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## Energy Systems Catapult Response to National Infrastructure Commission Call for Evidence: *Future of Regulation Study*

### Introduction

The Energy Systems Catapult (ESC) was set up to help navigate the transformation of the UK's energy system. We work across the energy sector to ensure businesses and consumers grasp the opportunities of the shift to a low carbon economy. The ESC is an independent centre of excellence that bridges the gap between business, government, academia and research. We take a whole-systems view of energy markets, helping us to identify and address innovation priorities and market barriers, in order to accelerate the decarbonisation of the energy system at the lowest cost.

In this response, due to the nature of ESC's business, we will concentrate on how innovation can be encouraged in the energy sector. Where relevant points can be made for other sectors, we will make these, citing evidence where appropriate.

We would be happy to discuss these issues in more detail if helpful. Please contact Tony Diccico at: [tony.diccico@es.catapult.org.uk](mailto:tony.diccico@es.catapult.org.uk)

### Key Points

- ***Innovation, and creating the right circumstances for it to flourish, are key considerations for regulation of energy networks, given the scale of the low carbon transition.*** Innovation can help to reduce costs, primary fuel, imports, disruption (to streets and buildings), increase exports, improve safety and reliability and enhance skill levels and working conditions. Innovation in technology, business models, value propositions, policy and regulation will be needed to meet the UK's climate change targets.
- ***Economic regulators should concentrate on ensuring that consumers interests are protected in areas where no natural competition exists such as in energy networks.*** Regulators should avoid prescribing rules in sectors where competition can deliver an effective outcome for consumers, unless there is evidence of market failure. Instead, regulators should devote more resources to working with market participants to enable innovation.
- ***Energy Networks Price Controls should be as transparent and simple as possible and investor returns should be fair*** - investors in an 'efficiently-run company' should be able to earn a reasonable level of return.
- ***Whole System thinking is increasingly being recognised as delivering high performance at low cost.*** Regulators need to promote a whole system, multi-vector

approach to network development, access and charging to account for increasing interconnection of energy vectors (e.g. via electrification of transport, hybrid heat systems and local heat or hydrogen networks). Due to the potential role of electricity in supporting wider economy decarbonisation, it is important that regulation is coherent across different parts of the power system such as generation, supply, distribution and transmission. Regulatory policies should not constrain whole system thinking or act as a barrier to creating a viable business case.

- ***Policy design and market frameworks should seek ideally to enable competitive markets to drive innovation but the role of government and regulators in supporting critical technologies should be recognised.*** The explicit aim should be to deliver clear progress towards a market environment where choices and investment are driven by market players focused on meeting consumers' needs, rather than decisions about levels of policy support to different categories of technology.
- ***Policy and regulatory reforms should enable plausible transition and implementation pathways.*** Market players and investors can only take greater ownership of delivering societal goals (i.e. reliable and low carbon energy services) if there is a credible long-term underpinning framework providing a business case for their actions (i.e. credible and enduring economic incentives to reduce carbon emissions through pricing instruments, taxes or stable mandation of low carbon outcomes).
- ***The low carbon transition raises a range of broader co-ordination issues, within and across network infrastructures which may not be capable of resolution through familiar market mechanisms.*** This includes handling integration and interactions within and across different sectors, for instance between energy and transport – the large-scale introduction of electric vehicles will have a profound effect on electricity networks and the demand for low carbon energy. Local area energy planning (LAEP) can be an important vehicle for clarifying strategic choices at a local level and building consensus.
- ***A statutory duty on regulators to promote innovation could be desirable but we would expect regulators to encourage innovation (in protecting the interests of existing and future consumers) with or without such a specific duty.***
- ***Regulatory arrangements for data and smart energy inter-operability are growing in importance and value*** – the industry is increasingly recognising the importance and power of digitalisation in transforming consumer offerings and business models in the energy sector. ***Regulators should monitor markets to consider the case for intervention to promote pro-competitive standards and could play a major part in promoting cross-sector co-operation to develop standards which promote interoperability across the whole industry.***
- ***Regulators need to work with government and industry participants to address the scale-up challenge required to decarbonise the energy system to meet the 2050 climate change targets.*** They need to help accelerate new products and services to market by enabling and encouraging community, local authority and

regional level trial and demonstration of energy innovation. An effective transition will not happen without a clear allocation of responsibilities for delivery.

