THE SOCIETY FOR THE ENVIRONMENT
RESPONSE TO THE DBEIS
BUILDING OUR INDUSTRIAL STRATEGY GREEN PAPER

Introduction

1. The Society for the Environment registers and champions environmental professionals. Operating under a Royal Charter, we are the custodians of the Chartered Environmentalist (CEnv) and Registered Environmental Technician (REnvTech) registers and we are mandated to promote good environmental practice for the public benefit. We work in partnership with 24 professional bodies, which we license to award the CEnv and REnvTech professional statuses. The Society has registered over 9,000 environmental professionals to date and, through our licensed bodies, we have access to over 500,000 individuals. Our registrants are diverse; they range from chemists to engineers, working in frontline delivery as well as senior leadership, all practising and promoting the highest standards of environmental management.

Key messages

2. The Society applauds the early reference to *sustainable* success in the Prime Minister's foreword to this Green Paper, however we note that the concept of sustainability is not embedded throughout the document. Where there are references to sustainable growth and methods, it is narrowly conceived. We urge the Government to reconsider this stance. Economic sustainability is predicated on environmental sustainability; long-term and holistic stewardship of our natural capital is the foundation of sustainable growth.

3. We welcome the references to resource efficiency and productivity, though we caution that the language around this can be interpreted as solely utilitarian if it is not matched by a broader responsibility and commitment towards a circular economy.

4. It is telling that environmental considerations are concentrated in Pillar 7 on *Delivering affordable energy and clean growth*. We strongly encourage much broader engagement with 'green growth' – embedded across all the pillars of the Industrial Strategy – for an economy that is sustainable and works in harmony with the environment whilst also delivering better living standards, including greater well-being, for all and for future generations.

5. A central tenet of our perspective is to instil and promote sustainability as a matter of principle in public affairs and corporate governance.
   5.1. We call upon the Government to honour its commitments made under the Paris Agreement and Climate Change Act.
   5.2. We also call upon the Government to demonstrate leadership in working towards the UN Sustainable Development Goals, particularly on SDGs 7, 8, 9, 11, 12 and 13[1] for which the

[1] SDG7 Ensure access to affordable, reliable, sustainable and modern energy for all
SDG8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Industrial Strategy presents significant opportunities (though we encourage recognition of the interdependencies of all the SDGs).

5.3. We welcome the inclusion of environmental sustainability in the 'balanced scorecard' approach to procurement; we strongly support the protection of this criterion in improving procurement (Pillar 5) and encourage its extension into all upgrades of infrastructure (Pillar 3) as well as into the business developments of Pillars 4 and 6 ('supporting businesses to start and grow' and 'encouraging trade and inward investment', respectively).

5.4. As the Society has highlighted in a previous submission (regarding corporate governance), sustainability in business does not have to sacrifice shareholder value and, indeed, this can be significantly bolstered by greater levels of customer and employee care[2].

6. Given our imminent exit from the European Union, the Society stresses the importance of environmental regulation to safeguard our common resources that are not bound by national boundaries. We must protect and maintain the environmental standards achieved through our engagement with the EU and we must continue to co-operate with our European neighbours to this aim. The Society broadly supports the notion of ensuring that regulation is efficient and effective, while we underline the significance of behavioural change to support environmental and sustainable practices.

7. We at the Society believe that education – from technical and transferable skills training to continued professional development – provides the foundation for a sustainable and resilient economy and society. We therefore welcome plans to invest in science, research and innovation (Pillar 1), particularly where this supports 'green jobs' for green growth. We encourage breadth and depth here and in developing skills, i.e. education about sustainability for all and education that is not solely responding to gaps in business and industry because innovation can arise through the convergence of a range of perspectives and in response to a number of drivers.

