GC0154

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

Meeting 6

October 6th 2022

nationalgridESO

Action Log Review

Action Number	Action	Owner	Due by	Status
1	Share further thoughts on CBA	Workgroup	July 2022	Close
2	Share the draft CBA scope with the workgroup for information once the external consultant is confirmed	Louise	August 2022	Open
3	To provide the workgroup with an update on the Interconnectors meeting mid - September	Tom	6 October 2022	Open
4	Reply to the questions on the email from 13th July, share concerns in relation to imbalance, what compensation they need and why and why this is different to a change to the Operating Protocols	Louise	July 2022	Close

TSO update from ENSOE meeting

ESO has met with ENTSO-E and the Chair of the Inter- Synchronous Area SG and they did not have time to discuss in Sept meeting so are going to cover this early October. They will provide any initial feedback and have suggested a joint meeting later this year.

CBA update

Thank you for sharing your suggestions for inclusion in the CBA

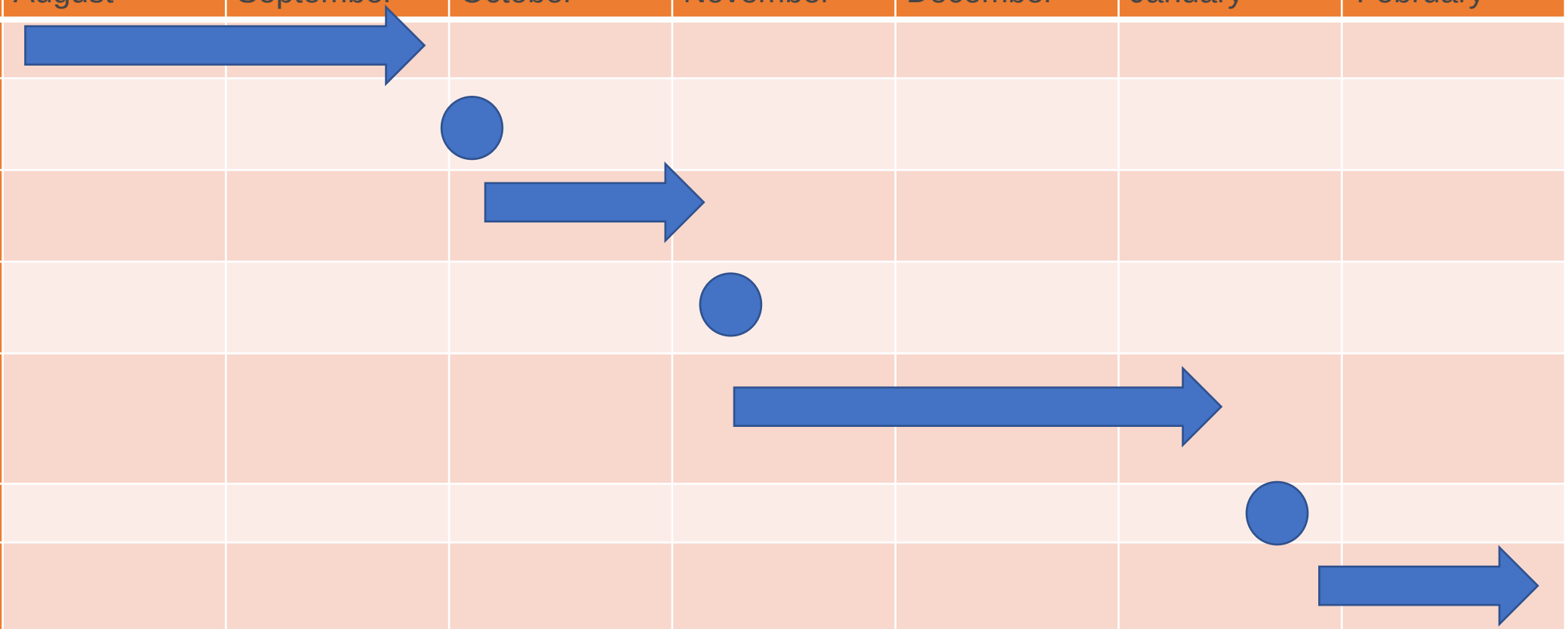
Next slide has an indicative timeline for progression on the CBA work

Clarity on some points is needed

Review suggestions in the document and discuss as a workgroup how to move forward

CBA update

Activity	August	September	October	November	December	January	February
Prepare CBA							
Appoint vender							
Create methodology							
Approval of methodology							
Conduct CBA and draft findings							
Review Draft							
Produce final report							



Operational examples

4/8/22

23:00hrs - 4.3GW swing out of GB (Nemo, Britned, IFA2, IFA, and NSL). Each at 100MW/min.

- 5 Pump storage units spinning in air with 3 instructed
- 300MW non-BM Fast Reserve
- Total cost estimated at ~£300k

6/8/22

23:00hrs – 2GW swing towards GB (IFA, IFA2 and NSL). Combined 223MW/min.

- Extra Hydro units instructed
- Increased levels of response instructed

7/8/22

16:00hrs – 3.64GW swing out of GB followed by 1.84GW swing out of GB at 17:00hrs

- Extra units advanced for margin and response reasons
- Total cost estimated at ~£150k

N.B. During these swings, Fast Reserve is used to manage the Frequency – if there is a concurrent system event the Frequency deviation is likely to be large and sustained.

