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MEETING EUROPE'S RENEWABLE ENERGY TARGETS IN HARMONY WITH NATURE

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A BirdLife Europe report, with the support of the RSPB (BirdLife UK).

Participating organisations:

- BirdLife Europe
- Association for Biological Research – BIOM/BirdLife contact in Croatia
- BirdWatch Ireland/BirdLife Ireland
- Bulgarian Society for the Protection of Birds – BSPB/BirdLife Bulgaria
- Centar za zaštitu i proučavanje ptica – CZIP/BirdLife contact in Montenegro
- DOPPS/BirdLife Slovenia
- Hellenic Ornithological Society – HOS/BirdLife Greece
- Lega Italiana Protezione Uccelli – LIPU/BirdLife Italy
- Ligue pour la Protection des Oiseaux – LPO/BirdLife France
- Natagora/BirdLife Belgium
- Naturschutzbund Deutschland – NABU/BirdLife Germany
- Natuurpunt/BirdLife Belgium
- Romanian Ornithological Society – SOR/BirdLife Romania
- Sociedad Española de Ornitología – SEO/BirdLife Spain
- Sociedade Portuguesa para o Estudo das Aves – SPEA/BirdLife Portugal
- The Polish Society for the Protection of Birds – OTOP/BirdLife Poland
- The Royal Society for the Protection of Birds – RSPB/BirdLife UK

Edited by Ivan Scrase and Benedict Gove

Contributors:

Joana Andrade, Yann André, Boris Barov, Richard Bradbury, Ariel Brunner, Helen Byron, Marina Cazacu, Claudio Celada, Melanie Coath, Luís Costa, Vincenzo Cripezzi, Isabel Diez, Siobhán Egan, Claire Ferry, Rachel Furlong, Dariusz Gatkowski, Małgorzata Górska, Benedict Gove, Elmar Große Ruse, Hermann Hoetker, David Howell, Harry Huyton, Tomaž Jančar, Peter Jones, Thanos Kastritis, Malamo Korbeti, Dave Lamacraft, John Lanchberry, Rowena Langston, Domingos Leitão, Caroline Lemenicier, Irina Mateeva, Kresimir Mikulic, Aly McCluskie, Sarah Oppenheimer, Sandra Pape, Jean-Yves Paquet, Joelle Piraux, Dan Pullan, Ivan Ramirez, Lucie Renuart, Darko Saveljic, Ivan Scrase, Aedan Smith, Marija Stanisic, Steven Vanholme, Carsten Wachholz, Olly Watts, Mike Webb, Arfon Williams, Julieta Valls, Magda Zadrag.

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PREFACE

Dear Reader,

A few years ago my attention was drawn to a powerful advertisement – part of a branding campaign launched by a big global bank. It was based on the observation that having different points of view can be a strength rather than a problem. Pictures of the same object were displayed next to each other, but with different accompanying text, reflecting different views and values.

A sports car, for example, could be viewed as "freedom" or a "status symbol" or even a "polluter". The bank was conveying the message that it understood and was able to encompass the different values of its customers, and therefore could offer solutions to a variety of clients all over the world.

When we look at renewable energy sources and technologies, we are facing a similar situation. For some they are an exciting business and development opportunity. For others, they are the main solution to cutting emissions and avoiding disastrous climate change. Renewable energy sources are often assumed to be less damaging for biodiversity than fossil energy sources, yet they are not always seen as "green".

Are all viewpoints valid? Yes, the more you look at renewable energy sources and technologies, the more you come to recognise that people are right in perceiving them differently. Is it possible to reconcile these viewpoints, making renewables a good business opportunity, as well as a good way to cut emissions and avoid further biodiversity loss? Yes, it is. Through this report, which is the result of the work of 17 leading bird and wildlife conservation organisations across Europe, we show that strategic planning, environmental assessment and stakeholder engagement are key elements of the solution.

We cannot afford to miss the EU's 2020 targets for energy efficiency, reducing CO_2 emissions and increasing the share of renewables in the energy mix. Indeed, BirdLife Europe supports increasing the emissions target from 20% to 30%.

At the same time, we cannot afford to miss another important EU 2020 target, that of "halting the loss of biodiversity and degradation of ecosystem services in the EU by 2020, and restoring them as far as feasible, while stepping up the EU contribution to averting global biodiversity loss". These climate and biodiversity targets are strongly interrelated and interconnected. We cannot achieve one aim without or at the expense of the other. What we need is to adopt holistic approaches and solutions encompassing both.

This report shows how policy makers can help make it possible to meet Europe's renewable energy targets in harmony with nature. Like the bank adverts, we see no problem in different points of view, only potential. And in order to deploy the full potential of renewables we need the wisdom, the long-term vision and the positive planning that you can find in the following pages.

Yours faithfully,

Angelo Caserta
(Regional Director, BirdLife Europe)

CHAPTER 1

THE TWIN IMPERATIVES – STABILISING CLIMATE AND PROTECTING BIODIVERSITY

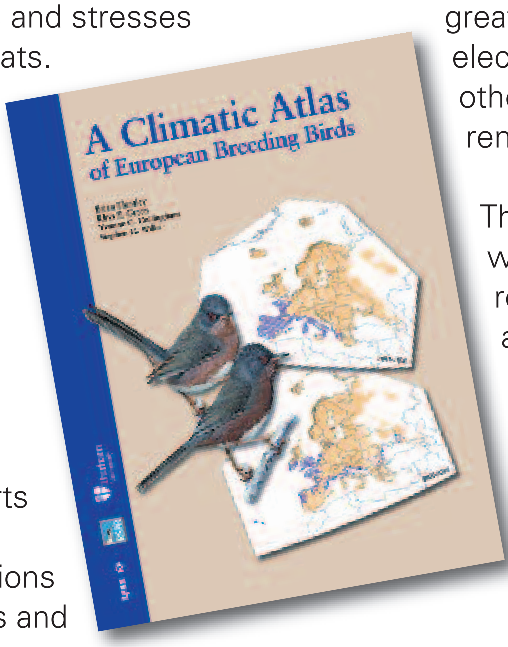
BirdLife International is a global partnership of conservation organisations that strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources. The BirdLife Partnership operates in over 100 countries and territories worldwide with over 2.5 million members, 10 million supporters and over a million hectares owned or managed. It is the world's largest partnership of conservation organisations. Together the BirdLife Partnership forms the leading authority on the status of birds, their habitats and the issues and problems affecting bird life.

The development of renewable energy sources is an essential element in fighting climate change. However, some measures intended to contribute to climate change mitigation, like unsustainably produced biofuels, are posing new threats and stresses on birds and their habitats. BirdLife works to promote effective emissions reductions using renewables without harming ecosystems and biodiversity, both at international and European levels.

BirdLife Europe supports action to cut Europe's greenhouse gas emissions through energy savings and displacing fossil energy with clean, sustainable, renewable energy sources. To be sustainable, harm to birds and biodiversity must be avoided, and Europe's most important sites for wildlife must be protected. This means the development of renewable energy sources must follow a strategic approach, so that the most appropriate energy sources are exploited in the most appropriate places.

BirdLife strongly supports the achievement of the EU's 20% renewable energy target. We believe it is an essential element in the fight against global climate change. With current policies and prevailing technologies, however, meeting the transport target using liquid biofuels does not meet the ecological sustainability criteria above. Therefore, BirdLife cannot support this element of the targets, and calls for greater use of energy savings, electrification of transport and other ecologically acceptable renewables instead.

This report explains why we support sustainable renewables deployment, and shows how policy makers can help to meet Europe's renewables targets in harmony with nature.



A Climatic Atlas of European Breeding Birds **predicts extinctions due to climate change.**

1.1 THE IMPERATIVE TO CUT GREENHOUSE GAS EMISSIONS

The scientific evidence is overwhelming: climate change is a stark reality, with a greater than 90% likelihood that this is caused by human activities (IPCC, 2007). It presents very serious global risks for people and biodiversity around the world and it demands an urgent global response. Climate change is already having multiple impacts on birds and their habitats, such as:

- changes in behaviour, for example timings of migrations
- range shifts and contractions
- disruption of species interactions and communities, and
- exacerbation of other threats and stresses, such as disease, invasive species and habitat fragmentation, destruction and degradation.

The publication of *A Climatic Atlas of European Breeding Birds* (Huntley *et al.*, 2008) was an important landmark in understanding the potential impacts of human-induced climate change on our environment. The Atlas projects that under a medium climate change scenario (a 3°C rise in average global temperature), the potential future range of the average European bird species will shift by nearly 550 km north-east, and will reduce in size by a fifth. Many more species look set to lose rather than to gain from projected climatic change.

For some species, there is no overlap between their potential future range and their current range; and for a few, there is no future potential range left in Europe. Some bird species that are currently found only in Europe, or that have only small populations elsewhere, are expected to run a significantly increased risk of extinction. This picture of climate change driving extinctions is seen across the literature on climate impacts and biodiversity (eg, Maclean and Wilson, 2011; Pimm *et al.*, 2006). A synthesis study published in Nature estimated that 15–37% of plants and animals will be "committed to extinction" by 2050 as a result of climate change under a mid-range warming scenario (Thomas *et al.*, 2004).

The concentration of carbon dioxide (CO_2) in the world's atmosphere has risen from a pre-industrial level of around 270 parts per million (ppm) to almost 400 ppm today. With current rates of emissions the concentration is likely to reach twice its pre-industrial level in a matter of decades. If CO_2 levels are stabilised at twice their pre-industrial levels, the Intergovernmental Panel on Climate Change (IPCC, 2007) estimates there would be a greater than 90% probability of global average temperatures increasing by 1.5°C or more this century, and a greater than 60% probability of average temperatures increasing by 2°C or more. Warming of 1.5°C would have some severe impacts, and 2°C is the limit beyond which many scientists would consider that warming had become "dangerous" to ecosystems and humanity alike. Avoiding this has been adopted as a target by the European Union (EU).

The likely impacts of a 2°C increase in global mean temperatures, according to the IPCC, include the accelerating loss of many of the world's most bio-diverse ecosystems including coral reefs, and increased risk of extinction for 20–30% of the world's species. For many species, poor ability to disperse, combined with fragmentation of habitat, will limit the extent to which they can adapt to shifting climatic conditions (Box 1). For some, particularly those already at geographical limits, such as mountain tops and high latitude land edges, there will simply be nowhere to go.

Increasing levels of carbon dioxide in the atmosphere are also expected to lead to a gradual acidification of the ocean with likely dramatic consequences for all marine organisms with calcium-based shells.

Society can help biodiversity adapt (Box 1), but the primary response must be deep cuts in greenhouse gas emissions to limit warming and stabilise the climate at the rate and level required to allow ecosystems to adapt naturally to climate change (UNFCCC, Convention on Climate Change Article 2). To have a greater than 50% chance of keeping global temperature increases from exceeding 2°C, the concentration of greenhouse gases in the atmosphere will need to be stabilised at well below twice pre-industrial levels (Meinshausen, 2005; Baer and Mastrandrea, 2006). For this to be achievable, global emissions will need to peak within the next 10–15 years and then be reduced by at least 50% by mid-century.

BOX 1

Can biodiversity adapt to climate change?

There is considerable concern that many species and natural ecosystems will not be able to adapt fast enough to keep up with the rapid rate of future climate change. As the climate warms, species may adapt "autonomously" through behavioural or evolutionary changes, or may benefit from human intervention. The chances of success vary between species and ecosystems, and will depend on the extent of warming. Cutting greenhouse gas emissions to limit future warming is paramount, but planned adaptation is also essential because of global warming that is already "in the pipeline" due to past emissions. Fortunately, many key current conservation actions are also those most required to address the impacts of climate change. Actions particularly important for climate change adaptation fall into four broad categories:

Increasing the population of threatened species. This increases "resilience", by reducing the risks of local extinction, and provides colonists for new sites. Actions include enlarging and improving management of important sites and special habitats. Large population sizes in diverse habitats also maximise genetic diversity, assisting evolutionary adaption to climate change. It must also be remembered that climate change effects are synergistic with other pressures, such as habitat loss and fragmentation. Therefore, actions to reduce these pressures, including through buffering wildlife sites, will likely increase resilience to climate change.

Assisting species movement by increasing ecological connectivity across landscapes. Better connected landscapes will allow species to move naturally to track the changing location of suitable climate. Key strategies here include increasing the size of current wildlife sites and creating new sites, as well as providing stepping stones, corridors and management to make the intervening landscape less hostile to specialist species. This strategy is sometimes known as a "landscape scale" approach to conservation.

Assisting relocation. For species with poor powers of dispersal, and those in poorly connected landscapes, help may be required to enable movement. In practice, time and cost (as well as technical feasibility and ecological risk) probably make this a viable option for relatively few species. Captive breeding and conservation of genetic material in seed and DNA banks are further options for consideration.

Developing landscape heterogeneity. Creating climatic refuges, below the mean temperature of their surroundings, improves the chance that species can stay in current locations. This enables local movements, rather than requiring longer-distance dispersal, and can enhance ecological resilience and accommodation of species on the move.

Dangerous climate change threatens humans as much as it does wildlife: the IPCC predicts that 2°C of warming will result in water scarcity affecting an additional 2 billion people, and significant reductions in agricultural productivity and food availability in developing countries. These impacts would have dire knock-on effects for everyone's quality of life, and even their security. In a speech in London in July 2011, the UK Secretary of State for Energy and Climate Change said[i]:

"A changing climate will imperil food, water, and energy security. It will affect human health, trade flows, and political stability. And the resulting pressures will check development, undo progress, and strain international relations. These risks will not be neatly divided. Different countries will face different challenges. Political solutions will become harder to broker; conflicts more likely. A world where climate change goes unanswered will be more unstable, more unequal, and more violent. The knock-on effects will not stop at our borders. Climate change will affect our way of life – and the way we order our society. It threatens to rip out the foundations on which our security rests."

Tackling climate change is an enormous challenge for an industrialising world with a growing population. Europe and other relatively wealthy regions have by far the highest per capita carbon emissions. The more developed countries bear historic responsibility for the climate change we are already experiencing, and to which we are already committed. Europe has, rightly, shown leadership in pushing for a global agreement to limit warming, and in promoting energy efficiency, renewable energy and other ways to cut greenhouse gas emissions.

1.2 THE IMPERATIVE TO HALT BIODIVERSITY LOSS

In 2001 the EU Heads of State agreed to a biodiversity target under which, by 2010, the EU should have halted the loss of biological diversity within its own territory and beyond. That it had failed to do so was very clear by 2010 – the International Year of Biodiversity. The principal reasons in the EU for this failure are well known: implementation of the Birds and Habitats Directives, which are the backbone of EU nature conservation policy, is still incomplete; failure to integrate biodiversity concerns into other policies; and a severe shortage of funding for conservation work.

While this makes depressing reading, there are reasons for optimism. The Birds and Habitats Directives have been shown to be effective at halting and reversing biodiversity loss, when properly implemented and adequately financed (Donald *et al.*, 2007), and great progress has been made in setting up the Natura 2000 network of protected sites. Furthermore, in March 2010 the EU Heads of State adopted an ambitious 2050 Vision and 2020 Target for biodiversity conservation. The 2020 target commits the EU to: "halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss".

We cannot afford to miss this target either. The biggest mistake is to think of the risks of climate change to people as a separate issue to the threat to biodiversity. Societies and our economic prosperity are dependent on the "ecosystem services" that nature provides – for example, enabling crops to grow, providing building materials, storing carbon, purifying water and protecting coast lines from erosion and flooding (Millennium Ecosystem Assessment, 2005; TEEB, 2009). Without properly functioning ecosystems the cost of adapting to a warmer climate would increase dramatically, compounding suffering and loss of lives and livelihoods. Large parts of the world could become uninhabitable, not because they are too hot or the weather events too extreme, but because the natural world is so damaged and impoverished it can no longer support human livelihoods.

In the words of José Manuel Barroso, President of the European Commission[ii]: "Biodiversity is integral to sustainable development, it underpins competitiveness, growth and employment, and improves livelihoods. Biodiversity loss, and the consequent decline of ecosystem services, is a grave threat to our societies and economies."

The EU is committed to halting the loss of biodiversity by 2020.

1.3 RENEWABLES AND CONSERVATION FOR A LIVEABLE PLANET

Getting greenhouse gas emissions down to a safe level will take enormous human effort, ingenuity and investment, particularly in the energy sector. Europe has taken a lead in the industrialised world in committing to making the transition to a sustainable energy system. By investing in renewables, leading nations are showing the world that prosperity can be built without ever increasing carbon emissions. Each time another political commitment is made to tackling climate change, and each time investment goes into renewables rather than fossil fuels, the world looks on and the transition to safe, clean energy gathers momentum and becomes a more realisable goal.

Sustainable renewable energy must become the backbone of our energy systems so that we leave a world that is able to continue to support people and the ecosystems upon which we and other species depend. We need to think of these as twin imperatives, or two sides of the same coin. Nature needs to be as resilient as possible in order to survive in a changing climate and continue providing services to society. This means we must urgently step up and reconcile climate change mitigation and biodiversity conservation efforts.

It is not an either/or choice between cutting emissions and protecting biodiversity, but an imperative to do both – so the planet in 2100 is fit to live in for people and for wildlife. Biodiversity matters in its own right, as well as for the millions of people who love and care for nature, and for whole societies that depend on it for their security and livelihoods. Biodiversity protection is an important consideration in the investment plans and decisions made by the renewables industries and developers of power lines in Europe.

The challenge now is for all *policy makers* to grasp biodiversity's importance and relevance to their work, and to push for positive change. BirdLife Europe believes renewable energy is central to a sustainable future. However, there are many choices to be made about how we move to a renewables-based energy system in Europe. Making good choices, through the right policy frameworks, is vital to make the twin imperatives of renewables deployment and nature conservation compatible and mutually reinforcing, rather than in conflict.

BOX 2

BirdLife at the international climate talks

Climate change is likely to have catastrophic effects on wildlife unless greenhouse gas emissions from human activities around the world are reduced both significantly and rapidly. BirdLife Partners have therefore attended meetings of the UN's Framework Convention on Climate Change since 1997, to try to ensure that global emissions are curtailed and that ecosystems can adapt to the climate change that will inevitably occur. As the threat of climate change has grown, increasing numbers of Partners have attended the climate negotiations, peaking in 2009 when Partners from 17 countries attended.

In addition, by tracking and influencing the bigger, political aspects of climate change policy, BirdLife focuses on areas where it has special expertise and where it can contribute most. Most Partners attending the negotiations, therefore, take an interest either in reducing emissions from deforestation in developing countries (REDD) or in ecosystems adapting naturally to climate change, or in both subjects. There is also interest from developed country Partners in land use change and forestry in developed countries, especially in forest management and saving carbon by restoring degraded peatlands.

We try to build up teams of Partners who, in addition to contributing to the UN negotiations, can also work on the implementation of UN decisions at home. For example, Burung Indonesia, Haribon (Philippines) and Guyra Paraguay often attend the international talks on REDD and also work on forest issues at home. Similarly, the RSPB and NABU both attend the climate talks and work with developing country Partners on forest projects in Africa and Asia.

1.4 PRINCIPLES FOR RENEWABLES DEPLOYMENT IN HARMONY WITH NATURE

In Europe, the Renewable Energy Directive (2009/28/EC), with its legally binding targets to meet 20% of Europe's overall energy consumption from renewables by 2020, has become a key driver in reducing EU carbon emissions and promoting the use of renewable energy. BirdLife Europe supports achieving and going beyond Europe's 2020 targets, in line with the following four principles:

1 **Renewables must be low carbon**. Renewable energy sources must make a significant difference in reducing greenhouse gas emissions, accounting for emissions from the full life-cycle. This is the case for most renewables technologies such as wind or solar power, but is not a given fact for all technologies and in all instances. For example, most current biofuels such as ethanol produced from maize or wheat, or biodiesel produced from oil seed rape, palm oil or soy do not meet this condition (Croezen *et al.*, 2010; Bowyer, 2011).

2 **A strategic approach to deployment is needed**. "Positive planning" frameworks are needed so that the most appropriate energy sources are exploited in the most appropriate places. If located in the wrong places, some renewables technologies can cause significant harm to birds, bats and other wildlife. However, impacts can be avoided or greatly reduced by choosing the right sites, assisted by maps showing ecologically sensitive locations. Early-stage and high-level strategic planning, strategic environmental assessments (SEA) and stakeholder consultations can help avoid conflicts and delays at the project level, and help realise project objectives more quickly.

3 **Harm to birds and biodiversity must be avoided**. Precautionary avoidance of harm to biodiversity and ecosystems is essential when locating and designing renewable energy facilities. Depending on the technologies, habitats and species involved, developments may be possible in places that are important for their biodiversity without resulting in significant negative impacts on wildlife. BirdLife considers that technologies that can present risks to birds, such as wind turbines, should in most cases be located outside Important Bird Areas (IBAs), and in every case should have no significant negative impacts on IBAs.

4 **Europe's most important sites for wildlife must be protected**. Where significant impacts on a Natura 2000 site (those protected under the Birds and Habitats Directives) cannot be ruled out, development may only proceed under strict conditions. Conduct of environmental assessments must be rigorous, and the conditions must be robustly applied.

A key approach in strategic deployment of renewables is mapping resources (eg, wind speeds) overlaid with maps of environmentally sensitive areas, such as IBAs, protected areas or bird migration corridors. These maps provide a practical tool for developers, so their investment plans are informed by the most extensive and up-to-date data possible. Location guidance and/or "resource and constraint/sensitivity" maps can be useful in policy making and planning. In combination with SEA, such guidance and maps enable governments to give the industries a steer towards priority zones for development, and indicate areas where greater precaution and more detailed environmental assessments are likely to be needed.

In the short-term, and on a narrow financial basis, it might be "cheaper" to proceed without applying these principles. In the short-run at least, "cheaper" might mean more overall investment in renewables, rather than in competing technologies. Equally, however, in this perspective, tackling climate change is not a priority – the benefits are not financial or immediate. Fortunately, across Europe, energy markets are incentivised and regulated to serve the public interest. The right policy frameworks for renewables – particularly strategic planning and adequate, stable incentive regimes – will enable rapid and sustainable deployment while safeguarding the natural environment for generations to come.

1.5 STUDY APPROACH AND REPORT STRUCTURE

This report was developed by BirdLife Europe with support from the RSPB/BirdLife UK. The work was part-funded by a grant from the European Climate Foundation. The RSPB co-ordinated the project over a one year period to November 2011. Seventeen BirdLife Partners (or contact organisations), each a leading bird and wildlife conservation NGO, participated.

The project followed five phases:

(i) Scoping and developing an understanding of current issues.

First a series of telephone interviews with project Partners was used to develop an understanding of renewable energy development and related conservation issues across Europe. In parallel, a preliminary literature review was undertaken on the ecological impacts of renewable energy technologies. Project Partners then met in Brussels for a two day workshop covering three main areas: scientific evidence on ecological impacts of renewables technologies; initiatives led by Partner organisations; and BirdLife's policy positions on renewables development in Europe.

(ii) Risk assessment of renewable energy technologies.

An assessment was carried out to identify the risks posed by different commercially available renewable energy technologies in Europe, based on the initial literature review and Partners' experiences. Technologies were categorised into three groups:

1 *Low risk technologies*: those presenting zero or negligible additional risks to birds and biodiversity, such as rooftop solar thermal panels.
2 *Medium risk technologies*: those that can be

developed without negative impacts, provided the right policy frameworks are in place and deployment proceeds sensitively.

3 *High risk technologies*: those presenting unacceptable risks in most instances with currently available technologies, such as new large hydropower dams and liquid biofuels.

(iii) Scientific literature review of biodiversity impacts and mitigation responses.

BirdLife makes constant use of scientific evidence to inform its work. BirdLife scientists involved in the project undertook a detailed, new literature review to assess known and potential sources of risk, and to identify proven means to avoid or reduce these.

BOX 3

Chapter Two focuses on "medium risk" technologies, which include wind, solar, wave, tidal and biomass for heat and power. It presents a detailed review of the scientific evidence on impacts, mitigation and enhancement measures for these technologies, and for associated power line development.

(iv) Analysis of current EU renewable energy plans.

The project team also undertook a quantitative analysis of EU Member States' National Renewable Energy Action Plans (NREAPS). This focuses on the additional renewables entering Europe's energy mix to 2020, by technology and location. In many countries renewables industries have already become established, and BirdLife Partners have developed an understanding of the kinds of technologies involved and how they are being deployed on the ground.

From a conservation perspective, what is now needed is an impression of the scale and distribution of Europe's renewables ambitions to 2020. Therefore the data extracted from the NREAPs and presented here is on the energy contributions the various technologies and nations will make in 2020 compared to a 2005 baseline.

BOX 4

Chapter Three explains the contribution each technology and conservation risk group is expected to make to increased renewable energy consumption by 2020, and the extent to which each Member State intends to make use of energy from each source (according to their NREAP).

(v) Policy analysis and development of recommendations.

Project Partners then completed a survey questionnaire on the adequacy of their national policy frameworks for the promotion of renewables in harmony with nature. The survey results were then used in a second series of telephone interviews, in which Partners suggested policy recommendations relevant to their country and the EU.

BOX 5

Chapter Four sets out BirdLife Europe's conclusions on how policy frameworks can enable renewables development in harmony with nature. It considers how sustained growth in renewables output can be achieved with minimal ecological impacts, through measures such as strategic spatial planning, mapping ecological sensitivities, use of environmental assessments and project-level mitigation.

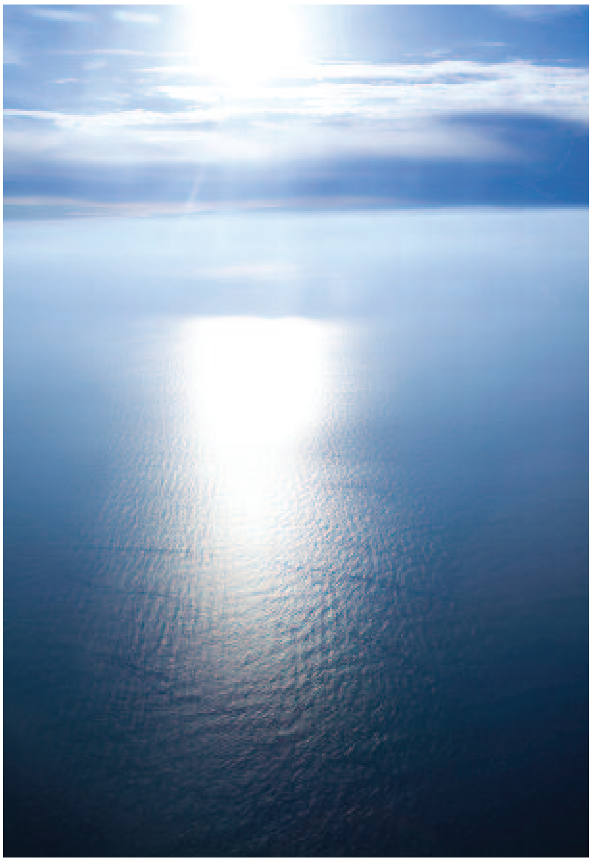
BOX 6

Chapter Five evaluates how well national frameworks contribute to these goals, and identifies some areas of common strengths or weaknesses across Partners' countries. In some areas, such as environmental protection, the European Commission has a major role to play, and some policy recommendations for Europe are presented. In addition, policy recommendations for each Partner country are suggested.

CHAPTER 2

RENEWABLE ENERGY TECHNOLOGIES AND ECOLOGICAL SUSTAINABILITY

Based on scientific evidence, ecological reasoning and conservation experience, the project team classified the renewable energy technologies into three risk categories: low, medium and high. Section 2.1 presents the classification, and a brief explanation for our assessment that certain technologies present particularly low or high risks. The detailed scientific review focuses only on the medium risk category. These are some of the major technologies available for industrial-scale renewable energy development: solar photovoltaic (PV) arrays and concentrated solar power (CSP); onshore wind power; offshore wind power; tidal stream and wave energy; and biomass for heat and power. Together these technologies account for two thirds of additional renewable energy consumption foreseen in EU countries' NREAPs to 2020 (see Chapter Three). The review also considers the power lines needed to distribute and transmit electricity. The Chapter explains how risks can be avoided and minimised, and how, in some instances, positive ecological benefits can be achieved while also cutting greenhouse gas emissions.



2.1 RISK CLASSIFICATION

The ecological risks presented by renewable energy technologies cannot always be defined very precisely, since much will depend on technical and site-specific variables, how developments are constructed and managed, and what mitigation measures are in place. Nonetheless, it is possible to put the major technologies into three broad classes of risk category.

Those that are small-scale, involve little or no additional new infrastructure, and/or do not result in any land-use change, are very unlikely to present significant risks to biodiversity. This "low risk" category includes roof-mounted solar panels, heat pumps and electric vehicles. Energy saving measures, while not renewables technologies, are relevant here since they make achievement of renewables targets easier. Conversely, technologies that result in complete changes in land use will inevitably present significant risks for the wildlife present, for example where valuable habitats are lost to intensive land use for energy crops or through the construction of dams for hydro or tidal range power. The "high risk" category refers to technologies that present unacceptable risks in most instances with currently available technologies, such as new large hydropower dams and liquid biofuels. With adequate safeguards and/or technical innovation some use of these technologies may become possible without significant ecological risks, but BirdLife sees current potential as extremely limited.

Low risk technologies

Energy saving measures. Europe's renewable energy targets are expressed as a percentage of total energy consumed. Therefore, measures that reduce total energy consumption, or limit its growth, make the renewables targets easier to achieve. These are not renewable energy technologies in themselves, but each unit of energy saved is as valuable as one produced and consumed. Moreover, all of the potential impacts associated with producing that unit are avoided, and energy saving measures typically present negligible risks to wildlife in themselves.

Vehicles using renewable electricity. In the light of the serious ecological and climate risks posed by liquid biofuels, a move to electric vehicles (EVs) is desirable for journeys that cannot be avoided, walked, cycled or moved to rail or ships. While EVs require some dedicated infrastructure for charging batteries, this would not be expected to result in significant direct ecological impacts. Combined with a major shift towards renewable energy in the EU's electricity mix, EVs have the potential to become serious low carbon alternatives to fossil- or biofuel-powered vehicles.

Heat pumps. Heat pumps draw heat from the air, water or ground and use it to heat or cool buildings. Pumping creates some demand for electricity, but heat pump technologies reduce energy requirements overall. As with electric vehicles,

Solar power poses low risks to wildlife. Installation of solar panels at Sandwell Valley RSPB reserve by Solar Century.

use of renewable electricity makes heat pumps a low carbon technology. Refrigerant leaks are an environmental risk, but significant short-term ecological impacts are unlikely. However, some localised impacts on biodiversity might occur, either through small changes to ground temperatures, or disturbance of habitats/soils during installation.

Rooftop solar thermal and PV panels. Microgeneration technologies can be deployed widely with minimal impacts on biodiversity, while having the potential to contribute significantly to reductions in greenhouse gas emissions. Solar thermal panels on rooftops heat water for use in buildings. They are a simple and reliable, low-cost technology with negligible conservation risks. Solar PV panels mounted on roofs and in cities or previously developed areas will also be very unlikely to be detrimental to wildlife.

High risk technologies

Liquid biofuels. While certain forms of bioenergy clearly have a role to play in tackling climate change, production of liquid biofuels is leading to severe negative impacts on biodiversity and natural resources. Competition for land, leading to clearing of natural habitats and unsustainable forms of intensification, is a particular concern (Box 7). Further, liquid biofuels are failing to deliver emission reductions in the short- to medium-term. The "carbon payback time" (Gibbs *et al*., 2008) or "carbon debt" (Fargione *et al*., 2008) for some liquid biofuels can be decades or even centuries (Chum *et al*., 2011).

BOX 7

Indirect climate and biodiversity impacts of EU biofuels policy

Biofuels do not necessarily save emissions compared to fossil fuels. Indeed, research has found that some biofuels have a greater overall climate impact than conventional fuels. In particular, the indirect land-use change (ILUC) caused by European rapeseed, Asian palm oil and American soybeans, means that they can create more emissions than they save (Bowyer, 2011). By comparison, crops like sugar beet used for ethanol production have a much lower land-use change effect, and so can create genuine emissions savings. New generation biofuels based on enzymes and algae may also offer a positive contribution if they do not rely on land for the production of feedstocks and providing issues of commercial viability can be overcome.

The Renewable Energy Directive contains sustainability criteria that go some way towards preventing biofuels production leading to the conversion of areas of high carbon stock and high biodiversity value. However, these criteria are by no means comprehensive and high biodiversity areas, such as savannah grasslands, not covered by the criteria are not protected. In order to avoid sensitive sites, BirdLife is calling for all Key Biodiversity Areas, as recognised by IUCN, to be protected.

There is increasing evidence that European targets, together with other global biofuel policies, are driving destruction of highly biodiverse forests and wetlands. For example, the Dakatcha woodlands of Kenya are threatened by a proposal from an Italian biofuels company to grow the oil rich crop jatropha. This would destroy one of the last remaining tracts of coastal forest in East Africa, potentially causing the endangered Clarke's weaver to become extinct and threatening other vulnerable species, as well as displacing 20,000 local people from their homeland. A life-cycle analysis of the energy crop jatropha from this site (North Energy, 2011) also found it would cause between 2.5 and 6 times more emissions than fossil fuels. While biofuels from this site would not be eligible to count towards European targets, they could still be sold on international markets, and traded on the European Emissions Trading Scheme where no sustainability criteria for biofuels are in place.

Furthermore, despite an ever increasing body of evidence pointing to the damaging consequences of indirect land-use change, the European Commission has failed to adequately deal with this issue. At the point of writing, the Commission still has not put forward proposals to address ILUC in EU legislation. Of the potential options being considered by the Commission, only feedstock-specific ILUC factors would represent a genuine attempt to reflect the impacts of ILUC on the climate. There are no proposals to deal explicitly with the impacts of ILUC on biodiversity but feedstock-specific ILUC factors may help rule out the feedstocks that are also most damaging to wildlife.

The Dakatcha woodlands in Kenya are threatened by plans to grow jatropha for biofuel.

Liquid biofuels from agricultural crops will make biodiversity and climate targets harder to meet.

Tidal range power. Tidal range power is risky from a conservation perspective."High head" shore-to-shore barrages, in particular, are likely to result in significant losses of important intertidal habitats to submersion and erosion (Box 8).

BOX 8

Potential impacts of a tidal power barrage on the UK's Severn Estuary

The Severn estuary and the rivers that feed into it contain a wealth of biodiversity, supporting over 60,000 wintering waders and wildfowl and several rare or scarce fish species. This wildlife wealth has been recognised in a series of national and international designations. The Severn Estuary Special Protection Area (SPA) supports internationally important numbers of Bewick's swan, gadwall, dunlin and redshank. The Severn Estuary Special Area of Conservation (SAC) is important for a range of habitats including sandbanks, mudflats, salt meadows and reefs. SACs on the Severn's major tributaries are important for fish such as salmon, bullhead, lamprey and twaite shad.

Tidal power could make a significant contribution to the urgent task of decarbonising the UK's electricity supply. However, the impacts on wildlife and the natural environment could be very severe, depending on the way the energy is harnessed. Tidal power barrages can submerge and erode intertidal areas, harming wildlife and potentially leading to increased flood risk. The 2008–10 Severn Tidal Power Feasibility Study showed that any structure in the Severn is likely to cause harm to wildlife. In particular, the so-called "Cardiff-Weston barrage" would lead to 80% loss of internationally protected intertidal habitat and cause 100% mortality of migrating fish populations such as shad and sea lamprey in the Severn.

The study also noted that a Severn barrage would cause changes to sediment erosion and deposition, resulting in erosion of existing flood defences. The cost of revetment works to address this for the Cardiff-Weston barrage option was estimated at between £672 million and £2,015 million. The erosion problem is most acute in wide estuaries with high sediment loads. The Eastern Scheldt storm surge barrier in the Netherlands provides some alarming lessons, revealed in a report[iii] by the Rijkswaterstaat – part of the Dutch Ministry of Infrastructure and the Environment. There the barrier has had massive negative implications for wildlife and flood risk management. By around 2050 the area of intertidal will have halved. As intertidal areas in front of flood defences are lost to erosion, flood risk increases, resulting in a need for additional flood risk investment. As tidal flats are eroded, the area and duration of their exposure for feeding birds is reduced – Dutch Government calculations suggest an 80% decline in oystercatchers by 2045.

New hydro power. Dams can have significant and lasting impacts on wildlife if they disturb species during construction, destroy habitat or create dramatic changes in physical and hydrological conditions. They can result in a permanent loss of freshwater and terrestrial habitats, drainage of wetlands and bogs, and subsequent loss of habitat and species diversity. Large dams disrupt the natural flows of rivers and migratory pathways of fish such as salmon and eels. Dams and reservoirs act as major sediment traps, interrupting natural transport of sediments. Water level fluctuations in reservoirs and the loss of habitat diversity can have indirect impacts on birds by decreasing the invertebrates and fish they eat or by flooding or stranding their nests. However, some carefully designed schemes, of appropriate scale and in suitable locations, with fish-friendly turbines and fish passes, may be able to avoid significant harm to biodiversity.

BOX 9

New hydro in Montenegro, Europe's first "ecological state"

Montenegro is a small country, with only 620,000 inhabitants. It was proclaimed an "ecological state" in its constitution 20 years ago. It already obtains over three quarters of its electricity from renewables, largely hydropower. National renewable energy plans focus almost exclusively on further hydro – other sources such as solar power are given little attention despite the significant potential.

Plans have been outlined for four dams on the river Moraca, with a combined capacity of 238 MW. Several small hydro generating stations are also being planned, with a combined capacity of over 30 MW. In parallel with the strategy of building dams on the Moraca, and contrary to the Spatial Plan of the State, there are plans to build 144 km of power lines through Montenegro continuing by undersea cable under the Adriatic to Italy. This will make Montenegro a hub for exporting energy from the Balkans to the EU. Many of Montenegro's NGOs consider the nation's well preserved nature should be its product for "export", rather than electricity.

During the public debates on the plans for the river Moraca, NGOs argued that reducing transmission losses in the electricity network could save as much electricity as the proposed dams would generate, while avoiding very significant investment and damage to biodiversity. An SEA for hydropower plans was started, but the Government decided to begin the tendering procedures before it was completed. Because of the high biodiversity value of the area and the incomplete SEA, CSO/BirdLife Montenegro are currently challenging the Montenegro Government for violation of legal procedures.

TABLE 1

Ecological risks associated with technologies needed to meet Europe's renewable energy targets

LOW RISK	MEDIUM RISK	HIGH RISK
Energy savings measures eg, domestic insulation	Solar PV arrays	Liquid biofuels
Vehicles using renewable electricity	Concentrated solar power	Tidal range power
Heat pumps	Onshore wind power	New hydropower
Rooftop solar thermal and PV panels	Offshore wind power	
	Tidal stream power	
	Wave power	
	Biomass for heat and power	

Medium risk technologies

Most renewable energy technologies fall between these extremes, and are classified here as "medium risk". This category includes the major renewables technologies: onshore and offshore wind turbines, ground mounted solar PV and CSP installations, tidal stream and wave power, and biomass for heat and power. Each of these can result in changes in the suitability of habitats for sensitive species, and may present collision, displacement or other risks. However, in each case, they can be developed without significant negative impacts – provided the right policy frameworks are in place to guide developments to the right locations and deployment proceeds sensitively. Technologies in this category, and overhead power lines, are addressed in detail in the Sections 2.2 – 2.7 below.

2.2 SOLAR PV ARRAYS AND CONCENTRATED SOLAR POWER

Large-scale solar electricity generation takes two forms. The first involves an array of ground-mounted PV panels. The second is CSP, in which mirrors, or "heliostats", are used to concentrate sunlight. This solar energy can be used to raise steam to drive turbines and generators in the conventional way, or it may drive Stirling engines with generators. "Concentrating photovoltaic" technology uses mirrors to concentrate sunlight on to special heat-resistant PV panels that convert the concentrated sunlight directly into electricity. The first commercially operating CSP plants have been built in the US and Spain.

Industrial-scale solar plant developments may have a greater direct impact on biodiversity than domestic-scale systems, depending on where such projects are located. Land deemed suitable for large arrays may be marginal in an agricultural context, but could nevertheless be important for wildlife. In order to minimise these risks, developers should seek to avoid protected and sensitive sites, manage surrounding land for the benefit of wildlife, and limit the ecological disturbance created by installation and maintenance operations, as well as associated infrastructure such as fencing and power lines.

2.2.1 MAIN CONSERVATION RISKS

The wildlife impact of a solar array scheme will be largely determined by location. Steppic (open grassland) bird species, such as bustards, face potential risks where habitats are lost or fragmented, for example. Where proposals are not within or close to protected areas and functionally linked land, it is unlikely that there will be major wildlife concerns. However, this will depend on the ecological characteristics of the site and its sensitivity to the proposed changes. Some national and internationally important bird resources are located outside of designated sites (and associated functionally linked land). For example, in England honey buzzard and woodcock fall into this category. In all cases, care should be taken to seek to implement appropriate mitigation and enhancement measures.

Significant negative ecological impacts are very unlikely where PV arrays are mounted on roofs, or on previously developed or sealed land with low wildlife value. Large PV arrays and CSP installations mounted in agricultural fields (or other non-urban/unsealed areas) are also unlikely to present significant risks, provided they are developed in suitable locations. If the site is not valuable for wildlife – eg, intensive arable or grassland – direct impacts are unlikely to be significant and may be positive, however, the indirect impacts of land-use change must be considered.

Some proposed sites may have strong potential to become more valuable for wildlife, for example, land behind sea walls identified for future "managed realignment" and strategic parcels of land for landscape-scale conservation initiatives. Realising this potential, however, is not necessarily incompatible with solar power development.

If the site is already valuable for wildlife, and particularly if it is in or near a protected area, the scheme will require greater scrutiny in environmental assessments, as there is potential for significant impact. Concerns are most likely when proposals are located in or close to protected areas, or near to water features where their

Solar power in built-up areas is a win-win, but poorly sited large-scale arrays can cause habitat loss for species such as bustards.

development could pose risks to aquatic invertebrates, waterfowl and waders.

