Public

GB Grid Forming Experience

Dr Xiaoyao Zhou

NESO
National Energy System Operator

How GB system evolves

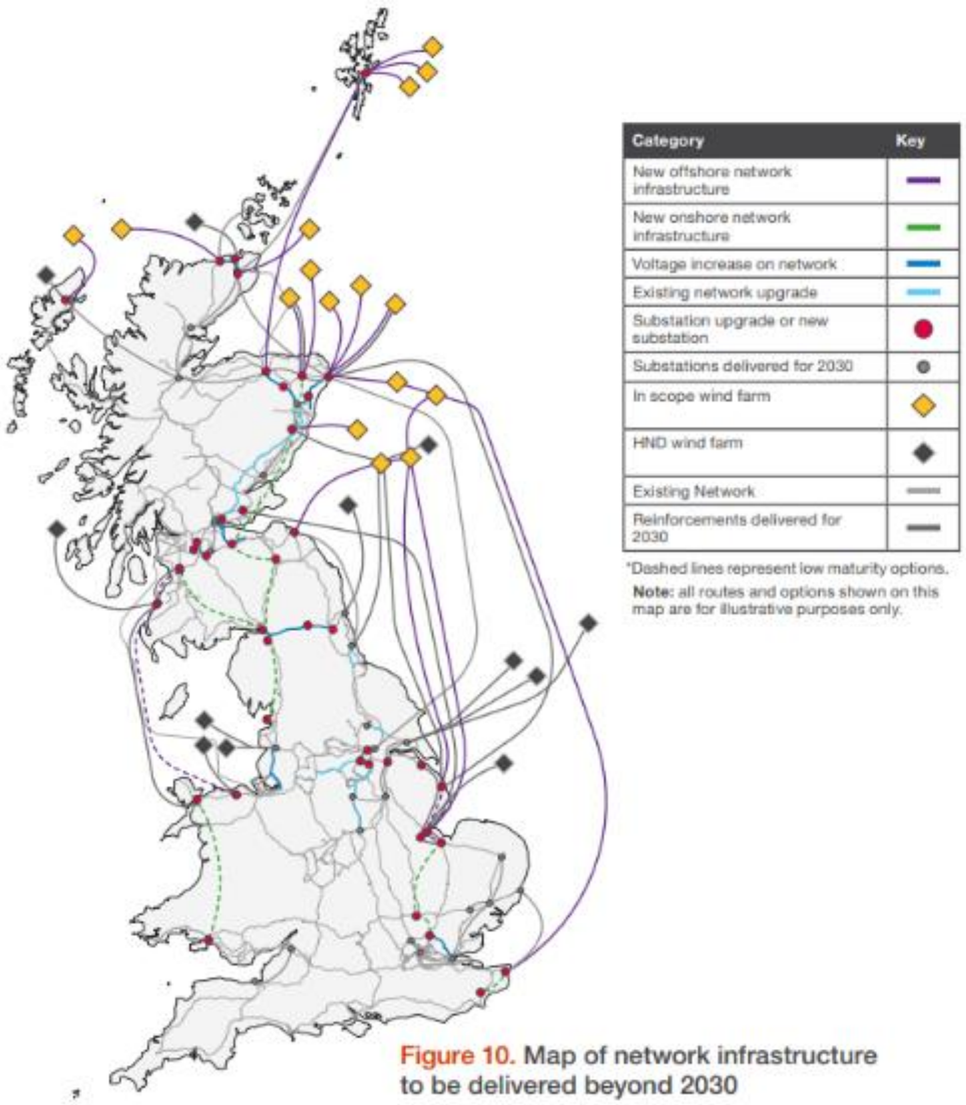


Figure 10. Map of network infrastructure to be delivered beyond 2030

Installed Capacities (GW)			
Technology	2023	2030 Further Flex and Renewables	2030 New Dispatch
Offshore wind	14.7	50.6	43.1
Onshore wind	13.7	27.3	27.3
Solar	15.1	47.4	47.4
Nuclear	6.1	3.5	4.1
Biomass/BECCS	4.3	4.0	3.8
Low carbon dispatchable power	0	0.3	2.7
Other renewables	4.7	5.7	5.7
Batteries	4.7	27.4	22.6
LDES	2.8	7.9	4.6
Interconnectors	8.4	12.5	12.5
Unabated gas	37.4	35.0	35.0