Solutions to review for consideration

Discuss the options suggested in the CBA document and refine what some of these mean and if they should be considered

Criteria

- Can we implement to the grid code and does it fit the SOGL text
- Is the solution resilient for the future - med term- 5-10 years

To discuss these options and review if they are presented in the table of initial thoughts for the CBA

Solutions suggested in the CBA

Market-based solutions - We've previously stated that market-based solutions should be considered. One potential option worth consideration could be where each IC gets a 'banked' 50 MW, and the extra 50 MW is multiplied across the number of ICs, then a market is run for this availability.	
Option E- Add ramp rates to the Grid Code and ESO to identify in supporting TSO to TSO trade what self provided response and reserve capability can be made available to offset the effect of the aggregate trades and adapt operator- operator agreements to realise that flexibility made available with the relevant TSO	
Option F- Add ramp rates to the Grid Code and ESO to identify opportunity for pan TSO balancing to enable response and reserve capability available at a given time of co-incident ramping to offset GB impact of additional holding elsewhere within the market- agreeing TSO- TSO agreements to reflect.	
Option G- ESO to consider voluntary tapering of ramps to respect settlement period positions whilst limiting the volume of instantaneous ramping within the settlement period.	
Option H ESO to set up a "ramping market" where, based on the day ahead position of trade and risks estimated across ramping transition a volume dependent escalating ramping price is identified reflecting the costs incurred in operating the GB system, which allows the benefits of offsetting that position to be reflected by those offering flexibility to mitigate it whether interconnectors or other providers	

Stakeholder analysis/thoughts?

Discussion point for any thoughts to be shared by the workgroup on any analysis that has been completed outside the workgroup

Next steps

Sally Musaka – National Grid ESO Code Administrator

Annex

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 is not in scope of this modification

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

Possible solutions discussed (Not in scope)

Not in scope for GC0154	Justification
Working with ESO, to understand how the new technology (i.e. battery) and new market design can help ESO manage ramping for ICs and other generation assets	Manages ramp rates but does not solve root ramping problem, fits more so into balancing services programme of work.
Effective utilisation and design of additional services with ICs and other technologies	Does not solve root ramping problem
Change of GB wholesale market design and IC capacity market which might be the enduring solution	High complexity, would require market reform, timescales not aligned with OFGEM/ESO expectations
Establish cross border Frequency response on all borders through the ICs	Would provide assistance to manage ramping but not necessarily solving the problem.
Change to a 5 minute settlement period to address the root cause.	Exemption already in place for 15 min ISP under EBR. This would involve total change of market design which is not in scope for this mod.
Create a market for ramp rates.	High complexity, would require market reform/lengthy process, also may seek to solve swings rather than ramp rates.
NGESO set a maximum ramp rate for each period of the day and then interconnectors bid for the use of this ramp rate.	High complexity, requires creating a market for ramp rates leading to same reasons not in scope as above.
Changes to the GB wholesale market design to be more compatible with cross border capacity market	Major change to the GB market – potential long term solution but not in scope with OFGEM or ESO expectations for solution timescales
Change cross border capacity markets	Complex to change and implement, requires holistic European agreement

Possible solutions discussed (In scope)

In scope for GC0154	Justification
Dynamic ramping rate - based on an assessment, NGESO will decide if any ramp rate limit needs to be amended	Provides a flexible, dynamic ramping solution to ensure ICs are given the max ramp rate possible (reduces imbalance compared to other options). Allow IC to move with system needs and capability providing future system resilience.
Apply a reduced static interconnector ramp rate limit	Provides a simple interim solution to the problem, providing the same ramp rates as BMUs. However, would require reviewing as the system changes and not a future resilience solution
Include current bespoke ramping arrangements, as they are, in the Grid Code BC1.A1.1	Provides compliance within Grid Code, however does not solve the operability problem, so lacks future resilience as security of supply is threatened Maintains current high costs and operational challenges due to IC ramping and aggravates with new IC. Also has the potential to create disparity within generation mix. Least preferred NGESO option.
Develop additional services with the interconnector and EU Transmission System Operators (TSOs) to mitigate ramping e.g. slow or delay	An additional service could be use in conjunction with other options to meets compliance and operational needs in addition to a commercial service to the IC. However. additional services are in scope of other NGESO work streams (TCA/Ancillary services)
A dynamic overall ramping rate, is only derived based on a verified market condition if above market solution doesn't work	This would allow more control over ramping across different periods with a pre agreed process. However, this does not provide NGESO enough time to manage the ramping issues (i.e. if IC gates reduce to 1hr), especially with increasing connecting IC.
Stagger ramping windows so only 1 or 2 ICs are ramping in the same period. this reduces the combined IC ramp rate meaning all ICs could continue to utilise 100MW/min. To reduce the imbalance exposure, ICs could move to a value such that the "area under the curve" is the same volume as the volume in the Market energy block	This would work with our current systems and energy market, by allowing for smoother ramping profile and allow for reduced ramping imbalance costs, however is not a future proofed solution due to the increasing IC numbers and may not fit with European markets.
Codifying the current IC ramping limit of 100 MW/min.	This suits compliance, but does not address the operational issues and therefore not future resilient, due to the increasing number of interconnectors.
Apply current BMU ramping rates to the interconnectors as per BC1.A.1.1	Provides compliance within Grid Code and provides parity across all GB connected generation units. However, is not a future proof solution as we would lose the benefit of faster ramping. This could also lead to an increased cost to GB consumer, due to imbalances created, whilst not being reflective of future generation mix.

Preferred ESO Solutions (In scope)

Option 1 - Dynamic

- Preferred NGESO option
- Allows control over ramping with a pre agreed process
- Applied base rate value to ramping using dynamic tool to release additional ramping based on rate of change in demand share
- Resilient for the future
- Risks- not tested

