SCOTLAND'S LOW-CARBON TRANSITION - *AN OVERVIEW OF THE SCOTTISH ENERGY OUTLOOK: CONTEXT, OPPORTUNITIES AND EQUITY.*

ALLISON ANGELIDIS

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ABSTRACT

Scotland is experiencing a low-carbon transition – a process recently accelerated by the 2019 Climate Change Act that legislated a net-zero target by 2045 and placed the nation as a world-leader in climate action. Yet, the ability of the Scottish Government to enforce an independent energy/climate agenda is limited due to its semi-autonomous nature as a United Kingdom constituent country. Scotland should instead rely on its devolved powers, massive renewable energy potential and transferable expertise from the North Sea oil/gas sector to realise the necessary emissions reductions. For the emerging 'new economy' to be just and sustainable, however, it should accommodate the workers and communities most affected by the shift. Therefore, this paper evaluates not only the present programmes instituted by the government and the economic opportunities available in green sectors, but also the inequalities likely to be exacerbated in the transition.

KEY WORDS

Scotland, low-carbon transition, just transition, renewable energy, net-zero, energy efficiency, economic opportunity, low-carbon economy

1. Introduction

The 2008 Climate Change Act formally committed and legally bound the United Kingdom (UK) to an 80% emissions cut by 2050 (UK Government 2008). This already ambitious target was substantially accelerated following a report published by the Committee on Climate Change (CCC) urging Scotland towards a 'net-zero' scenario by 2045 (CCC 2019a: 11). Using this recommendation, the Scottish Parliament amended its previous objective with the 2019 Climate Change Act (Scottish Government 2019a). Along with setting an aim five years ahead of the UK, this decree introduces interim emissions reduction targets of 56% by 2020, 75% by 2030 and 90% by 2040 (ibid).

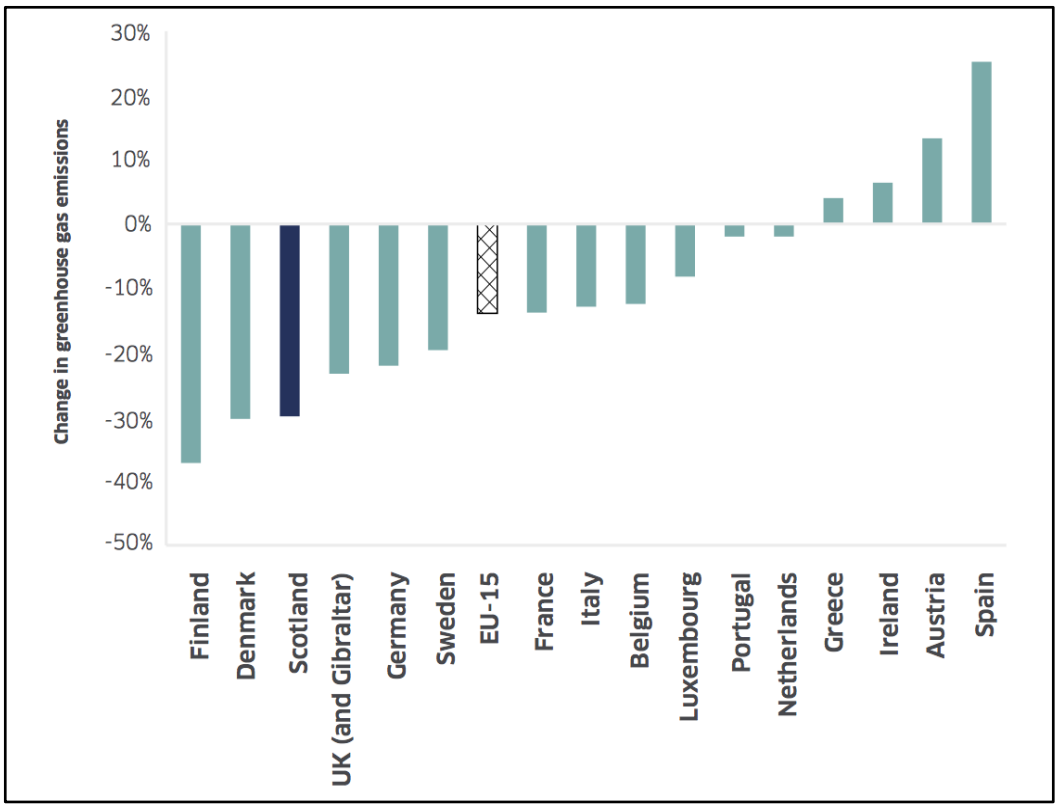
Additionally, this act alters the scope of emissions targets as it now covers Scotland's 'actual' emissions, including aviation and shipping, rather than 'net' targets which were previously adjusted using European Union Emissions Trading Scheme (EUETS) allowances (CCC 2019b: 14). The EUETS is the world's largest carbon market operating in all EU nations, including Iceland, Liechtenstein and Norway (European Commission 2020). It functions via 'cap and trade' which caps total emissions covered by all installations in the scheme, reduces this limit over time so that emission levels fall gradually and allows companies to receive/purchase emissions allowances (ibid). As the UK will mostly likely withdraw from this trading system following Brexit (Brown, Steel 2019), the act's sole focus on total Scottish emissions better reflects the prospective energy landscape.

