UNIVERSITY of STRATHCLYDE
CENTRE FOR
ENERGY POLICY

Centre for Energy Policy Response to the Second National Infrastructure Assessment: Baseline Report - Call for Evidence

February 2022

Introduction

The Centre for Energy Policy (CEP), led by Professor Karen Turner, was established in 2014 and is a multi-disciplinary hub that facilitates research, knowledge exchange and policy engagement on energy and climate issues from a wider public policy perspective

Uniquely, CEPs developing research foundation offers a 'wider view' of energy and climate policy, going beyond technology-driven analyses to consider the wider economic, social, political and, crucially, public policy context of decision making. In particular, CEP has expertise in multi-sector economy-wide modelling for political economy and public policy scenario analyses. This allows us to investigate in a holistic manner how different actions and options are likely to impact across the wider economy, the trade-odds involved for different actors, including how costs and benefits are ultimately distributed across different sectors and regions, and how consequences may be effected through policy intervention.

In this response we have answered questions 1,2,3 & 5 relating to the wider objectives and role of the National Infrastructure Commission (NIC) and questions 9,10,11 &12 relating to Net Zero. Other questions that fall beyond the scope of our expertise have not been addressed.

Answers to questions

Question 1: Do the nine challenges identified by the Commission cover the most pressing issues that economic infrastructure will face over the next 30 years? If not, what other challenges should the Commission consider?

Yes, we believe that the nine challenges identified by the Commission are among the most pressing issues that economic infrastructure will face over the coming 30 years. In delivering against each of these challenges, we would like to draw the Commission to the attention of CEPs Net Zero Principles, which have emerged from undertaking policy facing economic research across a range of energy and infrastructure related sectors. The Net Zero Principles are described in a peer reviewed paper published in Local Economy[1], and a linked policy briefing, 'Establishing a Net Zero Principles Framework to Support Public Policy Making'[2] and are summarised as follows:

1. Understanding who really pays and gains
2. Identifying pathways that deliver growing and equitable prosperity
3. Enabling actions that can deliver near term economic returns
4. Avoiding outcomes that involve offshoring of emissions, jobs and GDP
5. Understanding that Net Zero is a societal and public policy challenge

[1] Karen Turner, Antonios Katris, Julia Race. The need for a Net Zero Principles Framework to support public policy at local, regional and national levels (Jan 2021). Local Economy. https://doi.org/10.1177/0269094220984742

[2] Establishing a Net Zero Principles Framework to Support Public Policy Making, CEP Policy Brief, available to download at https://strathprints.strath.ac.uk/78032/

As reflected across these 5 principles, it is crucial that the wider economy perspective to understand how different policy choices, funding mechanisms and delivery timescales will impact different households, sectors, and the wider economy more generally. Here we suggest that out our principles align with the NICs overarching objectives on supporting sustainable economic growth across all regions of the UK, improving competitiveness and quality of life. We agree with the NICs focus on taking a whole systems approach, but we reiterate that understanding the wider economy perspective, and how actions in different sectors will interact and impact across society should be central to that approach. With this in mind, we agree with the NICs categories of cross cutting analysis (bills impacts, public spending impacts, distributional impacts, climate change impacts, environmental impacts, regional impacts) and reinforce the importance of understanding how they will be impacted by different actions set out to deliver against each of the 9 challenges.

As recognised in the HMT Net Zero Review[3], it is likely that actions to deliver against each of the challenges, and interlinkages between them, will bring both challenges and opportunities for the economy and society. Here it will be important to understand how potential opportunities can be grasped, and importantly how they can be used to offset inevitable costs. For example, in our recent work focussed on understanding the wider economy implications of deploying carbon capture and storage (CCS) to support decarbonisation of the UK's regional industry clusters, our research[4,5] shows that delivering a transport and storage sector in the economy brings opportunities for 'green growth' and could, depending on the funding model adopted and the evolution of supply chains, help deliver on 'just transition' objectives. Conversely, our research indicates that applying costly carbon capture to key industrial sectors could bring significant competitiveness challenges that could negatively impact the wider economy outlook unless transitory support acts to enable first in building efficiency and potential competitive advantage as the UK moves early in deploying CCS.[6] Using research to understand outcomes such as these will be important to understand the impacts of an economy transitioning to net zero emissions.

Question 2: What changes to funding policy help address the Commission's nine challenges and what evidence is there to support this? Your response can cover any number of the Commission's challenges.

