Scottish Draft Energy Strategy and Just Transition Plan Consultation
University of Strathclyde response

https://doi.org/10.17868/strath.00085444

May 2023

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Please cite as "Corbett, H., Calvillo Munoz, C., Hannon, M., Anderson, P., Cairns, I., Davies, K., Galloway, S., Hawker, G., MacIver, C., McGarry, C., Turner, K. and Yarr, R. (2023) Scottish Draft Energy Strategy and Just Transition Plan Consultation Response, University of Strathclyde, https://doi.org/10.17868/strath.00085444".

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Response Summary

The following sets out the key takeaways and messages from this response by chapter.

Chapter 1 – Introduction and Vision

- The ambition of the draft strategy is welcome and necessary given the pressing public policy challenge that needs to be addressed. This ambition needs to be underpinned by concrete policy detail which the draft strategy seeks to provide.
- The policies set out here need to be integrated across wider economic and social policy frameworks and decision-making processes.
- Coordination between Scottish Government and industry, as well as with government at UK and regional levels, will be critical to the delivery of this strategy and Net Zero and climate targets (at devolved and national levels) more broadly.
- Effective, coordinated and integrated policy planning and decision-making will also be essential for Scotland and the UK to capture the opportunities and advantage afforded by the transition in an increasingly competitive global environment shaped by frameworks such as the US Inflation Reduction Act.

Chapter 2 – Preparing for a Just Energy Transition

- Developing understanding around where the benefits (e.g., jobs and GDP) and costs of the transition and specific Net Zero actions may accrue/fall is crucial.
- This type of understanding, including distributional outcomes, will be essential to, for example, informing the ongoing drive to tackle fuel poverty and efforts to improve energy efficiency, ensuring the costs and benefits are fairly distributed. Moreover, ensuring Net Zero actions serve to address rather than exacerbate inequalities.
- Consideration of how labour markets will impact on the outcomes of different Net Zero actions is needs to be strengthened. Benefits such as jobs and GDP generated by different Net Zero actions could be eroded by persisting labour supply constraints, and where multiple Net Zero and major infrastructure projects are competing for resources.
- Coordinated action is required across Scottish and UK Governments, in order to put in place the necessary policy frameworks that incentivise and de-risk both decarbonisation action and the development of domestic supply chains and an appropriately skilled workforce.

Chapter 3 – Energy supply

- Consideration must be given to how the economic and social benefits once derived from the oil and gas industry can, and will, be replaced by those flowing from new renewable energy sectors.
- Supporting communities' transition to new energy supply sectors, in addition to sustaining and creating jobs and a skilled workforce, could also help avoid the problem of labour displacement and could contribute to meeting policy priorities around a Just Transition and 'Levelling Up'.
- The Scottish Government should take a stronger role as a mediator and matchmaker to identify complementary projects on the supply and demand side, to promote optimal use of national energy resources over least regret options and the loss of production potential to export markets.
- In line with Scotland's climate and energy ambitions and guidance from the international scientific (IPCC) and energy (IEA) community, the overwhelming message is that there must be no new oil and gas production if we are to meet climate goals. Consequently, a feasible and detailed plan needs to be set out Scotland's transition away from the country's reliance on fossil fuels, with consideration on how our energy demands can be met in ways that are sustainable, that preserve and create decent work and do not simply offshore emissions and jobs. There are important

lessons to be learn from the steel industry where production, along with jobs, GDP and emissions has been offshored, yet demand for steel in the UK remains.

Chapter 4 – Energy demand

- Increasing the efficiency with which households use energy, plays a key role in reducing energy use and bills, fuel poverty and emissions, as well as generating positive wider economy outcomes. Therefore, it is of key importance for achieving a Just Transition towards Net Zero.
- The Scottish Government can also support the effective deployment of energy efficiency and low carbon heat by providing policy frameworks and clear direction for sustained action, building certainty for industry, allowing for investment and to develop the required supply chains. Policy also needs to move away from assuming that homeowners act in a purely economically rationale entities and adopt a social relational approach.
- The energy system, in particular the electricity system will have to undergo significant change to accommodate and facilitate the decarbonisation of transport. This includes increased renewable generation capacity and greater emphasis on infrastructure planning, flexibility and security of supply.
- Besides the technical and societal challenges, the transition to low carbon transport can deliver important economic benefits. However, it is necessary to recognise that the benefits may not be shared on an equitable way. Standardisation or regulation for the setting of charging tariffs and/or subsidies are ways in which these issues could be addressed.
- Significant effort is required to reframing public mind set to regard cars as a transport service, in conjunction with continued support and increased visibility of alternatives to car ownership (e.g., zero emission car clubs), also promoting public transport and active travel.

Chapter 5 – Creating the conditions for a Net Zero energy system

- Establishing a Future System Operator (FSO) will be critical to achieving energy independence on an accelerated time scale, providing the right environment for business growth, supporting market reform and underpinning sustained lower energy prices for consumers and businesses all on a path to Net Zero. Developed in the right way - with the right set of people, skills and methods and sufficient funding - the FSO can offer leadership and support to the many parties to work together in pursuit of Government objectives and help build needed confidence for critical parties to act.
- The Scottish Government (along with the UK Government) needs to find a way of reconciling local environmental impacts and local opinion with society's need for timely access to reliable, low cost, low carbon supplies of energy.
- Scotland and the rest of GB mutually benefit from being part of GB-wide electricity and gas markets that allow energy to be exchanged between different regions and externally to other jurisdictions. Facilitating the expansion and or replacement/upgrade (in the case of shifting from natural gas to hydrogen) of this capability will be key to both unlocking Scotland's future renewable potential and maintaining security of supply.

Chapter 6 – Route map to 2045

- The roadmap provides a useful overview of the Scottish Government's route of planned activity and outcomes to realising its climate and energy ambitions. How this set of activities and outcomes is integrated, as well as measured against wider economic and societal outcomes, will be critical to its efficacy and success.

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Chapter 1 – Introduction and Vision

1. What are your views on the vision set out for 2030 and 2045? Are there any changes you think should be made?

1.1 The ambitions set out in the Scottish Government's Draft Energy Strategy and Just Transition Plan are a welcome and necessary response to the climate emergency and the pressing public policy challenge of transitioning to Net Zero. Indeed, the recent Synthesis Report of the Intergovernmental Panel on Climate Change Sixth Assessment Report underscored that 'there is a rapidly closing window of opportunity to secure a liveable and sustainable future for all.'[1]

1.2 The attempt to set out the concrete policy detail underpinning Scottish Government's energy and Just Transition ambitions is timely. In 2022, the Climate Change Committee report to the Scottish parliament highlighted that the Scottish Government "…has made substantial funding commitments, and good progress on enabling measures such as local energy and heat network planning. However, it does not have adequate policies in place to deliver low-carbon heat and energy efficiency at the required rates and lacks the powers required to implement certain policy levers."[2]

1.3 The framing of these issues as public policy and not just technological challenges is critical.[3] Through such a framing, understanding around the economy-wide opportunities, challenges and trade-offs across different areas of policy focus can develop and inform policy pathways and responses that provide the right incentives and are economically, socially and politically, as well as technologically, feasible.

1.4 Scotland's energy and Just Transition policies need to be integrated across wider economic and social policy decision-making. While the transition has the potential to support a strong and sustainable economy, ambitions set out in the draft strategy and plan will require much needed policy action and coordination with industry to ensure that Scottish supply chains and the broader economic activity they support can prosper as these low carbon sectors grow. Ensuring economic growth, alongside industrial and workforce transitions, that contribute to offsetting the impacts of declines in the oil and gas production sector, which Scotland's economy has so heavily relied upon, will not be easy to achieve. There is a real risk of challenging trade-offs affecting economic well-being, and the distribution thereof, emerging as Net Zero target timeframes close in.

1.5 As the recent Skidmore Review argued, 'Net Zero is creating a new era of opportunity…but government, industry, and individuals need to act to make the most of the opportunities, reduce costs, and ensure we deliver successfully' with an urgent need 'for clarity, certainty, consistency, and continuity from government.[4] Effective coordination of policy across national, devolved and regional levels of government is key. The Scottish Government has several policy levers at its disposal (such as in housing and transport). However successful interaction with the UK Government around areas such as reform of the wholesale energy market, an issue on which the draft strategy has called for action, will be important. The strategy talks about an 'Energy Transition delivery group', which they will invite UK Government to be part of, and the Skidmore Review suggested that UK Government create an 'Office for Net Zero Delivery'. The UK Government's response to the latter that responsibility for these coordination efforts lay with the newly created Department for Net Zero and Energy Security

[1] https://www.ipcc.ch/report/ar6/syr/
[2] https://www.theccc.org.uk/publication/scottish-emission-targets-progress-in-reducing-emissions-in-scotland-2022-report-to-parliament/
[3] https://strathprints.strath.ac.uk/78032/
[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128689/mission-zero-independent-review.pdf

with senior ministerial representation at Cabinet. Establishing effective and sustained coordination mechanisms between these different groups and departments at Scottish and UK levels will enable the success of the Scottish energy transition but contribute to meeting wider UK Net Zero ambitions. It will also help Scotland and the UK capture opportunities and advantage in an increasingly competitive global environment shaped by frameworks such as the US Inflation Reduction Act.[5]

Chapter 2 – Preparing for a Just Energy Transition

2. What more can be done to deliver benefits from the transition to Net Zero for households and businesses across Scotland?

2.1 As highlighted in 1.3, the framing of Net Zero as a public policy, and not just a technological challenge, can help develop understanding around where the benefits and costs of the transition and specific Net Zero actions may accrue/fall.

2.2 There is a critical need to focus on, and understand, the equity and distributional outcomes of different Net Zero actions, particularly in the context of persistently high energy prices.[6] When rising energy costs are driving price increases across the economy and the goods and services that we buy, lowest-income households suffer most. The absolute value of energy bills and real spending power losses in those 20%-40% of households on the lowest incomes is less than those households on mid-to-high incomes. However, the proportionate (percentage) impacts are greater. This is because the largest part of spending in lower income households is on energy; both in terms of direct energy costs (e.g., energy/petrol bills) indirect energy costs (e.g., food, which uses a lot of energy in production and distribution).[i]

2.3 Policies need to be designed that help tackle the main drivers of fuel poverty (i.e., the energy inefficiency of homes; low household income; and high energy prices)[7] to help ensure the Scottish Government's statutory 2040 fuel poverty targets are met.[8] While the recently announced increase in the Fuel Insecurity Fund is to be welcomed,[9] it will be important to monitor and measure the impact of this fund and other fuel-poverty reduction actions. The Scottish House Condition Survey (SHCS) provided fuel poverty data, but the last survey was published in 2020.

2.4 Energy efficiency is a clear example of a Net Zero measure that has the potential to:

- stimulate growth by freeing up real income in a manner that generates jobs, increases real wages and reduces the energy intensity and fossil fuel dependence of a higher GDP trajectory, while reducing energy poverty and the cost of running households;
- drive entrepreneurial activity in delivering more energy efficient technology and equipment in ways that present opportunities for expansion and investment across a range of different sectors; and
- strengthen energy security and resilience to future shocks.[10] [11] [12]

[5] https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/
[6] https://www.cornwall-insight.com/press/energy-prices-to-remain-significantly-above-average-up-to-2030-and-beyond/
[7] https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/howfuelpovertyismeasuredintheuk/march2023
[8] https://www.legislation.gov.uk/asp/2019/10/notes/division/2/1
[9] https://www.gov.scot/news/more-funding-made-available-for-fuel-insecurity-fund/
[10] https://strathprints.strath.ac.uk/76432/
[11] https://strathprints.strath.ac.uk/82777/
[12] https://strathprints.strath.ac.uk/82700/

However, the way in which such energy efficiency measures are implemented matters a great deal in terms of how and to what extent these potential benefits are realised, as does a recognition that policies will need to be tailored according to different tenures, income levels and geographical locations. For example, regulations around governance and property management are presenting barriers for homeowners who live in flats to take action on energy efficiency.[13] Remote rural areas have also experienced a sharp increase in fuel poverty (increasing from 33% to 43% between 2018 and 2019).[14]

2.5 Economy-wide opportunities and benefits including jobs created and GDP resulting from different Net Zero actions and policies could be eroded because of persisting labour supply constraints currently affecting the wider UK and Scottish economies. The Office for National Statistics (ONS) and energy industry bodies continue to report worker and skills shortages as a major barrier to progress.[15] [16] [17] Too many estimates of green job creation do not consider the potential displacement of employment and activity across sectors in tight labour market conditions. For example, projections of up to 50,000 jobs supported by carbon capture, utilisation and storage (CCUS) by 2050 – across multiple activities throughout relevant supply chains and new internal and export markets - could be massively overestimating likely actual outcomes if worker and skills shortages lead to cost competition and displacement of activity and jobs across sectors.[18] For example, new research suggests that a new Scottish CO_2 Transport and Storage industry built around the Acorn project, and sequestering up to 6.4 million tonnes of CO2 per annum (60% of which is generated in the Scottish cluster) could ultimately support just under 1,100 full-time jobs across UK supply chains, but with some displacement of employment in other sectors as real wage rates are bid up in the UK's supply constrained labour market. However, in the absence of persisting labour supply constraints and/or associated wage pressures this figure could more than triple to around 3.900, with limited or no displacement of jobs across other sectors.[19]

Similarly, actions to reduce energy demand, such as retrofitting for energy efficiency and electrifying private transport can deliver 'green growth' outcomes coupled with new job and career opportunities but these will constrained by labour market conditions and responses as different net zero and other activities compete for scarce workers and skills.[20]

Crucially, in addition to gross employment losses in important industries - such as in traditional car manufacturing (potentially up to 17,000 jobs) as we transition to EVs – associated with changing activity patterns, if worker and skill shortages are not addressed, cost and price pressures accompanying economic expansion could have broad jobs displacement and other distributional effects associated with cost-of-living and -doing business pressures.[21] [22] [23] [24] In summary, with multiple Net Zero projects and activities competing for constrained resources such as labour, and needing to demonstrate commitments to 'local content' (supporting

[13] https://pureportal.strath.ac.uk/en/publications/under-one-roof-the-social-relations-and-relational-work-of-energy
[14] https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2020/12/scottish-house-condition-survey-2019-key-findings/documents/scottish-house-condition-survey-2019-key-findings/scottish-house-condition-survey-2019-key-findings/govscot%3Adocument/scottish-house-condition-survey-2019-key-findings.pdf
[15] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/changingtrendsandrecentshortagesinthelabourmarketuk/2016to2021
[16] https://commonslibrary.parliament.uk/research-briefings/cdp-2023-0001/
[17] https://oilandgasuk.cld.bz/Workforce-Insight-2022-OEUK
[18] https://strathprints.strath.ac.uk/82451/.
[19] https://doi.org/10.17868/strath.00084117
[20] https://doi.org/10.17868/strath.00082451
[21] https://www.sciencedirect.com/science/article/pii/S0301421521002457.
[22] https://strathprints.strath.ac.uk/77545/
[23] https://www.sciencedirect.com/science/article/pii/S0140988322001736?via%3Dihub
[24] https://doi.org/10.17868/78270

domestic supply chains), trade-offs are likely to arise in the form of increasing cost and price levels and potential losses in international competitiveness.[25] [26] [27]

2.6 The strategy recognises that much of the action to deliver Scotland's energy transition will happen at a local and regional level. However, it seems to overlook the important role of the third sector in driving climate action, including action around thermal efficiency of homes and household level action. Consideration needs to be given to what Scottish support can be provided to place-based, community embedded organisations to support action for Net Zero, to ensure those benefits can be distributed fairly.

