All-Island Resource Adequacy Assessment

2026-2035 Inputs & Assumptions for Northern Ireland

Contents

1 Introduction

EirGrid and SONI, as the Transmission System Operators (TSO) for Ireland and Northern Ireland respectively, have a responsibility to operate the electricity transmission system every minute of every day, whilst also planning the future of the transmission grids in their relevant jurisdictions.

EirGrid, the TSO in Ireland, is required to publish forecast information about the power system, as set out in Section 38 of the Electricity Regulation Act 1999[1] and Part 10 of S.I. No. 60 of 2005 European Communities (Internal Market in Electricity) Regulations[2]. The forecast statement is a requirement of Condition 7 of EirGrid's Transmission System Operator licence, which also states that the methodologies on which the forecast statement is based shall be subject to the approval of the Commission for Regulation of Utilities in Ireland.

SONI, the TSO in Northern Ireland, is required to produce an annual Generation Capacity Statement (GCS), in accordance with Condition 35 of the Licence[3] to participate in the Transmission of Electricity granted to SONI by the Department for the Economy (DfE). Condition 35 also states that the statement shall be based on methodologies approved by the Utility Regulator for Northern Ireland.

The 'Clean Energy for all Europeans' package adopted in 2019 sets out a new framework for the transition away from fossil fuels to cleaner sources of energy which included the Regulation on the internal market for electricity (EU/2019/943) herein referred to as 'the Regulation'. Chapter IV (Articles 20-27) of the Regulation are focused on resource adequacy.

Article 23 of the Regulation mandates the European Network for Transmission System Operators for Electricity (ENTSO-E) to conduct annual resource adequacy assessments based on projected supply and demand for electricity across the EU to identify resource adequacy concerns for Member States. ENTSO-E's obligations under Article 23 of the Regulation are fulfilled through the European Resource Adequacy Assessment[4] (ERAA), the methodology of which was approved by the European Union Agency for Cooperation of Energy Regulators (ACER) on 2nd October 2020. ACER also has a responsibility for approving the annual implementation of the ERAA methodology conducted by ENTSO-E and issuing opinions where national assessments indicate adequacy concerns which are not identified in the ERAA assessment.

Article 20(1) of the Regulation states that Member States may also carry out national resource adequacy assessments where necessary. Article 24 of the Regulation states that the national adequacy assessment should be based on the ERAA methodology,

---

[1] https://www.irishstatutebook.ie/eli/1999/act/23/section/38/enacted/en/html
[2] https://www.irishstatutebook.ie/eli/2005/si/60/made/en/print#partx-article28
[3] https://www.uregni.gov.uk/files/uregni/media-files/SONI%20TSO%20Consolidated%20Feb%202019.pdf
[4] https://www.acer.europa.eu/Individual%20Decisions_annex/ACER%20Decision%2024-2020%20on%20ERAA%20-%20Annex%20I_1.pdf

and capture market specific characteristics or risks that the European assessment may not capture in detail. Effectively, the national adequacy assessment provides the scope to run studies that are relevant on a national level but may not be relevant at a pan-EU level.

The All-Island Resource Adequacy Assessment publication replaces the existing Generation Capacity Statement (GCS) methodology for adequacy modelling for Ireland and Northern Ireland, aligning with EU Regulation 2019/943[5] Article 24. The All-Island Resource Adequacy Assessment publication will support signalling future system outlook and requirements to the energy market as well as to policy makers, regulators, industry, TSOs, Distribution System Operators (DSOs), electricity consumers, and the general public.

This document prescribes the inputs and assumptions to be used in the All-Island Resource Adequacy Assessment process for 2025.

1.1 Changes from previous cycle

The All-Island Resource Adequacy Assessment (AIRAA) Inputs & Assumptions for Northern Ireland have been revised to include updated climate assumptions using the Pan-European Climate Database version 4.1, updated electric vehicle assumptions from the Department for Infrastructure and inputs and assumptions for an economic viability assessment. A summary of changes is provided in the table below.

Section	Summary of Change
Global	Replace 'Climate Year' with 'Weather Scenario' to reflect change from PECD3.1 historic climatic years to PECD4.1 forecast weather scenarios.
1. Introduction	Remove text to make section more concise.
2.1 Electric Vehicles	Revise electric vehicle assumptions to align with Department for Infrastructure Transport Emissions Model and adjust electric vehicle efficiency assumptions.
2.2 Heat Pumps	Revise heat pump assumptions to align with NIEN Distribution Network Scenarios Constrained Growth Scenario.
2.4 Conventional Demand	Revise temperature correction assumptions and smart meter effects assumptions.
3.1 Conventional Generation	Revise new plant capacity & deliverability language to reflect conclusion of the enhanced monitoring programme, update plant performance period and wording as needed.
3.2 Interconnection	Update data source references to latest revision.
3.3 Variable Generation	Text altered to update and explain onshore/offshore wind scaling factors.

