GC0154

Incorporation of interconnector ramping requirements into the Grid Code as per SOGL Article 119

Meeting 1

25th Jan 2022

Modification Process

Sally Musaka– National Grid ESO Code Administrator

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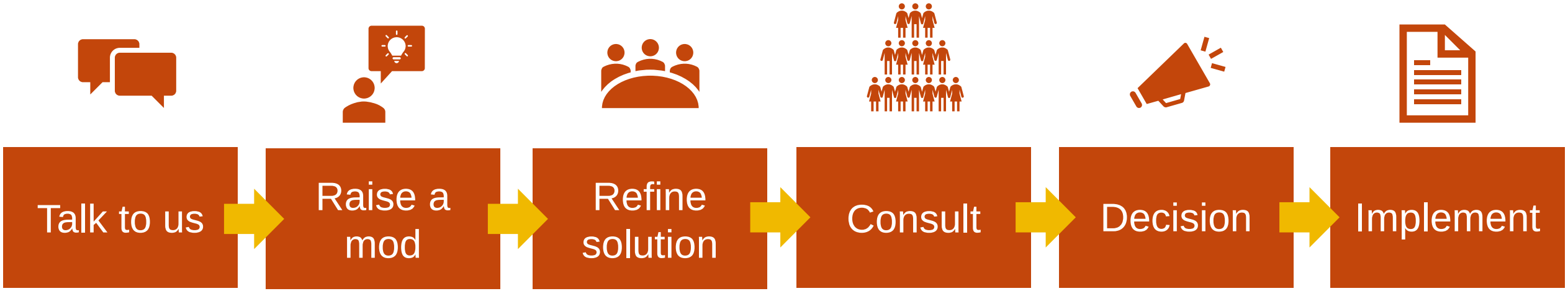
Code Modification Process Overview



Forums

Panels

Workgroups
(Workgroup Consultations)

Ofgem/Panel

Refine solution

Workgroups

- If the proposed solution requires further input from industry in order to develop the solution, a Workgroup will be set up.

- The Workgroup will:
  - further refine the solution, in their discussions and by holding a **Workgroup Consultation**
  - Consider other solutions, and may raise **Alternative Modifications** to be considered alongside the Original Modification
  - Have a **Workgroup Vote** so views of the Workgroup members can be expressed in the Workgroup Report which is presented to Panel

Consult

Code Administrator Consultation

- The Code Administrator runs a consultation on the **final solution(s)**, to gather final views from industry before a decision is made on the modification.

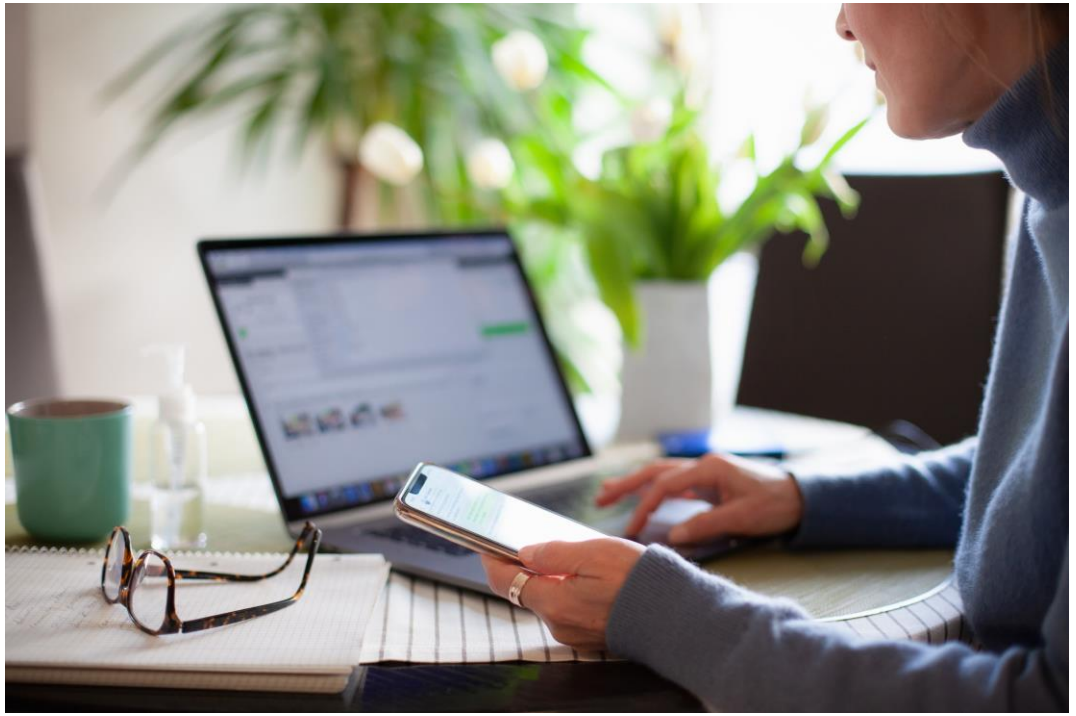
- After this, the modification report is voted on by Panel who also give their views on the solution.

Decision

- Dependent on the Governance Route that was decided by Panel when the modification was raised
- **Standard Governance:** Ofgem makes the decision on whether or not the modification is implemented
- **Self-Governance:** Panel makes the decision on whether or not the modification is implemented
  - an appeals window is opened for 15 days following the Final Self Governance Modification Report being published

Implement

- The Code Administrator implements the final change which was decided by the Panel / Ofgem on the agreed date.



Objectives and Timeline

Sally Musaka – National Grid ESO Code Administrator

Timeline for GC0154 as of 06 December 2021

Milestone	Date
Proposal Presented to Panel	16 December 2021
Workgroup 1 – (discussion of the proposal) and solution, agree timeline and review terms of reference	25 January 2022
Workgroup 2 (finalise solution to be consulted on and agree alternatives)	17 February 2022
Workgroup 3	17 March 2022
Workgroup 4	07 April 2022
Workgroup 5	12 May 2022
Work group 6(Consultation questions)	09 June 2022
Workgroup Consultation (15 Working Days)	20 June 2022– 08 July 2022
Work group 7- Assess Work group consultation responses	21 July 2022
Workgroup 8- Finalise solution(s) and legal text, agree that Terms of Reference have been met, Review Workgroup Report and hold Workgroup Vote	04 August 2022
Workgroup 9	11 August 2022
Workgroup Report issued to Panel (5 working days)	17 August 2022
Panel sign off that Workgroup Report has met its Terms of Reference	**25 August 2022**

Milestone	Date
Code Administrator Consultation	01 September 2022- 30 September 2022
Draft Final Modification Report (DFMR) issued to Panel	19 October 2022
Panel undertake DFMR recommendation vote	27 October 2022
Final Modification Report issued to Panel to check votes recorded correctly (5 working days)	31 October 2022
Final Modification Report issued to Ofgem	07 November 2022
Ofgem decision	TBC
Implementation Date	**10 working days after Ofgem decision**

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Workgroup Responsibilities

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Expectations of a Workgroup Member

- Contribute to the discussion
- Be respectful of each other's opinions
- Language and Conduct to be consistent with the values of equality and diversity
- Do not share commercially sensitive information
- Be prepared - Review Papers and Reports ahead of meetings
- Complete actions in a timely manner
- Keep to agreed scope

Your Roles

- Help refine/develop the solution(s)
- Bring forward alternatives as early as possible
- Vote on whether or not to proceed with requests for Alternatives
- Vote on whether the solution(s) better facilitate the Code Objectives

Workgroup Alternatives and Workgroup Vote

Sally Musaka– National Grid ESO Code Administrator

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Can I vote? and What is the Alternative Vote?

To participate in any votes, Workgroup members or the alternates need to have attended at least 50% of meetings

Stage 1 – Alternative Vote

- Vote on whether Workgroup Alternative Requests should become Workgroup Alternative Grid Code Modifications.
- The Alternative vote is carried out to identify the level of Workgroup support there is for any potential alternative options that have been brought forward by either any member of the Workgroup OR an Industry Participant as part of the Workgroup Consultation.
- **Should the majority of the Workgroup OR the Chair believe that the potential alternative solution may better facilitate the Grid Code objectives than the Original then the potential alternative will be fully developed by the Workgroup with legal text to form a Workgroup Alternative Grid Code modification (WAGCM)** and submitted to the Panel and Authority alongside the Original solution for the Panel Recommendation vote and the Authority decision.

Can I vote? and What is the Workgroup Vote?

