Royal Society of Edinburgh consultation questions

Max 6 A4 pages

Energy Landscape

1. What are the most significant challenges to, and influences on, the energy landscape that any future energy strategy needs to take into account?

All energy strategies must take into account the need for an energy system that addresses the ‘energy trilemma’, i.e. provides security of supply, addresses affordability and other impacts on people and communities, and also is environmentally sustainable. The environmental aspect of the energy trilemma is often expressed only in terms of meeting climate targets. Decarbonisation of our energy supply is essential in order to protect people and wildlife from dangerous climate change, and specific decarbonisation objectives should be informed by statutory climate targets, which are in turn compatible with Scotland and the UK’s commitment to the Paris Agreement. However, there is another aspect to the planning of energy systems that is routinely excluded from the expression of the ‘trilemma’ – impacts on habitats, species and biodiversity. It is vital that these impacts are considered at an early, strategic stage of planning energy systems, not only in terms of ensuring that projects and plans are compatible with national and international obligations and objectives on wildlife protection – but also in order to avoid additional delays, costs or conflict, for example at the project development stage.

Supply and Demand

2. What will energy demand in Scotland look like in 2030, 2040, and 2050?

Modelling undertaken by RICARDO on behalf of WWF Scotland, RSPB Scotland and Friends of the Earth Scotland suggested that in order to meet current climate targets, a 20% reduction in energy demand by 2030 will be required from 2010 levels[1]. Energy demand in Scotland reduced from 2005-07 to 2010 by 6.2%, which is faster than the trend in these results. The report also found that in a cost-optimised scenario this should primarily delivered through more efficient buildings, vehicles and electricity consuming products.

3. What are the biggest barriers faced to meeting the demand we will have for energy by 2030, 2040, and 2050?

The Scottish Government has proposed a target of 50% of Scotland’s energy needs across heat, electricity and transport coming from renewable sources by 2030. This target is in line with recommendations of both our own research, summarised in The RSPB’s 2050 Energy Vision, and research summarised in The Energy of Scotland as mentioned above. In the power sector, this research estimated that an additional 7-8GW of renewable energy capacity would be required in order to support the 50% target, likely to largely come from wind energy. Research by RSPB has shown these levels of deployment to be possible in harmony with wildlife, but this will dependent on a commitment to avoid the most sensitive sites. By 2030, we expect the electricity generation mix to be almost entirely renewable – which means ensuring security of supply is maintained by grid flexibility, energy storage and connection to UK and European grids.

Whilst significant progress has already been made in decarbonising electricity generation in Scotland through renewables, progress in the heat sector has been much slower and emissions in the transport sector have remained largely constant since climate change legislation was introduced. Key barriers therefore include an overall step-change in these sectors as well as in increasing energy efficiency.

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[1] See ‘Renewable energy in Scotland in 2030’, available at: http://assets.wwf.org.uk/downloads/ricardo_energy__environment___renewable_energy_in_scotland_2030_2016.pdf

The draft Scottish Energy Strategy predicts a pattern is of an increased requirement for heat in winter, and this requirement is currently predominantly met by gas. There is a strong need for substantial electrification of heating and development of energy storage options which will allow Scotland to meet demand at peak periods sustainably. By 2030, the used of low emission vehicles will need to be mainstream.

4. Given the international nature of the energy market, how should acceptable quantities and origins of energy imports, and their associated energy security risks, be assessed?

The environmental impacts – both in terms of carbon intensity and also impacts on habitats and biodiversity – of energy imports must be considered and incorporated into targets and regulatory systems.

In particular, we are very concerned by the significant use of imported woody biomass (primarily several million tonnes of wood pellets from the US) to generate electricity across the UK. RSPB Scotland supports the use of sustainably sourced biomass used for small-scale heat and power, prioritising the use of wastes and residues. In fact, if planned effectively, there are opportunities to enhance habitats by encouraging more sustainable management of woodland through local biomass supply chains. Materials generated from the management of nature reserves e.g. from reed beds can also provide an emissions saving while benefitting wildlife. The RSPB has successfully trialled the use of some of these materials on our own nature reserves including at its Insh Marshes reserve in Scotland.