This shift means Scotland's total emissions are now subject to an extremely aggressive target that necessitates an annual emissions reduction of 1.8 mtCO2e until 2045 (CCC 2019b: 14). Legislating such an objective places the nation as a world-leader in climate policy (ibid: 10) - a leadership position that will undoubtedly be tested at the United Nations Conference of Parties (COP26) hosted in Glasgow next year (Just Transition Commission 2020: 14). At the conference, Scotland should utilise[1] this sustainability-

[1] This paper will use UK spelling henceforth.

driven reputation to demonstrate a definite and dependable commitment to achieving net-zero emissions by 2045 (CCC 2019b: 9).

Figure 1, Change in emissions from 1990-2012 - Scotland and EU-15:

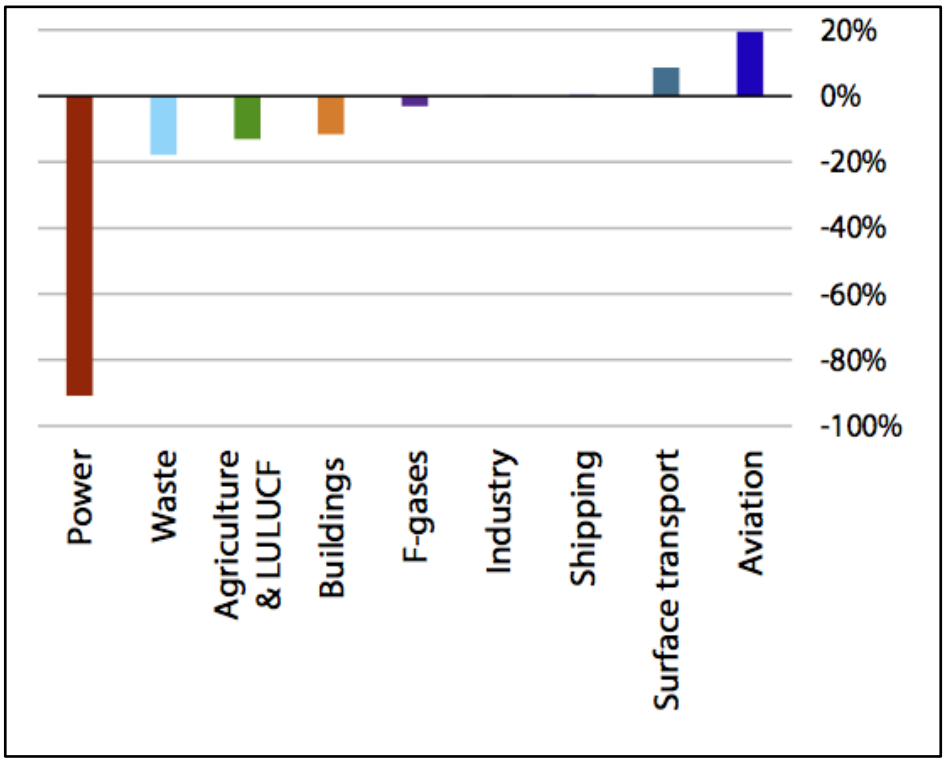


See Scotland dark blue and EU-15 chequered (Scottish Government 2015a: 32)

Scotland's progress in realising this target has been greatly supported by its abundant renewable resources (wind, wave and tidal) in the Western Isles, Shetland Isles and Orkney (Scottish Government 2015a: 46). These natural endowments have allowed Scotland's effort to reduce emissions to yield faster, greater results than the EU-15 (see figure 1). In fact, emissions have dropped 47% from 1990 levels due largely to the decarbonisation of the power sector and the absence of coal-fired electricity generation following the closure of the Longannet power station in early 2016 (CCC 2019b: 11-12) (see figure 2). In total, emissions from this sector have fallen by 91% since 2012 (ibid). To the contrary, surface transport emissions have increased by 9% within the same period and aviation emissions rose 6% in 2017 alone

(CCC 2019b: 57; NAEI 2019). Such growth in emissions levels makes transport, including surface and aviation, the highest emitting sector in the country with a representative share of 37% (see figure 2).

Figure 2, Scotland's change in emissions by sector 2012-2017:



(CCC 2019b: 12; NAEI 2019)

Because Scotland lacks independent sovereign status, reducing the necessary emissions cannot be accomplished without UK-wide action and legislation. This does not mean Scotland has no agency in its energy/climate agenda; rather, the Scottish Government can still make significant advancements using devolved policy levers. For example, though the nation lacks direct control over vehicle and fuel taxation, Scotland can still ensure a rapid rollout of electric vehicles (EVs) by developing the required charging infrastructure. To meet its 2030 interim target, the Scottish Parliament could reduce transport emissions by implementing 4,240 fast chargers, 2,800 rapid chargers and 900 ultra rapid chargers on top of its already existing 3,600 public charging points (CCC 2019b: 31). Scotland can also propose non-financial incentives to owners of electric vehicles, like privileged parking and driving access relative to petrol/diesel

vehicles (2019b: 32). These convenience incentives should be instituted alongside financial incentives, like the interest-free loans of up to £35,000 currently offered by Transport Scotland and the Energy Savings Trust (ibid).