To participate in any votes, Workgroup members or Alternates need to have attended at least 50% of meetings

Stage 2 – Workgroup Vote

- 2a) Assess the original and WAGCMs (if there are any) against the Grid Code objectives compared to the baseline (the current Grid Code)
- 2b) Vote on which of the options is best.

Why we need to change and history

Compliance

- Ofgem's decision letter regarding the Intermediate Methodologies requires the ESO to achieve alignment with the GB frameworks by incorporation relevant provisions into the appropriate sections of the Grid Code and the NETS SQSS
- Such provisions include ramping arrangements as set out in article 3 of the LFC Block Operational Agreement
- Ramping for BMUs is included in the Grid Code- this does not cover interconnectors
- SOGL Art 119c requires ramping restrictions to be determined for power generating modules in accordance with Art 137.4 and interconnectors in accordance with 137.3

Operational

- Increasing levels of interconnection- concern if all interconnectors react to the same coupled market signal
- The current interconnector ramping approach and rates are not feasible for the future- this could significantly increase the amount of reserve required
- Current arrangements are in bespoke agreements and new connections are based upon a precedence that was set whilst enduring solutions were considered- not considering system capabilities
- As an example, VikingLink (Denmark) is under construction now and further interconnectors are envisaged to be developed following the announcement from Ofgem inviting bids for new interconnectors

Assumptions

The aim is to map the requirements of Article 119 to the Grid Code as requested by Ofgem.

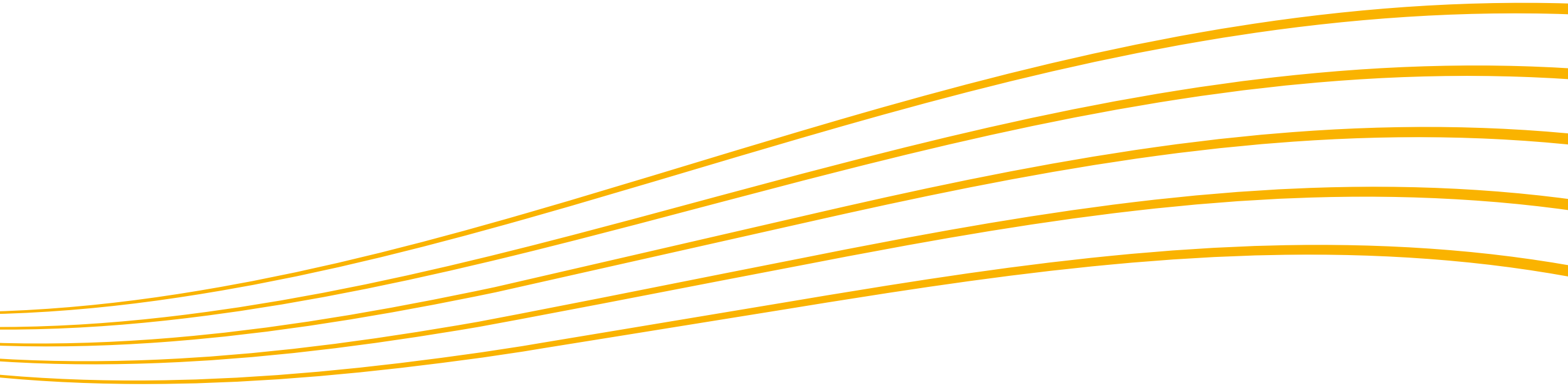
This will require the ESO and stakeholders to work collaboratively to find a solution that aligns with the text which has been written and approved.

The solution needs to consider the requirements of the transmission system now and be resilient enough for the future.

Cross –border ramping is a shared decision with the remote end EU System Operator. Therefore, their involvement and coordination with this process is key to ensure a mutually acceptable solution.

Ramping for BMUs will be considered outside this modification.

SOGL Articles to review



Ramping restriction for active power output - Article 119 (c)

LFC block operational agreements

1. By 12 months after entry into force of this Regulation, all TSOs of each LFC block shall jointly develop common proposals for:

   (a) where the LFC block consists of more than one LFC area, FRCE target parameters for each LFC area defined in accordance with Article 128(4);

   (b) LFC block monitor in accordance with Article 134(1);

   (c) ramping restrictions for active power output in accordance with Article 137 (3)* and (4)

*outstanding action

Text taken from the SOGL

Ramping restriction for active power output
Article 137 (3) & (4) of SOGL

	Code mapping
3. All connecting TSOs of an HVDC interconnector shall have the right to determine in the LFC block operational agreement common restrictions for the active power output of that HVDC interconnector to limit its influence on the fulfilment of the FRCE target parameter of the connected LFC blocks by agreeing on ramping periods and/or maximum ramping rates for this HVDC interconnector. Those common restrictions shall not apply for imbalance netting, frequency coupling as well as cross-border activation of FRR and RR over HVDC interconnectors. All TSOs of the GB synchronous area shall coordinate these measures within the synchronous area.	
4. All TSOs of an LFC block shall have the right to determine in the LFC block operational agreement the following measures to support the fulfilment of the FRCE target parameter of the LFC block and to alleviate deterministic frequency deviations, taking into account the technological restrictions of power generating modules and demand units: (a) obligations on ramping periods and/or maximum ramping rates for power generating modules and/or demand units; (b) obligations on individual ramping starting times for power generating modules and/or demand units within the LFC block; and (c) coordination of the ramping between power generating modules, demand units and active power consumption within the LFC block.	BC1.A.1.1

Highlighted to show gap to close

Text taken from the SOGL

LFC Block Operational Methodology for Article 119 (1) (c)

A119 Methodology text to map to codes	Supporting paper reference
1. Rules for ramping restrictions on the active power output of each HVDC interconnector between a LFC Block of another synchronous area and the GB LFC block, in accordance with SOGL Article 137(3):	N/A
a. The ESO, and the connecting TSOs supervising a LFC block of an HVDC interconnector shall have the right to determine common ramping restrictions in the form of ramping periods and/or maximum ramping rates and shall enter into agreement with the TSOs responsible for operating the interconnector, to determine the processes and mechanisms by which these restrictions will be put in place. These ramping restrictions shall not apply to imbalance netting, frequency coupling, cross-border activation of FRR or cross-border activation of RR. These ramping restrictions shall not apply to any service aimed at maintaining or returning one of the connected electricity systems to a normal system state.	The ESO has sought to maintain simplicity of application in that compliant regimes already exist on all GB connecting HVDC interconnectors, where the ramping restrictions and manner in which they are applied is agreed and defined in the operational agreements

Text taken from the LFC block operational agreement

LFC Block Operational Methodology for Article 119 (1) (c)

A119 Methodology text to map to codes	Supporting paper reference
b. The ramping restrictions for each interconnector shall be applied in a non-discriminatory manner. The ESO shall ensure alignment of ramping restrictions between all HVDC interconnectors linking the same two synchronous areas, taking into account the technical capabilities of each HVDC interconnector;	The ESO wants to demonstrate that all interconnector parties are being treated fairly, but highlights that rules between different synchronous areas may differ as ramping-restrictions imposed from another synchronous area may, if more onerous that those sought by the ESO, result in different rules for those particular interconnectors.
c. A summary of the ramping-restrictions to be applied to HVDC interconnectors connecting to the GB LFC Block, shall be published by the ESO on its website at least one week before the rules are enforced, in accordance with the obligations in SOGL Article 8;	Transparency and fairness is demonstrated by publishing a summary of the ramping-restrictions being applied to GB interconnectors on the internet.