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN

3.4 Battery Storage	Add text to denote battery storage aggregations and revise battery storage performance to reflect historic availability.
4. Modelling	Adjust wording for added cohesion across documentation and update reserve requirement LSI periods.
4. Modelling	Add text to describe regions outside the SEM operating at Reliability Standard.
5. Economic Viability Assessment	Add section on Economic Viability Assessment.
6. Scenarios	Update information to reflect scenarios modelled in AIRAA 2026-2035. Add new section on Additional Security Analysis sensitivities.

2 Total Electricity Requirement - Demand Assumptions

The assumptions shared below are for input to inform the median demand forecast of Total Electricity Requirement. Total Electricity Requirement is the amount of electricity required to meet final use electricity including behind the meter generation (such as solar PV) and the amount of electricity that is required to meet transmission and distribution grid losses.

The median Total Electricity Requirement demand forecast is SONI's best estimate of how demand will change in the future to meet government targets for energy policy and climate action. The Total Electricity Requirement demand forecast is dependent on a significant number of economic, social and policy factors, therefore low and high forecasts are also defined in the Scenarios section of this document. The low and high demand scenarios capture estimates above and below the median forecast that are realistically plausible given current trends and policies.

2.1 Electric Vehicles

Table 1: Electric vehicles annual electricity demand

Category	Northern Ireland Data Source / Assumption
Types of Electric Vehicles Modelled	• Passenger Battery Electric Vehicles (BEV). • Passenger Plug in Hybrid Electric Vehicles (PHEV). • Battery Electric Light Goods Vehicles (LGV). • Battery Electric Busses.
Historic Number of Electric Vehicles	• Vehicle Licensing statistics from DVLA[6].
Forecast Number of Electric Vehicles	• Projections informed by the Department for Infrastructure (DfI) Transport Emissions Model projections on the number of new electric vehicles to be sold across each horizon year • Future proportion of Electric Vehicle type based on historic proportions and forecasts provided by DfI
Distance Travelled / Year	• Assume 15,000 km per vehicle per year for BEVs and PHEVs • PHEVs assumed 47% of distance travelled in EV mode based on European study of real-world driving[7]. • Assume 22,550 km per vehicle per year for Electric Light Goods Vehicles • Assume 35,854 km per vehicle per year for Battery Electric Buses
Electric Vehicle Efficiency	• Current efficiency assumptions are below and are aligned to Tomorrows Energy Scenario (TES)2023[8]:

[6] Vehicles statistics - GOV.UK (www.gov.uk)
[7] https://theicct.org/publication/real-world-phev-use-jun22/
[8] https://www.eirgrid.ie/industry/tomorrows-energy-scenarios-tes

	• 0.181 kWh/km for passenger BEV in 2025, increasing to 0.165 kWh/km by 2035, • 0.217 kWh/km for passenger PHEV in 2025, increasing to 0.198 kWh/km by 2035, • 0.259 kWh/km for LGV in 2025, increasing to 0.246 kWh/km by 2035 • 1.369 kWh/km for busses in 2025, increasing to 1.302 kWh/km by 2035 • Efficiency projections are aligned with Tomorrows Energy Scenarios (0.9% improvement per year for passenger vehicles, 0.5% improvement per year for commercial vehicles). • PHEVs assumed to be 20% less efficient than BEV equivalent[9]

Table 2: Electric vehicles demand shape

Category	Northern Ireland Data Source / Assumption
Vehicle Usage Pattern	• Assume consistent usage in summer and winter. • 15.28% usage on weekday, 11.8% usage on weekend day based on 2022 Northern Ireland Traffic Count Data[10].
Charging Profiles	• Aligned to weekday and weekend charging profiles for cars, freight, and busses published in ENTSOE's TYNDP 2022 Scenario Building Guidelines [11]. • Simple and smarter[12] profiles used to reflect flexibility through incentives to avoid charging during peak times.
Proportion of Users on Charging Profiles	• Assume 10% of people currently using smarter profile, 90% using simple. • Assume this grows to 90% by 2032 and stays at 90% beyond 2032.

[9] https://evstatistics.com/2022/04/bev-batteries-average-83-kwh-versus-15-kwh-for-phevs/#:~:text=Using%20the%20median%20numbers%2C%20BEVs,mile%20per%20kWh%20for%20PHEVs
[10] https://www.data.gov.uk/dataset/be060ba2-19b1-426c-9736-94897e290bb4/northern-ireland-traffic-count-data
[11] https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2022/04/2021-10-TYNDP_2022_Scenario_Building_Guidelines.pdf
[12] https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2022/04/TYNDP_2022_Scenario_Building_Guidelines_Version_April_2022.pdf

