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ELECTRICITY DISTRIBUTION NETWORK REGULATION – TIME FOR A NEW APPROACH

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We are entering a new paradigm. Delivering net-zero emissions by 2050 will require the energy system to transform over the next decade and the government has outlined plans for a ‘new deal’ to accelerate investment in infrastructure to drive economic recovery from the COVID-19 pandemic . The upcoming regulatory price control review for distribution network operators (DNOs) must ensure the electricity network is upgraded in line with these priorities. This cannot be achieved through minor tweaks to the same basic ‘RIIO’ approach used for previous price control reviews. Instead, four major changes are required:

- > *Pathway choice*: The key outcomes should be determined by an independent science-based analysis of the pathway to net zero. This should involve a balance of expertise across energy sectors and along the value chain.
- > *System architecture*: These outcomes should be converted into a local plan of infrastructure deliverables covering the whole energy system. This would ideally be undertaken by an independent distribution system operator (DSO) with broad expertise, including delivering upgrades in the built infrastructure. It would need to work in close collaboration with local authorities and other local and regional actors



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driving the energy transition. It would also be able to fast-track the process of upgrading system operational capability.

- > *Aligned delivery mechanisms:* Delivery mechanisms across the energy system, including the DNO price control, should be aligned to ensure coherence of the infrastructure upgrades.
- > *Learning and adaptation:* There must be flexibility to adapt and adjust plans throughout the price control period and apply learning from progress with new technological developments and deployment experience.

Delivering net-zero

The UK Government has adopted the target to achieve net-zero emissions of greenhouse gases by 2050. The significance of this new policy cannot be understated. By precluding any major long-term role for those technologies and processes that have material lifetime emissions, it imposes the requirement to completely transform the economy. The extent of the transformation is such that it cannot be achieved quickly, and investment cycles of key technologies mean that decisions made now can lock-in infrastructure choices for many decades. The transformation of the economy must start now and proceed at pace.

This is particularly the case for energy. By 2030, power generation must be largely decarbonised, and significant progress made in decarbonising heat and transport sectors, both largely through electrification. Therefore, to remain on the pathway to net-zero, the energy system will need to have fundamentally changed within a decade. In addition, the economic impact of the coronavirus pandemic means that the government will shortly initiate a major recovery programme that will include key infrastructure investments. The government has expressed its intention that these investments will support the transition toward net-zero.

Within this context, Ofgem has embarked on the process to determine the next electricity distribution price control (RIIO-ED2). This is due to come into effect in April 2023 and run for 5 years out to 2028. It will, therefore, coincide with a



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critical period in which major changes will need to occur in the way energy is produced and consumed. Many of the changes that are needed, such as small-scale renewable generation, electric vehicle charging, and the role out of electric heat pumps, will present new challenges for local power networks. It is vital that the ED2 regulatory framework does not obstruct these changes but provides impetus and support for the actions that are required. This is not simply about spending lots of money on ‘just-in-case’ infrastructure. Indeed, there is already considerable evidence that a more flexible use of existing assets can provide better services for users of the grid¹. Instead, it is about integrating the network planning process with a detailed understanding of the requirement for new energy system resources to ensure the best overall value is delivered for energy consumers on the path to net-zero.

Regulatory challenges

Ofgem has committed to delivering the net-zero target at least cost to consumers as one of its three strategic priorities². The regulatory framework that it uses for network regulation involves setting Revenues using Incentives to deliver the Innovation and Outputs that consumers value (RIIO). However, it has identified some big challenges in aligning this framework with delivering the net-zero target³.

The actions distribution network operators (DNOs) will need to take depend on the technology pathway to net-zero. However, there is no clarity on how or when such a pathway will be defined, or whether it will just emerge as various policy and commercial initiatives succeed or fail. This makes it extremely difficult to define the outputs that are required. Also, it will be difficult to judge DNOs based on the benefits they deliver for consumers. Many benefits will not arise during the price control window and, in any case, they are often dependent on the actions of others.

Ofgem has committed to explore options for tackling these issues as it develops the methodology for RIIO-ED2, considering the interests of both existing and future consumers. However, it is not clear that they can be adequately addressed simply through adjusting the ED2 incentive arrangements. E3G has identified a range of challenges facing regulators seeking to support delivery of

¹ Challenges facing distribution system operators in a decarbonised power system, Phil Baker, Regulatory Assistance Project, June 2020

² Our strategic narrative for 2019 – 23, Ofgem, June 2019

³ RIIO-ED2 Framework Decision, Ofgem, December 2019



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net-zero and concluded that broader changes to the regulatory framework are required⁴.

The need for a more fundamental overhaul of the regulatory arrangements arises from significant changes in the nature of the problem that the regulations are trying to address. The net-zero emissions goal represents an explicit and radically different destination for the energy industry. Ofgem has historically focused on achieving incremental changes to the existing industry structures and approaches, largely through establishing unbiased inputs to market processes and allowing competition to determine what happens. In terms of network regulation, Ofgem has overseen and challenged plans produced by the regulated entities, based on their predictions of future demands for their services.

