All-Island Resource Adequacy Assessment

2025-2034 Inputs & Assumptions for Northern Ireland

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1 Introduction

SONI, as the Transmission System Operator (TSO) for Northern Ireland, has a responsibility to operate the electricity transmission system every minute of every day, whilst also planning the future of the transmission grid. To achieve this, SONI must balance supply and demand now and forecast how to do so in the future.

SONI is required to produce an annual Generation Capacity Statement (GCS), in accordance with Condition 35 of the Licence[1] 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.

Under these reporting requirements, SONI forecasts the projected level of electricity demand and the expected resources available to supply this demand. The demand and generation forecasts for Northern Ireland are modelled along with relevant operational requirements to evaluate power system reliability in reference to the relevant reliability standard. This process is referred to as a resource adequacy assessment where the reliability standard is specified on a jurisdictional basis for Northern Ireland using Loss of Load Expectation (LOLE).

As European policy direction and regulations have evolved, the approach for assessing resource adequacy has also evolved to appropriately represent the transforming power system i.e. transitioning away from aging fossil fuelled conventional generation plant and towards a power system increasingly dependent on variable renewables, interconnection, demand side response, long duration energy storage and other renewable gas ready dispatch power plants. Through the Shaping Our Electricity Future Roadmap[2], SONI identifies the need to enhance our reliability assessments to suitably dimension the possible risks to resource adequacy and align with European Union regulation.

1.1 Data Freeze Date

To obtain the most relevant information SONI engage with a range of stakeholders including market participants, distribution operators and other industry organisations to gather information and data to support deriving the annual demand and generation forecasts. To ensure consistency through the adequacy modelling process, there is a data 'freeze' date prior to initiating the modelling. When developing the forecasts in this report, the respective TSOs have endeavoured to use the most up-to-date information available at the time of the data freeze, which was 30th April 2024 for the demand data and 8th May 2024 for the generation data used in this report.

There is a possibility of additional information relating to input data or assumptions

[1] https://www.uregni.gov.uk/files/uregni/media-files/SONI%20TSO%20Consolidated%20Feb%202019.pdf
[2] https://www.soni.ltd.uk/media/documents/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf

arising between the time of the data freeze date and the publication of the final report. Such developments will not be included in the core modelling assessments however best efforts will be made to identify any developments and where possible provide a high-level assessment of any possible impact.

1.2 Structure of the Document

This paper is structured as follows:

- Section 2 specifies data sources and assumptions for the median demand forecast.
- Section 3 specifies data sources and assumptions for relevant generation inputs as listed in the methodology.
- Section 4 specifies data sources and assumptions for the configuration of the adequacy model.

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 2.1: 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[3].
Forecast Number of Electric Vehicles	• Aligned to NIEN RP7 submission EV projection[4]. • Future proportion of Electric Vehicle type based on 2022 proportions (64% BEV, 33% PHEV, 3% LGV, 1% Bus).
Distance Travelled / Year	• Assume 15,000 km per vehicle per year. • PHEVs assumed 47% of distance travelled in EV mode based on European study of real-world driving[5].
Electric Vehicle Efficiency	• Current efficiency assumes 0.169 kWh/km for passenger BEV, 0.263 kWh/km for LGV, and 1.39 kWh/km for bus, aligned to Tomorrows Energy Scenarios (TES) 2023[6]. • Efficiency projections aligned with Tomorrows Energy Scenarios (0.9% improvement per year for passenger vehicles, 0.5% improvement per year for commercial vehicles).

[3] Vehicles statistics - GOV.UK (www.gov.uk)
[4] https://www.nienetworks.co.uk/documents/future_plans/rp7-business-plan-full-report-april-2023.aspx
[5] https://theicct.org/publication/real-world-phev-use-jun22/
[6] https://www.eirgrid.ie/industry/tomorrows-energy-scenarios-tes

	• PHEVs assumed to be 49% less efficient than BEV equivalent[7].