2.7 Communities and businesses need access to the data, knowledge, skills and strategic partnerships to make their own net-zero transition. A regional and national 'mission' style approach is needed, with the inclusion of local 'skills hubs', designed to help educate and train these organisations to take effective net-zero action[28].

2.8 Dense urban environments can benefit from district heating schemes, but the success of these schemes will rely on heat users connecting to them and being incentivised and encouraged to do so. Crucially, the price of heat must incentivize these district heating connections, which also means that the price of electricity - if heat electrification solutions being considered, like district heat pumps - must also make this attractive.

3. How can we ensure our approach to supporting community energy is inclusive and that the benefits flow to communities across Scotland?

3.1 Some communities are in a much stronger position to engage with energy market than others, raising questions about how inclusive the sector is. Without careful design, community energy could serve to deepen, rather than alleviate inequality, if policy and market design affords wealthier communities to engage at the expense of more deprived communities. Scotland requires community access to the energy market to be much more inclusive and for the "playing field" to be levelled, so that *all* communities can access benefits from a Net Zero transition.

3.2 Inclusivity and energy justice concerns have been most acute in relation to how subsidies have been raised to support community energy over the past decade. Policies such as the Feed-in-Tariff (FiT) and Renewable Heat Incentive (RHI), have provided long-term revenue streams to subsidise the life-time costs of decentralised energy generation. They do not cover capital costs and so in order to access these subsidies, communities must already have the capital to construct energy generation assets. Furthermore, these were funded through policy costs levied on energy bills, where the lowest income households spend proportionally more of their income (10%) on energy versus the highest income households (1.5%)[29]. Lower-income households are therefore contributing a higher proportion of their income towards long-term revenue subsidies (e.g., FiT), whilst wealthier households have a greater opportunity to self-finance (some or all) of the capital to build the generation assets necessary to capture these subsidies.

This same dynamic can theoretically translate to the community level. Unlike many wealthier communities, poorer communities without the capital to construct generation facilities could not access these subsidies, yet they were still paying for them through their bills. Interestingly

[25] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/changingtrendsandrecentshortagesinthelabourmarketuk/2016to2021
[26] https://strathprints.strath.ac.uk/79477/
[27] https://strathprints.strath.ac.uk/80868/
[28] https://doi.org/10.1016/j.erss.2023.103086
[29] https://doi.org/10.1080/14693062.2020.1773754

however, in Scotland, “feed-in-tariff payments for household-level wind and solar PV systems have heavily benefitted more affluent socioeconomic groups…[FiT] payments to community energy projects have flowed more consistently into areas of higher deprivation”[30]. This highlights the important role community groups play in allowing households in deprived communities to capture the same value streams as individual households in wealthier neighbourhoods. Whilst, these two policies have now been discontinued, future policy makers must be sensitive to two questions regarding community energy: 1) *who pays* for these subsidies; and 2) *who benefits* from these subsidies?

3.3 A critical barrier to communities engaging in the energy sector relates to capability and/or capacity limitations. Capabilities refer to the skills and experience the community holds, which are necessary to actively engage with the energy market. Examples include financial acumen, legal expertise, experience of business development etc. Capacity on the other hand refers to communities' ability to exercise these capabilities, in a way that enables them to engage with the energy market. Examples include different forms of capital, such as financial, social, political, human and natural capital (e.g., land)[31]. A shortfall in either capability or capacity can exclude certain communities from engaging in the energy sector, and the associated benefits that flow to them.

3.4 Turning to capabilities in further detail, there is a critical need for nationwide community energy hubs that are designed to “upskill” communities via training, knowledge exchange and awareness raising [32]. The aim to ensure they have the necessary capabilities to engage with the marketplace. These capabilities must then be married with capacity building, such as the resourcing of community development officers to help communities exercise and hone these capabilities.

3.5 Both capacity and capabilities can also be significantly expanded through partnerships with local and/or national stakeholders, in particularly local councils and non-department public bodies (e.g., Forestry Land Scotland, Crown Estate) [33]. An important policy to support this would via mandating some form of partnership between community energy groups and these public bodies, such as a requirement for shared ownership of local energy projects and/or sourcing a minimum share of electricity from community generation. Intermediary organisations (e.g., Energy4All) are also essential in enabling communities to outsource essential project development and delivery activities, as well as acting as a locus for sharing best practice across projects and sector-wide. This can be critical to communities formulating an attractive investment proposition to investors and securing sufficient finance to deliver a project [34].

3.6 Focusing on financing capacity in greater detail, some communities are in a much stronger financial position than others, and thus less reliant on external investment. Furthermore, wealthier communities can self-invest, and through raising community finance (e.g., shares, loans, bonds etc.), the local community can retain majority control of both the project’s activities and associated benefits. Conversely, in the absence of significant state subsidy, poorer communities must look to external investors to finance their projects, in return for relinquishing a share of operational control and project benefits (e.g., revenue). It is therefore essential that communities that are unable to self-finance have easy and affordable access to project finance, which supports them from project development, right through to delivery [35] [36]. This should primarily be provided via state financing (e.g., Scottish National Investment Bank) but incentives ought to be in place to encourage “ethical investors” (e.g., Triodos) to prioritise

[30] https://doi.org/10.1016/j.enpol.2021.112512
[31] https://doi.org/10.1016/j.erss.2023.103086
[32] https://doi.org/10.1016/j.erss.2023.103086
[33] https://doi.org/10.1016/j.erss.2023.103086
[34] https://doi.org/10.1016/j.eist.2022.11.004
[35] https://doi.org/10.1016/j.eist.2022.11.004
[36] https://doi.org/10.1016/j.erss.2023.103086

finance offerings for community energy. Encouraging the wider investment sector to prioritise community energy would be encouraged via minimum Net Zero and Just Transition investment standards. This may include for example, a minimum share of funding for projects that deliver a 'triple bottom line' value proposition (i.e., environmental, social and economic) across an institutional investor's portfolio.

3.7 For all projects, community access to external and internal (i.e., local community) investment is impacted significantly by the wider policy and regulatory landscape. These conditions effectively raise or diminish how attractive a community energy investment proposition is to investors of all kinds, impacting key metrics such as return on investment, payback period etc. A handful of policy changes have been particularly damaging to prospects for community energy financing. In short, the removal of capital grants has meant that project finance for community energy has become increasingly important to project delivery. Simultaneously, the removal of long-term revenue streams and tax breaks has meant this same finance has also become harder to secure, by making investment propositions higher-risk and lower-reward in the eyes of investors.

3.8 Prior to 2015, under the Enterprise Investment Scheme (EIS) and Seed Enterprise Investment Scheme (SEIS), CE investors could reduce their tax liability by between 30% and 50% of the value of the shares they buy; up to a total investment of £150,000. However, in April 2015 government announced CE cooperatives would no longer be eligible for these investment tax breaks and in October 2015 announced it would be ineligible for support under its successor, the Social Investment Tax Relief (SITR). The rationale behind its removal was that CE was already receiving ample subsidy via the FiT. However, this has subsequently been cut and there is clearly an opportunity to support resource mobilisation by making CE projects once again eligible for investment tax relief via the SITR[37].

3.9 The dilution and removal of revenue payments, such as the FiT and RHI, has been particularly damaging to community access to the energy market have been highly lucrative for some community groups. Across our four case studies we find that revenue payments accounted for between 10 % and 79% of their revenue during the financial year 2017/18, with the total income ranging from £27,625 per annum (see BHESCo) to £191,252 per annum (see GEM)[38]. The withdrawal of revenue payments was considered to have significantly undermined investment into the CE sector (I5, 15, 19). As the Low Carbon Hub explain, the removal of the FiT has "significantly reduced the number of rooftop projects that we are able to deliver with our operating model"[39] [p.34]. The FiT was replaced by the Smart Export Guarantee (SEG) but it covers only export and not generation, offers "no minimum export price, and no long-term certainty beyond 12-month periods"[40] [p.3]. Together, this has reduced the security of revenue for communities generating renewable heat and/or power, in turn raising the risk profile of these projects, which has translated into higher financing costs and expenditure. Echoing the UK's Environmental Audit Committee[41], one solution would be a community energy revenue payment or FiT that provides a minimum term and index-linked revenue stream per kWh of both low-carbon power and heat for smaller community-owned projects[42].

3.10 Projects must move through a long period of project development prior to delivery and subsequent eligibility for operational subsidies. Grants for CE experimentation are therefore essential – such as those offered by Local Energy Scotland - with an explicit focus on earlier-

[37] https://doi.org/10.1016/j.erss.2023.103086
[38] https://doi.org/10.1016/j.eist.2022.11.004
[39] https://www.lowcarbonhub.org/wp-content/uploads/2020/11/CEF-Share-Offer-Document-2021-web.pdf
[40] https://committees.parliament.uk/publications/5718/documents/56323/default/
[41] https://committees.parliament.uk/publications/5718/documents/56323/default/
[42] https://doi.org/10.1016/j.erss.2023.103086

stage, feasibility scoping and project development. These should also target the most deprived communities, especially those not already in receipt of long-term revenue payments (e.g., FiT) from previous community-led projects. This is because these are least likely to have the local community wealth, nor existing subsidies or revenue streams, to self-finance energy projects[43]. Another potential revenue stream for capital grants would be to mandate a share of community benefit funds - associated with commercial renewable generation – to support community energy project formation[44]. However, most community benefit funds are locally restricted and not available regionally or nationally. State grants could therefore usefully target communities without access to these benefit funds.

3.11 A progression of this aspect would be to also enable communities, businesses and organisations to understand what the built environment and natural resources can do to generate clean affordable heat and power. This would enable a place-based alignment with land use planning. By allocating additional resource to Local Energy Scotland, this organisation could better deliver the CARES programme by engaging with local communities, businesses and organisations. This allocation of additional resource could be zoned in line with LHEES zoning at Local Authority level for affordable and clean heat networks which also need power.

3.12 Access to, and ownership of, land is a significant barrier to many communities looking to develop community energy projects. This is particularly challenging in urban areas where land is at a premium but is also an issue in rural areas too. Scotland has done much to lay the legislative foundations for communities to purchase land, most notably the Community Right to Buy. This gives communities the right of first refusal to buy private land for sale, providing it pre-registered its interest and has 10 % resident support in a ballot.[45] Subsequent amendments allowed communities to exercise their right to buy the sale of neglected or mismanaged land that is causing the community harm and if the way the land. The Scottish Land Fund was also established to help fund community land acquisitions. However, we note that an increasing number of land purchases – especially in rural areas – are happening “off market” and mean communities are unable to pre-register their interests. We also see land prices escalating quickly, making purchases less affordable to communities.[46] Both developments are restricting community access to land[47]; the bedrock for community energy projects.

3.13 Community access to established energy markets is a key barrier and a primarily function of the costs and capabilities associated with becoming a licenced supplier.[48] Instead, communities have traditionally engaged in two types of renewable power sales: 1) sale of own-branded energy tariffs via a licenced supplier; and 2) sale of power direct to the customer via a power purchase agreement (PPA), typically businesses. The former sees the community group partner with a licenced supplier, as part of a ‘white label’ arrangement, where the community group offers a tariff under their own brand, but it is the licenced supplier who meets the requirements of metering, balancing and complies with industry codes. However, our case of Green Energy Mull[49] points to a “gap … of ten pence a kilowatt” between the price it sells its electricity to an energy supplier for versus what a typical customer might pay. Regulation designed to support local electricity supply by reducing the licencing burden – such as Ofgem's Licence Lite - has not translated into new local energy projects and existing licence exemptions still require electricity meters and the meter registrant to be licenced. Our research

[43] https://doi.org/10.1016/j.erss.2023.103086
[44] https://doi.org/10.1016/j.erss.2023.103086
[45] https://www.gov.scot/policies/land-reform/right-to-buy-land-to-further -sustainable-development/
[46] https://www.landcommission.gov.scot/downloads/62543b9498bb1_Rural%20Land%20Market%20Insights%20Report%20April%202022.pdf
[47] https://doi.org/10.17868/strath.00083777
[48] https://doi.org/10.1016/j.erss.2023.103086
[49] https://doi.org/10.17868/69788

supports the need for regulation that affords communities the 'right to local supply'. It would allow local generators to become licenced suppliers, who would "face set-up costs and complexity proportionate to the scale of their operations"[50] (p.3). However, it remains unclear how small-scale and poorly resourced community groups can realistically meet the complex requirements imposed on licenced energy suppliers. Cornwall[51] recommends that the basis for licence-lite regulation is made "mandatory for eligible suppliers" to create "a guaranteed route to customers for local community supplies but without them being required to become licensed suppliers" (p.13).

