

Draft Final Modification Report

GC0154: Incorporation of interconnector ramping requirements into the Grid Code as per SOGL Article 119

Overview: This modification seeks to codify ramping requirements for Interconnectors (ICs) into the Grid Code.

Modification process & timetable

1	Proposal Form 01 July 2022
2	Workgroup Consultation 11 July 2023 - 03 August 2023
3	Workgroup Report 20 September 2023
4	Code Administrator Consultation 06 October 2023 - 07 November 2023
5	Draft Final Modification Report 06 December 2023
6	Final Modification Report 03 January 2023
7	Implementation 10 WD following Authority Decision

Have 10 minutes? Read our [Executive summary](#)

Have 60 minutes? Read the full [Draft Final Modification Report](#)

Have 120 minutes? Read the full Draft Final Modification Report and Annexes.

Status summary: The Draft Final Modification Report has been prepared for the recommendation vote at Panel.

Panel recommendation: The Panel will meet on 14 December 2023 to carry out their recommendation vote.

This modification is expected to have a: **High impact** on Interconnectors as the relevant SOGL (System Operator Guidelines) Article refers to the HVDC (High Voltage Direct Current) interconnector ramping restrictions for active power.

Modification drivers: This modification is driven by EU Compliance and direction from Ofgem. The Compliance is in line with SOGL Article 119 1 (c) as retained in UK Law under SI 2019, no. 533.

Governance route Standard governance modification which has been assessed by a Workgroup.

Who can I talk to about the change?

Proposer:
Louise Trodden, ESO
Louise.trodden@nationalgrideso.com
Phone: 07866 165538

Code Administrator Chair:
Catia Gomes
catia.gomes@nationalgrideso.com
Phone: 07843 816580

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Executive summary

The System Operator Guideline ([SOGL](#)) is one of the European Network Codes that has been retained in British law following the European Union exit. Currently Interconnector ramping arrangements are detailed within individual Operating agreements held between the Electricity System Operator (ESO), the Interconnector Owner and the connected Transmission System Operator (TSO). Ofgem recognise arrangements are in place for ramping to suit the requirements of SOGL, however, requested for ramping arrangements to be included in the Grid Code for clarity to all parties (including future connecting Interconnectors).

What is the issue?

The System Operator Guideline ([SOGL](#)) is one of the European Network Codes that has been retained in British law following the EU-exit. SOGL Article 119 required ESO as the responsible Great Britain (GB) Transmission System Operator (TSO) to write and have approved by Ofgem, operational methodology texts which included ramping arrangements for the active power output on High Voltage Direct Current (HVDC) Interconnectors. This included an LFC (Load Frequency Control) Block Operational Agreement (which covers Article 119 and is [here](#) with an accompanying supporting document [here](#)).

The methodology texts were submitted to Ofgem and approved however, Ofgem in their [Decision Letter](#)¹ set out that interconnector ramping arrangements should be incorporated into the Grid Code to allow clarity for stakeholders.

It is ESO's intention in this modification to address the need to set out provisions for interconnector ramping into the Grid Code as instructed.

What is the solution and when will it come into effect?

Proposer's solution: The proposer recommends a standard 50MW/min ramping limit for HVDC Interconnectors. This is based on a Cost Benefit Analysis (CBA) undertaken by Baringa. This option proposes to reduce balancing costs by £865m over the study period (2023-2030) to the GB consumer and reduces the impact to security of supply as a result of unforeseen fast simultaneous Interconnector ramping.

This ramping arrangement will be applicable to all existing Interconnectors in service, those currently in construction/scoping, and future connected Interconnectors.

Implementation date: The proposed implementation date is 10 days after approval by the Authority.

Summary of alternative solution(s) and implementation date(s):

Alternative 1 (WAGCM1) was raised by a collective group of Workgroup members, proposing that a ramp rate of 100MW/min is codified in the Grid Code. Codifying 100MW/min would reflect the existing maximum ramp rate already agreed and detailed in existing bilateral operational agreements between the ESO and individual Interconnectors, but does not preclude future discussions. Codifying 100MW/min also reflects Ofgem's expectation – as set out in its 2019 approval decision – that the codification process would not 'constitute a change to existing GB requirements'. The Alternative Proposers felt that the potential balancing cost savings indicated by the Original Proposal were not proven and overestimate the benefits of a ramp rate reduction by omitting key considerations from the CBA assessment.

Workgroup conclusions: The Workgroup concluded by majority that WAGCM1 better facilitated the Applicable Objectives than the Baseline.

Panel recommendation: Panel will meet on 14 December 2023 to carry out their recommendation vote.

What is the impact if this change is made?

The Proposer anticipated that the proposed changes will achieve an ample reduction of balancing costs incurred as a result of fast simultaneous Interconnector ramping; a positive impact on achieving the national net-zero objectives avoiding last-minute polluting plant; a positive impact on Interconnectors, allowing them to follow their commercial reference programmes with negligible imbalance; and aid overall operability and system security reducing the probability of frequency excursions and the risk of violating system constraints in the South Coast. There is limited direct impact to other system users (apart from the reduction of the overall balancing costs), but the proposed changes will bring Interconnector ramping in line with BMU (Balancing Mechanism Unit) ramping.

A majority of the Workgroup believe that implementing the Original Proposal (codifying 50MW/min) could undermine the well-established benefits to system flexibility and the security of supply provided by Interconnectors. Its anticipated that the Original Proposal would have negative impacts on both GB Interconnectors and connected European (EU) markets by increasing imbalance costs on Interconnectors, system imbalance in GB and EU and potentially impacting the frequency quality in the connecting markets (hence security of supply). Furthermore, the majority of the Workgroup members do not recognise the perceived benefit to their commercial reference programmes as these are currently followed. The impacts on the EU side need to be further considered and needs to be assessed further and discussed with the EU TSOs prior to any changes to the current ramping arrangements between GB and the connecting TSOs.

Interactions

This modification (both Proposal and WAGCM1) addresses a required change as driven by SOGL, which is a European Network Code. This modification is impacted by EBR Article 18 approach due to possible changes to the Balancing Code. The Workgroup have considered the EBR implications as part of the Workgroup Consultation.

What is the issue?

The System Operator Guideline ([SOGL](#)) is one of the European Network Codes that has been retained in British law following the EU-exit. SOGL Article 119 required ESO as the responsible GB Transmission System Operator (TSO) to write and have approved by Ofgem, operational methodology texts which included ramping arrangements for the active power output on High Voltage Direct Current (HVDC) Interconnectors. This included an LFC Block Operational Agreement (which covers A119 and is [here](#) with an accompanying supporting document [here](#)). Additionally, with increased interconnection there are operational challenges that need to be addressed to ensure security of supply as a result of fast simultaneous Interconnector ramping, alongside reducing the impacts to GB consumers with increased balancing costs.

The methodology texts were submitted to Ofgem and approved however, Ofgem in their [Decision Letter](#)¹ set out that interconnector ramping arrangements should be incorporated into the Grid Code to allow clarity for stakeholders. (Ofgem states in their decision letter that *'the intermediate methodology is designed so that obligations detailed within its articles will be incorporated within the Grid Code or NETS SQSS, thus providing an opportunity, if necessary, to add further details.'*)

It is ESO's intention in this modification to address the need to set out provisions for interconnector ramping into the Grid Code as instructed.

Why change?

Ramp rate limits are currently specified in BC1.A.1.1 of the Grid Code, but only apply to Balancing Mechanism Units (BMUs) and therefore Balancing Mechanism participants. This section demonstrates compliance to Article 137 (4). Interconnector ramp rate limits are not therefore covered in the same way as generators. Currently, ramp rates applicable to Interconnectors are specified within respective trilateral agreements (the Interconnector Operating Protocols). Such agreements are between the two connected System Operators and the Interconnector Operator. To fulfil the requirements of Ofgem's decision letter and the obligations in Article 137 (3), a solution is required to incorporate Interconnector ramping in the Grid Code.

Currently, Interconnector ramping limits in GB have been set by a historic precedent in bilateral connection agreement at 100MW/minute. It is the ESO's view that a 100MW/min ramp rate is no longer operationally feasible. It is expected in 2032 that there will be nine Interconnectors connecting Great Britain to Continental Europe markets. This could represent a maximum combined ramp rate of 900MW/min and (when considering full import to export) an Interconnector profile change of up to 23GW as defined within a settlement period once adopted into the standard form used for BMUs. ESO have reported that on a daily basis it encounters scenarios where cross border markets react to the same price signals simultaneously, leading to rapid changes in Interconnector flow and frequency deviations. Additionally, Interconnectors' final positions are typically only confirmed 65-70 minutes prior to real time. It is the ESO's view that this highlights that a change needs to be considered to ensure that system security measures can be appropriately controlled and accessed ahead of time and that the right balance is struck between operational flexibility, efficient functioning of cross-border energy markets of which Interconnectors are key facilitators, and cost to consumers.

