UK Energy Research Centre

Strategy and Policy Statement for energy policy in Great Britain

UKERC Consultation Response

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Introduction to UKERC

The UK Energy Research Centre (UKERC) carries out world-class, interdisciplinary research into sustainable future energy systems.

It is a focal point of UK energy research and a gateway between the UK and the international energy research communities.

Our whole systems research informs UK policy development and research strategy.

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Introduction

We welcome the re-assertion in the Strategy and Policy Statement (SPS) for Energy Policy in Great Britain of key policy objectives. UKERC is a whole systems research consortium. We greatly welcome the commitment to a whole system approach described in the strategy. UKERC's research encompasses infrastructure transformation, geopolitical factors and societal acceptance, as well as analysis of individual technologies and challenges.

The strategy has much to recommend it, but some notable omissions. In our view, most of what is labelled as "policy outcomes" is statement of further, more specific, strategic objectives. There is a general lack of detail on the means through which outcomes will be achieved.

Although the SPS adds to understanding of the respective roles of Government, Ofgem and the Future System Operator (FSO/ISOP), further clarity is needed. The creation of the FSO is welcome, but it is important to ensure the agency given to both the FSO and Ofgem to plan for a reinvented energy system is rooted in an accountable, democratic framework that ensures that the interests of citizens affected by change, as well as industry and other stakeholders, are adequately represented.

We also note the submission from the National Engineering Policy Centre, which coordinates across the learned societies and professional bodies such as the Energy Institute and IET, with which UKERC collaborates. Their submission makes detailed points additional to those provided below.

1. Does the strategy and policy statement identify the most important strategic priorities and policy outcomes for government in formulating policy for the energy sector in Great Britain?

1.1 A lack of geographical specificity

The SPS identifies many important priorities and outcomes. The need for network infrastructure investment ahead of need is particularly important. We welcome the prominence that this is given. The strategy describes the accelerated roll-out of network capacity – "*networks need to be transformed to meet the demands of a decarbonised energy system and to meet government's ambitions for low carbon and renewable energy generation*". The principal need for new networks is to electrify sectors currently run on direct combustion of fossil fuels – which leads to new demands from EVs and in heating. However, this is only half the story. It would be desirable if the *geographical/resource base* reasons we need new networks, in particular transmission infrastructure, were made explicit. New network infrastructure is needed to access new sources of renewable energy that are geographically constrained, whether because renewable resources are strongest in more remote locations and/or because of the competing pressure for land use. The UK has very large renewable energy resources available offshore, and in the North and West of the British Isles. Our existing electricity transmission infrastructure was built in a previous age, to access a different resource base – described at the time as 'coal by wire', taking energy from locations best suited to large coal fired power stations to (often remote) centres of population. In the 1960s Britain's high voltage power lines were constructed in order to realise this clear goal, as well as to provide for new nuclear power stations. In the 2020s we need 'wind by wire'. If we are to realise the energy transition, we need to redesign and re-engineer our networks, and build capacity in regions where renewable resource opportunities are large but network infrastructure is limited or non-existent. Equally, as industrial clusters are likely to play a key role in the decarbonisation journey it is important that their location and plans for network infrastructure – electricity, hydrogen, carbon dioxide and any remaining natural gas network capacity – are complementary.

Providing greater geographical specificity and clarity of purpose will help market participants prepare for a rapid transition. It can also help guide decisions about network charging, since it is not economically efficient to proceed as if network capacity is fixed whilst the renewable resource base is elastic. In many respects the opposite is true, in that renewable resource and available land are locationally constrained, whereas network infrastructure can be designed to access different resources. Upgrading distribution networks is also important, but unless the need to expand capacity into new locations to access new resources is made explicitly clear, there is a risk that the nature of the challenge is misconceived.

