increased available energy. For the same reason, Total Dispatch Down increases when additional offshore capacity is added. As installed wind and solar capacity increases, surplus dispatch down tends to become the driver for total dispatch down.

The battery sensitivity, which is the 2030 33% ECP + 2.6GW offshore model with approx. 1.9 GW (5.0 GWh) of future battery capacity removed from the model has higher Total Dispatch Down than the 2030 33% ECP + 2.6GW offshore model, implying that installing additional battery capacity can reduce dispatch down. Removing this battery capacity results in approximately 1 TWh of additional dispatch down in for the given portfolio in 2030. Most of the change to dispatch down occurs in the surplus study, curtailment and constraint dispatch down also increase.

More detailed results for each area can be seen in the corresponding excel format publication.

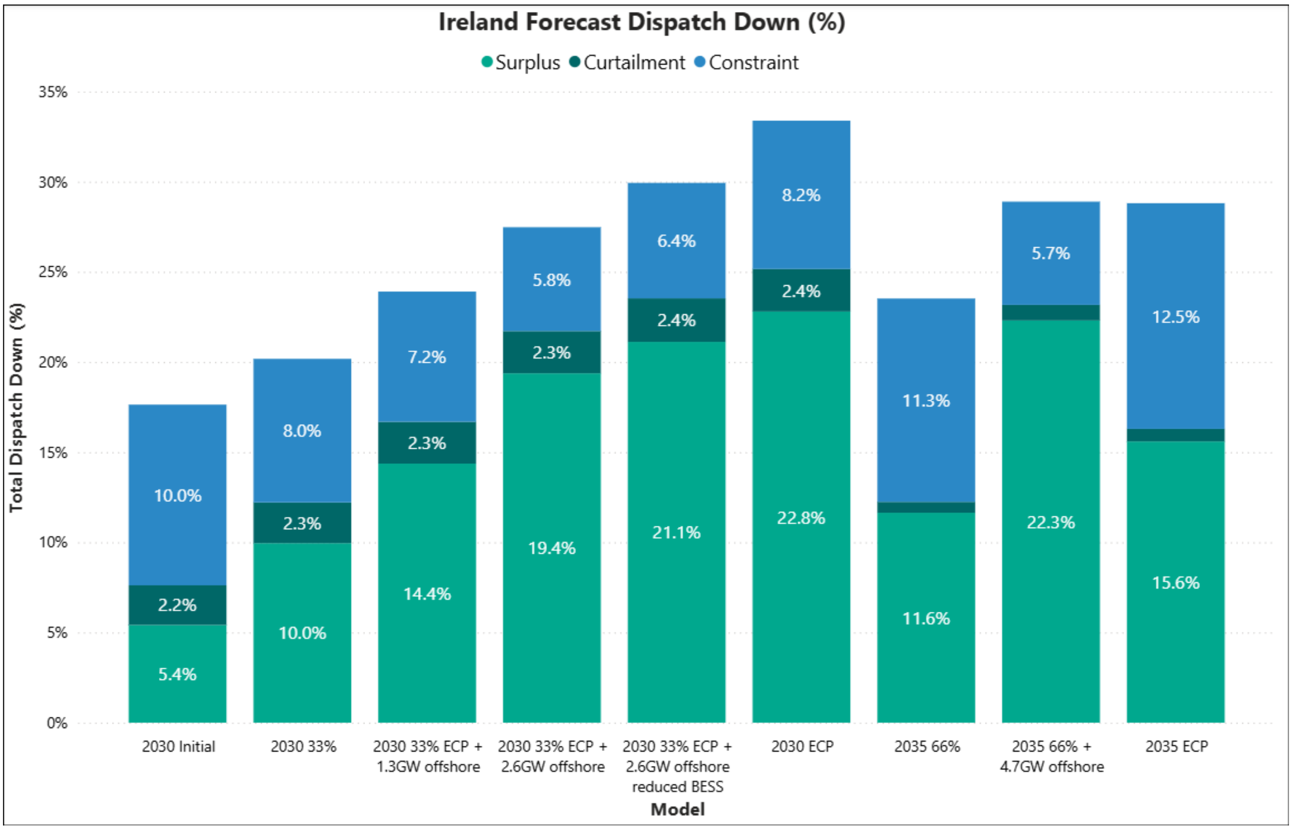

Figure 1-1 - Ireland Total Dispatch Down Percentage

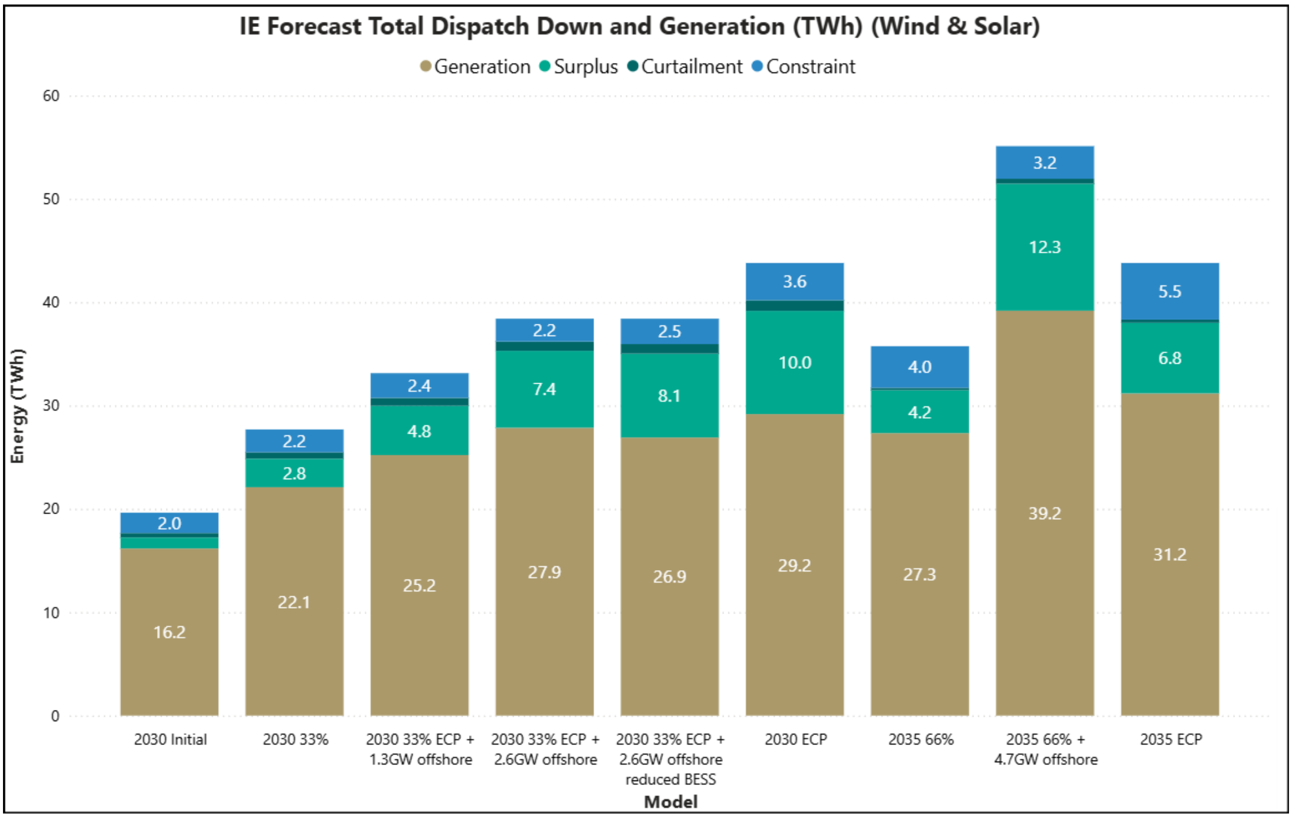

Figure 1-2: Ireland Generation and Dispatch Down in TWh

Note: The same weather profiles are used for all forecast years and portfolios. As a result, the available energy increases as the generation portfolio increases and remains constant for different models with the same generation portfolio.