2.2 Heat Pumps

Table 3: Heat pump annual energy demand

Category	Northern Ireland Data Source / Assumption
Historic Number of Heat Pumps	• Assume no heat pumps in 2020 and linear growth to 2025 forecast.
Forecast Number of Heat Pumps	• Aligned to NIEN Distribution Network Scenarios (specifically their Constrained Growth Scenario)[13]. In the Median Scenario 43,000 Heat Pumps are projected for 2030 and 143,700 projected for 2035
Heating Demand	• Annual heating demand assumes 83.8% of residential energy used for heating[14], equating to 16.82 MWh/yr/property in 2019. • Annual heating demand is assumed to reduce by 0.8% per year, aligned to TES 2023 constrained growth scenario. • Climatic variability factored into annual heating demand using when2heat study of heating demand from 2008-2022[15]. The ENTSO-E Demand Forecasting Tool ensures the average heating demand across 36 projected Pan-European Climatic Database (PECD) simulated weather scenarios is equivalent annual estimate, but captures the variability brought about by temperature.
Heat Pump Efficiency	• Based on SEAI low-carbon heating study giving 2020 efficiency and projecting out to 2030[16]. Efficiency remains at 2030 levels between 2030 and 2035. • The impact of temperature on the heat pump coefficient of performance (COP) is based on the when2heat study and is factored in by the ENTSO-E Demand forecasting tool when converting heat demand to electricity demand.
Heat Pump Type	• Informed by TES 2023 analysis, all heat pumps are air source heat pumps.

Table 4: Heat pump demand shape

Category	Northern Ireland Data Source / Assumption
Climate Dependency	• Hourly heat demand based on when2heat study, and hourly climate data from PECD 36 forecast years.
Heat Pump Usage	• Usage of heat pumps derived from Ireland's When2heat dataset, using hourly resolution of total space and water heating demand and heat pump COPs.

13 Distribution network planning scenarios
14 Energy consumption in Northern Ireland's housing stock: 2016 - GOV.UK (www.gov.uk)
15 https://data.open-power-system-data.org/when2heat/
16 https://www.seai.ie/data-and-insights/national-heat-study/low-carbon-heating-and-co/

2.3 Data Centres and New Technology Load

This sector considers large scale data centres and technology loads that have dedicated connections to the high voltage network. Customers with connection voltages less than 110 kV are captured as part of the commercial and industrial demand.

Table 5: Data centre and new technology load annual energy demand

Category	Northern Ireland Data Source / Assumption
Annual Demand	• The forecast is carried out on a site-by-site basis and aggregated into a total for the sector. • Connection dates are aligned with the latest information available in the connection offer process. • The forecasted growth rates for individual sites are compared to sites of a comparable size to verify if they are reasonable. Adjustments are made if required. • Final utilisation of contracted capacity is assumed on a site-by-site basis, considering current utilisation and typical utilisation for a particular customer or site size. • Demand is assumed to grow linearly across the year, from the previous year's forecast peak in December, to the subsequent years peak in December. This is based on historic trends.

Table 6: Data centre and new technology demand shape

Category	Northern Ireland Data Source / Assumption
Hourly Demand Shape	• Demand is assumed to be flat throughout the day on the basis of analysis of consumption patterns.
Daily Demand Shape	• Demand is assumed to be consistent across weekdays and weekends on the basis of analysis of consumption patterns.

2.4 Conventional Demand

This section analyses the conventional demand. For the purposes of this document, we are defining "conventional demand" as that from the residential, commercial and industrial sector, excluding the impact of electric vehicles, heat pumps and data centres and new technology loads.

Table 7: Conventional demand annual energy demand

Category	Northern Ireland Data Source / Assumption
Historic End User Demand	• Historic demand based on generator metered data. • Self-consumption from NIEN small scale generation connections with assumed capacity factors (10% for small scale solar and 25% for small scale wind). • Data quality controlled using NIEN data and SONI SCADA (Supervisory control and data acquisition). • Demand split by sectors assumed to be 35% residential, 41% Industrial, 24% Tertiary / commercial. • Assumed historic demand from electric vehicles, heat pumps and data centres and new tech loads is detracted to view the underlying conventional demand from residential, commercial and industrial sectors.
Historic Temperature Correction	• Temperature correction applied to conventional demand based on climatic data measured at the operations site in Belfast. • Daily average temperature for winter of each year compared to annual winter average to provide a metric of mild and cold days. • Delta to average winter temperature multiplied by temperature correction factor to calculate a correction to the total energy demand. • Temperature correction factor calculated as the correlation between demand and climate data.
Historic Economic Performance	• Historic GVA provided by Oxford Economics.
Forecast Economic Performance	• Forecast GVA provided by Oxford Economics. • To account for high prices effecting current electricity demand an adjustment is made from 2027 to increase demand by 1%, once the impact of high prices is expected to subside.
Smart Meter Effects	• The Design Considerations for a Northern Ireland Smart Systems and Flexibility Plan is currently under development by the Department for the Economy[17], though no specific plans are currently in place for the roll out of smart meters.
Efficiency Improvements	• Historic efficiency improvements inherent in historic demand trends assumed to continue. • No additional supplemental efficiency improvements assumed.