The potential re-purposing of the gas networks presents a different set of challenges, and it will be important to ensure continued supply to customers on the natural gas

network, while at the same time facilitating the development of a hydrogen network and CCUS in appropriate locations. We note that there is no need to leave all decision making on hydrogen to 2026. Indeed, as the Climate Change Committee has pointed out, decisions that appear to hang on a judgement regarding the role of hydrogen across different parts of the energy system need to be taken sooner than that. Government should identify, sooner rather than later, the role of hydrogen for heat in residential buildings (including regions where this is/is not viable). Since there is widespread agreement on the need to largely electrify heating, and develop district heating where appropriate, Government should press ahead with development of forms of low carbon heat in those regions that don't depend on hydrogen.

1.2 The need for a hierarchy of objectives

Flowing from the need for greater clarity about geography is the need to ensure that policies and objectives are focused on delivering the UK's geographical opportunities, developing a system that allows us to cost effectively access new sources of energy. This places the delivery of new network infrastructure and continued build out of renewable energy at the top of the hierarchy. Doing so as cost effectively as possible will also require that developers can access capital as cheaply as possible, likely to require policies that effectively de-risk some investment. The existing Contracts for Difference (CFD) regime has been highly successful at mobilising investment in generation capacity at low cost. The cost of capital remains important to overall decarbonisation costs, and UKERC research demonstrates the significance of policies that reduce exposure to wholesale market price uncertainty[1]. We note that supply chain cost pressures now present major challenges[2], but this does not undermine the importance of minimising cost of capital, or the value of policies in de-risking aspects of investment.

Sustaining low-cost investment is a high priority. If the roll-out of low carbon generation capacity and network expansion is not successful other objectives cannot be delivered – transport and heating may be electrified but will not be decarbonised, whilst the need for new sources of flexibility derives from the replacement of fossil fuel with renewable energy. If this does not proceed, then new flexibility options may be superfluous.

Natural gas will continue to provide a flexible energy system resource for many years. While UK market actors have shown their ability to respond to global shocks and procure enough gas to meet UK need, a cold winter would put that ability under extreme pressure and highlights a need for gas storage capacity. Recently published

[1] Blyth et al. 2021. Risk and investment in zero-carbon electricity markets https://ukerc.ac.uk/publications/zero-carbon-electricity/

[2] The recently announced decision by Vattenfall to pause its Norfolk Boreas project, recipient of a CfD offer in the 4th auction round, illustrates the supply chain inflation issues now arising https://www.regen.co.uk/a-bump-in-the-road-but-not-yet-a-car-crash-time-to-reset-and-rebuild-the-uk-offshore-wind-pipeline/

work by the CCC[3] and by National Grid ESO[4] show a likely demand for hydrogen storage. The 'switch' from methane to hydrogen will need to carefully managed to ensure security of supply for all customers.

1.3 Low and stable prices for electricity should be a core objective

The UK's abundance of renewable energy provides it with an opportunity to secure low-cost electricity for generations. Investments made in the coming years can be compared to the build out of hydroelectricity in Norway from the 1950s or the French nuclear programme of the 1970s. It offers the prospect of electricity that is largely insulated from fossil fuel price volatility, not because the market is split but because fossil fuels are eliminated from power generation. This objective should be expressed in ambitious terms. 'Lowest wholesale prices' in Europe does not convey very well the significant opportunity to deliver permanently low electricity prices.

It is important to ensure that low costs of energy production feed through into low prices for consumers. There is currently no guarantee that fossil fuels will be entirely removed from the electricity system by 2035, and a large (though, by necessity, shrinking) part of the end use of energy – notably for heat in buildings, for transport, and in industry – will still be using fossil fuels then. Due to the variability of wind and solar resources, there will be a significant number of hours in which a source of electricity other than that with a zero marginal cost – renewables and nuclear – will be the price setter in the spot wholesale market. Scenarios outlined by the CCC and NGESO suggest that natural gas – directly in electricity production with CCS, indirectly as a source of 'blue' hydrogen or, in small volumes to ensure security of electricity supply, in unabated electricity production – will still have a role in 2035, complemented by as much 'green' hydrogen as can be realistically produced. Market design and regulation needs to ensure that sufficient flexible, schedulable generation resources are available and financially viable without locking in to unabated use of natural gas or giving operators of zero marginal cost generation excess infra-marginal rent.

