Written evidence submitted by the Institution of Engineering and Technology (IET) (ECO0004)

About the Institution of Engineering and Technology (IET)

The IET is an independent source of impartial evidence-based engineering and technology advice and welcomes the opportunity to respond to this important Energy Security Committee inquiry on reforming the energy sector. The IET has produced a series of reports on low-carbon energy systems, and has previously responded to a range of related consultations. We hope our responses are of value and would welcome the opportunity to elaborate on our feedback in person to the inquiry.

Executive Summary

Decarbonising the future energy system affordably is vital for UK society and the sectors which are dependent upon it, notably those transitioning away from natural gas and other fossil fuels, including transport, industry and built environment.

Our key comments are as follows:

- A common vision of the future arrangements and how they are expected to work is needed to engender the necessary collaboration and common purpose needed for this immense challenge and for effective oversight and timely interventions to ensure a suitably resilient system develops.

- To achieve an affordable future energy system the energy sources, energy storage, transmission and distribution networks, and the markets that support them must be developed as a coherent system. In our view a whole systems approach should cover electricity, hydrogen and other energy vectors as they will be increasingly interactive.

- Building energy infrastructure remains a significant challenge. Infrastructure constraints will remain at both local and national level, at least in the medium term. Market design needs to reflect these and the increasing role of capacity and flexibility in ensuring secure, clean affordable energy. While debates around locational pricing and Contracts for Difference (CfDs) are attracting much attention and debate, an equal focus should be applied to flexibility reforms.

- The resources that form the system must not just supply energy, but all the vital services needed to safely operate the energy system. These 'ancillary services' are becoming ever more important to the operation of the electricity system and the location of the resources can be as important as their volume. Market design must recognise how financial management and these complex technical requirements interact.

- The market and planning functions must work together over at least three different timescales:
    - meeting the real-time needs of the energy systems, particularly so for the electricity system;
    - the efficient scheduling and despatch of existing resources; and
    - ensuring the long term development and investment in the infrastructure of tomorrow, requiring at least a 10-15 year forward horizon.

- Energy is a vital input to other systems and the outcomes of changes in energy markets can be far reaching as we have seen recently. A systems approach would include assessments of the risks, consequences, and mitigations, especially for those least able to manage the transition. Many of these issues have social and political dimensions outside our core expertise.

1. What should be the underlying principles of the UK energy market?

The Principles of Market Reform

a) Long Term Strategic Direction

The principal focus of this unique opportunity should be the development of an energy system and energy services that will benefit future society. The transition will involve the introduction of an extensive combination of new, reinforced, and re-purposed infrastructure to meet the likely doubling, or more, of electricity demand envisaged in 2050, circa 100GW. Generation investment includes significant growth and re-planting of renewable assets and sufficient capacity to meet that demands during the inherent sequential, cold, multi-day periods of low renewables output. The development of low carbon supply must be combined with concomitant changes to demand in homes, industry and transport. Policy, planning, markets and regulation must work together to achieve this.

b) Physical System and Markets Development

It is clear that the transition, future operation and service delivery of the energy system will be hugely dependent on both the technical capabilities of the system and the market mechanisms that support it.

Whilst the 2050 decarbonisation objective is clear, the changes to the system and markets required are fundamental, complex, and have to be founded on a robust strategic planning process. This includes consolidating technical, market and economic insights to optimise the balance of renewables and non-intermittent generation capacity, storage, transmission and distribution networks, energy interconnectors demand side flexibility and the interactions between energy vectors.

Importantly planning must identify the type and extent of the services required for successful operation of the resulting system. Planning should encompass all energy vectors and be the basis for understanding the interaction with associated interdependent sectors such as transport, water, and telecommunications.

The insights from this planning process can inform the development of effective markets to deliver the most efficient long and short-term system and minimise potentially ineffective interventions and distortions as part of a single, whole systems approach.

c) Security and Stability

The major reconfiguration of the nation's energy system and markets in pursuit of a low carbon energy society has the potential to progressively improve future energy security, reducing dependence on potentially volatile short term international commodity markets. An energy system founded on substantial, but less volatile long-run asset investment costs should offer, in principle, improved price stability for customers. The reconfiguration must recognise the imperative to maintain security and stability throughout the transition.

It is also an opportunity to consider wider security issues, including the implications of renewables dependency including future climate uncertainty and its impact on energy production, networks and demand, and develop the appropriate system and network security standards for 2050 as dependency on electricity increases. Risk management must be a part of any system design and this must include both technical and market risks and potential interactions.

d) National and Local Considerations

A major theme of this response has been the importance of a long-term national, strategic, spatial planning process and the future relationship with energy market development. Linked and in parallel, a suitably resourced process of local strategic spatial planning is essential to help to build consensus, limit piecemeal transition activities and focus on the advance investments needed in local networks.