Similarly, in regard to building decarbonisation, Scotland has control over heat policy to the extent it does not interfere with the gas network. In this way, Scotland can use its devolved powers to identify high-demand areas where low-carbon district heating, using geothermal heat or hydrogen, is a more cost-effective option than alternative solutions (2019b: 35). This could minimise consumer cost barriers to reaching the proposed target of renewable or low-carbon heat networks in all residential properties after 2024, a year prior to Britain (Scottish Government 2019b).

Likewise, Scotland's transition towards greener infrastructure must be advanced within its legal/political boundaries. The government can carry this out by outlining a strict procedure with feasible aims in Scotland's 2020 National Planning Framework. Ideally, this proposal should incorporate the deployment of Carbon Capture and Storage (CCS) technologies as the North Sea houses depleted gas fields and aquifers with extensive CO2 storage potential (2019b: 40). Equally as imperative to actualising Scotland's net-zero scenario is the mass production of hydrogen by 2030, which could be cost-effectively generated from natural gas and used in the industrial sector in the longer-term (CCC 2018).

The power sector, however, is much more contingent on UK policy-making to decarbonise. Nevertheless, Scotland can still institute measures to reinforce flexibility in the electricity system, especially as high proportions of variable generation (ex. wind) are introduced (CCC 2019b: 42). The government could integrate flexible solutions, like vehicle smart-chargers and hybrid heat pumps to ensure demand peaks are manageable. Further, as electricity demand is likely to rise across the nation, Scotland's potential for onshore and offshore wind generation will presumably position the nation as a net exporter of electricity to the rest of the UK (ibid).

Most importantly, notwithstanding issues of rising transport emissions and complex devolved-reserved dynamics, Scotland's low-carbon shift ought to be considered through a socio-technical lens (Rip, Kemp 1998). Whilst its fossil fuel economy remains dominant and deeply embedded within the foundations of the nation in the form of jobs, identity and community (Unruh 2000), new green actors, discourses and institutions will continue to emerge (Murphy, Smith 2013: 693). Scotland should anticipate this radical transformation and prioritise the tenets of a 'just transition' in a way that "aims to minimise the negative impacts on workers and communities with takes in high-carbon sectors... and to maximise positive opportunities for decent jobs in the low-carbon sectors of the future" (Zinecker et.al 2018: 2).

To fully evaluate the Scottish energy outlook, this paper will (a) review the current actions taken by the government to attain net-zero by 2045 (b) analyse the opportunities available in the energy and job markets of certain low-carbon sectors and (c) discuss any inequalities that could be exacerbated by the transition. Ultimately, this study concludes with several recommendations that could enhance the profitability and equity of Scotland's energy shift.

2. Context

The Scottish Government has allocated considerable funds to reaching its climate goals through various programmes and projects aimed at minimising emissions - namely, those relating to low-carbon infrastructure (LCI) investment, local and small-scale renewable financing, improved energy efficiency, heat network deployment and low-emissions vehicle promotion.

In regard to promoting LCI development, Scotland has initiated calls to bid for a £3 billion green investment portfolio and has reorientiated its 'Growth Accelerator' to pertain solely to green infrastructure investment (Scottish Government 2019b). Through its Energy Investment Fund, the Government has also invested £20 million from 2019-20 into community and energy projects most committed to delivering community benefits (Scottish Government 2020a). To maximise potential in low-

carbon sectors, Scotland launched a Low Carbon Infrastructure Transition Programme to enable the conditions necessary to attract commercial investment and to promote innovation in heat decarbonisation (Scottish Government 2020b). Since 2015, this programme has catalysed over 50 LCI projects and offered over £48 million in financial assistance (Scottish Government 2017a).

The Scottish Government has also streamlined the investment process for local and small-scale renewables. With the Community and Renewable Energy Scheme, Scotland's aim of increasing shared ownership energy installations across the nation to 500 MW by 2020 has been furthered (Scottish Government 2020c). Indeed, £5 million was allocated to community and local energy projects in the 2018-19 fiscal year (ibid). This aim has also been facilitated by the Community Energy Empowerment Programme, which centralises communities in the decision-making processes of local energy systems (Scottish Government 2015a: 47).