1.4 Economic opportunities and delivery risks

The SPS has a strategic objective to "*seize the economic opportunities of the net zero transition, boosting growth and innovation in green industries*." This is strongly welcomed. However, we would note that the balance of interests between lowest cost to end users of energy and support of UK manufacturing and construction will be subject to a political judgment on the strength of different priorities. It should also be noted that support of UK-based supply chains may be necessary to reduce risks of late delivery of the energy transition, with late delivery presenting geopolitical risks in relation to global efforts to reduce greenhouse gas (GHG) emissions. The potential for dependence on international markets, which might ordinarily be

[3] CCC. 2023. Delivering a reliable decarbonised power system https://www.theccc.org.uk/publication/delivering-a-reliable-decarbonised-power-system/
[4] National Grid ESO. 2023. Future Energy Scenarios. https://www.nationalgrideso.com/future-energy/future-energy-scenarios

expected to yield benefits of competition for UK energy users, might actually lead to higher costs as well as late delivery in light of the very high and growing international demand for energy system products and materials. The UK electricity supply industry's current tendency towards a project-by-project approach to procurement might be compared with an approach, being adopted in other countries such as the Netherlands, where manufacturing capacity is, in effect, being booked for many years in advance.

Tensions also arise between local environmental impacts and the need for infrastructure – most notably, electricity generation and transmission capacity – to enable reduction of the adverse global environmental impacts of GHG emissions. Clear rules and access to information need to be developed that enable timely resolution of tensions in a way that can be trusted by local stakeholders, infrastructure developers and end users of energy.

1.5 A managed transition is essential – with clear plans for legacy assets

The strategy refers to the "*transition to net zero alternatives from natural gas is planned and operated in a coherent way, with consideration to security of supply and costs for consumers*" – but it does not engage with the key requirement to manage the transition *away from gas* in a careful and considered fashion, that ensures that gas assets remain operational and economically viable for as long they are needed.

Work is underway within the Department for Energy Security and Net Zero to address the changing role of natural gas in the future energy system. However, there is a danger that discussions will be overly focused on security of supply issues and an assumption of smooth progress towards a net zero energy system. Key roles that gas currently plays in terms of meeting interseasonal heat demand, energy storage and flexibility in the power system will continue for some time.

There has already been significant progress in the power generation sector, but huge challenges remain in finding low carbon alternative to the energy system services played by natural gas today. Improvements in energy efficiency and demand reduction have a role to play in curbing gas demand in the short to medium term. The importance of these should not be underestimated in relation to energy security. The pace of natural gas demand destruction and the orderly management of its consequences is one of the most significant challenges facing the GB energy system in the medium-term.

It is important that short-term concerns about security of gas supply do not confuse matters. UK gas production will continue to decline faster than the expected decline in gas demand, with the attendant increase in import dependence. The priority should be managing the transition away from unabated gas consumption. The pace of change is a critical uncertainty here. Natural gas will have a role to play for some time to come and elements of the current gas infrastructure will have to remain in place, but how can their costs be covered in a fair way as gas demand falls? Equally, hydrogen network infrastructure will be needed in some parts of the country, and some of that need might be met by re-purposing natural gas infrastructure. The costs of decommissioning large parts of the natural gas infrastructure will also need to be

met as time goes on. Significant ‘transition risks’ exist for both the incumbent owners of the gas infrastructure and new entrants hoping to access that infrastructure for new purposes. Building parallel systems would be costly, but a complex balancing act will be required to maintain security and affordability for all consumers.

1.6 Ensuring resilience and security of supply

The SPS defines one strategic objective as “*an energy system which is secure and resilient, including from supply shocks and external changes in the international environment*”. How resilient is resilient enough, and do we have the means to assess it?

