Department for
Business, Energy
& Industrial Strategy

Enabling a High Renewable, Net Zero Electricity System: Call for Evidence

Closing date: 8 March 2021

December 2020

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Any enquiries regarding this publication should be sent to us at:
beiscontractsfordifference@beis.gov.uk

Executive Summary

Moving towards net zero greenhouse gas emissions for the UK requires transformation across all sectors of the economy and unprecedented levels of investment in renewable and other low carbon technologies. As we build back from the coronavirus pandemic, this transition can transform existing industries and provide opportunities for new ones ensuring that the economic recovery is both green and resilient.

The Committee on Climate Change estimated that meeting the challenge of net zero could require a quadrupling of low carbon electricity generation by 2050. A significant increase in renewable generation would need to be complemented by firm low-carbon generation provided from sources such as nuclear and gas or biomass generation with carbon capture, usage and storage, as well as hydrogen generation. A diverse generating mix is likely to be required and flexibility from technologies such as storage and demand side response will be important for integrating the level of renewables required to meet net zero.

We have made good progress to date in decarbonising our electricity generation, including committing to completely phase out unabated coal by 2024. In April 2017, the UK experienced its first coal free day since the industrial revolution and from April to June 2020, the total coal-free period lasted 67 days.[1] In 2019, 37% of the electricity generated came from renewables (up from 33% in 2018).[2] Taking into account nuclear, this meant 65% of power generated in the UK came from low carbon sources in 2019.

Renewable generating technologies continue to see innovation, reducing costs. Some renewable technologies, such as wind and solar, now provide the cheapest ways of generating power on a large scale. This means we are likely to see a large proportion of our power come from variable renewable sources in the future. We need to consider how our current mechanisms for supporting these technologies evolve effectively over the long term, to ensure that renewables come forward in a way that reduces overall system cost and maximises the benefits to consumers, including the potential for wider economic benefit.

The impacts of the coronavirus pandemic on the electricity system have demonstrated that it's possible to operate a system with very high percentages of renewable generation, which will be a central requirement of National Grid ESO's ambition to be able to operate a zero carbon electricity system by 2025. As a highly renewable generation mix becomes the norm, the deployment and development of additional technologies, such as electricity storage, will address some of those challenges and reduce the future costs of a more variable generation mix.

We are calling for evidence on how our policies can achieve these three objectives:

- Maintaining growth in renewable deployment to meet net zero targets;
- Ensuring overall system costs are minimised for electricity consumers; and
- Supporting and adapting to innovative technologies and business models.

The information that we receive will help us develop our existing large scale renewable support mechanism, the Contracts for Difference scheme, and allow us to consider how our wider policy instruments and the markets they operate in can facilitate a move to a low cost, low carbon power system.

[1] Elexon Portal, https://www.elexonportal.co.uk/article/view/7324?cachebust=0hmjyty3qx, accessed 26/08/2020
[2] BEIS (2020), Energy Trends table 6.1, https://www.gov.uk/government/statistics/energy-trends-section-6-renewables

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General information

Why we are issuing a call for evidence?

Ensuring the deployment of new low carbon generating infrastructure will be crucial in delivering on the government's target of net zero greenhouse gas emissions by 2050. As the contracts that support our transition to a low carbon power system can be in place over decades, it is important that we consider the long-term implications of our schemes and how they can evolve to remain effective in a complex and changing environment.

Obtaining evidence, views and information from those with expertise in the sector is an important part of designing effective policies. In low carbon power we have recently sought views on nuclear financing, carbon, capture, usage and storage (CCUS) business models, and the fourth Contracts for Difference (CfD) allocation round. We are now seeking evidence on how renewables will be deployed beyond Allocation Round 4 (AR4) and what this may mean for the future of the CfD mechanism. Information received will inform our design of upcoming allocation rounds and the future of our support mechanisms in the context of our high deployment ambitions for renewable technologies.

Though a means of consulting stakeholders and the public, this call for evidence does not constitute a formal consultation and the requirements that go with it. We invite your views in response to the questions.

Call for evidence details

Issued: 14 December 2020

Respond by: Midnight 8 March 2021

Enquiries to:

Futures Team
Clean Power Strategy and Deployment
Department for Business, Energy and Industrial Strategy
1 Victoria Street, London, SW1H 0ET
Tel: 020 7215 5000

Email: beiscontractsfordifference@beis.gov.uk

Consultation reference: Enabling a High Renewable, Net Zero Electricity System

Audiences: We are keen to hear from energy companies, network operators, technology suppliers, flexibility providers, large businesses, small and medium-sized enterprises, financial institutions, Energy Service Companies (ESCOs), Local Enterprise Partnerships, Non-Governmental Organisations, academics and anyone else with an interest in this area.

Territorial extent: This call for evidence seeks views on the CfD scheme and other market structures that apply to the UK but do not currently operate in Northern Ireland. The call for evidence therefore applies to Great Britain only.

How to respond

Your response will be most useful if it is framed in direct response to the questions posed, and with evidence in support wherever possible. Further comments and wider evidence are also welcome. When responding, please state whether you are responding as an individual or representing the views of an organisation.

We encourage respondents to make use of the online e-consultation wherever possible when submitting responses as this is the government's preferred method of receiving responses. However, responses in writing or via email will also be accepted. Should you wish to submit your main response via the e-consultation platform and provide supporting information via hard copy or email, please be clear that this is part of the same response to this call for evidence.

Respond online at: beisgovuk.citizenspace.com/clean-electricity/renewable-electricity-system-cfe

or

Email to: beiscontractsfordifference@beis.gov.uk

Write to:
Clean Power, Strategy and Deployment
Department for Business, Energy and Industrial Strategy

1 Victoria Street, London, SW1H 0ET
Tel: 020 7215 5000

When responding, please state whether you are responding as an individual or representing the views of an organisation.

Confidentiality and data protection

Information you provide in response to this call for evidence, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018 and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential please tell us, but be aware that we cannot guarantee confidentiality in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable UK and EU data protection laws. See our privacy policy.