The E3G analysis concludes that delivering radically different outcomes at pace will require Ofgem to address four key challenges:

1. *Pathway choice*: A new mechanism will be required to decide the outcomes that must be delivered, based on latest technical expertise across energy sectors and value chains.
2. *Defining market scope*: Previous boundaries separating regulated and non-regulated sectors must change to take advantage of new opportunities for competition and allow focused delivery of critical outcomes.
3. *Administering need in consumer facing markets*: Innovation is required to ensure critical changes are made in the way energy is consumed.
4. *Ensuring fairness*: Clearer political guidance will be required to ensure the benefits of the transition will be available to everyone and the costs be equitably distributed.

The following sections set out what this means for the regulation of DNOs and the RIIO-ED2 process.

Pathway choices

Despite the level of consensus over the broad structure of the future energy system and the timescales over which it must be achieved, there remain several key points of contention. Examples include the potential role of zero emissions gases, the extent of efficiency retrofits in buildings, and the proportion of

⁴ Regulating the new energy paradigm, E3G Briefing Paper, June 2020



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electricity demand that can be met by variable renewable generation. However, it is not in consumers' interests – current or future - to keep open the option of all potential pathways. Some choices about the future need to be made now to allow deployment to move forward at pace. Other choices can be left open on the basis that the risks are too great and we will be in a better position to decide later.

These choices cannot be made through market processes in which consumers express their long-term energy needs given the extent of the infrastructure transformation required (e.g. the upgrade of buildings, the establishment of hydrogen infrastructure, or the need to upgrade networks to accommodate demands from electric vehicles). Regulators have always acted on behalf of consumers in committing to cover network operator costs and the choices involved are now becoming far more complicated due to cross-sectoral interactions. An administered process is needed to make these choices and act as a proxy for current and future consumers.

It would be a major challenge for regulators to make such choices in the face of huge future uncertainty given the inevitability of imperfect forecasts and the risks of landing future consumers with large stranded costs. However, **it is inappropriate to leave the regulated entities with the responsibility to make key assumptions about the future given the inevitable biases arising from their partial expertise, the complexity of choices available to them, the need for cross sectoral engagement, and their commercial interests.** Indeed, these important decisions represent an existential threat to many business interests (e.g. gas network operators), and it is vital that the assumptions are not influenced by vested interests incentivised to ignore inherent risks. These requirements do not fit well with existing institutions or processes for infrastructure planning⁵. **A new approach is required.**

E3G has proposed that an independent body is needed with a balance of expertise across the various infrastructure and technology options in addition to deep social and behavioural insight. This body – which we call, for convenience, the 'Clean Economy Observatory' - would provide advice to government as the relevant executive body with the necessary democratic mandate to make important decisions. Instructions in the form of required outcomes can then be passed to delivery bodies to ensure they are achieved cost-effectively and using

⁵ It is concerning that the optimistic outlook for re-purposing the gas system for hydrogen presented by gas network owners has not been rigorously and independently stress tested alongside the risks and benefits of an electrification decarbonisation pathway.



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competition where appropriate. This would represent an enhanced version of the policy guidance currently provided by BEIS. The functions of a Clean Economy Observatory would differ from those of the current Committee for Climate Change in that it would be required to develop and maintain a much more detailed technical knowledge to enable robust and specific outcomes to be defined⁶.

System architecture

Delivery of broad outcomes, such as numbers of deep efficiency building retrofits, improvements in flexibility of electricity demand, or deployment of electric heat pumps, requires a plan. This plan must identify what changes are needed, when they must happen and where they must happen, to maintain coherence across the energy system and reduce costs. It is critical that the plan be based on a whole system analysis that ensures the safe, secure, and efficient operation of the energy system and be informed by latest evidence of deployment potentials. This is particularly important for deployments in the built infrastructure which depends on direct engagement and support of individual or business consumers. Investments in the electricity distribution network must be coherent with actions in other sectors and cannot be developed independently.

Current practise involves the DNOs preparing an investment plan based on their understanding of changes in demands for network capacity. This approach is no longer adequate given the complex and rapidly changing landscape and the increasing importance of understanding changes in individual behaviour. **The plan for power network investment must be developed as part of an integrated whole system plan and produced by an entity that has a balance of expertise across sectors and does not have commercial interests at stake.**

The process of ‘system operation’ has been progressively separated from that of ‘network operation’ at the transmission level. Now is the right time to extend these developments to the distribution level. **The function of distribution system operation (DSO) should be separated from the DNO and charged with the responsibility to develop an integrated whole system plan.** Expertise in power system operation must be augmented with a detailed understanding of behavioural change and deployment requirements in the built infrastructure. The plan must represent the least cost route to deliver the high-level outcomes defined in the government guidance.

⁶ These additional requirements could be added to the existing objectives of the Committee.



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Many cities and local authorities have their own net-zero delivery objectives approved at local government level. These plans are often promoted and co-ordinated by Local Enterprise Partnerships, energy hubs and various local demonstration consortia. The planning process would need to work closely with these local actors to help them deliver their objectives whilst maintaining coherence across the wider energy system.