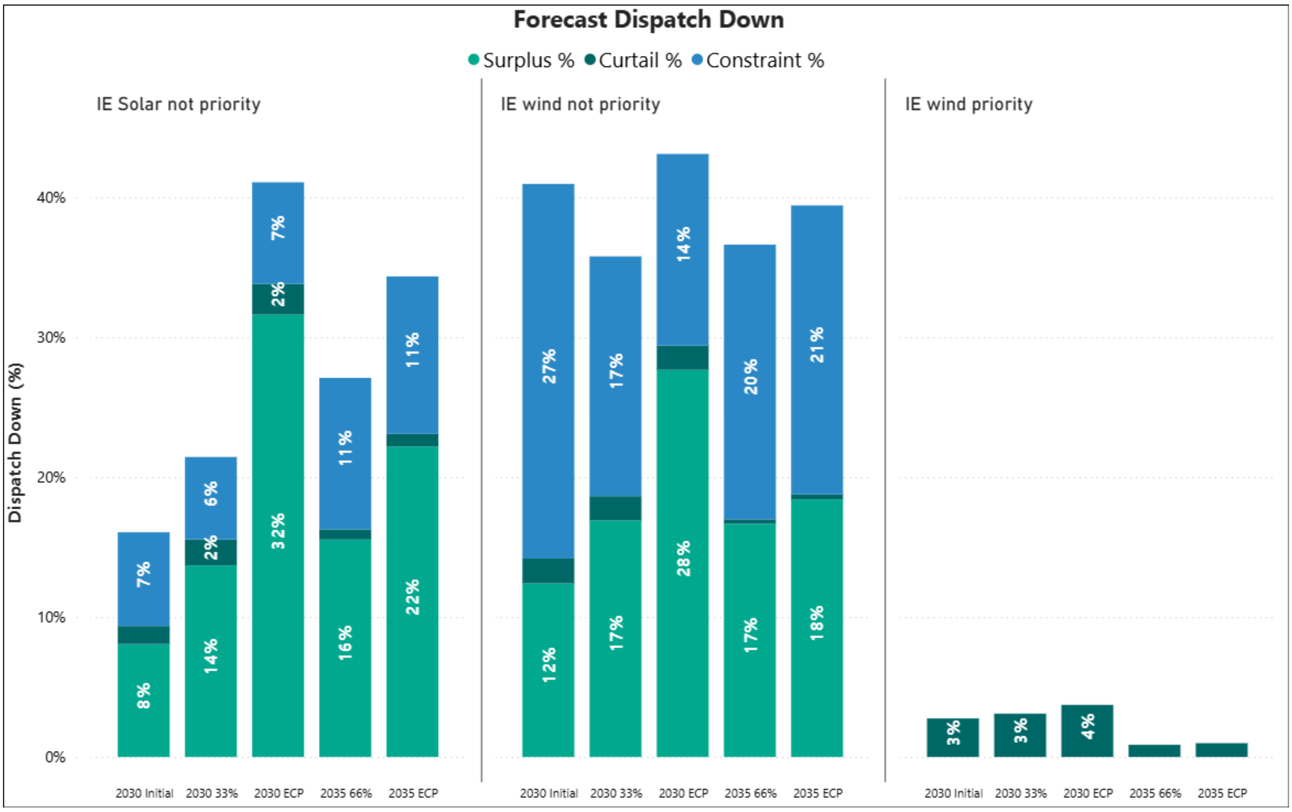

Figure 1-3: Ireland dispatch down by technology class - main studies

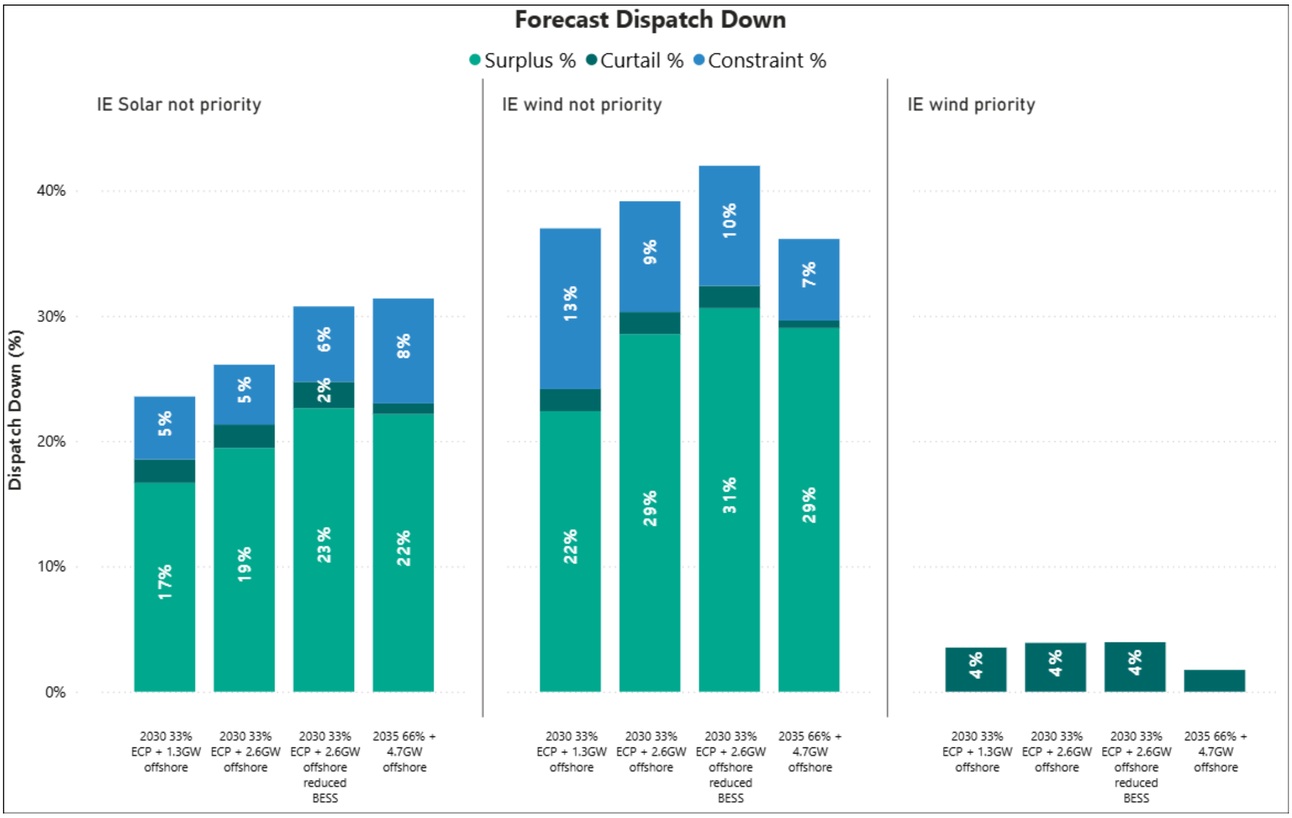

Figure 1-4: Ireland dispatch down by technology class - offshore and battery studies

Scenario	Full Scenario Name
S1	2030 Initial
S2	2030 33% ECP
S3	2030 33% ECP + 1.3GW offshore
S4	2030 33% ECP + 2.6GW offshore
S5	2030 33% ECP + 2.6GW offshore reduced BESS
S6	2030 ECP
S7	2035 66% ECP
S8	2035 66% ECP + 4.7GW offshore
S9	2035 ECP

