Institution of Engineering and Technology – Written evidence (ONZ0013)

1. The IET is one of the world's largest engineering institutions with over 158,000 members in 150 countries. Our aim is to inspire, inform and influence the global engineering community to engineer a better world. With our roots in electrical engineering, we have been championing engineering solutions and the people who deliver them for 150 years.

2. Please get in touch with Duncan Kenyon duncankenyon@theiet.org if you have any further questions.

Q1. What role should Ofgem play in the transition to net zero? What changes, if any, should be made to its remit, responsibilities and resources?

3. Ofgem's stated primary role as an economic regulator is to protect consumers by working to deliver a greener, fairer energy system. The transition to net zero will require significant changes in the way consumers purchase energy. It will introduce new complexities (e.g. time of use and dynamic tariffs) and Ofgem will have a vital role in helping to explain these changes to consumers as well as ensuring that suppliers adopt best practice in their marketing strategies. We believe (and Ofgem acknowledges) that it will need to develop its strategy to ensure it can play its full part in delivering a net zero energy system. A recent keynote speech delivered by Jonathan Brearley (Chief Executive, Ofgem) at Energy UK's annual conference on October 15 2020 outlined Ofgem's Vision for a net zero future: https://www.ofgem.gov.uk/publications/ofgems-vision-net-zero-future.

4. ***Our responses to the following questions describe how we believe Ofgem's role and terms of reference should evolve to ensure its regulatory strategy and responsibilities are consistent with delivering a net zero compatible whole energy system.***

Q2. How well does Ofgem balance environmental objectives against its responsibilities in relation to affordability for consumers?

Protecting Customers

5. Ofgem, as an economic regulator, is fully aware of the need to ensure energy-related environmental objectives are delivered as economically (and hence as affordably) as possible. In particular, Ofgem has a strong focus on fuel-poor and vulnerable customers for whom any energy price increases necessary to deliver environmental objectives might be very challenging.

6. By way of a practical example of how Ofgem balances environmental objectives against its responsibilities in relation to affordability for consumers, Ofgem requires Energy Suppliers to promote measures which improve the ability of low income, fuel-poor and vulnerable households to heat their homes. This includes actions that result in heating savings, such as the replacement or upgrade of inefficient heating systems, or through energy efficiency improvements. Ofgem maintains an ECO register which Suppliers must report into.

7. ***However, some 22.9% of a typical domestic electricity bill is accounted for by environmental and social obligations (cf. only 1.9% for gas bills)[i] and this raises a question as to the sustainability of this policy of charging electricity consumers for measures which are in place to reduce energy-related CO_2 emissions***.

8. Environmental and social obligation costs include those associated with the renewable obligation, feed-in tariffs, CfDs, and the capacity market. Given that electricity production is becoming increasingly less carbon-intensive whilst methane (or in future methane/hydrogen) gas consumption will continue to produce CO_2 emissions, this higher loading of social and environmental costs towards electricity bills might seem disproportionate. Moreover, given that decarbonisation of domestic space and water heating and personal transport is likely to result in higher levels of (low carbon) electricity consumption in future, the result of maintaining this loading of social and environmental costs towards electricity bills might become a barrier to consumers switching from gas to electric heating, or even switching from a petrol or diesel car to a BEV.

9. **C*onsideration should be given to a more equitable basis for recovering from consumers the costs of meeting environmental and social obligations, recognising the relative contributions to CO_2 emissions from electricity and gas consumption*.**

Incentives on Network and System Operators

10. In respect of electricity system, Ofgem rigorously scrutinises the business plans of the companies that own and operate the energy networks as part of its periodic regulatory reviews to ensure expenditure (or incremental expenditure) proposed in relation to delivering environmental benefits is justified on a cost-benefit basis. Ofgem has a standard form of cost-benefit analysis (CBA) based on discounted cashflow which allows the network companies to include carbon-related benefits alongside other benefits in their business case for any given project or programme of work. For example, an electricity network company might propose a more expensive system reinforcement option that delivers lower network technical losses where the higher initial cost is justified in net present value (npv) terms by the sustained reduction in generated electricity (and hence carbon emissions) to supply those losses.

