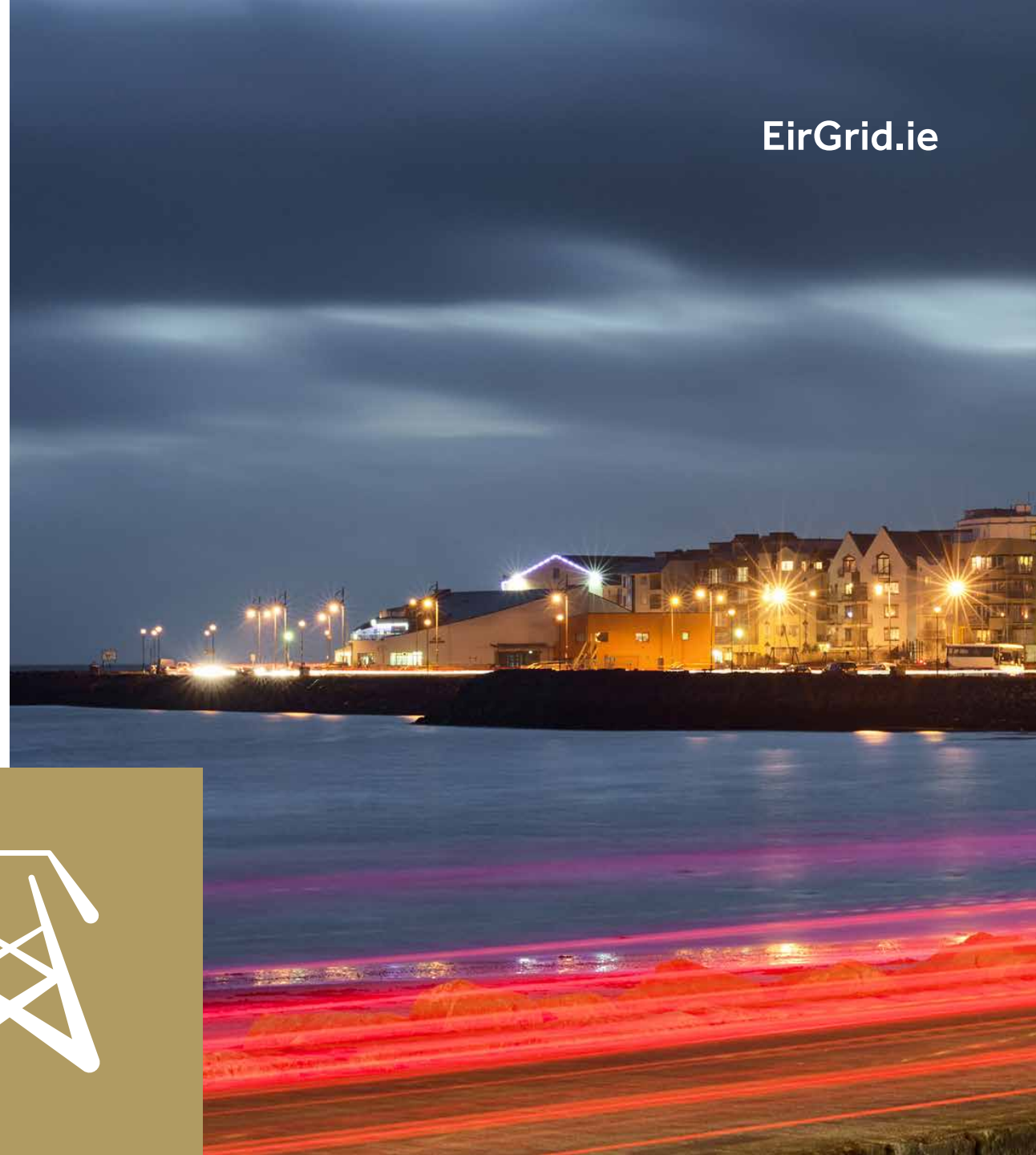




EirGrid.ie

# Winter Outlook 2023/24

October 2023



# Introduction

## EirGrid operates the electricity transmission system in Ireland.

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. EirGrid is providing consumers with a high quality and increasingly clean energy supply, while also managing an increasingly complex supply and demand dynamic.