GB Grid Forming History

1 INNOVATION

VSM Demonstrator

Jan 2018

2 VSM EXPERT GROUP

April 2018

3 BUSINESS CASE

SOF: The potential operability benefits of VSM

April 2020

4 GC0137

Min specs for Grid Forming

Feb 2022

5 BEST PRACTICE GUIDE

Refine the legal text & share best practice

Apr 2023

6 GC0163

Removing virtual impedance restriction

~Q3/Q4 2024

7 FIRST GFM BESS

The first Stability Pathfinder Phase 2 GFM unit

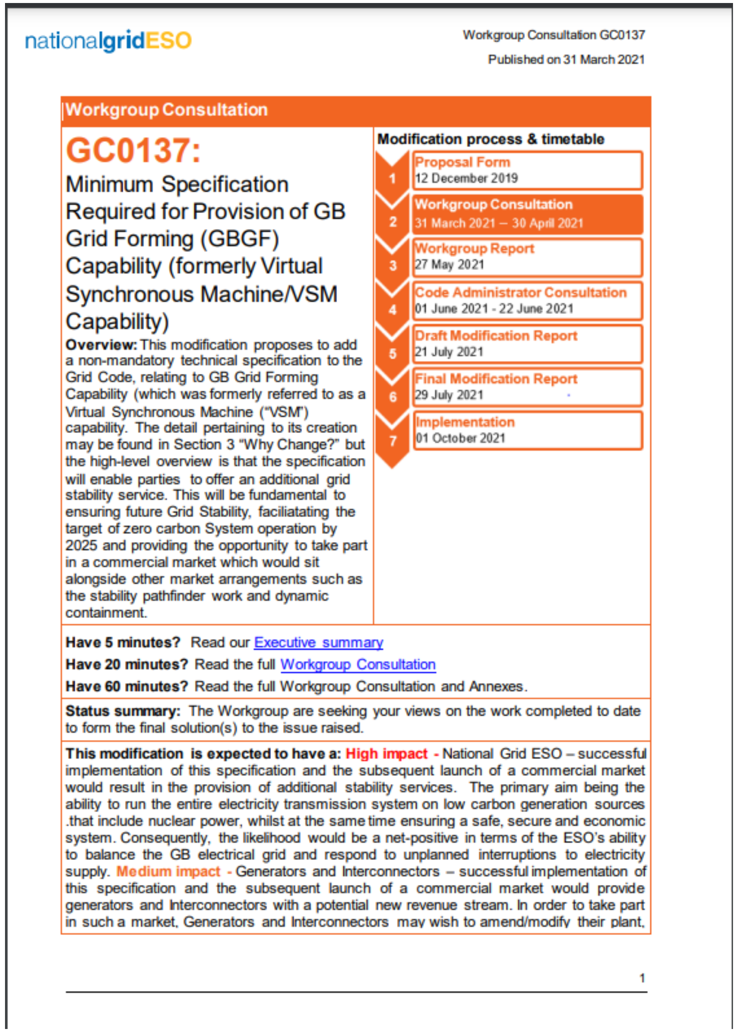
~Q4 2024

8 NEXT?

Grid Code mod related to GFM

Not an exhaustive list

GB Grid Forming Development



nationalgridESO

Workgroup Consultation GC0137

Published on 31 March 2021

Workgroup Consultation

GC0137:

Minimum Specification Required for Provision of GB Grid Forming (GBGF) Capability (formerly Virtual Synchronous Machine/VSM Capability)

Overview: This modification proposes to add a non-mandatory technical specification to the Grid Code, relating to GB Grid Forming Capability (which was formerly referred to as a Virtual Synchronous Machine ("VSM") capability. The detail pertaining to its creation may be found in Section 3 "Why Change?" but the high-level overview is that the specification will enable parties to offer an additional grid stability service. This will be fundamental to ensuring future Grid Stability, faciliatating the target of zero carbon System operation by 2025 and providing the opportunity to take part in a commercial market which would sit alongside other market arrangements such as the stability pathfinder work and dynamic containment.