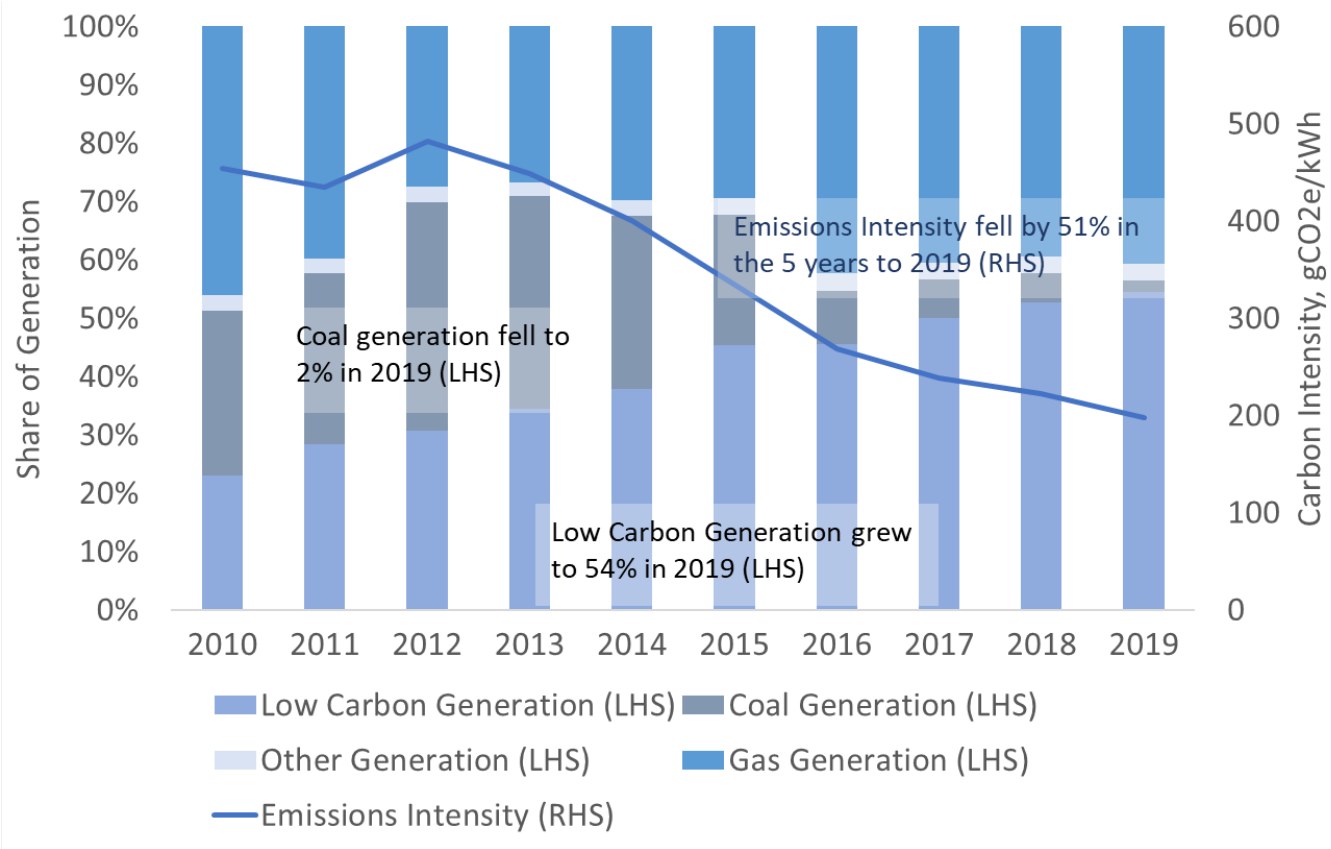
Quality assurance

If you have any complaints about the way this call for evidence has been conducted, please email: beis.bru@beis.gov.uk.

Context

The rate of renewable deployment in the UK has grown dramatically over the last decade. In 2010 over 75% of the electricity generated in the UK came from fossil fuelled sources, with only 7% coming from renewables.[3] By 2019, renewables made up over 37% of the electricity generated in the UK and carbon intensity of our power system had dropped to 198 g/kwh, largely due to the closure of coal power stations.[4]

Figure 1: UK Electricity generation share and GB emissions intensity



Source: DUKES; Energy Trends.

This growth in this low carbon generation would not have happened without government support. Early schemes like the Renewables Obligation and the Feed in Tariff helped kick-start widespread deployment. Now the Contracts for Difference (CfD) scheme supports large scale generators by reducing power price risk, therefore facilitating the financing of new projects. In addition, the competitive allocation of CfDs helps drive the costs of projects down, bringing benefits to consumers.

Since the CfD scheme was introduced, contracts have been awarded to around 16GW of new renewable generating capacity using a range of technologies, and projects are now coming forward at record low prices. For example, prices for successful future offshore wind projects in

[3] Digest of United Kingdom Energy Statistics 2011
[4] BEIS (2020), DUKES Table 5E, https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

the most recent allocation round are a third of what was awarded to projects in the first competitively allocated round, back in 2015.

As we build back better from the coronavirus pandemic renewable technologies can stimulate investment, support thousands of new jobs, level-up regions in need of economic revitalisation, and stand to do this without the need for significant government spending. Shovel-ready projects, particularly onshore wind and solar, can drive this deployment almost right away. We have announced that both originally Pot 1 and Pot 2 technologies will be able to compete in the next CfD auction which we believe will increase the number of the projects moving forward. However, we are aware this successful deployment needs to be sustained over the coming years and decades as our decarbonisation ambitions grow.

Net Zero

In June 2019, the UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. The target will require the UK to bring all greenhouse gas emissions to net zero by 2050. This means the UK will need to decarbonise across all sectors of the economy, and central to this will be cutting emissions further in the power sector.

This has implications for our future energy mix. With the success of schemes such as the CfD, we've seen some renewable technologies provide the cheapest means of producing electricity. Decarbonising in the most cost-effective manner will likely mean large increases in the volume of renewable generation, which, our analysis suggests will need to be backed-up by firm low carbon power such as nuclear and gas with carbon capture.

Not only will we need renewables to replace the fossil fuel plants that are currently operating, but it is likely that the total volume of clean power required will need to grow to meet increased electricity demand from sectors such as transport and heat.

Exact volumes of different technologies needed for a cost effective, net zero compliant 2050 power sector cannot be known now. However, estimating overall system costs of various 2050 electricity generation mixes can give an indication of the proportion of different technologies necessary, and help in ensuring market conditions are right for these volumes to be delivered.

