Policy guidance note

The UK has set itself a challenging target with the Climate Change Act: to reduce greenhouse gas emissions by 80% by 2050 (compared to 1990). This objective may be achieved by implementing different options for energy reduction, or shifting to low carbon renewable energy technologies. At the same time, the UK has also committed to conserve biodiversity and contribute to the achievement of EU targets and those of the Convention on Biological Diversity.. The UK's energy policy could lead to massive deployment of certain energy production technologies such as bioenergy, offshore wind power, tidal and wave power technologies. But how would this affect biodiversity?

Biodiversity impacts are difficult to characterise and quantify as they depend on which biodiversity components are considered (e.g. all taxa or only certain species and ecosystems), their conservation status and spatial context (e.g. whether they have a restricted range, are threatened and the scale of the threat) and the longevity of the impacts. . Furthermore, energy technologies affect biodiversity in multiple ways when considering all stages of energy production from extraction of natural resources through energy conversion to distribution. Impacts of energy technologies can be positive or negative; direct (e.g. direct mortality, habitat loss and disturbance, etc.) and indirect (e.g. through impacts on other components of the ecosystem). Impacts at each stage also often vary spatially and in time. As the nature, magnitude and duration of impacts on habitats and species are site and context dependent, it is especially difficult to assess current and future impacts based on current available information.

- **Status of the evidence on the impacts of energy technologies on biodiversity**

While there is good evidence of the impacts on biodiversity for many energy technologies, the impacts of more recent renewable technologies are not well understood or documented (e.g. offshore wind, second generation energy crops, agricultural and forestry residues, tidal stream, wave power, carbon capture and storage, etc.). This is of concern as renewable technologies are expected to be extensively deployed in the UK to meet the 2050 climate change target.

To support policy decisions on the development and deployment of energy technologies in the UK, the focus of future research should be on the energy technologies that have been identified as having potentially high impacts on biodiversity (e.g. tidal range), and those whose impacts are particularly uncertain including tidal stream, wave power, offshore wind, biofuels and dedicated energy crops (in relation to possible indirect land use change). An area that would also merit more research is more systematic assessment of mitigation options and monitoring of their effectiveness in terms of their population impacts (e.g. fish passes used to mitigate the impacts of hydroelectric schemes). There is a need for future research to establish better biodiversity impact assessment methodologies and develop predictive models and decision support systems for policy and planning purposes. Areas where predictive models are lacking are indirect land use change and impacts of changes in river flows and coastal currents on biodiversity.

- **Integration of impacts on biodiversity in the DECC 2050 Pathways Calculator**

A simple, transparent methodology that uses the existing evidence was developed to provide an indicative assessment of the current and potential future impacts of energy technologies on biodiversity in the UK. The aim was to integrate the impacts of possible energy technology deployment pathways on biodiversity in the UK into DECC's 2050 Calculator[1].

The assessment of baseline impacts of each energy production technology on biodiversity in the UK showed that detrimental impacts were often no more than moderate and the majority were very low. Some technologies may also provide biodiversity benefits if carried out at appropriate locations and scales and carefully managed (e.g. use of dedicated bioenergy crops on arable land, forest residues and genuine wastes). Others have mixed impacts depending on their context, such as offshore wind farms, which cause some habitat loss, disturbance and bird losses, but create new habitat/shelter and prevent trawling within their vicinity. However, detrimental impacts from many technologies could increase substantially in the future (e.g. large-scale hydropower, tidal barrages, biomass and biofuels), especially for those that would need to be massively deployed to achieve the UK's climate change target in 2050. For some technologies (e.g. tidal range) in future, under potential levels of increased use, it would be difficult or impossible to avoid impacts within protected areas.

With the caveats that the biodiversity assessment uses a simplified methodology, expert judgement and makes many assumptions, it is fit for its purposes of helping policy makers and the general public identify the main impacts that UK energy policy could have on biodiversity in the UK in the future.. With the biodiversity module in the Calculator users can easily compare the GHG emissions and biodiversity impacts of different energy deployment scenarios, and attempt to find pathways where both GHG reduction and biodiversity conservation objectives can be achieved. The biodiversity impact assessment takes many different aspects of biodiversity into account but does have several limitations.. Therefore, the assessment methodology and it results should always be complemented with more in-depth assessments and robust evidence. Decisions on particular schemes and projects must also take into account their specific context.