Direct habitat loss

In rural areas, it is likely that the least productive land for agriculture will be targeted for development, raising concerns as these grades are often valuable (or potentially valuable) in nature conservation terms. Some species specialising in open habitats (eg, bustards, lapwings or skylarks) may be displaced from foraging, roosting or breeding sites. Conversely, biodiversity gains are possible, particularly where intensively cultivated farmland is converted to lower-intensity grazing,or where projects and sites are actively designed and managed to achieve local ecological enhancements.

Direct impacts on birds

There is no scientific evidence of fatality risks to birds associated with solar PV arrays. Heliostats – the mirrors used in CSP – have been found to cause fatalities through collisions and burns in the US (McCrary *et al.*, 1986), though mainly during maintenance operations. Both heliostats and PV panels inevitably present some risk of collision mortality to birds. Birds may also collide with any fixed object or man-made structure, such as fences, towers or buildings (Drewitt and Langston, 2008). While PV panels or heliostats may be more likely to be developed in sensitive locations, there is no firm evidence of large numbers of bird strikes associated with either. There is some concern that waterfowl might be attracted to PV panels, mistaking them for water surfaces, but there is little evidence for this.

Security fencing around PV arrays could represent a collision risk for some bird species, particularly those with large body-mass and high wing-loading such as bustards, grouse and swans.

Direct impacts on other wildlife

Insects that lay eggs in water (eg, mayflies, stoneflies) may mistake solar panels for water bodies due to reflection of polarised light. Under certain circumstances insects have been found to lay eggs on their surfaces, reducing their reproductive success (Horváth *et al.*, 2010). This "ecological trap" could affect populations of these insects, so there may be concern if solar arrays are located close to water bodies used by rare or endangered aquatic invertebrates, or where such insects are an important food source for birds or other wildlife using the locality. Security fencing around PV arrays could act as a barrier to the movement of wild mammals, reptiles and amphibians. Loss of habitat for wildlife such as rare arable weeds and invertebrates may be a concern at specific sites. Some solar panels track the movement of the sun; moving parts may be a potential risk to wildlife and grazing animals, but this is unlikely given the slow movements involved.

Habitat fragmentation and/or modification

The development of solar farms within otherwise extensive areas of farmed or semi-natural landscapes could result in fragmentation of habitats and act as barriers to movements between populations. The modification of otherwise suitable habitat may reduce carrying capacity or ecological integrity.

Cumulative impacts

Each of the potential impacts described above may interact cumulatively, either increasing the overall impact on biodiversity or, in some cases, reducing a particular impact (for example, where habitat loss or changes in management causes a reduction in bird activity which might then reduce the risk of collision) (Drewitt and Langston, 2006). Direct impacts, barrier effects, habitat loss and indirect impacts might all lead to population level effects. Cumulative impacts might occur as a result of a number of energy developments operating on the same bird population and could have impacts in combination with other types of development.

There is a risk that large PV arrays may be clustered together due to limitations of location choices in terms of climate, topography, access, existing land uses, shading and proximity to grid connections. While each solar farm may be of little risk to wildlife individually, this clustering could potentially give rise to significant cumulative environmental impacts.

2.2.2 AVOIDING AND MITIGATING RISKS, AND ACHIEVING BENEFITS FOR WILDLIFE

Avoidance and mitigation

A variety of mitigation measures may be adopted by developers to avoid and reduce the potential environmental impacts of solar power developments. The suggested mitigation measures below should be considered on a case by case basis. Not all will necessarily be relevant to any particular case.

- Avoid legally protected areas (eg, SAC, SPA, Ramsar sites, sites of national or sub-national value), and other sensitive sites such as IBAs and some freshwater aquatic features.
- Hedgerows between sections may reduce collision risks to waterfowl.
- Landscape features such as hedgerows and mature trees should not be removed to accommodate panels or avoid shading.
- Time construction to avoid sensitive periods (eg, during the breeding season).
- Time maintenance operations to avoid sensitive periods.

Enhancement opportunities

Solar power developments may present lower ecological risks during their operational lifetimes than other potentially competing land uses (such as urbanisation or road building) or other pressures (eg, agricultural intensification). Moreover, there are significant opportunities to actively manage sites for positive ecological benefits. The suggestions below should be considered for suitability at specific sites.

- Biodiversity gains are possible where intensively cultivated arable or grassland is converted to extensive grassland and/or wildflower meadows between and/or beneath solar panels and in field margins.
- Grazing by sheep, chickens or geese is often preferable to mowing, spraying or mulching. However, there may be more appropriate management options for arable wildlife and farmland birds that could be incorporated into development designs.
- Hedges used to screen security fencing or for landscape mitigation can provide wildlife habitats, particularly if planted with a mix of native species of local provenance.
- Built structures such as control buildings can be designed or adapted to promote access by nesting, roosting or hibernating animals such as birds and bats, eg, by providing nest boxes or access to loft spaces.
- It may be possible for PV panels to be at a sufficient height for regular cutting or grazing to be unnecessary. Rough pasture could then develop, potentially providing nesting sites for birds.
- Lower density of PV panels may offer greater scope for environmental gain, depending on the characteristics of the site. However, any indirect land-use change impacts, in which the displaced land use is effectively reinstated elsewhere, will be greater.
- "Community gain" may provide money for environmental enhancements such as energy conservation measures and nature conservation.
- Biodiversity enhancement at solar PV sites could contribute to landscape scale conservation, climate adaptation, ecological networks or green infrastructure.
- Planting wild bird seed or nectar mixes, or other cover crops (such as linseed) between rows could benefit birds and other wildlife, by providing cover and food resources.
- Bare cultivated strips for rare arable plants, and rough grassland margins could also be beneficial.

2.3 ONSHORE WIND POWER

Onshore wind energy will be critical to delivering renewable energy over the next two decades, when emissions must begin to fall sharply. A single technology currently dominates the market – the familiar three-bladed horizontal axis turbine. The major area of technical innovation is in up-scaling to larger turbines. This increases a site's generation capacity, and with fewer individual turbines there are lower overall risks to most bird species (Hötker *et al.*, 2006) and collision rates per unit of electricity output are expected to decrease (Smallwood and Karas, 2009). Many wind farms have no discernible impacts on wildlife at all, and the scientific evidence does not suggest that species populations as a whole have been affected by wind farm development at present. However, there have been very few studies that have assessed population effects to date; such studies are only just coming forward now.

Furthermore, the impact of wind farms on bird populations depends crucially on where the turbines are located. If wind farms are located on sensitive wildlife sites, the results can be disastrous for the wildlife using the site. For maximum output and profitability, wind farms are often sited in open, exposed areas where there are high average wind speeds. This means that they are frequently proposed in upland and coastal areas (and offshore), thus potentially affecting important habitats for breeding, wintering and migrating birds (Drewitt and Langston, 2006). The effects of wind farms on birds are highly variable and depend on a wide range of factors including specifications of the development, the site topography and that of the surrounding area, the habitats affected and, importantly, the species of birds present, their population size, vulnerability to wind farms and activity levels. With so many variables involved, broad location guidance is valuable but the impacts of each wind farm must be assessed individually.

2.3.1 MAIN CONSERVATION RISKS

There are several ways in which wind farms can have negative impacts on birds and other wildlife such as bats: disturbance/displacement, habitat loss or damage, and collision. All of these impacts can be avoided and/or managed by choosing appropriate locations and then designing wind farms to minimise any damage to the natural environment.

There have been few comprehensive studies on the ecological impacts of wind farms. There are even fewer published, peer-reviewed scientific papers on this subject. Many studies are of inadequate duration to provide conclusive results (Langston and Pullan, 2003). Many others suffer from a lack of "before and after" data (or wind farm area and reference area comparisons), or fail to address relevant factors such as collision risk and differences in bird behaviour (eg, between night and day).

Factors such as the biogeographic range of a species, population size and the amount of available suitable habitat will all have a bearing on the potential for cumulative impacts. For example, collision mortality at several poorly sited wind farms or displacement of birds by multiple wind farm installations may have population level effects. Cumulative mortality, or more subtle effects on productivity, due to multiple wind installations could contribute to population declines in susceptible species (Langston and Pullan, 2003). Moreover, site-specific impacts and effects on local wildlife populations are significant concerns. These are well-documented, and can be anticipated with some accuracy for specific sites.

Disturbance/displacement

The reasons for displacement of birds by wind farm installations are not fully understood. Disturbance may potentially arise from increased human activity (eg, during construction and maintenance, or where road construction improves recreational access by the public). The presence, noise or movement associated with turbines and associated infrastructure may also deter birds from using areas close to turbines (Langston and Pullan, 2003). Disturbance can lead to displacement and exclusion from areas of suitable habitat, which effectively amounts to reduction in quality or loss of habitat for birds, leading to reductions in bird density (Pearce-Higgins *et al.*, 2009). There may also be an increase in predator activity and/or susceptibility, due to improved access and increased disturbance. The effects attributable to wind farms are variable, and are species-, season- and site-specific (Langston and Pullan, 2003). There is now some evidence that wind farm construction can have greater impact than operation (Pearce-Higgins *et al.*, in review).

Displacement may be temporary for species that have the capacity to habituate to the presence of turbines. For example, there is evidence of habituation by pink-footed geese to the presence of wind turbines in winter foraging habitats (Madsen and Boertmann, 2008). However, a systematic review of the effects of wind turbines on birds has shown that increasing time since operation typically resulted in greater declines in abundance (Stewart *et al.*, 2005), suggesting that habituation is unlikely in many cases.

Pearce-Higgins *et al.* (*in review*) found that most decline in the density of breeding upland waders occurred during construction, with little further change thereafter during wind farm operation, indicating stabilisation at a lower level rather than post-construction recovery in bird density/abundance. The long-term implications of habituation where it does occur are not clear. Even if individual adult birds show habituation, younger individuals, which would eventually replace them may not colonise, so habituation in the short- to medium-term may mask adverse impacts.

BOX 10

Susceptibility of different types of birds to disturbance/displacement by onshore wind farms

Wintering waterfowl and waders. Disturbance distances for onshore wind farms (the distance from wind turbines in which birds are either absent or less abundant than expected) from zero up to 850 m have been recorded for wintering waterfowl and waders (eg, Pedersen and Poulsen, 1991; Kruckenberg and Jaene, 1999; Larsen and Madsen, 2000; Kowallik and Borbach-Jaene, 2001; Hötker *et al.*, 2006; Madsen and Boertmann, 2008). However, 600 m is widely accepted as the maximum reliably recorded distance for the majority of species (Langston and Pullan, 2003; Drewitt and Langston, 2006). Some caution is needed in interpreting disturbance distances, as the consequences of such disturbance depends on both the availability of alternative habitat and the "fitness cost" of the disturbance event (Gill *et al.*, 2001).

Breeding waders. Studies of breeding birds have indicated smaller displacement distances (eg, Hötker *et al.*, 2006; Pearce-Higgins *et al.*, 2009). However, this may in part be due to the high "site fidelity" (return in consecutive years to the same breeding site or territory) and long life-span of breeding species (Drewitt and Langston, 2006). This may mean that the real impacts of disturbance on breeding birds will only be evident in the longer-term, when new recruits replace (or fail to replace) existing birds.

Passerines. Few studies have considered the possibility of displacement for short-lived passerines. These are the "perching birds" such as sparrows, which account for more than half of all bird species. However, Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in a reference area than within 80 m of the turbines, indicating that displacement in these species can occur. Pearce-Higgins *et al.* (2009) showed displacement of meadow pipits (up to 100 m) and wheatears (up to 200 m) from wind turbines. However, other studies have failed to find evidence to suggest that farmland birds avoid areas close to wind turbines (Devereux *et al.*, 2008).

BOX 11

Possible disturbance impacts during the lifetime of a wind farm

Construction Phase: These may include visual intrusion, noise, vibration, dust and the physical presence of a construction plant, and the presence of personnel associated with works and site security.

Operational Phase: These may include: visual intrusion of the turbines themselves; noise and shadow flicker; turbines and other structures providing vantage or access points for predatory species; the presence of personnel associated with maintenance and site security; and improved access by the public.

Decommissioning Phase: These may include visual intrusion, noise, vibration, dust and the physical presence of a construction plant, and the presence of personnel associated with construction and site security.

Barrier effects

The effect of birds altering their migration flyways or local flight paths to avoid wind farms is another form of displacement known as the "barrier effect". This has the potential to increase energy expenditure (which might have fitness consequences) or may result in disruption of linkages between distant feeding, roosting, moulting and breeding areas (Drewitt and Langston, 2006). The effect depends on a range of factors: species; type of bird movement; flight height and distance to turbines; the layout and operational status of turbines; time of day and wind force and direction. It can be highly variable, ranging from a slight change in flight direction, height or speed, through to significant diversions, which may result in fitness costs or reduce the numbers of birds using areas beyond the wind farm (Drewitt and Langston, 2006).

There is some evidence that wind turbines may act as barriers to movement of some bird species, with birds choosing to fly around the outside of clusters, instead of between turbines (Langston and Pullan, 2003). The cumulative effects of large numbers of wind farm installations may be considerable if birds are consequently displaced from preferred habitat or such detours become significant in terms of energy expenditure (eg, Masden *et al.*, 2010).

Collision mortality

Since the early 1960s it has been known that bats could be killed by collision with wind turbines (Hall and Richards, 1962). However, only in recent years have studies been made of the scale of resulting mortality. Estimates vary between zero and 50 collisions per turbine per year (for review see Hötker *et al.*, 2006). Both migrating and foraging bats from local populations could be vulnerable to collisions with turbines. Bats might be at particular risk if turbines are located close to roost sites, in or near to woodland, hedgerows, rivers or lakes, or within or adjacent to a protected site designated for bats (Natural England, 2009). There is evidence that mortality may increase on nights with low wind speeds (<6 m/sec) and immediately before and after the passage of storm fronts (Arnett *et al.*, 2008). Therefore, mitigation efforts focused on these high-risk periods could be valuable to reduce bat fatalities.

Direct mortality or lethal injury of birds can result not only from collisions with rotors, but also with towers, nacelles and associated structures such as guy cables, power lines and meteorological masts (Drewitt and Langston, 2006). The majority of studies have found low collision mortality rates per turbine (Langston and Pullan, 2003), but in many cases these are based only on chance finds of corpses, leading to under-recording of the actual number of collisions.

A review of the available literature indicates that, where collisions have been recorded, the rates per turbine are very variable, ranging from 0.01 to more than 60 bird collisions annually (Drewitt and Langston, 2008; Everaert and Steinen, 2007). The

Badly located wind farms in Spain have killed griffon vultures.

Collision with wind turbine blades is a risk for certain bird species.

higher figure, relates to birds of a wide variety of species at a wind farm on a mountain ridge in Spain (Lekuona, 2001; Hötker *et al.*, 2006).

This problem of under-recording is noted in a technical report for the USDA Forest Service (Erickson *et al.*, 2005), which compares bird killing rates in the US due to anthropogenic sources. The report estimates that wind turbines were a significantly smaller cause of bird deaths than collisions with buildings, power lines, vehicles and communication towers, or killings by cats or pesticides. The authors note, however, that cumulative bird mortality from all of these sources is a concern. The figures are totals across all bird species; as more wind turbines are installed, total collisions will increase. Moreover, birds of conservation concern may be particularly vulnerable to collision with wind turbines, because of behaviour and location-related variables. Collision rates per turbine and information on vulnerable species are therefore important additional considerations.

Although providing a helpful indication of risk, average collision rates per turbine must be viewed with some caution as they are often cited without information on variance around the mean, and can mask significantly higher rates for individual turbines or groups of turbines (Drewitt and Langston, 2006). Furthermore, as turbine size and output increases, this metric is unsatisfactory as a means of comparison with smaller, older turbine models. In addition, there may be considerable variation in total numbers of collisions associated with wind farms, which may differ greatly in terms of the number of turbines. Smallwood and Karas (2009) have found that mean fatality rates declined substantially with increasing turbine size for most species, though they increased for some bird and bat species. Repowering projects generally killed many fewer birds per MW per year than did the old-generation turbines.

Relatively high collision mortality rates have been recorded at several large, poorly sited wind farms in areas where high concentrations of birds are present (including some IBAs). In particular, migrating birds, large raptors or other large soaring species are at risk (Langston and Pullan, 2003). In these cases, actual deaths resulting from collision at certain poorly located wind farms have been particularly high, notably of golden eagles (USA) and griffon vultures (Spain). Repowering of older wind farms in the USA is beginning to reduce the risks to golden eagles there.

Wind speed and direction, air temperature and humidity, flight type, distance and height, time of day and topography all influence the risk of collision, as do species, age, behaviour and stage of the bird's annual cycle (Langston and Pullan, 2003). All these factors need to be incorporated in collision risk assessments. Collision risk is likely to be greatest in poor flying conditions that affect the birds' ability to control flight manoeuvres, or in rain, fog, and on dark nights when visibility is reduced (Langston and Pullan, 2003). In these conditions, the flight height of migrating birds tends to be greatly reduced. Lighting of turbines has the potential to attract birds, especially in bad weather, thereby potentially increasing the risk of collision, depending on the type of lighting used (Drewitt and Langston, 2008).

Habitat loss

Loss of, or damage to, habitat resulting from the development of wind farm infrastructure is not generally perceived to be a major concern for birds outside designated or qualifying sites of national and international importance for biodiversity (Langston and Pullan, 2003). However, depending on local circumstances and the scale of land-take required for the wind farm and associated infrastructure, the cumulative loss of, or damage to, sensitive habitats may be significant, especially if multiple developments are sited in such habitats. Furthermore, direct habitat loss may be additive to displacement.

The scale of direct habitat loss resulting from the construction of a wind farm and associated infrastructure will depend on the size of the project, but, generally speaking, is likely to be small per turbine base (Drewitt and Langston, 2006). Typically, actual habitat loss amounts to around 2–5% of the total development area (Fox *et al.*, 2006). However, in certain habitats wind energy development might have more widespread impacts, such as through hydrological (eg, disruption of ground-water flow in upland bogs and mires may lead to drying or water-logging of peat) or micro-climatic changes. Habitat loss from associated infrastructure (roads, transformer stations etc.) could also be significant. In a number of documented cases, erosion and large scale slumping has taken place following construction. Even relatively small-scale destruction and fragmentation of priority habitats in protected areas can be significant, for example, Ponto-Sarmatic steppe habitat in Bulgaria and Romania.

Indirect impacts

Improved access to remote areas (through improved access tracks etc.) might lead to increased recreational disturbance and/or an increased risk of predation. Agricultural intensification or changes in land management arising from the increased accessibility of the development site and surrounding areas may result in habitat changes, which may impact on the ability of an area to support birds or other wildlife.

Cumulative impacts

Even where collision rates per turbine are low, this does not necessarily mean that collision mortality is insignificant, especially in wind farms comprising large numbers of turbines or in landscapes with multiple small wind farms. Even relatively small increases in mortality rates of adult breeding birds may be significant for populations of some birds, especially large, long-lived species with generally low annual productivity and long adolescence, notably wildfowl and raptors (Langston and Pullan, 2003).

This is particularly the case for species which are already rare or facing a number of other pressures from environmental and/or anthropogenic impacts. In such cases, there could be significant effects at the population level (locally, regionally or, in the case of rare and restricted species, nationally or internationally), particularly in situations where cumulative mortality takes place as a result of multiple installations (Drewitt and Langston, 2006). For example, there could be cumulative impacts on migratory species where a migratory route passes through the footprint of multiple wind farm sites.

2.3.2 AVOIDING AND MITIGATING RISKS, AND ACHIEVING BENEFITS FOR WILDLIFE

Site selection

All projects need robust, objective baseline studies to inform sensitive siting to minimise negative effects on birds, other wildlife and their habitats, and post construction monitoring at consented installations where there are environmental sensitivities (Langston and Pullan, 2003). There is clearly a distinction to be made between temporary effects (for example disturbance due to construction activities) and those of a more permanent nature. There is also a need to put potential impacts into context, to determine the spatial scales at which they may apply (site, local, regional, national and/or international).

The weight of evidence to date indicates that locations with high bird use, especially by species of conservation concern, are not suitable for wind farm development (Langston and Pullan, 2003). Site selection is crucial to minimising collision mortality. The precautionary principle is advocated where there are concentrations of species of conservation importance that are vulnerable to aspects of wind power plants. Where at all possible, developers should avoid areas supporting the following:

- High densities of wintering or migratory waterfowl and waders, where important habitats might be affected by disturbance, or where there is potential for significant collision mortality.
- Areas with a high level of raptor activity, especially core areas of individual breeding ranges and in cases where local topography focuses flight activity, which would cause a large number of flights to pass through the wind farm.
- Breeding, wintering or migrating populations of less abundant species, particularly those of conservation concern, which may be sensitive to increased mortality as a result of collision or more subtle effects on survival and productivity due to displacement.
- Areas which have been identified as important for birds such as SPAs, SACs, IBAs, Ramsar sites, and Sites of Special Scientific Interest (SSSIs) should all be avoided.

Environmental assessments

Strategic environmental assessments (SEAs) are used by authorities in the development of spatial plans for a range of infrastructure needs, including energy installations. They provide a structured process of analysis and public consultation to integrate environmental protection considerations into plans and investment programmes, to promote sustainability. SEA is discussed in Section 4.5.

Environmental Impact Assessments (EIAs) are undertaken by developers to avoid, reduce and mitigate the impacts of projects, and their findings are taken into account in planning decisions. Potentially significant harmful effects on wild birds identified by an EIA must be addressed. If an impact can be avoided or mitigated then the assessment should identify suitable measures (Drewitt and Langston, 2006). In addition, in the event that the wind farm is consented, the assessment should include measures to compensate for any residual damage not covered by mitigation measures. If a proposed project or plan could significantly affect a Natura 2000 area, stricter “appropriate” assessment procedures and other tests apply (see Section 4.6)

If there are any other projects (including non-wind energy developments) that have been developed or are being proposed in an area where significant effects on an SPA or SAC are likely, then it is required that the assessment should take into account any cumulative effects that may arise from the wind farm development in combination with these other projects (Drewitt and Langston, 2006). SEAs and EIAs require detailed ecological survey data, and often make use of models and other predictive techniques, discussed below.

Modelling collision risks and estimating displacement impacts

Collision risk models enable a standardised approach to be taken to the measurement of the likelihood of collisions where birds take no avoiding action. Models such as the Band model (Band *et al.*, 2007) provide a potentially useful means of predicting the scale of collision risk attributable to wind turbines in a given location. To verify the models, they must incorporate actual (measured) avoidance rates and post-construction assessment of collision mortality at existing wind farms (Langston and Pullan, 2003). To be useful, the models require sufficient data on bird movements (numbers, activity, flight height and angle of approach) throughout the annual cycle and across a range of weather and light conditions (Scottish Natural Heritage, 2005; Drewitt and Langston, 2006).

Assessment of bird collision risk and mortality, arising from collision and electrocution, needs to include wind turbines and associated structures, including overhead power lines transporting energy from the wind farm (Langston and Pullan, 2003). It is recognised that the actual rate of collision is likely to be under-recorded, owing to the limitations of study techniques, particularly corpse searches, so it is essential that calibration is undertaken at each site to enable correction factors to be applied to produce more realistic estimates of collision mortality. Population modelling, or "population viability analysis" (PVA), provides a means of predicting whether or not there are likely to be population level impacts arising from collision mortality (Langston and Pullan, 2003). Population models also require post-construction verification at consented wind farms in light of the observed collision rates.

Spatial models may be useful for estimating displacement impacts, by testing different scenarios. The scale of displacement/effective habitat loss, together with the extent of availability and quality of other suitable habitats that can accommodate displaced birds, and the conservation status of those birds, will determine whether or not there is an adverse impact (Langston and Pullan, 2003). Few studies are conclusive in their findings, often because of a lack of well-designed studies both before and after construction of the wind farm. Furthermore, very few studies take account of differences in diurnal and nocturnal behaviour, basing assessments on daytime only, which is inadequate for those species which are active during darkness and which may behave differently at night, and could be using different areas compared with daytime (Langston and Pullan, 2003).

Sensitivity mapping and location guidance

Wildlife "sensitivity maps" record the locations and movements of species that are vulnerable to the impacts of specific types of infrastructure development, such as power lines or wind farms (Bright *et al.*, 2008). They can be developed at local, regional or national scales, and can be used in a variety of ways by developers, policy makers, regulators and conservationists. They may simply provide information to developers, indicating broad areas in which ecological impacts are likely to be more or less significant. This information can be valuable to financiers and developers when weighing up the planning risks associated with specific proposals or investment plans. In several countries, and many European regions and localities, sensitivity maps have been used in official location guidance for developers, and to inform strategic spatial plans and associated SEAs. Strategic plans and guidance can then be taken into account in regulations and planning procedures. In some countries policy makers encourage developers to locate wind farms in low risk areas, by varying the level or availability of subsidies. Sensitivity mapping is one of the most valuable tools for "positive planning" for renewable energy, and is discussed in detail in Section 4.5.1.

Mitigation

Mitigation measures fall into two broad categories: best-practice measures, which should be adopted as an industry standard, and additional measures, which are aimed at reducing an impact specific to a particular site/development.

Examples of best practice include the following measures:

- Ensuring that key areas of conservation importance and sensitivity, including the Natura 2000 network and IBAs, are avoided.
- Siting turbines close together to minimize the development footprint (subject to technical constraints).
- Grouping turbines to avoid alignment perpendicular to main flight paths and to provide corridors between clusters, aligned with main flight trajectories, within large wind farms.
- Where possible, installing transmission cables underground (subject to habitat sensitivities and in accordance with existing best practice guidelines for underground cable installation).
- Marking overhead cables using deflectors and avoiding use over areas of high bird concentrations, especially for species vulnerable to collision.
- Implementing appropriate working practices to protect sensitive habitats, for example, providing adequate briefing for site personnel and, in particularly sensitive locations, employing an on-site ecologist during construction.

Ecological enhancements are often possible within wind farms.

- Timing construction to avoid sensitive periods.
- Implementing habitat enhancement for species using the site.
- Implementing an agreed post-construction monitoring programme through planning or licence conditions.

At specific sites it may be necessary to prepare a site management plan designed to reduce or prevent harmful habitat changes following construction, and to provide habitat enhancement as appropriate (Drewitt and Langston, 2006). Off-site mitigation or compensation measures may be appropriate to reduce impacts (eg, through provision of alternative foraging areas to reduce collision risk or to accommodate displaced birds). Other measures that may be suitable in some circumstances include the relocation of proposed (or removal of existing) turbines associated with particular problems, halting operation during peak periods of activity or during migration, or reducing rotor speed. For birds with poor manoeuvrability such as griffon vultures, however, it may be that slow rotation speed remains a problem because the associated low wind speed makes flight avoidance more difficult.

Enhancement

Some habitat changes might be beneficial to wildlife, for example changes in land management that enhance particular sites for certain species (providing they are not at increased collision risk, which could outweigh the benefit). Opportunities for enhancement in respect of onshore wind energy generating projects should only be explored after all significant adverse impacts on biodiversity have been removed through negotiation, or through mitigation or, as a last resort, compensation. There is potential to carry out enhancement measures on land which is under the direct or indirect control of the developer, and which may be inside the project boundary. Onshore wind is particularly suited to an "enhancement" approach, for the following reasons:

1 Most major projects are located in either upland or coastal locations, in the remote countryside. These are also the areas which are most likely to contain substantive wildlife resources. They thus have the most potential to be the recipients of enhancement measures because the enhancement builds upon existing resources.

2 The physical footprint of such projects is relatively small, compared with the size of the project, which means that there is great potential to carry out enhancement measures on land which is under the direct or indirect control of the developer, and which may well be actually inside the "development boundary".

Measures such as control of grazing regimes, control of hydrology and conifer (or other exotic tree-species) removal can improve, restore or create upland or coastal habitats of acknowledged biodiversity importance.

Offsite ecological enhancements are also a possibility. Developers of many kinds of infrastructure sometimes provide incentives to local communities. This is sometimes in the form of funding for amenities such as sports facilities or school equipment. BirdLife recommends that creating new wildlife-rich areas, or helping improve existing ones, is an excellent way to benefit communities. Access to green space that is rich in wildlife has been found to be good for people's physical and mental wellbeing (Diaz *et al.*, 2006; Barton and Pretty, 2010), and provides local schools with opportunities for educational experiences.

2.4 OFFSHORE WIND POWER

Although more costly than their terrestrial counterparts, offshore wind farms have a number of advantages. Winds at sea tend to be stronger and more consistent, and weighty turbine components are more easily transported at sea, permitting larger turbines to be constructed. In addition, offshore wind farms typically encounter less resistance from local communities. However, the costs of installation at sea are greater than those on land, so larger installations are usually proposed. Some major differences with onshore development are the greater scale and pace at which offshore wind farms are planned in some countries such as the UK, and the relatively poor availability of ecological survey data and incomplete networks of Marine Protected Areas (MPAs).

Birds, fish and marine mammals may be disturbed or damaged by the construction of offshore wind farms, the movement and vibrations of operating turbines, and the activity of servicing craft. Once established, however, offshore wind farms have the potential to protect wildlife from other impacts, potentially providing safe havens for spawning fish, for example. Trawling, which is possibly the most severe threat to the marine environment, is prohibited or inhibited inside offshore wind farms.

Risks to birds, mammals and fish can be classified in the same way as those for onshore wind turbines, ie, disturbance/displacement, collision and habitat loss. Pollution and indirect impacts associated with construction and operations may also present risks.

Noise created by wind farm installation is a risk to marine mammals such as dolphins.

As with onshore developments, the risks may be small for individual developments, but significant in combination with other developments and as cumulative impacts of multiple developments.

2.4.1 MAIN CONSERVATION RISKS

Disturbance/displacement

Noise has the potential to cause short- and long-term impacts (Gordon *et al.*, 2007). It is a potential source of disturbance to cetaceans and could lead to displacement from an area and therefore loss of access to potentially important habitats. There is considerable concern that there might be a high risk of hearing damage in the vicinity of pile-driving and that animals will be able to hear and therefore be displaced by noise over large areas of sea (for more detailed review see Gordon *et al.*, 2007).

The impact of noise on marine mammals can be divided into three levels (BERR and DEFRA, 2008): those that cause fatal injury; those that cause non-fatal injury such as deafness and other auditory damage such as "temporary threshold shift"; and those that cause behavioural change (eg, avoidance, cessation of feeding). Available information suggests that species of marine mammals will show a strong avoidance reaction to sound levels of 90 dBht (species) and above (BERR and DEFRA, 2008).

While there are data demonstrating that construction noise will have effects on mammals and fish, which can detect pile driving noise over considerable distances, there are very few equivalent data available on birds. We can assume, however, that the most likely response is avoidance, and that noise may also have an impact on the availability of prey species of fish. Levels of marine noise are likely to be greatest during installation, especially from pile driving. However, mitigation measures to attenuate noise levels are estimated to reduce the distance at which noise from pile driving could affect marine mammals by at least 66% (Nehls *et al.*, 2007), and so presumably would also reduce any impacts on birds.

There is now evidence from operational offshore wind farms that densities of some bird species decline in the vicinity of offshore installations (Garthe and Hüppop, 2004; Desholm and Kahlert, 2005). In particular, divers and sea ducks have been shown to be displaced by up to 2–4 km from wind farm areas. This may have implications for foraging success, hence for individual survival and breeding success, and, in breeding birds, provisioning rates (the number of visits adults make to the nest with food). However, there is evidence that, at least for common scoter, birds displaced during the first few years after construction may return to using the wind farm area at similar densities to those present outside the wind farm. It is unclear to what extent food availability may have affected use of the wind farm area (Petersen and Fox, 2007). Evidence for divers so far does not indicate recovery of use of vacated areas and further spatial analysis is necessary to determine cause and effect. The magnitude of impacts will be determined in part by the extent and suitability of alternative habitat, and so the cumulative impact of multiple developments is an extremely important consideration.

Offshore wind farms may also cause "barrier effects", creating a physical or perceptual disruption to functional links, for example, between breeding and feeding areas or causing diversions of migrating birds (eg, Desholm and Kahlert, 2005; Madsen *et al.*, 2010).

The installation of submerged fixed structures such as support piles and anchor plinths and associated underwater substations and power cables may cause considerable disturbance to the seabed, for example, trenching for cables could cause disturbance from the turbines all the way to the shore. The level of impact will depend to a large extent on the method of installation, the sensitivity of seabed substrates/habitats and the species present in the area.

Collision risk

During installation and decommissioning, some collision risk with vessels is possible, such as boats and helicopters (McCluskie *et al.*, unpubl.). While collisions with installation vessels are likely to occur to the same extent as with other marine vessels, those involved in turbine construction are more likely to be stationary or moving slowly in comparison with other commercial vehicles. Overall there is a lack of empirical data to evaluate the risk (Wilson *et al.*, 2006).

It can be assumed that "rafting" bird species (those swimming on the surface, often in large groups), particularly those that do so at night, are more at risk of being hit by installation vessels than those that roost overnight on land (Daunt, 2006). Similarly, since the danger of collision with turbines is potentially greater at night or during periods of poor visibility, it is likely to increase with species that spend a higher proportion of time flying at night. There is evidence that in good light or weather conditions there is a considerable degree of avoidance of wind turbines at sea (eg, Garthe and Hüppop, 2004; Desholm and Kahlert, 2005).

Experimental studies at the Danish Tunø Knob offshore wind farm and the surrounding area indicated that wintering common eiders reacted to the visual presence of the wind turbines independently of whether or not the turbines were rotating (Larsen and Guillemette, 2007). Not all species however, show such a large degree of avoidance, and species such as gulls and terns, which spend a high proportion of flight time at turbine blade height, might be at considerable risk of collision (Everaert and Stienen, 2007).

Disturbance of the seabed during construction may result in an increase in suspended sediment levels and a consequent increase in turbidity. Diving birds' risk of collision with installation machinery may be raised by any increased turbidity associated with the installation, although the response to other non-visual cues, such as vibration, may compensate for the lack of visibility (McCluskie *et al.*, unpubl.). Furthermore, the reduced visibility caused by increased turbidity during installation could have effects on foraging success; marine birds are thought to have a high sensitivity to reductions in visibility (Strod *et al.*, 2008), although in all but the largest developments any such impacts are likely to be relatively short-lived.

Collision risk can also affect marine mammals. Harbour porpoise and bottlenose dolphin are the cetaceans most commonly encountered and described as part of offshore wind farm projects

(BERR and DEFRA, 2008). Harbour porpoise are by far the most abundant (Hammond *et al*. 2002). While there are no accurate records of the number of incidents of accidental collisions between marine mammals and shipping in UK waters, it is considered that a direct relationship exists between shipping intensity, vessel speed and the number and severity of collisions (eg, Hammond *et al*., 2003).

Habitat loss and indirect effects

Changes in food availability could be associated with displacement from preferred habitats, or through losses due to temporary or more permanent alterations in seabed communities. For example, pile driving is known to have significant adverse affects on fish (Hasting and Popper, 2005; Thomsen *et al*., 2006; Mueller-Blenkle *et al*., 2010). There are particular concerns over impacts on local sand eel populations, which are the prey species for a number of seabird species of acknowledged conservation concern. In addition, more permanent damage to important sea bed communities could occur, either directly during the construction of turbine bases, or indirectly through smothering of neighbouring habitats by sediments mobilized during installation (Gill, 2005), resulting in loss of foraging resources.

Pollution

Pollution can occur through the disturbance of contaminated sediments, and through oil and hydraulic fluids leaking or leaching from construction vessels and associated plant. Pollution incidents can poison birds and other marine life, oil feathers and they may result in negative changes to water quality (McCluskie *et al*., unpubl.).

Fine-grained benthic sediments tend to accumulate contaminants reducing the toxicity to aquatic organisms (McCluskie *et al*., unpubl.). The physical disturbance of these sediments can lead to changes in the chemical properties of sediments, and can in turn stimulate the mobilisation of contaminants (Eggleton and Thomas, 2004). The increase in toxic contaminants and possible accumulation in prey species may have implications for seabirds.

2.4.2 AVOIDING AND MITIGATING RISKS, AND ACHIEVING BENEFITS FOR WILDLIFE

Baseline surveys and targeted pre-construction studies

Adequate ecological survey data is unavailable for most offshore areas, and previously unknown bird concentrations may be identified during data collection. Year-round baseline data collection, over a minimum of two years, is needed for all species (not just those thought to be the most likely priority species) in potential development zones and other areas proposed for wind farm development, to cover breeding and non-breeding distributions (Langston, 2010). Spring and autumn surveys are needed to detect significant migration movements of seabirds, waterbirds and passerines (Langston, 2010).

Radar is a valuable tool in some cases, calibrated with visual observations, for example, in assessing migration activity or tracking movements of individual species groups such as geese and swans (Langston, 2010). Once the range of species present in each wind farm proposal area has been established, from a combination of existing information and baseline surveys, further studies should focus on addressing specific questions for priority species relevant to each zone or application area, to inform the project EIA and to improve understanding of the potential environmental effects of offshore wind farms (Langston, 2010). The scoping stage of EIAs is crucial to ensure that resources are targeted at the most relevant species. Such studies should include tracking individual birds to establish foraging areas in relation to specific coastal breeding colonies, SPAs, and particular development areas.

Understanding foraging associations with particular environmental features in the oceans is essential for identifying offshore feeding aggregations, for designation of marine SPAs and for risk assessment of offshore wind farms (Langston, 2010). It is likely that multidisciplinary approaches will be necessary, together with combinations of techniques. For example, surveys of distribution and abundance alone are inadequate to determine the importance of a feeding location without also knowing which colony or colonies are the sources of feeding aggregations.

Research on migrations and foraging destinations for a range of seabirds have been carried out using satellite tracking and data loggers (Langston, 2010). Further studies at different breeding colonies would greatly enhance our understanding of connectivity between specific colonies and foraging areas. This would provide essential information for EIAs of offshore wind farms.

Modelling is likely to be a valuable tool for identifying environmental determinants of bird distributions at sea as part of the risk assessment process (Langston, 2010). Spatial prediction models can be used to estimate impacts of displacement at a population level. For example, Skov *et al.* (2008) used landscape, topographic, hydrographic variables and data on prey availability to estimate impacts of Horns Rev wind farm (Denmark) on divers and common scoters.

Spatial planning and site selection

Spatial planning of offshore wind development should, logically, begin after thorough surveys have been completed and MPAs have been designated. However, SEA has been used in the North Sea to identify development zones, taking into account available ecological survey data and other factors such as average wind speeds, water depth and other constraints such as shipping lanes. In the UK, the process of Offshore Energy SEAs has enabled the industry to develop rapidly and with reduced risks to wildlife, although in this instance ecological data was considered of lower priority compared with so-called "hard constraints" such as shipping lanes, oil and gas platforms etc. In addition, given the poor quality of underlying data there is a significant risk to developers that previously unidentified and strictly protected bird species will be identified during EIA survey work.

Mitigation and enhancement measures

Location remains the most important mitigation measure, so spatial analysis of bird distribution data in relation to environmental variables is likely to provide the most productive tool for refining the siting, design and layout of offshore wind farms, in conjunction with information on constraints to turbine placement. Enhancement measures offshore encompass designation and implementation of conservation measures in MPAs, and safeguarding prey species (fish stocks, spawning areas). Enhancement measures onshore apply to seabird breeding colonies, including predator control and/or protection from predators, and management measures to control or reduce disturbance to breeding and non-breeding/wintering birds.

Monitoring and research. Discrete surveys could be used to add value to our knowledge of seabird distribution and movements. These could perhaps be funded through existing statutory monitoring programmes for MPAs or could be stand alone projects. Other projects could be focussed on filling gaps in knowledge (eg, European Seabirds At Sea data), or through contribution to seabird tracking studies, either stand-alone or through providing additional resources for ongoing work such as the Future of the Atlantic Marine Environment (FAME) project (See Box 25).

MPA management funding. Where renewable development is adjacent to existing or new MPAs, contribution might be made towards designation, management, monitoring and surveillance of such sites.

Conservation (plus onshore benefits). These might include contribution to the delivery of the seabird conservation species action plans, or funding of initiatives such as predator removal (eg, rat eradication on seabird breeding islands) and improved management of breeding colonies (eg, vegetation control). There may be potential to secure terrestrial habitat gains for biodiversity at the onshore terminus of cabling landfall, or ancillary developments (substations etc.).

Reef effects and marine no-take zones. Whilst it may not be possible for operators to exclude all fishing activity within their sites, it is likely that the presence of the turbines and underwater infrastructure will reduce fishing activity to some degree. The formation of marine reserves, where fishing is prohibited, has been shown to increase fish density, diversity and abundance not only within no-take zones but also in adjacent areas (for review see Langhamer *et al.*, 2010). The development of wind farms might benefit some marine species, for example there is evidence that the hard substratum of monopiles and scour protection can lead to the establishment of new species and fauna communities (Lindeboom *et al.*, 2011).

Human Resources. The training and/or employment of marine ecologists, people engagement officers and related staff might offer wider benefits to marine species.

Once operational offshore wind farms may be good news for fish.

2.5 TIDAL STREAM AND WAVE ENERGY

Wave power devices are designed to absorb the energy from waves and convert it to electricity. There are three main types of wave technology: buoyancy devices, fixed or semi-fixed pressure differential devices and channelling devices. Wave energy is an emerging technology, with the potential to supply a very significant amount of renewable electricity. For example, theoretically the wave power resource around the UK's coast is more than twice UK electricity consumption. The greatest potential is in the Atlantic seas, for example off western Scotland and Portugal. Test centres for wave power technologies have been established in both countries.

Tidal power also has the potential to generate significant quantities of energy. BirdLife has serious concerns regarding ecological impacts where this is exploited by impounding water at high tides and then releasing it through "high head" barrages (large dams). Tidal barrages of this kind were discussed in Section 2.1. Here the focus is on more innovative and potentially less risky technologies that make use of energy in tidal streams.

Currently, there is limited experience of operational wave and tidal devices at sea and hence little information about their impacts on marine birds (McCluskie *et al.*, unpubl.). Therefore, this section makes inferences about potential effects derived from existing knowledge of marine processes and engineering, as well as bird ecology and behaviour. Fish and marine mammals may also experience risks and/or benefits where tidal stream or wave energy devices are installed, but this section does not attempt to address these for the same reasons.

