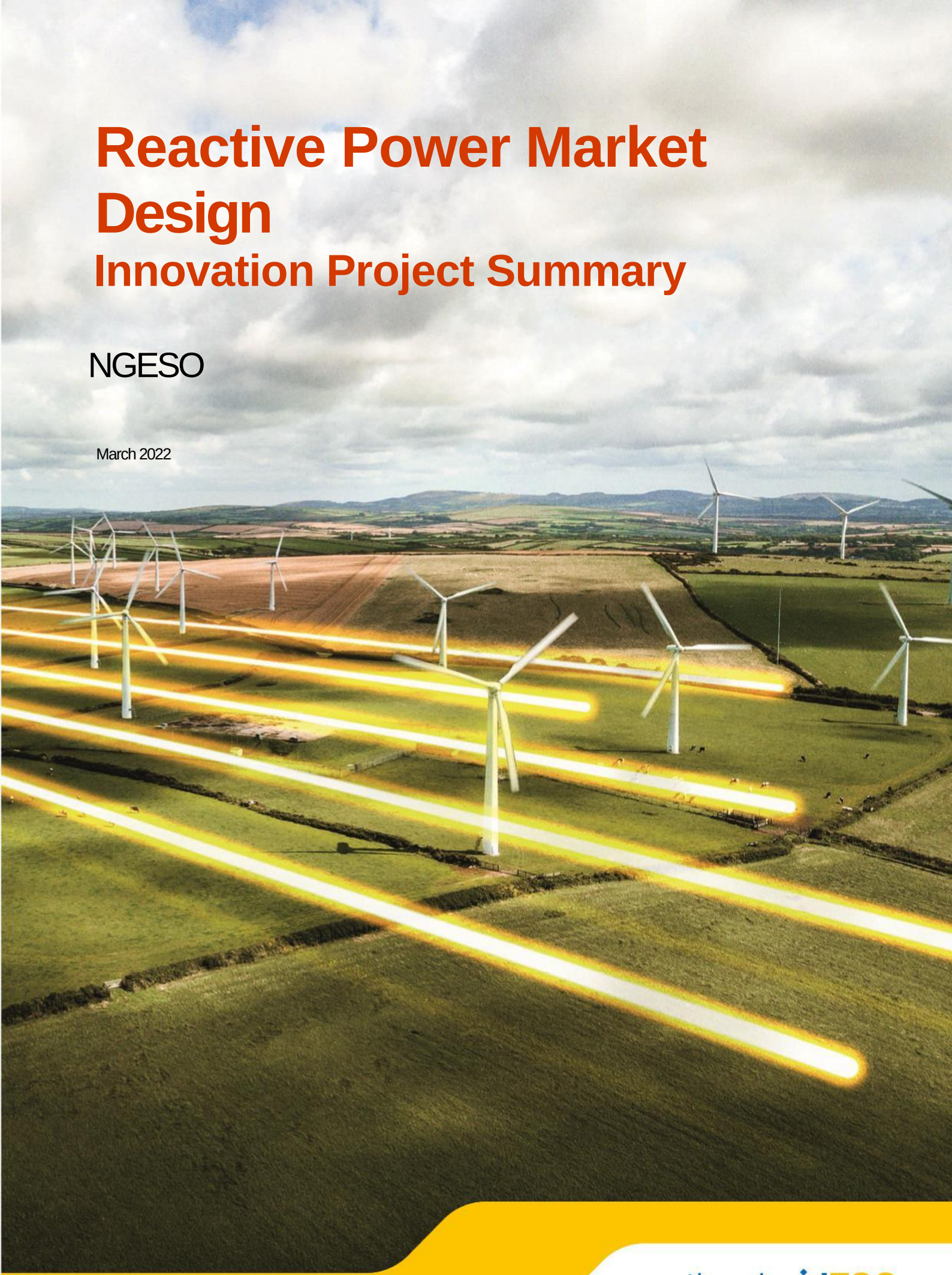
Reactive Power Market Design

Innovation Project Summary

NGESO

March 2022



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Developing options for a reactive power market

We have an ambition to operate a zero-carbon grid as well as ensuring the security and operability of the electricity system.

