Scheduling & Dispatch

Proposed Changes for Battery Storage Units

Modifications Committee

19 October 2023

This presentation provides background, content, and an explanation for the proposed changes to the Trading & Settlement Code for the Scheduling & Dispatch Programme initiative SDP_002: ESPS (Battery) Integration.

Achievable – Valuable – "Simple"

EirGrid semo Single Electricity Market Operator SONI

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Why are we here?

Inform	We will present the proposed changes to the T&SC for the SDP ESPS (batteries) initiative – SDP_002. We have submitted these as marked-up changes to the documents and submitted a Plain English Guide for your review. This presentation is offered as background, content, and an introduction to any committee member not already aware of SDP.

Discuss	We will discuss the proposed battery changes with the committee members. We will review the feedback already received from and discussed with the Market Participant community and Regulatory Authorities through the stakeholder engagement process. We will listen to any new thoughts on the proposed changes.

Agree Path Forward	We hope to close out any open questions from the market participant community and agree a path forward.

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Background and Content for ESPS (battery) Changes

Key Principles

For this complex programme…

1. Be **pragmatic** about solution pathways.
2. Solve the **immediate and urgent** problems at hand.
3. Don't allow perfect to be the enemy of **good**.
4. **Communicate** early and often – to all **stakeholders**.
5. Maintain **support of industry**.
6. **Actively manage** multidisciplinary delivery team.

Achievable – Valuable – "Simple"

SDP Objective & Drivers

To enhance and improve the technology and capability of scheduling and dispatch in Ireland and Northern Ireland. This is driven by market participant needs, the EU Clean Energy Package mandates, and in support of the broader goals of renewables and System Non-Synchronous Penetration (SNSP) penetration targets.

- Clean Energy Package requirements – NPDR treatment
- Ireland and Northern Ireland Government renewables targets for the 80% total renewable energy and 95+% system non-synchronous penetration (SNSP) on an instantaneous basis.
- Market Participant requests for certainty on treatment of renewable assets, batteries – revenue certainty.
- Market Participant requests for improvement in re-balancing and re-dispatching (prevailing weather).

There is an urgency to approve these changes now so the necessary system changes can be manifested.

Scope of SDP

One component of the broader SOEF programme.

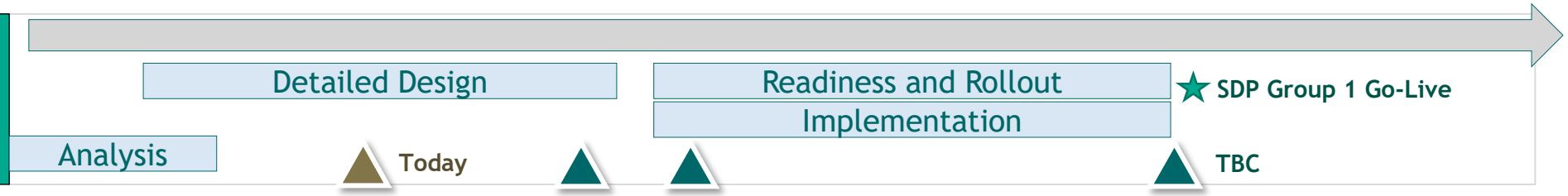
1. **SDP_001:** Operation of non-priority dispatch of renewables (NPDR)
2. **SDP_002:** Energy Storage Power Station (ESPS) integration
3. **SDP_003:** Fast Frequency Response (FFR)
4. **SDP_004:** Wind/solar dispatchability improvements
5. **SDP_005:** Reserve services scheduling and dispatch
6. **SDP_006:** Synchronous condenser scheduling and dispatch

Stakeholder Engagement

Sustained engagement to listen, understand, and negotiate the needs for ESPS - SDP_002

- **(3)** Industry Workshops [Nov 22, Sep 23, Oct 23]
- **(35)** Bilateral Meetings [Aug 22 – Oct 23]
- **(1)** Plain English Guide for ESPS SDP_002 Changes [Sep 23]

