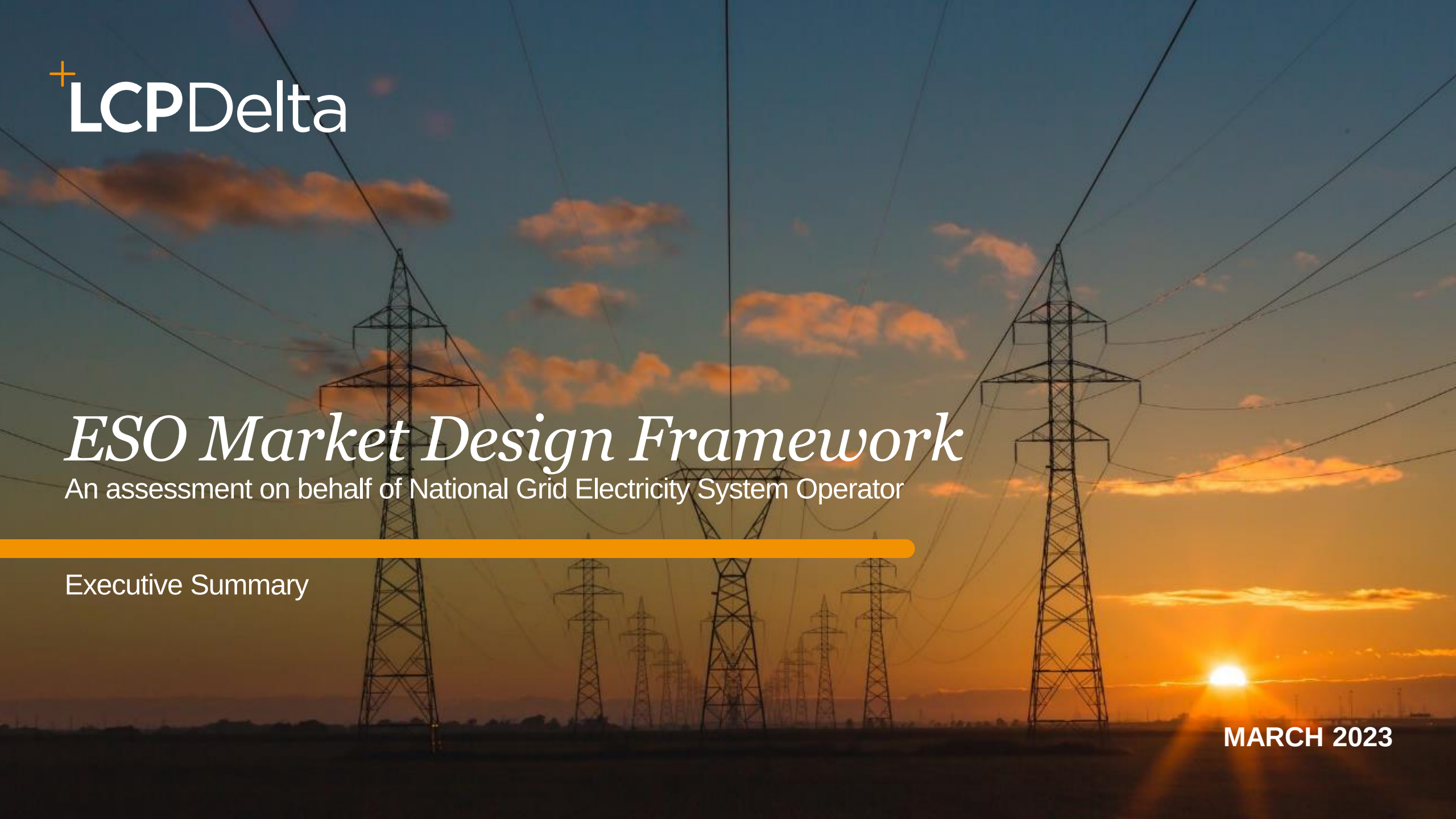


LCPDelta

ESO Market Design Framework

An assessment on behalf of National Grid Electricity System Operator

Executive Summary

MARCH 2023

Introduction and Approach

Introduction

An independent assessment of the Market Design Framework

- **National Grid Electricity System Operator (ESO) published its annual Markets Roadmap which covered how the ESO plans to reform its Balancing Services Markets. These reforms are required to be in line with the Market Design Framework (the "framework").**
- The framework sets out Market Design Objectives (the "objectives"), and within these objectives also identifies the Market Design Principles (the "principles") that the ESO should consider when designing and maintaining its market framework.
- LCP Delta was commissioned by the ESO to undertake an independent review into how well aligned decisions and market developments have followed the framework.
- Where markets are being developed, the assessment considered whether the approach taken by ESO in establishing these markets is in line with the principles.
- Conversely, where markets are mature, the assessment considered whether the way the market operates, and the market developments are in line with the framework and if any changes should be prioritised.
- The ESO have defined a set of objectives (Efficient Dispatch, Efficient Investment, Value for Money) that reflect what outcomes they expect from market procurement and to make market design decisions that are "robust, well-evidenced, and justifiable".
- The ESO expects that this framework will enable the assessment of the effectiveness of current market design considerations, and identify where they can be improved.
- Within this report, LCP Delta provides an assessment of the main products within the suite of ESO ancillary services through the lens of the established principles.

Explainer:

- *Market Design Objectives reflect what outcomes ESO expect from market procurement.*
