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RENEWABLE ENERGY IN SCOTLAND: A RESPONSE TO UK PARLIAMENT'S SCOTTISH AFFAIRS COMMITTEE

Summary

Scotland's renewable energy targets

Targets on their own are not enough. They need to be **accompanied by a series of impactful policy measures** to deliver the intended outcomes. However, even then, economy-wide emissions reduction targets for Scotland are important in **determining the tone of subsequent policy and in engendering the requisite political will** to meet them.

Targets can also **indicate a roadmap for future investment**, sending a signal to potential investors that Scotland will offer attractive political and economic conditions for their business activities.

Inappropriately set targets requiring **dramatic action that lock us into pathways that are unsustainable will not benefit Scotland's decarbonisation journey** over the long-term and could obscure issues of fairness and equity, such as fuel poverty.

It is important that **targets are supported by consistent policy**. This is particularly significant for more immature technologies that will require sustained investment and favourable policies in order to become a viable element of Scotland's energy mix.

Renewable energy sources

Wind energy has dominated the renewable energy mix due to a **favourable planning regime** and design optimisation achieved through industry collaboration and repeated cycles of **experimentation**.

Wave and tidal energy have not yet benefited from the same **accumulation of industry experience and technological refinement**, both of which have kept costs high and precluded large-scale deployment. **It is debatable whether government intervention in order to 'bootstrap' these industries would be advisable** as this could bypass the learning journey that has benefited the wind energy sector so greatly. It could also be that wave and tidal are better suited to niche applications, rather than large-scale deployment. There may be value in emphasising to politicians, media, and other public opinion-shapers the importance of risk and failure as a necessary part of a successful innovation process.

With all forms of renewable energy, **replenishable storage remains a key part of the whole-system energy equation** and one which has not yet been satisfactorily resolved. A multi-faceted solution will be required that accounts for varying quantitative, temporal, and geographic storage needs.

Summary

Scotland could be poised for global leadership in carbon capture and storage (CCS) if it is able to take advantage of conducive domestic conditions and experiment with more flexible and forward-thinking applications. As part of a bioenergy with carbon capture and storage (BECCS) process, CCS can potentially be used to **decarbonise urban waste treatment as well as distilleries and breweries**. Supporting the growth of **combined, community-based forestry and smaller-scale BECCS projects** could bring appreciable local community benefit, from employment in renewable forestry to power technology. CCS can also be used in processes that generate clean energy to **power vehicles and heat homes, both of which are already taking place in Scotland.**

Other types of negative emission technologies such as **direct air capture** and **nature-based solutions (NBS)** are beginning to emerge and with the right support could end up making a significant contribution to removing CO_2 from the atmosphere whilst also advancing wider environmental aims such as protecting biodiversity.

Employment in renewable energy sector

The **Scottish industrial base remains comparatively weak by international standards** and currently cannot offer the same quality guarantee as foreign manufacturers. According to the Just Transition Commission, the quest to deliver renewables projects at the lowest cost when bidding for **Contracts for Difference (CfD) may have had adverse implications on the development of a local supply and labour chain in Scotland**.

While the construction of renewable and low carbon energy infrastructure could generate jobs in the short-term, the **development of a local supply chain for operation and maintenance (O&M) services will provide Scotland with a higher value and more sustainable source of economic benefit**. Whole life carbon costs could be made a mandatory consideration during the assessment of project tenders, thereby giving further advantage to local suppliers of materials, local labour, and local added value products. There is also potential to upgrade existing port infrastructure on both the east and west coasts as part of supply chain development, particularly deep water facilities for offshore wind. This could help to revitalise coastal communities that have suffered economic hardships and population loss in the wake of declines in the fishing industry and a drop in tourism during the COVID-19 pandemic.

Simplifying the reskilling process through the use of skills passports and other mechanisms could encourage more people to make the switch to the renewables sector, as the time and money that are currently required to retrain could be a disincentive. It will also be important to remember that the **oil and gas sector is not homogenous**. Some workers have skills that can more readily be adapted or transferred to accommodate career shifts into related sectors such as renewable energy. However, others **are employed in more peripheral capacities**, such as hospitality or public relations. Diversification strategies for regions such as north-east Scotland can **consider such skills within regional economic diversification strategies** and offer targeted support as part of wider retraining programmes to ensure workers in supporting industries are not left behind.

