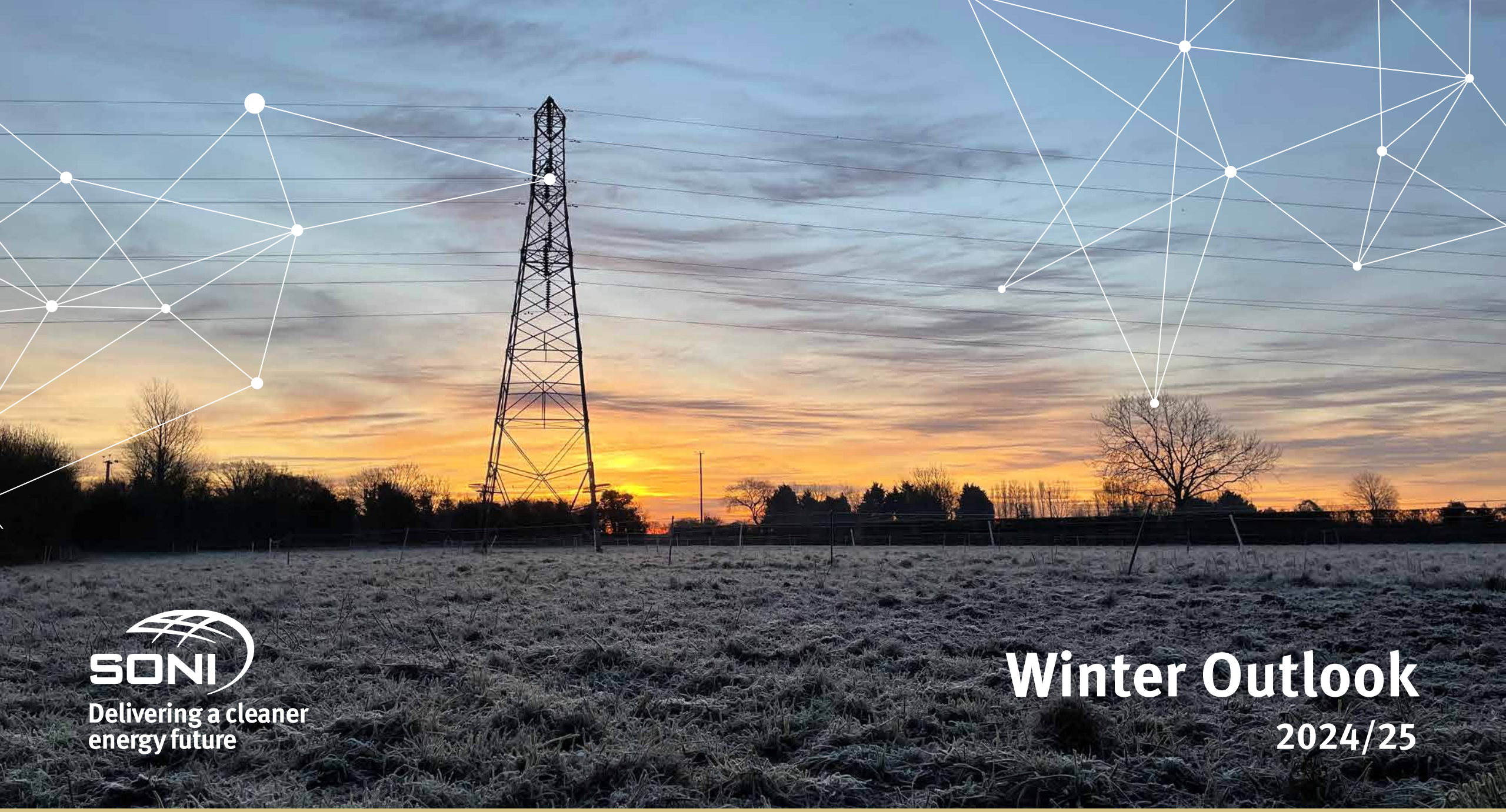


SONI

Delivering a cleaner energy future

Winter Outlook

2024/25

Executive summary

SONI (System Operator for Northern Ireland) is Northern Ireland's electricity Transmission System Operator.

SONI does not generate or sell electricity, rather we operate the electricity transmission system in real time to ensure power can flow from where it is generated to where it is needed. As such, we rely on those who secure contracts to generate electricity through the all-island markets for electricity, to make that generation available to us when it is required.

Each year, SONI publishes the Winter Outlook which sets out our assessment of the expected consumer demand for electricity against the expected available generation over the winter period.

