Winter Outlook 2021/22

EIRGRID

SONI

October 2021

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Introduction

EirGrid and SONI operate the electricity transmission system in Ireland and Northern Ireland respectively. Together we are responsible for the planning and operation of a safe, secure, reliable, economic and efficient electricity transmission system to ensure all reasonable demands for electricity are met. Both EirGrid and SONI are providing the island's consumers with a high quality and increasingly clean energy supply while also managing an increasingly complex supply and demand dynamic.

There are inherent vulnerabilities in complex power systems and all electricity transmission operators face a wide range of demands and challenges, from very cold spells, to storms, to outages at power stations and on interconnectors. We utilise our deep technical expertise to deal with these, however a confluence of these pressures at any one point can create an imbalance on the system which could lead to power shortages. In addition, EirGrid and SONI do not generate electricity; we depend on those who do, to have the power we need when we ask for it. These are the issues that we manage every second of every day on behalf of consumers.

The annual All-Island Generation Capacity Statement published by EirGrid and SONI presents information on generation adequacy studies that assess the balance between supply and demand over the next ten years. This Winter Outlook presents a more detailed view focusing on the upcoming winter in Ireland and Northern Ireland. This document helps inform the electricity industry and supports preparation for the coming months. We study the expected generation capacity and the forecast demand to determine if there is adequate generation capacity margin. We identify periods where the margin between generation capacity and forecast peak demand is low, and the security of supply of the electricity system may be at risk. The winter outlook for 2021/22 covers the period from 1 November 2021 to 3 April 2022. The data-freeze date for the outlook was 9 September 2021.

Two-System Approach

EirGrid and SONI take a two-system approach to the assessment, studying Ireland and Northern Ireland separately. This is due to system constraints which limit the amount of electricity that can be transmitted between the two systems, typically limited to a maximum of 400 MW in each direction. While there might be times where there is excess generation capacity in one system and not enough generation capacity in the other, we may not able to transmit the full excess due to this constraint.

Key Technical Terms

Here we explain some of the key technical terms used in the report. A full glossary of other terms can be found at the end of the document.

Loss of Load Expectation (LOLE) is a mathematical expectation, based on studies, of the number of hours in a period (typically a year) during which the available generation plant will be inadequate to meet the instantaneous demand. The higher this number is the greater the risk that there will be insufficient generation available to meet the demand at all times. The regulator in Ireland, Commission for Regulation of Utilities, and the Department for the Economy in Northern Ireland set LOLE standards which act as a maximum level of risk that they have judged the respective systems should be operated at. In Ireland the LOLE standard is 8 hours per year and in Northern Ireland it is 4.9 hours per year.

Expected Unserved Energy (EUE) is the expected amount of energy, based on the same LOLE studies, not supplied during a period (typically a year) due to insufficient generation being available.

Alert State is when a single event on the electrical power system would give rise to a reasonable possibility of one or more operational security limits being violated, e.g. failure to meet the demand. This designation is used across the EU and UK.

Emergency State is when one or more operational security limits on the electrical power system are violated, e.g. failure to meet the demand. This designation is used across the EU and UK.

De-rated Capacity is the capacity of generation that can be relied upon to contribute to capacity adequacy. It is typically based on the historical performance of each generator on the system. A generator that has performed poorly in the past by being unavailable for long periods due to breakdowns will have a lower de-rated capacity as its contribution to capacity adequacy is deemed to be less.

De-rated Margin is the sum of the de-rated generation capacity from all available generating units and interconnectors, less the forecast demand and reserve requirement.

Executive Summary

Northern Ireland

The Loss of Load Expectation (LOLE) in Northern Ireland for the five months of the winter period being studied is 2.2 hours. This is within the 4.9 hours per year standard meaning the system will operate within the level of risk that is set by the Department for the Economy. The results suggest that with the loss of just a single large unit in Northern Ireland, there is risk of the system entering the Alert State, most likely at periods of low wind and interconnector imports. The risk of the system entering the Emergency State due to insufficient generation being available to meet the demand is low. Based on information at the time of the data freeze, November and February are expected to be the most onerous periods from a capacity margin perspective.

Ireland

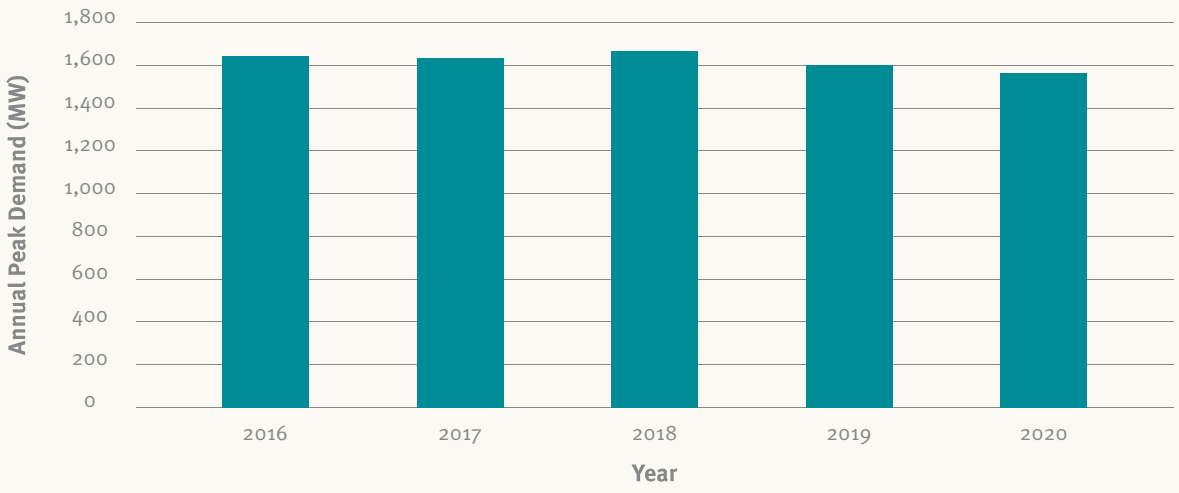
The Loss of Load Expectation (LOLE) in Ireland for the five months of the winter period being studied is 17.4 hours. This is outside the 8 hours per year standard meaning the system will operate at a higher level of risk than is set by the Commission for Regulation of Utilities. There is an expectation that the system will enter the Alert State at times, most likely at periods of low wind and low interconnector imports. There is an elevated risk compared to previous winters of the system entering the Emergency State due to insufficient generation being available to meet the demand. The Expected Unserved Energy (EUE) figure would suggest that, on average, electricity consumers could be without supply for approximately 40 minutes, approximately double the duration if meeting the 8 hour LOLE standard. This does not necessarily mean that electricity consumers will be without supply for any period. It is simply a metric used to measure the risk or likelihood of such an event happening. Based on information at the time of the data freeze, November and early March are expected to be the most onerous periods from a capacity margin perspective.