8. In a similar vein, we encourage the inclusion of a wide range of stakeholders in, for example, the 'sector deals' of Pillar 8 for holistic, integrated and resilient solutions. Our registrants – Chartered Environmentalists (CEnvs) and Registered Environmental Technicians (REnvTechs) – are well-placed to assist in such stakeholder engagement as they are professionals recognised for their evidence-based expertise and knowledge of sustainability in practice across a range of industries. The Society would be happy to facilitate such knowledge-sharing activities.

SDG9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG11 Make cities and human settlements inclusive, safe, resilient and sustainable
SDG12 Ensure sustainable consumption and production patterns
SDG13 Take urgent action to combat climate change and its impacts
https://sustainabledevelopment.un.org/sdgs

[2] http://socenv.org.uk/resource/collection/0CB82E27-56A5-4AD5-9A92-DC76DD657AF9/SocEnv%20response%20to%20DBEIS%20Corporate%20Governance%20.pdf

Responses to consultation pillars and questions

Q1. Does this document identify the right areas of focus: extending our strengths; closing the gaps; and making the UK one of the most competitive places to start or grow a business?

and

Q2. Are the ten pillars suggested the right ones to tackle low productivity and unbalanced growth? If not, which areas are missing?

9. The Society for the Environment recommends – in the strongest terms – that the Government's focus on growth is revised to headline *sustainable* growth throughout the entire Industrial Strategy and embed this across its ten pillars. Economic sustainability is predicated on environmental sustainability; long-term and holistic stewardship of our natural capital is the foundation of sustainable growth. Much greater focus is required on resource efficiency (including energy efficiency) to establish and champion a sustainable and circular economy.

Investing in science, research and innovation

Q5. What should be the priority areas for science, research and innovation investment?

10. The Society supports calls made by the *Royal Society of Chemistry (RSC)*, one of our 24 licensed bodies, to protect fundamental science, alongside strategic and applied research, as it "often lays the groundwork for future breakthroughs and applications"[3].

11. We also support the *Institution of Environmental Sciences (IES)*, another of our licensed bodies, in calling for interdisciplinary research to be prioritised. We believe that a collaborative approach, be it interdisciplinary research or cross-sectoral industrial development (in reference to question 31), is always preferable as it enables joined-up thinking and can help to prevent unintended consequences.

Q6. Which challenge areas should the Industrial Challenge Strategy Fund focus on to drive maximum economic impact?

12. The Society welcomes the tacit recognition of the impact of the UK's exit from the European Union on research and innovation funding (p.28). We recommend that the Industrial Challenge Strategy Fund is used, in part, to mitigate against any loss in European funding for science, research and innovation. In a similar vein, we recommend the consolidation and enhancement of existing programmes and institutions with analogous aims of the Fund ahead of the creation of new programmes and institutions.

[3] http://www.rsc.org/globalassets/04-campaigning-outreach/policy/research-innovation/higher-education-and-research-bill---briefing-from-the-iop-and-rsc.pdf

Developing skills

Q13. What skills shortages do we have or expect to have, in particular sectors or local areas, and how can we link the skills needs of industry to skills provision by educational institutions in local areas?

and

Q14. How can we enable and encourage people to retrain and upskill throughout their working lives, particularly in places where industries are changing or declining? Are there particular sectors where this could be appropriate?

13. We join the *Institute of Environmental Management and Assessment (IEMA)* and the *Institution of Environmental Sciences (IES)*, two of our 24 licensed bodies, in recognising the significant and continuing shift in our jobs market in response to technological changes.

14. We recognise and champion the importance of lifelong learning. We support people upskilling throughout their professional lives, and we recognise their value through our professional registers of Chartered Environmentalists (CEnvs) and Registered Environmental Technicians (REnvTechs).

15. We would like to draw attention to the role that professional bodies can play in assisting the Government in this area. The Society is well placed to facilitate this and we would be happy to involve our CEnvs and REnvTechs directly to this aim.

Upgrading infrastructure

Q17. What further actions can we take to improve the performance of infrastructure towards international benchmarks? How can government work with industry to ensure we have the skills and supply chain needed to deliver strategic infrastructure in the UK?