There is little among the policy outcomes set out in the SPS that is SMART, i.e. specific, measurable, attainable, realistic and timely. There is much that requires more precise articulation of objectives in order that action can be taken to get anywhere near to meeting those objectives. One example is resilience: new standards are likely to be required in order to drive the industry towards appropriate action, but the industry needs to know how resilient is resilient enough[5]. These standards should be defined to highlight the importance of the energy system and its constituent parts being resilience against climate change.

The Government will need to take a view on quite how secure and resilient energy supplies need to be in order that appropriate investment decisions can be made. That view will need, as far as possible in an uncertain world, to take account of which critical demands for energy must be met and which might be reduced under emergency conditions, the impacts of multi-year weather variations, and the extent to which domestic energy production of different forms has a material impact on prices likely to be paid by energy users in the UK.

A stated policy outcome is that “*Regulators ensure that licensed bodies meet their obligations and make use of the full range of their levers to ensure this, including in relation to compliance and enforcement*.” Our understanding is that the ESO has, in recent years, unilaterally withdrawn from its role, established at privatisation, of certifying and enforcing compliance of transmission network users with technical standards. In our view, it has been insufficiently proactive and robust in its development of those standards to manage the impacts of technology change. We are also concerned by the Distribution Network Operators' (DNOs) apparent inability or reluctance to enforce standards on equipment connected to their networks.

1.7 Energy efficiency

The SPS notes that one strategic priority is “*driving the net zero transition to increase and diversify the supply of energy*”. Is the objective of the net zero transition to increase supply of energy? No; it is about reducing greenhouse gas (GHG)

[5] For further discussion of resilience and standards see, for example:
MacIver, Bell and Nedd, “An analysis of the August 9th 2019 GB transmission system frequency incident”, https://pureportal.strath.ac.uk/en/publications/an-analysis-of-the-august-9th-2019-gb-transmission-system-frequen and; Cox, Bell and Brush. 2022. Response to JCNSSI Inquiry: Critical national infrastructure and climate adaptation. https://ukerc.ac.uk/publications/critical-infrastructure-climate/

emissions while meeting demand sufficiently reliably. That job can be made easier by reducing the total need for energy and its supply. Happily, meeting a much higher proportion of energy service needs via electricity and generating the electricity from low carbon sources both reduces the total need for energy (because electrification brings about energy efficiency relative to uses of fossil fuels) and reduces the emissions intensity of production.

Reference to Government strategic priorities to increase energy efficiency are very welcome, given the wealth of evidence on value of such efficiency for energy security, and affordability for business, industry and households, as well as jobs in infrastructure retrofit. There is, however, little indication of how such priorities are to be realised, and embedded in a sector and policy landscape largely focused on supply-side developments. Energy efficiency is best understood as a *systemic* issue; inability to realise value from energy efficiency derives from the framework of institutions geared to supply side 'economies of scale', and background assumptions that increasing energy supply is fundamental to economic growth.

Avoiding waste of energy and improving energy productivity have historically been positioned at the margins, rather than the centre, of business; consequently, routes to generate revenues from energy efficiency, as an asset in energy markets, are difficult to configure. For example, in the recent Ofgem DNO RIIO-2 Price Control determinations, there is an obligation on DNOs to consider energy efficiency as an alternative to reinforcement. There is however only one reference to energy efficiency in the Ofgem 2022 Final Determinations Overview, and this is as an entry in the Annex defining terms. Hence the opportunity, for example, for learning from area-based building retrofit pilots, and aggregated demand side response, before any major increase in heat electrification, is marginalised.

Although there is outline reference in the Statement to Ofgem's responsibilities, there is little indication of how the new FSO, with Government and Ofgem, will act to ensure that value from energy efficiency, or zero waste of energy, is now made an integral part of whole system analysis, planning and advice.