Modification process & timetable

1. Proposal Form – 12 December 2019
2. Workgroup Consultation – 31 March 2021 – 30 April 2021
3. Workgroup Report – 27 May 2021
4. Code Administrator Consultation – 01 June 2021 - 22 June 2021
5. Draft Modification Report – 21 July 2021
6. Final Modification Report – 29 July 2021
7. Implementation – 01 October 2021

Have 5 minutes? Read our Executive summary

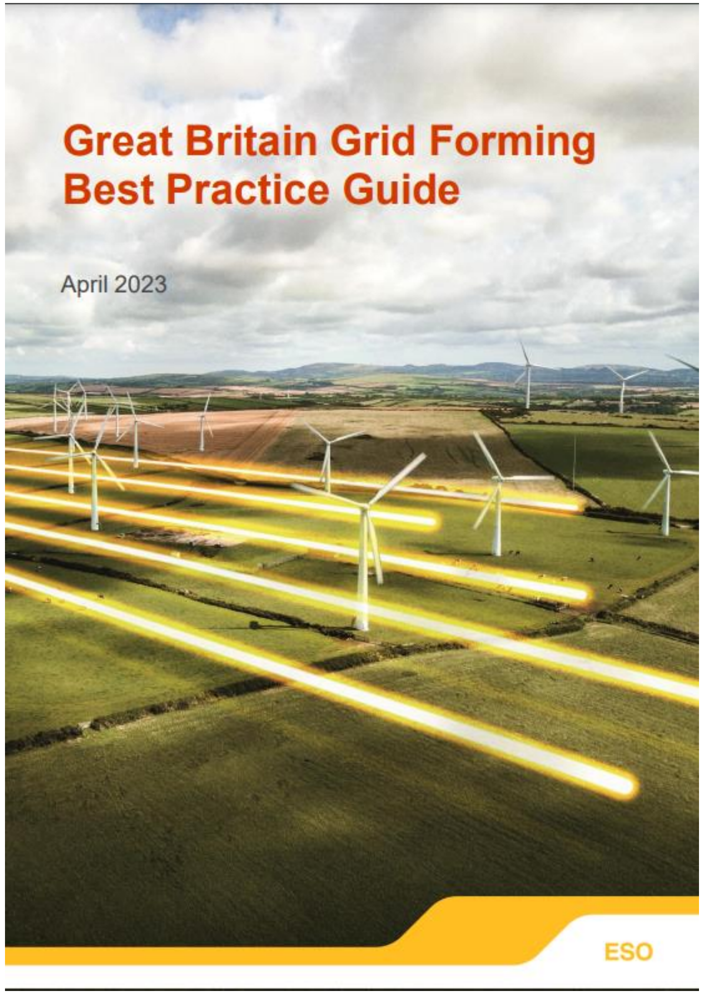
Have 20 minutes? Read the full Workgroup Consultation