4. What barriers, if any, do you/your organisation experience in accessing finance to deliver Net Zero compatible investments?

4.1 The University of Strathclyde has led work many energy reduction projects on the University built environment to reduce demand. Demand reduction is needed more than ever and investment in the fabric of the country's built environment should be a major focus of the strategy. There are some important lessons that can be drawn from this work regarding access to finance as follows:

- Through working with the Climate Neutral Innovation District[52] and Clyde Mission Net Zero [53] activities, the University has been able to identify an investment pipeline of energy projects. To do this, the University has used development funding via its SALIX Finance investment platform.[54] This model enables revenue development funding to be capitalised and has been successful. The draft Energy Strategy should consider allocating new forms of development funding that can be capitalised on projects that are built out in order to bring forward the development pipeline needed.
- The cost of retail power is such that communities, businesses and organisations should be encouraged to focus more on local generation and consumption. For instance, using waste heat from industry, For example, the National Manufacturing Institute of Scotland [55] which uses waste heat from Laigh Park STW and rooftop solar PV with onsite power generation and direct wire solutions that can power and heat strategic assets. The HE sector is providing leadership and collaboration that is enabling large-scale infrastructure to be deployed.

4.2 The strategy also needs to recognise and address the lack of funding for the third sector in driving climate action, as highlighted in the response in Q2.

5. What barriers, if any, can you foresee that would prevent you/your business/organisation from making the changes set out in this Strategy?

5.1 The University of Strathclyde has identified a number of barriers to it enabling the changes set out in the strategy. These include:

5.1.1 The ability to bring forward developments in partnership with others. Development funding for public sector bodies is hard to attract. One solution would be to bring forward a model of development partnership – public and private to share risk and benefits once projects are capitalised. If this could be applied at a regional level it would enable the transition to happen at scale and with the support of local authorities, communities, businesses and private sector delivery agents.

[50] https://powerforpeople.org.uk/s/Local-Electricity-Bill-Briefing.pdf
[51] https://powerforpeople.org.uk/s/Nigel-Cornwall-and-Power-for-People-Supporting-Community-Energy-and-Local-Electricity-Markets-An-Alt.pdf
[52] https://www.glasgowcityinnovationdistrict.com/aboutglasgowcityinnovationdistrict/climateneutralinnovationdistrict/
[53] https://regionaleconomicdevelopment.scot/blog/delivering-net-zero-along-the-clyde-river/
[54] https://www.salixfinance.co.uk/
[55] https://www.nmis.scot/

5.1.2. The ability to access affordable heat and power. Referred to in the Strategy is the EMR position and the ability to separate electricity pricing from fossil fuel markets. One way to address this at a local, regional and asset level is to introduce direct wire and energy storage systems in combination with a public/private investment model.

5.1.3 Demand side reduction is of paramount importance but the cost of this decarbonisation and reinforcement of climate resilience of the existing University of Strathclyde estate and built environment is currently prohibitive or at least hugely challenging under current market and economic conditions. The University now knows this decarbonisation and climate resilience reinforcement cost with a clear Net Zero pathway assessment study having been recently completed. The solution requires a new set of economic investment models and partnerships to be established together with the development of low carbon energy vectors that meet the needs of cities and regions. While the biggest reductions in Scope 1 and 2 emissions will come from the decarbonisation of electricity supply, many institutes have already invested in Combined Heat and Power Systems (CHP), which are fuelled by fossil gas. Whilst these systems provide some advantages in terms of the efficient use of energy, they have considerable cost and lock us in to emitting carbon for as long as fossil-fuelled sources of energy are used. The focus must be on reducing energy demand and switching to large scale use of low carbon energy[56].

5.2 On a more positive note, the University of Strathclyde has invested in decarbonisation systems and investment measures via the Salix Finance Investment Fund for several years. The investment in efficiency measures has enabled the University to control energy costs and carbon emissions despite a significant phase of growth. We have learnt what can be achieved through innovation and ambitious collaboration. After converting our energy system with the installation of the £20m district energy scheme in 2019, we are continuing with large scale building fabric upgrades to reduce energy demand. The major upgrade of buildings that can operate 24/7, like the University Library, are a good example with triple glazing fitted, fabric improvement and almost total LED lighting. The reduction in energy use as a result is exactly what we need to continue doing. We continue to create awareness amongst students and staff to enable them to understand what they can do. Our recent Energy Efficiency paper details recommendations for increased action across a number of areas of which behaviour change is a major part. The roll out of our Carbon Literacy training covers energy efficiency awareness. Our focus now is on improving the fabric performance of our existing building stock and collaborating with others to complete detailed design work needed to deliver the scale of green investment and infrastructure needed to meet our net zero targets.

6. Where do you see the greatest market and supply chain opportunities from the energy transition, both domestically and on an international scale, and how can the Scottish Government best support these?

6.1 Transitioning the Scottish and UK economy to meet Net Zero emission targets could deliver substantial wider economy benefits. This energy strategy and Just Transition plan, highlight the significant potential to support jobs in new or growing sectors such as offshore wind, nuclear and Carbon Capture, Utilisation and Storage (CCS), with near-term opportunities for possibly extended transitory employment gains at infrastructure development stages across the broad and ongoing Net Zero transition space.

6.2 Two main areas seem to present particularly important opportunities for Scotland: CCS and offshore renewables. Thanks to the availability of potential storage sites in Scottish waters

[56] Glasgow offers some examples of how this might be done. These include use of waste heat via a heat network, and of industrial-scale water-source heat pumps, such as deployed at Queens Quay in Clydebank.

and the availability of skills, expertise and infrastructure in the oil and gas sector. CCUS research[57] shows that a new Scottish CO_2 Transport and Storage (T&S) industry linked to the Acorn CCS project, with capacity to sequester 3.8Mt of CO_2 emissions from the Scottish cluster and a further 2.6Mt from overseas, could:

6.2.1 Deliver a sustained uplift in UK GDP of £257m per annum by 2035 and net creation of almost additional 1,100 full-time equivalent (FTE) jobs across the economy, even where labour supply constraints trigger wage competition price pressures.

6.2.2 Reduce the near- to mid-term public budget implications of intervention to guarantee utilisation of Scottish T&S capacity by 37%, from £171m per annum associated with Scottish cluster requirements to an estimated £108m per annum.

All these wider economy gains are delivered in the context of increases in wage rates, producer costs and consumer prices. If wage pressures are limited, there is potential for a greater sustained GDP uplift (up to £416m per annum) and substantially greater employment gains (up to 3,900 additional jobs) with almost no displacement of jobs across sectors or consumer price index (CPI) pressure. Identifying and exploiting sources of comparative advantage – such as the new export potential associated with enabling Scottish T&S through the Scottish cluster and Acorn CCS project - in the decarbonisation of different regional clusters will be critical.

6.3 Potential market and supply chain opportunities are also linked to improving energy efficiency.[58] [59] Benefits include:

6.3.1 New economic activity, with the likelihood and magnitude of a transitory net GDP impact depending crucially on how actions are funded (i.e., grants, loans or households paying upfront), signalling by government on the extent and length of the programme and the extent to which resources are displaced and consequent price responses.

6.3.2 Lower energy bills and gains in real income available for households to spend on other goods and services as a result of energy efficiency projects delivered. Sustained net gains in GDP can be expected to evolve over time and, crucially, to increasingly coincide with and uplift gains/offset losses associated with project delivery as more households make energy efficiency improvements. Ultimately, the magnitude and composition of evolving and sustained GDP gains will be dependent on constraints and price/cost responses across the economic system.

6.4 The decarbonisation of heat, via heat pumps can have positive economic impacts, while reducing total energy use, improving our energy security and helping to achieve Net Zero targets.[60]

7. What more can be done to support the development of sustainable, high quality and local jobs opportunities across the breadth of Scotland as part of the energy transition?

7.1 Economic benefits from different Net Zero actions could be limited due to the key challenge of how current and likely persisting labour market challenges may impact the deployment and operation of different decarbonisation projects across Scotland, the UK and internationally.[61] This is not only in terms of the timeliness of delivery, but the potential for net employment and GDP gains across multiple sectors, and how wage competition and bargaining may impact

[57] https://strathprints.strath.ac.uk/84117/
[58] https://strathprints.strath.ac.uk/82777/
[59] https://ukerc.ac.uk/project/net-zero-neighbourhoods/
[60] https://ukerc.ac.uk/publications/benefits-heat-pumps-role-electricity-gas-prices/
[61] https://strathprints.strath.ac.uk/83992/

producer and consumer prices, competitiveness and the cost-of living. The three key labour market drivers of outcomes include:

- The extent to which the national labour supply is fixed or constrained.
- Competition between sectors and projects for appropriately skilled labour.
- Whether real wage bargaining triggers wider economy ripple effects raising labour costs and prices across the economy.[62]

7.2 While many decarbonisation actions will trigger a process of wider economic expansion including increases in GDP and jobs, research observes displacement of labour across sectors and rising costs and prices across the economy where the labour supply constraint 'bites' through a shortage of workers. For example, it may ultimately be possible for UK CCUS to ultimately support up to 50,000 jobs by 2050, as argued in the UK Government's 'CCUS Supply Chains' roadmap[63]. However, this will depend on two key factors. First, effectively exploiting a fairly diverse range of export opportunities, not only via emerging international markets for CO_2 transport and storage services (where Norway and the Netherlands are already making early mover advances in exploiting capacity and capability established through the oil and gas industries of those nations) and for equipment and expertise (where wider global markets will feature major national players such as the US). Second, employment benefits will only be maximised under conditions where there is no labour market competition or cost and price pressures arising as sectors compete over resources. Where persisting UK labour supply constraints do bite, triggering wage cost pressures on the cost of doing business and the cost-of-living, our research for Scotland (see Paragraphs 2.5 and 6.2), happen, our research suggests that predicted sustained job gains could be eroded by up to 70% (in the Scottish CO_2 transport and storage case from 3,910 to 1,097 jobs) and GDP gains reduced by around 40%. Moreover, we note that most of the green jobs estimates for different Net Zero actions do not incorporate consideration of how those actions will be funded, which could further displace other demands and activities, e.g., if taxes have to rise or spending on other services fall.

7.3 Potential mitigating factors and solutions around labour markets include: Increasing the inward migration of workers with the appropriate skills.

- Increasing the level of full(er) time participation in the labour market.
- Increasing labour productivity (the output produced per unit of labour and associated costs) to increase the effective labour supply.
- Targeting skill development and training in existing and transitioning workforce, and in getting people back into the labour force.
- Strategic planning around timing of large infrastructure projects and overlapping labour demand.[64]

7.4 The energy transition will impact a broad range of jobs through the ongoing process of 'greening'.[65] New jobs (or jobs 'borne' out of exiting jobs) continue to emerge. Other jobs require significant changes in knowledge and skill requirements. The Scottish Government's Climate Emergency Skills Action Plan (CESAP) acknowledges the scale of these changes and the importance of a responsive skills system, particularly in areas where there are opportunities for job growth. There is the need for upskilling, re-skilling and new education/training pathways (including the development of 'micro-credentials' as appropriate)[66] to address changing demand – and universities, colleagues and other skills providers play a crucial role here.

[62] https://strathprints.strath.ac.uk/82451/
[63] https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-supply-chains-a-roadmap-to-maximise-the-uks-potential.
[64] https://strathprints.strath.ac.uk/83992/
[65] https://pureportal.strath.ac.uk/en/publications/the-green-factor-unpacking-green-job-growth
[66] https://education.ec.europa.eu/education-levels/higher-education/micro-credentials

7.5 In supporting the development of local jobs opportunities across Scotland, 'equally important will be the use of a place-based lens for more effective matching of local and regional demands with educational provision; one that maximises the opportunities for reducing inequalities and increases accessibility to education'.[67] It is also important to acknowledge that some jobs will largely stay the same but demand will increase or decrease ('sunrise' and 'sunset' energy transition job impacts). Even in areas where demand for some jobs are in structural decline, 'replacement demand will significantly exceed expansion demand' and 'there will still be a healthy demand for workers with these skills'.[68]

7.6 High quality labour market information, which should incorporate data to capture the dynamics of change 'real time' (e.g., web-scraped job vacancy data), is needed – disaggregated by sector, region and key equality indicators. A clear focus on supporting 'high quality' jobs is to be welcomed as 'creating good jobs and avoiding bad jobs are major priorities for all nations because work is central to human welfare and to the functioning of organizations and societies'.[69] The Fair Work Convention's framework for Fair Work in Scotland usefully captures the key dimensions of job quality i.e., effective voice, opportunity, security, fulfilment and respect.[70] These job quality indicators are needed to assess the extent to which the energy transition is delivering Fair Work for all. There are important questions to be answered around the longer-term job security for and career prospects of workers in some new and emerging jobs.[71] It appears too that the energy transition is not necessarily benefitting women and men equally.[72] Lessons from the oil & gas boom in Aberdeen serve as a reminder that many high-quality jobs tend to be undertaken by workers outwith local communities, and related unintended consequences (e.g., increase in income inequality).[73]

7.7 To allow the employment, economic and societal opportunities of energy independence and the energy transition to materialise, Scottish and UK Government will need to coordinate around long-term policy support in several areas including:

- Effectively designed and appropriately targeted policy support to enable industries and households to decarbonise without risking international competitiveness and livelihoods.
- Policy frameworks and planning that incentivise and de-risk both decarbonisation action and the development of domestic supply chains and an appropriately skilled workforce.
- A national labour strategy, ideally sitting within a national industrial strategy, is needed to ensure that the opportunities offered by increasing energy security through greater independence of energy supply and the transition to Net Zero, are realised.