1.8 The importance of flexibility

Flexibility should be utilised wherever it is available and cost-effective, but there also needs to be realistic expectations about how much is likely to be available from the various different sources (demand response, batteries, interconnectors etc) and the steps needed to make more of it available. It should also be recognised that "flexibility" is not always an alternative to network capacity; sometimes network capacity is needed in order to access flexible resources, e.g. large scale energy storage or flexible, schedulable generation, both of which may be location specific.

There needs to be a sufficiently broad understanding of "flexibility" – see for example work by Gill, MacIver and Bell on LMP and its potential role in incentivising

"flexibility"[6]; its importance should not be over-emphasised relative to that of having sufficient network capacity.

Flexible demand offers many opportunities; it is useful and important that the SPS recognises that it also has risks. As well as cyber-security risks, one concern is that we can get – already are getting – large step changes in demand as the clock ticks round to the next half-hour with resulting disturbances to system frequency. Time-specific settlement is crucial, but we need to consider whether the right time increment is half-hourly. How do we turn the steps into manageable ramps? Might 5-minute settlement do it?

1.9 Access to data

A strategic objective is noted for Great Britain to have "*an economic and efficient digital infrastructure which enables a smart, digital and secure energy system, based on principles of open data, security and a whole systems approach to data sharing*".

We welcome this objective but wonder how it will be met. For example, is the "presumption" of data openness and the intended ease of access to data consistent with Section 105 of the Utilities Act consistent with it? Noting that it was only issued in 2021, how effective is Ofgem's "Data best practice guidance" with which the network licensees are expected to comply? How do these principles work in respect of data owned by particular parties but collated by others?

1.10 The need for people

According to the CCC, reduction of UK Greenhouse Gas (GHG) emissions will require £50-60 billion of investment per year by the early 2030s with a very large part of that dedicated to low carbon electricity generation (up to £15 billion per year), electrification of end use of energy, and development of electricity networks (cumulative investment of up to £50 billion by 2030). National Grid Electricity Transmission (NGET) has stated that more than five times the amount of electricity transmission infrastructure must be delivered in the next seven years than has been built in the past 30.[7] To achieve this and ensure resilient system operation will critically depend on the availability of a suitably sized and skilled workforce able to do things not done before. The Electricity Networks Strategic Framework (BEIS/Ofgem, 2022) indicated a need for "*an additional 50,000–130,000 [full-time*

[6] Gill, MacIver and Bell, "Exploring Market Change in the GB Electricity System: the Potential Impact of Locational Marginal Pricing", https://pureportal.strath.ac.uk/en/publications/exploring-market-change-in-the-gb-electricity-system-the-potentia-2

[7] Johnson, T. 2023. National Grid seeks help in delivering 'unprecedented' electricity infrastructure project. https://www.newcivilengineer.com/latest/national-grid-seeks-help-in-delivering-unprecedented-electricity-infrastructure-project-10-01-2023/

equivalent] jobs by 2050" just for electricity networks.[8] Research for National Grid suggests a need for 400,000 jobs in the "Net Zero Energy Workforce" by 2050.[9]

People are required across the full range of roles: technicians, fitters, project managers, financiers, economists, natural scientists, behavioural scientists, lawyers and professional engineers. In particular, a highly trained population of thinkers, analysts and leaders is required to deliver this electrical system transformation and resolve the many technological and social uncertainties. Any Strategy and Policy Statement for Energy Policy in Great Britain must clearly address this need and ensure joined-up action by the energy and construction industries and government agencies to meet it.

[8] Department for Energy Security and Net Zero, Ofgem, and Department for Business, Energy & Industrial Strategy. 2022. Electricity networks strategic framework. https://www.gov.uk/government/publications/electricity-networks-strategic-framework
[9] National Grid. 2020. Building the Net Zero Energy Workforce Report. https://www.nationalgrid.com/stories/journey-to-net-zero/net-zero-energy-workforce

2. Does the strategy and policy statement effectively set out the role of Ofgem in supporting government to deliver its priorities?