## Detailed Response to Questions:

### Future changes

**Q1: Where has the economic regulation of water, energy or telecoms systematically failed or succeeded to:**

**a. facilitate future investment needs;**

1. The application of the RPI-x and later RIIO price control mechanisms has led to significant investment in energy networks and has driven an improvement in operational efficiency – this has been a significant success. It could be argued that the returns allowed to investors in networks were higher than needed and that shareholders and investors have benefitted to the expense of consumers. However, investment continues to flow into the energy sector to fund the development of energy networks and network reliability continues to be high.

**b. promote competition and innovation; and**

2. Ofgem has set up a dedicated team to work with stakeholders to enable innovation. This had led to the creation of Sandboxes that allow innovators to trial products in a test environment. This has been partially successful in facilitating the development of new business models and customers propositions. We believe that this facility should continue. We would envisage that the ESC will look to use this to test a number of its new business models and value propositions alongside the Living Lab that it has created to build understanding of consumer needs.
3. As part of the RIIO price controls, Ofgem introduced the **Low Carbon Networks Fund** and the **Network Innovation Competition (NIC)** – these have also been successful in stimulating innovation in energy networks. The next round of RIIO price controls offers an opportunity to facilitate further innovation. However, the RIIO process does not address explicitly the *Committee on Climate Change (CCC)* targets that are embedded in law. The RIIO regime should be a key driver for this but does not really address decarbonisation incentives or ambitions.
4. The RIIO regime should also incentivise more Innovation and collaboration: it could be argued that the RIIO-2 process creates significant penalties to collaborate for network companies: RIIO-2 creates competition between the networks on identifying solutions, rather than competition on improving efficiency. Collaboration and competition are not zero-sum games and some of the decarbonisation projects require common strategies across different networks and energy vectors.

***c. meet the needs of both current and future consumers;***

5. **It is only possible to put consumers at the heart of a sector if their requirements are clearly understood.** Successful innovators need a deep and detailed understanding of consumer preferences. The telecoms sector has developed mechanisms to reveal consumer preferences, through analysing sales and usage data of bundles of texts, minutes, data; handsets with different features; apps downloaded via google play or the Appstore; broadband with different speeds; tv packages with different channels.
6. The energy and water sectors have been unable to develop similar mechanisms. Instead, these sectors have focused on minimising the cost of commodities like water and energy, even though consumers clearly place significant value on the experiences they get from using these commodities to get comfortable, clean and so on. The emerging smart home presents opportunities for water and energy sectors to apply the successes of the telecoms sector and differentiate the service they offer, for example by scheduling the charging of electric vehicles at times when electricity prices are low.

***...and what do you see as the most important improvements that could be made to the UK's system of economic regulation?***

7. Regulators' primary function is to protect consumers' interests. In sectors where there is no natural competition, regulators seek to introduce competitive pressures. In these regulated sectors, regulators should seek to incentivise innovation – this has been partly successful in energy through the RIIO process for network owners/operators through initiatives such as the Network Innovation Allowance.
8. In a competitive market, market participants innovate to attract/retain customers. There is still a role to play by regulators in competitive markets in stimulating innovation. A key part of this will be to encourage innovation in technology, business models and customer propositions so that the UK's climate change objectives can be met. Ultimately it will be for market participants to deliver innovation, but regulators can help to provide the necessary conditions to facilitate this.
9. Any strategy associated with moving to a low-carbon future requires attention to issues of investment, but also to shaping the treatment of operational considerations and the consumer interface (allocative efficiency). The nature of low carbon technologies requires a review of wholesale market structures designed primarily for fossil fuels; conventional approaches to setting standards of capacity adequacy, historically based on "predict and provide" or "value of lost load" approaches, will also need to be redefined.
10. Satisfactory resolution of the infrastructure investment problem is important in financing investment with a reasonable cost of capital. Cost of capital is of fundamental importance both in determining strategic choices and for future affordability in the energy sector. It will be sensible to seek consistency in investment conditions across the sub-sectors, including investments made by municipal or local authorities, with comparable costs of capital for comparable investment opportunities.