SDP Timeline



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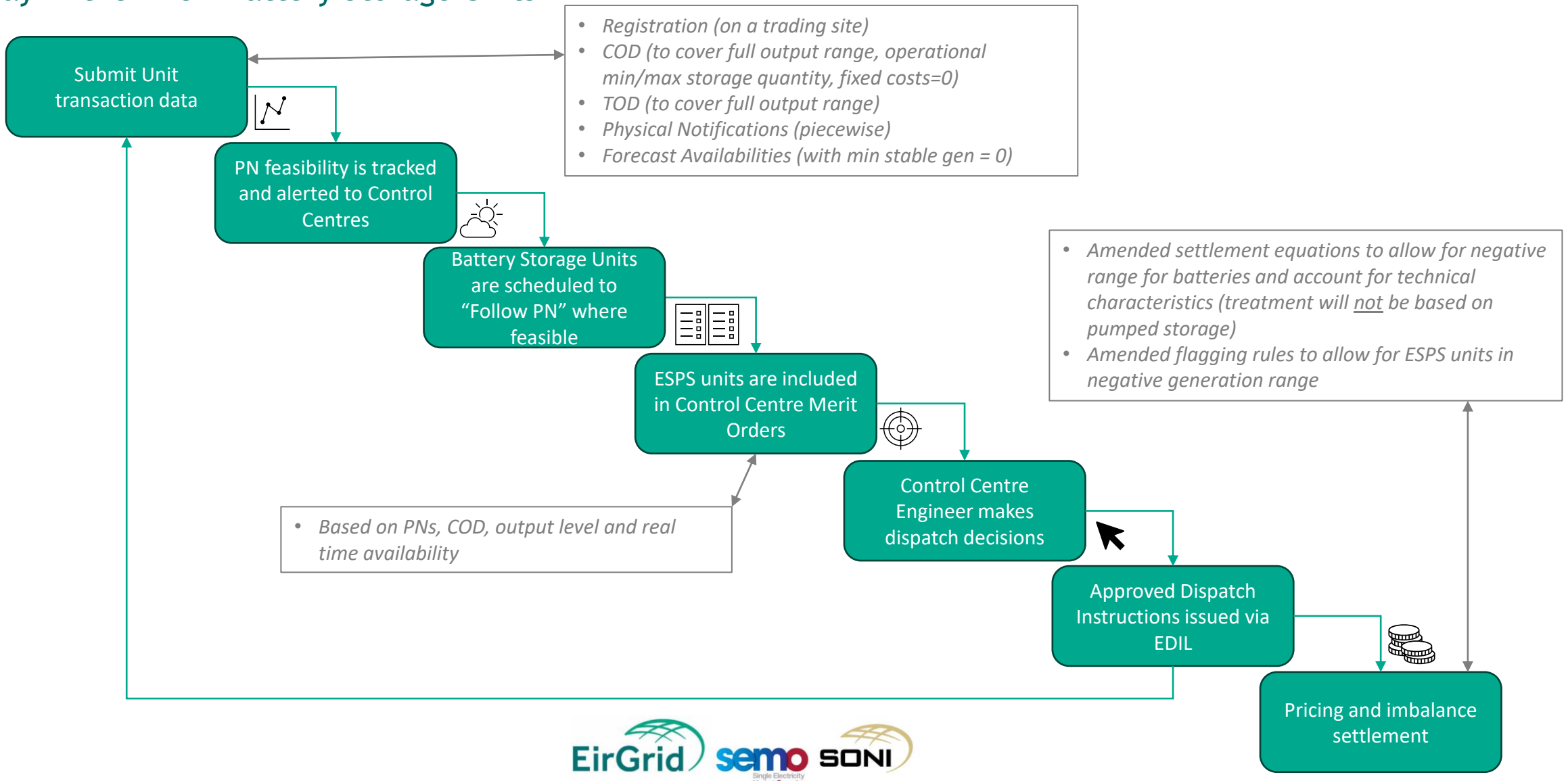
Day in the Life – Battery Storage Units



System Improvements

We are working with our vendors to remove limitations on market systems which currently restrict batteries' participation in the market.

The primary changes which will allow the control centre and market participants to gain greater value from these units in the balancing market are:

- The ability to register these units correctly as Battery Storage Units.
- The ability for participants to submit negative Physical Notifications, representing an intention to import.
- The ability to schedule these units to follow Physical Notifications.
- The ability for these units to receive negative Dispatch Instructions.

As a result of these changes, some of the rules for Battery Storage Units in the Trading and Settlement Code are no longer appropriate.

Registration as Part of a Trading Site

- Battery Storage Units will be required to register as part of a Trading Site like other generator units.

- Previously Battery Storage Units were required not to register as part of a Trading Site to match the treatment of Pumped Storage Units.