For example, our analysis suggests that over a range of very different scenarios, all low-cost systems require a significant proportion of generation to come from renewable sources. Volumes vary depending on assumptions such as the level of demand, future technology costs and whether sector coupling[5] is achieved through hydrogen, however figure 2 illustrates the relative capacities of different types of low carbon power systems.[6]

[5] Where one part of the energy system becomes linked to another, e.g. using electricity to produce gasses that can be stored and burned as fuel for industry, heating or other processes.
[6] https://gov.uk/government/publications/modelling-2050-electricity-system-analysis

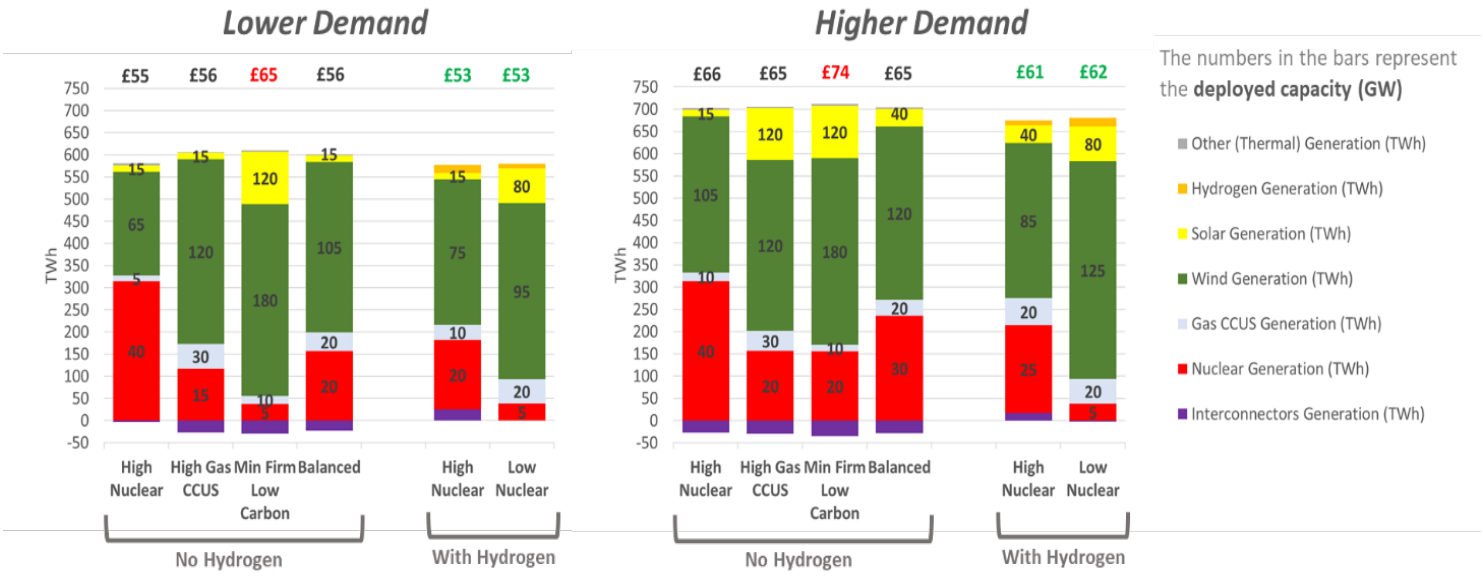


Figure 2: An illustration of how very different mixes can make up low-cost systems in both demand scenarios. The bar charts show different generation mixes with or without hydrogen. These are all at equivalently low cost except for the high renewable mixes without hydrogen. The bars indicate the annual generation provided by each technology; in the case of interconnectors this is the net generation, i.e. imports minus exports. The numbers in the bars represent the deployed capacity in GW. The annual systems cost (in £bn 2012) are shown above each bar.

For this scale of renewable deployment to be achieved, the government is keen that build-out continues at a sustained rate in the near-term. On 6 October 2020, the Government set out the ambition to have 40GW of offshore wind by 2030, including 1GW of floating offshore wind. We have also set a target to support up to double the capacity of renewable energy in the next Contracts for Difference auction, which will open in late 2021 - providing enough clean, low-cost energy to power up to 10 million homes.

Achieving the necessary rate of deployment

Enabling deployment at this scale will require us to overcome not just financial barriers. Whilst ensuring there is sufficient electricity system flexibility, Government must also collaborate with the industry, to address ecological impacts, radar interference, community acceptance, and impacts on regional prosperity.

This call for evidence focuses on the scale of investment required to drive these levels of renewable deployment, and the policy framework that will help deliver it at least overall system cost. The CfD has been highly effective at enabling new renewable projects to attract low-cost finance, which has lowered overall project costs and therefore benefitted consumers. We are keen that this success continues and have recently published our response to the fourth allocation round design consultation.

We are also considering our approach over the long term. Renewables are now a mainstream and fundamental part of our energy transition. We must consider how our mechanisms and markets should evolve to reflect the increased maturity of some of these technologies and

enable the continuation of this growth as efficiently as possible for consumers, while also considering how our mechanisms help support economic growth, particularly the Governments levelling-up agenda.

The Covid-19 pandemic has given us a window into understanding the challenges of an electricity system running with a high percentage of intermittent generators. At times over the Spring lockdown, wind and solar were generating two thirds of GB power, and since March we experienced over 70 hours of negative prices in the day ahead market.[7] This resulted in record low carbon intensity for April, but meant National Grid Electricity System Operator (NG ESO) needed to take additional balancing actions to keep the system stable. We are likely to see these kind of conditions more as increasing levels of variable renewables come onto the system.

We are aware that there is a plenitude of thinking around how to develop the CfD scheme, or alternate ideas for market design which would help facilitate transitioning to net zero. Dieter Helm CBE's Cost of Energy Review proposed changes to the electricity markets for example, along with other proposals for significant market redesign. Other organisations like the Energy Systems Catapult, in collaboration with Laura Sandys CBE are exploring how value could be derived in a future low carbon energy system, and multiple thinktanks and industry bodies have proposed specific changes to refine and optimise the CfD.