Northern Ireland Winter Outlook

Northern Ireland Demand

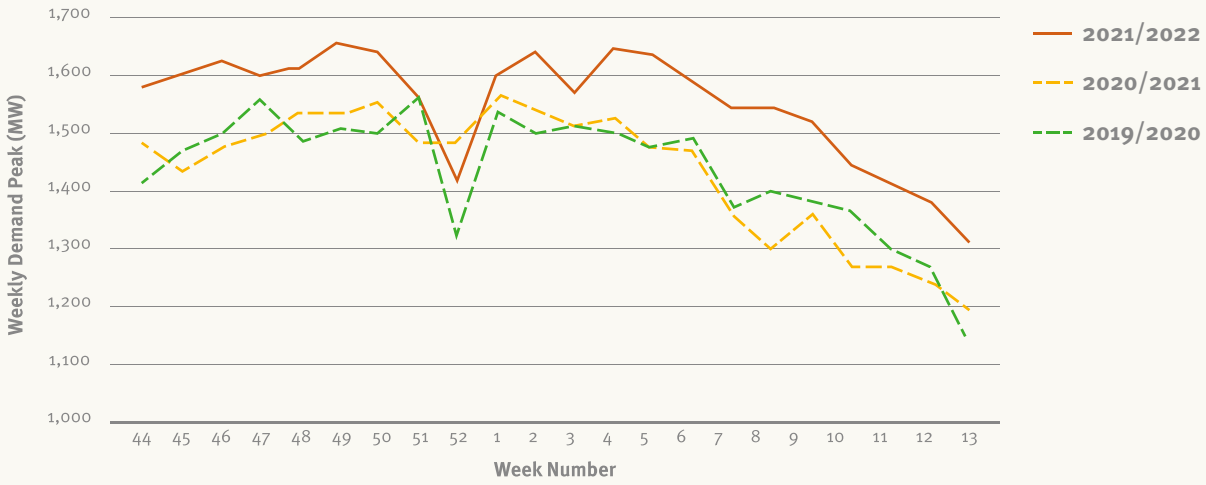
As can be seen in Figure 1, the peak electricity demand in Northern Ireland has remained broadly static over the last five years. The peak over last winter was 1,566 MW which occurred on 6 January at 17:30.

Figure 1: Northern Ireland historical annual peak demand



We anticipate a Northern Ireland peak demand of between 1,600 MW and 1,710 MW this winter. Figure 2 compares the weekly peak demand for the 2019/2020 and 2020/2021 winter periods to the forecast weekly peak demand for the 2021/2022 winter period.

Figure 2: Northern Ireland weekly peak demand for 2019/2020 and 2020/2021 winter periods versus forecast median weekly peak demand for 2021/2022 winter period



Northern Ireland Generation Capacity versus Forecast Demand

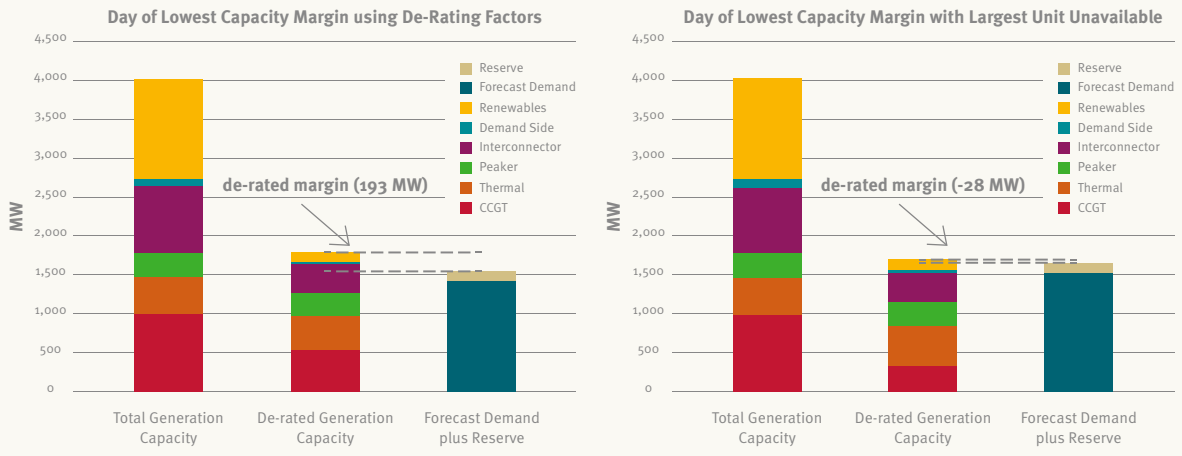
The total generation capacity in Northern Ireland is made up of a variety of different types of generating units; combined cycle gas turbines (CCGT) (gas), thermal generation plant (coal, heavy fuel oil, biomass), peaker plant (gas and distillate), renewables (mostly wind and solar), demand side units (DSUs), aggregated generating units (AGUs) and a small volume of other technologies. There are two interconnectors; the 500 MW Moyle interconnector connecting Northern Ireland and Scotland, and the North-South Tie Lines which connect Northern Ireland and Ireland.

We apply de-rating factors to the generation capacity to reflect the contribution of each generator to capacity adequacy to come up with a de-rated generation capacity. For conventional dispatchable generating units the de-rating factor is typically based on forced outage rates in a rolling three-year window. For wind and interconnection with Great Britain the de-rating factors are based on those used in the Capacity Market Auctions and the Generation Capacity Statement, respectively. The assumption of 200 MW support from Ireland on the North-South Tie Lines in the Generation Capacity Statement has been reduced to 100 MW based on the tight margins expected in Ireland this winter. Given the small generation portfolio in Northern Ireland and the size of the largest unit relative to the size of the system (26% of peak demand), it is important to also consider the unavailability of the single largest unit when assessing the winter outlook. Therefore, we assess two scenarios for Northern Ireland; one based on de-rating factors of all units and one based on the largest unit being unavailable.