- *Market Design Principles break down the objectives into testable concepts that are mutually exclusive and collectively exhaustive.*

Overarching Approach

Using the Market Development Framework to assess products

- **Using the ESO's internal guidance framework, LCP Delta reviewed each product against the individual principles.**

- This framework was developed to support ESO in thinking about market design by providing a consistent framework for developing procurement methods across its markets and forms the basis of this assessment.

- LCP Delta used a RAG rating to assess how aligned product development is to the framework, whether decisions taken have been suitable, and, for mature products, whether these meet the principles.

- We utilised ESOs internal Market Design Framework User-Guide in the assessment to review each product against the principles. This User-Guide set out suggested metrics that provided a 'long-list' of questions to guide the user to appropriately assess and apply the framework. These have been used by LCP Delta in its assessment and are provided in the annex.

- We provided a RAG rating for each market principle based on:
  - The alignment of the market product with the principle; and
  - Whether the developed approach is justified
  - What should be priority principles within framework

RAG	Summary
	Market design fully aligned with the principles
	Market design is aligned with the principles
	Market design is adequately aligned with the principles
	Market design is not aligned with the principles

- **LCP Delta reviewed the markets that have already been implemented, as well as those in development**

- Where products are in development, we assessed the emerging approach determining whether it aligns with the principles
  - A policy-based assessment will consider information available on Pathfinder projects, tender results and developments as appropriate.
  - Products in development are: Stability, Voltage, Thermal, Reserve (Quick and Slow), and Restoration.