2.1 Ofgem's role

We broadly welcome the role described for Ofgem. The demarcation of roles and responsibilities needs to be clarified (see below), but the text suggests that Ofgem will have a duty to regulate the FSO. We believe that this would be broadly consistent with existing arrangements. Whilst the FSO will not own assets it might, if not appropriately managed, have a predilection to plan for an excess of network capacity as that provides for greatest flexibility in system operation. Creating a system of checks and balances is important. We also welcome the intent for Ofgem to maintain responsibility for network charging. For reasons described below we believe it is correct for government to retain responsibility for areas with strong distributional implications, such as market design and locational pricing.

We have concerns that the remit of Ofgem is specified in very broad terms, with potential for overlapping responsibilities with the FSO and unnecessary duplication of work. The promise of increased focus on optimising efficiencies across the entire energy system does, however, provide a critical opportunity for regulatory review of core GB energy market institutions and establishment of more coordinated governance across scales, with due attention to democratic accountability. This should include establishing the materiality of the existing Ofgem Coordinated Adjustment Mechanism[10] in establishing best value from infrastructure investment in specific locations. Among other benefits, this should help to establish a 'level playing field' between electricity, gas and heat network infrastructures. It should also include integrated local and regional energy planning to improve network efficiencies and enable faster decarbonisation. As UK Government has previously stated, '"*decentralised approaches can more easily incorporate both supply and demand-side technologies, meaning they are more likely to support electricity demand reduction and flexible demand*" (UK Government REMA Consultation, 2022, p.53).

It is critical that the Statement gives clear direction to secure such whole system benefits. This will help to ensure that the envisaged institutional evolution, presaged by the FSO and Ofgem planning for local and regional energy governance, does not result in an increasingly complex array of organisations with further compartmentalised responsibilities in different segments of the architecture. Instead, the Statement needs to ensure constructive compromise between political leadership, policy, markets and technical expertise for a more innovative, clean and energy efficient system.

It is noted that Ofgem should use "*the full range of levers at its disposal including its compliance and enforcement powers*". It seems to us that Ofgem needs beefed up capability to do this. The time it takes to assess potential market abuses and the

[10] Ofgem. 2020. Statutory consultation on proposed changes to the Special Conditions (also known as the Charge Restriction Conditions 'CRC') of the electricity distribution licence. https://www.ofgem.gov.uk/sites/default/files/docs/2020/12/17_december_2020_ed1_statutory_consultation_on_cam_licence_002.pdf

weakness of outcomes can be compared unfavourably with market rules and monitoring capability in the US. Ofgem's capability should be strengthened and doing so needs to recognise the challenges associated with recruiting and retaining suitably skilled staff.

The opportunity presented by any major wholesale market reform to re-write the rules on good market behaviour should not be missed, learning lessons from other markets internationally. The ESO and Elexon should take steps to improve market transparency and make it easier for any potential abuses to be detected.

2.2 Resilient and investable markets

To make retail and wholesale markets both more resilient and more investable is a correct objective. It will be difficult to achieve. One particular issue lies around the present state of the Supplier licence which, as a result of modifications over a number of years intended to enhance consumer protection, is long, highly prescriptive but, based on the evidence of the last few years, still fails to ensure sufficient Supplier resilience with the result of high dependency on supplier of last resort arrangements. The licence is commonly argued to be a barrier to new entry, innovation and local energy trading. However, adequate consumer protection is still essential. A fundamental rethink and redrafting of the licence may be necessary.

3. Given the Future System Operator does not exist yet but will need to have regard to the strategy and policy statement once it does, do you consider that we have effectively reflected the Future System Operator's role in this document?