The *de-rated margin* is the sum of the de-rated generation capacity from all available generating units and interconnectors, less the forecast demand and the reserve requirement. The more positive the de-rated margin is, the greater the likelihood that we will have sufficient capacity to meet demand, while a negative de-rated margin indicates there may be a shortage of capacity to meet demand.

Figure 3 shows the total generation capacity on the system, the de-rated generation capacity based on de-rating factors and based on the largest unit being unavailable, the forecast demand plus reserve for the day with the lowest margin across the winter period.

Figure 3: Northern Ireland generation capacity versus forecast demand based on de-rating factors and the largest unit being unavailable on day of lowest capacity margin



Northern Ireland LOLE and De-rated Margin

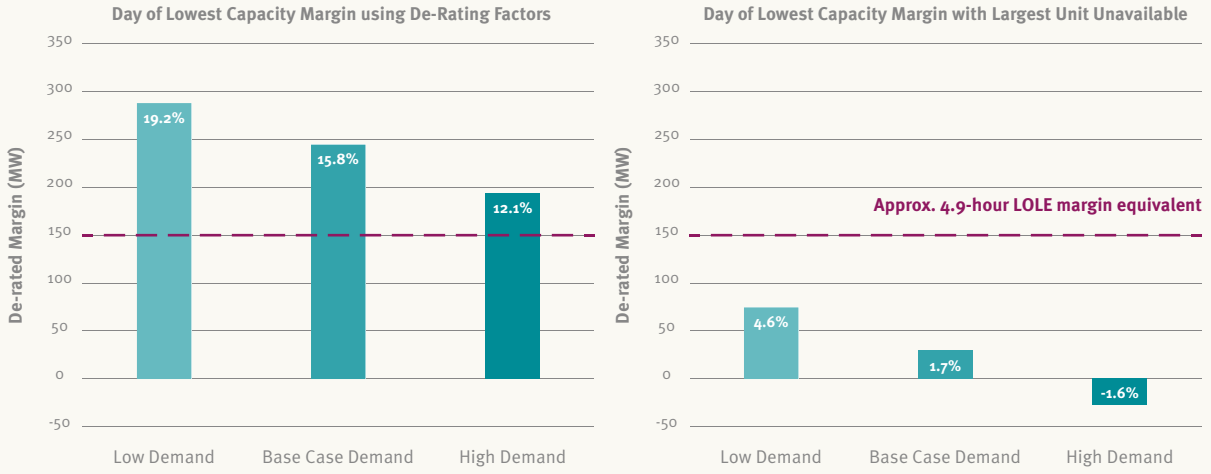
The Loss of Load Expectation (LOLE) for Northern Ireland for the five months of the winter period being studied is 2.2 hours. This is within the 4.9 hours per year standard meaning the system will operate within the level of risk that is set by the Department for the Economy. Based on the two scenarios described above the minimum de-rated margin over the winter period is expected to be in the range of -28 MW to 288 MW. The results suggest that with the loss of just a single large unit in Northern Ireland, there is risk of the system entering the Alert State, most likely at periods of low wind and interconnection. The risk of the system entering the Emergency State due to insufficient generation available to meet the demand is low.

Table 1: Northern Ireland key metrics for median demand level

	2021/22 De-rating factors	2021/22 Largest unit unavailable
Loss of Load Expectation (LOLE)	2.2 hours	0 hours[1]
Expected Unserved Energy (EUE)	206 MWh	0 MWh[1]
Minimum de-rated margin (MW) over winter period	193 MW	-28 MW
Minimum de-rated margin (%) over winter period	12.1%	-1.6%

Figure 4 shows the de-rated margin as a percentage of demand plus reserve based on de-rating factors and based on the largest unit being unavailable on the day with the lowest margin across the winter period for three demand scenarios. An approximate figure for the de-rated margin associated with an LOLE of 4.9 hours per year is also shown.

Figure 4: Northern Ireland de-rated margin for low, median and high demand scenarios based on de-rating factors and based on the largest unit being unavailable on day of lowest capacity margin



[1] Please note that the Loss of Load Expectation and Expected Energy Unserved for the scenario where the largest unit is unavailable are zero as all other units are given a de-rating factor of one. The assumption is made that there are no other overlapping outages for this scenario.

Northern Ireland Weekly Analysis

We study the expected de-rated generation capacity and the forecast demand for each week across the winter period. This allows us to identify weeks when the de-rated margin is low and when the system is at risk of entering the Alert and Emergency states. We look at three interconnector (Moyle and North-South Tie Lines) import scenarios; low (0 MW), medium (370 MW) and high (850 MW) imports. It should be noted that our studies also include probabilistic analysis of forced outages which can have a more significant impact than outlined below.

Figure 5 shows the weekly de-rated generation capacity. The de-rated generation capacity fluctuates throughout the winter period to due to known scheduled outages of generating units occurring during the period.

Figure 5: Northern Ireland weekly de-rated generation capacity per type of generating unit

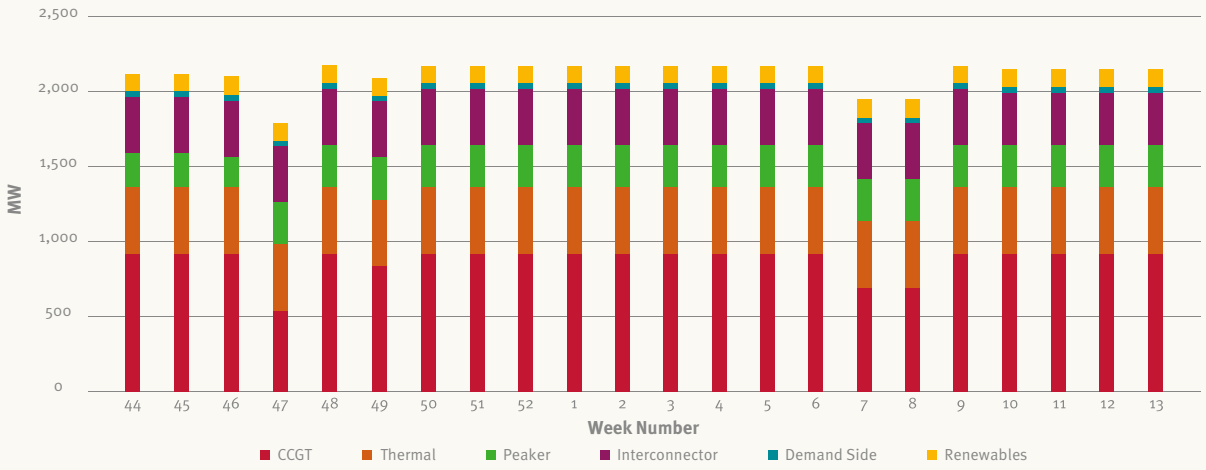


Figure 6 shows the weekly de-rated generation capacity based on de-rating factors for each import scenario versus the forecast demand plus reserve. In the low import scenario there are five weeks in which the demand plus reserve requirement exceeds the de-rated capacity. The risk of the system entering the Alert and Emergency states is higher in these weeks (November and late February).

