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Submitted to Draft Energy Strategy and Just Transition Plan consultation
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Chapter 1 - Introduction and vision

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

Please give us your views:

Scotland needs to do more and to work quickly if it is to achieve its net zero vision. There are a range of technologies, which working together in a holistic way can provide short, medium and long-term economic and social benefits and minimise negative consequences. Whilst the solutions are challenging, they can help deliver a Just Transition and provide energy security and resilience.

The Institution of Engineering and Technology (IET) (<https://www.theiet.org/>) has responded to most of the questions in this consultation. We would be pleased to discuss our full responses with you in detail at a time of your convenience. Below are a number of key recommendations that we would like to propose to the Scottish Government:

1. Keep the vision targets as at present. They are already challenging and need to remain achievable.
2. Develop and implement a robust, whole system engineering plan for net zero across the energy spectrum. This will give greater understanding of how the vision, its ambitions, roadmaps and outputs can be best managed, taking account of the current / future mix of sustainable energy sources (wind, solar, marine, hydrogen et al), infrastructure, usage and capacity. Without an integrated plan, siloed approaches can result in sub-optimal delivery that reduces the likelihood of meeting net zero ambitions.
3. Provide political leadership and develop long-term cross-party commitment at international, national and local levels.
4. Maintain Scotland's energy resilience and security in its transition to net zero. Pragmatically this may involve a longer phasing out of fossil fuels, though it supports a Just Transition by mitigating against fuel poverty.
5. Collaborate with and incentivise local green industrial initiatives by reviewing potential barriers to implementation such as administration, planning, regulation and funding. This can help create local jobs, provide well-paid careers and generate national economic benefits. Where necessary, provide funding, especially for the early-stage industrial development of sustainable solutions.
6. Provide the means to sustain the interest in STEM-related subjects of students from an early school age. Developing and maintaining STEM skills throughout education will help alleviate gaps in industry.
7. Research the opportunities provided by CCUS, recognising that this has revenue generation potential for Scotland.
8. Provide financial support for sustainability initiatives for households that cannot afford to implement net zero measures.

These recommendations aim to catalyse political, industry, academic and societal buy-in for realistic net zero measures. They will help the Scottish Government meet its future net zero energy needs in cost-effective ways that also provide for a just transition, especially for lower socio-economic communities.

A more detailed response to Q1 is given below, followed by responses to subsequent questions.

The recent IPCC report (<https://www.ipcc.ch/report/ar6/syr/>) highlights that Scotland must do much more and quickly to achieve its net zero vision for 2030 and 2045. The vision encompasses a wide range of interlinked industry and social challenges at local, regional, national and international levels. As such, a joined-up whole-systems approach is needed so as to gain a fuller understanding of key problems and identify technically feasible pathways with a view to developing optimal solutions for individuals, households and businesses. This approach is needed before focusing on developing and joining up solutions across particular sectors. Our concern is that if we go into providing solutions on a sector-by-sector basis, there's a risk that costly, less-than-ideal and potentially unconnected ways forward may be developed. Such solutions may double count energy provision and leave gaps in supply, resilience and security that prove costly to remedy, in terms of time, money and other resources.

We recommend that the Scottish Government develops, implements and monitors the delivery of a holistic engineering plan that encompasses a wide-ranging set of interlinked net zero programmes across many and varied areas, and takes account of supply and demand. This is not to delay the implementation of existing sustainability measures which must continue apace and indeed be ratcheted up as they are behind schedule. Rather it is to ensure the co-ordinated and integrated delivery of measures that will lead to effective delivery hand-in-hand with the ongoing maintenance of energy security and resilience, which impact on all, especially those from lower socio-economic groups.

Whilst this is an extremely challenging prospect, a more piecemeal, siloed approach without an underpinning plan will be much less likely to achieve milestone targets or to identify interlinkages / interdependencies. It will fail to inform priority activities, monitor against KPIs, and implement remedial approaches. All of these aspects are essential in increasing the likelihood of achieving desired net zero benefits, and delivering them with the most effective solutions, pooling resources in the most efficient ways.

Such a plan requires regular and flexible review, given emerging events, technological, social, political and financial uncertainties and pressures that will undoubtedly affect the plan's direction, transition, delivery and performance. That said, such difficulties must not prevent the development and delivery of key objectives so that desired benefits can be achieved.

This whole-system plan of action would build on and be integrated with the work undertaken in the Scottish Cluster (<https://www.thescottishcluster.co.uk/>), identifying practical constraints so that solutions and technically feasible pathways to net zero can be identified and implemented. The Institution of Engineering and Technology (IET) has previously identified the need for a whole-system Future Power System Architecture (<https://www.theiet.org/media/9408/fast-track-to-britains-future-power-system.pdf>) to help deliver the net zero vision. The Scottish Government should consider establishing such a body, suitably comprised with the necessary expertise and skill sets.