Table 1-1 Scenario names mapping in Area-wise figures

Area A

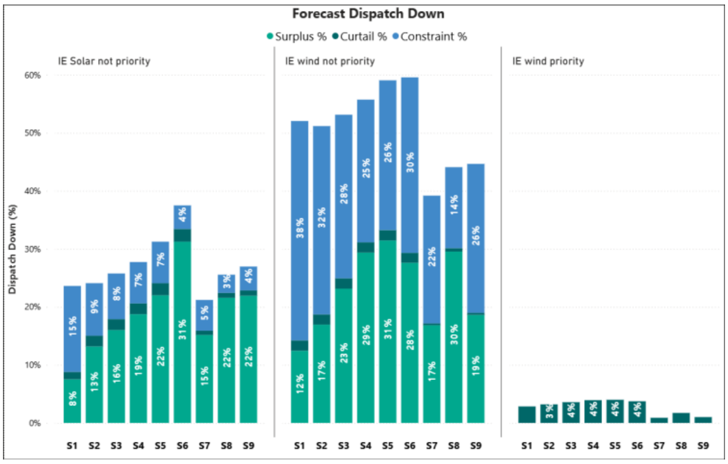

Figure 1-5: Area A dispatch down

Area B

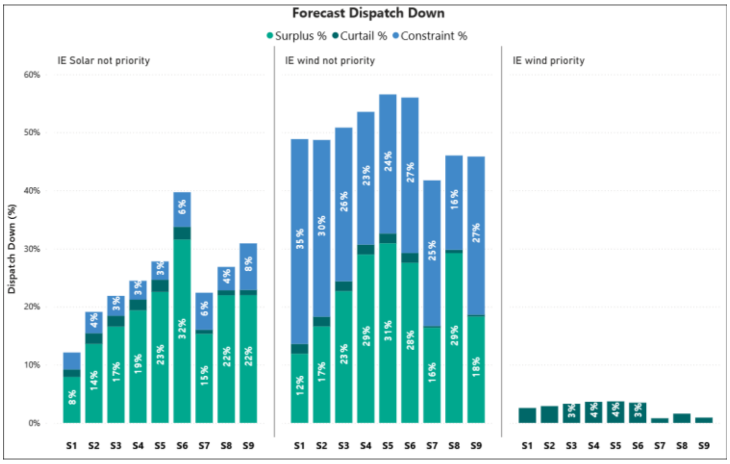

Figure 1-6: Area B dispatch down

Area C

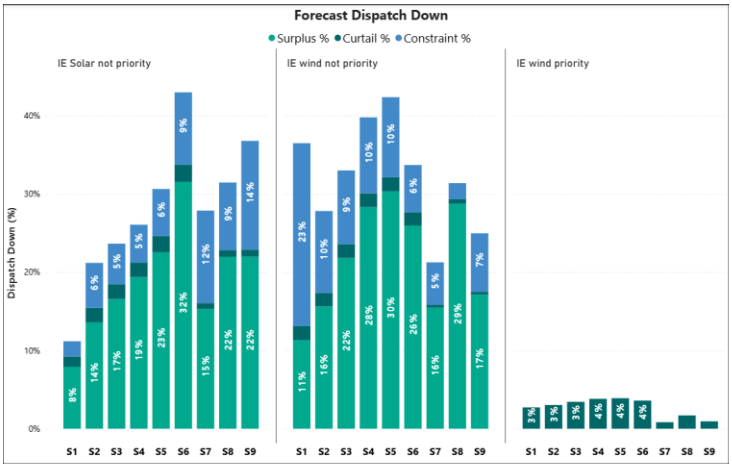

Figure 1-7: Area C dispatch down

Area D

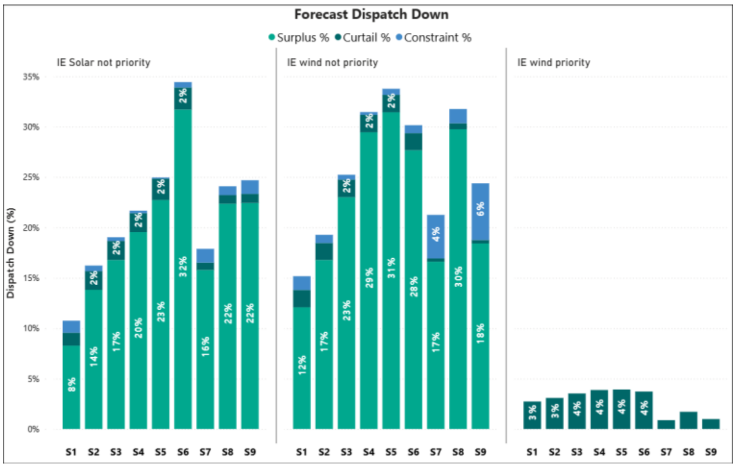

Figure 1-8: Area D dispatch down

Area E

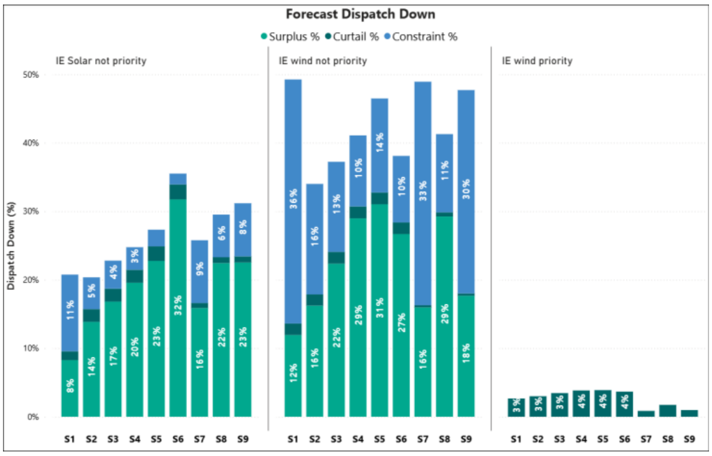

Figure 1-9: Area E dispatch down

Area F

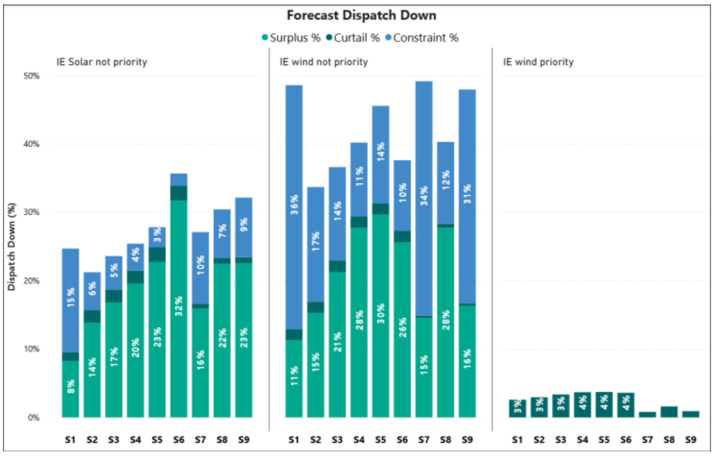

Figure 1-10: Area F dispatch down

Area G

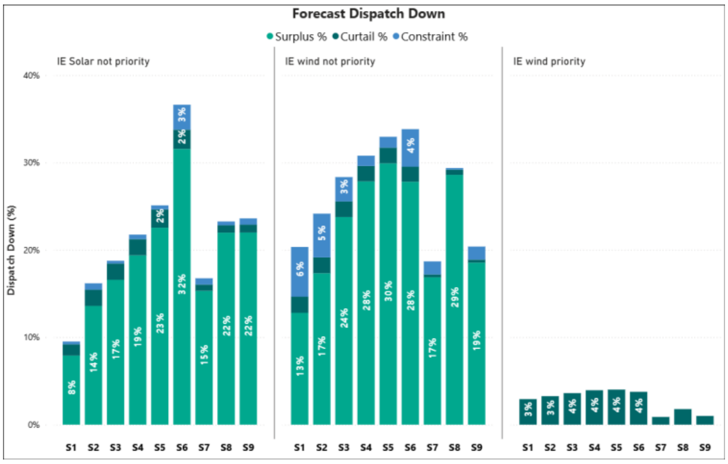

Figure 1-11: Area G dispatch down

Area H1

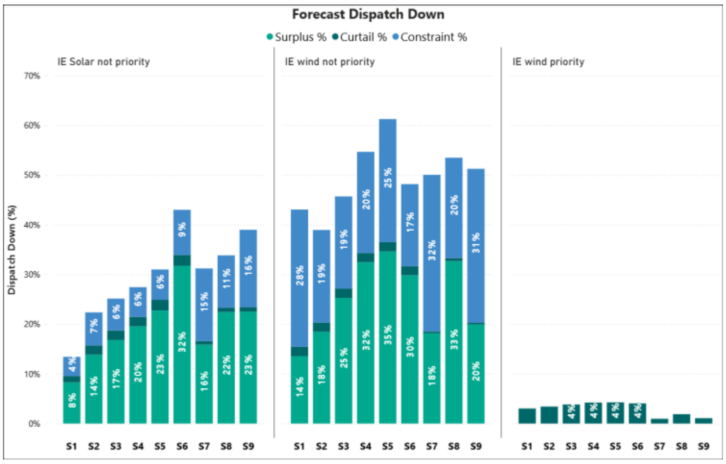

Figure 1-12: Area H1 dispatch down

Area H2

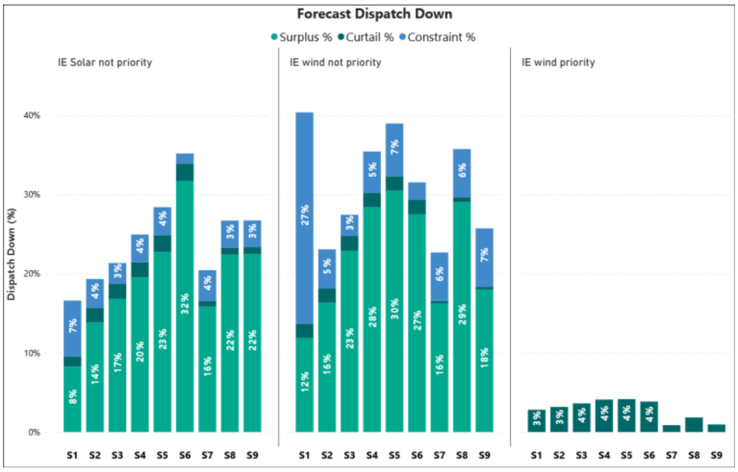

Figure 1-13: Area H2 dispatch down

Area I

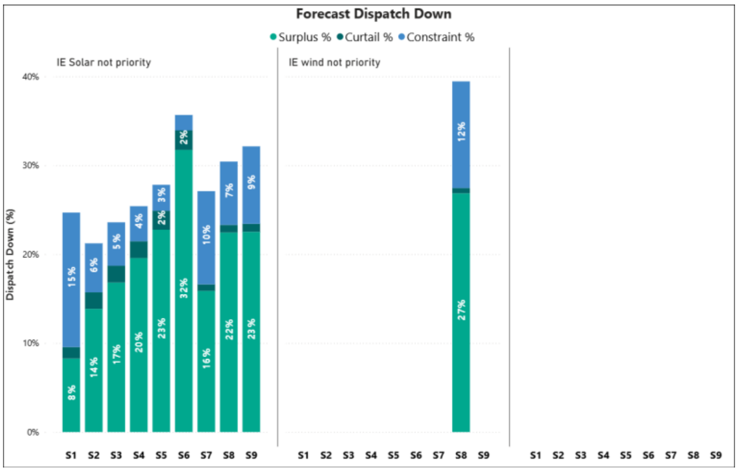

Figure 1-14: Area I dispatch down

Area J

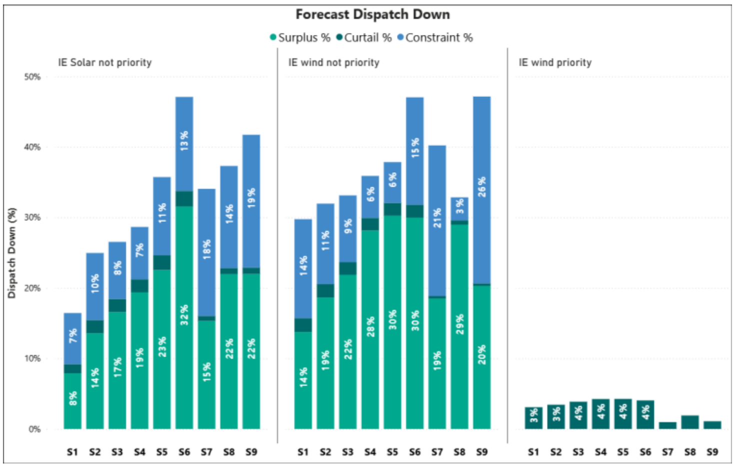

Figure 1-15: Area J dispatch down

Area K

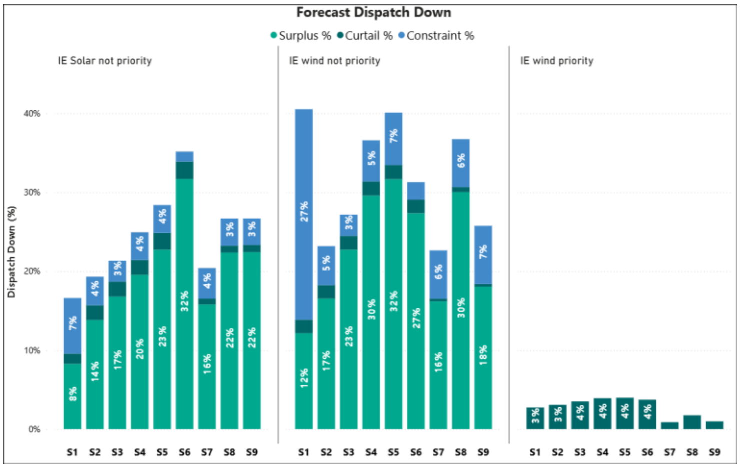

Figure 1-16: Area K dispatch down

Please note: if there is no data shown for a forecast year and portfolio, it is because there is no installed capacity of that technology class in that area in that portfolio. Area-wise results for core scenarios are shown above. For additional information, please see the excel-format publication.

Breaking the results down by area, forecast year, installed capacity, technology type and priority status, we can see that dispatch down is heavily dependent on all these inputs.

It is important to note here that dispatch down due to constraints are applied using a grandfathering methodology. This approach applies constraints pro-rata to all generators of the same priority status within a subgroup (for more information see the methodology document on the ECP section of the Eirgrid website[4]). Results using a pro-rata methodology are available in the excel-format publication.