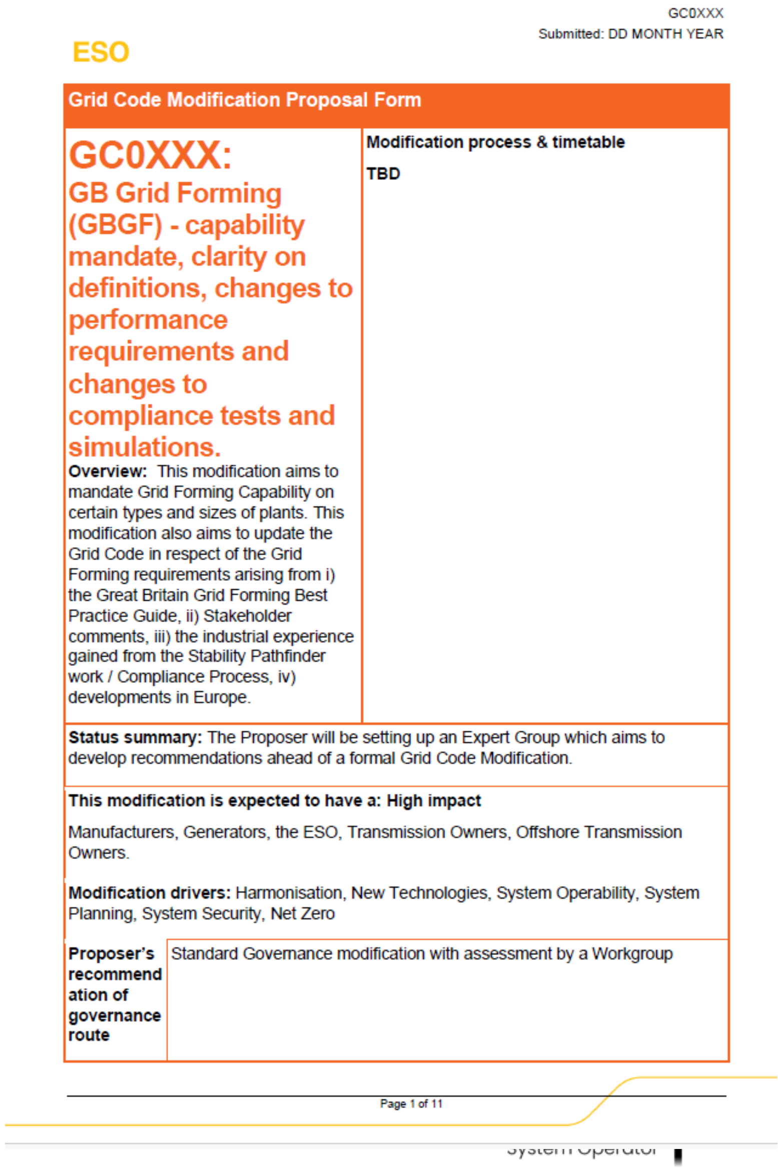
Have 60 minutes? Read the full Workgroup Consultation and Annexes.

Status summary: The Workgroup are seeking your views on the work completed to date to form the final solution(s) to the issue raised.

This modification is expected to have a: High impact - National Grid ESO – successful implementation of this specification and the subsequent launch of a commercial market would result in the provision of additional stability services. The primary aim being the ability to run the entire electricity transmission system on low carbon generation sources .that include nuclear power, whilst at the same time ensuring a safe, secure and economic system. Consequently, the likelihood would be a net-positive in terms of the ESO's ability to balance the GB electrical grid and respond to unplanned interruptions to electricity supply. Medium impact - Generators and Interconnectors – successful implementation of this specification and the subsequent launch of a commercial market would provide generators and Interconnectors with a potential new revenue stream. In order to take part in such a market, Generators and Interconnectors may wish to amend/modify their plant,

1





GC0XXX

Submitted: DD MONTH YEAR

ESO

Grid Code Modification Proposal Form

GC0XXX:

GB Grid Forming (GBGF) - capability mandate, clarity on definitions, changes to performance requirements and changes to compliance tests and simulations.

Overview: This modification aims to mandate Grid Forming Capability on certain types and sizes of plants. This modification also aims to update the Grid Code in respect of the Grid Forming requirements arising from i) the Great Britain Grid Forming Best Practice Guide, ii) Stakeholder comments, iii) the industrial experience gained from the Stability Pathfinder work / Compliance Process, iv) developments in Europe.

Modification process & timetable

TBD

Status summary: The Proposer will be setting up an Expert Group which aims to develop recommendations ahead of a formal Grid Code Modification.

This modification is expected to have a: High impact

Manufacturers, Generators, the ESO, Transmission Owners, Offshore Transmission Owners.