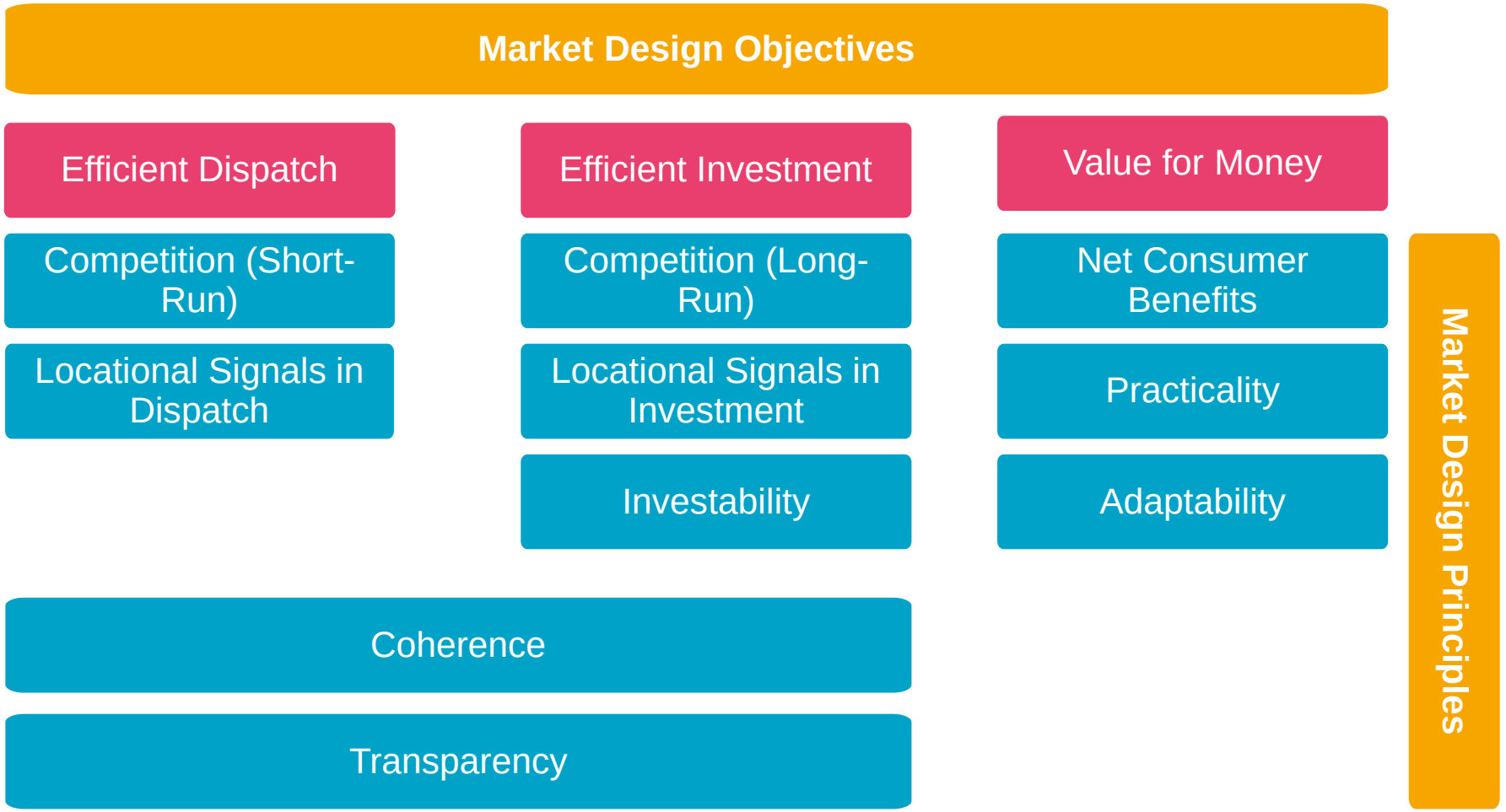
- Where markets are more developed, we provided a data-based assessment on how these markets align to the principles
  - We reviewed these markets for their pricing on an average basis over a month, and assessed them against the wholesale market. We analysed their fuel mix, excess volume, and market concentration. We employed backward-looking quantitative analysis to inform our qualitative analysis where appropriate.
  - Products in operation: Dynamic Containment, Dynamic Moderation, Dynamic Regulation, Reserve (STOR) and Frequency Response.

- The BM has a number of imperfections in its market design that is necessary for its operation. For example, the BM draws on a pool of providers to supply a number of differing products, of which the provider does not know what it is providing these for ahead of time; this will impact market price discovery. Given this, we applied the framework as appropriate, and focus on market developments rather than performance.

- Additionally, as part of the coherency principle, we assessed the ESO's balancing services against its impact on the wholesale market.

The Market Design Framework

National Grid ESO's Market Design Framework provides the basis of this assessment



The Market Design Principles

Using the principles from 'The Market Design Framework'

The table (ESO Markets Roadmap March 2022) provides a description of the principles.

For the purpose of this assessment, we have streamlined our review into the principles as shown to the right.

We did not provide an assessment on Practicality as this hinges on ESO's internal processes, practices and infrastructure, of which LCP Delta is not in a position to assess.

Principle	Description
Competition	The procurement method creates a market in which multiple current or potential participants seek to offer better terms (prices and quantities) than those offered by other participants, which is open to all providers technically capable of providing the service. That is, the market does not discriminate between technologies or providers. ▪ Short-run competition considers only existing assets. ▪ Long-run competition considers the assets expected to exist in future, given expected new build and retirement decisions.
Coherence	Across all of ESO's markets, the procurement methods enable market participants to make decisions about where to bid, which are efficient for both the market participants and the system. The procurement decisions are aligned with the evolution of government policy and other markets.
Transparency	Information is provided to market participants and procurement decisions are made in a clear and predictable way to minimise information asymmetries and uncertainty around ESO's decision making.
Investability	The procurement method provides investment signals which market participants and investors can respond to and rely on.
Locational Signals	The procurement method ensures that capacity is constructed and that services are procured in the right places.
Net Consumer Benefits	The costs to consumers do not outweigh the benefits conferred by the procurement method.
Adaptability	The procurement method is flexible to changes in balancing service requirements and the technology mix.
Practicality	The procurement method is practical to implement, transition to and operate. [Note: The practicality principle hinges on the ESO's internal processes, practices and infrastructure, and therefore, LCP Delta has not assessed this principle.]