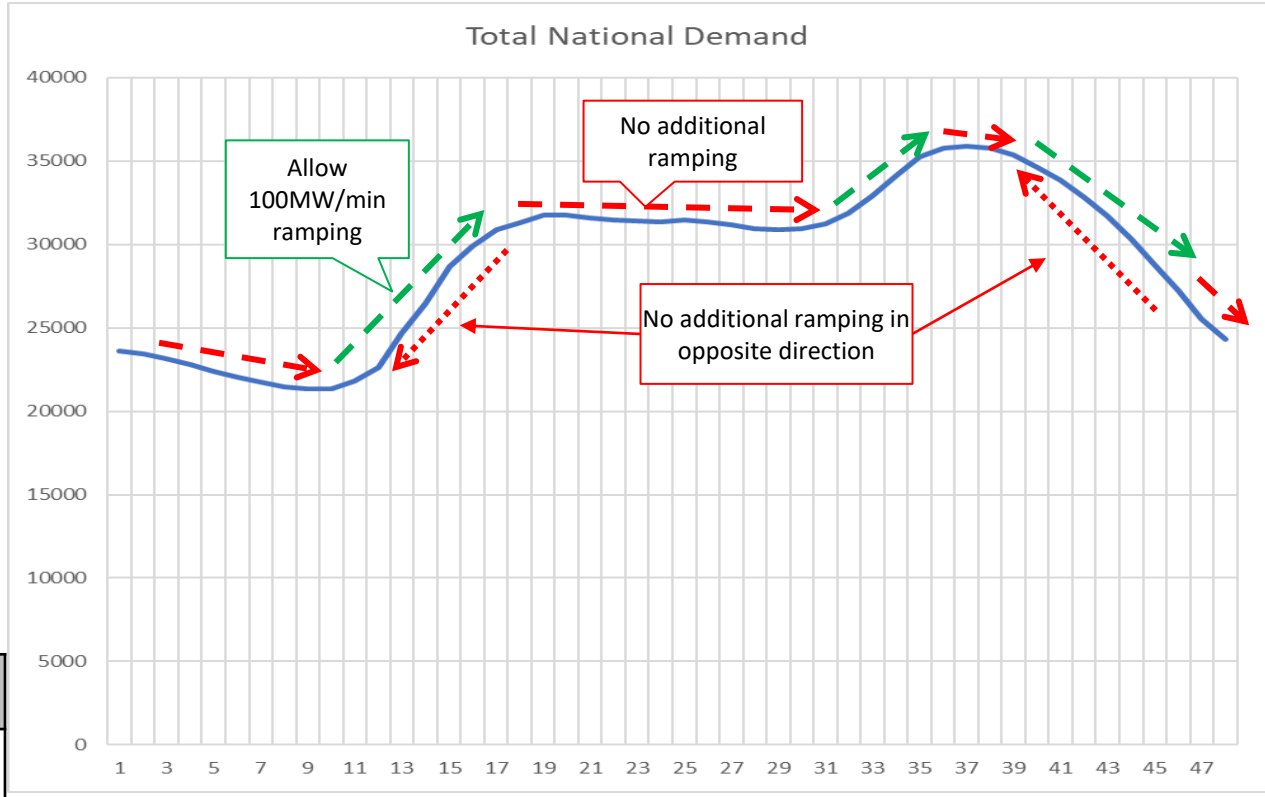
Option 2- Static

- Reduces ramp rate at all times not just when operational challenges exist
- Same ramp rate as BMU
- More of an interim solution to allow for testing

ESO Recommended Solution - Dynamic ramp rate

- Process to manage ramping when met by system needs
- Base ramp rate to be applied to IC at all times with increased ramp rates to be made available if system conditions allow
- We would allow for IC to ramp slower than the base rate at all times
- IC should follow base ramp rate when moving opposite to demand direction

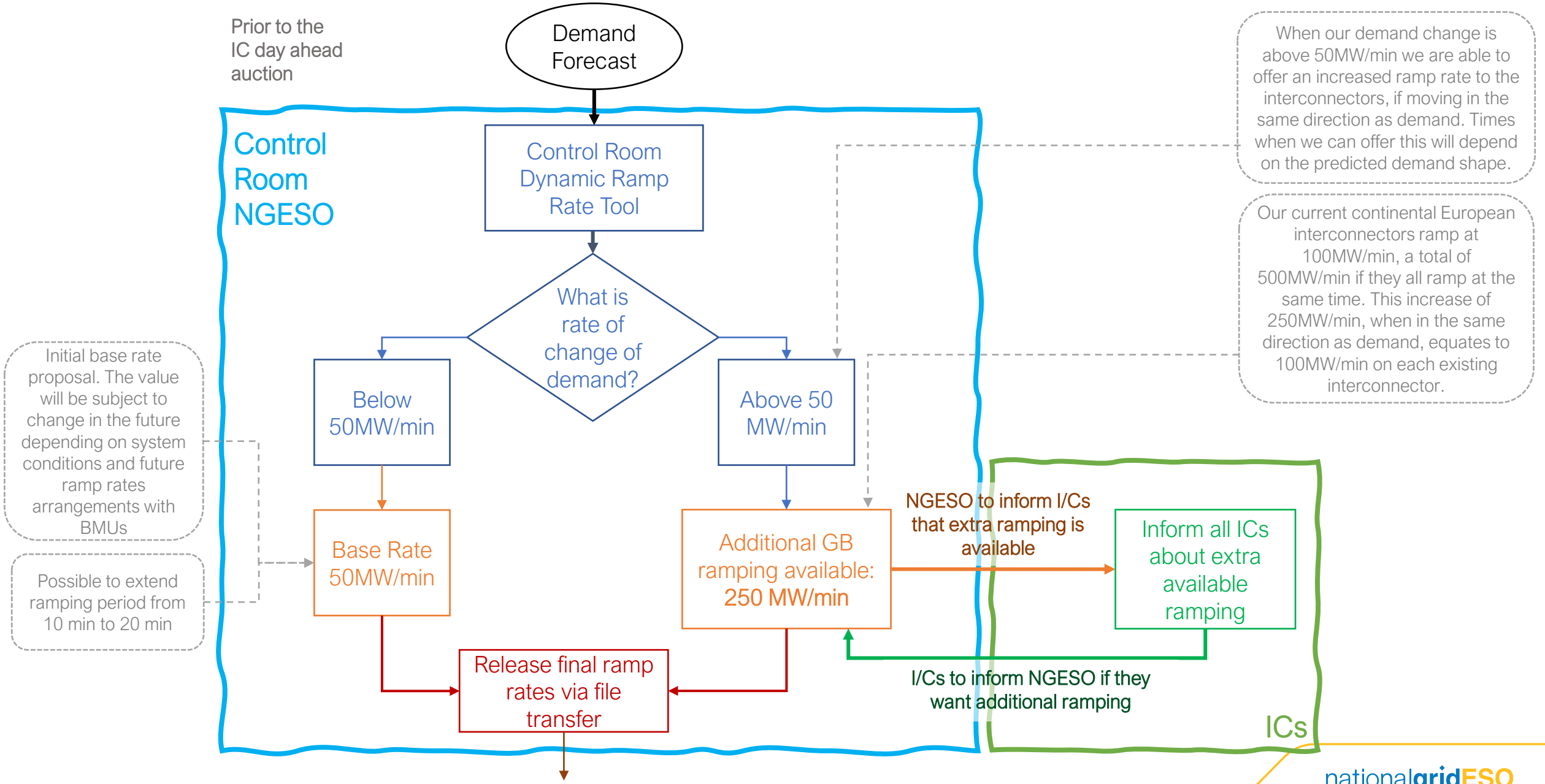
Data	Why?
Base Rate Value **50 MW/min**	As per BMU restrictions within the Grid Code
Additional available ramping cap of **100MW/min**	As per current arrangements
Additional GB ramping made available when rate of demand change is >50MW/min: **250 MW/min**	Our current continental European interconnectors ramp at 100MW/min, a total of 500MW/min if they all ramp at the same time. This increase of 250MW/min, when in the same direction as demand, equates to 100MW/min on each existing interconnector.
Notice for IC for extra ramping available:	Prior to the interconnector day ahead auctions



