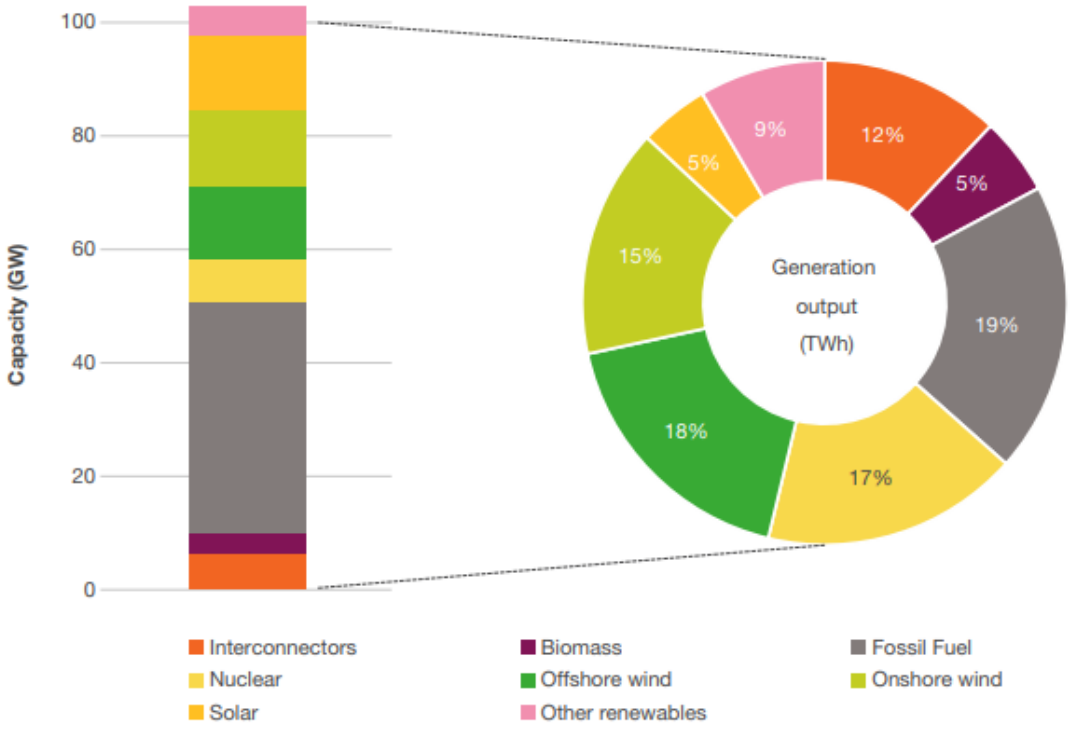
G-PST Session on Grid Forming Inverters

Dechao Kong, ESO

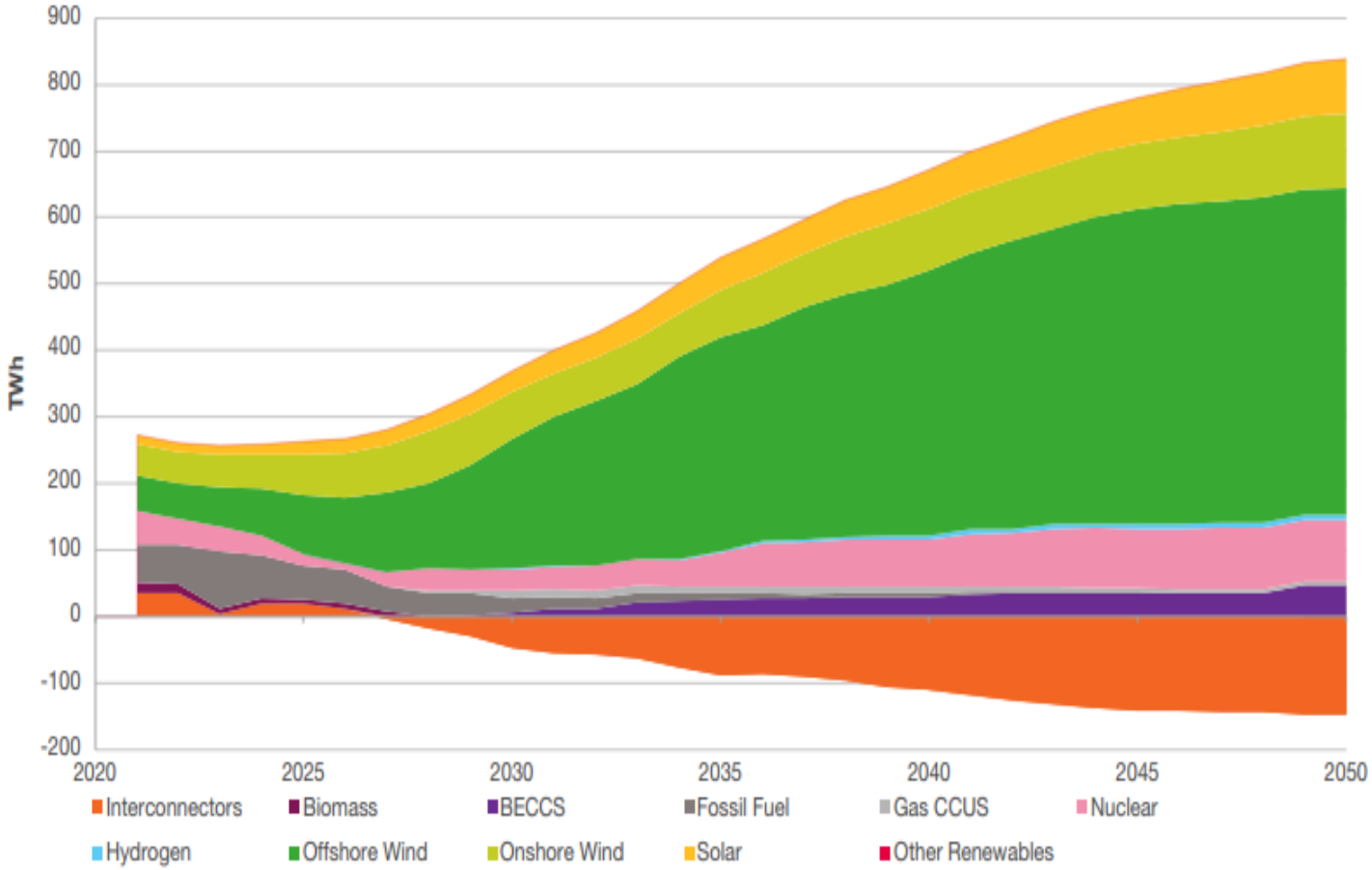
G-PST Research Workshop
London, UK; 10th November, 2022

ESO

Background: Generation Mix – Roadmap from 2020 to 2050



Electricity Generation Capacity (GW) and Output (TWh) in 2021



Customer Transformation (CT), ESO's Future Energy Scenarios, 2022

Key Messages

Evolution of GB electricity system towards 2050

- Decarbonised
- Decentralised
- IBR-Dominant
- Significant decline in thermal power plants