Summary

More evidence is needed about the **types of skills and roles industries such as those for renewables, low carbon heating, and building efficiency will be looking to fill** so that prospective entrants can make informed decisions about their learning and career pathways and so that tertiary education institutions can develop the most relevant programmes. Fundamentally, Scotland must ensure a corresponding number of jobs for those leaving the oil and gas sector. This could involve **stimulating the growth of more small and medium-sized enterprises (SMEs) in the renewables sector.**

Intergovernmental relations

Successful delivery of Scotland's decarbonisation and just transition ambitions will require **effective cooperation between UK and Scottish Governments and coherence across devolved and reserved policies**.

There is also a need to clarify the role of government in **influencing behaviour change** across the population. Further emissions reductions as well as the consolidation of certain types of renewable technologies within Scotland's energy mix will require lasting changes to be made at the level of the consumer.

Local authorities should be sufficiently resourced and empowered in order to deliver national ambitions on the ground.

Renewable energy in Scotland: A response to the UK Parliament Scottish Affairs Committee inquiry

1 The Royal Society of Edinburgh (RSE), Scotland's National Academy, welcomes the opportunity to respond to UK Parliament Scottish Affairs Committee's inquiry into renewable energy in Scotland. The RSE has been particularly active in the area of energy policy in recent years, including publishing a major inquiry into Scotland's energy future in 2019[1] and preparing policy advice for national consultations on the Draft Offshore Wind Policy Statement[2] and the interim report of the Just Transition Commission in 2020.[3] The working group preparing this paper was comprised of Fellows and Young Academy of Scotland members, all of whom have significant knowledge of the renewable energy sphere and occupy various roles across academia, industry, policy, and other sectors. We would be pleased to discuss this response further with the Scottish Affairs Committee should they consider this useful.

Questions

1) Scotland's renewable energy targets

- How effective has the setting of targets been in achieving 'net zero' emissions by 2050 (UK Government) and 2045 (Scottish Government)?
- What lessons can or have been learned from setting net zero targets?
- To what extent does the UK Government's latest white paper – *Powering our net-zero future* – ensure that renewable energy targets will be met in the UK.

1 Royal Society of Edinburgh. (2019). *Scotland's Energy Future*. https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf

2 Royal Society of Edinburgh. (2020). Draft Offshore *Wind Policy Statement: A Response to Scottish Government*. https://www.rse.org.uk/wp-content/uploads/2020/04/RSE-Response-to-Draft-Offshore-Wind-Policy-Statement-Final-Version.pdf

3 Royal Society of Edinburgh. (2020). *Just Transition Commission Interim Report: A Response to Scottish Government*. https://www.rse.org.uk/wp-content/uploads/2020/07/Just-Transition-Commission-Final-Published-Version.pdf

2 Emissions reductions in the UK in the last 15 years have largely been due to a reduction in the emissions associated with electricity production[4] and, in particular, the development of renewable power generation. The closures of large-scale, carbon-intensive industrial complexes such as Ravenscraig and Cambuslang have also made a measurable contribution to decarbonisation. Scotland has been very successful at promoting renewable energy – particularly wind energy – over more carbon-intensive forms. In particular, the Scottish Government created an atmosphere of confidence for investors and streamlined planning consents for renewables projects. Coupled with financial incentives for investment in renewable generation set at a UK level, these mechanisms have been the main ways in which targets have been met. That is, targets on their own are not enough. They need to be accompanied by a series of impactful policy measures to deliver the intended outcomes. While some of these are within the powers of the Scottish Government, others, such as electricity market arrangements, are reserved. However, even then, economy-wide emissions reduction targets for Scotland are important in determining the tone of subsequent policy and in engendering the requisite political will to meet them.