However, energy pricing concepts that are related to local energy resource availability are subject to much debate. Most major energy production locations are largely fixed by their topography, and population centres are well established, so the opportunity to steer either is relatively constrained; the delivery of networked heat being one notable exception. As a general principle the overall market is considered better if primarily driven by the most cost-effective national deployment signals rather than a series of more complex bespoke local or zonal price frameworks.

e) Institution and Consumer Confidence

Consumer and investor confidence is essential. Investor confidence is essential to enable the necessary investment in supply side and infrastructure and consumer confidence essential to ensure meaningful engagement in energy service and their investment in new low carbon technologies. This must be supported by a consistent stable policy and regulatory environment.

The enactment of a strategic system and market development process that is transparent, truly independent and driven by principles that deliver the best result for all future customers is an important step to help build the confidence of customers, investors, local planning offices, skills providers, education institutions and innovators.

2. Can Government deliver radical reform in the UK energy market?

The Government must take responsibility for reform decisions and delivery – vast amounts of private investment have been committed to the UK energy sector based on investor and lender confidence in the UK legislative and regulatory framework.

In delivering radical reform, the Government faces challenges in maintaining private investor confidence, and ensuring that the reform solutions deliver policy aims of clean, secure and affordable energy supplies. Delivery of market reform must be geared to attracting sufficient investor confidence in providing the additional capacity and new technologies required to meet energy decarbonisation and security of supply objectives.

It is critical that the Government takes account of advice not just from industry participants but others without vested interests. It must take responsibility for engendering the necessary collaboration and common purpose needed to deliver long term change. The establishment of the National Energy System Operator (NESO) is a key development in this regard, bringing independent technical and planning capabilities to reform decisions. Given the vast engineering and technology challenge underlying the energy transition, it is important that this is factored into policy and reform decisions.

3. Is the Review of Electricity Market Arrangements (REMA) likely to deliver the necessary changes to the energy sector?

REMA is a critical initiative that is seeking to design future electricity markets that can attract investment to deliver clean, secure electricity supplies at least cost. The recently published second REMA consultation sets out proposals for four main challenges:

1. Passing market benefits to consumers – using a unified wholesale market without technology distinction.
2. Investing in renewables at pace – reforming the Contracts for Difference (CfD) mechanism for renewables.
3. Transitioning to a flexible, resilient, decarbonised energy system – reforming the Capacity Market (CM) to give long-term price signals to attract flexibility resources.
4. Optimising a renewable-based system – introducing a form of zonal pricing in wholesale markets to deliver savings for consumers.

We welcome the progress being made by the REMA initiative. Future electricity markets must be able to deliver savings from competition and innovation, while also realising decarbonisation targets and security of supply. In this context, while debates around locational pricing and CfDs are attracting much attention and debate, we suggest that an equal focus should be applied to flexibility reforms, as described in REMA Challenge 3.

The REMA consultation highlights that the GB electricity system could require up to 55GW of short-duration flexibility and between 30 and 50GW of long-duration flexibility by 2035. The aim is for as much of this long-duration capacity as possible to be low carbon. This flexibility will be critical to ensure the stability of a high renewable electricity system.

It is not clear that the REMA consultation takes storage volumes into account. We suggest that the REMA consultation should also consider the volume in GWh of flexible capacity needed. For example, if the expected 'dunkelflaute' or extended low wind/cloudy periods lasted for say 200 hours, then the REMA forecast long duration storage capacity of 50 GW would need (200hrs x 50 GW) or 10,000 GWh (10 TWh) of storage volume to be available. This represents 2-3% of estimated annual electricity consumption in 2035[1] and may be an underestimate and is likely to increase by 2050. We suggest that CM reforms should take account of these volume requirements in the market design.

The consultation proposes reforms to ensure there is sufficient investment in all forms of low carbon flexibility at the pace and scale required. These include:

- Sharper **operational signals** demonstrating when and where valuable flexibility is needed, and to which these technologies can respond; and sufficient **investment signals** to bring forward technologies and services of all sizes and types.
- An **Optimised Capacity Market** which will be used as the capacity adequacy mechanism. The auction design will be a **single auction with multiple clearing prices** with a focus on introducing a minimum procurement target for desirable characteristics.

The consultation highlights that further work is underway to decide how to define flexibility capabilities and procurement targets, and how auction processes will work.

Overall, we welcome that the REMA proposals intend to deliver long- and short-term price signals for flexibility to both enable investment and optimise operation in electricity markets. The choice

[1] The ESO 2023 FES forecasts GB total annual electricity demand to be between 370TWh and 476TWh in 2035, so 10TWH equates to a range of 2.7% to 2.1%.

of the Capacity Market (CM) to deliver the long-term price signals has the advantage of being a proven mechanism.

However, the procurement of future flexibility needs is unlikely to be as straightforward as the current CM procurement of firm MW capability for times of system stress. There are other flexibility characteristics that will be needed to ensure a secure electricity system. A future CM design will need to address the following requirements:

Firm MW capacity - Dispatchable generation or demand, with appropriate capabilities including de-rating factors.