There are inherent challenges in all complex power systems. Electricity transmission system operators around the world face a wide range of demands and challenges, from geo-political pressures to the weather (including very cold spells and 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, in rare cases, lead to localised loss of supply.

EirGrid does not generate electricity, deliver demand response or control market flows on interconnectors. As transmission system operator, we depend on others to have the power we need when we ask for it. These are the challenges that we manage every second of every day on behalf of communities and businesses across Ireland.

The annual Generation Capacity Statement published by EirGrid presents information on generation adequacy studies that assess the balance between supply and demand over the subsequent ten years. This Winter Outlook presents a more detailed view, focusing on the upcoming winter. 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 2023/24 covers the period from 30 October 2023 to 31 March 2024. The data-freeze date for the outlook was 2 September 2023.



# 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 in the following section.

**Loss of Load Expectation (LOLE)** is a mathematical formula, based on studies, of the number of hours in a period (typically a year<sup>1</sup>) 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, sets the LOLE standard which acts as a maximum level of risk that it has judged the system should be operated at. The LOLE standard is 8 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 electricity 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.

**Emergency state** is when one or more operational security limits on the electricity power system are violated, e.g., failure to meet the demand.

**De-rated generation capacity** is the capacity of generation that can be expected 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 extended periods (e.g., 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.



<sup>1</sup> For Winter Outlook 2023/24 LOLE is assessed over the period 30 October 2023 to 31 March 2024.

# Glossary

## 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 Ireland and Northern Ireland has enough electricity to power homes, businesses and industry. The market takes the form of an auction, held every year, for capacity for the future.

## Combined Cycle Gas Turbine (CCGT)

A type of thermal generator that typically uses natural gas as a fuel source. It is a collection of gas and steam turbines where waste heat from the gas turbine(s) is passed through a heat recovery boiler to generate steam for the steam turbine(s).

## Conventional generating unit

The general term applied to generating units that produce electricity from coal, oil or natural gas.

## Demand

The amount of electrical power consumed by the power system.

## Demand Side Unit (DSU)

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 unit's 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.

## East West Interconnector (EWIC)

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 demand

The amount of electrical power that is expected to be consumed by the power system in a time period.

## Forecast peak demand

The maximum amount of electricity 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 Statement

Statement produced by EirGrid 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

An electrical link that connects two systems.

### Megawatt (MW)

Unit of power: 1 Megawatt = 1,000,000 Watts.

### North-South Tie Lines

The electrical link that connects the transmission system of 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.

### Security of Supply Programme

A programme of work published by CRU (updated programme available on 16 October 2023 at <https://www.cru.ie/>) to increase generation capacity to provide additional stability and resilience to the Irish energy system. The programme of work was in response to EirGrid's identification of a potential capacity shortfall, if no action was taken, from 2021 to 2026.

### 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 electricity from coal, oil or natural gas, using steam to power a turbine(s).



# Executive Summary

The Loss of Load Expectation (LOLE) in Ireland for the five months of the winter period being studied is 21 hours. The LOLE has reduced from 51 hours last winter; however, it remains outside the 8 hours per year standard.



This means 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 a reasonable probability of the system entering the Emergency State at times, due to insufficient generation being available to meet the demand.

The Expected Unserved Energy (EUE) figure would suggest that, on average, electricity consumers could potentially be without supply for up to 2 hours over the winter period. However, emergency protocols are in place with large energy users that would mitigate the impact on homes and businesses, where sufficient notice of an event can be provided (minimum of 1 hour). LOLE and EUE are metrics used to measure the risk or likelihood of such an event happening. This does not necessarily mean that electricity consumers will be without supply for any period during the winter. In last year's Winter Outlook, the EUE figure suggested that consumers could be without power for 4 hours, yet consumers experienced no loss of power during the winter due to capacity issues. Based on information at the time of the data freeze, mid-December is expected to be the most onerous period from a capacity margin perspective.