The reactive power market design project has explored market solutions to resolve the challenges for procuring reactive power, ensuring cost efficient provision to maintain system voltage security in the context of a zero-carbon system.

How we manage reactive power today

Current arrangements – which include Transmission Owner (TO) network assets, the Obligatory Reactive Power Service (ORPS), Voltage Contracts and our Voltage Pathfinders – are sufficient to ensure system security today; however, future challenges could be met more efficiently with reform to existing arrangements. We have explored areas where a new market could increase cost efficiency, improve system security and broaden participation from zero-carbon providers of reactive power.

Challenges

We are witnessing fundamental changes to the electricity system affecting our reactive needs: Retirement of old plant providing services under the Obligatory Reactive Power Service (ORPS) arrangements such as coal and in future gas and nuclear, means there is reduced access to reliable reactive power providers.

Changing economics of different technologies means retiring generators are not being replaced with 'like-for-like' assets.

We continue to experience rapid increases in embedded generation and a shift towards generation which is located increasingly far from the locations where we need reactive services.

Demand for reactive power services is increasing. Changes to network topology, reactive offtake at Grid Supply Points (GSPs) to Distribution System Operators (DSOs) networks (due to embedded generation) and consumer behaviour are all contributing to increasing demand for reactive power at the transmission network level.

Spend on reactive power is increasing as accessing providers is becoming increasingly expensive, traditional ORPS providers are being driven out of merit, requiring payment for synchronisation for us to access the services.

No enduring arrangements are in place to drive technical innovation. For some solutions, there is no route to market or insufficient economic incentives/clarity over our needs to stimulate innovation.

What is Reactive Power?

NGESO has an obligation to maintain voltage levels within agreed limits. Managing voltage levels requires us to maintain a balance between elements on the system which either absorb reactive power (decreasing voltage) or generate reactive power (increasing voltage). Reactive power is locational and a balance must be maintained at each location on the transmission network.

Reactive power services enable us to instruct generators or other asset owners to either absorb or generate reactive power to balance the system voltage.

Overview of Reactive Power Market Design innovation project

The project presents recommendations for the high-level design of a reactive power market, as well as providing new analysis tools for the assessment of reactive power needs and solutions.

The project does not represent a final decision; further consultation will be needed with industry to crystalise the way forward.

Phase 1 of the Reactive Power Market Design project started in September 2021 and finished in March 2022.

Stakeholder input has shaped the project through surveys, industry engagement from webinars and workshops, detailed case studies on technology types, modelling the inputs and outputs, internal engagement through workshops and project updates with ESO experts & AFRY. All previous information and materials can be found here.

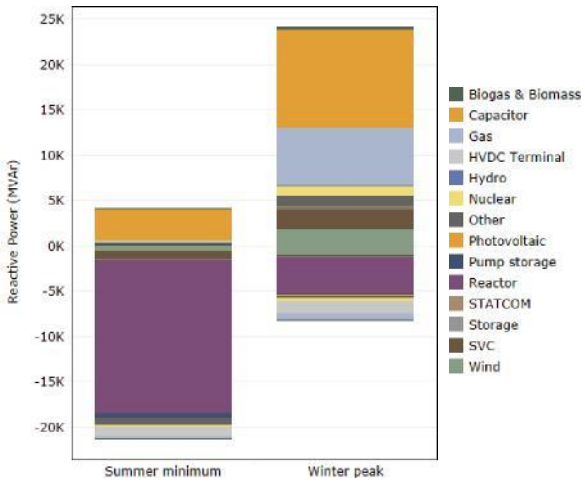


Chart to show peak requirements by technology (MVAR, ETYS 2025/26, National utilisation of Reactive Power)

Unlocking reactive capability

A large portion of our peak needs are currently met by grid assets, and we are seeking to access additional capability and providers beyond the existing providers.