The conventional demand shape is forecast within the ENTSO-E Demand Forecasting tool on the basis of historical correlation between demand and a number of factors

[17] https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/Transitioning-net-zero-energy-system-Consultation-design-considerations.pdf

that are forecast into the future.

Table 8: Conventional demand shape

Category	Northern Ireland Data Source / Assumption
Correlation Data	• Historic hourly demand measured by SONI at the transmission level from 2012 – 2023 used to train model, with historic data from 2024 used to verify correlation. • Historic calendar used to draw correlation between time of day, day of week and day of year for demand trends. • Special days identified and categorised to identify common trends where demand may be different to normal. Categories used include Public Holidays, Christmas Day, Boxing / St Stephen's Day, Easter Weekend, and St Patrick's Day, July holiday, Days around Christmas and New Year. • Hourly climatic data for each jurisdiction based on the Pan European Climatic Database (PECD). Data includes wind speed, irradiance, and population weighted temperature.
Forecast Data	• Future calendar including same categories of special days for study horizon. • Forecast 36 weather scenarios of PECD v4.1 data from 2025-2060 used to forecast climatic variability and model extremes of wind speed, irradiance and population weighted temperature. • Weather scenarios v4Future small scale (rooftop) solar incorporated into demand shape.

2.5 Network Losses

Network losses are included in the forecast of Total Electricity Requirement and are included as per Table 9.

Table 9: Network losses

Category	Northern Ireland Data Source / Assumption
Forecast Network Losses	• Historic Losses are calculated using the difference between metered generation (net of interconnection and storage) and metered demand. This data is historically recorded by the TSO and DSO. • Forecast losses are based on a 10-year average of historic network losses. • Network losses are estimated as 7.5% for the duration of the study.

2.6 Flexibility

Demand flexibility is contributed to by multiple different sectors included in the demand and generation assumptions. The table below shows the assumed contribution to demand flexibility based on the data sources listed.

Table 10: Demand flexibility

Category	Northern Ireland Data Source / Assumption
Storage	• Aligned to battery storage detailed in the Adequacy Resources section. • Storage is able to charge and discharge providing flexibility.
DSUs	• Aligned to Demand Side Units detailed in the Adequacy Resources section.
Electric Vehicles	• Electric vehicle contribution to peak shifting flexibility accounted for on the basis of charging profiles as described in the Electric Vehicles section.
Residential Demand	• On the basis of PR7[18] and the Department For Economy Smart System and Flexibility Plan[19], no assumptions of residential demand flexibility are included.

[18] RP7 Price Control Draft Determination | Utility Regulator (uregni.gov.uk)
[19] https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/Transitioning-net-zero-energy-system-Consultation-design-considerations.pdf

3 Adequacy Resources

This section specifies data sources and assumptions sources for relevant inputs as listed in the methodology.

3.1 Conventional Generation

Table 11 below outlines data input sources and assumptions related to conventional generation.

Table 11: Conventional generation input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)
Existing Plant Annual Operating Capacity	• Connection Agreements. • Operational data from Electronic Dispatch Instruction Logger (EDIL) declarations for information related to enduring capacity changes. • Closure notices submitted under the SONI Grid Code[20]. • Directive 2010/75/EU[21] of the European Parliament and the Council on industrial emissions (the Industrial Emissions Directive or IED). • REMIT Urgent Market Messaging (REMIT UMM)[22].	• In the instance where information differs between data sources, the most conservative value will be taken as the input e.g. a unit has declared unavailability through REMIT for a given year it will be excluded even if it still holds a valid Connection Agreement.
New plant capacity & deliverability	• Projects with awarded capacity in published capacity market auction results. Data for successful projects will be obtained from capacity market qualification data forms submitted to the capacity market team when seeking to qualify for a capacity auction. • Capacity market termination notices.	• Oversight Committee for New Awarded Capacity (OCNAC) oversees new developments which have secured capacity contracts. • New plant deliverability is tracked considering likely connection dates based on a range of factors including planning, grid connection, gas connection. • At the freeze date, the TSO will risk adjust each project to an expected delivery date aligned with best available information.
Heat Rate	• ENTSO-E Market Modelling Database Thermal Properties tab.	• Thermal operating characteristics based on standard values (e.g. efficiency) consistent with the ERAA modelling framework.
Plant Performance	• EirGrid and SONI monthly availability reports from 2020 – 2024 (five years of statistics).	• Forced outages are represented as an annual % that capacity is expected to be forced unavailable. • Ambient availability is represented as a weekly profile, applied to gas fired generation and reflects reduced capacity