Description of the principles taken from: NG ESO Market Design Framework user-Guide, unpublished

Assessment approach to developed markets

Assessing market concentration using the Herfindahl-Hirschman Index (HHI)

- **For market concentration, we have used the Herfindahl-Hirschman Index (HHI). This metric is recommended within the principles metric library, and is widely used across electricity markets to assess the competitiveness of the market.**

- We understand that the ESO has agreed with Ofgem that it should consider:
  - <1500 – not concentrated;
  - 1500-1800 – moderately concentrated; and
  - >1800 – highly concentrated

- We have taken an average approach across the time observed in each market in this report which could hide some circumstances of the market breaching 1500 or 1800 HHI on individual occasions. As a result, we have taken a blended approach to advising the ESO of market concentration with other market dynamics (see table on our assessment approach).

- We have complemented the HHI analysis with top three (CR3) and five firm (CR5) concentration ratios. This is not required in the framework, but helps to contextualise the HHI and understand whether <1500 is still of concern – particularly in the context of a merger or acquisition and risk of oligopoly. This approach will support our assessment to the risk to market competitiveness – particularly if an oligopoly (CR5 of >60%) is identified.

- NB - Some economists deem that a HHI >1000 demonstrates a moderately concentrated market as this makes the market susceptible to concentration through market exits or mergers and acquisitions. If the latter were to increase HHI by 200, this raises competitive concerns. Where markets are >1000 HHI, we note the need to monitor note this risk appropriately.

HHI	Screening Threshold	LCP notes
0-1000	Not Concentrated market	Not concentrated and a competitive market place exists.
1000-1500	Not Concentrated market	Not concentrated, but imperfect competition may exist, and may exceed moderately concentrated threshold in individual auctions. Market growth and mergers and acquisitions may cause concern.
1500-1800	Moderately concentrated market	Moderately concentrated, and imperfect competition likely exists particularly in individual auctions – where it may likely exceed 1800 threshold on occasion. Market growth and mergers and acquisitions will likely cause concern.
>1800	Highly concentrated market	A concentrated market that holds competitive concern. Individual auctions will fluctuate in HHI, however, it is likely that many significantly exceed this threshold. Action should be taken. Market growth and mergers and acquisitions will cause concern.

Summary Results

Summary RAG assessment
Summary of Market Concentration analysis
Product Assessment Summary
Summary of Wholesale Market Assessment

For full assessment and supporting analysis please refer to our full report

Summary RAG assessment

Competition is a key priority for all markets, but not always aligned with the framework

- **The table provides a summary of the RAG assessment for balancing services against the principles. Key conclusions are:**
  - Most products are partially aligned with the competition principles - despite this being a priority focus for all products. The ESO should ensure that enhancing competition (often through increasing participation) is considered further.
  - Most products have are well aligned with the adaptability principle and are flexible to changes in balancing service requirements and technology mix. This is reassuring given the energy transition.
  - We found that the BM is least well aligned with the framework. As discussed earlier, even though the BM is an imperfect marketplace, it is a vital mechanism for managing the system. We do not propose fundamental reform, rather, the ESO should continue its reform of balancing services as per the Markets Roadmap.
  - We find all principles are aligned in Voltage and Quick & Slow Reserve.

		Competition	Coherence	Tranparency	Investability	Locational Signals	Net Consumer Benefits	Practicality*	Adaptability
Response	Dynamic Products	P					P		P
	FFR	P					P		P
Reserve	STOR	P					P		P
	Quick and Slow	P					P		P
Balancing Mechanism		P		P			P		
Thermal		P			P	P			
Voltage		P			P	P			
Stability		P			P				P
Restoration		P	P				P		

Key: RAG assesment of each product. 'P' denotes priority MDP

*The practicality principle hinges on the ESO's internal processes, practices and infrastructure, and therefore, LCP Delta has not assessed this principle.

Summary of Market Concentration analysis

Whilst markets are not currently deemed to be concentrated, they should continue to be monitored regularly and in light of any significant market developments

- **None of the ESO's markets are deemed to be concentrated according to analysis using the Herfindahl-Hirschman Index (HHI)*. However, this does not fully describe the risk to the ESO of individual auctions being concentrated or risk to competition through market growth and mergers and acquisitions. Therefore, we recommend the ESO continues to monitor the markets, especially DM-Low and STOR.**

- The table provides a summary of HHI results across Dynamic Response products and STOR services. We utilised both the ESO data and LCP Delta's Enact platforms analytics, which has allowed us to analyse what overarching owners market share is. This may result in some inconsistencies between the ESO data and the findings in this report.