There is no risk of a system-wide 'blackout' (a total loss of control of the electricity system) solely due to insufficient generation under any circumstances this winter. Other conditions would have to be present or multiple and significant failures occur to cause a system-wide blackout. A key assumption underpinning the winter outlook analysis, based on best information available at the time of writing, is that there will be uninterrupted reserves of natural gas from both the Moffat terminal and the Corrib gas field, with no shortage issues.

# Winter 2022/23 Review

Generation adequacy remained very tight across the winter period at times of low wind generation. Daily engagement and reciprocal support arrangements with transmission system operators in Great Britain and Continental Europe were key to keeping the system out of the Alert and Emergency States during these periods. As a result, no System Alerts or System Emergencies<sup>2</sup> were experienced on the Ireland power system during Winter 2022/23.

Winter 2022/23 had a prolonged period of cold weather in December, when a system demand record of 5,544 MW was set, and a shorter period in January. On average, temperatures at the time of daily peak demand over the winter period were 0.4°C higher than the 15-year average. Minimum temperatures over the same period were approximately 0.6°C lower than the 15-year average.

The peak demand of 5,544 MW when temperature-corrected was below our median forecast from last year's Winter Outlook. We believe this may have been due to our forecast not fully accounting for the impact of high electricity prices over the period.

The forced outage rate of dispatchable generation (excluding DSUs) over the winter period was 17%. This was less than our assumption of 19%.

Wind generation output over the winter period was consistent with recent winters, supplying 41% of the electricity demand. However, wind generation output varied from 10 MW to 3,644 MW over the period. In terms of wind generation's contribution to capacity adequacy, we apply a capacity credit to account for the variability of its output.

During the ten periods with the tightest generation margin, the average import from Northern Ireland was 242 MW on the North-South Tie Lines and 511 MW from Great Britain on the East West Interconnector.



<sup>2</sup> There were 62 days during the winter period where the system was reliant on wind generation and/or interconnection from Northern Ireland and Great Britain to keep the system out of the Alert (42 days) and Emergency (20 days) States.

# Winter Outlook

## Demand

As can be seen in Figure 1, the transmission peak electricity demand in Ireland has been growing over the last number of years. The 2022 transmission peak demand (not temperature corrected) was a record of 5,544 MW, which occurred on 14 December at 17:26. The analysis of Ireland’s peak demand over winter 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.

We anticipate a peak demand of between 5,480 MW (low demand) and 5,930 MW (high demand) in Ireland this winter with a median demand of 5,740 MW. Figure 2 compares the weekly peak demand for the 2021/2022 and 2022/2023 winter periods to the median forecast weekly peak demand for the 2023/2024 winter period.