7.8 Jobs and employment are at the heart of a Just Transition and will form a key battleground for policy makers. However, a going concern is[74] how the ESJTP fails to provide baseline indicators to help gauge the "justness" of the existing labour force. This makes it very challenging to test the promise of proposed and implemented labour policies, in raising the degree of justice in our energy labour market. However, within the context of those broad mechanisms identified in the ESJTP, there are a number of clear additional interventions which could aid in the development of sustainable, high quality and local job opportunities across the breadth of Scotland.

[67] https://www.skillsdevelopmentscotland.co.uk/media/47336/climate-emergency-skills-action-plan-2020-2025.pdf
[68] https://www.nfer.ac.uk/media/5076/the_skills_imperative_2035_working_paper_2_headline_report.pdf
[69] https://www.academia.edu/89406292/The_SAGE_Handbook_of_the_Sociology_of_Work_and_Employment?f_ri=1235
[70] https://www.fairworkconvention.scot/the-fair-work-framework/
[71] https://pure.strath.ac.uk/ws/portalfiles/portal/117868215/Sofroniou_Anderson_ILR_2020_The_green_factor_unpacking.pdf
[72] https://www.skillsdevelopmentscotland.co.uk/media/49856/green-jobs-in-scotland-report_final-4.pdf
[73] https://aura.abdn.ac.uk/bitstream/handle/2164/19887/Shapovalova_etal_Just_Transition_Report_VOR.pdf
[74] https://localenergy.scot/community-benefits-map/

8. What further advice or support is required to help individuals of all ages and, in particular, individuals who are currently under-represented in the industry enter into or progress in green energy jobs?

8.1 The National Transition Training Fund (NTTF) supported a range of activities, which included micro-credential upskilling courses for universities and initiatives to help women transition to/already working in male-dominated sectors (e.g., in construction to upskill in Passivhaus standards). Evaluation evidence 'shows that the combination of tailored support for sectors, alongside employability support, and college and university-based training for individuals, has had a positive impact on the skills and training of people and businesses across Scotland'.[75]

8.2 The future of the NTTF is unclear, but it will be important to build on its success and continue to fund and target energy transition training (with a focus on addressing underrepresentation) – in addition to investment in apprenticeship and related provision. Lessons from some of the SFC-led Regional Pathfinders Pilot Projects (e.g., the National Energy Skills Accelerator (NESA) – Energy Transition Skills Interactive Pathway project) should help feed into and inform actions on 'how we can make the education and skills system more responsive, integrated, and supportive of economic recovery and inclusive growth'.[76]

8.3 There is also the need to evaluate the use-value of other initiatives and interventions that have been set-up to help individuals of all ages and, in particular, individuals who are currently under-represented in the industry enter into or progress in green energy jobs (e.g., the Green Jobs Workforce Academy).[77]

Chapter 3 – Energy supply

Scaling up renewable energy

12. What should be the priority actions for the Scottish Government and its agencies to build on the achievements to date of Scotland's wave and tidal energy sector?

12.1 An extensive review of the strengths and weaknesses of the UK's (and Scotland's) wave energy strategy was undertaken and a landmark report[78] was published in 2017, which covered data collection stretching back to 2013. The findings were as follows:

12.1.1 Wave energy's failure to reach market can, in part, be attributed to weaknesses in government and industrial strategy to support wave energy innovation in the UK, most notably a premature emphasis on commercialisation and a lack of knowledge exchange.

12.1.2 These weaknesses have resulted in a poor performance against some key innovation indicators. Examples include market leaders entering administration (e.g., Pelamis), a fall in installed and rated capacity of devices, and a lack of convergence around a dominant device design.

12.1.3 The downturn in UK wave energy innovation performance led to multi-national incumbents (e.g., energy utilities, Original Equipment Manufacturers (OEMs)) and

[75] https://www.gov.scot/binaries/content/documents/govscot/publications/corporate-report/2022/02/national-transition-training-fund-nttf-year-1-report/documents/national-transition-training-fund-nttf-year-1-report/national-transition-training-fund-nttf-year-1-report/govscot%3Adocument/national-transition-training-fund-nttf-year-1-report.pdf
[76] https://www.sfc.ac.uk/skills-economic-transformation/regional-skills-development/pathfinders-regional-pilots.aspx
[77] https://careers.myworldofwork.co.uk/green-jobs-workforce-academy/what-is-the-green-jobs-workforce-academy
[78] https://doi.org/10.17868/62210

investors withdrawing from the sector. This led to a concerted effort from the public sector to learn from past policy mistakes via knowledge capture initiatives, led primarily by the Scottish Government.

12.1.4 Policy learning resulted in a reconfiguration of the UK's wave energy innovation system in a bid to address these issues. Changes included a re-design of government RD&D programmes, the formation of new actor networks and the commissioning of world-class test infrastructure. These changes have already yielded some positive trends in measurable innovation performance (e.g., knowledge exchange), however, the full impact of this reconfiguration has yet to emerge.

12.1.5 As of 2017, the UK was home to an innovation system much better placed to deliver a commercial wave energy device. However, this recently re-configured system is likely to face severe disruption from wider political developments, such as Brexit's impact on EU RD&D funding (e.g., Horizon programme) and the UK Government's long-term shift away from investing in wave energy and towards other offshore technologies (e.g., floating wind). The authors have yet to revisit this case and assess how well the UK's and Scotland's wave energy innovation system had functioned over the past six years. The authors of this consultancy response could not easily identify an up-to-date in-depth assessment of Scotland's wave energy innovation system.

14. In line with the growth ambitions set out in this Strategy, how can all the renewable energy sectors above maximise the economic and social benefits flowing to local communities?

14.1 Consideration needs to be given to how the economic and social benefits once derived from the oil and gas industry can, and will, be replaced by those flowing from new renewable energy sectors. For example, ensuring that those in areas such as the North East of Scotland and the Shetland Islands with transferrable skillsets formerly employed in the Oil and Gas industry are enabled to work in new renewables sectors. Alternatively, that developers support the training of local populations to work in emerging sectors. In addition to sustaining and creating jobs and a skilled workforce, this investment also helps avoid the problem of labour displacement and could contribute to meeting policy priorities around Just Transition and 'Levelling Up'.

14.2 Sufficient attention needs to be paid to where jobs are created as a result of emerging industries such as carbon capture, utilisation and storage (CCUS) and renewables, and the implementation of decarbonisation actions such as retrofitting homes to make them more energy efficient. Concentration of jobs in areas such as the Central Belt at the expense of, for example, the Islands and the North East of Scotland, where employment has been centred around the Oil & Gas industry, could exacerbate regional inequalities and economic development.

14.3 Community benefit funds represent a common model employed by commercial renewable developers to "compensate" local communities for hosting generation facilities (e.g., wind farms), by providing them with a share of the project's revenue. The recommended compensation from Scottish Government currently stands at "£5,000 per installed megawatt per annum, index linked for the operational lifetime of the project" for onshore wind[79]. However,

[79] https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2019/05/scottish-government-good-practice-principles-community-benefits-onshore-renewable-energy-developments/documents/scottish-government-good-practice-principles-community-benefits-onshore-renewable-energy-developments/scottish-government-good-practice-principles-community-benefits-onshore-renewable-energy-developments/govscot%3Adocument/scottish-government-good-practice-principles-community-benefits-onshore-renewable-energy-developments.pdf

benefit funds have been established for a range of other renewable generation facilities[80], including offshore wind (e.g. Robin Rigg[81]) and hydro power. Interestingly, taken as a sector, the average community value from recent projects for the year to December 2022 was £4,500 per mW per year – notably lower than the recommended guidance – with total benefits of £24,900,748[82].

14.4 The benefits for individual communities can be significant. For example, Fort Augustus and Glenmoriston Community Company receive approximately £600,000 per annum from SSE in benefit payments, which they have distributed to support a whole range of initiatives, from investing medical centres, constructing affordable housing, apprenticeship schemes and travel for study bursaries[83].

14.5 A key issue with the community benefit fund model is that these funds distribute funding across a highly localised area; often just a few miles beyond the locus of the renewable generation site. This means that (typically) rural residents face something of a "postcode lottery", either being within the boundary of the fund or just outside it. Consequently, only those communities inhabiting a landscape suitable for harnessing renewable power stand to benefit. It is also at the discretion of the project developer with regard to what compensation they will receive, with sums ranging significantly, with many funds paying far below the £5,000 per MW per annum benchmark[84].

14.6 Analysis from Hannon (Figure 1), taking 1) the Ferret's collation[85] of Local Energy Scotland[86] community benefit fund data for 2022, 2) Scottish population data by council are from ONS for 2021[87] and 3) Scottish House Condition Survey data for fuel poverty by council area (for period 2017-2019)[88] finds a dramatic variation in the level community benefit funding per head by Scottish council areas, for developer-led renewable energy projects (excludes community owned projects). We also note how this bears little correlation with levels of fuel poverty, suggesting that some areas are benefitting more than others, regardless of whether they are in acute need of funding to alleviate fuel poverty. Consequently, some council areas with above average levels of fuel poverty (i.e. >26%) receive below the national average of community benefit payments per head (i.e. £6/head/yr), such as Na h-Eileanan Siar, East Ayrshire, Orkney and North Ayrshire. Conversely, we find the reverse, where councils with below average levels of fuel poverty receive above the national average for community benefit per head, such as South Ayrshire and South Lanarkshire. This spotlight a lack of distributional justice, with regards to the beneficiaries of these community benefit funds. The obvious policy implication of this is that all community benefit funds should ensure significant share of their funding targets alleviation fuel poverty, and deprivation more broadly, but that community benefit funds offer greater sums per MW installed to communities in the most deprived council areas.

[80] https://localenergy.scot/community-benefits-map/
[81] https://www.solwayfirthpartnership.co.uk/robin-rigg-community-fund/
[82] https://localenergy.scot/wp-content/uploads/2023/02/CB-Register-narrative-report-Dec-2022-.docx
[83] https://www.localzeropod.com/episodes/56-corporates-and-communities-how-renewable-energy-companies-are-investing-in-new-community-assets?rq=glenmoriston
[84] http://www.pointandsandwick.co.uk/news/community-owned-wind-pays-communities-34-more-than-private/
[85] https://theferret.scot/wind-farms-pay-loose-change-scots-fuel-bills-soar/
[86] https://localenergy.scot/community-benefits-register/
[87] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland
[88] https://www.gov.scot/publications/scottish-house-condition-survey-local-authority-analysis-2017-2019/

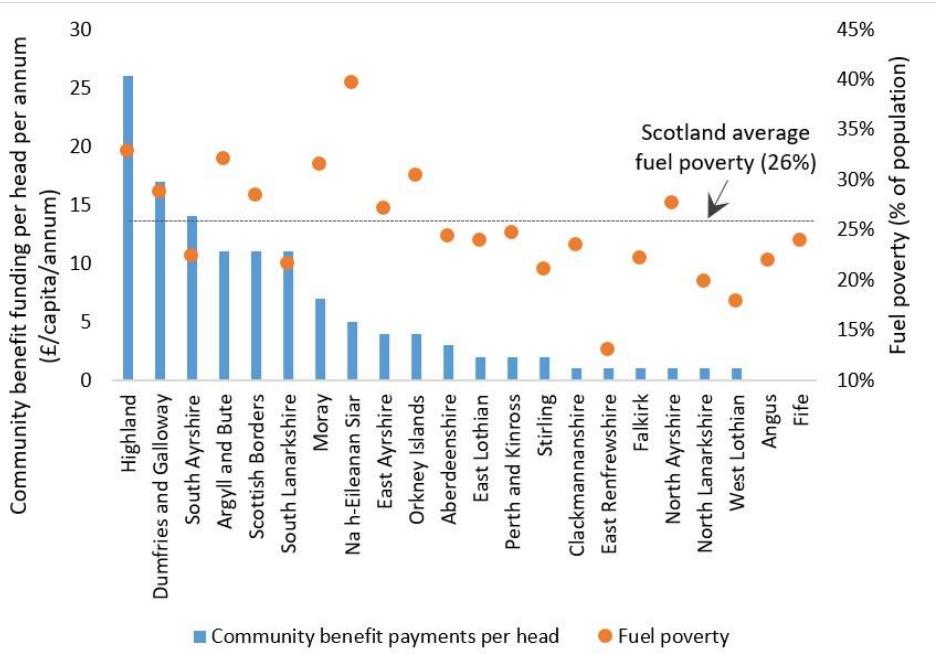

Figure 1: Community benefit payments for developer-led renewable power projects by Scottish council area (source: adapted from The Ferret, Local Energy Scotland)

14.6 There is also evidence to suggest that communities stand to financially benefit much more if they own their own generation assets. For example, an Aquaterra study[89] last year found that community-owned projects deliver 37 times as much money to locals when compared with privately-owned alternatives. "Returns from the community owned wind farms average[d] £170,000 per installed MW per annum, far exceeding the community benefit payment industry standard of £5,000 per installed MW per annum" [90]. However, for this greater reward, the community will naturally take on a greater share of the financial and operational risk associated with these projects. To take this option forward, we need to remove various barriers to enable *all* communities to finance and deliver their own energy projects (see Q3).

14.7 Planning frameworks can also play an important role in ensuring renewable power creates lasting community benefit. Firstly, "planning requirements [are] disproportionately demanding for small-scale projects, as compared to large-scale developments"[91] (p.145. Secondly, a combination of financial and technical support ought to be offered to communities to help them navigate a complex, and often gruelling.[92] Finally, for projects that either community owned or not, as a minimum requirement, renewable planning applications should include socio-economic assessments as part of the planning application, which details the opportunities for community benefits[93]. This can help ensure that all future renewable projects have been planned with community wealth building in mind from the outset.

15. Our ambition for at least 5 GW of hydrogen production by 2030 and 25 GW by 2045 in Scotland demonstrates the potential for this market. Given the rapid evolution of this sector, what steps should be taken to maximise delivery of this ambition?