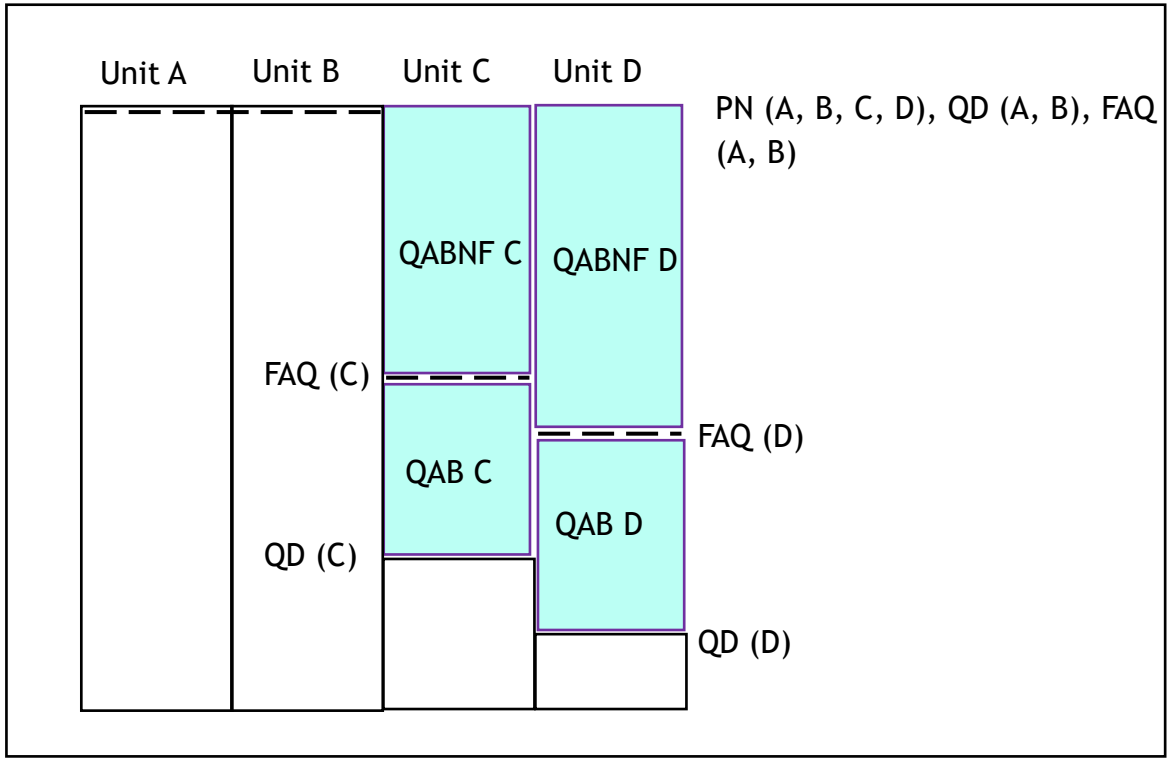
- Non-firm quantities are calculated on a Trading Site basis, so without being part of a Trading Site non-firm quantities will not be applied to Battery Storage Units.

Non-Firm Quantities

- Firm Access is a Trading Site concept, therefore there needs to be functionality to assign the Firm Access Quantity to the units under the Trading Site to allow for unit-level non-firm quantities to be calculated:

FAQ is divided in a way which is inversely proportional to the Accepted Bid Quantity on each unit:

- If unit dispatched to PN, fully firm;
- If unit dispatched below PN, non-firm;
- The greater the dec volume, the lower the firmness.



Example for a Battery Storage Unit registered as the only unit on a Trading Site with an Associated Supplier Unit

F.6.5.2 QFPNNF (Non-Firm Final Physical Notification Quantity for Trading Site)

$$QFPNNF_{s\gamma} = Max\left(\sum_{u \in s} QFPN_{u\gamma} + \sum_{v \in s} QM_{v\gamma} - \left(qFAQ_{s\gamma} \times DISP\right), 0\right)$$

>= 0 or < 0

= 0 as there is no Trading Site Supplier Unit (ASU instead)

Trading Site FAQ will be >= 0 as per Connection Agreement

- **If FPN >= 0:**
  Trading Site Non-Firm FPN Quantity QFPNNF = Max(positive - positive, 0) = between 0 and FPN
  (non-firm FPN quantity can be any value between zero and positive FPN quantity)

- **If FPN < 0:**
  Trading Site Non-Firm FPN Quantity QFPNNF = Max(negative - positive, 0) = 0
  (no portion of FPN quantity is non-firm)

Example for a Battery Storage Unit registered as the only unit on a Trading Site with an Associated Supplier Unit

F.6.5.2

$$If \sum_{u \in s} \sum_{o} \sum_{i} QAB_{uoiy} < 0, then$$

$$qFAQ_{uy}(t) = \frac{Max\left(QFPN_{uy} - QFPNNF_{sy}\left(\frac{\sum_o \sum_i QAB_{uoiy}}{\sum_{u \in s} \sum_o \sum_i QAB_{uoiy}}\right), 0\right)}{DISP}$$