16. The Society welcomes the Government's recognition of the value of natural capital in its thinking on infrastructure (p.54). The approach should be sustainable; our natural capital should be protected and enhanced. We recommend that any private investment and development in infrastructure is obligated to meet the highest environmental standards. This is an opportunity for sustainable business and green growth.

17. The Society's Chartered Environmentalists (CEnvs) and Registered Environmental Technicians (REnvTechs), a significant proportion of which work in infrastructure and related industries, are best placed to provide expertise on international benchmarks for sustainable development in this area as well as to advise on the skills and supply chains needed to deliver strategic infrastructure that is environmentally, and thus economically, sustainable and resilient.

Delivering affordable energy & clean growth

18. The Society would like to highlight the detailed perspective of the *Energy Institute (EI)*[4], one of our 24 licensed bodies, in response to this pillar, which is part of a response from the broader engineering community under the banner 'Engineering the Future' and led by the Royal Academy of Engineering. We defer to the *EI*'s specific expertise here, while we strongly support their emphasis on energy efficiency (in response to question 30). We believe that their call for behavioural change, both in how the Government approaches energy policy and how industry and consumers interact with the energy sector, has significant merit, particularly with regards to taking a more systems-thinking approach that addresses the interests of businesses and householders as well as reducing emissions.

Cultivating world-leading sectors

Q31. How can the Government and industry help sectors come together to identify the opportunities for a 'sector deal' to address – especially where industries are fragmented or not well defined?

19. The Society advocates a collaborative, cross-sectoral and interdisciplinary approach whenever and wherever possible. We recommend the inclusion of a broad range of interests in the Government's proposed 'sector deals'. The Society's Chartered Environmentalists (CEnvs) and Registered Environmental Technicians (REnvTechs) are well-placed to assist in a range of sector deals as they are professionals with evidence-based expertise and knowledge of sustainability in practice across a range of industries. We would be pleased to facilitate any such knowledge-sharing activities.

20. Our response will be made publicly available on our website www.socenv.org.uk. We would be happy to provide further information and/or assistance. Please direct any comments or questions relating to the Society's response to:

Dr Tatum Matharu
Policy and Parliamentary Lead
Society for the Environment
IC1.14a Technology Centre
Coventry Technology Park
Puma Way
Coventry
CV1 2TT
tatum.matharu@socenv.org.uk

[4] Attached as appendix (i).

Appendix

(i) Response by the *Energy Institute* to Pillar 7 *Delivering affordable energy and clean growth*

To deliver affordable energy and clean growth, the Government must develop a stable long-term Energy Strategy with a mechanism that ensures continuity across successive administrations and provides confidence and certainty for long-term planning and investment.

To meet its Climate Change Act and Paris Agreement obligations in the most affordable way, the UK needs to focus on energy efficiency. This, coupled with a holistic view of the energy system that takes into account how technologies operate as part of a system and work with consumers, should allow government to develop a least-cost strategy for decarbonised, integrated electricity, heat and transport.

To plan appropriately and deliver best prices and outcomes, industry requires a long-term and stable policy landscape that offers a clear direction of travel and long-term objectives and deliverables[5]. This is not only crucial for giving industry the confidence to enable investment, but also to address the skills issues that exist in areas such as nuclear technologies, where the UK has significant but ageing expertise. Energy policy changes should be consulted on with relevant industry professionals and fully explained prior to implementation. Industry is looking for a clear commitment by government to hold its nerve on energy efficiency and Climate Change Act-related policy, as investment and industry uncertainty created in one policy area or technology can be contagious.