Where large reactive power requirements exist, investment in new assets can reduce costs to consumers but only if sufficiently robust signals are in place for participants to site their assets effectively. This requires a reliable structure for remuneration to permit investment. There may be additional reactive capability already present on the system, but without adequate incentives it isn't possible for ESO to access this.

There is additional reactive capability embedded in the distribution networks that could help to resolve transmission level voltage issues, but due to DSO topology and rules around reactive power for providers in the distribution network, it is unclear how much reactive can be transferred to the transmission network effectively.

Summary recommendations from the Reactive Power Market Design project

The project has developed a market framework designed to meet the challenges faced by the ESO whilst seeking to maximise participation from potential providers. These recommendations will shape the development of competitively procured reactive power services.

We recommend that all commercial providers should be eligible to participate, although they will only be contracted if they bring a benefit to the system from the perspective of consumers – this means incentives should only be available for providers who change their behaviour.

Following thorough technical analysis we are recommending a nodal market, where reactive power requirements are identified and stated per node and effectiveness factors are calculated per node. A methodology has been developed to define nodal MVAr requirements, node-to-node effectiveness, and specific provider-to-node effectiveness. This enables a consistent, transparent and repeatable way to produce market signals.

To facilitate distribution connected providers DSOs will need to re-run network studies to understand limitations and potentially modify connection agreements to allow providers on the distribution network to provide reactive power services to meet transmission system voltage needs. This will require a coordinated approach to implementation.

We have recommended a market design that will runs over two timeframes:

- **Long-term** annual markets operating in investment timeframes which offer multiyear contracts to underpin investment in assets, with annual year-ahead contract rounds to finesse procurement as required;
- **Short-term** market operating at the day ahead stage to enable participation of assets unable to make long-term firm commitments, or unable for ESO to access from existing arrangements

Long-term contractual timeframes mean that we can ensure system security by giving participants a degree of certainty adequate to make investment decisions. We propose an assessment of TO asset costs to use as a counterfactual for commercial solutions to ensure value for consumers, similar to how the pathfinders work today. Further engagement with Ofgem and TOs will be required to settle on an enduring framework for this indirect participation of TO assets.

Including a short-term market ensures there is an appropriate route to market for a broad range of potential participants, facilitating providers which may be exposed to volatile opportunity costs, high variable costs, and/or low visibility of their future availability – ultimately increasing competition, promoting value for consumers and contributing to system security.

Looking to the Future

Throughout 2022 we will continue to engage with industry to co-create, share thinking and gather feedback as work on the project progresses.

The next steps for the project are summarised below:

- Carry out a feasibility study to identify gaps and efforts of implementation to understand the readiness of ESO and providers
- Optimise the details of design and further assess its effectiveness

Depending on the feasibility study and the further assessment on the effectiveness of the market design, we will continue to:

- Develop an **implementation plan** for a **short-term market**. We will quickly consider whether a regional daily trial is a necessary first step to de-risk some key uncertainties around market liquidity and the effectiveness of the market design. If we deem these risks to be manageable, we will progress with the implementation of a full GB short-term reactive power market without a regional trial.
- Develop the plan of **implementing long term market**, which aims to move pathfinder from an ad-hoc approach into an enduring solution

