Energy Systems Catapult Response to the Business Energy and Industrial Strategy Consultation: *Designing the Industrial Energy Transformation Fund*

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 Dicicco at: tony.dicicco@es.catapult.org.uk

Key Points

Our modelling identifies a few key technologies that can have the most significant impact on reducing the cost of decarbonisation:

- ***The IETF should focus on a few large-scale projects, including CCUS, as these stimulate other projects to follow and are transformative to meet decarbonisation targets***. For decarbonisation in particular, the IETF should encourage long-term value through creation of infrastructure or demonstration of technology which can be used by many other organisations.

- ***Progressing the development and deployment of CCUS remains of high strategic value to UK decarbonisation and can help to fill the 'nuclear gap'.*** A renewed strategy, including for deployment in the power sector and possibly hydrogen production, should be developed urgently, drawing on the lessons from cost reduction achieved in offshore wind resulting from sustained policy support.

- ***Sustainably grown biomass also has the potential to become a critical resource for the UK energy system.*** It can be burned directly for heat and power or converted into low carbon gases and liquid fuels to decarbonise hard-to-treat sectors.

- ***Bioenergy and CCUS are especially valuable in combination.*** Together, they offer the potential for negative emissions to counterbalance the continued use of fossil fuels in difficult sectors like aviation.

- ***A Local Area Energy Plan that has been agreed by key stakeholders (local and regional government, network operators, local businesses etc) can help to unlock private investment by providing certainty around likely outcomes and, therefore, potential revenues.*** It will also reduce the risk of stranded assets and lead to lower transition costs than an uncoordinated, piecemeal approach to decarbonisation.

- ***Industries should be rewarded for working collaboratively with local stakeholders, community energy projects and investors and for encouraging co-located early adopters of smarter, cleaner technologies and demonstrators***.

Detailed Response to Questions:

Q1: What wider benefits could the IETF deliver, such as local growth and low-carbon leadership opportunities?

1. Energy System Catapult recently updated to its 2050 scenario work to the Energy Technologies Institute (ETI); Clockwork & Patchwork – UK Energy System scenarios[1]. This work found that 'a balanced multi-vector approach can deliver an affordable, low carbon UK energy transition, with costs rising to around 1% of GDP by 2050'. **What is likely to become more important is taking a whole-systems[2] view**. This means understanding how the traditional silos between heat, power and transport are breaking down as a result of new technologies, including digitalisation. It also means understanding that how the consumer responds, is an essential part of the future energy system. This becomes more important as consumer-facing technologies like heating and transport undergo significant change.

2. IETF could facilitate decarbonisation by helping to provide infrastructure that lowers decarbonisation costs for follow-up investments, such as a hydrogen or low carbon electricity supply, CO_2 transport and storage etc. An infusion of investment, especially in new technology and skills, should reduce the environmental impact of heavy industry. In those industries that share key performance indicators, improved installations could be benchmarks for all other plants; improvements in air quality could be a secondary win.

Q2. Are these barriers the ones that prevent you from investing in industrial energy efficiency and decarbonisation projects or are there other barriers? If so, what are they?

[1] Energy Technologies Institute: *'Options, Choices, Actions: Updated'* (2018) https://www.eti.co.uk/options-choices-actions-2018/

[2] Adopting a *'whole system'* perspective implies understanding interactions between multiple vectors such as heat, gas, electricity, hydrogen and transport and how they are changing as a result of new technologies and digitalisation. Whole system thinking and action must also include 'both sides of the customer meter', and not be limited in definition to be transmission and distribution networks.

3. Yes, payback period (or similar metrics) is a key issue. A relative lack of materiality of the benefit from energy savings, compared to other opportunities in processing efficiency, for example, raw material savings, is also a key factor. Compliance with environmental regulations or product standards and other "essential" expenditure consume capital and energy, so spending more capital on "low reward" projects can starve the organisation of capital to improve its productivity.

Q3. How would you raise funding for a decarbonisation project? Would you consider third party financing? If not, why not?

4. The ESC works with partners to develop innovative solutions for decarbonisation. An example of this is our work with three local authorities Newcastle, Bridgend and Bury using the EnergyPath™ Networks (EPN) modelling framework. These Pilot studies (documented in the ETI/ESC report[3]*: 'Local Area Energy Planning: D11 Insight report 3: implications for government)* conducted by the ETI/ESC have shown the potential of Local Area Energy Planning (LAEP)[4] to provide the evidence, guidance and framework to enable the long-term transition to a low carbon energy system.

