Enduring Connection Policy (ECP) 2.3 Constraints Analysis

Initial Draft Assumptions Document

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2 Summary

This document outlines the draft assumptions made in developing a model for the Enduring Connection Policy (ECP) 2.3 Constraints Analysis studies, which includes energy balancing, curtailment and constraints to be applied and analysed.

Table 1: Summary of Assumptions

Feature	Assumptions
Study period	The study horizons are 2026, 2028 & Future Grid (aligned to SOEF 1.1).
Demand	The Total Electricity Requirement (TER) demand is from the Generation Capacity Statement (GCS) 2023 – 2032, median demand scenario.
Generation	Total generation capacity to be installed under ECP-2.3 is 3.7 GW (0.7 GW Battery, 0.5 GW Gas, 2.0 GW Solar, 0.5 GW Wind). Total generation capacity (Wind and Solar) considered in the study is 20.5 GW including up to 5 GW offshore.
Network developments	The network developments are based on the Network Development Plan (NDP) for 2026 & 2028 and the latest version of Shaping Our Electricity Future (SOEF), SOEF 1.1, for the Future Grid study.
Security constraints	System Non-Synchronous Penetration, Inertia, RoCoF limit and Min. Set rules are defined for each study year and are based upon the Operational Policy Roadmap 2023-2030[1] and SOEF 1.1[2].
Core ECP-2.3 scenarios	2026: • Initial, 33%, 66% & 100% of all offers up to and including ECP-2.3. 2028: • Initial, 33%, 66% & 100% of all offers up to and including ECP-2.3.
Sensitivities	2028: • 100% of all offers up to and including ECP-2.3 + 3.1 GW offshore. • 100% of all offers up to and including ECP-2.3 + 5 GW offshore. Future Grid: • 100% of all offers up to and including ECP-2.3. • 100% of all offers up to and including ECP-2.3 + additional maintenance sensitivity. Offshore Future Grid: • 100% of all offers up to and including ECP-2.3 + 3.1 GW of offshore. • 100% of all offers up to and including ECP-2.3 + 5 GW of offshore.

[1] See link: https://www.eirgridgroup.com/site-files/library/EirGrid/Operational-Policy-Roadmap-2023-to-2030.pdf
[2] See link: https://www.eirgridgroup.com/site-files/library/EirGrid/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf

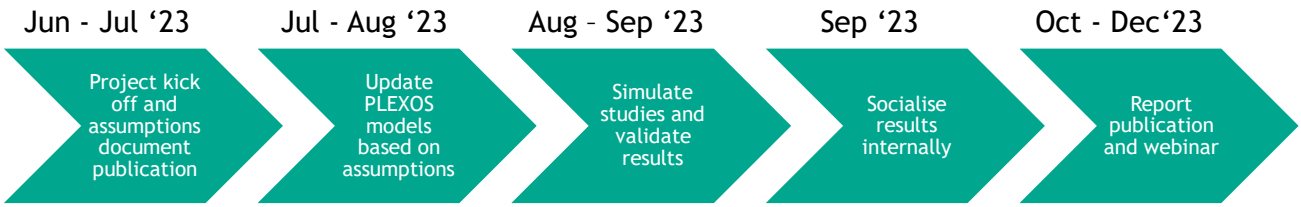
3 Introduction

The Enduring Connection Policy (ECP) 2-3 is the third of four batches of connection offers planned under ECP 2 by the Commission for Regulation of Utilities (CRU) to facilitate opportunities for connections to Renewable Energy Sources (RES) on to the Irish electricity network. The ECP-2.3 Constraints Analysis is carried out by the TSO (as mandated by CRU/20/060 decision on ECP 2) to forecast dispatch down levels for ECP-2.3 wind and solar projects. On completion of this constraint forecast analysis EirGrid plans to publish 12 regional constraints reports, which will provide ECP-2.3 developers with information on forecasted dispatch down levels in each region. The expected time for release of these reports is in Q4 2023.

While the progression of offshore wind applications is considered separately from the ECP process, EirGrid has decided to include offshore based study scenarios in the ECP-2.3 constraint forecast as sensitivities to the core study scenarios, following engagement with the CRU and the wider industry.