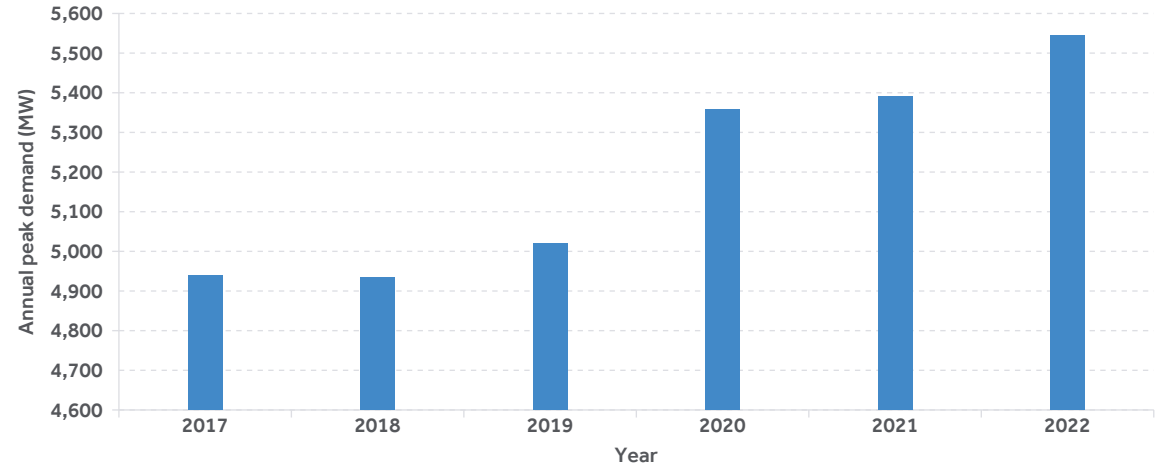


Figure 1: Ireland historical annual peak demand

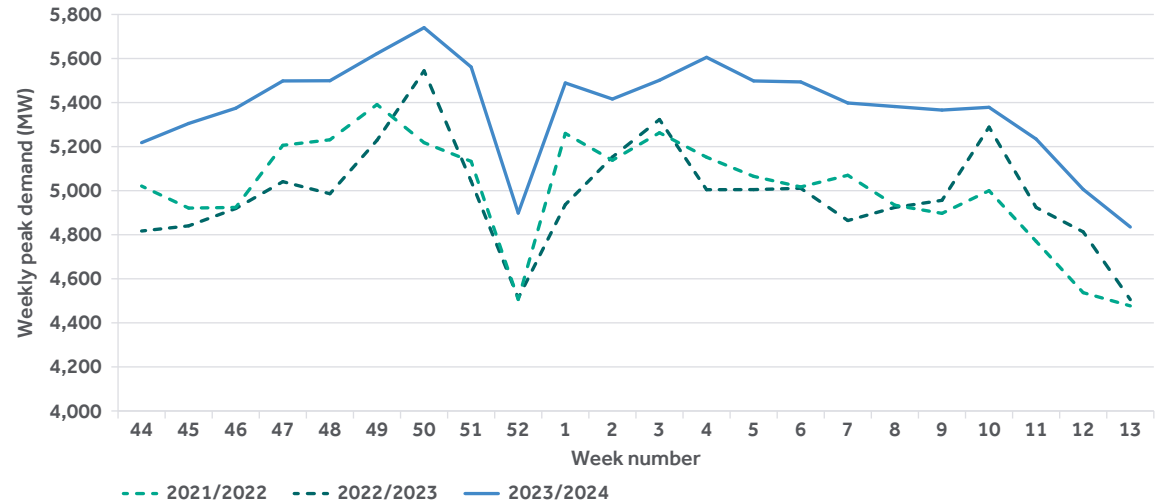


Figure 2: Ireland weekly peak demand for 2021/2022 and 2022/2023 winter periods versus forecast median weekly peak demand for 2023/2024 winter period





### 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 (CCGTs) (gas), thermal generation plant (coal, heavy fuel oil, peat/biomass), peaker plant (gas and distillate), renewables (mostly hydro, wind and solar), demand side units (DSUs), storage (pumped hydro and batteries), 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. Over the winter period, there will be a number of new units connecting to the system as new capacity delivers through the Capacity Market Auctions and Temporary Emergency Generation (TEG) is commissioned in Ireland as a result of measures taken in the Security of Supply Programme.

We apply de-rating factors to the generation capacity to reflect the contribution of each generator to capacity adequacy, to calculate 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 period. For wind generation and interconnection, the de-rating factors are those used in the Generation Capacity Statement 2023–2032.

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 generation capacity.

Figure 3 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/lowest capacity margin, across the upcoming winter period.