Advantages

- Resilient for the future
- Allows the control room to work with a pre agreed process set out in the code
- Have more flexibility to manage cost in the control room which in turn is a benefit to the end consumer
- The process can be a relatively simple file transfer

Dynamic ramp rate Process Flow Diagram



What questions do we still have?

Open questions	Mitigations
• What is the solution impact on the control room and IT systems? • Impacts to the remote end TSOs? • Emergency protocol if forecasting demand change is uncertain? • How we intend to integrate into the future balancing system?	• Potential for a phased approach of implementation to support transition • Plan in place to seek feedback with remote TSO after workgroup • Make ESO data transparent • Plan in place to begin impact assessment to internal ESO IT system • Ongoing conversations with IT about future impact assessments

Summary of feedback received (to 8th July)

Feedback	ESO Comments
100MW/Min to be included in the codes complies with the ask from Ofgem (SOGL)	Noted, this is the simple option, however it does not seek to resolve the operational issues we have shared as a result of fast IC ramping. Not addressing now could then require a further code change to be raised
Key driver for a dynamic solution is to impose more onerous ramping restrictions and has expanded the scope of what is required	The ESO wishes to have more control over the times when ramping is moving faster than demand. This approach does not seek to impose continuous restrictions, just when the system requires them
Examples provided do not show significant justification that IC cause increasing balancing costs in certain system conditions	The ESO has tried to share examples to demonstrate the operational issues with increasing number of IC on the network. This will increase as more IC connect unless a change is made
The time that a CBA may take to complete could mean further delays to compliance	Yes, this a concern, however as this change is seeking to ensure resilience to the network, ESO is keen to keep progressing and updating stakeholders on its progress
A review of ramping should be done as a wider review of balancing costs to allow careful consideration it deserves	Ramping for BMU is not in scope of this work as ramping restrictions are already in place. The ESO would like to recommend that the BMU ramping is reviewed should the dynamic solution be implemented for IC ramping
Impacts on the current tri-lateral agreements in place with each TSO	There will be engagement with the TSO to review these documents and the solution – including any impacts. This will be shared to the workgroup where possible
Understanding how the IC will be impacted financially and if there will be compensation payments made should this be the case	The ESO is keen to ensure that there is a fair solution for all parties and one that benefits the end consumer. Any costs that the IC are concerned about should be shared as part of the CBA. We would welcome this data being shared to understand where the impact lies

Feedback discussion

Meeting held to discuss with the ICS. Do we want to do anymore this time or wait and reply to the email properly?

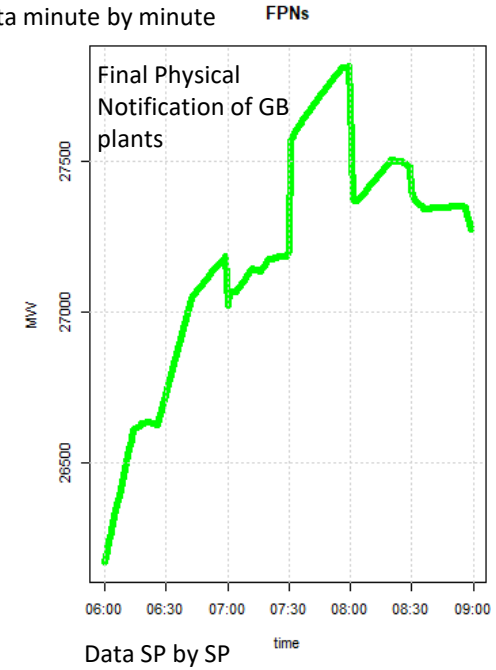
Operational Analysis – Costs of repositioning all the plants