Policies that stimulate development of technologies, business models and other opportunities should incorporate strict requirements around carbon dioxide emissions as well as affordability. These policies should take a medium- to long-term view, under a credible range of scenarios, and in doing so are likely to naturally promote areas in which there is some level of comparative advantage for the UK. This comparative advantage could consist of existing intellectual capital and experience, or particular features of the UK energy landscape. In our view, these areas will likely include greater efficiency of energy end use, certain aspects of nuclear power and Carbon Capture and Storage (CCS), expertise in market based solutions, and the leveraging of financial solutions to drive investment, alongside renewables and grid flexibility improvements such as energy storage and demand side response (DSR). Policies must also tackle the challenge of decarbonising the heat and transport sectors, and should not focus solely on electricity.

To work in a productive partnership, industry and government need to be clear about each other's roles and understand the boundaries. In our view, government's role is to set the goal and facilitate the travel – i.e. specify outcomes, provide enablers and incentives, ensure standards and regulations are enforced so that the cost of compliance with regulations does not become a voluntary tax on the law-abiding, and ensure that the playing field is level. Industry's role is to deliver on the targets that are set, but with the freedom to decide the methods and means.

[5] https://knowledge.energyinst.org/__data/assets/pdf_file/0019/250138/Energy-Barometer-2016.pdf

27. What are the most important steps the Government should take to limit energy costs over the long-term?

In order to achieve the goal of secure, stable and affordable energy supply, the Government needs to base its policy-making around multi-vector, system-wide solutions which build on end use energy efficiency measures. They should span low-carbon electricity, low carbon heat, low-carbon gas and decarbonised gas, and potentially hydrogen. In this, a systems view of energy production and consumption must be taken, joining up the disparate elements of business, energy, and industrial policy into a single coherent and long-term strategy, but one which is agile to the rapid changes in a complex global landscape.

Improving efficiency

When asked in the Energy Barometer survey[6] how to meet environmental and energy security goals most affordably, EI members prioritised improvement of energy efficiency above all other measures. This spanned domestic and commercial buildings, transport, and industrial processes. We believe there is potential for significant improvements in both energy efficiency and resource productivity[7],[8]. We advocate setting voluntary efficiency targets and providing incentives to encourage industry to generate their own clean energy where there is competitive advantage in so doing, such as where there is heat demand, or available land and resource availability to justify renewable solutions.

We believe that there is significant room to make both private and public housing stock – especially existing stock – more energy efficient. While we have good regulations in place for new build, there is a general need to ensure improved compliance, more rigorous enforcement of Building Regulations and for greater diligence in the building control industry to drive higher quality residential development and refurbishment. On existing housing stock, home owners need proper incentives to overcome what can be significant barriers to retrofitting insulation. The Bonfield report[9] provides detailed evidence of the challenges, and some possible solutions, in the existing domestic building stock. Further research into achieving energy-efficient buildings should be prioritised, along with programmes to encourage property owners to implement the best available techniques to improve the UK's building stock.

Smart meters are a starting point to raise consumer awareness, but are only of real value for the energy system when they are used to enable real time tariffs and as part of the development of the smart grid, and when they are linked to behaviour change initiatives. It is essential that those with smart meters have full access to data about their energy use in their home, and are able to transfer between energy suppliers with ease. We believe with the right incentives applied at the personal, community, and company level, it is possible to halve UK energy demand per person by 2050[10].

[6] https://knowledge.energyinst.org/barometer

[7] http://www.lowcarbonenergy.co/wp-content/uploads/2015/less-waste-more-growth/lwmg.pdf

[8] https://www.theade.co.uk/assets/docs/resources/2016_UK_Energy_Productivity_Audit.pdf

[9] Each Home Counts: An Independent Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy

[10] The 50% reduction in CO_2 emissions through energy efficiency and savings includes substitution of coal and oil with gas, electricity, biomass/wastes and heat from CHP. It is a common conclusion in a range of International Energy Agency reports, starting with IEA Energy Technology Perspectives 2008 (http://www.iea.org/media/etp/etp2008.pdf; See pp 61-67, especially Fig 2.2 p64
This has been backed up by a number of peer reviewed detailed studies, including

- Reducing Energy Demand: What Are the Practical Limits? - Jonathan M. Cullen, Julian M. Allwood,* and Edward H. Borgstein (Environ. Sci. Technol. 2011, **45**, 1711–1718; note Figure 2 and summary on page 7017)

There is significant opportunity to reduce overall carbon dioxide emissions and energy costs by smoothing demand peaks, enabled by time-shifting demand and local energy storage. Storage mechanisms can be as simple as hot water cylinders and immersion heaters, or as complex as battery installations or electric vehicles supplying electricity at times of shortfall. Integration across the whole energy system will be key to achieving significant cost and emissions reductions.