In addition, the Scottish Government has committed itself to bettering the energy efficiency of buildings across the country. Because heat is responsible for a substantial portion of the nation's emissions, Energy Efficient Scotland has specifically defined energy efficiency as a national infrastructure priority (Scottish Government 2020d). This programme has earmarked £0.5 billion - £125 million annually - throughout the tenure of the current Parliament (2018-21) (Scottish Government 2019b). The Government has also launched Resource Efficient Scotland which offers free, specialist advice and assistance to the private and public sectors regarding the financial and environmental benefit of instituting energy, resource and water efficiency measures (Scottish Government 2020c). Similarly, Home Energy Scotland has begun allocating loans of up to £38,500 per home to aid home-owners investing in energy and money-saving advancements (ibid). On a UK-wide scale, the Energy Company Obligation supports domestic energy efficiency improvements and encompasses policies geared towards low-income, vulnerable households (Scottish Government 2020d).

In a related vein, any feasible route to net-zero will likely require all homes to realise EPC standard by 2030, rather than by 2040 as promoted in Scotland's Programme for Government (Scottish Government 2019b). Whilst energy efficiency measures have been implemented in nearly one in three Scottish homes since 2008 (Scottish Government 2015a: 46), this accelerated target demands the current rate of annual renovations be doubled to 80,000 homes until 2030 (Scottish Government 2019c).

The Scottish Government has also encouraged the deployment of heat networks, which are generally more efficient than individual fossil fuel heating systems and can be generated from renewables or recovered waste (Scottish Government 2020e). In the 2020-21 Scottish Budget, the Heat Networks Early Adopter Challenge Fund has apportioned £50 million for local authority heat network projects (Scottish Government 2020f). Likewise, the District Heating Loan Fund has provided over £15 million in low-rate, unsecured capital loans to 50 distinct heating projects (Energy Saving Trust 2020). In Aberdeen, the Combined Heat and Power district heating scheme - whereby the heat emitted by the generator is captured and used to heat properties rather than released into the atmosphere - connected 741 flats throughout the city (Aberdeen City Council 2016: 29). Resultantly, energy demand lowered as the efficiency of the building stock improved (ibid).

Importantly, low and ultra-low-emissions (ULE) vehicle promotion has been high on the Scottish environmental agenda. Eight years ahead of the UK Government's 2040 target, the Scottish Parliament aims to phase out "the need for" petrol and diesel cars/vans by 2032 (Scottish Government 2017a). In Scotland's Programme for Government 2019-20, this objective was sped up to 2025, with an added goal of zero or ULE city centres by 2030 (Scottish Government 2019b). In fact, the UK administration's 2018 'Road to Zero Strategy' envisions up to 70% of new car sales to be ULE vehicles by 2030 (Department for Transport 2018). This has been supported by Scotland's new £500 million fund to promote bus services across the country and pledge to decarbonise rail services by 2035 and flights between Scottish airports by 2040 (Scottish Government 2019b).

Additionally, ChargePlace Scotland has invested over £30 million since 2012 in 2,300 charging points in homes, businesses and local authority land with 150 being 'rapid' chargers (Scottish Government 2017b). This makes Scotland's electric vehicle infrastructure one of the most comprehensive networks in Europe (Scottish Government 2017a: 20). Through Transport Scotland, interest-free loans of up to £35,000 have been offered to drivers purchasing an electric or plug-in hybrid vehicle (Scottish Government 2017b). In 2019, the available funding for this programme was increased from £8 million to £20 million (ibid). To further incentivise low-carbon transport, Scotland has advocated for electric vehicle (EV) charging points to be built in the local communities along the longest road in Scotland, the A9 highway (Scottish Government 2017b). EV owners have also been granted £300 through the Energy Saving Trust's EV HomeCharge Scheme to invest in private charging points (CCC 2019b: 32). In fact, almost 90% of all EV owners in Scotland possess home charging spots (ibid).

Thus, it is apparent that the Scottish Government has designated substantial fiscal resources across low-carbon sectors to reach its 2045 net-zero target; however, at the same time, the unavoidable financial and occupational transformations involved in the energy shift have been largely absent from the conversation. The next section will rectify this dearth of information.

3. Opportunities

As with any energy transition, Scotland's route to net-zero will be characterised by a reconstruction of the labour pool away from high-carbon sectors and towards low-carbon sectors. To ensure both the economy and the working-class fare well in this transformation, the opportunities available in the forthcoming low-carbon future should be considered.

The oil industry is a major presence in the Scottish workforce as it employs over 156,700 individuals directly, indirectly and through exports (Minio-Paluello 2015: 16) (see figure 3). The plurality of these workers are based within four constituencies that each have over 25,000 workers: Gordon, Aberdeen

North, Aberdeen South and West Aberdeenshire and Kincardine (2015: 17). Apart from these locations, five others have 1,000-2,000 jobs linked to the sector: Linlithgow and East Falkirk, Banff and Buchan, Glasgow Central, Edinburgh East, and Orkney and Shetland (ibid). Because high-carbon employment is concentrated within these few areas, the job losses will also cluster causing the affected households and surrounding communities to incur devastating impacts - unless vacant positions in renewable energy sectors are available, advertised and accessible.