11. There is not a strong case to abandon the current framework of network price controls given the strong monopoly characteristics of network ownership and operation. The FPSA project has concluded that future reforms should focus on increasing the agility of network governance processes to enable innovation and increasing the spatial and temporal accuracy of pricing of network capacity and constraints, to incentivise flexibility and efficient location and operation of generation.
12. Networks Price Controls should be as transparent and simple as possible and investor returns should be fair - investors in an 'efficiently-run company' should be able to earn a reasonable level of return. The RIIO-2 price control methodology should provide clear long-term signals on the future of particular asset types, so reducing risk and cost of capital required to provide the network investment necessary to deliver the low carbon transition.
13. Energy networks will need to need to change radically to support a low carbon transition. This will require significant investment: the RIIO price control framework can provide certainty and stability to facilitate that investment. In electricity, networks will need to accommodate an increasing role for decentralised generation, storage and multi-vector flexibilities. In gas, networks may need to be re-purposed to deliver low-carbon gases if the economic and technical case for hydrogen and biogas can be made. An appropriate policy framework for market development would also be needed to deliver fast and large-scale deployment of heat networks, which can be a cost-effective low-carbon heat delivery option for significantly higher share of UK in 2050 (especially in less efficient and higher density buildings).
14. **The work of the ESC points to the importance of Whole System thinking.** Promoting a whole system, multi-vector approach to network development, access and charging will become an increasingly important regulatory task in order to enable a cost-effective low-carbon transition. In future, there is potential for increasing regional variation and network diversity that would require better decision-making mechanisms to align regional and national infrastructure planning; and to enable cross-vector coordination of investment planning and network operation.
15. In the power sector it is becoming increasingly important to recognise that actions in one part of the system can have ramifications elsewhere. For example, a distribution company could consider working with its domestic customers on a housing estate to time-shift the load associated with electric vehicle charging and so avoid the cost of local network reinforcement. However, in doing so, they may also lower the national demand for electricity, thus reducing the amount of generation required by the system. It is important that investment decisions are taken in light of their cost to the whole system, not just a part of it.
16. ESC's experience through the Smart Systems and Heat programme points to the importance and power of Local Area Energy Planning (LAEP), particularly for heat decarbonisation. LAEP enables stakeholders, led by local government, to interrogate different energy futures for an area and to develop the most promising, cost-effective options for decarbonisation. For network operators, it provides a foundation for justifying and planning network upgrades. LAEP develops a shared vision as a basis for targeting

investment, encouraging innovation, securing value for money and gaining public understanding and support. A small, additional investment in planning future local energy systems, can leverage significant savings in the capital required to improve existing or build new energy infrastructure.

17. There are huge benefits in sharing the costs of underlying infrastructure that can support many 'experiments' and conducting trials in consistent ways so the results can be learned - the sector can learn more rapidly, rather than either public or private purse funding similar real-world trials as has been happening with energy. Similarly, it might make sense to encourage smart water and energy meters to work together so that societal challenges like decarbonisation and water efficiency can be tackled more effectively and rapidly.

**Q2: The National Infrastructure Assessment (<https://www.nic.org.uk/publications/national-infrastructure-assessment-2018/>) outlined a number of changes and challenges in infrastructure to 2050 (e.g. the move to fibre in telecoms, decarbonisation in energy and the need for long term resilience in the water sector). How might the scope, functions or activities of economic regulators need to adapt in light of future challenges?**

18. **The complexity of integrating new products into existing systems is a real barrier to innovators and is therefore one of the key areas of capability that must be addressed.** 'System integration' is the discipline of connecting together all of the necessary components (whether they be market mechanisms, price incentives, regulation, technologies, devices, data, communications, methodologies, processes or business models) that between them make up the energy system and ensure that they work efficiently together. For new products and services to make it into existing markets they need to seamlessly connect to and interoperate with the components that are already part of existing systems.
19. While past regulatory focus has rightly been on costs and efficiencies in a relatively static growth period for the energy sector, the scale of future energy system transformation is unprecedented. The requirements of the regulatory framework and leadership will need to reflect the UK's ambitions. This includes the need for a full understanding of consumer expectations and values in a future world with major energy vector switches for both transport and home heating. Given the extent of the transition, there is a need for leadership. The period up to 2030 is critical for both developing resources and beginning the transition.
20. The extent of the transformation required to decarbonise energy may require Ofgem to devote even more resources to its innovation team. New policy and regulatory frameworks and business models that promote an integrated, multi-vector approach to the low carbon transition are needed to optimise the combination of low carbon energy sources, heat and power supply, flexibility, retrofit, microgeneration and storage in delivering energy services to consumers.
21. New technologies, products, services or business models need to be demonstrated and proven before they can be deployed at scale. Scale-up trials have proved to be particularly