At present the gas system plays a key role in managing domestic energy demand peaks; in scenarios with reduced use of gas the role of local storage of heat will become much more important.

Network efficiency and flexibility can also be improved, through development of energy storage, smart grid infrastructure, and DSR technology and implementation. These will not only allow for increased overall efficiency, but can lower demand peaks and reduce the need for additional generation capacity.

Renewable Electricity

There have been dramatic reductions in the costs of renewables in recent years, driven by global demand and the dynamics of global supply chains. This includes offshore wind, in which the UK has internationally important resources. The UK also has significant resources in tidal energy, which is reliable and does not require backup in the same way as wind and solar. Given the relative immaturity of the technology, selective support should be given to projects and technologies that will drive learning and cost reduction.

Carbon Capture and Storage (CCS)

Hydrocarbons use should be increasingly limited to areas where alternatives are not readily available, such as petrochemicals, aviation, and process industries. Nevertheless, the UK Government must recognise that fossil fuels will continue to play a major role in the country's energy mix well into the second half of this century.

Decarbonising fossil fuel use will be a vital part of meeting our climate change obligations. To this end, the UK should:

- phase out the remaining coal-fired power plants as quickly as possible;
- recognise that Carbon Capture and Storage (CCS) will be essential for cost-effectively meeting the UK carbon budgets after 2023, is likely to play an essential role in decarbonising heat, and must be applied to all fossil fuel power stations running at substantive load factors and equivalent industrial processes; and
- lead global climate change efforts toward the introduction of some form of carbon pricing, to drive the rapid implementation of CCS.

- Halving global CO_2 by 2050; technologies and costs - N Shah et al on behalf of Imperial College London Grantham Institute for Climate Change and Energy Futures Lab (https://www.imperial.ac.uk/grantham/publications/all-publications/halving-global-co2-by-2050-technologies-and-costs.php; See main report and annex, specifically sections on Buildings, Industry and Transport).

The critical role of CCS in the transition to a low carbon energy system – both in large and relatively small scale plants – was addressed in detail in the Oxburgh report[11]. It advocates the need to exploit the cost saving benefits of implementation of multiple plants at scale and suggests business models whereby the cost of electricity from fossil fuels + CCS can be comparable to, or cheaper than, wind and nuclear within ten years. Scrapping the CCS demonstration has done severe damage to investor confidence in the low carbon programme. We believe support for CCS needs to be revisited and the technology put back on the agenda. Given a more cost reflective approach to carbon pricing, which might be more possible in a post-Brexit world, this might reduce significantly the extent of government support required. If decarbonisation of heating is to be achieved through substitution of natural gas by hydrogen (as, for example, in the Leeds h21 project - see later), then CCS will be an essential technology to remove the CO_2 produced alongside hydrogen in the shifted steam reformation of gas.

There will be a significant global need for proven and practical CCS technology, as many countries continue to exploit their indigenous coal reserves. The UK has significant expertise in power and coal research. With the UK withdrawing in the main from coal-fired power, there is only a narrow window for harnessing this expertise before it is lost to retirement and competition.

Nuclear Power

The UK nuclear industry has an international reputation for high standards of safety both in terms of operating facilities, decommissioning and new build. It makes a significant contribution to the UK's low carbon electricity, providing some 20% of the country's electricity today and will continue to make a major contribution well into the future through the new nuclear power plants now under construction. However, the sector struggles with an ageing workforce and relies on imported reactor designs, which is a lost opportunity for the historical strength of UK engineering and design.