2.5.1 MAIN CONSERVATION RISKS

Marine birds can be potentially affected by tidal stream or wave energy devices in a number of ways. These may be direct (eg, from the device itself) or indirect (eg, reducing visibility through increased turbidity), they may be adverse (eg, collision mortality) or beneficial (eg, creation of new foraging habitat). Additionally, the impacts may be temporary or long-term, and last the lifetime of the device or beyond. In most cases, little or nothing is known about the likelihood of occurrence or scale of potential impacts. An understanding of potential cumulative effects will also be vital (McCluskie *et al.*, unpubl.).

Collision risk

Wave and tidal devices are likely to present much smaller collision risks to birds than wind turbines (Grecian *et al.*, 2010), with the risk related to species, size and location. It has been argued that nocturnal and crepuscular species may be more vulnerable to collision (Daunt, 2006), but such species often have enhanced visual capabilities, and this may make them more able to respond to the presence of devices.

Collision may occur above or below the water surface, and risk to diving birds could be a concern. Little information exists regarding collision risk of animals with underwater structures (Wilson *et al.*, 2006; Inger *et al.*, 2009; Grecian *et al.*, 2010), and collisions are more poorly understood for birds than other species groups (Wilson *et al.*, 2006). This lack of knowledge has meant that few mitigation measures have been developed. Wave and tidal stream devices with rotating turbines are likely to pose a greater threat to birds than those without such blades (McCluskie *et al.*, unpubl.).

While in many ways analogous to both wind turbines and the propellers on ships and boats, turbines of wave and tidal devices spin at considerably slower speeds (at or below 12 ms-1) which may pose a lower risk of injury, although this may not apply to less manoeuvrable species. The burst speed of birds, while considerably slower than the speed of the turbine blade tip (Fraenkel, 2006), is thought to be fast enough to enable escape from the path of the blades under many situations (Wilson *et al.*, 2006). The majority, though not all, devices have fairly narrow turbine blades, which will further reduce the risk of collision injury (McCluskie *et al.*, unpubl.).

The response of birds will depend on their detection of a device and any associated structures; whether it is detected above or below the surface and how close they are before detecting it (McCluskie *et al.*, unpubl.). Fixed structures are likely to be less risky than mobile structures, such as anchor chains and cabling. The risks will be greater when birds are diving for prey, therefore the highest risk is when devices are located within the foraging range of diving species.

Devices with a surface presence will be more likely to be detected before a dive commences than fully submerged devices, which may not be detected before avoidance behaviour can be initiated (McCluskie *et al.*, unpubl.). Devices that are not detected until the bird itself is in the water will probably be avoided to some extent, depending on when detection occurs, which in turn is influenced by the nature of the environment and foraging behaviour of the species, eg, plunge diving birds may have less time to react and less ability to avoid collision than pursuit feeders. The risk of collision may be increased if the devices alter the characteristics of currents, since this may impact on the manoeuvrability and agility of birds in the water.

Entrapment

A number of structural elements of offshore energy devices, particularly turbine housing, articulations and mooring equipment, may entrap and kill seabirds (McCluskie *et al.*, unpubl.). In studies of the impact of fisheries on sea birds, pursuit diving species, particularly auks (eg, puffins), are most at risk of entrapment in gill nets and other fixed gear (Tasker *et al.*, 2000).

Disturbance/displacement

Disturbance is initially likely to be a temporary impact associated with construction activities. However, its effects may continue for several years for some species/location combinations (McCluskie *et al.*, unpubl.). The most probable response will be avoidance. Unlike tidal barrages, which can cause significant habitat losses (Clark, 2006; Fraenkel, 2006), other offshore renewable devices are thought to present a high risk only when inappropriately sited in relation to certain species groups, such as sea ducks (Inger *et al.*, 2009). These risks will vary depending on the type and size of installation, location and whether they are situated in degraded or good quality habitat.

Offshore wave power devices could contribute to underwater noise that disturbs sea mammals and fish. It is likely that any effects on birds will depend on both species and location. It is important that wave power developers avoid, wherever possible, concentrations of feeding and breeding seabirds and other wildlife where harm may occur. Shoreline wave devices are likely to have fewer impacts on marine species but should also be sited to avoid important bird breeding colonies and feeding areas. Thorough environmental assessment and monitoring are needed to avoid any such problems. BirdLife encourages the development of devices that produce the least noise possible, and with moving parts that minimise oil spill risks and do not endanger wildlife.

Indirect effects

As well as increased turbidity and risk of disturbance of contaminated sediments, there is evidence that seabirds are often attracted to large offshore structures (Wiese *et al.*, 2001). There is a well established body of literature detailing the tendency for a large number of fish species to aggregate around and beneath floating objects (Castro *et al.*, 2001). It is likely that energy generating devices attached to the seabed but free to float at the surface will act as such an attractant. It is unclear whether the effects of this on seabirds will be positive or negative. Since the greatest possibility of underwater collision is when devices are located within foraging areas, there is a potential problem in the creation of good foraging areas around devices; in other words attracting fish to a device would increase the risk to birds and mammals of collision or other terminal impacts.

2.5.2 AVOIDING AND MITIGATING RISKS, AND ACHIEVING BENEFITS FOR WILDLIFE

Tidal energy schemes could benefit some birds' ability to look for food: they may provide refuges from which other human activity, such as fishing and recreation, is excluded. This could lead to new spawning grounds and nursery areas for fish, and therefore better feeding areas.

Wave or tidal power devices that are visible from the air may be lower risk for diving birds.

For the EIA of any proposed marine renewable development, information on the use of the development site and surrounding areas by seabirds is essential. In order to obtain these data, surveys must be carried out, and these will then be used to determine potential receptors and impacts. Surveys should not only be of the "impact" area, but should also provide ecological context, and so the methods used for survey must be carefully considered (McCluskie *et al.*, unpubl.).

Seabird distribution is stochastic – densities and behaviours are highly variable and therefore need to be surveyed with a high spatial and temporal resolution. Understanding the mechanisms of this natural variability is vital for any assessment of whether a development has caused changes in bird behaviour or distribution. Therefore, distribution patterns need to be described in a context of geographical and oceanographic influences, as well as the effects of food supply and anthropogenic activity (McCluskie *et al.*, unpubl.).

Mitigation and enhancement measures

Given the diversity of technologies competing in the wave and tidal stream sectors, and lack of robust evidence regarding potential ecological impacts, it is not possible to identify generic mitigation or enhancement measures here.

Location remains the most important mitigation measure, so spatial analysis of bird distribution data in relation to environmental variables is likely to provide the most productive tool for refining the design and layout of offshore renewables. Enhancement measures offshore encompass designation and implementation of conservation measures in MPAs and safeguarding of prey (fish stocks, spawning areas). Enhancement measures onshore apply to seabird breeding colonies, including predator control and/or protection from predators, and management measures to control or reduce disturbance to breeding and non-breeding/wintering birds. See section 2.3.2 for more detailed discussion of the various options for mitigation and enhancement in the marine renewables sectors.

2.6 BIOMASS FOR HEAT AND POWER

Bioenergy has a vital role to play in moving towards a low carbon economy, but it is also a limited resource that needs to be produced and deployed in the most efficient and sustainable way possible. This requires understanding the availability and competing uses of different sources of bioenergy; their greenhouse gas efficiencies; the potential environmental impacts of their production and use; and the best ways to deploy them in the energy system. In addition to domestically produced material, a large range of feedstocks are already imported for energy use in Europe from a variety of sources, and volumes of feedstocks are set to increase dramatically as renewable energy targets and incentives in Europe and elsewhere drive up demand for such resources.

Biomass for heat and power is included among the "medium risk" technologies here on the basis that feedstocks can be produced sustainably and in significant quantities. Importation of feedstocks from outside Europe, however, presents significant risks as it will often be very difficult or impossible to monitor associated ecological impacts. In some countries such as the UK rapid expansion of biomass for electricity generation, usually without use of waste heat, has caused significant concern because the fuel required will greatly exceed what could be produced domestically (RSPB, 2011).

Bioenergy is often referred to by the industry as "carbon neutral", as growing plants absorb carbon dioxide and then release it back into the atmosphere as they are burnt as fuel in vehicle engines, boilers, stoves or power plants. However, the full life-cycle emissions of different bioenergy types can vary dramatically, and the "carbon payback time" (Gibbs *et al.*, 2008) or "carbon debt" (Fargione *et al.*, 2008) for some liquid biofuels and even some wood fuel (Zanchi *et al.*, 2010) can be decades or even centuries (see Chum *et al.*, 2011 for an IPCC review). Furthermore, emissions from combustion of the biomass itself are not adequately captured in international carbon accounting rules.

Bioenergy produced from many kinds of wastes or harvested from sustainably managed woodlands in Europe may deliver good greenhouse gas benefits, compared with fossil fuels. Some dedicated bioenergy crops, however, may generate significant greenhouse gas emissions from direct or indirect land-use change, the use of inputs such as fertilisers and pesticides, harvesting/processing and transportation.

There are also many potential end uses for bioenergy. It is far more efficient to use biomass to generate heat and power in dedicated boilers, for example, than to use liquid bioenergy in cars. As a result, it makes more sense for the climate if we use bioenergy supplies to power our homes and businesses than to power vehicles. BirdLife has serious concerns about the ecological risks associated with the production of liquid biofuels (Sections 2.1 and 3.3).

The main classes of biomass ("feedstocks") currently used in energy production are forestry products, dedicated energy crops, agricultural residues, waste streams (including food and industrial waste, animal manures, sewage sludge and waste wood) and by-products/co-products from other production processes (Gove *et al.*, 2010). The conservation risks and benefits vary greatly between feedstocks, and therefore the review below deals with each feedstock type in turn.

2.6.1 MAIN CONSERVATION RISKS

Each feedstock type has advantages and disadvantages associated with its production. In this section feedstock types will be dealt with separately. The issues of indirect land-use change and by-products and co-products are also considered.

Timber products and forestry waste

Resources available for bioenergy include wood harvested from forests but unsuitable for timber production (eg, stems, branches and brash, poor quality roundwood, deadwood and diseased trees), sawmill by-products and arboricultural arisings from municipal activities. It is possible that high subsidies for energy use could lead to higher-quality roundwood also being used for energy. The expansion of the forested area and an increase in the management of existing woodland might have both positive and negative impacts on biodiversity (Gove *et al.*, 2010).

An increase in the structural diversity of European woodland due to more active management will be likely to benefit much woodland wildlife, and to make woodland more resistant to the potential impacts of climate change (Fuller *et al.*, 2007). Careful management of woodland should allow for varying stand structures. Increased forest management (in a European context) will hopefully mean the reinstatement of the coppice cycle in neglected woods and its introduction, if appropriate. Regular felling and re-planting might be expected to serve a similar function in some regions (providing the scale is appropriate at the landscape level). This will generally benefit those species particularly associated with early successional habitats (Helle and Fuller, 1988) or open habitats within woodland such as rides, heath and grassland (Forestry Commission, 2007).

Increased overall management of forests might result in a reduction in "old growth" conditions (more often found in the east of Europe), and may therefore have a negative impact on species adapted to these habitats (Gove and Bradbury, 2010). However, the vast majority of woodland in the west of Europe has a long history of management, and therefore the number of species associated with old growth forest interiors is rather limited. Careful management of these forests should provide sufficient dead wood and preserve areas of mature trees and high forest to lessen these potential impacts. However, if forest biomass is derived from undisturbed primary forests the impacts on biodiversity are likely to be high. Although selective cutting and "continuous cover forestry" are probably less harmful to forest ecosystems than clear cutting, their effects on biodiversity remain largely unexplored.

Dead wood provides food for woodpeckers.

The removal of arisings and residues from woodland could have adverse impacts on the habitat and resources available to a wide range of wildlife. Impacts have been observed on microbial organisms (Kappes *et al.*, 2007); bryophytes and lichens (Humphrey *et al.*, 2002); invertebrates (Kappes *et al.*, 2007); fungi (Ferris *et al.*, 2000; Humphrey *et al.*, 2000); saprophytic beetles (Jonsell *et al.*, 2007); small vertebrates, including bats (EEA, 2006; Forestry Commission, 2007), as well as fungi and detritivores (Lonsdale *et al.*, 2008). Many of these species are at risk and some provide important roles in forest ecosystems. Similarly, the removal of deadwood could have an impact on a number of species that depend on itor species associated with it for food, for example woodpeckers (Forestry Commission, 2007; Paltto *et al.*, 2008).

Biomass crops

In general, the positive biodiversity impacts of energy crops are dependent on careful planning and good management of plantations. Species and varieties used, planting regimes, structural density and the level of floral cover are all likely to be important, with a potential conflict between maximum yield and biodiversity value.

Management of the crop will be central in establishing longer-term benefits (eg, rotation of cropping to allow open and closed habitat to both be present, linking harvest to the breeding regimes of sensitive species) (EEA, 2006; Semere and Slater, 2007a; Bellamy *et al*., 2009). Ultimately, genetic improvement of feedstock varieties and crop management techniques that attempt to maximize biomass production and simplify crop vegetation structure will be likely to reduce the value of perennial biomass plantings to bird populations (Robertson *et al*., 2011b).

Most studies have compared biomass crops to arable farmland systems. However, no energy crop compares well to hedgerows and other semi-natural habitats – eg, ancient woodland, wet meadows, hedgerow, scrubland and unimproved grassland (Semere and Slater, 2005; EEA, 2006; Sage *et al*., 2006; Woods *et al*., 2006; Rowe *et al*., 2009). In comparative studies of biodiversity in energy crops and other land uses, the intensity with which the arable/grassland control is managed can have an effect on the apparent benefits of perennial crops (Cunningham *et al*., 2006). Therefore, the land use that it replaces will be paramount in predicting its impact. Importantly, if energy crops replace set aside or other land uses rather than crops or intensive grassland, the impact on biodiversity is expected to be negative. There is also a possibility that plantations will be concentrated on land with a lower agricultural value, some of which has a high existing biodiversity value.

Many of the benefits associated with farmed land are linked to field structure, with most biodiversity found at the margins and in boundaries (Semere and Slater, 2005; 2007a). Greater floral establishment, a larger numbers of bird species and higher densities of male breeding birds are all found at the edges of plantations (Semere and Slater, 2005; 2007a; EEA, 2006; Sage *et al*., 2006; Rowe *et al*., 2009). Maximum biodiversity benefits would be obtained from a patchwork of relatively small plantations mixed with arable and grass crops (Cunningham *et al*., 2006; Defra, 2006), which maximise edge effects. Similarly, retaining headlands and field margins will have a beneficial effect, allowing species with a variety of habitat requirements to exploit those areas (Cunningham *et al*., 2006). In addition, energy crops have the potential to act as a buffer to vulnerable habitats (Cunningham *et al*., 2006; EEA, 2006; Woods *et al*., 2006), and possibly in providing corridors linking isolated habitat fragments.

There have been no studies to date of the potential cumulative impacts of dedicated energy crops. In particular, there could be impacts on vulnerable open-field species and displacement of farmland specialists if sizeable stands are planted or the density of the crops in the landscape is high. Species such as yellow wagtail, skylark or grey partridge, for example, might suffer (Bellamy *et al*., 2009). Woodland specialists are unlikely to establish in energy crop plantations, which are more likely to be colonised by species of disturbed or edge habitats. Perennial biomass feedstocks have the potential to provide post-breeding and migratory stopover habitat for birds, but the placement and management of crops will be critical factors in determining their suitability for species of conservation concern (Robertson *et al*., 2011a). European energy crops do appear to be valuable to migrant warblers, as well as several species of conservation concern including kestrel, woodcock, dunnock, woodlark and snipe (Sage and Robertson, 1994; Rowe *et al*., 2009). The potential benefits and risks to biodiversity are therefore heavily dependent on location, plantation design, management and scale, especially with respect to sensitive or vulnerable species.

Perennial grass crops

Understanding the impacts of the cultivation of perennial grasses, such as *Miscanthus*, is limited due to the small number of field trials that have been undertaken to date. The few studies conducted in the first years of crop growth indicate higher microbial, floral, invertebrate, avian and mammalian biodiversity (in terms of both abundance and number of species) in *Miscanthus* fields compared with arable crops (Semere and Slater, 2005; 2007a; 2007b; Bellamy *et al*., 2009; Rowe *et al*., 2009; Smeets *et al*., 2009). The higher species diversity has been shown to be related to the greater patchiness and weed flora in *Miscanthus* fields, which provides seed resources as well as habitat for invertebrates and therefore food for birds and other species, as well as cover, refuges and micro-climates (Bellamy *et al*., 2009). However insect prey resources for birds associated with *Miscanthus* itself were lower compared with wheat crops.

Perennial plantings of switchgrass have also been shown to support greater diversity and biomass of arthropods and avian richness was higher in perennial plantings with greater forb content and a more diverse vegetation structure compared with annual crops (Robertson *et al.*, 2011b). However, not all perennial grasses are equal in terms of wildlife value, with *Miscanthus* plots appearing to attract more biodiversity than those of reed canary grass or switchgrass (Semere and Slater, 2005; 2007b), although reed canary grass itself supported a larger number of invertebrate species than *Miscanthus*.

Miscanthus has been shown to provide a habitat for some ground-nesting species at certain times of the year, and a general foraging resource and cover over winter for a wider range of species (Semere and Slater, 2005; 2007a; 2007b; Sage *et al.*, 2006; Bellamy *et al.*, 2009). Studies to date do not provide information on breeding success and population effects, and the survival and fecundity of species associated with mature energy crops remains unknown (Sage *et al.*, 2006). Some Red and Amber List bird species (such as skylark and reed bunting) have been found in slightly higher numbers in *Miscanthus* compared with arable fields, either as residents or using it occasionally in summer or winter (Bellamy *et al.*, 2009). One particular concern is that the crops might act as breeding sinks, appearing early in the season to be suitable breeding habitat encouraging breeding attempts, but then growing extremely rapidly, quickly becoming unsuitable and so leading to nest failure. Bird use of Miscanthus in summer and winter is likely to be variable, affected by region, weediness, crop structure and patchiness (Sage *et al.*, 2010).

Most investigations of the ecology of *Miscanthus* to date have focused on a small number of field trials, with many of the stands having poor establishment and resulting in weedy crops. It is therefore not clear what level of floral and faunal diversity would be present in well-colonised or mature stands (Semere and Slater, 2005; 2007a; Sage *et al.*, 2006; Bellamy *et al.*, 2009; Rowe *et al.*, 2009). No mature *Miscanthus* stands have been studied (all plots were less than five years old), but they are not expected to be as attractive to biodiversity as younger plantations, based on current findings, as most weed flora become shaded out as the crop develops (Semere and Slater, 2007a; Bellamy *et al.*, 2009; Rowe *et al.*, 2009). The cultivation of perennial grasses is relatively new and as farmers gain experience in their cultivation and improved varieties become available, the density and uniformity of the crop is likely to increase and weediness will be reduced, thus making them less attractive for wildlife in general.

Short rotation coppice

Short rotation coppice (SRC) appears to support a higher abundance and diversity of species than arable and improved grassland (Cunningham *et al.*, 2006; EEA, 2006; Sage *et al.*, 2006; Woods *et al.*, 2006; Rowe *et al.*, 2009). Studies have found a higher floral and associated invertebrate diversity in SRC compared with arable crops (Britt *et al.*, 2002; Cunningham *et al.*, 2006; Defra, 2006; Rowe *et al.*, 2009). Many of the species recorded are of low conservation concern, however, for example high densities of common nettle or bramble. The reduced ground disturbance and less intensive weed control associated with the crops may, over time, lead to the development of more diverse plant communities than those associated with annual arable crops, although this will depend on the available seed resource, which itself is related to previous land use and location.

Positive overall effects on avian diversity have been found when SRC is grown within the farmland landscape. The density and number of bird species recorded is higher than arable land, with particular benefits for scrub and woodland species (Britt *et al.*, 2002; Cunningham *et al.*, 2006; Defra, 2006; Sage *et al.*, 2006; Rowe *et al.*, 2009). However, many of the species recorded are of low conservation concern – such as blackbird, sedge warbler and chaffinch (Britt *et al.*, 2002; Hardcastle, 2006). Crucially, whilst the use of SRC by birds for foraging and shelter has been established, less is known about the use of SRC for breeding, so without further study the long-term impact of large scale SRC plantings on avian biodiversity are unclear (Sage *et al.*, 2006; Rowe *et al.*, 2009). Nonetheless, some species of high conservation concern have been shown to hold territories in the breeding season (eg, bullfinch, reed bunting and song thrush) (Defra, 2006; EEA, 2006; Sage *et al.*, 2006) and SRC provides winter cover for many species (EEA, 2006), with snipe, woodcock, redwing and fieldfare being recorded (Sage *et al.*, 2006).

SRC fields harvested in winter/early spring can be attractive to species favouring open countryside, with studies recording skylark, lapwing and meadow pipit (Sage and Robertson, 1994; Defra, 2006; Sage *et al.*, 2006; Rowe *et al.*, 2009). However, the availability of this habitat to birds will depend on the harvest time of the crop, which may vary geographically.

Short rotation coppice could displace birds such as Montagu's harriers.

Overall, large-scale planting of SRC is expected to have a negative impact on open habitat species (Cunningham *et al*., 2006; EEA, 2006; Rowe *et al*., 2009). There is a potential for locally occurring farmland specialists to be displaced (eg, yellow wagtails, grey partridges, or stone curlews) (Sage *et al*., 2006; Rowe *et al*., 2009). Less widespread species are particularly vulnerable. For example, if SRC replaced arable land, stone curlews, Montagu's harriers and quails might be at risk; and if it replaced grassland, breeding waders such as lapwings would most likely be negatively affected (Sage *et al*., 2006). Therefore, it will be important to avoid the habitats of vulnerable species when planning plantations.

The value of SRC as habitat appears to change over time, with the greater structural complexity of older stands attracting a higher number of species as a perennial ground flora is able to develop (Cunningham *et al*., 2006; Rowe *et al*., 2009). There may be a trade-off between value for wildlife and productivity (yield), such that maximum biodiversity benefits may require a compromise in terms of profit. However, it may be possible to incorporate management techniques (eg, harvesting in a cycle which allows a maximum density of breeding birds, installation of nest boxes, sowing of perennial ground flora) that attract support through agri-environment payment schemes (Cunningham *et al*., 2006; Sage *et al*., 2006; Rowe *et al*., 2009).

Short rotation forestry (SRF)

Positive overall effects on bird species richness and diversity, similar to those found in SRC, have been observed if SRF is grown within a farmland landscape, with particular benefits for species typically associated with scrub, hedgerows and woodland (Hardcastle, 2006). As with SRC, many of the species recorded are of low conservation concern (Britt *et al*., 2002; Hardcastle, 2006).

Species that feed on litter and soil-dwelling invertebrates are likely to benefit, for example, woodcock and snipe, as are insectivorous species hunting in the canopy. Other species of conservation concern potentially benefiting include grey partridge, woodlark, dunnock, song thrush and bullfinch (Hardcastle, 2006). SRF also provides winter cover, which may be particularly valuable in open landscapes (EEA, 2006).

A number of rare species that depend on plantations could benefit greatly from widespread SRF, depending on the tree species grown (eg, in the UK, common crossbill, goshawk, firecrest and golden oriole) (Hardcastle, 2006). The edges of plantations and associated habitats appear to have greater attraction to birds, including species of conservation concern such as yellowhammer, cirl bunting and corn bunting, and birds of prey such as barn owl, kestrel and sparrowhawk are likely to adapt well to using SRF plantations for hunting (Hardcastle, 2006). Species requiring habitats associated with mature semi-natural woodland (such as mature or decaying wood) will not automatically be attracted to plantations, however – for example, marsh tit and nuthatch.

Some exotic tree species seem to provide more food for insectivores than native ones (Hardcastle, 2006), but the density of the canopy has a large influence over the species likely to use SRF – for example, those which rely on understory vegetation for food or cover will not be attracted to dense plantations with little understory cover. Eucalypts are likely candidates for European plantations due to their vigorous growth rates, but concerns have been raised over potential impacts on biodiversity due to high canopy densities and suppression of other plants, as well as the high water demand of these species. There is also concern that eucalyptus stands might not survive cold winters, with research underway into hybrids to overcome this (Hardcastle, 2006).

Little evidence is available to indicate that birds would avoid these plantations – in fact some species appear to favour them, but eucalyptus trees support fewer arthropods (eg, insects and spiders), and therefore provide less food for birds (Hardcastle, 2006). Likewise, sparse understory vegetation is likely to reduce the abundance and diversity of other wildlife able to utilise the plantations. As so few stands have been studied, these areas need further clarification before firm conclusions can be drawn.

Agricultural residues

Using agricultural residues as feedstocks can involve their conversion into biogas and digestate via anaerobic digestion (AD), combustion in dedicated power plants (eg, straw), co-firing with conventional fuels, or potentially fermentation to produce alcohols. The use of this material for bioenergy is likely to be of benefit by reducing the need to store and then dispose of these materials and reducing the demand for biomass from other sources. Environmental benefits might consist of reducing point source pollution from stored manures/wastes, and less material going to landfill. The digestate from AD can be used in place of raw slurry or manure to fertilise crop fields, reducing leaching and overall fertiliser demand. The AD process also destroys weed seeds (reducing the need for herbicides), reduces pathogen content and renders nutrients more readily available to crops. Better use of material which is otherwise incinerated (eg, poultry residues) could also improve local air quality.

Municipal solid waste, including wood waste

Municipal solid waste (MSW) consists of food and garden wastes, waste from home improvements, large household items, local commercial waste and litter. Waste wood encompasses a wide range of materials (eg, paper and paper production by-products, end-of-life furniture, domestic and industrial packaging). While it is important not to compromise the "waste hierarchy" of first reducing, then reusing and then recycling waste, the large-scale utilisation of the biodegradable element in MSW for energy would have significant benefits by reducing leachate and greenhouse gas production by landfilled material. There may be environmental impacts of using MSW for energy production (depending on the technology used to generate bioenergy), but increased efficiency of use of material is likely to outweigh any negative impacts.

Imported feedstocks

It is extremely difficult to quantify the direct environmental impacts of imported feedstocks for heat and power generation, given how little is known about their provenance. Imported crops whose production has resulted in the destruction of biodiverse forests will carry a particularly high environmental burden. The use of palm oil as a feedstock, for example, is particularly alarming, given that palm oil production is implicated in driving the destruction of South East Asian rainforest. While this is largely for transport use, liquid biofuels are also sometimes used in heat and power generation. Other areas of great concern include products from primary temperate forests, where management is unsustainable and damages local wildlife, ecosystem services and livelihoods as well as releasing carbon into the atmosphere. There is good evidence that forestry standards applied to many temperate forests are inadequate to prevent such damage.

Research by the RSPB/BirdLife UK (RSPB, 2011) has raised concerns over imported woody biomass for electricity generation in the UK. In Florida, for example, the scale of impacts is expected to be very significant. Just four biomass power stations proposed by one developer in Scotland, if consented, could lead to importation of up to 3.3 million tonnes of biomass annually from Florida. This area contains some of the most biodiversity-rich ecosystems in North America and has already experienced huge losses, with the conversion of natural forest to industrial pine plantations. According to the US Forest Service Southern Forests Research Assessment, only about 182 million acres of the original 356 million acres of natural forest still remain (Weir and Greis, 2002). New demand for wood production from these forests will put increasing pressure on this limited resource.

Indirect land-use change

Without significant improvements in resource efficiency or reduction in demand, the cultivation of dedicated biomass crops on land, which previously produced food will inevitably result in production being shifted elsewhere. This ILUC will potentially impact on biodiversity, carbon stocks, resource availability and other ecosystem services. The environmental costs of ILUC should therefore be taken into account when assessing the sustainability of dedicated biomass crops, in particular, but also other potential bioenergy feedstocks.

Residues/by-products/co-products

It is often assumed that bioenergy derived from secondary products (ie, residues or by-products), are environmentally benign since they do not drive production, and would otherwise be treated as wastes. However, a crucial factor to consider is whether certain waste co-products or by-products have an alternative value as a feedstock for another process, or in providing a service which will need to be replaced. This is important since the value of commodities changes in response to demand. If demand increases then a feedstock, which is a waste product, can quickly become a by-product or a co-product, which may then become a driver of production, either directly or indirectly. For example, a significant volume of cereal straw is either chopped up and returned to the ground where it acts as a soil improver, or is used for animal bedding. If the demand for straw for bioenergy use increased to the point where a significant proportion is diverted from these uses, then either the services they offer will not be fulfilled (ie, soil quality will decline) or alternative materials will be required to fill the demand. Another example might involve the use of a waste such as tallow (or tall oil) for bioenergy, thereby increased the price of these feedstocks. This might lead to a switch by oleochemical industries to using non-waste oils such as palm oil instead, which is potentially more environmentally damaging.

2.6.2 AVOIDING AND MITIGATING RISKS, AND ACHIEVING BENEFITS FOR WILDLIFE

Location guidance

The analysis above has highlighted the need for energy crops to be cultivated in the right locations to minimise direct, indirect and cumulative impacts on biodiversity. Location guidance should be valuable in ensuring the most important areas for biodiversity are avoided or that biodiversity constraints at a local and regional level are not exceeded.

Good practice guidelines

Many of the impacts identified from the literature involve a positive effect (co-benefits) on one group of species, or ecosystem services, at the expense of another; are heavily influenced by previous land use; and are largely dependent on the management techniques employed in their production. Therefore, there appears to be potential to mitigate negative and enhance positive effects with careful planning, planting the right crop in the appropriate location (and scale) and with informed management (Gove *et al.*, 2010). The production of good practice guidelines assists in ensuring that biomass feedstocks (from dedicated or waste streams) are produced and used in the most sustainable and biodiversity friendly ways.

Sustainability certification

In principle the introduction of a system of robust certification of sustainability should ensure that biomass feedstocks are produced and used in an efficient and sustainable manner with as few environmental impacts as possible. However, existing standards, such as those set out in the Renewable Energy Directive (2009/28/EC) or based upon them, are inadequate to protect biodiversity (RSPB, 2011). It is important that biomass production complies with national and international standards for sustainable management and production, and associated guidelines on water, soils, carbon and biodiversity, and that there is proper enforcement of such standards for all planting, management and harvesting activities. There is an urgent need for the development of robust national and international sustainability certification schemes.

The lack of information on imported biomass is likely to mean that in many cases high sustainability standards are not adhered to. Therefore, there is an urgent need to develop methods of centrally recording traded biomass on a national basis to ensure that origins are transparent, impacts are fully understood and methods of production are fully sustainable.

Monitoring commodity prices

At present there are large volumes of crop residues which are currently unused, and so it is unlikely that the majority of these represent a significant economic driver for primary production. Nevertheless, a major increase in demand for biomass could change the economics of production for a range of crops. Therefore, monitoring of commodity prices should be an element of continuing sustainability appraisal for bioenergy feedstocks. Where necessary, policies should be put in place to ensure that the demand for biomass for bioenergy production does not impact other biomass markets (thereby indirectly reducing sustainability).

Integrated policies for waste reduction

As with all potential sources of biomass for energy, there are multiple other uses for wastes, therefore energy, food, agriculture, forestry and waste policies must be integrated to incentivise and facilitate reduction in avoidable wastes (such as waste food and other MSW), and ensure the most efficient and sustainable "re-uses", for example, in efficient energy generation or composting.

2.7 POWER LINES

The transport of electricity from energy producers to users is mainly via above-ground power lines. The increase in renewable energy production and the locations in which such energy is produced will require the construction of new power lines, both to increase capacity and to create a wider and more coherent network. This will require the construction of new power lines in some of the more remote parts of the continent. This is likely to increasingly bring them into (and through) areas which are important for birds. Most above-ground power lines pose some level of risk and many significantly affect the habitats of vulnerable species, particularly the breeding, staging and wintering areas of large birds (Haas *et al.*, 2005).

Underground cables for high-voltage electricity transmission are expensive, and therefore are only used in exceptional cases. Consequently, above-ground power lines will remain in use for high-voltage power transmission (60,000 to 750,000 Volts). At these high voltages, safety standards require high hanging cables. The towers of these power lines often rise to heights of 50 m. Migrating birds flying at heights between 20 m and 50 m are at considerable risk of collision with such lines (Haas *et al.*, 2005).

Low-voltage power lines. In a number of countries, all or most of the low-voltage supply lines are routed underground, which is the best solution in

Expansion of renewable energy will require new power lines to be built.

terms of bird safety. When above ground, low-voltage supply lines often use well-insulated cables, directly attached to support poles, which is the second-best solution. Collision risks are minimised, because the black cables are highly visible. The risk of electrocution is low, because of the relatively low voltage and the high electrical resistance of birds. Collision risk with low-voltage power lines is higher when thin wires which are hardly visible are used. Generally, the risk of collision can be reduced by using single-level wire arrangements, or by changing to insulated cables (Haas *et al.*, 2005).

Medium-voltage power lines. World-wide the majority of medium-voltage (1,000–59,000 volts) power lines are still above-ground. Often, the conductor cables are attached via relatively short insulators to poles constructed of conducting material. Birds on the earthed pole can easily reach the energised conductor cables, or vice-versa. A similar risk of collision exists with medium-voltage power lines to low-voltage lines. Fortunately, most medium-voltage power lines have conductor cables arranged on a single level, which reduces the risk (Haas *et al.*, 2005). Overhead power lines on railways typically transmit power at 10,000–15,000 volts and therefore represent a similar level of risk to birds to other medium-voltage lines. Similar aspects of bird safety must be taken into consideration when designing such equipment (Haas *et al.*, 2005).

High-voltage power lines. High-voltage power lines are almost exclusively above ground. Because of their long suspended insulators, the risk of electrocution is generally low. Death by collision with the cables is by far the largest danger posed by high-voltage power lines. Different tower constructions are in use and present varying levels of risk. The highest risks are posed by those power lines where the conductor cables are arranged at different heights (multi-level arrangements), and with earth/neutral cables high above the conductor cables. Less dangerous constructions are in use, which have the conductor cables arranged at one height (single-level arrangement) and with the neutral cable only slightly higher (Haas *et al.*, 2005).

2.7.1 MAIN CONSERVATION RISKS

Overview

Research suggests that collisions with human built structures are the largest unintended human cause of avian fatalities worldwide. Although bird collisions with power lines are a relatively small part of this problem, it is considered to be a significant localised phenomenon. From a conservation point of view it is of serious concern to conservationists for two reasons: (1) when it takes place at specific high risk locations which exposes large numbers of birds to crippling and mortal danger and (2) when it affects already threatened species for which an additional risk factor may prove fatal.

Although collisions affect many species, statistically the birds most prone to collision are the large bodied species with proportionally small wingspan (eg, some birds of prey, pelicans, storks, bustards, cranes and waterfowl) or birds that congregate in large numbers during migration (eg, flocks of passerines and waterbirds). Collisions take place most often at specific high-risk locations, such as in proximity of wetlands or on a migration route to foraging grounds. Visibility is also thought to play a significant part with increasing risk in poor lighting (including at night for night migrants).

In Europe it was estimated that approximately 25% of juvenile and 6% of adult white stork died annually from power line collisions and electrocutions over a 16-year period (Schaub and Pradel, 2004). Electrocution is considered to be the primary mortality factor for a number of threatened species, such as the Spanish and Eastern Imperial eagle, Bonelli's eagle and Egyptian vulture.

Birds can collide with power lines, or suffer electrocution.

Electrocution is primarily associated with the low- and medium-voltage power lines (distribution network) and to a large extent is a function of the pole design. As electrocution is better studied it is now confirmed that the risks of electrocution are aggravated by increases in the energy demand of certain regions. It is particularly prevalent in natural areas where the introduction of power lines is a cause of significant disruption to local species (Rollan *et al.*, 2010), and even local extinctions, for example of the eagle owl in parts of the Alps and the Apennines (Sergio *et al.*, 2004).

Risk of electrocution

Birds are attracted by power poles, just as they are attracted by large dead trees in the open countryside. They are favoured as lookout points, as well as perching and roosting sites, and are sometimes used for nesting. Birds sitting on power poles and/or conducting cables are killed if they produce a short

circuit. Short circuits can occur between phases (ie, from one wire to another), or to an earth source. Electrocution can also occur either by troops of small birds causing an arc or through the urination jets of large birds roosting on the cross-arms.

In particular, poor design of medium-voltage power poles has resulted in an enormous risk for numerous medium-sized and large birds. Some commonly used constructions of medium-voltage power poles have become infamously known as "killer poles" due to high bird losses. In those regions and countries, where such "killer poles" are commonly used on medium-voltage power lines, numerous species of large birds suffer severe losses. For example, ringing (banding) studies of white stork have indicated that electrocution along their European migration routes represents one of the main causes of death (Garrido and Fernandez-Cruz, 2003). Field research and investigations of storks, vultures, eagles and eagle owls have shown that these losses can drive these species into decline and towards extinction (Haas *et al.*, 2005).

It is the combination of badly engineered insulator and conductor constructions and the attractiveness of poles as perches that explains the high risk posed to many birds. In particular, if the spacing of the energised wires (phases) is particularly small, if only very short insulators are used, or if protective gaps (arcing horns for lightning protection) are installed on a power pole, birds down to the size of starlings or house sparrows can suffer electrocution (Haas *et al.*, 2005).

Risk of collision

In principle, birds of any flying species can collide with any type of aerial wires or cables. In most cases, the impact of collision produces fatal injuries or immediate death. Potential high-risk areas include those of high importance for breeding, wintering and migrating birds; and wetlands, marshes, coastal areas, steppes and meadows. Environmental conditions that influence the risk of collision include disturbances leading to escape flight movements, poor visibility (eg, fog, night, dawn and dusk), weather conditions (eg, precipitation, strong head winds), and poor visibility of cables (eg, old oxidised unmarked wires are difficult to see).

Birds which migrate at night are particularly at risk, as are those flying in flocks, and/or large and heavy birds with limited manoeuvrability. High losses are reported from lines with thin and/or low-hanging wires in sensitive areas (Haas *et al*., 2005). Cranes, bustards, flamingos, waterfowl, shorebirds, falcons and gamebirds are among the most frequently affected avian groups, and collision frequency is thought to be an influential factor in ongoing population declines in several species of cranes, bustards and diurnal raptors (Jenkins *et al*., 2010).

In important areas of bird migration, considerable losses can occur. Birds migrating at night, and birds flying regularly between feeding areas and resting areas, are particularly at risk when power lines cut across their migration corridors or their staging/wintering areas. Breeding birds, which are mostly resident, may adapt to obstacles in their environment, but birds on migration and during stopovers are likely to remain in an area for a limited time and will therefore be unfamiliar with local hazards. Dangerous flight manoeuvres, which can lead to collisions with cables and wires, are observed more often in migratory than resident birds. At such locations, bird losses may exceed 500 casualties per kilometre of power line per year (Haas *et al*., 2005).

Migratory birds are at particular risk where power lines cut across important flyways and migration corridors, such as river valleys, mountain passes and straits. Above-ground power lines in or near to staging and wintering areas also cause a high toll of collision casualties, for example in wetlands or steppe areas. The risk is particularly high when they are located in the flight approach to these areas (Haas *et al*., 2005), or between resting and feeding areas.

Loss of habitat

Loss of habitat might occur through disturbance and/or displacement, or changes in the quality of breeding, staging and/or wintering areas. This is most likely to occur when above-ground power lines cut across open landscapes and habitats (eg, wetlands or steppe) (Haas *et al*., 2005). For example, Arctic geese have been shown to avoid the close vicinity of power lines when feeding (Ballasus and Sossinka, 1997; Larsen and Madsen, 2000), and the breeding density of little bustard has been shown to be negatively related to the presence of power lines (Silva *et al*., 2010). The situation for passerines is more complicated, with some species avoiding power lines (eg, stonechat), while others (eg, skylark and wheatear) are found in higher densities close to power lines (Pearce-Higgins *et al*., 2009). Above-ground power lines may also result in increased predation due to attraction of mammalian predators and by providing perching sites and lookouts for birds of prey.

In most situations the destruction of habitat through the construction of bases for power poles or towers is likely to be relatively localised. However, the undergrounding of long sections of power lines may cause significant damage to certain habitats (eg, heathland or peatland). It may take many years for such habitats to recover, and there may be impacts to very localised species. In some habitats there is a significant risk of hydrological impacts from subterranean cabling.

2.7.2 AVOIDING AND MITIGATING RISKS, AND ACHIEVING BENEFITS FOR WILDLIFE

Avoiding sensitive locations

Sensible changes to the routing of the power lines, to avoid installation of overhead lines in areas important for vulnerable bird species, will drastically reduce the number of collisions. Particularly sensitive areas such as wetlands and estuaries should be avoided wherever possible. Strategic spatial planning (including mapping and locational guidance) and technological solutions such as upgrading existing power lines and undergrounding can be used to minimise the need for new corridors in sensitive areas.

Environmental impact assessment (EIA)

In order to reduce collision losses, bird protection issues should be taken into account early in the planning stage of any new power line. A thorough EIA is necessary, including detailed pre-construction surveys. Prior to or in the initial stages of planning at least one year of field work is necessary for ornithological evaluation, and for the investigation of local flight routes and patterns during migration, breeding and post-breeding periods (Haas *et al*., 2005).

Retrofitting or replacing "killer poles"
"Killer poles" should be replaced or retrofitted for bird safety. If all medium-voltage "killer poles" were rendered safe, numerous endangered species of large birds, like storks, eagles and eagle owls, might be allowed to recover and start to repopulate lost ranges (Haas *et al*., 2005). Attempts to re-introduce these birds will only be successful if the main mortality factors, such as electrocution and collision, have been excluded as far as possible.

Fitting of rejectors and insulation
Suitably arranged rejectors can be used to deter birds from perching on poles and towers, thereby reducing the risk of electrocution. These can be retro-fitted to dangerous arrangements or used on new equipment to ensure that birds do not perch in areas where they might be at risk. Insulation sheathing, hoods or plastic caps may be retrofitted or factored into the design of new infrastructure, to increase the distance between exposed conducting cables/wires and earth sources.