We recognise that publication and delivery of a wide-ranging engineering plan makes public the high-level responsibilities and accountabilities that both Government and industry will face. It will also bring to the fore some difficult decisions on energy options. However, this challenge needs to be embraced with leadership, and long-term collaboration across the political spectrum to ensure successful delivery.

Chapter 2 - Preparing for a just energy transition

2 What more can be done to deliver benefits from the transition to net zero for households and businesses across Scotland?

Please give us your views:

In the first instance political leadership with long-term cross-party commitment to developing a whole-system approach for net zero should be implemented. This would involve facilitating regulation, funding, inter-regional and international collaboration, consulting with and communicating to the public and business to gain understanding and buy-in of decisions made and the rationale for delivery. The process would also help identify tailored, joined up and long-term solutions. It would help minimise the risk of realising short-term benefits that could perversely result in higher costs to households and businesses in the longer term.

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

Please give us your views:

Achieving desired outcomes need tailored, interlinked plans to be developed at local / regional levels (see CARES <https://energysavingtrust.org.uk/programme/community-and-renewable-energy-scheme/>) that cater for particular requirements such as different types of housing, rural v urban etc in efficient, scalable and manageable ways. This includes clear positions on community engagement and benefits, taking account of interconnected funding initiatives and models to support net zero solutions. Such efforts will aim to develop skills and create jobs and careers, especially in small and medium-sized Scottish enterprises.

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

Please give us your views:

We have included general responses for Q4 and Q5, rather than focus on the IET's own experience.

In its attempts to build up infrastructure, much net zero funding has tended to support the implementation stage of projects and the delivery of tangible impacts. Private finance is similarly focused on funding projects post final investment decision (FID).

In contrast, there's a shortage of funding for development costs (DevEx) pre-FID including feasibility and screening activities. This shortage acts as a potential barrier to low carbon project development. Government tends to be the focal point of such funding requests since private finance is less willing to fund without a tangible outcome. Industry is struggling to self-fund such project development due to low margins of operations, legacy costs and debt (e.g. from covid) and a lack of certainty around supporting decarbonisation system infrastructure. Industry may be understandably reluctant to make DevEx investments in unproven technologies. Whilst there may be kudos from being a first mover in green technology solutions, these may not translate into immediate market sales.

UK industry also faces global competition, with relatively high UK energy costs threatening their competitiveness – even before net zero aspects are considered. Industry needs Government help in relieving tax burdens to incentivise innovation. In addition, the number and complexity of the various competition funding opportunities and the specificity of their focus can also make it difficult to identify appropriate schemes.

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

Please give us your views:

In general, cumbersome administration, regulations and access to funding support, especially for pre-FEED DEVEX costs (see Q4), act as a barrier.

Although the National Transition Training Fund (<https://www.gov.scot/publications/national-transition-training-fund-nttf-year-1-report/>) supports upskilling, more funding is needed to help transition individuals (redundant / at risk) into green jobs, or to upskill them to 'greener' roles in their current trades. It's crucial that these funds are directed at the right people in a timely way, and that convincing arguments of the benefits of such training are made clear, especially for small businesses, that will otherwise not release staff.

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

Please give us your views:

Scotland and the UK lack an up-to-date industrial strategy in response to global geopolitical changes. If such a strategy were in place Scotland and / or the UK could determine the extent that they ramped up particular manufacturing / production capabilities (e.g. steel / cement / equipment) in support of net zero industries. An industrial strategy should similarly consider / address energy costs and how the UK might maintain global competitiveness despite increasing costs to achieve net zero operations.

As per previous comments, developing a more detailed, actively managed and aligned whole-system engineering-based plan would better enable opportunities to be identified, both in existing markets and supply chains, and emerging markets. This would also highlight potential mismatches

between development and operational needs.

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

Please give us your views:

As per Q2, firstly there's a need for political leadership and long-term, cross party decision-making that supports integrated problem-defining, so that solutions can then be developed by key sustainable industries and delivered with the support of local government. Long-term commitments would give industry greater confidence to assess realistic and specific opportunities and to invest locally accordingly. This in turn would enhance capacity within related supply chains, which would support the creation of local job opportunities, skills development and hopefully well-paid careers. It would provide a win-win for individuals, industry and Holyrood. It would also avoid potentially siloed ways forward that may produce short-term benefits, but require costly changes of course or remedial action later on.