$$Else$$

$$qFAQ_{uy}(t) = \frac{QFPN_{uy}}{DISP}$$

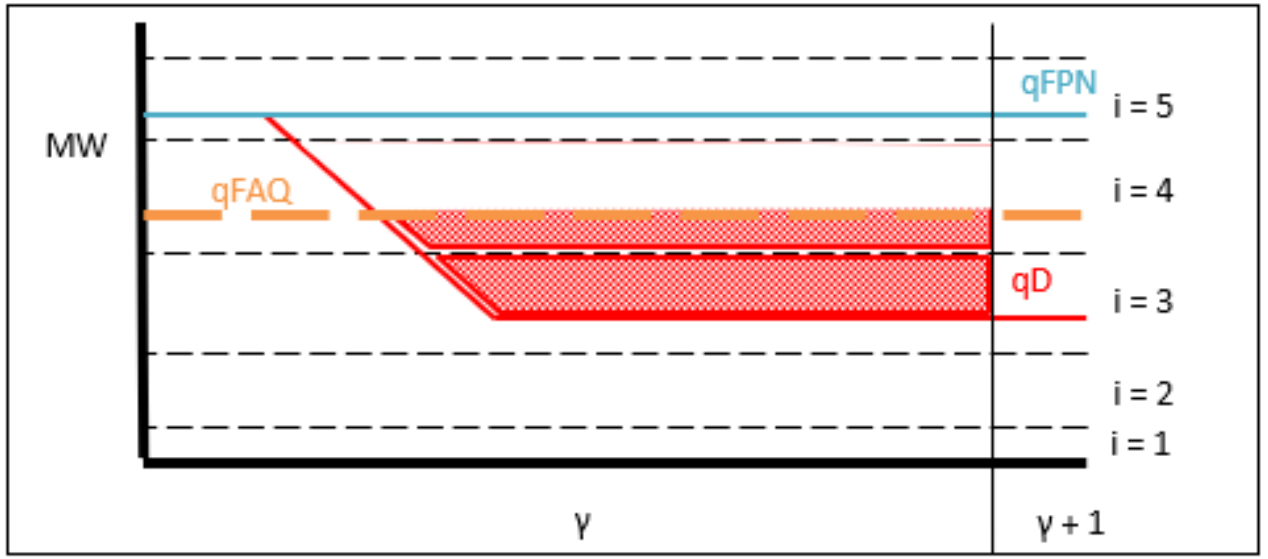
- When no dec actions are taken, Unit Firm Access Quantity qFAQ always = FPN
- When dec actions (QAB<0) are taken on the single unit Trading Site:

  If FPN >= 0:
  Unit Firm Access Quantity qFAQ = FPN - non-firm portion of FPN = Trading Site FAQ

  If FPN < 0:
  Unit Firm Access Quantity qFAQ = Max(negative - positive, 0) = 0

Example for a Battery Storage Unit registered as the only unit on a Trading Site with an Associated Supplier Unit

The Non-Firm Accepted Bid Quantity QABNF for a unit used in the calculation of CDISCOUNT payments represents the reduction in electricity output that has been accepted for levels of output above the Firm Access Quantity of the unit.



As shown above for a Battery Storage Unit on a single unit Trading Site with an Associated Supplier Unit subject to decremental actions:

- If FPN >= 0 then qFAQ = Trading Site FAQ which will be >= 0 as per Connection Agreement
- If FPN < 0 then qFAQ = 0

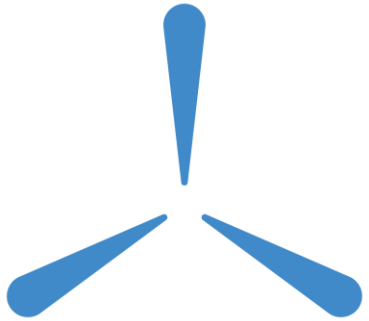
Therefore, quantities below zero will not be settled as non-firm.

Commercial Offer Data

- *Additional fields for battery storage units:*
  - Operational Minimum Storage Quantity (MWh)
  - Operational Maximum Storage Quantity (MWh)

These fields will allow a warning to be provided to the control centre if Physical Notifications submitted by a participant for a battery unit cause the unit's storage level to fall outside of these operational limits.

- *Forecast Minimum Stable Generation:*
  - To be mandated to be submitted as zero for all imbalance settlement periods.
  - This will allow unit to be synchronised to import or export.



Technical Offer Data

- *Updated field names:*
  - Storage Cycle Efficiency (for both Pumped Storage and Battery Storage)
  - Minimum Storage Quantity (for both Pumped Storage and Battery Storage)
  - Maximum Storage Quantity (for both Pumped Storage and Battery Storage)

- *Field to be removed:*
  - Battery Storage Capacity (exists to allow units to be profiled to storage capacity when a GOOP PUMP instruction is received, these units will not receive these instructions and so will not need this field, will instead be profiled to Target Instruction Level)

Charging Mode

- Definition of Battery Storage Unit in charging mode is proposed to be removed:

F.2.1.4 The Market Operator shall determine whether a Battery Storage Generator Unit, u, is in Charging Mode for the purposes of the calculations in this Code as follows:

(a) If the value of a Battery Storage Unit's Dispatch Quantity ($qD_{uo\gamma}(t)$) at all times within an Imbalance Settlement Period, γ, is positive (i.e. in the generating range of the Unit's output), then the Unit is deemed to be in Generating Mode for the entirety of that Imbalance Settlement Period; and

(b) If the value of a Battery Storage Unit's Dispatch Quantity ($qD_{uo\gamma}(t)$) at any time within an Imbalance Settlement Period, γ, is negative (i.e. in the charging range of the Unit's output), then the Unit is deemed to be in Charging Mode for the entirety of that Imbalance Settlement Period.