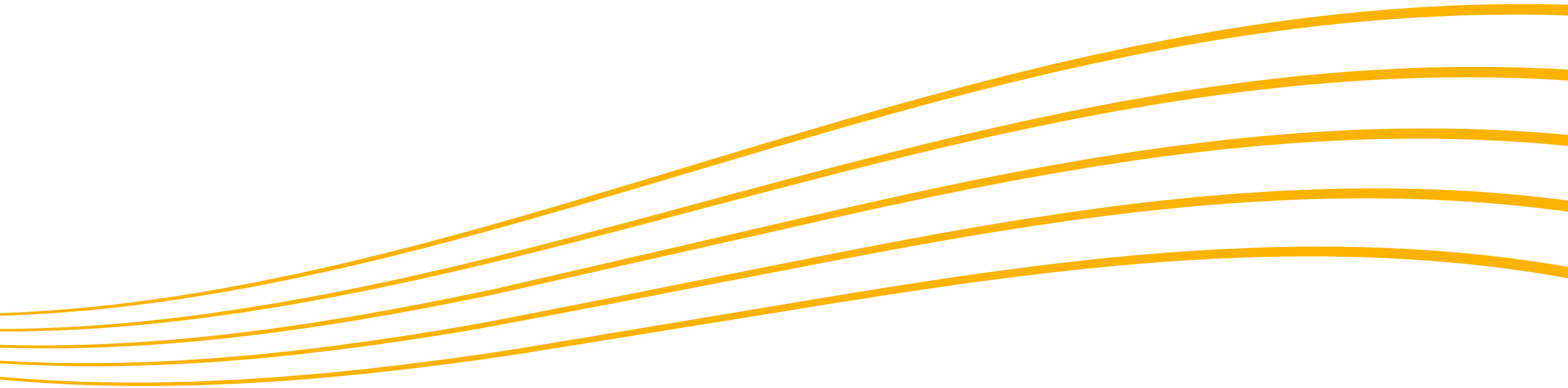
Text taken from the LFC block operational agreement

LFC Block Operational Methodology for Article 119 (1) (c)

A119 Methodology text to map to codes	Supporting paper reference
d. The ESO, in order to prevent the GB LFC block from entering into an emergency state, may restrict equitably the ramp rates of GB interconnectors between GB and the same connecting synchronous areas, in coordination with the affected national TSOs and affected interconnector operators according to the terms referred to paragraph (a) of this Article;	There is a need to be able to reduce the ramping-rates being applied to interconnectors when there is a current need or anticipated situation which, without action, would result in Great Britain entering an emergency state. Under these circumstances, the ESO will follow procedures to be determined in the operational agreements between parties to apply reduced ramp-rates to all market-based transfer programs on all the affected interconnectors.
e. Within 30 calendar days of an incident which restricted one or more of the HVDC interconnectors, under the process referred to in paragraph (d), the ESO shall prepare a report containing an explanation of the rationale, implementation and impact of this action and submit it to the relevant regulatory authority in accordance with Article 37 of Directive 2009/72/EC and neighbouring TSOs, and also make the report available to all significantly affected system users.	For transparency purposes, the ESO will publish information on the circumstances leading up to the need to reduce ramping-rates and the actions followed until operations were returned to normal ramping-rules.