In subgroups with very low installed non-priority generation, a small number of non-priority units absorb most or all of the constraint dispatch down and show distorted results. Area H2 in the initial portfolio is a good example:

- There is limited wind not-priority generation.
- The ratio of priority wind is relatively high.

Since non-priority wind is constrained down before priority wind, the single generator experiences a high level of dispatch down under this methodology. This represents a small amount of constrained energy and may not reflect actual outcomes. This is a result of the agreed dispatch down calculation methodology and may be reviewed in future iterations. In the 33%, 66% and ECP scenarios, additional non-priority wind generators are installed in the subgroup and lower levels of dispatch down are observed.

[4] ECP Constraint Reports | Customer Information | EirGrid

2 Key Summary for Each Area

Introduction

The following section summarises each area in terms of installed renewable capacity, dispatch down results, and contingency analysis. Further details are provided in the accompanying published Excel document.

- Generation information: Refer to the ‘RES & Battery Generation Table’ and ‘Generation Tables’ tabs.
- Dispatch down results: Refer to the ‘Modelling Results’ and ‘Figures and Tables’ tabs.
- Contingency binding hours: Refer to the ‘Contingencies and Lines’ tab.
- Interconnector flows and hourly information on surplus dispatch down: ‘Interconnector Flows’ tab.

Figure 2-1 below presents the transmission network map divided into 12 areas. The 220 kV circuits are shown in green and the 110 kV circuits in black.