Why we are holding a call for evidence

Through this call for evidence, we aim to gather evidence to inform how our policies should evolve throughout the next decade, focussing on three areas:

- **Maintaining growth in renewable deployment to meet net zero targets –** we are looking to understand more about how projects will derive revenue and the security of that revenue, what the impacts of increasing amounts of low marginal cost generation will be and how these will change over time.
- **Ensuring overall system costs are minimised for electricity consumers** – exploring how to minimise the whole system costs of renewable deployment, particularly looking at the balance between price stability and exposure to demand signals, as well as locational signals and the role of renewables in providing system services.
- **Supporting and adapting to innovative technologies and business models** – to learn more about the new types of project coming forward, such as those utilising multiple technologies, extensions of old projects or international projects that work across national borders.

In achieving these objectives there will inevitably be trade-offs, and these will need to be managed carefully. For example, extensive exposure to market risks could inhibit some developers from securing investment. Likewise, a stable policy framework could improve investor confidence but limit the flexibility needed to support innovation in business models or technologies which reduce overall system costs. Receiving views from those in the sector

[7] Wind and solar provided 66% of GB electricity on April 5th 2020.
ELEXON portal, https://www.elexonportal.co.uk/article/view/7324?cachebust=0hmjyty3qx, accessed 6th August 2020;University of Sheffield, https://www.solar.sheffield.ac.uk/pvlive/, accessed 6th August 2020;
Nord Pool, UK Day Ahead Auction Prices, https://www.nordpoolgroup.com/Market-data1/GB/Auction-prices/UK/Hourly/?view=table, Accessed 6th August 2020

helps government understand these trade-offs in more detail and strike the right balance in order to achieve our goals.

This call for evidence is part of an ongoing process of engagement. The information we receive will inform the government's position on the long-term future of support for renewable developments and design of future CfD allocation rounds.

Maintaining growth in renewable deployment to meet net zero targets

Achieving the rate of renewables deployment that we could need to meet net zero will require substantial and sustained investment. We must ensure that GB has an attractive and effective policy environment to support this investment, while reflecting the needs of the wider system.

The extent of the cost reductions that some renewable technologies have achieved require us to consider how our mechanisms should support deployment going forward. Prices in the most recent CfD allocation round came in around £40 per MWh (2012 prices),[8] and we expect the prices for some more established technologies could be even lower. This is driving an increase in projects deploying without government support. Onshore wind projects have progressed without a government contract. Similarly, we saw an increase in the number of solar PV projects developing without a CfD in 2019, with expectations for this to continue to grow in 2020. What's more, we are aware of some offshore wind developers exploring merchant revenue in the absence of a CfD contract, either by commissioning before the start of the CfD term, or by developing a portion of a project without a CfD at all.

We are interested in how the sector is approaching deployment in the absence of the security of a price-stabilising CfD, particularly around how projects will earn revenue. Unsupported projects have fewer restrictions on revenue streams that are available to them. How will these projects trade on wholesale and balancing markets for example and can revenue from these markets support merchant deployment? How much expectation is there of capacity market revenues? And are there other revenue streams being explored?

We are aware that the certainty of expected returns is also important for some investors rather than just the absolute value of those returns, with revenue security a key factor when considering a new investment. We are aware of some projects managing risk by agreeing deals with corporate offtakers to secure revenues. Others are exploring the benefits of co-locating with battery storage, which can both reduce network costs through shared infrastructure and flatten the volatility of returns through a portfolio effect.

1. **How is the industry currently approaching developing renewables projects without CfDs? In what ways might non-CfD backed projects obtain revenue from wholesale and other markets, and secure investment?**

[8] BEIS (2019), Press Release 'Clean energy to power over seven million homes by 2025 at record low prices'", https://www.gov.uk/government/news/clean-energy-to-power-over-seven-million-homes-by-2025-at-record-low-prices

We are also considering the impacts of our policies over the long-term. Currently CfD contracts for renewables have 15-year terms, and therefore if similar contracts are signed in allocation rounds after the next auction, those contracts could be in place until the mid-2040s. Therefore, decisions we make now will have lasting impacts on the system.

We are particularly interested in the impact of greater deployment of low-marginal cost generation and the 'price cannibalisation' this causes. This is where the wholesale power prices that variable generators are able to capture are lower than average due to the correlation of renewable generation pushing the most expensive, price-setting plant out of merit.

There are different forecasts of how much of an impact this is likely to have in future, but price cannibalisation could have significant implications for renewable deployment. The more variable renewable deployment that occurs, the more difficult it may become to create a business case based primarily on wholesale revenue. We want to know more about the understanding the industry has of these effects over the long term, what forecasts have been made of their extent on market prices, and how the industry and markets may evolve around this.

We would also like to know more about how the industry uses these long-term price forecasts in their investment decisions. Particularly around how post-CfD revenues are valued when deciding on strike price and how much consideration is given to this.

2. **What do you consider to be the effects of increased low-carbon deployment on future wholesale power prices and renewable capture prices?**

3. **How viable will investment in new renewable projects based primarily on wholesale prices be in future? Could this investment case be supported if there was more extensive deployment of flexible assets such as storage?**

Price cannibalisation also has fundamental implications for the CfD scheme itself. For example, even with expected lower strike prices in future allocation rounds, increasingly larger top-ups could be required if the prices in the applicable reference price market become substantially lower or more volatile than they are today (currently, the reference price for intermittent technologies is the day-ahead hourly price). This could result in successful projects receiving more revenue through the CfD than they do in the wholesale market, and overall levy payments increasing rather than subsiding. It could also have operational implications for the supplier obligation, which is the levy through which funds are recovered from electricity suppliers to cover CfD payments.

This needn't come at proportionally greater cost to the consumer as we would expect lower wholesale cost would be reflected in consumer bills. However, this does require us to consider the role of government schemes such as the CfD as the way of supporting future low carbon developments, as this could become the only route to market for new projects. Some commentators have suggested increasing the term of the CfD, beyond the current 15 years, as a possible solution to price cannibalisation. This would likely be an effective means to support financing, however it would also exacerbate the potential for the CfD to be the sole route to market for new entrants.

The next allocation round will continue to provide support for successful projects which are likely to commission in the mid-2020s, and we have set out our intention to hold further rounds

around every 2 years. We will keep this under review however and would like views on whether there is a need for a government provided secured price, based on the wholesale market, in order for plants to secure low-cost financing and deploy at the levels we may require for net zero. Can the now mature renewable technologies provide the low carbon power we need by deploying without further CfDs? Or will price support continue to be needed to achieve the necessary volumes?