Text taken from the LFC block operational agreement

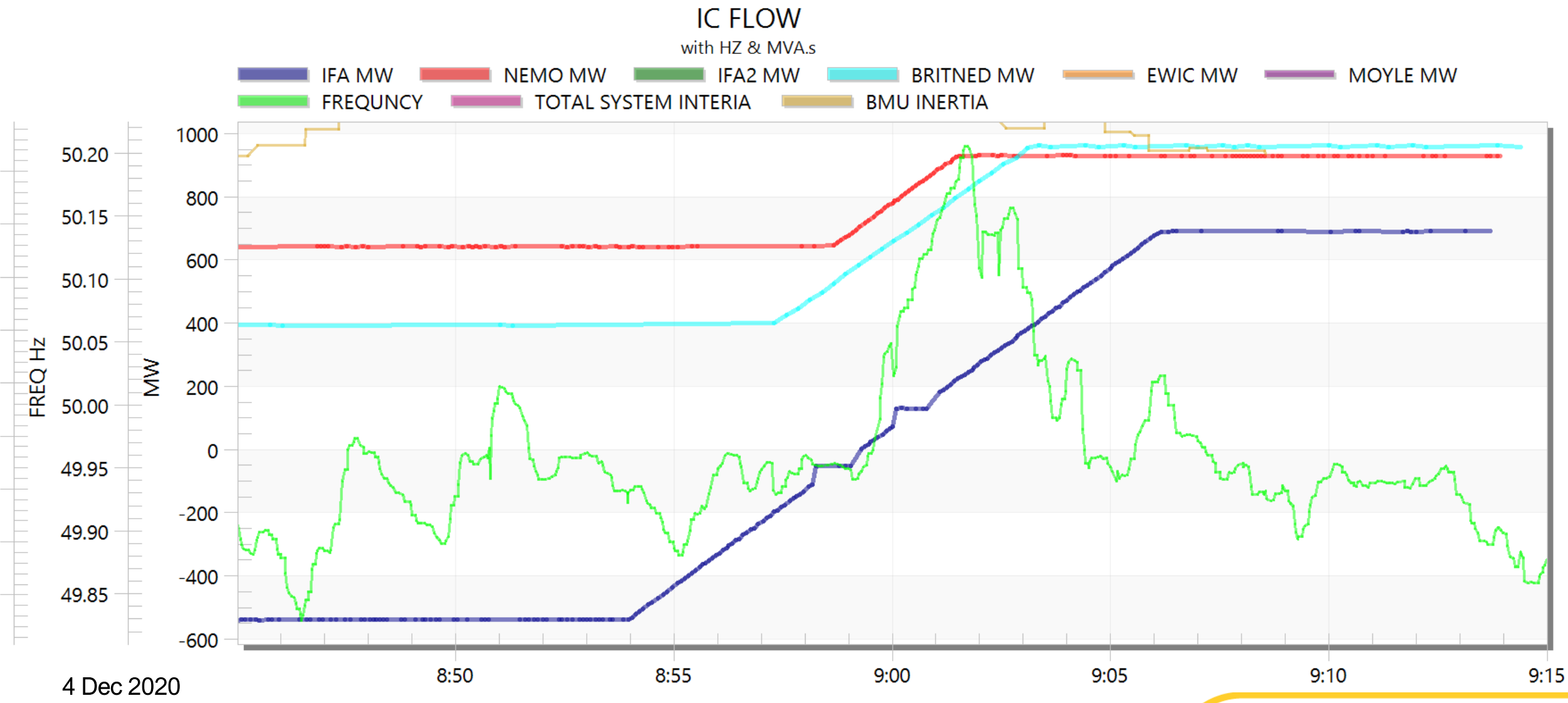
Operational Analysis



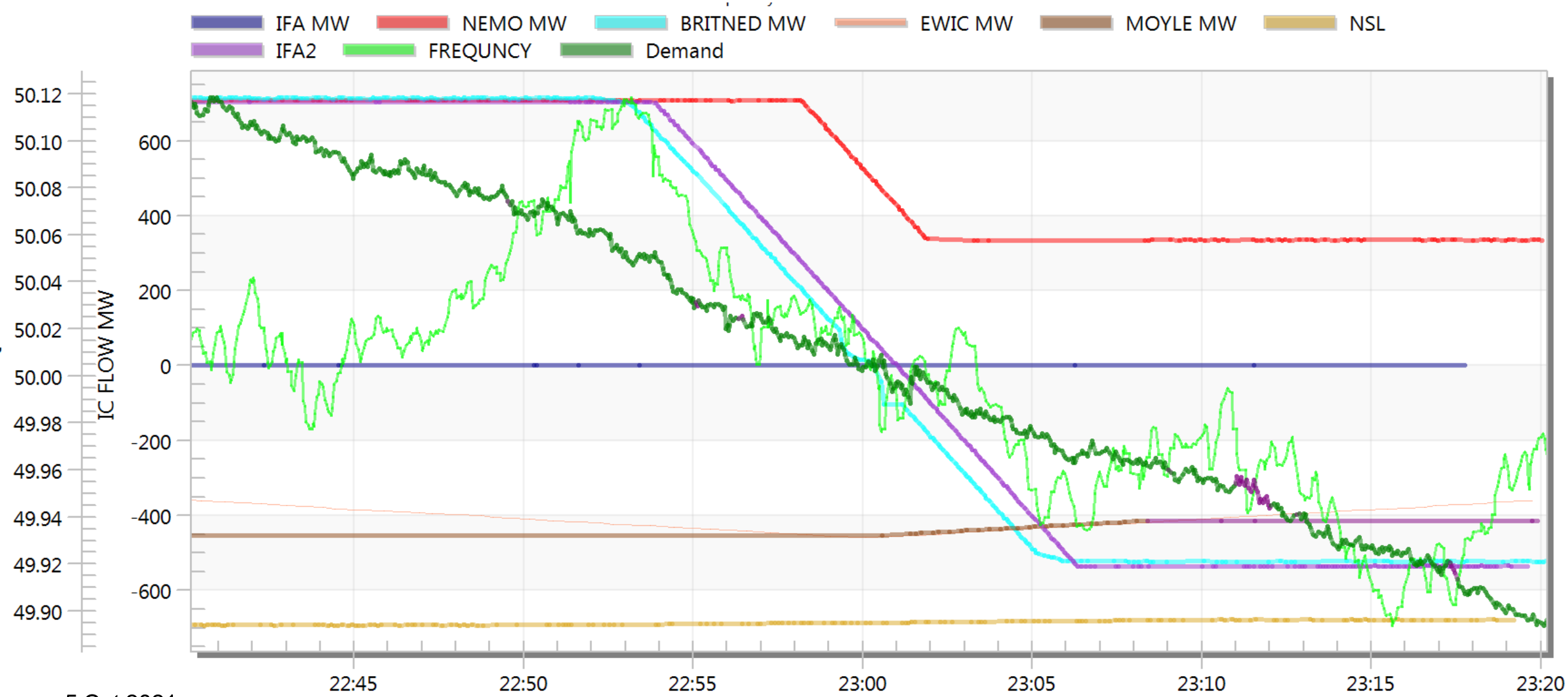
Operational Analysis - Background

	Past (-10 years ago)	Current situation	Future (+10 years ahead with no changes to current IC ramping)
Factors	• 2 Continental Interconnectors (3GW capacity) • Cumulative ramp rate 200MW/min • Ramp period 10 minutes • Low wind capacity (~8GW) • High inertia • Significant number of response units available • Interconnectors usually follow their Day Ahead program	• 4 Continental Interconnectors (5GW capacity) • Cumulative ramp rate 400MW/min • Ramp period 10 minutes • High wind capacity (~22GW) • Low inertia & low demand • Lower number of response units available • Interconnector Hourly Gate changes (with largest swing for ~4.5GW with only 60 minutes notice)	• Potential 8 Continental Interconnectors (~11GW capacity) • Potential Cumulative ramp rate 800MW/min • Ramp period 10 minutes • Higher wind capacity (~50GW) • Low inertia & low demand • Lower number of response units available • Interconnector Hourly Gate or Half-Hourly Gates changes (with total possible swing size of 22GW)
Interconnectors	• Rarely interconnectors ramping caused frequency deviations • Extra reserves were held for security	• More often interconnectors ramping is causing frequency deviations • IC swings requires careful energy management by Control Room and taking expensive corrective actions	• The magnitude of the swings is only expected to increase as more capacity is connected – therefore more frequency event could happened • What tools would be available for managing IC ramps in the future?
Managing	Feasible to manage the system in economic manner most of the time	Feasible to manage the system but often not in economic manner	May not be feasible to manage system and maintain system security without significant changes