This document briefly presents the current draft working assumptions for performing the ECP-2.3 constraint forecast studies. These assumptions are still in the process of being finalised and any further updates will be communicated through EirGrid's ECP-2.3 Constraint Reports for Solar and Wind web page[3].

Timeline



[3] See link: https://www.eirgridgroup.com/customer-and-industry/general-customer-information/ecp-2.3-constraint-report/index.xml

4 Total Dispatch Down

Total Dispatch Down (TDD) is the key metric for ECP-2.3 Constraint Analysis. TDD is the sum of Surplus, Curtailment and Constraints, where:

- Surplus is dispatch down applied for energy balancing when generation exceeds demand + interconnector export.
- Curtailment is dispatch down applied to ensure operational limits are met.
- Constraints is dispatch down applied to manage localised congestion on the grid, whereby variable generator output is constrained to stay within overload limits of the transmission lines. This is applied at a nodal level.

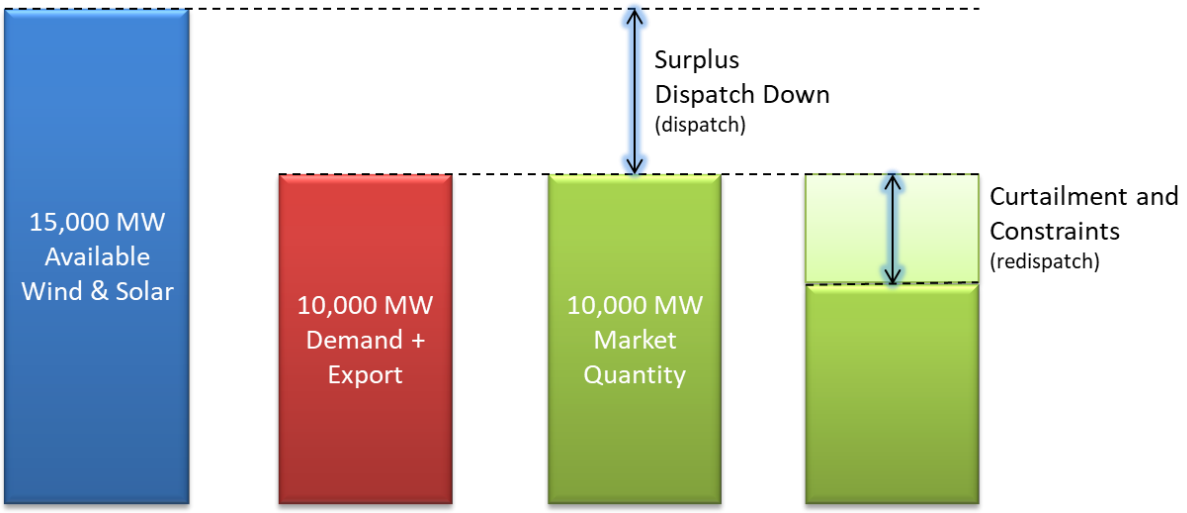


Figure 1 Illustration of Surplus, Curtailment and Constraints in the SEM.

5 Article 12 and Article 13

Following the SEMC decision on the 22nd of March 2022[4] (SEM-22-009 Decision Paper on Dispatch, Redispatch and Compensation Pursuant to Regulation EU 2019/943) the detailed design of Articles 12 and 13 implementation is yet to be determined and may differ from the implementation for Total Dispatch Down used in this study. Therefore, an assumed interpretation will be used for ECP-2.3 Constraint Analysis that applies a grandfathering[5] approach to resolving Surplus and Constraint conditions. The interpretation of Article 12 and Article 13 that will be modelled in ECP-2.3 is outlined below.

Surplus

Firstly, all non-priority dispatch units generating during *Surplus* will reduce output on a pro-rata basis. Then if the *Surplus* is unresolved by non-priority dispatch unit reduction alone, priority dispatch units will reduce output on a pro-rata basis.

This is unchanged from ECP-2.2.

Curtailment

All non-priority and priority dispatch units generating during *Curtailment* will reduce output on a pro-rata basis.

This is unchanged from ECP-2.2.

Constraints

Firstly, all non-priority dispatch units contributing to a *Constraint* will reduce output on a pro-rata basis. Then if a *Constraint* is unresolved by non-priority dispatch unit reduction alone, priority dispatch units contributing to the Constraint will reduce output on a pro-rata basis. This grandfathering approach is similar to how market Surplus is resolved in ECP modelling.

