Report Section

Energy UK

The voice of the energy industry

The Future of Energy

Funding future electricity generation and system services

Chapter 2

Funding future electricity generation and system services

Executive summary

The transition to a low carbon, smarter and flexible electricity market is already well under way.

The system is no longer dominated by a small number of large-scale thermal generators, serving passive end-consumers. Instead, there are nearly one million generating units across the UK capable of powering individual homes or businesses and exporting electricity to others. Increasingly, customers can choose the technology that provides their electricity, and whether to use local sources or generate and store their own electricity at their property. We will also see customers becoming active participants in various markets where they will contribute to our low carbon targets and support security of supply.

The UK has legally binding carbon reduction commitments under the Climate Change Act 2008, which are supported by "Carbon Budgets" recommended by the Committee on Climate Change. To achieve the UK's targets, the Government must reduce carbon emissions across the economy. Power generation is one of the most significant sectors, due both to its absolute emission levels and its enabling role to decarbonise the two other major polluting sectors - transport, and heating & cooling.

As the design of the system changes, the challenge is to keep policy and regulation up to speed to ensure the UK develops the most effective mix of technologies and innovative models. But there are significant barriers to negotiate. This chapter looks at what the system could look like by 2030, and the policy changes needed in the short-term to make sure least-regret options are taken forward.

The policy and market framework must continue to deliver the investment required to maintain security of supply and meet the UK's carbon budgets. To achieve this most efficiently, and at the least cost to consumers in the medium-term, Energy UK believes that the policy framework must include:

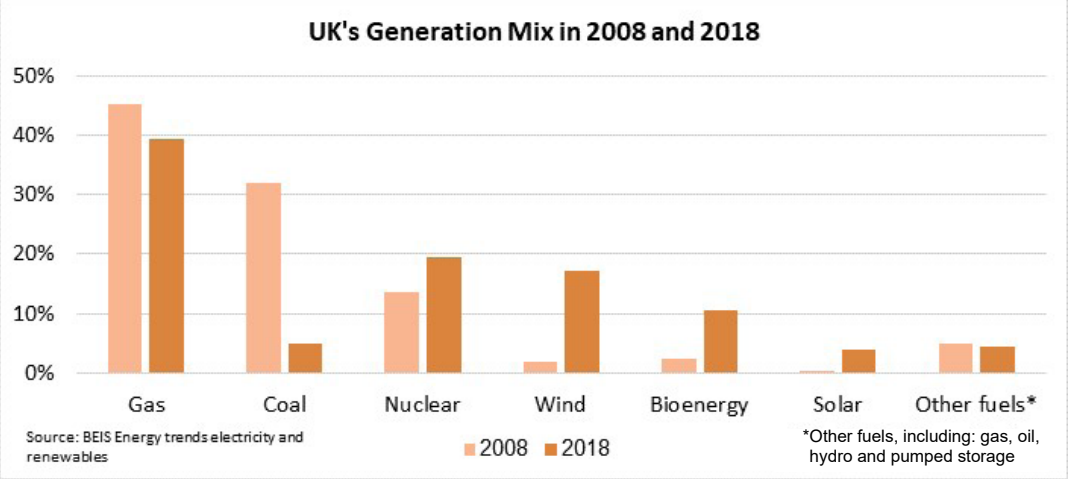
- a support mechanism to drive investment in low carbon generation
- a capacity market that is technology-neutral
- a wholesale market that is supported by an effective carbon price
- flexibility markets which are open and liquid.

These instruments would work together to incentivise low carbon investment. They will also provide the adequate levels of firm capacity and flexibility needed in a future energy system that has significantly higher amounts of intermittent low carbon generation. It's our firm view that any approach should avoid 'picking winners', and that all technologies should be able to compete in the same markets on their ability to offer the required service or product.

Cover image: iStock.com/DrAfter123

As a sector, we have already made real progress against our decarbonisation targets, with significant changes made to our generation mix since the Climate Change Act was made law in 2008. At the same time, we've achieved excellent cost reductions in renewable technologies, with offshore wind projects winning Contracts for Difference (CfD) auctions at a price of £57.50/MWh in the 2017 auction - over 50% lower than the first auctions run in 2015.

The chart below shows how the sector has changed since the Climate Change Act 2008, and we expect more evolution over the next decade as we continue to decarbonise the economy.