11. Ofgem has also previously introduced a 'low carbon network fund' (LCNF) which has provided electricity network companies with an innovation stimulus to develop low carbon technologies which are not yet at a 'technology readiness level' appropriate for widescale adoption as 'business as usual'. The LCNF is funded partly by the companies but mainly by customers. Whilst this does mean a small increase in use of system charges in the shorter term, the resulting rollout of the technical and/or commercial innovation developed through the fund should reduce network charges, and energy charges generally, in the longer term. Although the LCNF is now discontinued, it has been replaced by a Network Innovation Allowance and Competition which will be carried forward in the form of a Network Innovation Allowance and a Strategic Innovation Fund throughout the RIIO-2 period.

12. ***Ofgem's overall innovation stimulus package should be sufficient to encourage network operators to continue to develop commercial and technological innovations which support an increasingly efficient and affordable net-zero compatible energy system***.

13. However, given the level of innovation already delivered by network operators largely aimed at the anticipated future challenges for energy networks in supporting low carbon transition, it is important that customers who have largely funded these innovations are able to increasingly see a return on their investment in terms of lower use of system charges.

14. ***In order to maximise synergies and ensure the benefits to customers materialise promptly as low carbon transition progresses, there needs now to be greater focus on***

integration of innovation across the whole energy sector, and also on implementation as business as usual.

Q3. How well does Ofgem fulfil its obligations to consumers? Does Ofgem take consumer views into account sufficiently, particularly those of vulnerable consumers?

15. Ofgem takes consumers' views into account through various means. This includes public consultations and stakeholder / customer forums and surveys. Ofgem has also engaged a RIIO-2 Challenge Group which reviews and challenges network operators RIIO-2 business plans. The Challenge Group includes representatives from Which, Consumer Futures, and Citizens Advice as well as non-energy industry professionals and academics.

16. Ofgem also places a strong focus on vulnerable customers through its consumer vulnerability strategy: https://www.ofgem.gov.uk/publications/consumer-vulnerability-strategy-2025 which includes the objectives of:
    - improving identification of vulnerability and smart use of data
    - supporting those struggling with their bills
    - driving significant improvements in customer service for vulnerable groups
    - encouraging positive and inclusive innovation
    - working with partners to tackle issues that cut across multiple sectors

17. Ofgem also exercises its responsibility to ensure Suppliers meet their social obligations through Social Obligation Reporting on matters such as:
    - payment methods
    - levels of debt
    - disconnection rates
    - prepayment meters
    - non-financial support for customers in vulnerable situations

18. ***From a net zero and Energy White Paper perspective, Ofgem should ensure it has sufficient focus on Suppliers offering time-of-use or dynamic energy retail tariffs that make use of smart metering data, and half-hourly settlement (of currently 'profiled' consumer groups) and hence provide consumers with the opportunity to make savings on their electricity bills whilst supporting low carbon energy transition through being flexible in the way they use electricity***[ii].

19. Ofgem will have an important role to ensure that these more complex tariffs are made 'customer-friendly' so that customers can have the confidence to use them. These new tariffs will be particularly important in terms of future electrification of home heating once sales of new gas boilers are banned (potentially from as early as the mid-2030s) and also in terms of consumers having access to EV charging facilities that don't unduly penalise those who are unable to charge their EVs at home. In this respect it will be essential that markets for flexibility are not only established but also coordinated so that customers benefit from maximising flexibility across the full energy chain (we expand on this point in our response to question 5).

20. In terms of Ofgem's obligations to consumers, it is essential that Ofgem takes steps to ensure that customers are rewarded for the value of the flexibility they provide across the whole energy chain.

Q4. What implications will the transition to net zero have for the security of the UK's energy supply? How does Ofgem currently manage issues relating to security of supply?

Ofgem's Jurisdiction

21. Ofgem's remit for security of energy supply is limited to its regulatory duties in respect of the operation, transmission and distribution activities of the electricity and gas systems, and to gas and electricity energy market regulation in Great Britain. Ofgem is also responsible for managing the competitive tender process through which offshore transmission assets are sold and licences are granted. However, it is important to remember that Ofgem cannot ensure that sufficient generation capacity is built to provide supply security. There are various market mechanisms in place to encourage investment in new capacity and the future development of these markets is a subject in itself. Also, Ofgem has no responsibility for other energy vectors such as oil or heat networks, or for the security of supply of primary fuels (or for electricity and gas regulation in Northern Ireland).

22. It is for consideration whether Ofgem's duties should be extended, or whether a new independent body – such as an Energy System Architect – should be established to ensure optimum deployment and coordination of energy supply and demand across all vectors.

23. This includes for example cross-vector and arbitrage solutions, production of green hydrogen through electrolysis, short

and long duration energy storage in various forms, and CCUS (including CCUS associated with blue hydrogen production).