We are also interested in what sort of advancements could reduce the requirement for future CfD allocations. For example, the type of technological developments that could facilitate sector coupling, like producing hydrogen gas via electrolysis, using low carbon power that may otherwise be curtailed thus providing a revenue source when demand for electricity is low. A means of economically storing power that is generated from renewable sources over longer timeframes may emerge, allowing power generated from variable renewables to better match demand patterns. These changes could also be driven by consumers, potentially enabled by smart metering, increased digitisation and the right incentive packages. Achieving this is likely to take time, and the government has a role in ensuring market participants have the right incentives to develop these solutions.

4. **How much longer after the 2021 allocation round should the current CfD be used? Is a price based on a short-run marginal cost market the most effective basis for a long-term renewables contract?**

Achieving net zero will require sustained action throughout the coming decades. Creating a market structure which facilitates the deployment of renewable and other low carbon technologies, without the need for government intervention, has obvious potential benefits. Market forces can foster innovation that can't be predicted and find solutions that reduce the overall cost of transitioning to a low carbon power system for consumers.

What's more, the market should enable the effective and efficient deployment of renewable and other low carbon assets through agreements between market participants, and a potentially reduced role for government in supporting this deployment through contracts or schemes. Achieving this is likely to be a long process but we are interested to hear any views you have on how government should be approaching this challenge.

5. **Are there any changes or alternatives to the wholesale market that might facilitate merchant deployment?**

6. **How can market participants be encouraged to provide contracts to secure low-cost investment in renewables?**

Ensuring overall system costs are minimised

Moving to a system with a greater proportion of intermittent renewables requires a different type of electricity system. Our modelling suggests that decarbonisation of the GB electricity system means more decentralised generators, and a greater reliance on variable, weather dependant renewable sources, alongside firm low carbon power sources such as nuclear generation, hydrogen generation, and gas or biomass generation with carbon capture, usage and storage. We also expect to see a shift to a more active and responsive demand side, enabled by smarter metering and greater digitalisation.

Flexible technologies such as storage will be key to integrating intermittent renewables (and low carbon heat and transport) and achieving net zero. BEIS analysis suggests flexibility from demand side response, storage and interconnection could reduce system cost by up to £12bn a year in 2050, compared to a system with extremely low level of flexibility.[9] BEIS, in collaboration with Ofgem has set out how we can build flexibility and reliability into a new, digitalised, decentralised system, encouraging the deployment of smart technologies through the work of our Smart System and Flexibility Plan.[10]

Integrating renewables into this system effectively is a crucial aspect of delivering a decarbonised power system at least cost to the consumer. We want a market structure that enables different technologies to realise both the value and the costs that each bring to the system. This will drive the deployment of the most appropriate technologies whilst providing incentives for innovation.

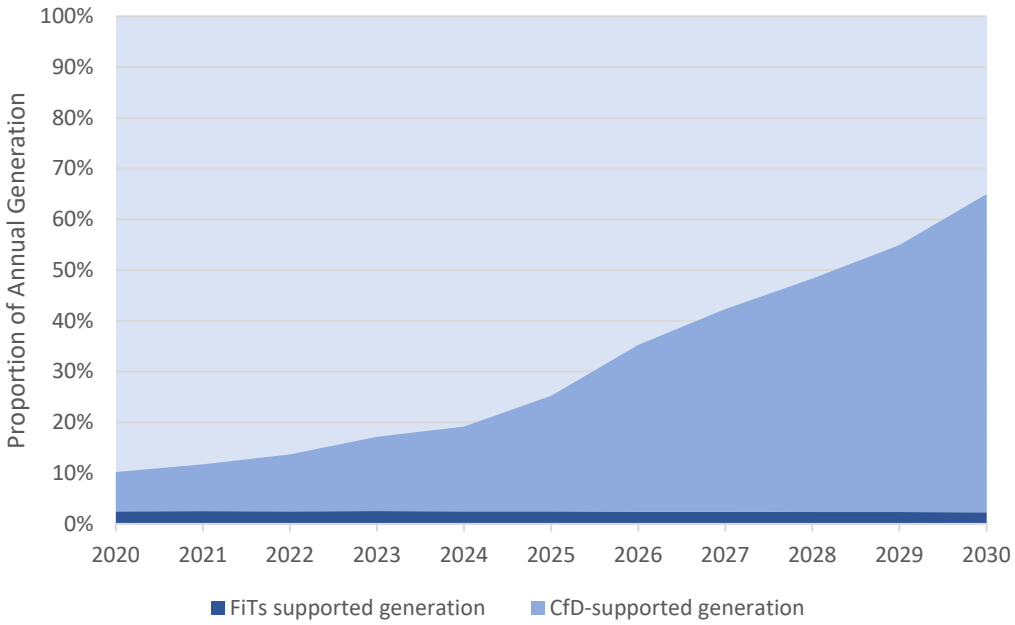
To achieve this, we must consider the overall system impact of each generating plant. All generating technologies impose costs on the system. For example, costs of providing the network to export the electricity generated, the costs of balancing the system at times of imbalance, or the costs of procuring reserve capacity to cover times of expected and unexpected outages. These costs are varied and depend on properties of the system, such as the level of flexibility and the nature of other generators.

In principle, minimising these costs means ensuring that they are borne by those who are best placed to manage them. Currently, CfD generators face charges for factors like network usage and balancing, which we would expect to be passed through into a project's strike price. However, these charges may not be fully cost reflective, and there may be other system costs that are not reflected in charges at all.

For example, CfD generators have generally not been exposed to the different value of their generated power at different times. Instead the CfD provides a fixed strike price for renewable electricity output to which generators receive a top-up if market prices are below it. Likewise, when market prices are higher than the strike price, they must pay back the difference. This improves revenue certainty but prevents generators from receiving signals to change behaviour based on the value of the power they are generating. We are interested in understanding how the projected growth in CfD generators' share of total generation could affect efforts to minimise system costs (see figure 3).

[9] https://gov.uk/government/publications/modelling-2050-electricity-system-analysis
[10] https://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan

Figure 3 – Modelled proportion of GB generation with limited wholesale price exposure[11]



Source: BEIS Analysis

These behavioural changes could be varied. For example, projects may choose to locate differently to avoid correlation with other similar developments, or adjust maintenance scheduling to maximise availability at times of high demand. Other changes could include developing technologies that assist in the provision of balancing services, or potentially operating across sectors, looking at things like producing hydrogen via electrolysis. We are looking to know more about how generators might adapt to different market signals.