15.1 Current progress in electrolytic (green) hydrogen projects indicates that the supply side is likely to proceed faster than downstream uses of hydrogen. Renewable project developers (particularly those holding ScotWind options) are increasingly looking towards green hydrogen

[89] http://www.pointandsandwick.co.uk/news/community-owned-wind-pays-communities-34-more-than-private/
[90] http://www.pointandsandwick.co.uk/news/community-owned-wind-pays-communities-34-more-than-private/
[91] https://doi.org/10.1016/j.erss.2023.103086
[92] https://www.gov.uk/government/publications/analysis-of-the-dynamic-effects-of-fuel-duty-reductions
[93] https://doi.org/10.1016/j.erss.2023.103086

markets as an alternative route to market where there are likely to be long lead times for firm transmission connections and high levels of ongoing curtailment. At the moment there is a risk that such developers look to mature export markets to de-risk their projects, rather than identifying or promoting domestic supply chains. At the same time, potential end-users of hydrogen are being disincentivised from investment due to high uncertainty in hydrogen production costs, alongside an absence of network, transport, and storage. The Scottish Government should take a stronger role as a mediator and matchmaker to identify complementary projects on the supply and demand side, to promote optimal use of national energy resources over least regret options and the loss of production potential to export markets. This is particularly key for the transport and industry sectors, where multiple decarbonisation options may exist, and short-term business uncertainty may lead to suboptimal decarbonisation pathways becoming locked in.

15.2 Similarly, it appears that the current focus for some identified/proposed hydrogen hubs is around areas with opportunities for production rather than consumption – while proximity to production will reduce transport costs, the benefits of demand clusters may outweigh this cost. There may also be significant breakpoints in costs of different form of transportation and conversion which mean that transportation from multiple production sites (such as co-located electrolysis capacity) may be viable, with hydrogen clusters located where off-takers (the end user and/or intermediary party who may purchase and resell hydrogen to end users) can be most easily coordinated and identified.

15.3 Electrolytic hydrogen production has the potential to significantly reduce the volume of curtailed renewable energy in Scotland[94], caused by electricity transmission network constraints that are likely to persist through the next 10-15 years. However, the load factors implied by the use of curtailed energy – compounded by uncertainty as to the progress of network reinforcement - are unlikely to, in isolation, support the deployment of significant volumes of electrolysis capacity. Market mechanisms, incentives and contracts for the deployment of electrolytic hydrogen capacity identified in the British Energy Security Strategy should be structured to consider the value of electrolyser location and its relation to curtailed renewable energy.

15.4 There is significant potential for network-embedded electrolysis to ameliorate the curtailment and flows of electricity across Scotland and in remote parts of the network. However, the regulatory principles for such hydrogen – which may in the near term have implied emissions from the carbon intensity of electricity, reducing over time as renewable deployments increase – should be explored further. Electrolysis connected to electricity networks will require a robust accounting mechanism to correctly determine the carbon emissions from hydrogen production and to prevent double-counting of zero-carbon energy within the electricity system.

15.5 The ESJTP contains little discussion around the use of steam methane reformation production of hydrogen (‘blue’ hydrogen) and it is not clear whether this is still seen as a significant pathway towards a hydrogen economy in Scotland, despite the Hydrogen Action Plan highlighting parallel development with CCS. The opportunity for rapid cost reduction of electrolytic sources of hydrogen means that ‘blue’ hydrogen may not be suitable for the bridging role previously envisaged and carries high risk due to dependency on unproven carbon capture technologies. The potential for a ‘blue’ hydrogen route to lead to significant novel emissions, where steam methane reformation is conducted in an inefficient or unabated manner, should not be underestimated, and developers in this space should be strongly regulated.

[94] https://www.climatexchange.org.uk/media/5627/the-potential-for-hydrogen-to-reduce-curtailment-of-renewable-energy-in-scotland-jan-23.pdf

15.6 Potential leakage of hydrogen from transport networks is not a solved problem, and as hydrogen itself is a short-term Greenhouse Gas, close attention should be paid to the potential for fugitive emissions in any transition to a hydrogen system.

16. What further government action is needed to drive the pace of renewable hydrogen development in Scotland?

16.1 The government should evaluate the potential for the 5 Statutory Independent Undertakings (SIUs), currently representing a significant cost and cross-subsidy for LNG and LPG gas networks, as an opportunity for the early development of cost-competitive hydrogen distribution networks.

16.2 The Scottish Government should explore with renewable project developers the potential for hydrogen production from currently curtailed renewable energy to reduce risk and business cost for new electrolysis capacity.

16.3 Hydrogen stakeholders should be kept informed on the progress of the time lag between new generation capacity and network expansion in the Scottish electricity networks. Quantitative volumes of forecast curtailment, which are detailed, disaggregated by location and with appropriate uncertainty bounds, should be published in collaboration with the National Grid Electricity System Operator and Distribution Network Operators to assist in the development of business cases.

16.4 It is likely that Scotland will require a volume of flexible thermal power plant in order to ensure electricity network security beyond the mid-2030s, such as currently exists at Peterhead. The opportunity for hydrogen CCGT plant to act as an anchor load for new hydrogen production capacity should be explored as an early opportunity to stimulate a hydrogen economy in Scotland.

16.5 If 'blue' hydrogen production, despite not being compatible with Net Zero in the long term, is seen as a valuable part of the transition for the North Sea oil and gas industry, due to the potential for retention of jobs and fossil fuel revenues, then this should be established in a transparent and open manner, in order to ensure a complex balance is struck between co-benefits and decarbonisation. A failure to declare key interests may threaten the public acceptance of any transition towards hydrogen.

16.6 The Scottish Government should look at scenarios where hydrogen is only a minor component of the energy system, used for edge cases of difficult-to-electrify technologies only (e.g., some industrial and transport applications, peaking power plant). An alternative credible route to a 'small' hydrogen economy in Scotland should be explored, where the economies of scale necessary for wide-scale bulk transmission of hydrogen are not achieved.

19. How can we identify and sustainably secure the materials required to build the necessary infrastructure to deliver the energy strategy?

19.1 Consideration needs to be given to how local supply chains can be developed to ensure that the materials and workforce required to build the necessary infrastructure for the energy strategy are in place. Moreover, that the risk of offshoring jobs and production, and related emissions, is avoided. Lessons should be drawn from the Scottish wind industry, where because the right supply chains were not in place, potential value was lost from the economy.[95]

[95] https://www.holyrood.com/inside-politics/view,energy-strategy-is-the-presumption-against-oil-exploration-the-right-approach

24. As part of decisions on any new production, do you think that an assessment should be made on whether a project demonstrates clear economic and social benefit to Scotland? If so, how should economic and social benefit be determined?

24.1 Assessments should play an important role in understanding the economic and social benefits that any new oil and gas production would bring, and how production may contribute overall to a transition that is economically, politically and socially feasible. Economic modelling employing a Computable General Equilibrium (model), in line with HM Treasury approaches [96] and as demonstrated in research undertaken to understand the economy wide impacts of different decarbonisation actions [97] [98] [99], could be used to assess the economic and social benefits.

25. Should there be a presumption against new exploration for oil and gas?

25.1 In line with Scotland's climate and energy ambitions and guidance from the international scientific (IPCC) and energy (IEA) community, the overwhelming message is that there must be no new oil and gas production if we are to meet climate goals. Consequently, a feasible and detailed plan needs to be set out Scotland's transition away from the country's reliance on fossil fuels. However, in doing so, consideration must now be given to how our energy demands can be met in ways that are sustainable, that preserve and create decent work and do not simply offshore emissions and jobs. [100] There are important lessons to be learn from the steel industry where production, along with jobs, GDP and emissions has been offshored[101], yet demand for steel in the UK, for products such as wind turbines, remains. Lessons can also be drawn from the wind energy industry in Scotland, where value was located overseas due to high levels of important and weak domestic supply chains.[102] Take for instance, the case of Scotland's two flagship floating wind projects – Kincardine and Hywind – where approximately 60–65% of the firms involved in the supply chain delivering these were from outside the UK.[103]

Chapter 4 Energy demand

Heat in Buildings

27. What further government action is needed to drive energy efficiency and zero emissions heat deployment across Scotland?

27.1 Increasing the efficiency with which households use energy, particularly in heating their homes, plays a key role in reducing energy use and bills, fuel poverty and emissions, and therefore of key importance for achieving a Just Transition to Net Zero. Also, research shows that energy efficiency interventions can have positive outcomes in the wider economy. [104] These are driven by the new economic activity associated with delivering energy efficiency projects, and by households facing lower energy bills and realising gains in real income available for spending on other goods and services as a result of energy efficiency projects delivered.

[96] https://www.gov.uk/government/publications/analysis-of-the-dynamic-effects-of-fuel-duty-reductions
[97] https://doi.org/10.1016/j.ecolecon.2022.107547
[98] https://doi.org/10.1016/j.enpol.2021.112375
[99] https://doi.org/10.1016/j.eneco.2022.106001
[100] https://journals.sagepub.com/doi/full/10.1177/0269094220984742
[101] https://strathprints.strath.ac.uk/74541/
[102] https://www.holyrood.com/inside-politics/view,energy-strategy-is-the-presumption-against-oil-exploration-the-right-approach
[103] https://doi.org/10.17868/69501
[104] https://strathprints.strath.ac.uk/82777/

27.2 To date, the challenge of improving energy-efficiency has often focused on policy-making prioritising technological fixes and / or interventions designed to appeal to the self-interest of individual energy users (e.g., grants, loans and price support). These approaches have proved limited in that their focus is not on understanding contextual factors including peculiarities of place and household dynamics. As explained by Middlemiss et al. [105]:

> "When we think about why people decide to make changes to their homes in the interests of energy efficiency, we tend to call upon rational explanations. 'People will only do this if it makes sense economically' is a common refrain, suggesting that people are mainly motivated by saving or getting 'value for' money."

In reality, we know the situation is much more complicated and sociological, "where spending money is understood to be relational: that is, our choices on how we spend different pots of money are shaped by our relationships with other people, and the broader social world" [106]. Our relationships with family and friends, as well as local organisations (e.g., faith groups, community groups, place work, education etc.), have a critical influence over if, how and when we retrofit our homes. [107]

27.3 Underpinning these social relations in the concept of 'relational work', which refers to the efforts that people make to build and maintain social relations through social practices of boundary making. This relational work involves real effort and the consumption of depleting material and immaterial resources (time, money, patience, etc.). By developing policy and incentives based upon a belief that human interaction can be reduced to financial transactions alone, the effort of the relational work involved in sourcing and negotiating advice, funding, and researching tradespersons becomes increasingly invisible. "When we recognise that people's decisions are not solely made in a rational way, but are navigated through complex social relations, this helps us to think of different ways to encourage more households to engage in energy retrofit". [108] Thus, these findings indicate the need to move away from retrofit policy making that assumes homeowners a purely economically rationale entities and adopt a social relational approach.

27.4 Recommendations from a case study of multi-occupancy buildings (primarily Victorian sandstone tenements) in the south side of Glasgow offers important insights[109]. Prevailing conceptualisations that treat individuals as discrete, isolated decision-makers are problematic in addressing the collective decision-making processes of occupants in multi-owned properties (MoPs). Research finds that increased social relational work required to smooth relations between neighbours in MoPs is a critical barrier to retrofit, but conversely, that more intimate relations between neighbours in MoPs can be supportive of renovation works. Furthermore, inadequately designed legislation inhibits renovations in MoPs, as it subjects householders to excessive relational work. Two key policy changes are required.

First, the UK is an outlier in its lack of compulsory and legally constituted owners' associations for MoPs. Legislation that clarifies the legal rights and responsibilities of MoP occupants, as well as policies that provide funds to enable less financially able residents to embrace retrofit, are desperately needed. Second, property managers (factors) could be made responsible for not just the maintenance of buildings but also for achieving acceptable standards of energy efficiency and - with sufficient support - develop knowledge and expertise in delivering this for owners' associations.

[105] https://ukerc.ac.uk/news/relationships-between-people-and-place-and-how-they-shape-energy-retrofit-decisions/
[106] https://ukerc.ac.uk/news/relationships-between-people-and-place-and-how-they-shape-energy-retrofit-decisions/
[107] https://ukerc.ac.uk/news/relationships-between-people-and-place-and-how-they-shape-energy-retrofit-decisions/
[108] https://ukerc.ac.uk/news/relationships-between-people-and-place-and-how-they-shape-energy-retrofit-decisions/
[108] https://ukerc.ac.uk/news/relationships-between-people-and-place-and-how-they-shape-energy-retrofit-decisions/
[109] https://doi.org/10.17868/strath.00084471

For factors to take a greater role in retrofit, then, requires reform to ensure trust and encourage owner participation. One approach to establish trust could be for property managers to be established as community cooperatives, in which all householders served by the manager become members, allowing all owners served by a factor to attend AGMs and scrutinize company expenditure. Third, the existing exclusive rights afforded to absentee landlords in MoP building governance is difficult to justify where a long-term tenant may have a greater interest in the building and the community which surrounds it than the landlord. Measures such as allowing long-term tenants (e.g., who have rented a property for 2 years or more) to exercise votes in building governance in the place of landlords or insisting upon agreement between owner and tenant if the vote of the owner is to be counted would:

a) allow those most badly affected by neglect of energy efficiency to have a voice;
b) encourage landlords to be more attentive to tenants' energy needs; and
c) ease the governance of buildings by making it more likely that decision-makers will be accessible.

27.5 Financial support must also form part of any retrofit drive in historically important MoPs, and not just be limited to the unable to pay. Conservation rules imposed upon owners - coupled with difficult-to-treat properties - mean owners of historic buildings find retrofit prohibitively expensive. Further, the lack of sufficient governance arrangements, which have resulted in tenement neglect, is a political failure; the historic neglect of tenements is primarily a consequence of political choices at government level and not necessarily owners of MoPs. Thus, there is a strong argument that owners alone should not be expected to bear the full costs of both regeneration and retrofit.