- The ESO's new markets utilise new types of technologies – particularly battery storage. This market is a particular growth sector at present, where we are observing a good number of investments being made in both the primary (i.e. new build) and secondary (i.e. mergers and acquisitions) markets. This does seemingly increase the risk of a market becoming concentrated, and therefore there is a higher need to contextualise the HHI results of the market. Top three (CR3) and five firm (CR5) concentration ratios have been used here to better explain the market.

- Although below the 1500 HHI threshold agreed with Ofgem, the ESO should monitor DM-Low and STOR carefully for individual excursions into concentrated markets. Although a lot of this for DM-Low can be explained by the immaturity of the market, STOR should be considered in the context of the read across to reserve reform markets (particularly Slow reserve).

Balancing Services		Monthly Average HHI
Dynamic Containment	High	430
	Low	455
Dynamic Regulation	High	861
	Low	750
Dynamic Moderation	High	978
	Low	1095
STOR		1171

*The Herfindahl-Hirschman Index (HHI) is a metric used to measure the concentration of a market and deem its competitiveness. It is used across power markets and in wider market analysis.

Product Assessment Summary

Dynamic Response Product Suite

- **ESO has a licence obligation to control system frequency at 50Hz plus or minus 1% with different dynamic response products to meet that requirement.**
- The dynamic frequency response markets continue to mature and develop following phased implementation over the last couple of years. The ESO seeks to further their application, gradually taking over from existing response services. Dynamic Containment (DC), launched in October 2020, is the most liquid and mature market exhibiting good levels of competition which has driven down its price. Despite being newer products, Dynamic Moderation (DM) and Dynamic Regulation (DR) also have an unconcentrated market which is showing good signs of development.
- The services have not attracted any assets other than batteries to participate in the dynamic services. The ESO should ensure that there are no market barriers to other technologies that could provide the system need, as the more diverse fuel mixes can increase competition and therefore more market reflective pricing.

Priority	Assessment rational
Competition	There is a significant lack of diversity of fuel mix in the dynamic products - solely batteries. The ESO should review as to whether any of its technical requirements unnecessarily preclude other technologies capable of meeting the system need.
Net Consumer Benefits	Net-consumer benefit would be improved if the ESO focussed on increasing market depth and competition.
Adaptability	The dynamic products are all procured at day-ahead stage and split into six EFA blocks for committed delivery making them highly adaptable.

Firm Frequency Response (FFR)

- **Demand / Supply imbalances can cause large deviations in system frequency. FFR uses pre-approved assets to rapidly reduce demand or increase generation to keep frequency of the system within prescribed limits.**
- With Dynamic FFR due to be phased out over the coming financial year, we have reviewed only Static FFR in detail.
- The daily Static FFR procurement is highly adaptable, with delivery windows within-day and pricing set on a pay-as-clear basis in a day-ahead auction. These developments will increase participation in Static FFR as new technologies, particularly Demand Embedded Resources (DER), are attracted to the ability to optimise at day-ahead stage. This will also enable optimisation across ESO's day-ahead auctions and the wholesale market – likely increasing participation across the markets and possibly reducing total ESO expenditure if all markets have good liquidity. With Static FFR expected to be phased out in due course, the ESO would do well to ensure good transparency is provided of the future of the service.

Priority	Assessment rational
Competition	The changes that have been made to the Static FFR procurement framework, and indicative mock results, means that the market may enable the participation of new, non-conventional assets such as interconnectors.
Net Consumer Benefit	Moving to day-ahead procurement has opened the possibility for a service provider to co-optimise across all response markets.
Adaptability	The day-ahead procurement and EFA block commitment window enables the ESO to vary its requirement on a daily basis and throughout the day

Product Assessment Summary

Short Term Operating Reserve (STOR)

- **The ESO procures sources of extra power ahead of time through the STOR service to help manage actual demand on the system being greater than forecast or unforeseen generation unavailability.**
- Despite expectations that STOR would be phased out due to the ESO's issues with operating it at net zero, it has proven to be a resilient balancing service.
- Although a significant portion of the market is held by the top three and five asset owners, we found that STOR is not a centralised market – but we note signs of imperfect competition existing. As this product is phased out, the ESO should prioritise competition and net consumer benefit to ensure that a fair price is paid and no market power is exhibited as the risk of assets exiting the market increases.