Figure 6: Northern Ireland weekly de-rated generation capacity based on de-rating factors (dashed lines) for each import scenario versus the forecast demand plus reserve (bars)

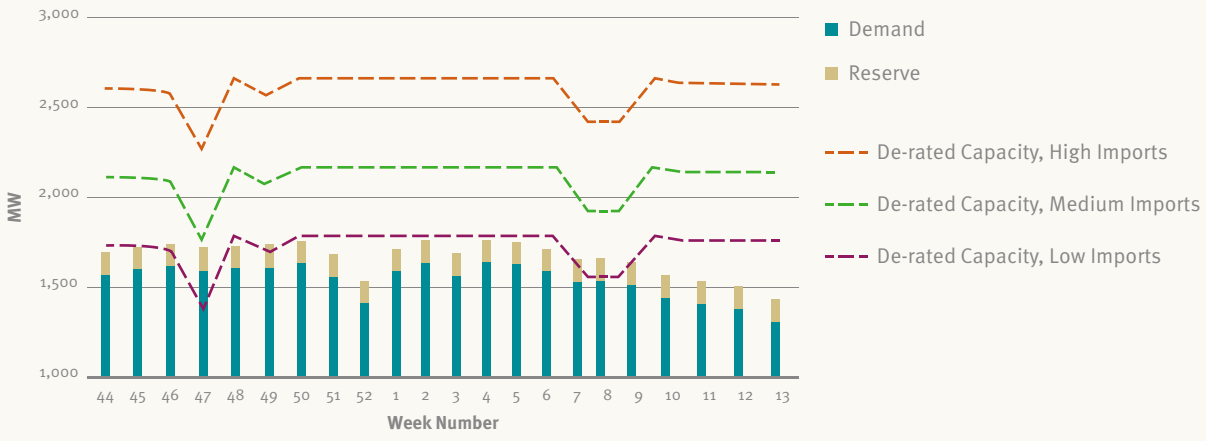
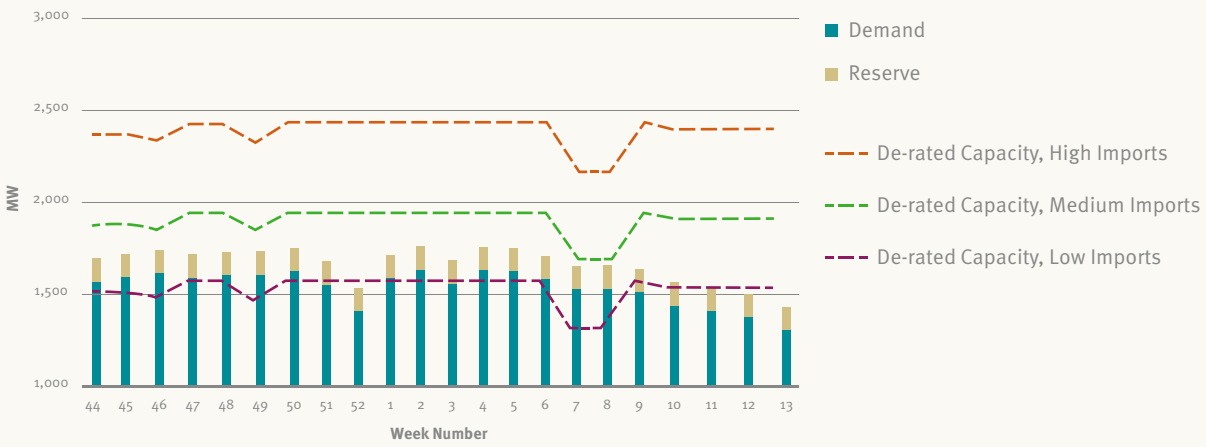


Figure 7 shows the weekly expected Northern Ireland generation capacity based on the largest unit being unavailable for each import scenario versus the forecast demand plus reserve. In the low import scenario there are only two weeks in which the de-rated capacity exceeds the demand plus reserve requirement.

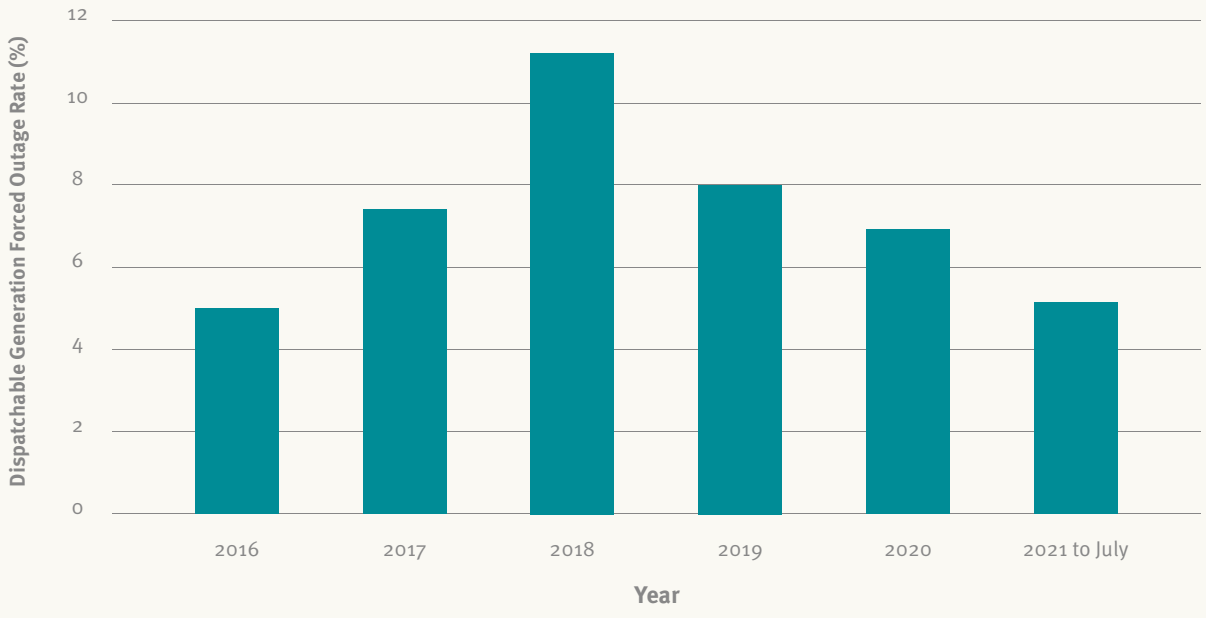
Figure 7: Northern Ireland weekly de-rated generation capacity based on the largest unit being unavailable (dashed lines) for each import scenario versus the forecast demand plus reserve (bars)