National standards and guidance
It is possible to reduce the risk of electrocution significantly without raising the costs of installing power lines to unacceptable levels (Haas *et al*., 2005). This can be achieved by developing construction criteria and principles for bird safety which ensure a high standard of design with bird safety in mind (international agreements on bird safe power lines are discussed in Box 22). This applies to new constructions and for retro-fitting kits. National governments are recommended to pass suitable legislation, which makes technical standards for bird safety legally binding.

Better design of new power lines
In various parts of the world, different technical solutions for bird safety are under test and evaluation, so far with moderate results (Haas *et al*., 2005). Unfortunately, many electricity transmission companies do not seem to be aware of the progress that has already been achieved for bird safety in relation to power lines. Adopting safe power pole or tower constructions can effectively reduce the risks posed to birds.

Undergrounding sections in sensitive areas
Fortunately, with continuing technical progress many types of high-risk transmission lines will eventually be removed. In addition, favourable trends can be reported from the low- and medium-voltage networks of some utility companies, which have made the step to change from above-ground power lines to underground power lines (Haas *et al*., 2005).

Where sensitive locations cannot be avoided power lines should be undergrounded where the terrain is suitable and ecological impacts are acceptable. However, this remains an expensive option for high-voltage lines and will therefore continue to be used sparingly. It is important that all of the potential impacts of burying power lines are fully considered when plans are drawn up, as impacts on sensitive habitats might be significant.

Markers
The use of markers to increase the visibility of power lines and earth wires has been shown to be effective at reducing collisions of many species (Jenkins *et al*., 2010). There are many designs and some are more effective than others. There is also variability in terms of the lifespan of different markers. Consideration of the need to renew markers on a regular basis should be made, or a design selected which has a long shelf-life.

Removal of the earth wire
Many large power lines are designed to carry a single earth/neutral wire above the current-carrying ones. This earth wire tends to be thinner and less visible. Often on encountering power lines birds will flare upwards on recognising the obstacle, but fail to clear the earth wire and collision ensues. Removal of the earth wire can significantly reduce the risk of collision (Jenkins *et al*., 2010).

Habitat management
There are considerable opportunities for ecological enhancement through the management of habitats beneath and around power lines to benefit wildlife. There may be opportunities to mitigate (or compensate) for losses elsewhere, through managing habitats to benefit species which are not considered at risk of collision. Habitat management to deter large raptors might be partially successful if it reduces attractiveness of the areas to these birds. On the other hand, power poles and towers offer perching, roosting and nesting sites for some large birds. Bird-safe power lines enable birds, like raptors, storks and ravens, to nest in otherwise treeless landscapes, which may benefit these species.

CHAPTER 3

THE ECOLOGICAL SUSTAINABILITY OF EUROPE'S 2020 RENEWABLES PLANS

Under the Renewable Energy Directive (2009/28/EC), EU Member States were required to draw up NREAPs. These specify how each Member State plans to meet their agreed contribution of the overall target of a 20% share of renewables in EU energy consumption in 2020.

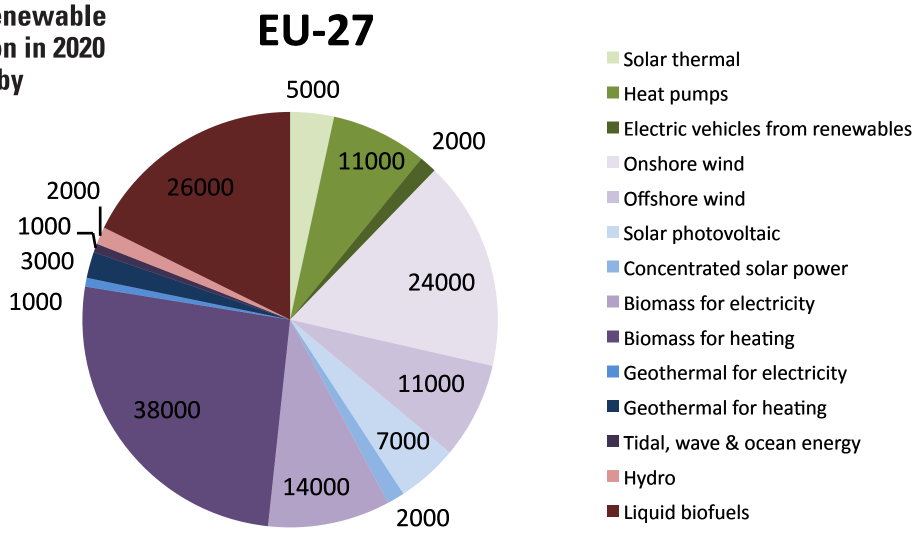
Total (gross final) energy consumption in 2020 is projected to amount to 1189 million tonnes of oil equivalent (Mtoe). According to the NREAPs, by 2020 the EU 27 will consume energy from renewable sources equivalent to 244 Mtoe per year, which is fractionally over the 20% target. In 2005 renewables provided for 97 Mtoe (8.3%) of energy consumed. Therefore sufficient capacity and infrastructure needs to be in place across the EU by 2020 to provide an additional 147 Mtoe of renewable energy use per year, relative to 2005.

Figure 1 breaks down this additional contribution to the EU energy mix from renewables by technology. The largest contribution is made by biomass for heating. In 2005 this technology contributed 49 Mtoe to Europe's energy needs, and in 2020 it is expected to provide 87 Mtoe, so biomass for heat contributes an additional 38 Mtoe per year – or 38 thousand kilotonnes of oil equivalent (ktoe).

The second largest contribution to meeting the 20% overall target is to be made by liquid biofuels (29 Mtoe per year – an additional 26 Mtoe compared to 2005). Onshore wind makes a substantial contribution, with additional turbines installed 2005–20 expected to contribute 24 Mtoe of renewable electricity to the EU's energy mix in 2020. Offshore wind is expected to provide a further 11 Mtoe.

FIGURE 1

EU-27 additional renewable energy consumption in 2020 compared to 2005, by technology [ktoe][iv]



The "medium risk" technologies (see Chapter Two) – onshore and offshore wind, solar, biomass for heat and electricity, and tidal/wave – plus a small contribution from geothermal energy, together provide for 69% of additional renewable energy consumed in 2020 compared to 2005 (101 Mtoe of the total 147 Mtoe increase). A further 12% of the increase is expected to be provided by technologies in our "low risk" category: solar thermal and heat pumps, plus renewable electricity consumed in electric vehicles. In our "high risk" category, additional hydropower provides a little over 1% (partly accounted for by small scale facilities and "repowering" existing facilities, which may present few risks) and the remaining 18% of the increase in consumption is attributed to liquid biofuels. These statistics are summarised in Table 2.

In order to give an impression of the implications on the ground in terms of land-use changes and investments, these increases in energy consumption can be related to the output of typical renewable energy installations with current technologies and average load factors[v]. For example, to meet the target for solar PV using domestic rooftops the EU would require an additional 19.4 million 4-kW photovoltaic home systems. The target for CSP would require 170 50-MW facilities. The wave and tidal targets would require an additional 5,100 1-MW tidal/wave turbines.

TABLE 2

Meeting the EU renewables targets: contributions from low, medium and high risk technology groups

Total energy use in the EU in 2020	1189 Mtoe
Total renewable energy use in the EU in 2020	244 Mtoe (20% of total energy use)
Additional annual renewable energy use 2005–20	147 Mtoe
Additional "low risk" renewable energy use 2005–20 (%)	18 Mtoe (12%)
Additional "medium risk" renewable energy use 2005–20 (%)	101 Mtoe (69%)
Additional "high risk" renewable energy use 2005–20 (%)	28 Mtoe (19%)

TABLE 3

Illustration of facilities that would meet additional EU renewables use 2005–20[v, vi]

TECHNOLOGY	1 MTOE = APPROX. CAPACITY	1 MTOE = EXAMPLE INSTALLATIONS/ INPUTS	EU-WIDE TARGET FOR ADDITIONAL USE IN 2020 (MTOE)	EU ADDITIONAL INSTALLATIONS/ INPUTS 2005–20 (ILLUSTRATIVE ONLY)
Photovoltaic	11,000 MW	2.8 million 4-kW solar home systems	7	19.4 m solar homes systems
CSP	4,300 MW	86 50-MW CSP plants	2	170 plants
Onshore wind	4,900 MW	2,450 2-MW turbines	24	59,000 turbines
Offshore wind	4,800 MW	600 8-MW turbines	11	6,600 turbines
Tidal/wave	5,100 MW	5,100 1-MW devices/turbines	1	5,100 devices/turbines
Biomass elec.	2,300 MW	13. 8 m oven dried tonnes wood	14	194 m odt wood
Biomass heat	N/A	2.3 m oven dried tonnes wood	38	88 m odt wood

Meeting the biomass for electricity target using wood fuel would demand annual consumption of an additional 194 million oven dried tonnes (odt) of wood. Additional annual consumption of over 88 million odt of wood would be needed to meet the target for biomass for heating. Despite this lower fuel demand for heat compared to electricity, in terms of meeting the EU's 2020 renewable energy target, biomass for heating makes a far greater contribution than biomass for electricity. This reflects the inefficiency of thermal power generation when waste heat is not used. For reference, total woody biomass production across the EU each year for all purposes and serving existing markets is approximately 500 million odt.

Providing for an additional 35 Mtoe of the EU's energy consumption through wind power, approximately 59,000 2-MW onshore wind turbines and 6,600 8-MW offshore wind turbines would need to be installed across Europe by 2020. These would occupy surface areas of approximately 11,800 km^2 onshore and 5,300 km^2 offshore[vi]. Table 3 summarises these illustrative scenarios.

In Chapter Five the technology mixes in NREAPs for project Partners' countries are illustrated and discussed, showing how each intends to meet this greater consumption of renewable energy. The remainder of this Chapter focuses on the renewable energy technologies themselves, and on which EU nations plan to make use of them. The technologies are classified into the same three risk categories presented in Section 2.1 above. In Figures throughout this report, shades of green indicate "low risk" technologies, shades of blue/purple represent "medium risk" and shades of red represent "high risk".

3.1 LOW CONSERVATION RISK TECHNOLOGIES

BOX 12

Small scale and local: essential but not enough

In Germany, the idea that building small PV systems could significantly contribute to the country's energy mix has long been contested. It was not until recently that home owners all over Germany proved that PV does make a difference. In 2010 alone more than 7 GW of PV capacity were installed in Germany. Following this development, on sunny days in the spring of 2011 (when, after the Fukushima accident, half of the German nuclear power plants were turned off) PV for the first time ever fed more electricity into the public grid than nuclear sources.

Despite this success, building small scale PV will never be the backbone of Germany's energy supply. The electricity system becomes too vulnerable to effects of regional weather conditions when relying heavily on only one energy source such as PV. A balanced renewable energy mix including solar energy, wave, tidal, onshore and offshore wind, biomass, hydropower and geothermal energy is needed.

All over Europe, many municipalities have the potential to be energy self-sufficient by making use of the local renewable energy sources. In fact, in Germany more than 100 local authorities strive to become "100%-renewable-regions" in the near future. For many people, self-sufficient energy communities seem like a simple solution to avoid the expansion of the power grid. However, very few regions in Europe can completely rely on regional renewable energy sources throughout the year. And even in these regions, high-voltage power lines are needed to transport surplus power to other regions, big cities, or industrial areas which cannot be completely energy self-sufficient. Developing regional energy storage capacities can contribute to solving the problem, but is often much more expensive and inefficient in terms of energy losses than grid expansion. Connecting small scale PV systems to batteries can help, but power lines with adequate capacity and large-scale energy storage facilities will still be needed.

Reducing the energy required to heat or cool buildings will be vital to lower European CO_2 emissions. "Zero carbon" or "passive house" design can decrease the energy needs of new buildings to very low levels. In some buildings, and at certain locations, the remaining heat energy demand can be delivered by solar energy, heat pumps or biomass – ideally all of them integrated in highly efficient district heating systems. And by 2020, all new buildings in the EU must be constructed as nearly-zero-energy buildings under the proposed re-cast of the Energy Performance of Buildings Directive. However, most of the demand for heating buildings derives from the existing building stock. Retrofitting existing houses for energy efficiency and micro-renewables will make a big difference, but not all existing houses can reach the "passive house" standard without very high costs borne by the owner, landlord, tenant or society as a whole. Again, small scale solutions such as building insulation must contribute to the abatement of CO_2 emissions, but they alone will not do the job.

In general, energy saving measures, solar thermal, heat pumps and use of renewable electricity in vehicles are not expected to result in significant additional direct ecological impacts. A move to electric vehicles is important because of the ecological risks associated with biofuels, but overall demand for private transport must also be reduced through better public transport provision and measures to reduce the need to travel, such as urban planning. Both heat pumps and electric vehicles will increase electricity consumption – this underlines the importance of decarbonising Europe's electricity supplies. BirdLife calls for greater ambition in the use of these technologies.

Building-scale renewables will make an essential contribution in the transition to a low carbon Europe, but decentralised sources and energy savings will not be sufficient to make large-scale renewables and new power lines unnecessary (see Box 12). This is particularly true if renewable electricity is to provide for transport and heating needs.

3.1.1 ENERGY SAVING

The NREAPs also include details of additional energy efficiency policies, and estimate how much energy these will save relative to the "business as usual" (BAU) scenario. In total, these additional measures identified in the NREAPs are estimated to lower overall energy consumption in the EU in 2020 by 10% (saving 128 Mtoe per year by 2020) relative to BAU. To give a sense of the magnitude of this saving, total energy consumption in the EU 27 in 2009 was just under 1114 Mtoe[vii]. With these additional energy saving policies, this is expected to grow only marginally to 1189 Mtoe in 2020.

Figure 2 shows where these savings will be made, expressed in ktoe. Three quarters of the energy savings are accounted for by just five countries: France, Spain, Germany, Poland and Italy.

FIGURE 2

National reductions in annual energy consumption in 2020 compared to reference scenarios resulting from additional energy savings measures indentified in NREAPs [ktoe][iv]

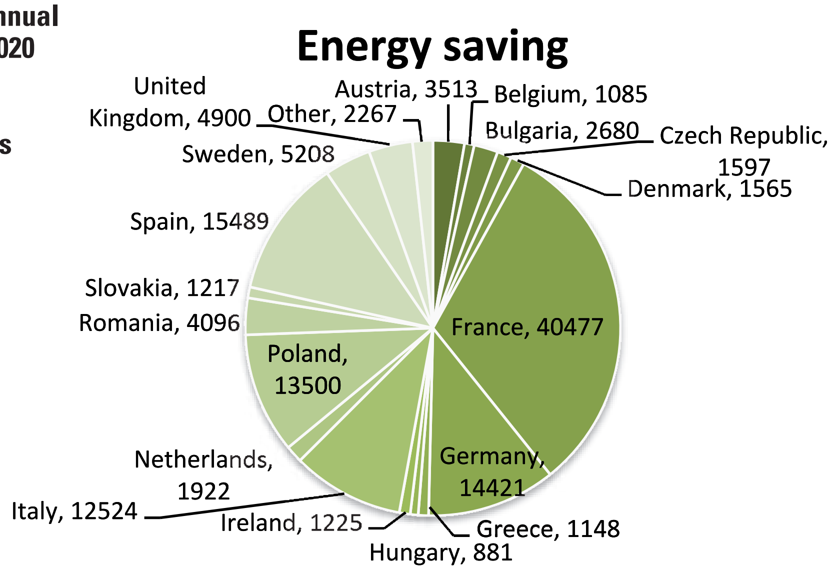
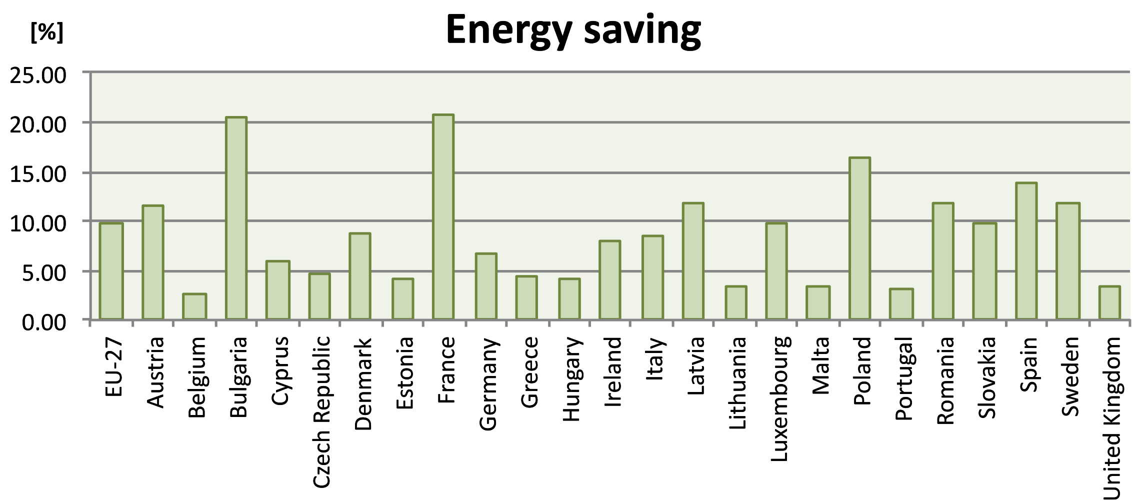


Figure 3 shows the role energy saving is expected to play in each country, with some aiming higher than the overall EU figure of 10%. France and Bulgaria both aim to consume over 20% less energy in 2020 as a result of additional energy savings policies. Poland, Spain, Sweden, Romania and Latvia also plan to go beyond the EU average.

FIGURE 3

Figure 3: Energy saving plans of the EU-27 States, comparing business as usual scenarios to their energy saving scenarios for 2020 [%][viii]



The statistics are difficult to interpret as the EU Member States have widely varying starting positions in terms of current energy efficiency and also existing policies or targets. However, they suggest that many EU countries could do significantly more to save energy. In particular, countries such as Belgium, Hungary, Portugal and the UK urgently need to revise their plans, taking the lead from countries such as France and Bulgaria.

3.1.2 SOLAR THERMAL

In 2005 solar thermal accounted for 1 Mtoe (0.1%) of the EU's energy consumption. By 2020 an additional 5 Mtoe of the energy consumed in the EU 27 will be provided by this technology, bringing its share of total energy consumed up to 0.5%. On average in Europe, solar thermal is expected to grow by 10 to 15% per annum between 2010 and 2020, and should account for 1.2% of total heating and cooling energy demand in 2020 (EREC, 2011a). As Figure 4 illustrates, and as one might expect, many southern European countries plan to make greater use of solar thermal technology. However, Germany and Austria also expect significant contributions from this technology, and Poland[ix] and Belgium recognise the potential for this technology in Northern Europe. BirdLife recommends much greater use of this technology across Europe, and calls for northern Member States that have neglected the potential for widespread solar thermal to follow the lead of Germany and increase their ambition accordingly.

3.1.3 HEAT PUMPS

The NREAPs suggest heat pumps will provide 1% of total energy consumed in 2020, supplying 12 Mtoe compared to just 1 Mtoe in 2005. Heat pumps represent 2.6% of the planned EU heating and cooling mix in 2020 (EREC, 2011a).

FIGURE 4

Additional solar thermal energy in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv, ix]

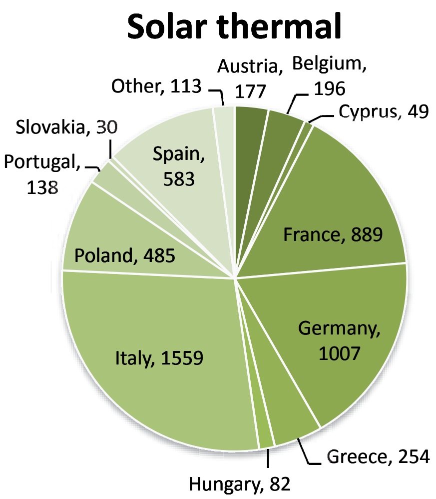


Figure 5 shows which countries account for this expected increase in renewable energy consumption from heat pumps. Most EU countries plan to make greater use of this technology, with the UK, Italy, France and Sweden most ambitious. There is clearly scope for further use of heat pumps, for example in Spain or Poland. Geothermal energy, derived from heat in the earth's core, is expected to provide an additional 1 Mtoe of electricity and 3 Mtoe of heat in 2020.

3.1.4 ELECTRIC VEHICLES

The NREAPs report on expected renewable energy consumption in EVs. Europe's ambitions for EVs as set out in the NREAPs are very modest, taking their share in energy consumption from less than 0.1% in 2005 to less than 0.3% in 2020. However, commitments to EV technology by many EU governments, notably Germany, France, Italy and Spain (Figure 6) are pushing forward commercialisation and technical improvements.

FIGURE 5

Additional heat pump-derived energy in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]

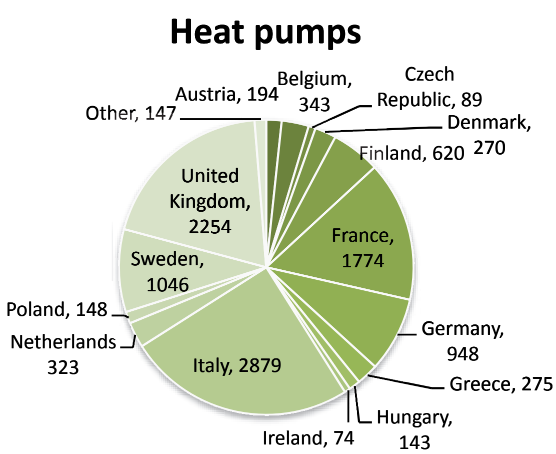
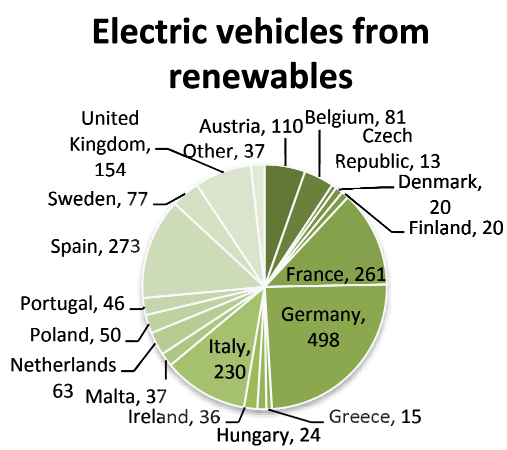


FIGURE 6

Additional renewable electricity used in vehicles in 2020 compared to 2005, by Member State according to NREAPs [ktoe][iv, ix]



3.2 MEDIUM CONSERVATION RISK TECHNOLOGIES

As Chapter Two indicates, there are low risks associated with most renewable energy technologies when sensitively deployed. Solar PV is low risk when mounted on roofs or land with low ecological value, but is included here because there are some risks associated with large "solar farms" and CSP. Similarly, while we consider tidal range technologies "high risk", tidal power is included here as our data analysis does not distinguish between "range" and "stream" technologies.

3.2.1 SOLAR POWER

Depending on location and scale, large PV arrays could reduce the conservation value of agricultural land and rural areas. Conversely they could enhance a site's conservation value if projects are actively managed for that purpose (Box 13).

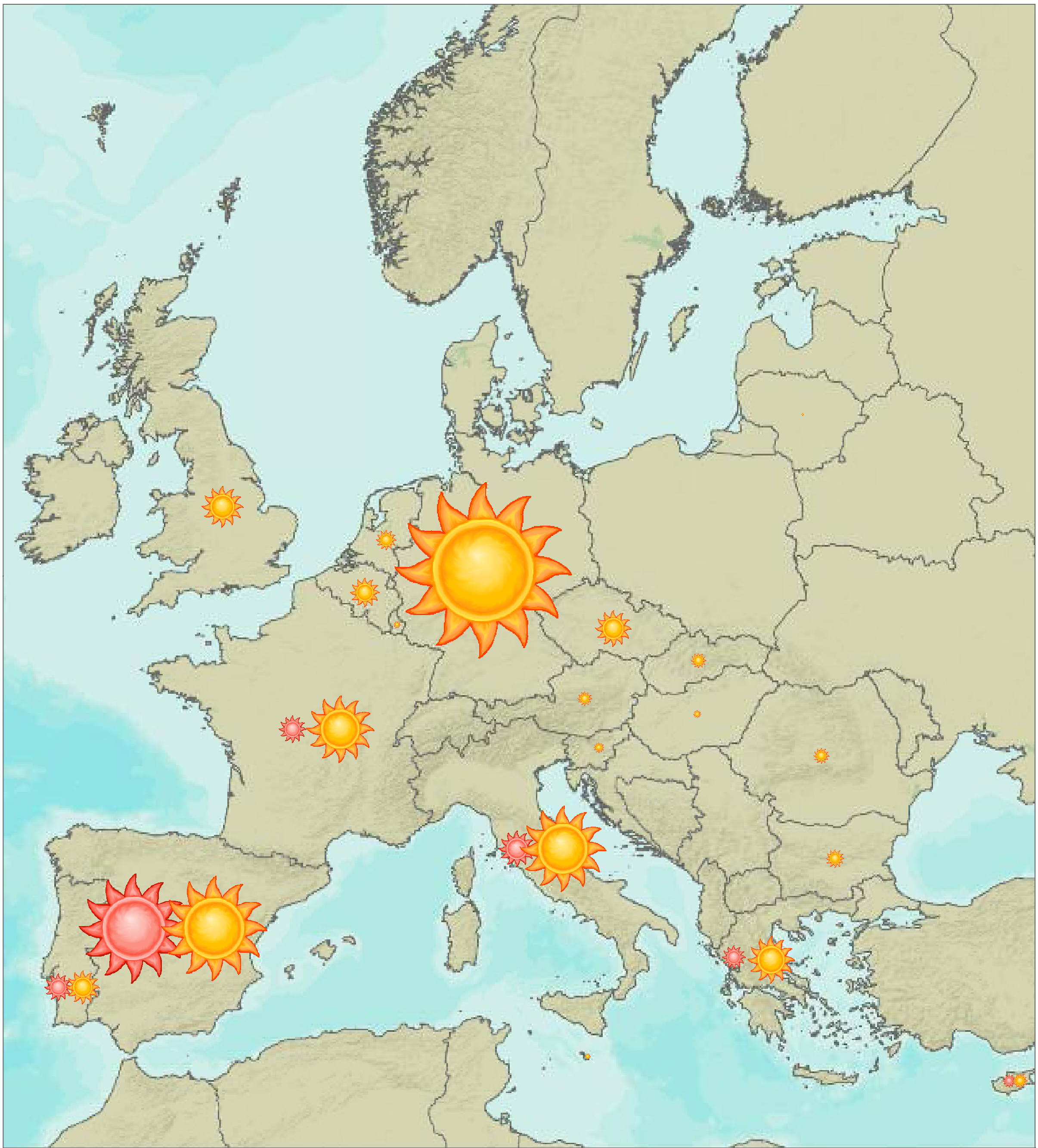
BOX 13

Solar PV for conservation in Germany

Since 2005, new feed-in-tariffs for electricity from PV panels have resulted in a roll out of solar farms across Germany. By the end of 2010 these installations covered about 7,500 hectares of land. While the largest projects demand up to 200 hectares, the average land consumption of a solar farm is estimated between five and 30 hectares. Although about 85% of all PV systems are still installed on buildings, conservation concerns about possible impacts of solar farms on landscape, habitat fragmentation and biodiversity were raised at an early stage. In association with the German Solar Association (BSW), NABU/BirdLife Germany (2005) published guidelines for sensitive development of solar farms, and these have been widely applied.

The German Renewable Energy Act contains a legal provision that specification in a Local Development Plan and an EIA are required before a location for a solar farm can be approved and the operator can claim the feed-in-tariff. In most cases this instrument has been very effective in directing PV investments towards sites of low ecological sensitivity. Usually construction is only allowed on land that has already been sealed alongside existing infrastructure corridors like railways, and previously developed sites that are no longer used for economic or military purposes.

Until 2009 it was also possible to build a solar farm on agricultural land, which then had to be converted into low intensity grassland. Land that is deemed suitable for solar farms may be considered marginal in an agricultural or economic context, but could nevertheless be an important site for wildlife. On the other hand, over a solar farm's lifetime of 20–25 years there is a valuable opportunity to create synergies if development is restricted to less biodiverse areas of a site and revenues from the feed-in-tariff are partly spent for additional decontamination or nature conservation measures. The German Renewable Energies Agency (2010) has published a useful report on solar farms and biodiversity, with helpful guidelines and case studies showing how solar farms can benefit wildlife.



Additional solar power 2005 - 2020

Additional electricity in total final energy consumption derived from solar photovoltaic cells and concentrated solar power in EU Member States National Renewable Energy Action Plans 2005 - 2020

Concentrated solar power	Solar photovoltaic	
		10 ktoe*
		100 ktoe*
		1000 ktoe*

* kilo tonnes of oil equivalent

0 500 1,000
Km

Notes:

1:26,000,000
Scale on A4 paper

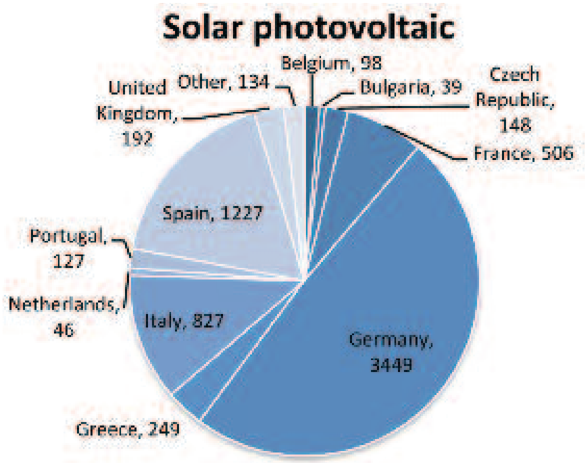
Acknowledgements:

Created by:
Sergio Boggio, CDMU, 20 October 2011

The NREAPs suggest consumption of electricity from solar PV will grow from a negligible amount in 2005 to 7 Mtoe in 2020. According to EREC (2011a) analysis of the NREAPs, 2.35% of EU electricity consumption in 2020 will be derived from solar PV.

FIGURE 7

Additional solar PV power in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]



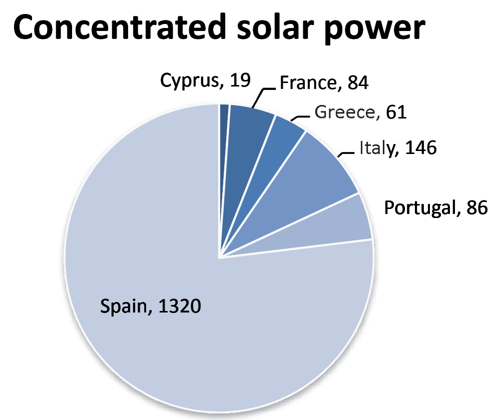
As Figure 7 shows, just under half of this additional PV capacity will be installed in Germany. Spain, Italy and France also plan to make significant use of solar PV. Strong, sustained support for the PV sector in countries such as Germany is rapidly driving down costs. Germany has also demonstrated that very significant electricity generation is possible relying almost exclusively on rooftop installations. While southern European countries have the greatest solar energy resource, the UK, Netherlands and Belgium have recognised its potential as a clean energy source in northern Europe. By applying some readily achievable safeguards (Section 2.2 above), and with greater ambition and support from many Member States, solar power has huge potential as a major source of clean and ecologically benign electricity across Europe. Current low ambitions in many Member States are a missed opportunity, and mean higher risk technologies will be used to meet the 2020 targets.

3.2.2 CONCENTRATED SOLAR POWER

A further 2 Mtoe (0.2%) of energy consumed in 2020 is expected to be provided by CSP. More than three quarters of this will be located in Spain, as illustrated in Figure 7. EREC (2011a) analysis suggests that 0.5% of the EU's electricity will be provided by "solar thermal electricity" by 2020.

FIGURE 8

Additional concentrated solar power in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]



CSP is a relatively novel technology compared to solar PV, and has very significant potential. With six countries now intending to develop CSP facilities, the sector should benefit from technical advances. This demonstrates the value of binding renewable energy targets for stimulating technological innovation.

Onshore wind is a low cost, proven technology.

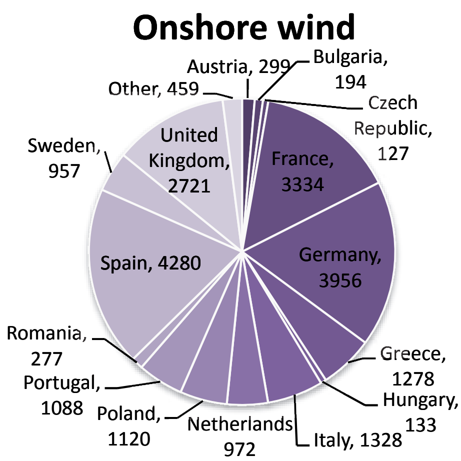
3.2.3 ONSHORE WIND POWER

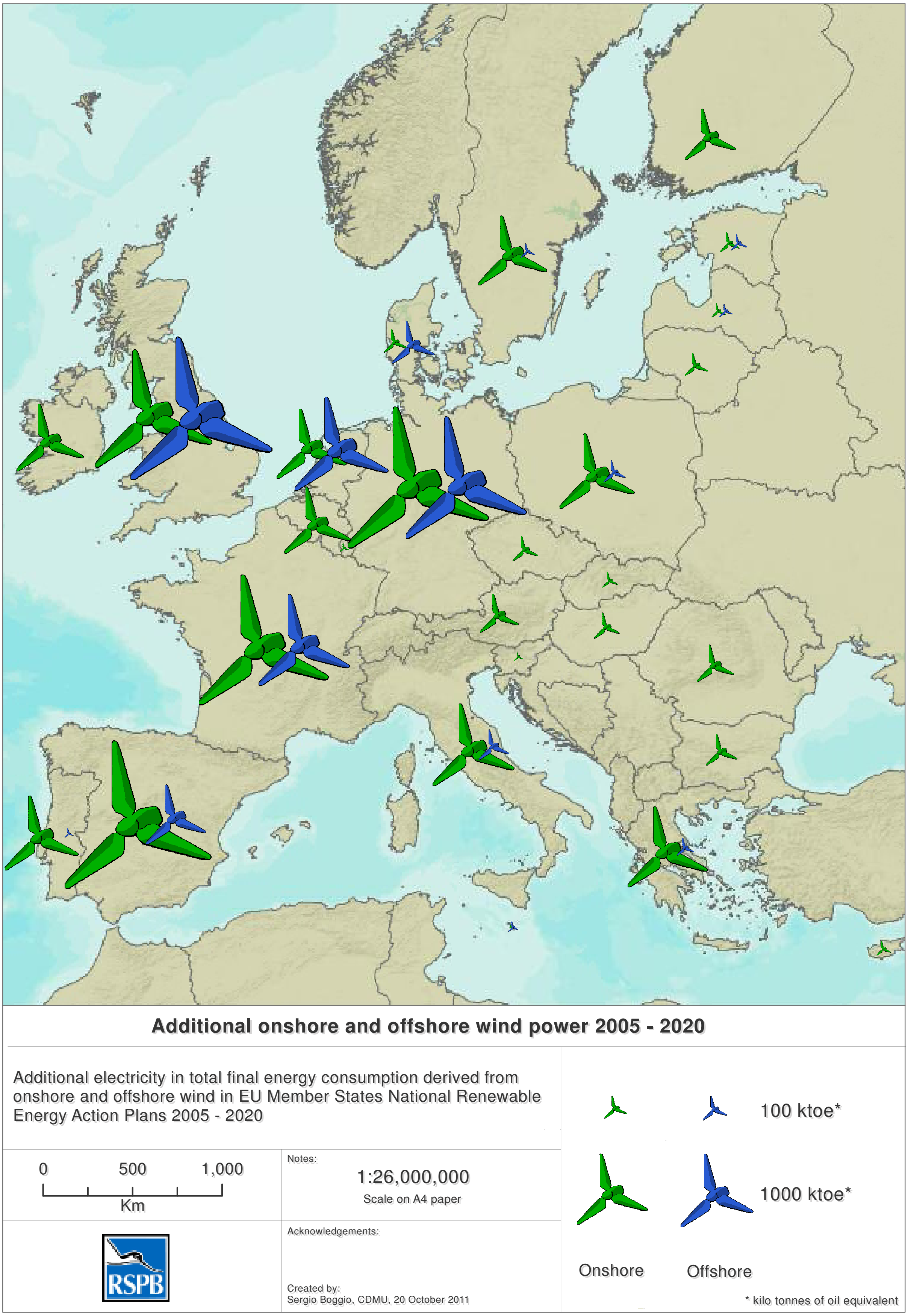
In 2005 onshore wind power provided 6 Mtoe towards the EU's energy consumption, and the NREAPs suggest this will rise to 30 Mtoe (2.5%) by 2020. Germany, the UK, Spain and France are expected to account for a little under two thirds of this increase.

That so many EU Member States intend to make greater use of onshore wind power reflects the fact that it is one of the lowest cost and most technologically mature renewable energy sources. Since the NREAPs were drafted some countries have decided to increase their targets. For example, Scotland has decided to produce renewable electricity in sufficient quantities by 2020 to meet 100% of its electricity needs. Stimulating the onshore wind industry and steering developers towards suitable locations are key ingredients in Scotland's policy framework for achieving their ambitious targets. Meanwhile in many countries the wind power industry is in its infancy, and governments have yet to fully appreciate the importance of strategic spatial planning and stable incentive frameworks for sustainable growth of the sector.

FIGURE 9

Additional onshore wind power in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]





Additional onshore and offshore wind power 2005 - 2020

3.2.4 OFFSHORE WIND POWER

Offshore wind power is expected to grow as a share of EU energy consumption from a negligible amount in 2005 to 11 Mtoe (1%) in 2020. As Figure 10 demonstrates, the North Sea is the focus for most of Europe's offshore wind development, with the UK, Germany and the Netherlands having ambitious plans. France and Spain also plan to exploit wind energy in the Atlantic, and a small contribution is expected in the Mediterranean.

Combined, onshore and offshore wind power is expected to reach over 14% of total electricity consumption in 2020, according to EREC (2011a) analysis of the NREAPs. As with onshore wind, strategic spatial planning will be vital for orderly and sustained growth of offshore wind. Co-operation between Member States, particularly the North Sea states, will be needed to ensure development of offshore wind and associated electricity transmission infrastructure is developed in a rational way and without unacceptable cumulative impacts. Rapid development of the offshore wind sector adds urgency to the need to designate a coherent network of marine Natura 2000 sites.

3.2.5 TIDAL AND WAVE POWER

The contribution to EU energy consumption made by tidal and wave power is expected to grow from a negligible amount in 2005 to approximately 1 Mtoe in 2020. According to EREC (2011a) analysis ocean energy is planned to represent 0.15% of electricity consumption in 2020.

Just six countries plan to make use of these technologies. The UK share (Figure 11) assumes a large contribution from tidal range power on the Severn Estuary. A feasibility study concluded in 2011 that there was no economic case to support a major scheme on the Severn, and that a tidal barrage in particular would cause very significant harm to birds and biodiversity in the estuary (Box 8). It is now very unlikely that a scheme will be in place and generating electricity by 2020. Therefore the actual contribution from these technologies in 2020 may be lower than suggested in the NREAPs. Despite this small overall contribution, however, national commitments to support research and demonstration projects is vital to enable these technologies to make a significant contribution beyond 2020.