Emerging thinking and potential solutions

No.	Opportunity	Forward direction	Potential solution
1	Recent policy changes and their opaque implementation, as well as limited frameworks beyond 2020, mean the development of power projects is becoming increasingly risky.	Changes to policy and regulation should therefore be carried out via a well-understood and transparent process so that investors can manage potential changes to policy-related revenues and costs with some degree of certainty.	Each government should set out its energy policy objectives over the life of the Parliament.
2	Energy UK's members recognise and share the Government's ambition that low carbon power can be the cheapest power by the mid-2020s.	BEIS/Ofgem should ensure that the recommendations set out in Energy UK's EMR 5-year review position paper are taken forward[19]. In particular, CfD auctions should be open to all renewable technologies.	Energy UK will work alongside the Government to explore routes forward, including alternative ways of funding large scale low carbon projects such as new nuclear and CCUS, to continue to bring down costs to customers.
3	The CM will continue to be the most effective way to ensure security of supply at lowest cost.	The CM still has a number of issues, such as renewable energy participation, that need to be worked through to ensure the mechanism functions efficiently.	The CM should be entirely technology neutral, allowing for the market to drive the innovation needed to secure supply at the least cost.
4	The current market arrangements for ancillary service procurement are fragmented and no longer suited to the evolving market.	Review and reform the market to ensure all flexibility providers, whether transmission or distribution, can participate in the market.	National Grid to step up its work programme to deliver the System Needs & Products Services (SNAPS) work to meet the expectations of the industry.
5	The delivery of a smart and flexible power system is not optimised under the current market structure.	All parties should be able to access and provide services in near-real-time to meet system needs.	Facilitating access to the Balancing Mechanism (BM) needs to be carried out as a priority. Ofgem should consider when it will be viable to reduce the length of settlement periods, and how the market can trade closer to real-time.

[19]Energy UK 5-year review paper: https://www.energy-uk.org.uk/publication.html?task=file.download&id=6662

No.	Opportunity	Forward direction	Potential solution
6	Competitive flexibility markets are in their infancy and there is currently no framework for commercial and domestic customers to participate in these local markets.	When additional network capacity is deemed to be needed, network operators (at both distribution and transmission level) should always consider flexibility options, from all providers (commercial and consumer) as an alternative to grid reinforcement.	All electricity network reinforcement proposals should be tendered through independent market platforms to ensure innovative solutions can be brought to market at least cost.
7	Peer-to-peer trading has the potential to open up participation in the energy market.	Trials will be required to test the ability for peer-to-peer to work efficiently. These trials will identify appetite, the value of this model and any regulatory barriers that need to be overcome.	Industry will continue to bring forward trials of peer-to-peer trading and identify any regulatory changes that are necessary to the benefit of customers.
8	Carbon markets have been fundamental to the reduction of harmful emissions and continue to be an integral part of ensuring a cost-effective pathway to decarbonising the power sector and wider industry. There is uncertainty around the scope and mechanisms for carbon pricing in the UK long-term.	Energy UK supports continued participation in the EU-ETS, and considers that a strong carbon price is important for future market design.	Government should clarify as soon as possible its long-term plans for carbon pricing and work with the industry on the optimal mechanism. It should also review whether exemptions for specific technologies from carbon pricing are appropriate.

The power system beyond 2030

Key points:

- **Significant change to the market framework will be needed, but EMR remains the right tool for the foreseeable future.**
- **The EMR 5-year review process provides an opportunity to make changes as the market evolves.**

Looking beyond 2030 (when the power system will need to be largely decarbonised and potentially increasingly decentralised) today's market arrangements are likely to face a number of challenges. It has been discussed widely that the continuing deployment of zero or low marginal cost generation will act to reduce wholesale prices to zero or even negative values over greater periods of time.

Increasingly, revenues from the traditional wholesale market will only be available during periods of low renewable output. Investments may, therefore, be based on one of the following scenarios:

- The wholesale price will need to reach a sufficiently high value (driven by carbon and scarcity prices) to recover the energy revenues required over a smaller number of hours
- The revenue for these generators no longer comes predominantly from the wholesale market. Rather, there is greater value in other revenue streams such as capacity markets, ancillary services markets and low carbon support mechanisms
- An altogether new mechanism/market framework, if the existing arrangements are no longer the most cost-effective.

Closer interactions with the transport and heat sectors, resulting from increased electrification, will provide new opportunities but also challenges around the impact on demand and the predictability of how these demands might fluctuate within days and over the year. The role of smart systems, from smart metering through to the creation of Distribution System Operators (DSOs) and local markets, will mean that power is generated, traded, stored and consumed in very different ways.

The impact of carbon pricing on the generation sector is also likely to change as the power system continues to decarbonise. The cost of a marginal improvement in decarbonisation could be high after this point. In the future, combined with the cannibalisation effect resulting in lower wholesale prices, this may require a significant overhaul of market arrangements as we move forward through the full transition to a low/no carbon power market. While the prospect of an almost fully decarbonised power grid appears to be an issue for beyond 2030, the report section – Reducing Emissions from Buildings - considers how the electricity market will need to evolve over the medium-term while bearing in mind changes to the system that will still be relevant in the future.

We have reviewed several alternative market designs as part of this work including Dieter Helm's Equivalent Firm Power auction[20] and Malcom Keay's two market model[21]. Although both, as well as other options, present novel solutions they were no less complex or more efficient than the current arrangements.