Operational Analysis - Examples

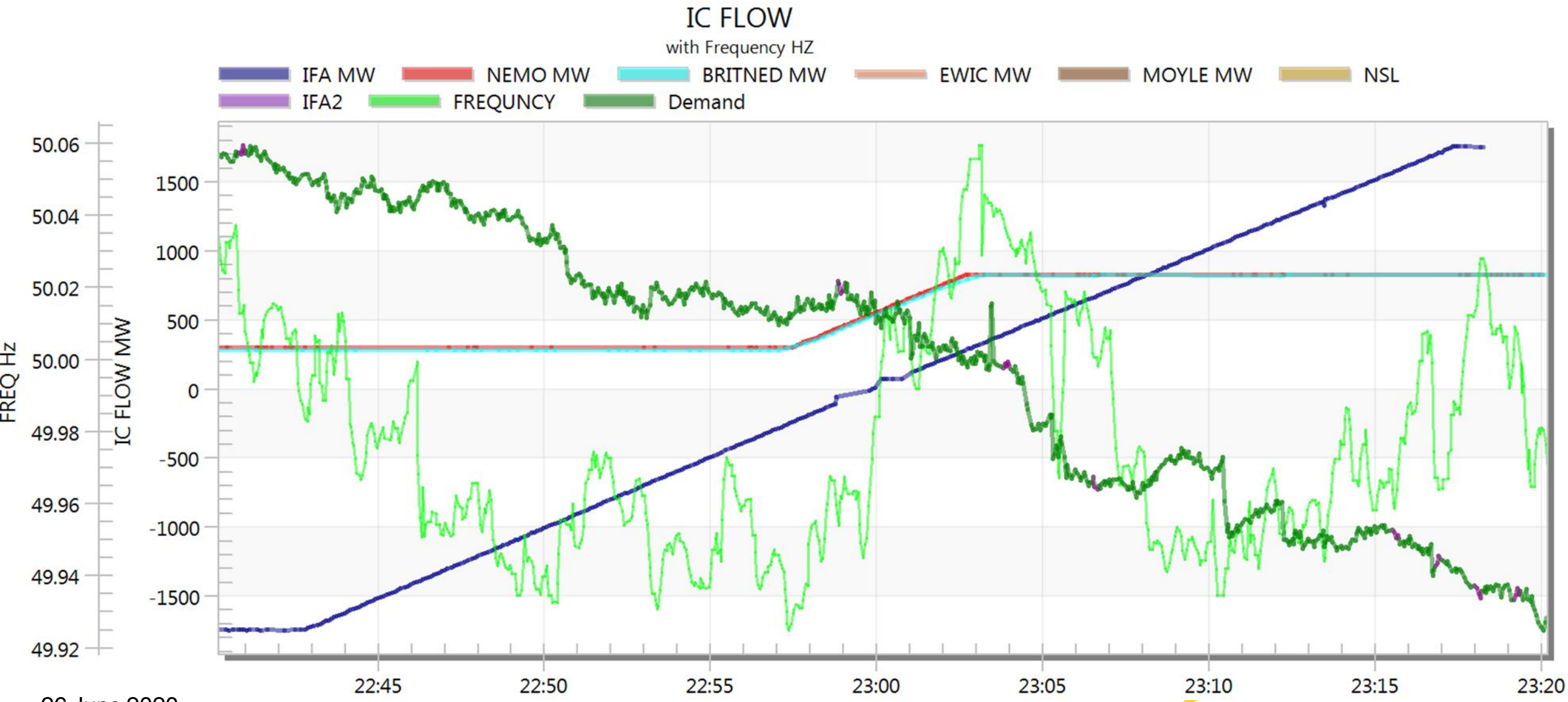


Operational Analysis - Examples



5 Oct 2021

Operational Analysis - Examples



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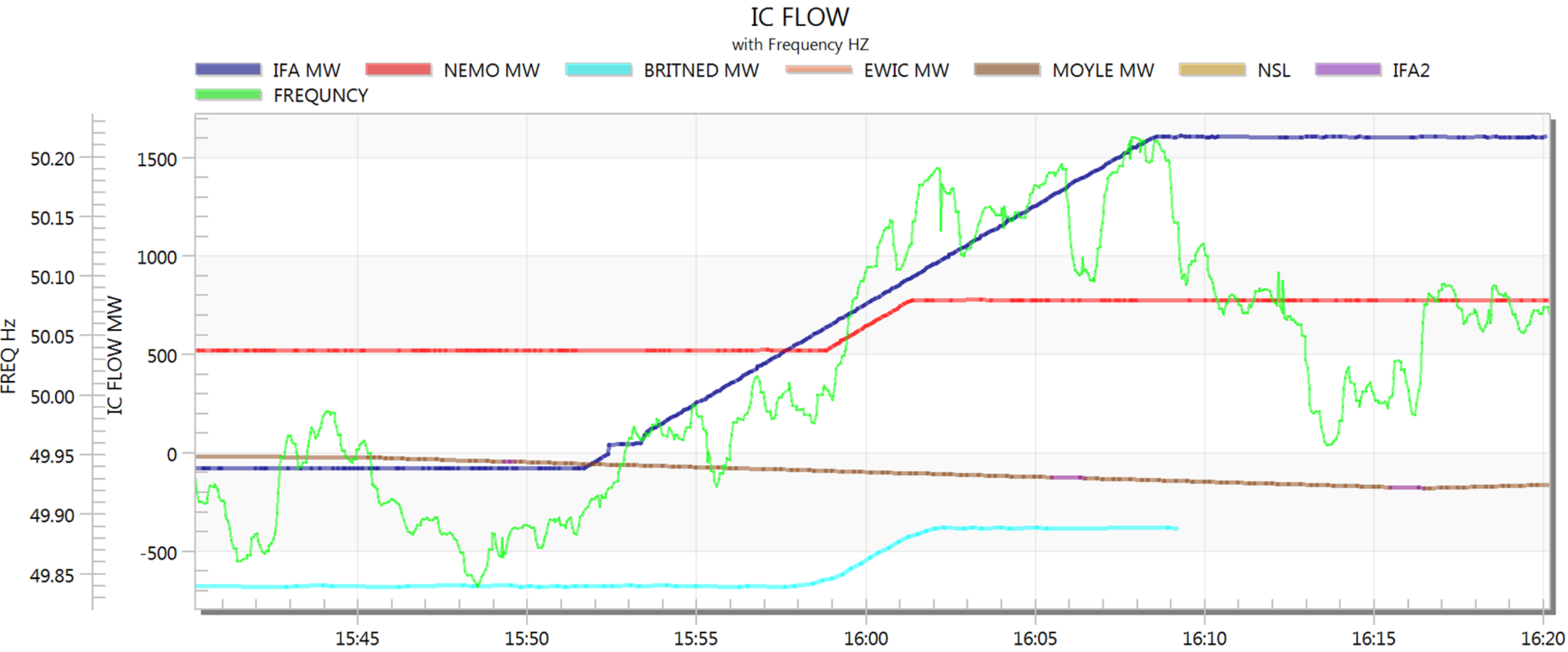
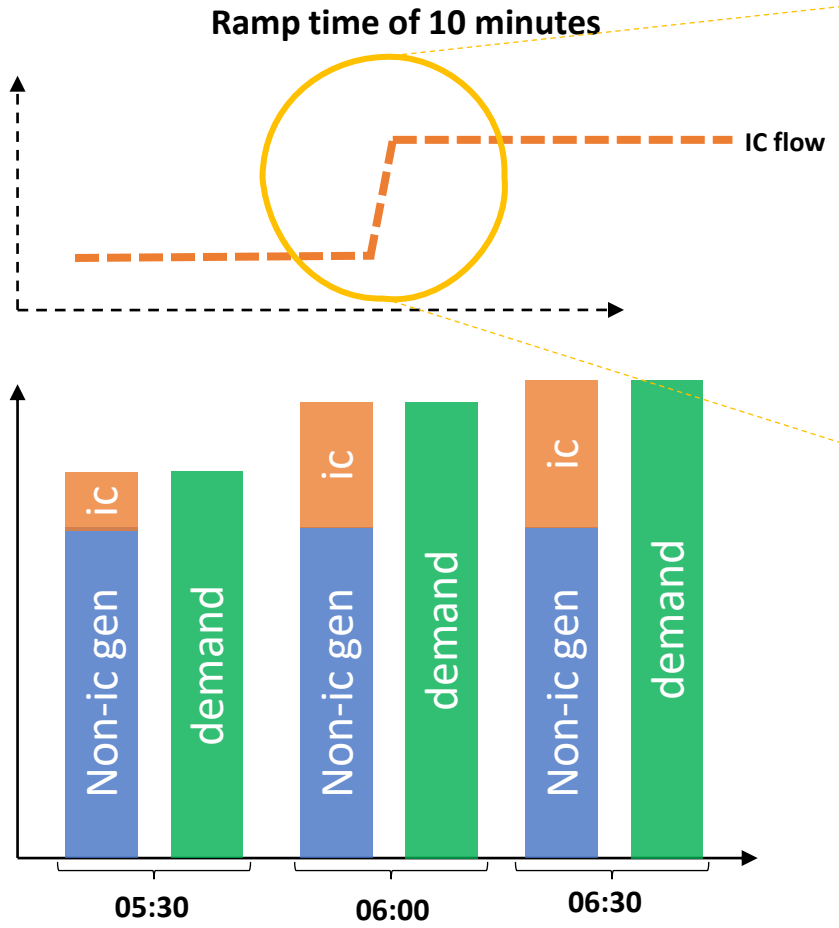
Operational Analysis - Examples