challenging for innovators to set up and participate in. They require the participation of multiple stakeholders as well as access to existing energy assets and energy consumers.

22. For example, achieving the changes that are needed to decarbonise the energy system on the scale required to meet the 2050 climate change targets will be a massive task over the coming decades. Even if the decarbonisation programme started in 2025, around one million dwellings per year to 2050 would need to be retrofitted with low carbon measures – this is a considerable logistical challenge and is likely to cost over £300 billion (in 2015 money)<sup>1</sup>.
23. **Creation of a coherent market and regulatory framework for the heat network market is highly valuable to long-term consumer interests.** A range of evidence, including that based on whole energy system modelling, points to the high value of heat networks as a key option for the future decarbonisation of heat supply, in line with legally binding carbon targets. Therefore, the creation of a coherent market and regulatory framework for heat networks which can deliver fair and efficient outcomes is of fundamental importance to consumers.
24. **A coherent economic and governance framework is needed to shape choices around heat network development in ways that are socially optimal and serve consumers' broad long-term interests.** The district heating market is currently immature and lacks a coherent regulatory framework, which is key to unlocking its potential to deliver future consumer benefits as the UK moves to decarbonise its heat markets in the decades ahead. Markets on their own are unlikely to be able to deliver an efficient outcome for consumers because heat supply has some monopolistic characteristics as well as a range of social and environmental externalities (e.g. enabling reductions in carbon emissions).

**Q3: How might the increasing availability of data impact regulation in future? Can data increase the pace at which regulation responds to change, enabling innovation?**

25. The Energy Data Taskforce (EDT), supported by the Energy Systems Catapult, has been considering the issues of data and information. The Taskforce has responded recently to Ofgem's consultation on licence conditions and guidance for whole system outcomes. In its response, ***“the Taskforce finds that there is a huge opportunity to unlock whole system benefits (i.e. to benefit electricity and gas consumers) by Ofgem acting now to require both electricity and gas network operators to publish data based on principles the Taskforce has established.*** This should not wait for RIIO-2. Early actions can inform RIIO-2 decisions and can improve the quality of RIIO-ED2 stakeholder engagement on business plans. Throughout the RIIO-2 period, the expectation should be that increasingly all companies move towards the pace of the fastest, not the slowest.
26. As electricity generation capacity becomes more distributed, Ofgem must find new ways to ensure compliance. Using data would be a comprehensive way to do this. This would make regulation more flexible as the conditions of compliance are not based on

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<sup>1</sup> ESMc Forecast – Energy Technologies Institute (2015)

prescribed actions but the outcome of the activity. This would allow new innovative methods of completing actions to be deliverable without first working to change regulations.

27. **Digitalisation of home energy can enable radical new ‘smart energy service’ business models.** These could combine deep and differentiated learning about consumer needs with smart and targeted control. Smart controls coupled with data analytics can reveal the varied detail of consumer preferences and building requirements, enabling better outcomes for households and for the wider energy system. This includes greater system flexibility, better management of peaks in the power sector and cost-effective decarbonisation.
  
