Scottish Government Draft Climate Change Plan Consultation

UK Energy Research Centre Response

January 2026

About UKERC

The UK Energy Research Centre (UKERC) www.ukerc.ac.uk carries out world-class, interdisciplinary research into sustainable future energy systems. We are a focal point of UK energy research and a gateway between UK and the international energy research communities. Our whole systems research informs UK policy development and research strategy. UKERC is funded by UK Research and Innovation (UKRI).

UKERC is a distributed academic consortium, headquartered at Imperial College, London, with significant representation in Scotland (including research leaders at the University of Edinburgh and University of Strathclyde), as well as energy researchers drawn from 13 different institutions throughout the UK. Our interdisciplinary expertise includes engineering and physical science, economic and social science, and natural environmental science. We collaborate with other energy research centres, including the Centre for Energy Policy (CEP)at the University of Strathclyde and the UK-wide Energy Demand Research Centre (EDRC), and our submission includes contributions from CEP and EDRC researchers.

We welcome the opportunity to engage with the Scottish Government on its Draft Climate Change Plan, and we would be happy to follow-up on any aspects of our submission. While we have responded on a sectoral basis to many of the questions, it is vital to maintain a whole system view of energy transitions and decarbonisation of the economy, alongside detailed sectoral analysis.

Our response includes contributions from many different UKERC experts working on different aspects of the Scottish and UK energy transitions; individual contributors are named alongside their contributions below. The synthesis and editing was carried out by Dr Mark Winskel, University of Edinburgh mark.winskel@ed.ac.uk and Jordan Willis, UKERC HQ jordan.willis@ukerc.ac.uk.

Section 1: Delivering a Just Transition

The following questions concern the Delivering a Just Transition section of the Plan, more specifically: communities, skills, workforce, employers and adapting to climate change.

Question 1 What are your views on our approach to delivering a just transition for people and communities?

Dr Jess Britton and Prof. Jan Webb (University of Edinburgh)

We welcome the inclusion of just transition indicators as part of the CCP monitoring and evaluation framework. However, as the Monitoring and Analytical Annex identifies, these indicators are currently quite limited in scope and do not represent a complete assessment of whether a just transition is being delivered for Scotland. It is positive that a project is underway to develop a more comprehensive just transition M&E framework but a timescale and process for engagement and cocreation should be detailed in the plan.

The plan makes reference to the ECCI's co-benefits tracker, which indicates that co-benefits of climate action in Scotland could be over £6.3 billion between 2025 to 2040. We make two points in relation to co-benefits; 1) monitoring and evaluation of co-benefits should be included in the M&E frameworks, and 2) the plan should also recognise that the financialisaton of climate action benefits (including co-benefits) can under-represent benefits that are hard to assign costs to or related to intrinsic values such as such as place-attachment and cultural values. In addition to quantitative cost-benefits analysis we advocate for the use of qualitative tools such as well-being frameworks or multi-criteria analysis to better account for the complex benefits and trade-offs of decarbonisation pathways.

A Draft Energy Strategy and Just Transition Plan was consulted upon in 2023 but this appears to have stalled and it is not clear how consultation responses (including from UKERC: https://ukerc.ac.uk/publications/scottish-government-draft-energy-strategy-and-just-transition-plan-consultation) have been integrated into any subsequent development of a final Energy Strategy or the draft CCP.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

While the Plan's emphasis on just transition is welcome, current approaches risk insufficient depth beyond worker protections. Research carried out by the Energy Demand Research Centre (EDRC) on protected characteristics reveals critical gaps as groups including people with disabilities, ethnic minorities, older people, and those in rented accommodation face structural barriers to accessing transition benefits—not merely financial ones.

Housing patterns illustrate this clearly. Census 2021 data shows people with disabilities are twice as likely to live in flats (27% vs. 14% population-wide) and more likely to rent (48% vs. 34%), with similar patterns for ethnic minorities (40% flats, 56% renting). These patterns create practical barriers to heat pumps and energy efficiency improvements, yet policies focus on financial incentives rather than removing structural inequalities https://www.edrc.ac.uk/publications/understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic/

The Plan emphasises preventing harm over improving livelihoods for those most at risk. Economic modelling of decarbonisation reveals wage-driven employment displacement risks, as CCUS deployment creates transitory employment peaks of 11,000 FTE in 2023 and 4,200 FTE in 2027 that drive wage inflation, displacing precarious workers in non-unionised sectors concentrated in regions not directly benefiting from industrial investment https://pure.strath.ac.uk/ws/portalfiles/portal/199937455/Corbett-etal-CEP-2024-Policy-brief-driving-effective-workforce-planning.pdf

The Plan should strengthen commitments by embedding equity and inequality reduction as explicit outcomes alongside worker protections, developing place-based just transition plans that recognise historical disadvantage, and ensuring strategies address both job quantity and quality, particularly wage parity with declining industries.

Prof. Jason Chilvers and Dr Phedeas Stephanides (University of East Anglia)

Meeting ambitious emission reduction targets depends on meaningful societal engagement and a people-centred approach https://doi.org/10.5871/jba/011s4.097 . Accordingly, it is encouraging to see statutory 'just transition principles' underpinning Scotland's Draft Climate Change Plan, with the plan reaffirming commitment to a fair and inclusive low carbon transition and successfully embedding key aspects of the Net Zero Nation Public Engagement Strategy https://www.gov.scot/publications/net-zero-nation-public-engagement-strategy-climate-change/ in planning.

Whilst the plan focuses on the social opportunities of the transition to net zero – as evidenced by the focus on delivering community co-benefits, distributive and cosmopolitan justice, inter-generational equity, and addressing energy poverty – it also accounts for the need to empower people to participate. However, significantly more should be done to ensure public participation and engagement are actually meaningful and empowering. Novel ways of thinking about publics and engagement emerging from UKERC's Public Engagement Observatory https://ukerc-observatory.ac.uk challenge acceptance-based approaches exclusively focusing on *'bringing people with us'* (see Draft Climate Change Plan, Annex 1, p.4), and highlight how successful energy transitions depend on being more, not less, responsive to society https://doi.org/10.82226/543.p.000007; https://doi.org/10.5286/ukerc.edc.000954 The Public Engagement Observatory's work suggests three key ways the plan can go further in responding to people and communities, and offers pathways to support its delivery:

1. Recognising the multiple and diverse ways that people and communities across Scotland can and do already engage with energy and climate change is crucial to the successful delivery of the plan. Alongside communicating climate change, inviting participation in policy design, and encouraging community and individual action – as outlined in the plan – the Scottish Government should make use of additional methods and capacities that evidence how publics are *already* engaging in diverse ways. UKERC's Public Engagement Observatory has pioneered novel methods for mapping for such diverse public engagements on an ongoing basis including through comparative case analysis, digital methods, crowdsourcing, and citizen social science (see: https://doi.org/10.1038/s41560-020-00762-w; https://doi.org/10.1016/j.erss.2018.03.020). Such mappings can: (a) offer more comprehensive evidence on diverse publics and their views, values and actions; (b) help account for typically overlooked instances of citizens who productively address climate change in their own terms through forms of citizen-led action, innovation, or activism; (c) better attend to emerging instances of net zero scepticism and local opposition to low-carbon infrastructures; and (d) help uncover interrelations of public engagements and responses across the energy system in place of accounting for specific instances of participation in isolation.

2. While it is encouraging to see commitment to continue enabling participation in policymaking and to measure public satisfaction with opportunities to influence decision-making (see Annex 3, Just Transition Indicator 1.1), the real challenge will be to move significantly beyond just capturing public views at specific moments in time through the Scottish Climate Survey, to listen and respond to the diverse public engagements highlighted above and the societal concerns, views and

solutions they bring forth. In doing so, decision makers ought to openly and transparently explain where, how, why, and to what extent public views or actions have been accounted for, with relevant indicators around decision-making responsiveness included in monitoring and evaluation.

This also necessitates developing new capacities for listening and responding to public engagements and making this publicly accountable. Collaboration experiments undertaken by the UKERC Public Engagement Observatory and the Natural England Public Engagement Laboratory provide examples of how this can work in practice (e.g. see: https://ukerc.ac.uk/news/how-ukercs-public-engagement-observatory and https://www.uea.ac.uk/about/news/article/uea-and-natural-england-form-a-new-partnership-to-improve-public-engagement-with-nature).

3. Whilst some aspects of the draft plan speak to a more joined up approach to public engagement that involves actors from across national and local government, industry, regional partners, and local communities, there remains a pressing need to adopt a more systemic approach to participation nationally. This would help ensure the Scottish government becomes more joined up and responsive to society by taking an interconnected, shared and systemic approach to how engagement is organised, governed, supported and evaluated (see https://doi.org/10.5286/UKERC.EDC.000962 for detailed recommendations).

   Practically, this shift involves capitalising on emerging experience from the recently established Public Engagement Laboratory for Nature and Society embedding the approaches and thinking of UKERC's Public Engagement Observatory within Natural England (https://research-portal.uea.ac.uk/en/publications/a-public-engagement-laboratory-for-nature-and-society). It includes: (a) building cross-departmental capacity and sustaining collaboration with social scientists to support ongoing responsiveness to existing public engagements across wider systems; (b) coordinating public engagement activities and related responses across departments, disciplines, and locations; and (c) further strengthening the public participation monitoring and evaluation framework (set out in Annex 3) by incorporating criteria that define what constitutes an effective system of public participation and engagement. The key roles of such novel whole-systems approaches and entities have already been acknowledged in major reviews undertaken by UK Government departments (e.g. see: https://assets.publishing.service.gov.uk/media/65c106fbc4319100141a45a7/Public_Engagement_Review_10_Oct_2022.pdf), and developing such institutional capacities and architectures would help ensure Scottish policymaking becomes more socially just and responsive.

Question 2 We recognise that workers face particular impacts from the Plan and we have outlined our approach to supporting the transition of the workforce, including skills for jobs. What skills, training and qualification provisions will be most important in a net zero future and what more could be done to support them?

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Skills shortages represent a broader challenge across industrial decarbonisation. Our economy-wide modelling demonstrates that without coordinated workforce planning, labour demand creates wage pressures that ripple across sectors, displacing employment in hospitality, retail, and services rather than reducing inequality.

For example, the demand for skilled labour from heat pumps is likely to increase labour costs, putting pressure on wages. In areas where demand for heat pump installation and maintenance exceed availability, skilled workers may have to relocate. This raises questions of fairness, as regions with weaker labour markets may struggle to capture the benefits of the transition without strong retraining and mobility support. https://d2e1qxpsswcpgz.cloudfront.net/uploads/2025/03/1-s2.0-S0301421525000862-main.pdf Monitoring the regional balance of heat pump skills will be a major policy challenge, particularly due to the labour market differences between Scottish regions.

One of the main mechanisms to support a fair transition for workers and communities is through targeted skills and retraining programmes. Meeting heat pump roll out targets will require a large and skilled workforce. By targeting existing inequalities in the training of heat pump engineers and manufacturers, underrepresented and disadvantaged groups can directly benefit from building decarbonisation. Strengthening domestic manufacture of heat pumps and supply chains can also retain more jobs and income within the UK, giving a boost to green industries and opportunities for affected communities to benefit from the transition. https://d2e1qxpsswcpgz.cloudfront.net/uploads/2025/03/1-s2.0-S0301421525000862-main.pdf ; https://strathprints.strath.ac.uk/89989/19/Katris-Turner-EPG-2024-Achieving-economy-wide-gains-from-residential-energy-efficiency.pdf

The principle of targeting support at disadvantaged groups is also relevant for deciding who receives grants for heat pump installation, since those with lower incomes are unlikely to opt in to heat pumps without incentives and direct financial support. Grants eliminate household repayment burdens and so targeted grants or progressive subsidy schemes can ensure that the benefits of decarbonisation are equitably shared and those sceptical of the transition are more likely to buy-in. https://d2e1qxpsswcpgz.cloudfront.net/uploads/2025/03/1-s2.0-S0301421525000862-main.pdf

Dr Richard Hanna (Imperial College, London)

In the EU, supply chains for building energy renovation are typically comprised of small businesses with an insufficient supply of workers who have the competencies needed to deliver high-quality work. In the UK, over two-thirds of practitioners in repair, maintenance and improvement are micro-enterprise businesses; many make sufficient income using trusted products and processes without entering the energy efficiency market https://doi.org/10.1016/j.erss.2021.101943

Building trades in the UK and the EU tend to be characterised by low skills and a low demand for, and supply of, good quality training across multiple skill sets, increasing the risk of sub-optimal renovations that do not account for whole-house implications (https://doi.org/10.5334/bc.43). Given the variability of vocational education and training (VET)

content across Europe, the EU Skills Registry (https://skillsregistry.eu/) has been developed to support international comparison of qualification and training schemes, as well as skills and competency profiles for different construction and building energy efficiency jobs.

Question 3 The Plan will bring opportunities and challenges for businesses and employers. How can we best support employers across the private, public and third sectors to make the changes needed and seize the benefits of net zero?