Proposed change in methodology from ECP-2.2.

[4] See link: https://www.semcommittee.com/sites/semc/files/media-files/SEM-22-009%20Decision%20Paper%20on%20Dispatch%2C%20Redispatch%20and%20Compensation%20Pursuant%20to%20Regulation%20EU%202019943.pdf

[5] 'Grandfathering' is where an old rule continues to apply to some existing situations while a new rule will apply to future cases. In the context of Article 12 and Article 13, grandfathering refers to the distinction between how priority dispatch renewable generators (those installed prior to 4th July 2019) and non-priority dispatch renewable generators (those installed on and after 4th July 2019) are treated in the SEM.

6 Study Scenario Matrix

Each of the study scenarios are based on generation capacities for specific study years. The core ECP-2.3 study years are 2026 and 2028. The RES generation capacity in the initial study includes all generators that are expected to be connected by the end of 2025.

The remainder of the RES generation in the offer pipeline is split into 33% and 66% to give the respective generation scenarios. The ECP generation scenario includes all the RES generation in the pipeline up to and including ECP-2.3 applicants (some of the ECP-2.3 applicants may not have received offers at this point in time but are still considered within these studies).

The sensitivities on the offshore studies include a study with the Phase 1 offshore projects in addition to the ECP generation on a 2028 network and on a SOEF 1.1 Roadmap-based network (Future Grid). A 5 GW offshore generation scenario is also included to align with the SOEF 1.1 offshore assumptions, again for a 2028 network and the Future Grid network.

All studies will include a representative maintenance schedule. We have also included a maintenance sensitivity scenario based on the ECP generation scenario and the Future Grid network. The maintenance sensitivity removes the representative maintenance schedule from the model and compares the results to the core ECP study (which includes the representative maintenance schedule).

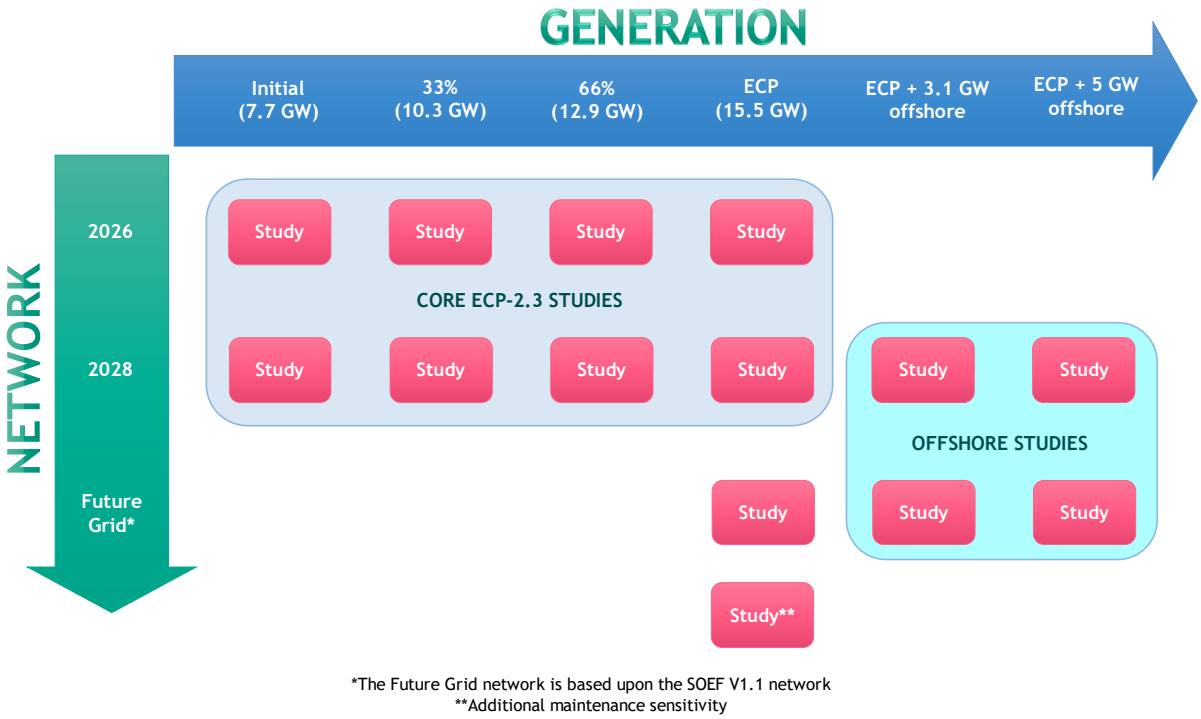


Figure 2: Study Scenarios (GW values include wind, solar and battery generation in Ireland).