For winter 2024/25, the Loss of Load Expectation (LOLE) in Northern Ireland for the five months of the winter period being studied is 0.23 hours. The LOLE has reduced from 1.95 hours last winter.

This means the system will operate within the acceptable level of risk set by the Department for the Economy and there is a low probability of the system entering the Alert State due to insufficient generation being available to meet the demand.

The decrease in LOLE this year is largely due to the connection of new generation capacity in Northern Ireland. The Analysis assumes that all run-hour limited generation and new generation capacity in receipt of a Market Readiness Certificate will be available for dispatch throughout the winter period.

The Expected Unserved Energy (EUE) figure of 10 MWh suggests that, on average, some electricity consumers could potentially be without supply for less than 14 minutes over the winter period.

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.

Based on information available at the time of the data freeze, early November is expected to be the most onerous period during winter from a capacity margin perspective.

There is no risk of a system-wide 'blackout' (a loss of control of ≥50% 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.

From July to September 2024, the Northern Ireland system has experienced multiple prolonged forced generator outages. This has led to tight margins at times and has impacted the system's ability to accommodate planned generator and transmission maintenance. There have been two System Alerts in Northern Ireland during the summer period due to insufficient levels of dispatchable generation and these challenges are expected to continue ahead of the winter period.

There have been three System Alerts in total in Northern Ireland during 2024 due to insufficient levels of dispatchable generation.

A key assumption underpinning the Winter Outlook analysis, and 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.

Introduction

SONI is Northern Ireland's electricity Transmission System Operator.

We are responsible for the planning and operation of a safe, secure, reliable, economic and efficient electricity transmission system to ensure power can flow from where it is generated to where it is needed.

SONI works in partnership with government, the Utility Regulator and industry to ensure Northern Ireland consumers receive a high quality and increasingly clean energy supply, while also managing an increasingly complex supply and demand dynamic.

There are inherent challenges and risks in all complex power systems. Electricity transmission system operators around the world face a wide range of demands and challenges, from geo-political pressures, the weather (including very cold spells and storms), delays in new generation development, to outages at power stations and on interconnectors.

We utilise our deep technical expertise to assess the impact of these factors and develop mitigation plans, however a confluence of these pressures at any one point can create an imbalance on the system which could lead to the system operating outside of our security standards or, in rare cases, localised loss of supply. This risk can be heightened in winter when demand in Northern Ireland is at its peak.

SONI does not generate electricity, deliver demand response, or control market flows on interconnectors. As a transmission system operator, we plan and manage the electricity grid with the generation that is made available to us by the providers who secure contracts through the all-island capacity market for electricity. We rely on others to have this generation available to us when it is needed.

Our team of expert and experienced engineers manage risks to the electricity system every second of every day on behalf of local communities, businesses, and farms across the country.

The All-Island Resource Adequacy Assessment, which replaces the All-Island Generation Capacity Statement, 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 analysis, focused specifically 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 weekly peak demand is low, and the security of supply of the electricity system may be at risk.

The Winter Outlook for 2024/25 covers the period from 4 November 2024 to 6 April 2025. The data-freeze date for the outlook was 30 August 2024.

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[1]) 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 demand at all times. The Department for the Economy 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 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[1]) due to insufficient generation being available.

Alert state is when a single event on the electricity power system could 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.

1 For Winter Outlook 2024/25 LOLE and EUE is assessed over the period 4 November 2024 to 6 April 2025.

Glossary

All-Island Resource Adequacy Assessment
The All-Island Resource Adequacy Assessment, which replaces the All-Island Generation Capacity Statement, presents information on generation adequacy studies that assess the balance between supply and demand over the next ten years.

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. For the Winter Outlook, de-rating 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.

Forced outage
An event where a generator is unavailable for electricity production for a period 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 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
An electrical link that connects two electricity systems or markets.

Megawatt (MW)
Unit of power; 1 Megawatt = 1,000,000 Watts.

Moyle Interconnector (Moyle)
A 500 MW Interconnector that connects the electricity transmission systems of Northern Ireland and Great Britain.

North-South Tie Lines
The electrical link that connects the transmission system of Northern Ireland to the transmission system of Ireland.

Open cycle gas turbine (OCGT)
A type of thermal generator that typically uses kerosene or natural gas as a fuel source. It is similar to a CCGT but less efficient, as waste heat from the primary turbine(s) is not recovered.

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 standards generation margin
SONI aims to operate the transmission system in accordance with security standards which are important to ensure security of supply. It is important to maintain margins to allow these standards to be met, and to provide insurance against unexpected events.

System constraints
Congestion at one or more parts of the transmission network that prevents 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).