We have taken steps to improve these signals; we have announced our intention to amend the negative pricing rule so that new CfD generators do not receive a top up when the day-ahead hourly market reference price goes below zero. However, as intermittent renewable technologies continue to make up a greater proportion of our generating mix, there may be a need for that generation to be able to respond better to the time-value of power. There are further steps we could take to remove some of the insulation supported plant receive from the CfD. These include the following.

- Moving the reference price used for intermittent generators from the day-ahead hourly market to a more forward market such as the seasonal market price used for baseload plant.
- Moving from paying based on physical output to paying on deemed generation, thus reducing the incentive to export power to the grid in order to receive payments and presenting the opportunity to utilise other market opportunities.
- Capping the amount of subsidy provided at times of low prices. This would have a similar effect to the negative pricing rule though would be expected to occur more often.
- Reducing contract length from the current 15 years, thus allowing projects to capture, and respond to, merchant prices sooner.

[11] Scenario assumes 40 GW of offshore wind and one nuclear project beyond Hinkley Point C in 2030.

- Moving to a price floor where generators would retain the ‘upside’ of high prices but be protected against low prices. Or combine with a cap so that generators are exposed to variable prices but are protected against very low prices and must payback an extra revenue earned at very high prices.

Other means to provide more exposure to market signals could include moving away from providing security based on power prices altogether. For example, a revenue guarantee scheme, where a generator’s overall revenue was secured to a minimum value, could improve certainty for investors without affecting operating behaviour. Another idea is to provide security based on a carbon price or carbon price trajectory, such that successful generators would be ‘topped up’ if the carbon price was below an agreed level. More fundamental proposals such as these would require additional time to design and implement.

In deciding the right level of exposure to wholesale market prices, we must strike the balance between incentivising efficient behaviour based on the needs of the market and providing security of price to facilitate lower costs of financing. Some responses to the negative pricing proposal in the AR4 consultation pointed out the potential for increasing the financial risk and impact this could have on investment. Making further changes to increase exposure to market prices would need to be done in a way that allows security for investors, while rewarding those who innovate their financing strategies and physical assets. Obtaining views on the benefits and drawbacks of the above options, and the best time to implement these changes, will help us design more efficient policies.

Maintaining levels of renewable deployment consistent with the volumes we need for net zero is a priority, therefore we are considering carefully how and when to introduce any further measures over coming rounds. Gradually increasing exposure to the market allows participants more time to adapt to changes aimed at delivering benefits to the consumer. In the near-term we anticipate changes will be aimed at more effectively integrating intermittent generation rather than completely reforming the way we incentivise investment in renewables. Similarly, whilst we need to begin to consider the longer-term market design for the delivery of net zero, we are not imminently embarking on a major restructure of our market framework

7. **How could intermittent renewable generators change their operating or investment behaviour to respond to wholesale price signals?**

8. **What would be the impact on the cost of capital of introducing greater exposure to the market price for power?**

9. **In your view, which of the potential options for providing increased exposure to market signals offers the greatest benefit to the consumer? Are there any other options that we should be considering?**

We are also interested in understanding how the CfD mechanism could account for the increased need for flexibility, besides exposure to wholesale market signals. One of the benefits of a flexible system is that it allows for a more efficient use of existing assets. This means we would need to build less generation capacity to achieve a power sector consistent with net zero than we would need to in an inflexible system, which reduces overall costs. We want to understand what incentives could encourage CfD plants to behave in more flexible ways, or account for their wider impact on the system.

CfD plants could also contribute to the wider stability of the system. As a greater proportion of our power comes from renewables, low-carbon technologies will increasingly need to provide services traditionally provided by non-renewable generators, such as inertia, frequency management and black start. Besides flexible technologies such as storage and demand side response, renewables generators could also provide some of these services. Currently, however, there are limited incentives to install the required equipment or adopt the appropriate behaviours. We want to consider the role of renewables generators in providing some of these services in the future and how our policies can facilitate this.

10. **Should CfD generators be incentivised to account for flexibility and wider system impacts, and/or to provide balancing services to the system operator? How could this be achieved?**

11. **Should the CfD mechanism incentivise minimum grid stability requirements (in CfD plants) to minimise system costs and help ensure secure and stable operation? How could this be achieved and what are the barriers?**

As we move to a system with greater volumes of distributed generating assets, where those assets are located will be of increasing importance. The closer generators are to demand, the less investment is needed in network infrastructure, however, with generators that depend on natural resources such as wind speed or solar irradiance, proximity to demand has to be weighed up against the availability of resources at each location, as well the correlation of those areas with other generators of the same type, and other aspects such as community acceptability. Locational signals are largely provided through the network charges that generators pay, which take into account the cost of managing and upgrading the network. For CfD generators these charges are expected to be accounted for when strike price bids are submitted. We want to ensure that as we continue to transition to a low carbon grid, this way of accounting for locational impact continues to be effective.

This is relevant to Ofgem's Access and Forward-Looking Charges Review, which includes consideration of options for improving the locational accuracy of network charges incurred by distributed generation. In addition, Ofgem asked National Grid Electricity System Operator to launch a Balancing Services Charges Task Force to consider the future of balancing services charges, particularly who should pay them and how the charges should be recovered. The Task Force's recommendations were sent to Ofgem on 30th September 2020. We will work closely with Ofgem to ensure consistency between our respective areas of consideration.

12. **Do CfD projects receive the right incentives to locate in the optimum locations?**

13. **Are there actions which Government should consider, outside of Ofgem's current electricity network charging reviews, to help incentivise efficient market behaviour regarding the location of renewable assets?**

As we consider how the CfD scheme evolves in the long-term to minimise costs to electricity consumers, the Government wants to understand the balance between sustaining low-cost renewable deployment and supporting our economic growth agenda, particularly in the regions, and continuing to ensure that costs are as low as practicable.

The sector has raised that there is a risk that failing to consider the relationship between the CfD mechanism and economic development could result in low prices driving a move to use low-cost supply chains, reducing the economic benefit to UK communities from clean energy deployment and the contribution that the UK can make in the long-term to enhancing the sustainability, innovativeness and competitiveness of the sector.