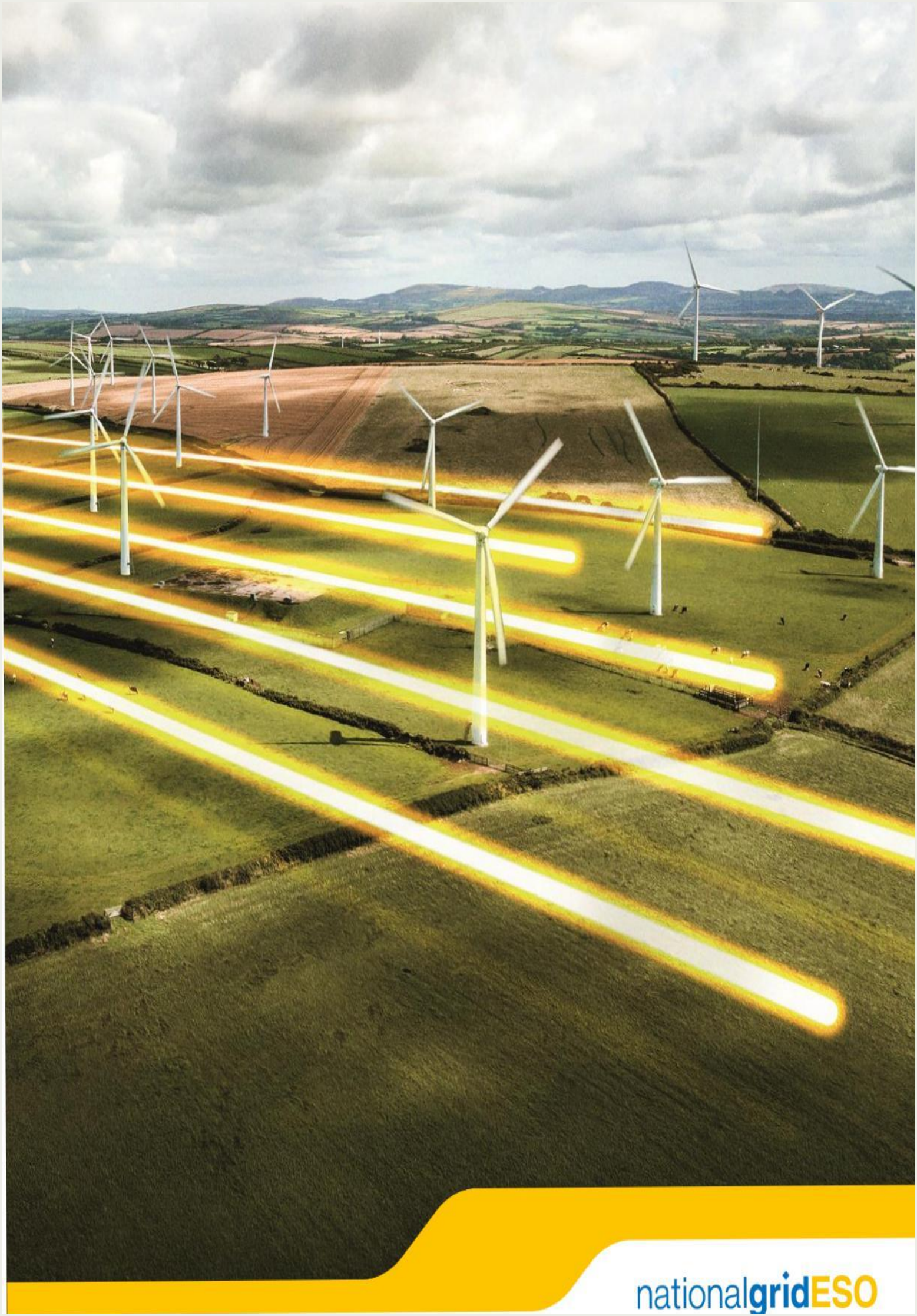
Furthermore, we will continue to:

- Support the work to **explore a co-optimised procurement method** considering the interaction across different markets
- Support the work to develop a **coordinated approach with DSOs** for accessing DER capacity as part of our whole system ambition.

Our Market Design Objectives and Principles are also helping us identify change in our current arrangements.

To learn more about our Market Design Objectives and Principles, please read our Markets Roadmap.

If you have any questions, please contact: box.futureofbalancingservices@nationalgrid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