FIGURE 10

Additional offshore wind power in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]

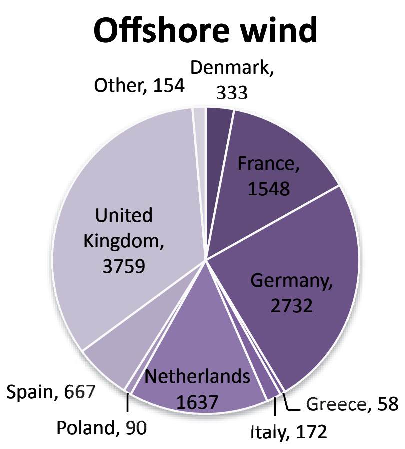
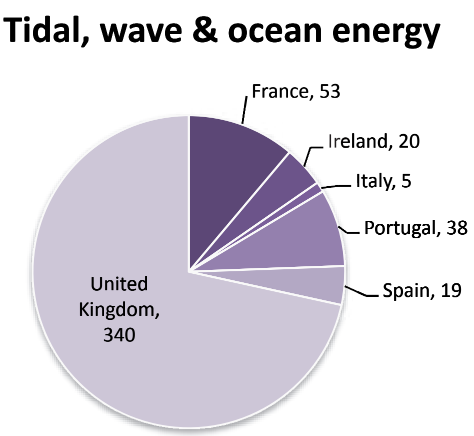
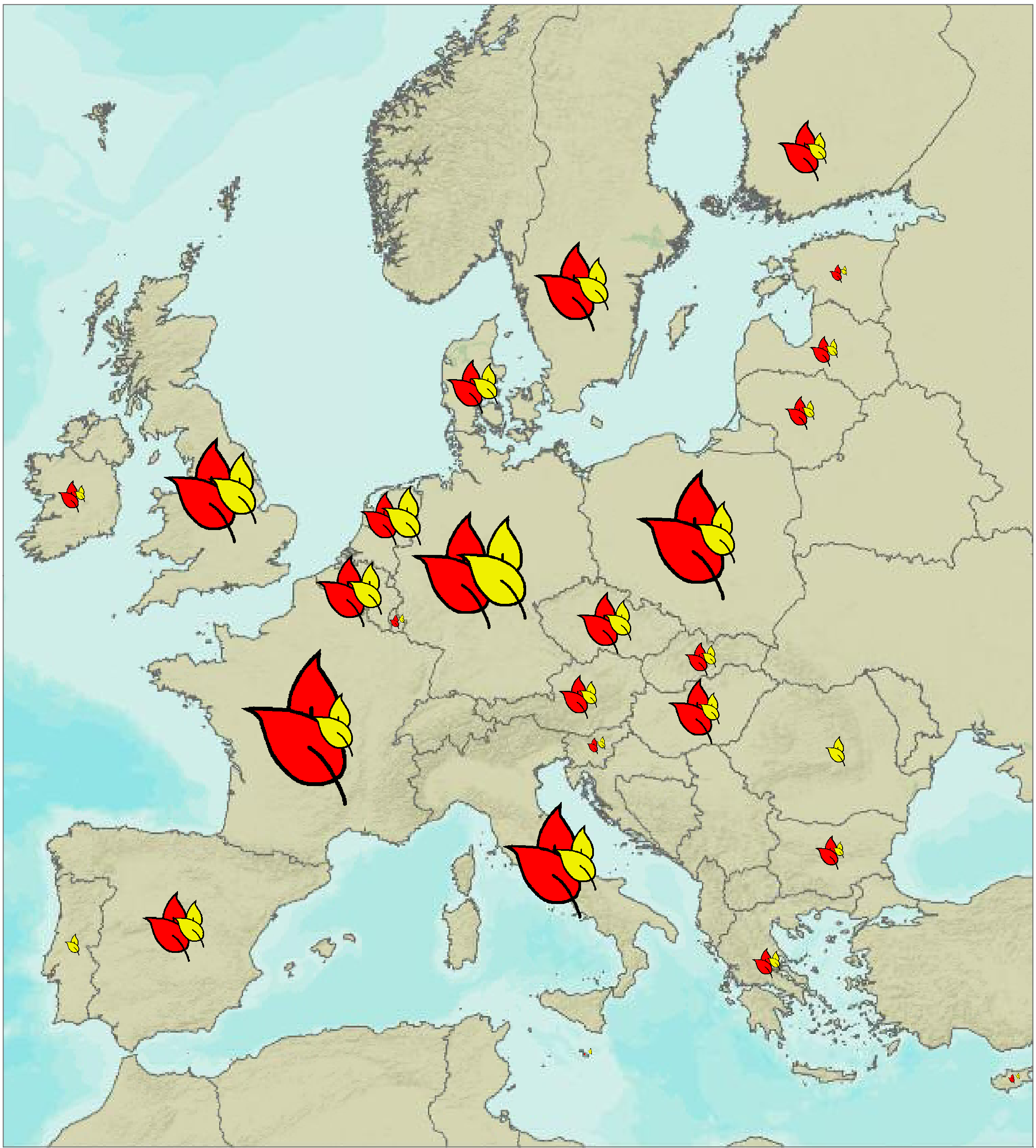


FIGURE 11

Additional tidal, wave and ocean energy in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]





Additional biomass heat and power 2005 – 2020

Additional electricity and heat in total final energy consumption derived from biomass in EU Member States' National Renewable Energy Action Plans

Biomass for electricity	Biomasss for heating	
		100 ktoe*
		1000 ktoe*

* kilo tonnes of oil equivalent

0 500 1,000
Km

Notes:
1:26,000,000
Scale on A4 paper

RSPB

Acknowledgements:

Created by:
Sergio Boggio, CDMU, 20 October 2011

3.2.6 BIOMASS FOR HEAT AND POWER

Sustainably sourced biomass has a major role to play in meeting the EU's renewable energy targets. It is possible to manage woodlands, grow energy crops and source waste material in Europe in ecologically acceptable and even beneficial ways (Box 14), to provide large quantities of fuel (EEA, 2006). However, there is also potential to cause significant ecological harm, particularly if fuel is sourced from international markets. Biomass for heat makes a much greater contribution to meeting the 2020 renewables targets (see map), using much less total biomass fuel (see Table 3). Unless the heat from power stations is used for "combined heat and power", generating electricity is a wasteful use of biomass resources.

As Figure 12 demonstrates, almost every EU country plans to make greater use of biomass in electricity generation over this decade. Electricity from biomass contributed 6 Mtoe (0.5%) of overall EU energy consumption in 2005. This is expected to grow to 20 Mtoe (1.7%) in 2020. EREC (2011a) calculates that biomass will represent 6.5% of electricity consumption in 2020.

Biomass for space heating already makes a significant contribution to Europe's energy needs, largely in the form of domestic wood burning. In 2005 it accounted for 4% (69 Mtoe) of EU energy consumption, and this is expected to grow to over 7% (87 Mtoe) in 2020. Biomass is planned to represent 17.2% of the planned EU heating and cooling mix in 2020 according to EREC (2011a).

Again most EU countries plan to make significantly greater use of this technology (Figure 13). Many Member States such as the UK (RSPB, 2011) and the EU as a whole (Hewitt, 2011) will only be able to meet demand for fuel on this scale through imports. While bringing some European forests or even wetlands (Box 14) into better management could help meet both energy and biodiversity targets, wood fuel imports from countries such as the US, Russia and Canada will be necessary. This has raised concerns among NGOs over potential ecological impacts outside the EU (RSPB, 2011; Hewitt, 2011).

FIGURE 12

Additional biomass electricity in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]

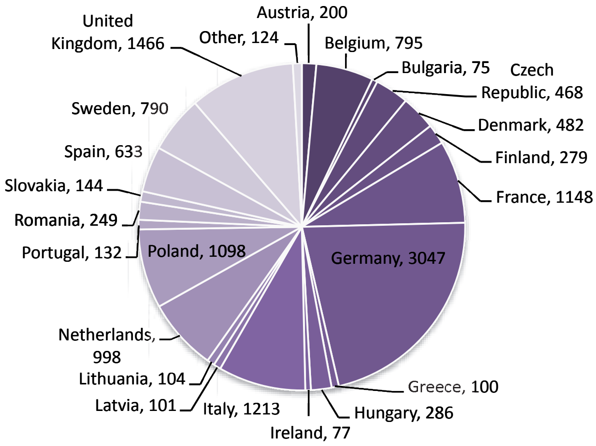
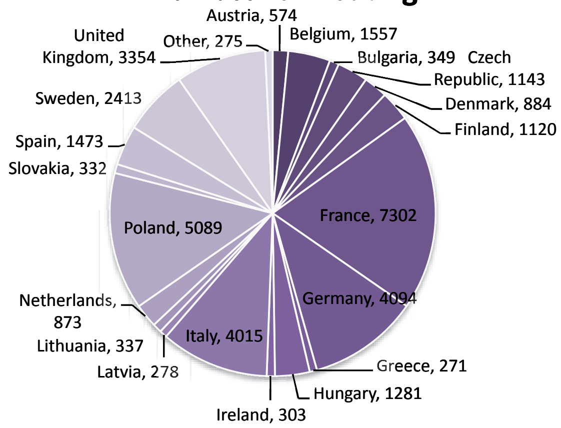


FIGURE 13

Additional biomass heat in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]



Mowing using a modified "piste basher" to produce fuel and save the aquatic warbler.

BOX 14

Biomass fuel production for wetland conservation in Poland

The famous wetlands of the Biebrza Valley in north-east Poland are probably Europe's most pristine fen mires. The main reason for their popularity with visitors is the sheer wealth of their wildlife. A unique system of fen mires and wet meadows supports both nature and local employment in nature-oriented activities.The Biebrza Marshes are said to be one of the EU's best sites for species such as great snipe and greater spotted eagle. Moreover, the aquatic warbler, the only globally threatened songbird of the European mainland, breeds here. With about 2,500 singing males, the Biebrza Valley holds 20% of the species' world population. In the Biebrza Valley OTOP/BirdLife Poland, in partnership with RSPB/BirdLife UK, is running two projects (both supported by LIFE Nature programme) for aquatic warbler conservation.

The need for conservation measures arises from the threat of the wetlands becoming overgrown with dense reeds and trees, caused mainly by changes to the hydrology of the valley and the decline of extensive agriculture. For hundreds of years this ecological succession was prevented by extensive traditional hand scything practices, but from the 1970s onwards that practice died out. By the end of the last millennium, over half the area of open fen mire vegetation was already overgrown. Breeding waders like black-tailed godwits, redshanks and lapwings had abandoned large areas, and suitable habitat for the aquatic warbler had significantly decreased, despite the establishment of a National Park. Biomass production has helped find and fund a solution to this problem, and conservation measures are now undertaken on 12,000 ha of National Park land. Hand mowing has been replaced by machines that can be used on the boggy ground, using an adapted alpine "piste-basher" on caterpillar tracks, with very low ground pressure (to protect the delicate peat soil and vegetation) and fast working speeds. Financial support for management was secured thanks to work with the Government to develop a targeted aquatic warbler agri-environment package. Now, farmers and entrepreneurs who use land occupied by aquatic warblers can get financial support for regular mowing. Finally, all of the elements needed for starting large scale conservation works were available: the machines, financial support and the land.

As the fen mires conservation system started to work, a use had to be found for the harvested biomass (sedges, reeds, grass), which is produced in huge quantities. The biomass, which is too poor quality for animal feed, is now being used for bioenergy generation. A processing facility has been built in Trzcianne village that will process approximately 2400 tonnes of dry biomass harvested from approximately 2400 hectares of wetlands into pellets. As well as generating low carbon energy and local employment, profits will finance further nature conservation measures.

3.3 HIGH CONSERVATION RISK TECHNOLOGIES

With currently available technologies and regulatory frameworks, BirdLife considers that new hydropower facilities and liquid biofuels present high ecological risks. While acknowledging that both can be developed sensitively, BirdLife considers the potential for sustainable deployment to be very limited. The EU's ambitions for increased electricity from hydropower are modest, in line with this assessment. However, BirdLife considers the EU's targets for liquid biofuels to be excessive and should be scaled back.

3.3.1 HYDROPOWER

Hydropower was already a significant source of renewable energy in 2005, providing 30 Mtoe (2.6%) of total energy consumed. This is expected to grow only a little, to 32 Mtoe in 2020. Hydropower is expected to represent 10.5% of electricity consumption in 2020 (EREC, 2011a).

This limited growth reflects the fact that suitable sites, particularly for new large hydro schemes, are very limited in Europe (Box 15). A proportion of the increase will be achieved by repowering existing hydro facilities. Provided this is achieved in compliance with the Water Framework Directive's requirements regarding the conservation status of water bodies, this is an acceptable way to boost renewable energy output from a conservation perspective.

BOX 15

Are there suitable sites for new hydro in Slovenia?

Hydropower is the most important source of renewable energy in Slovenia apart from biomass. The first public hydropower plant in Slovenia was built in 1914. The river Drava now has eight hydro facilities, and its power generation potential is fully exploited. The Slovenian economic Ministry is preparing a new National Energy Plan to 2030 in which the construction of 596 MW of new hydropower plants is planned. The proposal is for 448 MW of new hydro capacity on the river Sava, 55 MW on the river Mura and 93 MW on other, smaller rivers.

Almost half of Slovenian rivers are already used by power plants, and are consequently degraded in ecological terms. Following construction of large hydropower plants on the rivers Drava and Sava, and subsequent destruction of the largest gravel bars in the late 1970s, stone curlew became extinct in Slovenia, while little tern is now restricted to the coast. Because the remaining unaltered rivers have high conservational value, it can be expected that it will be increasingly difficult to find suitable locations for new facilities.

Among the remaining larger rivers with potential for additional hydropower production (Sava, Soča, Mura, Krka, Kolpa and Idrijca), only the Sava is not part of the Natura 2000 network. Here there are no protected areas and conflicts with bird conservation are not foreseen, so this river offers some suitable sites for new hydro facilities. However, it will not be easy to place power plants on the river Mura – the largest preserved lowland river in Slovenia, with extensive floodplain forests and rich biodiversity. Construction of one or two power plants here may be possible, provided that extensive compensatory habitats are created to comply with the requirements of the Habitats Directive.

3.3.2 LIQUID BIOFUELS

According to the NREAPs, liquid biofuels contributed 3 Mtoe (0.3%) of EU energy consumption in 2005. This is expected to increase to 29 Mtoe (2.4%) in 2020. Under the Renewable Energy Directive (Directive 2009/28/EC) every Member State has a target of 10% of renewable energy in the transport sector by 2020 (Figure 15). This can be met with renewable electricity, hydrogen and second generation biofuels, but liquid biofuels are the predominant technology in the NREAPs.

The EU drive to increase the use of liquid biofuels for transport is rapidly bringing new pressures on land and natural resources, both inside the EU and globally. The EU must urgently revise its deeply flawed policy choices on liquid biofuels by scrapping the targets driving their production, and bringing in effective sustainability standards to ensure that all bioenergy delivers for the climate while not harming biodiversity. Active policies must be pursued to ensure that the most promising bioenergy technologies are developed while the worst ones are not supported. In particular, ILUC caused by biofuels needs to be reflected in full life-cycle assessments of biofuel impacts and policy measures adopted that enable this to be mitigated effectively.

BirdLife considers that the ecological risks associated with liquid biofuels outweigh any environmental benefits. This is the one renewable energy technology for which BirdLife considers the 2020 targets are too high and should be lowered. To achieve the 15% 2020 target, greater use of the low and medium risk technologies discussed above, in particular energy saving, should make up the shortfall.

FIGURE 14

Additional hydropower in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv]

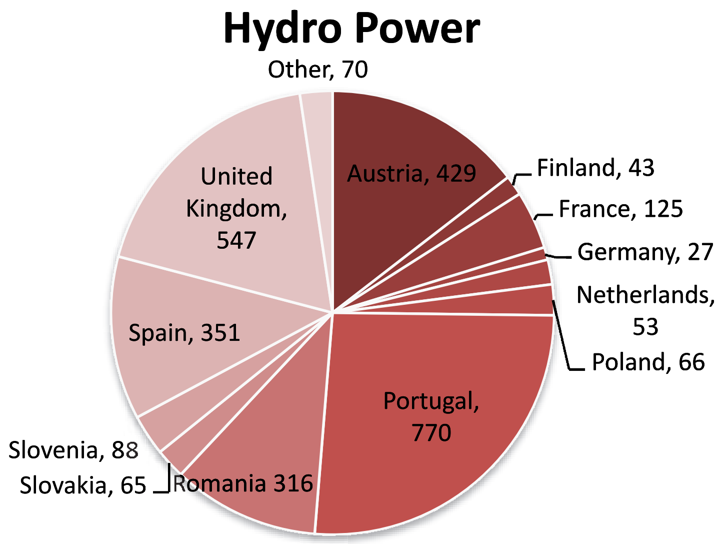
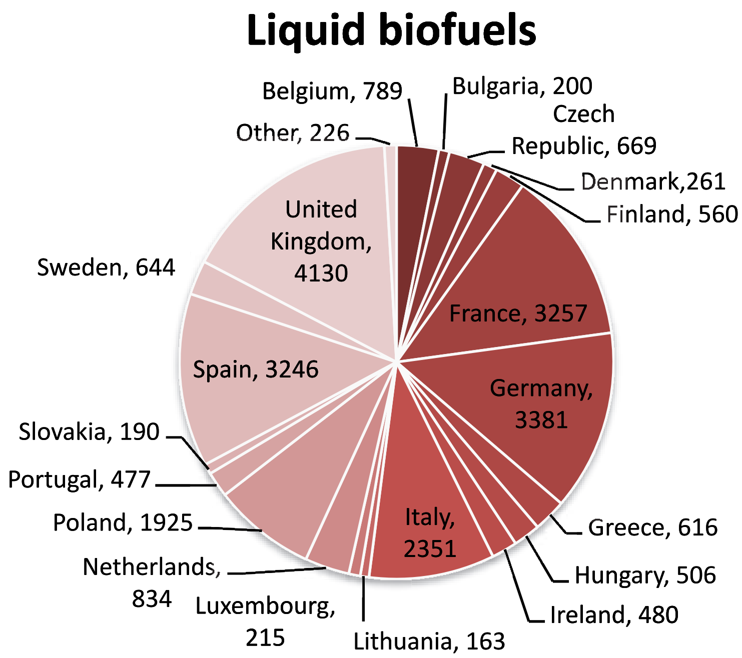


FIGURE 15

Additional liquid biofuels in EU energy consumption in 2020 compared to 2005, by Member State [ktoe][iv, ix]



CHAPTER 4

HOW TO ACHIEVE A EUROPEAN RENEWABLES REVOLUTION IN HARMONY WITH NATURE

Harnessing the clean, renewable energy provided by the sun, wind, waves and tides is the only sustainable energy future for Europe. The renewables revolution can and must work in harmony with, and not against, nature. This Chapter sets out BirdLife's views on what needs to happen to stimulate renewables investment and to make sure that investment proceeds sensitively.

4.1 COMMIT POLITICALLY AND FINANCIALLY

Experience across Europe has clearly shown that renewables investment and innovation require strong political commitment and stable incentive frameworks. Investors and their backers need the confidence that they will receive an adequate return. Uncertainty over possible policy changes leading to lower than expected returns deters investors and drives up the cost of capital. Ambitious and firm long-term commitments are needed at the European level for tackling climate change and for increasing the share of renewables beyond 2020, to give more certainty and confidence to all stakeholders. The European Renewable Energy Council has called for 45% of total energy use to come from renewables by 2030 (EREC, 2011b) and the European Wind Energy Association strongly supports binding targets for 2030.

The European Commission, national governments and non-government actors have begun to develop "roadmaps" towards a low-carbon, high-renewables future. Many of these come to similar conclusions on the technical feasibility of a very high renewables energy system: the challenges are mainly political and economic. For example, the European Renewable Energy Council's report *Re-thinking 2050 – A 100% Renewable Energy Vision for the European Union* (EREC, 2010) concludes "...it is not a matter of availability of technologies. It is a matter of political will and of setting the course today for a sustainable energy future tomorrow. A 100% renewable energy supply for Europe will require paramount changes both in terms of energy production and consumption as well as concerted efforts at all levels – local, regional, national and European."

The European Climate Foundation's *Roadmap 2050* study (ECF, 2010) provides a system-wide European assessment of the feasibility of very high shares of renewables, including an electricity system reliability assessment. It is also the first study to develop its analysis in co-operation with NGOs, major utility companies, transmission system operators and equipment manufacturers across technologies and throughout Europe. This study

BOX 16

The European Climate Foundation's Roadmap 2050 study

The European Climate Foundation's *Roadmap 2050* study found that by 2050 Europe could achieve an economy- wide reduction of greenhouse gas emissions of at least 80% compared to 1990 levels and still provide the same level of reliability as the existing energy system. The study assumes no fundamental changes in lifestyle, and use of technologies that are already commercially available today or in the late development stage. This transition, nonetheless, requires that all currently identified emission abatement measures in all sectors are implemented to their maximum potential. Realising this radical transformation requires fundamental changes to the energy system. The study concludes: "Achieving the 80% reduction means nothing less than a transition to a new energy system both in the way energy is used and in the way it is produced. It requires a transformation across all energy related emitting sectors, moving capital into new sectors such as low-carbon energy generation, smart grids, electric vehicles and heat pumps... Realistically, the 2050 goals will be hard to realise if the transition is not started in earnest within the next five years. Continued investments in non-abated carbon-emitting plants will affect 2050 emission levels. Continued uncertainty about the business case for sustained investment in low-carbon assets will impede the mobilisation of private-sector capital." (ECF, 2010, p. 9) also stresses the political and economic transformation needed to realise the potential of renewables (Box 16).

A political vision for EU countries to adopt a low-carbon, resource-efficient and biodiversity-friendly development pathway is therefore crucial. In March 2007 the European Heads of State took a first step when they decided on the so-called "20-20-20 targets" for their climate and energy policy. Between 1990 and 2020 EU Member States committed themselves to reduce greenhouse gas emissions by at least 20%, to increase the share of renewable energy sources to 20% of the total demand in Europe, and to improve energy efficiency by 20%. This was a strong signal to encourage suitable frameworks and conditions at EU, national and regional levels, and to speed up the necessary investments for the transformation of energy systems in the coming years. Since the failure of the UN Climate Change Conference in Copenhagen in December 2009 the EU has struggled to raise their ambition and to agree on binding targets beyond 2020.

Transformation of the energy sector will require sustained investment in reduced energy demand, renewable energy and "smarter" electricity grid infrastructure. Massive investment over decades in long-lived assets with long planning and investment cycles demands stable economic, regulatory and policy frameworks. Continual change in incentives and frameworks damages confidence and raises the costs of capital. While some very large energy firms can finance investments from their own balance sheets, instability in particular works against smaller investors, who cannot raise finance at reasonable cost if policy risks are seen to be high. Many small investors are needed to stimulate competition, and to tap into renewables potential at all scales – including households and communities. Therefore, the EU should also provide for clear targets and achievable pathways for the medium- and long-term – to 2030, 2040 and 2050.

The European Union Emissions Trading Scheme (ETS) has a vital role to play, but needs major reform. Its future and effectiveness have become uncertain as negotiations on an international climate regime after 2012 stumble. Several cases of fraud, inconsistent rules, non-additional offsetting projects and other loopholes seriously undermine the functioning of the ETS. As a consequence, the market faces an over-allocation of emission permits, and the carbon price remains too low to provide certainty and to incentivise the necessary investment decisions. In this situation, use of other, less flexible policy instruments, such as regulations on emissions and binding renewable energy and efficiency targets, will become more important and urgent.

Competition and private investment will remain major drivers, but there is an urgent need to change the logic of markets to achieve an energy system based almost exclusively on renewable sources by the middle of the century. Only binding targets, instruments and regulations will give sufficient confidence and clarity to innovators and investors. Providing clear, stable policy frameworks, incentives and planning regimes is necessary to reduce political and planning risks and thereby reduce the cost of capital. Intelligent policy frameworks aim at minimizing overall infrastructure needs, optimizing the geographical spread of renewable energy technologies and unlocking the potential of smart grids. Such an approach will lower both ecological impacts and overall costs.

Clarity on the vision for Europe's energy future is vital. The public acceptability of the necessary investments, and the legitimacy of the necessary policies, will be undermined if doubts remain about the imperative for change and its implications on the ground for European citizens. Energy system transformation will raise costs to energy consumers in the short-term, affect communities' landscapes and property values, and present risks to Europe's cherished wildlife. In addition to clear political signals, the EU and its Member States must give much greater attention to building trust

BOX 17

BirdLife initiatives to promote public support for renewable energy

BirdLife has a role to play in improving the public acceptability of renewables, through messages to our members about their role in the fight against climate change, and highlighting good practice in biodiversity-friendly renewables deployment. BirdLife Partners are increasingly making use of solar power on their reserves. BirdLife Partners in Belgium, Natuurpunt and Natagora, have both set up a solar PV business and have found that sales events are a useful opportunity to tell people about climate change and the need for renewables.

and public acceptability through mechanisms such as increased transparency, public participation in decision making and opportunities for buy-in and investment at an individual and/or local level.

Ambitious, clear and stable policy and regulatory frameworks will be necessary, but are insufficient to enable a renewables revolution in harmony with nature. They will drive down costs for technologies that are already commercially available, but basic research and development (R&D) is also needed to bring forward the new technologies of tomorrow. Innovation will make the transformation to a low-carbon, high-renewables future more readily achievable, by reducing costs and risks, and radical innovations remain a possibility. Basic R&D budgets for low-carbon technologies should be increased by an order of magnitude in Europe, with an increased emphasis on promoting innovations that minimise ecological risks and improve public acceptability.

Cultural change will also play a role in making the energy transformation possible, as people see the benefits of avoiding waste and living with low impacts. We need to protect our natural heritage, and help people to reconnect with it, for this shift in lifestyles to make sense and gain momentum. And, in all this, we must not forget that protecting biodiversity is not just about what nature can do for society – it is also right to protect nature simply because it is valuable in its own right.

4.2 PROTECT THE NATURA 2000 NETWORK

Healthy, biodiverse environments play a vital role in maintaining and increasing resilience to climate change, and reducing risk and vulnerability in ecosystems and human societies. In the European Union, Natura 2000 sites provide these healthy and biodiverse environments. The Natura 2000 network of sites protected under the EU Birds and Habitats Directives lies at the heart of Europe's efforts to protect its biodiversity. Natura 2000 sites are not "fenced-off" protected areas. On the contrary, they are often dependent on sustainable human activities and land uses that have shaped them and maintained them over the years. They cover almost a fifth of the EU territory, over 25,000 sites where nature can exist in harmony with humans. BirdLife makes major contributions to data gathering and identification of sites that make up the Natura 2000 network. The network is now almost complete on land, but there is still much work to do offshore (Box 18, Box 25).

Marine spatial planning and a robust Natura 2000 network will be vital for enabling biodiversity to adapt to climate change. In order to increase the ability of ecosystems to adapt, as well as accommodating the need of species and habitats to move into areas with more suitable climatic conditions, BirdLife promotes the following principles:

- increasing efforts in addressing the existing threats to species, sites and habitats, in particular through the full and swift implementation of EU conservation legislation set out in the Birds and Habitats Directives
- urgently implementing at all levels the European Union's Biodiversity Strategy
- improving the connectivity and coherence of protected areas networks, crucially Natura 2000, and, where necessary, increasing protected areas in number and size

BOX 18

Offshore wind farm development in Spain

Spain is a European and world power in terms of installed onshore wind energy capacity. Furthermore, with almost 5,000 km of coastline, and a reliable coastal wind resource, it should also be in the top rank of countries for coastal offshore wind power capacity. However, a range of economic, commercial and licensing constraints have impeded offshore wind development in Spain. There are concerns that, despite an SEA process that was positive and ground-breaking in many respects, the lack of attention given to the designation of future marine SPAs will further delay progress in what has the potential to be a key area of wind energy growth.

In April 2009, following the associated SEA process, the Spanish government published its *Strategic Environmental Report of the Spanish Coast for the Installation of Marine Wind Farms*. In nature conservation terms the key output was a sensitivity map which, after taking into consideration numerous possible constraints, divided Spanish inshore coastal waters into three categories of sensitivity to wind farm development: suitable for development; suitable for development but with constraints; and unsuitable for development (but with some possibilities for certain types of project if the concerns raised in EIA process can be adequately resolved).

The SEA process was led by the Ministry for Industry, Trade and Tourism (promoter) and the Ministry for Environment, Marine and Rural Affairs (environmental authority). It involved wide consultation with the energy sector, the regional governments, industry groups such as fishing and shipping interests and interested parties in wider society such as the environmental NGOs. In nature conservation terms it took into account existing protected areas designated in the Natura 2000 network and other areas protected under Spanish legislation, as well as the known distributions of key protected marine species.

In general, the process and final product was well-regarded, although regional and sectoral concerns remain. The principal concern from a nature conservation point of view – raised consistently by SEO/BirdLife Spain (and yet to be adequately addressed by the Spanish government) is the failure to take into account in the sensitivity analysis the marine IBAs identified in a LIFE+ project and accepted as potential SPAs by the Ministry responsible.

This hugely important project, innovative in nature and pioneering in its use of satellite and other technologies to identify the key areas most important for seabird conservation, proposed 42 marine IBAs (covering nearly 43,000 km^2) for SPA designation in Spanish waters (Acros *et al.*, 2009). It is clear that onshore wind energy development cannot be allowed to proceed until the existence of these areas is fully acknowledged in the sensitivity map produced by the Spanish Government.

- improving the "permeability" of the landscape in general, in particular by making land-use (policies) more biodiversity friendly
- seeking synergies and reducing trade-offs between climate change mitigation (eg, renewable energy generation) and biodiversity conservation.

The Birds and Habitats Directives represent an “enlightened approach to dealing with environmental constraints, and one that is at the heart of sustainable development” (SDC, 2007, p. 143). A key part of this is making sure the best areas for wildlife in Europe, Natura 2000 sites, are properly protected in the wider public interest, so that they continue to make their full contribution to securing the favourable conservation status of the habitats and species they conserve. For good reason, the Directives only allow these sites to be damaged in exceptional circumstances and require strict tests to be passed first (Section 4.6). Applied in a systematic, robust and transparent manner, they can ensure decisions on whether to damage some of Europe’s most important wildlife areas are taken in the genuine interests of society as a whole. Where this fails in sub-national decision making, Member States may decide that it is necessary to go beyond the Directives’ requirements, by banning certain types of development in Natura 2000 areas (Box 19).

BOX 19

The Italian reaction to inadequate application of the Habitats Directive tests

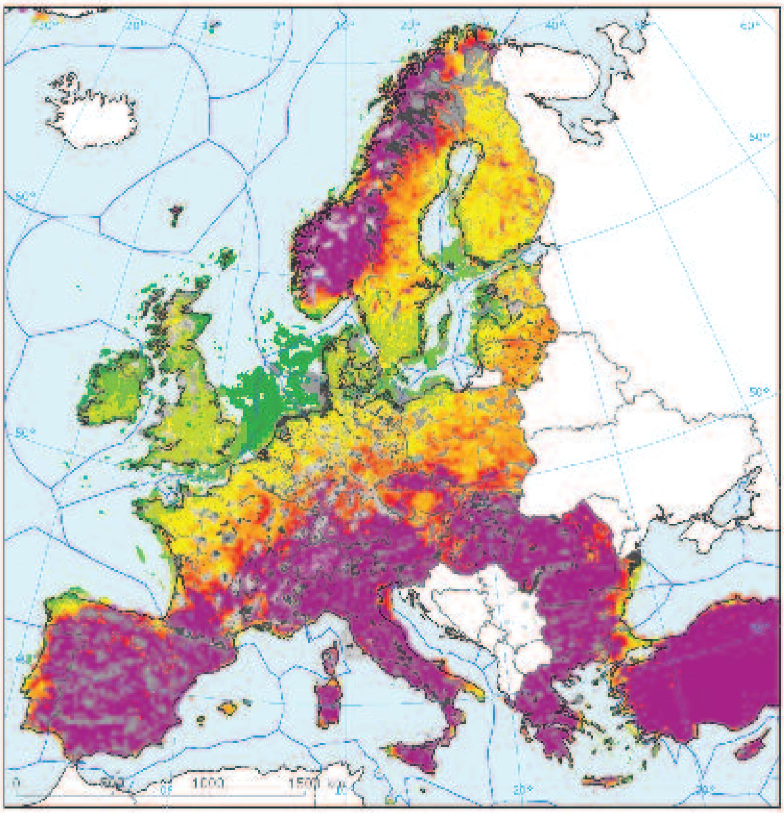
In Italy, ill-conceived or non-existent spatial planning has jeopardised many sites of great value for biodiversity. In the Puglia Region, hundreds of wind turbines have been developed within an IBA (Monti della Daunia), resulting in serious degradation of the site. The nearby Basilicata Region is the most important in Italy for red kite, and is home to over half of the 10–12 pairs of black stork breeding in Italy.

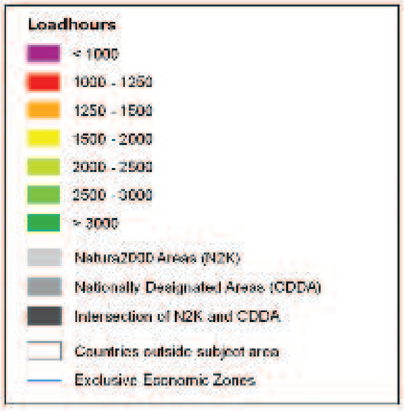
Unfortunately the Basilicata Regional Energy Plan pays very little attention to IBAs and Natura 2000 sites. Near Campomaggiore, a wind farm development consisting of seven 1.5 MW turbines has been recently completed. The towers are well within an IBA and between three Natura 2000 sites, each of which is classified as an SPA. Red and black kite, lanner falcon, short-toed eagle, eagle owl, and black stork nest in the IBA; these are all species listed in Annex 1 of the Birds Directive, and all have "unfavourable" overall pan-European conservation status (BirdLife International, 2004). Nevertheless the regional authorities decided that the project mentioned above was exempt from EIA and from "appropriate assessment" under Article 6 of the Habitats Directive. The project was not even made public, so stakeholders had no chance to comment on it. On the wind farm site, a winter-roost hosting a stable population of about 100 Red Kites was present – not any more.

In November 2007, a decree named "*Minimum homogenous criteria for definition of conservation measures for SACs and SPAs*" was signed by the Minister of Environment. In SPAs it prohibits certain activities such as waste disposal and off-road driving, and restricts others such as hunting and fishing. The decree was issued in response to the infringement procedure 2131 (2006), which points, among other things, to the lack of coherent conservation criteria for Natura 2000 sites. The focus is mainly on SPAs, but principles for future conservation measures for SACs are also laid out. It prohibits the construction of new ski lifts and ski runs. The decree also prohibits construction of new large wind turbines in SPAs.

This measure was recently referred to the European Court of Justice by a wind energy company, based on the refusal of Apulia Region to authorise the location of wind turbines in "Alta Murgia National Park" SPA. The developer bringing the legal action had argued that European law required "appropriate assessment" before authorisation could be refused, and that the Decree is therefore unlawful. The court concluded that the ban on locating wind turbines in SPAs does not contravene EU Directives on nature protection and promotion of renewable energy.

Italian wind farm construction site that has displaced red kites.





Natura 2000 and Common Database on Designated Areas Sites in Europe, and wind energy full load hour potential.

The European Environment Agency (EEA, 2009) calculated that the technical potential for onshore wind energy in Europe is over 10 times total electricity consumption, and that excluding Natura 2000 and other protected areas would reduce this by only 13.7%. The same study estimated that the economically competitive potential for onshore plus offshore wind energy in Europe by 2030 is over three times greater than total electricity consumption. BirdLife agrees that the potential for renewable energy in Europe is immense, and that therefore sufficient suitable locations can be found for our energy needs to be met using renewables and without creating risks for biodiversity in protected areas or in the wider countryside. However this cannot be left to chance: sufficient suitable locations for development must be identified and developers must be steered towards them.

4.3 MINIMISE ENERGY CAPACITY AND INFRASTRUCTURE NEEDS

Most project-related risks can be avoided by good location choices and minimising reliance on the riskier technologies such as liquid biofuels. However, the ecological risks presented by renewables development in aggregate will inevitably also relate to the total quantity of new structures and extent of changed land uses – numbers of turbines, hectares of solar panels, or kilometres of new power lines, for example. Costs to society, to pay for new capacity and infrastructures, will also be higher if system development is not optimised.

Enabling competitive markets to function can stimulate overall investment, but without strategic planning it is likely to result in piecemeal and inefficient energy system development. For example, the current UK framework for building power lines to bring electricity to markets from offshore wind farms appears to emphasise competition at the expense of developing a rational configuration with lower costs, fewer impacts and greater potential to form part of a wider EU electricity transmission network (Box 20).

The example of offshore grid development in the UK illustrates a wider point about energy system development: competition does not automatically result in an efficient outcome from systemic and long-term societal perspectives. The same can be said of renewable energy development across Europe as a whole. Under the NREAPs each Member State has decided how much of each kind of renewable energy it aims to deploy, and they also decide on the appropriate level of financial incentives they will offer to attract investment.

BOX 20

The case for an integrated offshore grid in the North Sea

Under current UK arrangements, offshore transmission owners (OFTOs) enter a competitive tendering process to build and own the assets. Large "Round 3 Zones" for offshore wind development in UK waters have huge capacity. For example, Zone 5 off East Anglia has a target capacity of 7.2 GW (enough power for 5 million homes). East Anglia Offshore Wind plans to develop six 1200-MW wind farms within the zone, in a rolling programme to 2022. The tendering process and regulatory framework means the only option is to allow the OFTOs to connect the zone to the mainland in a piecemeal and inefficient configuration with six individual lines and six landfalls. Each landfall will require an onshore HVDC convertor station, and onshore overhead (or underground) power lines for connection into the national grid. National Grid Electricity Transmission (NGET), which operates all onshore and offshore transmission, argues that this "radial solution" is an inefficient approach, will lead to increased consenting problems and will fail to future-proof network evolution as a more integrated European grid develops. NGET argues that an "integrated" solution for offshore grid development would be 25% less costly for consumers, and require half as many landing sites and 75% fewer kilometres of onshore lines.

Under subsidiarity rules this is the right approach, but it is not necessarily efficient or rational. Were there to be uniform incentives for investment in the various renewable energy technologies across the EU, investors would be attracted by the availability of energy resources (wind speeds, sunshine and so on) and the availability of suitable sites, rather than by subsidy levels. This would increase electricity generation for a given level of overall investment. Much more effort needs to be made at the EU-level to envisage and plan for rational exploitation of Europe's renewable energy resources.

In addition to rational energy system planning, the need for new capacity and infrastructure that carry risks to wildlife can be limited by reducing the overall growth in demand for centralised electricity supply. In many locations it is possible for homes to meet or exceed their own electricity and heating needs over the year, using effective thermal insulation and micro-renewables. Whole communities can become net exporters of electricity, using small scale renewables generation connected into the electricity distribution network. BirdLife considers that the EU and its Member States need to go further in promoting energy savings, micro- and distributed renewables and smart grid technologies to limit the need for new large scale power generation of all kinds. Nevertheless, electrification of transport and some heating and unpredictable renewable electricity output at any given location mean that very significant investment in new large-scale renewables facilities and power lines is unavoidable (Box 12).

4.4 ENSURE FULL STAKEHOLDER PARTICIPATION AND JOINT WORKING

Conflicts between different groups of stakeholders are a symptom of failures to come together in the processes of developing policy and planning frameworks. Where policy makers, planners, authorities, NGOs, industry groups and researchers all work together in a spirit of openness and problem solving, the necessary "buy in" and trustful relationships are in place to head off conflicts and ensure successful policy implementation.

BirdLife Partners welcome opportunities to work with developers and policy makers to promote biodiversity-friendly renewables deployment. Often developers will approach BirdLife Partners before making a project proposal to find out if there are likely to be significant impacts on birds and other biodiversity. We also work with developers, scientists and government institutions to produce guidance documents on sensitive renewables deployment (eg, Boxes 21-23).

BOX 21

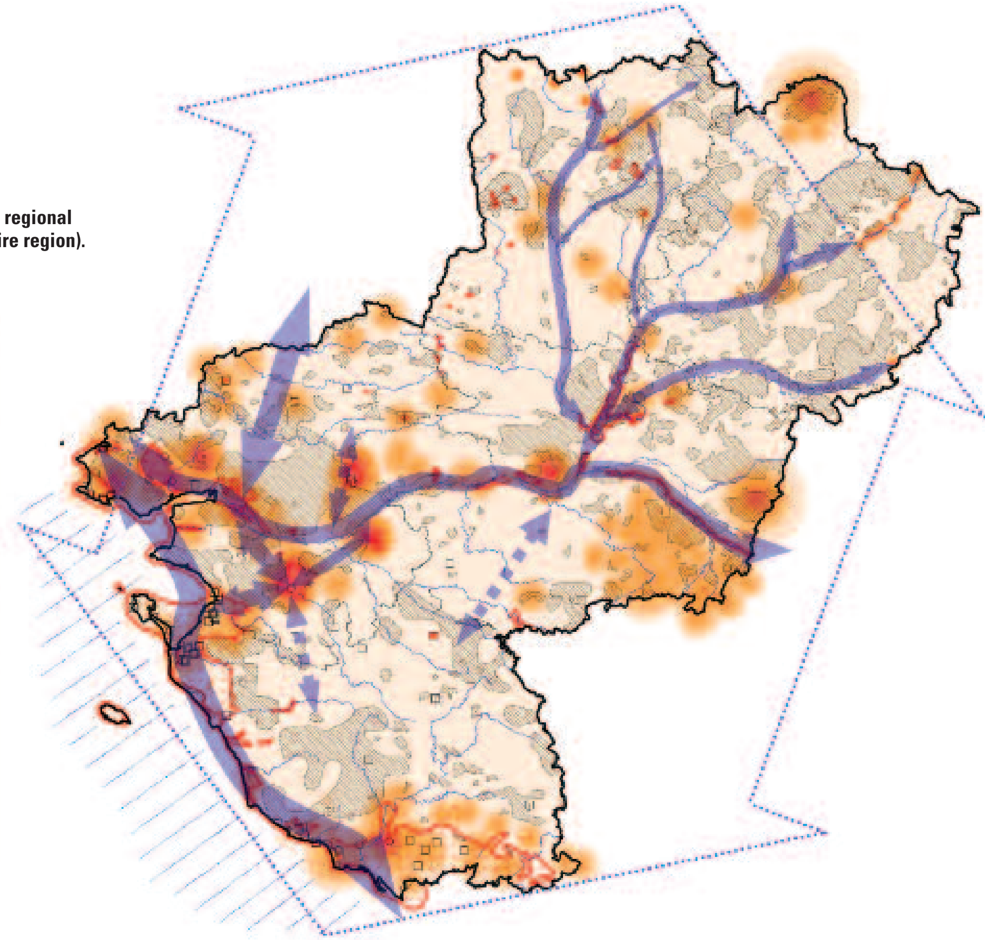
Working with government and industry for biodiversity-friendly wind power in France

The French national programme on wind energy and biodiversity, 'Éolien – Biodiversité', was created in 2006. It is managed by the French energy agency (ADEME), the ministry of the environment (MEDDLT), renewable energy professionals (SER-FEE), with overall co-ordination by LPO/BirdLife France. The programme is based on a set of quality criteria, such as:

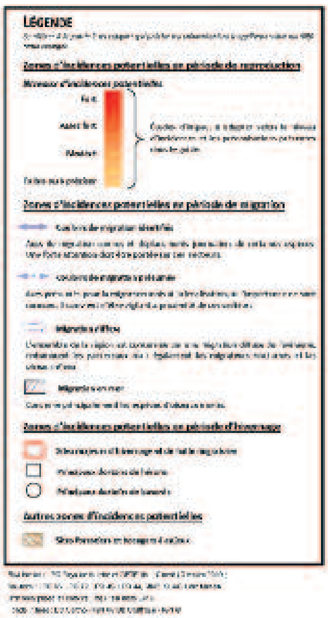
- respect for the ecological sensitivity of development sites, using spatial planning
- preservation of biodiversity when building, aiming for no net loss of biodiversity
- ecological monitoring for birds and bats during operation, and reduction of impacts found during monitoring
- rehabilitation of the site, taking into account biodiversity.

example, an up-to-date bibliography; a dedicated web resource area and online advice; accurate guidelines on EIA and specific surveys; expert advice on specific projects (eg, R&D, spatial planning, surveys); financial support; and environmental NGO networking and capacity building.

The programme supports regional authorities to prepare regional wind energy schemes, defining zones within which the feed-in tariff will be available. Biodiversity sensitivity maps are used to determine the best locations, and to minimize cumulative effects. The data needed for mapping is linked with accurate knowledge on bird diversity, quantity, location and potential sensitivity to wind turbines. The map below is an example of one of the regional maps produced through compilation of this data.



Example of a bird sensitivity map used in regional spatial planning in France (Pays de la Loire region).