24. The transition to net zero has implications for all energy vectors but in the context of Ofgem's responsibilities, the focus is primarily to ensure that security of electricity supply is not degraded as a consequence of changes in the electricity generation mix (in particular the ongoing displacement of fossil fuel generation by wind and solar PV generation) and as a consequence of potentially much higher electricity demand due to decarbonisation of heat and transport. From a whole energy system perspective, it will be important for Government to ensure that Ofgem's responsibilities for (methane) gas supply, transmission and distribution are extended to cover either a mixed methane / hydrogen or potentially a pure hydrogen system. The technological and market complexities surrounding a future mixed or hydrogen system will need careful consideration in terms of required regulatory functions.

Future Electricity System Insights

25. National Grid as the Electricity System Operator (ESO) publishes annually updated Future Energy Scenarios which explore different routes to net zero and their implications for both electricity and gas supply (the former including low carbon technologies such as wind and solar PV, the latter including low carbon fuels such as bioenergy and hydrogen) and for electricity and gas demand (including domestic, commercial, industrial and transport). Distribution Network Operators also produce future energy scenarios which show the anticipated impact on electricity distribution networks of low carbon transition under different scenarios. These supplement 'Long-Term Development Statements' which network operators are required to publish as part of their licence obligations.

26. It follows that Ofgem has well-informed, annually updated, sources of information and analysis on which to base its regulatory strategies and polices. In particular, these sources of information are key to Ofgem's assessment of system and network operators' business plans and regulatory settlements.

27. This information will enable Ofgem to approve appropriate base levels of revenue for network operators, along with appropriate incentives to encourage efficient investment and operating costs, high levels of network resilience and performance, and excellent customer service.

Licence and Code Obligations

28. The Electricity Act 1989 requires that electricity transmission and distribution networks are developed and maintained in an efficient, coordinated, and economical manner. A new licence condition (from April 2021) additionally requires licensees to advance the efficient and economical operation of the 'Total System'. In terms specifically of electricity system security of supply, there are two definitive standards: the National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS) and the Electricity Networks Association Engineering Recommendation ENA EREC P2/7. Transmission licensees, both onshore and offshore, are required by their licences to comply with SQSS in both the planning and operation of the GB transmission system. Distribution licensees are required by a licence condition to plan and develop their distribution systems in accordance with a standard not less than that set out in Engineering Recommendation P2/7[iii]. Importantly EREC P2/7 permits the use of procured flexibility services to meet the required design level of demand restoration criteria and so enables an economic alternative to traditional network reinforcement subject to specified conditions.

Electricity System Balancing

29. A further aspect of ensuring electricity security of supply is the Balancing Mechanism, in particular 'Residual System Balancing' which is a function performed by the Electricity System Operator (ESO) and entails the acceptance of bids and offers[iv] from Balancing Responsible Parties to maintain the electricity system in balance in real time – i.e. post gate closure when the commercial balancing process for the half hour period one hour beyond gate closure is completed. In order to further support this function, the ESO can call on a range of ancillary services from (for example) generators, suppliers, aggregators and energy storage operators to provide additional real and/or reactive power or demand response. A particular type of service is that of frequency response which enables the ESO to maintain system frequency within the operational limits of +/- 0.4% of the nominal 50Hz system frequency under normal operating conditions, and within the statutory limits of +/-1% under most abnormal but credible operating conditions.

Emerging Electricity System Operational Challenges

30. In order to monitor and manage changes in system operating conditions, ESO undertakes an annual assessment of system operability and publishes a System Operability Framework which highlights potential future operability challenges, for example in

terms of maintaining voltage and frequency stability, and resilience to system events such as transmission faults and major losses of infeed.

31. Due to the ongoing transition from fossil fuel (typically gas and coal) power stations to renewable sources of electricity generation (principally offshore and onshore wind, solar PV and some biomass) there has been, and will continue to be, an increasing challenge for ESO in maintaining system frequency within the above limits. This is due to an ongoing reduction in system inertia arising from the systematic displacement of 'synchronous' generation associated with traditional gas and coal-fired power stations by asynchronous generation, in particular converter-connected wind and solar generation which is unable to provide inertia to the system which in turn results in a less stable system[v].