Dr Richard Hanna (Imperial College, London)

Retrofit installer certification schemes are already established in various European countries, however these could be strengthened by incorporating a license to trade linked to regularly updated, minimum qualification standards. Existing examples of licensing to trade and minimum training requirements include those required for contractors to provide services via 'one stop shops'.

In several European countries, there are examples of national retrofit strategies or 'one stop shops' which include training, certification and/or quality assurance of retrofit tradespeople (examples available here: https://www.theccc.org.uk/wp-content/uploads/2023/06/Climate-policy-that-cuts-costs-International-policy-comparisons-Energy-Saving-Trust-and-GreenAlliance.pdf). In Germany, the KfW bank scheme provides access to householder advice via building energy specialists on a registered list. It is mandatory to consult an independent expert on this quality-assured list (https://www.rehva.eu/rehva-journal/chapter/quality-assurance-for-energy-efficient-construction-and-retrofitting).

The construction and retrofitting workforce in the UK and Europe is acutely lacking in diversity, comprising predominantly older, white males, with only 10% of EU construction workers categorised as female. In the UK, only 6% of construction labourers are classed as Black or minority ethnic (BAME) and 6% are people with disabilities. Masculine construction cultures, concerns about job security, health and safety and difficult working conditions can be key barriers to attracting more diverse employees, as well as younger generations, into the building energy retrofit sector (research on this is available here: https://doi.org/10.1007/978-3-031-66481-6_6).

Acceptable working conditions, including fair wages and job security, need to be enabled. For example, long hours, inaccessible sites and recruitment practices based on word-of-mouth rather than qualifications are not inclusive. Outreach campaigns promoting the attractiveness of the industry and seeking to overcome cultural barriers to participation, as in the European Construction Blueprint and Women Can Build project (which runs across Spain, Germany, Portugal, Belgium, France and Italy), can provide a start in overcoming these challenges. Incorporating retrofit-related content into school curricula can also provide early exposure to the sector, influencing career decisions as early as primary school. Resources developed by the Construction Blueprint could be adopted for use in schools (https://doi.org/10.1007/978-3-031-66481-6).

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

The draft Plan may underestimate upfront cost challenges and the strength of business disincentives. Our modelling identifies four critical support gaps.

First, electricity pricing creates a fundamental barrier. The Plan depends on heat pumps achieving cost-competitiveness, but current electricity-to-gas price ratios make heat pumps uneconomical. Our research shows the break-even point where efficiency gains offset higher electricity costs requires a price ratio of 3.59. In the last few years, UK electricity:gas price ratio range from 3.31 to 4.8, meaning heat pumps may be more expensive to run than gas boilers in many scenarios. This directly undermines consumer adoption and supply chain confidence in investment https://strathprints.strath.ac.uk/86820/ . Where the electricity-to-gas price ratio achieves parity, GDP gains reach £3.8 billion and net job creation reaches 67,247 FTE. Where electricity remains expensive, these gains are substantially reduced. These pricing challenges lie with UK Government, yet are important for just transition.

Second, labour cost pressures from simultaneous investment in nascent sectors create competition for constrained labour (see our response to Question 2).

Third, regional variation in benefits and costs remains substantial. For heat pump manufacturing, job creation concentrates in southern regions. Crucially, sectors such as hospitality and other services experience job losses from wage pressures, particularly in regions where these sectors dominate employment. Some regions will experience net employment losses despite decarbonisation, unless place-based policy support addresses diversification https://strathprints.strath.ac.uk/86820/

Fourth, business investment depends on clear timelines for critical infrastructure, long-term carbon pricing certainty, and coordinated sectoral strategies that manage investment timing.

Support for employers must include direct grant funding for decarbonisation capital expenditure rather than loans alone, urgent action on electricity pricing reform to enable cost-competitiveness, coordinated cluster strategies managing investment timing to avoid labour congestion effects, and clarity on UK Government timelines for critical infrastructure that private investment depends upon.

Prof. Peter Taylor and Dr Imogen Rattle (University of Leeds)

Policymakers first need to decide whether they believe a distinct Scottish approach for dispersed industrial sites is warranted. If so, this should be clearly stated in the Climate Change Plan, along with an indication of how these sites will be supported relative to the Grangemouth cluster. If dispersed sites are to be included, the following steps will assist in the development and implementation of policy.

- Establish or improve mechanisms to ensure dispersed industries are aware of funding opportunities;
- Support collaboration among geographically dispersed sites through networking events, regional coordinators, or digital platforms that allow industries to find partners and share knowledge safely;
- Offer guidance on bid preparation to help smaller or less experienced organisations submit competitive proposals;

- Adapt funding criteria opportunities to account for the unique challenges of dispersed sites, including smaller scale, geographic separation, or cross-sector collaborations.;
- Track the uptake and success of dispersed-site projects and adjust policy interventions accordingly.

Question 4 Our approach recognises that some of the Plan's impacts will have greater implications for particular regions of Scotland. What are your views on our approach to supporting places where the transition presents particular regional impacts?

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

The draft Plan acknowledges regional impacts, but it may lack the specificity and financing mechanisms needed for genuinely differentiated regional support. Our research on heat pump deployment and CCUS employment demonstrates significant regional vulnerabilities and uneven distributional outcomes.

Employment concentration creates complex regional patterns. For heat pumps, job creation is highly concentrated by region and sector, with manufacturing jobs favouring southern regions whilst construction jobs for electricity network upgrades are more dispersed but smaller in scale. Critically, regions with existing economic strength benefit most whilst less prosperous regions benefit substantially less, risking entrenchment of regional inequality rather than reduction https://strathprints.strath.ac.uk/86820/ .

CCUS deployment creates temporary job gains in specific regions during Track 1 and Track 2 construction peaks, yet simultaneously wage-driven displacement occurs in regions not hosting industrial investment, with employment losses in hospitality, retail and services concentrated in lower-wage sectors. Regions not hosting industrial investment experience net employment loss, despite claiming decarbonisation benefits nationally.

Beyond employment, transition impacts fall disproportionately on vulnerable households. Fuel poverty affects 861,000 Scottish households (34 per cent), with 491,000 in extreme fuel poverty. Heat pump installation costs of £7,500+ exceed grant support for most homeowners. More critically, even where installation costs fall, running costs depend on UK Government action on electricity affordability.

EDRC research on protected characteristics shows groups most vulnerable to energy poverty—people with disabilities, older people, ethnic minorities, and those in rented accommodation—face non-economic barriers to accessing transition benefits. Structural barriers including lack of off-street parking for EV charging, inability to install external heat pump units in flats, and landlord disincentives for capital investment in rental properties require targeted policy solutions beyond financial incentives https://www.edrc.ac.uk/publications/understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic/

Effective regional support requires explicit recognition that some regions will experience net employment losses despite decarbonisation, with compensation mechanisms including place-based investment funds, business rate relief, and community wealth building established alongside transition support. Investment in diversification beyond energy transition is essential,

particularly in regions historically dependent on single industries, as CCUS employment cannot replace oil and gas job numbers.

Decision-making and funding should be devolved to local authorities to design place-based just transition plans informed by local stakeholder engagement. Targeted policy support for vulnerable groups with protected characteristics must address non-economic barriers through tailored, flexible interventions rather than generic approaches. Mandatory impact assessments and annual monitoring of deprivation indicators by region should track whether transition is reducing or exacerbating inequality.

Section 2: Sectoral contributions, Policies and Proposals

Buildings (Residential and Public)

Question 5 How can we decarbonise homes and buildings in a way that is fair and leaves no one behind?

Dr Jess Britton and Prof. Jan Webb (University of Edinburgh)

The draft Plan includes a target to decarbonising heating systems by 2045 and a commitment to prepare a heat decarbonisation strategy by the end of 2026. Whilst both these commitments are welcome, the draft Plan merely indicates that delivery will be supported by various existing and forthcoming policies in relation to grants, loans and support services. Detailed analysis of whether and how the identified policies will put Scotland on track to achieve building decarbonisation by 2045 is lacking. It is therefore difficult to evaluate the effectiveness of the draft Plan in respect of buildings, and much will depend on the publication of the Heat in Buildings Strategy and Delivery Plan by the end of 2026.

The schemes identified, including HES, ABS, WHS, PRS, have provided valuable support to households, however it is clear that delivery needs to be scaled up substantially to deliver the 2045 target. It is not clear how the Plan will do this and much remains in the realm of 'proposals'. The residential CCP policy package is expected to have an additional cost of around £1.8 billion from 2026 to 2040, but is costed only to 2030. The majority of GHG reductions is allocated to 2036-2040, which is concerning given the already *long* history of policy development. The seems to delay substantive action to subsequent Parliaments and, overall, the Draft CCP implies significant loss of political leadership and momentum on decarbonisation of Heat in Buildings.

Progress on building decarbonisation is also hampered by the multiple delays in policy and legislation. The Buildings (Heating and Energy Performance) and Heat Networks (Scotland) Bill has been delayed several times, and now will not be introduced to the Scottish Parliament until after the 2026 elections. Additionally, the 2023 Draft Energy Strategy and Just Transition Plan appears to have stalled and it is not clear how consultation responses have been integrated into any subsequent development of a final Energy Strategy, HiBs or the draft CCP.

The Plan makes no reference to the former Heat in Buildings Bill (published 2021 and revised 2022: https://www.gov.scot/publications/heat-in-buildings-strategy-2022-update/pages/progress/), or to the National Public Energy Agency (HiBS 2021) which was intended to 'accelerate the transformational change in how we heat and use energy in homes

and buildings' and became Heat & Energy Efficiency Scotland (HEES), operating in virtual form within the Energy and Climate Change Directorate in 2022. HEES is an important development, in principle providing leadership and coordination, but does not appear to play at role in the CCP. Additionally there is limited transparency on the HEES' role, impact, future trajectory or public engagement on heat in buildings, with it largely invisible as an agency.

In relation to the proposed Buildings and Heat Networks Bill: the original bill has already been revised to focus on collective action and targets rather than homeowner mandates, reflecting concerns about public opposition. Whilst it is essential that the bill protects the most vulnerable, addressing fuel poverty and avoiding an undue financial burden on homeowners, there is also a role for mandated energy efficiency standards and we welcome commitments in this regard. Such standards, if properly implemented and supported by comprehensive advice and financing schemes, can play an important role in establishing householder and market certainty in decarbonisation, including building the essential skills and supply chains.

Testing technical feasibility and targeted exclusions (for example in specific hard to decarbonise or remote, rural properties) can play an important role in addressing concerns regarding bill impacts. The adoption of New Build Heat Standard regulations is an important development, and implementation should be rigorously monitored.

We also note that in 2015 a Government statement defined energy efficiency of buildings as a 'National Infrastructure Priority'. At that stage, the intention was that every building owner would be made an offer to retrofit their property, mainly combining grant and (low or zero interest) loans for those expected to self-fund. This programme would be developed through the Energy Efficient Scotland capital grants and LHEES pilots. Please see our later comments on energy planning and local government for additional detail. There is relatively strong evidence that the policy and institutional landscape to support heat decarbonisation and local energy systems is more advanced in Scotland, relative to the UK-wide picture. This is largely based on structuring of the local government role through: the statutory duty to prepare Local Heat and Energy Efficiency Strategies and delivery plans (LHEES); a Public Bodies Climate Change Reporting Duty, and the knowledge and capacity base developed by the long history of programmes delivered in partnership with organisations such as Energy Saving Trust/Home Energy Scotland, ChangeWorks, SCARF, Scottish Futures Trust, Zero Waste Scotland and Business Energy Scotland (https://ukerc.ac.uk/publications/institutional-landscapes-for-localenergy-systems-mapping-england-scotland-and-wales/).

Heat networks

Heat networks are likely to be a critical factor in a cost-effective system – not least as source of flexible demand (operating as thermal store: https://iuk.ktn-uk.org/wp-content/uploads/2023/06/Project-Remedy-project-fact-sheet.pdf), but this seems under-represented in the Draft Plan. Delays to the Draft Buildings (Heating and Energy Performance) and Heat Networks (Scotland) Bill limits the implementation of the Heat Networks (Scotland) Act 2021, and key elements including Heat Network Zoning, licensing, and requiring connections will not be established for some time.

More broadly we support the continuation of the Heat Network Support Unit (HSU) and Heat Network Fund (SHNF), monitoring the effectiveness of building assessments and heat zoning (derived from LHEES) and adoption of post-2035 targets.

SHNF investment also needs to accelerate; it has awarded to date approximately £14.1 million to five heat network projects (out of a commitment to £300 million in capital grants during this parliament). In England, the Green Heat Networks Fund (GHNF) has invested at least £380 million since 2022 (Triple Point HN Investment Management). DESNZ nomination of six pilot cities for heat network zone development in England has already resulted in rapid cross-sector investment, for example the SWAN Partnership has secured with £21 million from the GHNF and capital investment commitment by Hemiko and Vital Energi.