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

Please give us your views:

It's important to capture the interest of individuals at an early age in schools (before secondary school years). Embedding such interest early on can diminish under-representation of certain groups and inspire later vocational green skills development at FE and HE levels. Schemes such as Education Scotland's (<https://education.gov.scot/>) sustainability programme and materials / activities such as provided by IET Education support & resources (<https://education.theiet.org/>) are useful ways of promoting interest and studies in these fields to individuals who may not be aware of possibilities. Industry should be encouraged to release staff, especially those from under-represented groups, to support the useful STEM Ambassadors (<https://www.stem.org.uk/stem-ambassadors>) scheme. Ambassadors are individuals who volunteer their time to work with young people in schools and the community to inspire the next generation in STEM pathways. Scottish Education is potentially moving towards inter disciplinary learning (see the Hayward Report <https://consult.gov.scot/education-reform/professor-haywards-independent-review/>), which will also provide an opportunity to tie green-related studies with project work, industry visits etc, all of which are important in encouraging the transition from green studies into employment.

Chapter 3 - Energy supply - Scaling up renewable energy

9 Should the Scottish Government set an increased ambition for offshore wind deployment in Scotland by 2030? If so, what level should the ambition be set at? Please explain your views.

Please give us your views:

As per Q1, robust ambitions are welcome. However, they should only be increased if there's a realistic plan in place that demonstrates existing and stretch targets can be achieved. Without such a plan, a change of ambitions wouldn't be a realistic proposition. For example, current wind deployment plans need to factor in that the construction of an onshore wind farm can take 4 to 8 years in total; an offshore wind farm can take 7 to 11 years.

Generation capacity ambitions need to be set in the context of how such ambitions combine to deliver net zero on time and at lowest cost to consumers. This should include a whole energy system perspective (not just electricity) and the security of supply aspects. Increased ambitions for offshore wind deployment would potentially focus on energy export opportunities rather than supplying local demand. This potentially requires a different business case.

Legislative measures would also need to be considered for example to ease permit provision and streamline planning so as to reduce delays. In Germany, federal legislation in 2022 stipulated that the use of renewable energy is of paramount public interest in a move to give deployment an upper hand in legal challenges.

10 Should the Scottish Government set an ambition for offshore wind deployment in Scotland by 2045? If so, what level should the ambition be set at?

Please explain your views:

Please see the Q9 response as the same points apply here.

11 Should the Scottish Government set an ambition for marine energy and, if so, what would be an appropriate ambition?

Please explain your views:

Wave and tidal energy, e.g. from submerged turbines, could potentially provide up to 20% of UK electricity needs (see E&T Magazine <https://eandt.theiet.org/content/articles/2023/02/is-it-time-for-tidal-stream-energy/>). However, the perspective of developers is increasingly that full scale commercialisation of wave and tidal is taking too long (in which case the potential prize in terms of the future market is insufficiently attractive) to continue investing in these technologies, especially when compared with wind or solar. This has led to greater difficulty in obtaining funding for sustained technology development and market delivery at scale from industry.

That said, tidal has a clear advantage over wind and solar, namely its predictability. Reaching Net Zero will require a diverse range of technologies as part of a whole-systems approach. Tidal provides some stability of delivery when other renewables are not available. Such predictability and resilience are valuable assets in the delivery of net zero. If the Scottish Government can afford and is willing to provide significant funds to invest in marine energy to reduce overall energy resilience risks, then a realistic, modest ambition for marine energy should be set.

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

Please give us your views:

Please see the Q11 response. We recommend continued investment by the Scottish Government to build a small but robust marine energy infrastructure as part of its overall energy provision.

13 Do you agree the Scottish Government should set an ambition for solar deployment in Scotland? If so, what form should the ambition take, and what level should it be set at?

Please explain your views:

As identified in the University of Birmingham's "Net Zero – Keeping the Energy System Balanced" briefing note (August 2021, <https://zenodo.org/record/5172034#.ZFO-76DMLct>) the 'optimum' mix of wind and solar for minimising UK electricity imbalance differs according to both the applicable timescale and to how / how much heat is electrified. Solar generation is partially correlated to electricity demand and, over longer timescales, an 80:20 wind : solar mix can halve the system imbalance seen with no solar. However, in contrast, solar output is seasonally anti-correlated to heat. Any level of solar in the heat scenarios reduces the positive impacts attributable to wind on the cumulative system imbalance. A 20% solar component almost doubles the cumulative system imbalance compared to a mix containing none. Completely eliminating solar would enable the availability of electricity to better match heat demand. In other words, if you are planning to electrify heat, increased solar creates a greater imbalance between supply and demand. This increases the overall system cost, which makes it less economically viable.

Solar does have some clear advantages. For households it offers distributed clean energy generation close to consumption and gives some degree of energy independence and ownership. Its payback period is falling, especially with scaled production and the rise in energy prices – though prices still remain out-of-reach for many homeowners and supply chain / trained personnel issues remain.

The aspects previously mentioned with regards to setting targets within an overarching energy plan apply equally to solar deployment. The use of solar should take account of whole-system impacts. This includes a consideration of land usage for food v energy production. Decisions should take account of real estate so that ideally solar deployment is delivered on brownfield rather than greenfield sites, or as agrivoltaics.