32. A consequence is that a transmission fault or loss of infeed (i.e. a generator or interconnector) or even a sudden large change in demand will cause a more rapid rate of change of system frequency. If not contained, this rate of change of frequency would result in major losses of supply and potentially a total system shutdown. To mitigate this risk, the ESO is exploring new forms of frequency response and new sources of inertia. For example, ESO now procures three categories of frequency response:

- 'Dynamic Regulation' is a service designed to slowly correct continuous but small deviations in frequency and regulate frequency around the target of 50Hz.
- 'Dynamic Moderation' enables ESO to manage sudden large imbalances between demand and generation, such as due to an erroneous wind forecast, by responding quickly when frequency moves towards the edge of the operational range of +/-0.4%.
- Dynamic Containment is designed to operate post-fault after a significant frequency deviation (for example due to the loss of a major infeed such as a large generator or interconnector) to deliver a fast-acting frequency response to arrest a rapidly falling frequency.

33. As an important contingency, ESO is now exploring new sources of 'Black Start' services to provide the means to reenergise the electricity system should a total or partial shutdown occur. This is particularly pertinent given the reducing numbers of synchronous generation mentioned above which have hitherto been core to 'Black Start' procedures through their ability to establish stable synchronous power islands as part of the system rebuilding process. An innovation project - Distributed ReStart - is currently exploring the feasibility of rebuilding the electricity system 'bottom-up' from

distribution systems rather than the traditional approach of 'top-down' from the transmission system.

DNO-DSO Transition and ESO–DSO Coordination

34. The Distributed ReStart project mentioned above is just one example of how ESO and DSO's will need to coordinate their activities in future. Distribution networks are increasingly being 'actively' managed as opposed to the largely 'passive' approach to electricity distribution network management that has hitherto prevailed. Far more extensive and granular levels of monitoring of system conditions (through real-time and time-series data – including data from smart meters) is now being undertaken along with Advanced Distribution and Distributed Energy Resource Management Systems (ADMS and DERMS) to maximise network capacity headroom through dynamic load sharing and voltage control, and active management of generation output. This in turn improves network access to further generation, demand and energy storage whilst minimising network losses and improving security of supply. Security of supply is further enhanced through post-fault automatic network reconfiguration, and both pre and post-fault dispatch of flexibility.

35. This ongoing DNO-DSO transition is core to the successful integration of Distributed Energy Resources and the electrification of heat and transport, and hence to the achievement of UK's net zero by 2050 ambition.

36. However, a key aspect of the DNO-DSO transition is to establish stronger coordination between ESO and DSO functions. For example, in south-east England, the transmission and extra-high voltage distribution networks are interconnected, and high levels of weather-dependent generation and a concentration of European interconnectors results in highly variable power flows on both systems. This requires complex data exchanges between the ESO and the DNO (UK Power Networks) control centres in operational planning timescales and in real-time. This ensures robust contingency planning to deal with planned and unplanned outages, and enables constraints on generation export to be minimised by managing reactive and real power flows. The data exchange between the control centres is enabled through real-time data exchange inter-control centre protocol (ICCP).

37. ***Coordination and integration of ESO and DNO/DSO functions will become increasingly important to ensuring not only security of supply but also in the day-to-day operational management of a net zero compatible electricity system***.

38. Ofgem and BEIS have issued a public consultation on the Energy Future System Operator which (inter alia) advocates the separation of the ESO and TNO functions of National Grid. At this stage there is no proposal to separate out the DSO functions of Distribution Network Operators (albeit one DNO – UK Power Networks - proposes to establish an Independent Distribution System Operator (IDSO).

39. Irrespective of the outcome of the consultation and any future consideration of DNO and DSO role separation, it will be essential for Ofgem to ensure that the development of further 'whole electricity system' functional coordination and integration is not adversely impacted by separation of ownership between ESO, TNO, DNO and DSO businesses.

40. Moreover, the need for functional coordination will necessarily extend to other energy vectors such as gas and heat in order to deliver a net-zero compatible whole energy system.

Consequences of Increasing Levels of Low Carbon Generation

41. ESO publishes annual Winter and Summer Outlook reports which highlight any predicted issues around generation margins, including, increasingly, any predicted summer generation surpluses arising from increasing levels of self-dispatching renewables. Such surpluses can be significant from a system balancing and system stability perspective in that they may lead to generator constraint payments and higher system balancing costs, and also reduced levels of system inertia.