Background and history of work to date

¹ https://www.ofgem.gov.uk/sites/default/files/docs/2019/08/article_118_and_119_final_decision.pdf

On 14 September 2017, Ofgem published a [decision](#) which assigned obligations in Article 119 of SOGL to ESO.

Within the Article 119 proposals, there are some sections which specifically require approval from the Authority. They are:

(c) ramping restrictions for active power output in accordance with Article 137(3) and (4)²
(h) the Frequency Restoration Reserve (FRR) dimensioning rules defined in accordance with Article 157(1).

(q) coordination actions aiming to reduce Frequency Restoration Control Error (FRCE) and defined in Article 152(14).

(r) measures to reduce the FRCE by requiring changes in the active power production or consumption of power generating modules and demand units in accordance with Article 152(6).

A full review of all obligations took place and led to submission of mapping documents and intermediate methodologies to Ofgem in 2019. The mapping included the SOGL obligations which were already covered in the relevant GB codes (the Grid Code and NETS SQSS). This was inclusive of articles (h), (q) and (r), mentioned above. These articles have been acknowledged by Ofgem as meeting the provisions set out within the Article. The [Intermediate GB LFC Block Operational Methodologies³](#) were developed to outline the remaining obligations not covered by the GB codes. A supporting [document⁴](#) was also developed to accompany the methodology text.

Ofgem approved the intermediate methodology in August 2019, acknowledging that most obligations mapped to the Grid Code and NETS SQSS covered most of the requirements within 119, but outlined necessary steps that must be taken to ensure full compliance. In order to provide clarity to stakeholder requirements, Ofgem's [Decision Letter⁵](#) requests the ESO to publish the intermediate methodologies (in accordance with Article 8(1) of SOGL) until mapping to the Grid Code and the NETS SQSS is completed for the outstanding areas. The expectation was also that the ESO would expedite this work.

The remaining obligation refers to item (c). Whilst the approved methodology highlights that ESO has the right to agree common ramping arrangements with Interconnectors and EU TSOs, further work is required to set this out within the GB frameworks. This will allow development of a solution to enable ramping arrangements for active power output of each HVDC Interconnector to be mapped to the Grid Code within Balancing Code 1 (BC1), and the accompanying Annex of this section of the code.

Since the publication of the decision in August 2019, GB has left the EU. A set of Statutory Instruments (SI)⁶ were published, including [The Electricity Network Codes and Guidelines \(System Operation and Connection\) \(amendment etc.\) \(EU Exit\) Regulations 2019](#). This SI has been reviewed against the pre-EU exit SOGL European Network Code (which originally placed requirements on ESO through articles mentioned in the proposal paper). This review was carried out to assess whether the obligations are still relevant and retained

² Article 119 within the SI removes the reference to article 137 (3), however, 137 (3) is retained in GB law. the ESO has discussed this inconsistency with BEIS and we have clarity that this a discrepancy in the legislation which will be updated at an appropriate time.

³ <https://www.nationalgrideso.com/document/127201/download>

⁴ <https://www.nationalgrideso.com/document/127196/download>

⁵ https://www.ofgem.gov.uk/sites/default/files/docs/2019/08/article_118_and_119_final_decision.pdf

⁶ Statutory Instruments (SIs) are a form of legislation which allow the provisions of an Act of Parliament to be subsequently brought into force or altered without Parliament having to pass a new Act.

in GB law. The review confirmed that the only outstanding SOGL reference which requires mapping and subsequent implementation to the codes is:

A119 (c) ramping restrictions for active power output in accordance with Article 137(3) and (4).

The Grid Code already specifies ramping rates for power generating modules and/demand units within BC1 demonstrating compliance for Article 137 (4). It is important to note this modification is only seeking to address Article 137 (3) (as detailed below)

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.

To comply with the outstanding requirements of SOGL Article 119, a code change is required. This will allow the ESO to implement and map the outstanding approved methodologies (referred to above) within the relevant codes as directed by Ofgem. This will be done through agreeing and defining Interconnector ramping and appropriately incorporating it into the Grid Code.

What is the solution?

Proposer's solution

The requirements of SOGL Article 119 (c) refer to the ramping restrictions on active power output of each HVDC Interconnector. To address this and be fully compliant, the Proposer suggests all existing and new GB Interconnector ramping requirements are included in the Grid Code.

The Proposer initially suggested a range of possible solutions which could be developed with industry stakeholders within the Workgroup.

Following the CBA completed by Baringa, the proposer recommends a static 50MW/min ramping limit for HVDC Interconnectors. This is based on independent analysis undertaken by Baringa.

Reducing Interconnector ramping to a static 50MW/min limit presented the largest cost saving in balancing costs in the Baringa study; this option proposes to reduce balancing costs by £865m to GB consumers over the study period (2023-2030), however some Workgroup members couldn't replicate the cost reductions due to information provided by Baringa. As per the options explored within Baringa's analysis, the static 50MW/min option is the least cost option so that the impact of implementation is not passed onto consumers. The lower ramping rate will also allow the Electricity National Control Centre more focus on economic despatch and daily actions to manage the system, rather than managing fast simultaneous ramping from Interconnectors, therefore benefiting security of supply. To meet the requirements of SOGL, this ramping arrangement will be applicable to all existing Interconnectors, those currently in construction/scoping and future connected Interconnectors.

This solution meets the compliance requirements detailed in SOGL and can be included into the Grid Code as per Ofgem's request.

Workgroup considerations

The Workgroup convened 17 times to discuss the perceived issue, detail the scope of the proposed defect, devise potential solutions, and assess the proposal in terms of the Applicable Code Objectives.

The discussion within the meetings has centred on the following topics:

Compliance to SOGL

The ESO shared the requirement from SOGL, and the subsequent letter based on the methodologies approved by the regulator to include ramping arrangements for Interconnectors into the Grid Code. There were no objections or concerns raised regarding this.

Operational and economic analysis/drivers

The ESO shared with the Workgroup several examples of the impacts of fast simultaneous ramping. The analysis shared highlighted that when Interconnectors react to market signals the rate in which the flow is reversed causes a change in energy. Data was presented to demonstrate that the size of this change has increased with the increase of Interconnectors on the network. The Workgroup also noted other contributory factors such as recovery from the Covid period, intermittent generator forecast, demand forecast, war in Ukraine and the ramping of a range of other types of generation assets all active at these times.

Indicative examples were shared with the Workgroup by ESO in an effort to demonstrate the costs of the actions taken in the control room to manage the system when large simultaneous ramping occurs. A majority of Workgroup members expressed concern that these were specific, individual examples and requested a broader, more comprehensive assessment of the nature of the operational challenge raised by ESO, e.g. confirmation of the proportion of total 2022 balancing costs driven by fast, simultaneous interconnector ramping, the lack of evidence provided for probability of frequency excursions and the risk of violating system constraints in the South-Coast. The requested information was not made available to the Workgroup so there remains significant disagreement as to the salience of the operational drivers asserted by ESO above. The ESO has provided statistics of occurrences for fast ramping and scenarios to illustrate the issue, although some Workgroup members weren't satisfied. The ESO also noted that there are some instances where the impact to balancing is not negative, however this is less frequent and operationally is still a risk for fast ramping arrangements continue.

Some Workgroup members sympathised with the issues faced in the control room and there were some Workgroup members who raised concerns of the severity of the issue as there have not been a frequency of events as result of large simultaneous ramping. The ESO advised that whilst it is 'manageable' to reposition units as a result of the change in flow on the Interconnector close to real time, it is a risk to security of supply and that this is likely to increase with the additional Interconnectors in the future. Some Workgroup members felt that there was no detailed assessment on the impact to the risk on security of supply and that in some cases, slower ramping can lead to increasing risk to security of supply as well.

Some Workgroup members further noted that by limiting Interconnector ramping, this would also limit benefits seen from rapid market ramping in alleviating regional constraints across normal operation, and these risks should also be factored into a given decision to limit current levels of ramping. It was noted that in some cases, limiting Interconnector ramping could reduce the ability for Interconnectors to support security of supply. Practical considerations surrounding how limits to ramping would be introduced into the control systems of Interconnectors, and how trading arrangements would be impacted in the short-medium term were also highlighted and discussed.

Discussion was also held regarding the fact that the current arrangements in place for Interconnector ramping were based on agreements made in 1986 when the IFA Interconnector was first commissioned and that the changes to the system over the last 30+ years require a review to ensure system operability.