Peak energy demand in Scotland (winter) coincides with the lowest solar intensity (unlike wind energy). Prioritising the roll out of solar potentially presents an opportunity cost to technologies which dispatch low carbon energy supply to consumers when there's peak demand. This needs to be taken into account when making decisions. For these varied reasons we have not specified a particular ambition.

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

Please provide further details:

Large, centralised power production can offer perceived benefits of economies of scale and security of supply to communities. There is also a role for small systems installed on / at homes that provide jobs for local firms and benefits to inhabitants. All renewable schemes should be made easy in terms of administration, regulation and taxation for local communities so as to maximise benefits. Government investment in renewable sectors can also reduce dependency on imports.

All these measures can improve supply chains and engender the development of skills (upskilling / reskilling) and careers opportunities. These are particularly valuable in areas of high deprivation or areas that have been hit by a decline in fossil fuel industries. Please see the response to Q8 for further details.

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

Please give us your views:

The Scottish Government first needs to be clear about the holistic nature of the problem it is trying to solve. It needs to consider whether it is designing a regulated structure, or a market structure for the private sector. It also needs to develop a process for assessing the scale and most appropriate use of hydrogen for Scotland. Without understanding these aspects, it would be difficult to make considered policy decisions about delivery. Scotland may struggle to produce enough green hydrogen for its needs or have the infrastructure to deliver it. There's a risk that sub-optimal decisions could be made which would have opportunity costs, take time to remedy and detract from tackling the hard-to-decarbonise areas.

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

Please give us your views:

Government action is dependent on the problem(s) that it wants to tackle. There's a keenness to operationalise the technology for hydrogen development. However, before moving ahead the Government needs to resolve challenges in some key areas:

- What is the market for hydrogen in Scotland and how large is it? Industry typically requires a steady flow of hydrogen 24/7, especially for use as a process feedstock and for process heating. Demand can be variable, though not as much as domestic heat demand, which rises and falls according to the seasons.
- How is hydrogen going to be stored? In principle storage can be used to balance intermittent supplies, but this will cost. Such storage doesn't yet exist in

Scotland and in fact Scotland doesn't have the geology (salt caverns) to support the development of conventional storage solutions at scale. Academic research (e.g. HyStorPor project, University of Edinburgh, <https://blogs.ed.ac.uk/hystorpor/>) has been looking at the potential feasibility of aquifer storage offshore. However, this concept is at a very early stage of commercialisation. This means that it may be necessary to factor in a reliance on England. However, the developing backbone spine for hydrogen transmission in England and Wales isn't linked up with Scotland. Without the necessary infrastructure, Scotland may be left behind and have to develop alternative strategies.

• How is hydrogen going to be transported? Hydrogen facilities may not be in the same place as storage. Pipelines are very costly and in fact road tankers may be more cost effective, though that brings different issues.

Scotland's ability to drive hydrogen development may be limited until these matters are resolved.

17 Do you think there are any actions required from Scottish Government to support or steer the appropriate development of bioenergy?

Please give us your views:

Bioenergy looks like only playing a minor role in the delivery of net zero by 2050 due to constraints on sustainable production / availability of waste feedstocks etc.

18 What are the key areas for consideration that the Scottish Government should take into account in the development of a Bioenergy Action Plan?

Please give us your views:

The key areas for consideration depend on the end use activity, for example it may include efuels for HGVs, where battery size precludes their effective use.

There needs to be a better understanding of the architecture, of the units, of where the feedstock is coming from so as to get a sense of what production would be the most efficient element of the portfolio. Biofuels from harvested crops are problematic, as they are in competition with food crops. A Europe-wide approach is needed with alignment cross-borders to ensure streamlined development and delivery.

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

Please explain your views:

First, it's important to understand how the problems that need resolving are best tackled in an integrated way. The Government will need to assess and then decide on which technologies it is going with and for which purposes. It needs to understand the processes that are required in place at local, regional, national and international levels. There needs to be clarity over whether products are going to be made in Scotland or imported. This raises questions about supply chains and skills development. Responses to such questions will determine the materials that need identifying and securing. Contingency plans will need forming especially if materials or supply chains are beyond borders. Otherwise, delivery could stop after years of development and money if there were overreliance on particular materials that were in limited supply.

Chapter 3 - North Sea oil and gas

20 Should a rigorous Climate Compatibility Checkpoint (CCC) test be used as part of the process to determine whether or not to allow new oil and gas production?

Please give us your views:

The key point is to introduce aspects such as CCC tests once it has been demonstrated that this can be done technically while also supporting a just transition.