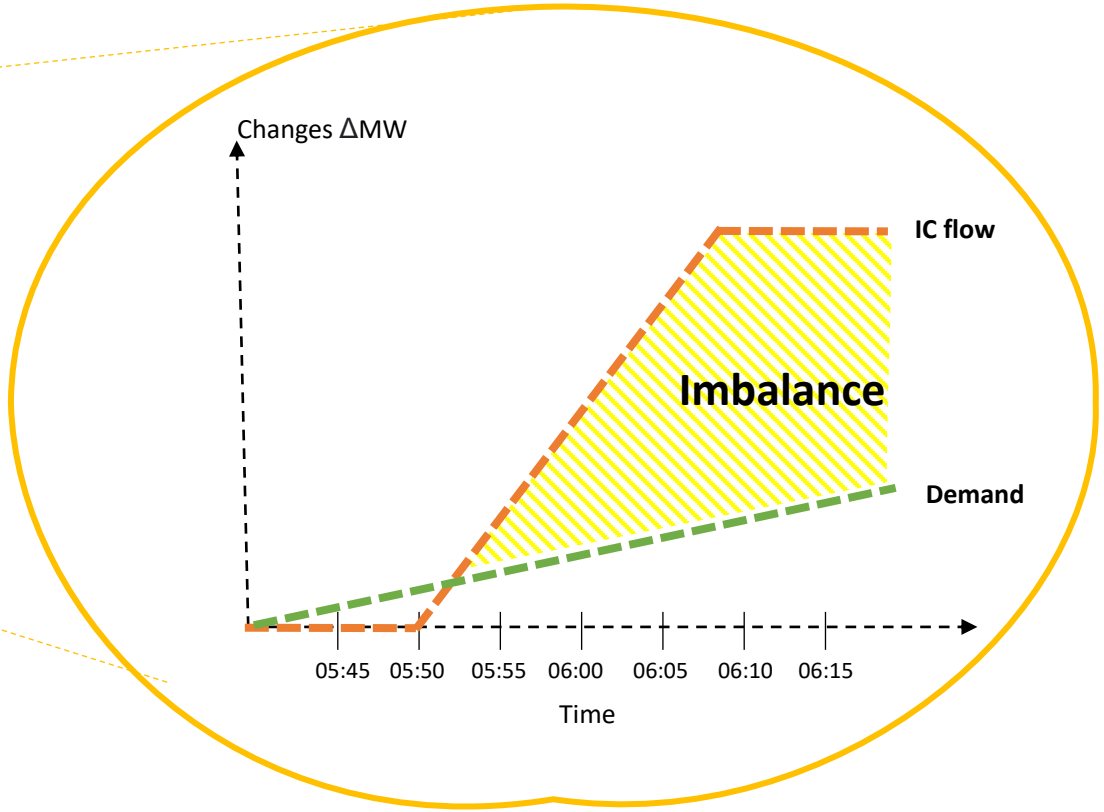


25 May 2020

Operational Analysis – Energy imbalance

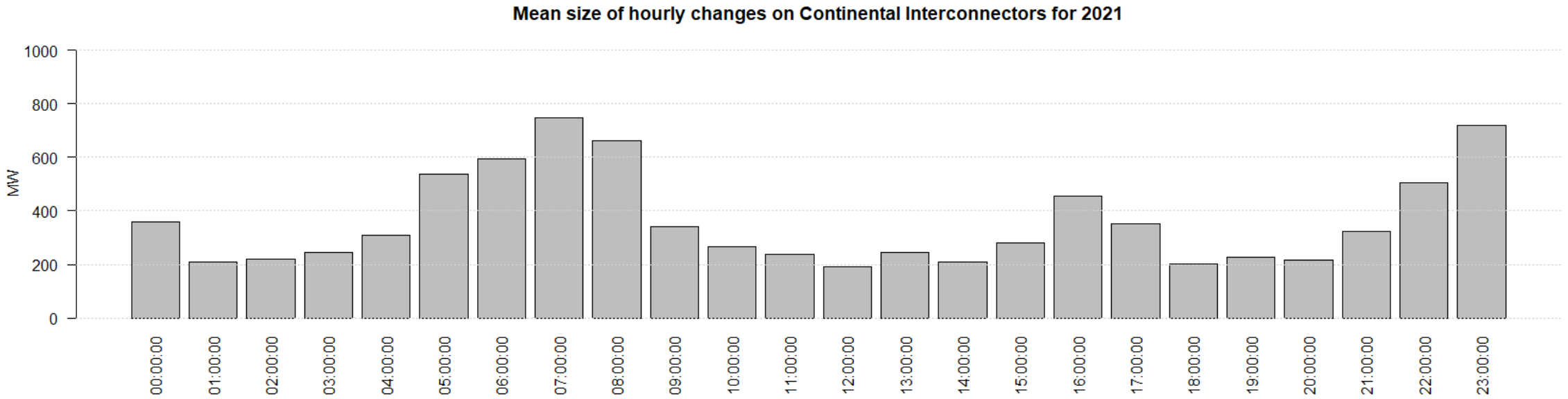


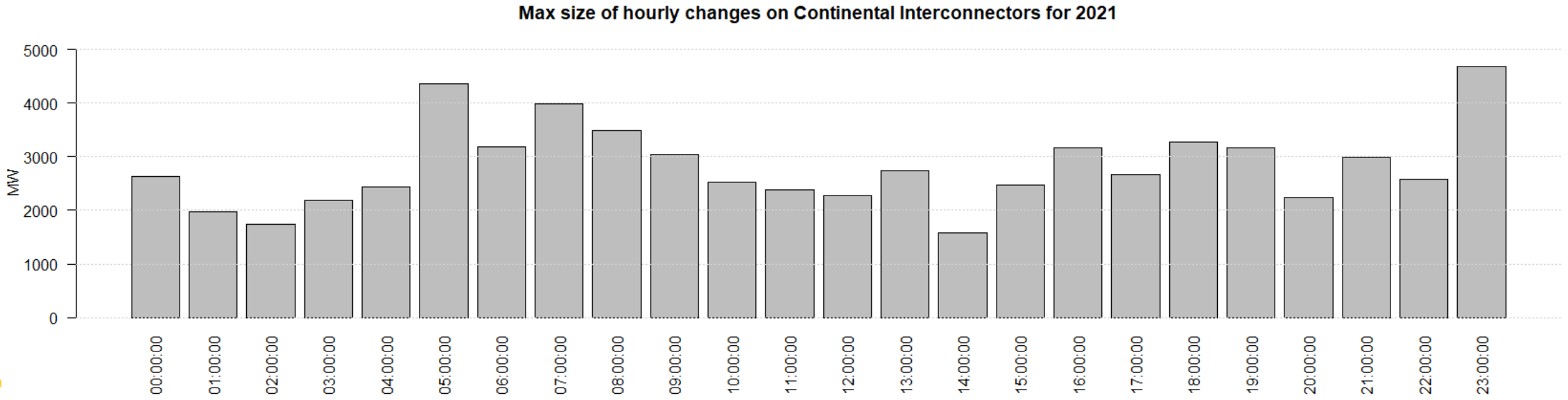
In each half-hour, the system is considered to be balanced.



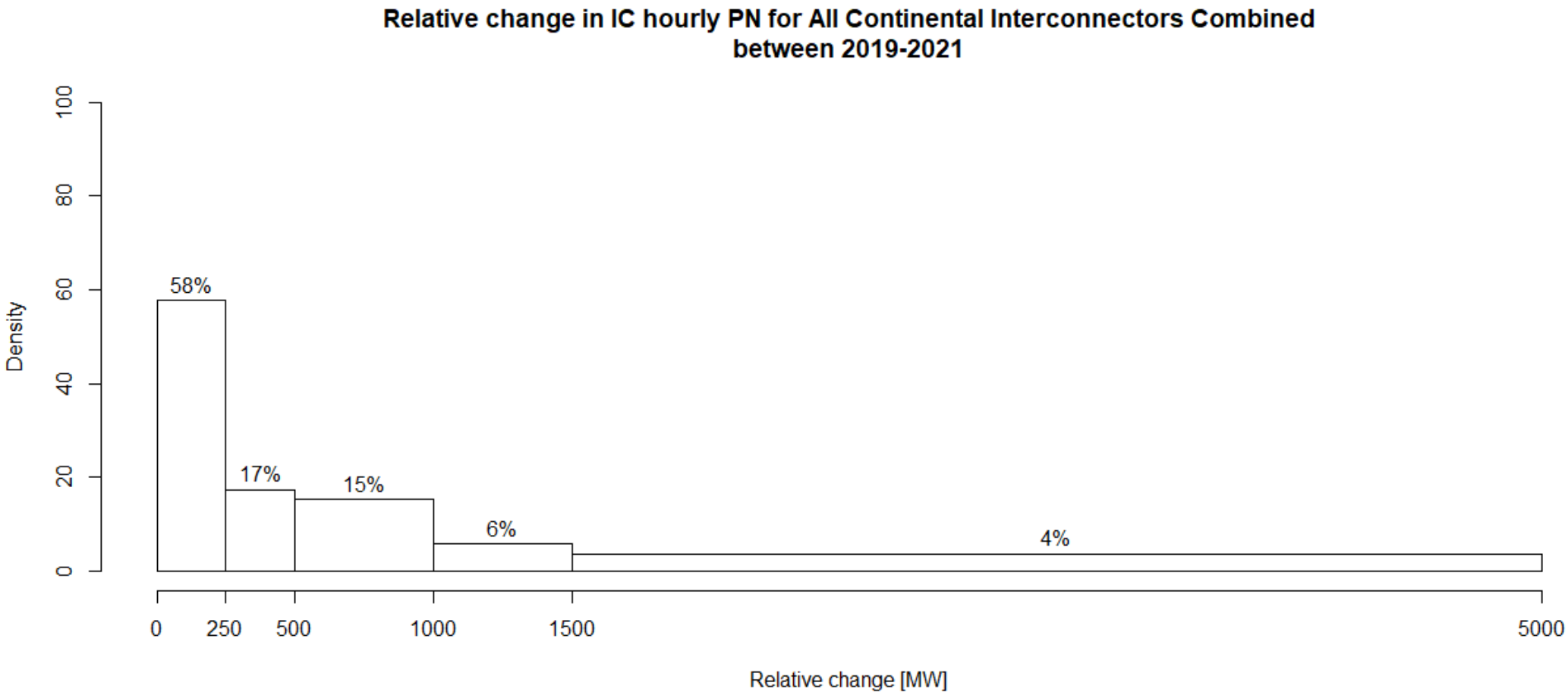
In minute-by-minute basis, there is a significant short-term imbalance created by rapid interconnector changes. That imbalance is cause frequency deviation issues.