Recommendations/Solutions

The proposer shared several options for discussion, which aim to resolve the issue operationally (with the aim that these could ultimately be included in the Grid Code). The initial thoughts were as follows:

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

The Workgroup was asked to share feedback on these options and detailed discussion took place in meetings relating to the feasibility of them and the impacts that may arise, with the positives and negatives being considered for each. The feedback was taken verbally, via polls in meetings and via email. All feedback from this has been collated and responded to; it can be found in Annex 3. Through the modification process the Proposer highlighted which options were and were not in scope. The justification for this was based on the requirements from SOGL and operational drivers for change linked to the Terms of Reference for the modification. The Workgroup considered future technology capabilities in this process; however, this was not considered in scope as this modification relates to Interconnector ramping arrangements only and is considering a solution for the now to medium term, not a long-term strategic view.

Some Workgroup members expressed concern regarding the impacts to Interconnector imbalance and the ESO requested that imbalance costs/data be shared in order to understand and help support the development of a solution. Consideration was given to any compensation that may result from imbalance. This data was not supplied by Workgroup members.

The ESO proposed a solution it favoured from the discussion held in the meetings and the initial list of solutions. This was a dynamic ramping option. The ESO presented why this was preferred but recognised there were challenges with the option to understand before formally suggesting it as the proposed solution.

Through the discussion with the Workgroup and the request for the Workgroup to share thoughts or ideas that they would like to recommend solving the issue, a list was formed of 8 options (9 including the status quo) These were broken down into 3 categories- ramp management, ramping arrangements and market-based options based on conversations in Workgroup meetings. It was recognised by all parties that a market-based solution may not be feasible in this instance. This list shows the solutions for review in the CBA (Annex 4) .

Baringa ref	Theme	Suggested solution	Detail
1a	Ramp Management Tools	TSO- TSO agreements	Use the existing ramp rates in Interconnector agreements and add to the Grid Code. Then arrange a tool that allows for SO- SO trades to counteract the ramp to slow down ramping.
1b		TSO- TSO agreements	Use the existing ramp rates in Interconnector agreements and add to the Grid Code. Utilise European balancing platforms to allow for optimisation of products in the market when simultaneous fast ramping requires counteraction
2a	Ramping arrangements	Dynamic ramp rate	Base ramp rate of 50MW allocated to all Interconnectors. Additional ramping to be made available based on day ahead forecasting of up to 250MW with a max ramp rate of 100MW. The additional ramping is based on the rate of change of demand forecast
2b		Static ramp rate	Interconnectors have a base rate ramp limit of 50MW the same as generators
2c		Static ramp rate (status quo)	Interconnectors currently connected to the system have a ramping maximum of 100MW- continue with this rate

3a	Market Based Options	Procure increased Frequency response	ESO to hold sufficient Frequency Response to facilitate up to 100MW/min Interconnector ramping
3b		Base rate set for all IC and a market would be created for IC to participate	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. The IC to choose if they wanted to be in that market.
3c		Create a ramping market	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.

There was no agreement in the Workgroup for a preferred option, despite various in-depth discussions. This led to the agreement that a CBA should be conducted to support the Workgroup in making a decision on a recommendation to solve the issue both from an operational perspective and to meet SOGL compliance.

Cost Benefit Analysis (CBA)

CBA inputs

The Workgroup agreed that a CBA would be required to support the development of the solution. The ESO employed Baringa to complete this independently and included the Workgroup in the process where possible. The purpose of the CBA was to review the list of options collated to review if there was a requirement to change the current ramping arrangements. The Workgroup expressed interest in being part of this process and stated the CBA needed to be clear in its scope and assumptions.

The solutions presented to Baringa were discussed in a Workgroup meeting and shared by email to the Workgroup members for comment and review.

Baringa attended several Workgroup meetings. In the first meeting they attended, the purpose was to introduce themselves and to share how they had determined which options they would review in the CBA, noting that it was not possible to review all the 8 options. Baringa explained the approach they had taken, using the Harvey Balls method, informed

by bilateral discussions with the Proposer. The Workgroup challenged this approach as there was concern that this was driven by the ESO. There were also transparency concerns raised by the Workgroup that any feedback shared was not visible as the whole Workgroup were not included in the Proposer's bilateral meetings with Baringa. The Proposer and Baringa assured the Workgroup that all feedback received has been shared to Baringa for them to use in their work and Baringa advised the Workgroup that the selection process was done independently. This led Baringa to seek the views of the Workgroup to advise what solutions it would have preferred to see modelled with rationale to support this. The objective being to review inclusion of options that all parties were comfortable with.

Baringa attended meetings to update the Workgroup at specific milestones of the CBA and supported discussion to determine what would be included in the CBA. The Workgroup shared two possible solutions to consider in the CBA and Baringa created a set of assumptions based on these options. Some Workgroup members provided feedback, and the overarching comments were responded to. There were some more specific questions which related to implementation, and possible consultation questions to consider that were not directly responded to. There was also an ask back to the Workgroup to provide imbalance data to support the modelling and the CBA work.

The options list was reduced from the original 8 through the shortlisting and options assessment completed by Baringa, supported by bilateral discussions between Baringa and the Proposer. Subsequently, this created discussion in the Workgroup and the interconnector parties shared a preference to include specific solutions. Baringa reviewed these suggestions, provided some assumptions to complete the modelling, and reviewed how the solutions were aligned with the scope of work. This then suggested that the final list was as detailed below.

2c-100MW/min (status Quo)

2b-50MW/min(static)

2a-50MW/min dynamic option- increased ramping available based on demand.

1a-100MW/min with a ramp management service to reduce ramping.

Option 3a to include the ESO holding more response and reserve was removed, despite it being an option that could provide market-based solutions, as the ESO already had a workstream to review response and reserve. Therefore, Baringa concluded this option was out scope of the work being conducted. The dynamic ramping option was included as the 4th option to review in the study. The operational issue being addressed is fast simultaneous ramping, which as more Interconnectors connect to the network is likely to increase. Increasing the response and reserves (if there are available market parties to do so) does not solve the issue of fast simultaneous ramping. Workgroup members felt that no further suggestion was made from the ESO on how to solve the issue if a market-based solution was to be established. These fast changes in flows across the network also impact system stability and voltage issues and some Workgroup members expressed concerned about this, as this has come up very late during the Workgroup discussion and they felt that no evidence has been given to support. The markets roadmap details the work being completed and can be found on the ESO website [here](#).

The Workgroup had a preference to review the TSO-TSO arrangements under option 1a so option 1b was removed from the list.

Option 3b was a combination of option 2a and 2b, both of which were being included in the CBA. This was not included as the Workgroup did not share a preference for this after the Harvey Balls review session.

Option 3c was discussed as part of the Workgroup's solutions, but it was agreed in the meeting that at the present time, there are not enough connected Interconnectors to create a market for ramping.

Where decisions for the CBA were concluded, all Workgroup members were invited to review and provide feedback. Where feedback was provided, this supported discussions between the Proposer and Baringa regarding the approach and assumptions. Following this dialogue Baringa advised the Workgroup on which solutions it intended to model and the assumptions it was proposing to use to use. Feedback on the approach was welcomed.

CBA outputs

In the final meeting attended by Baringa, they presented the outputs of the CBA. The Workgroup discussed the CBA results at length. The key highlights were:

- Concerns regarding the balancing costs methodology and clarity over the way that volume and cost was calculated. The Baringa representative advised that weighted averages were used to calculate these figures, explaining that the reason for this is that demand is not linear and that by using the data for a year, this gives more confidence. Workgroup members expressed significant concern that Baringa's methodology could not reliably assess the likely impact of each option on GB balancing costs.
- Workgroup members highlighted that there could be actions in the BM that are not Interconnector actions, which raised some concerns; the ESO representative advised that the Interconnector has a 1hr MTU (Market Time Unit) and the rest of the market has a 30 min MTU and this shows where the Interconnectors are likely to be ramping. The Baringa representative added that this was why the methodology looked at the delta for the instructions on the hour and half hour +/- the 15 minutes for ramping periods. However, Workgroup members felt that this explanation by Baringa was still not sufficient as even within the hour change, there are other assets that could be ramping at the same time as Interconnectors so balancing actions around the hour should not be attributed by ramping on Interconnectors alone.
- The Workgroup discussed consideration of Multipurpose Interconnectors (MPIs)- however felt that this was not in scope as it is not clear if MPIs are to be treated as Interconnectors.
- Concern that constraint cost and management was not reflected in the analysis which viewed TSO areas as unrestricted in operation.
- Discussions about ramping rate and ramping size, with the Baringa representative advising that there is a combination of both to consider as with more Interconnectors the rate increases, therefore it was considered that the best estimate of costs is determined by establishing a relationship which affects the volume and the rate, which will give the suggestion of cost.
- The Baringa representative advised that they have been cautious with the costs so as to not overestimate and that should the numbers be adjusted to IFA (Interconnexion France-Angleterre) then these costs would indeed be greater. Some Workgroup members expressed concern about the methodology that Baringa used for the CBA.