The supply chain plan process within the CfD scheme is aimed at encouraging the effective development of open and competitive low carbon supply chains. The government is currently consulting on changes to the supply chain plan process ahead of CfD Allocation Round 4. A government response and follow on consultation published in November set out proposals to strengthen the supply chain plan process by aligning the process more closely to government priorities including the Industrial Strategy, increasing the clarity, ambition and measurability of developers' commitments and ensuring those commitments are delivered by introducing new consequences for non-delivery. A further consultation is planned on a revised supply chain plan questionnaire.

This call for evidence seeks views for subsequent allocation rounds on how the CfD scheme and our broader supply chain policy (beyond the supply chain plan process) relate, and whether and how the CfD regime may evolve to support supply chains in light of the government's net zero target and wider priorities.

Government welcomes views on how to reconcile the aims of deploying renewables in a cost-effective manner without missing out on economic opportunities for the UK.

14. **Should the CfD do more to enable the sustainable growth, cost reduction and competitivity of UK supply chains and how could this be achieved?**

Supporting and adapting to innovative technologies and business models

As decarbonisation of the energy sector continues, we are seeing the industry innovate to develop projects with different characteristics. Projects are now being developed which capitalise on the value of multiple technologies located at the same site. Solar projects are deploying with co-located battery storage such as Anesco's Clayhill Farm development. Renewables developers such as Scottish Power are exploring hybrid sites with both wind and solar generating infrastructure paired with battery storage. And as understanding grows about the role hydrogen gas has to play in our path to net zero, interest is increasing in the possibility of co-locating renewables with electrolytic hydrogen production.

Sharing infrastructure, as well as operation and maintenance can improve the economics of co-located sites, and pairing low-carbon technologies that have complementary characteristics can optimise operation and facilitate financing by reducing risk. The government supports innovation that maximises the amount of low-carbon electricity that powers our homes and businesses as cost effectively as possible. We would like to understand more about these sorts of developments and the potential they have in supporting the decarbonisation of our energy sector.

The CfD currently supports projects of a single technology. Each project bids as a technology type and bids must be below the Administrative Strike Price for that technology. We received views on the potential benefits of co-location of renewables and storage in the AR4 consultation. However, as we consider the future of government support, and how the scheme evolves after the 2021 allocation round, should we be considering mechanisms which support sites of multiple technologies and characteristics?

15. **What are the benefits of renewable projects using multiple low carbon generation technologies or being co-located with low-carbon flexible assets? Should the CfD support these projects and why?**

Going further, some projects in future could include multiple low-carbon technology types, that are located in different places and connected through a virtual power plant (VPP). These VPPs could bid into an auction based on the overall amount of low carbon generation supplied. This could therefore include assets that improve the flexibility or adaptability of generation such as storage. Currently CfD projects can have geographically dispersed assets (for example two separate wind farms presenting as a single CfD project) as long as the metering at point of export is aggregated into a single entity. But we are interested to know if there is value in rethinking that, and whether projects with multiple metering points could and should be considered for future rounds.

16. **What are the benefits of projects with assets in different locations, including projects paired with flexible assets? Should the CfD support these and why?**

The current design of the CfD regime means that offshore wind developers control the timing and location of projects which compete in each CfD auction. The competitive element incentivises them to connect as directly and as quickly as possible. This is mirrored by the offshore transmission regime, which allows developers to design and build their connection to shore, before Ofgem tenders for a third party (an Offshore Transmission Owner, or OFTO) to own and operate the link. This developer-led approach to offshore generation and transmission deployment has been very successful to date at securing investment in offshore wind while minimising costs for consumers. However, with much higher levels of offshore wind deployment envisaged to realise our net zero ambitions, a more coordinated approach to offshore generation and transmission development may be desirable in future.

The Offshore Transmission Network Review[12] establishes two separate strands, one to focus on the medium term to explore what can be done within the existing framework, and one to design and implement an enduring regime for the longer term. This approach is designed to account for the different stages of development of projects already in the pipeline.

We are already working closely with the other organisations involved in delivering the review to understand what can be done for such ‘medium term’ projects, while recognising that it will be challenging to amend the regulatory framework in these timeframes. We are however exploring ways in which these projects can be incentivised to take a different approach, which we hope will result in some coordination before the outcomes of the review for the enduring regime are finalised. We have also engaged with developers to identify either early opportunities for

[12] https://www.gov.uk/government/publications/offshore-transmission-network-review/offshore-transmission-network-review-terms-of-reference

coordination or barriers that are stopping coordination happening in practice.[13] This information will also be used to inform the design of an enduring regime.

In the longer-term, we are aware that there are proposals for much greater levels of coordination in the development of offshore energy infrastructure. For example, strategic deployment of a coordinated offshore network could allow multiple windfarms to share infrastructure to bring energy onshore, reducing the overall number of connections required. We are also aware of the need to balance the risk and cost between developers, network companies and consumers in relation to a more coordinated offshore network. The review will consider the costs and benefits of these different approaches in designing an enduring regime, which we aim to provide clarity on during 2021.

In this call for evidence, we are interested in evidence of the benefits and costs of a more coordinated approach to generation deployment, as well as how the CfD regime would need to adapt in order to enable this.

17. **What changes would Government need to make to the Contracts for Difference regime to facilitate the coordination of offshore energy infrastructure, what would be the benefits and costs of making them, and could there be a similar case for other renewable technologies?**

As offshore wind generation is deployed further out to sea, combining the technologies of offshore generation and market-to-market interconnectors has the potential to further reduce costs, increase the flexibility of wind generation and limit environmental footprint onshore and offshore compared with completing projects separately.

The UK has been collaborating with other countries to explore the benefits of greater strategic coordination in the deployment of market-to-market interconnectors with wind generation, to increase the capacity for cross-border trade and make offshore wind generation available to more than one national market. However, there are a number of actions by private and public entities that may need to be taken to fully realise these benefits.

In this call for evidence, we are interested in views on how support schemes would need to be designed with regard to offshore wind farms that connect to more than one national market, or that have a link to shore shared with market-to-market transmission assets. We are conscious that any change to the CfD will need to consider the interdependencies with wider considerations being taken forward in the Offshore Transmission Network Review on multi-purpose hybrid project design, including market arrangements for trade over multi-purpose assets and the asset classification of the export cable connecting offshore wind to shore, which respondents may also wish to comment on.