Modification drivers: Harmonisation, New Technologies, System Operability, System Planning, System Security, Net Zero

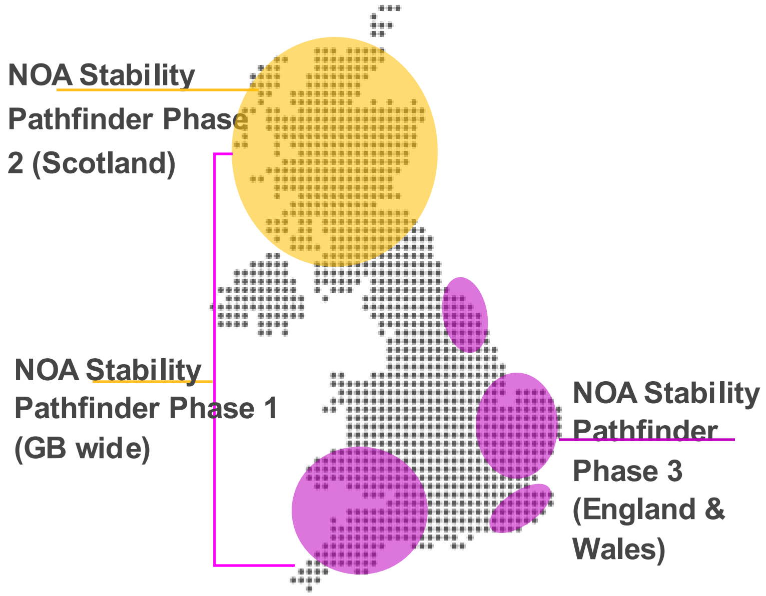
Proposer's recommendation of governance route	Standard Governance modification with assessment by a Workgroup

Page 1 of 11

Stability Market

Stability Pathfinder

	Stability Pathfinder Phase 1	Stability Pathfinder Phase 2	Stability Pathfinder Phase 3
Requirement	Inertia and dynamic voltage GB wide	Inertia, SCL and dynamic voltage	Inertia, SCL and dynamic voltage
Status	All Synchronous compensators most units now live	5 GFM BESS 5 SynComp Go-live from Apr 24	29 Synchronous compensators Go-live expected from 2025
Participating technology	0MW Synchronous Compensators only	Synchronous and Grid Forming Converter based	Synchronous and Grid Forming Converter based
Procurement regions	GB wide	Scotland	England and Wales
Procurement volume	12.5 GW.s of inertia	8.4 GVA of SCL 6 GW.s of inertia	7.5 GVA of SCL 15 GW.s of inertia
Contract Detail	Up to 6 years	End of Mar 2034	End of Mar 2035 £1.35b
Contract payments	Availability payments for SCL& Inertia Utilisation payments for reactive power		



https://www.neso.energy/industry-information/balancing-services/network-services-procurement/stability-network-services-procurement

NESO National Energy System Operator

Stability Market Overview

To maintain compliance and reduce costs associated with managing stability, we have concluded an innovation project to explore designing new markets to procure stability services.

		Long Term (Y-4)	Mid Term (Y-1)	Short Term (D-1)
Purpose		– Procure capacity in advance (LT), to signal the need for new assets – Allow financing of new build capacity (and enhanced capability, TBD) through LT contracts	– Procure capacity in advance (MT), to adjust LT procurement in case necessary – Allow MT financing of new, incremental and existing capability able to provide stability	– Procure capacity to fulfil residual of total requirements for Stability closer to real time (ST) – Allow remuneration of marginal costs for providing Stability.
Timeline	Procurement lead time Contract duration	– Y-4 – 10+ years – Y-4 – 3 years	– Y-1 – 1 year	– D-1 – Service windows
Product	Contract type Contract obligations	– Baseload availability – e.g. 90% availability	– Baseload availability – e.g. 90% availability	– 4 h (EFA blocks) – 100% availability
Payment Design		– Availability only	Synchronous Machines – Availability and Utilisation Inverter Based Generation – Availability Only.	– Utilisation Only.

NESO
National Energy System Operator

Thank You!

Questions?

NESO
National Energy
System Operator