Grid Forming Capability to Meet GB Operability Challenges

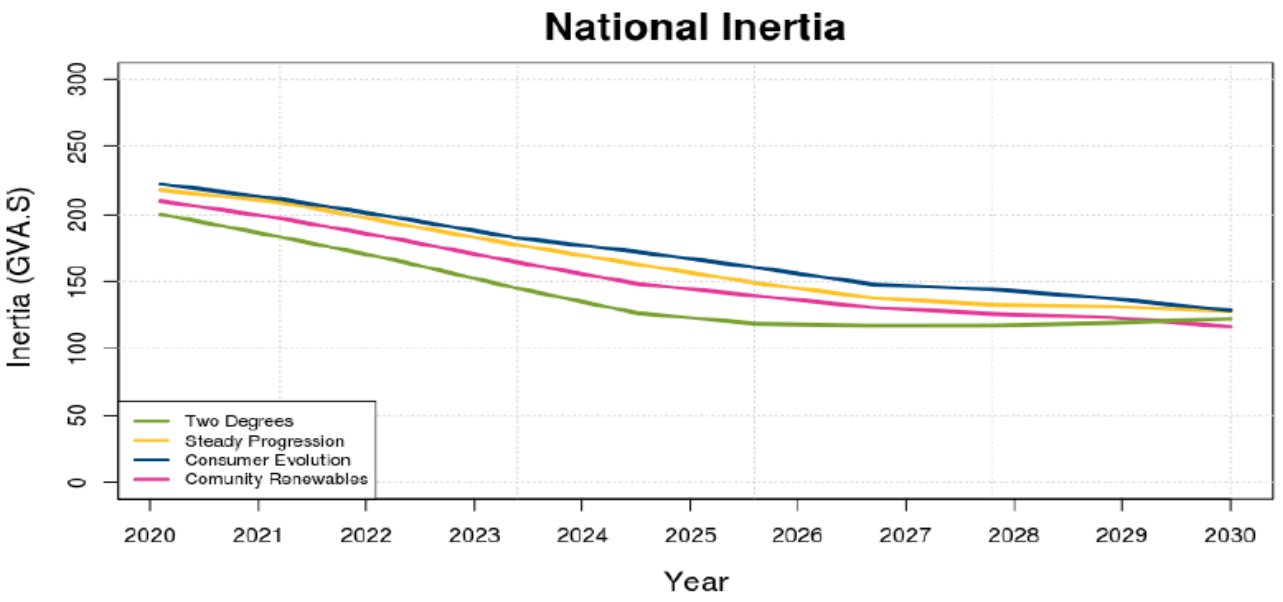


Figure 1: Inertia Trend to 2030,
System Operability Framework (SOF): "Operating a Low Inertia System", Feb 2020