42. One consequence of a higher reliance on weather-dependent generation, particularly wind and solar PV generation, is the need for greater flexibility in electricity demand and the availability of short-duration energy storage such as batteries. This might well include batteries of electric vehicles which, when plugged-in to their battery chargers, allows charge periods or charge rates to be controlled to provide a form of demand response or even frequency response, which can extend to injecting power into the system with suitable inverter-based EV battery chargers. A further consequence of a higher dependency on wind generation is the need to be able to maintain security of supply in the event of a prolonged period of low wind generation which experience shows can be sustained for several days. An important proviso for sustained security of supply with high levels of dependency on wind generation (as advocated by the Energy White Paper) is that of adequate long-duration energy storage for which there is currently no clear development pathway.

Summary

43. In summary, security of electricity supply is assured in through Transmission and Distribution licensees' continued compliance with the requirements of NETS SQSS and EREC P2/7 and through ESO maintaining sufficient system balancing and ancillary services – and through ongoing analysis of emerging system operability issues, including those highlighted by Summer and Winter Outlook Reports, Future Energy Scenarios, and a System Operability Framework.

44. ***Ofgem therefore has a comprehensive and regularly updated source of information on which to base its regulatory duties. However, it will be important that any gaps identified in terms of available resources, such as the need for long-duration energy storage (which in some forms might fall outside Ofgem's current jurisdiction) are addressed in good time*.**

Q5. Is Ofgem's current system of price controls appropriate? Does it provide sufficient incentives to invest in the context of the transition to net zero?

Regulatory Approach

43. Ofgem has traditionally applied a system of benchmarking and regression analyses to determine the 'efficient frontier' in respect of network operators. This enabled Ofgem to apply an 'RPI-X' approach to regulation, ensuring a reduction in network charges in real terms, which in turn has driven down costs and improved efficiency of both capital and revenue expenditure (capex and opex). A consequence has been that costs (and hence distribution charges) have fallen whilst quality of supply and customer service has risen markedly since privatisation.

44. However, Ofgem now applies a 'RIIO' methodology (revenues determined by innovation, incentives and outputs) for both electricity and gas transmission and distribution which is a more appropriate form of regulation for an energy system in transition. Ofgem has also taken steps to incentivise transmission and distribution companies to consider the combined transmission and distribution impact of network interventions irrespective of which party is undertaking the intervention. This is helpful in promoting 'whole electricity system' efficiency but does not in itself ensure whole *energy* system efficiency; neither does it directly extend to 'beyond the boundary meter' assets; though Ofgem does now promote a 'flexibility first' approach which inevitably embraces beyond the meter assets in delivering demand flexibility.

Flexibility-First

45. As a consequence of the focus on innovation is that procurement of flexibility is an option now considered by electricity distribution network operators when undertaking cost-benefit analyses to determine the least cost option in npv terms of ensuring sufficient available network capacity to meet demand. For example, procuring year-on-year increasing levels of flexibility might defer major network reinforcement for several years which is justified provided the present value cost of flexibility procured is less than the discounted cost of major reinforcement. This also helps network operators to optimise the timing of major reinforcement when the rate of demand growth is uncertain. This will be particularly valuable under any credible net zero strategy where demand growth due to electrification of heat and road transport will be very significant but difficult to quantify in terms of timing and location. Network operators are incentivised to adopt a flexibility-first methodology through both the Business Plan Incentive (BIP) whereby network companies can earn a reward or be penalised based on Ofgem's assessment of their submitted business plans, and also the Totex Incentive Mechanism (TIM) by which savings in network expenditure (capex or opex) are shared between company shareholders and customers.

46. However, whilst these incentives certainly encourage efficient investment, it will be important in the context of net zero to ensure this results neither in 'short-termism' in network investment nor an unmanageable ramp-up of investment in future years once the flexibility option is fully exploited and demand continues to grow – possibly at an accelerating rate (for example following 2030 when the ban on sales of new petrol and diesel cars and vans is introduced, and possibly from the mid 2030's if a ban on sales of new domestic gas boilers is introduced). A further important consideration in the context of a flexibility-first policy is that flexibility should be considered from a whole system perspective. In particular, with increasing levels of weather-dependent generation, the need for enhanced system balancing and frequency response services will place a higher overall market value on flexibility. It might then be that relying on flexibility solely to manage network constraints will prove inefficient and even unsustainable from a whole energy system perspective.

47. ***It will be important to optimise procurement and dispatch of flexibility to capture its full value across the whole of the energy supply chain – i.e. in terms of maximising the utilisation of renewable, but weather***

dependent, sources of generation to supply demand, and by optimising network power flows to limit the need for investment in further capacity. It will also be important to ensure that contracted flexibility providers and customers who flex their demand in respond to tariff price signals are rewarded accordingly.