Northern Ireland Forced Outage Rates

The recent dispatchable generation (excluding DSUs) forced outage rate in Northern Ireland is within historical ranges. For 2021 year to July it stands at 5%.

Figure 8: Northern Ireland historical dispatchable generation annual forced outage rates

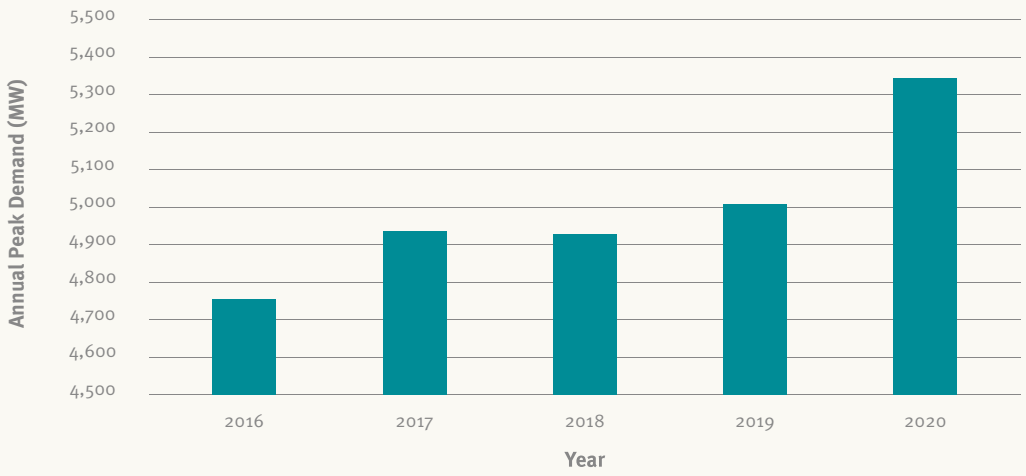


Ireland Winter Outlook

Ireland Demand

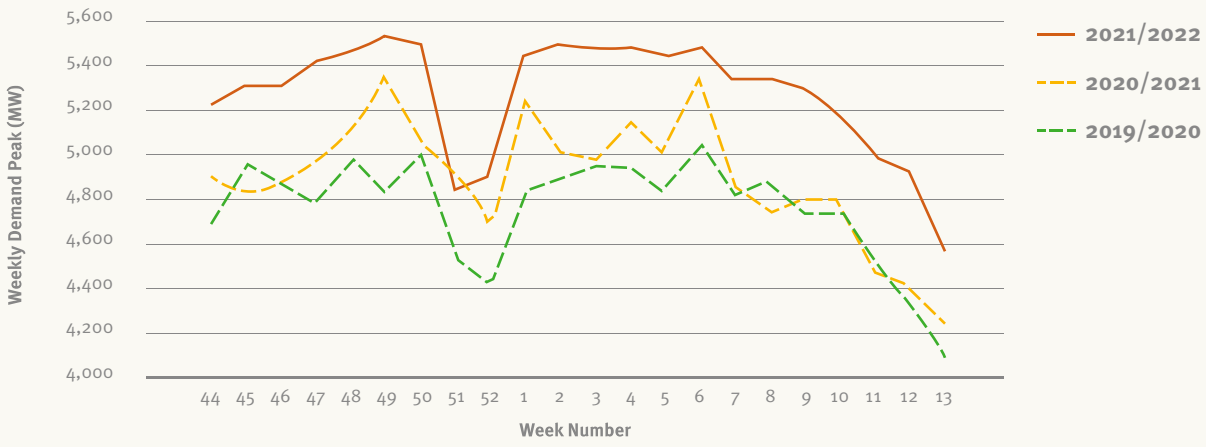
As can be seen in Figure 9, the peak electricity demand in Ireland has been growing over the last number of years with a 7% increase in 2020 compared to 2019. The 2020 peak demand was a record of 5,359 MW which occurred on 7 December at 17:33. An all-island peak demand record of 6,904 MW occurred around the same time. Analysis of Ireland peak demand over the past two winters indicates that a 1°C decrease in outside temperature results in a 40 MW increase in peak demand (50 MW when wind-chill is taken into account), and vice-versa, meaning electricity demand in the winter is heavily influenced by weather conditions.

Figure 9: Ireland historical annual peak demand



We anticipate an Ireland peak demand of between 5,430 MW and 5,680 MW this winter. Figure 10 compares the weekly peak demand for the 2019/2020 and 2020/2021 winter periods to the forecast weekly peak demand for the 2021/2022 winter period.