- Questions raised on system buy and sell price, with the Baringa representative advising that this was based on wholesale prices as using assumed sell prices would be overstating the problem, highlighting again that if there is data that can be shared it would be taken into consideration. Workgroup members expressed concern on this, and felt that Baringa did not understand how the balancing cost has been evaluated, i.e., the replacement cost concept.
- Points raised regarding the use of batteries as response to fast ramping frequency issues and pointed that the market will be different in the future. The ESO representative agreed that batteries are great for this as they can deliver the response in short time, however, there is also the time to recharge to consider and that this is not predictable, advising this could be reviewed in the future where we could be looking at ramping generally, not just for Interconnectors.
- Concerns surrounding the use of interim solutions discussed in work group- e.g., staggered ramping, Interconnectors holding own reserves. These were beyond the capability of the Baringa model to analyse.
- Concerns about the impacts of imbalance for Interconnectors being qualitative and not quantitative and worries about the spill to the next period. The ESO representative advised that data had been requested from the Workgroup with regards to imbalance costs but may not have been provided in its entirety. Workgroup members noted that Interconnector imbalance costs can be fairly calculated from public data. i.e., Elexon, therefore there was no need to require Workgroup members to provide this.
- Questions regarding the PLEXOS outputs and how this was impacting the markets, the flows, how this represents consumer welfare and the EU costs. The Baringa representative advised that the flows are in the PLEXOS model, and this is the Pan EU model that is used in industry and well recognized. Explaining that it is also not possible to model a market in real time and that the data used was at the same granularity on both sides- GB and EU. Areas of uncertainty present within this data were discussed but the impact of this was not further quantified by Baringa in the CBA report.
- The Baringa representative advised the Workgroup that the CBA results are not a recommendation but a high-level overview and a summary.
- Questions about the way the costs for Security or Supply were calculated, with the Baringa representative advising that this was a qualitative assessment reflected by the control room.
- Concerns regarding the balancing cost for EU/welfare; the Baringa representative advised that this is in the table in Annex 4 and that PLEXOS considers the reserves costs for the EU countries.
- Questions about how the EU TSO manage AC (Alternating Current) ramping and the ESO representative advised that they have a bigger network, so it is not as obvious when there is a change to the frequency due to ramping.
- The Baringa representative advised the implementation in the PLEXOS modelling is assuming that the Interconnector capacity connecting GB is the same in all options, recognising that there may be an impact on Interconnector value from changing the ramp rates and if is sufficiently large, this could influence investment, advising that this will be captured qualitatively, not within the PLEXOS modelling but

as a separate line item. Workgroup members expressed concern this hadn't been evaluated.

- A Workgroup member pointed that when reducing ramping to 50MW/min the biggest concern is to complete it in compliance with the ramping window and if this is passed into the adjacent period it can pose a serious risk that could increase the imbalance costs for the Interconnectors as well as systems operability difficulties. The Workgroup member questioned how Baringa handles this issue when assuming a 15-minute granularity as it could potentially be a significant cost increase. The Baringa representative advised that they decided to keep demand flat as the markets operate on an hourly basis and only change those inputs granularity for purposes of the Interconnector ramping.
- There has not been clarity over whether the consumer welfare effects of increased imbalance costs for Cap and Floor Interconnectors resulting from lower ramp rates, have been factored into the projected savings to GB consumers.
- Some Workgroup members still have strong reservations on the outputs of the CBA and have asked for further clarity on some questions. Some Workgroup members also requested sight of the underlying data informing Baringa's analysis, to enable validation of the work undertaken. Some Workgroup members also had additional questions regarding the CBA as the potential additional costs to Interconnectors are not reflected in the document. The responses to this have been shared with the Workgroup in the feedback file which has been collated and shared with the Workgroup. This can be found in Annex 3.

EU TSO engagement

As part of the initial Workgroup discussion, the Proposer highlighted that there would be a need to engage with the connected EU TSO in the process. There was agreement from the Workgroup that this was essential, and some Workgroup members wanted the connected TSO to be part of the Workgroup. A standing item was included in the agenda to discuss TSO engagement.

Following the above, the ESO representative shared an update to the Workgroup of the outputs from a meeting with the EU TSOs which had taken place on 31 January 2022. This meeting was to ensure clear communication between the two groups and highlight to the EU TSOs the initial views from the first Workgroup meeting. The ESO further explained to the Workgroup that a TSO Engagement plan was in place and that they would be seeking to engage with the EU TSOs in this process.

Through the process, the ESO representative shared outputs from the Workgroup meetings with the EU TSOs noting that due to the changes since BREXIT, GB was not a participant in these meetings, so was sharing the information through a member of that Workgroup. A document with all engagement was shared to the Workgroup at the end of March 2023 (Annex 3).

The ESO has since had more detailed discussions with the connected EU TSOs regarding the recommendation from both the ESO and the Workgroup. The ESO also shared the CBA from Baringa for review. The Workgroup expressed that more detailed discussion was required.

During Workgroup meetings and emails, the Workgroup raised concerns that there had not been enough engagement with the connected TSOs. In response to this, the ESO asked the Chair from the Intra Synchronous Area Working Group to attend a Workgroup which was a welcomed channel of information which the Workgroup hoped would continue in future meetings if possible. It was also noted that EU have used HVDC projects such as INELFE (France-Spain interconnector) for fast AC line emulation, and that similar Grid forming controls are now being specified on new continental European ends of new interconnectors, which would drive near instantaneous power flow swings not captured within ramp rates as defined above.

Consideration of the proposer's solution

There has been significant concern raised by the Workgroup regarding the Proposer's solution:

- **EU TSO alignment:** There was a lack of sufficient engagement with partner EU TSO's and therefore changes in parallel by EU TSOs have not been considered. This could create operability mismatches and risks damaging relations where effective co-operation will be essential going forwards.
- **Energy Security Risks:** A proposal to reduce the ramp rate on Interconnectors means reducing the speed and flexibility of Interconnectors to respond to system tightness and in most cases to match supply and demand between countries.
- **Insufficient CBA:** Although a significant amount of work has been carried out to present the results of the CBA, there are several areas where the CBA has not quantified and covered deeply enough, particularly the operational risk, implementation costs and impacts of imbalance costs in EU markets.
- **Potential negative impact on meeting GB net zero targets:** Despite the best attempts thus far of the ESO, the approach of the Original Proposal risks having a negative impact on the role of interconnection and offshore infrastructure as a key facilitator of the GB and EU energy transition as recognised by UK and EU Governments in recent months.

Workgroup members noted:

- The need to limit ramp rates occurs at specific times, relating to a combination of Interconnector actions and other energy market factors at those times. The option of applying these more stringent ramp rates only to these specific periods of market stress was discussed as a potential variation of this proposal.
- The lower ramp rate restriction would limit the flexibility that Interconnectors currently have to stagger ramps to avoid co-incident ramping.
- High ramp rates are not always a disbenefit to system operation, given that they allow more rapid alleviation of regional constraints in normal operation than would otherwise occur and provide flexibility to respond quickly to market signals on margins and capacity.
- The proposal being retrospective in nature would impact existing control systems interfacing with the market and market contracting.

Some Workgroup members expressed concern that in the single-out of one factor of Interconnector coincident ramping meant that only a short-term response to a broader issue was being responded to. It was noted that as transitions to Net Zero occur, more intermittent generation will need to be "pooled" across TSO areas driving the Interconnectors to transfer power to greater volumes and adjust individual positions more

rapidly than before. This need was not limited to Interconnectors, but also a variety of energy storage devices and demand-side actions, and the central challenge was the organisation/ incentivisation of these individual changes such that they do not become herded in nature. By reducing the ramp rate to individual parties, this does not address the point that over time more parties are emerging that will respond in similar ways at the same time if action is not taken to address the issue.

Some Workgroup members disagreed with the Proposer's view of the Baringa analysis output which indicates that the Original (option 2b) proposes to reduce balancing costs by £865m over the study period (2023-2030) to GB consumers and reduces the impact to security of supply. This potential balancing cost reduction was not supported by some of the Workgroup members who felt that there was a lack of detailed data and supporting information, as well as the CBA overestimating the benefits by omitting key considerations from its assessment.

Consideration of other options

Several Workgroup members collectively proposed an alternative solution to the Workgroup.

WAGCM1

On 28 June 2023, the Workgroup voted as to whether or not the proposed "Request for an Alternative" should become a Workgroup Alternative Grid Code Modification (WAGCM).

The Workgroup voted by majority that the Alternative better facilitates the Grid Code Objectives rather than the Original, and that it should be taken forward as a Workgroup Alternative Grid Code Modification (WAGCM1). The full results from this vote are set out in Annex 9 and the Alternative Proposal is available in Annex 5.