- The current text is based on legacy arrangements which recognised that Pumped Storage Units cannot control the exact level to which they consume power when dispatched to pump.
- Battery Storage Units are currently aligned with pumped storage units in the Trading and Settlement Code.
- However, unlike Pumped Storage Units, Battery Storage Units can control the level to which they consume power and can run to specific negative MW Target Instruction Levels when dispatched to charge, and so do not need different treatment while importing and exporting.

Imbalance Charge

- We propose that Battery Storage Units be removed from the clause below so that the Imbalance Charge is applied the same while charging as discharging.

F.5.3.3 The Market Operator shall calculate the Imbalance Component Payment or Charge ($CIMB_{u\gamma}$) for each Pumped Storage Unit or Battery Storage Unit, u, in each Imbalance Settlement Period, γ, for which it is in Pumping Mode (as determined in paragraph F.2.1.3) or in Charging Mode (as determined in paragraph F.2.1.4), as the case may be, as follows:

$$CIMB_{u\gamma} = PIMB_{\gamma} \times \left(\sum_{o} \sum_{i} \left(QAOLF_{uoi\gamma} - Max\left(QAOBIAS_{uoi\gamma}, QAOUNDEL_{uoi\gamma} \right) \right) + \sum_{o} \sum_{i} \left(QABLF_{uoi\gamma} - Min\left(QABBIAS_{uoi\gamma}, QABUNDEL_{uoi\gamma} \right) \right) \right)$$

- As described above this exception was put in place to account for the technical limitations of Pumped Storage Units, which do not apply to Battery Storage Units.
- This change is required in order to comply with regulatory requirements for Balance Responsible Parties under the EU's Clean Energy Package (CEP), Energy Balancing Guidelines (EBGL), and Imbalance Settlement Harmonisation Proposal methodology (ISHP).
- The need for this change was identified in SEM-21-017: EirGrid and SONI Analysis of SEM Compliance with Commission Regulation (EU) 2017/2195 of 23 November 2017 Establishing a Guideline on Electricity Balancing.

Uninstructed Imbalance

F.9.4.2 When a Pumped Storage Unit or Battery Storage, u, is in Pumping Mode or Charging Mode, as the case may be, for an Imbalance Settlement Period, γ, or any part thereof, the Market Operator shall calculate the Uninstructed Imbalance Charge ($CUNIMB_{u\gamma}$) for that Pumped Storage Unit or Battery Storage Unit, u, in that Imbalance Settlement Period, γ, as having a value of zero.

- We propose that Battery Storage Units be removed from the clause above so that the Uninstructed Imbalance Charge is applied while charging as it is while discharging.
- Unlike Pumped Storage Units, Battery Storage Units can control the level to which they consume power when dispatched to charge, and so do not need different treatment while importing and exporting.

Pre-Agreed Charging ("Trickle Charge")

- Due to the inability to send negative Dispatch Instructions within EDIL, it has not been possible for Control Centre Engineer to charge a battery unit to date. As a result, a "Pre-Agreed Charging" approach was agreed by the TSOs to allow battery operators to charge themselves without the need for a dispatch instruction from the TSOs.
- The Scheduling and Dispatch Programme will allow negative Dispatch Instructions to be sent via EDIL, and so pre-agreed charging is no longer required.
- Participants will also have the ability to obtain a position to charge in ex-ante markets, or price themselves to do so in the balancing market.
- Under the SEM's central dispatch arrangements, the TSOs schedule and dispatch all units (SEM-12-105b).
- With an increasing volume of Battery Storage Units connecting to the grid, allowing these units to self-dispatch to charge could cause risks to system security.
- EirGrid's recently approved Grid Code modification MPID304: Incorporation of Battery ESPS Grid Code Implementation Note included the following:

  "Pre-Agreed Charging was not deemed appropriate for inclusion in this modification. Pre-Agreed Charging is a temporary operational measure that was included in V3 to give guidance to industry, not necessarily to advise on Grid Code alterations."

Minimum Output in the Calculation of Accepted Bid Offer Quantities for Incs

- At present Outturn Availability is included in the algebra for calculating Accepted Bid Offer Quantities for decs to ensure that any decrease in output from PNs due to reduced availability is seen as an imbalance, rather than an Accepted Bid:

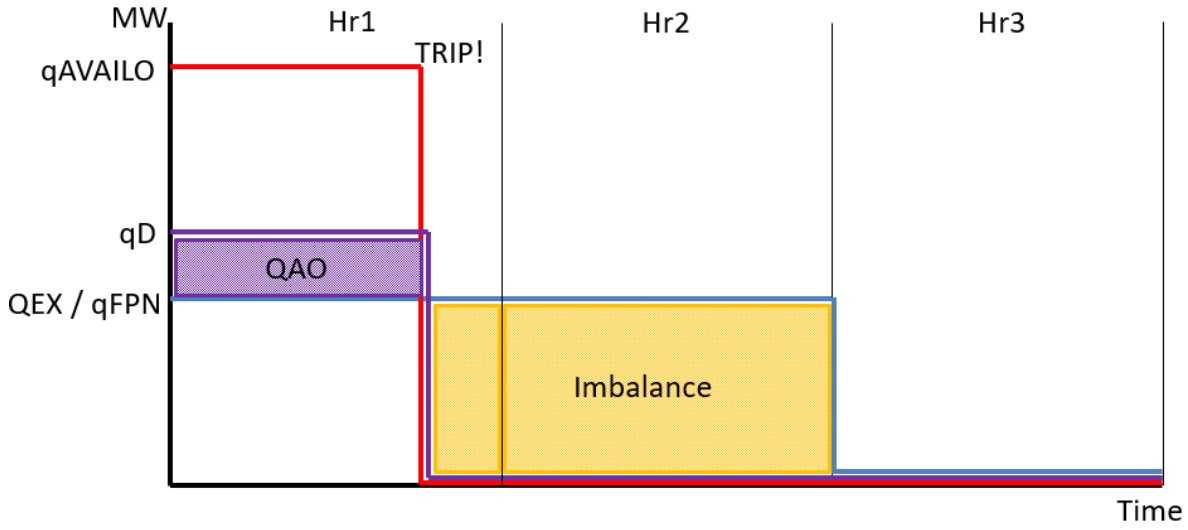
F.6.2.4

$$qDA_{uoh}(t) = Min\left(qD_{uoh}(t), qDA_{u(o-1)h}(t)\right)$$

$$qDA_{u(o-1)h}(t) = Min\left(qD_{u(o-1)h}(t), qAVAILO_{uh}(t)\right)$$

$$qD_{u(o=0)h}(t) = qFPN_{uh}(t)$$

$$qBOUR_{u(i=0)h}(t) = 0$$
$$qBOLR_{u(i=0)h}(t) = 0$$



Minimum Output in the Calculation of Accepted Bid Offer Quantities for Incs

- Minimum Output under the Trading and Settlement Code is the minimum level of output at which a Generator Unit may operate.
  - For units other than Pumped Storage and Battery Storage Units Minimum Output is always zero.
  - For Pumped Storage and Battery Storage Units Minimum Output is their availability to import.

To mirror the inclusion of Outturn Availability in the algebra for calculating Accepted Bid Offer Quantities for decs, and to ensure that any increase in output from PNs due to reduced minimum output (i.e. incs from PNs that the unit did not have sufficient storage capacity to reach) is seen as an imbalance rather than an Accepted Bid, we propose that Outturn Minimum Output is included in the algebra for calculating Accepted Bid Offer Quantities for incs as shown below:

- F.6.2.3

$$qDA_{uoh}(t) = Max\left(qD_{uoh}(t), qDA_{u(o-1)h}(t)\right)$$

$$qDA_{u(o-1)h}(t) = Max(qD_{u(o-1)h}(t), qMINOUT_{uh}(t))$$

$$qD_{u(o=0)h}(t) = qFPN_{uh}(t)$$

$$qBOUR_{u(i=0)h}(t) = 0$$

$$qBOLR_{u(i=0)h}(t) = 0$$

Minimum Output in the Calculation of Accepted Bid Offer Quantities for Incs

Trade Opposite TSO Accepted Bid Offer Quantities for Incs (F.6.4)

- Trade Opposite TSO is where a unit can increase the volume of a Bid or Offer accepted by the SOs after the time it has been accepted.
- For completeness the Outturn Minimum Output is proposed to be included in the same way in the calculation of Trade in the Opposite Direction to the TSO Quantities.
- Where Outturn Availability is included in the algebra for Without Trade Opposite TSO Accepted Bid Offer Quantity for Decs resulting from Bid Offer Acceptance (F.6.4.8), Outturn Minimum Output will be included in the algebra for Without Trade Opposite TSO Accepted Bid Offer Quantity for Incs resulting from Bid Offer Acceptance (F.6.4.7).
- This functionality is not currently switched on for any unit in the market.

Accepted Offers Below Physical Notification and Accepted Bids Above Physical Notification Quantities (F.7)

- Similarly, Outturn Minimum Output is proposed to be included in the same way in the calculation of Accepted Offers Below Physical Notification and Accepted Bids Above Physical Notification Quantities.
- Where Outturn Availability is included in the algebra for Price Only Accepted Bid Offer Quantity for Decs resulting from Bid Offer Acceptance (F.7.1.4), Outturn Minimum Output will be included in the algebra for Price Only Accepted Bid Offer Quantity for Incs resulting from Bid Offer Acceptance (F.7.1.3).