Box: Digitalisation of the distribution network

The transition towards a net-zero energy system can only be achieved cost-effectively through ensuring as many system assets as possible are controllable and adopting system operational practises that make maximum use of all these resources. Decision making can no longer be controlled at the transmission level but must be devolved, not only to the level of a distribution system operator but down to substations or even individual appliances. The vast increase in system resources, whether in the form of distributed generation, electric vehicles, battery storage capacity, or other controllable devices, will make system management increasingly complicated to the point where it will no longer be possible for these systems to be managed by humans. Indeed, it will not even be possible to optimise system operation using pre-programmed heuristics. The energy system will need to become fully digitalised and use algorithms to identify the most energy and cost-efficient way to utilise system resources. This will require accurate and granular forecasts of demand and variable supply using data science and machine learning techniques. This may include the requirement to allow anonymous communication between devices such as electric vehicles to coordinate usage and avoid overloading the distribution network.

These changes will require vastly more innovation than is currently being undertaken within the DNOs. Establishing independent DSOs presents the opportunity to drive forward these changes.

Apart from meeting the requirement for coherent energy system planning, the creation of an independent DSO will help ensure progress is made towards dynamic and efficient system operation. The Box above explains the importance of digitalisation for the distribution network alongside the application of artificial intelligence to cope with the rapidly changing and interrelated demands on the grid. The whole system plan should incorporate the requirement to deploy the information and control technologies that will allow dynamic system operation. The DSO should also be required to develop the operational practises that will



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maximise the use of digital technologies to ensure efficient use of all system resources.

Aligned delivery mechanisms

Any pathway to net-zero requires delivery across a range of infrastructure investments. Currently, delivery is managed in a variety of largely un-coordinated ways. For example, property upgrades to improve efficiency and install low carbon heating systems are driven via a range of grant funded initiatives and supplier obligations whilst the installation of smart devices to control energy usage is left entirely to market processes⁷. Also, the deployment of electric vehicle charging infrastructure does not currently take account of the impact it can have on overall system efficiency.

DNO plans therefore treat delivery across other elements of the energy system as uncertain externalities and must cater for a range of possible outcomes. This creates potentially significant additional costs which could be avoided if greater certainty could be associated with delivery in other areas. However, this requires that delivery bodies exist that are responsible for ensuring outcomes are efficiently achieved on time. **In the same way that Ofgem is responsible for regulating delivery of investment in the network infrastructure, other bodies (or Ofgem themselves) must be responsible for regulating delivery elsewhere.** It is unfortunate that the timescales for electricity and gas distribution network price controls do not currently align. The phased removal of fossil gas supply will be critical for investment requirements in both networks and these investments must be aligned both in terms of overall objective and delivery schedules.

Co-ordination is challenging in those areas where delivery depends on the active engagement and participation of energy consumers, such as building refurbishment or the adoption of smart energy control systems. Hence the requirement for regulators to administer need in consumer facing markets is a critical new challenge in the net-zero regulatory paradigm.

Learning and adaptation

There is much that remains unknown about the energy system transition journey. Even the most informed views of the future will be wrong. Given the extent of the changes envisaged, major deficiencies in expectations can emerge

⁷ Except for the smart meter delivery programme.



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quickly and remedial measures would need to be adopted to avoid escalating costs or a mismatch between overall energy system resource capabilities.

The processes for defining outcomes, system architecture and regulation of delivery must involve continuous refinement and adaptation as new learning emerges. Indeed, one of the highest value functions of the Clean Economy Observatory proposed above would be to constantly learn from progress with new technological developments and deployment experience and share these learnings with all relevant stakeholders. Whilst the regulation of delivery must recognise the constraints imposed by different timescales associated with planning and construction of new resources, delivery mechanisms must not be constrained by arbitrary timings such as the 5-year price control window.

The new independent DSO function has a key role to play in this regard. It would act as the interface between the Observatory, that provides latest technical insights and revised outcome requirements, and those involved with delivery such as the DNOs, who can provide information on the opportunity to adapt and change course. The DSO function would, therefore, be able to update local delivery requirements given latest information, whilst recognising practical constraints in the ability to adjust delivery plans. **ED2 must be designed to incentivise DNOs to be more flexible and adaptive in delivering change to the network infrastructure.**

Conclusion

Adoption of the net-zero target has changed the challenge for regulators and current approaches are not fit for purpose. It is not possible to address these deficiencies through incremental adjustments and more fundamental reform is required.

The RIIO-ED2 process is an important test case for Ofgem's ability to implement the strategic priority to support delivery of net-zero. It must be prepared to consider how to address four key requirements.

- > Pathway choices should be based on independent expert technical analysis and this be used to define the broad outcomes that must be delivered.
- > Local cross-sectoral system architecture should be used to define specific infrastructure needs including, but not only for, the DNO. There is the opportunity to meet this requirement through progressing the separation of DSO activities from the DNO businesses.



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- > Delivery of network infrastructure should be aligned with delivery of other local system resources. This is particularly important for the upgrades required for the built infrastructure.
 - > There should be the ability for delivery of the network infrastructure to be adapted due to learning obtained throughout the price control window. Updating plans would be a key role for an independent DSO function.