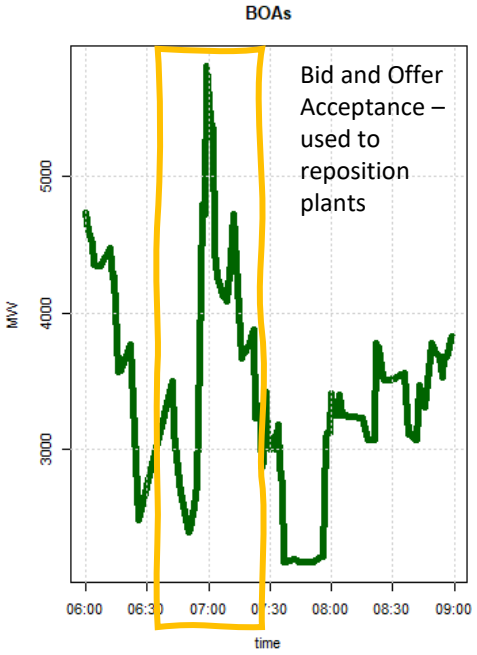
Example of 24th March 2022 07:00

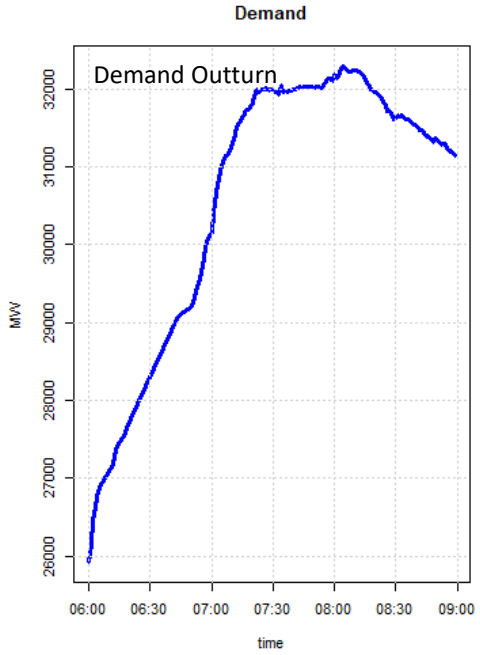
Close to 7:00 am – we can see the highest volume of Bid and Offer Acceptance close to IC ramp before gate change

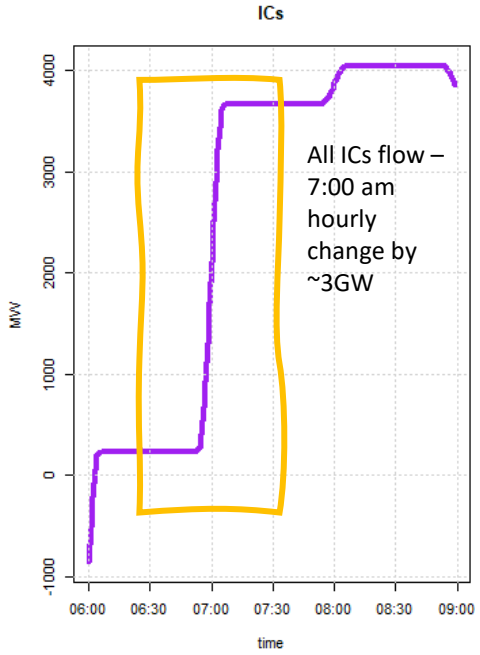
The high volume of BOA taken has a direct influence on high Energy Imbalance Costs for this Settlement Period as well as Frequency Control Costs