28. **Regulatory arrangements for data and smart energy inter-operability** – ensuring the interoperability of controls, devices and interfaces will be vital to support consumer choice and competition by reducing the risk of lock in to proprietary platforms. The example of other industries suggests some form of industry standards or regulation may be needed to unleash the full potential of a digitalised energy system. ESC’s early consumer trials point to the importance of suitable standards on the interoperability of controls, data and connected home devices and appliances to support consumer choice and reduce the risk of lock in to proprietary platforms for smart energy services or control. **The ESC and the EDT will continue to interact with Ofgem to inform the development of new standards and regulations that facilitate greater inter-operability and new customer propositions.**

## Competition and innovation

### ***Q4: How have the energy, water and telecoms sectors performed with respect to efficiency, since privatisation?***

29. It could be argued that the energy sector has been efficient in moving away from high-carbon sources of electricity production, first to gas-fired power stations and more recently to renewable sources of power such as wind and solar. Some of this transition has been achieved through market mechanisms, some through incentives and subsidies. These incentive schemes, such as the Renewables Obligation, have not always provided the correct economic signals. The same is true with the production of renewable heat: the Renewable Heat Incentive (RHI) has not lead to the wide-spread adoption of low carbon, renewable heating.
  
30. The governance of the gas and (especially) electricity markets has acted as a barrier to competition and innovation. The industry codes that stipulate how parties participate in the markets are too cumbersome, prescriptive and difficult to change. Ofgem has recognised this and is currently conducting a review.

**Q5: How has competition impacted on investment, innovation and outcomes for consumers across energy, water and telecoms since privatisation?**

31. There has been competition in generation and some elements of supply in energy since Privatisation but six large vertically-integrated companies have had significant market power. This has started to dissipate but has not totally disappeared. This had led to accusations that energy prices have been held at levels that do not reflect the underlying economic fundamentals. Ofgem has responded by introducing a price cap to try to assuage these concerns – so far this has only been partially successful.

**Q6: How has regulation affected the level of innovation in energy, water and telecoms, compared to these utilities in other countries and/or other comparable industries?**

32. Developments in new consumer propositions in markets such as telecoms and automotive suggest that consumers are willing to pay for new propositions that deliver added value, convenience or a better experience. The level of technological sophistication, control and consumer focus in home energy for example, appears relatively less developed by comparison with the sophisticated consumer-friendly interfaces and offerings in other more competitive markets (communications, automotive).
33. **Policy design and market frameworks should seek ideally to enable competitive markets to drive innovation but the role of government and regulators in supporting critical technologies should be recognised.** The explicit aim should be to deliver clear progress towards a market environment where choices and investment are driven by market players focused on meeting consumers' needs, rather than decisions about levels of policy support to different categories of technology. It could be argued that regulation in the energy sector has not yet provided the stimulus for innovation in new business models and customer propositions.
34. Our broader analysis of energy system transitions suggests that the mix of technologies and business models best suited to deliver reliable, low carbon electricity, and support wider decarbonisation, is inherently unpredictable. As well as a portfolio of low carbon generation with different performance characteristics, we may also need innovation in business models to unlock greater supply and demand flexibility over a range of timescales and geographies. The future timing and configuration of 'system stress' events will also change, with the electrification of significant parts of heat and transport energy demand. Reliance on centrally designed, directed and defined auction and regulatory mechanisms will risk stifling new opportunities opened up by digitalisation and new distributed technologies.
35. This inherent uncertainty, and the need for innovation in low carbon technologies and services, points towards the advantages of flexible markets and innovative contracting between buyers and sellers of system services. The alternative of continued reliance on complex, centrally specified contracting mechanisms, is likely to mean that the competitive playing field (and therefore the incentive to innovate) is heavily conditioned by administrative decisions. Market arrangements that internalise service reliability and decarbonisation objectives within the prices and incentives facing market players could

better enable innovation in both technologies, digitalisation and new service propositions to maximise system flexibility in the face of stress. They could also more straightforwardly deliver a level playing field for competition between different technologies and business models.

36. **It will prove key to ensure that the benefits of innovation flow to everyone, including vulnerable groups, and that we develop smarter consumer protection.** There are vulnerable groups who struggle to afford a basic level of energy/water/telecoms service. Decarbonisation will change the cost of using energy and water (and to a lesser extent telecoms). It is imperative that we take steps to understand how to harness the potential for innovation to reduce various forms of vulnerability and to design smarter protection. One approach could be to encourage industry and consumer groups to co-design smarter consumer protection and support them by providing Living Lab environments where regulators can test out alternative arrangements to discover which are most effective.