Operational Analysis – Size of hourly changes

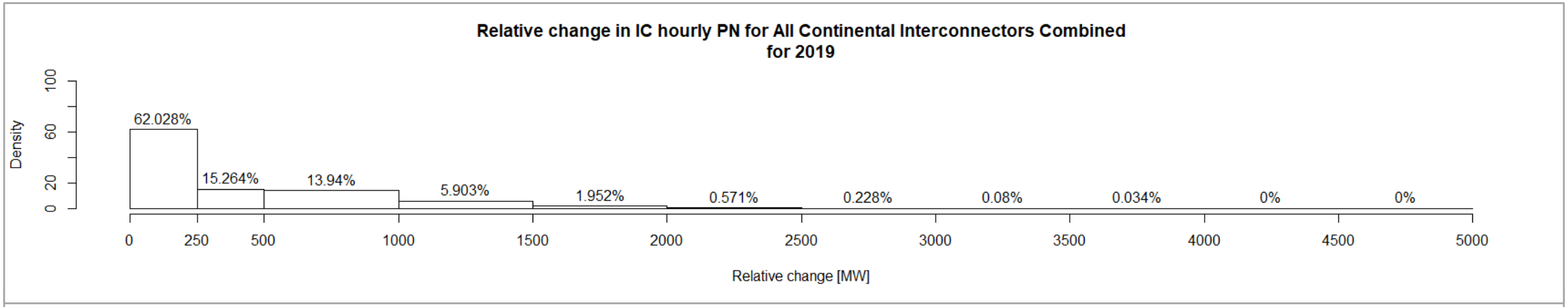


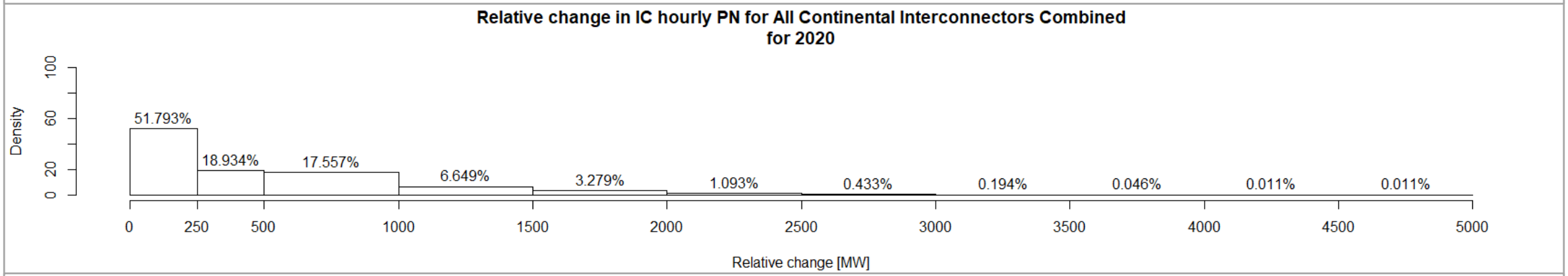


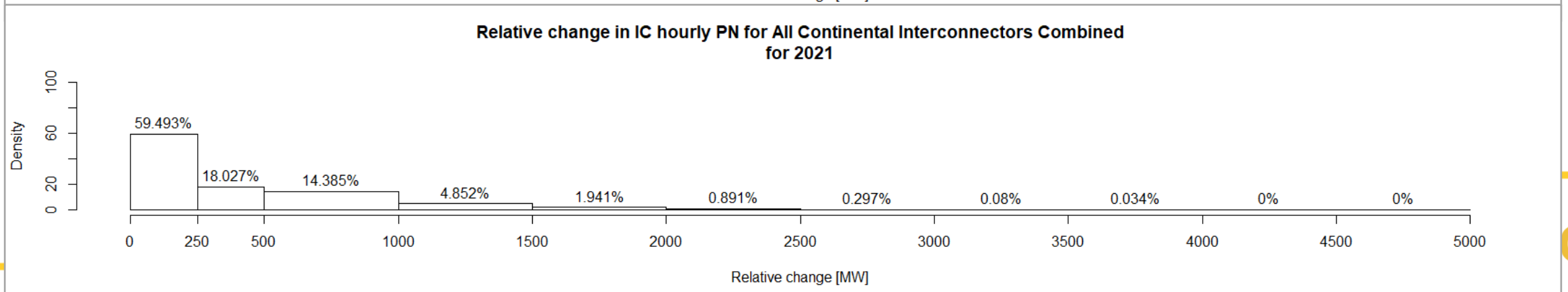
Operational Analysis – Frequency of hourly changes



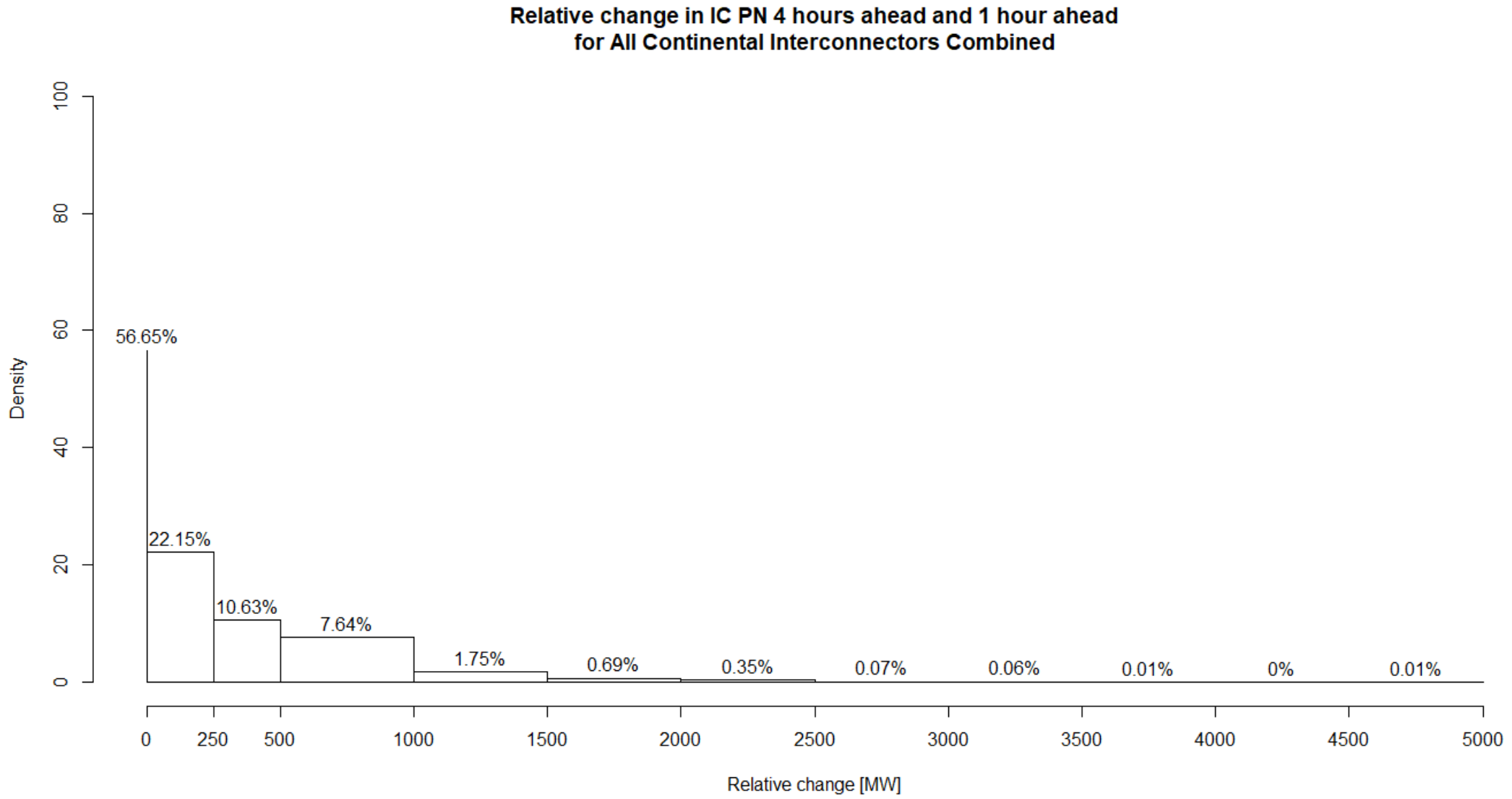
Operational Analysis – Frequency of hourly changes



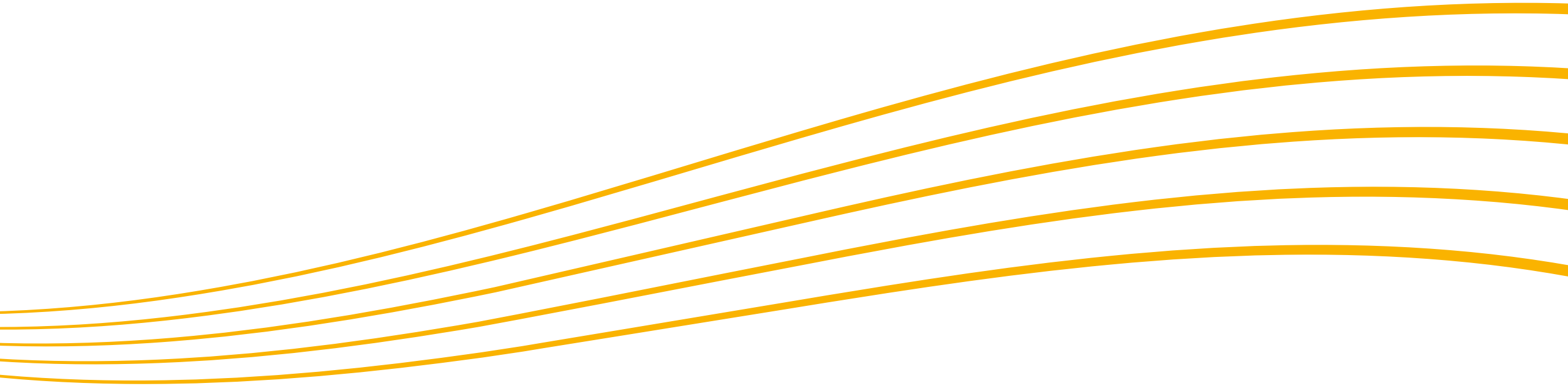




Operational Analysis – Short notice changes



Possible solutions to review



Possible solutions to review*

1. Apply current BMU ramping rates to the interconnectors as per BC1.A.1.1
2. Include current bespoke ramping arrangements, as they are, in the Grid Code.
3. Dynamic ramping rate - based on an assessment, NGESO will decide if any ramp rate limit needs to be amended.
4. Apply a reduced static interconnector ramp rate limit
5. Ensure NGESO holds sufficient response and reserve to facilitate unrestricted interconnector ramping.
6. Develop additional services with the interconnector and EU Transmission System Operators (TSOs) to mitigate ramping e.g., slow or delay.
7. Change cross border capacity markets.
8. Changes to the GB wholesale market design to be more compatible with cross border capacity markets.

*taken from the proposal paper.

Note: not exhaustive list of solutions to resolve the defect.