The new economy will be defined by several new developments: growth in industrial sectors, like offshore wind and marine energy; expansion of existing public services, like buses and city-wide composting; infrastructure construction for electric vehicles, railways, energy storage and hydrogen generation; contraction in the oil and gas extraction sector with a focus on decommissioning; building retrofitting and the introduction of district heating systems aimed at minimising energy demand (Minio-Paluello 2015: 5).

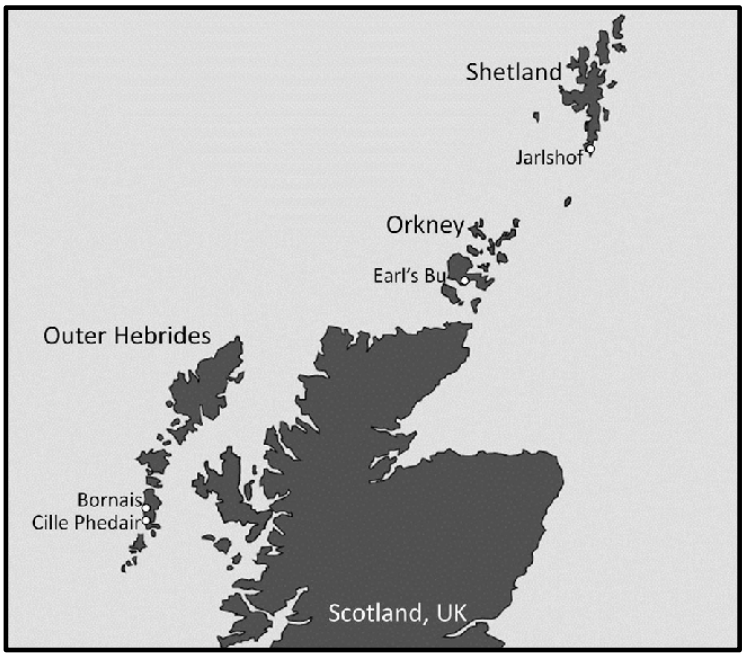
Figure 3, Job market potential in the new and old economy:

	Old Economy[59]	**New Economy - 2035[60]**
North Sea extraction	151,200	10,000
Nuclear & fossil fuel plants	2,000	
Refining & Gas / Synthetic gas	3,500	3,500
Offshore Wind		106,700
Offshore Wave		28,300
Offshore Tidal Stream		20,600
Forestry		5,900
Building Retrofitting		18,900
Decommissioning		20,000
Training		4,000
Total	**156,700**	**217,900**

(Minio-Paluello 2015: 20)

The greatest portion of the new labour force - roughly 150,00 people - will be constructing and maintaining offshore renewable energy infrastructure (2015: 20) (see figure 3). This means welders, engineers, surveyors, machine operatives and those with science, technology, engineering and maths skills more generally will be in high demand. Fortunately, much of the offshore oil and gas workers in the North Sea supply chain share this skill-set and could thus transfer their expertise to low-carbon sectors (ibid). In this sense, if companies that formerly serviced the offshore oil sector are able to renovate themselves to support offshore wind or marine energy, workers previously employed by fossil fuel industries will be able to locate similarly-placed work opportunities (2015: 21).

Figure 4, Map depicting the Hebrides, Orkney and Shetland Islands:

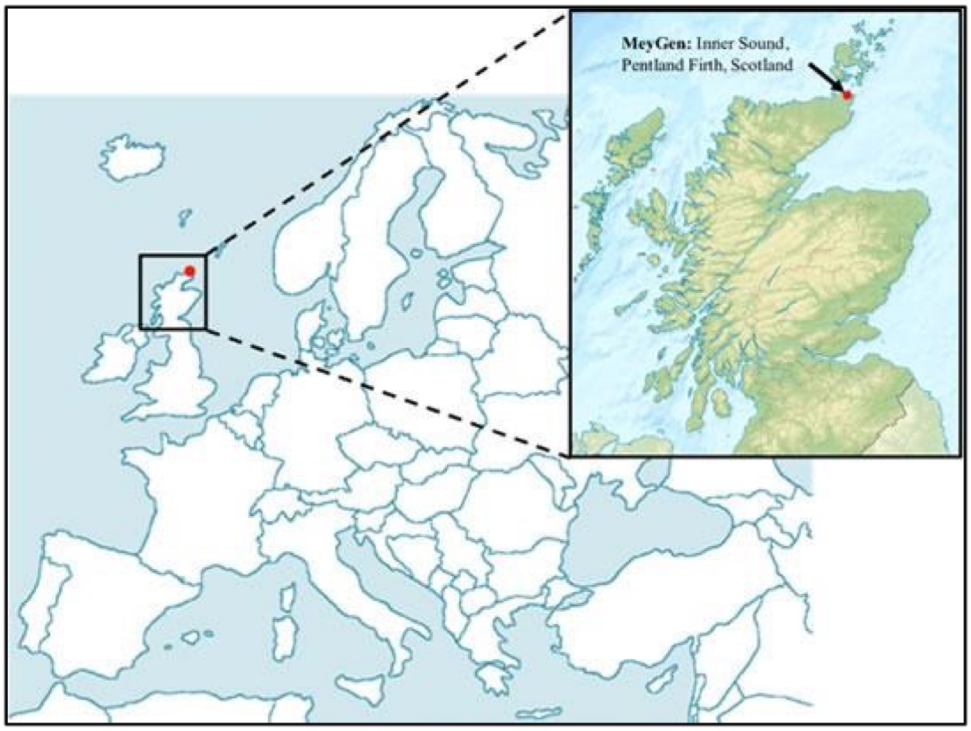


(Jones, Mulville 2018)