Winter 2023/24 review

Generation adequacy remained very tight in Northern Ireland across the 2023/24 winter period at times of low wind generation.

Daily engagement and reciprocal support arrangements with transmission system operators in Ireland, Great Britain and Europe were key to minimising the number of System Alerts and keeping the system out of the Emergency State during these periods. As a result, there was only one System Alert due to reduced generation capacity margins and no System Emergency[2] in Northern Ireland during winter 2023/24.

Winter 2023/24 overall was marginally milder and somewhat drier than average. In December and January there were two periods of cold weather, with the January cold spell resulting in the winter peak demand of 1,436 MW[3], below the median forecast in last year's Winter Outlook.

2 There were 147 days during the winter period where Northern Ireland was reliant on interconnection and/or wind generation and/or support from Ireland to keep the system out of the Alert (97 days) and Emergency (50 days) States.
3 Sent-out peak demand, not temperature corrected.

The combined forced outage rate of dispatchable generation (excluding DSUs) over the winter period was exceptional at 0.5%. This was significantly less than our assumption of 11% and supported the secure operation of the system throughout a challenging period. This exceptional performance is further emphasised when compared to August and September 2024, with the Northern Ireland system continuously operating throughout this period with 50% of the large generating units in Northern Ireland unavailable due to forced outages.

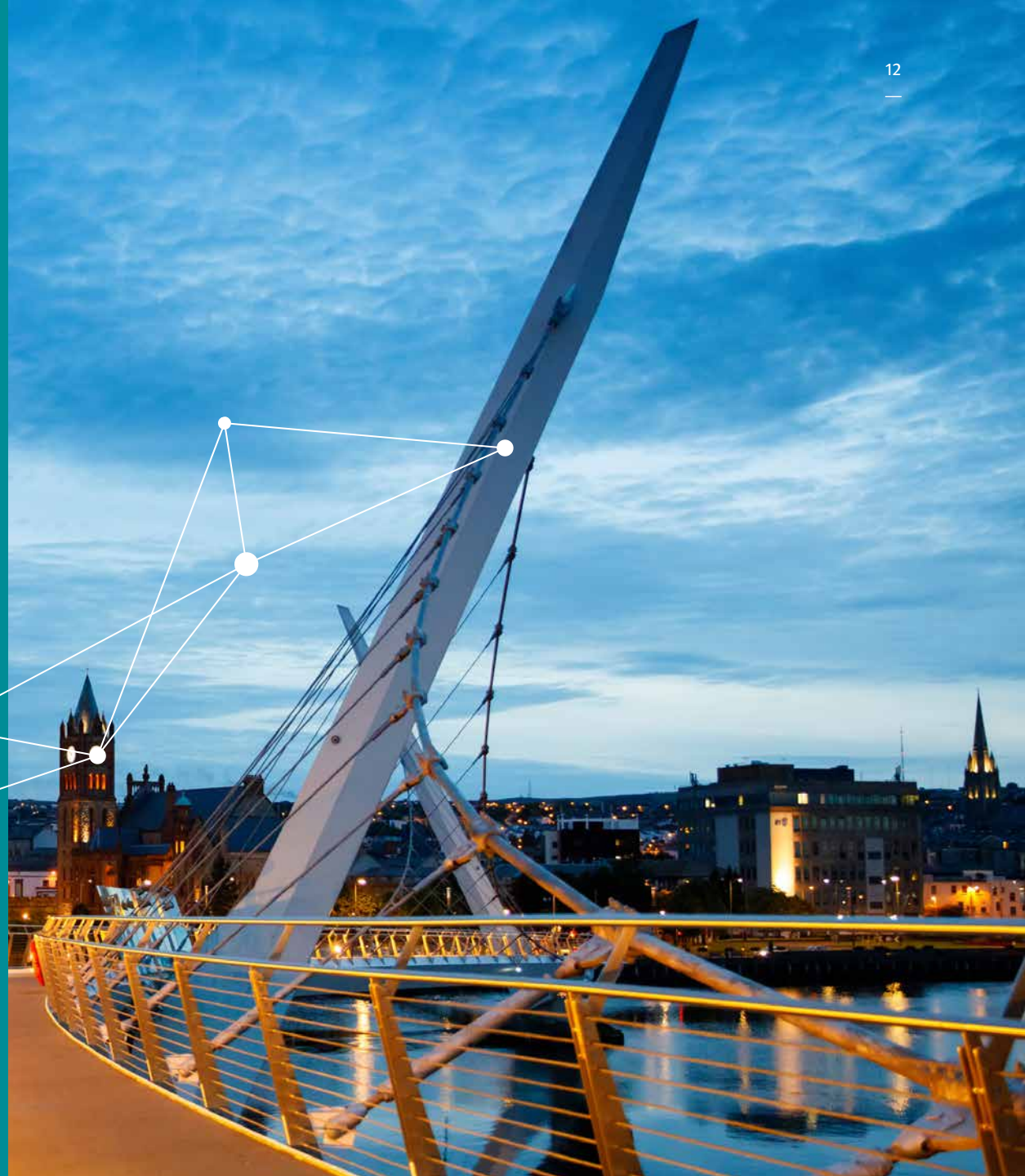
Wind generation output over the winter period was consistent with recent winters, supplying 37% of the electricity demand. However, wind generation output varied from 0 MW to 952 MW[4] over the period. In terms of wind generation's contribution to de-rated margin, we apply a capacity credit to account for its contribution to reliability.