There is an opportunity for the UK supply chain to play some part in the development of Small Modular Reactors; however, this will likely need some form of catalytic activity from Government and a clearer focus from the industry on commercially viable solutions. The UK could use its history of reactor development and international reputation for safety and quality to develop and promulgate UK technology for a worldwide market.

Innovation Partnerships

To encourage the introduction of new technology to improve productivity and fuel consumption, a promising approach is fostering partnerships between energy-intensive industries and entrepreneurial SMEs in fields such as bioenergy, hydrogen and CO_2 use.

Decarbonised heating

Heating buildings and hot water accounts for 40% of UK energy consumption and 20% of greenhouse gas emissions but progress on decarbonising these has stalled[12]. Electrification of heat

[11] Parliamentary Advisory Group on CCS – Final Report
[12] https://www.theccc.org.uk/publication/next-steps-for-uk-heat-policy/

using heat pumps would facilitate the decarbonisation of heat, but fully removing gas-fired boilers from the heat mix and replacing them with electrical heating would be very expensive and disruptive.[13] Promising alternative approaches include repurposing the existing gas grid to deliver low-carbon fuels, developing district heating, and recovering and re-using waste heat. The Energy Systems Catapult's Smart Systems and Heat programme is working with local authorities to create the capability to deliver local area energy plans specific to their communities.

Efficiency

As with electricity, the most sustainable form of heating is that which is not required. Heating efficiency savings should be at the core of a drive towards decarbonised heating, resulting from better incentives to make the UK's existing housing stock more energy efficient and from tightening and enforcing building regulations on energy efficiency. Behavioural changes, encouraged through better education and communication, also have great potential for reducing energy use for heating (and in other sectors).

Low carbon gas

National Grid's Energy Strategy and Policy Group found that introducing renewable gas could save £500m per year in 2030 (for 37 TWh/a of renewable gas) rising to £3.9 billion per year in 2050 compared with continued use of natural gas (for 100 TWh/a of renewable gas).[14] Mechanisms should be established to support the development and roll-out of large-scale plants producing BioSNG (biomethane), which could be a low cost, low carbon energy solution for many communities.

Hydrogen

The option of using hydrogen (100% or blended) is being explored in projects such as the Leeds h21 pilot project and should be supported. However, safety concerns must be addressed before the technology can be rolled out beyond restricted and carefully regulated schemes. CCS is likely to be a critical element in the production of clean hydrogen produced from natural gas.

District heating

The November 2015 Spending Review provided £300m to fund heat networks over the next five years, which is expected to create up to 200 large heat networks in England and Wales heating commercial offices, public sector buildings like hospitals and schools, as well as flats and houses by 2025. Heat networks not only allow heat recovery but also yield benefits in terms of grid balancing, demand management, energy storage and flexibility. All of these benefits reduce overall costs, but this needs to be captured in current investment models to ensure heat networks' commercial viability. [15]

Heat pumps

Ground- and air-source heat pumps have been installed in the UK since 2004, but high upfront costs, low cost savings and the age and size of the UK housing stock all contributed to the slow uptake of the technology in the UK. There is an interesting opportunity to use heat pumps as a low-carbon

[13] KPMG: 2050 Energy Scenarios - The UK Gas Networks role in a 2050 whole energy system http://www.energynetworks.org/gas/futures/the-uk-gas-networks-role-in-a-2050-whole-energy-system.html

[14] https://www.ofgem.gov.uk/sites/default/files/docs/national_grid_gas_distribution_-_commercial_biosng_demonstration_plant.pdf (Appendix 2)

[15] http://www.ukerc.ac.uk/publications/meeting-report-heat-networks-and-governance.html

source of energy for district heating schemes. While the integration of heat pumps into heat networks is a new phenomenon in the UK, such schemes have been running successfully elsewhere in Europe for over ten years. [16]

Network flexibility

To accommodate the changes in feedstocks and use patterns, the existing gas distribution network will need to become smarter, more flexible and responsive, to ensure network capacity does not become a barrier. All these technologies are expected to require significant upfront investment but will yield benefits in the long term.