27.6. There are other areas where the Scottish Government can support the effective deployment of energy efficiency and low carbon heat. One such key area is for the Government to provide policy frameworks and clear direction for sustained action, building certainty for the industry, allowing for investment and to develop the required supply chains.[110]

27.7 Development of regulatory frameworks for different heating technologies, tariffs and other mechanisms is necessary to support zero emission heat deployment at scale. Also, greater understanding of non-domestic heat demand is necessary to establish market mechanisms for excess heat re-sell.

27.8 There is evidence that suggest that EPCs are no longer fit for purpose in their current form and there is considerable effort required to improve the EPC framework[111]. The following describes several key areas necessary to support this development:

27.8.1 Those carrying our EPC assessments should be appropriately trained and their payment reflective of the skills gap.

27.8.2 The modelling assumptions used to underpin the EPC assessment should be revised on a regular basis and further evidenced.

27.8.3 EPCs should be updated when there are significant heat-related changes in buildings e.g., installation of a new boiler or building of a conservatory. Typically, EPCs are only carried out when a house is built or sold.

[110] https://www.sciencedirect.com/science/article/pii/S0301421521002457
[111] https://www.theccc.org.uk/wp-content/uploads/2023/02/CCC-Letter-Reform-of-domestic-EPC-rating-metrics-to-Patrick-Harvie-MSP.pdf

27.8.4 Billions have already been invested in EPCs and a spend of this magnitude should warrant a dedicated centre aimed at maintaining EPCs, improving the modelling which underpins these assessments, staff training and assessment, amongst many other functions.

EPCs are factored into most build environment and heat related research used to inform policy and future scenarios. It is recommended that significant government action is required on this front to improve the quality of EPCs and to future proof as heat decarbonises.

Energy for transport

28. What changes to the energy system, if any, will be required to decarbonise transport?

28.1 The decarbonisation of transport is a key component of reaching mid-century Net Zero targets now set in statute across the UK. The energy system, in particular the electricity system will have to undergo significant change to accommodate and facilitate the decarbonisation of transport. The following summarises several of the broader high-level developments that are necessary in this transition.

28.1.1 The share of renewable generation connected to electricity system will have to significantly increase to accommodate additional electrical demand from various modes of transport.

28.1.2 The share of alternative fuels including hydrogen and biofuels will have to increase to support decarbonisation of key sectors, harder to electrify, such as shipping and aviation.

28.1.3 The proportion and energy share of available resources will have to be managed to satisfy demand across various different modes of transport both spatially and temporally. This will impact infrastructure planning and security of supply.

28.1.4 It is also expected that there will be a societal modal shift towards increased walking, cycling and use of low carbon public transport. These mechanisms have to be in-place ahead of need to support this shift e.g., support for 10-minute neighbourhoods, increased affordability and reliability of public transport. This shift and change in societal behaviour will inform the demand for energy and thus it is likely to impact significantly on the energy system.

28.2 Looking at more specific challenges for the power network, there remains a significant need for increased visibility of low voltage network infrastructure, particularly in rural settings. With this there remains a need for improvements in data sharing and access to open data. Particularly, in relation to the geospatial locations of infrastructure and the technical information pertaining to age and asset loading.

28.3 A challenge on visibility of phasing exists. The vast majority of network modelling at LV is carried with the assumption of 3-phase connections due to the significantly limited visibility of existing phase connections. It is recommended that DNOs undertake a phase identification campaign to support enhanced network modelling capabilities and hosting capacity quantification. It is further recommended that a cost benefit appraisal be carried out between the value proposition of 3-phase and single-phase connections for future LV connections.

28.4 On data availability and access, there is a need for increased access to home installation charging usage data for EVs to greater understand consumer charging behaviour, needs and rhythms. This would also help to inform analysis of public infrastructure usage.

28.5 Use of innovative technologies such as microgrids and islanding may be required in remote rural settings as reliability on the electricity network is increased given the impact of recent extreme weather-related events.

28.6 Drawing comparisons with the heat sector, the Local Heat and Energy Efficiency strategies (LHEES) aim to establish local authority plans for systematically improving the energy efficiency of buildings and decarbonising heat. There is scope to take a similar approach for transport with regards to the rollout of charging infrastructure, pricing and regulation of public infrastructure, uptake incentivisation, social welfare and Just Transition policy amongst many other local level challenges.

28.7 Besides the technical and societal challenges, the transition to low carbon transport can deliver important benefits. Research shows that upgrading the electricity network and the wider rollout of electric vehicles (EVs) can ultimately deliver net benefits across the economy[112]. The potential outcome is one of sustained net gains in GDP per annum (ultimately +0.15% above what it would otherwise be). This is associated with net gains in employment (+0.11% or 32,177 additional full time equivalent, FTE, jobs), and real earnings from employment (+0.18%).This is based on the economic activity required to expand and upgrade the power network, to be able to accommodate the new electric demand, and on the benefits of using a more efficient mode of transport (i.e., EVs are 2 to 3 times more efficient in terms of fuel costs per mile travelled than conventional diesel/petrol cars) and a fuel (electricity) with a greater domestic component (relative to petrol/diesel with international supply chains). The observed gains are driven largely by the shift from using petrol and diesel to EVs to fuel private transportation. This is predominantly a result of electricity generation in the UK relying more on domestic industries compared to more import-intensive petrol and diesel, with the implication that a greater share of the households spend on transportation fuels is directed to UK industries.

28.8 However, even if the transition to low carbon transport brings net benefits to the economy, it is necessary to recognise that the benefits may not be shared on an equitable way. In the example shown above, the cost for network reinforcements has been socialised through energy bills, both in standing charges and the energy unit price. However, this may be a regressive policy as poorly insulated households may use more energy (driving the variable energy cost up) than more affluent and better insulated ones; or if cost is put on the standing charge, this may affect fuel poor households trying to reduce their energy use to a minimum but still paying high energy bills. Crucially, and more directly, lower income household may not own or be able to access a comparatively more expensive EV, therefore 'subsidising' the costs for those households who can afford and benefit from the new technologies. This is an important consideration that should be taken into account in this and other low-carbon interventions across the system.

29. If further investment in the energy system is required to make the changes needed to support decarbonising the transport system in Scotland, how should this be paid for?

29.1 Linked to previous response (Q28), research has explored the case where the cost of the network upgrade is passed to all the users of the electricity network; domestic, commercial and industrial. This leads to substantial increases in the price of electricity, affecting the entire UK economy. The main challenge is that EVs are only used by part of the population, but the impacts of the higher electricity and other prices are affecting everyone, even those who do not benefit from electric private transportation. Generally, socialising costs via energy bills is

[112] https://strathprints.strath.ac.uk/78270/

a regressive way to pass the cost, directly or indirectly, to the public as the price increase is uniform and therefore affects the lowest income households disproportionately more compared to the highest income ones[113]. Alternatively, there is the option to raise the necessary funds through general taxation. In principle, this is more progressive as it takes into consideration the income variations across households and passes more of the cost to higher income households, who are also more likely to be EV users. Such an approach may also be preferable to having differentiated tariffs (for EV and non-EV users), which have the risk of discouraging people to adopt EVs, in fear that they will have to pay higher electricity prices due to EV ownership.

29.2 From a more technical perspective, it is unclear as to the impact of the recent 'socialising' of new grid connection costs, based on the Significant Code Review (SCR) conducted by OFGEM, will have on delivering the electrical infrastructure required for decarbonisation of the transport sector. The University of Strathclyde and PNDC (formerly the Power Networks Demonstration Centre) have several examples of not-insignificant population centres and island communities who are currently unable to install electric vehicle charging infrastructure due to long-term grid constraints.

29.4 Evidence that justifies 'ahead of need' upgrades to networks must be a) agreed upon with OFGEM, DNOs and enabling stakeholders, and b) developed to allow DNOs to prioritise infrastructure upgrades though pressure needs to be applied to ensure these upgrades are timely.

29.5 Energy islands in areas of DNO constraints should also be considered to allow communities to expand infrastructure without reliance on grid reinforcements. Financial support will be required to provide suitable capital to build out infrastructure. This could come from private sector, although the business case for rural and islanded communities will likely require governmental support particularly in the early development of these networks.

29.6 As heavier and larger vehicles decarbonise, electrification will play a key role in most scenarios (ultra-fast mega-watt charging systems, hydrogen, etc.). A strategic framework needs to be developed to design a charging system for this sector ahead-of-need and to be truly Scotland wide – just as the rollout of the initial ChargePlace Scotland network provided.

30. What can the Scottish Government do to increase the sustainable domestic production and use of low carbon fuels across all modes of transport?

30.1 The current regulations and processes could be clearer and made more accessible, particularly to make it easier for organisations who may not traditionally be considered likely to install charging infrastructure e.g., small independent operators (of the 5,592 truck fleets registered in Scotland, 90% run fewer than 10 trucks).[114] It could be beneficial if up to date information on infrastructure estimated costs and available funding/financial assistance for installation of charging infrastructure was made more accessible.

30.2 Additionally, the responsibilities that organisations will bear as the owner and operator of charging infrastructure could be made clearer and more accessible, again particularly to make the processes easier to understand for organisations not typically involved in transport/energy infrastructure. This could assist organisations in installation of the best type of infrastructure for their needs, and increase the reliability of the infrastructure if they have a clearer understanding of the processes surrounding maintenance and servicing of chargers.

[113] https://www.sciencedirect.com/science/article/pii/S0301421521002457
[114] Zero Emission Truck Taskforce: Significant opportunities and hurdles in the move to zero emission trucks https://tinyurl.com/2mxn5wez

31. What changes, if any, do you think should be made to the current regulations and processes to help make it easier for organisations to install charging Infrastructure and hydrogen/low carbon fuel refuelling infrastructure?

31.1 In addition to the points made in 30.1 and 30.2, the Scottish Government may want to consider relaxation and standardisation of planning requirement for EV infrastructure – Currently local authorities have different requirements for installation of e.g., journey chargers due to their heights.

32. What action can the Scottish Government take to ensure that the transition to a Net Zero transport system supports those least able to pay?

32.1 Linked to our response to question 28. In principle, the switch to EVs can help the wider economy grow, leading to more employment opportunities and therefore income from employment, etc. Which can, directly and indirectly, bring benefits to lower income households.

32.2 However, thinking on practical terms, there are several ways that the Scottish Government could enable the transition towards a Net Zero transport system that supports those least able to pay.

32.2.1 Tariffs for public EV chargers belonging to the ChargePlace Scotland network are free to be set by the local authority/private organisation that owns and operates them, leading to disparities in charging fees. Standardisation or regulation for the setting of charging tariffs, could allow for a balance to be struck between avoiding unfair disadvantage of those without a residential/workplace charging opportunity, and avoiding incentivisation of driving further (e.g., across local authority borders) to reach cheaper charging rates, which in turn would threaten the 20% reduction in car kilometres travelled target. Additionally, a subsidy mechanism for individuals in certain groups (e.g., those without a driveway, those least able to pay etc.) could help to tackle this issue.

32.2.2 Increased financial support for installation of home chargers where there is practical private parking would also be beneficial for those least able to pay. It should also be ensured that public EV chargers are distributed equitably to ensure that less affluent localities have an equitable presence of public chargers. Furthermore, public EV charging infrastructure should be reliable and support should be given to local authorities to ensure charge points are adequately serviced and maintained.

32.3 In addition to the support around EVs, significant effort is required to reframing public mind set to regard cars as a transport service, in conjunction with continued support and increased visibility of alternatives to car ownership (e.g., zero emission car clubs). [115]

32.4 Public transport and active travel should also be encouraged as alternatives to private car usage. Effort is required to ensure multi-stage journeys are efficient and affordable. Mobility as a service and establishment of public transport/active travel mobility hubs may be mechanisms for achieving this. Additionally, public transport timetables should be reflective of diverse working and social patterns.

32.5 For those who are least able to pay, although an EV may not be financially viable, other active travel modes termed 'ridables' (e.g., electric bikes, electric scooters etc.) should be encouraged. Development of supporting infrastructure for these modes (e.g., parking/storage facilities, dedicated lanes, charging facilities) and legislation is required for co-existence with other travel modes. Subsidised safety equipment for active travel (e.g., helmets, reflective

[115] https://www.transport.gov.scot/news/30-million-to-support-the-shift-to-zero-emission-transport/.

strips etc.) would enable those least able to pay to safely participate in more active travel. Further to this, the development of ride/park and stride schemes could allow those least able to pay to reduce their car kilometres travelled and reduce their travel costs.

33. What role, if any, is there for communities and community energy in contributing to the delivery of the transport transition to Net Zero and, what action can the Scottish Government take to support this activity?

33.1 Communities are already playing a small but important role in decarbonising transport and many communities are increasingly considering transport as a focus for action. Driving this in particular is an appetite from communities to diversify beyond straightforward decentralised power generation – which has seen subsidies cut in recent years - in a bid to capture new value streams that simultaneously help accelerate decarbonisation and secure their financial future[116]. Community Energy England's UK-wide state of the sector report notes that the number of planned transport projects outstrips those for energy storage, heat generation or demand-side management respectively. In 2021 alone, "90 organisations delivered a range of low carbon transport activities including installing 113 electric vehicle charging stations"[117]. The case of Gwent Energy CiC in South Wales offers one way forward, which as of 2020, owned nine charge points across four sites; located at either community- or council-owned properties. Income from these chargers was approximately £1,500 from August 2018 to August 2019[118]. The income it derives from EV charging is hoped to deliver for the CIC "a 7-year payback before any return"[119] (p.2). Other common schemes include provision of electric cars and e-bikes, platforms for car sharing and EV education. Whilst community transport represents a small share of the total transport decarbonisation action at present, it is growing in scale and scope[120].

33.2 There are preliminary suggestions that community transport projects may face fewer barriers versus many other types of energy projects. Community Energy England found that across the UK "only 8% of all stalled projects in the past year were low carbon transport (LCT) projects, indicating there are fewer significant barriers to development than for other project types. Indeed, 38 organisations indicated they were planning low carbon transport projects in 2022, with EV charge point installation the most commonly cited"[121] . However, this should not be interpreted as being an easy marketplace for communities to enter.