Testing Charge

Testing Charge for Generator Units other than Interconnector Error Units (F.13.2.1):

$$CTEST_{u\gamma} = -Max\left(QMLF_{u\gamma}, 0\right) \times PTESTTARIFF_{u\gamma}$$

Testing Charge for Interconnector Error Units (F.13.2.2):

$$If\ QMLF_{u\gamma} > 0\ then$$

$$CTEST_{u\gamma} = -Max\left(QMLF_{u\gamma}, 0\right) \times PTESTTARIFF_{u\gamma}$$

$$else$$

$$CTEST_{u\gamma} = QMLF_{u\gamma} \times PTESTTARIFF_{u\gamma}$$

We propose that Battery Storage Units also be included under F.13.2.2 so that negative meter quantities can be handled appropriately, and the Testing Charge can be incurred for testing while importing and exporting.

Application of Loss Adjustment Factors

Application of Loss Adjustment Factors for most Generator Units (F.4.3.2):

$$XXXLF_{\gamma} = XXX_{\gamma} \times FCLAF_{\gamma}$$

Application of Loss Adjustment Factors for Interconnectors, Interconnector Error Units, Interconnector Residual Capacity Units, Capacity Market Unit related to an Interconnector (F.4.3.3):

$$If\ XXX \geq 0\ then$$

$$XXXLF_{u\gamma} = XXX_{u\gamma} \times FCLAF_{l\gamma}$$

$$else$$

$$XXXLF_{u\gamma} = \frac{XXX_{u\gamma}}{FCLAF_{l\gamma}}$$

Application of Loss Adjustment Factors

Application of Loss Adjustment Factors to QABLF and QAOLF for Interconnectors, Interconnector Error Units, Interconnector Residual Capacity Units, Capacity Market Unit related to an Interconnector (F.4.3.4):

$$If\ QD_{u\gamma}\ \geq 0\ then$$

$$QAOLF_{u\gamma} = QAO_{u\gamma}\ \times FCLAF_{l\gamma}$$

$$QABLF_{u\gamma} = QAB_{u\gamma}\ \times FCLAF_{l\gamma}$$

$$else$$

$$QAOLF_{u\gamma} = \frac{QAO_{u\gamma}}{FCLAF_{l\gamma}}$$

$$QABLF_{u\gamma} = \frac{QAB_{u\gamma}}{FCLAF_{l\gamma}}$$

Application of Loss Adjustment Factors to qCLF for Capacity Market Unit related to an Interconnector (F.4.3.5):

$$\mathrm{qCLF}_{u\gamma} = \mathrm{qC}_{u\gamma}\ \times FCLAF_{l\gamma}$$

Application of Loss Adjustment Factors

We propose:

- excluding Battery Storage Units from F.4.3.2

and including Battery Storage Units in

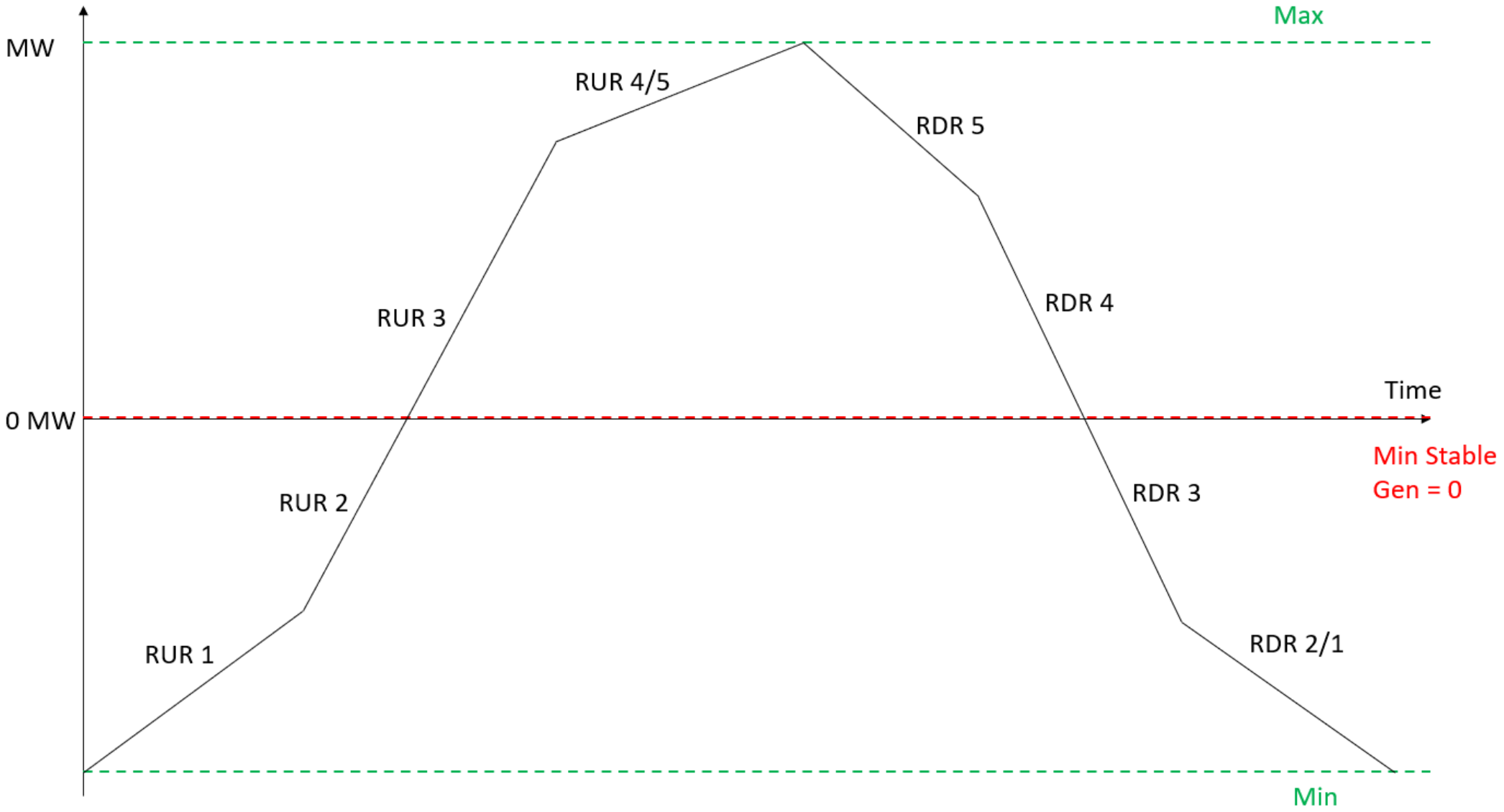
- F.4.3.3,
- F.4.3.4 and
- F.4.3.5

so that loss adjustment factors are applied similarly to Battery Storage Units as they are for Interconnector Units, taking into consideration import as well as export.

Instruction Profiling

- Battery Storage Units will be dispatched using MWOF Dispatch Instructions rather than GOOP instructions as GOOP instructions are more aligned to the technical characteristics of Pumped Storage Units and are not well suited to Battery Storage Units.
- Minimum Stable Generation to be submitted as zero.
- SYNC instructions may be issued to charge or discharge.
- Ramp Rates will be used between Registered Minimum Output and zero as well as between Minimum Stable Generation and Maximum Generation.

Sample Technical Offer Data Profile



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Queries on ESPS

Questions Raised by Market Participant Community

#	Topic	Query	Current Status
1	Recovery of startup Costs and No Load	Several MPs requested the solution make provision for the recovery of SUP/NL costs for these units.	• T&SC already requires fixed costs to be entered as zero for battery storage and pumped storage units, no proposed change to this.
2	ESPS Unit registration	Query from 6 Sep 2023 workshop regarding whether existing units will be "converted" automatically, or whether a re-registration process will be required	• SDP team working with the technology vendor on auto-conversion to make this process easier on MPs.
3	Firmness for ESPS units when charging	Query from 6 Sep 2023 workshop regarding treatment of firmness for ESPS Units	• The treatment of firmness for ESPS units will be the same as all other generator units. As such, there is no expectation of a change to rules or systems on this topic. • If a battery unit is the only unit on a trading site, charging quantities will always be considered firm. • If there are multiple units on a trading site, the site non-firm quantity will be distributed across all dec actions as it is today.
4	Trickle Charging Arrangement	Query from 6 Sep 2023 workshop regarding application of "trickle charging" for battery units	• Currently, there is an arrangement in place by which battery units can "trickle charge" up to the min(5MW, 20%*MEC, MIC). This is in place particularly as these units cannot currently have negative quantities to reflect charging (e.g., negative PNs, inability to dispatch to charge). • SDP_002 addresses this limitation so that ESPS units will be able to reflect negative quantities and dispatch to charging will be possible . • As a result, the current "trickle charging" arrangement will no longer be applicable once the SDP_002 changes are implemented.

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Queries on ESPS

SDP Stakeholder Engagement + Questions Raised by Market Participant Community

#	Topic	Query	Current Status
5	Deviation from PN	Query from 6 Sep 2023 workshop regarding obligation on Participants to update PNs following TSOs dispatching away	***Solution Presented - Ongoing Discussion*** Participant concerns that PNs may not be able to be updated (i.e., gate closed or insufficient ex-ante liquidity) <u>Key considerations:</u> • TSOs must be able to dispatch ESPS units . • PNs must reflect ex-ante trading position and must be physically feasible . • Participants can reflect any commercial risk in their Simple COD, including prices which indicate the desire (or not) of being dispatched by the TSOs away from PNs . • This principle exists already for pumped storage, by which the effects/risks of dispatch away from PNs is managed by the participant . • Initial discussions by TSOs suggests that there would be no practical means to address in balancing market settlement situations where PNs across the day become infeasible as a result of TSO actions . As a result, the TSOs' <u>current assumption</u> is that existing mechanisms will be used by Participants to manage/reflect the commercial risk of deviations from PNs