Figure 10: Ireland weekly peak demand for 2019/2020 and 2020/2021 winter periods versus forecast median weekly peak demand for 2021/2022 winter period



Ireland Generation Capacity versus Forecast Demand

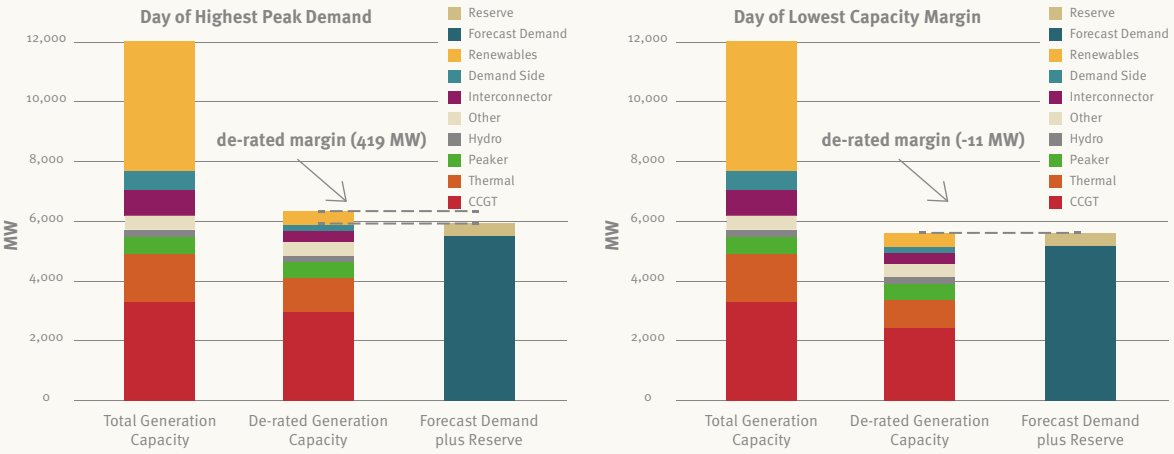
The total generation capacity in Ireland is made up of a variety of different types of generating units; combined cycle gas turbines (CCGT) (gas), thermal generation plant (coal, heavy fuel oil, peat/biomass), peaker plant (gas and distillate), renewables (mostly hydro and wind), demand side units (DSUs) and a small volume of other technologies. There are also two interconnectors; the 500 MW East West Interconnector (EWIC) connects Ireland and Great Britain, and the North-South Tie Lines connect Ireland and Northern Ireland.

We apply de-rating factors to the generation capacity to reflect the contribution of each generator to capacity adequacy to come up with a de-rated generation capacity. For conventional dispatchable generating units the de-rating factor is typically based on forced outage rates in a rolling three-year window. For wind and interconnection the de-rating factors are based on those used in the Capacity Market Auctions and the Generation Capacity Statement, respectively.

The de-rated margin is the sum of the de-rated generation capacity from all available generating units and interconnectors, less the forecast demand and the reserve requirement. The more positive the de-rated margin is, the greater the likelihood that we will have sufficient capacity to meet demand, while a negative de-rated margin indicates there may be a shortage of capacity.

Figure 11 shows the total generation capacity on the system, the de-rated generation capacity and the forecast demand plus reserve for the day with the highest peak demand and the day with the lowest de-rated margin across the upcoming winter period.

Figure 11: Ireland generation capacity versus forecast demand on day of highest peak demand and on day of lowest capacity margin



Ireland LOLE and De-rated Margin

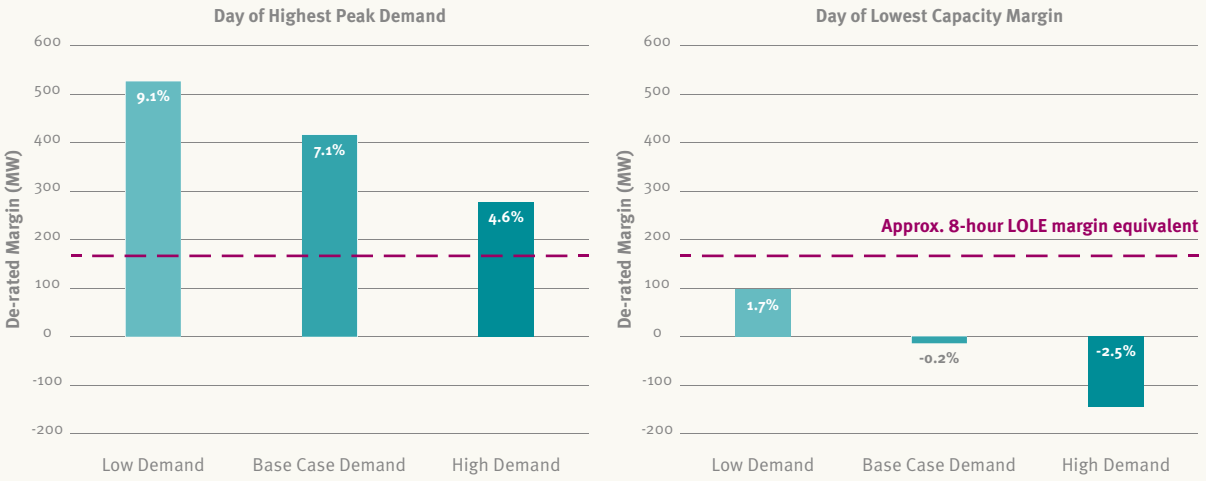
The Loss of Load Expectation (LOLE) in Ireland for the five months of the winter period being studied is 17.4 hours. This is outside the 8-hours per year standard meaning the system will operate at a higher level of risk than is set by the Commission for Regulation of Utilities. The minimum de-rated margin over the winter period is expected to be in the range of -144 MW to 93 MW. There is an expectation that the system will enter the Alert State at times, most likely at periods of low wind and interconnection. There is an elevated risk compared to previous winters of the system entering the Emergency State due to insufficient generation available to meet the demand. The Expected Unserved Energy (EUE) figure would suggest that, on average, electricity consumers could be without supply for approximately 40 minutes, approximately double the duration if meeting the 8 hour LOLE standard. This does not necessarily mean that electricity consumers will be without supply for any period. It is simply a metric used to measure the risk or likelihood of such an event happening.

Table 2: Ireland key metrics for median demand level

	2021/22 Base Case
Loss of Load Expectation	17.4 hours
Expected Unserved Energy	3,369 MWh
Minimum de-rated margin (MW) over winter period	-11 MW
Minimum de-rated margin (%) over winter period	-0.2%

Figure 12 shows the de-rated margin as a percentage of demand plus reserve for the day with the highest peak demand and the day with the lowest margin across the winter period for three demand scenarios. An approximate figure for the de-rated margin associated with an LOLE of 8 hours per year is also shown.