Another avenue for co-operation between BirdLife and developers is through joint declarations of intent suchas the "Budapest Declaration" (Box 22) and the Renewables Grid Initiative "Declaration on Electricity Network Development and Nature Conservation" (Box 23).

BOX 22

Budapest Declaration on power lines and bird mortality in Europe

On 13 April 2011, Budapest hosted a special Conference *Power lines and bird mortality in Europe*. This event was co-organised by MME/BirdLife Hungary, the Ministry of Rural Development of Hungary and BirdLife Europe, and was hosted by MAVIR (the Hungarian Transmission System Operator Company Ltd.), as part of the official programme of the Hungarian EU Presidency.

The aim of the Conference was to bring together nature conservationists, industry professionals and governments and to stimulate joint actions to address the problem of large-scale bird mortality on power lines at the European level. The Conference was attended by 123 participants of 29 European and Central Asian countries, the European Commission, UNEP-AEWA, six energy and utility companies, experts, businesses and NGOs. The participants adopted a special Declaration[x] calling on European governments and EU institutions to ensure that the production and transport of our energy will not be the cause of unnecessary death of millions of birds.

The declaration calls on the European Commission and national governments "as they formulate, commit to, and pursue an ambitious set of climate, energy and biodiversity conservation targets and strategies to reconcile energy generation, transmission and distribution with the protection of wild birds within and beyond protected areas" to

"*maintain high levels of implementation of the EU's environmental acquis including the Birds and the Habitats Directives and relevant international legislation through the application at national or regional level of effective legal, administrative, technical or other requisite measures for: 1) minimisation of the negative impacts of power lines on the natural environment and wild birds, 2) ensuring a system of general protection of wild birds as requested by the Birds Directive, and 3) ensuring that such measures are incorporated in the assessment of investment projects such as the electricity 'Projects of European Interest' that will be advanced through the follow-up of the EU's Energy Infrastructure Package.*"

The declaration then calls on all interested parties to jointly undertake a programme of follow-up actions leading to effective minimisation of the power-line induced bird mortality across the European continent and beyond.

BOX 23

The Declaration on Electricity Network Development and Nature Conservation

The Renewables Grid Initiative (RGI) is a coalition of electricity transmission system operators (TSOs) and green NGOs including BirdLife and WWF. It calls for strong political leadership to ensure that the right grid infrastructure is developed to enable rapid deployment of renewable energy in Europe. The RGI recognises that installing thousands of kilometres of new lines in Europe requires careful planning, so that all stakeholders' concerns are properly addressed. Working with the RGI, BirdLife has begun engaging constructively with European transmission system operators to find ways to accelerate development of Europe's grid infrastructure to accommodate a high share of renewables, while also protecting the natural environment. The RSPB and TenneT, the Dutch TSO, have led an RGI initiative to develop a joint declaration on grid development in line with nature conservation objectives in Europe. In this the TSOs commit to taking steps to minimise overall infrastructure needs, and to avoid and minimise impacts on biodiversity. In turn the NGOs commit to constructive working with the TSOs to enable these principles to be applied, in support for the transition to renewable energy in Europe.

4.5 STRATEGIC SPATIAL PLANNING FOR RENEWABLES

In a highly regulated, publicly subsidised sector such as energy, for the provision of services upon which people depend for their livelihoods and safety, and in which rapid expansion of networked infrastructures is needed, many people understandably expect there to be a plan in place. Often there is, to the benefit of the public and developers, who gain some certainty that the locations they wish to develop are likely to be appropriate to the authorities. Good plans steer development so it serves the public interest and does so in ways that best fit the circumstances and needs of the communities on whose behalf (and with whose participation) those plans were developed.

Plans do not have to be imposed in a "top-down" manner, and they do not have to impede investment. Like anything else, planning can be done well or badly. Done well it enables investment because an open, legitimate democratic process is seen to have balanced competing interests and needs, and therefore each proposal for development does not become a flashpoint for debate and protest. Representative democracy needs reinvigorating, and needs to work for people "on the ground", whether they are already investors in renewable energy, or could become investors, or simply are among the millions of energy consumers who ultimately pay.

Energy development is one area where planning is most justified given the urgency to decarbonise and the controversies infrastructure development brings. Moreover, electricity provision of all kinds, and particularly from renewables, is highly geographically specific – it has to take into account existing infrastructures, demanding locations and resources (eg, wind speeds). One can argue that developers, rather than officials, are best placed to understand those factors and to plan investments accordingly. There are many enlightened investors and developers, but their first priority will always be to run a profitable business and make sound investments. They cannot be expected to weigh-up the local benefits of one land use over another, nor to consider the wider public benefits for this and future generations. Nor can they be expected to undertake the necessary studies and develop the necessary vision over appropriate time and geographic scales to ensure co-ordinated and efficient energy system development that minimises overall infrastructure needs and related costs to society and nature.

It falls to elected representatives and public authorities to reconcile different stakeholders interests, and failing to do so can prolong conflict and thereby stall investment. This has been the experience in Slovenia with wind power development, for which strategic spatial planning has not been developed (Box 24).

The experience with wind energy development in Spain also illustrates the problems that can arise when authorities allow rapid and largely unplanned investment to go ahead. Unfortunately, renewable energy development in Spain is taking place in a highly accelerated and disorganised way. The first few wind farms were evaluated as individual projects, but within a few years the avalanche of projects being presented forced the autonomous regions to call a halt to new projects whilst they prepared wind energy plans. Whilst in some cases these plans have been produced at the regional level, in others such as Andalusia or Castilla and León they have been produced for each province.

BOX 24

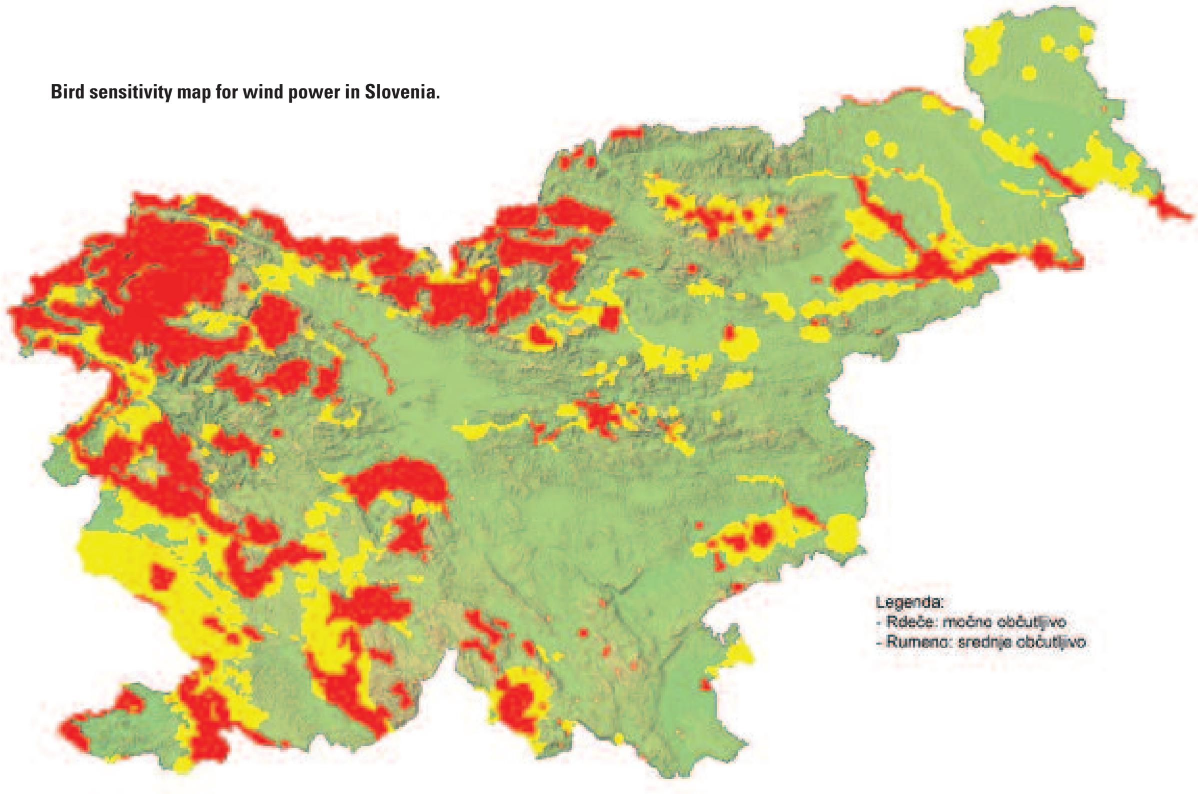
Investment delays due to lack of strategic planning for wind power in Slovenia

Wind power potential in Slovenia is relatively weak. In spite of this, the public electricity corporation launched an ambitious wind-power investment programme in 1999. After a few years of measuring wind speeds, and without further strategic planning, the corporation identified three locations as those likely to be most profitable: Mount Nanos, Mount Goli and Mount Volovja reber. All three mountains are of exceptional landscape beauty and are part of the Natura 2000 network. All three sites are designated to protect griffon vultures and golden eagles – species known to be particularly susceptible to collision with wind turbines.

The proposed programme would have led to degradation of some of the most valuable parts of Slovenia's natural heritage, so provoked widespread opposition among nature conservationists. In the case of proposed Volovja reber wind farm, where 47 turbines are proposed, an intense conflict developed. After eight years of procedures, and several court cases lodged by DOPPS/BirdLife Slovenia, it is still unclear whether the wind farm will receive planning permission.

As a consequence of these conflicts, Slovenia has no wind turbines erected so far. The key obstacle is that the country has no national strategy or consensus on how and where to develop wind power. In 2006 a coalition of conservation NGOs proposed that the Government should develop a national strategy, identifying sites for wind-power development informed by bird sensitivity mapping. Sadly, the authorities have refused this approach. However, DOPPS continues to call for strategic planning for wind power, and has managed to find funds to produce a sensitivity map (see below) relating to seven highly sensitive bird species and 13 moderately sensitive ones. The maps suggests that only 19% of total Slovenian territory is highly sensitive (red) for wind development, while additional 14% is moderately (yellow) sensitive. In the remaining two thirds of national territory it is foreseen that wind farm development would not harm the interests of bird conservation.

Bird sensitivity map for wind power in Slovenia.



Aerial view of wind turbines in parched Spanish fields.

The EU SEA (see also Section 4.5.2 below) Directive (2001/42/EC) requires authorities developing plans in a range of sectors, including energy, to take environmental considerations into account through a process of assessment and consultation. In Spain only two wind energy plans have been subjected to this type of evaluation: the regional government of Castilla-La Mancha conducted an SEA of its "Wind Energy Plan to 2011", and the national Ministry for the Environment has carried out an SEA for offshore wind farm developments (Box 18). In each case the plan includes zoning, which identifies compatibility of wind energy development with environmental conservation in certain areas, as well as identifying those zones most appropriate for development.

The failure to carry out SEA of wind energy plans elsewhere has in many cases meant that they have been prepared simply in terms of the distribution of the wind resource, without taking into account any environmental concerns. This is the case, for example, in the autonomous community of Valencia where the Wind Energy Plan was based almost exclusively on an evaluation of the wind resource carried out by one of the leading electricity companies in Spain, which was clearly interested in installing various wind farms in the region. The European Commission is investigating this plan given that the areas identified as having potential for wind farm development overlap with the expansions of SPAs proposed by the regional government.

The failure to carry out SEA, far from accelerating wind farm development, can result in lengthy delay, as has been the case in Catalonia, where the Supreme Court of Justice has halted the planning of wind farms in priority zones for wind energy development because of the lack of environmental evaluation. A similar situation exists in Cantabria, where complaints have been registered in the courts because the wind energy plan was approved without being submitted to SEA, thereby failing to comply with Directive 2001/42/EC and the Aarhus Convention.

In the language of economics, there are public good and natural monopoly arguments that not only justify strong regulation of energy industries and various financial incentives (seen almost everywhere), but also planned development. The urgency of tackling climate change, while protecting and restoring biodiversity, only adds to this need to steer development to locations where it can be of most benefit and do least harm. This does not amount to state ownership of assets, or Soviet-style "indicative planning" in which officials decided unilaterally what should go where, how much and when. Rather, it is a matter of indicating on maps those areas and locations that are most suitable for specific types of development, and making these available to developers.

Spatial planning has a long history in Europe, but is in its infancy in the marine environment. In the UK SEA and mapping of resources and constraints has been used to define areas for licensing offshore wind development in the North Sea. This has been extremely useful to developers, who have shown a very keen interest in investment. The European Wind Energy Association's EU funded project called SEANERGY2020[xi] is developing policy recommendations on marine spatial planning and offshore wind power. BirdLife Partners are now engaging in an ambitious project to enable strategic planning for biodiversity-friendly offshore energy exploitation in the Atlantic (Box 25).

BOX 25

The Future of the Atlantic Marine Environment project and offshore renewables

Offshore wind farms are already a reality in some countries, such as the UK, but are still new to France, Spain or Portugal. However, it is clear that the next five to six years will witness a rapid increase in the number of proposals in the Atlantic, both for offshore wind farms and wave-energy harnessing. FAME[xii] – is an ambitious strategic transnational co-operation project involving BirdLife Partners from five countries (UK, Ireland, France, Spain and Portugal). It will engage with the offshore renewable energy sector in order to facilitate strategic planning and robust assessment of impacts. By facilitating direct communication with key energy stakeholders and linking the scientific, conservation and private sectors, a unique open and honest discussion will be enabled. This will help to ensure that key areas are protected for seabirds, while ensuring that a sustainable generation of renewable energy is facilitated.

FAME Partners have been gathering and analysing information on seabirds for several years now, and some already have identified marine IBAs or contributed to the designation of Natura 2000 network at sea in their countries. The FAME project will build on that information and knowledge to generate risk maps, identify the most sensitive areas, produce guidelines and disseminate relevant information to enable sustainable implementation of the renewables sector in the marine environment. The guidelines will identify negative and positive impacts of offshore energy deployment on seabirds in view of different project phases (installation, exploitation and decommissioning), develop methodologies for impact prediction and evaluation, and identify critical impact uncertainties. Mitigation measures will be selected for a range of technologies considering different project phases. A list of recommendations for future baseline and monitoring studies on seabirds will also be provided.

FAME will benefit from using a common methodology and will create a common GIS-based database for all countries to identify hotspots of seabird activity and energy production proposals. The final aim of such an assessment is two-fold. By providing access to these data to private developers, and engaging with them through this project, offshore energy developments will be better planned and better able to avoid conflict with key areas for biodiversity. In addition, the data will help governments, NGOs and developers properly assess cumulative impacts caused by offshore energy developments. Cumulative impacts are probably the most difficult threat to assess from a transnational perspective, as developments in different administrative regions will not always be taken into account when assessing proposals. By providing comprehensive data to all stakeholders, FAME will enable impacts on biodiversity across the whole Atlantic Area to be considered.

Netherlands national wind turbine risk map for birds.

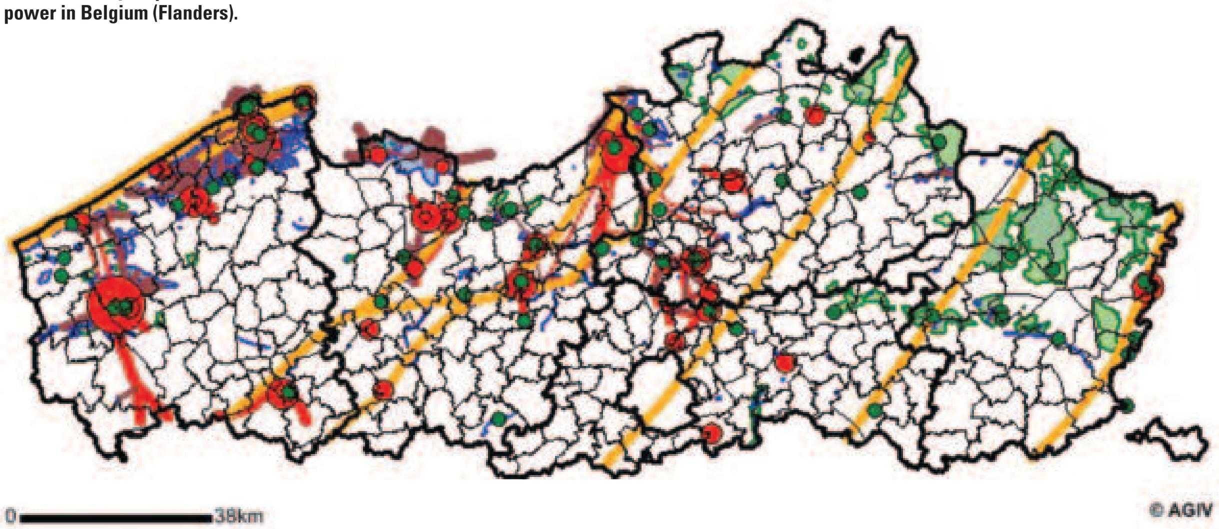
4.5.1 USE OF BIODIVERSITY SENSITIVITY MAPS

Land use planning of some kind exists in most places. BirdLife calls for this to routinely and robustly make reference to the suitability of places for development of specific kinds of renewable energy in terms of likely impacts on important wildlife and habitats. This is one element of mapping the constraints that are relevant in steering the development of major new infrastructures. Other "layers" in these maps may identify areas that are out of bounds for military reasons, for example, or areas set aside for some other competing use. The important step that needs to be taken is the routine use of bird and biodiversity "sensitivity maps" as part of overall plans that steer investors to appropriate locations within broad zones.

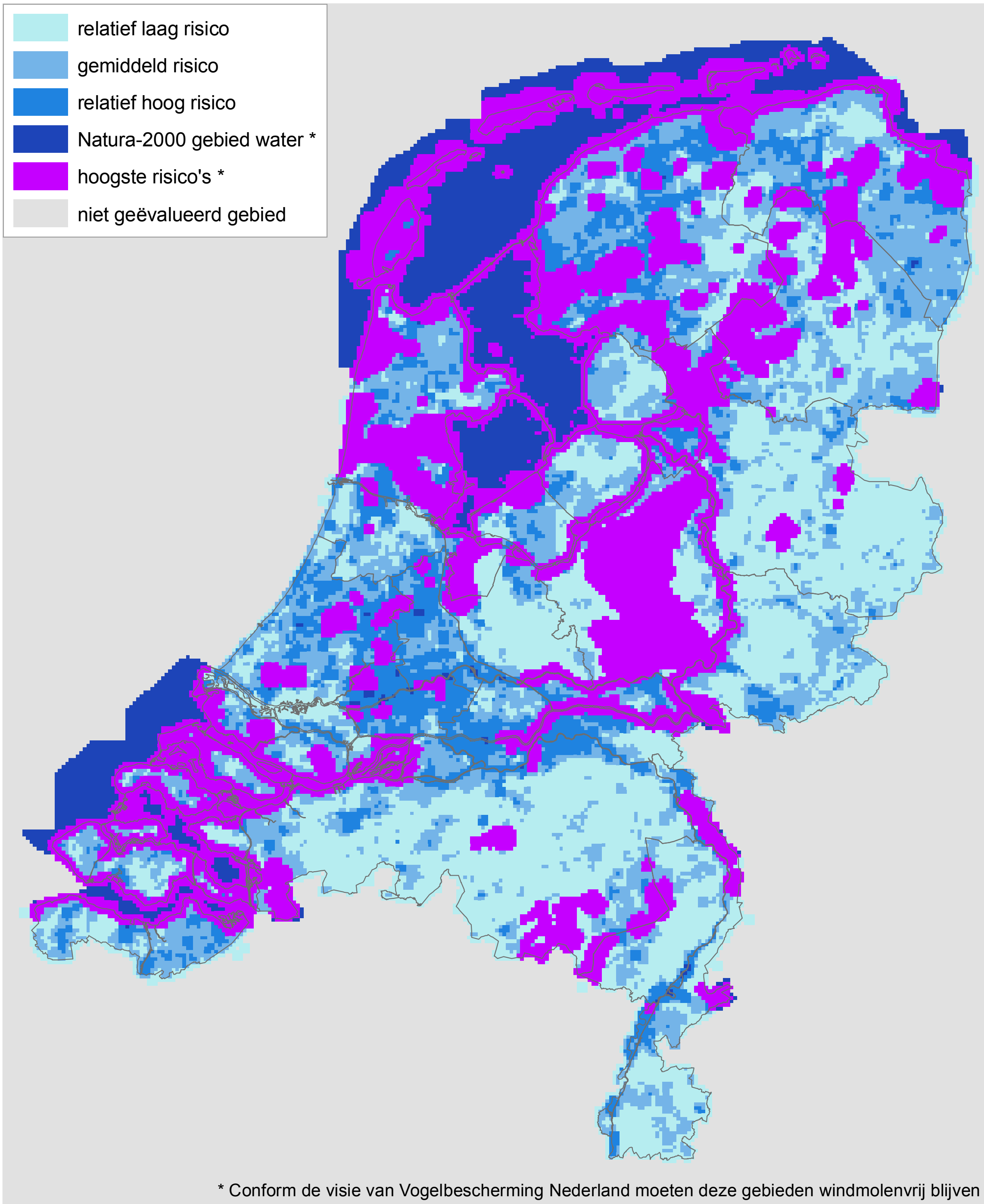
Developers should have easy access to maps showing these protected areas and important features or locations, and indicating the "vulnerability" to various types of development of the species and habitats found there. This will give them a good initial indication of whether refusal of planning consent is likely on grounds of environmental impacts, or where there may be legal issues and/or high costs for creating compensatory habitat should they seek to develop those locations. Wildlife sensitivity maps can also be used in defining zones that are most suitable for specific types of renewable energy development. The underlying data will not normally justify indication of exclusion zones. Rather, indication of more sensitive areas assists developers by alerting them that there is likely to be a need for targeted site-specific data collection and more detailed environmental assessments. The maps also assist strategic planning by indicating zones where there may be greater risk that a location is found to be unsuitable on environmental grounds.

In France every region defines wind energy zones, and receipt of subsidies depends on locating within them. Wildlife sensitivity maps are also used in spatial planning in Scotland, Belgium and parts of Germany. In some countries, such as Wales and Scotland, zoning for wind power does not affect subsidy levels, but location within an area identified as suitable increases developers' chances of obtaining planning permission. In many European countries BirdLife Partners have developed sensitivity maps, but these have yet to be used routinely in spatial planning, such as England, Greece and the Netherlands. Other BirdLife Partners are developing bird sensitivity maps, and/or providing expert assistance to national or regional authorities to do so. BirdWatch Ireland, for example, has recently piloted a sensitivity mapping approach with a view to produce a layered multi-species sensitivity map (BirdWatch Ireland, 2010).

Bird sensitivity map for wind power in Belgium (Flanders).



Nationale windmolenrisicokaart voor vogels



Vogelbescherming Nederland · Altenburg & Wymenga · SOVON

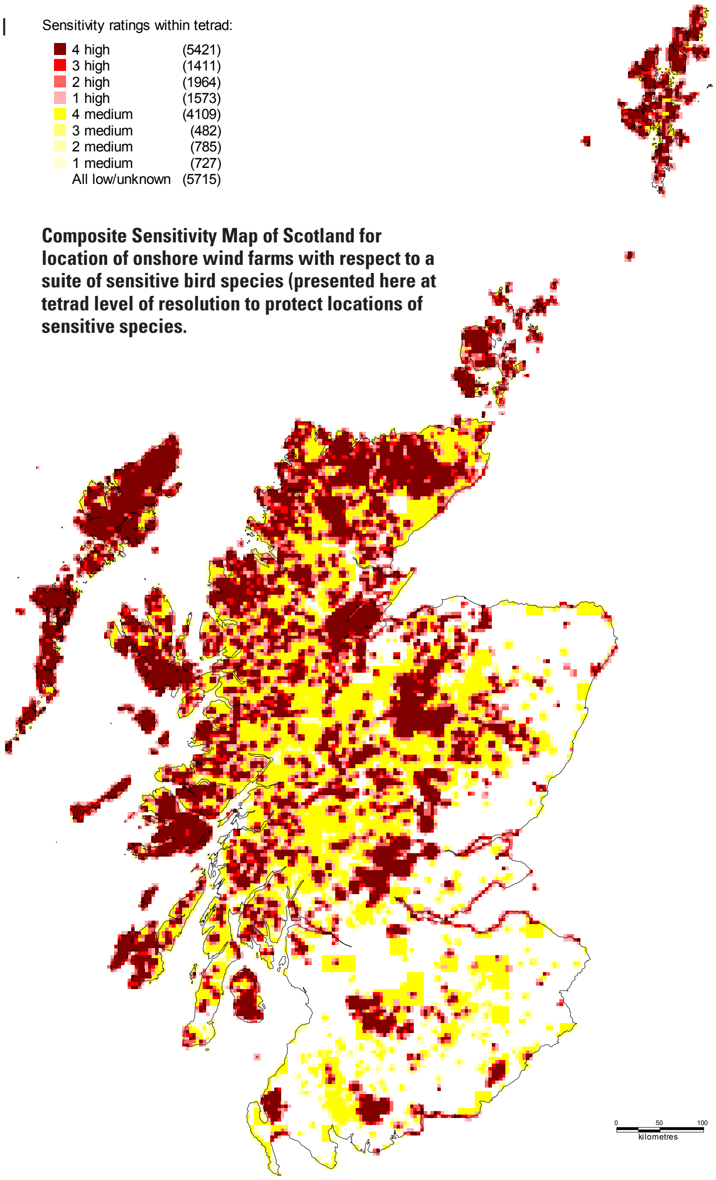
Doel van de Nationale windmolenrisicokaart voor vogels is het weergeven van feitelijke risico-informatie zodat windmolens op de minst schadelijke locaties voor vogels worden gepland en aangelegd.
Dit kaartbeeld is gebaseerd op de SOVON telgegevens t/m 2008.
Lees de toelichting en bekijk de deelkaarten voor het beoordelen van het type en de omvang van het risico van windmolens voor vogels.
De totaalkaart en de deelkaarten zijn niet geschikt voor de beoordeling van concrete windmolenplannen noch van cumulatieve effecten.
Daarvoor is nader onderzoek, analyse en beoordeling op locatieniveau noodzakelijk.
De deelkaarten kunnen wel richting geven bij het formuleren van de concrete onderzoeksvragen.

BOX 26

Bird sensitivity mapping in the UK

RSPB Scotland/BirdLife UK and Scottish Natural Heritage have worked together to produce a Scottish "birds and wind farms" sensitivity map (Bright *et al*., 2006). This was based on (1) distributions of 18 species of bird that are considered sensitive to wind energy developments, (2) SPAs, and (3) other sites hosting nationally important populations of breeding waders and wintering waterfowl. Reviews of literature on foraging ranges, collision risk and disturbance distances were conducted for each of the 18 species, to determine appropriate buffering distances. The findings were used to create a map of Scotland with each 1 km square classified as "high", "medium" or "low/unknown" sensitivity. The map is intended to identify areas where it is considered there is more potential for impact of wind farms on sensitive bird species and stricter assessment of possible effects may be required, rather than to identify "no go" areas.

Following completion of the map, RSPB Scotland wrote to Local Planning Authorities in Scotland inviting them to request more detailed maps for their area, and also provided the map to developers, consultants and other stakeholders. The Highland Council used the sensitivity ratings, alongside other constraint layers such as cost, visibility and designated sites, when identifying preferred areas for wind farm development in the Highland Renewable Energy Strategy. Scottish Natural Heritage has produced its own location guidance for wind farms in Scotland, incorporating a number of different "natural heritage sensitivities" and including the RSPB Scotland/SNH birds and wind farms sensitivity map. Following this, RSPB worked on a joint RSPB/Natural England project to create mapped and written guidance for England (Bright, *et al*., 2009), using a similar approach.



Composite Sensitivity Map of Scotland for location of onshore wind farms with respect to a suite of sensitive bird species (presented here at tetrad level of resolution to protect locations of sensitive species.

BOX 27

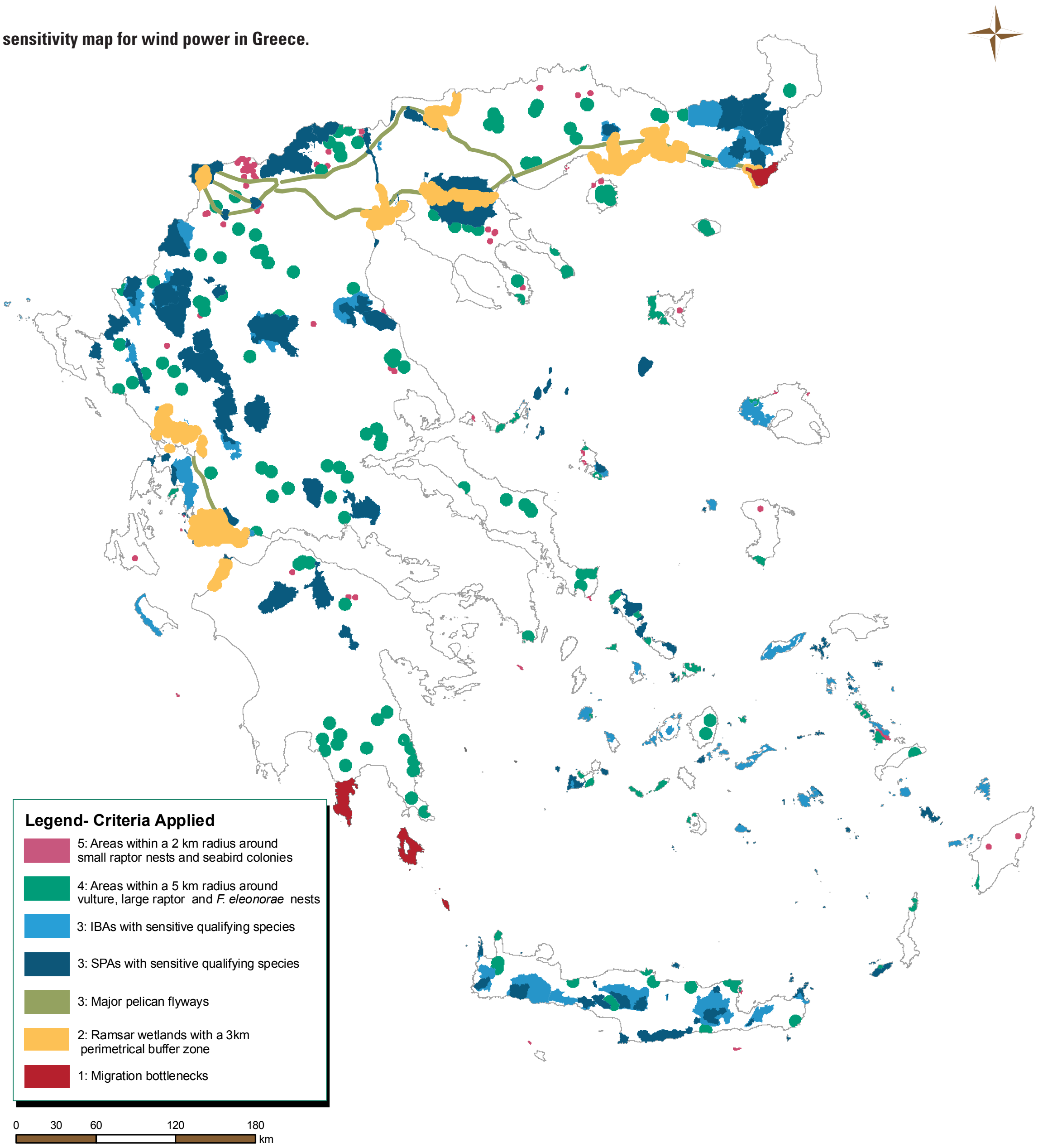
Bird sensitivity mapping in Greece

HOS/BirdLife Greece has completed a first attempt to identify and map those sites in Greece that are more sensitive to the presence of wind farms from an ornithological and biodiversity perspective. The best available ornithological information was compiled and processed cartographically, to indicate areas that are least suitable for wind farm development across the whole country. The aim is to provide the Greek administration and stakeholders with the information needed to protect critical habitats and the most vulnerable bird species.

The methodology employed is a stepwise process, applying five distinct criteria of equal importance to determine areas of high sensitivity to wind farm development. The purpose of this approach is to produce a final map product, composed from the five non-overlapping thematic criteria maps (see below). The criteria used were:

- IBAs and SPAs that have been identified as migration-bottlenecks
- Ramsar sites with a 3 km buffer zone around their limits
- IBAs and SPAs with qualifying (trigger) species most threatened by wind farms, and major pelican flyways
- certain species of small raptors and seabirds breeding at sites other than those covered by the criteria above, with a 2 km buffer zone around nests and colonies.

Bird sensitivity map for wind power in Greece.



4.5.2 USE OF STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)

SEA provides the ideal framework for using wildlife sensitivity maps and other environmental information to develop strategic plans for renewables. It is a publicly accountable process of identifying and assessing alternative ways to meet a plan's objectives, ensuring that the final plan provides for a high level of protection to the environment. Environmental authorities are consulted on the scope of the SEA, to ensure relevant alternatives, baseline information and impacts will be addressed. Assessment of alternatives and mitigation measures is then undertaken, usually by expert consultants and often in partnership with outside experts from academia and NGOs. Then the findings are released for public consultation. The consultation responses and assessment findings are then taken into account in deciding on the final plan. Through a process of open and rigorous assessment, the plan is not only more environmentally beneficial, it should also have greater public support and legitimacy. Examples from Romania and Spain (Boxes 28 and 29) illustrate the damage to Europe's most important protected areas that are likely to ensue where such plans are absent and/or do not take environmental considerations into proper account through the use of SEA.

BOX 28

The need for strategic planning for wind power development in Romania

From 2006 Romania rapidly started to develop a wind energy industry. Based on a recent analysis (June 2011) over 8400 turbines are planned or are in the environmental assessment procedures in Romania. About half of the proposed wind turbines (4000) are planned or are already built in the Dobrogea region – one of the richest areas for biodiversity in Romania.

About 64% of Dobrogea is designated as Natura 2000 sites or other protected areas by national law. It is one of Europe's most important bird migration areas (on a migration route known as the "Via Pontica"). It the only wintering area in Romania for the critically endangered red-breasted goose, and is an important area for at least 20 bat species. About 30 habitats protected by the Habitats Directive have been described in Dobrogea.

Two priority habitats (ponto-sarmantic steppe and deciduous thickets) are likely to be directly affected by construction of turbines. About 300 turbines have already been built in sensitive areas in Dobrogea, some of them near to the unique Danube Delta ecosystem affecting areas for wintering red-breasted goose (eg, Istria, Sacele), or migrating areas of geese, storks, and pelicans. Some of the proposed wind farms in Dobrogea will affect breeding or migrating areas for raptor species (eg, Babadag, Macin Mountains).

NGOs (including SOR/BirdLife Romania) have been lobbying central and local environmental authorities over the last three years, to put pressure on them to develop an SEA for wind energy development in Dobrogea, and to produce a bird sensitivity map. In 2011 they became more receptive and started to develop some documents for a national SEA. However, so far no concrete action has been taken. The main problem is that baseline data are missing: surveys are needed for birds, bats and habitats. In 2011, SOR started the necessary bird surveys to develop a sensitivity map for the Dobrogea region.

One of the most important problems is that EIA studies for wind farm projects in Romania have been of very poor quality, hiding the real biodiversity situation in the proposed locations. The environmental authorities have little capacity to check the quality of EIAs, or to take action to improve this situation. SOR/ BirdLife Romania is working with authorities to improve the quality of environmental procedures, and working with investors who seek its views.

If the right frameworks for sustained investment and protecting biodiversity are in place, and necessary development is steered towards suitable locations, specific projects are much less likely to have significant impacts on the natural environment. However, some further steps are necessary, especially where strategic planning is not sufficiently robust.

BOX 29

Failing to take the environment into account: the example of Spanish regional government planning for wind power

The case of the Extremadura Region in Spain provides a vivid illustration of the grave deficiencies detected by SEO/BirdLife in the environmental evaluation of wind farms in Spain. In December 2006, the Regional Government announced in its Official Bulletin that 116 formal requests had been received to install wind farms in Extremadura (1,952 turbines totalling 3,670 MW) putting an end to the previous moratorium on wind energy development in this autonomous region. The number of projects, their geographical distribution, and the administrative arrangements for considering the applications for development consent make it abundantly clear that it was a wind energy plan in all but name, and, as such, should previously have been submitted to SEA prior to the subsequent EIA of individual projects.

The public information provisions were seriously deficient: the 116 projects were made publicly available from 13 December–2 January (over the Christmas/New Year holiday period) in only one location (Mérida), during the mornings only, with a limit of seven people allowed to inspect the documentation at any one time and without the possibility of making any copies of the information presented. Furthermore, there was no additional publicity given to the fact that these 116 projects were available for public consultation, not even in the affected municipalities. The regional government had detailed information on the projects, and their corresponding EIAs, since June 2006.

Of the 116 projects proposed, 16 had at least part of their area within an SPA and 11 within a SAC. Furthermore, 82 projects were sited within 10 km of Natura 2000 sites designated for birds or bats, and thus potentially could adversely affect the values of these sites and the integrity and coherence of the Natura 2000 network. However, not one of these projects was evaluated in terms of its impact on Natura 2000 sites, and alternatives with no impact on the Natura 2000 network were not considered. Projects were proposed in sites as important as the Sierra de San Pedro SPA, with the highest density of Iberian imperial eagle in the world. Whilst 70 of the projects were proposed within IBAs, in not a single case was there any detailed evaluation of possible impacts on the IBA's ornithological values.

Highly endangered species likely to be affected included: Iberian imperial eagle (12 projects in 10 x 10 km grid squares where the species breeds); black stork (64 projects); Egyptian vulture (43 projects); red kite (78 projects); lesser kestrel (76 projects); and black vulture (25 projects). All of these species are vulnerable to collision with turbine blades yet in no case was the appropriate assessment required by the EU Habitats Directive carried out. Similar problems were encountered with endangered bat species: not one of the 116 project evaluations considered impacts on the bat fauna yet projects were located in grid squares hosting colonies of bats recognised as endangered by the Extremadura Endangered Species Catalogue. Other serious deficiencies in the evaluation of these wind farms (including clear infringements of EU law) detected by SEO/BirdLife in the case of Extremadura include:

- lack of consideration of project alternatives
- failure to consider cumulative effects of the projects proposed
- insufficient consultation with the nature conservation authority
- inadequate inventories of fauna with failure to identify species especially vulnerable to wind farms or protected or endangered species
- failure to consider the barrier effects of wind farms for birds and bats.

4.6 MINIMISING PROJECT IMPACTS

A wide range of technology-specific mitigation and enhancement measures relevant to developers are described in Chapter Two above. This Section focuses on "positive planning" approaches that can be promoted by national, regional and local policy makers to ensure specific projects are environmentally acceptable.

Planning control – the granting or refusal of planning consent – is a vital tool enabling elected representatives to ensure that damaging proposals are modified to make them acceptable, or do not go ahead (see Box 30). Authorities can refuse permission on a wide range of grounds, and some proposals for renewable energy facilities are rejected because of unacceptable ecological impacts at the proposed location. Environmental assessment procedures are an essential means by which the authorities can be informed about likely environmental impacts before they make a consent decision. Where BirdLife considers that impacts may be significant and that environmental assessments have not been conducted in a robust manner that would identify any impacts, it strives to take action to ensure assessments are properly conducted before a decision is taken.

Where a proposed development is likely to have significant impacts affecting a Natura 2000 site, it must first satisfy a series of strict tests (as explained in Section 4.2 above). BirdLife recommends precautionary avoidance of development in these areas. However, provided it is permitted in locally applicable legislation, development can go ahead where these tests are satisfied. The strict tests are set out in Article 6(4) of the Habitats Directive and are intended to make sure any damage permitted to Natura 2000 sites is both unavoidable and necessary in the genuine and overriding public interest. They are about deciding, in the interests of wider society, where the balance lies between the public interest of conserving Europe's biodiversity and the public interest(s) provided by a particular plan or project.

These tests on alternative solutions and imperative reasons of overriding public interest (IROPI) under Article 6(4) are central to ensuring that the Habitats Directive contributes to sustainable development by making damage to Europe's most important wildlife sites a last resort. Where a plan or project is to be consented on the basis of no alternative solutions and IROPI, Article 6(4) then requires compensatory measures to be secured to protect the overall coherence of the Natura 2000 network. We think this will mean any damage permitted to Natura 2000 sites is fully justified only as a last resort, having exhausted all other options to protect the site in situ.

In many Member States the "appropriate assessment" required to satisfy the strict tests are conducted as part of an EIA. In others, these are treated as two separate processes. EIA applies to large projects that are likely to have significant impacts on the environment. Like SEA, it is a publicly accountable process, relying on rigorous scientific assessment work, transparency and public participation. Biodiversity impacts are covered in EIA, but are not always accorded adequate priority, and guidelines are absent or not well applied in many Member States. As a result, EIA's potential to help biodiversity protection is not always realised. Common weaknesses are:

- not all projects affecting biodiversity are subject to impact assessment
- transparency and opportunities for public participation are often inadequate
- provision of baseline information and assessments of likely impacts are often poor quality, where these are not carried out in an impartial and rigorous way
- impact assessments often concentrate on limited components of biodiversity, such as designated sites, rather than looking at all levels/facets of

BOX 30

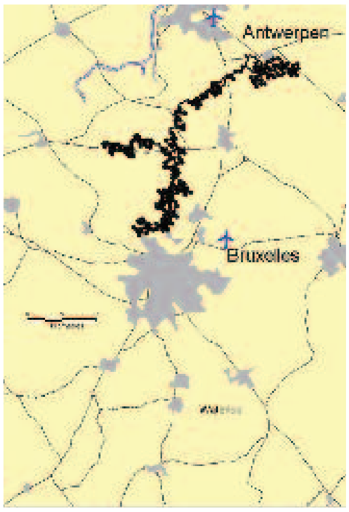
Planning control to stop the worst proposals: the case of Lewis wind farm in Scotland

In April 2008, Scottish Ministers announced their decision to refuse consent for the proposal by Lewis Wind Power to construct a very large-scale wind farm on the internationally protected peatlands on the Isle of Lewis in the Outer Hebrides. This robust decision by the Scottish Government was warmly welcomed by the RSPB in Scotland, particularly because it recognises that there is no need to destroy important natural heritage resources in order to deliver renewable energy developments, which are a key element in the fight against climate change.