Priority	Assessment rational
Competition	The market is moderately concentrated which could provide an opportunity for market power to be exercised and inflate costs outside of a rational market when the requirement increases. The market also has a limited fuel mix.
Net Consumer Benefits	The cost of the ESO not holding a STOR product is significant, as one of the last interventions it can make to maintain security of supply in the event of pre- and post-fault incidents. Net-consumer benefit could be improved by improving market depth and seeking to reduce market concentration from the three largest providers.
Adaptability	STOR auctions run on a daily basis with two windows: one over the morning and the other over the evening peak. This allows for a flexible and adaptable market procurement approach.

Quick/Slow Reserve

- **Quick and Slow Reserve are the ESO's long-term enduring solution to meet the reserve need for the system. Over time, these two products will replace STOR and Optional Fast Reserve.**
- We have found that the design principles of Quick and Slow Reserve are well aligned to the framework, however, it will be easier to assess once active. The Quick and Slow Reserve products are well designed to enable high levels of participation while achieving the base requirement far enough ahead of real time for ESO control room planning. This should ensure a deep pool of providers that will promote competition and lead to positive net consumer benefits.
- We believe that new products must be highly adaptable, to allow for adjustments to be made once implemented, and the ESO should focus on ensuring that as much competition is possible to keep prices low and ensure net-consumer benefit is high.

Priority	Assessment rational
Competition	We have identified a significant and growing capacity capable of providing both Quick and Slow reserve
Net Consumer Benefits	The cost of not reforming could bring about very real risk to security of supply in the future. As zero cost generation increase in system penetration it is important that the ESO has tools ready to manage the system.
Adaptability	The ESO also has the option of not procuring windows, and also opting to not procure firm reserve over windows where the requirement is low. This means that an availability fee is not provided and only a utilisation fee is paid out in the event of dispatch

Product Assessment Summary

Balancing Mechanism

- **The Balancing Mechanism (BM) is the ESO's primary tool to balance supply and demand, manage constraints, ensure system stability and maintain real-time security of supply.**
- The BM is an unusual marketplace. The ESO uses the BM to procure multiple services; implicitly stacking energy products with system services (i.e. for thermal congestion as well as energy balancing). It therefore does not procure a single homogenous product from the market (which is inconsistent with economic theory of an efficient marketplace).
- As a heterogenous product, it is not designed to give forward signals to market participants to price their supply ahead of time. Therefore, to ensure as effective a market place as possible within these limitations, the ESO should focus on encouraging as much competition as possible by enabling greater levels of participation and transparency. This provides more reflective price formation of the cost of a service and improved net consumer outcome.

Priority	Assessment rational
Competition	Despite the ESO's attempts to encourage market participation, large gas-fired generation continues to be the dominant provider in the BM.
Net Consumer Benefits	Costs to balance the GB power system rose to £1.5 billion between November 2021 and February 2022
Transparency	The BM is typically transparent on an operational basis. However, the ESO should prioritise providing suitable levels of transparency to enable greater participation and competition.

Thermal constraints

- **The ESO is required to take action if there is a risk of exceeding the physical limit of power which can be transmitted through equipment in order to avoid overload or overheating.**
- The BM is the primary market the ESO has to manage thermal constraints. For the reasons given earlier, the BM is limited in sending clear useful signals for thermal constraints. To mitigate this, the ESO is developing market solutions including Constraint Management Intertrip Scheme (CMIS); the Local Constraint Markets (LCM) and MW Dispatch Service.
- The tenders for CMIS showed a relatively illiquid market. The ESO should identify any entry barriers, or explore why many that expressed interest did not tender so as to maximise competition in future.
- When designing MW Dispatch Service, the ESO should ensure that the infrastructure required is not overly-costly or burdensome to install; this would otherwise reduce participation.

Priority	Assessment rational
Competition	There have been two tenders for the B6 Pathfinder with little apparent competition despite expressions of interest. The ESO should explore whether capability rules were appropriately applied. The MW dispatch service has specific requirements that will necessarily limit access and this should continue to be considered as whether appropriate by the ESO. LCM provides a route to market for non-BM Units which is positive.
Investability	There is significant spread in the service cost of the contracts awarded and considerable variation within the B6 tenders. Whilst the value / price of service remains unclear, this may cause investment challenges
Locational Signals	Products are for a local solution. The ESO continues to consider providing other market signals to alleviate constraints.