Figure 12: Ireland de-rated margin for low, median and high demand scenarios on day of highest peak demand and on day of lowest capacity margin



Ireland Weekly Analysis

We study the expected de-rated generation capacity and the forecast demand for each week across the winter period. This allows us to identify weeks when the de-rated margin is low and when the system is at risk of entering the Alert and Emergency states. We look at three interconnector (East West Interconnector and North-South Tie Lines) import scenarios; low (0 MW), medium (400 MW) and high (900 MW) imports. It should be noted that our studies also include probabilistic analysis of forced outages which can have a more significant impact than outlined below.

Figure 13 shows the weekly de-rated generation capacity. The de-rated generation capacity fluctuates throughout the winter period to due to known scheduled and forced outages of generating units occurring during the period.

Figure 13: Ireland weekly de-rated generation capacity per type of generating unit

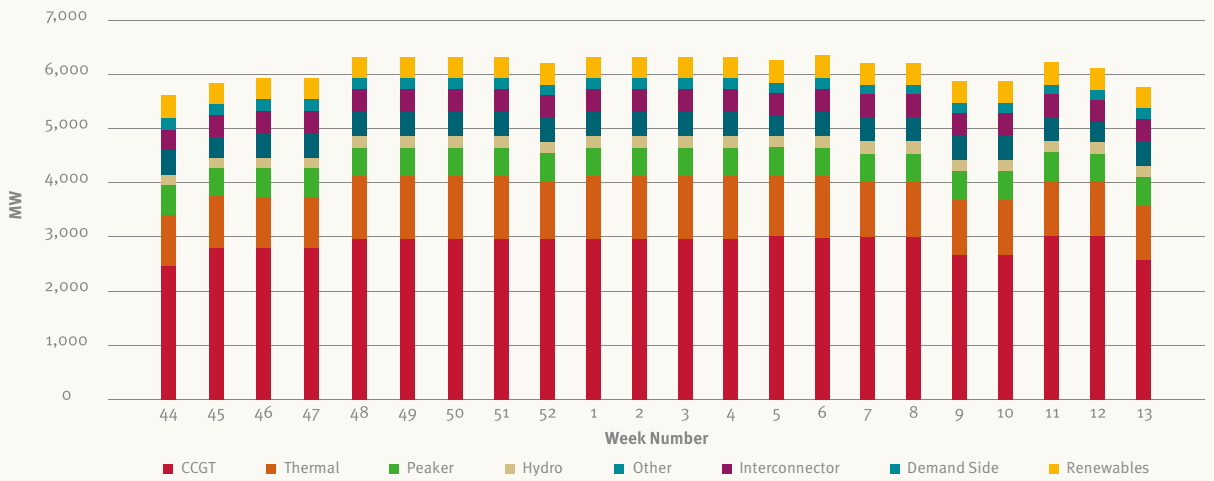
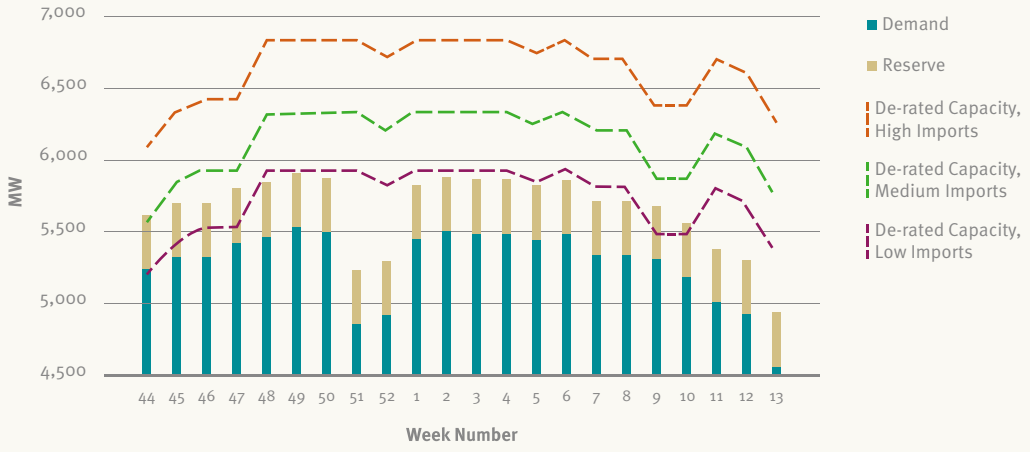


Figure 14 shows the weekly de-rated generation capacity for each import scenario versus the forecast demand plus reserve. In both the low and medium import scenarios there are weeks in which the demand plus reserve requirement exceeds the de-rated capacity. The risk of the system entering the Alert and Emergency states is higher in these weeks (November and early March).

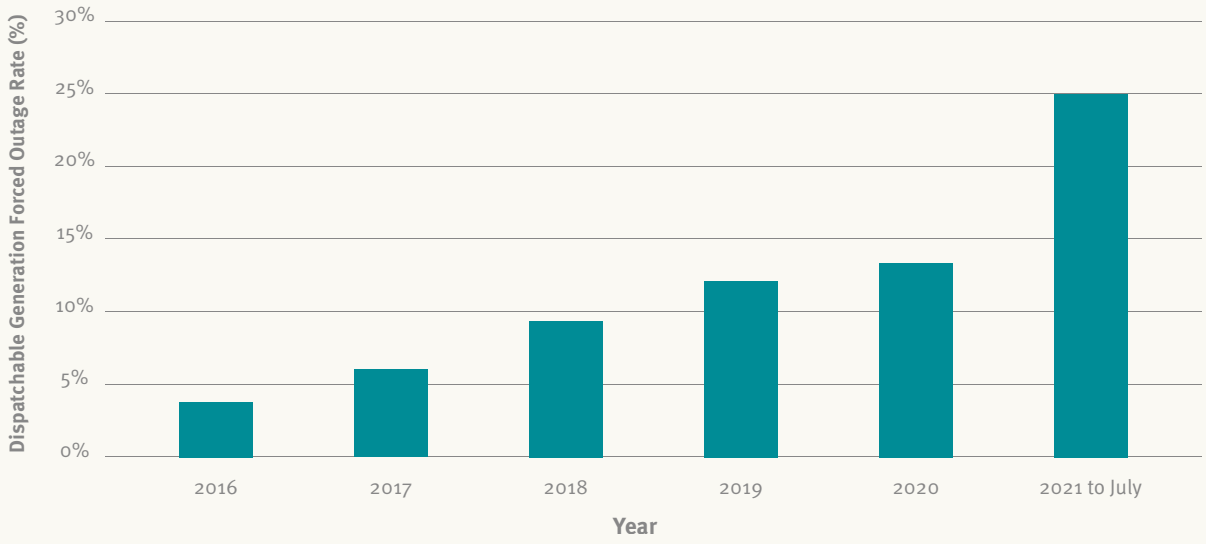
Figure 14: Ireland weekly de-rated generation capacity (dashed lines) for each import scenario versus the forecast demand plus reserve (bars)



Ireland Forced Outage Rates

The dispatchable generation (excluding DSUs) forced outage rate in Ireland has increased every year for the past five years. For 2021 year to July it stands at 25%. This has led to very tight margins in 2021 and has impacted the system's ability to accommodate generator and interconnector planned outages with a number of outages being postponed.