Firm stability capacity - Dispatchable ancillary service characteristics e.g. response, reserve, voltage support, inertia, black start.

In addition, both of these requirements should be optimised by the following:

- Locational characteristics, which may provide alternatives to network investments as a way of relieving congestion
- Temporal characteristics e.g. available duration
- Low carbon characteristics

In order to achieve this, there are a number of market barriers that we think should be considered in the future CM design:

- co-ordination of CM auctions with NESO tenders for long-term stability service contracts (assuming these continue). There is a risk that separate NESO tenders do not attract the most efficient investment in assets that provide both firm power and stability services. Investors may receive conflicting investment signals and revenues from more efficient resources may be cannibalised by expensive short-term solutions
- integration of all flexible resources into the CM and other electricity markets, including the demand side. This is an area of significant potential but there is much coordination and market design work to be done before the benefits can be realised
- grid access – there is a major challenge for new flexible technologies in gaining grid access and being able to participate in auctions. It may be appropriate to consider ways in which grid access may be prioritised for CM assets
- coordination with transmission network planning and investment. There will be many cases where there will be a choice as to whether investment is needed in transmission or in non-network solutions – flexible technologies can provide an alternative solution.

In summary, we suggest that, alongside the provision of MW capacity adequacy, the package of reforms should also take account of how price signals may be provided for 'dispatchable stability capacity' to be optimally provided in future electricity markets, and especially how the long-term price signals may best be provided to trigger investment.

4. **What are the major benefits that the UK should be seeking to deliver from energy market reform?**

The IET's key points in response are covered under Q1.

5. **What are the chief barriers to reform of the energy market and is the Government serious about addressing those?**

We would suggest the following are key barriers to reform that need to be addressed.

Investor uncertainty
Reform of the energy market is needed to decarbonise the energy system, to enable the electrification of heat and transport, demand and supply side flexibility, and greatly expand energy storage. This is a hugely complex undertaking which must be undertaken while maintaining secure, affordable energy supplies. Reforms must reduce attract efficient investment, and retain investor confidence by enabling stable markets, without ad hoc policy interventions.

The market reform challenge is to create easy-to-understand, robust and transparent arrangements that take into account the challenges, that will attract investment and allow investors adequately to assess risks.

The grid connection challenge
A stable and efficient market cannot be designed unless there is agreement on a plan and timescales for the grid system being developed to connect new resources and serve new demands. The connection queue arising from speculative connection requests (solar PV and BESS in particular) affects both transmission and distribution networks. A coordinated plan of transmission and distribution developments is needed to serve new electrified transport and heating demand whilst also accommodating the bulk of onshore generation and BESS.

Uncertain transition arrangements
We are currently in a rapidly changing environment as the system is being decarbonised. A potential barrier for reform will be the transition arrangements that maintain the momentum towards increased capacity and decarbonisation, while continuing to respect historic feed-in agreements, and planning and implementing a redesigned system.

A whole-system approach will be needed that includes retail and wholesale markets, the strategic reinforcement of electricity networks and the introduction of new generation and storage technologies, including CCUS. Reform of energy markets must be coordinated with strategic decisions on the future of the gas grid.

Community acceptance
A fourth potential barrier is community acceptance. While a whole system approach significantly strengthens the case for more optimal asset placement and therefore planning provisions, local opposition to potential development is understandable and inevitable irrespective of the market environment. With so many diverse and conflicting views on decarbonisation, lack of agreement can be a barrier to reform. Independence, transparency and objectivity are vital to ensure that views and commercial interests are justly incorporated.

6. Is it possible to ensure that consumers are insulated from market failures in the energy sector?

Ultimately, we don't think that consumers can fully insulated from market failures. The most effective means of providing consumer protection is to ensure that market regulations are designed to enable effective competition and minimise the risk of failure to a level whereby the risk/reward balance is at a level which is acceptable to consumers. There is also a social and moral obligation to protect vulnerable customers from market failures resulting in volatile energy prices or loss of supply.

Many measures are already available or planned to prevent and mitigate the impact of market failures. These include measures e.g., special administration, to address the potential failure of supply, network, or generation companies.

While these measures should protect customers from energy company failures, we would suggest that there are several market design failures that are impacting consumers. We would suggest that these include:

- Licencing of energy suppliers that are not financially robust. The recent energy crisis led to the failure of many energy suppliers, demonstrating the need to ensure greater financial resilience of such companies.
- Delays in the roll-out of smart meters and the widespread introduction of 'Time of Use' and 'Flexibility' tariffs.
- An extensive electricity connection queue for the construction of new renewables and a licencing regime that prioritises 'first come first served' connections rather than efficient development of the whole system.
- The absence of effective long term investment signals for flexible capacity.

These design failures are limiting the benefits available from competition as well as increasing costs for consumers. A contributing factor may be that market design policies are developed and implemented through a fragmented approach.

We would suggest that a whole system energy strategy and development plan is needed to minimise the risk of energy market failures such as these.

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