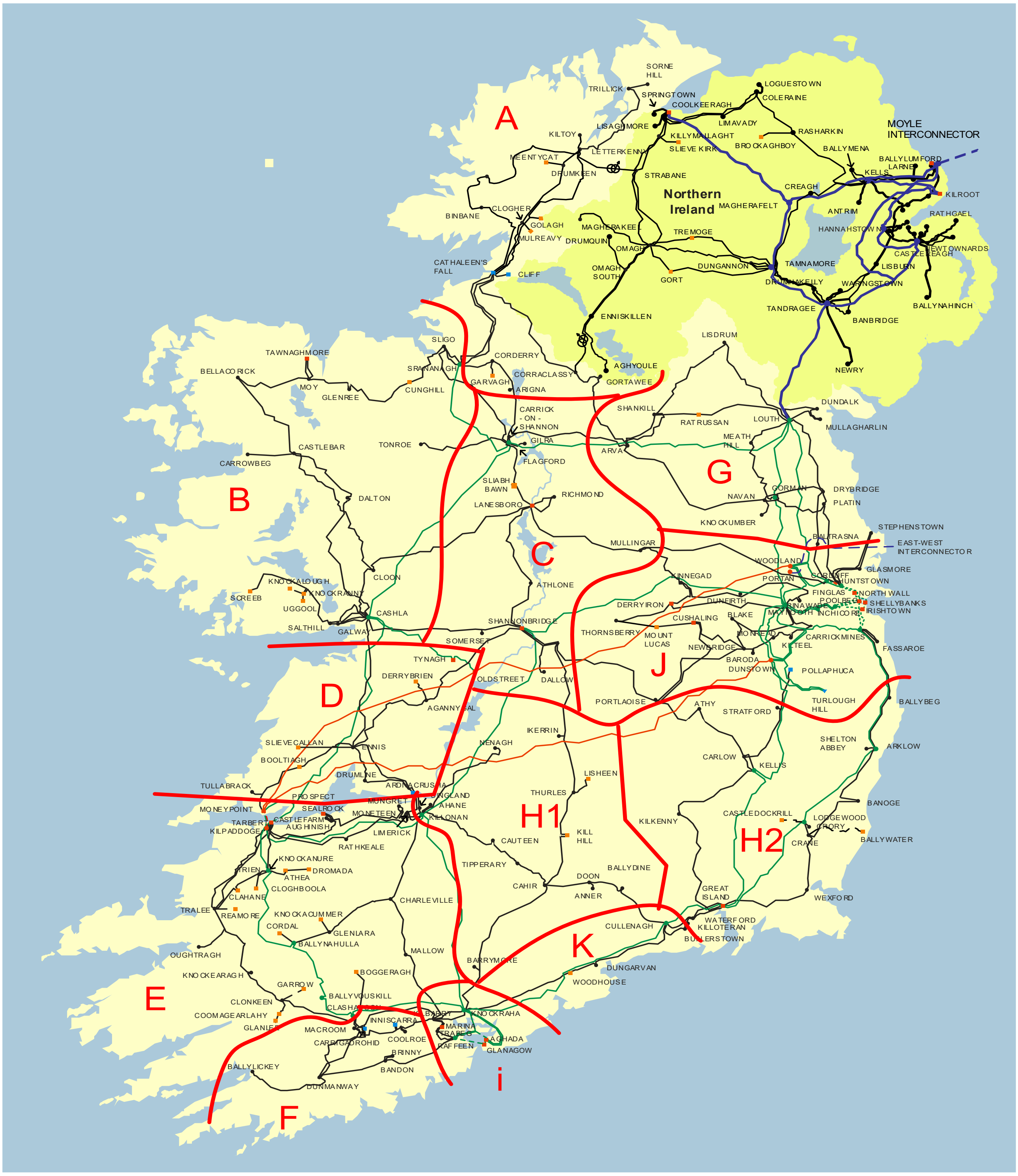

Figure 2-1 Transmission Network Area Map

2.1 Area A

Area A, in the northwest of the country includes a mix of wind and solar generation. The counties that are covered in this area include Donegal and Sligo (partial). Area A is a wind heavy region with a significant volume of wind generation with around 1.3 GW of installed wind capacity in the 100% ECP study. There are 7 network projects that have been considered in Area A for the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. At times of high renewable generation, there is a net export of power from Area A, and the dominant power flows tend to be from Area A towards the load centres on the east coast and the interconnectors.

The total dispatch down percentage in Area A in the 2030 initial scenario is 25%. With the increasing installed capacity of renewable, it reaches 39% in the 2030 100% ECP scenario. However, the total dispatch down reduces in the future grid scenario, owing to increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It falls to 29% in the 2035 100% ECP scenario.

During times of high wind scenario, as a net export area, major portion of the power flowing through Area A flows into the Srananagh 220 kV station in Area B, the Flagford 220kV station in Area C and the Arva 110kV station in Area G. The power flow from Cathaleen's Falls to Srananagh becomes the major bottleneck from area A to B in 2030, however, it would get further benefit from the additional network reinforcements beyond 2030. Between Areas A and C, the Arigna–Carrick-on-Shannon corridor represents the key bottleneck. Within Area A, loss of any parallel sections from Letterkenny station to Cathaleen's falls station can potentially overload the parallel 110kV circuits during high power flow in 2030, but it is expected to be relieved after 2030 due to network reinforcement projects.

During the high-RES scenarios, the power from this area tends to flow onto the 220 kV circuits, and then towards Area J. Issues in the power flow path can cause dispatch down in Area A. Further, contingency on the 220 kV circuits will put additional stress on the supporting 110 kV circuits, causing dispatch down of RES generators in the area. The 110 kV parallel paths are critical transmission infrastructure in these areas during times of high wind. Any loss of these 110 kV parallel lines results in additional dispatch down. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.2 Area B

Area B, in the west of the country includes a mix of wind and solar generation. The counties that are covered in this area include Sligo (partial), Mayo, Roscommon (partial), Leitrim and Galway (partial). Area B is a wind-dominant region, characterised by a significant level of wind generation, with approximately 1.3 GW of installed wind capacity in the 100% ECP study. Twelve network projects have been considered in Area B for the 2030 study scenarios and two for the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. At times of high renewable generation, there is a net export of power from Area B to Area C and D, and the dominant power flows tend to be from Area B towards the load centres on the east coast.

The total dispatch down percentage in Area B is 24% in the 2030 initial scenario. As renewable installed capacity increases, this rises to 38% in the 2030 100% ECP scenario. However, the share decreases under future grid scenarios, particularly in the north of Area B, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It reduces to 30% in the 2035 100% ECP scenario.

In the northern part of Area B, during the high renewable energy scenarios, the power flow on 110 kV lines west to east corridor from Bellacorick via Moy, Glenree, Cunghill, towards Sligo becomes the major bottleneck for the northern part of Area B. Power flowing from Area A and generation from Area B merge in Srananagh region. In the southern part of Area B, during the high renewable energy scenarios, the power flow on 110 kV line from Knockranny to Galway becomes the major bottleneck. The 110 kV parallel paths are critical transmission infrastructure for these areas during times of high wind. Any loss of these 110 kV parallel lines results in additional dispatch down. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.3 Area C

Area C, in the middle of the country, includes a mix of wind and solar generation. The counties that are covered in this area include Roscommon, Leitrim (partial), Galway (partial), Westmeath (partial) and Offaly (partial). Area C is a key central region within Ireland's transmission network, acting as a bridge between Area A (north), Area B (west), Areas D, E and H1 (south), and the eastern regions of Areas G and J, where the primary load centres are located. In the 100% ECP study, Area C includes approximately 1.3 GW of installed solar capacity and 0.7 GW of installed wind capacity. Two network projects have been considered in Area C for the 2030 study scenarios and 2 for the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. For Area C, renewable power from the west and northwest will flow across the transmission network and the dominant power flows tend to be towards Area J on the east coast and the interconnectors.

The total dispatch down percentage in Area C is 24% in the 2030 initial scenario. As renewable installed capacity increases, this rises to 36% in the 2030 100% ECP scenario. However, the share declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 29% in the 2035 100% ECP scenario.

In Area C, during the high renewable energy scenarios, Area C experiences several critical network constraints. The 110 kV power flow from Lanesboro to Sliabh Bawn becomes a major bottleneck in this area but it is expected to be alleviated by additional network reinforcements post 2030. Another major issue within Area C is with respect to the 110 kV power flow from Shanonagh to Mullingar corridor. In terms of connecting to other neighbouring areas, between Areas A and C, the 110 kV Arigna to Carrick-on-Shannon corridor represents a bottleneck. Power flow from 110 kV Derrycarney to Portlaoise line is another bottleneck to restrict power flowing from Area C to Area J. Furthermore, between Area D to Area C, Tynagh to Oldstreet 220 kV line is going to be another bottleneck. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.4 Area D

Area D, in the west of the country, includes a mix of wind and solar generation. The counties that are covered in this area include Clare and Galway (partial). In Area D, there is approximately 0.5 GW of installed solar capacity and 0.6 GW of installed wind capacity in the 100% ECP study. The 2035 study scenarios incorporate four network projects in Area D. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. At times of high renewable generation, there is a net export of power from Area D, and the dominant power flows tend to be from Area D towards Area J on the east coast and the interconnectors.

The total dispatch down percentage in Area D is 9% in the 2030 initial scenario. As renewable installed capacity increases, this rises to 27% in the 2030 100% ECP scenario. However, the total dispatch down declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 21% in the 2035 100% ECP scenario.

In addition to the power flows out of Area D, there are also power flows across or through Area D. The generators within Area D have access to the 220 kV stations at Shannonbridge, Cashla, Moneypoint and Killonan through the 110 kV circuits, and thus, the power flowing out of Area D meets and joins with other power flows from areas connected to these 220 kV stations. The power flow from Area D is towards east region. The generators on the meshed 110kV network in Area D would be affected by contingencies in the area as well as outside the area. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.5 Area E

Area E, in the southwest of the country includes a mix of wind and solar generation. The counties that are covered in this area include Clare (partial), Kerry, Cork (partial) and Limerick. The Area E is the most wind-dominant region with a substantial volume of wind generation with around 2.2 GW of installed wind capacity and 0.8GW installed solar in the 100% ECP study. Three network reinforcement projects have been considered in Area E for the 2030 study scenarios and one for the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. At times of high renewable generation, there is a net export of power from Area E, and the dominant power flows tend to be from Area E towards Area J on the east coast and the interconnectors. With the addition of the Celtic interconnector, during high renewable scenarios, the power flow changes and flows towards the interconnector connected at Knockraha.

The total dispatch down percentage in Area E is 13% in the 2030 initial scenario. As renewable installed capacity increases, this rises to 22% in the 2030 100% ECP scenario. It raises to 24% in the 2035 100% ECP scenario, driven by the higher constraint dispatch down, likely driven by higher imports across the Celtic interconnector in that scenario.

During the high renewable energy scenarios, Area E experiences several critical network constraints across the region. In the northern part of Area E, the Knockanure 220kV region is one of the congested areas as the 220 kV line Kilpaddoge to Knockanure and the 110 kV line Knockanure to Trien are heavily loaded. In the central part of Area E, the 110 kV corridor from Ballynahulla to Charleville via Glenlara becomes a major bottleneck. In the southern part of Area E, the 110 kV line Clonkeen to Garrow is another major congestion issue. Moreover, the 110 kV line Clashavoon to Macroom becomes the bottleneck, limiting power flow from Area E to Area F.