***Q7: When has regulation been too slow to adapt to changing market circumstances and what have been the consequences for consumers and investors?***

37. It can be argued that Ofgem has been successful in enabling significant investment in energy infrastructure and in introducing the RIIO price control arrangements to incentivise competitive behaviour by monopoly providers. In the retail market, there have been accusations that energy prices have been too high and that Ofgem has been slow to act. This would appear harsh in a market where profit margins are relatively low. Even so, it is hard to disagree that vulnerable customers have been adversely affected by high energy prices and that fairer funding for these customers is required. The ESC has initiated a Fairer Funding project that seeks to mitigate the effects of high energy prices on vulnerable customers.
38. In energy, regulators need to work with government and industry participants to address the significant scale-up challenge required to decarbonise the energy system<sup>2</sup> to meet the 2050 climate change targets. They need to be alert to potential regulatory barriers and help accelerate new products and services to market by enabling and encouraging community, local authority and regional level trial and demonstration of innovation.

## **Regulatory consistency**

***Q8: Where could regulators work together more consistently to meet future challenges, achieve efficiencies within the regulatory system or to promote better outcomes for consumers, investors or society?***

39. The low carbon transition raises a range of broader co-ordination issues, within and across network infrastructures which may not be capable of resolution through familiar market mechanisms. This includes handling integration and interactions within and across different sectors, for instance between energy and transport – the large-scale introduction

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<sup>2</sup> If large-scale decarbonisation of domestic heating starts in 2025, 1 million properties annually will need to be upgraded to low carbon solutions to meet the 2050 climate change targets.

of electric vehicles will have a profound effect on electricity networks and the demand for low carbon energy.

40. In a competitive market, market participants innovate to attract/retain customers. There is still a role to play by regulators in competitive markets in stimulating innovation. A key part of this will be to encourage innovation in technology, business models and customer propositions so that the UK's climate change objectives can be met. We are currently seeing the first steps in moving from competing solely on price, to an attempt to differentiate the service being offered. Ultimately it will be for market participants to deliver innovation, but regulators can help to provide the necessary conditions to facilitate this.
41. Regulators could play a major part in promoting cross-sector co-operation to develop standards which promote interoperability across UK industry. Importantly the standards should target the right level, for example how rules defining the internet interfaces work such as TCP/IP or mobile phone standards such as 4G/5G, and not down at technology level which should be left open enough for innovation to thrive.

***Q9: What changes to the existing regulatory framework would be necessary to promote greater collaboration and regulatory consistency? Are there functions that might better be provided on a multi-utility basis without the need for wider organisational change?***

42. In energy, decarbonisation of heat will call for appropriate technical solutions and close co-ordination between many different stakeholders, including local and national government, regulators, vehicle manufacturers, network operators, energy providers, local communities and businesses as well as individual consumers.
43. It is conceivable that regulators from different sectors such as energy and transport or energy and communications could better coordinate or even merge their activities. There is no doubt that the interaction between the electricity requirements from electric vehicles (EVs) and the potential flexibility that these vehicles could provide to electricity networks, mean that greater regulatory collaboration and equalisation of standards is required.
44. **The installation of smart meters will open up opportunities for both consumers and energy suppliers.** New innovative customer propositions such as Heat-as-a-Service (HaaS) where consumers buy comfort (warm homes) rather than kWh of energy are being developed. Large amounts of data will be available from homes and these homes will be able to be connected to potentially trade energy and flexibility services. The collection and use of this data will need to be regulated and this may require collaboration between Ofgem and Ofcom.

***Q10: What is the case for or against a multi-utility regulator covering energy, digital and water?***

45. Given the scale and complexity of infrastructure challenges across energy, water and telecoms, we do not see the case for a single combined regulator.

## Policy and regulation

**Q11: Is the traditional role of economic regulation, to mimic the outcome of a competitive market, sufficient to ensure future investment and to meet the needs of current and future consumers, and if not, how might this role need to change?**

46. The extent of the transformation required in energy and water will require regulators to broaden their traditional roles of concentrating on promoting competitive behaviour for monopoly providers. The scale of the challenge to decarbonise energy will require Ofgem to devote even more resources to its innovation team. New policy and regulatory frameworks and business models that promote an integrated, multi-vector approach to the low carbon transition are needed to optimise the combination of low carbon energy sources, heat and power supply, flexibility, retrofit, microgeneration and storage in delivering energy services to consumers.