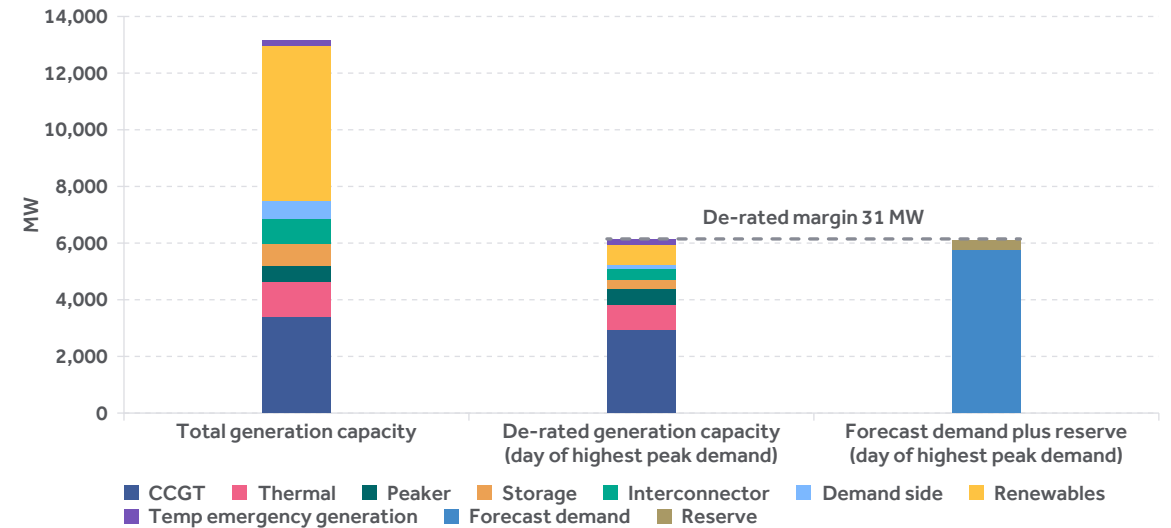
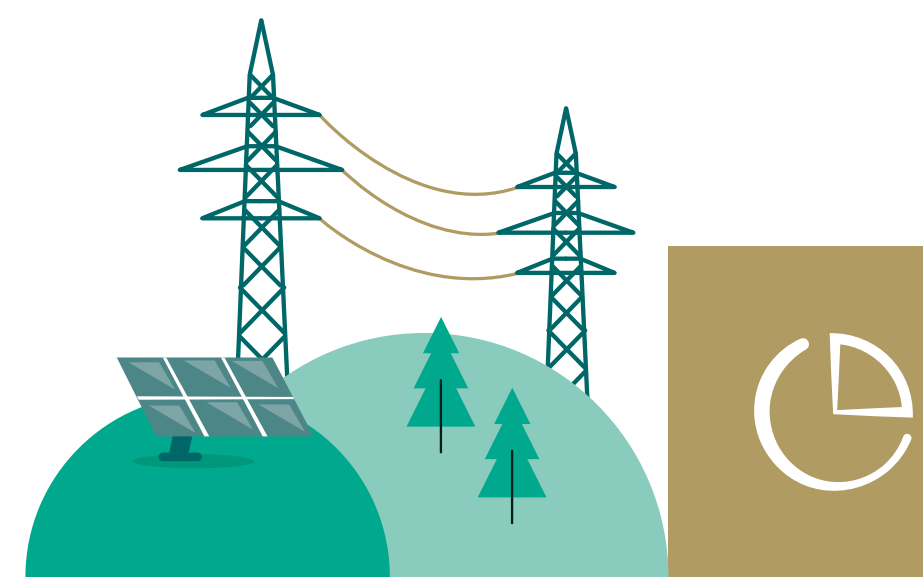


Figure 3: Ireland generation capacity versus forecast demand for the day of highest peak demand/lowest capacity margin



### LOLE and de-rated margin

The Loss of Load Expectation (LOLE) in Ireland for the five months of the winter period being studied is 21 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 -159 MW to 291 MW. 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 a reasonable probability of the system entering the Emergency State at times due to insufficient generation being available to meet the demand. The Expected Unserved Energy (EUE) figure would suggest that, on average, electricity consumers could potentially be without supply for up to 2 hours over the winter period. However, emergency protocols are in place with large energy users that would mitigate the impact on homes and businesses, where sufficient notice of an event can be provided (minimum of 1 hour). LOLE and EUE are metrics used to measure the risk or likelihood of such an event happening. This does not necessarily mean that electricity consumers will be without supply for any period.