WAGCM1 (Annex 5) proposes to codify the existing 100MW/min ramp rate which has been agreed between the ESO and respective Interconnectors in bilateral agreements in the Grid Code to ensure compliance as per SOGL article 119. The key difference between WAGCM1 and the Original Proposal is the codified ramp rate value with the Original being 50MW/min and WAGCM1 being 100MW/min.

Other Workgroup considerations

The Workgroup discussed the option of specific ramping market arrangements to more generally address the issues of coincident ramping. This option was considered by the Proposer and the Baringa analysis to represent unjustified complexity and delay in response to the issue. The option of holding balancing reserves on Interconnectors whilst ramping was further raised. This option was considered to be precluded by existing EU arrangements. However, given that the EU are actively applying this same approach to within EU TSO trades across both HVDC and AC assets it remains unclear why this should be the case going forward.

Across Workgroup meetings there was disagreement in the benefits attributed to the proposal and of the CBA associated with it as discussed above.

The Workgroup considered the potential for a new modification to be raised based on the Alternative proposal as it relates to reflecting the existing maximum ramp-rate as already agreed and detailed in the current operational agreements within the Grid Code, the ESO and Interconnectors then exploring flexible responses to cumulative ramping within the clarity this provides.

Some Workgroup members considered that the materiality and complexity of this matter requires a whole-system approach and the potential development of new market-based solutions to support the ESO's management of the GB system, based on a robust evidence base and without unnecessarily imposing an onerous technical restriction on all current and future Interconnectors at such a pivotal stage of our transition to net zero.

Such arrangements range from those available by bilateral agreement, to those requiring new control or updates to existing control whose timeframes for implementation would need to be agreed bilaterally. It was suggested at the time that the date by which such new measures are made available and/or a reporting of progress towards these could be made a part of this Grid Code modification, and consistent with practicalities of the implementation of the proposal would not be expected to exceed 6 months from implementation.

Some Workgroup members also suggested that addressing ramp rates alone does not of itself address the issue of cumulative ramp rates occurring at the same time. They noted there are a variety of contributing factors to how the operational challenges arise which do not completely relate to Interconnectors alone, but also other ramping actions, changes in availability of intermittent generation and net transmission system demand. Given the need to ensure timely SOGL compliance, some Workgroup members suggested reviewing the operational challenges via a further Grid Code modification with the view to possibly introduce a market-based tool such as a TSO-TSO ramp management service. Such a Market could be based on following principles of:

- A given estimated market cost for a given total ramp occurring being attributed at a given time.
- Reflective on the market cost then incrementally charging those BM units contributing to the cost at that time.
- Paying others capable of reducing the net ramping effect at that time in reflection of the benefit to the operator from that action at that time.
- The overall nature of such a market arrangement could be constructed to be cost-neutral in nature to balancing costs, and/or reflect a default assumption of ramp rates allowed without cost incurred. It may provide for short/ medium market/ contract participation to further limit costs incurred.

The exact market proposal is beyond the scope of this Workgroup to formulate and would require the involvement of parties not part of the current Workgroup to deliver an overall solution.

Workgroup consultation summary

The Workgroup Consultation was launched on 11 July 2023 and closed on 03 August 2023. The full responses and a summary of the responses can be found Annex 7⁷. Eight non-confidential responses were received within the Workgroup Consultation timeframe, with 1 non-confidential response received after the Workgroup Consultation closed; this response

⁷ Post Workgroup Consultation it was identified that objectives f) and g) were incorrectly included on the Proforma for the Grid Code objectives. This didn't impact the Workgroup vote.

wasn't included in the summary of responses, but it was shared with the Workgroup for their information (full response available in Annex 8). Key findings are summarised below:

Objectives and Implementation

- Out of 8 respondents, 7 supported WAGCM1 agreeing that it better facilitated one or more of the applicable Grid Code objectives; All of the 8 respondents had comments and 7 didn't support the implementation approach for the Original Proposal.
- The majority of respondents (6 out of 8) considered that WAGCM1 effectively codifies the current ramping arrangements and provides additional transparency to all market parties, clearly meeting the requirements of Ofgem's 2019 decision. 4 respondents suggested that in their interpretation of Ofgem's decision letter of August 2019 which prompted this proposal, Ofgem expected existing ramping arrangements to be codified within the Grid Code to provide clarity on this existing regime, and support transparency within the Grid Code with the expectation of no major change such as the one now included in the Original Proposal.
- The ESO response noted that the Original Proposal meets the requirements of Ofgem's August 2019 decision to include ramping arrangements into the Grid Code. The ESO has also used this opportunity for additional detail to be considered to allow for a more efficient operation of the GB electricity system by proposing to reduce ramping arrangements and increase system security whilst seeking to reduce balancing costs. The ESO also advised that that reducing the speed at which interconnectors ramp allows the ESO to better fulfil its licence and operate in a more economical and efficient manner and that the current ramp rate (100MW/min) which often results in the ESO having to reposition units in the Balancing Mechanism (BM) at a cost to the GB consumer.

EU TSO's engagement

- 7 out of 8 respondents considered that the impact of the Original Proposal to the EU TSO's wasn't suitably assessed by the Proposer, advising that the Original Proposal presents multiple risks that are not clearly understood, documented, or quantified at this stage. e.g., EU system frequency or EU security of supply impacts. They suggested that further engagement and consideration is required to align views on how the future cross border ramping would be managed with 1 respondent stating that EU TSOs need to be included in the Workgroup as a change in ramp rate will directly affect the market parties and end consumers on both sides of the Interconnectors.
- The ESO response stated that as a result of BREXIT, the ESO is no longer a member of ENSTO-e (European Network of Transmission System Operators for Electricity) and formal engagement with EU TSO's was problematic, therefore it was not possible to undertake detailed engagement in the early stages of this work. They noted that the impacts of BREXIT meant that the ESO has been reliant on sharing outputs of meetings with members of the Intra Synchronous Area group (ISA) to feed into the regular ISA workgroup meetings. All material was shared to the Workgroup (including the request for proposal for the CBA, before being conducted), and the outputs of the CBA were also shared. To date, there have been

seven conversations/discussions with the EU TSOs. The ESO also invited the chair of the ISA group to attend Workgroup meeting 12 which was welcomed by the Workgroup.

- One respondent stated that when an ENTSO-e representative was invited to the Workgroup, it was mentioned that it would be good to pause this workgroup because of the upcoming change to 15-minute MTU on the European side and that the process had “felt rushed” so far.

CBA Comments

- 7 out of 8 respondents considered that the CBA cannot be seen as a reliable evidence base for the imposition of a significant operational restriction on Interconnectors, suggesting the CBA presents an incomplete assessment of the impacts of the options considered.
- One respondent advised that the CBA presented by the ESO is fundamentally flawed. They advised that Workgroup members have expressed concerns about the lack of transparency on the methodology used and the assumptions made, considering that those concerns haven't been adequately addressed. They concluded that it is disappointing that the ESO has been advertising the outcome of the CBA (for instance at the weekly Operational Transparency Forum) when it is clear that the majority of the Workgroup members (in fact everyone but the ESO representatives) fundamentally disagrees with the outcome.
- One respondent advised that they see the CBA as a one-sided analysis that focuses primarily on the ESO, not necessarily with the wider Workgroup considerations at the centre of it. As such, it is not clear what the effects will be on the EU or Interconnector side. More analysis will need to be done to examine the full effect of the Original solution.
- One respondent recommended an extension for the Workgroup to be able to do an extensive CBA focussing on the potential impacts of the Original solution on the Interconnectors and the EU TSOs/consumers to shape a solution that delivers operational certainty without harming social welfare gains from Interconnector trading or future investment into offshore grid projects.
- One respondent stated that the apparent use of 2022 figures to benchmark balancing costs savings outputs seems questionable, as this was an atypical year with extreme market conditions.
- The ESO response noted that the Interconnector imbalance costs data (to account for compensation regarding imbalance) has been required by the ESO and Baringa from the Interconnectors to support the CBA and that the data was not provided, therefore couldn't be included in the CBA. The ESO advised that WAGCM1 (100MW/min and status quo) was the baseline for comparison on cost savings for the options in the CBA suggesting that to propose this as the alternate is no better than what there is today as this presents no costs savings to the consumer and does not solve the issues that ESO faces in managing fast ramp rates in real time operation.
- The ESO response also noted that the ESO thoroughly challenged Baringa in the playback session in respect of the results, methodology and assumptions to determine the outputs of the CBA. The CBA has allowed further discussion in the Workgroup and has provided the ESO the opportunity to use the outputs to suggest

a recommendation to solve the operational drivers whilst respecting and adhering to the compliance requirements in SOGL. The ESO advised that the Interconnectors are considering completing their own CBA for this modification which has the potential to delay the progress of the Workgroup. The scope of the analysis had not been shared at the time of the Workgroup Consultation. It was also not clear what benefit it would have, or why it was not done earlier in the process to support the development of a solution.