High-carbon sources such as the use of roundwood should be ruled out, and flaws in the EU and international rules for accounting for land use emissions urgently need to be fixed. Evidence produced by the former Department of Energy and Climate Change showed that the use of imported woody biomass from hardwood forests can be more carbon intensive than fossil fuels[2]. Furthermore, imported biomass is counted as zero carbon in the UK's energy system, as it is incorrectly assumed that emissions are always accounted for in the country of origin. Large quantities of emissions from US imports are occurring 'off the books' because the US does not account for land use emissions (see Chatham House report[3]). Sustainability criteria only requires a high level 'regional assessment of risk' which can be at the level of a US state or a European country, which could miss significant impacts on the ground on wildlife. Significant concerns exist around damage to forest habitats including clear felling of natural forest.

We welcome the recent commitment of the Scottish Government to develop a Bioenergy Action Plan. To date, the Scottish Government has adopted UK biomass sustainability standards. Whilst stating a policy preference for small-scale Combined Heat and Power schemes which are more likely to be sustainable (through more local supply chains and effective use of waste heat), large scale biomass plants have not been ruled out, leading to consents being issued for in some cases above 100MW capacity sites where ensuring sustainable feedstocks is a challenge in addition to effective use of waste heat. This has missed an opportunity to ensure bioenergy in Scotland generates genuine emissions savings and avoids damage to habitats in Scotland and globally.

The Energy Mix

5. What overall role should be played by various elements of the energy landscape, for example:

- Different sources of renewable energy;
- Offshore oil and gas;
- Unconventional oil and gas;
- Nuclear power;
- Energy storage;
- Others

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf
[3] https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2017-02-23-impacts-demand-woody-biomass-climate-forests-brack-final.pdf

- **Renewable energy**

Scotland's energy system should be based around high levels of renewable energy – RSPB Scotland strongly supports the 50% renewable energy by 2030 target proposed in the draft Energy Strategy and considers this is achievable in harmony with nature, but only if planned well to avoid sensitive wildlife.

In 2016 the RSPB published peer-reviewed4 research which considered the potential to develop wind farms (onshore and offshore), field-scale solar, bioenergy crops, and wave and tidal stream energy at different levels of ecological risk across the UK. The overall aim was to determine whether a UK energy system with high levels of renewable energy was achievable without significant damage to sensitive species and habitats. A mapping approach was used to assess the potential opportunity for each technology, taking into account physical and policy barriers (e.g. housing and other infrastructure, landscape designations, MoD land) followed by available evidence on distribution of sensitive habitats and species. Results found that Scotland could for example increase its onshore wind capacity by three times, and its solar capacity by thirty times (compared to 2016 levels). More information on how we assessed the potential for renewable energy in harmony with nature can be found in the RSPB's 2050 Energy Vision Technical Report5.

Results for the potential output at low ecological risk of the range of technologies assessed were as follows:

- Onshore wind: up to 41 TWh/year
- Solar: 215 TWh/yr
- Biomass: 28 TWh/yr
- Offshore wind (fixed base): 1-10 TWh/yr
- Offshore wind (floating turbines): 65-155 TWh/yr
- Tidal stream: 0-19 TWh/yr

In the longer term, significant potential was identified for offshore renewables in deeper waters (bearing in mind the project took a 2050 outlook), using wave and floating wind technologies which will take time to develop. In order to ensure security of supply, the scenarios developed in the research also underlined the importance of developing energy storage technologies, significant action to reduce energy demand and increase energy efficiency, and maintain and increase interconnections across the UK and Europe to allow for the most effective use of high levels of renewable energy.