The power from Area E tends to flow onto the 220 kV circuits connecting Tarbert 220 kV station and Clashavoon 220 kV station as well as the 400 kV circuits connecting Moneypoint 400 kV. Any issues with the 220 kV circuit or with parallel paths can limit the generation in this area. The power flows towards either direction depending on the wind availability in the region. Additionally, the issues binding for the circuits in Area E can create additional stress in the Area F and Area I circuits, as they merge with rescue flows towards Knockraha. Contingencies in this area were seen to affect adjacent areas as the rescue flow utilizes the available parallel path formed by 110 kV circuits. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.6 Area F

Area F, in the south of the country includes a mix of wind and solar generation. The counties that are covered in this area include Kerry (partial) and Cork. In Area F, there is approximately 0.07 GW of installed solar capacity and 0.24 GW of installed wind capacity in the 100% ECP study. Two network reinforcement projects have been considered in Area F for the 2030 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. At times of high renewable generation, there is a net export of power from Area F, and the power flows tend to be from Area F towards the load centres on the east coast and the interconnectors. This area is adjacent to area with Celtic and at times the flow can be towards the interconnector.

The total dispatch down percentage in Area F is 23% in the 2030 initial scenario. This reduced to 20% in the 2030 100% ECP scenario. It increases to 22% in the 2035 100% ECP scenario. Small changes from initial to 100% ECP in installed capacity and generation mix as well as changes in interconnector flows likely contribute to the fluctuations in total dispatch down.

Area F is adjacent to Area E, and the power from Area E tends to flow onto the 220 kV circuit running from Kilpaddoge towards Knockraha. Area F pulls its power onto the 220 kV nodes in Area E or I. During the high renewable energy scenarios, the 110 kV line Clashavoon to Macroom becomes a major bottleneck between Area E to F. Any issues with the 220 kV circuit or with parallel paths can limit the generation in this area. Additionally, the issues binding for the circuits in Area E can create additional stress on the Area F and Area I circuits, as they merge with rescue flows. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.7 Area G

Area G, in the east of the country, includes a mix of wind and solar generation. The counties that are covered in this area include Monaghan, Louth, Meath, Cavan (partial) and Westmeath (partial). In the 100% ECP study, Area G includes approximately 1.1 GW of installed solar capacity and 0.3 GW of installed wind capacity. Four network projects have been considered in Area G for the 2030 study scenarios and seven for the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication.

Area G is connected to Northern Ireland through the North South Interconnector and well connected to Area J which has Ireland's largest load centres. The EWIC interconnector is also located in Area J which can potentially export when renewable generation is high. In general, when renewable generation is high, power flows are predominantly from Area A and B towards Area G which then flows towards Area J to supply the demand and the EWIC flow. A transmission bottleneck between Area G and Area J can be affected by power flows coming from other areas.

The total dispatch down percentage in Area G is 11% in the 2030 initial scenario. As renewable installed capacity increases, this increases to 30% in the 2030 100% ECP scenario. However, the total dispatch down declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 19% in the 2035 100% ECP scenario.

In Area G, any loss of the 220 kV circuits will put additional stress on the supporting 110 kV circuits, causing dispatch down of RES generators in the area. The 110 kV parallel paths are critical transmission infrastructure in these areas during times of high wind. Any loss of these 110 kV parallel lines results in additional dispatch down. Additionally, the loss of a 220 kV circuit applies additional stress on the 110 kV circuits in the region. During the high-RES scenarios, the power from Areas A, B and C also flow onto the 220 kV circuits, and then towards the load centres in Dublin. Loss of 220 kV lines connecting the Gorman, Louth and Woodland stations can cause congestion in the 110 kV line Louth to Drybridge and the 110 kV line Meath Hill to Ricetown. Hence a bottleneck is created around the Louth, Meath hill, Drybridge and Gorman region. The Louth to Drybridge bottleneck is expected to be alleviated by additional network reinforcements post 2030. Moreover, the 220 kV line Arodstown to Maynooth becomes the bottleneck when loss of the parallel 220 kV line, limiting power flow from Area G to Area J, however, it would get further benefit from the additional network reinforcements beyond 2030. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.8 Area H1

Area H1, in the south of the country, includes a mix of wind and solar generation. The counties that are covered in this area include Tipperary, Waterford (partial) and Kilkenny (partial). In the 100% ECP study, Area H1 includes approximately 1.1 GW of installed solar capacity and 0.8 GW of installed wind capacity. Three network reinforcement projects have been considered in Area H1 for the 2030 study scenarios and one for the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. In most study years, there is a tendency for renewable power to flow toward Area J on the east coast and the interconnectors. Renewable power from Cork and Kerry will flow east across the transmission network - some of this power will flow through H1.

The total dispatch down percentage in Area H1 is 12% in the 2030 initial scenario. As renewable installed capacity increases, this increases to 30% in the 2030 100% ECP scenario. However, the total dispatch down declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 28% in the 2035 100% ECP scenario.

There is a tendency within Area H1 for some 110 kV nodes to see higher constraints than others. The model is demonstrating that it is more efficient to constrain generation at some locations in Area H1 than at others. Additionally, when any one section in the meshed 110 kV circuit in the area is lost, it creates overloading in other sections in the area. Area H1 is a meshed 110 kV network connecting to four different 220 kV stations and is negatively affected by the loss of any section of 110 kV circuit. The area is also sensitive to the loss of neighbouring 110 kV and 220kV circuits in adjacent areas. In Area H1, during the high renewable energy scenarios, the 110 kV line Cahir to Barrymore becomes a major bottleneck for Area H1. Additionally, the 110 kV lines Killonan to Cauteen and Rathkeevin to Doon becomes prominent bottlenecks in 2030 and Future Grid scenarios. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.9 Area H2

Area H2, in the south-east of the country, includes a mix of wind and solar generation. The counties that are covered in this area include Waterford (partial), Wexford, Kilkenny (partial) and Wicklow (partial).

In the 100% ECP study, Area H2 is a solar-dominant region includes approximately 2.2 GW of installed solar capacity and 0.8 GW of installed wind capacity. Area H2 includes a significant number of network reinforcement projects in future years, with seven projects considered in the 2030 study scenarios and eight projects in the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. Area H2 includes the assumed connection point for the Greenlink interconnector at Great Island. The area also receives connections at Arklow for future offshore wind in the offshore based scenarios. For Area H2, the dominant power flows tend to be towards the load centres in Area J and the interconnectors.

The total dispatch down percentage in Area H2 is 12% in the 2030 initial scenario. As renewable installed capacity increases, this increases to 29% in the 2030 100% ECP scenario. However, the total dispatch down declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 22% in the 2035 100% ECP scenario.

In the Area H2, the Arklow 220/110 kV transformer is the major bottleneck in the area during the high-RES scenarios. Further, the loss of 220 kV circuit Dunstown to Kellis creates additional stress to the network in this area, bringing the 110 kV line Carlow to Kellis to the forefront as the prominent bottleneck. Moreover, the 110 kV line Ballyragget to Coolnabacky becomes the bottleneck when loss of the parallel 220 kV and 110 kV lines, thereby limiting power flow from Area H2 to Area J. The Greenlink and Celtic interconnectors provide additional extraction points during high-RES scenarios. Thus, generation in Area K and H2 tries to push power towards the Dublin and interconnectors through the 220 kV and 110 kV circuits. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.10 Area I

Area I, in the south of the country. The counties that are covered in this area include Cork (partial). In the 100% ECP study, Area I includes approximately 0.7 GW of installed solar capacity. Three network projects have been considered in Area I for the 2030 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. Celtic and one of the south coast offshore are connecting to this area in future. For Area I, the dominant power flows tend to be towards Area J on the east coast and the interconnectors. With Celtic getting connected in Area I, the power flow at times can be towards area I and towards Interconnector depending on the flow on the Celtic.

In the 2030 initial scenario, Area I records a total dispatch-down percentage of 25%. As renewable installed capacity increases, this increases to 36% in the 2030 100% ECP scenario. However, the total dispatch down declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 32% in the 2035 100% ECP scenario.