Dealing with Uncertainty

48. Given the inherent uncertainty in the scale and timing of future network investment to address demand growth (and also, to an extent, growth in distributed resources such as generation and energy storage) there is a need for appropriate 'uncertainty mechanisms' which effectively permit periodic 'reopeners' of revenue control settlements as greater clarity emerges over the need for load-related investment***.***

49. ***It will be important, especially in the context of RIIO-ET2 (currently effective until March 2026) and RIIO-ED2 (effective from April 2023 until March 2028) that transmission and distribution network companies (respectively) are appropriately incentivised to invest in 'low carbon transition-ready' networks***.

50. Whilst this carries some risk of investment ahead of actual need it is much less likely to result in stranded investment given the anticipated overall growth in electricity consumption and peak demand.

51. ***Failing to invest in readiness for low carbon transition is likely to result in piecemeal investment in electricity transmission and distribution inconsistent with the obligation to develop an efficient, coordinated and economic whole electricity system***. ***As well as higher system charges, such an approach might also result in delays in connections of low carbon technologies.***

Network Use of System and Access Charging

52. Ofgem has conducted both a Targeted Charging Review and a Significant Code Review in respect of network charges. The former dealt with 'residual' charges (associated with the ongoing costs of operating and maintaining the network, including costs of non-load related refurbishment and asset renewal); the latter (yet to be concluded) has considered the network costs in respect of 'forward looking and access' charges (associated with the costs of load-related reinforcement and network connections).

Residual Charges

53. In its consideration of residual charges, whilst the objective has been to ensure cost-reflectivity, Ofgem has been particularly mindful of the effect of any changes on low income or vulnerable customers. Of the numerous options considered (and consulted on) it has decided (inter alia) that network residual charges should be recovered through fixed (rather than volume-related) charges. Ofgem's view is that a single domestic band, with equal residual charges for all domestic consumers, provides a reasonable balance between the different electricity usage of domestic consumers, including vulnerable groups, across the usage levels. For non-domestic customers, Ofgem's view is that a banded fixed charge arrangement removes existing distortions, while appropriately balancing equity across bands with equality among relatively similar users within them.

Forward-Looking and Access Charges

54. In the case of forward-looking and access charges, Ofgem has considered how best to equitably share costs between existing and new customers (and customers whose increasing electricity demand gives rise to a need for network reinforcement) and hence how best to improve locational accuracy of distribution charges to better reflect the impact that network users have on network costs. Ofgem's view is that the current method of charging new customers (or customers increasing their maximum demand) for a portion of any upstream costs of reinforcement (beyond the assets solely associated with the customer's connection) does not give an effective locational signal in many cases. Moreover, Ofgem believes the current arrangements hinder the efficient development and investment in distribution networks. While other factors such as uncertainty around the ability to recover sunk investment will also have an influence, they contribute to DNOs taking an incremental and reactive approach to reinforcement as the means of facilitating new connections, rather than investing in light of anticipated wider network needs.

55. In light of the above, Ofgem's 'minded to' position is to move towards a shallower connection charging regime but with stronger locational use of system charges (based on long-run marginal costs). This should help ensure that new customers connecting to the network are not subject to a portion of upstream network reinforcement charges (which might in some cases be very high if the existing network is operating close to its limits) but will be subject to local use of system charges which will reflect the long-run marginal cost of meeting demand in that part of the system. The

increased socialisation of costs associated with a new or increased capacity connection should help ensure DNOs take a more holistic approach when a new or increased capacity connection triggers network reinforcement. However, there could be downsides: for example generators who currently are often happy to accept a curtailment clause in their connection agreement in return for a faster and cheaper connection, might in future be less willing to do so if they do not have to contribute to upstream reinforcement costs.

56. ***It will be essential for Ofgem to continue to carefully monitor the impact of its decisions on residual and forward-looking and network access charges and the extent to which they are supporting the energy transition by encouraging energy resources such as distributed renewable generation and energy storage, and new large power connections such as EV charging hubs, to locate where they are most needed from both an electricity system and customer perspective.***

Emerging Priorities

57. An increasingly important consideration for network companies and Ofgem, in terms of system security, is resilience to cyber-attacks. The essential digitalisation of electricity infrastructure monitoring and control systems will inherently enhance the cyber security risk. Examples of digitalisation include Advanced Distribution and Distributed Energy Resource Management Systems (ADMS and DERMS), increased interconnection of DNO and ESO control centre functions, and wider digitalisation of energy market mechanisms.