In principle new oil and gas production runs counter to net zero ambitions. However, the reality is that Scotland will continue to be dependent on fossil fuels in the short to mid-term. Hydrocarbons are used in a wide range of products (including food / clothing production) beyond the energy sector. It has not yet been demonstrated that we are able to holistically replace fossil fuels at scale, sufficiently to maintain present societal needs and operations. This includes scaling up renewable energy production and also the development of alternative processes and raw materials / feedstocks for other industrial processes.

There is also the slow pace of development and roll out of renewables, and the need to consider energy security and resilience. Scarcity of energy and / or produced goods will increase costs and be less likely to deliver a Just Transition outcome. Blue hydrogen will initially be cheaper than green (and available at larger scale) and support the Just Transition narrative.

The above points have not been mentioned to promote fossil fuel development. Additional fossil fuel extraction means additional GHG emissions and an exacerbation of climate change. Production is also not an excuse for limiting the roll out of renewables. Instead this is a pragmatic assessment of Scotland's energy resilience and security deficit and its reliance on hydrocarbons in product development. Scotland needs to ensure its energy system remains adequate to support its overall transition to net zero. There is little benefit in banning UK production if Scotland then needs to import fossil fuels from England or elsewhere to meet shortfalls. The opportunity costs of not focusing fully on net zero energy need assessing, and a plan for replacement by renewables to be incrementally put in place as capacity comes on stream.

The key is understanding how to get hold of the carbon that we need and to retain it, so it doesn't go into the atmosphere.

21 If you do think a CCC test should be applied to new production, should that test be applied both to exploration and to fields already consented but not yet in production, as proposed in the strategy?

Please explain your views:

As per the response to Q20, the evidence doesn't point to the ability to meet the needs for energy (and other products) without new oil and gas production. As such, there are likely to be shortfalls, resilience issues or increased imports if exploration / production were not permitted. Proportionately higher costs are likely to be felt most by those from lower socio-economic backgrounds, which would work against the ambition to achieve a Just Transition.

22 If you do not think a CCC test should be applied to new production, is this because your view is that:

Not Answered

Please explain your answer:

Please see the responses to Q20 and Q21.

23 If there is to be a rigorous CCC test, what criteria would you use within such a test?

B) the emissions impact associated with both the production and consumption aspects of oil and gas activity i.e. also cover the global emissions associated with the use of oil and gas, even if the fossil fuel is produced in the Scottish North Sea but exported so that use occurs in another country – as proposed in the Strategy

Please explain your answer:

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Should a CCC test take account of energy security of the rest of the UK or European partners as well as Scotland? If so, what factors would you include in the assessment, for example should this include the cost of alternative energy supplies? :

Yes – there should be an integrated European approach as this would provide the most cost-effective and efficient method of development and delivery. Security of supply has also become a key issue in the past year, and is likely to remain so in the future. A hydrocarbon test should involve whether additional extraction is necessary to replace and avoid imports.

Should a CCC test assess the proposed project's innovation and decarbonisation plans to encourage a reduction in emissions from the extraction and production of oil and gas? :

Strict regulation should ensure technology is used to minimise emissions from extraction and production.

In carrying out a CCC test, should oil be assessed separately to gas? :

Both the need for oil and gas extraction should be assessed on a case-by-case basis. Whilst running counter to longer term net zero ambitions, pragmatically the dependence on oil and the need for energy security and resilience may necessitate the continued extraction of oil in the short to mid-term. However, this should not be an excuse for watering down or delaying Scotland's focus on renewables. See Q20 for further details.

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

Please explain your views:

Yes, all new production should be assessed in terms of their short, medium and long-term economic and social benefits, and the need to prevent downside consequences. This should take account of region by region variations, the need for Just Transition and for energy and infrastructure resilience. The oft-cited criteria should be assessed - wealth generation, export potential (including through technological development), well paid, professional job creation and career development, and re / upskilling potential, especially in areas of low socio-economic backgrounds. It should also assess the infrastructure and resources in place / required to enable such benefits to be achieved. Pragmatically the level of public / private finance injection, economies of scale / scope and return on investment also need considering.

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

Please give us your views:

Please see the responses to the previous answers in this section. The aim is to reduce dependency on oil and gas to minimal levels and to replace fossil fuels with renewables in a realistic way. However, the plan to implement this switch must be robust, evidence-based and credible. A presumption against new exploration of fossil fuels must not jeopardise the energy resilience of Scotland or make it unaffordable.

26 If you do think there should be a presumption against new exploration, are there any exceptional circumstances under which you consider that exploration could be permitted?

Please explain your views:

Please see the responses to the previous answers in this section. A current ban on new fossil fuel exploration can only be the best solution if Scotland's energy security and resilience are not affected, and if the development of a Just Transition is not jeopardised. That said, permission for exploration should be assessed on a case by case basis, and reviewed periodically over time, with decisions made using the latest data.