Solar generation's contribution to the secure operation of the system during winter 2023/24 was low, as expected. Solar output is typically reduced throughout the winter period due to shorter, colder days. With the winter peak demand typically occurring after sunset, the installed solar capacity has been assigned a rated capacity of zero for its contribution to reliability.

During the ten periods with the tightest generation margin, the average import from Ireland was 120 MW on the North-South Tie-Lines and 440 MW from Great Britain on the Moyle Interconnector.

4 Dispatched to the system.

Winter Outlook 2024/25



Demand

As can be seen in Figure 1, the transmission peak electricity demand over the winter period in Northern Ireland has been relatively static over the last number of years. The 2023/24 sent-out transmission peak demand (not temperature corrected) was 1,436 MW and occurred on 17th January 2024 at 17:15.

We anticipate a peak demand of between 1,450 MW and 1,670 MW in Northern Ireland this winter. Figure 2 compares the historical weekly peak demand for the 2022/2023 and 2023/2024 winter periods, to the median forecast weekly peak demand of 1,560 MW for the 2024/2025 winter period.

Figure 1: Northern Ireland historical annual peak demand

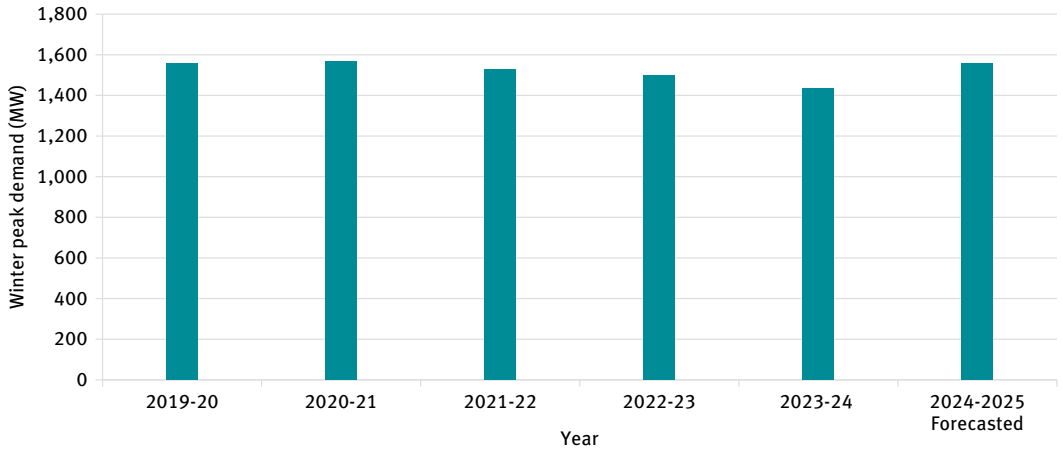
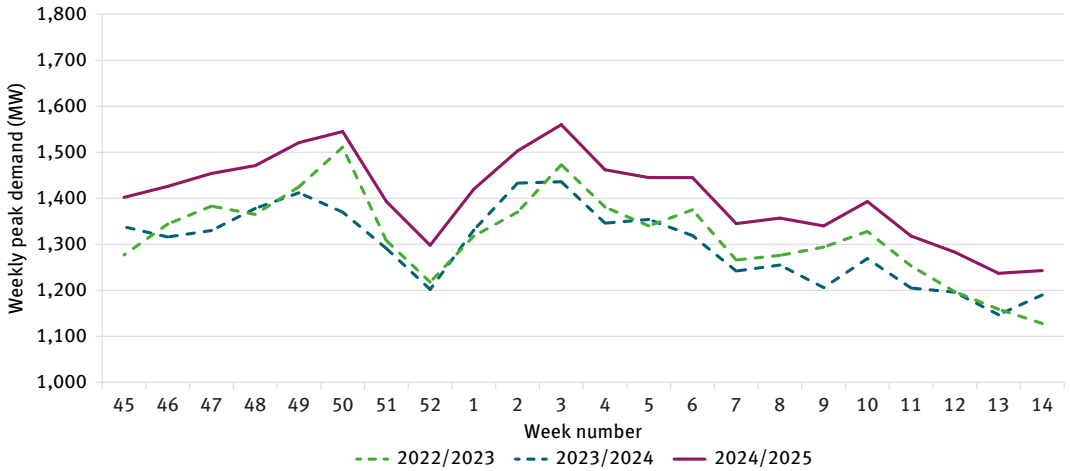