Data minute by minute

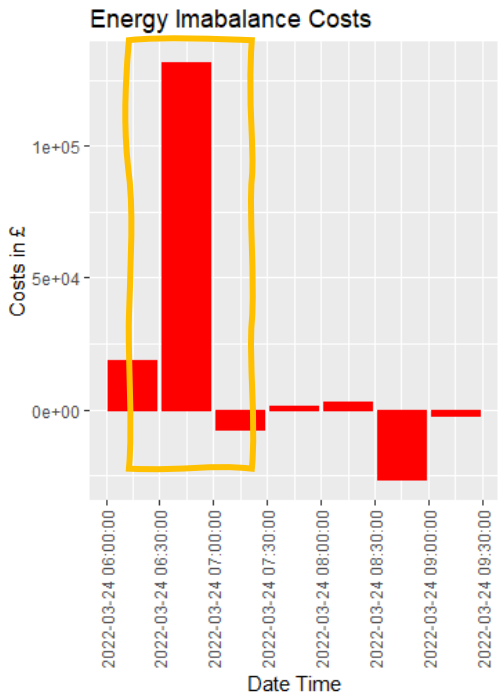


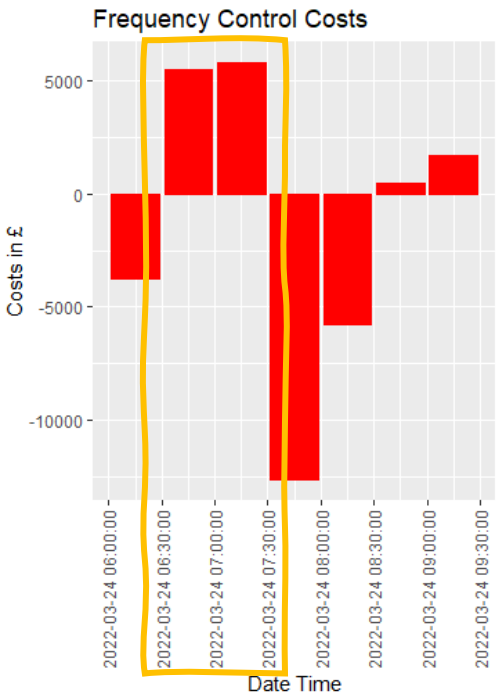


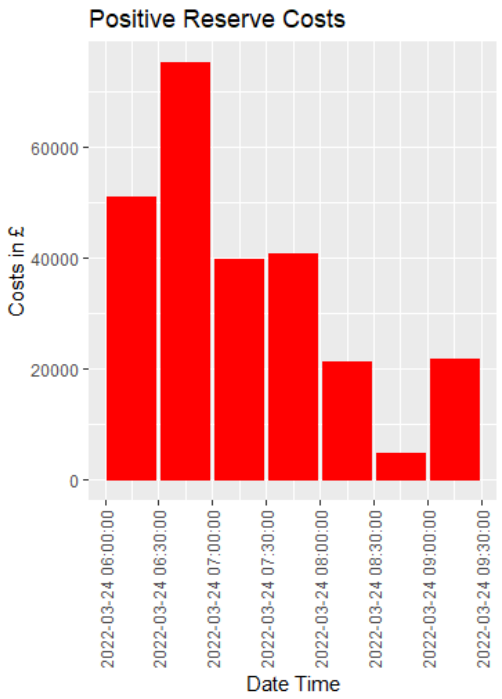


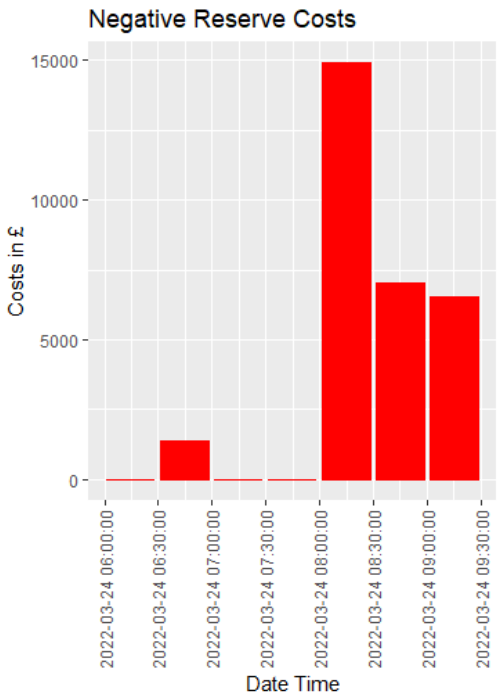


Data SP by SP







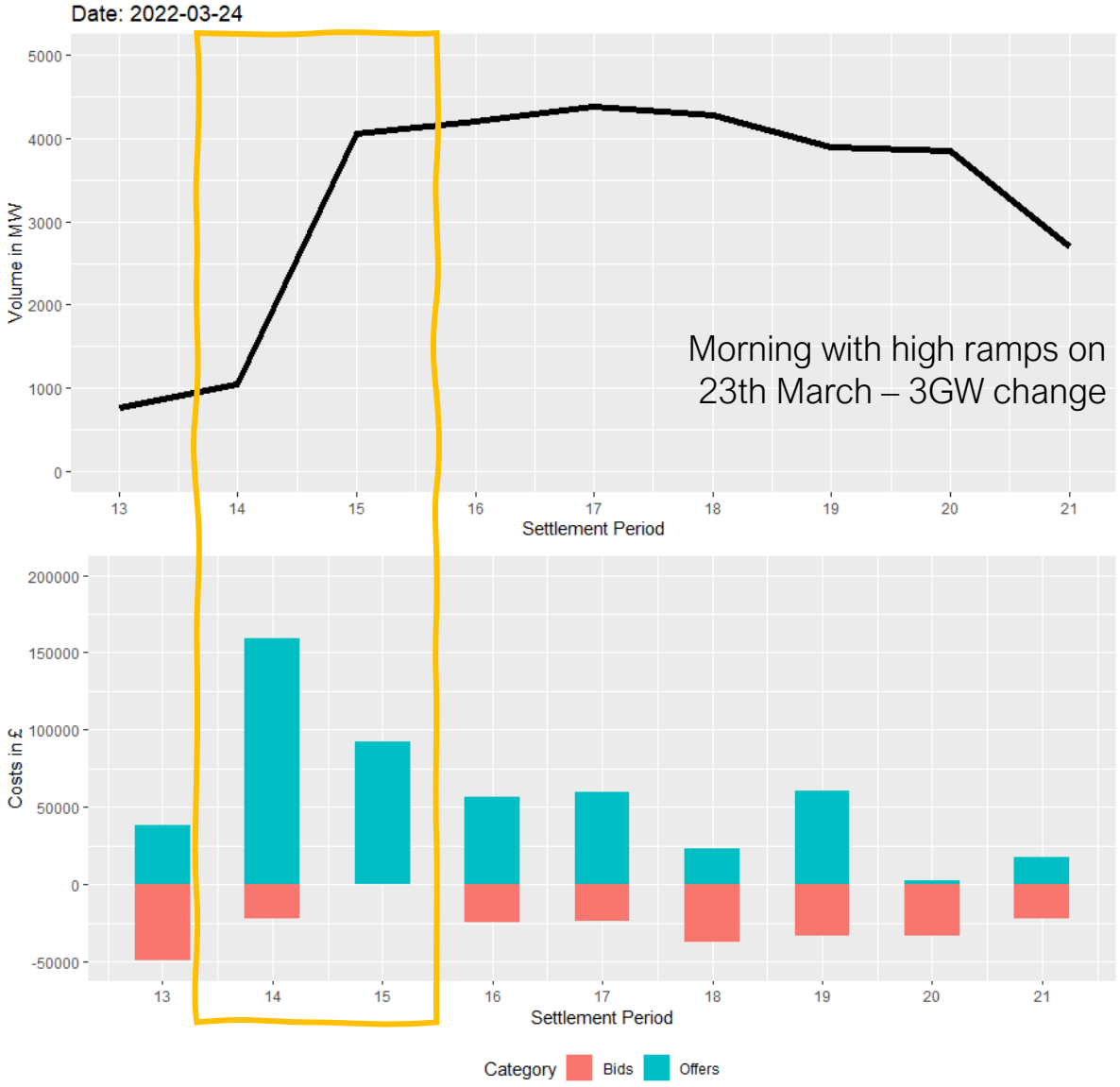


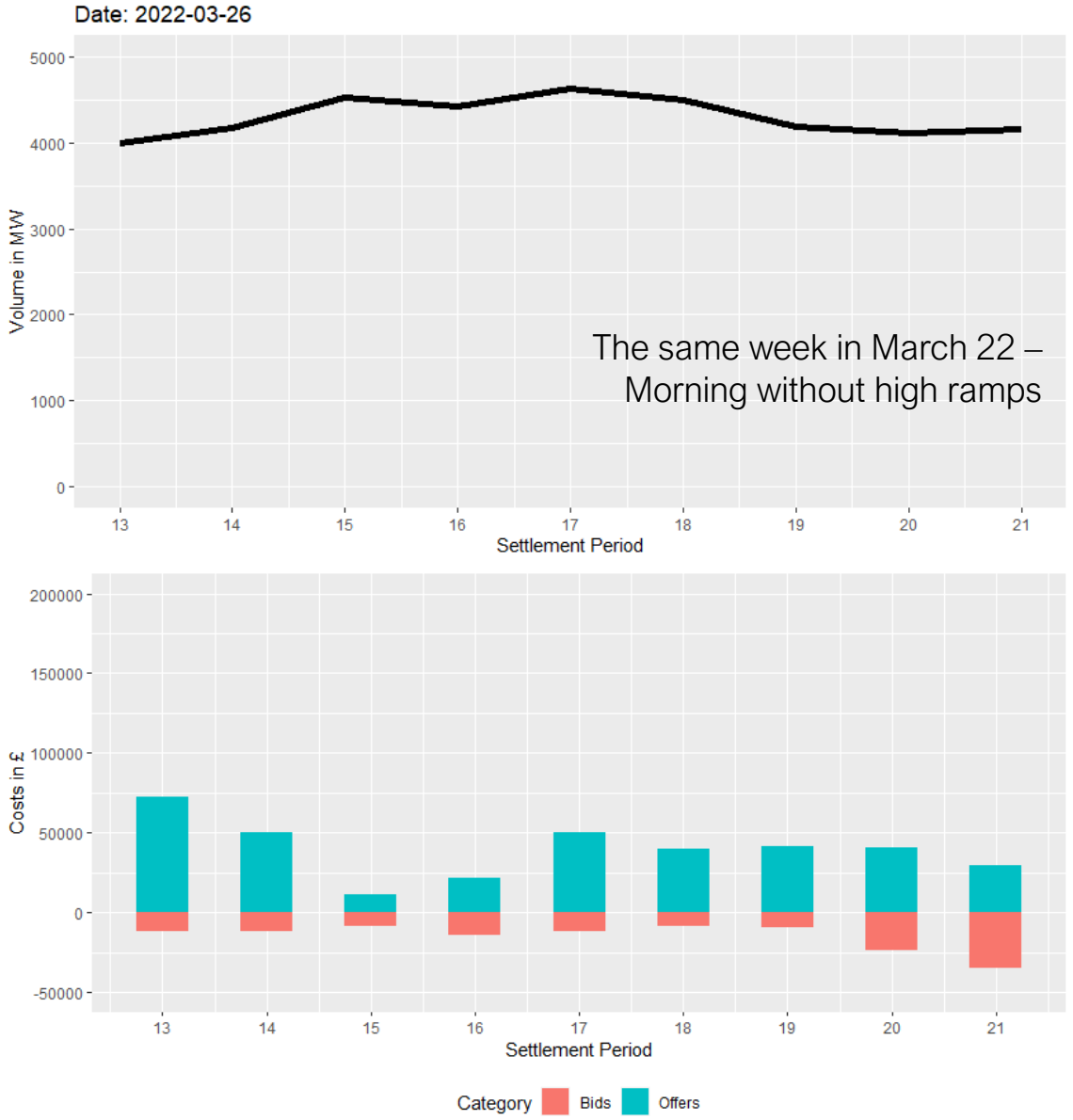
Costs data available on ESO Data Portal