Energy UK recognises that the power system may need to be overhauled in the future. We consider regular 5-year reviews of the EMR framework will provide a sufficient horizon to identify issues and act accordingly. For example, if zero short-run marginal cost plant sets prices for a very high proportion of the time. Energy UK considers the EMR framework to be the right tool to drive forward decarbonisation and provide security of supply up to 2030.

[20]Equivalent Firm Power auction: http://www.biee.org/wpcms/wp-content/uploads/Cost_of_Energy_Review.pdf

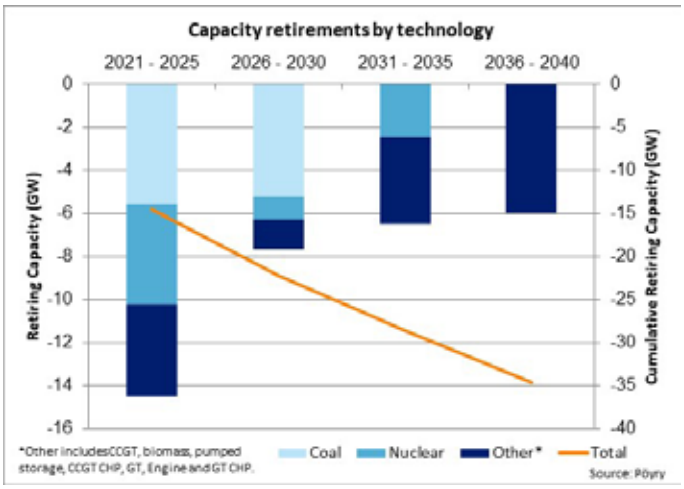
[21]Two Market model: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/06/The-Decarbonised-Electricity-Sysytem-of-the-Future-The-Two-Market-Approach-OIES-Energy-Insight.pdf

What is the investment challenge?

Key points:

- **Long-term policy and regulatory stability are essential to attract investment in the energy sector at lowest cost.**

We face significant challenges in UK power generation over the coming years. All coal power stations will close by 2025, a number of nuclear stations are being decommissioned over the next decade and other natural plant closures are expected. Analysis by Poyry for Energy UK estimates that up to 35GW of plant could be retired by 2040.



Alongside the declining existing supply base, we are expecting a significant increase in power demand. This will be driven by the electrification of heat and transport that could dramatically change consumption volumes and habits.

Investors and developers alike value predictability within the energy policy framework. It gives them confidence that the investments they are preparing today will be supported by a regime lasting many years, with no unreasonable changes undermining or threatening their interests.

Issues of instability, unpredictability and the lack of a long-term framework are particularly noticeable at the development and operational stage of power projects. They have a long gestation period to advance from planning to final investment decision (FID), so changes to policy can easily impact projects that have been in planning for a number of years.

Energy UK's report on investment[22] showed how policy predictability, coupled with a long-term strategy, will deliver innovation, investment and security of supply, as well as attracting least-cost capital in a low risk environment.

Government can provide clear signals for investors looking to finance energy technologies that offer economic value, with a framework that enables those projects to formulate a viable business case. Regulation should therefore give investors clear sight of potential revenue streams, to some degree of certainty, by setting out an annual policy statement that provides advance notice of future market changes.

No.	Opportunity	Forward direction	Potential solution
1	Recent policy changes and their opaque implementation, as well as limited frameworks beyond 2020, mean the development of power projects is becoming increasingly risky.	Changes to policy and regulation should therefore be carried out via a well-understood and transparent process so that investors can manage potential changes to policy-related revenues and costs with some degree of certainty.	Each government should set out its energy policy objectives over the life of the Parliament.

[22] www.energy-uk.org.uk/publication.html?task=file.download&id=6303

RES/Keith Arkins

The importance of an efficient market design

Key points:

- **Markets have been proven to deliver power, capacity and services at competitive prices and should be technology-neutral to ensure the most efficient outcomes.**
- **Externalities will have an impact on the operation and development of the system – these should be addressed to reduce distortion.**

Both existing and new assets will need investment to meet the UK Government's legally binding carbon budgets, economically and efficiently, while maintaining security of supply and system stability. As customers become more active, the market must evolve to ensure price signals lead to efficient investment decisions and behaviour by all market participants.

Competitive markets have a vital role in delivering cost reductions and innovation for the benefit of consumers. However, the Government's role is also important, by giving a strategic direction to develop a diverse and balanced generation mix, and through supporting R&D to bring on new technologies ready to compete in the market.

We believe that efficient market design will ensure that the most cost-effective mix of technologies will be deployed. The guiding principles below should be applied as a minimum to evolve the power market in a way that improves the power system:

- liquid, competitive markets deliver best outcomes for consumers
- efficient price signals incentivise efficient system operation
- predictable long-term policy and regulatory environments improve investment outlook
- market neutrality and open access deliver a level playing field
- a whole-system approach, which includes strategic direction from across government and the regulator, creates the right signals for investment and system operation.