- **How to improve biodiversity impact assessments for policy purposes**

The biodiversity assessment methodology and the assessments are still at an early stage of maturity and could be further improved. The following recommendations are suggested to improve the biodiversity impact assessments performed in this study:

  - Expand the assessments to cover more species and a wider range of taxa;
  - Regularly update the individual sensitivity assessments incorporating the latest evidence of the impact of certain technologies on specific habitats or species.
- Update the individual energy technology exposure assessments regularly to incorporate the latest baseline data ensuring that they remain policy relevant.
  - Expand the assessment to include energy technologies that have potentially high impacts, but are not well understood, e.g. wave power.
  - Revise the assessment methodology when research and evidence on the impacts of energy technologies on habitats and species become more advanced, e.g.:

[1] https://www.gov.uk/2050-pathways-analysis

- incorporate the effects of the air and water quality impact assessments (exploiting ongoing development of the Calculator);
- further develop the land use modelling and spatial specificity;
- improve the consideration of indirect land use effects;
- address impacts on ecosystem services economic valuation;
- include other established models such as the wind turbine bird collision model; and
- integrate parameters for adaptation capability and mitigation.

To overcome two of the identified shortcomings of the developed assessment methodology, spatially-explicit land use modelling and indirect land use change (i.e. displacement of biomass demand resulting in intensification and/or expansion of cropland elsewhere) were investigated in more detail to see if they could be developed and integrated into future biodiversity impact assessments.

Using spatially explicit land use modelling to assess impacts on biodiversity

To explore whether spatially-explicit modelling could be used to better assess the impacts on biodiversity, two scenarios of bioenergy deployment were assessed using Countryside Survey Land Cover Map 2007 (LCM2007) of habitats in the UK. Based on spatial information of available land with potential for growing non-food (second generation) energy crops, the location of the habitats most likely to be converted to bioenergy production was identified. This was then used to estimate in a more systematic manner which habitats and plant species were most at risk due to increases in bioenergy production. It is possible to use spatially-explicit data and models in biodiversity assessments, but this approach is limited to whether reliable information exists on the (probable) location of future deployment of each energy technology. The current spatial and temporal resolution of land use and biodiversity data sets limit assessments.

Assessing the effects of indirect land use change on biodiversity

A framework for assessing the impacts of indirect land use change on biodiversity developed by the United Nations Environment Programme's World Conservation Monitoring Centre (UNEP-WCMC), was evaluated to see if this aspect could also be integrated into biodiversity assessments. The UNEP-WCMC framework is a broad framework and does not offer detailed guidance on how to determine indirect land use change (ILUC) or its impacts on biodiversity. Spatially explicit ILUC data at a fine resolution are required to perform a reliable assessment of the impacts on biodiversity. The challenge to effectively and reliably determine ILUC location and extent remains. Like most other biodiversity assessments, it is still a challenge to identify robust evidence and relevant information on key biodiversity indicators.

Some of the assumptions made in the framework were found to be too limiting. The framework risks not taking into consideration some important effects of ILUC such as differences in crops and cultivation practices, long-term effects, off-site effects and habitat fragmentation. The WCMC framework can serve as a basis for ILUC impacts on biodiversity, but needs to be developed further.

Conclusion

Biodiversity impact assessments are in general limited by robust evidence and available data of the impacts of energy technologies and knowledge of biodiversity in specific locations. This study recommends that the initial focus of future research should be on the energy technologies that have been identified as having potentially high impacts on biodiversity (e.g. tidal range, imported bioenergy), and those whose impacts are particularly uncertain (e.g. tidal stream, wave power, offshore wind, biofuels and dedicated energy crops (in relation to possible indirect land use change)). Other areas that would also merit more research are monitoring of the effectiveness of mitigation options, their expression in terms of population impacts and the consequences of combinations of energy generating technologies. There is also a need for future research to establish better biodiversity impact assessment methodologies and develop predictive models to feed decision support systems for policy and planning purposes.