7 Demand

Demand in each study year is based on the forecasted median scenario due to be published in the Generation Capacity Statement (GCS) 2023 – 2032. The shape of demand is based on the 2022 demand year.

Further details on demand data will be available to the public once the GSC 2023 – 2032 is released.

8 Generation

The conventional generation in the ECP-2.3 studies will be obtained from the GCS 2023 - 2032. The RES capacities given in Table 2 below are the sum of all offers (Pre-Gate, Gate 3, Non-GPA, T-4, ECP-1, ECP-2.1, ECP-2.2 and ECP-2.3) and existing generation. The different study scenarios will have various levels of RES capacities. The total installed capacity (of solar, wind and battery) considered in this study is 20.5 GW, this includes 5 GW of offshore wind. The initial study has the generation expected to connect by the end of year 2025.

This generation data is currently in draft and may be subject to change until the data freeze date of the project.

Table 2: Generation Capacities for Ireland (IE).

ECP 2-3 Breakdown of IE Generation Capacity (MW)						
	Initial Study	33% Study	66% Study	ECP All Study	ECP + 3.1 GW offshore	ECP + 5 GW offshore
Battery	836	1,296	1,756	2,230	2,230	2,230
Solar	1,635	3,180	4,724	6,315	6,315	6,315
Wind	5,190	5,783	6,376	6,987	6,987	6,987
Wind Offshore	-	-	-	-	3,100	5,000
Totals	**7,660**	**10,258**	**12,856**	**15,533**	**18,633**	**20,533**

9 Interconnection

Interconnector capacities used in the different scenario years are detailed in Table 3 below. The second North - South Interconnector will be included in the 2026 studies. The hourly capacity modelling of each interconnector is expected to be similar to that used in the ECP-2.2 studies, were the interconnectors to GB are given full export capacity for 65% of the time, while the capacity is reduced for the remainder of the time. This was based upon the interconnector flow analysis conducted during high wind periods over the course of a year.

The final decision on ECP-2.3 interconnector capacity will be made after completing an updated analysis on historical interconnector flows.

Table 3: Interconnector Export/Import Capacities.

Interconnector	Export/Import	2026	2028	Future Grid
Moyle Capacity (MW)	**Export**	400	400	400
	Import	450/410	450/410	450/410
EWIC Capacity (MW)	**Export**	500	500	500
	Import	500	500	500
Celtic Capacity (MW)	**Export**	-	700	700
	Import	-	700	700
Greenlink Capacity (MW)	**Export**	500	500	500
	Import	500	500	500
North-South 2[6]	**Export**	-	1500	1500
	Import	-	1500	1500

The details of interconnector MARES, LirIC and 2nd France will be included in the final version of assumptions document.

[6] See link: https://www.eirgridgroup.com/site-files/library/EirGrid/North-South-Interconnector_Comparative-Assessment-of-Transmission-Techno....pdf

10 Network Developments

The network development in each study year is obtained and based upon the information published within the:

- Network Delivery Portfolio (NDP)[7]
- Shaping Our Electricity Future Roadmap (SOEF) 1.1[8]

[7] See link: https://www.eirgridgroup.com/customer-and-industry/general-customer-information/network-delivery-portfoli/
[8] See link: https://www.eirgridgroup.com/site-files/library/EirGrid/Shaping-Our-Electricity-Future-Roadmap_Version-1.1_07.23.pdf

11 Operational Constraints

The list of operational constraints applied in the study are given in Table 4. Other system specific operational rules and system constraints are modelled in the studies and will be detailed in the final report. Operational constraints have been taken from the Operational Policy Roadmap 2023 - 2030[9] and aligned to SOEF 1.1 where applicable.

SNSP, Rate of Change of Frequency (RoCoF), inertia, minimum number of conventional units and system service provision from new, low carbon sources.