3.1 Roles and responsibilities need to be clarified

The statement is understandably cautious about the detail it is possible to provide on the role of the FSO, given that this is still being determined. Nevertheless, it is important to provide a clear demarcation of roles and responsibilities. That includes a clear hierarchy of responsibility, balancing the need for politically impartial and evidence-based decision making against democratic accountability. Many of the decisions associated with the energy transition have potential distributional and economic impacts that can create 'winners and losers.' These include distributional concerns related to protection for the poorest and most vulnerable consumers, and the need for a fair transition away from fossil fuel-based industries. However, there is also an important geographical dimension: some regions will find that they are 'resource rich' whilst others are 'resource poor'. Even within distribution networks some localities will be served by networks better able to absorb new demands than others. Perceptions of fairness are therefore likely to become more focused on geography, with the possibility that fairness between different regions in terms of energy pricing becomes politicised. It will be important to ensure that decisions such as network charging and market design (particularly locational pricing) are not divorced from the legitimate concerns of citizens and subject to democratic accountability.

A significant amount of what the SPS says it wants Ofgem to do concerns making policy-related judgments. The development and articulation of policy should be the clear and sole responsibility of Government. For example, it is stated on p18 that "*Ofgem will have a role in enabling Transmission Operators to deliver community benefits to communities close to electricity network infrastructure, by considering the appropriate balance between adequate provision of benefits and affordability for consumers*". In our view, the correct balance is a matter of judgment. At the very least, clearly articulated guiding principles should be decided by elected policy makers.

We note that as the existing ESO transitions to the FSO there is a profound change of role. During the transition it is possible that the interests of the ESO will not align with those that the FSO is likely to take, given the latter will need to have a broader, whole energy system focus on network planning and redesign. The mindset (and skillset) of a system operator is rather different from that needed for a system planner, with the operative word being *future* system operator. The FSO will need to be genuinely whole system in thinking. It will need to avoid capture by various

interest groups, or priorities for the ESO as currently constructed. It will also need to be mindful of the roles and responsibilities described above, and of the importance of retaining democratic oversight as a key principle of good governance – simply put, this means the FSO is accountable to government and government to citizens. Where areas of policy are reserved to government rather than devolved to Ofgem and the FSO it is important this is respected by both. We elaborate on this using the example of REMA and locational pricing below. It will be important for the FSO to ensure it takes a wide view of stakeholder impacts, understands diverse perspectives and avoids overly partisan views. The FSO also needs to build internal capacity that includes an interdisciplinary approach to engineering and societal acceptance, taking into account political and environmental social science, and behavioural considerations (for investors as well as consumers) rather than taking a narrow and neoclassical view of economics.

As an example of this we note that in responding to the REMA process the ESO has been advocating very strongly in favour of locational marginal pricing (LMP). This has become the most contested aspect of the REMA process. This is not surprising given that it has potentially profound distributional impacts, for both generators and consumers. UKERC and our colleagues at the University of Strathclyde have attempted to provide a balanced discussion of LMP.[11,12] We note that whilst LMP may offer benefits, there are also significant potential costs (due to risk transfer to generators), and many practical impediments to implementation at least in the short-to-medium term. If the FSO is to provide a fully whole system view on such topics it will need to be more holistic in approach, more inclusive, and to be clear on where the competence of the FSO ends and that of government begins.

The FSO is also taking on responsibility for longer-term strategic gas planning and forecasting functions and will also be assessing GB gas security. This is a positive move in terms of ensuring a whole system approach to managing the energy transition. In the immediate term it does raise question of capacity and capability given the overlapping roles of Ofgem and DESNZ, as noted above, with the latter seeming to have significantly increased its capacity in relation to the gas system in the context of the current global gas crisis. When it comes to assessing gas security, it is hoped that their approach will be more sophisticated than the current N-1 approach which is not fit for purpose in the current geopolitical environment. As the plan is to ‘evolve’ the ESO to FSO there is a further risk of the FSO becoming a slightly adapted ESO, with the attendant risks of ‘capture’ by established perspectives and interests, and inability to provide the independent advice, analysis and information described in the SPS. More generally, there is the danger that the FSO will be left with all the difficult challenges but with insufficient capacity to deal with them.