Product Assessment Summary

Voltage

- **To keep voltage stable, the ESO can increase it by injecting reactive power and decrease it through absorption of reactive power.**
- The ESO are carrying out long-term reforms under the 'Reactive Reform - Market Design' programme to enable more participants across different technologies and connection types to provide reactive power in the right locations. This assessment also considered some of the interim arrangements made, for example the Merseyside and Pennines Pathfinders.
- Proposals recommended under the Reactive Market Design Reform are well aligned with the framework. The ESO's minded-to position is to create three markets across different time periods (longer-term, mid-term, and day-ahead) that will promote investment and encourage competition. As assets in one region are less effective at meeting the need in a different region, the ESO is minded to establish nodal markets to provide locational signals.
- Regarding the two Pathfinders; competition was adequate in both auctions (stronger in Merseyside). However, investment signals may have been affected by changes in contracts post tender within Merseyside Pathfinder.

Priority	Assessment rational
Competition	Recommendations in the Reactive Reform Market Design focus on including all possible assets to promote competition and avoid market power. Interim arrangements to 2026 have not (yet) provided detail to assess if sufficiently competitive and at what cost.
Investability	Long and short term markets are to be established which provides multi-year contracts for those that require additional investment and certainty within the Reactive Market Design. However, investment signals may have been affected by changing contractual terms.
Locational Signals	Nodal markets are to be established that provides market information and signals to service providers.

Stability

- **To keep the power system stable, the ESO needs to maintain sufficient amounts of inertia, Short Circuit Level (SCL) and dynamic voltage support.**
- As the power system transitions, the need for more stability products from non-traditional sources will be required. The ESO is preparing reforms through the Stability Market Design project to assess eligibility rules, contracts and procurement approach. To date, the ESO has completed three long-term pathfinders.
- Introducing competition into these markets is key, the first Pathfinder attracted bidders for stability from rotating stabilisers, synchronous condensers, re-purposed thermal generators and pumped storage. For the second and third pathfinders, the ESO was expecting a wider range of technologies to take part. According to the results of the two tenders, these additional technology providers have not materialised outside of battery storage. The ESO should assess potential technology providers and ensure that there are not barriers to entry that prevent assets from tendering.

Priority	Assessment rational
Adaptability	The core recommendation of the Stability Market Design innovation project is to develop a combination of a dedicated short-term market (day-ahead) with a long-term market
Competition	Limited range of technologies have come through the pathfinder despite a stated objective by the ESO following the first Pathfinder to increase the diversity of assets and promote innovation.
Investability	The ESO is proposing to procure stability services with a dedicated market across several timescales with an initial focus on procuring inertia services.

Product Assessment Summary

Restoration

- **Restoration is the process used to restore power in the event of a total or partial shutdown of the national electricity transmission system**.
- The historic approach to restoration relies on transmission connected thermal generation. The Distributed ReStart project explored how distributed energy resources can restore power through a competitive tender process. These learnings have now been incorporated into BAU following two regional tenders to date and with additional regional tenders to follow.
- The ESO (Market Roadmap, March 2022) expects to see an overall increase in Restoration services costs going forwards compared to the existing framework. This has been mitigated to some extent with a more competitive tender process, pay-as-bid mechanisms, and more potential providers.
- Gas based technologies are still applying in both the SE and Northern Tender but there is a healthy number of other DER technologies competing.

Priority	Assessment rational
Competition	Gas based technologies are still applying in the SE and Northern Tender but there is healthy numbers of other DER technologies to compete with
Coherence	Bringing in learnings from the Distributed ReStart project has been necessary in response to the energy transition and increasing intermittent and local sources of generation.
Net Consumer Benefits	Annual costs are due to increase in the baseline scenario, so a cost-effective solution is required, especially given the nature of power outage services as a public good insurance product in the event of a need for a system restart. It is anticipated to save at least £115M through increased competition by 2050

Summary - Wholesale Market Assessment

An impact on the wholesale market is unavoidable, but the ESO is developing good mitigations in its market design to limit any risk

- **As part of the coherency principle, we assessed the ESO's balancing services against its impact on the wholesale market.**

- We found that there is a real risk regarding the impact that the ESO's balancing services has on the GB power wholesale market, particularly from energy products. This is not a new risk and it is driven by the competition for the same energy volumes. However, the ESO has developed adequate mitigations to limit this impact.