18. **What changes would Government need to make for the Contracts for Difference to facilitate deployment of offshore wind as part of a multi-purpose hybrid offshore wind-interconnector project, and what would be the benefits and costs of making them?**

[13] https://www.gov.uk/government/publications/increasing-the-level-of-coordination-in-offshore-electricity-infrastructure-beis-and-ofgem-open-letter

Achieving a net zero compliant electricity system will require us to source power from a diverse range of sources and increase the levels of flexibility that we currently see in the system. This diversity could extend to supporting international renewable projects, which could directly flow power into our electricity grid. This could involve opening future support to renewable generation projects outside of GB, which are not currently eligible under our existing policy and legal framework.

Supporting renewable generation outside of GB could help achieve decarbonisation at low cost, given projects overseas could have different patterns of intermittency or different availability of baseload or dispatchable renewable resource. However, this is one of many potential options for the future GB electricity system, and would need to be considered in the context of wider objectives, including system costs, risks such as cable vulnerabilities, economic value and opportunity cost, as funding such projects through the current renewables levy will mean that less GB based generation could be supported. We would also need to ensure the development of any international low carbon projects, have the backing of partner governments and be compatible with their different legislative frameworks.

19. **What role could international renewable projects play in our future generation mix in GB? Are there benefits to supporting these projects with government schemes and how could this be achieved?**

Under the current CfD eligibility criteria, only projects which have been commissioned (that have started generating electricity) are excluded from applying for a CfD. This means that part-built projects (those which have begun construction but have not yet commissioned) are eligible to apply. The CfD scheme was established in 2015 to provide income stabilisation for new projects. At that time, the high upfront costs of renewable technologies would have made it prohibitive for many projects to begin building without the certainty the CfD offers against external market conditions. However, since the first allocation round the costs of some technologies have dropped significantly. More projects are looking at deploying on a merchant basis, selling their electricity onto the wholesale market without a CfD. It is therefore appropriate to review the impacts of continuing to allow part-built projects to compete in the scheme for AR5 and beyond.

We are interested in obtaining evidence on the overall benefits and risks of part-built projects competing in the CfD (for example on end consumer costs and net zero targets) and what the likely impacts of excluding them would be. We want to understand if developers who are making investment decisions on merchant low carbon projects actively consider later bidding into CfD allocation rounds, and whether this approach is likely to change for future allocation rounds. We are also interested in views on the potential bidding behaviour of these projects, and how this would impact auction dynamics and value for money.

20. **Should part-built project continue to be eligible to compete for CfDs after the fourth allocation round? Are we considering the right implications and what are your views on these?**

Other types of projects that are becoming more common are projects that are extensions of existing sites, which may already receive CfD (or RO) support. For example, this could be a new offshore wind development being built adjacent to an existing wind farm. These sites

could come forward at reduced costs, compared to a standalone new development, by benefitting from shared network infrastructure or operation and maintenance programmes.

Similar cost savings could be made by the repowering of older projects. As the current fleet of renewable generators age, increasing numbers of projects will reach the end of their asset lives. Equipment on these sites can be replaced with more modern and more efficient equipment while benefitting from some of the existing infrastructure.

We want to obtain evidence on the potential of both, extension and repowering projects, particularly, where the costs savings come from and their magnitude. We would also welcome views on, and any justification for them being supported by government mechanisms.

21. **Can cost savings be achieved by developing extensions to existing projects, if so, how great are these cost savings, and what is the justification for these projects being supported through CfDs or any other government mechanism?**

22. **Similarly, can cost savings be achieved by repowering older projects, if so, how great are these cost savings, and what is the justification for these projects being supported through CfDs or any other government mechanism?**

Call for evidence questions

Maintaining growth in renewable deployment to meet net zero targets

1. **How is the industry currently approaching developing renewables projects without CfDs? In what ways might non-CfD backed projects obtain revenue from wholesale and other markets, and secure investment?**

2. **What do you consider to be the effects of increased low-carbon deployment on future wholesale power prices and renewable capture prices?**

3. **How viable will investment in new renewable projects based primarily on wholesale prices be in future? Could this investment case be supported if there was more extensive deployment of flexible assets such as storage?**

4. **How much longer after the 2021 allocation round should the current CfD be used? Is a price based on a short-run marginal cost market the most effective basis for a long-term renewables contract?**

5. **Are there any changes or alternatives to the wholesale market that might facilitate merchant deployment?**

6. **How can market participants be encouraged to provide contracts to secure low-cost investment in renewables?**

Ensuring overall system costs are minimised

7. **How could intermittent renewable generators change their operating or investment behaviour to respond to wholesale price signals?**

8. **What would be the impact on the cost of capital of introducing greater exposure to the market price for power?**

9. **In your view which of the potential options for providing increased exposure to market signals offers the greatest benefit to the consumer? Are there any other options that we should be considering?**

10. **Should CfD generators be incentivised to account for flexibility and wider system impacts, and/or to provide balancing services to the system operator? How could this be achieved**

11. **Should the CfD mechanism incentivise minimum grid stability requirements (in CfD plants) to minimise system costs and help ensure secure and stable operation? How could this be achieved and what are the barriers?**

12. **Do CfD projects receive the right incentives to locate in the optimum locations?**

13. **Are there actions which Government should consider, outside of Ofgem's current electricity network charging reviews, to help incentivise efficient market behaviour regarding the location of renewable assets?**

14. **Should the CfD do more to enable the sustainable growth, cost reduction and competitivity of UK supply chains and how could this be achieved?**

Supporting and adapting to innovative technologies and business models

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18. **What changes would Government need to make for the Contract for Difference to facilitate deployment of offshore wind as part of a hybrid offshore wind-interconnector project, and what would be the benefits and costs of making them?**

19. **What role could international renewable projects play in our future generation mix in GB? Are there benefits to supporting these projects with government schemes and how could this be achieved?**

20. **Should part-built project continue to be eligible to compete for CfDs after the fourth allocation round? Are we considering the right implications and what are your views on these?**

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This call for evidence is available from: www.gov.uk/government/consultations/enabling-a-high-renewable-net-zero-electricity-system-call-for-evidence

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