33.3 An obvious boon for communities would be policy that encouraged – or even mandated – partnerships with local organisations (see Q3). This would give communities a clear route to access strategically located properties and land, to site EV/e-bike charging and storage. It would also allow them scope to generate renewable power at a much cheaper rate, which could be used to charge these vehicles as demonstrated by the cases of Edinburgh Community Solar Cooperative[122] and Gwent Energy CiC. Community examples include schools, community halls and leisure centres.

33.4 Where population density is higher and car ownership is lower, typically in inner city areas, community groups have a different role to play in decarbonising transport. In the Southside of Glasgow, South Seeds has been instrumental in supporting the council to roll out

[116] https://doi.org/10.1016/j.erss.2023.103086
[117] https://communityenergyengland.org/files/document/615/1654781666_CommunityEnergyStateoftheSectorUKSummaryReport2022.pdf
[118] https://doi.org/10.17868/69789
[119] https://communityenergyengland.org/files/document/119/1517571395_CommunityOwnedElectricalVehicleChargers.pdf
[120] https://communityenergyengland.org/files/document/615/1654781666_CommunityEnergyStateoftheSectorUKSummaryReport2022.pdf
[121] https://communityenergyengland.org/files/document/119/1517571395_CommunityOwnedElectricalVehicleChargers.pdf
[122] https://doi.org/10.17868/69787

secure hangers for cycle storage, which are not easily accommodated in tenement blocks[123]. South Seeds also offers cheap or even free hire of e-bikes, whilst Bike for Good (another local active travel charity) offer masterclasses for cycle maintenance. However, the popularity of cycling is constrained by the availability of safe cycling infrastructure. Glasgow's construction of the South City Way[124] is one such important development. Coupled with the introduction of Glasgow's new Low Emissions Zone in June 2023, where polluting vehicles are penalised for entering the city centre. This active travel strategy will likely further bolster cycling numbers further. Taken together, there is a critical need for government to resource community groups to educate communities about the multiple benefits of active travel (e.g., health, air pollution, carbon), as well as help them access and maintain bicycles, alongside council directives to offer safe spaces to cycle and discourage car use.

Energy for Industry

36. What are the key actions you would like to see the Scottish Government take in the next 5 years to support the development of CCUS in Scotland?

36.1 Linking to our response to Q.2, 6, 7, 38 and 39, we anticipate significant opportunities for the development of CCUS in Scotland, but at the same time, there is likely to be a number of challenges. For example, greater policy certainty and funding will be needed to deploy CCUS at pace. However, we understand that some of the actions required to address these challenges are not available to devolved governments.

36.2 A different but also very significant challenge for the development of CCUS is labour market constraints and the availability of a skilled workforce. Research shows that current and likely persisting labour market challenges may impact the deployment and operation of CCUS projects across the UK's regional industry clusters (where competition for skilled workers may exacerbate these challenges). This is not only in terms of the timeliness of CCUS delivery, but the potential for net employment and GDP gains across multiple sectors. Our research also suggest that wage competition and bargaining may impact producer and consumer prices, competitiveness and the cost-of living for households across the economy[125].

36.3 The Scottish Government can take steps to address or mitigate these challenges by managing and promoting inward immigration, targeted skills development in a transitioning workforce, and for supporting the increase of labour productivity[126]. See also our responses to Q. 6, 7 and 8.

37. How can the Scottish Government and industry best work together to remove emissions from industry in Scotland?

37.1 See our response to Questions 36, 38 and 39.

38. What are the opportunities and challenges to CCUS deployment in Scotland?

38.1 The introduction of a new CO_2 Transport and Storage (T&S) industry in Scotland could service decarbonisation, 'green growth' and Just Transition agendas.[127] [128] New industry activity could enable a sustained UK GDP uplift and create new jobs, locally and across the Scottish and UK economies, in a range of sectors, including many higher wage and/or labour-intensive service activities.

[123] https://www.glasgow.gov.uk/index.aspx?articleid=26991
[124] https://www.glasgow.gov.uk/scw
[125] https://strathprints.strath.ac.uk/83992/
[126] https://strathprints.strath.ac.uk/83992/
[127] https://strathprints.strath.ac.uk/78261/
[128] https://journals.sagepub.com/doi/pdf/10.1177/02690942211055687

38.2 One key challenge to CCUS deployment (and applying to any Net Zero or other expansionary activity) is delivering and sustaining such expansionary power in the face of the persisting labour supply constraint characterising and constraining the UK economy. Taking consequent wage-driven competition, and wider cost and price pressures, into account, sustained per annum GDP gains would be more limited. Moreover, outcomes ultimately depend on 'who pays', where moving too quickly to a 'polluter pays' approach could damage the international competitiveness of clustered industry using the Scottish CCS network, with consequent offshoring of not only emissions but jobs and GDP.

38.3 Another challenge linked to the 'who pays' question around the deployment of CCUS and the need to establish competitive business models for all elements of CCS, is the additional capital (equipment) requirements of firms in capturing CO_2. Taking the case of the Scottish Chemicals industry, initial public support is required to ensure that returns to capital, activity levels and jobs are sustained as industry adopts CCS as a solution.[129] Where firms can used supported periods to build efficiency, and competitive advantage in using carbon capture, sustained negative impacts can be avoided.[130] There is even potential for a reversal of offshoring effects with more industry activity attracted to locations where CCS is available as a decarbonisation solution.

39.Given Scotland's key CCUS resources, Scotland has the potential to work towards being at the centre of a European hub for the importation and storage of CO2 from Europe. What are your views on this?

39.1 Scotland has the potential to work towards being at the centre of a European hub for the 'importation' and storage of CO_2 from Europe (i.e., exporting CO_2 transport and storage services) and this could bring important benefits to the Scottish and wider UK economy, including increase tax revenues associated with greater activity (including employment).

39.2 Analysis[131] demonstrates that exploiting overseas T&S export opportunities (i.e., importing and storing CO_2 from elsewhere in Europe/the world) provides a crucial opportunity to generate sustained wider economy gains without increasing demands on the public purse. Specifically, a new Scottish CO_2 T&S industry linked to the Acorn CCS project, with capacity to sequester 3.8Mt of emissions from the Scottish cluster and a further 2.6Mt from overseas, could:

- Deliver a sustained uplift in UK GDP of £257million per annum by 2035 and net creation of a minimum of 1,100 full-time equivalent (FTE) jobs across the economy. This is a somewhat conservative estimate, taking account of how persisting UK labour supply constraints may trigger wage competition price pressures (if not, the extent of particularly employment gains could be substantially greater).
- Reduce the near- to mid-term public budget implications of intervention to guarantee utilisation of Scottish T&S capacity by up to 40%. This is largely due to the generation of additional tax revenues associated in the order of £130 million per annum as the economy expands.

39.3 It is also important to explore how Scotland's tradeable CCUS potential could extend beyond the ACORN project and mainland capture particularly in terms of transitioning the Shetland economy, and as part of the Energy Hub being developed by Shetland Islands Council and NZTC. There, deployment of storage capacity in more northerly reservoirs and shipping of international CO_2 in ways that further exploit the capacity created through Oil and Gas industry presence in Shetland.

[129] https://www.sciencedirect.com/science/article/pii/S0921800921000367
[130] https://www.tandfonline.com/doi/full/10.1080/14693062.2022.2110031
[131] https://strathprints.strath.ac.uk/84117/

Chapter 5: Creating the conditions for a Net Zero energy system

40. What additional action could the Scottish Government or UK Government take to support security of supply in a Net Zero energy system?

40.1 The development and operation of a well-coordinated energy system depends on recognition of links across sectors – between electricity, natural gas and hydrogen sectors – and between production and the different uses of energy for heat, transport, communication, manufacturing and so on. A clear and forecastable (necessary to inform investment) set of price signals across all these dimensions does not yet exist. One way of managing the risk of delayed or poorly coordinated investment in the energy transition that has been proposed by Government has been to establish a 'Future System Operator' (FSO) and grant it the responsibility to provide clear strategic direction to energy system development[132]. Establishing the FSO requires legislation through the Energy Bill and more work is needed in relation to its design; crucially, its place and authority alongside other bodies needs to be defined. The importance of the FSO in supporting growth on the journey to Net Zero are built on its role in a number of ways.

40.1.1 Accelerating energy independence and achieving growth will require accelerated decision making and the coordination of many parties – government at all levels, regulators, industry, businesses, investors, amongst others.

40.1.2 This will require a view of the big picture if the implications of 'pulling all the levers' are going to be understood sufficiently well that risks can be evaluated, appropriate plans prepared and costs understood, and that the energy system will actually work ("keep the lights on").

40.1.3 Strategic direction needs to be developed with sufficient detail to inform real investment. We need to move on from ambition and strategies and lists of possible interventions to real action with a sense of urgency.

40.1.4 It is likely that the government will see a market as necessary to ensure that energy users benefit from competition. However, with the cost and physical characteristics of low carbon sources of energy being so different from high carbon sources, markets and market actors need support to work quickly enough, given the accelerated timeline. Some proposed market reforms such as Locational Marginal Pricing offer potential benefits but are not overnight solutions and must be part of a coherent set of measures to ensure that investment in emissions reduction and electrification is not impeded[133].

40.1.5 We need to build the confidence of all stakeholders including industry, innovators, supply chains, investors and others to act with shared purpose and direction. This means parties will have to work together in various ways along a spectrum of coordination – collaboration – influence, with clarity of roles and responsibilities.

40.1.6 This will require frameworks and processes to prepare viable, credible and adaptive plans and enable businesses and investors to evaluate and price risk and then invest.

Developed in the right way with the right set of people, skills and methods and sufficient funding to enable those things, the Future System Operator appears to be the entity best positioned today (and can be further shaped) to offer leadership and to support the many

[132] https://www.gov.uk/government/consultations/proposals-for-a-future-system-operator-role
[133] https://ukerc.ac.uk/news/locational-marginal-pricing/

parties to work together in pursuit of Government objectives and to help build needed confidence for critical parties to act. This will help achieve energy independence on an accelerated time scale, provide the right environment for business growth, support market reform and underpin sustained lower energy prices for consumers and businesses all on a path to Net Zero.

40.2 Security of supply for the energy system can be thought of in two distinct respects[134]: Reliability of supply – balancing of supply and demand in real-time and resilience in the face of disturbances. The challenges of maintaining power system balance in a Net Zero system are well illustrated by examination of residual demand (demand – variable renewable output, in any hour) duration curves – an example of which is given in Afry's recent report for the CCC[135]. Sorting residual demand for each hour of the year from highest to lowest shows that the combination of greater electrification of demand (including heat and transport sectors) and expansion of renewable variable generation create new challenges of both surplus generation and peak demand in the electricity system. Surpluses arise in hours where there is an excess of variable renewable generation compared with demand. This creates a need for increased flexibility to utilise the power or high levels of curtailment are inevitable which will ultimately hinder the ability to build out the requisite wind capacity in Scotland. Flexibility can be delivered by various means including storage, demand response and interconnections allowing for export.

The future residual demand duration curve for Scotland will be even more stark in terms of hours spent in surplus and the relative scale of excess compared with that shown for GB. NGESO FES scenarios indicate indicative wind capacity in Scotland of ~50GW by 2035 would be required to meet GB targets for decarbonisation[136]. This would be set against a peak demand that is currently an order of magnitude lower than this in Scotland and export capacity, despite plans via the Holistic Network Design[137] process for significant expansion, that is likely to fall well short of what could be the peak installed capacity for Scotland under FES scenarios (~16GW)[138].

40.3 More strictly relevant to security of supply concerns are expectations that increased electrification, particularly of heat and transport sectors, will drive new highs in peak electrical demand (and so residual demand when coupled with periods of low renewable/wind output). This speaks to a capacity adequacy challenge in terms of having an overall generation capacity and stores of energy, from low carbon, dispatchable assets to sufficiently cover such periods. Where low winds are experienced across a long time period (potentially measured in weeks), sufficient capacity (GW) and equally importantly energy stores (GWh/TWh) are required to meet demand in these periods. By 2035 these must be predominantly from low carbon sources[139] with use of unabated fossil fuels limited to a small percentage of hours per year. Options here include low carbon thermal generation (e.g., via use of nuclear, biomass, hydro, gas + CCS or hydrogen), long (e.g., pumped Hydro, LAES, CAES) and short (e.g. battery) duration storage, and new types of demand (e.g., hydrogen electrolysis).

40.4 Given limits on other resources (e.g., biomass for production of energy must be within the limits of sustainable production and strictly prioritised, e.g., for negative emissions[140]) producing electrolysed hydrogen, storing and then generating electricity is the most promising

[134] https://www.climatexchange.org.uk/research/projects/security-of-scottish-electricity-supply-gauging-the-perceptions-of-industry-stakeholders/
[135] https://www.theccc.org.uk/publication/net-zero-power-and-hydrogen-capacity-requirements-for-flexibility-afry/
[136] https://www.nationalgrideso.com/future-energy/future-energy-scenarios
[137] https://www.nationalgrideso.com/future-energy/pathway-2030-holistic-network-design
[138] https://www.nationalgrideso.com/research-and-publications/electricity-ten-year-statement-etys/etys-documents-and-appendices
[139] https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035
[140] https://www.theccc.org.uk/publication/sixth-carbon-budget/

means of providing long-term energy storage to manage surpluses and deficits of electricity production[141]. The advantage of hydrogen as an energy vector is that it can be stored and it can be manufactured, in theory relatively cheaply, using surplus available renewable energy – thus it presents solutions at both ends of the residual demand duration curve. However, the CCC's recent report on "Delivering a reliable decarbonised power system"[142] questions Britain's ability to produce enough 'green' hydrogen to meet demand for hydrogen in the medium term. It nevertheless made a number of recommendations to help ensure that a market for low carbon hydrogen and associated infrastructure are in place to support the reliable supply of electricity.