Bid and Offer Data is available on ESO Data Portal & BMRS (Elexon)

Operational Analysis – Costs of repositioning all the plants

Example of BOA costs with large Ramping and without large Ramping





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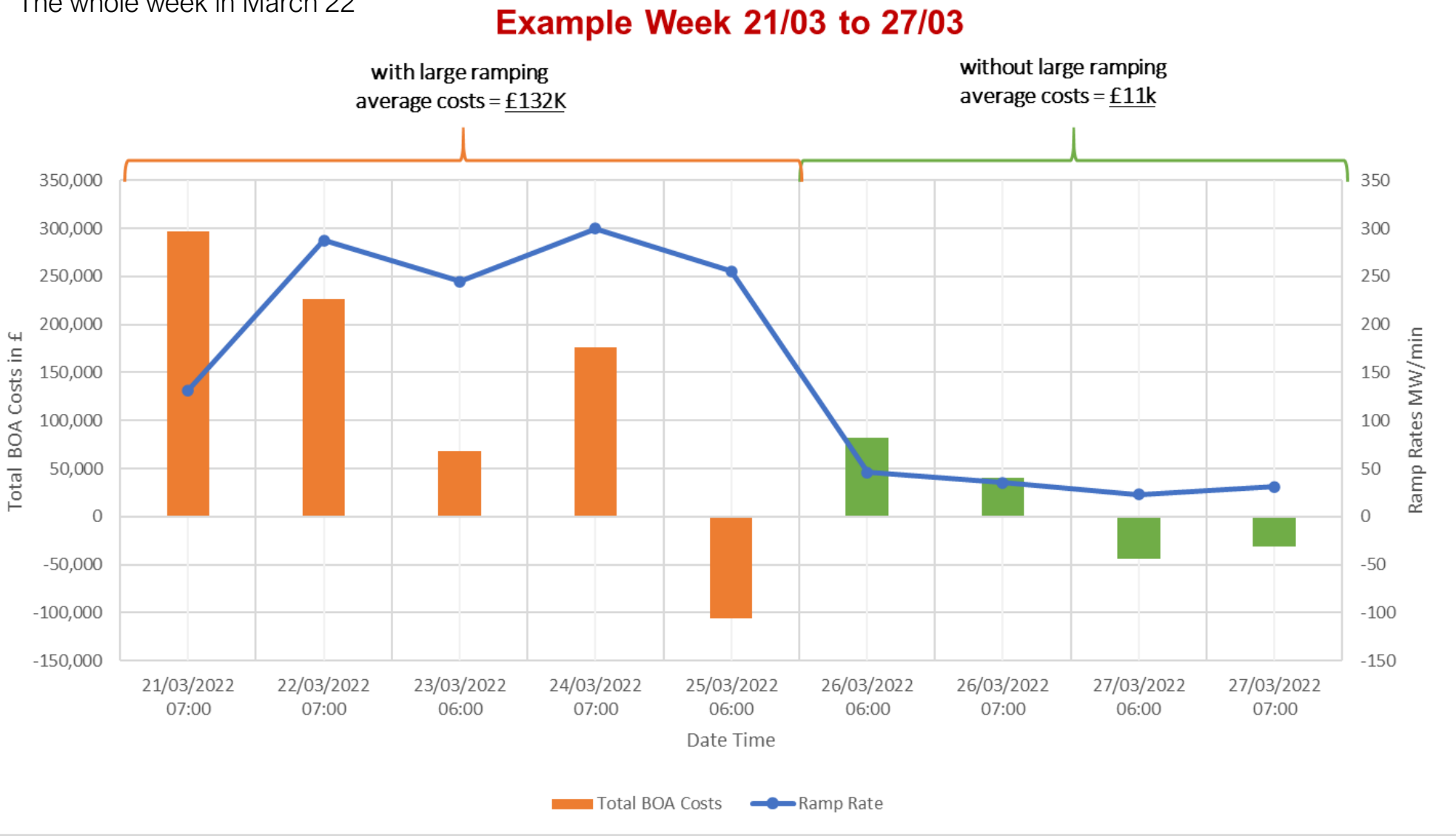
Operational Analysis – Costs of repositioning all the plants