58. ***Given the 'critical infrastructure' status of the electricity and wider energy system it will be essential that companies are incentivised (if not mandated) to invest in adequate cyber security measures.***

59. A further consideration is the effect of climate change. Whilst the global pursuit of net zero will abate (and hopefully eventually halt) the rate of global temperature rise, the measures will be insufficient to prevent increasingly frequent incidences of severe and unusual weather patterns. Meteorological studies have identified changes in the Jet Stream which have already led to 'weather blocking' events meaning that extreme or unusual weather conditions may persist over prolonged periods. It also means that we are likely to sometimes experience periods of consecutive days when wind speeds across The British Isles are unusually low potentially leading to a deficit in generation output. Hotter

summers will reduce plant ratings whilst increasing demand from air cooling. This will be a significant challenge for summer-peaking networks serving central business districts such as Central London and other major cities. Further weakening of the Gulf Stream will also lead to colder winters meaning that demand due to electrification of heating will increase winter peak demand. Whist network operators have taken some steps to increase resilience to weather storms, more will need to be done to prepare for the more extreme and prolonged weather patterns we can expect in future – even if global temperature rise is constrained to 1.5 deg.C.

60. ***It follows that transmission and distribution networks will require targeted investment to improve resilience to weather storms and flooding (coastal and fluvial) and also to prepare their networks for unusually high summer and winter peak demands. It will therefore be important for Ofgem to recognise such investment as not only prudent, but essential, and allow appropriate provision in their assessment of companies' regulatory revenues.***

61. Finally, the transformative nature of the fast-evolving energy system will require an increase in both traditional engineering skills and new commercial and technical skills***.***

62. ***It will be important for regulated companies to develop robust recruitment, staff development, and succession planning initiatives, and for Ofgem to acknowledge that these are essential investments in our future capability to operate and manage an increasingly complex energy system in an efficient, coordinated and economic way. Such investments must therefore be adequately supported by regulated revenues and not considered as inefficient or discretionary costs.***

Q6. Is the current system of governance for the UK energy market appropriate to secure the transition to net zero? What improvements could be made and what role should Ofgem play?

63. The current form of code governance is not sustainable in the context of a need for transformative change and a more integrated cross-vector approach to industry code governance. Ofgem and BEIS have published a consultation on the 'Design and Delivery of the Energy Code Reform' (closing date 28 September 2021) and we shall reserve the bulk of our comments for our response to that consultation. We would however particularly cite the Future Power Systems Architecture Programme Phase 3 reports

https://es.catapult.org.uk/news/fast-track-to-britains-future-power-system-2/.

64. ***In particular the 'Fast Track to Britain's Future Power System Synthesis Report' promotes the concept of 'Enabling Frameworks' as a new agile and more dynamic form of energy system governance far better suited to the transformation of the energy system now required to deliver net zero.***

Q7. Are Ofgem's duties and powers appropriate and sufficiently clearly defined? Do Ofgem's objectives conflict and, if so, how should any conflicts be managed?

65. Whilst Ofgem's duties are well defined and generally consistent with an economic transition to net zero for the energy system, it would seem appropriate to consider how its duties might be helpfully modified or extended to make net zero a primary objective in respect of energy supply and demand. This would enable Ofgem to consider the activities of regulated parties necessary for the achievement of net zero as an imperative when assessing their economic benefit. For example, it would be helpful in Ofgem's consideration of the economic justification for anticipatory investment by electricity network operators in preparing for higher system demand arising from electrification of heating and transport, and in accommodating increased levels of distributed energy resources such as distributed generation and grid-connected energy storage.

66. ***Effective targeted anticipatory investment in the electricity system should ultimately result in a more efficient, coordinated and economic (and hence more affordable) system than one developed incrementally in a piecemeal fashion***.

67. However, given the Government's new Hydrogen Strategy, it will be important that Ofgem's duties and powers in relation to gas transmission and distribution are consistent with the need for the necessary gas network investment to safely accommodate a methane / hydrogen fuel mix (up to 20% hydrogen is currently envisaged). Domestic and other gas appliances will need to be either replaced or adapted to safely accommodate a methane / hydrogen mix and to provide similar levels of performance to that of a pure methane appliance (noting that hydrogen carries less energy per volume than methane).