Table 4: Operational Constraints

Active System Wide Constraints		ECP-2.3 Assumptions
Non-Synchronous Generation	There is a requirement to limit the instantaneous penetration of asynchronous generation connected to the All-Island system.	• 2026 – 85% • 2028 – 90% • Future Grid – 95%
Operational Limit for Rate of Change of Frequency (RoCoF)	There is a requirement to limit the RoCoF on the All-Island system.	• 2026 – 1 Hz/sec • 2028 – 1 Hz/sec • Future Grid – 1 Hz/sec
Operational Limit for Inertia	There is a requirement to have a minimum level of inertia on the All-Island system.	• 2026 – 20,000 MWs • 2028 – 20,000 MWs • Future Grid – 20,000 MWs
Minimum Sets **(IE, NI)**	There is a requirement to have a minimum number of conventional generators in Ireland and Northern Ireland.	• 2026 – 6 • 2028 – 4 • Future Grid – 3 ○ No jurisdictional split
Reserve **(IE, NI)**	The amount of spare capacity in the system to manage any system disturbance.	• POR • SOR • TOR I • TOR II

[9] https://www.eirgridgroup.com/site-files/library/EirGrid/Operational-Policy-Roadmap-2023-to-2030.pdf

12 Modelling Approach to Dispatch Down

The main modelling approach for each of the ECP-2.3 constraint forecast studies is given below.

- Renewable generation is modelled at 110 kV stations
  - A 110 kV station can have wind/solar Priority Dispatch (PD), non-Priority Dispatch (non-PD) or Uncontrolled generation connected to it.
  - Wind and solar hourly profiles are used to calculate RES generation within the model.
- Surplus
  - Applied if there is not enough demand, or export capability to meet renewable generation.
  - For each hour, the non-PD renewable generators are dispatched down first (applied pro-rata across the all-island grid) before PD generators are dispatched down if the surplus situation cannot be resolved by non-PD reduction alone.
- Curtailment
  - Following dispatch down for surplus reasons, curtailment is applied to meet operational limits e.g. SNSP, Inertia, Min Sets Rules, Generator Must Runs, Operating Reserve.
  - For each hour, reduction in output due to curtailment is shared equally between PD and Non-PD renewable generators (applied pro-rata across the all-island grid).
- Constraints
  - Following curtailment, reduction in output due to generation constraint is applied to solve localised transmission issues.
  - The model dispatches down by individual station to mathematically minimise the total renewable generation dispatch down.
  - For annual energy, the results are then averaged across adjacent 110 kV stations.
  - The non-PD renewable generators are dispatched down first (applied pro-rata across renewable generators that are effective in managing a particular network limitation) before PD generators are dispatched down if the constraint situation cannot be resolved by non-PD reduction alone.

Definitions:

1. Surplus: Dispatch down applied for energy balancing when generation exceeds demand + interconnector export. Applied According to Article 12, whereby non-priority dispatch generation is dispatched down ahead of priority dispatch generation.
2. Curtailment: Dispatch down applied to ensure operational limits are met. Applied to all priority dispatch and non-priority dispatch generation pro-rata.
3. Constraints: Dispatch down applied to manage network constraints. Applied According to Article 12 and 13, whereby non-priority dispatch generation dispatched down ahead of priority dispatch generation at relevant nodes.

13 ECP-2.3 Analysis Process

The constraint forecast modelling will use PLEXOS software to model the generation, loads, transmission lines and operational constraints. Three studies will be run in sequence, as shown in the figure below to simulate the dispatch down of the RES generation at each stage. A post calculation methodology is also employed in the final stage to process the results according to the assumptions.