Figure 2: Northern Ireland weekly peak demand for 2022/2023 and 2023/2024 winter periods versus forecast median weekly peak demand for 2024/2025 winter period



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), open cycle gas turbines (OCGT) (gas), thermal generation plant (biomass), peaker plant (typically gas and distillate), renewables (mostly wind and solar), demand side units (DSU), aggregated generating units (AGU) and a small volume of other technologies.

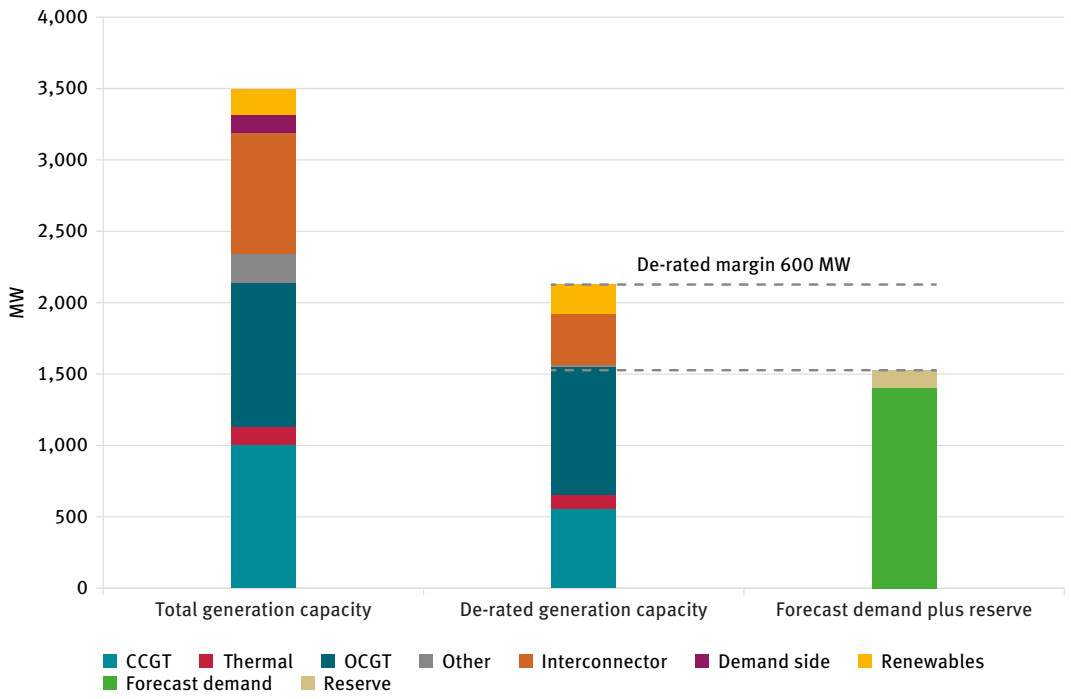
There are two interconnectors; the 500 MW Moyle interconnector which connects Northern Ireland and Scotland, and the North-South Tie-Lines connecting Northern Ireland and Ireland.

To calculate generation margin, we apply de-rating factors to the generation capacity to reflect its expected contribution to reliability throughout the winter period. For conventional dispatchable generating units, the de-rating factor is based on forced outage rates in a rolling three-year period. For wind generation and batteries, the de-rating factors are based on those used in Capacity Market auctions, whilst DSU de-rating factors based on an annual availability rate. With the winter peak demand typically occurring after sunset, the installed solar capacity has been assigned a rated capacity of zero. Support from Ireland across the North-South Tie-Lines is assumed to be 100 MW. Support from Moyle is assumed to be 258 MW in the median scenario based on historical flows and following discussion with National Energy System Operator.

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[5], and the forecast demand plus reserve for the day with the lowest capacity margin across the upcoming winter period.

Figure 3: Northern Ireland week containing lowest de-rated capacity margin



5 A key assumption of this analysis is that run-hour limited generation and generation in receipt of a Market Readiness Certificate remains available for dispatch throughout the winter period.