[11] Bell, K. 2023. The Potential Impact of Locational Marginal Pricing. https://ukerc.ac.uk/news/potential-lmp-impacts/

[12] Gill, Simon and MacIver, Callum and Bell, K. 2023. Exploring Market Change in the GB Electricity System : the Potential Impact of Locational Marginal Pricing. University of Strathclyde, Glasgow. (https://doi.org/10.17868/strath.00083869)

The SPS says that "*the FSO should seek to understand how the behaviours and preferences of each party influences the other, to ensure the energy system is flexible to meet the needs of users and the end consumer in Great Britain*". This understanding is important and will be essential to informed planning and operation. However, where incentives and regulations appear to be too weak to realise the potential benefits of flexibility, is the FSO expected simply to highlight gaps, or to propose solutions? Who is then responsible for taking action: Ofgem or Government or, given suitable powers, the FSO?

In many respects, the FSO will depend on other parties for access to data, these other parties being owners of measurement devices. Are suitable governance arrangements in place that grant the FSO access? In some instances, e.g. phasor measurement units on the electricity transmission network or real-time metering on the low voltage network, the devices are not yet in place across large parts of the network and depend on investment in those devices by network owners. Will the FSO have any power to steer or oblige such investment?

It is reasonable to "*expect the FSO to be prepared and adaptable to take on new roles in future*". However, the FSO's funding must be sufficient to enable it, to be able to recruit and retain staff expertise in an increasingly competitive market, and to be able to train, educate and develop staff, both through its own actions and in partnership with key external parties such as leading universities.

Based on our own interaction with the ESO across a number of areas, it seems to us to be short of the expertise and capacity that it requires to fulfil its anticipated role as the FSO. It needs to be allowed to invest in improving it.

3.2 Delivery of the future energy system

The SPS notes that "*the FSO will play a role in being the tender body for onshore electricity network competition*". This is only one aspect of network infrastructure development, the others being:

- onshore electricity network developments undertaken by incumbent network owners,
- offshore electricity network development,
- development of networks for other energy vectors, such as natural gas, hydrogen and heat, which ought to be considered as part of the FSO's whole energy system planning.

Then, what is the procurement approach, and what – if any – role is there for Ofgem in verifying the need for the network developments being procured by the FSO and the value for consumers of the tenders that are received? What authority does the FSO have to act independently of Ofgem?

The FSO can make recommendations and give advice, but who has the power to take action on the basis of those recommendations or advice or to force action to be taken? Ofgem is unable to build anything. It can only allow money to regulated parties to build things, or develop market mechanisms to incentivise other actors to build.

It appears that the FSO would procure large onshore transmission infrastructure, placing a contract for its delivery directly. There is nothing equivalent for generation, storage, interconnectors or other network infrastructure. The implication – because this is what happens today – for generation, storage and interconnectors is that the market will deliver in response to price signals. How will a plan developed by the FSO relate to the price signals? The FSO's plan must somehow anticipate how market actors will respond to signals and propose a network plan that complements those responses. For onshore network infrastructure developments other than 'large' ones, we are left to assume that existing transmission owners will just get on with it, driven by licence conditions though with the possibility that they will have a different view from the FSO on precisely what's needed and can be delivered. Greater clarity is also needed for offshore electricity network infrastructure, including whether generation developers continue to develop it, or if it will also be under the auspices of the FSO.

3.3 Innovation and risk

We note that "*The FSO will also have a statutory duty to have regard to the desirability to facilitate innovation within itself and in the wider sector*".

Openness to new ideas is one thing. These can serve end users' interests very well in the long-term. However, an innovative approach might also entail risk. How is the FSO to approach the taking of risk?

A major opportunity for innovation may be argued to lie in the "early model" for competition in provision of major onshore transmission network developments. That has been discussed for many years with, as far as we understand, concern from potential developers about the risks to which they might be exposed. If they are exposed to those risks, tendered contract prices are likely to be higher. If risks to developers are to be reduced, it is likely that risks faced by bill payers will be higher. The approaches to risk taken by the FSO and Ofgem need to be defined.