There are two main elements to an efficient market design. Firstly, the markets and investment mechanisms themselves. Secondly, the costs, charges and pricing signals associated with operating within the electricity system which also impact investment decisions.

The mix of charges and costs faced by electricity market participants will have an impact on investment decisions. These signals need to be designed so that the most efficient investment decisions are made to benefit the system and, ultimately, customers.

Differences in the treatment of different actors with regards to policy or regulatory costs, obligations and exemptions will impact the outrun of the market. In energy, we have seen a number of distortions, created in part by radical changes in the way electricity is produced and consumed. These distortions may start on a small scale, with minimal impacts on the efficiency of the market. There may be arguments in favour of them in the short-term, for example, in reducing barriers for new entrants and new technologies. However, once they come into play, they will be hard to remove unless they are clearly flagged as being temporary at the point they are introduced.

What are the market mechanisms that will deliver investment, and do they need to change?

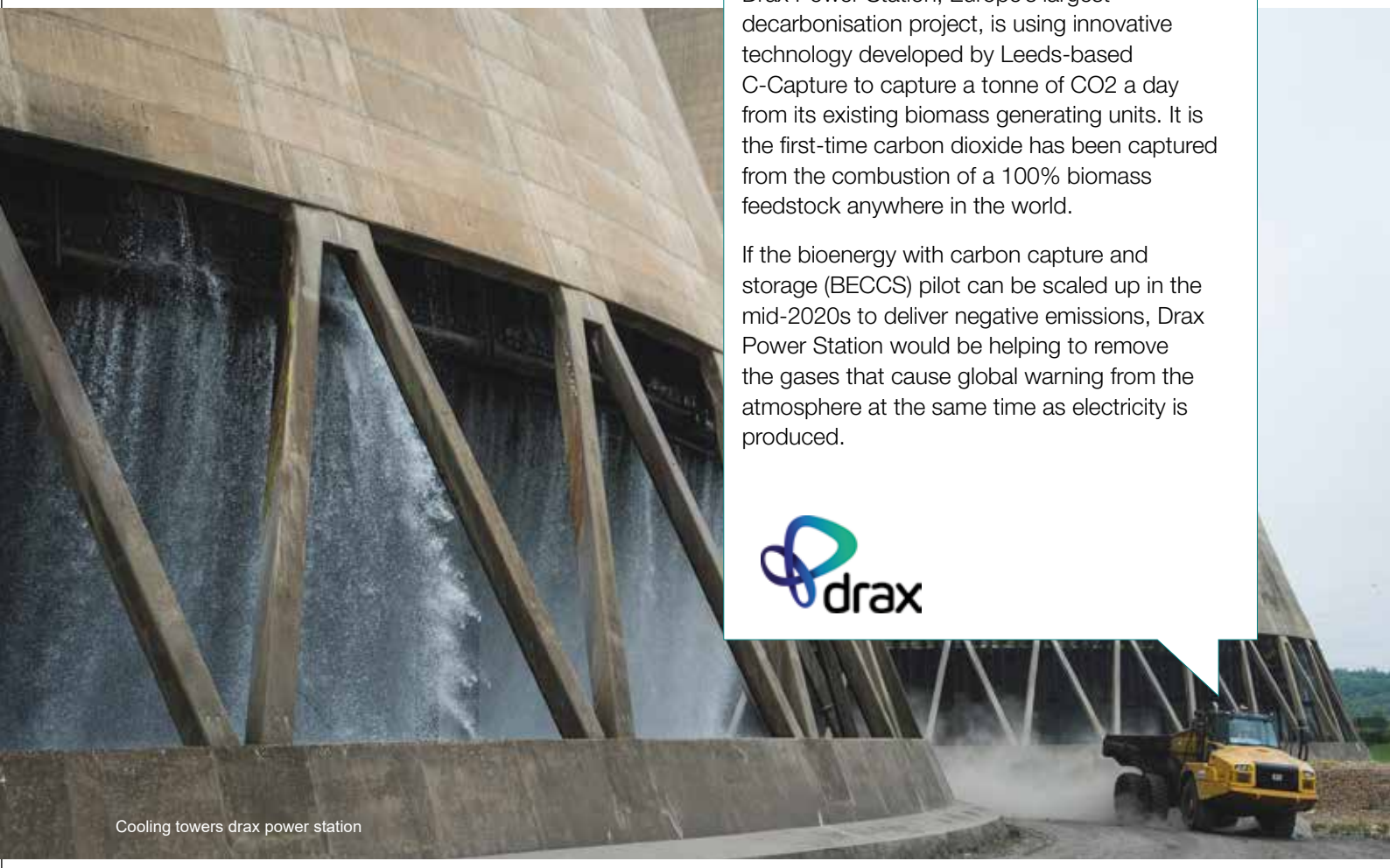
Key points:

- **EMR is the right tool to maintain security of supply and decarbonise the power sector.**
- **Evolution of the ancillary services market and Balancing Market will improve the efficiency of the system as new technologies become more dominant.**
- **Smart systems will unlock new markets which need to be nurtured to ensure they develop.**
- **Strong carbon pricing remains an important tool to reduce carbon emissions across the power sector as well as the wider economy.**
- **Appropriate public funding support will still be needed where private markets can't deliver, such as for large infrastructure projects (e.g. new nuclear, Carbon Capture Usage and Storage) (CCUS).**

Case study

Drax Power Station, Europe's largest decarbonisation project, is using innovative technology developed by Leeds-based C-Capture to capture a tonne of CO2 a day from its existing biomass generating units. It is the first-time carbon dioxide has been captured from the combustion of a 100% biomass feedstock anywhere in the world.

If the bioenergy with carbon capture and storage (BECCS) pilot can be scaled up in the mid-2020s to deliver negative emissions, Drax Power Station would be helping to remove the gases that cause global warning from the atmosphere at the same time as electricity is produced.



Cooling towers drax power station

Electricity Market Reform

Electricity Market Reform (EMR) was originally conceived as a transitional measure to address market failures in delivering a low carbon energy system. Both Contracts for Difference (CfD) and the Capacity Market (CM) have been successful, with the CfD delivering unprecedented cost reductions above and beyond initial ambitions. In addition, the CM has guaranteed security of supply at far lower prices than anticipated. The other elements of this policy include the Carbon Price Support and Emission Performance Standard, used to reduce the use, and construction, of new high-intensity carbon plant.

The Energy Act (2013) obliges the Government to undertake a 5-year review of EMR to ensure that it is meeting its objectives. In May 2018, Energy UK published a position paper ahead of the latest review that set out ten requirements for the process. In the intervening months, and in response to these calls, the Government has announced future CfD allocation rounds, begun work on including renewable generation in the Capacity Market and issued the call for evidence for the Review.

Low carbon investment through the CfD

The CfD regime has delivered significant cost reductions to date in low carbon generation, particularly given the latest contracts for offshore wind in 2017. The success of this regime has been notable in delivering cost savings, buy-in from investors and stability from policymakers, and we believe this should be the main mechanism for financing low carbon plant for the years to come.

Immature technologies should be nurtured with initial R&D funding until commercial projects can be developed for the market. Although commercial Power Purchase Agreements (PPAs) can provide a route to market for some projects, it is much harder to access PPAs for larger schemes and in the quantities needed to meet the UK's carbon reduction commitments.

Wholesale market revenues, under a merchant-based approach, are highly risky without some kind of revenue stabilisation mechanism. Without one, it is questionable how much investment can be made, especially with wholesale cannibalisation risk. The cost reductions in established low carbon technologies, such as offshore wind, mean that the required strike prices are now approaching current wholesale price levels. For mature technologies it is likely that these would clear below the current wholesale market price. There is also a long-running question around what constitutes a 'subsidy' and whether it should be linked to the wholesale price of power or the cost of providing firm power.

Appropriate public funding support will still likely be needed where private markets can't deliver, such as for large high-risk infrastructure (e.g. new nuclear, Carbon Capture Usage and Storage) (CCUS).

No.	Opportunity	Forward direction	Potential solution
2	Energy UK's members recognise and share the Government's ambition that low carbon power can be the cheapest power by the mid-2020s.	BEIS/Ofgem should ensure that the recommendations set out in Energy UK's EMR 5-year review position paper are taken forward[24]. In particular, CfD auctions should be open to all renewable technologies.	Energy UK will work alongside the Government to explore routes forward, including alternative ways of funding large scale low carbon projects such as new nuclear and CCUS, to continue to bring down costs to customers.

Case study

Automated drone robots inspect massive 80m wind turbine blades. Standing at a staggering 195m above sea level, 32 eight-megawatt wind turbines are generating clean energy off the coast of Liverpool Bay at Burbo Bank Extension offshore wind farm.

Wind turbine technology has surpassed the industry's expectations, making huge strides in innovation in a surprisingly short amount of time. Bigger turbines have certainly helped in the rapid cost reduction we've witnessed in offshore wind, but also means the industry faces new technical challenges in terms of inspecting and maintaining the turbines.

Working with SkySpecs, a provider of robotics solutions for the wind energy industry, Ørsted who operate the wind farm, has successfully completed an automated drone inspection of these giant turbines. Using drones has reduced the time taken to inspect the blades by 85%, helping to limit the time these turbines are down for inspection.

Ørsted

Capacity market

Capacity mechanisms ensure security of supply by incentivising each successful capacity provider to deliver power or DSR at times of system tightness. In Great Britain a fixed amount of capacity is procured through four-year and one-year ahead auctions, allowing existing and new build assets to compete to deliver capacity at lowest cost. Due to the evolution of the market, the increasing number of participants and maturing technologies, we consider that the current market structure (with some tweaks) can form the basis for investment until at least 2030.