Figure 4 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.

Table 1: Ireland key metrics for median demand level

	2023/24 base case
Loss of Load Expectation (LOLE)	21 hours
Expected Unserved Energy (EUE)	5,427 MWh
Minimum de-rated margin (MW) over winter period	31 MW
Minimum de-rated margin (%) over winter period	0.5%

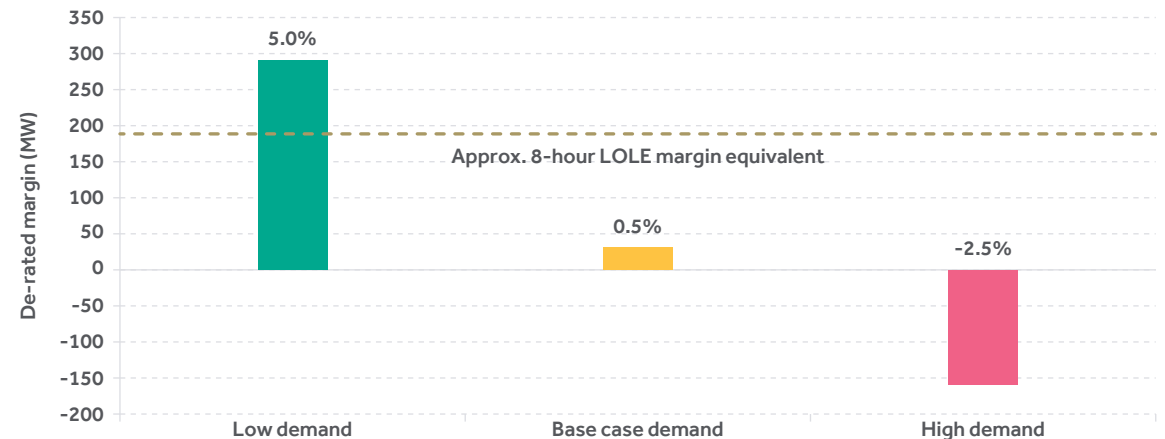


Figure 4: Ireland de-rated margin for low, median and high demand scenarios on day of highest peak demand/lowest capacity margin



### 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 5 shows the expected weekly de-rated generation capacity in the medium import scenario. The de-rated generation capacity remains broadly static throughout the winter period, as there are relatively few scheduled outages of generating units.

Figure 6 shows the expected weekly de-rated generation capacity for each import scenario versus the forecast demand plus reserve. In the medium import scenario, the de-rated capacity is greater than the demand plus reserve requirement in all weeks. There are thirteen weeks in the low import scenario where the demand plus reserve requirement exceeds the de-rated capacity. The risk of the system entering the Alert and Emergency states is higher in mid-December.