Example of BOA costs with large Ramping and without large Ramping

The whole week in March 22



Operational Analysis – Costs of repositioning all the plants

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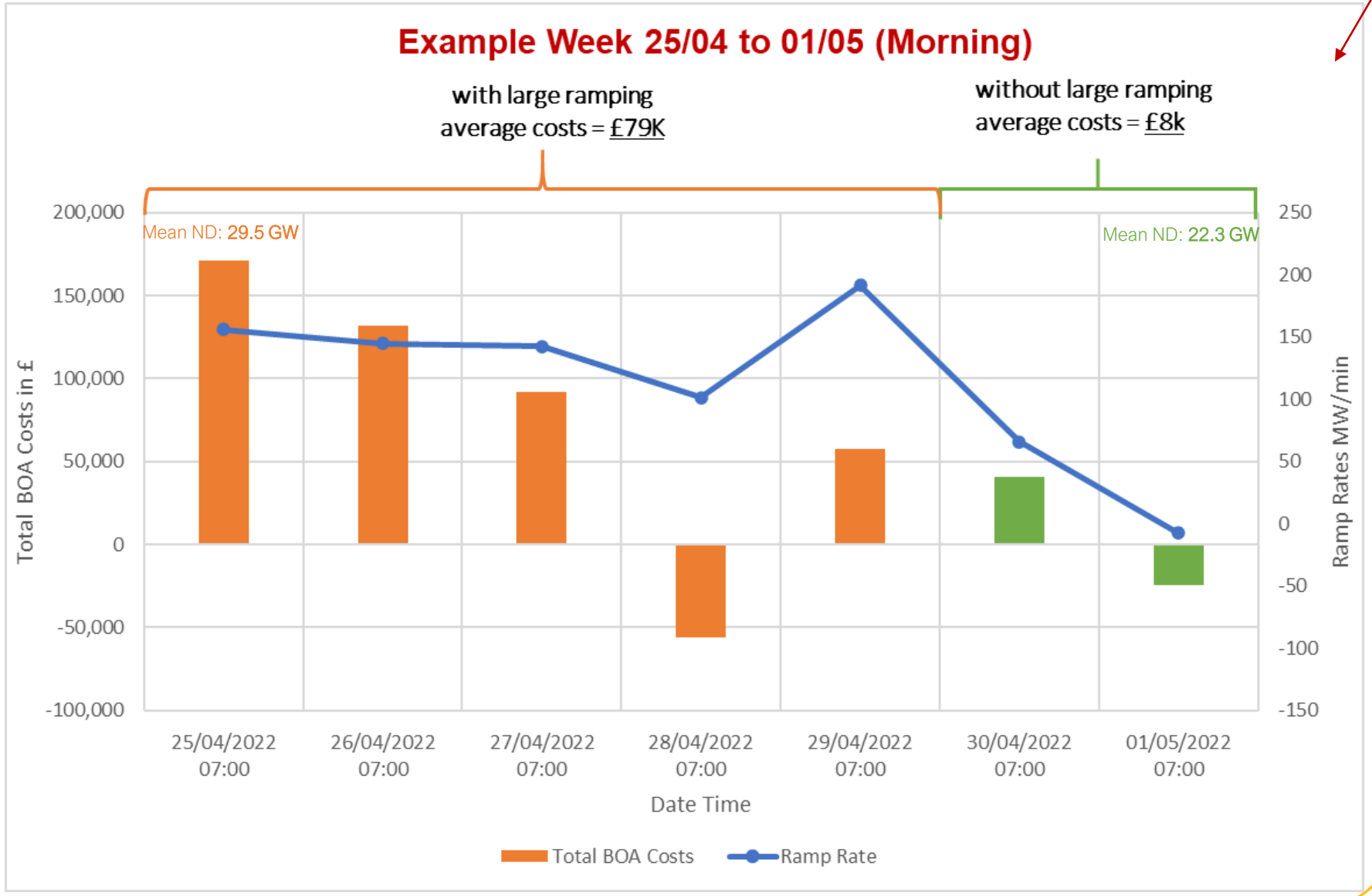
Wind during the week: Low (between 1-3 GW)

Example of BOA costs with large Ramping and without large Ramping



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