EBR Impacts

- One respondent suggested that while in principle both options would be non-discriminatory and transparent, simply codifying a static ramp rate is not market based as mentioned under EBR article 3 (e). Advising that they believe that the Original Proposal does not fulfil the indicated requirements on lower bills than otherwise be the case, benefits for society as a whole and improved quality of service.
- The ESO stated that reducing ramping rates means that there is less potential for instructing more costly BM units to manage fast ramping, which in turn could inadvertently result in undue market distortions that may then be passed to the end consumer- impacting EBR article 3 (e). Also noting that there was the possibility that a slower ramp rate would allow other BM units to respond to changes to Interconnector flows, rather than those which are fast response units instructed close to real time.
- One respondent advised when commenting on EBR objectives that the system imbalance volumes and prices will be impacted as a result of the Original Proposal, suggesting that there is a material impact on the balancing markets (required volumes and expected prices) which will also impact all other market participants. Concluding that this should be more profoundly analysed on both sides of the interconnectors, to ensure acceptable balancing market impacts as well as system security effects on the frequency on second / minute basis and not just on ISP (Imbalance Settlement Period), basis (15/30min).

General comments from the Workgroup Consultation

- One respondent believes European initiatives, in particular the 15-minute MTU project with associated shorter ramping windows, appears not to have been factored into the CBA. It was not clear how the Original was compatible, with a high risk that market-nominated flows could not be achieved and how to account for the imbalance that would likely be incurred.
- One respondent suggests both proposals could be impacted by EU 15-minute MTU changes. The Original will have bigger impact to the Interconnectors. The ramp that can't be finished will need to be spilled to other period or have direct impact to the market and end consumer welfare.
- One respondent suggested that if ramp rates are restricted, that less Interconnector Operators are able to achieve the market's cross-border nominated flow. Where this

occurs ESO may need to replace the undelivered generation from plant that is more expensive and potentially with fossil-fuelled generation, could affect GB's net-zero targets.

- One respondent suggested the Original Proposal will impact the Interconnectors ability to respond to market signals and thus reduce the revenue position from market arbitrage, and/or other services. Likewise, a reduced ramping position will also expose Interconnectors to a greater potential degree of imbalance risk. The magnitude of these commercial impacts and thus the materiality to the overall business model of Interconnectors is under review and manifests on a case by-case basis within the Interconnector community.
- The ESO response stated that the Original Proposal is seeking to reduce the speed of ramping on HVDC Interconnectors and to bring Interconnectors more in line with BM Units and that by operating with a static limit; this gives clarity to the connected TSO and there will be less opportunity for changes closer to real time. It also means that the requirement of enhanced or emergency actions is reduced to manage the GB system should sufficient reserves in GB not be available and that the Original still enables GB to utilise the flexibility that Interconnectors offer, and it continues to allow Interconnectors to transfer energy to and from GB to connected countries. Therefore it supports the net zero target with the goal to operate the system by using green energy.
- One respondent considered that an attempt by the ESO to unilaterally change a key operational parameter risks encouraging equivalent unilateral changes being imposed by EU TSOs, undermining much-needed cross-border cooperation at a time of fundamental market reform and if the Original Proposal would be approved by Ofgem, over the strong objections of the affected parties, there is a risk that this precedent would undermine market confidence in this element of the regulatory framework, given that the Grid Code was designed as being owned/run by the industry.
- One respondent sees the Original proposal as a step back in flexibility on the Interconnectors and WAGCM1 as initially neutral on impacts as there is no change to the ramping rate, although it could positively impact it once a market-based ramp service is developed.
- The ESO response considers WAGCM1 does not promote an efficient, coordinated, or economical system, noting the CBA shows that the current arrangements contribute to an increase in balancing costs, which in turn incurs a cost to the GB consumer. The original proposes to save £865m against WAGCM1.
- The ESO commented that it supported a 10-day implementation period from the date of a decision by Ofgem to implement this proposal.

Post Workgroup Consultation Discussions

The Workgroup reviewed the responses from the Workgroup Consultation and some Workgroup members had differing views on those. The ESO noted that the letter from

Ofgem to request codification of ramping arrangements suggests adding more detail where necessary, which is why the ESO has both operational and compliance drivers for this change.

Further comments were made by some Workgroup members that the CBA had not provided enough detail, but it was acknowledged that no further work could be done on this at this stage. The Interconnectors Workgroup members view was that the CBA presents an incomplete assessment of the impacts as it doesn't take into account the imbalance costs that Interconnectors incur; there are several questions around the methodology and the assumptions used that have not been clarified. Also, the operational challenges examples given by the ESO were considered not to have enough evidence, advising that further detail was required on the scenarios presented by the ESO. The Proposer noted that the Workgroup members were actively involved in the CBA, and all had the opportunity to comment on the request for proposal, shape the work being commissioned along with assumptions for modelled options. The consultant was part of several Workgroup meetings and received and acted on feedback from the Workgroup. The ESO also requested an extension and further funding for the work being commissioned to accommodate the request of the Workgroup to include a specific option which had not been in the recommended shortlist provided by to the consultant.

It was acknowledged by the Workgroup that there were challenges relating to Brexit and existing arrangements to engage with Europe. There were some Workgroup members who felt that there has not been enough engagement with the EU TSO's. The Proposer pointed out that at Workgroup 15, there had been 7 conversations and or meetings with the EU TSO, that is 50% which is positive considering the challenges with engagement post BREXIT. Also, the Proposer noted that the comment reported by a respondent made by the Chair of the ENSTOE ISA Working group related to this work being rushed had not been heard when he joined the meeting.

The Proposer advised that the ESO is concerned that when the 15-minute MTU is introduced in the EU, the Interconnectors will have the ability to ramp 4 times per hour (with the EU imposed 10 min ramping period) rather than once as is today. Reducing ramping to 50MW/min mitigates the risk of managing large flow changes on Interconnectors, and in turn the possibility of re positioning units 4 times per hour. There is also the risk that fast reserves may not be available to support re positioning in these time scales impacting security of supply. The Interconnector Workgroup members thought that a proper assessment of the 15 minutes MTU implementation needs to be carried out thoroughly. It is unclear that reducing ramping to 50MW/min mitigates the risk of managing large flow changes on Interconnectors as it could be the opposite when reducing MTU to 15 minutes of both DA (Day Ahead) & ID (Intra Day) products, as well as the ISP (Imbalance Settlement Period); this will lower the size of the problem and allow most efficient granularity of products to solve the issue of large ramping volumes.

The Proposer advised that is also not clear on the impacts for the same points noted should ramping continue at 100MW/min.

The Workgroup agreed and stated that there is a planned change in Continental Europe in 2025 which might have an impact on the ramping window, but still needs to be proposed to all GB industry and impact will have to be assessed once the full details are disclosed. This is commonly known as 15min MTU, there hasn't been clarification yet of number of auctions, auction times, provision of data prior to gate closure, etc.

The Interconnectors (ICs) Workgroup members have come together and commissioned a report from AFRY to analyse the CBA done by Baringa and commissioned by the ESO. Those findings were presented in Workgroup meeting 16 and the ESO SME pointed out these findings were brought to the Workgroup extremely late in the process and question the relevance of it. The several Interconnector Workgroup member advised that the intent of these findings is to provide support to their views with regards to the CBA done by Baringa and to support WAGCM1. It was agreed by the Workgroup that the findings would be presented, discussed, and added as an Annex (Annex 10) for the Authority consideration.

The ESO raised concerns about the work which had been commissioned with AFRY by the ICs Workgroup members, advising that is not clear what the scope of this work is, why it was not communicated, what material has or has not been shared with the consultants, or the level of expertise available to undertake the work given the complex nature of this issue.

Some Workgroup members advised that they felt that they had not been involved in the Baringa CBA and stated that it was the ESO CBA, advising that they questioned the methodology and assumptions made by the Baringa work. The Proposer advised that the ESO instructed Baringa to undertake an independent CBA which the Workgroup fed into from the start. The Proposer questioned whether the study would have been completed if the result of the CBA had favoured the option the Workgroup preferred. The ICs Workgroup members responded that they would still have commissioned the study, as they still see the CBA as incomplete.

The ESO representative asked what the AFRY study was being completed for, along with the scope and rationale, advising that it did not feel collaborative and was shared at the last hour with only seconds to review any slides which were viewed for the first time in the meeting. The ESO questioned if it was a commentary on the CBA that has already been completed and stated that Baringa wanted data from the Interconnectors and requested this on many occasions, as did the ESO to make a rounded view and that this study appears not to have that approach. The ICs Workgroup members advised that the reason they didn't advise on the work commissioned was the fact of not being sure if the work would be completed in time, stating that they only received the slides on the morning of the meeting and that the purpose for the work done by AFRY was to try to understand the outputs of the Baringa analysis.