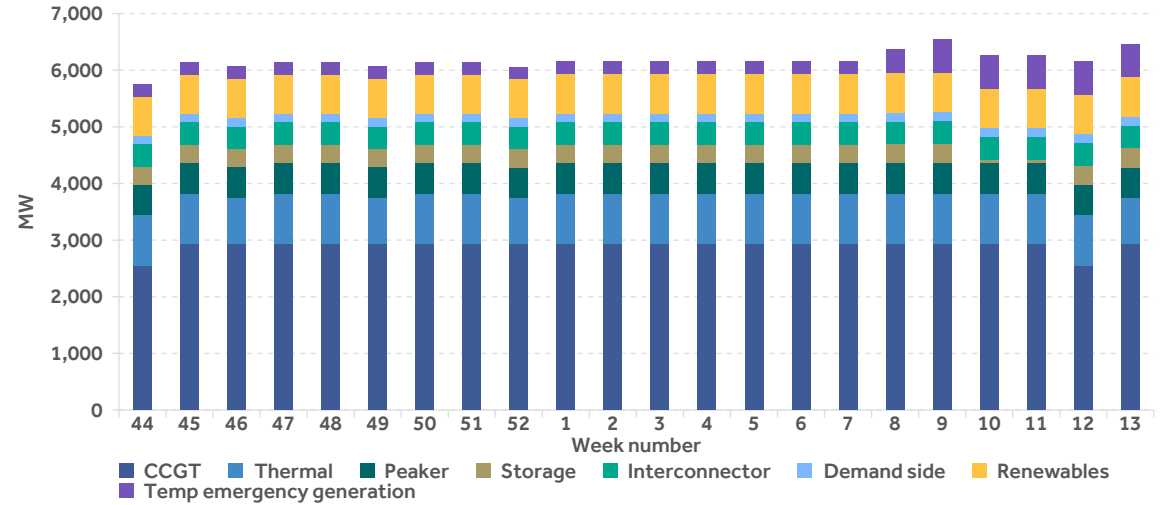


Figure 5: Ireland expected weekly de-rated generation capacity per type of generating unit

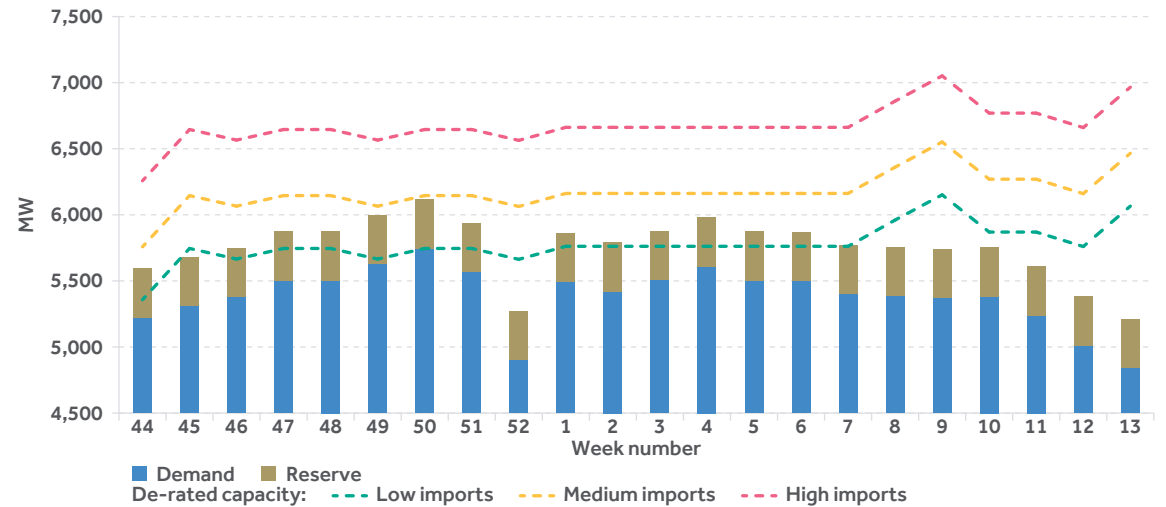


Figure 6: Ireland weekly de-rated generation capacity (dashed lines) for each import scenario versus the forecast demand plus reserve (bars)



## Ireland forced outage rates

The dispatchable generation (excluding DSUs) forced outage rate in Ireland has increased significantly over the past five years. For January to July 2023, it stands at 19%. This has led to tight margins in 2023, resulting in the system entering the Alert state on one occasion during the summer period and has impacted the system's ability to accommodate generator and transmission planned outages.