Chapter 4 Energy demand - Heat in buildings

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

Please give us your views:

The response to this question should be read in conjunction with Q13. An integrated perspective and plan is needed to remove any contradictions in proposals and actions.

Energy efficiency and zero emissions require leadership from government, a credible plan of delivery drawing on a range of technologies, collaboration across the political spectrum and a consistent, committed and integrated focus at national, regional and local levels. This needs to be backed up by policies, resources and systems-wide infrastructure to incentivise customer buy-in, to develop the technology, to drive down prices, to enhance supply chains and to allow for the re / upskilling of staff.

Below are a few possible solutions related to heat in buildings. These must be tailored to particular needs as solutions for cities and rural areas, households and industry will all differ. There's no silver bullet and significant infrastructure development and deployment at scale is needed if solutions are to be credible and deliverable. In particular, decarbonisation in rural areas may be significantly challenging, for example at industrial sites.

- We recommend that heat pumps are subsidised to increase demand, recognising that, to be achievable and affordable, this requires the development of a network of supply chains and skilled staffing levels at scale. Heat networks are also possible, but require a high density population in a small area to be cost-effective. Costs could be relatively low if shallow installations are possible. However, there will be significantly greater costs if deep tunnels are needed to avoid existing underground infrastructure.
- Mandatory rules may be needed to speed up the insulation of buildings with accompanying financial assistance e.g. in Germany, a federal law states that if you remodel 20% of a façade or more, you must insulate it.
- Deployment at scale of renewable power generation will bring down power prices. That said, energy poor households will need to be supported to ensure a Just Transition.
- There could be research into reusing the heat outputs from high generation businesses e.g. data centres, to power homes. Such provision could be built into the planning process for future developments. However, this begs the question of replacement heat if a particular business were to move location or cease production.
- The use of fuel cells with solar panels can provide a distributed network in rural and small to medium sized villages and towns. Larger cities can have a centralised setup for power source, delivered to homes and offices using existing networks with some interface modifications. This may be attractive, especially on brownfield sites.
- With regards to finance, business, taxation and funding, models exist (e.g. energiesprong uk, Kreditanstalt für Wiederaufbau, Hauts-de-France Pass Rénovation etc) but need tailoring to local needs to make delivery more affordable for consumers and engender buy-in. In the same vein, national government should look at ways of reducing and streamlining related administrative processes and regulations.

However, it must be recognised that all proposed solutions will be out of reach for many people, who are already financially constrained. Schemes that are not backed up with significant Government funding risk achieving limited and slow levels of success.

Chapter 4 Energy demand - Energy for transport

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

Please give us your views:

Increasing the supply capacity of renewable energy needs a whole-systems approach, taking account of both heating and transportation in households and industry. Architecting such a system requires Government intervention, rather than being subject to market forces, to avoid siloed, potentially counter-productive solutions. For example proposals to replace ICE vehicles by EVs e.g. with subsidies / scrappage fees, would boost EV numbers on the roads. However, they may also lead to energy supply problems - or the need for non-renewable electricity provision, which would defeat the point of running EVs.

A significant expansion of renewable electricity infrastructure and EV charging station capacity is needed to meet demand. This will be very challenging and costly, and will require detailed infrastructure expansion planning, with regional pathways.

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

Please give us your views:

Further investment will be needed to decarbonise the transport system. Graduated CO2 taxes based on fossil fuel usage would seem the most suitable option, based on the 'user pays' principle. However, such taxation would need to take into account particular circumstances, such as the ability to pay, the provision of rural services etc.

We do not recommend subsidising e-fuels, as use of these tends to be inefficient. E-fuels and hydrogen should be limited to trains (on tracks that are very hard to electrify) and heavy transport.

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

Please give us your views:

Please see the response to Q28.

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

Please explain your views:

Planning regulations should not present obstacles to the development of renewables infrastructure, especially where this is done on brownfield sites. Processes should be digitised to make it as easy as possible to obtain legal security to install EV chargers.

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

Please give us your views:

No comment.

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

Please give us your views:

Communities should be given opportunities to form local energy cooperatives or otherwise participate in renewable energy projects at installation, operation and use levels. Financial incentives on the price of energy (including the sale of excess production) should be offered to incentivise the local take up of such schemes.

34 What, if anything, could be done to increase the reuse of electric vehicle batteries in the energy system?

Please give us your views:

Identify the areas in which EV batteries could be reused most cost-effectively. This also includes the use of batteries to support energy resilience by levelling out supply and demand. Identify the key technological requirements, the infrastructure, supply chains and skills that would be needed to facilitate such reuse. Draw up plans. Develop business models to incentivise industry to take up opportunities. Facilitate planning and support businesses in putting plans into effect.

Chapter 4 Energy demand - Energy for agriculture

35 What are the key actions you would like to see the Scottish Government take in the next 5 years to support the agricultural sector to decarbonise energy use?