Acceleration of investment is likely to require an obligation on buildings with large heat loads to connect to district heating when available. Our research indicates that such regulations are important in developing certainty in heat network investment in comparator European countries (see https://ukerc.ac.uk/publications/institutional-context-and-the-governance-of-heat-transitions-the-cases-of-the-netherlands-and-the-uk/. Such a mandate is incorporated into heat network zoning in England and should be adopted in Scottish legislation. The draft Plan uses non-committal language in relation to commitments on heat network connections, stating (authors emphasis) "plans to boost heat network development by potentially requiring large, non-domestic premises to move away from fossil fuel heating systems when they have the opportunity to connect to a heat network".

Local authorities should be able to access additional specialist support and resources in areas where there is potential for the development of cross-authority or regional heat networks (such as Edinburgh and Lothians). Such large, cross authority networks have the potential to optimise cost, carbon and socio-economic efficiencies but this involves additional technical, political and contractual complexities (see more: https://ukerc.ac.uk/publications/scottish-government-net-zero-energy-and-transport-committee-inquiry-into-the-role-of-local-government-and-net-zero/).

Energy Planning and the role of local government

In the Draft CCP, many of critical actions to enable building decarbonisation are devolved to Local authorities, but the Draft Plan does not recognise the limited capacity, powers and resources within LAs, or reflect on the complex socio-technical skills involved in delivering rapid place-based decarbonisation (see https://www.sciencedirect.com/science/article/pii/S2214629619306322?via%3Dihub and https://www.sciencedirect.com/science/article/abs/pii/S0301421519307931).

Within the Draft Plan, local authorities are expected to: build on LHEES to coordinate and sponsor development of place-based projects, aggregating projects into programmes, explore opportunities for developing heat networks alongside industry partners, collaborate across neighbouring authorities to join up on heat plans at appropriate spatial level, partner with community-focused organisations to align efforts, continue to deliver energy efficiency and clean heat projects across the LA social housing stock. A detailed evaluation of progress,

barriers and development needs within local government should be carried out to inform support programmes.

The development of Local Heat and Energy Efficiency Strategies and plans (LHEES) by Scottish local authorities has helped to develop a stronger evidence base to inform retrofit and heat decarbonisation in buildings, including waste industrial or other residual heat sources and heat network development (https://www.gov.scot/publications/local-heat-energy-efficiency-strategies-lhees-phase-2-pilots-evaluation/documents/). However, translating these plans into delivery programmes is challenging and (in line with our response to the draft Energy Security and Just Transition Plan consultation in 2023 (https://ukerc.ac.uk/publications/scottish-government-draft-energy-strategy-and-just-transition-plan-consultation/), the Scottish Government should conduct a rapid, systematic review of LHEES and Delivery Plans ensuring alignment of plans with priorities in the draft CCP and intended Heat in Buildings Strategy and Delivery Plan. This should include: an assessment of strategic zones and delivery priorities to inform Scottish Government policies and a review of project pipeline development (including coordination of investment portfolios). Given the resourcing and skills constraints in local governments, this should include engagement with local government on barriers and enablers to high quality LHEES and rapid, coordinated delivery.

The likely electrification of a significant proportion of heat demand will create substantial new demands on electricity distribution networks, as well as scope for demand flexibility and for use of waste or residual heat in heat networks to reduce the high costs of investment in power generation and grids. Whilst LHEES do not currently incorporate wider energy planning (beyond heat and energy efficiency), these strategies will have a material impact on distribution networks through identification of priority areas for electrified heat.

Research suggests that approaches to incorporating local flexibility are less developed in Scotland than in the rest of Great Britain (https://ukerc.ac.uk/publications/institutional-landscapes-for-localenergy-systems-mapping-england-scotland-and-wales/). The Scottish Government should work closely with Ofgem and NESO (Scotland is a defined as a single region for development of a Regional Energy Strategic Plan (RESP)) to incorporate LHEES as material considerations in DNO and heat network business planning and investment. Currently the Plan makes no reference to the emerging RESP role, despite it representing a major restructuring of energy system planning in GB.

A number of Scottish Local Governments have also developed whole-system Local Area Energy Plans (LAEPs), including exploring methods to integrate LHEES and LAEP to better inform both network planning and local authority project development. The learning from these areas should be integrated into future development of Scotland's RESP, as well as revised LHEES and delivery plans (https://www.sustainabledundee.co.uk/case-studies/local-energy-net-zero-accelerator-lenza).

Retrofit

Provision of a national energy advice service in the form of Home Energy Scotland and the Social Housing Net Zero Heat Fund play an important role in ensuring common access to consistent, trusted advice on energy efficiency and heat decarbonisation, and funding support. Continuing to combine these advice services with long-term access to grants and interest-free

loan schemes for households and social landlords to install low carbon heat and/or energy efficiency measures is essential. UKERC research indicates that funding scheme longevity and the development of institutional knowledge capacity through delivery bodies such as the Energy Saving Trust, Change Works, SCARF, Scottish Futures Trust are important elements of a comprehensive policy and institutional landscape for local energy systems and retrofit (https://ukerc.ac.uk/publications/credible-and-comprehensive-comparing-policy-mixes/ and https://ukerc.ac.uk/publications/institutional-landscapes-for-local-energy-systems-mapping-england-scotland-and-wales/).

Nevertheless, to enable the rate and scale of retrofit required to meet carbon targets, government financial incentives are likely to need to be combined with innovation in financial products (green mortgages, blended finance, energy service contracting). The Scottish Government should respond to and implement the recommendations of the Green Heat Finance Taskforce (https://www.gov.scot/publications/green-heat-finance-taskforce-report-part-2/), including developing a place-based demonstrator programme and exploring innovative financing methods such as collective and/or blended financing models.

There is extensive experimentation in this area across Great Britain, and the Scottish Government should evaluate learning from initiatives such as the Cities Commission for Climate Investment (3Ci - https://www.3ci.org.uk) and UK Government trials (including the Local Net Zero Accelerator (LNZA) project (https://www.gsenetzerohub.org.uk/local-net-zero-accelerator/), Innovate UK Net Zero Living Programme, the Heat Network Zoning Pilot Programme (https://www.gov.uk/government/publications/heat-networks-zoning-pilot and https://www.gov.uk/government/news/six-towns-and-cities-to-pilot-clean-heating-innovation) and the Green Home Finance Accelerator Pilots https://www.gov.uk/government/publications/green-home-finance-accelerator-discovery-phase-projects/green-home-finance-accelerator-details-of-pilot-phase-prBottom-up.

Solutions that work for individual neighbourhoods, towns and cities will also be central to accelerating retrofit. Evidence from UKERC research (https://ukerc.ac.uk/project/net-zero-neighbourhoods/) highlights the need for 'relational' approaches that consider household circumstances, social relations and building characteristics to create tailored solutions. These approaches could leverage the billions of pounds people already spend as part of their aspirations for a 'better home'. For example it is estimated that UK households spent £28billion on home improvements in 2022 alone, indicating substantive potential for the estimated £33bn cost of transforming Scottish building stock to be achieved. Engaging with publics on decarbonisation at particular trigger points such as when moving home, applying for building control consent or making home renovation investments has significant potential to accelerate delivery and unlock financial investment.

As the plan identifies, while the Scottish Government has significant policy levers available to it to shape the decarbonisation of buildings, there are also a number of areas where powers are retained by the UK Government. In particular, changes to retail market arrangements and tariff structures require action by the UK Government and/or Ofgem. Action by the UK Government to rebalancing relative gas and electricity prices could significantly reduce costs to households of electrifying heating; potentially increasing costs for others and impacting on fuel poverty.

Changes to retail markets and tariff structures should be coordinated and aligned with policy for retrofit in Scotland, ensuring that households can fund whole house retrofit via 'one stop shops' and area-based programmes with consumer protection guarantees. However, the rebalancing of levies was a notable omission in the UK Government's recently published Warm Homes Plan.

The UK Government's new Warm Homes Plan and the ending of the Energy Company Obligation (ECO) will have an important influence on Scottish building decarbonisation and energy efficiency programmes for the fuel poor. Early analysis suggests that measures announced in the WHP represent an increase in total funding for home heat and energy upgrades (https://www.nesta.org.uk/blog/how-will-the-warm-homes-plan-change-home-heating/), but with a shift in emphasis from home insulation to supply side investment.

The WHP intends that Scottish funding be delivered via existing programmes, but the relationship between the new Warm Homes Agency and Home Energy Scotland – and whether WHP measures will increase spending on fuel-poor and low-income homes in Scotland – is not yet clear. The final version of the CCP should include a sensitivity assessment of the impact of UK Government policy changes, such as the changes on the delivery of the 2045 target.

We also note that in the Draft CC Plan, the word 'energy' now seems largely to equate to 'electricity' and the focus seems to be action by *UK Government* on electricity prices, creating the impression that this is regarded as sufficient to create societal change in residential heating systems, in the absence of any clear decision on the future of the gas system. The earlier definition of heat as a devolved matter has faded away.

Dr Richard Hanna (Imperial College, London)

Renovation measures to help improve energy efficiency and decarbonise homes can include loft and cavity wall insulation, heat pumps and solar PV. The UKERC working paper 'Accelerating Energy Efficiency Retrofits in Owner-occupied Homes' (https://ukerc.ac.uk/publications/accelerating-energy-efficiency-retrofits-in-owner-occupied-homes/) reviews international evidence on six individual policy instruments, and key examples and features of these are synthesised in the report. The working paper identifies policy instruments which have been applied in different countries and are considered important for implementing residential energy renovation, including regulations, financial support and information provision. Most reviews also include policies to develop workforce skills and competencies, supply chains and quality assurance.

Effective home energy renovation policy requires a holistic approach integrated across consumer demand and retrofit supply side; demand-side polices focused only on encouraging owner-occupiers to retrofit will not be sufficient without quality-assurance initiatives which help to expand the competent workforce and raise consumer trust. There is a consensus, particularly in existing reviews on home energy retrofit policies, that the application of single policies alone will not be enough to achieve a transformational increase in energy renovation rates. Indeed, the latter remain low despite the application of various policies internationally. In countries where higher volumes of renovations have been achieved, such as Canada, France, Germany and Ireland, we have identified several cross-cutting success factors: long-term policy

reliability and flexibility, effective policy mixes, policy integration and multi-scale governance, including the use of intermediaries such as 'one stop shops'.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

The Plan's commitment to achieving clean heat by 2045 while reducing fuel poverty is the right intent, but implementation risks deepening inequality. Fuel poverty currently affects 861,000 Scottish households (34 per cent), with 491,000 in extreme fuel poverty. Heat pump installation costs exceed grant support for most homeowners, and running costs depend entirely on electricity affordability—something determined by UK Government action on pricing.

Structural barriers for vulnerable groups cannot be addressed through financial incentives alone. Census 2021 data shows that people with disabilities are 1.3 times more likely to live in flats (27 per cent versus 21 per cent) and significantly more likely to rent (48 per cent versus 34 per cent). Similarly, people from ethnic minority groups show higher rates of flat living (40 per cent) and renting (56 per cent). These housing patterns create practical barriers to heat pump installation as external units cannot be installed in flats without suitable outdoor space and landlords have little incentive to invest in capital improvements in rental properties https://www.edrc.ac.uk/publications/understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic

Furthermore, people with disabilities and older people have greater energy needs due to medical equipment and higher heating requirements for pain management, yet household incomes are substantially lower. The Energy Saving Trust estimates that 3.6 million of the 14.6 million disabled people in the UK are in fuel poverty, whilst lone parents face fuel poverty rates of 29 per cent.

Electricity pricing is the critical constraint on fairness outcomes. Heat pump affordability depends on the electricity-to-gas price ratio, with break-even at 3.59. Current UK prices range from 3.31 to 4.8, meaning heat pumps are currently more expensive to run than gas boilers in most scenarios https://strathprints.strath.ac.uk/86820/ Without electricity price reform, decarbonisation cannot achieve fairness outcomes for low-income households.

The Plan should be strengthened by making electricity affordability a Scottish Government priority in negotiations with UK Government and Ofgem, with decoupling of electricity from gas pricing and carbon pricing on gas non-negotiable for fair transition.

A statutory fuel poverty floor should be established, where heat decarbonisation must be wary of areas where it may increase fuel poverty rates. Upfront grant support rather than loans should be expanded for households in or at risk of fuel poverty, redirecting public funding toward energy efficiency measures—loft and cavity wall insulation—which deliver more permanent outcomes than direct energy bill support, provided targeting prioritises the most deprived areas and ensures comprehensive programmes rather than partial retrofit https://www.edrc.ac.uk/publications/the-economy-wide-impacts-of-different-approaches-to-addressing-fuel-poverty-the-importance-of-where-when-and-how-public-funds-are-spent/

Non-economic barriers must be addressed through tailored, flexible policies rather than one-size-fits-all approaches, integrating housing protection with heat decarbonisation for renters

and accounting for specific needs and practical constraints for people with disabilities and older people https://www.edrc.ac.uk/publications/understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic Annual monitoring of fuel poverty outcomes alongside emissions reductions should be established, with targets to reduce fuel poverty to zero by 2045.