[20] https://www.soni.ltd.uk/how-the-grid-works/grid-codes/Dec23_SONI-Grid-Code.pdf
[21] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0075&from=EN
[22] Nord Pool - REMIT UMM (nordpoolgroup.com)

		availability during summer months when conditions are warmer. • Scheduled outages are represented as an annual number of hours that capacity is expected to be on an agreed outage. • Statistics are calculated on an all-island basis i.e. not on a jurisdictional level. • Units that have retired or are known to be retiring within the study horizon are excluded from the calculation of outage statistics. Rationale: Such units do not represent the performance of the fleet expected to be operational over the study horizon. • Statistics are applied to new and existing units. • Statistics are fixed across the study horizon i.e. performance is not modelled as improving or declining over time. • Assumed 24 hours for a plant to return to operation when forced offline. • Assumed each unit undertakes a single scheduled outage pear year. • No distinguishment made to differentiate minor from major planned outages.
Run Hour Limitations	• Best Available Techniques[23] (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants. • Environmental Protection Agency (EPA) guidance. • Data or information received from market participants or project developers. • Generator Survey. • Planning permission. • Fuel scarcity considerations.	• In the instance where information differs between data sources, the most conservative value will be taken as the input.

[23] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021D2326

3.2 Interconnection

Table 12 below outlines data input sources and assumptions related to interconnection including HVDC and HVAC interconnection.

Table 12: Interconnection input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)
SEM to GB and France HVDC Interconnection	• Connection Agreements. • European Ten-Year Network Development Plan. • European Commission Project of Common Interest (PCI) status. • SONI Transmission Development Plans.	• In the instance where information differs between data sources, the most conservative value will be taken as the input.
Ireland to Northern Ireland HVAC Interconnection	• SONI Transmission Development Plans for delivery dates of new North-South interconnector. • ERAA 2024 for Net Transfer Capacity.	• The existing North South consists of two bi-directional lines having a combined NTC of +/- 300 MW. The new North South Interconnector will increase this NTC by +900/-950 giving a total NTC of 1200 N → S and 1250 S → N. • The Net Transfer Capacity increase from the new North South Interconnector was determined through Grid Transfer Capacity Studies for TYNDP studies in 2016. • No outage statistics applied to HVAC.
Pan European model	• The model used for the European Resource Adequacy Assessment 2024.	• Model used to derive fixed import/export flows for non-explicitly modelled regions (regions beyond GB and France).
HVDC Interconnection Availability	• SEM Interconnectors: Regulatory Authority approved outage statistics received through capacity auction process for interconnection to the SEM. • Non-SEM Interconnectors: European Resource Adequacy Assessment 2024.	• Implemented as forced outage only.

3.3 Variable Generation

Table 13 below outlines data input sources and assumptions related to variable generation including wind, solar and hydro resources.

Table 13: Variable generation input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)
Variable Renewable Capacity	• Connection offer process figures. • Northern Ireland Energy Strategy – The Path to Net Zero Energy 2021 and Path to Net Zero – Action Plan 2025[24]. • Climate Change Act (Northern Ireland) 2022[25]. • Shaping Our Electricity Future Roadmap v1.1[26]. • SONI / NIEN publications of renewable connections.	• Shorter term trajectories are derived based on renewable connections processes. • Medium to long term trajectories will consider climate ambitions and targets. • Where renewable capacity targets are not explicitly set e.g. beyond 2030, trajectories will be assumed to continue to increase appropriately.
Northern Ireland Hourly Renewable Rating Factor (%)	• ERAA PECD 4.1 database profiles.	• The PECD profiles include significantly high-capacity factors beyond what has been observed in actual recorded wind availability. Overestimating wind availability could present underrepresent risks to resource adequacy and therefore scaling factors are proposed to adjust the PECD onshore and offshore profiles (detailed further below). • Onshore profiles will be scaled to an annual target average capacity factor of 29% (averaged across the weather scenarios) through applying a scaling factor of 0.68902. • Offshore profile scaled to an annual target capacity factor of 42% (averaged across the weather scenarios) through applying a scaling factor of 0.89392. • Performance of renewable generators is considered to be consistent across the study horizon. Considerations for degrading performance of renewable generators towards the end of operational life, plant retirements, or repowering to more efficient turbines are outside of the scope of this methodology. • Assume that any technological efficiency improvements are captured in the PECD profiles which show increase capacity factor of technologies across the study horizon. • Assuming same profile for rooftop solar as with large scale solar.

24 The Path to Net Zero – Action Plan 2025

25 https://www.legislation.gov.uk/nia/2022/31/enacted

26 https://www.soni.ltd.uk/media/documents/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf

France and Great Britain Hourly Renewable Rating Factor (%)	• ERAA PECD 4.1 database profiles.	• Profiles used for GB and France are consistent with ERAA.

3.4 Battery Storage

Table 14 below outlines data input sources and assumptions related to battery storage.