3 Targets can also indicate a roadmap for future investment, sending a signal to potential investors that Scotland will offer attractive political and economic conditions for their business activities. From this perspective, the relative ambition of any targets can perhaps be indirectly measured by assessing the level of innovation and investment that follow. In this sense, ambitious targets that encourage the growth of numerous types of renewables or low carbon and heat vectors could give rise to a low carbon and renewable technology race in Scotland that leads to knock-on benefits by building a diversified industry value chain.

4 The setting of targets is also more nuanced than merely delineating a goal for gross emissions reductions. For example, targets can be applied to the proportion of total electricity derived from a particular source or to bringing unit costs down. Sectoral targets can be important in highlighting areas in which more work is needed, such as the significant reductions that remain to be achieved in heating and transport. Taken as a whole, these targets are important in determining whether continued decarbonisation is proceeding in a fair and sustainable manner. Inappropriately set targets requiring dramatic action that lock us into path ways that are unsustainable will not benefit Scotland's decarbonisation journey over the long-term and could obscure issues of fairness and equity, such as fuel poverty.

5 It is important that targets are supported by consistent policy. This is particularly significant for more immature technologies that will require sustained investment and favourable policies in order to become a viable element of Scotland's energy mix.

6 Lastly, it is important to remember that, however ambitious they may be, targets do not automatically translate into successful delivery. As COP26 nears and nations take stock of their variable progress towards decarbonisation commitments, it is a timely reminder that targets must be supported by a realistic framework of concerted and consistent action that includes regular evaluation across a range of metrics.

2) Renewable energy sources

- What variables have contributed toward wind energy providing more energy to the grid than any other renewable source?
- Why does marine energy account for such a small proportion of the total energy output of renewables in Scotland?
- What is being done to develop and research other forms of renewable energy in Scotland such as wave/tidal energy and carbon capture usage and storage (CCUS) energy or others?

7 As *Scotland's Energy Future* describes, Scotland has excellent wind resources due to the regular passing of low-pressure systems across the North Atlantic. The planning system in Scotland has also supported onshore wind farm development, grid connections, and low-carbon transition infrastructures.[5]

4 This includes the closure of coal fired power stations such as Longannet and Cockenzie.
5 Royal Society of Edinburgh. (2019). *Scotland's Energy Future*. https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf

8 Costs for wind have maintained a downward trend. Over the period from 1989 to 2019, UK levelised costs[6] for onshore wind fell by two thirds. While capital costs fell, a major source of the reduction has been major growth in productivity from larger, more efficient turbines and the optimisation of turbine design.[7]

9 Changes in cost for offshore wind installations have been even more impressive. The major gains relate to economies associated with fewer, larger turbines; greater experience; and substantial industry collaboration.[8]

10 As developing technologies, costs for tidal, and especially wave, are currently well above those for offshore wind. With only a few MW of capacity installed worldwide, there has been little scope for significant learning by doing, economies of scale, or cost of capital reductions.[9]

11 Technological development across the wave and tidal sectors has been uneven; wave energy in particular has experimented with a multitude of designs, none of which has advanced to the stage where large-scale commercial deployment is economically feasible. There is also an observed shortage of entrepreneurial capacity in wave and tidal energy in Scotland. Despite these challenges, wave and tidal resources are vast and are potentially more reliable than wind power at source.

12 Artificially integrating wave and tidal energy into the energy mix through government intervention could have benefits and drawbacks. While such 'bootstrapping' could be necessary to overcome cost barriers and could also potentially provide new employment opportunities, there are also clear advantages to allowing these technologies to follow a more organic trajectory of experimentation, demonstration, failure, and improvement. Indeed, although risk and failure are often regarded as undesirable, especially for developments involving public funds, they are intrinsic features of successful innovation. There may therefore be value in emphasising to politicians, media, and other public opinion-shapers the importance of risk and failure as a necessary part of a successful innovation process. Many of the advances made in wind energy were the result of trial and error and the application of lessons learned. It might also prove to be the case that wave and tidal energy are not suited to the same level of large-scale deployment as offshore wind energy and may instead be more useful in specific circumstances, such as contributing to energy security in island settings.