Specific electricity market and regulatory arrangements are likely to be required for such long-term storage options that, unlike short-term storage that cycles energy in and out of the store on a daily or more frequent basis, is unable to earn significant revenues from traditional 'energy arbitrage'. While Scotland looks like a promising place to focus expansion of hydrogen electrolyser capacity given current and potential future levels of renewable curtailment it should be noted that suitable sites for geological storage of hydrogen at large scale may be quite distant from Scotland[143] [144]. With limited demand for energy in Scotland using electrolyser's to maximise utilisation of renewable energy resources therefore depends on development of sufficient network capacity for the transport of hydrogen. This creates a whole energy system optimisation problem centred on the question of assessing balance between build out of electrical transmission infrastructure and hydrogen electrolyser plus transmission infrastructure.

40.5 As the draft ESJTP notes, Scotland and the rest of GB mutually benefit from being part of GB-wide electricity and gas markets that allow energy to be exchanged between different regions and externally to other jurisdictions – facilitating the expansion and or replacement/upgrade (in the case of shifting from natural gas to hydrogen) of this capability will be key to both unlocking Scotland's future renewable potential and maintaining security of supply. The development of network capacity depends on a number of factors not all of which can be addressed by the Scottish Government. What is, in principle, within the Scottish Government's gift is the granting of planning permission for onshore developments. (We understand that rules and responsibilities for offshore developments are more complicated). As Government in the rest of the UK also must, it needs to find a way of reconciling local environmental impacts and local opinion with society's need for timely access to reliable, low cost, low carbon supplies of energy.

40.6 To address the challenges associated with both surplus renewables and to enable security of supply through import capability, Scottish government (to the extent it has any authority e.g., through planning and consenting and through engagement with UK government) and UK government policy should be focused primarily on finding ways to facilitate and speed up the roll out of the transmission investment. This includes both internal GB import/export capacity and cross border links with European neighbours (e.g., Norway). The HND envisages an extensive offshore grid in the North Sea that may on the face of it avoid or reduce the need for highly contested decisions on onshore network developments. However, energy would still need to reach onshore demand centres so a degree of onshore expansion is unavoidable. In addition, the technologies and regulatory arrangements for offshore networks are still under development (in spite of many years of discussion)[145], we know through industry channels that the supply chains for manufacture and deployment of relevant technologies – cables and HVDC converter stations, especially – for offshore

[141] https://www.theccc.org.uk/publication/delivering-a-reliable-decarbonised-power-system/
[142] https://www.theccc.org.uk/publication/delivering-a-reliable-decarbonised-power-system/
[143] https://www.climatexchange.org.uk/research/projects/redirecting-excess-renewable-energy-to-produce-hydrogen/
[144] https://doi.org/10.1016/j.apenergy.2020.116348
[145] https://strathprints.strath.ac.uk/53592/

electricity networks are particularly constrained. Work by the GWEC outlines some of these challenges from a European perspective[146].

40.7 In conjunction with transmission investment, having the right policy and market signals in place to encourage investment in new sources of dispatchable plant and flexibility including storage and demand solutions in the places where they can most usefully help manage the integration of renewable with the system (e.g., Scotland) or aid security of supply is a significant challenge. The draft ESJTP notes that this is a challenge for the UK government and one currently being deliberated through the REMA process but it is incumbent upon Scottish representatives to formulate a coherent position on what can and should be achieved through the process.

One of the key options for reform is the shift from national to locational marginal pricing (LMP). Its proponents (most notably but not only the electricity system operator[147] among others[148]) promise that it offers the right price signals in the right places to achieve the above stated goals for enabling the siting of new flexibility and demand sources like hydrogen electrolysis. By splitting the electricity market into many hundreds of nodes that price electricity locally, it also theoretically promises benefits to consumers in export constrained areas (like Scotland) – allowing zero marginal cost renewables to set the local price in times of surplus. However, as is discussed in[149], other stakeholders in Scotland could be negatively impacted and there are many complexities to consider before being assured that the stated benefits of LMP would indeed manifest.

Direct wholesale market revenues of wind generators in Scotland would be reduced which leaves the renewables sector in Scotland very nervous of LMP. It is argued that potentially lower prices and the increased unpredictability of LMP markets places excessive new risks on investors in renewable generation assets to the extent that cost of capital may rise or investment may dry up altogether. It is argued that this may offset any potential gains for consumers. While accompanying policy decisions, for example on the structure of CfD support schemes, could mitigate some of these risks, without such measures the Scottish Government's ambitions for wind generation capacity in Scotland may not be realised. Depending on the extent to which potential alternative locations for the development of low carbon generation elsewhere in GB can be utilised, that might mean that UK Government targets also fail to be met.

While presenting risks to much needed drive for development of renewables, other factors also mean that LMP may not be the silver bullet for delivery of flexible assets. As previously discussed, while the theoretical mechanism by which LMP could incentivise investment is clear, price signals alone will not ensure development of the necessary complementary infrastructure (transport, storage and demand) that would enable large scale development of the hydrogen electrolyser market in Scotland. Likewise, storage options that are able to absorb excess generation in Scotland may be limited in their ability to make a business case unless there is sufficient transmission capacity to allow export of that stored energy when economically viable. If the constraints bind for too long then it may be impossible to "get the power out" and make a viable business case. In summary we agree with the Scottish Government that there is an urgent need to progress new electricity transmission capacity between Scotland and England. While that happens depends on a number of things only one is significantly within the Scottish Government's control - planning consents within Scotland.

40.8 The Scottish Government should also be working constructively with the REMA process to ensure that full exploration is given to the range of REMA reform packages such that a

[146] https://gwec.net/wp-content/uploads/2022/06/GWEC-Offshore-2022_update.pdf
[147] https://www.nationalgrideso.com/document/258871/download
[148] https://es.catapult.org.uk/report/locational-energy-pricing-in-the-gb-power-market/
[149] https://strathprints.strath.ac.uk/83869/

deliverable and acceptable suite of solutions can be agreed upon. That should include packages with and without LMP and with a range of complementary packages. Key prioritises should be a package of reforms that enables both continued support for and delivery of low-cost renewable energy as well as mechanisms for encouraging new forms of flexibility to locate in Scotland – while noting that external challenges still need to be met to deliver on these opportunities.

40.9 A resilient system is one in which interruptions to supply of energy due to disturbances, such as severe weather, equipment faults or deliberate interference, are prevented, contained and recovered from[150]. Both climate change (in respect of new, more frequent or more severe extreme weather patterns) and the changing background of the electricity system potentially present new challenges for the system in terms of maintaining resilience. The latter relates to the proliferation of non-synchronously connected renewables generators and increased use of HVDC (high voltage direct current) networks. These present new technical challenges for developers and the system operator to ensure reliable integration with and operation within the existing HVAC (high voltage alternating current) system. This integration challenge depends largely on power electronic control systems for which new codes and standards continue to be developed.

Recent events such as the 2019 frequency disturbance that triggered the loss of power to over 1 million customers in GB highlight that the electricity system represents a tightly coupled, dynamic, non-linear and very large set of components that can interact with each other very quickly, in timescales of seconds or milliseconds[151]. Other near miss disturbances highlight the lack of experience in dealing with high penetrations of inverter connected generation[152]. Work carried out to gauge stakeholder perceptions of security of supply in Scotland[153] showed that key sector stakeholders harbour doubts about the current and future systems ability to maintain operability with challenges expect to grow out to 2030. There was also "a feeling of concern around the trend of the Scottish power system's ability to prevent, contain and recover from interruptions to supply arising from disturbances, i.e., its resilience." That report made a number of recommendations for UK and Scottish Government action including to "ensure vulnerable groups and regions are not disadvantaged in the prioritisation required in the process of restoring the electricity system following a national black out, as laid out in the new system restoration standard" and "consider the introduction of a regional capacity market or a similar mechanism that might, for example, stipulate the type, power and energy capacities of production or import capability".

40.10 While the draft ESJTP suggests that "Responsibility for the security and resilience of infrastructure lies solely with UK Government". To that end, like the Scottish Government, we welcome the Electricity System Restoration Standard that was proposed by BEIS in April 2021. This requires that at least 60% of demand can be restored in each region of GB (including Scotland) within 24 hours of a GB wide blackout, and that all demand can be restored within 5 days. However, we note that the electricity sector's compliance with the standard is not required until 31st December 2026[154]. We have some concerns about restoration times were the GB system or a region of it to suffer a collapse before then. It is though worth remembering that, as *Keeping Scotland Ready* [155] points out, responsibility for the following sectors is devolved: Government – Scottish Government, Scottish Parliament, NDPBs and other agencies, Local Authorities; Health; Food; Water – Drinking Water, Waste Water; Transport – Roads and Bridges; Emergency Services – Police, Fire and Ambulance;

[150] https://ukerc.ac.uk/publications/critical-infrastructure-climate/
[151] *https://doi.org/10.1016/j.epsr.2021.107444*
[152] https://www.youtube.com/watch?v=QA2wU0tsPbQ&ab_channel=EnergySystemsIntegrationGroup
[153] https://www.climatexchange.org.uk/research/projects/security-of-scottish-electricity-supply-gauging-the-perceptions-of-industry-stakeholders/
[154] https://www.gov.uk/government/publications/introducing-a-new-electricity-system-restoration-standard/introducing-a-new-electricity-system-restoration-standard-policy-statement
[155] https://ready.scot/how-scotland-prepares/preparing-scotland-guidance/keeping-scotland-running

and Chemicals. All of these would be affected by losses of energy supply. Although most energy users' experiences of interruptions to energy supply are seen at a local level – local garage forecourts are closed, or local gas or electricity network connections are out of service – each part of the energy system – gas, electricity and liquid or solid fuels – must be seen as system and, further, as an integrated system of systems. The need to consider them as such will only grow as more and more systems rely on electrification in some way or another.

40.11 It is important to note that some responsibility for ensuring resilience against loss of energy may best lie with action at the end consumer side. For example, it may be more cost-effective for local back-up systems based on fuelled generators or battery storage to provide continuity of supply in the face of outage events than it would be to provide e.g., additional redundancy in network connection. We therefore agree with *Keeping Scotland Ready*'s promises of "a move from silo working to a holistic approach to critical infrastructure resilience; a move from a culture of secrecy to a culture of sharing information appropriately between partners; improved relationships with critical infrastructure owners and operators; and enhanced engagement with essential services owners and operators during disruptive events, resulting in improved response arrangements".

Chapter 6: Route map to 2045

42. Are there any changes you would make to the approach set out in this route map?

42.1 The roadmap provides a useful overview of the Scottish Government's route of planned activity and outcomes to realising its climate and energy ambitions. Drawing on responses to Q1 and Q43, how this set of activities and outcomes is integrated and measured against wider economic and societal outcomes will be critical. It will also be important to define how progress will be measured and reported on, and how the route map will be adjusted accordingly.

42.2 The importance of this integration between climate, energy and economic policy setting and decision-making was also highlighted through work done by the University of Strathclyde's Fraser of Allander Institute to improve emissions assessment of Scottish Government spending decisions and the Scottish Budget. [156] The associated research report set out a number of key recommendations for Scottish Government including improving the clarity and transparency of Government decisions that impact on climate change, acknowledging that trade-offs will always exist between different objectives; periodic external auditing of climate change policymaking governance, processes and carbon assessments and introducing a Net Zero Test to ensure that all spending with major emissions implications undergoes a quantitative carbon assessment.

43. What, if any, additional action could be taken to deliver the vision and ensure Scotland captures maximum social, economic and environmental benefits from the transition?

43.1 As highlighted in the response to Q1, in order for Scotland to capture the maximum social, economic and environmental benefits from the transition, the following factors are critical:

43.1.1 Framing of these issues as public policy and not just technological challenges to enable understanding to develop around the economy-wide opportunities, challenges and trade-offs across different areas of policy focus which in turn can inform policy pathways

[156] https://www.climatexchange.org.uk/research/projects/improving-emissions-assessment-of-scottish-government-spending-decisions-and-the-scottish-budget/

and responses that provide the right incentives and are economically, socially and politically, as well as technically, feasible.

43.1.2 Scottish energy and climate policy needs to be integrated across wider economic policy decision-making, and coordination with industry ensured so that Scottish supply chains and the broader economic activity they support can prosper as low carbon sectors grow.

43.1.3 Effective coordination between Scottish Government and UK Government that recognises where Scottish Government has policy levers at its disposal and where interaction with UK Government will be required.

Just Transition energy outcomes

49. What are your views on the draft Just Transition outcomes for the Energy Strategy and Just Transition Plan?

49.1 The Scottish Government's focus on Just Transition outcomes is welcome and as highlighted in responses to Q1 and Q43, integrating energy and climate policy with wider economic decision-making will be critical to capitalising on opportunities and realising economic growth and Just Transition outcomes as well as environmental ones.

49.2 The Energy Justice Policy Overview and Impacts for Ne Zero Transitions (POINTs) framework[157] developed by researchers at the University of Strathclyde offers a tool that could help refine the design of, and assess implementation and progress on, the Scottish Government's Just Transition Plan as well the wider set of energy and climate policies. The framework was created to aid decision makers to explore the wide-reaching energy justice implications of their Net Zero visions, strategies, and policies. It is based on four tenets of justice: (1) *Distributional* – where injustices lie; (2) *Recognition* – who is affected; (3) *Procedural* – how injustices can be overcome and (4) *Restorative* – what we can do to ameliorate past injustices and mitigate against future injustices.

It also includes an additional four dimensions to take a whole-systems approach to a Just Transition which has been developed through a review of the literature.

49.3 Examples of how the framework has been used include the Cornwall Local Energy Market[158], CARES (Scottish Government's Community and Renewable Energy Scheme)[159] and Glasgow Community Energy. [160]

[157] https://strathprints.strath.ac.uk/76421/
[158] https://ore.exeter.ac.uk/repository/handle/10871/124214
[159] https://strathprints.strath.ac.uk/76421/13/Bray_Ford_CEP_2021_CARES_community_and_renewables_energy_scheme_energy_justice_POINTs_case_study.pdf
[160] https://strathprints.strath.ac.uk/76421/14/Bray_Ford_CEP_2022_Glasgow_community_energy_energy_justice_POINTs_case_study.pdf