Question 6 How can clean heating systems (such as heat pumps) be made more affordable for everyone?

Dr David Drabble and Dr Christian Calvillo (University of Strathclyde)

UKERC research carried out by the Centre for Energy Policy, University of Strathclyde, suggests that building decarbonisation will require supportive policies to reduce heat-pump purchase and installation costs. We are currently assuming that over 10.2 million air source heat pumps need to be installed to achieve long term carbon budget goals https://d2e1qxpsswcpgz.cloudfront.net/uploads/2025/03/1-s2.0-S0301421525000862-main.pdf

Building and encouraging the development of domestic supply chains will also be needed. A sustained programme of grants, subsidies, and supply-chain investment is essential to meet the new UK Warm Homes Plan target for 450,000 heat pumps to be installed annually by 2030. Without major reductions in purchase and installation costs, households will face higher bills and uptake stalls. Bringing equipment and installation prices down requires long-term industrial strategy, R&D support, and market-making procurement policies (https://strathprints.strath.ac.uk/89989/19/Katris-Turner-EPG-2024-Achieving-economy-wide-gains-from-residential-energy-efficiency.pdf).

Addressing issues around how the price of electricity is set is critical. The relative price of electricity vs gas determines whether heat pumps reduce household bills and so policies addressing energy prices and electricity: gas price signals are necessary https://pure.strath.ac.uk/ws/portalfiles/portal/176306169/Corbett_etal_UoS_2023_Unlocking_the_Benefits_of_the_Low_carbon_Heat_Transition.pdf

The upfront costs of adopting heat pumps for households can also have wider economic impacts, depending on the policy design of consumer financing and subsidy mechanisms. Grants and loans have different household spending implications. Our modelling shows grants sustain disposable income and GDP while household-borne upfront costs or loans can depress consumption and job outcomes. A policy that balances investment affordability vs long term household benefits will be needed to realise benefits for Scotland.

Policies to drive mass heat-pump deployment must be coupled with electricity network upgrades. Our scenario modelling shows that if delivered at scale, heat pumps will significantly increase electricity demand, and current networks will need investment of over £20 billion over the next three decades to cope with the demand. These network upgrades should be front-loaded in the next ten years to enable millions of heat pump connections; regulators will need to prioritise grid reinforcement in anticipation for this demand

For heat pump policies, the full rollout of heat pumps needs to be concluded by 2050, steadily rolling out over a 25-year period. This means consistent annual installations are required, with no possibility of delay if carbon budgets are to be met. https://d2e1qxpsswcpgz.cloudfront.net/uploads/2025/03/1-s2.0-S0301421525000862-main.pdf

To achieve these aims, cost-reduction and supply-chain policies should begin immediately so installation costs fall by the late 2020s. Our modelling suggests that heat pump component costs will start to reduce from 2028, with domestic manufacturing and supply chain development essential for achieving further savings. If these reductions are not realised, the household affordability challenge will persist, and wider economic benefits will be undermined. Early policy actions supporting affordability will pay off by increasing economic gains and offsetting the initial costs.

Additional policy investment will also be needed to support supply chain and skills through training and scaling heat pump manufacture. Our research emphasises that policy-funded support and industrial strategy are required to maximise net benefits by strengthening domestic manufacturing and lowering equipment and installation costs. https://strathprints.strath.ac.uk/89989/19/Katris-Turner-EPG-2024-Achieving-economy-wide-gains-from-residential-energy-efficiency.pdf; https://pure.strath.ac.uk/ws/portalfiles/portal/176306169/Corbett_etal_UoS_2023_Unlocking_the_Benefits_of_the_Low_carbon_Heat_Transition.pdf

Investment in heat pumps will result in significant macro benefits and job creation. Under favourable price conditions, our UKERC modelling finds positive GDP and job impacts. For example, under a 1:1 electricity:gas parity scenario, heat pump roll out will add £3.8 billion to the UK GDP and add 67,245 in FTE jobs. Rollout activity (that is, manufacturing and installation) provides both stimulus and regional employment opportunities. The higher energy efficiency of heat pumps could therefore drive positive economic outcomes and long-term job creation, especially if domestic manufacturing is increased. https://d2e1qxpsswcpgz.cloudfront.net/uploads/2025/03/1-s2.0-S0301421525000862-main.pdf

Dr Richard Hanna (Imperial College, London)

Recent analyses advocate moving beyond a ‘fabric first’ approach, which has previously set out that building fabric improvements such as insulation should be prioritised over low carbon heating and renewable energy systems installed in buildings. Instead, researchers argue that insulating every home to a high standard would not be cost-effective or feasible for rapid decarbonisation of the housing stock. https://journal-buildingscities.org/articles/10.5334/bc.388

In this revised approach, many homes can have heat pumps or other zero carbon heating installed without needing to improve their thermal fabric. Building fabric improvements still have an important role, but may only be typically needed in 30%-50% of national building stocks. They should be prioritised in new buildings, in retrofits where low-cost measures are

possible, and where they can bring other co-benefits such as better comfort and health, reducing heat pump running costs and lessening electricity demand from the grid https://journal-buildingscities.org/articles/10.5334/bc.388

Similarly, others emphasise that policymakers should be more receptive to evidence demonstrating that deep building energy retrofit may not pay back within reasonable timescales (https://link.springer.com/article/10.1007/s12053-024-10227-8). This may mean focusing on heat decarbonisation, e.g., through a shift to heat pumps, and redirecting subsidies towards more basic rather than very highly energy-efficient renovations. This approach is reflected, to some extent, in the UK Government's new Warm Homes Plan.

Dr Graeme Hawker (University of Strathclyde) and Dr Mark Winskel (University of Edinburgh)

The deployment of heat pumps will, for the majority of buildings in Scotland, require improvements to the building fabric and central heating systems, which entails a significant upfront capital cost.

A review of heat pump installed costs is available at https://ukerc.ac.uk/publications/heat-pump-cost-review/. This review concluded that reductions in total installed costs of 20–25% were likely by 2030 in the UK – a significant reduction, but relatively modest compared to the target for installation cost parity with gas boilers in the previous UK Government's Heat and Buildings Strategy https://doi.org/10.1016/j.apenergy.2024.124014. These targets were omitted in the recently published UK G Warm Homes Plan.

This recalibration means that heat pump affordability in Scottish homes is likely to remain a barrier to policy delivery in the late 2020s and early 2030s, at a time when deployment needs to expand rapidly for net zero to be feasible by 2045. This requires policy to better reflect the whole lifetime and running cost advantages of heat pumps. For example, by supporting low-cost loans, subscription and rental schemes, including pay-as-you-save or heat-as-a-service mechanisms. A review of such schemes published by ClimateXChange is available at: https://www.climatexchange.org.uk/projects/heat-pumps-on-subscription/

Dr Richard Carmichael (Imperial College, London)

The upfront cost of heat pumps is supported through the Home Energy Scotland (HES) Grant and Loan scheme; more could be done on heat pump running costs. There are three elements to making heat pump running costs more affordable: (i) electricity prices; (ii) heat pump efficiency; and (ii) informed consumer decision-making.

(i) Reducing the cost of electricity and the relative cost of electricity to gas (the 'spark gap') would be very helpful. Domestic electricity prices in the UK are the third highest among 28 IEA countries (https://www.gov.uk/government/statistical-data-sets/international-domestic-energy-prices) and electricity is still more than four times the cost of gas (https://www.nesta.org.uk/blog/what-does-the-budget-mean-for-energy-bills/).

This is a challenging context for heat pumps to compete with gas on cost. Impactful action on electricity prices would be a suite of reforms that cumulatively deliver a significant reduction in electricity prices. There are a number of possibilities across the spectrum of wholesale, network, policy, operating costs, tariff design and consumer-led flexibility and these are currently being

explored by the UKERC mission on reducing energy bills (https://ukerc.ac.uk/project/whole-systems-mission-rapid-bill-reduction/) for the first discussion paper from this work, see https://ukerc.ac.uk/publications/the-price-of-power-wholesale-market-price-formation-policy-costs-and-domestic-electricity-bills-in-britain/

UKERC proposals for a 'Pot Zero' reform could still offer savings in policy costs (an update to the is work was done in 2025 https://ukerc.ac.uk/publications/pot-zero-2025-update-reducing-the-cost-of-renewable-support-to-consumers/

(ii) Heat pump in-situ performance: A heat pump system running with an average efficiency or COP of 2 costs twice as much to run as that heat pump system with a COP of 4. The SPF (Seasonal Performance Factor) of the installed heat pump system is the real-world performance over a year in a real home, and can differ greatly from COP (a snapshot of performance at a particular time) and the SCOP (heat pump unit performance as calculated for laboratory conditions). The in-situ operating efficiency is affected by both the *installation* and how the system is *set up and operated* – both of these are risks to running costs that should be addressed.

Installation depends on installer expertise and this varies widely; as the installer base grows it is at risk of deteriorating or becoming inconsistent. To mitigate, there would be value in greater measurement-based assessment of in-situ performance to help make installer expertise, and outcomes, more transparent: this could inform householders' choice of a trusted installer and avoid the need for redress and reputational damage to the heat pump industry. Measuring in-situ performance using heat meters and other sensors is challenging, but an adequate proxy could be based on smart meter data. Data and transparency on heat pump real world performance and householder satisfaction could also involve a potentially important peer-to-peer aspect that could help shift norms and build confidence in heat pump technology and in finding a trusted installer. https://www.imperial.ac.uk/energy-futures-lab/reports/briefing-papers/paper-10/

How the heat pump is set up and operated can also greatly affect efficiency and running costs, but some adopters report installers offering poor set-up, and little to no guidance on controls and operation. Mitigation could include formalising minimum installer duties for hand-over and post-installation.

(iii) Supporting informed-householder decisions about adoption and tariffs is the third aspect of heat pump affordability. Making heat pumps cheaper to run will not deliver the needed adoption unless consumers can access clear information about running costs, by making real world data on heat pump installations more accessible by a digital database of installation case studies. This could be supplemented by other digital comparison tools to give tailored support for decisions on potential running costs of heat pumps including the impact of different tariffs, again leveraging smart meter data see https://www.gov.uk/government/publications/smart-meter-enabled-tariffs-comparison-project-smarter-tariffs-smarter-comparisons.

Question 7 Which of the following would be most effective in enabling you to transition your vehicle(s) to zero emissions alternatives? Please rank your choices from highest to lowest priority, where 1 is the highest priority. Please only give one ranking to each option. If you're responding for an organisation: you may want to consider car fleets as well as HGV fleets.

Dr James Dixon (University of Strathclyde)

Whilst all listed options address barriers to zero-emission vehicle adoption, UKERC's transport research (for a compendium, see https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/ demonstrates that focusing primarily on vehicle transition misses the fundamental challenge: meeting Scotland's climate targets requires substantial reductions in overall vehicle use, not just fleet electrification. In particular:

1. **Technology alone is insufficient**: Our research shows that even with 100% EV adoption by 2030, Scotland would need a **20% reduction in vehicle kilometres** to meet net zero targets https://www.creds.ac.uk/publications/reverse-gear-the-reality-and-implications-of-national-transport-emission-reduction-policies/ and https://www.nature.com/articles/s41560-022-01057-y

2. **Timeline constraints**: With median vehicle longevities approaching 18 years (https://blogs.lse.ac.uk/politicsandpolicy/a-novel-way-to-estimate-car-longevity-shows-that-electric-vehicles-life-mileage-is-increasing-fast/), vehicles purchased today will still be on roads in 2040. **Electrification alone cannot deliver the speed of emissions reduction required**.

3. **Co-benefits missed**: Modal shift to active travel and public transport delivers **multiple co-benefits** (health, air quality, equity) that EV transition alone cannot achieve. Our research quantifies transport air pollution health costs at **£6 billion annually in the UK**, with non-exhaust PM2.5 emissions from tyre/brake wear persisting even under full electrification—particularly from heavier EVs.

Therefore, the most effective enabling actions are to **reduce the need for vehicle ownership** through investment in **integrated public transport**, active travel infrastructure, and compact urban design; **implement car restraint policies** (parking pricing, workplace parking levies, low-emission zones) that make alternatives competitive; **prioritise shared mobility** (car clubs, demand-responsive transport) over individual ownership; and **integrate transport, housing, and land-use planning** to reduce travel distances.