Our expertise at CEP, where our work focusses on energy and climate policy, mainly lies in addressing challenges 2-4. Here, research undertaken across a range of different policy areas (such as transport, heat and industrial decarbonisation) delivers insight on how different funding approaches may deliver different outcomes across the categories identified by the NIC – such as bill, public budget, and distributional impacts.

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[3] https://www.gov.uk/government/publications/net-zero-review-final-report

[4] Turner, Karen, Julia Race, Oluwafisayo Alabi, Christian Calvillo, Antonios Katris, Jamie Stewart, and Kim Swales. 'Could a New Scottish CO2 Transport and Storage Industry Deliver Employment Multiplier and Other Wider Economy Benefits to the UK Economy?' Local Economy: The Journal of the Local Economy Policy Unit 36, no. 5 (31 October 2021): 411–29. https://doi.org/10.1177/02690942211055687.

[5] Turner, Karen, Jamie Stewart, Antonios Katris, Julia Race, Oluwafisayo Alabi, and Christian Calvillo. 'Moving Early in Carbon Capture and Storage: Opportunities and Challenges for Delivering Green Growth and Just Transitions'. Report. Glasgow: University of Strathclyde, 1 November 2021. https://doi.org/10.17868/78347

[6] Turner, Karen, Julia Race, Oluwafisayo Alabi, Antonios Katris, and J. Kim Swales. 'Policy Options for Funding Carbon Capture in Regional Industrial Clusters: What Are the Impacts and Trade-Offs Involved in Compensating Industry Competitiveness Loss?' *Ecological Economics* 184 (30 June 2021). https://doi.org/10.1016/j.ecolecon.2021.106978.

For example, our research[7] to understand the wider economy impacts of delivering the transition to electric vehicles in private transport, shows that some wider economy gains could materialise (largely from the greater use of domestic supply chains in fuelling vehicles). However, our research indicates that the current approach of passing the costs of upgrading the electricity distribution networks to consumer bills, combined with the economy expanding in the context of persistent labour supply challenges, will have sustained price and cost of living impacts over long time periods. This may suggest the need to consider particularly how lower income households, who may already be fuel poor, can be protected.

In the case of decarbonising heat, improving the energy efficiency of the UK's building stock is recognised as a key component. However, current schemes, such as the energy company obligation (ECO) are also funded through a levy on consumer energy bills, which brings distributional impacts for low income households in particular. Here, our research[8] indicates that the provision of government grants to install energy efficiency measures in domestic properties could bring wider economy benefits, by reducing energy bills and alleviating pressures on household budgets, particularly for lower income households. However this approach has inevitable consequences for public budgets which must be considered.

Finally, our research (cited above)[9] to understand the impacts of deploying CCS in the UK, has highlighted that an 'industry pays' approach to funding new CO_2 transport and storage infrastructure could lead to negative economic outcomes. Here, where industries take on additional costs to apply CCS ahead of international competitors, the associated negative impacts will hit the sector, the associated supply chains and ultimately the wider economy. This is particularly true in timeframes where efficiency gains and competitive advantage in the delivery/use of CCS systems is yet to develop. Additionally, these negative impacts may be particularly felt in the regions where jobs and economic prosperity are heavily dependent on key industries. This should be an important consideration for factors such as the 'levelling up' agenda.

To summarise, expertise gained across our research portfolio reinforces the importance of identifying the wider impacts of different funding mechanisms and crucially understanding who really pays, how, when and where. Ahead of policy implementation, robust independent research and analysis can be used as an important tool to understand the inevitable trade-offs and consequences of different policy options.

Question 3: How can better design, in line with the design principles for national infrastructure, help solve any of the Commission's nine challenges for the next Assessment and what evidence is there to support this? Your response can cover any number of the Commission's challenges.

We welcome the inclusion of the Commission's principles and particularly highlight the importance of engaging with a wide range of stakeholders to understand and frame the key challenges associated with designing policy and delivering new national infrastructure. For

[7] Alabi, Oluwafisayo, Karen Turner, Gioele Figus, Antonios Katris, and Christian Calvillo. 'Can Spending to Upgrade Electricity Networks to Support Electric Vehicles (EVs) Roll-Outs Unlock Value in the Wider Economy?' Energy Policy 138 (1 March 2020): 111117. https://doi.org/10.1016/j.enpol.2019.111117

[8] Katris, Antonios and Turner, Karen (2021) Can different approaches to funding household energy efficiency deliver on economic and social policy objectives? ECO and alternatives in the UK. Energy Policy, 155. 112375. ISSN 0301-4215

[9] UK focussed work is under peer review but results are presented in our 2021 report 'Moving early in carbon capture and storage' cited above.

example, in our research[10] undertaken to understand the wider economy implications of delivering a new nationwide energy efficiency programme, our close collaboration with officials in the department for Business, Energy and Industrial Strategy (BEIS) allowed us to understand the control that key but less well recognised parameters (such as economic rent) had on economic outcomes associated with delivering large scale energy efficiency schemes. Additionally, in our aforementioned work on carbon capture, close collaboration and engagement with industry associations allowed us to understand the key implications on industry of applying carbon capture (such as the importance of capital efficiency and returns rather than the more recognised and commonly used metric of 'costs per tonne of CO_2 captured').