Table 14: Battery storage input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)
Battery Storage Capacity	• Capacity market auction qualification data for MW and storage duration information. • Operational data from Electronic Dispatch Instruction Logger (EDIL) declarations. • Capacity market termination notices.	• In the instance where information differs between data sources, the most conservative value will be taken as the input.
Battery Storage Deliverability	• Projects with awarded capacity in published capacity market auction results will be considered as part of the input generation portfolio when also considering the latest risk assessment of project delivery. Data for successful projects will be obtained from capacity market qualification data forms submitted to the capacity market team when seeking to qualify for a capacity auction.	• Enhanced Monitoring programme in Northern Ireland comprising the TSO, Regulatory Authority, and DfE. The programme tracks new plant deliverability and assesses likely connection dates based on a range of factors including planning, grid connection, gas connection.

Technical Characteristics	• ERAA 2024 methodology.
	• 3rd party independent review of battery storage technologies.
		• Round Trip Efficiency: 80%.
		• Max State of Charge: 90%.
		• Min State of Charge: 10%.
		• It is assumed that performance does not decline over time as units are cycled more frequently or chemical storage erodes. The parameters above are a balanced approach as opposed to purely representing units at the start of end of life.
		• Battery Storage units will be aggregated by duration to improve the modelling simulation time, grouped by the following durations:
		  ○ 1 hour
		  ○ 2 hours
		  ○ 3 hours
		  ○ 4 hours
		  ○ 6 hours

Pump Load	• Connection offers and agreements.	• No MIC limits for batteries in Northern Ireland.
Storage Performance	• EirGrid and SONI monthly availability reports from 2024 (one year of statistics).	• Forced outages are represented as an annual % that capacity is expected to be forced unavailable. • Statistics are calculated on an all-island basis i.e. not on a jurisdictional level. • Statistics are applied to new and existing units. • Statistics are fixed across the study horizon i.e. performance is not modelled as improving or declining over time.

		• Assumed 24 hours for a plant to return to operation when forced offline. • Scheduled outages for battery storage units were observed to be close to 0% and therefore have not been included.

3.5 Demand Side Units

Table 15 below outlines data input sources and assumptions related to demand side units.

Table 15: Demand Side Units input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)
Demand Side Units Capacity	• Capacity market auctions successful projects information. • Capacity market termination notices.	• In the instance where information differs between data sources, the most conservative value will be taken as the input.
Rating Factor	• EirGrid and SONI monthly availability reports from 2020 – 2024 (five years of statistics).	• Applied as a rating factor in the model to restrict capacity available to the economic dispatch rather than model using forced and scheduled outages which are less representative of DSU availability.
Daily Run Hour Limits	• Run hour limits based on capacity market data.	• Run Hour Limits are applied on a daily basis. They do not change throughout the day or across the year i.e. depending on what loads may be available for response. • Annual Run Hour Limits associated with Individual Demand Sites are not considered. This is assumed to be reflected in overall DSU performance captured in the Rating Factor.

3.6 Other RES / Other Non-RES

Table 16 below outlines data input sources and assumptions related to other RES and other non-RES.

Table 16: Other RES / Non-RES input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)
Capacity	• DSO data (NIEN).	• Assumed to be fixed across study horizon.

4 Modelling

Table 17 below specifies modelling input(s) sources and assumption(s).

Table 17: Modelling input sources and assumptions

Category	Input Source(s)	Assumption(s)
Reliability Standard	• GCS 2023-2032[27].	• 4.9 hours Loss of Load Expectation.
Modelling application	• N/A	• Energy Exemplar's Plexos application will be utilised for stochastic modelling of resource adequacy.
Modelling resolution	• N/A	• Hourly
Monte Carlo samples	• Internal convergence analysis.	• Assessing the variation of sample results for a single weather scenarios and target year to a ±50MW tolerance. This represents a reasonable balance between the time taken to run stochastic simulations and convergence analysis of results.
Maintenance Factor	• Generator outage schedules from previous 5 years.	• The maintenance factor is an hourly profile representing the average historic scheduled outages pattern. This profile is used by Plexos to generate maintenance patterns for future years which on average reflect the typical scheduled outage pattern observed historically. • Single maintenance factor profile used in both Northern Ireland and Ireland. Rationale: The pattern of outages in either jurisdiction is not observed to be significantly different from the other in terms of when maintenance may occur as such generating different maintenance factor profiles for Ireland and Northern Ireland does not have significant impact results.
Reserve	• Operational constraints policy (example[28]). • System Operator GuideLines[29] (SOGL).	• LSI before Q2 2028: 500 MW. • LSI from Q2 2028: 700 MW. • Reserve is fixed across each hour of the model optimisation i.e. does not vary dynamically over time.
Transmission Outage Planning	• Analysis of transmission outages on operation of plant.	• 0 MW requirement assumed for Northern Ireland Transmission Outage Planning.
Fuel and carbon prices	• ERAA 2024.	• Fuel and carbon price forecasts for adequacy modelling.
Weather Scenarios	• European Resource Adequacy Assessment 2024.	• There are 36 forecasted weather scenarios available from the PECD 4.1 database.