Table 2.2: 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[8].
Charging Profiles	• Aligned to Weekday and weekend charging profiles for cars, freight, and busses first published in TES 2019[9]. • Simple and smarter[10] 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 2030 and stays at 90% beyond 2030.

2.2 Heat Pumps

Table 2.3: 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 RP7 submission Heat Pump projection[11].
Heating Demand	• Annual heating demand assumes 83.8% of residential energy used for heating[12], 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[13]. The ENTSO-E Demand Forecasting Tool ensures the average heating demand across 35 historic Pan-European Climatic Database (PECD) simulated climate years is equivalent annual estimate, but captures the variability brought about by temperature.

[7] 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
[8] https://www.data.gov.uk/dataset/be060ba2-19b1-426c-9736-94897e290bb4/northern-ireland-traffic-count-data
[9] https://www.soni.ltd.uk/media/documents/TESNI-2020.pdf
[10] https://2022.entsos-tyndp-scenarios.eu/wp-content/uploads/2022/04/TYNDP_2022_Scenario_Building_Guidelines_Version_April_2022.pdf
[11] https://www.nienetworks.co.uk/documents/future_plans/rp7-business-plan-full-report-april-2023.aspx
[12] Energy consumption in Northern Ireland's housing stock: 2016 - GOV.UK (www.gov.uk)
[13] https://data.open-power-system-data.org/when2heat/

Heat Pump Efficiency	• Based on SEAI low-carbon heating study giving 2020 efficiency and projecting out to 2050[14]. • The impact of temperature on the heat pump coefficient of performance (COP) is based on the when2heat study[15] 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 2.4: 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 35 historic years.
Heat Pump Usage	• Usage of heat pumps aligned to Loughborough University Study[16] showing 28% of homes have a daytime usage, 8% have a bimodal usage, and 64% have continuous usage.

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 2.5: 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 2.6: 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.

14 https://www.seai.ie/data-and-insights/national-heat-study/low-carbon-heating-and-co/
15 https://data.open-power-system-data.org/when2heat/
16 https://www.sciencedirect.com/science/article/pii/S037877882100061X?via%3Dihub

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 2.7: 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. • Number of degree days (15.5°C Base) for winter of each year compared to average to provide a metric of mild and cold winters[17]. • Delta to average number of degree days multiplied by temperature correction factor to calculate a correction to the total energy demand. • Temperature correction factor calculated as factor which gives strongest correlation between temperature corrected demand and economic performance.
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	• PR7 includes no confirmed funding for smart metering[18]. • The Design Considerations for a Northern Ireland Smart Systems and Flexibility Plan is currently under development by the Department for the Economy[19], though no specific plans are currently in place for the roll out of smart meters. • On the basis of these sources, there are currently no smart meter effects included in the demand forecast for Northern Ireland.
Efficiency Improvements	• Historic efficiency improvements inherent in historic demand trends assumed to continue.

[17] https://www.sustainabilityexchange.ac.uk/files/degree_days_for_energy_management_carbon_trust.pdf

[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

	• 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 that are forecast into the future.

Table 2.8: Conventional demand shape

Category	Northern Ireland Data Source / Assumption
Correlation Data	• Historic hourly demand measured by SONI at the transmission level from 2012 – 2018 used to train model, with historic data from 2019 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. • Historic 35 climate years of PECD v3.1 data from 1982-2016 used to forecast climatic variability and historic extremes of wind speed, irradiance and population weighted temperature. • Future 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 2.9.

Table 2.9: 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 2.10: 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[20] and the Department For Economy Smart System and Flexibility Plan[21], no assumptions of residential demand flexibility are included.

[20] RP7 Price Control Draft Determination | Utility Regulator (uregni.gov.uk)
[21] 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 3.1 below outlines data input sources and assumptions related to conventional generation.