The ESO representative also requested clarity on how the data was used to determine the results, noting that the option presented by the ESO still showed a cost saving to consumers, however, the way in which the calculations have been generated does not compare against the Baringa CBA as different assumptions have been used. They advised that the purpose of the work that Baringa did was to understand what solutions could be potentially set out in the Grid Code to satisfy compliance and operational drivers and suggested that this work does neither of these. The ICs Workgroup members advised that AFRY referenced the material published by Baringa to conduct their work.

The Proposer also concluded that whilst the work that AFRY had completed did not demonstrate the same level of savings to GB consumers through the solution that the ESO had recommended, there was still a saving.

The ICs Workgroup members advised that AFRY have identified the following findings:

- Significant savings available based on alternative monetisation factor for balancing volumes.
- The Baringa CBA has no consideration for negative impacts on limiting IC ramping.

- High correlation of IC cumulative ramping and increased balancing volumes has not been replicated.
- The CBA assessment assumes no changes in procurement method for reserve and response products.
- The value of implementing a static IC ramp rate of 50MW/min is likely to reduce in the second half of the 2020s.

The Proposer challenged the outcomes of the AFRY report stating that the Baringa CBA did consider the negative impacts on limiting the IC ramping and pointed out that due to timescales and the lateness of the AFRY report, made it difficult to fully assess and challenge the results.

The ESO representative asked several questions to the IC Workgroup members who commissioned the work, which can be seen in Annex 11.

Legal text

The legal text for this change can be found in Annex 6.

What is the impact of this change?

Original

- All existing and new Interconnectors are impacted by this change if the maximum standard ramping rate will be reduced to 50MW/min. This CBA output indicated that over the study period there was a minimum reduction to IC operations. The change still allows interconnectors to transfer energy to and from the GB system to the same overall extent as before, albeit at a slower rate of change in market position.
- GB Consumers will be positively impacted as there is a potential to reduce balancing costs incurred as a result of fast simultaneous ramping on interconnectors. The CBA showed a saving of £865m over the study period (2023-2030).
- ESO are positively impacted as this will aid overall operability and system security in the short term. Concern was expressed by some Workgroup members over the longer-term view. The ESO believe that this still allows the use of interconnectors to support the drive to net zero. Some Workgroup members disagree with this view and noted that the current ramp rate or a faster ramp rate would support Interconnectors to deliver/match the intermittency of renewable energy better, and hence better supports the drive to net zero.

Several workgroup members have disagreed with the above as, in their view, the reduced ramping rate compared to the existing ramping rate could hinder operability and increase the system security risk in some cases. It was felt that this hadn't been covered in the CBA sufficiently. Workgroup members also felt that due to a lack of sufficient EU TSO alignment, if this was to be implemented it could cause operability mismatches and damaging effective cooperation between EU TSO and in turn damage GB consumer benefit. Furthermore, it was felt that the impact to meeting GB net zero targets need to be assessed more thoroughly.

WAGCM1

- Interconnectors are not impacted by a change to existing interconnector ramp rate practice as the Alternative Proposal reflects the 100MW/min rate as currently agreed across the ESO, interconnectors and TSOs. In the short term the flexibility provided by the adoption in the Grid Code of this limit shall be used to trigger new approaches to avoid and mitigate instances of combined ramping on a bilateral basis. The progress of adopting these measures and their impact in addressing the issues of combined ramping will be reported to the Grid Code Review Panel. GB Consumers will be positively impacted against the status quo as bilateral arrangements are adopted to mitigate these combined ramping conditions. Due to the limitations of the Baringa CBA tool the cost benefit to these actions have yet to be quantified and the Alternative was not explicitly costed in comparison to the Status Quo within the CBA work.
- The GB electricity industry and the ESO are also positively impacted as this proposal will again aid overall operability and system security, still allowing the use of interconnectors to support the drive to net zero in GB and in Europe.
- WAGCM1 identifies an enduring market route to the central issue of dealing with the combination of ramping events offers the potential for more significant and enduring consumer benefit as these actions are taken under the auspices of the subsequent proposed Workgroup.

Proposer's assessment against Code Objectives

Proposer's assessment against Grid Code Objectives - original proposal	
Relevant Objective	Identified impact
(a) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity	Positive Defining and updating ramping rates which reflect the current market participants' capabilities
(b) Facilitating effective competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);	Positive Having a clear set of ramping rates within the code will aid transparency across generation types
(c) Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole;	Positive A more complete consideration of ramping will address its impact on security of supply
(d) To efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and	Positive Compliance with SOGL Article 119 as retained in GB law

(e) To promote efficiency in the implementation and administration of the Grid Code arrangements	<p>Positive By including ramping rates for interconnectors, this will fill a gap in the Grid Code and improve the Code's operability</p>
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Impact of the modification on the stakeholder / consumer benefit categories	
Proposer's assessment:	
Stakeholder / consumer benefit categories	Identified impact
Improved safety and reliability of the system	Positive: Interconnectors are a key part of the drive to net zero and in facilitating an efficient solution to ramping issues this will aid overall operability.
Lower consumer bills	Positive: By finding the right balance between flexibility for interconnector owners and the operational costs that are incurred by the ESO optimum value for consumers will be enabled.
Benefits for society as a whole	Positive: Reduced overall cost, better participation by interconnectors.
Reduced environmental damage	Positive: As above – interconnectors are a key part of the drive to net zero.
Improved quality of service	Positive: As above – interconnectors are a key part of the drive to net zero.

Workgroup Vote

The Workgroup met on 14 September 2023 to carry out their workgroup vote. The full Workgroup vote can be found in Annex 9. The table below provides a summary of the Workgroup members view on the best option to implement this change.

The Applicable Grid Code Objectives are:

Grid Code

- a) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity
- b) Facilitating effective competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);
- c) Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole;
- d) To efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and

- e) To promote efficiency in the implementation and administration of the Grid Code arrangements

The Workgroup concluded by majority that WAGCM1 better facilitated the Applicable Objectives than the Baseline.

Option	Number of voters that voted this option as better than the Baseline
Original	1
WAGCM1	6

Code Administrator Consultation Summary

The Code Administrator Consultation was issued on 06 October 2023, closed on 07 November 2023 and received 11 non-confidential responses (and 0 confidential responses). A summary of the responses can be found in the table below, and the full responses can be found in Annex 13.

Code Administrator Consultation summary	
Question	
Do you believe that the GC0154 Original Proposal or WAGCM1 better facilitate the Grid Code Objectives?	<p>Three respondents believed that the Original Proposal better facilitates all Grid Code Objectives.</p> <p>For WAGCM1, seven respondents believed that the WAGCM1 better facilitates objectives a and b, five respondents believe that WAGCM1 better facilitates objective c and eight respondents believed that WAGCM1 better facilitates objectives d and e.</p> <p>Three respondents preferred the Original Proposal, seven respondents preferred WAGCM1, and one respondent had no preferred solution.</p>
Do you support the proposed implementation approach?	Four respondents stated that they support the proposed implementation approach, with seven respondents not supporting the proposed implementation approach.
Do you have any other comments?	<p>The Key points raised:</p> <p>Several respondents highlighted that they believe WAGCM1 has benefits for the flexibility of the system versus the Original Proposal.</p> <p>Several respondents believed the results of the Baringa CBA undertaken was misleading and/or insufficient.</p>

	<p>The ESO response stated that the AFRY analysis does not use the same input data to model balancing costs as the Baringa CBA therefore the outputs will differ slightly. The response also said that the ESO had not been made aware of the work the interconnector companies commissioned with AFRY, so was not able to supply any information or inputs to this work.</p> <p>Several respondents stated that they did not believe the EU TSOs and other EU stakeholders had not been consulted enough during this modification, resulting in the impact on secure system operation not being adequately considered.</p> <p>The ESO response noted that as part of the ongoing engagement for this workstream, the ESO met with the EU TSO's in October 2023.</p> <p>One respondent stated that there are significant disadvantages of WA(G)CM1 when assessed against Grid Code objectives and EBR objectives, especially competition, participation, efficiency, and security.</p> <p>One respondent stated that a proper, holistic review of interconnector operation should be undertaken, including proper engagement with all affected stakeholders, to ensure that market-based solutions are developed that deliver benefits to consumers.</p> <p>One respondent requested that should the original proposal be approved by the Authority then the implementation date should be delayed until after the Winter 2023/24 period.</p> <p>Several respondents were concerned that isolated and unilateral movement by the ESO in GB would encourage reciprocal behaviour from the EU member states and their respective TSOs.</p>
<p>EBR issues raised in the consultation</p>	<p>ESO view on the Code Administrator Consultation responses</p>
<p>Nine out of eleven respondents believed that GC0154 impacts the Electricity Balancing Regulation</p>	<ul style="list-style-type: none"> • Clarity to all users is achieved by including the ramping arrangements in the GB Grid Code. This is the same at either

(EBR) Article 18 terms and conditions held within the Grid Code.