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 0.23 hours. For reference, the annual LOLE standard is 4.9 hours, as set by the Department for the Economy. The minimum de-rated margin over the winter period is expected to be in the range of 490 MW to 710 MW. The results suggest that even with the loss of a single large unit in Northern Ireland, there is low risk of the system entering the Alert State, under normal operating conditions[6].

Any risk is reduced with increased availability of wind and imports, or when demand is less than expected. The Expected Unserved Energy (EUE) figure suggests that, on average, electricity consumers could potentially be without supply for a minimal period of time (less than 14 minutes) over the winter period. LOLE is a metric 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.

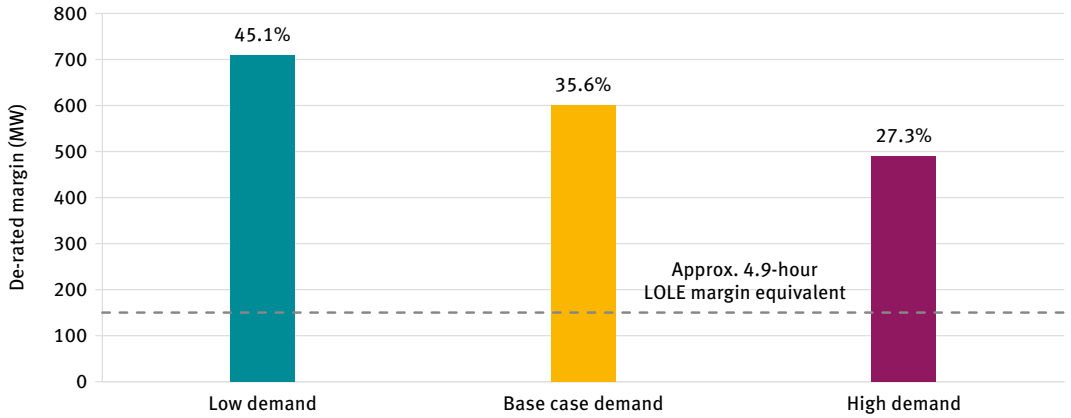
Table 1: Northern Ireland key metrics for median demand level

	2024/25 base case
Loss of Load Expectation (LOLE)	0.23 hours
Expected Unserved Energy (EUE)	10 MWh
Minimum de-rated margin (MW) over winter period	600 MW
Minimum de-rated margin (%) over winter period	35.6%

6 A key assumption of this analysis is that run-hour limited generation and generation in receipt of a Market Readiness Certificate remains available for dispatch throughout the winter period.

Figure 4 shows the de-rated margin, as a percentage of demand plus reserve, for the day with the lowest capacity 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 shown below.

Figure 4: Northern Ireland week containing lowest de-rated capacity margin per demand scenario



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 Interconnector and North-South Tie-Lines) import scenarios; low (0 MW), medium (358 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 the analysis outlined in Figure 5.

Figure 5 shows the expected weekly de-rated generation capacity in the medium import scenario. The de-rated generation capacity fluctuates throughout the winter period due to scheduled outages of generating units, as planned at the time of the data freeze.

Figure 6 shows the expected weekly de-rated generation capacity for each import scenario versus the forecast demand plus reserve. In all import scenarios, the de-rated capacity is greater than the demand plus reserve requirement in all weeks.

Figure 5: Northern Ireland expected weekly de-rated generation capacity[7] per type of generating unit