13 With all forms of renewable energy, replenishable storage remains a key part of the whole-system energy equation and one which has not yet been satisfactorily resolved. Storage can take various forms, including battery storage of electricity, pumped hydroelectric storage, and storing natural gas or hydrogen in salt caverns or depleted oil fields. Ultra-high temperature thermal energy storage,[10, 11] is a fast-emerging technology which both the UK and Scottish Governments have earmarked for rapid industrial development. Each form of storage contributes in its own way to system resilience. All potential forms of increasing storage capacity would provide storage on different timescales and for different purposes. Batteries may balance electrical demand on timescales of seconds or minutes. Reserve dispatchable power from pumped storage, hydrogen combustion, or fuel cells can balance hours or days. Storage of several tens of TWh for multiple days can contribute to overall security of supply by providing accessible reserves of energy during periods of high demand and by stabilising the variable availability of renewably generated energy. A multi-faceted solution will be required that accounts for varying quantitative, temporal, and geographic storage needs.

6 According to BEIS, 'levelised costs' refer to the average costs of the lifetime of the plant per MWh of electricity generated. They reflect the cost of building, operating and decommissioning a generic plant for each technology.

7 Royal Society of Edinburgh. (2019). *Scotland's Energy Future*. https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf

8 ibid

9 ibid

10 Robinson, A. (2017). Ultra-high temperature thermal energy storage. Part 1: Concepts. *Journal of Energy Storage*, 13, 277-286. https://doi.org/10.1016/j.est.2017.07.020

11 Robinson, A. (2018). Ultra-high temperature thermal energy storage. Part 2: Engineering and operation. *Journal of Energy Storage*, 18, 333-339. https://doi.org/10.1016/j.est.2018.03.013

14 While considerable investment has been dedicated to carbon capture and storage (CCS) research and development, there remain significant barriers to large-scale implementation over the short- to medium-term. Scotland could be poised for global leadership in this field if it is able to take advantage of conducive domestic conditions and experiment with more flexible and forward-thinking applications. North Sea deposits that once held oil and gas could be repurposed for carbon dioxide storage on a geological time scale. There are extant pipeline, CO_2 capture, industrial, and combustion facilities on the east coast which could be adapted to CCS and DACCS[12] activities. In addition to trees and energy crops – whose role in BECCS[13] can be contentious if appropriate sustainability considerations are not taken into account – BECCS feedstock could potentially be derived from urban waste facilities or from fermentation emissions arising from breweries and distilleries. These waste products can also be directed towards the production of biofuels.

15 CCS can also provide clean electricity from gas combustion by 2026[14] if used as part of a fuel-generating mechanism to produce 'blue' hydrogen which already supplies several small fleets of heavy goods vehicles (HGV) and public service vehicles (PSV) in Scotland. Hydrogen can be fed into a suitably adapted gas network, where hydrogen-compliant polyethylene pipes already exist through all mainland low-pressure distribution supplies. Conversion of individual dwellings from methane to hydrogen is stated to be £2-3k with low fuel prices, compared against the more than £10k cost of conversion to electric heat pumps. The first conversions to 100% domestic hydrogen are underway in Levenmouth, Fife.[15] These applications can develop simultaneously with CCS' more immediate role in industrial decarbonisation.

16 The deployment of BECCS on a very large scale has been met with criticism by some non-government organisations (NGOs) and other stakeholders, who argue that the adverse arithmetic of life cycle carbon analysis, time to re-grow the forestry crop, and land use requirements can be at odds with food production and biodiversity, particularly in the global south.[16] If BECCS is to feature in Scotland's journey towards continued decarbonisation, more nuanced arguments are needed to demonstrate its sustainability, dispel misconceptions, and differentiate between macro-scale, land-based BECCS initiatives and those used to decarbonise existing industrial activity or that operate on a more local level. Indeed, supporting the growth of combined, community-based forestry and smaller-scale BECCS projects could bring appreciable local community benefit, from employment in renewable forestry to power technology.

17 Other types of negative emission technologies such as direct air capture[17] and nature-based solutions (NBS) are beginning to emerge and with the right support could end up making a significant contribution to removing CO_2 from the atmosphere whilst also advancing wider environmental aims such as protecting biodiversity. For example, DACCS has a much smaller land-take than plantation forestry while NBS can recreate ecosystems.