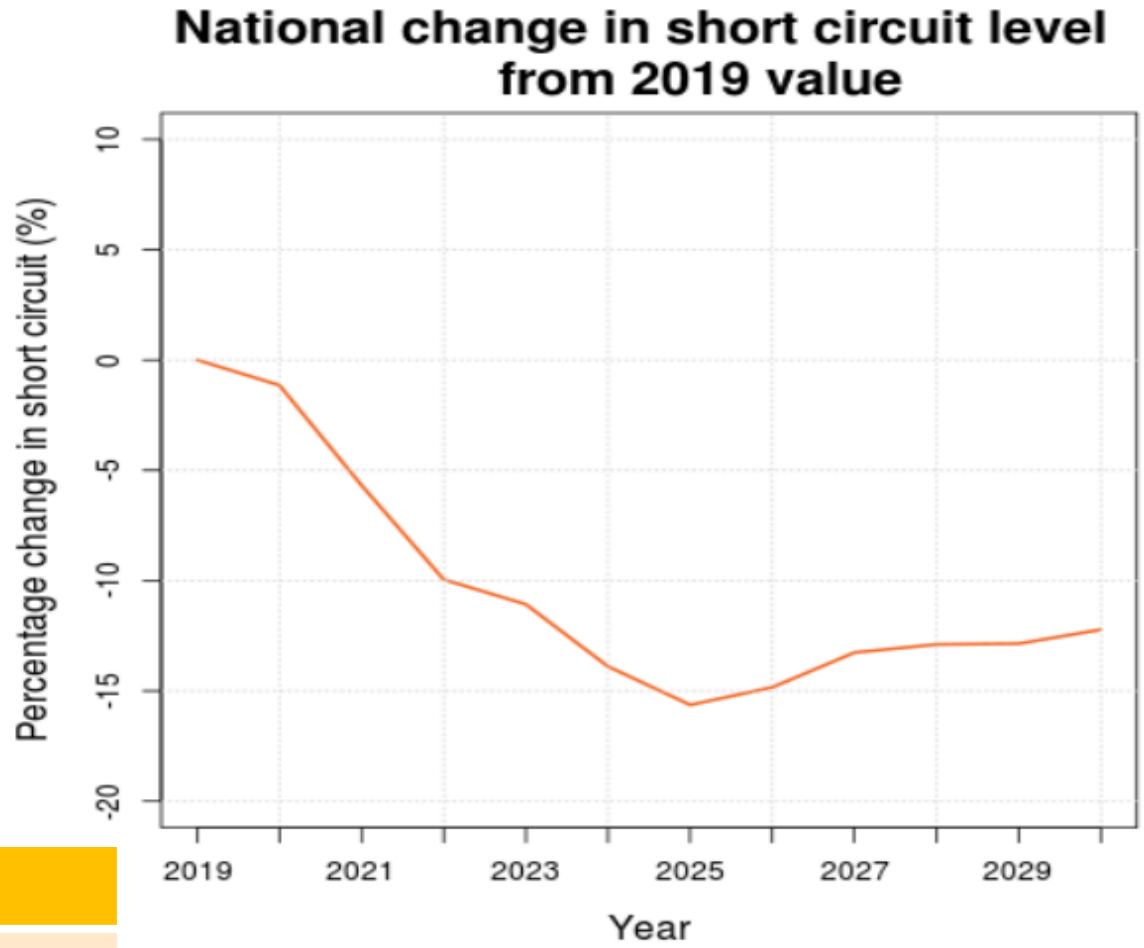


Figure 2: National Short Circuit Level 2019-2030,
SOF: "Impact of Declining Shor Circuit Levels", Dec 2018

Key Messages

1. Key Challenges for Future IBR-Dominant GB Electricity Tx System:
   - Declining Inertia
   - Declining System Strength
2. As suggested in ESO's Operability Strategy - Grid Forming capability is considered to meet these operability challenges.

ESO's Current Strategic Roadmap for GB Grid Forming Development

Business Case

- ESO Operability Strategy Report
- System Operability Framework (SOF) Article on GFM/VSM

Collaboration with External Stakeholders

- VSM Expert Group (Completed).
- GC0137 GB Grid Forming Working Group (Completed).
- GB Grid Forming Best Practice Group (To be completed by end 2022)

SOF "The Potential Operability Benefits of Virtual Synchronous Machines and Related Technologies", Apr, 2020

Share insight

Feasibility Studies

Tech Spec & Best Practice

GC0137: Minimum Specification Required for Provision of GB Grid Forming (GBGF) Capability (formerly Virtual Synchronous Machine/VSM Capability), implemented in Feb, 2022

Innovation Projects:

- Virtual Synchronous Machine (VSM) Demonstrator (Completed)
- Hybrid Grid Forming Converter (Completed)
- Demonstration of Virtual Synchronous Machine Control of a Battery System (Completed)

ESO's Prospective on GB Grid Forming

The penetration and proportion of Grid Following (GFL) based IBRs on the GB energy system will increase hugely into the foreseeable future.