Ranking (most important to least important):

4. Noticeably cheaper running costs	Particularly since the increase in electricity prices following the Russian invasion of Ukraine, the running costs of electric mobility have increased significantly and the long-established “high-upfront costs but low running costs” mantra of electric vehicles is being eroded, particularly for individuals without access to overnight residential charging (for whom the cost rate of energy addition to their vehicles is often now comparable with fossil fuel vehicles).
3. Reliable infrastructure for vehicles	Critical for transport-energy system integration, including V2G potential https://www.sciencedirect.com/science/article/pii/S2590116822000261 and avoiding “charging deserts” particularly in disadvantaged communities https://theconversation.com/where-does-the-uk-most-need-more-public-ev-chargers-259623

5. Convenient access to public charging infrastructure	Essential for households without access to off-street parking, who risk a significant "inconvenience penalty" of electrification without widespread destination charging opportunities https://www.sciencedirect.com/science/article/pii/S0306261919317775
7. Access to funding support / low cost finance	The above-mentioned mantra of "high upfront cost, low running costs" that applies to electric mobility in general can be overcome with access to low-cost finance.
2. Cost of used zero emissions vehicles needs to come down	Prioritising the cost of used vehicles (e.g. by expanding concessional finance to the second-hand market)
1. Cost of new zero emissions vehicles needs to come down	-
6. Ensuring an adequate number of trained mechanics available	The opportunity for a just transition in the vehicle servicing industry should not be missed; however, many elements of servicing electric vehicles are in common with fossil fuelled-vehicles.

Prof. Jillian Anable, University of Leeds and Energy Demand Research Centre (EDRC)

My submission focuses on the content of the draft CCP in relation to its plans for accelerating the uptake of electric passenger cars. It is divided into six key areas as follows:

1. ***Lack of targeted focus on help to buy EVs***

There is currently a focus on increasing the affordability of EVs *in general*. However, **even *good* EV policy can be regressive if it mainly subsidises new car buyers with driveways. A targeted approach is needed to widen access** to EVs across all income levels and thus ensure the market maintains momentum over the next decade. This needs to involve identifying segments of the population and places that require targeted assistance. For instance:

- Those who are most 'transport vulnerable' and most impacted by rising fossil fuel costs – i.e. those who own a car, live in rural areas on the lowest income deciles or those who undertake high mileage for relatively low paid work regardless of where they live.
- Those without the ability to charge off-road at home.

Scotland is currently the only part of the UK offering financial support in the form of an interest free loan for consumers to purchase electric vehicles. However, this is not targeted or tiered by income. Moreover, the uptake of this scheme (i.e. who has benefited) is not being evaluated. This is a missed opportunity to have implemented something akin to France's social leasing

scheme, which offers low-to-middle-income households affordable, subsidized monthly rentals for electric cars, typically for 3+ years, with low or no upfront costs. The leases can be tiered by income and proof can be also used to tie these leases to long commutes (>15 miles). France had 90k applicants in the first couple of weeks for its €100/month scheme.

2. ***Lack of deliberate support for the second-hand EV market***

Each year, four times more used cars are sold than new cars. Therefore, the used-car market is where the 'mainstream' (and lower income) consumer resides. Motor manufacturers and financers rely on a healthy second-hand market to increase residual values as this is a determinant factor in fleet uptake where most (75% so far) BEVs are first purchased.

The draft CCP largely assumes a second-hand EV market will emerge but does not yet set out policies to actively enable it. Yet, **international experience shows that a strong second-hand EV market is not automatic but requires deliberate policy support**, particularly through procurement and fleet electrification, scrappage schemes, used-EV incentives, battery assurance and affordable finance. There are several initiatives that could be used:

- *Direct purchase incentives for used EVs*. These are still relatively rare but are growing quickly. E.g. France's "Bonus écologique" initially involved an income tested cash bonus for purchasing a used BEV (€1,000–€2,000). This was available regardless of whether the seller is a dealer or private individual and is explicitly framed as a social equity measure, not just a climate policy.

- *Scrappage schemes*. The Spain MOVES programme and France's Prime à la conversion" pays a bonus for scrapping an older ICE vehicle and replacing it with a new OR USED EV. Higher payments are made to low income households and higher mileage drivers. Other more local/ sub-national jurisdictions (i.e. in Germany) have also piloted Scrappage-for-used-EV schemes.

- *Public-backed guarantees for battery condition and resale value*. Japan has had long standing battery health reporting standards (initially for hybrids, now for EVs). The EU's new Battery Regulation will require battery passports and health and durability information but the UK, including Scotland, does not yet have a mandatory, industry-wide, standardized battery health certification scheme for used EVs.

Scotland has no equivalent devolved incentives like the second-hand purchase incentives or scrappage schemes outlined above, despite the equity rhetoric in the plan. **A targeted used-EV grant could align with fuel poverty and just transition aims**.

3. ***Lack of clarity on the assumptions behind EV uptake, utilisation and charging deployment to determine deliverability and emissions pathways***

The plan includes ambitious emissions projections without specifying the principal demand-side EV measures needed to deliver them. Given the CCP's reported reliance on transport for a very large share of emission reductions, and the substantial forecasted financial benefits associated with the switch to EVs, there is a very concerning accountability issue: **the plan**

should provide policy-by-policy quantification or at least transparent assumptions behind EV uptake and charging deployment.

In particular, key delivery levers are *underspecified*—especially the "consumer incentives" package. If incentives are new but undefined, it is not possible to assess the expected uptake (new vs used EVs), fiscal cost, distributional impacts, or whether it closes the gap to the emissions pathway the plan assumes. Answers are needed to the following questions:

- What is the **defined EV uptake trajectory** assumed (by vehicle type) to deliver the transport emissions pathway?
- What is the **expected utilisation profile** of EVs and of the residual ICEs on the road to determine final fuel demand and emissions?
- How will the EV strategy be aligned with **car-km reduction / modal shift** to avoid rebound effects?
- What exactly are the **"consumer incentives"** (eligibility, scale, budget, start date, evaluation plan)?
- How are **rural, island, and tenement** charging needs handled, and who funds grid upgrades?
- What minimum standards will apply to **public charging** (coverage, reliability, accessibility, price transparency)?

In addition, on the calculation of benefits, there is reference to 'co-benefits' or 'wider impacts' in various sectors but it is not clear to what extent these are included in total benefits – and if so, what these are.

4. ***Lack of attention to travel patterns to prioritise the location of charging infrastructure***

Achieving an equitable and geographically accessible charging network will depend as much on policy intervention as on market-led rollout, particularly where those interventions shape both EV uptake and wider travel behaviour. The draft CCP pathways appear to assume a charging network that delivers broad accessibility across Scotland, but they do not **make explicit how infrastructure planning will be linked to expected travel patterns**—i.e. where future vehicle miles will be undertaken, and what level of geographic coverage will be required to support them. Nor does the draft provide sufficient detail on how modal shift is expected to redistribute demand between electric motoring, bus use and active travel (for example, whether shorter sub-10km trips are primarily expected to transfer to walking and cycling, or whether a substantial share of 10–40km journeys will instead shift to public transport).

Without a clearer articulation of which journeys will remain reliant on car travel—and where—there is limited basis to prioritise charging investment, or to scrutinise whether the proposed charging network can credibly enable the emissions reductions claimed. This creates a practical "trilemma" for delivery, particularly in rural and remote areas: balancing total charger numbers, technology and service accessibility (including for those without home charging), and the geographic distribution needed to ensure reliability and fairness.

5. ***Slow and unclear effort to plan the roll out of residential charging infrastructure***

While the draft CCP recognises the importance of near-home charging, delivery still needs to be framed at the level of outcomes and pace required to make uptake equitable for households without off-street parking. **The CCP should move beyond aggregate charge point numbers and commit to targeted residential coverage standards**—e.g. a defined minimum level of reliable overnight charging access within a short walk of homes in high on-street-parking neighbourhoods, rural towns, and areas with high proportions of flats/tenements—supported by a transparent roll-out plan and reporting/monitoring.

International experience suggests this is achievable where governments and municipalities use explicit targeting and delivery mechanisms, rather than relying on opportunistic deployment:

- *Demand-led-replacement*: the Netherlands has built a dense, reliable network, in part through demand-led placement (installing kerbside chargers in response to demonstrated local need), and through coordinated regional concessions that pool municipal demand and reduce procurement friction.
- *Legal 'right-to-plug'*: France addressed governance barriers in multi-occupancy settings by adopting a legal "right to plug" concept for shared buildings, combined with the ADVENIR grant support programme that helps fund charging in shared buildings and parking contexts.

The CCP should therefore specify (i) how locations will be prioritised using travel/parking, vulnerability and housing data, (ii) the delivery model (for example, regional concession frameworks led by councils/regions), and (iii) the affordability proposition for those without home charging, so that near-home provision actively closes—rather than perpetuates—the cost and convenience gap between driveway and non-driveway households.

6. The role of local authorities is not set out

A further gap in the draft CCP is that the role of local authorities in accelerating EV uptake is not consistently specified or clearly embedded as a delivery requirement. Given councils' central influence over the practical conditions for EV adoption—through local charging strategies, planning and consenting performance, parking and pricing levers, and the transition of public sector fleets—**the CCP would benefit from an explicit Local Government EV Delivery Framework annex**. This could define core responsibilities for councils alongside associated milestones, annual metrics and reporting expectations, enabling clearer accountability and more transparent scrutiny of progress.

A strong Scotland-specific comparator already exists in Transport Scotland's *EV Public Charging Network Implementation Plan*, which is structured as a multi-stakeholder delivery plan and repeatedly identifies local authorities as key delivery partners. The draft CCP could usefully lift this approach by setting out a concise action table for EV delivery, specifying (a) the lead partner (e.g. councils, Scottish Government, DNOs), (b) deadlines, (c) expected outputs (such as on-street chargers delivered or planning service standards achieved), and (d) measurable metrics—helping ensure that delivery responsibilities match the pace and scale of uptake assumed in the emissions pathway.

Question 8 How can the Scottish Government support communities to participate in planning of local sustainable infrastructure (such as, walking, wheeling and cycling routes)?

Dr James Dixon (University of Strathclyde)

UKERC research demonstrates that **co-design builds social license for transformative change** https://www.sciencedirect.com/science/article/pii/S0301421520300914 , but only when it addresses a fundamental disconnect**: communities are asked to make significant changes (like reducing car dependency) for abstract, global climate goals they struggle to connect with personally**. The challenge is making visible the **immediate, local, tangible benefits** that sustainable infrastructure delivers.

We make the following specific recommendations:

1. Make local co-benefits visible and quantifiable

Communities need compelling reasons beyond climate change itself, which is routinely met with justification for inaction along the lines of several discourses of delay https://www.cambridge.org/core/journals/global-sustainability/article/discourses-of-climate-delay/7B11B722E3E3454BB6212378E32985A7.

UKERC research on transport demonstrates that there are many compelling local co-benefits to sustainable infrastructure:

- Air pollution from cars and vans costs the UK **£6 billion annually** in health impacts, with nearly 90% from diesel vehicles (https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/, p.54)
- People who cycle daily have **84% lower CO_2 emissions** from all travel than non-cyclists https://www.sciencedirect.com/science/article/pii/S0959378021000030
- Net zero transport policies could prevent **201,000 COPD cases and 192,000 childhood asthma cases** https://www.sciencedirect.com/science/article/pii/S0160412025000340
- Active travel delivers immediate benefits: cleaner air, physical activity, reduced household transport costs, safer streets for children

Health and economic co-benefits are more immediate and motivating than 'distant' climate impacts https://www.nature.com/articles/s41467-019-09499-x. Infrastructure proposals should be framed with street-level air quality impacts, NHS cost savings, safety improvements, and community cohesion benefits.

2. Use genuine co-design practices to address communities' concerns, including bold commitments through trials and community consultations

Historic successes in transport can be showcased to demonstrate the potential of interventions for climate action, e.g. London's combination of congestion charging, ULEZ, and public transport improvements drove both reduced car ownership and increased EV uptake https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/, p.17.

Trial schemes and demonstration projects allowing communities to experience benefits, which are particularly effective when partnerships are built with trusted community organisations with established relationships. Behavioural change is more effective at a community, rather than

individual level https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium, p.45. Combine incentives, education and infrastructure changes with mechanisms to monitor and adapt policies over time to promote long-term behavioural shifts.

3. Design for equity

Historically, Scottish Government climate policy has a commendable focus on Just Transition. This must be a central part of the climate plan in transport. Policies must consider the needs of vulnerable groups (e.g. low-income households, rural residents) through targeted subsidies, improved accessibility and equitable distribution of infrastructure.

Citizens' assemblies, independent facilitation, capacity building and targeted engagement with transport-poor communities are important tools in the development of the Climate Change Plan https://www.gov.scot/publications/net-zero-nation-public-engagement-strategy-climate-change/pages/1/.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Community participation in planning sustainable transport infrastructure requires addressing structural barriers that prevent meaningful engagement by groups with protected characteristics. Communities most affected by transport poverty—ethnic minorities, people with disabilities, older people, and those with lower incomes—have different travel needs and constraints than the general population, yet are underrepresented in infrastructure planning processes.