Based on this research, a range of other research undertaken on renewable energy and, RSPB Scotland is clear that Scotland can and should be deploying high levels of renewable energy. However, the research, and our experience engaging with the planning system (our planning and conservation staff have assessed over 1,300 wind energy projects for their impacts on birds and wildlife), also tell us that siting projects such as wind farms in sensitive areas can be highly damaging to wildlife and habitats (see more information in response to question 8 below), therefore it is important that the deployment of renewable energy is in harmony with the natural environment, through e.g. robust planning policies, investment in research and other work to understand and mitigate environmental impacts, and strategic spatial planning to direct developers to the best sites and to avoid conflicts arising at project stage. RSPB Scotland's ten key recommendations for the Scottish Government based on this research can be found here: https://www.rspb.org.uk/Images/rspb_scotland_energy_vision_tcm9-419579.pdf

- **Offshore oil and gas**

Investment in the oil and gas sector should be focused on making a just transition to a low-carbon economy. There needs to be a recognition that a significant percentage of existing fossil fuel reserves can not be used if we are to fulfil our Paris agreement commitments[6]; and this means that any new resources will need to be left in the ground. Continued investment in oil and gas has the potential to draw funding away from the renewable energy sector and lock Scotland in to a higher carbon future. Subsidies, tax relief and other

[4] Gove B, Williams LJ, Beresford AE, Roddis P, Campbell C, Teuten E, et al. (2016) Reconciling Biodiversity Conservation and Widespread Deployment of Renewable Energy Technologies in the UK. PloS ONE 11(5):e0150956. doi: 10.1371/journal.pone.0150956 available at https://doi.org/10.1371/journal.pone.0150956.g004

[5] Available at https://www.rspb.org.uk/Images/energy_vision_technical_report1_tcm9-419581.pdf

[6] McGlade, C & Ekins, P (2015), The geographical distribution of fossil fuels unused when limiting global warming to 2C. Available at http://www.nature.com/nature/journal/v517/n7533/abs/nature14016.html

financial support for fossil fuel industries need to be phased out in order to create a more level playing field for renewables, and so that economic incentives pull in the same direction towards decarbonisation.

There is also the risk of a catastrophic collapse of the oil and gas industry if the Scottish Government does not start to plan now for a just transition to a low carbon economy. The risks associated with a 'carbon bubble' were explored further in a 2014 report by Scottish Environment LINK[7]. The significant interventions needed by Scottish Government, local authorities and partners to support communities affected by the closure of Longannet for example underline the need for forward planning of the low carbon transition.

Our 2050 Energy Vision report highlighted significant long-term opportunities for 'deep water renewables', in particular floating offshore wind power, located further from shore where ecological sensitivities are likely to be lower. There are opportunities here to transfer skills and infrastructure away from North Sea oil and gas towards offshore renewables. However, this also requires significant investment in understanding our marine environment, particularly closing ecological data gaps e.g. through seabird tracking studies, to enable industries to move forward more quickly and cost-effectively.

- **Unconventional oil and gas**

The Committee on Climate Change found that exploiting unconventional oil and gas on a significant scale is not compatible with Scottish climate targets unless three onerous tests are satisfied: well development, production and decommissioning emissions must be strictly limited; fossil fuel consumption must remain in line with the requirements of Scottish emissions targets; and unconventional oil and gas production emissions must be accommodated within Scottish emissions targets[8]. RSPB Scotland has welcomed the Scottish Government's precautionary approach to unconventional oil and gas extraction. Unfortunately, the research programme commissioned by the Scottish Government to inform the consultation on fracking earlier this year did not include an overarching environmental study. Environmental issues considered were limited to climate change, induced seismicity and decommissioning. The RSPB, in partnership with other leading conservation charities, carried out research on the potential environmental impacts of fracking, presented in its 2014 'Fit to Frack' report[9], and made recommendations on how regulation of the shale gas industry could be made fit for purpose.

- **Carbon capture and storage**

If there is to be new fossil fuel power in Scotland, then carbon capture and storage will be required from the outset. Although carbon capture and storage could have a transitional role in Scotland's energy future, our *2050 Energy Vision* research suggested that commercial CCS power stations could be excluded from the energy mix if there is strong progress with renewable energy, particularly marine renewables. However, CCS could play a role in reducing industrial emissions outwith the power sector.

- **Hydrogen**

Hydrogen could play a role in decarbonising Scotland's heat supply, although the need for it could be reduced by substantial improvements in electrification of heating and energy efficiency. Any hydrogen that is used needs to be produced in environmentally sustainable and low-carbon ways. Given the low likelihood of the deployment of CCS in the next decade given limited progress to date in the UK, it is unlikely that hydrogen could be produced from natural gas combined with CCS. The deployment of hydrogen should not be a barrier to other necessary changes to reduce emissions from heating, such as electrification of heat for off-grid homes, much higher levels of energy efficiency and the use of local heating solutions such as small and medium-scale combined heat and power plant.

Climate Change and Renewable Energy

6. What action needs to be taken to ensure that Scotland fulfils its climate change obligations while also meeting demand; and what are the main obstacles to achieving this?

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[7] Available at http://www.scotlink.org/wp/files/documents/Scotland-and-the-carbon-bubble-final-for-publication.pdf

[8] https://www.theccc.org.uk/wp-content/uploads/2016/11/Scottish-Unconventional-Oil-and-Gas-Committee-on-Climate-Change-2016.pdf

[9] Available at: https://www.rspb.org.uk/Images/shale_gas_summary_tcm9-365778.pdf

RSPB's 2050 Energy Vision demonstrates that Scotland and the UK can meet their climate change ambitions, meet energy demand and avoid harm to nature, using high levels of renewable energy.

The key findings of the analysis are:

- With careful planning, it is possible to meet the UK's climate targets by using high levels of renewable energy, whilst avoiding significant negative impacts on nature.
- Massive strides in demand reduction and energy efficiency are important, both to ensure that energy is affordable in future, and to avoid significant ecological impacts.
- Available technologies such as onshore wind and solar are key to decarbonisation, and well-sited projects should be supported.
- Research is needed into the impacts of technologies, and to determine where the sites most in need of protection are located – particularly at sea.
- Research and development of technologies such as energy storage and smart grid networks are critical to ensure long-term security of supply.

There are opportunities for new technologies, such as floating offshore wind turbines, to unlock substantial renewable energy capacity, potentially with low ecological risk, but this requires greater investment in ongoing ecological research and monitoring.

7. What are the factors and risks which may impact upon the Scottish Government meeting the targets it has proposed on sustainable and renewable energy?

Early action to strategically identify how to sustainably deploy high levels of renewable energy is needed, in particular to steer developers towards the sites most likely to be appropriate for development. Whilst there are systems in place through the planning system and environmental regulations e.g. EIA requirements to assess and mitigate environmental impacts at project stage, a failure to incorporate these risks at the strategic planning stage can lead to perverse outcomes, delays and higher costs.

We recommend a number of measures the Scottish Government should take to minimise risks and address potential barriers to meeting the targets.

Plan for nature - steer developers to the best sites: The Scottish Government and Local Authorities should work together to ensure development happens in the right places, avoiding the most important wildlife sites, by identifying suitable sites through the development planning system. A plan-led approach, informed by strategic spatial planning, will help to minimise conflict and delays in the planning system, leading to lower costs and faster progress.

Develop a roadmap for decarbonisation in harmony with nature: We welcome the proposal of a 50% renewable energy target by 2030 in the draft Energy Strategy. As part of the forthcoming Energy Strategy Review, the Scottish Government needs to deliver a roadmap for decarbonisation which is evidence-based, with clear timelines, interim targets and policies covering and linking the electricity, heat and transport sectors. We welcomed the commitment to 'working in harmony with the natural environment' stated in the draft strategy but are concerned this is not currently reflected in the detail of the strategy.

Eliminate energy waste: Reducing energy demand is critical to meeting our climate targets, reduces requirements for new energy infrastructure which can harm wildlife, and helps ensure energy is affordable. Heating our buildings accounts for over half of Scotland's carbon emissions. We welcome the designation of energy efficiency as a National Infrastructure Priority, but this must be put into action with strong measures to improve the energy performance of our buildings, through measures like retrofitting home insulation and facilitating district heating.

Invest in understanding our environment to help renewables grow sustainably Failing to invest in understanding our natural environment holds up the development of renewable energy. Closing ecological data gaps, especially in the marine environment (e.g. through seabird tracking studies), could enable industries with significant future potential such as wave, tidal and floating wind to move forward more cost-effectively. Understanding impacts could be improved through standardised monitoring and sharing of environmental information by existing projects. Currently, large amounts of data gathered at project level are not accessible, making it harder and more costly for new projects.

Promote low carbon, nature-friendly innovation Many low carbon technologies are already available, such as onshore wind and solar PV. However, in the longer term, meeting 2050 targets in harmony with nature will require investment in innovation. This includes developing a smarter grid, energy storage, and technologies to unlock renewable energy, particularly in the marine environment, such as floating wind. Our research shows that there is vast potential for marine renewables in deeper waters around Scotland, potentially with low risk to wildlife, if we invest in developing these technologies sustainably

Transform low carbon heat and transport More rapid decarbonisation of heat and transport is crucial to meeting climate targets. Support is needed to encourage shifts to public transport, active travel and electric vehicles, and to speed up transition to low carbon heat technologies like heat pumps. The planning system should be used more effectively to reduce the need to travel, and require uptake of renewables in all new developments in combination with improved building standards.

Make economic incentives work for nature and the climate The transition to low carbon energy will require economic incentives to shape the energy mix. The Scottish Government should continue to support well-sited onshore wind and solar and encourage the UK Government to support these technologies.

Ensure bioenergy supplies are sustainable Bioenergy could play a role in Scotland's energy future in harmony with nature. However, it can also pose risks to wildlife – see our answer to question 4.

Support a grid network fit for the future Scotland and the UK's grid network will require investment to integrate high levels of renewable electricity, including decentralised energy generation by local and community projects. If the grid network is not developed in a timely way, it could become a bottleneck that holds back the low carbon transition. Increased interconnection with other nations will be needed to optimise how we use energy, and distribution networks need to become smarter in order to help ensure demand matches energy supply as much as possible through, for example, smart heating and appliances.

Environmental Impact

8. What are the environmental impacts of individual elements of a future energy mix, to what extent can these be mitigated, and how can any remaining waste products be dealt with?

As part of the RSPB's 2050 Energy Vision, we reviewed the potential environmental impacts, and mitigation measures to address them, of a range of low-carbon energy technologies. In the interests of brevity, we have only included here the likely impacts of those that we classed as either medium or high risk. A fully referenced summary of the impacts of the full range of technologies can be found in the RSPB's 2050 Energy Vision Technical Report, pages 30-72.

Onshore wind

Risks to biodiversity from onshore wind strongly depends on where turbines are sited. Commercial-scale onshore wind farms are typically located in exposed areas with high wind speeds. These areas can coincide with priority wildlife sites such as upland and coastal areas that are important for breeding, wintering and migrating birds, and also important habitats such as peatlands (also important carbon stores). Wind farms can have negative impacts on birds and other wildlife such as bats, through disturbance and/or displacement, barrier effects, collision risk, and habitat loss or damage. Many of the negative impacts on biodiversity from onshore wind can be mitigated by appropriate siting and design which takes into account the habitats affected, the species present, their population and vulnerability to wind farms. RSPB Scotland has assessed over 1,300 onshore wind energy projects for their impacts on birds and wildlife and objected to approximately 10% of those assessed. It is likely that as we progress towards Scotland's 100% renewable electricity target, siting wind farms will become more challenging, although gains can also be made by repowering existing sites where appropriate to increase output. Although there have been no catastrophic bird-windfarm conflicts at operational sites in Scotland, there certainly have been, and continue to be, significant bird impacts including some concerning examples such as Gordonbush[10] and Griffin[11] wind farms.

Offshore wind

RSPB Scotland supports the Scottish Government's ambition to build a thriving offshore wind industry – however, given Scotland is also home to one third of the EU's breeding seabirds, considerable siting challenges in areas where initial proposals have come forward, and concerns about serious risks to seabird populations have meant we have had to oppose some plans when we think the risks are too high.

Risks to biodiversity of offshore wind are similar to those for onshore wind: disturbance/displacement, collision, barrier effects and habitat loss or fragmentation. Appropriate site selection and design are again key to limiting ecological risks. There are lower levels of certainty regarding the impacts of offshore wind as there is less data on the distribution of sensitive marine species, their interaction with turbines and the location of key foraging areas. Collision risk is likely to be greatest for species with a similar flight height to turbine blades, such as gulls and terns. However some bird species have been shown to avoid offshore wind farms, thereby reducing the risk of collision. This could result in indirect habitat loss if birds begin to avoid particular areas, or if turbines create a barrier effect between functionally linked areas such as roosting and foraging areas. Barrier effects can have consequences in terms of energy expenditure, for example if birds fly greater distances to feed, which can have an impact upon breeding success and population viability.

However, in some circumstances, impacts may be positive, for instance through creating an 'artificial reef effect' that provides foraging grounds for birds or marine mammals, or by reducing vessel activity within certain areas. Impacts can also arise from the construction of turbines. In particular, construction related noise during the installation of turbines can potentially have significant impacts on cetaceans, ranging from avoidance behaviour to auditory damage or injury. Measures are under development within the industry to better understand and mitigate impacts. An advantage of floating wind turbines is that ecological risks from construction-related noise are likely to be reduced.

Solar farms

There is relatively limited research on the impacts of solar farms on biodiversity, meaning that understanding of ecological risks is largely based upon inferences about farmland species and their interaction with agriculture and other activities. Impacts will strongly depend on site location and the type of land. Potential negative impacts include disturbance, displacement, habitat loss and fragmentation. Cumulative impacts and indirect land-use change (ILUC) also needs to be taken into account, for example, solar farms built on agricultural land may displace agricultural production. However, solar farms can also be deployed on brownfield sites or contaminated land. If appropriately managed, solar farms present opportunities for biodiversity enhancement. For example, intensively farmed land could be converted to low-intensity grazing or wildflower meadow between panels and around margins. Examples of management measures include grass strips for butterflies or bees or winter food for birds. Development is likely to have lowest impact on land of low wildlife value such as intensive arable or improved grassland. There are also potentially ecological risks associated with the production of solar PV panels which should be considered.

Bioenergy technologies

The ecological risks of bioenergy generation will strongly depend on the type of feedstock used and management system applied. However, a key risk across a range of bioenergy feedstocks is the potential for impacts owing to land-use change, indirect land-use change (ILUC) and/or changes in the use of the marine environment, as a result of converting land or sea to biomass production. This can result in the release of greenhouse gases (where land is cleared for the production of bioenergy), or the land-use change to production of bioenergy causing other land uses such as food production to be shifted elsewhere. The types of habitats displaced through ILUC, such as grassland or woodland, often absorb high levels of carbon dioxide. Additionally, some bioenergy fuel cycles may deplete freshwater, soil and/or forest resources. In the marine environment, cultivation of macro-algae crops may impact on ecosystems through the release of nutrients, or as a result of increased human activity causing disturbance and/or displacement of species. More detail on

[10] https://www.rspb.org.uk/our-work/rspb-news/news/417576-study-reveals-that-wind-farm-led-to-reduction-in-number-of-breeding-birds

[11] http://www.rspb.org.uk/community/ourwork/b/scotland/archive/2016/07/04/raptor-windfarm-deaths.aspx

biomass sustainability is included in our answer to question 4. There are also opportunities to increase biodiversity through bioenergy, for example through putting woodland under sustainable management, or utilising arisings from ecological management e.g. wetland management as a biomass feedstock (see RSPB's wetland biomass to bioenergy project).

Hydropower
New large-scale hydropower schemes are likely to have significant and lasting impacts on wildlife and habitats. Species can be disturbed during the construction of dams and reservoirs, and dramatic changes in physical and hydrological conditions are likely to be caused. Flooding land for a hydroelectric reservoir can result in permanent loss of freshwater and terrestrial habitats, drainage of wetland and bogs, and subsequent loss of habitat and species diversity. Large dams also disrupt the natural flows of rivers and migratory pathways of fish, and can interrupt natural transport of sediments leading to a build-up or deprivation of silt and nutrients. Most of the suitable larger sites in Scotland have now been used, but there is potential for many more small to medium sized schemes, where siting is important and impacts on fish, habitats and other wildlife can be mitigated through site selection and good project design and construction to high environmental standards. Impacts on fish species can be mitigated to some extent using 'fish passes', and water levels need to be considered for impacts on plant species such as bryophytes. The area occupied by infrastructure such as hydraulic works, pipelines and access roads should be taken into account to avoid impacts for example on sensitive woodland, as well as the potential cumulative impacts of schemes, including habitat fragmentation. Development of Scotland's pumped storage capacity could support further emissions reduction by storing surplus energy from other renewables.

Wave power and tidal stream
As wave and tidal stream devices are in relatively early stages of development, there is limited data on their ecological impacts, and impacts will depend on the type of device used and the location in which it is deployed. Inferences about potential effects are largely derived from existing knowledge of the marine ecosystem and the behaviour of wildlife in relation to marine infrastructure. The main risks of wave and tidal stream technologies to birds and other wildlife are collision, displacement and/or disturbance (including noise impacts), and barrier effects. Rotating underwater turbines pose a potential risk to diving seabirds and marine mammals, particularly where the device has no surface presence or if the structure has exposed moving parts underwater. However the risk to seabirds of collision is generally expected to be lower than for offshore wind turbines.

Noise disturbance during construction, installation, maintenance, operation and decommissioning can potentially have negative effects on marine mammals, and there may be increased collision risk with boats if vessel activities associated with construction and maintenance are increased. Disturbance to sedimentary processes and pollution are another potential risk, for example moving parts are associated with an increase in turbidity, which can reduce visibility and potentially increase collision risk. However, wave and tidal stream technologies may also have some positive ecological impacts, for example their deployment may reduce human activities such as fishing and other vessel activity, which may reduce disturbance and collision risks. Given the diversity of technologies in development and the limited knowledge surrounding potential ecological impacts, phased deployment with a commitment to monitoring will be important to understanding and mitigating potential impacts on wildlife. An understanding of cumulative impacts will also be crucial for the ecologically sustainable deployment of wave and tidal stream at scale. RSPB Scotland supports the development of wave and tidal energy, provides risks to the environment are identified and addressed. A strategic approach to planning all marine renewables, alongside other uses of our marine environment, is vital to ensure we make best use of our offshore resources, alongside a network of well-managed Marine Protected Areas (MPAs).

Tidal range power
Shore-to-shore tidal barrages are likely to have significant impacts on biodiversity and lead to substantial losses of important intertidal habitats. Several proposed sites for tidal barrages in the UK, such as the Solway Firth, support a wealth of biodiversity and are designated for nature conservation at national and international levels. These estuary sites often support internationally important numbers of bird species, and consist of a range of important habitats such as mud flats, sandbanks, salt marsh and reefs. Tidal barrages may cause mortality to migratory fish, which pass through the barrage on their migration routes, though it may be possible to mitigate impacts using measures such as fish passes. Collision with turbines is also a potential risk for

marine mammals and diving bird species such as grebes. The ecological risks of tidal lagoons are potentially significant, although they are not expected to be as great as shore-to-shore barrages, depending on where they are located. There are currently no tidal lagoons deployed anywhere in the world, so understanding of impacts is limited. As with barrages, collision with turbines is a potential risk for fish, marine mammals and diving birds. Each lagoon will change the shape of the coastline, affecting flows of water and sediment. This could have knock-on effects on intertidal and coastal habitats, and may increase flood risk. The salinity inside of the tidal lagoon is also likely to be affected, which could have implications for marine organisms and bird species which forage in these areas. Thorough monitoring and research into impacts will be necessary before a roll-out of this technology in order to prevent ecological damage.

Ethics, Social Issues and Impact on Communities

9. What account should be taken of the environmental and social impacts on those living elsewhere in the world, of the international energy supply chains on which we may choose to rely?

See answer to question 4 on environmental impacts of large scale imports of biomass. The social implications of biomass imports should also be considered, for example there are risks of impacts on vulnerable and poor communities where poorly planned large-scale afforestation projects exclude communities and harm ecosystem services. We would also like to highlight emerging evidence in relation to the life-cycle impacts of lithium-ion batteries. The reserves of concentrated lithium of the world are mainly in shallow saline lakes in the high-elevation Andean deserts of Argentina, Chile and Bolivia. These lakes are important sites for three flamingo species, including the globally threatened Andean Flamingo (*Phoenicoparrus andinus*)[12]. Research on the wider sustainability of batteries (including toxicity, scalability and recycling) is ongoing[13]. These potential challenges remain a hurdle to ensuring a truly sustainable flexible future energy system. Governments have a responsibility to ensure end-to-end environmental impact of innovation in the energy sector is taken into account as the energy transition unfolds.

10. What actions can be taken, and by whom, to ensure that energy is accessible to all at an affordable cost for those on low incomes; and that any changes in energy provisions and associated tariffs are understandable and acceptable?

Energy efficiency measures are crucial to ensuring energy is affordable. They also minimise requirements for new energy infrastructure, helping to avoid associated environmental impacts. The designation of energy efficiency as a National Infrastructure Priority by the Scottish Government in 2015 was welcome, and this must be translated into ambitious policies and implementation. We support the call by Stop Climate Chaos Scotland for the Scottish Government to commit to bringing all homes up to a good energy performance standard of C by 2025. The Government should also set out further milestones and targets towards zero carbon homes. Fuel poverty in Scotland still stands at around three-quarters of a million homes and around half of Scotland's emissions come from heating our buildings. The planning system could also be used more effectively in Scotland, in combination with building standards, to ensure all new developments meet high standards in terms of insulation, deployment of renewable heat technologies (e.g. heat pumps) and solar panels, or connection to district heating networks.

11. What are the particular advantages enjoyed, and challenges faced, regarding energy; and what lessons can be learned on a national scale from community energy schemes undertaken by:

a) Rural and remote communities

b) Urban communities

[12] Sutherland, W.J et al. Horizon scan of global conservation issues for 2011. *Trends in Ecology and Evolution*. **26**, 1. 10-16 (2011) - http://www.conservation.cam.ac.uk/sites/default/files/file-attachments/Horizon%20Scanning%20TREE%202011.pdf

[13] Larcher, D. & Tarascon, J-M. Towards greener and more sustainable batteries for electrical energy storage. *Nature Chemistry.* **7**,19–29 (2015) - http://www.nature.com/nchem/journal/v7/n1/full/nchem.2085.html

Regulation and Governance

12. To ensure that energy is successfully sourced for, and delivered to, the people living in Scotland, how can different levels of government best cooperate:

a) With one another

b) Internationally;

c) With existing energy generators, network operators and retailers?

Informed Debate

13. How can we best encourage objective, evidence-informed debate around energy while also acknowledging the differing perspectives and priorities held by businesses, civil society and government?

Commitment from all parties including Scottish Government and other decision-makers, project developers, and NGOs to open dialogue, partnership working, sharing of information and stakeholder consultation, involving wider civil society is crucial to ensure energy strategies are based on evidence, consider the full range of interests and meet defined objectives. This also applies to the development of key Scottish Government policy and plans that influence the energy mix in Scotland such as Scottish Planning Policy and the National Planning Framework, and related plans such as the land use strategy. Parliamentary scrutiny is also important. In relation to wildlife impacts, collaborations such as Scottish Windfarm Bird Steering Group (SWBSG) are crucial to the sustainable deployment of renewable energy. It is vital that the Scottish Government continue their contribution to the SWBSG or a similar approach to collating monitoring data and identifying targeted research needs. An improved understanding of the impacts of windfarms on birds is essential to ensure that Scotland continues to comply with international biodiversity obligations, and will also help to provide more certainty for developers.

Skills

14. How can Scotland ensure that it retains, and develops, the necessary workforce of skilled professionals needed to meet its energy needs?

Meeting the Challenge

15. What issues arise regarding innovation for Scotland's energy future; how might this interact with an industrial strategy for Scotland?

There is an opportunity for Scotland to invest in innovative energy technologies that present significant future opportunities – both in economic and environmental terms, such as energy storage, electrification of heat and transport (e.g. heat pumps and electric vehicles) and deep water marine renewables like floating wind. The Scottish Government should call on the UK Government to support these technologies in reserved areas, as well as supporting established low carbon technologies including onshore wind and solar – but we were also concerned by the heavy reliance on the UK Government apparent in the draft Energy Strategy to make decisions that align with the Scottish Government's priorities. We urge the Scottish Government to make the most of the powers available to it to deliver the ambition of its Energy Strategy, and set out an alternative way ahead in case the UK Government's decisions do not meet its requirements.