27 https://www.soni.ltd.uk/newsroom/press-releases/soni-publishes-generation/SONI-Generation-Capacity-Statement-2023-2032.pdf
28 Wk06_2024_Weekly_Operational_Constraints_Update_Rev2.pdf (sem-o.com)
29 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R1485

Geographic Scope	• European Resource Adequacy Assessment 2024.	• Regions outside the SEM, which are modelled explicitly are assumed to be operating at their Reliability Standard as described in the list below: o Great Britain 3 hrs LOLE o France 3 hrs LOLE

5 Economic Viability Assessment (EVA)

In this section the inputs for the EVA will be outlined, this includes the capacity constraints, the technical assumptions, the cost assumptions and the revenue assumptions for Ireland and Northern Ireland. The proposed input source for the majority of the inputs is in the first instance the SEMC BNE Study[30], where these assumptions are not available from the BNE study these will be supplemented by the ERAA 2024 inputs[31]. However, note that some assumptions may have to be taken if the data is not available from the main data sources.

Input Category	Input Source(s)	Input Assumption(s)
Minimum capacity floor constraint	• Assumption based on existing capacity resources. • Each technology type will have a minimum floor of capacity to reflect the minimum potential size of a particular unit. For example, a CCGT would not be able to be built at a capacity of 100 MW.	• CCGT: 200 MW • OCGT: 50 MW • BESS: 5 MW
Maximum capacity cap per year constraint	• Assumption based on existing capacity resources. • This capacity constraint is to ensure the level of commissioning is not significantly above historical rates of commissioning. • Note: in reality, the constraints are unlikely to be binding for a large portion of technology types or modelled years.	• CCGT IE: 600 MW/year • CCGT NI: 400 MW/year • OCGT IE: 300 MW/year • OCGT NI: 200 MW/year • BESS IE: 300 MW/year • BESS NI: 200 MW/year
Economic and technical assumptions for capacity resources in the EVA	• Inputs are consistent with the properties outlined in section 3 • ERAA 2024 EVA Model	• This may include but is not limited to fuel prices, price caps, VOWC, start costs, unit efficiency, fuel offtake at start, minimum up and down times, and emissions intensity.
Technology costs	• Technology costs will be separated by new and existing, for Ireland and Northern Ireland, by technology type, and by modelled year. • SEMC BNE Study • ERAA 2024 EVA Model	• Technology costs detailed in the table below. • This may include but is not limited to WACC, hurdle premium[32], economic lifetime, fixed costs, capex.

[30] SEMC BNE Study 2023
[31] ERAA 2024 Input Data & Assumptions
[32] Hurdle rate is equal to the hurdle premium plus WACC.

Variable costs for gas units	• N/A	• An assumption of an additional variable cost for gas units to reflect gas units in the SEM seeing higher costs (e.g. due to gas transportation charges).
Mothballing costs	• ERAA 2024 EVA Model	• For the costs associated with mothballing or de-mothballing used in the decision making of the EVA the costs from the ERAA 2024 EVA Model are used.
Ancillary service revenue assumptions	• SEMC BNE Study	• Ancillary service revenue assumptions detailed in **Error! Reference source not found.**. • The revenues from the electricity market will be modelled using the All-Island Resource Adequacy Model as described in the methodology document. • The additional revenues from ancillary services are accounted for by assuming a flat EUR/kW/year assumption for different technology classes and jurisdictions.
Inflation adjustment assumptions	• Eurostat Monthly Harmonised Index of Consumer Prices (HICP) for Eurozone	• The inflation adjustment is used to bring money into a consistent money basis. The money basis used in ERAA 2024 is real 2023 EUR money, therefore, this will be the money basis for the EVA. • For moving money from the SEMC BNE Study which is in real 2022/23 money to real 2023 money an inflation adjustment of 1.007 is used.

Table 18 - Technology costs and revenues for the Economic Viability Assessment in rated capacity terms

Source	Data type	OCGT	CCGT	BESS 2hr
SEMC BNE (Input data)	Capital fixed costs (million EUR, real 2022/23)	126.46	500.3	97.01
	Recurring costs (million EUR/year, real 2022/23)	5.23	28.19	2.97
	WACC (%)	9.39%	9.39%	9.39%
	DS3 Revenue (EUR/kW/year, real 2022/23)	6.38	15.15	57.17
	Capacity (MW)	198.6	470.62	100
ERAA 2024 [1] (Input data and used in model)	Hurdle premium – new entry (%)	6%	4.5%	3%
	Hurdle premium – existing (%)	3.5%	3%	N/A
AIRAA 2025 [1] [2] (Calculated based on SEMC BNE and used in model)	Capex (EUR/kW, real 2023)	640.97	1,070.1	976.52
	Opex (EUR/kW/year, real 2023)	26.51	60.3	29.9
	Economic lifetime (yr)	20	20	10
	Ancillary service revenue (EUR/kW/year, real 2023)	6.42	15.25	57.55

[1] The are the values used in the revenue based viability assessment.

[2] These are the technology costs used in the EVA, calculated from SEMC BNE and the inflation adjustment.