28. How can we move towards a position in which energy is supplied by competitive markets without the requirement for on-going subsidy?

Some renewables are nearing the price of gas generation in the UK, including wind and solar PV. Government funding would be well-used to research effective integration of these renewables into a flexible UK electricity grid, in combination with efficiency measures to reduce the amount of new generation required.

However, other forms of low-carbon energy remain significantly more expensive than using hydrocarbons. Previous initiatives aimed at making renewables competitive were created in a time of high oil prices. With the oil price at current levels, and no international carbon pricing mechanism yet in place, it is likely that some subsidy will be required to achieve a competitive market supplying cheap low-carbon energy to industry. It is recommended that subsidy regimes have clearly-articulated deployment targets and payment reduction structures for when prices of renewable technologies come down. This could help avoid subsidy cost overruns as well as industry shocks as subsidies are reduced or removed.

Shale gas can offer a secure indigenous source of energy and with appropriate technology and oversight can be exploited safely. However, public acceptance presents a non-trivial barrier, and significant production is likely years away. Balanced information should be available to the public about the benefits and risks of exploiting shale gas, and how these can be safely managed[17], as well as about other future energy issues such as CCS, wind, and other renewables that play a key role in a long-term UK energy strategy. Furthermore, while emissions could be reduced by replacing the remaining coal-fired generation with shale gas, CCS would be required to make further carbon cuts, which would add to the cost.

In Germany, the cost of electricity is borne disproportionately by commerce, government and domestic consumers, while heavy industrial users pay only the marginal costs of electricity generation. Industry would no doubt welcome a similar approach being taken in the UK; however, this is not compatible with the government's current focus on improving energy affordability.

Distributed and community energy offers opportunities for higher efficiencies and cost advantages through higher end-use efficiencies, potential re-use of waste products in a circular economy, and avoidance of transmission losses. Community schemes benefit from greater local transparency and potentially local involvement and acceptance of low carbon generation, which could improve public

[16] https://www.gov.uk/government/publications/heat-pumps-in-district-heating

[17] https://knowledge.energyinst.org/collections/shale-gas

acceptance of higher prices. District heating schemes should be used to make more efficient use of waste heat from industrial processes, and will require regulation to ensure consumer protection.

In the longer term, we would like to see a future where there is an internationally level playing field, enabled by standardised carbon pricing or tax. Currently, different sustainability standards adopted by individual countries distort the market and push high-carbon and high-emission industries to countries with less advanced environmental policies. Accounting for the global cost of carbon dioxide emissions would resolve the current market failure and benefit the UK's economy by incentivising local, sustainable products and services rather than offshored emissions. Money raised from a carbon tax could be re-invested to support a faster transition to a low-carbon economy. To achieve this internationally-level playing field, the UK should maintain a leadership role in global climate negotiations and mitigation efforts.

29. How can the Government, business and researchers work together to develop the competitive opportunities from innovation in energy and our existing industrial strengths?

The UK should aim to maintain energy research funding at near the G8's level as a proportion of GDP. Government should base funding decisions on comprehensive evidence such as life cycle assessments detailing total energy costs and environmental impact as well as ancillary effects, such as the need for backup power for intermittent sources. It should prioritise funding of long term solutions and whole-system approaches. At the same time, research should be allowed to explore how better to enable new business models that allow market-based innovation to flourish, and to make the UK a first choice for innovators in this area.

Cities, and cities-within-cities such as university campuses or hospitals could be used as test beds for fully joined up energy systems comprising community heating, electricity etc., which would allow for testing of new technologies as well as systems integration. Frequently, there is considerable community interest but insufficient infrastructure. A limited amount of government funding could unlock significant potential here, and catalyse development and investment in the regions. Regional innovation and development will be vital, but this will need to clearly fit into a national energy framework to ensure the least cost energy solution is delivered to UK plc.