As well as the importance of engaging with the wider stakeholder community, we would also like to reiterate the importance of taking a 'whole system approach' that also considers the economic system, rather than purely a 'energy or infrastructure' system. Here, tools such as whole economy Computational General Equilibrium (CGE) models – already used by HMT, with our own model shared with colleagues at BEIS following the aforementioned collaboration on understanding wider economy impacts of supporting residential energy efficiency gains - can be useful to understand the trade-offs and consequences of different approaches to delivering critical infrastructure. Such tools also provide the basis for developing understanding of how cross cutting and often less considered parameters (such as labour market conditions) can impact outcomes across the economy. As shown in our work[11], labour market assumptions, such as 'wage adjustment' can have positive or negative impacts on outcomes depending on whether the economy is expanding or contracting – i.e. wage responses can add to inflationary pressure or buffer the impacts of additional costs. These factors will be especially important to consider given the current issues we are seeing in the UK with labour markets constraints in certain sectors.

Question 4: What interactions exist between addressing the Commission's nine challenges for the next Assessment and the government's target to halt biodiversity loss by 2030 and implement biodiversity net gain? Your response can cover any number of the Commission's challenges.

Question does not align with our area of expertise

Question 5: What are the main opportunities in terms of governance, policy, regulation and market mechanisms that may help solve any of the Commission's nine challenges for the Next Assessment? What are the main barriers? Your response can cover any number of the Commission's challenges.

As described in our recent discussion paper 'Green growth, price pressures and productivity'[12], using policy frameworks to support productivity and efficiency gains across a range of sectors in the economy could be seen as a central opportunity that lies within control of UK actors and which can interact with a range of governance, policy, regulation

[10] Katris, Antonios and Turner, Karen and Stewart, Jamie (2021) Meeting the UK's energy efficiency goals : securing greater wider economy benefits through longer term programmes. Preprint / Working Paper. University of Strathclyde, Glasgow. https://doi.org/10.17868/77545

[11] See for example - Turner, Karen, Julia Race, Oluwafisayo Alabi, Antonios Katris, and J. Kim Swales. 'Policy Options for Funding Carbon Capture in Regional Industrial Clusters: What Are the Impacts and Trade-Offs Involved in Compensating Industry Competitiveness Loss?' *Ecological Economics* 184 (30 June 2021). https://doi.org/10.1016/j.ecolecon.2021.106978.

[12] Turner, Karen (2021) Green Growth, Price Pressures and Productivity. Discussion paper. University of Strathclyde, Glasgow. https://doi.org/10.17868/78418

and market mechanisms to improve positive outcomes and mitigate negative ones. This can help to mitigate the costs associated with reaching net zero emissions and help deliver against the nine challenges set out.

Conversely, the evolving and likely sustained labour supply constraint in the UK could be seen as a key barrier to delivering against the nine challenges set out by the Commission. This will both make it challenging to deliver through and evolve UK supply chains and exacerbate inflationary pressures/cost of living challenges of enabling such large scale transition as required here.

2. Reaching net zero

Challenge 2: Decarbonising electricity generation – the Commission will consider how a decarbonised, secure and flexible electricity system can be achieved by 2035 at low cost.

Question 8: What are the greatest risks to security of supply in a decarbonised power system that meets government ambition for 2035 and what solutions exist to mitigate these risks?

Question does not align with our area of expertise

Challenge 3: Heat transition and energy efficiency – the Commission will identify a viable pathway for heat decarbonisation and set out recommendations for policies and funding to deliver net zero heat to all homes and businesses.

Question 9: What evidence do you have on the barriers to converting the existing gas grid to hydrogen, installing heat pumps in different types of properties, or rolling out low carbon heat networks? What are the potential solutions to these barriers?