5. We believe that having a Local Area Energy Plan that has been agreed by key stakeholders (local and regional government, network operators, local businesses etc) can help to unlock private investment by providing certainty around likely outcomes and, therefore, potential revenues. It will also reduce the risk of stranded assets and lead to lower transition costs than an uncoordinated, piecemeal approach to decarbonisation. The costs involved in providing energy services are substantial even under *'Business-As-Usual'* (BAU). For the three pilot areas, with total population of 620,000, just less than 1% of the UK population, the forecasted future BAU cost of providing energy services to homes, businesses, public buildings and industry is £24 billion over the period 2015-2050[2]. The increase between BAU and deep decarbonisation, to 95% below 1990 levels, is a further £3.4 billion**. Access to funding to deliver the required energy transformation will be a key consideration; third-party funding must be part of the solution.**

Q4. What evidence is needed in your organisation in order to make investment decisions, or to spend resources on exploring energy efficiency and industrial decarbonisation projects?

6. The ESC has a modelling capability at every level of the energy system, including:

    - **National Energy System Modelling and Analysis** - internationally peer-reviewed Energy System Modelling Environment™ (ESME) tool, based on deep sector expertise. Developing additional tools such as the **Storage and Flexibility Model** and national datasets such as the Infrastructure Cost Calculator.

[3] ETI (2018*): 'Local Area Energy Planning: D11 Insight report 3: implications for government'.*
[4] LAEP considers the unique characteristics of the local area and its existing energy system to guide the transition; aid decision making; prioritise resources; and support project and investment decisions.

- **Local Energy System Modelling and Analysis** - drawing on the EnergyPath Networks™ local area energy planning tool, to inform and support local authorities and Local Enterprise Partnerships with a cost-effective low carbon energy transition.
- **Building Energy System Modelling and Analysis** - drawing on the Integrated Electric Heat tool to understand the interactions within a home, between different domestic heating systems, controls, building fabric, weather and consumer needs.

7. The ESC uses this modelling capability to determine a whole-system approach to decarbonisation, including energy efficiency.

Q5. What were the payback periods of some of your recent investments? Are there any additional/alternative quantitative factors that heavily influence your investment decisions? Which of these could be an effective test of additionality for the IETF, and why?

8. No answer.

Q6. Do you have views on what design features might best support achieving an appropriate balance of both IETF objectives?

9. The amount of funds available through the IETF could be split between energy efficiency and decarbonisation projects. It will be important to support large-scale trials of Carbon Capture, Usage and Storage (CCUS) as the updated ESC UK Energy System *(Clockwork and Patchwork)* Scenarios have concluded that without CCUS, the UK carbon abatement costs could be double by 2050. Sustainably grown biomass (within a wider context of GHG-friendly land use change) also has the potential to become a critical resource for the UK energy system. It can be burned directly for heat and power or converted into low carbon gases and liquid fuels to decarbonise hard-to-treat sectors. The analysis also highlights the importance and versatility of CCUS and biomass-based approaches to reducing emissions, with applications across power, industry and hydrogen production.

Q7. How can we best target the IETF to maximise value for money?

10. Industry should be incentivised to propose transformations that consider the wider needs of surrounding communities, local energy actors and the future uses of the energy system, especially electrification of transport, smarter home energy systems and innovation in domestic heat. This is important because industry is served by the same energy networks as other large-scale users and industrial scale changes to demand and generation can have a disproportionate effect on other stakeholders and projects. For example, industry has more upstream connections to the electricity network than other local stakeholders and one project can have a large impact on available network capacity. Large industrial plants could compete for spare grid capacity with the roll-out of network-interoperating EV charge-points in town centre retail centres, causing slower EV growth in a location where it is most needed and beneficial to the community.

11. IETF can build-in independent evaluation of industrial-scale effects on dynamic energy use and interaction with the energy system. Incentives should not be granted where the

dynamic impacts on network flexibility and profiles of headroom for generation or supply have not been properly evaluated. Industries should be rewarded for working collaboratively with local stakeholders, community energy projects and investors and for encouraging co-located early adopters of smarter, cleaner technologies and demonstrators.

12. Including these measures will allow funding to be allocated to proposals that recognise and will act to unlock area-wide decarbonisation opportunities. The Catapult works with other large energy use projects to understand the wider local area assets, needs, trends and stakeholders and to help shape area plans that consider the medium- and long-term pathways that will optimise decarbonisation. This local area modelling approach provides local energy asset representations, so that planned transformation projects also work for neighbourhoods, districts, town and local authorities.

Q8. How do you think we should focus the IETF's decarbonisation element? What is your evidence for this view?

13. For decarbonisation in particular, the IETF should encourage long-term value through creation of infrastructure or demonstration of technology which can be used by many other organisations. The IETF should focus on a few large-scale projects[5], including CCUS, as these stimulate other projects to follow and are transformative to meet decarbonisation targets. Industry-wide proposals can be properly evaluated over the wider energy system, so they integrate effectively as part of cohesive approaches to UK energy system decarbonisation, clean growth and efficient use of energy.

14. Our whole system analysis of the UK energy transition points to the importance of creating market conditions which enable and incentivise investment in a balanced portfolio of low carbon technologies. In particular, CCUS has a high system value and the evidence suggests it is vital to a cost-effective low carbon transition. New nuclear is also of strategic importance in enabling large-scale low carbon electricity generation and reducing the risk of relying on a narrow set of options.

Q9. Are there any additional complementary policies that the Government could consider to maximise the impact of the IETF funding?

15. Industrial transformation through wider process efficiencies such as the reuse of waste-heat has strong dependencies on effective complementary policies for local heat networks and district heating. The ***Industrial Clusters Mission*** is cited in the Consultation as a complementary policy.

16. **Nearly half of UK heat demand could be met by heat networks[6]. From a whole energy systems perspective, heat networks should play a much larger part in the UK's heat delivery system in 2050, especially in less efficient and higher density buildings.** A

[5] About 70% of UK industrial emissions are from 30 sites (2 steelworks, 6 refineries, 2 crackers,10 cement works, 10 chemical plants (NAEI point source data, 2016).
[6] ETI/ESC (2018): *"District Heat Networks in the UK: Potential, Barriers and Opportunities"*

key factor affecting the commercial viability of heat networks is capital cost. The IETF could be used to provide support for innovation in heat networks, especially where there is the possibility to use "waste" heat. Not only would capital cost and investment barriers be reduced, but in the longer term the size of the market would likely expand due to increased competitiveness with other methods of heat delivery.

17. There are clearly specific investment challenges for CCUS. The government is right to explore a range of options for improving the investibility of 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.

Q10. What stages of development are most in need of IETF funding, to enable projects to reach deployment?

18. There isn't time to develop new technology, test and deploy it before the end of the funding period (2024). If the Fund does not assist deployment per se, which would be desirable, then funding detailed design/business cases for specific projects at specific sites would be the next best use of funds.

19. 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.

20. 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.

Q11. Can you provide evidence for the type of support (such as regulation, grants, loans, equity) that could enable industrial decarbonisation projects to go ahead?

21. The government's Clean Growth Strategy represents a significant step forward in integrating climate policy objectives with broader industrial and economic objectives. A continued policy commitment to industrial strategy and public investment in energy innovation is important.

Q12. Do you have any additional suggestions of how you could engage with us as we design the scheme?

22. There needs to be strong emphasis on systems integration and the need to develop best practice integration frameworks and methods akin to the ERIS **"Aspects of integration"**

formative work. The Industrial Clusters Mission may be an appropriate vehicle to develop this approach.

23. The experience of working with three local authorities and other stakeholders has shown the value of planning at local level to identify the cost-effective technological options for decarbonisation in the specific area. Further work is needed to consolidate evidence and establish formal decision-making framework, funding streams and planning processes, while ensuring that local actions meet regional and national priorities.

24. New policy frameworks and business models that promote an integrated, multi-vector approach to low carbon energy 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. 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 with CCUS, hydrogen and vehicle charging demands and infrastructure.

25. Our **Rethinking Decarbonisation Incentives** project points to the need for the UK to improve the economy-wide coherence of carbon policy across different sectors. Current policies deliver uneven incentives for investment in reducing emissions across different sectors, and generally deliver rewards to investors that are too low to reflect the value of investment in new low carbon infrastructure and technology