Area I is adjacent to Area E and the power from Area E tends to flow onto the 220 kV circuit running from Kilpaddoge towards Knockraha. Power flows to the 220 kV nodes from Area I. Any issues with the 220 kV circuit or with parallel paths can limit the generation in this area. During the high renewable energy scenarios, Area I experiences several network constraints. When loss of the parallel 110 kV line, the 110 kV line from Kilbarry to Marina becomes a major bottleneck in this area. Another major issue within Area I is with respect to the 110 kV power flow from Knockraha to Lysaghtstown corridor. In terms of connecting to other neighbouring areas, the 110 kV line Knockraha to Barrymore represents a bottleneck, restricting power flowing from Area I to Area H1. Additionally, the issues binding for the circuits in Area E can create additional stress on the Area F and Area I circuits, as they merge with rescue flows towards Knockraha. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.11 Area J

Area J, in the east of the country includes a mix of wind and solar generation. The counties that are covered in this area include Dublin, Kildare, Laois, Westmeath (partial), Wicklow (partial) and Offaly (partial). In the 100% ECP study, Area J is the most solar-dominant region includes approximately 4.2 GW of installed solar capacity and 0.9 GW of installed wind capacity. Area J has the greatest number of network reinforcement projects among all areas, with 23 projects considered under the 2030 study scenarios and 17 under the 2035 study scenarios. Details are provided in the "Network Reinforcements" tab of the accompanying Excel publication. Ireland’s largest load centre is in the greater Dublin area, which is in Area J. This includes the majority of Large Energy User (LEU) demand that has been assumed for the study. The EWIC interconnector is also located in Area J. In general, when renewable generation is high, power flows are predominantly towards Area J from the rest of the system to supply the demand and the EWIC flow, depending on the flow.

In the 2030 initial scenario, Area J has a total dispatch-down rate of 22%. With the expansion of renewable installed capacity, this increases sharply to 46% in the 2030 100% ECP scenario. However, the total dispatch down level moderates in the future grid scenarios, reflecting the impact of higher demand, network reinforcements, enhanced interconnection, and more flexible system-level operational limits. As a result, the dispatch-down percentage reduces to 42% in the 2035 100% ECP scenario.

The power in the meshed 110 kV circuits in the midland flows to the East, towards the 220 kV stations which feed the load centres. With increasing generation in the 110 kV network in the midlands, the power flow increases, which causes bottlenecks in the circuits that have lower ratings. A loss of a circuit in the midlands area creates overloading in other circuits and therefore results in RES generation being dispatched down.

During the high renewable energy scenarios, Area J experiences several critical network constraints. Increased power transfers towards Dublin from neighbouring areas further exacerbate congestion within Area J. The Timahoe 110 kV node is one of the congested areas as the 110 kV line Timahoe to Maynooth is heavily loaded. Another major issue within Area J is with respect to the 110 kV power flow from Craddanstown to Corduff corridor via Curraghdoo and Blundelstown when loss of the parallel 110 kV line towards to Dublin. Further, the loss of 400 kV circuit Coolnabacky to Dunstown creates additional stress to the network in this area, resulting in the 110 kV line Newbridge to Blake as another bottleneck. Moreover, within Dublin city region, the loss of any 220 kV circuit would lead to the 220 kV lines Finglas to Mooretown and Inchicore to Irishtown heavily loaded. Additionally, the loss of a 220 kV and 400 kV circuit would exert additional stress on the 110 kV circuits in the region. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

2.12 Area K

Area K, in the south of the country includes a mix of wind and solar generation. The counties that are covered in this area include Tipperary (partial) and Waterford (most of). In the 100% ECP study, Area K includes approximately 0.3 GW of installed solar capacity and 0.3 GW of installed wind capacity. For Area K, the dominant power flows tend to be towards Area J on the east coast and the interconnectors via north-east Area H2. However, with Celtic interconnector active, at time the power flow can be towards the Area I.

In the 2030 initial scenario, Area K records a total dispatch-down percentage of 22%. As renewable installed capacity increases, this increases to 31% in the 2030 100% ECP scenario. However, the total dispatch down declines in future grid scenarios, driven by increased demand, network reinforcements, interconnection, and relaxed system level operational limits. It decreases to 25% in the 2035 100% ECP scenario.

Area K is affected by issues in other areas and especially in the Area H2 through which the power flows towards the north-east region. The loss of connecting circuits can cause overloading on other neighbouring circuits. The Greenlink and Celtic interconnectors provide additional extraction points during high-RES scenarios. Thus, generation in Area K and H2 tries to push power towards the north-east through the 220 kV and 110 kV circuits majority of times.

During the high renewable energy scenarios, Area K experiences two main network constraints. When loss of either the parallel 220kV line Knockraha to Cullenagh or 110 kV line Knockraha to Woodhouse, the 110 kV line from Woodhouse to Dungarvan becomes a major bottleneck in this area. In terms of connecting to other neighbouring areas, the 110 kV lines connecting to Waterford represents the bottleneck when loss of the parallel 220 kV and 110 kV lines, restricting power flowing from Area K to Area H2. Further details regarding network contingencies are provided in the "Contingencies and Lines" tab of the accompanying Excel publication.

3 Maintenance Sensitivity Study Report

Following ECP-1.0, industry feedback suggested that including a maintenance outage programme would be beneficial. Hence, as part of ECP-2.1 a representative maintenance programme was included in the baseline models and a further addendum was published which included a sensitivity to show the impact of this maintenance outage programme.

ECP-GSS-1 follows this same methodology (as in ECP-2.1 to ECP-2.5) with a representative maintenance programme (given in the assumptions document on the ECP section of the Eirgrid website). The maintenance program included in ECP-GSS-1 has been updated to reflect changes in transmission outages. The representative programme now includes outages in all 12 calendar months. The maintenance schedule was discussed with internal operations team, and it provides a reasonable representative outage programme for the network. However, every maintenance and outage season is different, and the results need to be interpreted with this in mind.

This section provides results of a sensitivity study performed to quantify the impact of the maintenance schedule used in the ECP-GSS-1 constraints analysis. The study selected for the sensitivity is the 2030 33% ECP, 2030 ECP, and Future Grid i.e. 2035 66% ECP. All other study assumptions have remained the same, however, the maintenance schedule has been removed.

The area-wise/subgroup results are presented for the above-mentioned study scenarios. The differences in constraints are reported as the difference between the study with maintenance and the study without maintenance (Maintenance Study Constraints – No Maintenance Study Constraints = Difference). The calculated constraint is distributed on a pro-rata basis among non-priority generators within the relevant area/subgroup. If this is not sufficient to resolve the constraint, priority generators within the same area/subgroup are then dispatched down. The details of the subgroups selected in each area are given in the excel-format publication. The percentage difference is given in Figure 3-1 and Table 3-1 for all maintenance sensitivities. This is followed by the GWh difference tables (Table 3-2, Table 3-3 and Table 3-4) for each maintenance sensitivity scenario.