3) Employment in renewable energy sector

In 2010 the Scottish Government said there was a potential for 130,000 jobs (Scottish Government, *A low carbon economic strategy for Scotland*, November 2010, p.10) in the low carbon renewable energy sector.

- What policy decisions do the UK and Scottish Governments need to make to increase the number of jobs in the renewable energy sector?
- How effective has the renewable energy sector been in producing careers for Scottish people?
- What UK and Scottish Government support would facilitate the growth of jobs in this sector?
- What do the UK and Scottish Governments need to do to achieve a 'just transition' for workers in the oil and gas industry to successfully redeploy to the renewable sector or other sectors?

12 DACCS refers to direct air carbon capture and storage.

13 BECCS refers to bioenergy with carbon capture and storage.

14 SSE. (2021). *SSE Thermal and Equinor join forces on Peterhead CCS power station project.* SSE. https://www.sse.com/news-and-views/2021/05/sse-thermal-and-equinor-join-forces-on-peterhead-ccs-power-station-project/

15 SGN. (undated) *H100 Fife: A world-first green hydrogen-to-homes heating network on the Fife coast.* SGN. https://sgn.co.uk/H100Fife

16 Brack, D & King, R. (2020). Managing land-based CDR: BECCS, Forests and Carbon Sequestration. *Global Policy, 12* (S1), 45-56. https://doi.org/10.1111/1758-5899.12827

17 Budinis, S. (2020). *Direct air capture: more efforts needed.* IEA. https://www.iea.org/reports/direct-air-capture

18 It was agreed that the Scottish renewables sector has not been particularly successful at producing careers for Scottish people to date. The Scottish industrial base remains comparatively weak by international standards and currently cannot offer the same quality guarantee as foreign manufacturers. According to the Just Transition Commission, the quest to deliver renewables projects at the lowest cost when bidding for Contracts for Difference (CfD) may have had adverse implications on the development of a local supply and labour chain in Scotland. As such, there could be scope to | re-examine the current CfD design and consider how it might be reformed so that price is no longer the sole driver behind successful bids and alternative measures such as a project's contribution to the local economy are afforded greater weight in the bid appraisal process.[18] This may be particularly important from 2021 onwards, when low carbon projects for CCS, DACCS, and hydrogen are expected to be awarded.

19 While the construction of renewable and low carbon energy infrastructure could generate jobs in the short-term, the development of a local supply chain for operation and maintenance (O&M) services will provide Scotland with a higher value and more sustainable source of economic benefit. Whole life carbon costs could be made a mandatory consideration during the assessment of project tenders, thereby giving further advantage to local suppliers of materials, local labour, and local added value products. There is also potential to upgrade existing port infrastructure on both the east and west coasts as part of supply chain development, particularly deep water facilities for offshore wind. This could help to revitalise coastal communities that have suffered economic hardships and population loss in the wake of declines in the fishing industry. As Scotland is currently facing significant rates of depopulation among its rural and island communities, such an initiative could help to ensure these communities remain viable and encourage inward migration. COVID-19 has also exposed the reliance of many rural and island communities on tourism. Developing local supply chains could thus help to diversify and enhance the resilience of Scotland's rural economies.

20 Government must also provide reassurance to oil and gas workers that retraining to work in other parts of the energy sector will be worth the effort and will indeed lead to meaningful and stable employment. Simplifying the reskilling process through the use of skills passports[19] and other mechanisms could also encourage more people to make the switch, as the time and money that are currently required to retrain could be a disincentive. It will also be important to remember that the oil and gas sector is not homogenous. Some workers have skills that can more readily be adapted or transferred to accommodate career shifts into related sectors such as renewable energy. However, others are employed in more peripheral capacities, such as hospitality or public relations. Although these jobs may transfer into the renewables industry less readily and directly, the generic skills these workers hold are re-deployable across a number of sectors. Diversification strategies for regions such as north-east Scotland can consider such skills within regional economic diversification strategies and offer targeted support as part of wider retraining programmes to ensure workers in supporting industries are not left behind.