6 Scenarios

6.1 High and Low Demand Scenarios

Given the high number of variables in the demand forecast that are highly dependent on external factors, low and high demand scenarios are modelled as an expected upper and lower band of where SONI believe demand could realistically fall. These are not deemed as extreme scenarios, but realistic forecasts. Table 19 below details the assumptions which are altered in comparison to the median demand forecast for deriving high and low demand forecasts. Whilst this does not adjust all parameters within the forecast, each sector has a factor adjusted to provide a projection built on the same foundation. Unless stated below, all other assumptions remain the same as the median forecast.

Table 19: Low and High Demand Forecast Assumptions for Northern Ireland

Sector	Northern Ireland	
	Low forecast	High Forecast
Electric Vehicles	Number of electric vehicles equal to the DfI Transport Emissions Model projections less 20%.	Number of electric vehicles equal to the DfI Transport Emissions Model Projections plus 20%.
Heat Pumps	Number of heat pumps equal to NIE Networks Constrained Growth Scenario projections less 20%.	Number of heat pumps equal to NIE Networks Constrained Growth Scenario projections plus 20%.
Data Centres & New Technology Loads	Assume no projects in the connections process reach completion.	Includes projects in the connections process with increased probability of connection.
Conventional Demand	Economic growth 1% lower than Oxford Economics forecast.	Economic growth 1% higher than Oxford Economics forecast.

6.2 Modelling Scenarios and Sensitivities

Table 20: Adequacy Scenarios

Scenario	Description
Base	The Base scenario analyses the adequacy position in line with the European Resource Adequacy Assessment (ERAA).
Secure	Secure scenario analyses the system considering outcomes of additional security analysis (e.g. annual run hour limits, low interconnector imports, climate risks, extended plant outages and other operational requirements).

Table 21: Additional Security Analysis sensitivities

Risk Sensitivity	Description
Low French Nuclear	Assessing the impact of removing 2 or 4 medium sized nuclear units in France.
Dunkelflaute	Assessing the impact of a 1 or 2 weeklong Dunkelflaute, implemented through assuming low wind availability across Ireland, Northern Ireland and Great Britain.
Large Unit Outage	Assessing the impact of a prolonged outage of the largest generator in Northern Ireland (C30), where the outage period occurs over winter from December through to February.
Interconnector Outage	Assessing the impact of a 6-month interconnector outage, implemented through taking out a 500 MW interconnector between SEM and GB for 6 months during the winter period.

Table 22: Adequacy Sensitivities

Sensitivity	Description
Demand	Assessing the impact of a lower or higher demand trajectory.
Flexibility	Assessing the impact of a lower or higher level of flexibility.
Renewable Trajectory	Assessing the impact of a lower or higher level of renewable deployment.
Annual Run Hour Limits (ARHL)	Assessing the impact of removal of Annual Run Hour Limits, or reduced availability of ARHL plant.
Energy Storage	Assessing the impact of additional storage deployment.

7 Glossary

ACER	The European Union Agency for Cooperation of Energy Regulators
AHC	Advanced Hybrid Coupling
ATC	Available Transmission Capacity
BESS	Battery Energy Storage System
BEV	Battery Electric Vehicles
CCS	Carbon Capture & Storage
CHP	Combined Heat & Power
CO2	Carbon Dioxide
CONE	Cost Of New Entry
COP	Coefficient Of Performance
DFT	Demand Forecasting Tool
DSU	Demand Side Units
EENS	Expected Energy Not Served
ENS	Energy Not Served
ENTSO-E	European Network of Transmission System Operators for Electricity
ERAA	European Resource Adequacy Assessment
EU	European Union
EV	Electric Vehicles
EVA	Economic Viability Assessment
FBMC	Flow Based Market Coupling
FCR	Frequency Containment Reserve
FOR	Forced Outage Rate
FR	France
FRR	Frequency Restoration Reserves
GB	Great Britain
GCS	Generation Capacity Statement
GJ	Gigajoules
GW	Gigawatts
LOLD	Loss Of Load Duration
LOLE	Loss Of Load Expectation
LOLP	Loss Of Load Probability
LSI	Largest Single Infeed
MW	Megawatt
NCV	Net Calorific Value
NRAA	National Resource Adequacy Assessment
NTC	Net Transfer Capacities
P2X	Power-to-X
PEMMDB	Pan-European Market Database
PHEV	Plug-in Hybrid Electric Vehicles
PTDF	Power Transfer Distribution Factor
PV	Photovoltaics
RES	Renewable Energy Sources
ROCOF	Rate-of-Change-of-Frequency
RR	Replacement Reserves
SEM	Single Electricity Market
SNSP	System Non-Synchronous Penetration
SONI	System Operator for Northern Ireland
SRMC	Short-Run Marginal Cost
SY	Submission Year
TSO	Transmission System Operator
VO&M	Variable Operations & Maintenance
VOLL	Value of Lost Load
WACC	Weighted Average Cost of Capital