Likewise, the ports that sustained oil/gas drilling with vital routes to the North Sea and the Atlantic, like Lerwick Harbour in the Shetlands, will also be hubs for offshore wind (ibid). Whilst much of Scotland's offshore wind potential lies off the North of Scotland, there will be many job opportunities in onshore wind nearer to the east coast as well. This means the prospective job market for the wind sector will be well-distributed across the country. As for wave energy, two thirds of Scotland's capacity lie to the West

of the Hebrides and one third exists in the areas surrounding Orkney and the Shetlands (2015: 21) (see figure 4). Indeed, the greatest tidal stream potential is in the Pentland Firth, between the mainland and Orkney (ibid) (see figure 5). Beyond this, a substantial portion of the supply chain will also be available remotely, like component manufacture and project management. All in all, the nation's low-carbon economy could employ over 200,000 workers in 2035 (2015: 3).

Figure 5, Map depicting the Pentland Firth:



(Gallucci 2014)

There are several sectors that will witness considerable job growth in the new economy, including but not limited to: offshore wind, hydrogen and marine and tidal innovation. Offshore wind, in particular, is now much cheaper than nuclear electricity generation and is expected to receive £210 billion in global expenditure in the coming decade (Scottish Government 2020g). This sector represented 70% of Scotland's total renewable energy capacity in 2014 and has only risen in importance as it has become crucial to reducing emissions and maximising the nation's export potential (Dalglish et.al 2017: 517;

Scottish Government 2015b: 13). Building up Scotland's offshore wind capacity would be relatively straightforward as it maintains a comparative advantage due to its expertise and experience in offshore oil/gas, skilled offshore workforce, established port infrastructure and strong basis of innovation (Scottish Government 2020g).

This country has a possible 46 GW of accessible wind capacity for fixed turbines in shallow seabeds and 86GW of floating capacity for deep-sea generation off the west and north coasts (Minio-Paluello 2015: 6). Of this 132 GW of theoretical wind capacity, it is estimated that only 50% will be actually installed in the next two decades; in this sense, 3.3 GW per year is the necessary installation rate (ibid). Using this metric, it is expected 101,000-107,000 workers would be employed either directly or indirectly in the supply chain over 20 years (2015: 7). This sizable workforce is largely a result of the complicated engineering, increased infrastructure and heightened marine support needed to maintain an offshore wind farm (DECC 2013). As of presently, however, the UK government recently announced an Offshore Wind Sector Deal that aims to increase the workforce to only 27,000 by 2030 (UK Government 2019) - much less than hypothetically possible.

Differently, the hydrogen sector provides an opportunity to maximise renewable energy capacity as it acts as an energy storage medium (Aberdeen City Council 2016: 24). Though switching to hydrogen power generation does entail high marginal costs (£80-120/tCO2e), these are offset by the cost savings of renewables (CCC 2019c: 224). Also, as 90% of the UK's hydrogen-generated power is produced in Scotland, the Scottish population and economy will experience much of the benefits associated with the sector (Scottish Government 2017a: 49). Of these advantages, the most significant include increased investment and the construction of high value-added local jobs in rural areas (ibid).

By 2050, much of demand previously met by natural gas could be converted to low-carbon hydrogen through Steam Methane Reforming (SMR) plants alongside CCS (Scottish Government 2017a: 26). CCS is absolutely critical to unravelling the potential for large-scale hydrogen generation. Fortunately, Scotland's

waters in the North Sea provide the greatest carbon storage capability in Europe (2017a: 63). Accompanied by its oil/gas capabilities, ready supply chain and pipeline/platform infrastructure, the nation is well-positioned to carry out CCS on a commercial scale (ibid). Large-scale pumped storage hydro (PSH) facilities, like those already existing at Cruachan and Foyers, can also store extensive quantities of power and release energy when demand is high (2017a: 56). Investment in this technology could enhance the flexibility and resilience of the Scottish electricity network.