The CM should be entirely technology-neutral, allowing for innovation and facilitating decarbonisation. Enabling renewables that don't receive low carbon support (either those that have never had or no longer do) to access the CM (with appropriate deratings) could be a helpful way for those technologies to stack different revenue streams. The success of the CM is linked intrinsically to a number of externalities which will impact what types of technologies win CM agreements. For the CM to deliver the needs of the future GB power system we need to ensure that policy and regulations - such as network charging arrangements, environmental regulations, carbon pricing, derating factors and the technologies which are allowed to compete - provide the right signals.

No.	Opportunity	Forward direction	Potential solution
3	The CM will continue to be the most effective way to ensure security of supply at lowest cost.	The CM still has a number of issues, such as renewable energy participation, that need to be worked through to ensure the mechanism functions efficiently.	The CM should be entirely technology neutral, allowing for the market to drive the innovation needed to secure supply at the least cost.

[23]Energy UK 5-year review paper: https://www.energy-uk.org.uk/publication.html?task=file.download&id=6662

Case study

ENGIE is investing £50m in its Ffestiniog Power Station in North Wales thanks to a 15-year capacity market contract. In addition to providing a fast and reliable source of electricity that helps balance the nation's electricity demand during peak times, flexible sources of power such as Ffestiniog are important for integrating the increasing amounts of renewable generation so the UK can meet its carbon reduction targets at lowest cost to the consumer.

Ffestiniog is capable of generating enough electricity to supply North Wales for several hours and this investment will ensure the operational life is extended for at least 20 years.

We note that a ruling by the General Court of the European Union in November 2018 resulted in an annulment of the Commission's state aid approval for the UK Capacity Market. This market is currently in a 'standstill period', which will inhibit new capacity auctions and suspend UK capacity payments until further notice. Given the serious financial implications for capacity providers and the need for investor certainty, this scheme must be reinstated as soon as possible to rebuild badly dented investor confidence and to ensure security of supply.

Ancillary services

A continuing rise in the capacity provided by intermittent renewable generation will increase the need for flexibility (matching the supply and demand for electricity over time and across different areas of the grid), to make sure that consumers can continue to use electricity when demanded at lowest cost. At the same time, increased digitalisation and decentralisation will expand the scope of active participation in short-term balancing and ancillary services markets to a wider range of participants, with consumers taking part via aggregators in the future. The combination should deliver a much broader and more granular market which can become more efficient and secure - provided it facilitates and ensures the widest possible scope for competition.

The ancillary services market should be designed to help the evolution of the energy system and be allowed to adapt to meet this challenge. This should include scope for innovation by enabling new and existing technologies to participate in the market without undue barriers to entry. This can be achieved by keeping service design as simple as possible and by avoiding incorporating design assumptions about the technologies used to provide them. National Grid has been doing this by updating the suite of ancillary services to reduce the number of products, as well as aligning the relevant procurement processses.

Case study

Air turns to liquid when cooled down to -196°C (-320°F), and can then be stored very efficiently in insulated, low pressure vessels. Exposure to ambient temperatures causes rapid re-gasification and a 700-fold expansion in volume, which is then used to drive a turbine and create electricity without combustion.

The CRYOBattery, pioneered by Highview Power, offers giga-scale storage potential and grid ancillary services (such as frequency response, inertia, and reactive power).

Highview, with support from BEIS, has built a 5MW/15MWh system demonstrating its proprietary cryogenic energy storage technology at a site near Bury, and has announced several new projects globally.

We see several opportunities for change to make sure the ancillary services market delivers those needed by the Electricity System Operator (ESO) as well as Distribution Network Operators (DNOs). These include:

- The length of ancillary service contracts. Longer contracts help support new investment but may carry the risk of locking in high costs to be borne by customers. A balanced approach of both long and short-term contracting is required. A simple, stable and transparent short-term market for services will help to support certainty among investors and better enable the system operator to manage the system.
- As the CM is not designed to signal investment in specific locations where particular steps are needed to ensure system resilience, better alignment is needed between the CM and ancillary services used to manage other aspects of security of supply, including; flexibility, resilience and Black Start. While the industry supports the work of National Grid to enable shorter-term markets to deliver ancillary services, requirements must be considered for longer term capability to provide ancillary services (as part of a portfolio approach) when capacity is being procured at the CM T-4 auction.
- The need to secure a suitable base level of area resilience regarding security of supply becomes more acute as we move closer to delivering decarbonisation goals.
- Information about the requirements to participate in different markets needs to be set out clearly in a central location along with data on past auctions. Procuring different ancillary services needs to ensure that multiple services can be contracted for, provided the services do not conflict.

No.	Opportunity	Forward direction	Potential solution
4	The current market arrangements for ancillary service procurement are fragmented and no longer suited to the evolving market.	Review and reform the market to ensure all flexibility providers, whether transmission or distribution, can participate in the market.	National Grid to step up its work programme to deliver the System Needs & Products Services (SNAPS) work to meet the expectations of the industry.