Please give us your views:

Support to investigate synergies with other industries (e.g. production of hydrogen from waste in the water industry), conversion of farm vehicles to low carbon operations (e.g. HGV transport) and the supply of reliable low carbon heat could help decarbonise the Scottish agriculture sector at lowest cost.

We note that the James Hutton Institute has been awarded a £6 million grant (February 2023) for the HydroGlen project (https://www.hutton.ac.uk/sites/default/files/files/publications/Glensaugh_HydroGlen_NonTech_Feasibility_March2021.pdf#:~:text=HydroGlen%20is%20a%20prop) to pioneer a green hydrogen-powered farming community demonstrator facility at Glensaugh, Aberdeenshire. By producing green hydrogen from renewable energy generated on site, HydroGlen will have the capacity to support the entire energy needs of both the farm and the seven associated households. This could prove a very useful model to roll out to other farming communities in the future.

Chapter 4 Energy demand - Energy for industry

36 What are the key actions you would like to see the Scottish Government take in the next 5 years to support the development of carbon capture, utilisation and storage (CCUS) in Scotland?

Please give us your views:

CCUS is part of the mix in reducing carbon in the atmosphere. As per the other sections of this response, it should be considered as part of a planned whole-systems approach. However, the extent and the areas in which it forms an effective part need to be ascertained first before targets are set and actions undertaken. The Government obviously needs to maximise the effective use of its limited resources.

CCUS can be beneficial, for example it can be used in the thermal processing of waste (in combined heat and power plants) that cannot be reasonably recycled. However, there are concerns that CCUS can reduce a power plant's efficiency by 20% or more.

The long-term emphasis must be on phasing out fossil fuels completely, but in pragmatic ways over time. CCUS isn't a perfect solution, but it is useful if we can largely (95% plus) capture the carbon from combustion and 1. do this either more cheaply than other forms of generating energy, 2. do so to meet overall energy demand and 3. help develop our ability to implement projects which can achieve negative emissions via BECCS technology. Any carbon captured must not be reused for fuel production that simply releases the carbon at a later date.

It's also recognised that Scotland's CCUS capability is far in excess of its needs. This creates an import / revenue generation opportunity by offering a service to the rest of the UK and Europe.

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

Please give us your views:

Regulation and cap and trade schemes are an avenue. However, again, these should not be used to delay or limit the move towards net zero emissions.

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

Please give us your views:

Please see the response to Q36.

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

Please explain:

Please see the response to Q36. Scotland's role as a European hub for importing / storing CO2 must be built into the plan for a whole-systems approach. Developing an appropriate infrastructure network forms a key element of such a plan. This work would clearly involve collaboration on a pan-European scale to ensure supply and demand, standards, timing, construction and operationalising developments coalesced to form the most appropriate use of scarce resources.

Chapter 5 Creating the conditions for a net zero energy system

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

Please give us your views:

A key aspect for the Scottish Government to consider is the extent that it would wish that Scotland develops a homegrown ability to deliver energy system security of supply within a net zero energy system, rather than potentially relying on others to support this outcome. As detailed in the 'Draft Energy Strategy and Just Transition Plan', reliance on others as part of an overall solution is less expensive than developing Scotland's own comprehensive solution in country. However, this also results in a lower level of control over the resilience offered to the Scottish populace. The Scottish Government may wish to reconsider its position in light of the significant change in the global geopolitical perspective since February 2022.

41 What other actions should the Scottish Government (or others) undertake to ensure our energy system is resilient to the impacts of climate change?

Please give us your views:

The Government must ensure that the energy infrastructure has the scope and capacity to create and manage demands as and when needed. This includes legislation / actions / business models to ensure a robust system. Without a resilient supply of renewables, it will be difficult for countries to wean themselves off fossil fuels (domestic / imported) and provide for a Just Transition.

Climate change is leading to increasingly frequent extremes of weather and impacts, including storm damage and flooding. We suggest that the Scottish Government also considers a climate impact analysis and the benefit of applying mitigation solutions, such as improved flood defences or water provision during increased periods of drought. The impacts of climate change are already being experienced today.

Chapter 6 Route map to 2045

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

Please give us your views:

Please see the detailed responses to earlier questions, e.g. regarding rooftop PV, insulation / retrofit, heating and transportation.

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

Please give us your views:

Please see previous detailed responses. The vision needs translating into robust, credible, long-term delivery plans, at national and local levels that are followed through with collaboration across the political spectrum. Plans need to build in current and future supply and demand across the energy

spectrum, and to develop ways of resolving capacity and infrastructure challenges in the most effective ways. This may require a review of solutions that are not politically ideal (including a longer phasing out of fossil fuels), but which are pragmatically needed to ensure a secure, resilient energy supply. In the same vein such responses should not be allowed to dilute or slow down overall ambitions towards net zero.