**Q12: What should be the boundary between government setting policy and strategic direction and independent regulation in these sectors? Do the existing duties and functions of regulators need to be adjusted to reflect this?**

47. **Policy design and market frameworks should seek ideally to enable competitive markets to drive innovation but the role of government and regulators in supporting critical technologies should be recognised.** The explicit aim should be to deliver clear progress towards a market environment where choices and investment are driven by market players focused on meeting consumers' needs, rather than decisions about levels of policy support to different categories of technology. Markets can integrate large amounts of information and meet differentiated needs (consumer insights) and provide strong incentives for innovation. Open and flexible markets and platforms, with co-design by participants rather than central direction, should help to ensure the best technology mix and openness to innovative new options.

48. **On balance, the existing duties and functions of regulators seem appropriate for their primary role which is to protect consumers' interests.** In sectors where there is no natural competition, regulators seek to introduce competitive pressures. In these regulated sectors, regulators should seek to incentivise innovation. Regulators already have tools available to them to promote innovation through licence conditions and price controls and through the regulatory oversight of industry codes. In energy, Ofgem can use code reviews to effect changes to the operation of the energy markets: these can be used to facilitate innovation in areas such as flexibility services e.g. Demand Side Response (DSR) and energy storage. The third stage of the IET/ESC Future Power systems Architecture project (FPSA3) has found that more agile code governance would allow a more-timely response for market change.

**Q13: Has there been a lack of clarity over strategic goals? What is the cause of this and what has been the impact on investment?**

49. In energy, there is clarity over the UK's strategic goals, although there is some uncertainty on the best way to achieve these. The *Clean Growth Strategy* sets out the UK Government's proposals for decarbonising all sectors of the UK economy through the

2020s. There are a number of key decisions that will need to be made over the next decade on the best way to decarbonise heat: what role will electrification, low carbon gases such as hydrogen and heat networks play?

50. There are clearly specific investment challenges in energy for both nuclear and Carbon Capture Usage and Storage (CCUS). The government is right to explore a range of options for improving the investibility of both of these options. In CCUS particular attention should be paid to the financing of carbon dioxide transport and storage infrastructure, and the allocation of risk between private investors and the state. Similar issues apply in relation to the specific risks associated with financing large scale nuclear plants.
51. In the longer term, the investment environment for low carbon technologies can be improved by creating a durable long-term policy framework to incentivise emissions reduction across the economy. Our Rethinking Decarbonisation Incentives project has taken a fresh look at the options for improving incentives across the UK economy. This merits further attention, particularly in the context of the emerging 'net zero' agenda.
52. Finally, a key set of investment challenges awaits in creating the market environment for major national investment in decarbonising heat supply. This is likely to require investment in a mix of locally adapted solutions including heat networks, electrification of heat, potentially hydrogen as well as building retrofits and upgrades. The complexity and scale of this investment challenge is immense. Our work on Smart Systems and Heat suggests the importance of building an enduring low carbon policy framework to drive decarbonisation – an outcome-based decarbonisation standard or obligation on energy service providers could incentivise the market to invest in integrated solutions that work for consumers and localities.

***Q14: Are the government's principles for economic regulation<sup>\*</sup> – accountability, focus, predictability, coherence, adaptability and efficiency – fit for purpose; and if not, how should they change?***

53. We support the government's principles for economic regulation and agree with a move to a more principles-based rather than a prescriptive rules-based regulatory approach.

***Q15: How can regulators act in the future to support public trust in the regulatory system for water, energy and telecoms?***

54. Regulators need to be open and transparent and continue to engage consumers in their work. They also need to work with market participants to enable more radical innovation using sandboxes and Living Labs to develop customer-friendly propositions. In energy, innovation is key to meeting consumers' evolving needs and aspirations for comfort, mobility and control in everyday life and to deliver the low carbon transition. Providing certainty and direction on a clear pathway for innovation in the UK energy sector will also encourage new entrants across the supply chain to offer new products and services for customers, driving competitiveness in the sector and overall and ultimately bringing down energy costs for consumers.