The following comments regarding this were also made:

- EBR objectives require consistency and clarity in ramp rates applied between GB and European markets, which can be best achieved by reflecting current ramp rates into the code.
- GC0154 Original Proposal will affect the efficiency of the electricity market in GB and Europe, so the impact on EU TSOs and stakeholders needs to be considered in addition to the impact on the ESO and GB prior to any changes to the status quo. Several respondents stated that they did not believe the EU TSOs and other EU stakeholders had been consulted enough during this modification, resulting in the impact on secure system operation not being adequately considered.
- Concern that flow change restrictions will limit capacity available for market trading, potentially impacting EBR objective (d).
- WAGCM1 includes market-based solutions to address operational challenges, which the Original Proposal does not, which is not market based as mentioned under EBR article 3 (e).
- Concern that BMUs are currently discriminated against through the imposition of the 50MW/min ramp rate, whereas interconnectors can currently ramp at 100MW/min. Maintaining the current arrangements would continue

50MW/min max ramping rate, or 100MW/min ramping rate.

- The interconnector will only sell the capacity it can deliver in the parameters available. There are restrictions placed on interconnectors from the EU TSO in the form of ramping periods – this is +/- 10 mins at the start of the hour. The EU TSO do not impose a ramping rate. The interconnector therefore has to manage the restriction placed at either end of its connected TSO. The ESO has not been party to discussions or been able to give a view on the ramping periods imposed on GB system operation and has highlighted concerns that when the EU TSOs are required to implement a 15 min MTU Q12025, this will mean that the IC have the opportunity to ramp for 10 mins every 15 minutes – this is a risk for GB system security and balancing costs.
- The ESO has engaged with the EU TSOs through this process and there have been several in person meetings and a number of virtual meetings to do so. The ESO has also asked for the EU TSO to respond to this modification. The independent CBA completed by Baringa also reviewed the impacts on the GB and EU electricity market. However, the main focus for the ESO is to ensure system security in GB and reduce GB consumer costs.
- The interconnector will only sell the capacity it can transfer in a given time frame. As the EU TSO implement the 15 min MTU, the interconnector will be able to ramp 4x per hour, as opposed to 1x per hour today. This means that there will be additional ramping capacity for trading.
- There are no market-based options in the WACM1 as this is to retain the status quo. There would be the requirement of a new modification to be raised to complete any further work to create any possible market. This option was also discounted by some members of the workgroup at the time of the CBA completed by Baringa. The original reduces the impact of

<p>to discriminate against BMUs who are unable to optimise the use of their technical capabilities, which is in direct conflict with the aims of the EBR.</p> <ul style="list-style-type: none"> • Belief that the proposal is counterproductive as it reduces market efficiency and negatively impacts system operation of EU TSOs. • That the Original Proposal would have a positive impact on EBR objectives a, b, d, e and g, and a neutral impact on objectives c and f. 	<p>instructing more costly BMUs that could inadvertently distort the market and be passed to consumers.</p> <ul style="list-style-type: none"> • The ESO is aware of the current disparity between BMUs and interconnectors and the 50MW/min allows for this gap to be closed, therefore reducing discrimination between parties. • EU TSO has not considered the GB consumer in the development of their proposals (current example of the 15 min MTU and enforced 10 min ramping periods) for the same system operation requirements and have, where it has been necessary (as in the Nordics or the Irish) created a ramping arrangement that suits the needs of specific borders to maintain security of supply. • With the current ramp rates, the ESO needs to 'interfere' with the market solution (e.g. instructing out of merit fast BMUs) as it does not provide for secure operation. This has a significant impact on market efficiency. A change to 50MW/min would reduce the ESO actions and allow the market to better provide a securable solution. Whilst market efficiency is important, system security must take priority. • Slower ramping arrangements mean that the ESO has more time to react to changes in interconnector flows. This creates the possibility that other BM units may be able to support any changes, rather than use fast response close to real time, there is the risk of distorting the markets with instructing most costly BMUs and the reduced ramp rate also increase system security. The change also does not prevent interconnectors from providing energy from renewable services to support net zero.
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Panel Recommendation vote

The Panel will meet on 14 December 2023 to carry out their recommendation vote. They will assess whether a change should be made to the Grid Code by assessing the proposed change and WAGCM1 against the Applicable Objectives.

Panel comments on EBR

The Panel will discuss this when they meet on 14 December 2023 to carry out their recommendation vote.

Vote 1: Does the Original or WAGCM1 facilitate the objectives better than the Baseline?

Panel Member: Alan Creighton, Network Operator Representative

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: Alastair Frew, Generator Representative

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: Darshak Shah, Generator Representative

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: David Monkhouse, Offshore Transmission Licensee

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: **Terry Baldwin, National Grid ESO**

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: **John Harrower, Generator Representative**

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: **Robert Longden, Supplier Representative**

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: **Ross Kirkwood, Onshore Transmission Licensee**

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						
Voting Statement						

Panel Member: **Matthew White, Network Operator Representative**

	Better facilitates AO (a)?	Better facilitates AO (b)?	Better facilitates AO (c)?	Better facilitates AO (d)?	Better facilitates AO (e)?	Overall (Y/N)
Original						
WAGCM 1						

Voting Statement

Vote 2 – Which option is the best?

Panel Member	BEST Option?	Which objectives does this option better facilitate? (If baseline not applicable).
Alan Creighton		
Alastair Frew		
Darshak Shah		
David Monkhouse		
Terry Baldwin		
John Harrower		
Robert Longden		
Ross Kirkwood		
Matthew White		

Panel conclusion

Panel will meet on 14 December 2023 to carry out their recommendation vote.

When will this change take place?**Implementation date**

The implementation date will be 10 days after approval by the Authority.

Date decision required by

No specific deadline but requirement imposed at this stage.

Implementation approach

The ESO recommendation does not require any system changes for the ESO, however it might present potential system changes for Interconnectors, as the ramping rate has never been limited before.

Interactions

- | | | | |
|------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------|--------------------------------|
| <input type="checkbox"/> Grid Code | <input type="checkbox"/> BSC | <input type="checkbox"/> STC | <input type="checkbox"/> SQSS |
| <input checked="" type="checkbox"/> European Network Codes | <input checked="" type="checkbox"/> EBR Article 18 T&Cs ⁸ | <input type="checkbox"/> Other modifications | <input type="checkbox"/> Other |

Acronyms, key terms and reference material

Acronym / key term	Meaning
AC	Alternating Current

⁸ If the modification has an impact on Article 18 T&Cs, it will need to follow the process set out in Article 18 of the Electricity Balancing Regulation (EBR – EU Regulation 2017/2195) – the main aspect of this is that the modification will need to be consulted on for 1 month in the Code Administrator Consultation phase. N.B. This will also satisfy the requirements of the NCER process.

BC1	Balancing Code 1
BM	Balancing Mechanism
BMU	Balancing Mechanism Unit
BSC	Balancing and Settlement Code
CMP	CUSC Modification Proposal
CUSC	Connection and Use of System Code
DA	Day ahead
EBR	Electricity Balancing Guideline
ENTSO-e	European Network of Transmission System Operators for Electricity
ESO	Electricity System Operator
EU	European Union
GB	Great Britain
HVDC	High Voltage Direct Current
IC	Interconnector
ID	Intra Day
IFA	Interconnexion France- Angleterre
ISA	Intra Synchronous Area
ISP	Imbalance Settlement Period
LFC	Load Frequency Control
MPIs	Multipurpose Interconnectors
MTU	Market Time Unit
SO	System Operator
SOGL	System Operator Guideline
STC	System Operator Transmission Owner Code
SQSS	Security and Quality of Supply Standards
T&Cs	Terms and Conditions
TSO	Transmission System Operator

Annexes

Annex	Information
Annex 1	Proposal form
Annex 2	Terms of reference
Annex 3	Feedback document
Annex 4	Baringa CBA outputs for the Workgroup
Annex 5	WAGCM1
Annex 6	Legal text
Annex 7	Workgroup Consultation Responses and Summary table
Annex 8	Workgroup Consultation Late Response
Annex 9	Workgroup Vote
Annex 10	AFRY Report
Annex 11	ESO Questions on AFRY Report
Annex 12	Distribution List
Annex 13	Code Administrator Consultation Responses and Summary