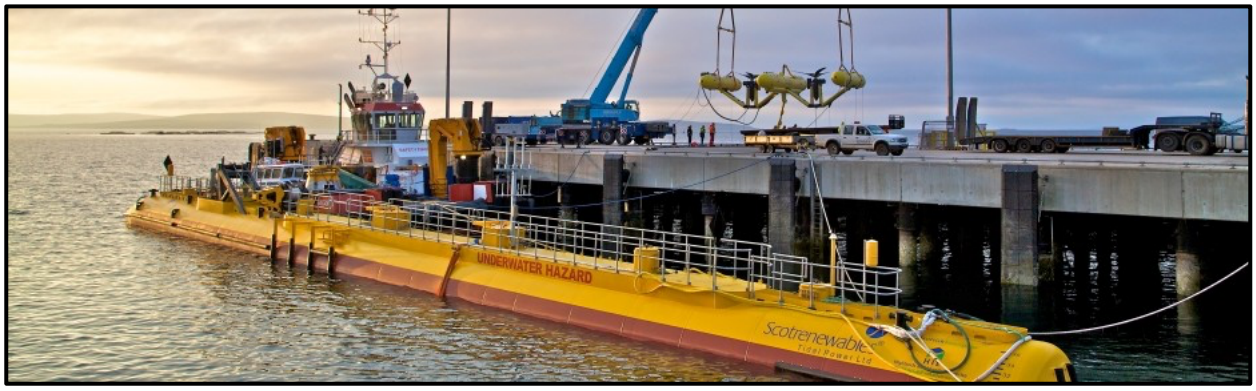
The H2 Aberdeen initiative, in particular, has utilised the city's transferable oil/gas expertise and renewable readiness to capitalise on the benefits of a hydrogen economy. To date, the programme has implemented hydrogen hybrid vans and plug-in range extended vans, a hydrogen production and bus refuelling station, a 10-year hydrogen strategy and ten hydrogen fuel cell buses - Europe's largest fleet (Aberdeen City Council 2016: 32). In 2017, the Scottish Government allocated £3 million to double this bus fleet to 20 vehicles (Scottish Government 2017a: 50).

In a different vein, the 'Surf' 'n' Turf' project in Orkney is the UK's first smart grid that uses hydrogen produced from tidal and onshore wind turbines (Scottish Government 2017a: 53). The hydrogen power generated is then used to provide low-carbon heat, power and transport on the islands (ibid). Similar projects exist in other remote rural communities, like the Mull Garmony Community Hydro Scheme.

Lastly, marine energy and tidal innovation are major aspects of Scotland's low-carbon energy generation. Over half of the UK's practical wave energy resource extends from the West Hebrides with 25% located off the North of Scotland around Orkney and the Shetland islands (Minio-Paluello 2015: 8). Located largely in these regions, Scotland has an installed wave capacity of 11 GW and an installed tidal stream capacity of 8 GW (ibid). This translates to an annual installation rate of 0.55 GW and 0.4 GW, respectively. In terms of employment opportunities, this yearly quota would create 49,000-57,000 jobs over 20 years (2015: 9).

Although there have been recent job losses at Pelamis and Aquamarine Power, Scotland's continued investment and support should allow the wave and tidal industry to flourish (2015: 8). The Scottish Government has invested over £30 million into Wave Energy Scotland's technology programme aimed at developing wave devices, sub-systems and components (Scottish Government 2020h). In a like manner, the Government apportioned £10 million to the Saltire Tidal Energy Challenge Fund to support the marine energy sector and tidal modernisation (ibid). Scotland is also host to globally-renowned facilities and technologies in this sector including: the world-leading wave and tidal test centre, the European Marine Energy Centre (EMEC) in Orkney (see figure 6), the world's most powerful tidal stream turbine and the world's largest tidal stream array (ibid).

Figure 6, The European Marine Energy Centre:



(EMEC 2020)

4. Equity

Because there will undoubtedly be significant financial and occupational opportunities available in the low-carbon sectors of Scotland's future, it is clear that realising this transition is neither a financial nor technical issue (IPCC 2018). Rather, the present barriers to this energy transition are largely socio-political. Indeed, deep decarbonisation is only politically viable with the support of all relevant stakeholders (Reitzenstein 2018: 2); but, some - namely carbon-dependent industries and communities - will incur adverse consequences. To mitigate any resistance to the new economy, the socio-economic implications

for these actors should be brought to the fore of the decarbonisation discussion (Gambhir et.al 2018: 2; Healy, Barry 2017). In other words, the transition ought to be centred around the "people - workers, consumers, businesses, communities" most affected by this labour market shift (Zinecker et.al 2018: 1). Therefore, for Scotland's transition to be considered just, it must intend to create jobs along the supply chain in value-added, low-emitting sectors (ILO 2015: 6) and share the burden of emissions reduction equally across society (Just Transition Commission 2020).

As shown in Scotland's Economic Strategy, this 'just transition' concept is embedded within the nation's priorities - i.e. the creation of "a society that promotes inclusive growth and creates opportunity through a fair and inclusive jobs market and regional cohesion to provide economic opportunities across all of Scotland" (Scottish Government 2015a: 36). Similarly, the 2019 Climate Change Act commits Scotland to cut "greenhouse gas emissions in ways that create decent, fair and high value work, address inequality and poverty and maintain social consensus" (Irwin, Robins 2019).