Differential travel needs and barriers to participation reveal this. People from ethnic minority groups travel more for commuting (26 per cent) and less for leisure activities (19 per cent) than people from white groups, and rely significantly on public transport (25 per cent of trips) compared with only 13 per cent for white groups. However, these groups face practical barriers to participation as ethnic minorities are more likely to live in flats and rented accommodation, constraining ability to engage in neighbourhood-level planning. People with mobility difficulties have higher dependence on car-based travel (85 per cent of trips) yet face accessibility challenges in cycling infrastructure. Older people and people with disabilities have specific journey types and purposes that differ from average travel patterns https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf

Current planning processes rely on consultation models that overlook non-economic structural barriers. Communities with protected characteristics require tailored approaches that are flexible, agile, and geographically sensitive, accounting for time constraints, accessibility needs, and language barriers. Lone parents (mean disposable income of £25,234) and people renting from social housing (£24,216) face greater time poverty and cannot easily attend standard daytime consultation sessions. People with disabilities require accessible venues, advance notice for personal assistance, and flexibility in participation methods. The intersectional nature of people's lived experiences means policies must move beyond one-size-fits-all engagement approaches https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf

Effective community participation requires embedding equity and accessibility in planning from the outset rather than treating participation as an add-on, with early identification of affected communities and engagement designed around their specific constraints. Dedicated funding for community participation infrastructure—paid community coordinators, accessible venues, translation services, childcare provision—is essential, recognising that meaningful participation requires resource investment. Planning should move from consultation to co-design models where affected communities have decision-making authority, not merely advisory roles, particularly for communities experiencing transport poverty determining priorities and accessibility standards.

Transport planning must integrate with broader equality and inclusion agendas, linking transport planners, local authorities, health services, and welfare agencies in coordinated approaches. Accountability mechanisms should require planners to report annually on representativeness of participation by protected characteristics, income, and postcode, demonstrating how community inputs shaped final designs, with communities having veto rights over designs affecting local areas.

Question 9 What action by the Scottish Government would be most helpful in supporting you to live a more climate-friendly lifestyle?

Dr James Dixon (University of Strathclyde)

This question risks placing responsibility on individual "lifestyle choices" when UKERC research consistently shows **car dependency is structural, not individual**: factors such as infrastructure lock-in https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/, p.4 often 'force' car use and make transitions away from this cultural norm difficult, on an individual level. Moreover, the Draft Plan demonstrates this disconnect: it projects a 68% reduction in transport emissions by 2040, yet relies heavily on optimistic assumptions about consumer EV adoption, while lacking concrete measures to reduce car use.

The most helpful government action is creating systems where sustainable choices are the easy, affordable, default option, rather than asking individuals to overcome structural barriers through willpower. Our recommendations for action by the Scottish Government are:

1. Set a quantified car use reduction target with a clear implementation plan

The Draft CCP includes a 'Transport Outcome' to "create an environment for reducing car use" https://spice-spotlight.scot/2025/12/01/climate-change-plan-policies-proposals-and-sector-summaries/ but provides no specific target, timeline or credible implementation plan. UKERC evidence shows that:

- Scotland requires a **20% reduction in vehicle kilometres by 2030** (relative to 2019) to meet net zero by 2045 https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/ p.40
- For the UK overall, a **20-50% reduction in car mileage by 2030** is necessary to meet carbon budgets (https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/ p.40

- Without explicit targets, the "lifestyle and efficiency" scenario that Scotland has previously explored (which delivered earlier reductions, higher cumulative savings, and lower system costs) https://link.springer.com/article/10.1007/s12053-018-9678-9 cannot be achieved

The most helpful action that Scottish Government can make is to announce a specific, time-bound car use reduction target in the final CCP (e.g., 20% reduction by 2030, 40% by 2040) with interim milestones and accountability mechanisms.

2. Address aviation and shipping

Aviation accounts for a disproportionate share of Scotland's transport emissions while primarily benefiting higher-income groups. UKERC evidence has shown that an average UK resident flies 2.9 times/year (0.4% of trips) yet flying contributes **44% of passenger miles and 55% of CO_2e emissions** https://www.nature.com/articles/s41560-024-01561-3 The wealthiest fly most frequently while lower-income groups rarely fly; without demand management, UK climate targets may be unattainable due to projected aviation growth.

The most helpful action that Scottish Government can make within devolved powers is to advocate to UK Government for frequent flyer levies (progressive taxation on those flying most, which are generally supported by a majority of the public (see UK Climate Assembly); to champion virtual meeting solutions for business travel (lessons from COVID-19); do not expand airport capacity in Scotland; and include aviation/shipping in Scotland's territorial accounting to make impacts visible.

3. Make health co-benefits central to policy communication

The Draft CCP mentions health benefits but doesn't quantify them in the transport section, unlike the detailed health analysis for Heat in Buildings. As per our response to Question 8, there are a multitude of health co-benefits in climate action in the transport sector, which can be better communicated in order to deliver change at a community level.

4. Address non-exhaust emissions from EVs; address “mobesity” in the car fleet

The Draft CCP heavily emphasises EV but doesn't address the persistence of PM2.5 from non-exhaust emissions (tyre/brake wear), particularly from heavier vehicles. UKERC evidence shows that PM2.5 from non-exhaust emissions remains an issue even under full electrification https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/, p.51, and that heavier EVs (particularly SUVs) cause greater tyre and road wear, emitting more harmful particulates. ‘Mobesity’ – the increasing footprint and kerbweight of passenger cars – undermines climate mitigation efforts https://www.nature.com/articles/s41560-024-01559-x Global evidence suggests that weight-based vehicle taxation can discourage large EVs and incentivise smaller, lighter models. **EV subsidies should favour efficient models**, not large vehicles.

5. Integrate transport with housing, energy and urban planning

The Draft CCP acknowledges cross-sector challenges (particularly for EV charging and grid integration) but lacks concrete integration mechanisms. Transport planning remains siloed from housing and land-use, which drives car dependency in the UK

https://ukerc.ac.uk/publications/ev-charging-and-its-implications-across-transport-power-buildings-and-planning/

UKERC evidence shows that cross-sector coordination is the 'holy grail' of land-use planning, which is currently fragmented across electricity, housing, transport, and land-use sectors https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/, p.21. At-home EV charging creates sectoral friction: strain on low-voltage networks, development cost trade-offs with affordable housing, lack of integration across sectors. Compact, mixed-use urban design reduces travel distances and enables active travel, but requires integrated planning https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/ , p.46). 20-minute neighbourhoods bringing services within short walk/cycle distance eliminate the need for many car trips.

On the basis of the evidence, we recommend:

- Setting statutory requirements for integrated transport-housing-energy planning at local authority level
- National planning policy prioritising compact development near public transport nodes, and expansion of integrated public transport systems across urban areas (taking lessons from many demonstrated cases, e.g. Berlin, Vienna, London)
- Grid investment planning coordinated with transport electrification scenarios (building on our V2G research showing controlled demand-side flexibility can reduce grid strain by 43-69%) https://www.sciencedirect.com/science/article/pii/S0306261924002198
- Local authority capacity building for integrated planning, following the Active Travel Transformation Programme model https://www.transport.gov.scot/active-travel/transforming-active-travel/

6. Ensure that Just Transition addresses rural and island transport poverty

UKERC evidence shows that transport poverty is **multidimensional**: availability, reliability, affordability, accessibility, safety. Rural households face legitimate car dependency due to lack of alternatives; therefore, policies focused on urban modal shift can exacerbate rural inequality without targeted measures.

We recommend that Scottish Government promote **demand-responsive transport** solutions for rural/island communities where fixed routes aren't viable, and prioritise rural EV charging infrastructure to avoid "charging deserts" https://theconversation.com/where-does-the-uk-most-need-more-public-ev-chargers-259623

7. Address the EV uptake optimism

The Draft CCP assumes that BEV uptake will **outstrip the ZEV mandate** through consumer choice, driven by price parity (2026-2028) and consumer preference. The current reality is that only **3.7% of UK cars are BEVs** https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/), with median vehicle longevity of nearly 18 years https://blogs.lse.ac.uk/politicsandpolicy/a-novel-way-to-estimate-car-longevity-shows-that-electric-vehicles-life-mileage-is-increasing-fast/

As previously mentioned, UKERC evidence has consistently shown that technology transitions alone are insufficient: even with 100% EV adoption by 2030, vehicle use reduction is still needed https://ukerc.ac.uk/publications/ukerc-transport-evidence-compendium/, p.40

On the basis of this evidence, the most helpful actions are to establish **contingency plans** (e.g. what if EV uptake lags projections?) and introduce **stronger policy levers** that do not rely on consumer choice (e.g. fleet procurement mandates, car club requirements, charging infrastructure requirements based on local authority planning). Aside from electrification mandates, policy should (as aforementioned) focus on **reducing the need for vehicles** through modal shift to deliver faster emissions reductions than waiting for fleet turnover.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Supporting climate-friendly lifestyle choices requires addressing multiple barriers beyond financial incentives. Centre for Energy Policy (CEP) research on transport electrification and protected characteristics reveals that capacity to make climate-friendly choices varies substantially across populations, and policies must account for these structural inequalities.

Transport remains Scotland's largest emitting sector (26 per cent of total emissions in 2022, with cars and vans contributing 17 per cent). Electrification of private transport offers macroeconomic benefits with investment in electricity network upgrades supporting sustained economic expansion and up to 30,000 additional full-time equivalent jobs. However, these benefits depend on smart charging adoption and are unevenly distributed across income groups https://strathprints.strath.ac.uk/73568/

CEP modelling shows the most positive economic outcomes occur where smart charging is adopted quickly, reducing network investment requirements from £16.9 billion to £9.8 billion. However, this investment is funded through consumer electricity bills recovered over 45 years, creating sustained upward pressure on electricity prices, with electricity costs increasing by 0.35 per cent by 2050 in slow-uptake scenarios. Crucially, low-income households—least likely to benefit from wider economic gains—are most exposed to rising electricity costs, potentially widening real income inequalities https://strathprints.strath.ac.uk/73568/

Barriers to climate-friendly choices for vulnerable groups are not purely financial. People with disabilities face multiple constraints with higher dependence on car-based travel (85 per cent of trips versus 79 per cent without mobility difficulties), lower mean incomes (£32,232 versus £40,981), limited access to accessible models, and charging point accessibility challenges. Ethnic minorities rely more on public transport (25 per cent of trips) yet are concentrated in areas with weaker infrastructure or cannot access alternatives due to working patterns requiring reliable transport regardless of carbon content (26 per cent travel for commuting) https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf

Capacity to shift to active travel depends on infrastructure quality and personal circumstances, as older people and those with mobility difficulties require wheeling infrastructure, lone parents (29 per cent fuel poverty risk) face time constraints preventing car travel shift, and people in weak public transport areas cannot reduce car dependence regardless of climate motivation.Supporting climate-friendly lifestyles requires a series of measures:

- recognising that active travel and public transport use must be supported by comprehensive infrastructure investment, particularly in underserved regions and for currently excluded groups, including accessible cycling facilities for people with disabilities, secure storage for those in flats, and safe lit routes for older people and women.
- Low-income households must be protected from electricity price pressures by decoupling household electricity prices from network investment cost recovery, with direct support mechanisms (bill subsidies, upfront grants) accompanying any shift toward electric transport.
- Public transport infrastructure and affordability should be prioritised as the primary decarbonisation pathway for groups with protected characteristics, with free or low-cost fares maximising access.
- Non-economic barriers require flexible, tailored support including accessible infrastructure design and transport options for people with disabilities, culturally responsive engagement for ethnic minorities, and infrastructure supporting flexible transport timing for lone parents.
- Mandatory impact assessments for all transport decarbonisation policies, disaggregated by protected characteristics, income level, and geography, should ensure policies are only rolled out where evidence demonstrates equitable access and outcomes, with affected communities having veto rights.
- Health, welfare, work, and transport planning should be integrated, recognising interactions with employment access, health outcomes, and social inclusion.
- Clear, sustained funding mechanisms for decarbonisation support should replace time-limited schemes, providing confidence in long-term commitment.

Question 11 What are your views on Scotland generating more electricity from renewable sources?

Dr Graeme Hawker and Dr Callum MacIver (University of Strathclyde)

The expansion of renewables, and the electrification of energy services (heating, transport and some industry needs) are the key enablers of economy-wide decarbonisation in Scotland. Scottish policies have three key roles to play in enabling the electricity sector to contribute the required levels for the future carbon budgets:

1. Enabling the build-out of renewable energy capacity in Scotland and in Scottish waters. While the conclusion of the Review of Electricity Market Arrangements (REMA) has opted against zonal pricing, reformed national pricing is still under review and potential reform and it is key to renewable development in Scotland that this increases certainty for investors. Potential amendments to CfD and/or transmission charging design may significantly affect the price signals to developers looking to locate new renewable generation capacity in Scotland. These issues, as well as the implications of 'volume risk' on renewable assets competitiveness, are addressed in https://ukerc.ac.uk/publications/zonal-pricing-volume-risk-and-2030-clean-power-target-working-paper/ and a forthcoming UKERC working paper on CfD design. Options for improving locational signals within a reformed national pricing system to better optimise asset utilisation in a renewables-dominated electricity system are

explored in https://ukerc.ac.uk/publications/locational-signals-in-a-reformed-national-market-a-review-of-options/

2. Accelerating the design, planning and build-out of new electricity network capacity to both increase the capacity of the network to reduce constraints, as well as permitting new generation capacity to be accommodated. https://ukerc.ac.uk/news/transmission-network-unavailability-the-quiet-driving-force-behind-rising-curtailment-costs-in-great-britain/

3. Supporting the electrification of energy services currently supplied directly from fossil fuels. The reduction of emissions from passenger vehicles is a key contributor to carbon budgets, meaning that the Scottish Government must promote the uptake of EVs such as through the coordination of new charging infrastructure. The uptake of heat pumps in buildings must be promoted as a priority. Industrial decarbonisation through electrification must also be supported.