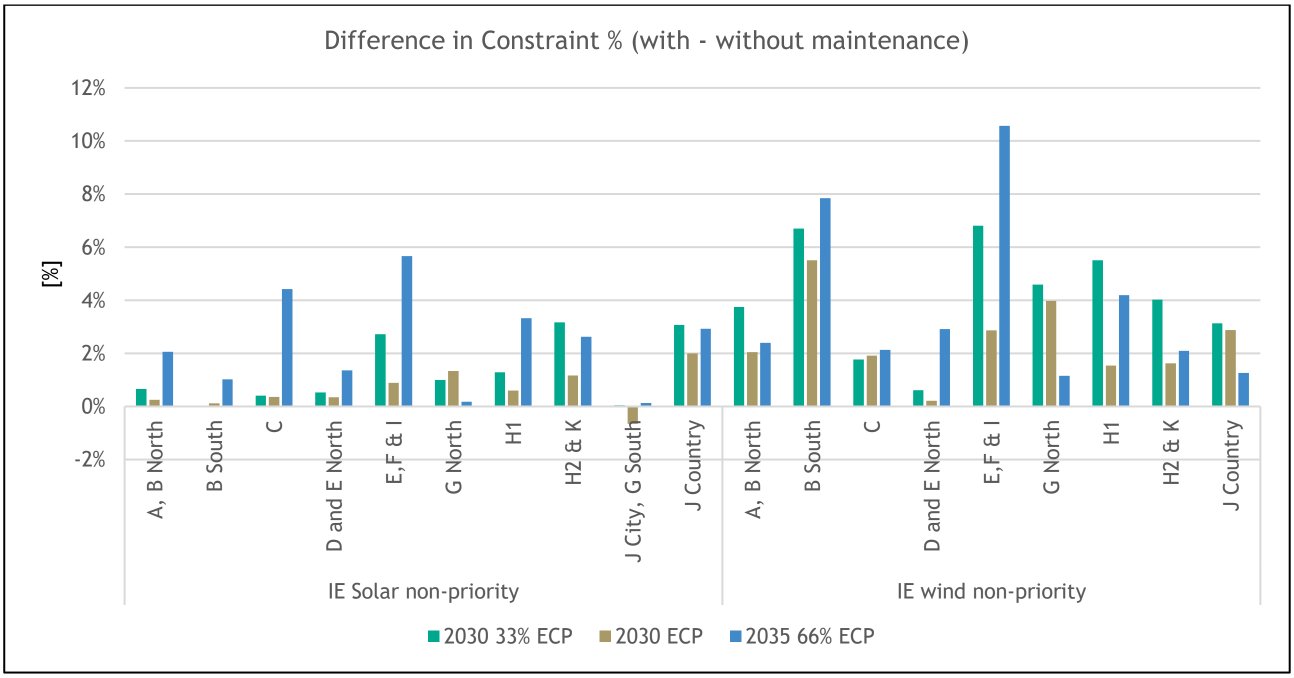

Figure 3-1: Difference in constraint dispatch down with and without maintenance

Generation Category	Subgroup	2030 33%	2030 ECP	Future Grid 66%
IE Solar non-priority	A, B North	1%	0%	2%
	B South	0%	0%	1%
	C	0%	0%	4%
	D and E North	1%	0%	1%
	E,F & I	3%	1%	6%
	G North	1%	1%	0%
	H1	1%	1%	3%
	H2 & K	3%	1%	3%
	J City, G South	0%	-1%	0%
	J Country	3%	2%	3%
IE wind non-priority	A, B North	4%	2%	2%
	B South	7%	6%	8%
	C	2%	2%	2%
	D and E North	1%	0%	3%
	E,F & I	7%	3%	11%
	G North	5%	4%	1%
	H1	6%	2%	4%
	H2 & K	4%	2%	2%
	J Country	3%	3%	1%
IE wind priority	A, B North	0%	0%	0%
	B South	0%	0%	0%
	C	0%	0%	0%
	D and E North	0%	0%	0%
	E,F & I	0%	0%	0%
	G North	0%	0%	0%
	H1	0%	0%	0%
	H2 & K	0%	0%	0%
	J Country	0%	0%	0%

Table 3-1: Difference in Constraint Percentage (with - without maintenance)

Generation Category	Subgroup	Surplus + Curtailment (GWh)	Constraint without Maintenance (GWh)	Difference in Constraint with and without Maintenance (GWh)
IE Solar non-priority	A, B North	4	5	0
	B South	0	0	0
	C	118	21	3
	D and E North	31	0	1
	E,F & I	123	24	23
	G North	35	0	3
	H1	89	31	7
	H2 & K	289	7	47
	J City, G South	212	9	1
	J Country	213	209	42
IE wind non-priority	A, B North	499	722	94
	B South	106	122	37
	C	153	74	15
	D and E North	97	2	5
	E,F & I	301	196	135
	G North	71	2	19
	H1	86	73	31
	H2 & K	149	8	35
	J Country	340	145	55
IE wind priority	A, B North	23	0	0
	B South	10	0	0
	C	2	0	0
	D and E North	10	0	0
	E,F & I	69	0	0
	G North	5	0	0
	H1	61	0	0
	H2 & K	30	0	0
	J Country	5	0	0

Table 3-2: Area subgroup GWh difference in constraint for 2030 33% ECP

Generation Category	Subgroup	Surplus + Curtailment (GWh)	Constraint without Maintenance (GWh)	Difference in Constraint with and without Maintenance (GWh)
IE Solar non-priority	A, B North	14	3	0
	B South	1	0	0
	C	739	112	7
	D and E North	165	1	2
	E,F & I	553	15	16
	G North	164	1	9
	H1	390	108	8
	H2 & K	1297	3	34
	J City, G South	1063	174	-25
	J Country	1011	632	57
IE wind non-priority	A, B North	1306	1107	80
	B South	215	135	38
	C	461	37	33
	D and E North	402	10	4
	E,F & I	848	247	95
	G North	142	2	21
	H1	269	145	15
	H2 & K	649	13	36
	J Country	908	348	81
IE wind priority	A, B North	29	0	0
	B South	9	0	0
	C	3	0	0
	D and E North	19	0	0
	E,F & I	106	0	0
	G North	9	0	0
	H1	70	0	0
	H2 & K	53	0	0
	J Country	7	0	0

Table 3-3: Area subgroup GWh difference in constraint for 2030 ECP

Generation Category	Subgroup	Surplus + Curtailment (GWh)	Constraint without Maintenance (GWh)	Difference in Constraint with and without Maintenance (GWh)
IE Solar non-priority	A, B North	8	3	1
	B South	0	0	0
	C	243	27	60
	D and E North	64	0	6
	E,F & I	183	63	75
	G North	62	6	1
	H1	148	105	31
	H2 & K	433	28	58
	J City, G South	346	1	3
	J Country	393	734	62
IE wind non-priority	A, B North	616	632	77
	B South	109	188	49
	C	207	3	28
	D and E North	183	18	37
	E,F & I	391	627	279
	G North	83	2	5
	H1	139	209	32
	H2 & K	249	62	32
	J Country	431	459	29
IE wind priority	A, B North	8	0	0
	B South	4	0	0
	C	2	0	0
	D and E North	6	0	0
	E,F & I	22	0	0
	G North	2	0	0
	H1	20	0	0
	H2 & K	8	0	0
	J Country	1	0	0

Table 3-4: Area subgroup GWh difference in constraint for 2035 66% ECP

Appendix A RES Percentage

Renewable Energy Source (RES) percentage** is calculated as the ratio of renewable energy generation to the total system load. This metric reflects the maximum utilisation of RES to meet the demand in Ireland. The RES calculated below considers the wind, solar and hydro is given in the table and figure below. Small scale wind and solar generation (less than 1 MW) is not considered in this calculation.

Study Year	Initial	33% ECP	33% ECP + 1.3GW Offshore	33% ECP + 2.6GW Offshore	33% ECP + 2.6GW Offshore Reduced BESS	66% ECP	66% ECP + 4.7GW Offshore	100% ECP
2030	43%	57%	65%	71%	69%			74%
Future Grid						64%	90%	73%

*Table A-1: Ireland RES** Percentage in ECP-GSS-1 studies* (wind and solar)*

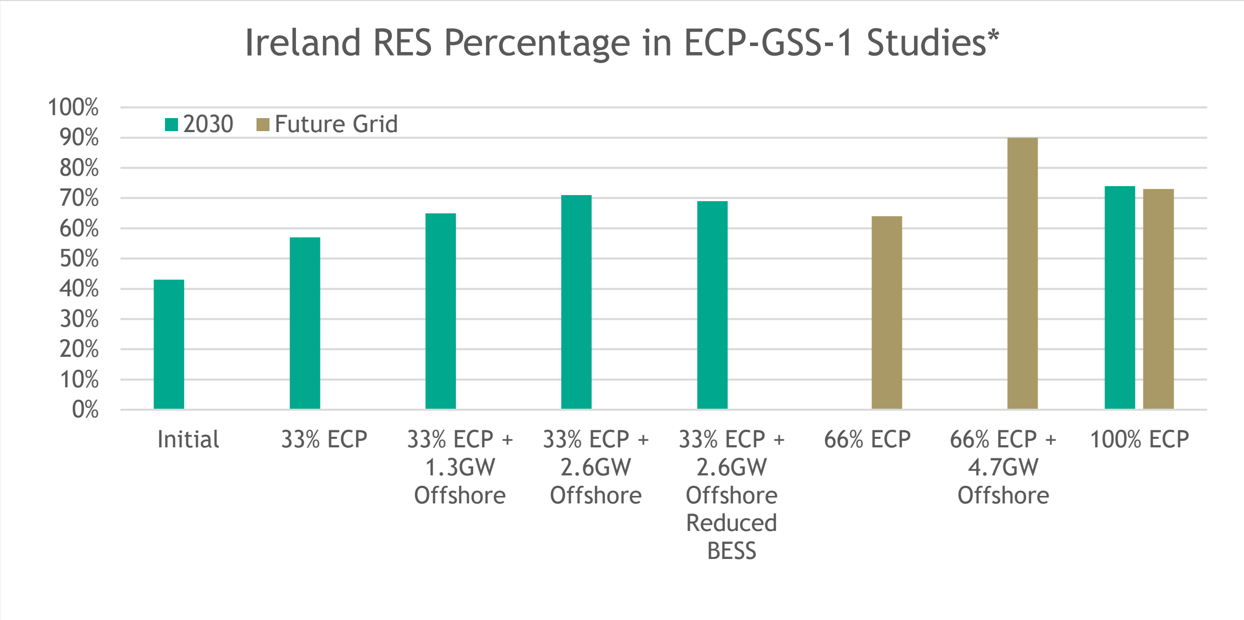

Figure A-1: Ireland RES Percentage in ECP-GSS-1 Studies (wind and solar)*

*Small scale generation, storage, peat and waste plants are not included in this calculation.

**The calculation of RES % presented here is not same as the RES % calculation used in SOEF 1.1.