We expect that UKRI will decide on research funding for energy and look forward to seeing its thinking and focus. We would welcome a funding setup that actively fosters links between academia and industry to encourage a focus on real-world energy issues and commercialisation. Such innovation could be encouraged through tax reliefs for research and development.

A longstanding but important issue for the UK is the support to transition promising innovations into commercialisation. All too often, research that started in the UK is commercialised elsewhere. The most common reason is lack of available funds to scale-up, though legal, regulatory and human resource barriers also play a role.

Catapults have an important role to play with helping developments bridge the gap from R to D, particularly in SMEs, but are less applicable in large companies which have greater in-house resources but bigger concerns over protecting intellectual property. The Energy Systems Catapult in particular is focussed on whole system issues in electricity and heat, including the establishment of enabling platforms for innovators to bring forward new technologies and business models. Many of

the most promising new technologies and business models lie close to the end user, and are driven by the same technology ecosystems that have produced the internet and smartphone revolutions.

One solution is to mandate a proportion of corporate profits made in the UK to go into energy-related R&D, perhaps match-funded by Government. A study of the supported mechanisms for innovation in selected and successful overseas countries is recommended.

30. How can the Government support businesses in realizing cost savings through greater resource and energy efficiency?

Energy efficiency is often overlooked, but a kWh saved is usually much cheaper than all production options. Existing international protocols for the measurement and verification of energy-saving projects are widely used to underpin investments using energy performance contracting models. They can directly help the UK to meet carbon reduction commitments and ease pressure on security of energy supply.

Government could play a key role in sharing of best practice and highlighting the cost savings arising from resource and energy efficiency projects, enabling industry and consumers to see this as an investment rather than an additional cost.

Energy productivity should be a priority; this is the measure of how much energy is required to produce a pound in the economy. Boosting energy productivity supports the UK economy by getting more for less. Energy policy is currently approached in silos, separately addressing carbon and the environment, security, and cost, resulting in policies pulling against one another. We should be taking a systems-thinking approach, addressing the interests of businesses and householders, as well as reducing emissions.

In industry, we can learn from how a change in approach to Health and Safety has brought about a culture change and apply this to energy saving. Applied to industrial energy efficiency, this could lead to a scheme to identify opportunities, and implement the findings so that energy consumption in an organisation is As Low As Reasonably Practicable (ALARP), insofar as this does not undermine the competitiveness of the plant.

In the domestic and non-domestic housing sector, Minimum Energy Efficiency Standards (introduced through the Energy Act 2011) use energy performance certificates initiated in response to the EPBD. The minimum energy efficiency regulations will mean that, by 1 April 2018, all properties in the private rented sector with energy ratings falling below a certain level will normally have to be improved to a specified minimum energy efficiency standard before being let to tenants. These standards are proving to be an effective catalyst in both the private rented residential and commercial sectors.

To help meet the UK's requirements under Article 8 of the EU Energy Efficiency Directive, the Energy Savings Opportunity Scheme (ESOS) has been set up. This is an energy assessment scheme that is mandatory for organisations in the UK that are classified as large enterprises or are part of a large group enterprise. According to the government, the scheme will identify thousands of energy saving initiatives in buildings, industrial activities, and transportation, which could save organisations more than £31bn between 2015 and 2030 if all the recommendations in the ESOS reports are carried out. ESOS could have a huge positive impact on UK businesses and is an example of how effective policy can deliver beneficial outcomes.

Third-party funding can help overcome barriers, and could be modelled on the energy performance contracting model which has been operating for many decades in the USA.

More voluntary/incentivised targets for the industrial sector would be of assistance. UK business has a good understanding of what should be done and where to seek expertise. Policy which prioritises internal business spend in the direction of efficiency and energy cost saving would help.