National policies to manage/lower costs of renewables (see, for example, UKERC's work on 'Pot Zero', a plan which aims to save £2-8 billion per year in the late 2020s: https://ukerc.ac.uk/publications/pot-zero-2025-update-reducing-the-cost-of-renewable-support-to-consumers/ and the costs of operating a renewables-dominated system (such as recent work on minimising curtailment costs in the UK energy system: https://ukerc.ac.uk/news/transmission-network-unavailability-the-quiet-driving-force-behind-rising-curtailment-costs-in-great-britain/ will have a particular impact on Scottish generators, so engagement with responsible UK bodies to ensure their interests are well-represented are key.

Generally, the costs of new generation and transmission infrastructure implies no additional costs to the public purse, as both attract private investment recovered from future energy markets and network charging elements of consumer bills respectively. However, the need to de-risk investment means that there may be benefits to public investment with long-term returns.

While there will be large upfront capital costs, it is expected that investment in a low carbon electricity sector will have a number of benefits to society, such as an overall reduction in costs in the long term compared to maintaining the current system. The potential scale of renewable generation in Scotland will mean a proportionally larger amount of energy in Great Britain will come from generators in Scotland or Scottish waters, and this in turn creates an opportunity for increased economic activity within Scotland.

Some of the shifts in energy services demands come with additional benefits; for example, the uptake of heat pumps is likely to result in significantly improved health outcomes and a reduction in costs to NHS Scotland from e.g. respiratory illness. https://ukerc.ac.uk/publications/benefits-heat-pumps-role-electricity-gas-prices/ The removal of ICE vehicles from urban environments will bring improved air quality. https://ukerc.ac.uk/publications/climate-change-policies-reduce-air-pollution-and-increase-physical-activity-benefits-costs-inequalities-and-indoor-exposures/

For all elements of the electricity sector, the development of supply chains are key, so irrespective of the timeframes for particular transitional shifts, early work should be conducted

and led by government to identify and promote necessary supply chain development for generation, transmission, and shifting energy service demands in heating, transport and industry.

The affordability of energy during the transition, in particular where electrification of existing fossil fuel demands is concerned, presents particular challenges. For example, it is difficult for local authorities to promote heat-pump-based heat networks as part of their heat and efficiency plans where this potentially equates to an increased cost of heating for the consumers connected to that network. Similarly, industrial decarbonisation via electrification may make products less competitive in international markets due to UK energy being higher cost than in other countries.

Another challenge is that public opposition to new infrastructure, such as the growing movement against new electricity lines, is likely to increase. It should be pre-empted by government messaging which makes the case for such infrastructure in the drive to meet net zero, alongside communicating the potential benefits to consumer energy bills due to increased low-cost renewable energy volumes and reduced constraint costs.

However, the low-cost case for renewables is also predicated on the current situation of high gas prices https://ukerc.ac.uk/publications/review-of-energy-policy-2025/ . Policy should be prepared with the case borne in mind that there may be a potential future reduction in the cost of gas to the point where it again becomes the cheapest form of electricity generation, and any justification for public expenditure in other areas of the electricity system should be sustainable in a future with different cost assumptions.

Question 12 What support do industries need to reduce their carbon emissions while remaining competitive?

Dr Imogen Rattle and Prof. Peter Taylor (University of Leeds)

Much of Scotland's focus on industrial decarbonisation has been around the Grangemouth cluster, but Scotland is also home to several dispersed industrial sites that fall outside this cluster, including cement, paper, glass and metals, as well as food and drink (including a large number of distilleries). The 2024 Green Industrial Strategy, however, made no specific reference to dispersed sites. It is therefore important that the Climate Change Plan clarifies what the Scottish government's approach is to these industries, and how it plans to decarbonise them.

Recent UKERC work https://ukerc.ac.uk/project/decarbonisation-of-dispersed-industrial-sites has explored what lessons can be learned from the UK Government's Local Industrial Decarbonisation Plans competition, which funded 13 local industrial clusters to develop place-based plans for decarbonisation. Notably, of the 13 winning projects, ten were based in England, one in Northern Ireland, one in Wales and one extended from south-west England into Wales. None were based in Scotland. We do not have the data to explain why no Scottish projects were awarded funding. Policymakers first need to decide whether they believe a distinct Scottish approach for dispersed industrial sites is warranted. If so, this should be clearly stated in the Climate Change Plan, along with an indication of how these sites will be supported relative to the Grangemouth cluster.

If dispersed sites are to be included, the following steps will assist in the development and implementation of policy.

- Establish or improve mechanisms to ensure dispersed industries are aware of funding opportunities
- Support collaboration among geographically dispersed sites through networking events, regional coordinators, or digital platforms that allow industries to find partners and share knowledge safely;
- Offer guidance on bid preparation to help smaller or less experienced organisations submit competitive proposals;
- Adapt funding criteria opportunities to account for the unique challenges of dispersed sites, including smaller scale, geographic separation, or cross-sector collaborations
- Track the uptake and success of dispersed-site projects and adjust policy interventions accordingly.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Industrial decarbonisation is essential for meeting Scotland's 2045 target, but firms face overlapping barriers on capital, energy costs, labour and policy certainty. CEP research shows that without coordinated support across these areas, low carbon investment will remain limited and uneven across sectors and regions https://www.edrc.ac.uk/publications/the-economy-wide-impacts-of-different-approaches-to-addressing-fuel-poverty-the-importance-of-where-when-and-how-public-funds-are-spent/ and https://strathprints.strath.ac.uk/86820/

Upfront capital costs remain a major obstacle, particularly for first of a kind projects in CCUS, hydrogen and electrification. Estimated costs for Track 1 and Track 2 CO_2 transport and storage infrastructure exceed £3.2 billion between 2023 and 2029, meaning public schemes such as SIETF need to be significantly scaled and sustained to leverage private capital (Katris et al., 2024; https://strathprints.strath.ac.uk/86820/

At the same time, electricity pricing is a fundamental competitiveness constraint. Electrification is the most likely route for many industrial processes, yet current electricity to gas price ratios and network cost recovery through bills (raising electricity prices by up to 0.35 per cent by 2050 in slower uptake scenarios) erode returns for energy intensive industries and risk carbon driven relocation https://www.edrc.ac.uk/publications/the-economy-wide-impacts-of-different-approaches-to-addressing-fuel-poverty-the-importance-of-where-when-and-how-public-funds-are-spent/ . UK level reforms on price rebalancing and targeted relief for energy intensive users are therefore critical to Scottish industrial strategy.

Labour and timing also matter. Simultaneous deployment of CCUS projects creates concentrated construction peaks (around 11,000 FTE in 2023) which push up wages and displace around 1,000 FTE jobs elsewhere in the economy by 2027, particularly in lower wage sectors and regions not hosting new investment. Coordinated sequencing of major infrastructure programmes, integrated skills planning, and application of Fair Work First to publicly supported projects can help manage these pressures while improving job quality.

To keep industry competitive during the transition, support should combine: expanded grant based capital funding for industrial decarbonisation; rapid UK action on electricity price

rebalancing and carbon pricing on gas; clear long term commitments and timelines for CO_2 transport and storage and grid upgrades; and place based strategies for sectors and regions at highest risk of carbon driven deindustrialisation, including diversification support and community wealth building approaches https://strathprints.strath.ac.uk/86820/.

Question 16 Which groups or communities do you think will be most affected by the transition to net zero, and in what ways?

Professor Nick Pidgeon and Professor Karen Henwood (University of Cardiff)

Public attitudes and obtaining a 'social license to operate' within communities asked to host major technology deployments will also be a key consideration. Extensive work by members of the UKERC consortium, but funded by other UKRI investments, shows that the UK public will place strong conditions upon any large-scale deployment of any technologies, including: (a) needing an assurance that they will work as intended; (b) that they will not create additional risks to local biodiversity, the environment, or to workers and communities; and (c) for Negative Emissions Technologies (NETs) in particular, that they should not be deployed without parallel and extensive efforts at conventional mitigation https://doi.org/10.1038/s41558-020-0823-z and www.nature.com/articles/s41599-025-05384-9). Deep reductions in emissions, alongside minimising risks to environments (especially those seen as 'iconic') are the *sine qua non* for gaining social acceptability of land-based and other NETs.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Transition impacts are unequally distributed across communities. Island economies face acute challenges. Shetland's oil and gas closures will free approximately 140 skilled workers at Sullom Voe by 2035, yet simultaneous demand for green hydrogen and low-carbon fuel production risks wage inflation and pressure on housing and public services. The Dales Voe quay could require 28 additional workers by 2034, potentially compounding labour competition and cost-of-living pressures.

People with protected characteristics experience compounded vulnerability. These patterns create practical barriers to heat pump installation and EV charging. Ethnic minorities rely more on public transport (25 per cent vs. 13 per cent of trips) with less flexibility in travel patterns, making transport cost changes disproportionately affecting them. People with disabilities have higher car dependency (85 per cent vs. 79 per cent of trips) yet face barriers installing chargers in rented or flat properties. Simultaneously, disabled people and older people have higher energy needs due to medical equipment and heating requirements, yet 3.6 million disabled people in the UK experience fuel poverty. Lone parents face 29 per cent fuel poverty risk, with dependent children households at 16 per cent https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf

Question 17 How do you think the Climate Change Plan aligns with existing local, regional, or national priorities that you are aware of or involved in?

Dr Jess Britton and Prof Jan Webb (University of Edinburgh)

UKERC research indicates that local government-led energy planning (LHEES and LAEP), dispersed industrial site decarbonisation, and business planning for the electricity distribution networks are currently insufficiently integrated https://www.research.ed.ac.uk/en/publications/accelerating-transitions-planning-for-decarbonisation-in-local-an and https://committees.parliament.uk/writtenevidence/139509/pdf/

NESO development of the Scottish RESP is intended to enable integrating whole system energy planning, and it is important that industrial stakeholders are closely engaged in RESP development. The geographies of these development processes are complex, with only one RESP proposed for Scotland, and the Scottish Government should ensure that industry representation encompasses strategic sites, existing clusters and emerging industries.

As discussed in our answer to Question 5, there is potential for the development of cross-authority or regional heat networks (such as Edinburgh and Lothians). Such large, cross-authority networks have the potential to optimise cost, carbon and socio-economic efficiencies but involve additional technical, political and contractual complexities https://ukerc.ac.uk/publications/scottish-government-net-zero-energy-and-transport-committee-inquiry-into-the-role-of-local-government-and-net-zero/

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

The draft Plan's industrial decarbonisation commitments align with Scotland's 2045 net zero target, but evidence suggests critical timing and sequencing misalignments with place-based strategies and sectoral realities.

Island communities exemplify this challenge. Shetland's green hydrogen production at Sullom Voe could support 120 jobs by 2030, rising to 155 by 2044. However, simultaneous Dales Voe development creates conflicting labour demand. Sequential rather than simultaneous deployment would reduce wage-driven employment displacement across the wider economy, yet the Plan lacks explicit commitment to managing deployment timing at this granular level.

For vulnerable groups, Plan commitments on heat pumps and building retrofits misalign with the lived reality that disabled people, ethnic minorities, and renters cannot easily make these changes. The existing fuel poverty gap—affecting 3.6 million people with cumulative annual costs of £417 per household—requires policy integration across housing, work, transport and energy, particularly for renters whose landlords lack incentive to invest https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf . The Plan's sectoral focus on decarbonisation pathways must be paired with explicit distributional equity commitments and monitoring mechanisms, ensuring that transition benefits reach those currently most vulnerable to energy poverty and employment displacement.

Section 6: Monitoring Just Transition

The following questions concern the following 14 proposed indicators for monitoring and evaluation of the Climate Change Plan.

Question 29 Please detail any specific changes that would improve any of the 14 proposed indicators, including any data sources not currently included within this framework that could provide a useful indicator of progress towards a just transition in Scotland on an annual basis.

Dr Richard Hanna and Dr Richard Carmichael (Imperial College, London)

On indicator 10 (Green Jobs): there is ongoing debate among policymakers and experts about how to define the "greenness" of jobs created by the clean energy transition. This includes questions about whether metrics should capture not only the environmental contribution of jobs but also their quality—such as security, long-term prospects, and working conditions. Without agreed-upon definitions and metrics, the Scottish Government will not be able to fully understand the scale of emerging skills demands, or ensure that new roles provide meaningful opportunities for workers.