Table 3.1: 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[22]. • Directive 2010/75/EU[23] of the European Parliament and the Council on industrial emissions (the Industrial Emissions Directive or IED). • REMIT Urgent Market Messaging (REMIT UMM)[24].	• 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.	• 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. • 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[25] 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 2019 – 2023 (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

[22] https://www.soni.ltd.uk/how-the-grid-works/grid-codes/Dec23_SONI-Grid-Code.pdf
[23] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0075&from=EN
[24] Nord Pool - REMIT UMM (nordpoolgroup.com)
[25] https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/sdc-documents/ERAA/2023/ERAA2023%20PEMMDB%20Generation.xlsx

		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. • Stats 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. • Stats are applied to new and existing units i.e. no assumptions made regarding the performance of new units joining the system over the coming years. • Stats 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[26] (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. • Run Hour Limits will restrict the availability of plant to a limited number of operating hours per year.

3.2 Interconnection

Table 3.2 below outlines data input sources and assumptions related to interconnection including HVDC and HVAC interconnection.

Table 3.2: Interconnection input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)

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

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 2022[27] 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 2023[28].	• 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 2023.	• Implemented as forced outage only. • Availability statistics for SEM interconnectors are available in the accompanying data workbook.

3.3 Variable Generation

Table 3.3 below outlines data input sources and assumptions related to variable generation including wind, solar and hydro resources.

Table 3.3: 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[29] 2021 and Path to Net Zero – Action Plan 2023[30].	• Shorter term trajectories are derived based on renewable auctions and connection offer processes. • Medium to long term trajectories will consider climate ambitions and targets.

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[27] https://eepublicdownloads.azureedge.net/clean-documents/sdc-documents/ERAA/2022/data-for-publication/Net%20Transfer%20Capacities.zip *Note: The ERAA23 published data contains an error, therefore ERAA2022 is used instead. ENTSO-E are aware of this, and the data will be corrected for ERAA24.*
[28] https://www.entsoe.eu/outlooks/eraa/2023/
[29] https://www.economy-ni.gov.uk/sites/default/files/publications/economy/Energy-Strategy-for-Northern-Irelandpath-to-net-zero.pdf
[30] 8 https://www.economy-ni.gov.uk/sites/default/files/publications/economy/Energy-Strategy-Path-Net-Zero-Energy-2023-Action-Plan.pdf

	• Climate Change Act (Northern Ireland) 2022[31]. • Shaping Our Electricity Future Roadmap v1.1[32]. • SONI / NIEN publications of renewable connections.	• 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 3.1[33] 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 profile scaled on an hourly basis by a 0.9 scaling factor. Rationale: Comparison of PECD profiles against recorded historic availability profiles provides the basis for scaling down PECD profiles. The average scaled capacity factor of PECD onshore profiles is 30% in 2030. • Offshore profile scaled on an hourly basis by a 0.75 scaling factor. Rationale: Comparison of PECD profiles against profiles used in the ECP[34] modelling process provides the basis for scaling down PECD offshore profiles. The average scaled capacity factor of PECD offshore profiles is 45% in 2030. • 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.
France and Great Britain Hourly Renewable Rating Factor (%)	• ERAA PECD 3.1[35] database profiles.	• Profiles used for GB and France are consistent with ERAA.

3.4 Battery Storage

Table 3.4 below outlines data input sources and assumptions related to battery

[31] https://www.legislation.gov.uk/nia/2022/31/enacted
[32] https://www.soni.ltd.uk/media/documents/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf
[33] https://www.entsoe.eu/outlooks/eraa/2023/eraa-downloads/
[34] https://cms.eirgrid.ie/sites/default/files/publications/ECP-2.3-Wind-and-Solar-Profiles-Excel-Format.xlsx
[35] https://www.entsoe.eu/outlooks/eraa/2023/eraa-downloads/

storage.