RES/ Ben Osborne

The Balancing Mechanism

The Balancing Mechanism (BM) will remain the primary instrument for balancing supply and demand. Ancillary service markets will continue to complement the BM by procuring additional services. These services will include reserve services, frequency response, voltage support and others.

As new patterns of generation and demand evolve, changes to these market mechanisms will ensure that the BM and ancillary service markets continue to work together efficiently. This will require removing some of the current barriers to efficient competition. These solutions are presented by allowing distribution-connected generation to effectively participate in the BM and also be dispatched in merit order. The opening up of the European markets for balancing through Project TERRE[25] and MARI[26] is also a key step in extending BM access to all market participants by increasing liquidity in several markets.

As systems become smarter, we foresee a need for shorter settlement periods to provide greater granularity in the pricing of energy. This allows some services that are deemed "ancillary" at a 30-minute duration to be more explicitly priced as short-term energy, thereby increasing competition and the efficiency of short-term markets. A shorter settlement period should be introduced, when appropriate, with a clear transition to accommodate the enhancement of the required systems and meter recalibration. This, coupled with a single marginal cash-out price, should allow gate closure to be removed, softened or moved closer to real-time.

No.	Opportunity	Forward direction	Potential solution
5	The delivery of a smart and flexible power system is not optimised under the current market structure.	All parties should be able to access and provide services in near-real-time to meet system needs.	Facilitating access to the Balancing Mechanism (BM) needs to be carried out as a priority. Ofgem should consider when it will be viable to reduce the length of settlement periods, and how the market can trade closer to real-time.

DSO-enabled local and constraint markets

With increasing levels of distributed energy resources, Distribution Network Operators (DNOs) will no longer be able to passively manage the distribution networks. New models are being investigated currently, including a possible transition to Distribution System Operators (DSOs) that actively manage networks to ensure that network capacity is used in the most cost-effective way.

Although we expect there will be a requirement for networks to be actively managed by DSOs, this transition is likely to occur at different times for distinct areas of the country. The South-West and South-East of England are already experiencing issues with local constraints due to increasing renewable penetration at a local level and increasing and changing demand profiles.

We welcome DNO's consideration of flexibility options alongside traditional reinforcement to enable optimal operation of the distribution network, local constraints and network issues. These options, when needed, should be procured competitively in local flexibility markets. This will also allow DNOs to manage their networks in the face of greater intermittency and decentralisation at the local level. These local markets should be designed according to similar principles to the national balancing and ancillary service markets.

[25]Trans European Replacement Reserves Exchange (TERRE) is the European implementation project for exchanging replacement reserves in line with the Guideline on Electricity Balancing in order to create a harmonized playing fields for the Market Participants.

[26]MARI is the European implementation project for the creation of a common platform for manual frequency response reserve.

When it's identified that reinforcement is needed, Distribution and Transmission Network Operators must first consider flexibility solutions as a potential option. Network investment deferment, due to the use of flexibility providers, may result in lower whole-system costs to customers. This could take the form of batteries being connected at a network constraint of local demand, providing turn-up or turn-down services.

For flexibility providers to offer cost-effective solutions to local network issues, sufficiently granular information is required on a variety of timescales to allow existing assets to be used efficiently, and to develop new products and services. This will enable specific services, requested by the DSO, to be contracted and deployed to resolve the constraint. This will require:

- Ofgem to ensure RIIO-ED-2 (Revenue = Incentives + Innovation + Outputs) incentivises adequate network data provision and monitoring capabilities to accurately indicate the current state of the network
- DNO/DSOs to provide more detailed information regarding the forecast for flexibility services. This should include location of planned network reinforcement, queue management and duration of contract to encourage market investment in the right areas to meet the needs of the network
- all network reinforcement proposals should go to market to see if it can deliver alternative solutions. There should also be clear queue management and granular heat maps to support this
- the development of the IT capabilities required to enable coordinated system operation
- clear market design rules, established by Ofgem, to coordinate with ESOs, DSOs and other third parties.

Ongoing trials of trading platforms by UKPN, WPD and Centrica are advancing the capability to provide local energy markets. The trials' outcomes should be shared widely, so they can be considered within future planning.

DSOs will require adequate frameworks to ensure their actions are neutral and do not favour specific solutions. This will be instrumental in developing efficient markets which meet the needs of consumers at lowest cost. Markets and platforms developed at the local level will need to be aligned with, or integrated into, national market mechanisms. As such, common terminology and processes should be agreed ahead of need.

No.	Opportunity	Forward direction	Potential solution
6	Competitive flexibility markets are in their infancy and there is currently no framework for commercial and domestic customers to participate in these local markets.	When additional network capacity is deemed to be needed, network operators (at both distribution and transmission level) should always consider flexibility options, from all providers (commercial and consumer) as an alternative to grid reinforcement.	All electricity network reinforcement proposals should be tendered through independent market platforms to ensure innovative solutions can be brought to market at least cost.