We recommend that the Scottish Government liaises with The Office for Clean Energy Jobs (OCEJ) and Office for National Statistics (ONS) to establish standardised definitions and metrics. This effort should prioritise capturing data on both the environmental aspects of jobs (e.g., their contribution to decarbonisation) and job quality indicators such as contract stability, wages, and progression opportunities. Such clarity would provide a stronger foundation for workforce planning and investment decisions.

There is a policy need for clear metrics to assess not only whether a job is "green" but also to what extent its tasks contribute to net zero goals. The UK could learn from international metrics, such as the US O*NET system (https://www.dol.gov/agencies/eta/onet), which captures the 'greenness' of work activities and technical and non-technical competencies needed for defined occupational roles. Current UK government data sources, such as the Low Carbon and Renewable Energy Economy (LCREE) survey https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2022 lack the granularity needed to track occupations and skills required for clean energy jobs, while statistics on wider supply chain employment remain experimental https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/lowcarbonandrenewableenergyeconomylcreesurveyqmi. Standard Industrial Classification (SIC) codes do not map onto specific clean energy sectors https://www.gov.uk/government/publications/industrial-strategy/industrial-strategy-sector-definitions-list

The recent UK Clean Energy Jobs Plan has developed an experimental approach to produce occupational splits for different LCREE sectors, by extracting employee numbers at the 4-digit Standard Occupation Classification level (SOC): https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc and comparing these to total employment in relevant SIC divisions from the LCREE survey. While such estimates can be useful, the various simplifications and assumptions involved in their production means that they are indicative only.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Current indicators lack specificity on participation outcomes, spatial justice, and safeguarding vulnerable groups. Key improvements:

- **Participation (Indicator 1.1):** Replace sentiment measures ("people feel involved") with outcome-focused STEP index (Stakeholder Engagement, Transparency, Equity, Procedural fairness) at project level. Measure proportion of Just Transition activities meeting minimum standards and stakeholder satisfaction with whether input influenced decisions. National surveys mask poor local engagement and excellent targeted consultation.
- **Oil and Gas Worker Equity:** Indicators focus narrowly on O&G employment without addressing equitable distribution. Add: demographic composition of new green jobs vs. baseline O&G workforce (disaggregated by sex, ethnicity, disability, age) and proportion of company profits reinvested locally vs. extracted nationally, ensuring wealth distribution benefits communities, not only privileged workers.
- **Spatial Justice (Major Gap):** No current indicator measures whether deprivation gaps narrow between richest and poorest areas. Recommended additions: ratio of Gross Disposable Household Income by local authority; Gini coefficient for vulnerable groups; geographical disparities in fuel poverty, transport poverty, and health access by local authority; and investment flows to historically deprived areas (public spending by deprivation quintile; private sector investment location).
- **Safeguarding Vulnerable Groups:** Given recent poverty increases in Scotland, add baseline "no additional harm" measures: annual monitoring of child poverty, fuel poverty, and food insecurity disaggregated by disability, ethnicity, lone parent status; complementary quality-of-life ratings for vulnerable groups.
- **Biodiversity and Environment:** Strengthen with Biodiversity Intactness Index disaggregated by locality; track species abundance annually; add environmental justice screening measuring whether renewable energy infrastructure siting disproportionately burdens deprived or minority communities https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf

Question 30 What are the most appropriate indicators for judging whether we are achieving meaningful public participation in decisions related to the climate? This includes both the quality of the participatory process itself, and the impact of that participation on the decision-making process.

Professor Nick Pidgeon and Professor Karen Henwood (University of Cardiff)

The Scottish Government was the first of the UK nations to publish a Public Engagement strategy for climate change. We strongly commend this approach, arguing for it to be accorded attention and resources appropriate to the size of this task, as well as supporting the many citizen-led initiatives to engage with climate change and the energy system transition that also exist across Scotland. One criticism of government-led public engagement in general, including large activities such as Citizen Assemblies, is that some fail to have a clear route or pathway to influence policy. Here, the committee might usefully serve to hold SG to account regarding its own activities in public engagement.

We also note here that helping the public to contribute to climate action requires far more than simple economic incentives, behavioural nudges or communications. Successful change programmes in e.g. public health typically involve a combination of upstream- (regulatory), mid-

stream (incentives, support structures), and down-stream (communications) interventions. Moving to a net zero society should be viewed similarly.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Participation is a mechanism, not an outcome. Meaningful outcomes are empowerment and democratic participation—communities shaping decisions affecting them. Suggested indicators are:

- **Process quality:** Proportion of climate decisions involving stakeholder consultation meeting STEP minimum standards; proportion where stakeholder input demonstrably changed final decisions (measuring actual influence, not token consultation); frequency of Citizens Assemblies for complex decisions.
- **Outcome indicators—Empowerment:** Percentage in affected communities agreeing with the proposition: "I can influence decisions affecting my local area" (disaggregated by locality, deprivation, demographic); percentage reporting increased agency/hope about transition.
- **Democratic participation:** Local participation rates in climate decision-making forums; percentage feeling that: "my council listens to people's views" on climate decisions.
- **Equity of access:** Demographic composition of climate decision-making bodies vs. local population; proportion of underrepresented groups reporting participation barriers (access, language, work, childcare); satisfaction ratings by demographic group.
- **Distributional justice:** Target participation at communities most affected (O&G workers in transition decisions; local communities in renewable energy siting; low-income households in retrofit decisions), not nationwide sentiment surveys. National measures mask poor local engagement and excellent targeted work.

Question 31 What indicator would provide the best measure of the impact of net zero development in local communities across Scotland? For example, the impact of the installation of renewable energy infrastructure or other land use changes (e.g. through peatland restoration or tree planting).

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Net zero development creates local winners and losers. Comprehensive measurement requires capturing a series of both benefits and burdens:

- **Positive impacts:** Local wealth creation (community-owned renewable capacity; revenue shared with communities via benefit agreements; local jobs per MW deployed; supply chain employment multiplier); local asset ownership (assets in community ownership related to net zero; proportion of infrastructure locally vs. externally owned).
- **Community engagement:** STEP index scores for renewable energy and net zero infrastructure decisions; community satisfaction and perceived fairness of benefit distribution.
- **Negative impacts—Environmental justice:** Air quality changes in neighbourhoods hosting renewable energy (are poor-air-quality communities further burdened?); proximity of installations to populations with high respiratory disease or vulnerability.

- **Land-use impacts:** Incidence of community displacement due to peatland restoration, rewilding, energy projects in rural/island communities; impacts on tied housing and rural identity; displacement of gamekeeping and rural land manager employment.
- **Economic disruption:** Net employment change by local area; wage and security comparison of green jobs vs. jobs lost; SME viability in affected sectors; energy price increases in communities hosting renewable energy; cost-of-living changes by deprivation quintile.
- **Rationale:** Without disaggregation by locality and deprivation, Scotland risks concentrating green economy benefits in affluent regions whilst deprived areas bear infrastructure burdens and community disruption.

Question 32 Ensuring positive outcomes for workers who have transitioned from jobs within high-carbon industries is central to delivering a just transition. What specific data or indicators could we use to monitor the extent to which workers in high-carbon industries are securing alternative employment?

Dr Richard Hanna, and Dr Richard Carmichael (Imperial College, London)

While data on green jobs is available at the national level, it remains fragmented or insufficient at regional levels. For example, a point of concern is the spatial distribution of supply and demand of Net-Zero jobs and training. High carbon jobs in the oil and gas industry, which are likely to experience significant job displacement, tend to be spatially concentrated, whereas emerging Net-Zero job opportunities are expected overall to be more geographically distributed https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/01/Skills-and-wage-gaps-in-the-low-carbon-transition_Comparing-job-vacancy-data-from-the-US-and-UK.pdf

If green jobs or reskilling opportunities do not appear in areas where jobs have been phased out, workers will either have to lose out on opportunities, seek employment in other high-carbon sectors, or relocate, which risks reinforcing existing regional inequalities https://www.nature.com/articles/s41467-023-41133-9

Automatic coding of job advertisements can be used to track green jobs without overburdening businesses. This approach was used in experimental analysis conducted for the Clean Power 2030 Action Plan, which found that Scotland had the highest regional proportion (16%) of all clean energy jobs advertised in the UK from 2021 to 2024 https://www.gov.uk/government/publications/clean-power-2030-action-plan-assessment-of-the-clean-energy-skills-challenge

Elsewhere, Nesta's Open Jobs Observatory (OJO) https://www.nesta.org.uk/project/open-jobs-observatory/ is a pilot collaboration with the UKG Department for Education that analyses job postings to identify trends in the distribution of green employment. This tool could be expanded for broader use.

Instead of coding jobs by analysing text in adverts, as done by OJO and Cascot https://warwick.ac.uk/fac/soc/ier/data_group/cascot/ work from the UKERC Win-Window project https://ukerc.ac.uk/project/win-window/ looking at tracking green jobs, recommends

that employers could be required to code advertised jobs using a revised Standard Occupational Classification (SOC) that better reflects both job 'greenness' and quality. This could streamline and improve accuracy in data collection for tracking progress in creating quality green jobs, and identifying gaps in green skills (unfilled vacancies) – the latter could help inform policy for training provision.

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

A key issue is to monitor worker transition quality, not just job creation numbers. This involves tracking:

- **Headline measure:** Proportion of workers made redundant from high-carbon sectors (O&G, coal, refining, heavy manufacturing) in continuous employment 6, 12, and 24 months after job loss, disaggregated by age, gender, ethnicity, disability.
- **Wage and job quality:** Percentage earning above Real Living Wage; percentage in secure permanent contracts; wage comparison (new vs. previous role—are workers in financial loss?); access to occupational pension, sick leave, employment protections; job satisfaction ratings (pay, work-life balance, security, health).
- **Skills utilisation:** Percentage completing accredited retraining; of those trained, percentage in related fields utilising qualifications; training duration from redundancy to start; trainee and employer satisfaction with programme relevance.
- **Sectoral and regional spread:** Sectoral concentration of transitioned workers; geographic mobility (staying in local community or forced relocation); occupational change (concentration in "green" sectors vs. other sectors).
- **Vulnerable groups:** Compare transition success and wage outcomes across women, ethnic minorities, disabled workers, older workers (50+) vs. white male workers; track demographic composition of green job apprenticeships.
- **Psychosocial outcomes:** Qualitative interviews on transition experience (stress, dignity, agency); community cohesion; household financial stress (energy bills, food costs).
- **Data sources:** Annual Supported Transition Survey (Skills Development Scotland); tax record linkage tracking post-redundancy employment; employer surveys; qualitative research with worker groups. Rationale: Transition is social and psychological, affecting dignity and community, not just economic https://pure.strath.ac.uk/ws/portalfiles/portal/199937455/Corbett-etal-CEP-2024-Policy-brief-driving-effective-workforce-planning.pdf

Question 33 What specific data or indicators could we use to meaningfully monitor the impact of the transition to net zero on the environment and biodiversity across Scotland on an annual basis?

Dr Christian Calvillo and Dr David Drabble (University of Strathclyde)

Annual monitoring must be disaggregated by locality and deprivation—national aggregates hide local environmental justice issues. This should include:

- **Climate emissions:** Scotland's carbon footprint (sectoral breakdown); annual percentage reduction vs. net zero pathway; territorial vs. consumption-based emissions (measure genuine decarbonisation vs. carbon leakage).
- **Biodiversity:** Biodiversity Intactness Index (0–100) by ecosystem type and locality; species abundance trends (marine, terrestrial); population-specific monitoring of threatened species; habitat connectivity and fragmentation.
- **Environmental quality:** Air quality (PM2.5, NO_2 by local authority, disaggregated by deprivation); water quality (proportion of rivers in good ecological status); soil health (organic matter, peatland condition—restored vs. degraded).
- **Net zero transition impacts—Environmental justice:** Renewable energy distribution by local authority; proximity analysis (percentage of infrastructure within 5 km of populated areas); community reports of air quality decline, noise, habitat disruption; changes in air quality, water quality, biodiversity by deprivation quintile (ensure net zero doesn't worsen conditions for deprived areas).
- **Land-use change impacts:** Peatland restored vs. degraded; native woodland planted vs. agricultural loss; fishing ground impacts from offshore wind; environmental benefits location (affluent vs. deprived areas).
- **Data sources:** SEPA (water, air quality); Natural History Museum/UK Biodiversity Indicators (annual); Scottish Greenhouse Gas Emissions Inventory (annual); local authority renewable energy monitoring (annual); qualitative community surveys (biennial).
- **Critical caveat:** Accompany annual reporting with place-based case studies. Disaggregation by locality and deprivation is essential to surface local environmental justice issues https://www.edrc.ac.uk/wp-content/uploads/2025/02/Understanding-the-barriers-and-impacts-of-green-choices-on-people-with-protected-characteristic.pdf