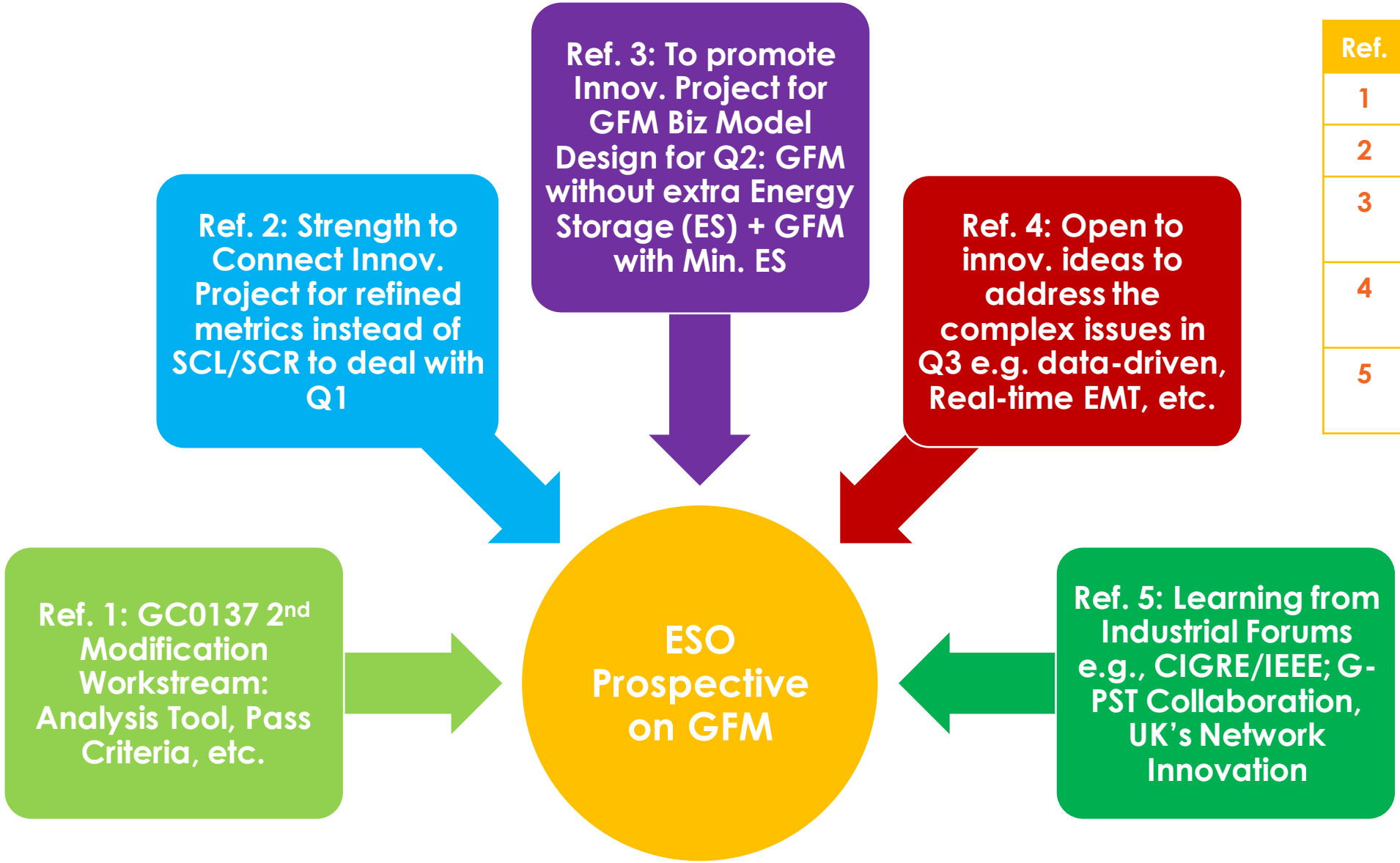
A number of challenges are foreseen below. How best can we address these issues?

- Q1: How much Grid Forming (GFM) capability will be required on the system to manage operability issues?
- Q2: Should GFM capability be mandated?
- Q3: How can we assess interoperability issues between GFL/GFM-based IBRs and Synchronous Machines?

ESO's Future Strategic Roadmap for GB GFM Development

Ref.	Key Activities	Term
1	To **further update GC0137** in line with key findings/suggestions of **GBGF Best Practice Group**.	Short
2	To understand how to **quantify the GFM capability** as required on the system to manage operability issues (in line with Q1).	Middle
3	To **set flexible entry requirements** for potential players in the GB Grid Forming markets (in line with Q2).	Middle
4	To **understand how to assess interoperability issues** among GFL-based IBRs, GBGF-Inverter/Synchronous and conventional Synchronous Gens (in line with Q3)	Middle
5	To **learn from industrial forums**, **facilitate international collaborations** and **implement network innovation projects** for further technical/market developments of GB GFM.	Middle/Long

On-going and Future Activities in line with ESO's Prospective on GB GFM



Ref.	Key Activities
1	GC0137 2nd Modification
2	GFM capability quantification
3	Flexible market entry requirements
4	Interoperability Issue Assessment
5	Learning from Others, Collaboration and Innovation

Q&A

Thanks for your attention!

Any Question?