As previously described, these measures, regularly reviewed and updated, are designed to engender business confidence and investment. They can support technological competitive advantage and provide an economic boost, with economies of scale and scope making schemes more affordable for users.

Impact assessment questions

44 Could any of the proposals set out in this strategy unfairly discriminate against any person in Scotland who shares a protected characteristic?

Please explain your views:

We are not aware of any such dangers. On the contrary, it's hoped that the proposals open up new skills and careers opportunities for all persons, including those with protected characteristics.

45 Could any of the proposals set out in this strategy have an adverse impact on children's rights and wellbeing?

Please explain your views:

We are not aware of any such adverse impacts.

46 Is there any further action that we, or other organisations (please specify), can take to protect those on lower incomes or at risk of fuel poverty from any negative cost impact as a result of the net zero transition?

Please give us your views:

The measures will demand significant investment over many years. Increased growth in the sector, if planned holistically, should make costs more affordable. However, it must be recognised that costs will still be out of reach for a significant section of the population, who will not view net zero as an immediate priority. Government financial intervention will be particularly needed to support such communities with sustainability initiatives.

As described, measures to plan and manage energy supply, using all available sources, will be necessary to maintain resilience and minimise price leaps that will increase fuel poverty. There is potentially a tension between the desire to phase out fossil fuels, and the role of solutions such as CCUS in a managed Just Transition towards net zero. Analysis and the articulation of the potential pathways and their relative merits may reduce the polarization of perspectives within the Scottish public.

47 Is there further action we can take to ensure the strategy best supports the development of more opportunities for young people?

Please give us your views:

There's a need to focus on STEM in Scottish schools, as previously mentioned. Incorporating targeted sustainability skills and knowledge within STEM syllabuses in Scottish Universities will also be beneficial in training up successive generations. This requires the Scottish Government to commit to and consistently follow through on policy. In turn this will engender academic and industry confidence in investing in skills and work programmes that enhance future sustainability delivery.

Just Transition energy outcomes

48 What are your views on the approach we have set out to monitor and evaluate the Energy Strategy and Just Transition Plan?

Please give us your views:

The energy strategy includes visions, targets and roadmaps. However, it still needs a detailed, whole-system plan that can be implemented with cost and time-effective solutions, that cater for varied needs in tailored ways, and that can be monitored in measurable ways so as to allow for amendments that improve delivery potential.

Without a holistic plan, there's a concern that a series of siloed partial approaches may be developed that benefit certain areas and resolve particular challenges, but which create issues elsewhere and do not lead to joined-up sector, national and international solutions. The risk is that siloed approaches act as a drag on net zero ambitions, reduce the likelihood of hitting vision targets, diminish the public's support for sustainable approaches, and potentially lessen Just Transition benefits.

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

Please give us your views:

They sound fine, but focus needs to be on rapid action now to turn ideas into reality.

50 Do you have any views on appropriate indicators and relevant data sources to measure progress towards, and success of, these outcomes?

Please explain your views:

Please see Q48.

Strategic Environmental Assessment

51 Do you have any comments on the environmental baseline information referred to in the Environmental Report?

Please provide comments :

52 Are you aware of further information that could be used to inform the assessment findings?

Please explain:

53 What are your views on the assessment findings?

Please explain your views:

54 Are there other environmental effects arising from the draft Energy Strategy and Just Transition Plan?

Please explain:

55 Do you agree with the justification for the approach to the alternatives?

Please explain:

56 What are the most significant environmental effects which should be taken into account as the draft Energy Strategy and Just Transition Plan is finalised?

Please explain:

57 How can the draft Energy Strategy and Just Transition Plan be enhanced to maximise positive environmental effects?

Please explain:

58 What do you think of the proposed approach to mitigation and monitoring?

Please explain:

About you

59 What is your name?

Name:

Andrew Rylah

60 What is your email address?

Email:

arylah@theiet.org

61 Are you responding as an individual or an organisation?

Organisation

62 What is your organisation?

Organisation:

The Institution of Engineering and Technology

63 The Scottish Government would like your permission to publish your consultation response. Please indicate your publishing preference:

Publish response with name

64 We will share your response internally with other Scottish Government policy teams who may be addressing the issues you discuss. They may wish to contact you again in the future, but we require your permission to do so. Are you content for Scottish Government to contact you again in relation to this consultation exercise?

Yes

65 I confirm that I have read the privacy policy and consent to the data I provide being used as set out in the policy.

I consent

Evaluation

66 Please help us improve our consultations by answering the questions below. (Responses to the evaluation will not be published.)

Matrix 1 - How satisfied were you with this consultation?:

Very satisfied

Please enter comments here.:

Matrix 1 - How would you rate your satisfaction with using this platform (Citizen Space) to respond to this consultation?:

Very satisfied

Please enter comments here.: