ECONOMY, ENERGY AND FAIR WORK COMMITTEE

ENERGY INQUIRY

SUBMISSION FROM RENEWABLE ENERGY FOUNDATION

This response assumes Scotland remains part of a GB electricity network.

Background on the Renewable Energy Foundation (REF)

REF is a registered charity promoting sustainable development for the benefit of the public by means of energy conservation and the use of renewable energy.

REF is supported by private donation and has no political affiliation or corporate membership. In pursuit of its principal goals REF highlights the need for an overall energy policy that is balanced, ecologically sensitive, and effective. We aim to raise public awareness of the issues and encourage informed debate regarding a structured energy policy that is both ecologically sensitive and practical. The issues of climate change and security of energy supply are complex and closely intertwined. REF contributes to the debate surrounding these issues by commissioning reports to provide an independent and authoritative source of information. Further details can be found at www.ref.org.uk.

Electric Vehicles

1. The impact of increasing numbers of EVs on electricity generation, transmission and distribution?

Impact on security of supply requires consideration
The EEFW Committee notes that National Grid (NG) forecasts that demand from electric vehicles could result in an 8% increase in peak electricity demand. Lest the significance of this should be underestimated, the impact of electric vehicles needs to be seen alongside other increases in peak demand caused by energy and climate policies. For example, because of other factors, in one National Grid scenario, peak electricity demand could increase by 30 GW up to 2046, a more than 50% increase on the current GB peak demand on the transmission network of about 55 GW.

Apart from the introduction of electric vehicles, one of the principal causes of increasing peak demand is the transition of space and water heating from natural gas to electricity by means of the use of Ground or Air Source Heat Pumps. In very cold weather, heat pumps are expected to be ineffective, causing consumers to switch to resistive heating. These occasions will be infrequent on an annual basis but will result in very high peak electricity loads, greater than 100 GW, against which the system must provide adequate insurance. Providing sufficient generation capacity to meet such infrequent and brief loads implies the existence of a great deal of little utilised capacity, and thus intolerably high costs. Indeed, so serious is this problem that the Committee on Climate Change has recommended the use of hydrogen as a supplementary heat source to support heat pumps and thus prevent consumers switching to resistive electric heating (*Hydrogen in a Low Carbon Economy* 2018, pp. 32–33).

It seems reasonable to expect that Scotland might be one of the most affected areas in such a scenario, and we urge the Committee to request that the Scottish Government explains its position on this matter. An aggressive EV adoption policy could exacerbate this problem.

Moreover, and compounding this problem, Scotland has a high concentration of non-despatchable, asynchronous generation, since the country hosts about 60% of the UK's onshore wind generation (8 GW of a total of 13.3 GW), not to mention about 1 GW of offshore wind. The UK and Scottish Governments both expect this installed capacity to grow both absolutely and proportionally. Indeed, Scottish nuclear generation is due to close by 2030, and all indications are that onshore and offshore wind is expected to provide the bulk of low carbon electricity. Such non-dispatchable, asynchronous generators are not obviously well-suited to providing energy for EVs or for heating, both of which are demands likely to produce regular patterns of high requirement that may not synchronise well with stochastic wind output.

This is clearly a very complex equation to solve, and there is a significant possibility that the electricity grid in Scotland could come under strain, since it would be simultaneously contributing to meeting the large and fluctuating demands in Scotland and in the UK overall while ensuring security of electricity supply at reasonable cost. This will require very careful planning as well as considerable investment in improved infrastructure, implying much increased consumer costs. Investment implies a standing charge on the consumer, and controlling these costs will present significant difficulties.

Of course, as well as contributing to the problems outlined above, electric vehicles may offer some opportunities in mitigation, which we discuss in the next section.

2. The role of EVs in balancing electricity transmission and distribution networks. Are new battery and grid technologies being adequately supported and rolled out to enable this?

There has been much interest in using the EV fleet as part of the Balancing Mechanism for a renewables-dominated generation portfolio both in Scotland and more widely.

There is certainly a pressing need for innovative balancing technologies. Due to wind production in excess of what can be absorbed locally, and the limit on power exports to England due to grid constraints, nearly 9 TWh of Scottish wind energy has been discarded since 2010 – equivalent to the annual electricity consumption of more than two million Scottish households, and at a cost of nearly £650 million pounds to the GB consumer. The following table from data published by REF summarises these volumes and payments on an annual basis (REF holds detailed, half-hourly data that can be made available to the committee on request and REF would be happy to give oral evidence on it).

Examination of this data delivers insight both into the increasing need and opportunity for balancing resources to reduce this curtailed generation and the cost to consumers.

Table 1: Constraint Payments to Wind Power in Scotland, 2010 to 11 December 2019. Source: Balancing Mechanism data reprocessed and analysed by Renewable Energy Foundation (www.ref.org.uk).

Year	***Cost***	***MWh***	***Mean Price (£/MWh)***	***Number of Wind Farms***
2019	£134,399,637	1,878,986.72	£72	86
2018	£124,649,106	1,724,187.68	£72	84
2017	£108,247,860	1,542,284.95	£70	73
2016	£81,861,075	1,134,627.17	£72	52
2015	£90,738,134	1,276,263.80	£71	46
2014	£53,261,058	659,350.27	£81	40
2013	£32,707,351	379,816.99	£86	33
2012	£5,924,231	45,462.92	£130	19
2011	£12,826,756	58,708.14	£218	14
2010	£174,128	975.98	£178	3
Total	£644,789,336	8,700,664.62	n/a	n/a

Very little is known at present about how electric vehicles would interact with this need on a half-hourly Balancing Mechanism settlement period basis, but an approximate estimate of the scale of the vehicle fleet required can be calculated from the volumes typically constrained off per day. At the time of writing there have been 206 days in 2019 so far when wind power generators in Scotland were paid to reduce generation. The average constrained volume on these days was 9,100 MWh, though with a very wide range, from 1 MWh on some days through to 51,000 MWh on others reflected in the median value of 2,900 MWh, suggesting that *any balancing technology capable of addressing peak need would be underutilised over the year*. This presents a significant economic conundrum. The extreme variability of days when there is excess electricity is easily seen in the following histogram.

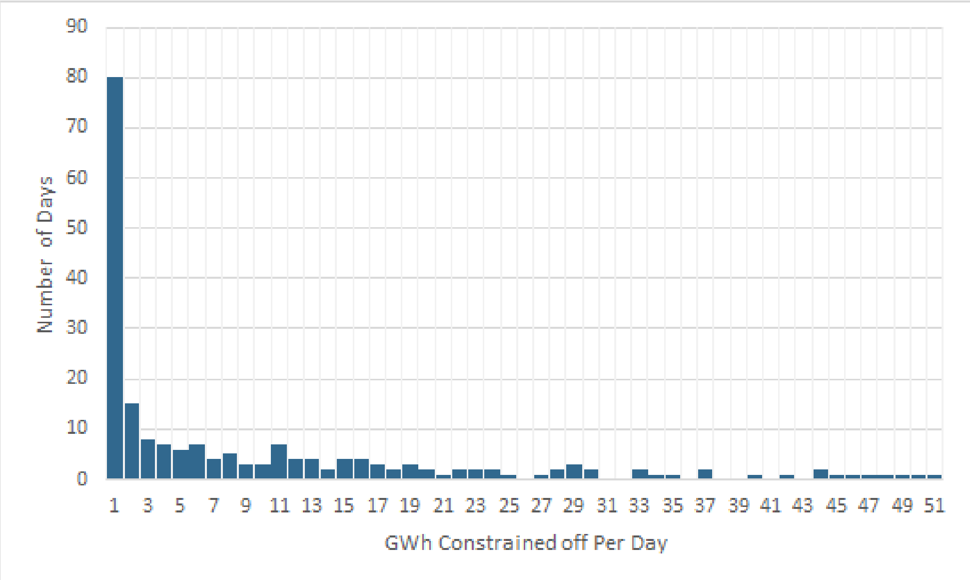

Figure 1. Frequency of days in 2019 when wind farm constraints occurred, by GWh of wind farm energy discarded on those days. Source: Renewable Energy Foundation chart, derived from Balancing Mechanism data.

Note that there were 80 days when up to 1 GWh was discarded but only one day when between 20 and 21 GWh was discarded.

The vehicle fleet might be asked to absorb this energy over the day for use at another time, including resupply to the system. Assuming the mean daily value of constrained wind energy, some 165,000 vehicles with batteries capable of absorbing 55 kWh (the approximate capacity of a modern battery powered vehicle such as a Tesla 3) would be needed, roughly equivalent to about 7% of the current Scottish private and light goods vehicle fleet, and also roughly equivalent to the number of new vehicles registered in Scotland annually. The Tesla 3 retails at approximately £40,000, implying a capital fleet expense of about £6.6 billion.

Capital expenditure on that scale is unlikely to occur rapidly, and therefore it is improbable that an EV fleet capable of addressing constraint payments in Scotland will be delivered in very short order. Electric vehicles are currently expensive in comparison to transport propelled by internal combustion engines and are in any case not currently ideal for use in rural Scotland where travel involves both long distances and steep inclines, both of which put electric vehicles at a disadvantage. Widespread adoption in Scotland will take time, and be dependent on significant technological improvement.

Fixed batteries are an alternative. A Tesla Powerwall has a capacity of 13.5 kWh, so some 650,000 such devices would be required to absorb and use or resupply the average daily constrained wind volumes in Scotland. A Powerwall retails at approximately £7,750 installed, implying a total capital cost of approximately £5 billion, not including ancillary installation costs.

So while there is a theoretical potential for EV vehicles, or small scale fixed storage, to address the balancing difficulties currently found in the Scottish grid, timescales and economics dictate that this potential will not be realised quickly if at all, and that it is more probable that industrial scale storage will be adopted and will dominate. As noted by the RSE Report, “The variable nature of wind energy means that large-scale storage, or another form of generation, would likely be required in tandem.” However, as the RSE study goes on to note, even batteries are “likely to remain an expensive solution on a large scale. Substantial development would require enormous capital investment.”

It is likely therefore that even with additional network capacity such as the Western Link, wind power in Scotland will continue to be constrained off the network in significant volumes. *The cost constraints to the consumer will be increasingly controversial, and it is at least conceivable that wind power generators will not be compensated at the current levels, or at all, a risk that bears heavily on our answer to the following question concerning community owned generation schemes*.

<u>Local Energy</u>

1. The appropriateness and achievability of the 2020 and 2030 community and locally owned energy targets. What are the key issues impacting the viability of relevant schemes?

Renewable Energy Foundation (REF) notes “the approach the Scottish Government’s wishes to see embedded in practice and behaviours of all stakeholders as Scotland's energy system becomes increasingly decentralised (i.e. energy being generated close to where it will be used)”. While superficially attractive, locally generated energy has a number of drawbacks. As noted by the RSE Report, “The investment required for local energy schemes will vary greatly, depending on the location, type and scale of the project. Evidence suggests that the cost of community energy projects varies more than that of commercial projects, but that these costs are decreasing.” That may be true, but they are falling from a very high starting point, and it will remain the case that community-scale wind developments have costs per MW which are significantly greater than industrial-scale wind developments. Consequently, there is only one direction of travel for wind development – reducing the costs per MWh by scaling up to very large commercial projects.

So there is a contradiction in the two Scottish government aims of 1) more community schemes and 2) much more wind energy production. Any reduction in the costs of wind development is dependent on larger wind turbines which may reduce the cost per MW installed but require very significant capital per unit for construction. Similarly, improved Operation & Maintenance techniques can also contribute to reduced costs but will come from large-scale operations with specialised equipment and staff. Both these factors mitigate against locally owned schemes.

Wind developments will therefore tend to be "local" only in name, since it is very unlikely that communities will be able to put capital at risk on the required scale to invest in the larger devices that are cheaper per unit of capacity, or to manage the risk in the future of being constrained off the network without significant or any compensation. On the other hand, the higher capex per kW installed for smaller, less productive schemes will degrade the rate of return making them unattractive.

Only state intervention could resolve these problems, taking on risk and creating a sheltered or artificial "market" around the schemes, but such intervention would be at the expense of true local ownership. In effect, these schemes would be state enterprises, and would increase costs for consumers overall. Consequently, it is difficult to see any realistic future for locally owned wind power schemes of significant scale.

2. Whether it is appropriate to incorporate community and locally owned schemes in the same target and policy area? What more could be done to encourage and support community owned schemes?

We will comment on the second part of this question only. Our answer to the question above highlights some key economic difficulties standing in the way of true community ownership. To these must be added environmental concerns, that do not appear to be easy to remedy. Many communities who already host significant wind generation developments are expressing concern about the burden on them – Caithness, Aberdeenshire, Moray, South Ayrshire and the Borders are examples.

The RSE study notes that:
"A major area of contention for wind energy is the visual impact, particularly with concentrations of wind farms, as well as some issues associated with shadowing and noise pollution. This is particularly the case for communities in rural areas, where onshore wind farms are generally located, although concerns have also been raised regarding offshore wind farms which can be seen from the coast. A set of Good Practice Principles for Community Benefits from Onshore Renewable Energy Developments was published by the Scottish Government in 2014, with a public consultation and review of the relevance of the principles beginning in late 2018. The Principles promote a national rate for onshore wind community benefits packages equivalent to at least £5,000 per MW per year".
Recommendation 9 of the Report is that "Serious consideration should be given to how best to socialise the costs of transition to address issues of social justice." We note that while Scottish Community benefit settlements from wind power schemes are frequently distributed over very large areas in an ad hoc way across a wide community, the environmental burden of a large scale wind development is frequently most acutely felt only by part of the local population. Those closest to the wind farm, immediate neighbours of a scheme, possibly affected by noise and shadow flicker for instance, are not given compensation. In our opinion the Scottish government should at the least consider *legislating to enforce the compensation of any affected parties within a*

set radius of a wind farm, as well as contributing to community funds for the less directly affected parties, as is being considered in Germany.

5. What role can smart, decentralised local energy systems play in ensuring security of supply and supporting a just transition to net-zero by 2045?

For the reasons cited above in response to question 1, we do not think there is a strong case for decentralised systems, and we conclude that these are unlikely to arise spontaneously. Whether there is a strong public interest case for state support of such systems is an open question, but it remains to be proved and we are inclined to think that de-risking such projects is not in the broader consumer interest.

6. What systemic and behavioural changes are needed to increase the use of smart local energy systems? Has public engagement to date been successful and what more could be done?

See answer to Question 5 above.