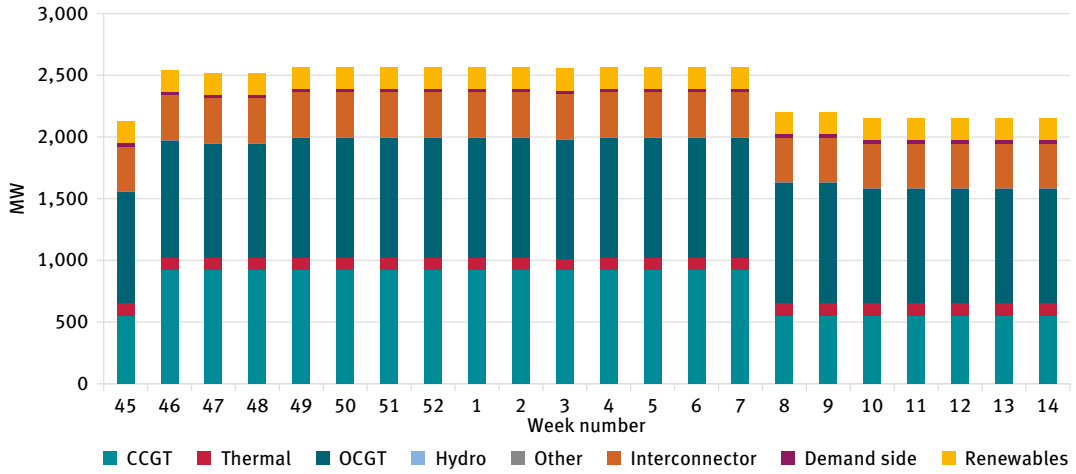
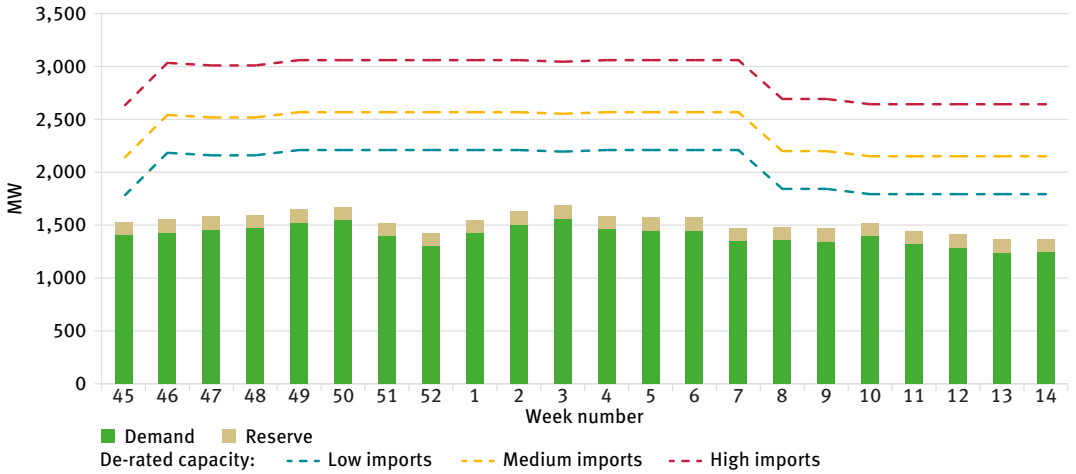


Figure 6: Northern Ireland weekly de-rated generation capacity (dashed lines) for each import scenario versus the forecast demand plus reserve (bars)



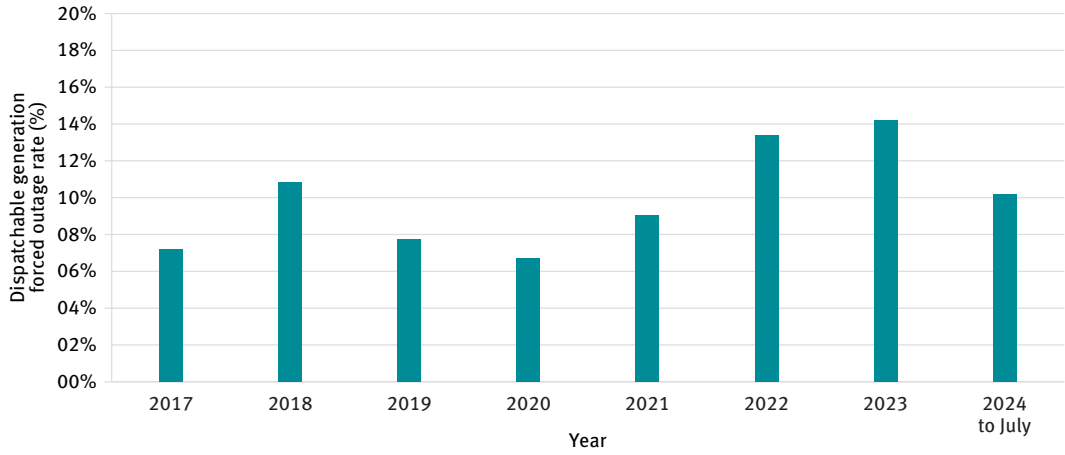
7 OCGT includes large open cycle gas turbines and smaller peaker plant, both of which are subject to run-hour limitations.

Northern Ireland forced outage rates

The dispatchable generation (excluding DSUs) forced outage rate in Northern Ireland has increased significantly over the past five years. During winter 2023/24 the forced outage rate of large conventional units was 0.5%, which was exceptional, and supported the secure operation of the Northern Ireland system.

From January 2024 to July 2024, the dispatchable generation forced outage rate stood at 10.2%, and this figure has increased in subsequent months. This has led to tight margins at times in 2024 and has impacted the system's ability to accommodate planned generator and transmission outages. There have been three System Alerts in Northern Ireland during 2024 due to insufficient levels of dispatchable generation.