- Following our assessment, we have the following three conclusions:

- **(1) Balancing services compete for volume in the wholesale market**
  - The day-ahead energy auctions and balancing services compete for the same supply, which will likely impact on the price outcomes of the different auctions as the supply profile and additional risk premia are considered.
  - In recent years, asset owners have started using the ESO markets – particularly the Balancing Mechanism (BM) – to access scarcity and achieve higher revenues than what could be offered in the wholesale markets.
  - The UK Government, Ofgem and the ESO has taken steps to try and address these issues. We particularly note the recently rejected the ESO proposal to implement the Balancing Reserve product which would have removed the need for the ESO to maintain regulating reserve through the BM.

- **(2) Day-ahead trading session is becoming crowded, which poses a risk to efficient dispatch**
  - Auction timings taking place so closely together poses risks based on how they influence and correlate with one another's price. Overarching risks from the sequencing of auctions exist particularly in the form of market fragmentation; where different prices (and values for energy) may emerge in different auctions based on sub-optimal information.
  - Conversely, auctions that occur at similar timeframes may experience price convergence or correlation where a preceding auction directly impacts bidding behaviour in a subsequent auction.
  - The ESO's proposals to proceed with the Enduring Auction Capability (EAC) for new products, and apply a co-optimised procurement approach in favour of sequential auctions is a positive step. This should mitigate risks through increasing simplicity in the trading day.

- **(3) System services interaction with the wholesale power market is limited, but could influence supported units bidding behaviour.**
  - System services do not compete with energy markets (such as the wholesale market) for the same supply. Rather, system services are delivered by providers as either a by-product of producing or consuming active energy, or they do not produce or consume active energy to deliver the system requirement (such as flywheels or synchronous condensers).
  - Stacking system service revenue streams with energy contracts is generally permissible. For assets that can be paid for system services and commercially selling energy, the additional system service revenue stream would support their participation (financially) in energy markets. In some scenarios (especially if a unit is in receipt of CM payments too), less efficient units could displace more efficient units in the merit order.

Project team

Matthew Deitz
Consultant

Tel: +44 (0)20 7432 6799
Email: Matthew.Deitz@lcp.uk.com

Sam Hollister
Head of Markets

Tel: +44 (0)20 7432 3780
Email: Sam.Hollister@lcp.uk.com

Shivam Malhotra
Consultant

Tel:+44 (0)20 3824 7283
Email: Shivam.Malhotra@lcp.uk.com

Chris Matson
Partner

Tel: +44 (0)20 7432 0674
Email: Chris.Matson@lcp.uk.com

Disclaimer

About LCP Delta

LCP Delta is a trading name of Delta Energy & Environment Limited and Lane Clark & Peacock LLP. References in this document to LCP Delta may mean Delta Energy & Environment Limited, or Lane Clark & Peacock LLP, or both, as the context shall require.

Delta Energy & Environment Limited is a company registered in Scotland with registered number SC259964 and with its registered office at Argyle House, Lady Lawson Street, Edinburgh, EH3 9DR, UK.

Lane Clark & Peacock LLP is a limited liability partnership registered in England and Wales with registered number OC301436. All partners are members of Lane Clark & Peacock LLP. A list of members' names is available for inspection at 95 Wigmore Street, London, W1U 1DQ, the firm's principal place of business and registered office. Lane Clark & Peacock LLP is authorised and regulated by the Financial Conduct Authority and is licensed by the Institute and Faculty of Actuaries for a range of investment business activities.

LCP and LCP Delta are registered trademarks in the UK and in the EU. Locations in Cambridge, Edinburgh, London, Paris, Winchester and Ireland.

https://www.lcp.uk.com/emails-important-information contains important information about this communication from LCP Delta, including limitations as to its use.

Disclaimer and use of our work

This work has been produced by LCP Delta under the terms of our written agreement with National Grid for the Client's sole use and benefit, subject to agreed confidentiality provisions, and for no other purpose. To the greatest extent permitted by law, unless otherwise expressly agreed by us in writing, LCP Delta accepts no duty of care and/or liability to any third party for any use of, and/or reliance upon, our work. This document contains confidential and commercially sensitive information. Should any requests for disclosure of information contained in this document be received, LCP Delta request that we be notified in writing of the details of such request and that we be consulted and our comments taken into account before any action is taken.

Where this report contains projections, these are based on assumptions that are subject to uncertainties and contingencies. Because of the subjective judgements and inherent uncertainties of projections, and because events frequently do not occur as expected, there can be no assurance that the projections contained in this report will be realised and actual events may be difference from projected results. The projections supplied are not to be regarded as firm predictions of the future, but rather as illustrations of what might happen. Parties are advised to base their actions on an awareness of the range of such projections, and to note that the range necessarily broadens in the latter years of the projections.


LCPDelta