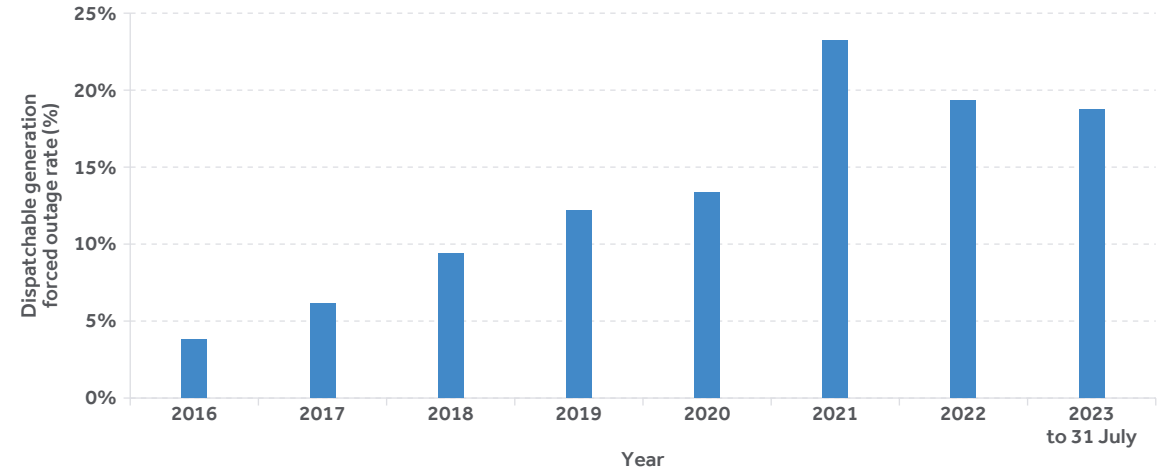


Figure 7: Ireland historical dispatchable generation annual forced outage rates



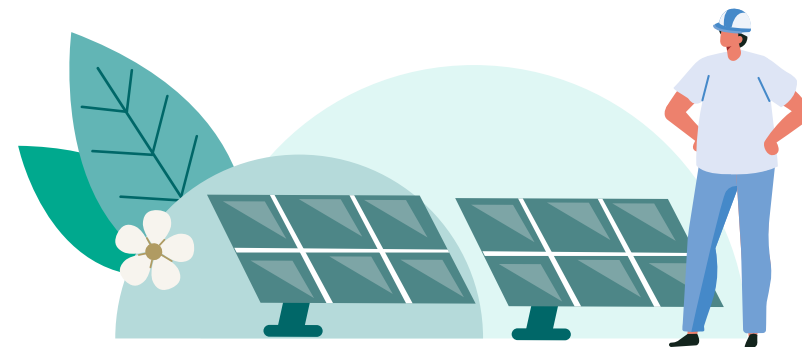
# Assumptions

- ✓ There will be uninterrupted reserves of natural gas from both the Moffat terminal and the Corrib gas field, with no shortage issues.
- ✓ De-rating factors/capacity credits:
  - CCGT, large thermal and hydro units (high- and mid-merit units) de-rating factors based on forced outage rates in a rolling three-year period from August 2020 to July 2023 inclusive.
  - Peaker de-rating factor: 0.9.
  - DSU, battery, wind, solar, interconnection as per Generation Capacity Statement 2023–2032.
  - New unit de-rating factor: 0.95.
- ✓ Non-market Temporary Emergency Generation is included in the studies.

- ✓ A fully intact network will be available.
- ✓ Demand scenarios: low, median (base case) and high as per the Generation Capacity Statement 2023–2032.
- ✓ Ireland interconnector scenarios:

Table 2: Import scenario breakdown

	Low Import (MW)	Medium Import (MW)	High Import (MW)
East West Interconnector	0	300	500
North-South Tie Lines	0	100	400
<b>Total</b>	<b>0</b>	<b>400</b>	<b>900</b>







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