The original proposal, launched in 2001, was to build 234 turbines, 105 km of roads, 141 pylons, five rock quarries and a range of other associated works such as cabling and sub-stations. The vast proportion of the proposal was to be built on the Lewis Peatlands SPA designated and protected under European law. The proposal was for one of the biggest wind farms in Europe on one of the most sensitive peatland sites, which has some of the highest densities of breeding birds in the UK.

The developers carried out extensive survey work and, their environmental assessment showed that the site was even more important than had been previously appreciated. With populations of golden eagles, red- and black-throated divers, merlins, dunlins, golden plovers, greenshanks, corncrakes and migrating whooper swans from Iceland, it was not possible for the developers to redesign their proposal to avoid damaging impacts on either species or habitats.

However, a revised application for 181 turbines was submitted in 2006. The Scottish Government considered and rejected the application, concluding that the impacts were still so severe that they would affect the integrity of the designated site and that because there were many alternative solutions to meet wind farm and electricity generation objectives (which were considered to be the primary issues to be considered by Ministers), the proposal should not go ahead. In this instance, compensatory measures did not need to be considered as part of the decision-making process (because the development was being refused). However, the decision letter did note that the peatland habitats affected could not be re-created elsewhere in the Western Isles or in Scotland in a location or manner likely to be suitable for the large populations of rare and vulnerable species involved.



Original Lewis wind farm proposed layout, superimposed to scale on the Brussels region to illustrate scale.

biodiversity that could be impacted (eg, ecosystems, habitats, species, genes, connectivity and ecosystem services)

- impact assessments often fail to include economic information relating to changes in ecosystems services
- assessments do not assess alternative proposals in order to identify a most environmentally beneficial option
- the "no net loss" and "mitigation hierarchy" principles are not implemented adequately, and
- monitoring and enforcement of mitigation measures are often inadequate.

BirdLife believes that these weaknesses should be addressed, and that better implementation of the EU environmental assessment requirements should play an important part in supporting delivery of renewables and the EU's post-2010 biodiversity policy. The highest priorities are finding ways to ensure that agreed mitigation and monitoring measures are implemented; ensuring all Member States have adequate guidance documents available on good practice in environmental assessment; and making assessment professionals more financially independent of their clients, to remove incentives to underestimate impacts. In many European countries EIA is normally a robust and useful process. Where there are deficiencies in specific countries involved in this project, they are highlighted among the policy recommendations in Section 5.3 below.

4.7 ACHIEVING ECOLOGICAL ENHANCEMENTS

Ecological "enhancements" are improvements that go beyond measures required to mitigate or compensate for damage. These may be within or adjacent to sites where renewables are developed, adding biodiversity benefits to the facilities' green credentials. For example, at Whitelee in Scotland one wind farm developer is re-establishing heathland and blanket bog over a very large area (Box 31).

Enhancements may also be made off-site. Developers often provide incentives to communities to make their proposals more readily acceptable, such as paying for community facilities. Providing attractive and wildlife rich habitats is another way to provide community benefits, and to contribute to local and national biodiversity strategies and targets. Ideally, biodiversity enhancements, like renewables developments, should not be piecemeal but rather planned for maximum benefit. For example the RSPB Cymru (Wales) has developed a "Statement of Environmental Masterplanning Principles" (SEMP). This "masterplans" one of the Welsh "strategic search areas" (SSAs) for wind power in terms of broad habitat enhancement, and spatially expresses locations for "environmental community benefit". The two local planning authorities are in the process of enshrining the SEMP in their development plans, so that it becomes a major material consideration in the decision-making process. The aim is that this will result in landscape-scale habitat enhancement within the SSA.

BOX 31

Habitat enhancement at Whitelee wind farm, Scotland

Whitelee wind farm, near Glasgow in Scotland, is a good example of a wind farm development contributing to habitat enhancement. This large site (5,000 ha+) is in an area not considered particularly sensitive for birds, and RSPB Scotland/BirdLife UK had few concerns with the original proposal. Mitigation measures include re-establishing 900 ha of heathland and blanket bog through the clearance of conifer plantations, drain blocking and the continued management of a mosaic habitat to benefit black grouse. Liaison with the developer, ScottishPower Renewables, has been effective and RSPB Scotland is represented on the Habitat Management Group, which oversees ongoing habitat management to benefit wildlife.

Because of these positive benefits for wildlife and renewable energy generation, RSPB Scotland supported ScottishPower Renewables' application to extend the wind farm by a further 75 turbines, giving it the capacity to power nearly 300,000 homes. The Whitelee visitor centre, which opened in 2009, now attracts over 9,000 visitors a month, and includes an exhibition about the construction of the wind farm and the ongoing habitat management work conducted on-site.

4.8 GUIDANCE AND CAPACITY BUILDING

Legislation, regulations and good practices for biodiversity-friendly renewables development are not always well-understood by all parties concerned. Moreover, institutions often lack the necessary capacity to ensure they are properly applied, particularly in the newer and less wealthy EU Member States. Wherever possible BirdLife is keen to help develop guidance documents and build capacity in institutions, for example, by providing training and advice (Box 32).

BOX 32

Good Practice Wind project

RSPB Scotland and the European Wind Energy Association are among the organisations involved in an ambitious project called "Good Practice in Wind Energy Development" (GP Wind)[xii]. The project aims to promote the deployment of appropriately located wind energy development in Europe. Led by the Scottish Government, and funded by the Intelligent Energy Europe Programme, GP Wind aims to address barriers to the development of onshore and offshore wind generation. It will do this by identifying and developing good practice in two key areas: community engagement and reconciling renewable energy with wider environmental objectives. By bringing together renewables developers (such as ScottishPower Renewables and Scottish and Southern Energy), regional and local government, environmental agencies and NGOs such as the RSPB from eight different regions of Europe to share experiences, the project aims to facilitate the deployment of renewable energy in support of the European 2020 targets. The aims of the project are as follows:

- increase the consenting rate for on- and offshore wind projects, and reduce the processing period for applications
- increase the efficiency of processing applications, thereby reducing process costs
- build evidence-based support for the design, planning and implementation of projects which are sensitive to environmental and community concerns
- assist quicker, more transparent and less costly deployment of wind energy across Europe, contributing to the achievement of 2020 targets for renewable energy generation
- secure endorsement of project outputs by participating Partner administrations and commitment to adopt relevant good practice
- secure endorsement of project outputs by other Member States and commitment to adopt relevant good practice.

The main outputs of the project will include a good practice guide and "how to" toolkit, which can be adapted for use across Europe. Through active engagement with stakeholders including BirdLife International, the GP Wind project Partners identified 16 thematic case studies which cover the key environmental and community engagement issues. These case studies include; impacts on species and habitats, carbon accounting, landscape and visual impacts issues, cumulative impact issues, community concerns and community benefits, public perception issues and socio-economic impacts. The case studies will form the basis of the good practice guide and will highlight examples of good practice and lessons learned.

The "how to" toolkit will provide specific information, models and tools which can be adapted for use across Europe. The project website will include a database of information, case study reports, good practice and expertise, and will be maintained beyond the life of the project. At completion of the project an international dissemination event and nine regional dissemination events will be held in order to publicise the findings.

CHAPTER 5

RECOMMENDATIONS FOR NATIONAL AND EU POLICY MAKERS

This Chapter provides an evaluation of the policy frameworks in 18 European countries (within 13 Member States and two candidate Member States) in terms of their adequacy to enable a renewables revolution in harmony with nature (Section 5.1). Using this to identify common areas of strengths and weaknesses across Europe, and taking into consideration the European Commission's areas of competence, recommendations for the EU are presented in Section 5.2. Policy recommendations for policy makers in project partners' countries are presented in Section 5.3, with some relevant background information about renewables and conservation issues.

5.1 EVALUATION OF NATIONAL POLICY FRAMEWORKS

BirdLife Partners were asked to evaluate how well the policy framework in their country achieved the following:

- stimulating investment in a range of renewable energy technologies
- protecting biodiversity and enabling it to adapt to climate change
- minimising overall infrastructure needs and impacts
- spatial planning for renewables, and
- minimising project impacts.

Table 4 summarises the results of these expert evaluations. It presents a complex picture, with considerable variation in the perceived adequacy of policy frameworks across issues and between countries. However some broad observations can be made, and some "leaders" and "laggards" can be identified.

5.1.1 STIMULATING INVESTMENT IN RENEWABLES

Leaders: Germany, UK, Spain
Laggards: Poland, Montenegro, Romania

In general, the results suggest this aspect is relatively well addressed by national policy frameworks. In particular onshore wind power is seen to be positively or very positively incentivised in most countries. The offshore wind power industry was also considered to be well stimulated by policy frameworks in many countries. None of the Partners considered that energy efficiency policies in their country are "very positive". There were few negative evaluations, but doing more to promote energy efficiency was a high priority in many Partners' recommendations (see Section 5.3), because of its value in reducing the overall need for new generation capacity and power lines.

5.1.2 BIODIVERSITY PROTECTION

Leaders: Germany, Portugal, UK (England and Scotland)
Laggards: Ireland, Montenegro, Bulgaria, Greece, Spain

In general, Partners gave quite positive evaluations regarding designation of the Natura 2000 network and protection of biodiversity within Natura 2000 sites. Bulgaria, Spain and Ireland are notable exceptions. Protection of priority bird species was also seen to be quite positively promoted by national policy frameworks, except in France, Ireland, Montenegro and Spain. Again, broadly speaking, designation of conservation areas of national and local importance was relatively positively evaluated, with the exceptions of Wales, Slovenia and Ireland. However, biodiversity protection in the wider environment outside protected areas was considered an important area where national policy frameworks are inadequate. Evaluations were at best "neutral/mixed", and "very negative" for several countries. The survey revealed climate change adaptation as another weak policy area, with many countries yet to give it serious consideration. Only France and Germany were considered to have positive policy frameworks in place to enable biodiversity to adapt to the effects of climate change.

TABLE 4

BirdLife Partners' evaluations of how positively their government promotes meeting renewables targets in harmony with nature

- **A** VERY POSITIVE
- **B** POSITIVE
- **C** NEUTRAL/MIXED
- **D** NEGATIVE
- **E** VERY NEGATIVE
- **-** NO EVALUATION/NOT RELEVANT

	BELGIUM : WALL'IA	BULGARIA	CROATIA	FRANCE	GERMANY	GREECE	ITALY	IRELAND	MONTENEGRO	POLAND	PORTUGAL	ROMANIA	SLOVENIA	SPAIN	UK: ENGLAND	UK: N. IRELAND	UK: SCOTLAND	UK: WALES
STIMULATING INVESTMENT																		
Energy efficiency	C	C	C	C	C	C	D	C	E	C	B	C	B	C	C	C	D	B
Onshore wind power	C	B	B	C	B	A	A	B	A	C	B	A	C	A	C	B	B	B
Solar power	B	B	D	D	A	B	B	D	D	D	C	C	B	C	B	C	B	C
Biomass heat and power	C	C	B	B	B	D	B	D	E	D	C	D	C	B	A	B	B	B
Offshore wind power	B	-	C	B	C	B	B	A	-	E	B	E	C	C	A	A	B	B
Tidal stream and wave energy	C	E	C	C	-	C	E	B	-	C	C	-	C	C	C	A	A	A
BIODIVERSITY PROTECTION																		
Natura 2000 sites	B	D	C	B	B	C	C	D	D	B	B	B	C	E	B	B	B	C
National/local protected areas	C	C	B	B	A	C	C	E	B	B	C	B	D	D	B	C	C	D
Priority bird species	C	B	C	D	B	C	C	D	D	B	B	C	B	E	C	C	C	C
Outside designated areas	D	D	D	D	D	E	D	E	E	C	C	D	D	E	C	D	C	E
Climate change adaptation	D	E	C	B	B	E	E	E	E	D	C	D	C	C	B	D	C	E
MINIMISING OVERALL INFRASTRUCTURE NEEDS																		
Energy system planning	B	C	D	D	D	D	E	D	C	C	C	C	E	E	D	D	D	C
Decentralised energy	B	C	D	C	B	B	C	E	C	D	B	D	C	E	B	B	C	B
Undergrounding power lines	C	D	D	B	C	D	E	E	E	E	C	B	D	D	E	D	C	B
Repowering	C	-	C	D	C	C	D	-	C	C	-	-	A	C	E	C	-	C
SPATIAL PLANNING																		
National-level	C	E	D	E	C	C	E	E	C	E	D	C	C	C	E	E	D	B
Regional/ local level	B	D	B	A	C	D	D	C	E	D	D	E	D	E	E	E	C	B
Use of bird sensitivity maps	C	C	E	B	C	D	D	E	-	E	D	E	D	D	E	E	B	C
Use of SEA	B	D	D	B	C	E	E	C	D	D	C	D	C	E	C	-	B	D
Habitats Directive tests	C	E	B	B	B	D	C	C	-	C	D	D	D	D	B	C	B	D
MINIMISING PROJECT IMPACTS																		
Planning control	B	E	D	C	B	D	C	C	E	C	C	E	C	C	B	B	B	A
EIA mitigation and monitoring	C	E	E	B	C	D	E	D	C	D	B	D	D	E	B	D	C	D
Guidance and training	D	B	E	B	B	E	D	E	D	D	C	D	E	D	B	C	B	D

5.1.3 MINIMISING OVERALL INFRASTRUCTURE NEEDS

Leaders: Germany, Belgium (Wallonia)
Laggards: Ireland, Italy, UK (England), Spain

Very few countries were considered by Partners to have positive policies in place for energy system planning. Italy and Slovenia were considered to have very negative frameworks in this respect. Policies to encourage decentralised energy, which should reduce the need for large renewable energy installations and new power lines, were seen to be positive in many countries, but very negative in others such as Spain and Ireland. Undergrounding power lines was seen to be used in a positive way in France, Romania and Wales. Many Partners commented that undergrounding is often not the best solution for birds, and therefore they would not wish to suggest that failure to promote it further is "negative". Others, such as Italy, Montenegro and Poland considered current policies to be very negative. Repowering existing renewables facilities was not an issue in many countries, or was seen to be generally adequately addressed by policy frameworks. Slovenia (hydro) and Scotland (wind) were seen to have a positive policy approach to repowering.

5.1.4 SPATIAL PLANNING

Leaders: UK (Scotland), Belgium (Wallonia), France
Laggards: Bulgaria, Italy, Romania, Spain, Poland, UK (England, N. Ireland), Greece, Montenegro

National level spatial planning for renewable energy is an area in which many BirdLife Partners consider current policy frameworks are negative or very negative. Many commented that the renewables industries are well subsidised by public funds, but that governments were doing too little to steer development towards suitable locations in the public interest. "Very negative" assessments were made by Partners in Bulgaria, France, Italy, Ireland, Poland, England and Northern Ireland. In some countries this is seen to be ameliorated by relatively positive regional and/or local planning, such as France and Ireland. In general, however, regional and local planning frameworks for renewables are an area of weakness across much of Europe in the opinion of BirdLife Partners. Use of bird sensitivity maps and SEA depends on there being an adequate planning system in place at national or sub-national levels. Use of sensitivity maps was seen to be positive in France and Scotland, and neutral or mixed in several other countries including Wallonia, Bulgaria, Germany, Spain and Wales. Half of the Partners surveyed felt use of sensitivity maps was a negative or very negative element of their countries' policy frameworks, usually because no maps are available. Use of SEA is another area of policy weakness across Europe, with only France and Scotland seen to have a positive framework. Application of the "Habitats Directives tests", which only permit development in Natura 2000 sites under strict conditions, was seen to be positive or very positive in many countries (Wallonia, Croatia, France, Germany, England, Scotland). It was considered negative in many southern European countries and very negative in Bulgaria.

5.1.5 MINIMISING PROJECT IMPACTS

Leaders: UK (England, Scotland), France, Germany
Laggards: Croatia, Romania, Bulgaria, Italy, Ireland, Montenegro, Slovenia, Spain

BirdLife Partners considered that planning control is one of the more positive elements of the policy framework in many countries. Only five of the 18 Partners found this to be a negative or very negative aspect. Most Partners felt that the most damaging project proposals are usually refused planning consent in their country. However, there was a less positive overall evaluation of policies relating to post-project follow-up, ie, ensuring that mitigation measures agreed at the EIA stage are actually implemented, and impacts monitored. Only France, Portugal and England felt this aspect was a positive element of their policy frameworks. Finally, the adequacy of guidance and training is very mixed across Partners' countries.

5.1.6 COMMON STRENGTHS AND WEAKNESSES ACROSS EUROPEAN COUNTRIES

In general, the most positive aspects of the policy frameworks are stimulating investment in renewables, designation and protection of areas of European, national and local importance for biodiversity and their protection, and use of planning control to refuse consent to the most damaging proposals. Areas where policy frameworks are seen by many Partners to be negative or very negative are: protection of biodiversity outside designated areas; climate change adaptation policies; national energy system planning; national-level spatial planning for renewables; use of bird sensitivity maps and SEA; and enforcement of mitigation and monitoring measures agreed in EIAs.

Under subsidiarity rules, many of the policy changes required to enable renewables deployment in harmony with nature can only be made at the level of Member States. For example, changes to spatial planning frameworks and policies shaping national energy mixes are not European Commission competences, and are addressed below in Section 5.3. There are, nevertheless, very important roles for the EU institutions in ensuring that European biodiversity and renewable energy targets are mutually compatible and even reinforcing. Where specific European binding targets or legislation are not possible, the European Commission can still have considerable influence through facilitating and supporting best practice across Europe.

5.2 POLICY RECOMMENDATIONS FOR THE EUROPEAN UNION

1 Adopt binding 2030 targets for renewable energy.

Beyond 2020 the renewable energy industries face uncertainty in Europe. While the Energy Roadmap 2050 will provide indications of how the European Commission envisages the EU energy mix evolving to 2030 and 2050, the lack of binding targets for renewables beyond 2020 will begin to undermine investor confidence in the next few years. BirdLife recommends that binding targets for renewables as a share of energy consumption should be established for 2030 as a matter of urgency. These targets will need to be backed by a level of commitment and vision that will sustain investment and public/NGO support.

2 Assess 2050 energy pathways.

Post-2020 plans for renewables must be built on an analysis of the level of investment in various technologies that is both necessary and respects ecological limits. The European Commission and/or European Environment Agency should lead on assessing the impacts of different 2050 energy pathways on the European and global environment to identify the most sustainable and cost-effective way forward.

3 Adopt binding energy efficiency targets.

Europe needs ambitious binding targets to save energy in every Member State. The Commission must ensure that there are adequate mechanisms to ensure targets are met (such as an obligation on electricity suppliers to reduce domestic electricity demand through investments in customers' homes), and strong sanctions for non-compliance.

4 Make biodiversity protection a high priority in energy infrastructure plans.

Enabling rapid development of an integrated European electricity transmission network that can accommodate a high share of renewable electricity is a key challenge. While the European Commission does not have powers over transmission system development within Member States, it does concerning projects that are necessary for European electricity market integration. BirdLife Europe calls on DG Energy to prioritise renewables and nature protection in the implementation of its Energy Infrastructure Package. In particular, the regulatory and financing mechanisms must enable the right infrastructure to be put in place for timely and efficient development of Europe's renewable energy resources. It falls to European institutions to take the geography of Europe's energy and biodiversity resources into proper consideration in shaping Europe's future electricity systems.

5 Increase R&D funding for biodiversity-friendly renewables.

EU R&D funding should be increased for specific technologies with potential to make significant contributions to renewable energy supplies with low ecological impacts and high public acceptability. Key technologies with potential for high carbon savings and low biodiversity impacts include micro-renewables, floating offshore wind turbines, wave power and tidal stream power.

6 Improve implementation of the Birds and Habitats Directives.

While the designation and protection of Europe's most important sites for biodiversity under the Birds and Habitats Directives is one of the EU's greatest achievements, the potential of those Directives to fully contribute to achieving Europe's 2020 biodiversity target will require further action. It is essential that the European Court of Justice takes firm action where Member States fail to implement fully the provisions of the Directives. In particular, many Member States are failing to protect species and habitats in the wider countryside outside the Natura 2000 network. This will require better policy implementation in a range of sectors. In part it requires better application of the provisions in the Birds and Habitats Directives applying to the wider countryside. It also requires continued and expanded financing of agri-environment schemes. Specifically the Commission should:

- Develop up-to-date guidance on "appropriate assessment" for all renewables sectors, and in particular for the appropriate assessment of plans. Increase commitment to enforcement action on infringements of the rules on development in Natura 2000 areas.
- Develop targeted information campaigns that raise awareness of the seriousness and value of Natura 2000 designation, in particular its importance for climate change adaptation, and that explain/demonstrate that businesses can thrive within Natura 2000 areas.
- Improve Member States' understanding of EU laws on development in Natura 2000 areas. Ensure developments are not automatically refused consent if they cause no harm (and are also permitted in national legislation), or contribute to the conservation objectives of the designated area, such as sustainable agriculture and forestry practices and sustainable biomass schemes.

7 Enable better strategic spatial planning for renewables and for climate change adaptation.

The European Commission should provide R&D funding for EU-wide biodiversity sensitivity mapping for a range of major renewables technologies, following an agreed common methodology. Guidance and capacity building will then be needed to enable Member States and sub-national authorities to apply the maps in strategic planning for renewables. The Commission should also develop a European strategy to enable biodiversity to adapt to climate change, and require the development of national adaptation strategies and their integration with other sectoral policies. Maintaining or extending current agri-environment payments under the Common Agricultural Policy will be essential to better enable biodiversity to adapt to climate change.

8 Improve implementation of the SEA Directive.

The SEA Directive (2001/42/EC) has the potential to become a powerful tool to enable environmentally sensitive spatial planning for renewable energy and associated infrastructure. Under the Directive, SEA is only required for a limited set of plans and programmes that authorities at the Member State level are "required" to produce. BirdLife recommends that the European Commission, in recognition of the value of SEA, should voluntarily extend its scope to include EU-wide infrastructure and spending plans. In any future review of the SEA Directive, steps should be taken to ensure that alternatives are studied in SEAs as a means to identify plans that give a high level of protection to the environment, rather than as a formality. Steps are also needed to strengthen assessment of cumulative and transboundary impacts in SEA. This is particularly important to enable sensitive development of offshore renewable energy. The requirements for public participation and assessment of alternatives should also be extended to national policies, where these set the framework for future SEAs and EIAs. There is also a need to clarify how alternatives should be defined in SEA.

9 Improve implementation of the EIA Directive.
The EIA Directive is another key tool for ensuring Europe's renewable energy targets are compatible with its biodiversity targets. However, steps need to be taken to ensure it works as intended. There are three key areas of weakness: a lack of objectivity in the preparation of Environmental Statements where consultants put the interests of securing future business over those of scientific rigour; lack of capacity in environmental and planning authorities to scrutinise EIA reports; and failure of national authorities to ensure impacts are monitored and agreed mitigation measures are implemented. In each case steps can and must be taken at the European level to address these weaknesses. Specifically the Commission should:

- Require EIAs for all sectors including renewables to set out a clear and specific plan for implementing mitigation and monitoring measures, and for reporting on measurable outcomes that can be verified by competent authorities.
- Explore how to build capacity in some Member State authorities to scrutinise environmental assessments and ensure that agreed mitigation, compensation and monitoring provisions are implemented.
- Ensure environmental assessment reports are scientifically robust, for example, by requiring independent selection of consultants to carry out studies from a pool of approved professionals.

5.3 POLICY RECOMMENDATIONS FOR PROJECT PARTNERS' COUNTRIES

For each project Partner's country or Member State, this Section presents some background information about conservation and renewables development, a chart showing which renewables technologies are expected to supply additional energy by 2020, and some policy recommendations specific to that country.

5.3.1 BELGIUM (WALLONIA)

Two BirdLife Partners operate in Belgium – Natuurpunt in Flanders and Natagora in Wallonia. The Flanders region is the wealthier and more densely populated part of Belgium. Wind power developments have faced strong opposition on visual amenity ("landscape") grounds at many locations in Flanders, and the Regional Government applies strict location criteria. This has resulted in intense competition among developers for available sites for wind power development, which has driven up their costs. Bird sensitivity maps are used by the Flanders authorities in decisions on planning consent, but not in strategic spatial planning for wind power or other renewables (ie, they are not used to define zones where development is considered more appropriate). Consent processes are often lengthy, with a high refusal rate.

Wallonia is less densely populated, and consequently wind developers did not initially face such strong opposition on grounds of visual amenity. More recently, however, wind power projects have begun to face strong local opposition, with many now receiving a negative decision from regional administrative authorities. However, the current political majority has strong ambitions in terms of wind power development, and the initial negative decision from the Administration is frequently over-ruled by the Government leading to consent. Very recently, the Government has announced that a positive map of areas for wind power will be developed, on the basis of wind resources and local constraints. A bird sensitivity map is also being developed by Natagora.

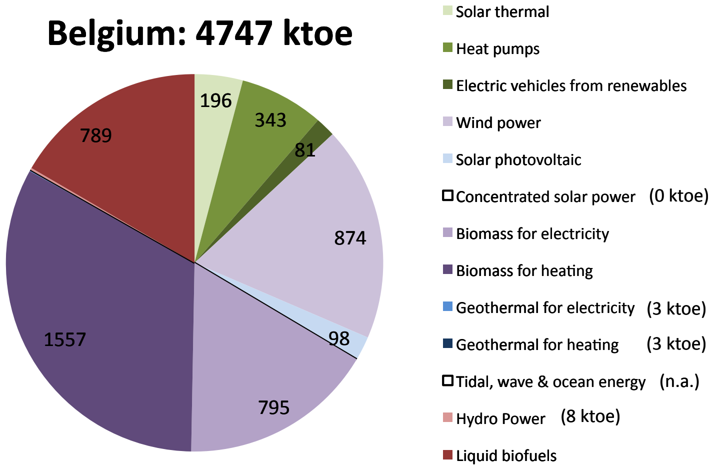
Belgium's target is to increase its share of renewable energy to 13%, from 2.2% in 2005. In 2020 it will consume 4747 ktoe more renewable energy than in 2005. As Figure 16 illustrates, 70% of this increase will be based on technologies requiring sensitive deployment – mainly biomass (for heat and electricity) and wind power. The remaining 30% is roughly evenly split between liquid biofuels and technologies with low conservation risks (mainly solar thermal and heat pumps). However, the contribution of wind power is set to increase relative to the NREAP figures: in 2011 the Wallonia regional Government introduced a new target to meet half its 2020 renewable electricity consumption using onshore wind.

Natagora – BirdLife Belgium makes the following key recommendations for the Wallonia regional Government:

1. Maintain subsidy levels for solar power, and the current emphasis on rooftop installations.
2. Publish a clear, stable spatial framework for

FIGURE 16

Additional renewable energy consumption in Belgium in 2020 compared to 2005, by technology [ktoe][iv]



development of onshore wind power.
3 Delay further promotion of the biomass heat and power sector until research trials and experience have better identified how to source biomass sustainably.
4 Deliver against Wallonia's ambitious targets for creation of protected areas, including for large forest reserves with natural ecosystem functioning.
5 To compensate for impacts of grid expansion to accommodate renewables, continue to encourage grid operators to identify sections of power lines that create risks for birds and to add mitigation devices.
6 Promote undergrounding of power lines in Natura 2000 areas where this is compatible with conservation objectives.
7 Investigate the potential to repower wind farms and promote this if it can significantly increase output.
8 Fund the development of bird sensitivity maps and ensure they are used in regional and local spatial planning for renewables.
9 Review experience so far in dealing with renewable energy planning applications, and issue guidance on good practice for developers and planning authorities.

5.3.2 BULGARIA

The "Via Pontica", one of the two most important migratory flyways for birds in Europe, passes through the Kaliakra region on the Black Sea coast in Bulgaria. Kaliakra contains one of the last remnants of the unique steppe habitats in the EU and some of the largest coastal cliffs. Thousands of birds travelling from Europe to Africa and the Middle East – including the white stork and pallid harrier – stop at Kaliakra to roost or forage. The globally threatened red-breasted goose overwinters at the site. BirdLife is very concerned about uncontrolled development in this region for tourism and wind power.

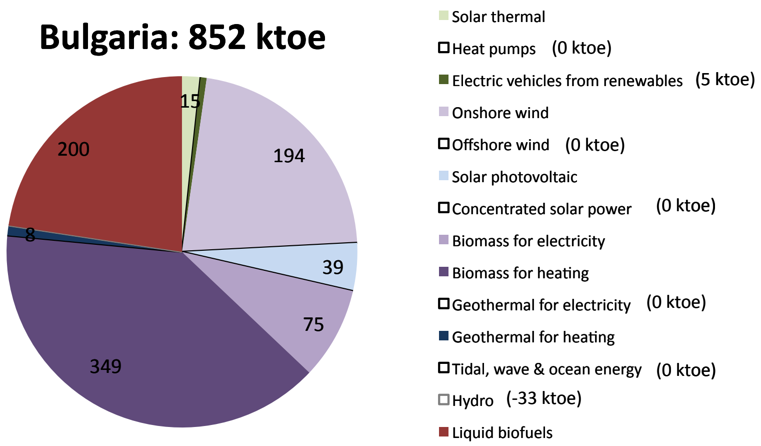
Bulgaria plans to increase its renewable energy share from 9.4% in 2005 to 16% in 2020. In 2020 852 ktoe more energy from renewables will be consumed than in 2005. Almost half of this increase (424 ktoe) will come from use of biomass for heat and electricity. Bulgaria is also planning significant growth in its onshore wind power industry, and to have sufficient additional capacity installed by 2020 to provide 194 ktoe of renewable energy. Bulgaria also has ambitious energy efficiency plans, and aims to keep total energy consumption approximately constant to 2020.

BSPB – BirdLife Bulgaria recommends the following key policy changes:

1 Develop policies and implementation plans to achieve the ambitious energy efficiency target.
2 Ensure development of the onshore wind industry, under the new rules introduced in spring 2011, is orderly and sustained.
3 Prioritise, and increase incentives for, installation of solar PV on roofs, in urban areas, and on land with low biodiversity value.
4 Extend current work on sensitivity of birds to wind farm development to address other species and other forms of renewable energy.
5 Develop a national spatial plan for renewables using SEA and sensitivity maps for birds and other biodiversity, and for all forms of renewable energy. Ensure all regions and local authorities develop spatial planning for renewables.
6 Develop and implement management plans for all Natura 2000 areas as a matter of urgency. Commit to not using biomass produced in Natura 2000 areas except where this is specified in management plans for the conservation of these areas.
7 Ensure robust application of "appropriate assessment" procedures for developments in Natura 2000 areas by making assessment experts more independent of the developer, and requiring employment of different assessment professionals if work is repeatedly inadequate.
8 Change legislation to allow authorities to refuse consent for the most damaging proposals, or where EIAs are clearly inaccurate or inadequate. Improve the working of the "expert councils" who vote on planning consents, to make them more independent from investors' interests.
9 Prevent use of "ecological assessment of plans and projects" (SEA) for major developments that should be subject to more detailed EIA. Make SEA and EIA consultants independent of their clients by making payments indirect. Introduce a "three strikes" rule whereby inadequate assessment reports can be returned to the same

FIGURE 17

Additional renewable energy consumption in Bulgaria in 2020 compared to 2005, by technology [ktoe][iv, ix]



assessment experts for improvement only once or twice, but not more.

10 Update existing guidance on EIA procedures and on wind farm development, and develop similar guidance for other renewable sectors in good time before the industries take off. Introduce a rolling programme of training in how to apply such guidance, for developers, assessment experts and competent authorities.

5.3.3 CROATIA

Croatia is a candidate EU Member Sate, and as such is not yet required to have an NREAP. However, a national energy plan drawn up in 2010 sets a target of 20% renewable energy by 2020. Croatia has three large hydropower dams on the river Drava in the north of the country. The state energy agency wants to build more hydropower dams in other parts of the country which are still quite natural and important for biodiversity. Five wind farms are in operation in Croatia, and the sector is expanding rapidly, mainly in the coastal regions. BIOM (BirdLife's contact in Croatia) reports that golden eagles were displaced by one of the earliest wind farms. There is very high potential for solar PV, but current subsidies appear to be too low to stimulate investment.

The 21 county governments set regional planning policies with land use zoning. However, zoning appears to be very flexible in the face of pressure from developers, and bird sensitivity maps are not yet available.

BIOM makes the following key policy recommendations:

1 Update national energy plans to reflect the need to save energy and move away from fossil fuels.
2 Develop a national spatial plan for renewables, indicating zones that are most suitable for different technologies. Support the necessary surveys and mapping work to indicate to developers where their EIA surveys are likely to reveal major issues for wind power development.
3 Make grid connection quicker and easier for wind power developers and small-scale renewable electricity suppliers.
4 Increase subsidies for solar power, and the emphasis placed on solar power in national renewable energy targets, and increase subsidies.
5 In the biomass heat and power sector, prioritise use of agricultural by-products and only exploit forest resources where this is compatible with biodiversity protection.
6 Increase capacity in the 21 counties to protect areas designated for inclusion in the Natura 2000 network. Develop an information campaign so that developers understand that

Natura 2000 areas are not "no go" areas and under what circumstances development is acceptable. Ensure early experience in "appropriate assessment" takes a robust approach, eg, by ensuring assessment experts are independent of developers' interests.

7 Study the costs and benefits of undergrounding power lines in Croatia (depending on terrain/ habitat types and use by vulnerable species) and raise awareness among government departments, the state energy company and developers.

8 Introduce a system of objective environmental cost-benefit analysis to identify opportunities to increase renewable energy output through re-powering and to remove installations that are unprofitable and/or most damaging for biodiversity.

9 Ensure European funding bodies do not support highly damaging major projects.

10 The State Institute for Nature Protection should lead on the development of a suite of up-to-date guidance and best practice documents on SEA, EIA and biodiversity-friendly renewables development, in partnership with government ministries and stakeholders.

5.3.4 FRANCE

France has a strong regional planning system. The July 2010 "Grenelle II" law requires regional planning for renewables contributions towards the national targets. Most regions have bird and bat sensitivity maps and these are used by the regional offices of the Ministry of Ecology to produce spatial plans for renewable energy development. Opposition to wind power on landscape grounds, and to solar PV on high grade agricultural land, has pushed developers to more remote areas. This increases pressure on areas with high biodiversity value, and increases electricity transmission losses. Natura 2000 areas are generally well protected, but LPO has objected to one very large solar farm proposed in a Natura 2000 site in the South of France because it could lead to loss of raptor habitat.

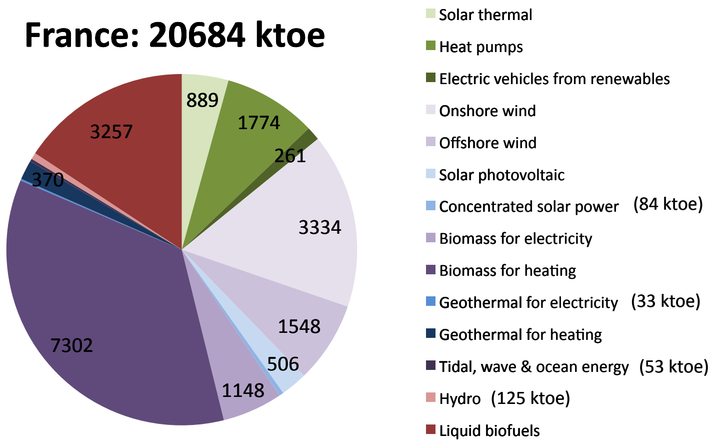
France intends to increase its share of renewable energy from 10.3% in 2005 to 23% in 2020. This will require capacity to provide an additional 20 Mtoe of renewable energy. Figure 18 shows which technologies are expected to provide this energy. Seventy per cent of the energy is expected to come from medium risk technologies that require sensitive development. Biomass will be used to provide an additional 7.3 Mtoe of heat energy. France also has ambitious plans for expansion of onshore wind, and for offshore wind development in the Atlantic.

LPO – BirdLife France makes the following policy recommendations:

1 Ensure that financial incentives and the energy policy framework become stable, to give more

FIGURE 18

Additional renewable energy consumption in France in 2020 compared to 2005, by technology [ktoe][iv]



confidence to investors and more certainty for all stakeholders.

2 Assess the available sustainable resource of biomass from French sources, given competing land uses and conservation goals.
3 Plan for a more decentralised energy system that makes greater use of low-risk technologies and reduces transmission losses, by increasing incentives for solar thermal, micro-wind and smaller wind farms supplying local users.
4 Develop a national spatial plan for renewables using SEA. Strategic planning of electricity generation should take into account the costs and potential ecological impacts of new power line development.
5 Develop a standardised methodology for integrating bird/bat sensitivity maps into regional plans.
6 Fund ecological surveys of the French marine area, and use the results and SEA to develop a strategic plan identifying further zones for offshore wind development. Make ecological data collection in offshore SPAs and SACs more detailed.
7 Make strong links between the Regional Scheme for Ecological Coherence and the Regional Scheme for Climate, Air and Energy in designating and protecting sites, and in regional/ local spatial planning for renewables.
8 Make climate adaptation a more explicit and central element of the Regional Scheme for Ecological Coherence. To ensure "green" and "blue" corridors are effective, the programmes must be well funded: industry should contribute, to offset fragmentation and loss of habitats across France estimated at 80,000 ha per year.
9 Develop environmental criteria for repowering of hydro facilities, and guidance on environmental assessments for biomass and offshore renewables.
10 Develop good practice guidance on SEA methodologies, and improve capacity in regional authorities to control the quality of "appropriate assessments" and EIAs, in particular for cumulative impacts.

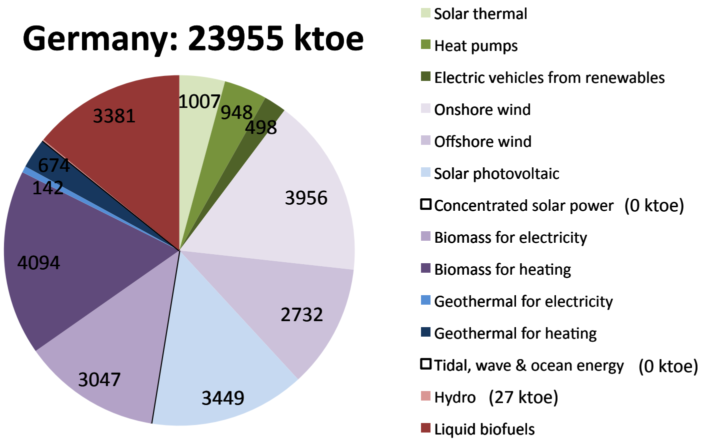
5.3.5 GERMANY

NABU

Germany is a world-leading nation in renewables development, particularly solar PV and wind power onshore. The move to larger wind turbines makes repowering of older wind farms in the north of the country worthwhile, and it is becoming economic to use less windy sites in the centre and south of the country. NABU (BirdLife Germany) works together with project developers to encourage management of the land under solar or wind farms for the benefit of biodiversity. Bird sensitivity maps are used in spatial planning in some German regions. Data is less well developed for bats, which could be put at risk by the increasing development of wind farms in forested areas.

FIGURE 19

Additional renewable energy consumption in Germany in 2020 compared to 2005, by technology [ktoe][iv, ix]



Under the Renewable Energy Directive, Germany is committed to increasing its share of energy from renewables from 5.8% in 2005 to 18% in 2020, but intends to go beyond this, bringing the share to 19.6%. This equals an increase in annual renewable energy consumption of almost 24 Mtoe. Figure 19 shows that Germany plans to use a balanced mix of all the major renewables technologies to achieve this increase. The contribution of 3449 ktoe of energy from solar PV is particularly ambitious. Biomass for electricity is needed in part to balance generation from intermittent renewables such as wind and solar. With the 2011 decision to phase out nuclear power, Germany's renewables ambitions are likely to be stepped up beyond those reported in the NREAP.

NABU – BirdLife Germany makes the following key policy recommendations:

1 Define programmes to improve the efficiency of specific appliances and heating/cooling systems, targeted to maximise carbon savings. This should be funded through revenues from the European ETS, and should start with electrical appliances/systems like circulating pumps.
2 Vary the feed-in tariffs for onshore wind to encourage a better geographical spread of wind and solar power developments across Germany. Maintain the current policy of only allowing large solar arrays to be built in zones defined by municipalities with public participation, and only where EIA is carried out.
3 Examine the national and regional limits to sustainable use of biomass for energy, given other land use priorities and other end-uses. Encourage usage of a broader variety of biomass sources including organic residues, liquid manure and energy crops from sustainable cropping systems.
4 Push the European Commission to remove harmful subsidies in the forestry and agriculture sectors (eg, for woody biomass) and to move funds into subsidies that make these sectors more supportive of biodiversity.
5 Support more research into minimising noise impacts on marine mammals and fish during installation of offshore wind turbines, and develop standards for "best available technology".
6 Move away from planning of individual power lines to a more integrated national planning approach based on SEA and that proves the need for specific infrastructures and evaluates use of innovative technologies. Raise the ratio regulating justifiable costs of undergrounding, to increase the proportion of new underground power lines.
7 Maintain the current situation whereby municipalities have decision rights on developing decentralised energy, and promote this as good practice across the EU.
8 Zones for renewable energy development defined by local authorities should always be co-ordinated by regional planning authorities, to avoid the designation of small, fragmented zones at the edges of local planning areas.
9 Set up and operate regional "pools" for data on the presence of sensitive species, using data collected by developers and NGOs, and make this available to all parties involved in the planning process.
10 Where sensitivity maps are available, require their use in defining renewable energy zones and in planning control.