Table 3.4: 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 2023 methodology[36]. • 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.
Pump Load	• Connection offers and agreements.	• No MIC limits for batteries in Northern Ireland.
Storage Performance	• ERAA 2023 methodology.	• There is insufficient data to appropriately dimension outage statistics for battery storage, given the relatively recent introduction of this technology. In the absence of appropriate data, outages will not be modelled for batteries at this time.

3.5 Demand Side Units

Table 3.5 below outlines data input sources and assumptions related to demand side units.

Table 3.5: Demand Side Units input sources and assumptions

Input Category	Input Source(s)	Input Assumption(s)

[36] https://www.entsoe.eu/outlooks/eraa/2023/report/ERAA_2023_Annex_2_Methodology.pdf

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 2019 – 2023 (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 3.6 below outlines data input sources and assumptions related to other RES and other non-RES.

Table 3.6: 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 4.1 below specifies modelling input(s) sources and assumption(s).

Table 4.1: Modelling input sources and assumptions

Category	Input Source(s)	Assumption(s)
Northern Ireland Loss of Load Expectation Standard	• GCS 2023-2032[37].	• 4.9 hours.
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.	• The Stochastic Class within Plexos will create 20 samples for the LOLE and EENS calculation, where each sample has a random forced and scheduled outage. Additional detail on the generation of scheduled outage patterns is provided below for the Maintenance Factor. Note this is increased to 40 samples for the MW calculation. • Assessing the variation of sample results for a single climate year and target year to ensure with a 95% confidence that results are ±50MW within each other. 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[38]). • System Operator GuideLines[39] (SOGL).	• LSI pre-2027: 500 MW. • LSI from 2027: 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.

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

Fuel and carbon prices	• ERAA 2024 Preliminary Input Data[40].	• ENTSO-E have issued a call for evidence on input data for ERAA 2024. NRAA will use the fuel and carbon price forecasts for adequacy modelling. Note that as NRAA 2024 is not doing an Economic Viability Assessment fuel and carbon prices are less relevant as they have negligible impact on resource adequacy.
Climate Years	• European Resource Adequacy Assessment 2023.	• There are 35 historic climate years available from PECD database. The core adequacy analysis will model 35 of these climate years.

5 Scenarios

5.1 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 5.1 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 5.1: Low and High Demand Forecast Assumptions for Northern Ireland

Sector	Northern Ireland	
	Low forecast	High Forecast
Electric Vehicles	Number of electric vehicles aligned to NIEN RP7 low forecast.	Number of electric vehicles aligned to NIEN RP7 high forecast.
Heat Pumps	Number of heat pumps aligned to NIEN RP7 low forecast.	Number of heat pumps aligned to NIEN RP7 high forecast.
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. Adjustment for year-to-year variation relative to long term trend. 2nd most extreme drop in 16 years (-1.9%) applied to 2023 demand.	Economic growth 1% higher than Oxford Economics forecast. Adjustment for year-to-year variation relative to long term trend. 2nd most extreme increase in 16 years (+3.6%) applied to 2023 demand.

40 https://consultations.entsoe.eu/system-development/eraa2024-call-for-evidence-preliminary-dat/

5.2 Modelling Scenarios

Table 5.2: Adequacy Scenarios

Scenario	Description
Base	The Base scenario analyses the adequacy position in line with the European Resource Adequacy Assessment (ERAA).
Secure	The Secure scenario analyses the system considering Low Imports, where Low Imports are modelled through restricting the maximum imports to 70% for each interconnector to the SEM.

5.3 Other Sensitivities

Table 5.3: Adequacy Analysis

Scenario	Description
Demand	Assessing the impact of a lower or higher demand trajectory.
Flexibility	Assessing the impact of varying levels of flexibility.
Renewable Deployment	Assessing the impact of varying levels of renewable deployment.
Annual Run Hour Limits (ARHL)	Assessing the impact of not having Annual Run Hour Limits.
Storage	Assessing the impact of varying levels of storage deployment.
Interconnection	Assessing the impact of lower dependence on interconnection, either through limited imports or low generation availability in neighbouring regions.

6 Glossary

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