Apply current BMU ramping rates to the interconnectors as per BC1.A.1.1

PRO	CON
• We already have ramping requirements in the Grid Code which apply to BMU's. To extend these to the interconnectors would be a more simplistic change in the Grid Code • This would give parity to all Grid Users with the same ramping requirements for all parties	• The requirements in the Grid Code are slower than that currently agreed with some interconnectors • The arrangements in the Code are not reflective of the current generation mix and will be reviewed this year- could be amended post another code change • There is not a permanent need to slow ramping down, it is just when the system needs it for security of supply • EU TSO's would not support it

*taken from the proposal paper

Current Grid Code legal text – BC1 BM Unit data

BC1.A.1.1 Physical Notifications

For each **BM Unit**, the **Physical Notification** is a series of MW figures and associated times, making up a profile of intended input or output of **Active Power** at the **Grid Entry Point** or **Grid Supply Point**, as appropriate. For each **Settlement Period**, the first "from time" should be at the start of the **Settlement Period** and the last "to time" should be at the end of the **Settlement Period**.

The input or output reflected in the **Physical Notification** for a single **BM Unit** (or the aggregate **Physical Notifications** for a collection of **BM Units** at a **Grid Entry Point** or **Grid Supply Point** or to be transferred across an **External Interconnection**, owned or controlled by a single **BM Participant**) must comply with the following limits regarding maximum rates of change, either for a single change or a series of related changes :

- for a change of up to 300MW — no limit;
- for a change greater than 300MW and less than 1000MW — 50MW per minute;
- for a change of 1000MW or more — 40MW per minute,

unless prior arrangements have been discussed and agreed with **The Company**. This limitation is not intended to limit the Run-Up or Run-Down Rates provided as **Dynamic Parameters**.

An example of the format of **Physical Notification** is shown below. The convention to be applied is that where it is proposed that the **BM Unit** will be importing, the **Physical Notification** is negative.

Grid Code BC1 and appendix

Include current bespoke ramping arrangements, as they are, in the Grid Code BC1.A1.1

PRO	CON
• As there is already ramping set out in the Grid Code in BC1.A.1.1 for BMU's, we could include an additional annex for interconnector ramping, or section for interconnector ramping to be detailed • There would be no operational changes to the current processes for interconnectors • Transparency of all generation types ramping would be in the Grid Code	• SOGL states agreed ramping should not discriminate when it's applied • A change to the Code may be required to include this for each new connected interconnector • This maintains totally bespoke arrangements for each interconnector • This is the do nothing option, just keep it as it, but publish the rates. Either as an annex or in the section of code – it does not solve the issues that are arising operationally with the increasing interconnector connections or fully comply with the methodology text which Ofgem have agreed

*taken from the proposal paper

Dynamic ramping rate - based on an assessment, NGESO will decide if any ramp rate limit needs to be amended

PRO	CON
• By having a dynamic ramp rate, this will allow new and existing interconnectors to ramp at a standard rate which suits current system capacity. Our thoughts to do this are to forecast this in advance, based on Physical Notification's (PN) • This could influence thoughts for ramping to suit other generation types and was a suggestion in a previous meeting • There is an opportunity to review how this works with other TSO who follow this approach	• Current data provided to the ESO may not allow for enough time to forecast this accurately • Creates uncertainty of future operating conditions for a new interconnector or EU TSO • Consideration of a new section of the code for interconnectors may be required rather than to amend the current section to allow for compliance

*taken from the proposal paper

Apply a reduced static interconnector ramp rate limit

PRO	CON
• By applying a static rate that interconnectors can ramp at gives equal treatment to all interconnectors • This could be applied into the Grid Code in the Balancing code annex alongside ramping for other parties • Retains a certainty and transparency of the existing approach	• Difficult to forecast the appropriate ramp rate- the optimum ramp rate changes with system conditions • Concerns over substantial imbalance costs • This could significantly damage the socio-economic benefit from the interconnector

*taken from the proposal paper

Ensure NGESO holds sufficient response and reserve to facilitate unrestricted interconnector ramping

PRO	CON
• Allows for existing interconnector protocols to be continued • Market-based solutions have been expressed as a way to solve this defect • Demonstrates the cross border value of interconnectors	• Consequential operational risk- not enough reserves, inertia and voltage issues. What is Plan B? • Does not tackle the cause of the issue (IC ramps), it deals with the symptom. • Procurement cost would be high. Who would be able to pick up this cost and check it is cheaper overall for consumers?

*taken from the proposal paper

Develop additional services with the interconnector and EU Transmission System Operators (TSOs) to mitigate ramping e.g. slow or delay

PRO	CON
• Having commercial agreements with the interconnectors could support a range of system conditions • Allows ESO to value a user operating flexibly • Service would only be used when required	• Introduces bespoke interconnector treatment • Requires active controls • Could create limited number of providers

*taken from the proposal paper

Terms of Reference

Sally Musaka– National Grid ESO Code Administrator

nationalgridESO

GC0154– Terms of Reference

Please see terms of reference

Changes to the GB wholesale market design to be more compatible with cross-border capacity markets

PRO	CON
• Could facilitate different ramp rates in the whole GB area • A forward looking, market-based approach • Could link in with the TCA cross-border balancing work	• Could be duplicating work in the TCA or could require rework through the TCA • Changes to the GB wholesale market is very complex • Could also require changes to the EU Markets

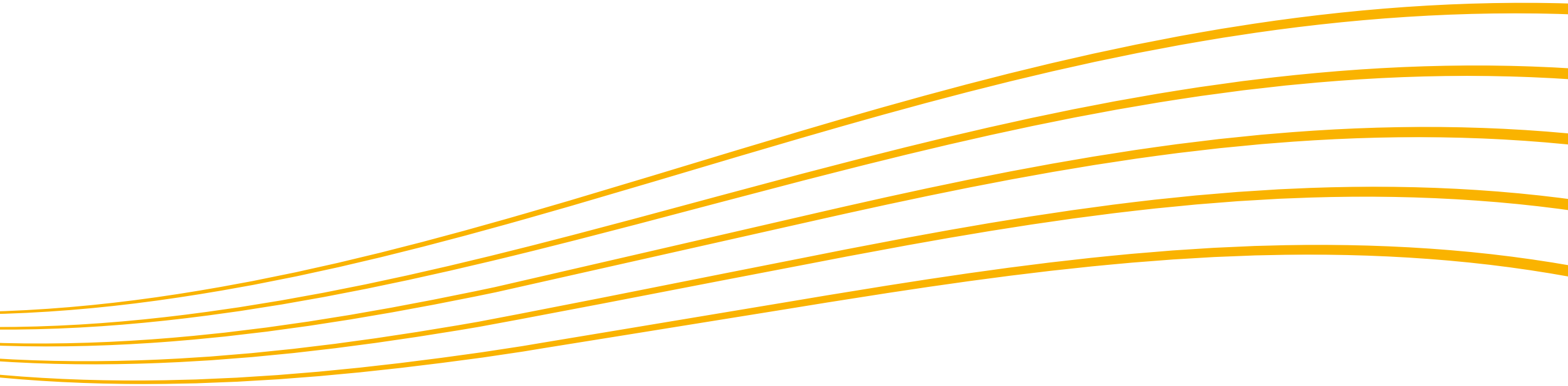
*taken from the proposal paper

Change cross border capacity markets

PRO	CON
• An alternative auction design may also have other wider benefits • A forward looking, market-based approach • Could link in with the TCA cross-border balancing work	• Not a decision that the ESO is able to easily influence • Could be duplicating work in the TCA or could require rework through the TCA • Could reduce the efficiency of interconnector capacity auctions

*taken from the proposal paper

Feedback



Feedback previously shared by Interconnectors

Concerns	Suggestions
Deviations	Could dynamic ramp rates help
Who is to pay the costs for imbalances	IC are kept financially firm for imbalances
This is an issue for certain times of the day, could this be disproportionately costly?	Only apply a dynamic ramp rate restriction when there is a system need
ESO causes imbalances on the continental side	Continental TSO are consulted with and in agreement
Will there be reviews into the compensation on imbalance as the long and short is assumed to 'even out'	Flows are market driven- can this drive the IC being part of the balancing services?
All focus is on ramp rate restrictions	More market based solutions- not just a code change
Removal of the flexibility of IC seems blunt	Could the IC provide frequency response?
3 examples over 4 months does not indicate a big issue	Solution meets and need that cannot be reached with the current EA ramp management programmes
Restrictions on ramping moves the problem to the IC due to imbalances	
IC are flexible plant and this could prevent us responding positively in the markets	
Will reduced ramping have a cost to consumers	

Next Steps

- Review feedback we have had from the session – what do we like or not like for possible solutions
- Collate this to share back to the workgroup
- Solutions to be ratified further internally
- Look to create matrix with preferences of solutions so far (based on feedback)
- Consider when to start some modelling for this work and timescales for this