5.3.6 GREECE

Ορνιθολογική
HELLENIC ORNITHOLOGICAL SOCIETY

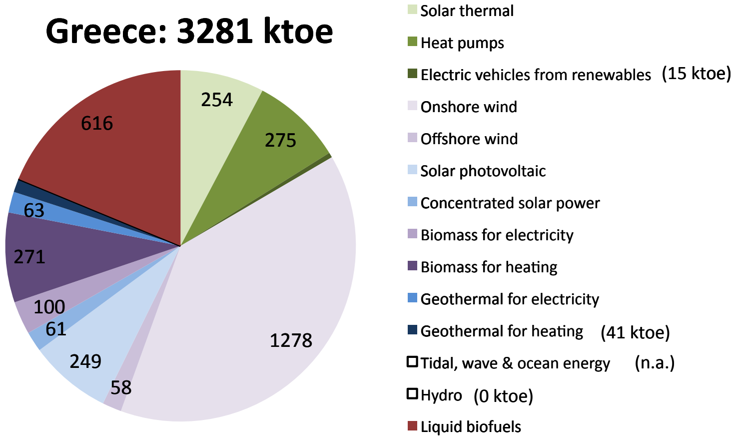
Greece is committed to increasing its share of renewable energy from 6.9% (2005) to 18% in 2020. Over the period 2005 to 2020, annual renewable energy consumption will increase by 3.3 Mtoe. Onshore wind power will provide 39% of this additional energy (1278 ktoe). HOS (BirdLife Greece) has developed sensitivity maps for onshore wind, but these are not yet used in spatial planning. Marine ecological surveys are urgently needed ahead of development of the Greek offshore wind industry.

HOS – BirdLife Greece makes the following policy recommendations:

1 Endorse the available bird sensitivity maps as an interim measure, and fund development of improved maps at the national scale, to inform spatial planning and investor decision making.
2 Revise and update the national spatial plan for renewables, using high-quality SEA, to reflect recent major increases in targets and the inadequacy of the earlier SEA.

FIGURE 20

Additional renewable energy consumption in Greece in 2020 compared to 2005, by technology [ktoe][iv, ix]



3. Develop spatial plans for renewables at the regional level, using resource assessments, bird sensitivity maps and SEA.
4. Increase incentives for investment in small wind farms serving small communities and islands – the current emphasis is all on very large wind farms.
5. Develop new guidelines on ornithological assessment requirements for wind power development in SPAs.
6. Maintain the current policy allowing solar farms to be developed on agricultural land, and go further to discourage use of high nature value land. Reduce bureaucratic hurdles for solar developers, particularly for small-scale installations (without compromising on standards and EIA requirements).
7. Speed up identification of marine IBAs and designation of marine SPAs. The current strategy for offshore wind does not take into account ecological sensitivities and protected areas – it should be developed using SEA and strategic "appropriate assessment" to protect marine wildlife and to give more certainty to developers on appropriate development zones.
8. Bring together and integrate/optimise sectoral energy strategies in an open, accountable process informed by SEA and sensitivity mapping.
9. Re-work existing budgets for power line development to enable undergrounding where lines cross major bird migration paths, and to mitigate risks in the existing networks.
10. Prioritise re-powering rather than development of new hydro and micro-hydro schemes. Assess the need for the current very high number of small scale hydro plants.

5.3.7 IRELAND

BirdWatchIreland
protecting birds and biodiversity

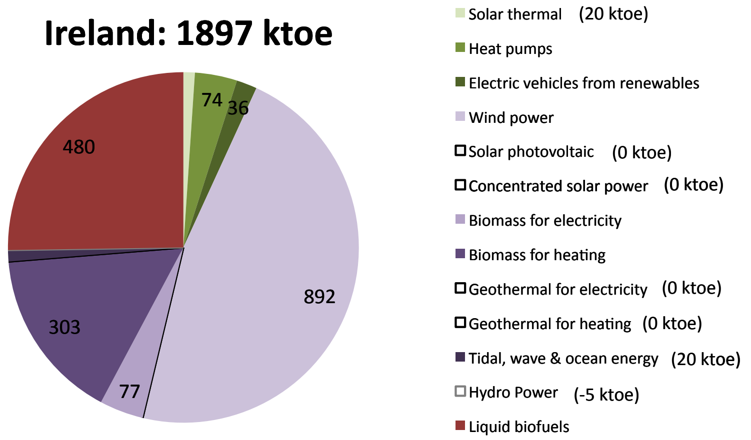
In its NREAP, Ireland is committed to increasing its share of renewables in total energy consumption from 3.1% (2005) to 16% in 2020. This requires an additional 1.9 Mtoe of renewable energy. As Figure 21 illustrates wind power will account for the largest technological share of this increased consumption. Ireland is developing an offshore wind industry, but the NREAP does not provide details.

BirdWatch Ireland – BirdLife Ireland makes the following policy recommendations:

1. Increase incentives for and uptake of the domestic energy efficiency retrofit scheme and decentralised renewables.
2. Streamline licensing procedures for grid development needed for growth in renewable electricity capacity.

FIGURE 21

Additional renewable energy consumption in Ireland in 2020 compared to 2005, by technology [ktoe][iv]



3 Use SEA to examine the least damaging energy mixes and spatial configurations for an onshore renewables strategic plan. In particular, develop a strategic spatial plan for onshore wind power development.
4 Extend support (currently only for new-build) to large scale PV arrays and for use on existing buildings.
5 Expedite completion of spatial planning for offshore wind, using high quality SEA. Support biodiversity survey work and expedite completion of the SPA network (onshore and offshore) and SAC network (offshore).
6 Revise the "Grid 25 Plan" to take account of protected areas. Develop criteria for use of undergrounding in sensitive areas and integrate these into the Grid 25 plan.
7 Require regional and local spatial planning for renewables, and provide guidelines for doing so.
8 Provide support for development of sensitivity maps and commit to their use by a specified date eg, 2015.
9 Develop national guidance on application of appropriate assessment for various kinds of renewables infrastructure.
10 Improve consistency in planning control policies among competent authorities (local authorities and agencies).

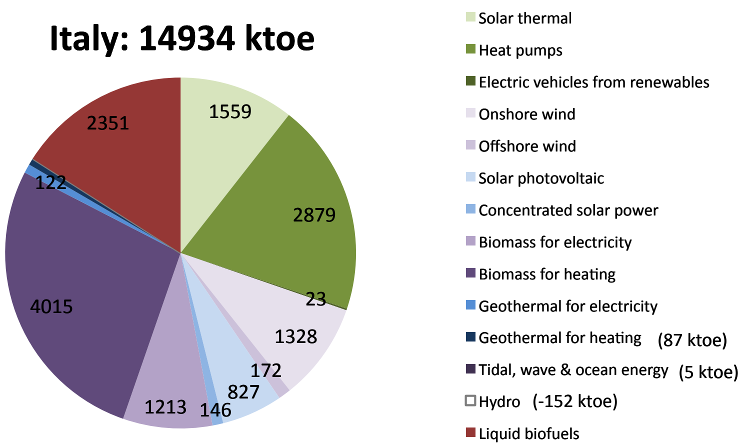
5.3.8 ITALY

Italy has taken a different approach to protected areas and wind power development to other EU countries. Rather than use sensitivity maps and spatial planning, it has adopted a decree that prohibits wind power development in Natura 2000 areas. This goes beyond the requirements of the Birds and Habitats Directives, which allow development under certain conditions designed to ensure conservation objectives are not undermined. This decree is seen as necessary partly because the wind industry has been somewhat chaotic, unplanned and even corrupt. Subsidies have been available for simply installing turbines, and some in Sicily were found not to be connected into the grid.

In its NREAP, Italy is committed to increasing its share of renewables from 5.2% to 17% (2005–20). This requires an increase in renewable energy consumption of almost 15 Mtoe. Figure 22 provides the technological makeup of this increase. Over 50% is derived from biomass to be used for heat, electricity or liquid biofuels. Italy also plans to make very significant use of heat pumps and solar thermal technology for space heating. In common with Greece, Italy plans to develop some offshore

FIGURE 22

Additional renewable energy consumption in Italy in 2020 compared to 2005, by technology [ktoe][iv]



wind power in the Mediterranean. It will also make use of CSP, and already has a facility in operation in Sicily.

LIPU – BirdLife Italy makes the following policy recommendations:

1 Improve incentives and mechanisms to increase domestic and industrial energy efficiency and improve public transport. Provide incentives to the construction industry to replace inefficient 1930–50s housing in suburban areas with energy efficient housing.
2 Introduce incentives to replace inefficient wood fires used for heating in southern Italy with efficient wood fuel stoves and/or other micro-renewables (rooftop solar PV and solar thermal).
3 Harmonise wind power incentives (and push for this also at the EU-level) so developers are attracted to the best locations rather than by subsidy levels.
4 Maintain the existing decree excluding wind power from SPAs. Some older, badly sited wind farms should be relocated. Use sensitivity mapping plus full application of "appropriate assessment" to enable some renewables development in SACs, limited to small scale developments only.
5 Maintain a stable support regime for solar power that favours honest investors who need a reliable income stream. (Instability favours very rich investors who can move quickly and cope with losses of revenue eg, organised crime groups investing to launder money). Provide stronger incentives for PV development in urban areas (on buildings, in particular commercial buildings such as warehouses) than for development on farm land.
6 Assess the sustainable level of biomass use for energy in Italy and plan how to exploit it at the national level. Prioritise agricultural wastes and management of existing forests currently in poor condition for biodiversity (eg, in the Apennines). Do not import biomass from countries where the sustainability of sourcing is uncertain. (South America is currently a major source of imported wood fuel).
7 Develop a national energy infrastructure plan that takes into account biodiversity protection, including measures to minimise infrastructure needs (energy efficiency, smart grids, electricity storage).
8 Develop national, regional and local spatial planning for renewables. Use sensitivity mapping and SEA to plan renewables deployment outside Natura 2000 sites.
9 Make wider use of undergrounding power lines where this will be environmentally beneficial. Use the opportunity when upgrading power lines to develop a smarter grid system.
10 Promote repowering of existing hydro facilities rather than development of the last remaining natural rivers in the Alps. Identify at national level the most beneficial sites in terms of electricity system management and ecological impacts for converting some hydro facilities to pumped-storage.

5.3.9 MONTENEGRO

Montenegro is a candidate EU Member State, and does not have an NREAP. Two large hydro dams built 40–50 years ago supply approximately 80% of Montenegro's electricity. A State Strategy for Energy Development to 2025 identifies wind and hydro as priorities. The Strategy suggests locations for development of the wind industry, many of which are IBAs or potential IBAs. This reflects the problem that spatial planning for energy development has not been informed by SEA, and bird sensitivity maps are not yet available. Solar PV is not yet supported in Montenegro, despite its potential in this sunny country.

CZIP – BirdLife's contact in Montenegro make the following policy recommendations:

1. Turn good intentions on energy efficiency into actions – introduce subsidies to encourage investment in households and industry.
2. Maintain financial support for the onshore wind sector, but go further to ensure ecologically sensitive development.
3. Make use of Montenegro's good solar resources – introduce subsidies to attract investment in solar power, favouring rooftop installations. Favour solar for power and heat rather than biomass until there has been a thorough assessment of potentially sustainable biomass resources.
4. Designate and protect areas in the preliminary list of future Natura 2000 areas as nationally protected areas as soon as possible. Introduce EU requirements for areas in the list.
5. Use SEA to revise the national energy infrastructure plan to 2020, taking into account ecological sensitivities.
6. Introduce financial incentives for decentralised renewables, particularly for rooftop solar power and solar thermal heating.
7. Define a policy on power lines and protected areas, prioritising avoidance first and undergrounding where this is feasible and environmentally acceptable.
8. Ensure new power lines for re-powered hydro facilities and other renewables do not harm biodiversity.
9. Revise national spatial planning for renewable energy using SEA to minimise impacts on biodiversity, and introduce a system of regional spatial planning for renewables using SEA.
10. Prepare national and regional bird sensitivity maps and require their use in spatial planning for renewable energy.

5.3.10 POLAND

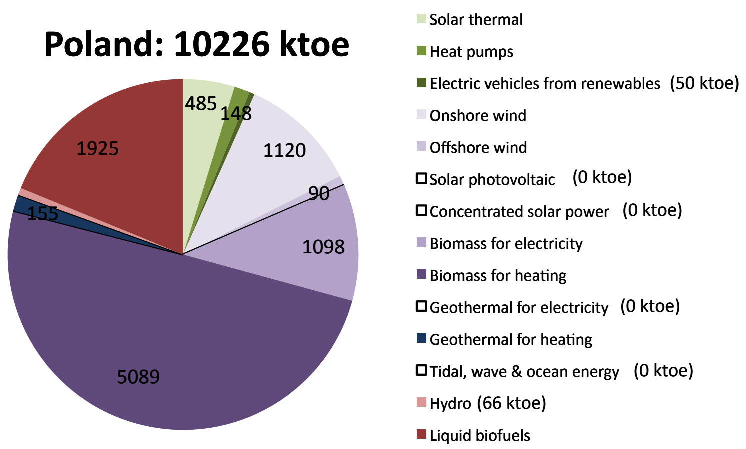
Poland will increase its share of renewable energy from 7.2% in 2005 to 15% in 2020. This requires additional capacity to provide 10.2 Mtoe of renewable energy. As Figure 23 illustrates, Poland's renewable energy plans are strongly dependent on biomass for heat and electricity. Onshore wind and a small offshore contribution are also planned. However renewable electricity expansion is hampered by the need to renovate Poland's electricity transmission system.

OTOP – BirdLife Poland makes the following policy recommendations:

1. Widen financial support for energy efficiency measures to private owners and raise public awareness of the need for, and benefits of, energy efficiency.
2. Give developers a clear indication of areas that are suitable for wind farm development, with reference to wind speeds, grid connections and ecological sensitivities.
3. Take urgent steps to modernise the electricity grid to make it possible for the grid operator to connect renewable electricity, and enforce the requirement to connect new suppliers. Clarify the legal position on who should pay for grid connections, ensuring this does not penalise small producers. Build on existing trials of mitigation measures (diverters and undergrounding) on power lines and prepare a national strategy to make existing and new power lines bird-safe.
4. Introduce support for solar PV, in addition to current support for solar thermal. Provide financial support to the regions to promote

FIGURE 23

Additional renewable energy consumption in Poland in 2020 compared to 2005, by technology [ktoe][iv, ix]



small-scale renewables, and require all regions to actively promote their use.

5 Conduct an assessment of the sustainable biomass resource in Poland, and provide maps and/or guidelines on sustainable exploitation of the resource. Enforce regulations on the air quality impacts of biomass burning, to prevent mixing of industrial waste into biomass fuels and combustion in older facilities without adequate emissions controls.

6 Implement the draft law regarding artificial "islands" to enable offshore wind development. Designate marine SPAs urgently and develop marine spatial planning for offshore wind.

7 Develop guidelines on repowering of hydro facilities, including on achieving/maintaining good ecological status of water bodies. Change the national Act on EIA to require EIA for water management works.

8 Amend the Polish Act on EIA to make it clearer where EIA is required (with infrastructure-specific thresholds), and to clarify that "appropriate assessment" under Article 6 of the Habitats Directive is required for any project, irrespective of size or infrastructure type, where it is likely to adversely affect a Natura 2000 area.

9 Support development of nation-wide bird sensitivity maps, and their use in spatial planning and environmental assessment of plans and projects.

10 Develop a national spatial plan for energy using SEA, including for modernisation of the electricity grid, so that renewables targets can be achieved while protecting the natural environment and minimising electricity transmission losses. Implement existing requirements for regional and local spatial planning.

5.3.11 PORTUGAL

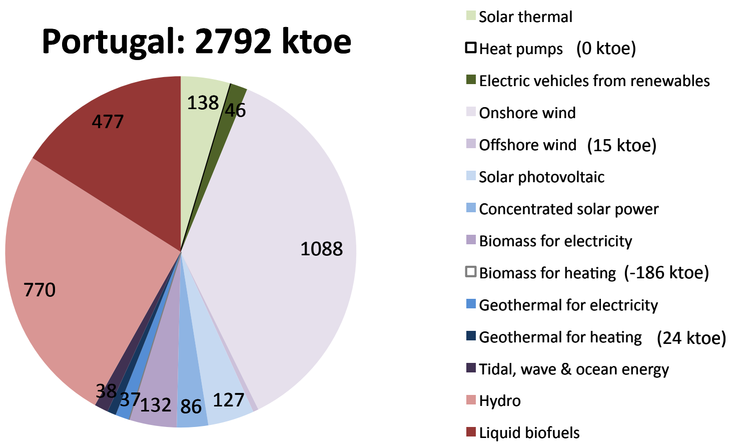
spea

Wind farms in Portugal have so far usually been small, and outside of IBAs. However, there are many wind farms in the south-west coastal area, which is a very important area for birds during migrations periods. Portugal has a very steep continental shelf, which limits potential for offshore wind power. However, this may change if floating turbines become commercially available. Portugal has a significant wave power resource, but there have been delays in getting a test centre for wave technologies up and running. Portugal also has ambitious plans to develop hydropower and pumped storage. Significant grid development, including interconnectors with Spain, is needed to enable renewable electricity development.

Portugal is committed to increasing renewable energy consumption from 20.5% (2005) to 31% in 2020. The high share in 2005 was largely accounted for by use of biomass for space heating. The

FIGURE 24

Additional renewable energy consumption in Portugal in 2020 compared to 2005, by technology [ktoe][iv]



NREAP suggests this use of biomass will actually be reduced slightly, and greater use will be made of solar and geothermal heat. An additional 2.8 Mtoe of renewable energy is required.

SPEA – BirdLife Portugal makes the following policy recommendations:

1 Evaluate progress on the 2008 implementation plan, and target funding and programmes where the greatest carbon savings can be made with the lowest wildlife impacts eg, energy savings.
2 Increase support and incentives for solar heat and solar power on homes and public facilities (schools, hospitals, sports facilities, etc).
3 Develop a spatial plan for offshore renewables that excludes the most sensitive areas, in dialogue with SPEA and using survey data and guidance from the FAME project (available late 2012). Move ahead urgently with designation of the three marine SPAs for which preparatory work is already complete.
4 Get the wave energy pilot zone functioning with adequate monitoring and biodiversity assessments. Continue/expand testing of floating turbines, and include biodiversity criteria in technical evaluations/specifications.
5 Continue identifying power lines that are dangerous for birds and introduce mitigation measures and monitoring. Achieve first undergrounding of power lines in Portugal in the most critical areas.
6 Prioritise repowering of existing hydro, where this is compatible with Water Framework Directive requirements on ecological status, rather than new hydro.
7 Support national bird sensitivity mapping (and/or use existing designations and data), and use this and SEA to develop a national spatial plan for all renewables.
8 Develop guidelines on regional and local spatial planning for renewables, and require such planning to implement the national spatial plan.
9 Continue using EIA screening as an effective tool to prevent the worst projects coming forward, but give more weight to biodiversity and reducing carbon emissions when deciding on national interests.
10 Update guidelines on wind power development and the natural environment, and extend to other renewables eg, solar PV. Improve coverage of cumulative impacts assessment and monitoring in guidelines. Raise awareness, and increase capacity to apply the guidelines and to carry out monitoring.

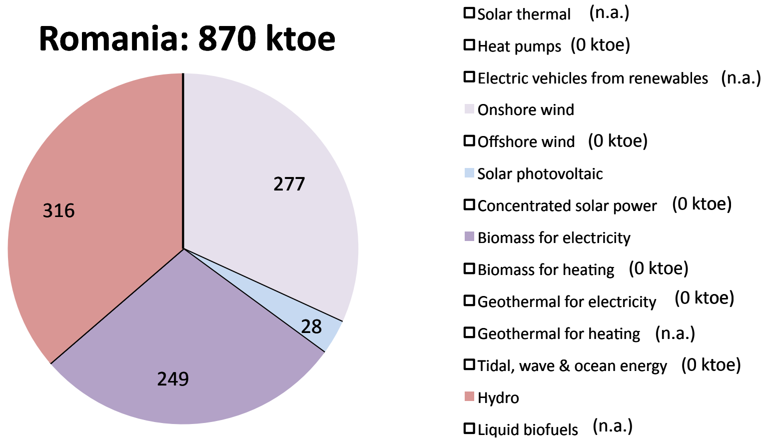
5.3.12 ROMANIA

SOR
SOCIETATEA ORNITOLOGICĂ ROMÂNĂ

Romania intends to increase its share of renewables in total energy consumption from 17.8% (2005) to 31% in 2020. As Figure 25

FIGURE 25

Additional renewable energy consumption in Romania in 2020 compared to 2005, by technology [ktoe][iv]



illustrates the additional 870 ktoe of energy will be provided by three main sources: hydro, biomass for electricity and onshore wind. Romania already uses hydro to produce around 30% of its electricity, and intends to increase this by about 20%. In contrast the wind and biomass industries will be newly established. Romania also plans for a significant new solar PV capacity.

New wind development is concentrated in the Dobrogea region, near the Black Sea. Almost two thirds of this large, ecologically important region is designated as Natura 2000. This includes some agricultural areas, where wind power development could be safely developed. However, development in the region has been quite chaotic so far. There are collision risks for lesser spotted eagles, displacement risks for red-breasted geese and breeding raptors, and potential creation of barrier effects for birds going to the Danube Delta for feeding and resting. Appropriate assessment under the Habitats Directive has only been implemented since June 2010 and even now the authorities do not have the necessary skills and data to make robust assessments.

SOR – BirdLife Romania has been in discussions with the Ministry of Environment for two years about making a spatial plan using SEA for wind development in the Dobrogea region. Work is expected to begin soon, but faces several obstacles. Funds for multiple ecological surveys are needed; and these data will need to be interpreted to produce bird sensitivity maps.

The biggest problem for ensuring ecologically sensitive renewables development is a lack of capacity in the Ministry of Environment.

SOR – BirdLife Romania makes the following policy recommendations:

1 Increase support for solar power, energy saving and micro-renewables to a similar level to that available for wind power.
2 Develop a clear strategy for the biomass sector avoiding damage to protected areas.
3 Carry out biodiversity surveys to identify suitable areas for offshore wind in the Black Sea.
4 Carry out a national level strategic "appropriate assessment" for energy infrastructure development, to ensure integrity of the Natura 2000 network is respected.
5 Complete national sensitivity mapping in stages, starting with regions where development is concentrated and is affecting Natura 2000 areas ie, the Dobrogea and Moldova regions.
6 Ensure full implementation of the 2010 national spatial plan for renewable energy and develop a system of regional spatial planning for renewable energy, starting with areas where development is concentrated.
7 Ensure use of suitably qualified specialists to carry out EIA work, and improve public participation in planning procedures.
8 Increase capacity in the Ministry of Environment to complete and protect the Natura 2000 network.

9 Increase capacity and scientific expertise in local and regional authorities to scrutinise "appropriate assessments" through recruitment and training. Where capacity is lacking, the Ministry of Environment should scrutinise proposals (rather than local authorities) and NGO advice should be used.

10 Improve capacity in environmental authorities to require mitigation measures and to carry out monitoring and enforcement. The Ministry of Environment should work with NGOs to develop clearer guidance and a training programme for environmental authorities.

5.3.13 SLOVENIA

Slovenia intends to raise it share of renewable energy from 16% in 2005 to 25% in 2020, requiring an additional 330 ktoe of renewable energy. As Figure 26 illustrates, roughly one quarter of the increase will be in hydropower, and roughly another quarter from technologies with low ecological risks (solar thermal, heat pumps and renewables used in electric cars). The remaining 161 ktoe of energy will come from medium risk technologies as identified in Chapter Three. Biomass for heating and electricity are important sources in this heavily forested country. Solar PV and onshore wind also make small contributions to 2020 targets.

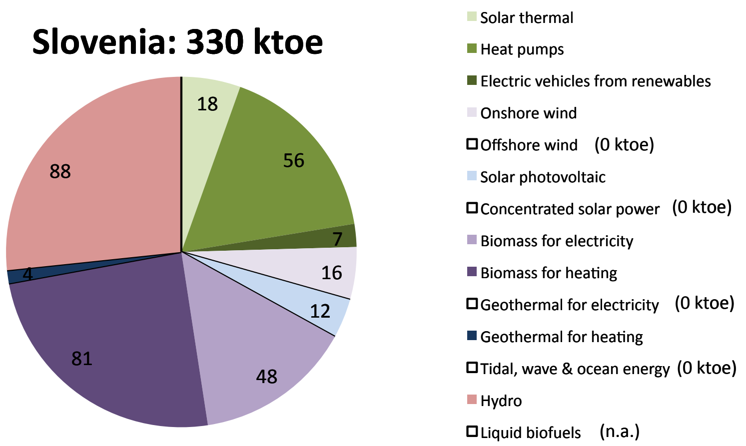
Slovenia has a strong tradition of spatial planning, but this is not yet being used effectively to promote biodiversity-friendly renewables. There are national-level plans, such as the national Energy Plan to 2030, and also "community plans" for 200 communities. Permission for large renewables developments depends on inclusion in spatial plans.

DOPPS is produced sensitivity maps for wind energy for all of Slovenia, and these will be in the public domain by 2012. Large scale wind development has been on hold pending the result of one controversial proposal. In 2001 a Slovenian electricity distribution company decided to build in a mountain IBA/SPA (Snežnik-Pivka) that is important for griffon vultures and golden eagles. Environmental consent and a construction licence were initially given, but DOPPS BirdLife Slovenia took legal action because the EIA was inadequate.

One third of Slovenia's electricity is from hydro, and older facilities are being systematically re-powered to improve their electricity output. There are also many proposals for new hydro schemes, often in Natura 2000 areas eg, on the Mura river at the border with Austria. This has been very controversial with nature NGOs. A first Slovenian pumped storage hydropower plant was finished in 2010, and a second one is planned.

FIGURE 26

Additional renewable energy consumption in Slovenia in 2020 compared to 2005, by technology [ktoe][iv]



DOPPS BirdLife Slovenia makes the following policy recommendations:

1 Revise the central goals in the National Energy Plan to 2030 to focus on climate and environmental protection, rather than on expanding output (using fossil fuels and nuclear) to meet domestic and export demand. In addition, Slovenia needs an ambitious goal to reduce energy use (eg, by 15% by 2030 and 30% by 2050).
2 Continue progress towards a framework that will enable investment in wind power in acceptable locations. Identify further areas for development of renewables outside Natura 2000 sites.
3 Further stimulate investment in solar power on roofs, in urban areas, and in other locations with low ecological sensitivity, by banding the feed-in tariffs.
4 Build public support for biomass energy by shifting financial support away from using food crops (eg, maize for biogas production) towards sustainable, domestic wood and agricultural by-products.
5 Give more priority to undergrounding where this is necessary to overcome public opposition to power lines needed for renewables and pumped storage, and/or to protect priority species and habitats.
6 Introduce regional spatial planning for renewables, to overcome current problems with lack of resources/capacity and highly fragmented planning at the local level. Use bird sensitivity maps in spatial planning at national and regional levels, in planning control, and to band feed-in tariffs.
7 Support further sensitivity mapping to include other (non-bird) taxa and (non-wind) renewables.
8 Build on positive experience in using SEA in developing the National Energy Plan to remove the most damaging plan alternatives. Require effective consideration of alternatives in local (or new regional) spatial planning. Continue improving enforcement of planning control regulations.
9 Implement existing law requiring accreditation of EIA consultants, including removal of accreditation where malpractice is found, including concealing information that shows risks of significant impacts.
10 Produce new guidance on EIA and a training programme to improve understanding of EIA among government and planning officials. The Environment Agency (or National Institute for Nature Conservation) must develop capacity to ensure mitigation measures are implemented effectively.

5.3.14 SPAIN

SEO/BirdLife

Spain has seen very rapid development of its onshore wind and solar industries. In terms of growth in these sectors, Spain is among the leading EU Member States. In most Spanish regions, development has been very poorly planned. In particular, recent rapid and uncontrolled growth (with little use of SEA), and some poorly sited early wind farms have caused significant ecological impacts, and lasting and unnecessary damage to the industry's reputation among conservation organisations.

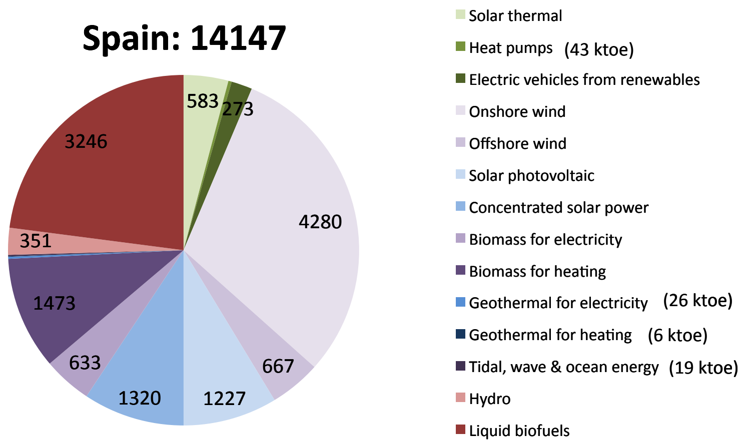
Spain intends to increase the share of renewables in its energy consumption from 8.7% (2005) to 20% in 2020, requiring over 14 Mtoe of additional renewable energy. Onshore wind will provide for an additional 4.3 Mtoe of renewable energy consumption in 2020 (compared to 2005). Among the other technologies identified as "medium risk", biomass for heat, concentrated solar power and solar PV also make large contributions. Offshore wind and biomass electricity are also important in Spain's NREAP.

SEO – BirdLife Spain makes the following policy recommendations:

1 Introduce a new Renewable Energy Act that provides a clear framework for development of all forms of renewable energy industries in the medium- and long-term, based on a robust geographical analysis of potential and constraints and with the goal of minimising overall impacts of new infrastructure.
2 Undertake sectoral analyses to find out where the greatest energy savings can be achieved, as a starting point for coherent and properly monitored energy efficiency programmes. Investigate innovative incentive schemes for energy saving, as alternatives to providing up-front subsidies.

FIGURE 27

Additional renewable energy consumption in Spain in 2020 compared to 2005, by technology [ktoe][iv]



3 Ensure current high investment in wind power and power lines is not jeopardised by legal problems that may arise from failure to follow requirements on environmental assessment in regional planning. The national electricity company should signal to developers that it takes designated areas and SEA very seriously and therefore may be unable to connect up renewable energy developments in these areas.

4 Redress the current imbalance towards large and rural solar PV installations, to favour smaller and urban installations. Increase incentives for distributed energy, and make it easier and cheaper for households to get consent for small scale renewables.

5 Provide a clearer strategy for biomass energy based on a realistic assessment of sustainable long-term feedstock sourcing, taking into account the importance of maintaining environmental standards required for continued Forest Stewardship Council certification of timber operations.

6 Fast-track designation of offshore marine protected areas and raise awareness among developers of the designation process and its significance, to reduce risks to offshore wind power investors. Assess Spain's wave energy resource and develop a clear strategy to guide development of the industry. Increase funding for R&D in wave technology.

7 Investigate repowering opportunities to maintain overall output while removing those facilities that are in the worst locations in terms of impacts on biodiversity (principally wind farms and power lines). Remove barriers to repowering such as uncertainty about the need for a new EIA process.

8 Spatial Planning should remain a regional competence, but more clarity is needed on overall national ambitions in each sector. National and regional governments should work with renewables industries to develop good practice guidance on the development of regional and local spatial plans using SEA, and commit to refusing/withholding investment where such plans are not in place.

9 National Government should produce guidance on the need for cross-border co-operation between regions on identifying ecological sensitivities and on the requirements and good practice in EIA and "appropriate assessment".

10 The Environment Ministry should push for reforms to the EIA regulations and Directive to prevent "salami slicing" of projects ie, dividing large projects that require stricter assessment into a series of smaller projects. Regional governments and the energy sector should train their staff in good practice in EIA for renewable energy projects.

5.3.15 THE UNITED KINGDOM

In the UK's NREAP, the national Government committed the UK to increasing its share of renewable energy from 1.3% in 2005 to 15% in 2020, requiring almost 19 Mtoe of additional renewable energy. At the time this was very controversial, as many commentators felt this was an unachievable level of ambition from such a low starting percentage. However, the UK has large wind and wave power resources, and investment in the wind sector, particularly in Scotland and offshore in the North Sea, has been rapid. Moreover, the devolved Governments in Scotland and Wales have announced even more ambitious plans for renewables deployment. Strong political will to stimulate investment, plus use of strategic planning approaches that guide wind power developers towards favourable locations, have been important features of wind power investment offshore and in Scotland.

As Figure 28 illustrates, the NREAP foresees a significant role for solar thermal energy by 2020, and expects the "wave/tidal/ocean" sector to be contributing 340 ktoe by 2020. This may be an over-estimate, as it is now unlikely that the significant tidal energy resource in the west of England/south Wales region will be exploited by this date.

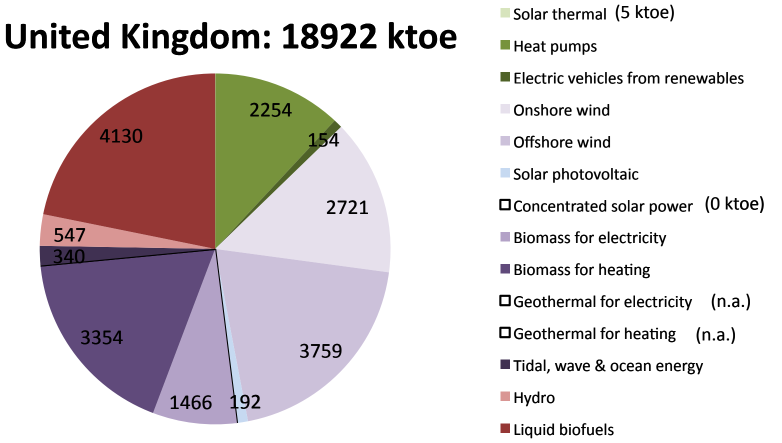
Offshore wind power is expected to make a very significant contribution to the UK's renewables targets. Biomass for heat and electricity are expected to grow into large sectors, raising concerns about the sustainability of feedstocks imported from around the world.

The RSPB – BirdLife UK makes the following policy recommendation for the UK as a whole:

1 Give greater emphasis to energy saving and efficiency, particularly in industry, energy generation and in existing buildings
2 Link banding of support for renewable energy to sustainability, and increase support available for marine renewables in England, Wales and Northern Ireland to match Scotland.
3 Develop national and local level spatial frameworks for growth of all renewables industries, with reference to energy resources (eg, wind speeds), grid development and minimising environmental impacts.
4 Work with other North Sea nations to ensure co-ordinated and ecologically sensitive development of offshore wind power and associated onshore power lines.
5 Do not allow development that would damage designated wildlife sites, or protected species.
6 Set up a forum with developers and NGOs to find ways to improve the public acceptability of new wind power developments and necessary power lines, learning from successful practices across the UK and EU.
7 Do not allow controversial large biomass electricity schemes and unsustainable biomass

FIGURE 28

Additional renewable energy consumption in the UK in 2020 compared to 2005, by technology [ktoe][iv]



imports to undermine the credibility of the bioenergy sector and the wider renewables industry.

8 Do not allow investment in fossil fuel electricity generation capacity to lock the UK into future carbon emissions that would jeopardise future carbon budgets.

9 Fast-track data gathering and sharing on marine biodiversity and designation of offshore SPAs and SACs, so that investors can be given a clearer steer towards low-risk locations for development.

10 Ensure resources are in place across the UK to pay for post-construction monitoring, and ensure that adequate enforcement measures are in place, rather than relying on third parties such as the RSPB to do this work.

The RSPB makes the following policy recommendations specific to the four UK countries:

England

1 Promote the use of available bird sensitivity maps and written guidance in spatial planning for renewables in England to identify favourable areas for development.

2 Require local authorities to develop spatial plans for renewables deployment, and to identify how they will contribute to UK renewable energy targets in their Local Plans.

3 Create mechanisms for local authorities to co-operate towards co-ordinated and timely delivery of renewables and power lines in appropriate locations.

Northern Ireland

1 Support development of bird sensitivity maps and targeted habitat restoration for Northern Ireland.

2 Develop a spatial plan for all renewables on- and offshore in Northern Ireland, and include spatial planning for renewables in Local Development Plans.

3 Invest in energy efficiency and minimisation of energy use across all sectors including new built development and transport.

Scotland

1 Do not support major projects that will increase energy use such as new fossil fuel plants and major roads proposals.

2 Scottish Government and local authorities must ensure energy projects are in line with existing national policy favouring small scale and use of co-produced heat. Develop detailed guidance and training for local planning authorities on application of Scottish Planning Policy provisions on decentralised energy.

3 The SEA for wave and tidal should be carried out and completed to encourage the sustainable development of marine energy. The "Saltire Prize" awarded for output of energy from wave or tidal power should reward designs with minimal environmental impacts.

Wales

1 Major investment in R&D is needed to harness Wales' significant wave and tidal energy in an environmentally acceptable way.

2 Clarify the Welsh Government's position on repowering wind farms, as it is preferable in environmental terms to creating new sites.

3 Extend coverage of sensitivity maps to all of Wales and to non-bird species. Further detailed work is needed to map ecological sensitivities within SSAs for wind power development, with some "no go" areas needed for the most vulnerable species eg, nesting honey buzzards. Require biodiversity "master planning" for wind power development in SSAs.

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ENDNOTES

[i] Chris Huhne, UK Secretary of State for Energy and Climate Change. '*The Geopolitics of climate change*'. Speech to Future Maritime Operations Conference at the Royal United Services Institute, London 7 July 2011, http://www.decc.gov.uk/en/content/cms/news/chsp_geopol/chsp_geopol.aspx [accessed 10-10-11].

[ii] José Manuel Barroso, President of the European Commission in *Wellbeing through wildlife in the EU.* http://www.birdlife.org/eu/pdfs/Wellbeing_EU_final_version_2mb.pdf [accessed 10-10-11].

[iii] See RSPB briefing on the implication of the Eastern Scheldt (Oosterschelde) for the Severn Estuary. http://www.rspb.org.uk/Images/RSPBbriefEasterScheldtreportfinal_tcm9-240984.pdf [accessed 10-10-11].

[iv] Calculations based on National Renewable Energy Action Plan data presented in Beurskens and Hekkenberg (2011). For gross final consumption values the "total before aviation reduction" was taken. Totals do not always include all technologies given in NREAPs. Where national NREAPs show additional use of a technology totalling less than 1% of the EU increase, these are grouped as "other". BirdLife makes no guarantee for completeness or correctness of data: mistakes might have occurred due to copying of wrong numbers, typing mistakes, misinterpretation or mistakes of our sources.

[v] Using a conversion factor of 11,630 GWh/Mtoe, facility run times of 8,760 hours per year, capacity factors of 12% for PV, 31% for concentrated solar power, 57.6% for biomass electricity, 27% for tidal/wave turbines and 34.8% for hydropower. To calculate demand for biomass in oven dried tonnes (odt), a conversion factor of 6,000 odt/MW was used for electricity, and 18 GJ/odt (41.9 GJ/toe) to calculate the demand for biomass for heat.

[vi] Using a conversion factor of 11,630 GWh/Mtoe, facility run times of 8,760 hours per year, load factors of 27.1% for onshore wind turbines and 27.6% for offshore wind turbines (Digest of UK Energy Statistics, Department of Energy and Climate Change, London) and surface areas based on EEA (2009, p. 10).

[vii] DG Energy Countries Factsheet, http://ec.europa.eu/energy/publications/statistics/doc/2011-2009-country-factsheets.pdf [accessed 10-10-11].

[viii] Finland, the Netherlands and Slovenia are excluded, as they did not provide a reference scenario to be compared to the additional energy efficiency scenario.

[ix] For some countries and specific technologies, special calculations were necessary. For "solar thermal" and "geothermal for heating" for Bulgaria and Poland, and for "electric vehicles from renewables" for Greece, a minimum value based on the 2010 targets compared to 2020 was calculated as data for 2005 was not available. Data for "liquid biofuels" was incomplete for Germany, Greece, the Netherlands and Poland.

[x] Budapest Declaration on bird protection and power lines adopted by the Conference "Power lines and bird mortality in Europe" (Budapest, Hungary, 13 April, 2011) , http://www.mme.hu/termeszetvedelem/budapest-conference-13-04-2011/1429.html [accessed 10-10-11].

[xi] SEANERGY 2020 web site: http://www.seanergy2020.eu/ [accessed 10-10-11].

[xii] FAME Project web site: http://www.fameproject.eu/en/ [accessed 10-10-11]. The FAME project is co-funded by the Atlantic Area Programme of the EC European Regional Development Fund, http://atlanticarea.ccdr-n.pt/, [accessed 20-10-11].

IMAGES: organic hay meadow, common or eurasian crane, electricity cables and pink footed geese by Nick Upton; aerial view of the ocean, offshore wind turbines, Copenhagen and aerial view of Europe by iStockphoto.com; solar panels at Sandwell Valley by Andy Hay; Dakatcha woodlands by Nature Kenya; oilseed rape harvesting, drilling rig and offshore wind turbines by Ernie Janes; solar panels on farmland, houbara bustard, Montagu's harrier, Spanish wind turbines by Roger Tidman; griffon vulture by Gordon Langsbury; wind turbine with planted hardwood trees by Niall Benvie (rspb-images.com); Polarmis tied at quayside by Laurie Campbell; great spotted woodpecker by Steve Round; crane grus grus by Chris Knights; mowing using a modified "piste basher" by Lars Lachman; biomass fuel briquettes by Piotr Marczakiewicz; Biebrza Valley wetlands by Dariusz Gatkowski; Italian wind farm site by Claudio Celada.

GRAPHS: Sandra Pape

MAPS: Additional solar power, additional onshore and offshore wind power, additional biomass heat and power by Sergio Boggio; Natura 2000 and wind potential by EEA (2008); bird sensitivity in France by LPO Pays de la Loire and CETE de l'Ouest; bird sensitivity in Slovenia by Tomaž Jančar/ DOPPS; bird sensitivity in Belgium by © Agentschap voor Geografische Informatie Vlaanderen – Geovlaanderen – Vogelatlas; bird sensitivity in the Netherlands by SOVON Vogelonderzoek Nederland/Altenburg & Wymenga © 2009; bird sensitivity in Scotland by the RSPB (Bright et al., 2006); bird sensitivity in Greece by Thanos Kastritis/HOS (BirdLife Greece); Lewis wind farm on Brussels by RSPB Scotland.

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www.rspb.org.uk/climate

BirdLife Europe, Avenue de la Toison d'Or 67 (2nd Floor), B-1060 Brussels, Belgium. Tel: +32 2280 08 30

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