68. ***Ofgem should also have a specific duty to support low income and vulnerable customers in their transition to low***

carbon forms of energy: for example in terms of mitigating the impact on their energy bills in converting to electric domestic space and water heating, helping them meet the costs of gas appliance conversion to accommodate a methane/hydrogen fuel mix, and supporting their investing in energy efficiency measures such as improved home thermal insulation.

Q8. Is Ofgem's relationship to Government and Parliament appropriate? Are there issues related to the split of responsibilities, transparency or accountability

69. We have no comment at this stage other than to say that the outcome of the two joint BEIS / Ofgem consultations: 'The Energy Future System Operator' and the 'Design and Delivery of the Energy Code Reform' consultations may have implications for Ofgem's relationship to Government and Parliament depending on which of the proposed possible models are implemented.

Q9. How does Ofgem compare to similar bodies internationally? What lessons can be drawn from the experience of other countries or jurisdictions?

70. It is not possible to make general comparisons between energy regulators in different countries. As the UK was one of the first countries to pursue a policy of privatising state utilities it, by necessity, also led the way in establishing regulatory practice. It has therefore been used as a case study by other countries.

71. In the more specific area of encouraging innovation in regulated monopolies some comparisons are possible. Ofgem is a member of the Council of European Energy Regulators[vi] which has published a series of reports on this subject. For example, in 2020 it published a 'Status Review Report on Regulatory Frameworks for Innovation and Security of Supply in Gas Transmission Infrastructure'[vii]. These reports show that Ofgem is generally amongst the more proactive regulators in terms of incentivising innovation.

72. Ofgem's first moves to encourage innovation date back to 2005 and it has built on these in subsequent price control reviews. Ofgem should now be encouraged to ensure that their future policies on innovation take a more 'whole systems' approach wherever opportunities arise.

73. It will also be important for Ofgem to continue to benchmark itself against other energy regulators and benefit from observed successful regulatory interventions and market mechanisms.

74. ***One particular area for observation is the development of flexibility markets, for example where countries with more vertically integrated energy structures might be more able to realise the benefits of full-chain flexibility.***

75. ***A further area for comparison is the approach to offshore investment where the approach in other countries to offshore transmission systems and generator connections might be more coordinated.***

Q10. Are there any other aspects of Ofgem's work that the Committee should consider?

76. The UK's net zero by 2050 ambition will require closer coordination between governmental departments and Ofgem, and also between Ofgem and other utility regulators. The current joint BEIS / Ofgem consultations on the Energy Future System Operator and the Design and Delivery of the Energy Code Reform are examples of a closer working relationship between Government and Ofgem. Other areas where closer coordination between government departments and regulators will be important include matters of cyber security (and telecommunications generally) and climate resilience.

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[i] Source: https://www.ofgem.gov.uk/publications/infographic-bills-prices-and-profits

[ii] Half-hourly settlement will also enable network operators' time-banded distribution charges to be fully reflected in consumers' energy bills, hence providing an additional incentive for customers to avoid consumption at times of peak demand as far as is reasonably practicable.

[iii] SQSS is both a planning and operational standard; ENA EREC P2/7 is a planning (but not operational) standard.

[iv]BSPs can 'Offer' to sell energy (by increasing generation or decreasing consumption) to the system or 'Bid' to buy energy (by decreasing generation or increasing consumption).

[v] Because wind and solar PV generation is unable to connect directly to an AC system of constant frequency, their interface is provided by power electronics converters which convert their DC output to AC. Whilst this enables injection of power to the system, it does not emulate the characteristic of synchronous generators in also conferring inertia to the system through the rotating mass of the generator rotor. This is because, unlike with conventional synchronous generators, there is no direct electromagnetic coupling between the rotational speed of the (wind) generator's rotor and the electricity system frequency (solar PV generation involves no rotating mass). Note that some smaller onshore wind generators are connected through doubly-fed induction generators (DFIG) where the generator stator (and hence its output) is directly connected to the AC system but the rotor is connected through an AC-DC-AC link, and hence, as with full converter-connected generation, the rotating mass is unable to confer inertia to the system.

[vi] CEER - https://www.ceer.eu/#

[vii]https://www.ceer.eu/documents/104400/7006065/Status+Review+Report+on+Regulatory+Frameworks+for+Innovation+and+Security+of+Supply+in+Gas+Transmission+Infrastructure+-+21+December+2020/dee0bbd8-59db-0992-574a-94cede1623ff

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