To carry this out, Scotland established a Just Transition Commission (JTC) tasked with consulting workers, communities, NGOs, businesses and industry leaders and ultimately providing practical, affordable recommendations for action by January 2021 (Scottish Government 2019d). These propositions should ensure "growth is shared and sustainable" (Scottish Government 2015a: 4) by focusing on more than just job loss/gain. Instead, the JTC should also reserve budgetary attention to broader issues like the way this low-carbon transition could negatively impact energy bills for lower-income households or the connectedness of rural communities (JTC 2020: 25).

Such potential inequalities that will inevitably arise in the wake of Scotland's transition should be addressed to ensure the new economy is equitable for all stakeholders. The first is fuel poverty, which the Scottish Government defines as a household that spends more than 10% of its income on fuel use (heating, cooking, lighting, appliances, hot water) (Aberdeen City Council 2016: 17). Though the government has allocated over £1 billion pounds since 2009 to tackle this issue (Scottish Government

2017a: 17), energy prices have more than doubled for domestic consumers in the last decade with over 100,000 people plunged into fuel poverty in 2016 (ibid). In 2018, 25% of all Scottish households - amounting to 619,000 - were in fuel poverty (National Statistics 2020: 66). This number is set to increase substantially by 2037 - especially in Aberdeen (Aberdeen City Council 2016: 17).

Though new energy companies have eroded the market share of the 'big six' from 98% in 2013 to 80% in 2017, not all households have the capacity to take advantage of increased energy options (Scottish Government 2017a: 34). The consumers most likely to capitalise on competition are typically higher income earners with access to mains gas supply and the internet to compare prices (ibid). This generates a dynamic in which those with less of an ability to pay subsidise the more fortunate, engaged consumers. Resultantly, fuel poor households are often on the most expensive energy tariffs and would be unable to switch to cheaper, renewable energy providers in the new economy.

Also, any project focused on compensating workers who lost their jobs in the transition cannot ignore the repercussions massive unemployment has on the community more broadly. For example, the company managing the closure of the Longannet power station offered its employees early retirement but failed to address the economic development and empowerment concerns of the nearby town of Kincardine (JTC 2020: 22). This left Kincardine both voiceless and lacking the necessary economic stimulation to thrive in the new economy. In order for Scotland to build a resilient low-carbon economy, the transition should be inclusive of all opinions and actors.

This includes individuals living in rural areas, especially with regards to the electric vehicle transition. Without infrastructure investment in these regions, rural communities could be excluded from the switch to electric private and public transport. The networks located in remote neighbourhoods could also be less flexible thereby intensifying the prospect of these individuals feeling cut-off (JTC 2020: 26). To avoid this rural community isolation, their voices should be incorporated into the transition conversation.

5. Concluding thoughts

In order to achieve net-zero by 2045, the Scottish Government should effectively engage with the human side of the issue alongside its related public policy and political challenges. When policy is made from the top-down without social 'buy in', there is a greater risk of political resistance to the new economy. With public participation in the decision-making process, however, low-carbon policies are more durable and tailored to local needs. For instance, public consultation in energy efficiency installation - through housing associations - would result in individually customised measures that reduce energy demand whilst also minimising the budgets of private homeowners.

Thus, to ensure procedural justice and minimal resistance from communities, corporations and workers, a well-informed and continuous dialogue should transpire between all relevant stakeholders (ILO 2015: 5; Gambhir et.al 2018: 3). Such discourse strengthens the efficacy of policies, builds trust between governments and their citizenry thereby enhancing credibility and produces robust social support for the transition by achieving public buy-in (Rosemberg 2017; Zinecker et.al 2018: 9; Caldecott et.al 2017; Moerenhout et.al 2017).

Following this social dialogue, the actual measures put in place should be a combination of reactive policies aimed at mitigating negative impacts and proactive policies aimed at maximising the long-term advantages of transition (Mertins-Kirkwood 2018: 36). Bridle et.al (2017) argues that the optimal policy prescriptions are short-term social protections (wage guarantees, healthcare benefits, cash transfers, early retirement packages) to minimise workers' financial losses, medium-term infrastructure spending and inward investment to avoid industrial downturn and long-term expenditure in education and innovation to promote the growth of low-carbon industries. Particularly, Scotland should invest in inclusive education centres as skills development for all is imperative to a successful, just LCT (UNFCCC 2016: 59). Union Learning Representatives could play an important role in facilitating these retraining schemes (Minio-Paluello 2015: 28).

Finally, this just transition can be funded using the Scottish National Investment Bank (SNIB). Not only has it been specifically charged with securing the transition to net-zero (Scottish Government 2019b), but other national banks (the KFW in Germany) have been successful in financing large-scale energy programmes (KFW 2017). This success is tied to the ability of national investment banks to construct and shape new markets through strategic investing and the protection of developing industrial landscapes (Scottish Government 2018: 8). For this reason, the SNIB, with its £2 billion-pound budget over ten years, has both the fiscal and political capacity required to fund a truly just low-carbon transition for the workers and communities of Scotland (Scottish Government 2020i).

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