"When it's identified that reinforcement is needed, Distribution and Transmission Network Operators must first consider flexibility solutions as a potential option."

Peer-to-peer trading and the role of data

We are already seeing greater market participation from sources that are either outside the balancing and settlement arrangements (i.e. non-BM) or behind-the-meter. To allow competition to continue to flourish, the availability of transparent data is key. This will become increasingly important as smart meters, Half Hourly (HH) settlement and local flexibility markets all create a need to understand what is happening on the system at a much more granular level.

Open access to this data, while ensuring that customer data is protected, should be a guiding principle to ensure the benefits of a smart system are realised by all parties. The industry, in conjunction with Ofgem and BEIS, will need to decide how this data is best used and what value it should have. As the majority is already provided by the industry itself, it would seem only fair that no company should unduly profit while overall system efficiencies are lost due to data being unavailable to all parties.

Another local market development will be the prospect of peer-to-peer trading between individual consumers and businesses, which will encourage multiple buyers and sellers of flexibility and energy. We have yet to see how this new trading activity will interact with the wider system, but questions about fairness and overall system costs will need to be thought through when integrating these new services and evolving the regulatory framework to support these developments.

Trials will be required to test the ability of peer-to-peer to work efficiently. They will identify appetite, the value of this model and any regulatory barriers that need to be overcome. This will then help to identify and deliver the optimum model, which should be done in conjunction with plans to open up data availability.

No.	Opportunity	Forward direction	Potential solution
7	Peer-to-peer trading has the potential to open up participation in the energy market.	Trials will be required to test the ability for peer-to-peer to work efficiently. These trials will identify appetite, the value of this model and any regulatory barriers that need to be overcome.	Industry will continue to bring forward trials of peer-to-peer trading and identify any regulatory changes that are necessary to the benefit of customers.

Carbon

Carbon pricing is widely recognised as the most efficient and technology-neutral driver of reducing carbon emissions. Unlike other regulatory interventions, it places a direct cost on the negative externalities of carbon emissions. It has an impact both on existing market operations and on future investment decisions.

The UK total carbon price is currently made up of:

- The European Union Emissions Trading Scheme (EU ETS) which allows emission certificates to be traded for a number of areas of the economy (other than just power)
- Carbon Price Support - an additional carbon tax applied to fossil fuels used in power stations.

A strong carbon price, delivered consistently over the long-term, will reduce the need for certain policy interventions for carbon abatement, leaving more decisions to markets. Participation in the EU ETS[27] is acknowledged as the most effective way to decarbonise as it covers multiple countries, and indeed sectors beyond just power. Energy UK believes that the learning gained from the success of existing carbon mechanisms points to carbon pricing as the best support for further decarbonisation.

The future role of carbon pricing

As the carbon intensity of the power system decreases, with increased levels of low/zero-carbon plant running, the impact of carbon pricing on the wholesale electricity price decreases also. However, peak power prices could increase considerably if a high carbon price is applied to peaking plant. The role of carbon pricing in electricity markets will evolve as electricity generation is decarbonised, and as electricity plays an increasing role in the decarbonisation of other sectors of the economy.

As electricity is decarbonised and the proportion of renewables in the fuel mix increases, low or zero marginal cost renewables will be at the margin more frequently. Nevertheless, fossil fuel is likely to provide the marginal generation source for some time to come. A strong carbon price will support developing low carbon sources of capacity and flexibility to displace fossil fuelled peaking plant. It is also possible that price arbitrage by assets such as battery storage (charging at low-priced periods and supplying power to displace carbon emitting generation) will limit the incidence of zero or negative prices in the market.

The price paid for carbon has an impact on both power and investment decisions. The difference in the treatment of different sizes of generation, as well as power traded across interconnectors, can influence the operation of the system. It can also undermine policy intended to address climate change and lead to increased operational costs. Examples of this include small thermal generation, which is exempt from the EU ETS, and power flowing over interconnectors which is considered carbon neutral (therefore avoiding the Carbon Price Support) - even though the power may have been produced by carbon emitting plant.

No.	Opportunity	Forward direction	Potential solution
8	Carbon markets have been fundamental to the reduction of harmful emissions and continue to be an integral part of ensuring a cost-effective pathway to decarbonising the power sector and wider industry. There is uncertainty around the scope and mechanisms for carbon pricing in the UK long-term.	Energy UK supports continued participation in the EU-ETS, and considers that a strong carbon price is important for future market design.	Government should clarify as soon as possible its long-term plans for carbon pricing and work with the industry on the optimal mechanism. It should also review whether exemptions for specific technologies from carbon pricing are appropriate.

[27]Note, at time of drafting, the UK is preparing its exit from the European Union. Energy UK supports continued participation in the EU Emission Trading Scheme

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