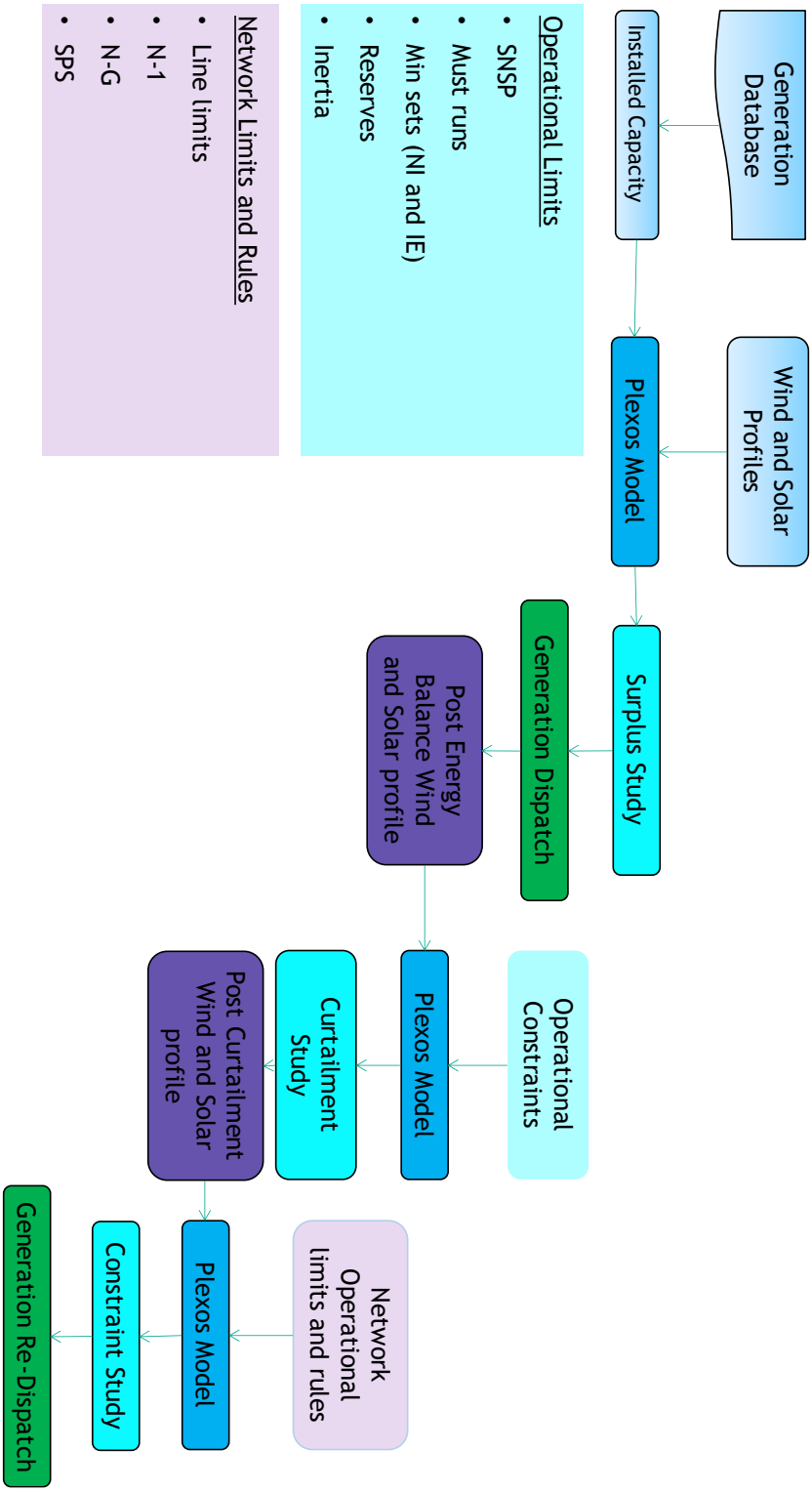


Figure 3 ECP-2.3 Analysis Process Flow Chart

14 Other Assumptions

Wind Profile – The available wind profile for each area is selected by analysing wind profiles from the respective areas for the year 2022. A wind profile is then selected to represent that specific area.

Solar Profile – The solar profile for the three regions in Ireland – North, Central and South – will use 2022 data, this is yet to be processed and will be confirmed in the final assumptions document.

Offshore Wind Profile – The offshore wind profile will be synthesised from 2022 data, this will be finalised in the final assumptions document.

Batteries – Short duration batteries (batteries with a storage duration of up to 2 hours), are modelled to supply reserve and residual shorter duration batteries are used for energy arbitrage when the reserve requirements are met. Batteries with a storage duration greater than 2 hours are used within the model for energy arbitrage. The cycling of these batteries is decided by PLEXOS's Battery Optimisation tool, where the software identifies the optimal charge and discharge times to maximise financial returns.