Figure 15: Ireland historical dispatchable generation annual forced outage rates



Assumptions

Northern Ireland

- There will be uninterrupted reserves of natural gas from the Corrib gas field as well as from the Moffat terminal with no shortage issues.
- Northern Ireland De-rating factors:
  - CCGT and large thermal units (high- and mid-merit units) de-rating factors based on forced outage rates in a rolling three-year window between July 2018 to Jun 2021
  - Peaker de-rating factor: 0.9
  - DSU de-rating factor: 0.35[2]
  - Wind de-rating factor: 0.0904[3]
  - Moyle Interconnector de-rating factor: 0.6[4]
  - North-South Tie-Line de-rated to 100 MW for flows from Ireland to Northern Ireland (please note that this is 100 MW lower than that assumed in the Generation Capacity Statement based on the tight margins expected in Ireland this winter)
- A fully intact network will be available.
- Due to the winter peak typically occurring after sunset, the installed solar capacity has been assigned a capacity credit of zero.
- Northern Ireland reserve requirement: 125 MW
- Demand scenarios: low, median (base case) and high as per the Generation Capacity Statement
- Northern Ireland interconnector scenarios:

	Low	Medium	High
Moyle Interconnector	0	270	450
North-South Tie Lines	0	100	400
Total	0	370	850

[2] Based on recent analysis
[3] Based on T-2 Capacity Auction for 2021/22 Capacity Year
[4] Based on Generation Capacity Statement

Ireland

- There will be uninterrupted reserves of natural gas from the Corrib gas field as well as from the Moffat terminal with no shortage issues.
- Ireland De-rating factors:
  - CCGT, large thermal and hydro units (high- and mid-merit units) de-rating factors based on forced outage rates in a rolling three-year window between July 2018 to Jun 2021
  - Peaker and small thermal (low merit units) de-rating factor: 0.9
  - DSU de-rating factor: 0.35[2]
  - Wind de-rating factor: 0.0904[3]
  - East West Interconnector de-rating factor: 0.6[4]
  - North-South Tie-Line de-rated to 100 MW[4] for flows from Northern Ireland to Ireland
- A fully intact network will be available.
- Ireland reserve requirement: 375 MW
- Demand scenarios: low, median (base case) and high as per the Generation Capacity Statement
- Ireland interconnector scenarios:

	Low	Medium	High
East West Interconnector	0	300	500
North-South Tie Lines	0	100	400
Total	0	400	900

[2] Based on recent analysis
[3] Based on T-2 Capacity Auction for 2021/22 Capacity Year
[4] Based on Generation Capacity Statement

Glossary

Acronym/ Abbreviation	Term	Explanation
	capacity	The rated continuous power output of a generator
	capacity/generation adequacy	When there is sufficient generation capacity to meet the demand and reserve requirements
	capacity market auction	The Capacity Market is a mechanism designed to ensure that the island has enough electricity to power homes, businesses and industry in both Ireland and Northern Ireland. The market takes the form of an auction, held every year, for capacity for the future
CCGT	combined cycle gas turbine	A type of thermal generator that typically uses natural gas as a fuel source. It is a collection of gas turbines and steam units; where waste heat from the gas turbines(s) is passed through a heat recovery boiler to generate steam for the steam turbines
	conventional generating unit	The general term applied to generating units that produce electrical energy from coal, oil, or natural gas
	demand	The amount of electrical power consumed by the power system
DSU	demand side unit	A unit consisting of one or more individual demand sites that can be dispatched by the TSO to reduce demand
	de-rating factor	The percentage of a generating units' capacity that reliably contributes to capacity adequacy. It is typically based on forced outage rates
	dispatchable generating unit/ generation	Sources of electricity that can be used on demand and dispatched at the request of the TSOs. Does not include wind and solar generation which are non-dispatchable generation
EWIC	East West Interconnector	A 500 MW Interconnector that connects the electricity transmission systems of Ireland and Great Britain
	forced outage	An event where a generator is unavailable for electricity production for a period of time due to unforeseen/ unplanned reasons
	forced outage rate	The proportion of time that a generation unit is expected to be unavailable for electricity production due to unforeseen/ unplanned outages
	forecast peak demand	The maximum amount of electrical power that is forecast to be consumed by the power system on a daily, weekly or annual basis
	generating unit	Any apparatus which produces electrical energy
	generation capacity	
	Generation Capacity Statement	Statement produced by EirGrid and SONI outlining the expected electricity demand and the level of generation capacity that will be required on the island of Ireland over the next ten years

	interconnector	The electrical link that connects two systems
MW	megawatt	Unit of power; 1 Megawatt = 1,000,000 Watts
MWh	megawatt hour	1 megawatt hour = 1 megawatt of power used continuously for one hour
	North-South Tie Lines	The electrical link that connects the transmission system of the Ireland to the transmission system of Northern Ireland
	outage	A partial or total reduction in the availability of a generating unit such that the generating unit is unavailable to achieve its maximum capacity
	peaker plant	A dispatchable generating unit that is typically used to meet evening peak demand
	renewable	A natural resource or source of energy, such as wind, solar and hydro
	reserve requirement	The additional generation capacity that is required to be available to meet demand in the event that the forecasted supply of power is disrupted
	scheduled outage	Outage where a generator is unavailable for electricity production due to planned reasons, e.g. for maintenance
	security of supply	The electricity system's capability to ensure uninterrupted availability of electricity at a reasonable cost
	system constraints	Congestion at one or more parts of the transmission network that prevent power being transmitted to the location of demand
	thermal generating unit	Generating units that produce electrical energy from coal, oil, or natural gas using the intermediary of steam

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