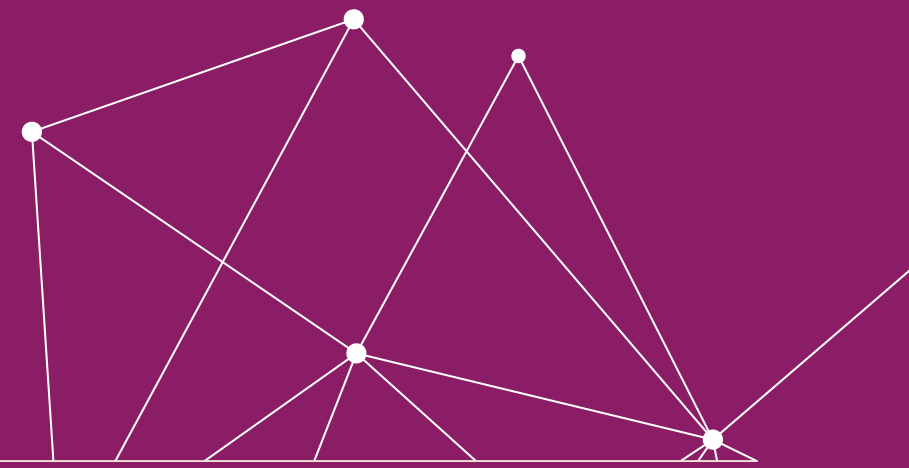
Figure 8: Northern Ireland historical dispatchable generation annual forced outage rates



Concluding observations

The assessment contained in this Winter Outlook points to a number of key observations:

- The assessment of the generation margin for this coming winter period indicates there will be sufficient generation margin throughout the winter period, where there is expected availability of dispatchable generation.
- Under normal operating conditions, the risk of the Northern Ireland system entering the Alert State during the winter period is low.
- This analysis assumes that new generation capacity in receipt of a Market Readiness Certificate will be available for dispatch throughout the winter period.
- Additionally, the analysis assumes that run-hour restricted generating units will remain available throughout the winter period.
- From July to September 2024, the Northern Ireland system has experienced a number of prolonged forced generator outages. This has led to tight margins at times and has impacted the system's ability to accommodate planned generator and transmission maintenance. There have been two System Alerts in Northern Ireland during summer 2024 due to insufficient levels of dispatchable generation, and these challenges will remain ahead of the winter period.
- Our team of expert engineers are always managing a degree of risk in operating the transmission system and we have tried and tested mitigation and contingency plans in place in the event that any challenges arise. These plans include:
  - Maximising all available generation on the system;
  - Maximising imports from Great Britain and Ireland;
  - Reconfiguration of the planned outage schedule;
  - Acceleration of any new generation due to come onto the system; and
  - Use of small, more responsive generation, such as Open Cycle Gas Turbines and other technologies such as batteries.



Assumptions

- There will be uninterrupted reserves of natural gas from both the Moffat terminal and the Corrib gas field, with no shortage issues.
- A fully intact network will be available.
- Generating units with annual run-hour limitations remain available for dispatch throughout the winter period.
- New generation capacity in receipt of a Market Readiness Certificate will be available for dispatch throughout the winter period.
- Demand scenarios: low, median (base case) and high as per the All-Island Resource Adequacy Assessment (for diagrams only). Studies use median demand.
- The All-Island Resource Adequacy Assessment methodology[8] was used as a basis for the LOLE and EUE studies. 2016 has been selected as an average climate year for Winter Outlook studies.
- De-rating factors/capacity credits:
  - CCGT and large thermal units (high- and mid-merit units) de-rating factors based on forced outage rates between July 2021 and June 2024 inclusive.
  - Peaker and new unit de-rating factors: 0.9.
  - DSU de-rating factors based on availability rates between July 2023 and June 2024 inclusive.
  - Battery and wind de-rating factors as per 2024/25 Capacity Market auctions (for diagrams only).
  - Solar de-rating factors: 0.
- Northern Ireland interconnector scenarios as per Table 2 (for diagrams only). Studies include model of Great Britain and France systems.

Table 2: Import scenario breakdown

Import scenario	Moyle Interconnector (imports)	North-South Tie-Line (South to North)	Combined total
Low	0 MW	0 MW	0 MW
Median	258 MW	100 MW	358 MW
High	450 MW	400 MW	850 MW

8 The All-Island Resource Adequacy Assessment methodology can be found here: National Resource Adequacy Assessment Methodology for Ireland and Northern Ireland (SONI Consultation Portal).

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