We welcome the Committees focus on this challenge and would like to highlight the importance of considering non-technical barriers and opportunities to the decarbonisation options described in the question. In recent months CEP has started work on a new research project funded by the UK Energy Research Centre (UKERC). The project titled 'Delivering an equitable and sustainable heat transition'[13] will identify and shape evidence-based, policy driven pathways which can successfully balance the conflicting technical, economic and socio-political dimensions of the residential heat transition in the UK. Crucially, looking beyond the technical challenges of decarbonising heat, it will do so by strengthening understanding of the economic and societal impacts and consequences, and the associated opportunities, challenges and trade-offs of different actions to decarbonise heat.

For example, our research will consider how the inevitable negative impacts on the economy and household budgets associated with the capital requirement to install heat-pumps, and collectively paying to upgrade the electricity networks, could be offset if the greater efficiency of heat-pump systems can be made use of alongside making buildings more energy efficient. However, we know that the current retail market framework, where electricity costs significantly more than gas (per unit of energy) will limit the ability to make use of this efficiency gain. Understanding factors such as these will be crucial in effectively planning and delivering a low carbon heat transition across society whilst retaining a strong and

[13] https://ukerc.ac.uk/project/delivering-heat-transition/#:~:text=The%20sustainable%20and%20equitable%20heat,heat%20transition%20in%20the%20UK.

prosperous economy. As our work on this project moves forward we will endeavour to share findings and learnings with the NIC.

Question 10: What evidence do you have of the barriers and potential solutions to deploying energy efficiency in the English building stock?

We have undertaken a programme of work to understand the wider economy implications of delivering energy efficiency retrofit programmes in both Scotland[14,15] and across the UK[16]. In our most recent work we looked at the implications of delivering both a short term 4 year and long term 15 year programme. As described in our answer to question 2, we explore the impacts of using different funding options (such as grants, loans, and regulation) and explore how the timing of retrofitting activity and certain labour market conditions will affect outcomes.

A central barrier to delivering a nationwide energy efficiency programme is the cost of installing measures. Through engagement with BEIS, we estimate a 15 year programme to bring all eligible households up to an EPC C rating will cost in the magnitude of £68.5bn over a 15 year period.[17] While this cost could be seen to be prohibitive, we find that even short-term energy efficiency improvement programmes can trigger long-term household income and economy-wide gains – with real incomes being freed up being the main driver of economic expansion. For example, we find a sustained GDP increase of £1,285 million per annum (0.07% p/a) is possible, along with 22,545 (0.077% p/a) new full-time equivalent (FTE) jobs, regardless of the funding option used for the 15-year programme. However, our research shows that the timing of the retrofitting activity plays a significant role on the labour requirements in the sectors that deliver the retrofitting's and the economy-wide impacts in general. Early action means that over 135,000 skilled workers will be necessary in year 1, while under late action the requirements are raised to over 137,000 skilled workers in year 15. Steady action smooths out the labour requirements and the wider economic impacts.

This requirement for a high number of skilled workers could also be seen as a key barrier to the deployment of energy efficiency schemes across England. This is particularly true if the labour market is constrained and other sectors expanding to meet net zero related infrastructure development concurrently demand workers with similar skills. However, the job opportunities created could bring a range of wider economy benefits. Therefore as a solution, actions should be taken to ensure the suitable supply of a trained workforce. This is likely to be more forthcoming if long term Government programmes are set out with a commitment to deliver the appropriate funding and policy support, which will build confidence for those thinking of entering and working in the sector.

Challenge 4: Networks for hydrogen and carbon capture and storage - the Commission will assess the hydrogen and carbon capture and storage required

[14] Turner, Karen and Katris, Antonios and Figus, Gioele and Low, Ragne (2018) Potential Wider Economic Impacts of the Energy Efficient Scotland Programme. https://strathprints.strath.ac.uk/63819/

[15] Gioele Figus, Patrizio Lecca, Peter McGregor & Karen Turner (2019) Energy efficiency as an instrument of regional development policy? The impact of regional fiscal autonomy, Regional Studies, 53:6, 815-825, DOI: 10.1080/00343404.2018.1490012

[16] Katris, Antonios and Turner, Karen (2021) Can different approaches to funding household energy efficiency deliver on economic and social policy objectives? ECO and alternatives in the UK. Energy Policy, 155. 112375. ISSN 0301-4215 https://strathprints.strath.ac.uk/76432/

[17] Katris, Antonios and Turner, Karen and Stewart, Jamie (2021) Meeting the UK's energy efficiency goals : securing greater wider economy benefits through longer term programmes. Preprint / Working Paper. University of Strathclyde, Glasgow. https://strathprints.strath.ac.uk/77545/. Paper on this work now under peer review.

across the economy, and the policy and funding frameworks needed to deliver it over the next 10-30 years.