18 The Just Transition Commission has observed that many in the oil and gas sector are cognisant of the challenges that are facing the sector and are indeed willing to leave the industry for more secure opportunities.[20] This suggests we have moved past the need for a persuasive narrative and should instead focus on how such a transition can be implemented and supported in practice.

18 Just Transition Commission. (2021). *A national mission towards a fairer, greener Scotland.* https://www.gov.scot/publications/transition-commission-national-mission-fairer-greener-scotland/

19 A skills passport is a tool or document in which people to record their skills, competences, and knowledge. These can reflect both formal, informal, and non-formal learning.

20 Just Transition Commission. (2021). *A national mission towards a fairer, greener Scotland.* https://www.gov.scot/publications/transition-commission-national-mission-fairer-greener-scotland/

22 More evidence is needed about the types of skills and roles industries such as those for renewables, low carbon heating, and building efficiency will be looking to fill so that prospective entrants can make informed decisions about their learning and career pathways and so that tertiary education institutions can develop the most relevant programmes. This will involve cooperation between government, industry, trade unions, and other key bodies. Fundamentally, Scotland must ensure a corresponding number of jobs for those leaving the sector. This could involve stimulating the growth of more small and medium-sized enterprises (SMEs) in the renewables sector. Multi-national firms can provide opportunities on a considerable scale but their long-term presence and investment in the UK can be difficult to predict. In contrast, SMEs and start-ups can provide enduring value to Scotland and their growth should be encouraged. Building back better and building forward to 2050 can be taken as an opportunity to create a modern industrial base in Scotland, founded on a just transition and sustained education, aspiration, and investment across multiple decades.

23 Community-scale generation projects such as those utilising run-of-river hydroelectric generation or solar photovoltaic (PV) cells have been growing in number and could form a substantial part of the energy mix in some locales as well as providing ancillary benefits such employment opportunities and increased resilience.

4) Intergovernmental relations

- How effective have the Scottish and UK Governments been in harnessing Scotland's renewable energy potential?
- How effective has consultation between the two Governments been on the development and design of renewable policies?
- What discussions took place between the Scottish and UK Governments in preparing the Energy White Paper?
- How will the Energy White Paper affect the renewable energy sector in Scotland?
- How can the UK and Scottish Governments work together effectively to achieve their respective targets of net zero by 2050/2045?

24 Although this response does not delve into the more profound aspects of intergovernmental relations between Scotland and the UK,[21] it emphasises that successful delivery of Scotland's decarbonisation and just transition ambitions will require effective cooperation between UK and Scottish Governments and coherence across devolved and reserved policies. For example, Scottish Government possesses many levers by which it could promote skills development but the power to make modifications to the parameters of Contracts for Difference (CfDs) for low carbon power generation in order to better benefit Scotland's economy lies with UK Government.

25 There is also a need to clarify the role of government in influencing behaviour change across the population. Further emissions reductions as well as the consolidation of certain types of renewable technologies within Scotland's energy mix will require lasting changes to be made at the level of the consumer, some of which may not happen without the appropriate incentives or in the absence of more encompassing culture change.[22] Such shifts include the greater use of sustainable modes of transport and retrofitting homes with heating efficiency measures.

26 In addition, the significance of local authorities should not be overlooked. In respect of local energy plans, for example, processes such as planning, land use management, and the enforcement of environmental legislation often fall to local government. As a result, they must be sufficiently resourced and empowered in order to deliver national ambitions on the ground.

Additional Information

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Responses are published on the RSE website (https://www.rse.org.uk/)

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21 On this topic, readers are directed to RSE advice papers on the UK Internal Market White Paper (August 2020), UK Intergovernmental Relations (November 2018), and Common UK Frameworks (August 2018).

22 The Royal Society of Edinburgh's recent response to Scottish Government's Draft Public Engagement Strategy for Climate Change explores the factors necessary or achieving lasting behaviour and culture change at a societal level. Royal Society of Edinburgh. (2021). *Draft Public Engagement Strategy for Climate Change: A Response to Scottish Government*. https://www.rse.org.uk/wp-content/uploads/2021/04/Draft-Public-Engagement-Strategy-for-Climate-Change-RSE-response.pdf