Question 11: What barriers exist to the long term growth of the hydrogen sector beyond 2030 and how can they be overcome? Are any parts of the value chain (production, storage, transportation) more challenging than others and if so why?

Through researching how the deployment of CCS infrastructure, and effective new sector/industry introduction, will impact the wider economy, a number of more generic findings have emerged that could similarly apply to the deployment of a new hydrogen sector in the UK economy. These are detailed in a recent CEP report 'Moving early in carbon capture and storage'[18] and include:

- **Lesson 1 -** Introducing new sectors in the economy to reduce carbon emissions to meet net zero targets will inevitably involve increased costs that will feed through to consumer prices and risk losses in GDP. Where one nation moves first in incurring and reflecting these costs in prices, it will lose competitive advantage in international markets in the near-term. However, a leading nation could potentially win this back through early learning-by-doing, technological progress and resulting efficiency gains over time.

- **Lesson 2 -** 'Green growth' opportunities arising from opportunities to develop new sectors (such as hydrogen) or building strong domestic supply chains to service such emerging low carbon sectors – could help offset cost-driven employment and other economic losses associated with decarbonisation costs. However, like any form of economic expansion, 'green growth' in an economy characterised by constraints on labour supply and/or other 'factors of production', this is likely to involve consumer price pressures that can only be effectively and sustainably alleviated through productivity gains in supply and/or mitigated through increased efficiency in use.

- **Lesson 3 -** Potential tensions between decarbonisation, 'green growth' and regional 'levelling up' agendas exist, where, depending on the policy approach and funding model adopted, the costs of delivering any one solution may be borne disproportionately by firms, workers and households in particular geographical regions within any one nation.

Question 12: What are the main barriers to delivering the carbon capture and storage networks required to support the transition to a net zero economy? What are the solutions to overcoming these barriers?

As noted in our response to question 2, we have undertaken a programme of work across a number of years and projects to understand the wider economy implications of deploying CCS in the UK.[19] Through this work a number of barriers have emerged, some of which relate directly to CCS, and others that could more generally apply to a range of net zero technology and infrastructure areas.

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[18] Turner, Karen, Jamie Stewart, Antonios Katris, Julia Race, Oluwafisayo Alabi, and Christian Calvillo. 'Moving Early in Carbon Capture and Storage: Opportunities and Challenges for Delivering Green Growth and Just Transitions'. Report. Glasgow: University of Strathclyde, 1 November 2021. https://doi.org/10.17868/78347. Two papers resulting from this work are currently undergoing peer review.

[19] In addition to the papers cited elsewhere in this response, please see our CEP website for a range of academic publications, policy briefings and reports linked to the wider economy implications of CCS deployment in the UK - https://www.strath.ac.uk/humanities/centreforenergypolicy/ourpublications/

As discussed in our response to previous questions, a key barrier identified is the challenge that arises around requiring firms to operate capture equipment ahead of other international competitors. Here our research,[20] informed by close engagement with industry actors and associations, identified that increased capital requirements could result in between 30% and 50% increases in the capital equipment required to produce a given level/unit of chemicals output, mapping to reductions in the capital efficiency of firms. In passing such cost on impacts on through industry output prices, the consequent reduction in international competitiveness acts to reduce demand for output and activity levels, impacting the sector itself, employment and value-added generation throughout supply chains, and across the wider economy, with implications for GDP and tax revenue generation. Similarly if industrial firms take on the costs of servicing the demand for a newly deployed CO_2 transport and storage infrastructure (which initially may be oversized), similar competitiveness challenges emerge and may compound impacts.

However, the consequent negative implications for both capture firms and the wider economy could be offset by a combination of subsidies to avoid passing such costs through to output prices and 'learning-by-doing'. Here these options could limit the overall capital efficiency implications of operating additional capture equipment, with potential to gain competitive advantage as international competitors follow in bearing carbon capture costs. This competiveness challenge has been recognised by BEIS who have set out policy frameworks for 'CCUS Business Models'[21] to support industry operators with the additional costs of CCS ahead of international frameworks for emission control developing or markets for 'green products' emerging.

[20] Turner, Karen, Julia Race, Oluwafisayo Alabi, Antonios Katris, and J. Kim Swales. 'Policy Options for Funding Carbon Capture in Regional Industrial Clusters: What Are the Impacts and Trade-Offs Involved in Compensating Industry Competitiveness Loss?' *Ecological Economics* 184 (30 June 2021). https://doi.org/10.1016/j.ecolecon.2021.106978.

[21] https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-business-models