Good Practice Guide

for the mitigation of impact of wind farms on biodiversity with the use of modern technologies

WindFarms & Wildlife

ΚΑΠΕ CRES

The LIFE+ Biodiversity project entitled "Demonstration of good practices to minimize impacts of wind farms on biodiversity in Greece" (LIFE12 BIO/GR/000554) is implemented by the Center for Renewable Energy Sources and Saving (CRES), in collaboration with the Nature Conservation Consultants Ltd (NCC), with the financial support of the European Union LIFE Instrument and the Green Fund.

The objectives of the project are the demonstration of modern methods and approaches to minimize the impacts of wind farms on biodiversity in Greece, to improve the compatibility of wind farm development with the EU's biodiversity conservation objectives and to develop standards and guidelines that will enable stakeholders in Greece to better design, implement and evaluate methods to reduce the potential impacts of wind projects on biodiversity.

During the preparation of the present Guide there was an important contribution of members of the LIFE12 BIO/GR/000554 Advisory Board, which is composed of representatives from the Wind Energy, Environmental and Biodiversity sectors. Their assistance was essential and contributed on the contents and information selection, as well as on the successful completion of the Guide.

Text: Jakob Fric, Margarita Tzali / NCC, Eftihia Tzen / CRES

Contribution: Kyriakos Rossis / CRES, Anastasios Dimalexis / NCC

Cover: Photo material: CRES, NCC

www.windfarms-wildlife.gr

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Table of Contents

About the Good Practice Guide 1
Introduction 5
Wind Energy 9
EU Policy Framework and Legislation in Greece 13
Implementation of the Institutional Framework 27
Potential Impacts of Wind Energy projects on Biodiversity 31
Evaluation and Monitoring 36
Impact Mitigation Measures 46
Conclusions - Suggestions 65
Annex 68
Bibliographical References 71
Additional Bibliography for Reading 73

Abbreviations Directory

AA	Appropriate Assessment
COP	Conference of Parties
EIA	Environmental Impact Assessment
EC	European Commission
EEC	European Economic Community
EU	European Union
ETAD	Environmental Terms Approval Decision
IBA	Important Bird Area
INDC	Intended Nationally Determined Contribution
IUCN	International Union for Conservation of Nature
JMD	Joint Ministerial Decision
PD	Presidential Decree
RES	Renewable Energy Sources
L.	law
LIFE	EU Financial Instrument for the environment and climate action
MD	Ministerial Decision
SAC	Special Area of Conservation
SCI	Site of Community Importance
SEC	Standard Environmental Commitments
SEI	Species of European Importance
SPA	Special Protection Area
UNFCCC	United Nations Framework Convention on Climate Change

About the Good Practice Guide

The development of Renewable Energy Sources (RES) and the increase of their share in the total energy production is a priority in the European Union's (EU) Policy Agenda to tackle climate change and reduce greenhouse gas emissions. The share of energy from renewable energy sources in the EU's energy mix is still rising and, according to today's figures, is well on track to reach the 20% target by 2020.

In this context, Wind Energy is one of the most important contributors to tackle climate change with a significant share in total energy production at the European level. Thus, in addition to other environmental benefits, the ability of wind power to generate carbon-free electricity is expected to reduce the capacity of the devastating effects of climate change on wildlife. However, the rapid development of wind projects raises concerns about possible impacts on nature and wildlife that cannot be ignored due to the predicted scale of growth. It is important to ensure that such rapid growth is sustainable in all respects and is carried out in accordance with EU environmental legislation, including Habitats and Birds Directives.

WIND ENERGY & BIODIVERSITY

Through the implementation of the legislative frameworks, such as the Directive 2001/42/EC on the assessment of the effects of certain plans and projects on the environment, the wind farms are being developed according to the principles of environmental protection. Additionally, as stated in the Directive 92/43/EEC the projects, including wind energy projects, within or adjacent to Natura 2000 sites are not excluded in advance, but should be examined on a case-by-case basis.

The implementation of wind energy projects in Natura 2000 areas, as confirmed by the EU and particularly through the European Commission Guidance Document entitled “Wind energy developments and Natura 2000”, should follow particular guidelines, [1]. This document provides guidance to national and regional authorities regarding the development of wind farms in protected areas of the Natura 2000 network, as well as in areas of distribution of protected species inside or outside Natura 2000 sites, in line with the EU Birds and Habitats Directives.

The potential impacts on flying fauna in specific areas can be avoided and minimized, by careful and appropriate planning and siting, mitigated or even compensated, [1, 30].

The wind farm investors are required to conduct environmental impact assessments, to assess all potential significant environmental impacts and meet all the requirements of EU legislation before the construction is initiated. Moreover, the concept for the proper development of wind projects in relation to the biodiversity is much supported and adopted by environmental and other organizations in Europe and internationally. In particular, BirdLife International in the report "Meeting Europe's Renewable Energy Targets in Harmony with Nature" confirms its support for the development of wind and other renewable energy sources and the goals set for 2030.

In addition, the study "Delivering Synergies between Renewable Energy and Nature Conservation" by the Institute for European Environmental Policy (IEEP) confirms that the impact of wind farms on most habitats and species is usually very small when the wind farms are properly designed, sited and smartly managed.

Source: NCC

The present Good Practice Guide was developed in the framework of the project LIFE12 BIO/GR/000554, “Demonstration of good practices to minimize impacts of wind farms on biodiversity in Greece”, with the aim of contributing to the proper development of wind energy in Greece, in accordance with the European Directives and the Greek Legislation.

The project LIFE12 BIO/GR/000554, among others, includes the pilot application of modern technologies for the reduction of the impacts of wind farms on biodiversity, such as radar, thermal imaging, video surveillance, bat detecting, and visual monitoring at wind farms in Greece, in order to evaluate their operation and use under the terms and conditions prevailing in Greece and in the Eastern Mediterranean.

It is obvious that the main way of mitigating and minimizing the potential impact of the wind farms on biodiversity is **proper siting**. Provided that the principle of proper siting is met, the good practices and technologies presented in the Guide can significant contribute in minimizing the impacts of wind farm projects on biodiversity.

Based on the results of the pilot applications, as well as the available literature, the Guide aims to review good practices to reduce the impacts of wind farms on flying fauna throughout the natural environment, with emphasis on protected areas of the Natura 2000 Network, based on the available methods and modern technologies that already have been successfully applied in several countries worldwide.

The Guide consists of eight (8) chapters. These chapters are as follows:

Introduction - the chapter deals with the climate change through a historical retrospective and references to the European Unions' and global community's plans for the protection of the environment.

Wind Energy - the chapter refers to the development of wind energy in Europe and Greece.

EU Policy Framework and Legislation in Greece - the chapter provides information on the institutional framework for RES and the Protection of the Environment and Biodiversity through the European Directives and the Greek legislation in force.

Implementation of the Institutional Framework - the chapter summarizes the implementation of the institutional framework for RES and Environment in Greece through procedures to be followed.

Potential Impacts of Wind Projects on Biodiversity - the chapter presents the potential impacts of wind farms on the flying fauna.

Assessment and Monitoring - the chapter refers to the importance of evaluating information for the assessment of the potential impacts of wind farms on biodiversity and proposes procedures and methods of data collection and their assessment for the proper decision-making for in the area of interest.

Impact mitigation measures - the chapter refers to good practices that can be applied to mitigate the impacts of wind farms on biodiversity, wherever this is considered necessary. More specifically, a series of applications of modern technologies in Greece and abroad to mitigate or avoid the impact of wind projects on biodiversity are presented, with relevant assessments and conclusions, in line with the EU guidelines.

Conclusions - Suggestions - the chapter refers to conclusions and suggestions as they can be deduced from the up to date experience on the application of modern technologies to mitigate the impact of wind farms on biodiversity.

The Guide seeks to provide information to competent authorities, consultants, environmental organizations, investors, project managers and other professionals involved in the design, implementation or approval of wind farm plans or projects with the aim of contributing to:

- the monitoring and evaluation of wind energy projects by providing information on the available technologies and the capabilities to monitor and evaluate the effectiveness of the measures, wherever they are required, by allowing the effective monitoring of the impacts of a project on biodiversity,
- the provision of information on the latest developments concerning the mitigation of potential impacts of wind farms on flying fauna and their utilization in the elaboration of Appropriate Assessments (AA) and
- ensuring the compatibility of wind energy development with the provisions of the Habitats and Birds Directives.

Through integrated information provided, the reader has the opportunity to comprehend and evaluate the data in order to make the best use of it for the benefit of the environment, man and biodiversity.

Note: Within the project LIFE12 BIO/GR/000554, following the Good Practice Guide, a Decision Support Tool developed in an Geographic Information System (GIS) environment to provide support for decision-making during the design and operation of wind farms on the basis of the location of the wind farm and on the available information on the flying biodiversity of area of interest. The tool is available on the project's website (***www.windfarms-wildlife.gr***).

Introduction

Climate change poses a series of threats to people and their environment as it increases the risk of serious, widespread and irreversible impacts on people, species and ecosystems. In recent years, climate change and its impacts have become increasingly evident, making its mitigation and the conservation of the natural environment and biodiversity key priorities for the European Union (EU).

In this context, in December 2008, the EU adopted an ambitious and imperative “Climate Change and Energy package”, consisting of a series of measures that inter alia, commits the EU-27 countries to increasing the share of renewable energy to 20% of Europe’s total energy production by 2020.

As a consequence, in April 2009 the **Directive 2009/28/EC** on the promotion of the use of energy from renewable sources, "the RES Directive", was adopted, which sets mandatory national targets for each Member State to ensure the delivery of the overall target. Until today, the European Union has made satisfactory progress in meeting the climate and energy targets for 2020. However, given the long-term prospects set by the EU, the Energy Roadmap for 2050 and the White Paper, the substantial long-term target is higher and involves the reduction of the greenhouse gas emissions by 80-95% below 1990 levels by 2050, [33].

In parallel, the EU has set as one of its main objectives to halt the loss of biodiversity and to ensure that it is maintained in good condition. Following the 1992 Convention on Biological Diversity, in 2001, the EU Heads of Countries and Governments set out as a goal to "halt the loss of biodiversity in the EU by 2010", while in 2002 the leaders of 130 countries pledged to drastically reduce the rate of global biodiversity loss by 2010, [33].

In 1992, the Rio Summit meeting, in which the Convention on Biological Diversity was signed, was the first international recognition of this need at international level and was where the term "Biodiversity" was actually introduced.

Source: CRES

In this context, in 2010, the 10th Conference of the Parties (CoP10) of the United Nations Convention held in Nagoya, Japan, concluded, among others, in the adoption of an international Strategic Plan for Biodiversity for the period 2011-2020. The EU, from its side, has developed its own strategic plan to halt the loss of biodiversity and the degradation of ecosystem services within the EU by 2020, and to restore them, as far as possible, while in the same time enhancing the EU's contribution to halt loss of biodiversity worldwide.

The first objective of this strategy is to fully implement the Birds and Habitats Directives, in order to address the deterioration in the status of all species and habitats covered by EU nature legislation and achieve a significant and measurable improvement of their status so that, by 2020, compared to current assessments:

(i) 100% more habitat assessments and 50% more species assessments under the Habitats Directive show an improved conservation status, and

(ii) 50% more species assessments under the Birds Directive show a secure or improved status.

The vision is, by 2050, the biodiversity of the European Union and the ecosystem services it offers, to be properly protected, valued and restored. The EU seeks also to play an active role at international level as well, in respecting the international commitments on biodiversity undertaken at the Nagoya Conference, [34].

In December 2015, on the way of reaching a global agreement on the continuation of the Kyoto Protocol, the EU ought to set the climate targets for 2030 in order to actively participate in international negotiations towards a new global climate agreement, which should come into force in 2020 and cover at least the decade until 2030. Therefore, it was necessary to establish a strategic framework for the EU's objectives and policies on climate change and energy with a horizon to 2030. This framework had to be defined as soon as possible in order to ensure the appropriate investments that will deliver sustainable growth, affordable competitive energy prices and greater security of energy supply.

The new framework should also take into account the consequences of the economic crisis, but at the same time be ambitious enough to meet the long-term goal of reducing emissions by 80-95% until 2050.

The EU has started the configuration processes for the necessary climate and energy policies towards 2030 with the Green Paper, issued at the end of March 2013, launching a series of processes that resulted in the agreement of the European Council, in October 2014. This agreement, and especially the goal of reducing greenhouse gas emissions within the EU by at least 40%, is the basis of the EU's contribution to the new Global Climate Change Agreement.

This contribution, known as Intended Nationally Determined Contributions (INDC), was formally adopted at the Environment Council Meeting on 6 March 2015. It should be noted that the EU and its Member States were the first major economy to announce INDC for the negotiations held at the COP21 conference, (also known as 2015 Paris Climate Conference).

The **Paris Climate Change Agreement**, reached in 2015, (UNFCCC - COP21) is the culmination of a series of efforts by the global community to tackle climate change effectively.

The Agreement reached in Paris in 2015 (UNFCCC - COP21) is the culmination of a series of efforts by the global community to effectively address climate change.

The Agreement aims to limit the rise in global warming and to decouple national economies from fossil fuels. The measures adopted are aimed at the deceleration of the impacts of climate change over the coming decades. This agreement will replace the Kyoto Protocol, which was signed in 1992.

STRATEGIES AND TARGETS FOR CLIMATE CHANGE

A rapid growth in RES is required for the achievement of the above mentioned goals and for tackling climate change. Wind energy is one of the main sources of clean energy, contributing significantly to the Europe's electricity requirements.

According to the available data from a series of scientific studies and technical reports from around the world, it has been recognized that with the proper siting and proper design of wind projects and the development of wind energy in general, is not a significant threat to biodiversity, [2]. However, there is a wide range of possible interactions between the biodiversity and wind farms, including their associated infrastructures, which can potentially lead to significant impacts on wildlife.

It is apparent that the contribution and cooperation of all relevant actors is crucial to avoid causing negative impacts on biodiversity and to further develop wind energy in the Member States and therefore also in Greece.

Wind Energy

The contribution of RES to the total energy production in EU countries, with a significant contribution of the wind energy, is rapidly increasing (see Figure 1). Since 2000, Europe has installed 495 GW of new power capacity; with 33% related to wind power and 60% related to other renewable energy sources. In 2017 a total of 336 TWh of electric energy was produced from wind farms in the EU-28, which covered an average of 11.6% of EU total electricity consumption, [31].

Wind energy now accounts for 18% of EU's total installed power generation capacity in the EU-28. With a total net installed capacity of 169 GW (153 GW onshore and 15.8 GW offshore wind farms), wind energy remains the second largest form of power generation capacity in Europe, closely approaching gas installations. In addition, in 2017, the EU countries recorded a significant wind power penetration rate of over 20%, such as Denmark with 44%, and Portugal and Ireland with 24% each. In addition, Germany remains the EU country with the largest installed wind power, followed by Spain, the United Kingdom and France (Table 1).

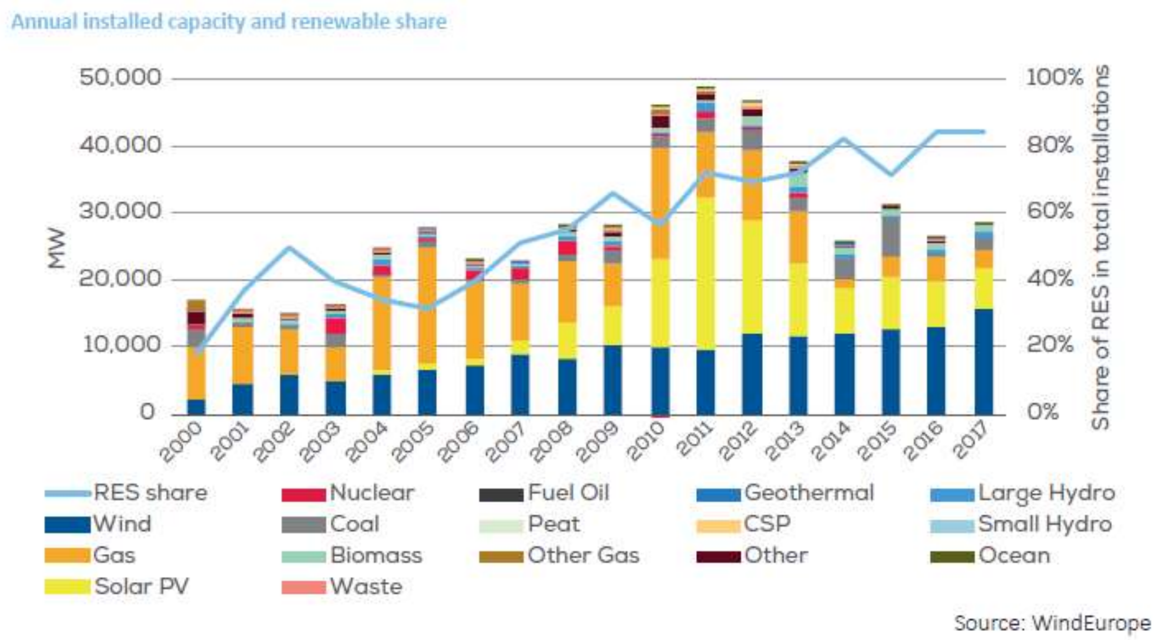


Figure 1. Annual installed capacity and RES share in EU countries.

WIND ENERGY IN EUROPE

Table 1. Installed Wind Power capacity in EU-28, [31].

Total EU Electricity Consumption (TWh)	Onshore Wind Energy Production (TWh)	Offshore Wind Energy Production (TWh)	Total Wind Energy Production (TWh)	Share of EU Consumption met by Wind Energy
2,906	292	43	336	11.6%

EU-28 (MW)	INSTALLED 2016	END 2016	INSTALLED 2017		END 2017
			ON-SHORE	OFF-SHORE	
Austria	228	2,632	196	-	2,828
Belgium	168	2,378	302	165	2,843
Bulgaria	-	691	-	-	691
Croatia	79	466	147	-	613
Cyprus	-	158	-	-	158
Czech Republic	-	281	26	-	308
Denmark	223	5,230	342	-	5,476
Estonia	7	310	-	-	310
Finland	570	1,539	475[1]	60	2,071
France	1,561	12,065	1,692	2	13,759
Germany	5,443	50,019	5,334	1,247	56,132
Greece	234	2,369	282	-	2,651
Hungary	-	329	-	-	329
Ireland	255	2,701	426	-	3,127
Italy	283	9,227	252	-	9,479
Latvia	7	70	-	-	66
Lithuania	178	493	-	-	493
Luxembourg	56	120	-	-	120
Malta	-	-	-	-	-
Netherlands	887	4,328	81	-	4,341
Poland	682[2]	5,807	41	-	5,848
Portugal	268	5,316	-	-	5,316
Romania	48	3,024	5	-	3,029
Slovakia	-	3	-	-	3
Slovenia	-	3	-	-	3
Spain	49	23,075	96	-	23,170
Sweden	468	6,494	197	-	6,691
UK	796	14,602	2,590	1,680	18,872
Total EU-28	12,489	153,731	12,484	3,154	168,729

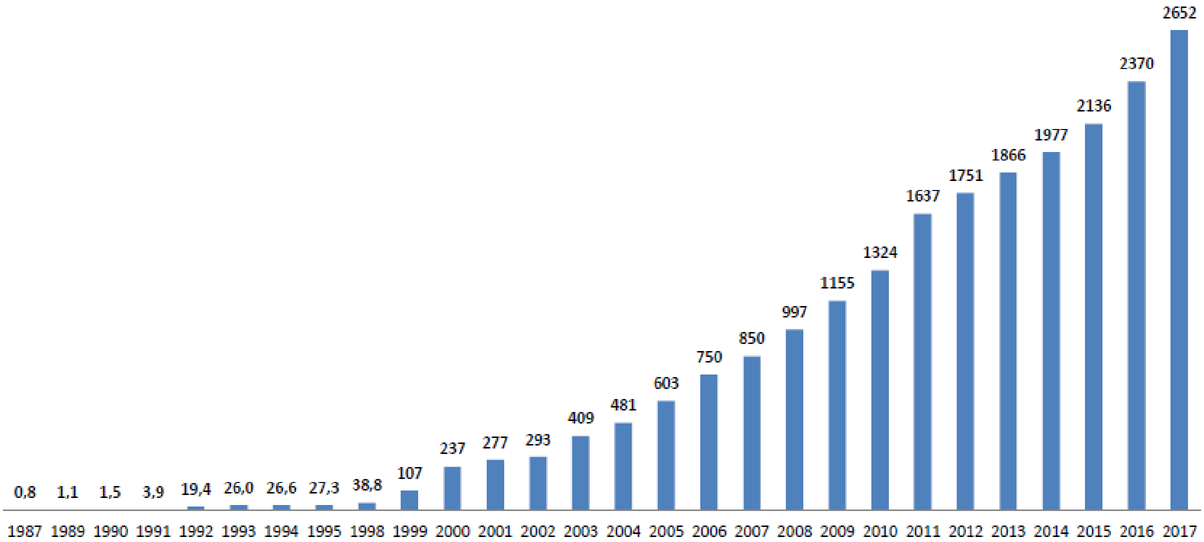

Source: CRES


Source: CRES

There has been a significant progress of wind turbine technology over the past 20 years, which is also the main reason for the rapid development of wind power. Additionally, the nominal capacity of onshore wind turbines has increased from less than 50 KW in the 1980s, to more than 3 MW today. In general, in new wind farms the rated power of wind turbines ranges from 1.5 MW to 3 MW with a tower height of 80-100 m leading to the requirement of fewer wind turbines for a specific wind farm power capacity.

WIND ENERGY IN GREECE

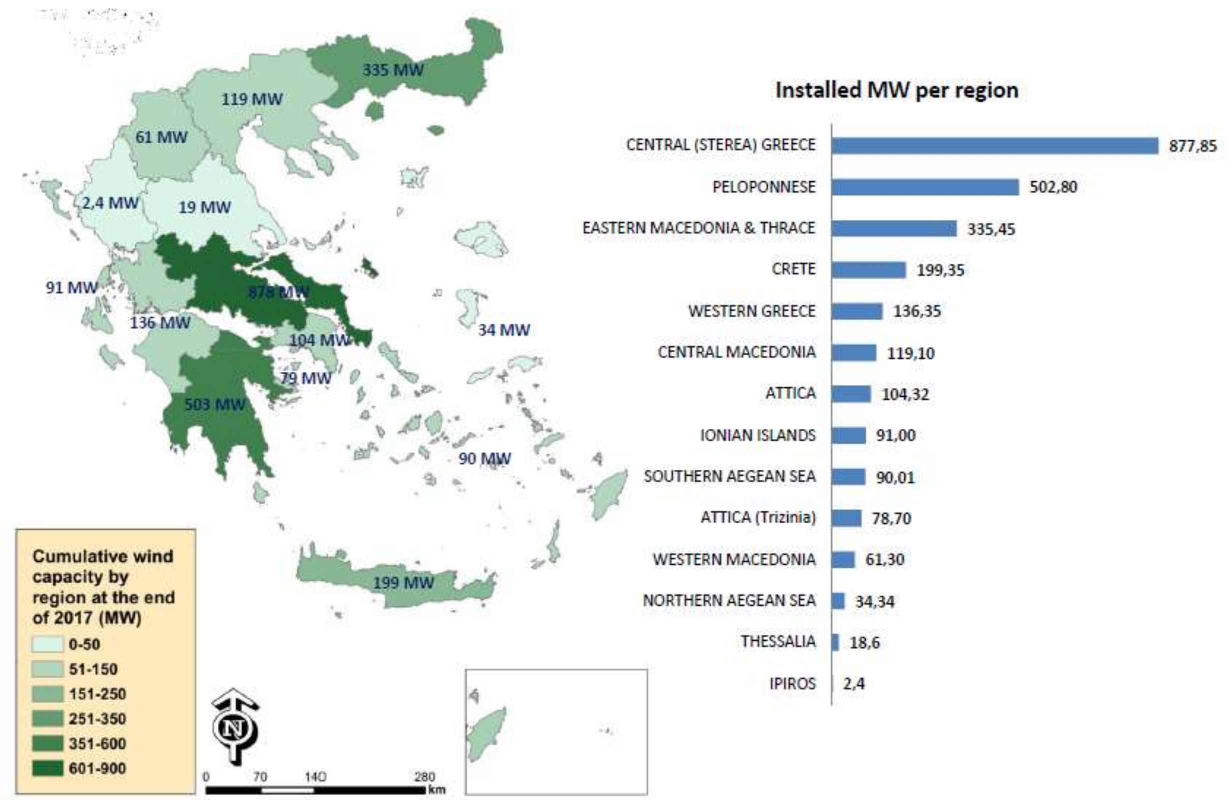
In Greece, during the last decade, there has been a significant increase in wind energy, with the average annual electricity demand covered by wind being of the order of 8.3%, (Figure 2).



Source: HWEA

Figure 2. Wind energy development progress in Greece (installed power in MW), [32].

In 2017 the total installed capacity of wind farms in Greece amounted to **2,652 MW**, with most of the facilities being located in the Central Greece (33%) and in the Peloponnese regions (19%,) (see Figure 3).



Source: HWEA

Figure 3. Cumulative wind capacity by region in Greece at the end of 2017, [32].

EU Policy Framework and Legislation in Greece

The Natura 2000 Network

In 1979, the European Community adopted the **Directive 79/409/EEC** on the Conservation of wild birds (the Birds Directive) for the protection, management and conservation of avifauna species, occurring within the European Union, in various ways. The Directive 79/409/EEC was updated by **Directive 2009/147/EC**. One of the main measures of the Directive foresees the creation of an internationally coordinated network of protected areas. In particular, Article 4 of the Directive deals with the conservation of wild birds through the implementation of specific conservation measures for the species listed in Annex I of the Directive, as well as of migratory species with regular presence in their area of distribution. The most suitable sites for the conservation of these species are designated as Special Protection Areas, but also the priority species are protected throughout their distribution range.


Source: TTstudio (Tomas Sereda), www.depositphotos.com

In 1992, the **Directive 92/43/EEC** on the conservation of natural habitats and of wild fauna and flora, (the Habitats Directive) was adopted by the Council of the European Communities in order to contribute to the protection of biodiversity through conservation of natural habitats and wild fauna and flora in the territory of the European Member States covered by the Directive. The Habitats Directive includes more than 200 types of habitats and 1,000 species of organisms in need of protection. Among these, 13 species of chiroptera (bats) are included in the Annex II of the Directive, i.e. “Animal and Plant Species of Community Interest whose conservation requires the designation of Special Areas of Conservation", while all species of micro-chiroptera are included among species requiring strict protection in their natural distribution range, (Annex IV “Animal and Plant Species of Community Interest in need of strict protection”). Furthermore, all species of micro-chiroptera, the mega-chiroptera (*Pteropodidae-Rousettus aegyptiacus*) have been included in the Annex IV "Animal and Plant Species of Community Interest in need of strict protection" of the **Directive 2006/105**.

NATURA 2000 NETWORK

The Habitats Directive and its Annexes have been incorporated into Greek legislation with the Joint Ministerial Decisions (JMDs) 33318/3028/1998 and 14849/853/E.103/2008. In line with the Birds Directive, one of the main measures of the Habitats Directive is to designate the most appropriate areas as Special Areas of Conservation (SACs). The **Natura 2000 network**, the world's largest ecological network, which includes both Special Areas of Conservation (SAC) and Special Protection Areas (SPAs), was set up under this Directive.

EUROPEAN DIRECTIVES for the biodiversity and RES	
DIRECTIVE 79/409/EEC COUNCIL DIRECTIVE of 2 April 1979 on the conservation of wild birds	**79/409/EEC**
DIRECTIVE 92/43/EEC COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora	**92/43/EEC**
DIRECTIVE 2001/77/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market	**2001/77/EC**
DIRECTIVE 2001/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment	**2001/42/EC**
DIRECTIVE 2006/105/EC of 20 November 2006 adapting Directives 73/239/EEC, 74/557/EEC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania	**2006/105/EC**
DIRECTIVE 2009/147/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 November 2009 on the conservation of wild birds	**2009/147/EC**
DIRECTIVE 2011/92/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment	**2011/92/EU**
DIRECTIVE 2014/52/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment	**2014/52/EU**

The Natura 2000 network, as defined, (see Figures 4 and 5) ensures the conservation and restoration of the favorable conservation status of the habitat types and species habitats in their natural ranges [28].

In this context, the Member States choose the Natura 2000 sites within their territory, which are established under the Habitats Directive in collaboration with the European Commission. Through this selection, the SPA sites (as defined in Birds Directive) are directly integrated into the Natura 2000 network, while the areas established under the Habitats Directive are initially recognized as Sites of Community Importance (SCIs), whereas for their selection a scientific evaluation and negotiation is carried out between the Member States and the EC, in accordance with the results of each ecological section of the Biogeographical Seminars, and after the provision of the necessary management measures for them within a six-year period.

The management of SPAs follows the provisions of Article 6, paragraphs 2, 3, 4 of the Directive 92/43/EC and the provisions of Article 4 of the Directive 2009/147/EC, while of SCI/SACs follow the provisions of Article 6, paragraphs 2, 3, 4 of Directive 92/43/EEC.

The Natura 2000 online viewer

The application was developed by the European Commission with the assistance of the European Environment Agency. The application entitled "Natura 2000 online viewer" allows the search for Natura 2000 sites in every part of the EU with the press of a button. It has been developed in a GIS environment and is an interactive and user-friendly tool that allows quick access to information on Natura 2000 sites and on species and habitats of interest. (http://natura2000.eea.europa.eu/).

The Natura 2000 network consists of two categories of areas:

- the **"Special Protection Areas (SPAs)**" for avifauna, as defined in the Birds Directive 2009/147/EC
- the **"Special Areas of Conservation (SAC)"** as defined in the Habitats Directive 92/43/EEC.

Source: CRES

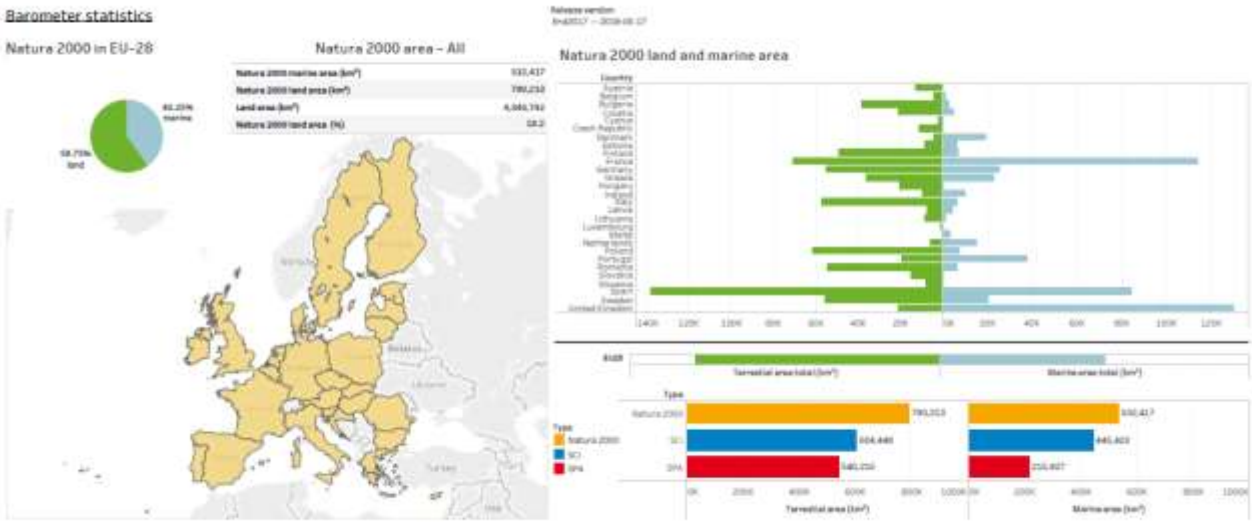


Figure 4. The Natura 2000 network in EU-28 involves sites of 790,213 km^2 total land area, covering the 18.2% of the total land area of EU-28, [9, 10].

Source: Natura 2000 barometer statistics, 2017

Furthermore, regarding the protection of species outside the Natura 2000 network, the Birds Directive (Article 5 of the Directive) and the Habitats Directive (Article 12 of the Directive) require from the Member States to establish a general scheme for the protection of all species of birds in the EU and of the species listed in the Annex IV of the Habitats Directive across their natural range in the EU. This applies both within and outside the Natura 2000 sites and therefore any human intervention should take into account potential effects on species of Community Interest also outside Natura 2000 sites, [1].

In the context of the implementation of the Directives, Greece has identified 163 SPAs, which cover a total area of 1,370,323.40 hectares that is equivalent to 10.38% of the Greek territory. In 2010, through the JMD 37338/1807/E103 as an annex to the new integration of the Directive 79/409/EEC (which is codified with the Directive 2009/147/EC), Greece designated 202 Special Protection Areas (SPAs) and 193 "trigger species", i.e. wild bird species as listed in Annex I of Article 14, as well as the migratory species that are not included in this Annex and whose passage through our country is regular.

The list of the Greek Special Protection Areas was published in the Government Gazette 1495/B/ 06.09.2010 as Annex to the new incorporation of Directive 79/4009/EEC (codified by Directive 2009/147/EC).

Barometer statistics per country

Country	Release version
Greece	End2017 --- 2018-05-17

Land area in km² (European part): **131,940 km²**

Natura 2000 area data (km²)

	SPA	SCI	Natura 2000
Number of Natura 2000 sites	207	265	446
Natura 2000 land area (km²)	27,646	21,912	35,982
Natura 2000 marine area (km²)	8,516	17,528	22,796
Natura 2000 total area (km²)	36,161	39,440	58,778
Proportion European land area covered by	21.0%	16.6%	27.3%

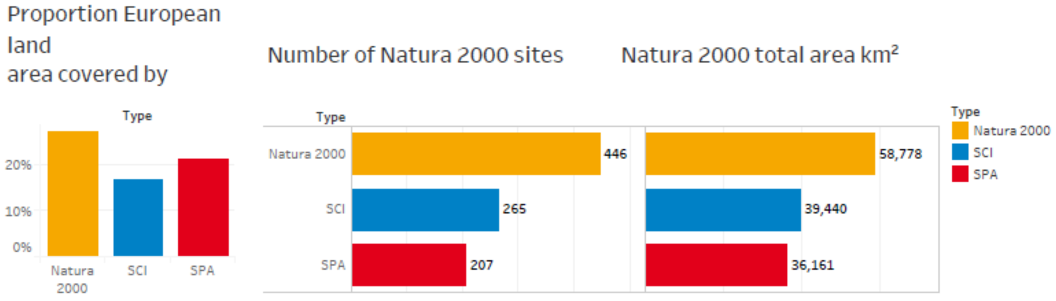


Figure 5. Greece has 446 Natura 2000 sites, covering 35,982 km² of land area and 22,796 km² of sea area, [9, 10].

Source: Natura 2000 barometer statistics, 2017

In 2011, according to L.3937/2011, two hundred and thirty-nine (239) Greek Sites of Community Importance (SCI) included in Decision 2006/613/EC, were designated as Special Areas of Conservation (SAC). Furthermore, the Article 17, paragraph 3 of the same law defines as basic tools for managing biodiversity the following:

(a) the National Biodiversity Strategy (updated every five years). The National Biodiversity Strategy was established by the JMD 40332/2014 "Approval of the National Biodiversity Strategy for the years 2014-2029 and Action Plan with five years duration", and

(b) the National biodiversity census (updated every decade).

Source: wrangle (Vladimir Wangel), www.depositphotos.com

THE NATURA 2000 NETWORK IN GREECE

In Greece, the Directives 79/409/EEC, 92/43/EEC, 2009/147/EC have been incorporated into the national legislation as outlined below [11].

The Directive 92/43/EEC, has been integrated into the national legislation with the following JMDs (in free translation):

- **JMD 33318/3028/11-12-1998 (G.G1289/B/28-12-98)** "Determination of measures and procedures for the conservation of natural habitats and of wild fauna and flora".

- **JMD 14849/853/E103/4-4-2008 (G.G.645/B/11-4-08)** "Amendment of Joint Ministerial Decisions

JMD 33318/3028/1998 (B'1289) and JMD 29459/1510/2005 (B'992), in compliance with the provisions of Council Directive 2006/105 of 20 November 2006 of the European Union".

The Directive 79/409/EEC (as codified with the Directive 2009/147/EC) has been integrated into the Greek legislation by the following JMD (in free translation):

- **JMD 414985/29-11-85 (G B΄757)** "Measures for the management of wild birds".

- **JMD 37338/1807/E.103/1-9-10 (G 1495/B/6-9-10)** "Establishment of measures and procedures for the conservation of wild birds and their habitats, in compliance with the provisions of Directive 79/409/EEC, "on the conservation of wild birds", of the European Council of 2 April 1979, as codified by the Directive 2009/147/EC.

- **JMD 8353/276/E103/17-2-2012 (G 415/B/23-2-2012)** "Amending and supplementing of the JMD 37338/1807/2010 "Determination of measures and procedures for the conservation of wild birds and their habitats/nests, in compliance with Directive 79/409/EEC ..." (B' 1495), in compliance with the provisions of the first paragraph of Article 4 of Directive 79/409/EEC "on the conservation of wild birds" of the European Council of 2 April 1979 as codified in Directive 2009/147/EC".

In December 2017, through the JMD 50743/2017, a revision of the national list of Natura 2000 sites was carried out and Greece currently hosts 446 Natura 2000 sites.

According to the above and based on Article 6 of the Habitats Directive, any plan or project that may affect a Natura 2000 site should be evaluated for its potential impacts. EU countries must agree on a plan or a project only after they are satisfied that this plan or project does not significantly affect the integrity of the protected areas.

In cases of lack of alternative solutions, some projects with significant negative impacts may be authorized due to imperative reasons of overriding public interest. In such cases the Member State has to define, in agreement with the EC, compensatory measures in order to ensure that the overall coherence of Natura 2000 is maintained.

RES STRATEGIC PLANNING & BIODIVERSITY

RES Strategic Planning and Biodiversity

The strategic planning is achieved by the development of wind energy in accordance with spatial planning at a national or regional level, supported by the Strategic Environmental Assessment (SEA). Thus the special framework for "Spatial Planning and Sustainable Development for Renewable Sources of Energy (RES) and its strategic environmental impact assessment" was approved at the national level in Greece in 2008, in the Official Gazette 2464 B/03.12.2008.

The special frameworks for Spatial Planning and Sustainable Development are a set of documents and/or diagrams that specify or complement the guidelines of the General Framework of Spatial Planning and Sustainable Development concerning the development and organization of the national area and in particular concerning:

- the spatial structure of certain divisions or sectors of productive activities of national importance,
- the spatial structure of networks and services of technical, social and administrative infrastructure of national interest, with the exception of the telecommunication networks and services, as well as spatial distribution of knowledge and innovation infrastructures,
- special areas of the countryside, in particular coastal and insular regions, mountainous and lagging zones, the areas covered by international or European environmental conventions, as well as other zones of the national territory that present critical environmental, developmental and social problems, [11].

The special spatial planning framework (JMD 49828/2008) aims to define the basic guidelines and general rules for the spatial planning of RES projects in the whole of the national territory, so as to determine in advance on the one hand the categories of areas in which the placement of RES projects is entirely or partly excluded, and respectively the potentially suitable areas, and on the other hand, more specific spatial planning conditions per category of RES, particularly in relation to the physical characteristics, the carrying capacity and in general the environment of the installation sites.

Furthermore, in accordance with the JMD 49828/2008, Article 6 “Exclusion areas and incompatibility zones”, paragraph 3, the siting of wind farms within SPA sites designated for the avifauna of Directive 79/409/EEC, may be allowed after the implementation of a special ornithological study and in accordance with the specific conditions and constraints that will be laid down in the relevant act of Environmental Terms Approval Decision.

The mapping of sensitivity zones within SPAs (see Box 1), which identifies the presence and movements of species and habitats, with particular sensitivity to the wind energy development, plays a key role in distinguishing between the potentially low risk areas, i.e. areas with a high potential for the wind farm development, but also with minimal or no risk to the species of interest, and the potentially high risk areas, which should be avoided or where mitigation measures or a more in-depth impact assessment are expected to be required.

As described above, the impacts of wind energy development vary considerably between different projects. For this reason, the impacts of each project are assessed both, individually and in combination with other projects and activities in the region, in order to modify accordingly the design of the project.

Supplementary and supportive to this institutional framework, a variety of guidelines and guides of good practice have been developed to provide additional information on the development of wind energy and biodiversity conservation [4, 5, 12, 13, 29].

Box 1 | Sensitivity mapping within SPAs

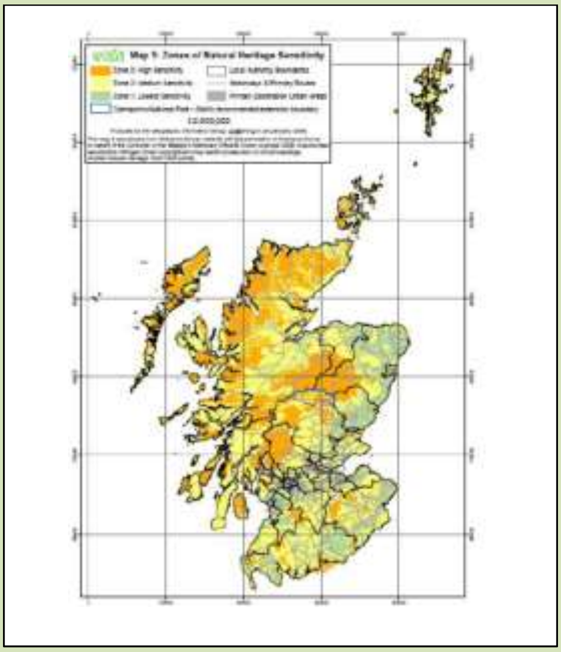
The process of sensitivity mapping in order to achieve the objective of favourable protection and conservation status of the wild avifauna within the SPAs in Greece, as referred in Article 3 of the JMD 8353/276/E103/2012, should be included as a separate chapter or attached inseparable Annex, to the "National Biodiversity Census", referred to as "National Mapping Program of critical habitats and distribution cores of trigger species, as well as of sensitivity zones".

In the JMD 40332/2012 "Adoption of the National Biodiversity Strategy for the years 2014-2029 and a Five-Year Action Plan", Part B Action Plan for the Implementation of the National Biodiversity Strategy, in Actions for the Implementation of Specific Objectives (2014- 2018), the Objective 5.6.6 concerns the Mapping of Sensitive Zones within the SPAs for the installation of RES.

The sensitivity mapping within SPAs, involves projects and activities that can cause significant impacts on trigger species. The Sensitivity Mapping will create three categories of sensitivity zones (high, medium and low), which then will be used by the competent central and regional authorities in the environmental licensing of projects and activities. Such sensitivity maps will also help to avoid possible conflicts with the provisions of Article 5 of the Birds Directive and Articles 12 and 13 of the Habitats Directive.

The wildlife sensitivity maps are useful tools for the development of wind energy projects in areas that are compatible with nature conservation requirements in the context of spatial planning and decision-making. They aim at determining the sensitivity of a specific area in relation to particular species and projects.

Many EU member countries have demonstrated how this can be achieved successfully. The sensitivity mapping for selected categories of species or groups of species has been applied in several countries or regions in Europe, such as Scotland, Germany, France, the Netherlands, Ireland, [7]. In Greece, relevant studies have been carried out by environmental organizations, such as the Hellenic Ornithological Society and WWF Hellas.



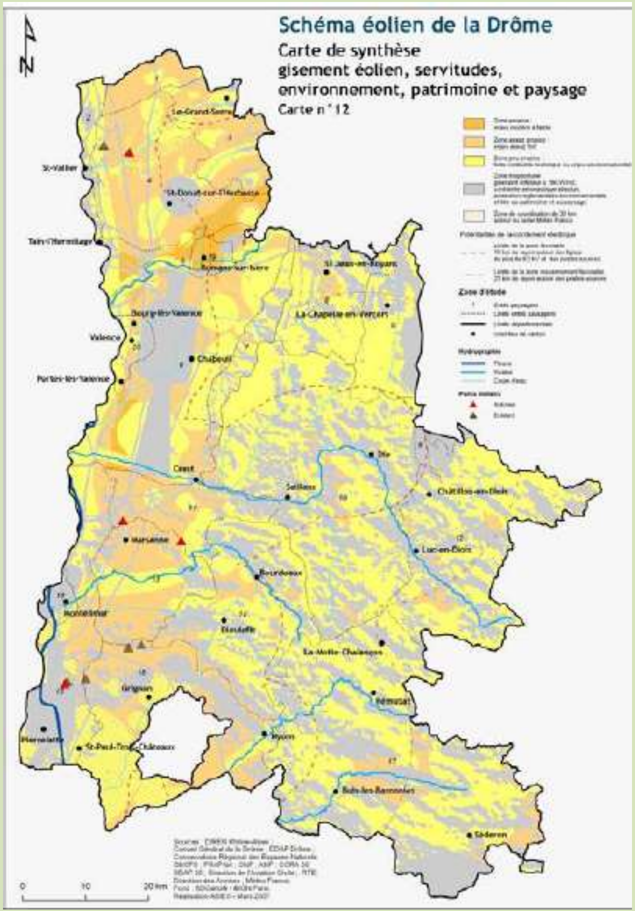
Map of sensitivity zones by the Scottish Natural Heritage, [1]

Box 1 (continue) | Example of advanced strategic planning – Drôme Region, France, [1]

The development of Sensitivity Maps for wildlife at the stage of strategic planning allows the identification of areas where the development of wind farms can be considered of low, medium or high risk to nature and wildlife. One such example is the Drôme Region in France, where a strategic plan for the development of wind energy in the region has been prepared with the aim of timely guidance of the stakeholders (competent authorities, investors, etc.) concerning the benefits, constraints and collection of the necessary information for the preparation of studies [1, 3, 4]. Thus, the zones were set based on:

• Areas of high, medium and low potential for the development of wind farms (e.g. wind potential), and

• Areas of high ecological sensitivity (sensitivity maps)



The multilayer map combines wind potential, public infrastructure, environmental parameters, cultural heritage and landscapes [8].

The zones are classified into:

- Areas favorable to wind farms (dark orange),

- Areas moderately favorable, but with restrictions (light orange),

- Areas of low potential for technical and environmental reasons (yellow), and

- Unsuitable areas e.g. low wind potential and significant environmental constraints (grey).

Project Licensing and Environmental Impact Assessment

The Directive 2011/92/EU and its amendment, the Directive 2014/52/EU, refer to the impact assessment of certain public and private projects that may have a significant impact on the environment. Annex II includes projects for which Member State authorities will have to assess whether an Environmental Impact Assessment (EIA) is necessary. This Annex also includes wind energy projects ("3(i) Installations for the harnessing of wind power for energy production (wind farms)). According to the latest amendment (2014), the direct and indirect impacts of a project on biodiversity should be assessed, with emphasis on protected species and habitats under Directive 92/43/EEC and Directive 2009/147/EC, as well as the cumulative impacts on the under investigation Natura 2000 site. If the projects have significant impacts, the investors are required to take the necessary measures to avoid, prevent or minimize them. These projects must be monitored on the basis of procedures laid down by the Member States.

According to Greek legislation for the environmental licensing of projects and activities, the projects are classified into categories and subcategories according to their expected impact on the environment. Thus, projects and activities that are likely to cause very significant/significant environmental impacts are classified into category A (with two (2) subcategories A1 and A2), while the projects and activities that may cause local and non-significant environmental impacts belong to category B projects[1].

ENVIRONMENTAL LICENSING OF WIND PROJECTS

Table 2 presents the classification of renewable energy projects related to wind energy (Group 10) in accordance with the MD 2307/2018 of the Greek legislation, which is the most recent amendment to a series of Ministerial Decisions.

According to the Law 4014/2011, an **Environmental Impact Assessment (EIA)** is required for Category A (A1, A2) projects, i.e. those whose construction is likely to have significant effects on the environment, to impose specific conditions and restrictions for the protection of the environment. According to the same law, in the case of projects and activities taking place within protected areas of the Natura 2000 network, environmental licensing is carried out on the basis of the relevant provisions of the specific presidential decrees and ministerial decision for their protection.

[1] Projects and activities are classified in the first (A) category, subdivided into subcategories (A1) and (A2), and in the second (B) category according to the criteria of Article 1 paragraph 1 of L.4014/2011.

Table 2. Classification of public and private projects and activities in categories and subcategories according to the JMD 2307/14.02.2018 according to the Greek legislation.

10th GROUP Renewable Energy Sources				
Type of project or activity	Subcategory **A1**	Subcategory **A2**	Category **B**	Notes
Electricity production from wind energy	P ≥ 60 MW or P > 30 MW and within Natura 2000 sites or L ≥ 20 Km	5 ≤ P < 60 MW and L < 20 km	0,02 < P < 5 MW or P< 0,02 and observation Ξ applies	The classification excludes RES projects that do not require the adoption of environmental conditions (e.g. photovoltaic and wind generators installed on buildings or within other building structures or within organized industrial receptacles). P: installed power. L: length of the high voltage interconnection line (150 kV). Ξ: Exemption pursuant to paragraph 13 of article 8 of L.3468/2006 as amended by article 3 of L.3851/2010, that is: a) the project is installed within an area located within Natura 2000 or a coastal position at a distance less than 100 m from the coastline, with the exception of islets, or b) the project is adjacent, at a distance less than 150 m, to a RES station of the same technology, established at another site, for which a production license has been issued or an Environmental Term Approval Decision or connection offer, and the total capacity of the plants exceeds 0.5 MW for photovoltaic, solar and geothermal plants as well as for biofuels, bioliquids and biogas plants or 20 kW for wind farms. The associated projects (e.g. road, interconnection) follow the projects' category.

In the absence of relevant provisions for:

(a) Category A projects, an Appropriate Assessment is submitted to the appropriate competent authority as an integral part of the Environmental Impact Assessment (EIA).

(b) Category B projects, an Appropriate Assessment (AA) shall be submitted to the competent Environmental Services Department of the Region, in accordance with paragraph 8 of Article 11.

The contents of the EIA and AA are described in detail in Greek legislation (MD 170225/2014). The MD 170225/2014, concerning the specialization of the contents of the environmental permitting application folders for the Category A projects and activities, defines the contents of the studies (Preliminary Determination of Environmental Requirements, Environmental Impact Assessment, Appropriate Assessment and their modifications, as well the renewal study of the Environmental Terms Approval Decision (ETAD) for a project or activity).

The Appropriate Assessment includes the following:

(a) a detailed recording of natural environment elements , with emphasis on the protected objects of the Natura 2000 sites that may be affected by the project or activity;

(b) an appropriate assessment and impact assessment,

(c) mitigation measures to address the potential impacts,

(d) compensatory measures, if required, and

(e) a monitoring program. The impact assessment should take into account all the associated projects, as well as, the cumulative impacts of licensed or installed projects in the wider project area (Annex 3.2 of MD 170225/2014).

The siting of wind energy projects, in particular, within the Special Protection Areas (SPAs) and Important Bird Areas (IBAs) is allowed after carrying out of a Special Ornithological Assessment (L.4014/2011, Article 10) and under the relevant provisions of MD 170225/2014 and MD 53983/1952/2013 for the projects of Category A and B (L.4296/2014, Article 13).

The Environmental Impact Assessments Category A1 and A2 projects are evaluated by the Ministry of Environment and Energy and the Decentralized Administrations. The decisions for the approval of environmental terms are taken by the Minister or the General Secretaries, respectively. The bodies giving opinion on projects and activities of the subcategories A1 και A2 of Group 10 RES are listed in Tables 10.1, 10.2 of the MD 1649/45/15.01.2014.

According to the MD 3791/2013, the Category B projects are a subject to **Standard Environmental Commitments (SECs)**. For RES Category B projects, which do not require installation permit, their assignment to SEC is carried out by the Directorate of Environment and Spatial Planning of the Region in concern. In case an installation permit is required, the reference of the project to SEC is made by the authority issued the installation licensing. According to the Ministerial Decision, the inclusion of RES projects in SEC remains in effect as long as there is no change in the technical characteristics of the project.

It should be noted that every project or activity of Category A or B is subject of preventive and regular or non-routine inspections to verify the compliance with the Environmental Terms Approval Decision or the SEC and the environmental legislation in general.

The competent authorities responsible for verifying the compliance with environmental conditions and conducting environmental inspections are described in L.4014/2011, Article 20.

Implementation of the Institutional Framework

A brief review of the implementation of the institutional framework of RES and Biodiversity in Greece is presented below.

Competent authorities

The competent authorities play a key role in the reduction of the impacts of wind farms on wild avifauna during their construction and operation. The process and the competent authorities responsible for the development of a wind farm are briefly outlined in Figure 6.

Licensing of wind farms - approval of environmental terms

The following are required during the evaluation procedure of a project for its approval and setting of the necessary environmental terms for the protection of wild avifauna that may be affected by the project:

- Assessment of the adequacy of the studies that have been carried out to assess the impacts on flying fauna during construction and operation of wind farms and their associated projects.
- Assessment of the cumulative impacts in combination with other existing or licensed projects in the wider project area.
- Provision of measures in the environmental terms with priority on (a) compensation of impacts, where appropriate, (b) avoidance of impacts and (c) mitigation of impacts.
- Provision of monitoring of the selected measures' effectiveness, such as regular carcass searches.
- Provision of monitoring of flying fauna in the area by data recording, to assess whether the impacts expected by the Appropriate Assessment are equally, more or less significant.

Control of environmental terms application during construction and operation

Regular inspection by the competent authorities, regarding the implementation of the environmental terms set out in the ETAD or SEC, as referred in Article 10 of L.4014/2011 is required during the construction and operation phase of wind farms. This inspection may include annual reporting on the monitoring of the effectiveness of the measures taken to prevent collisions, the implementation of on-site visits, as well as remote inspection (if feasible) of the applied prevention systems, in cases where it was assessed that they need to be installed.

Evaluation of the monitoring results and updating of environmental terms

The evaluation of the effectiveness of the measures implemented to avoid collisions, as well as of the condition of wildlife in the area, has to be applied by the competent authorities, in order to adjust planning and environmental terms, wherever necessary.

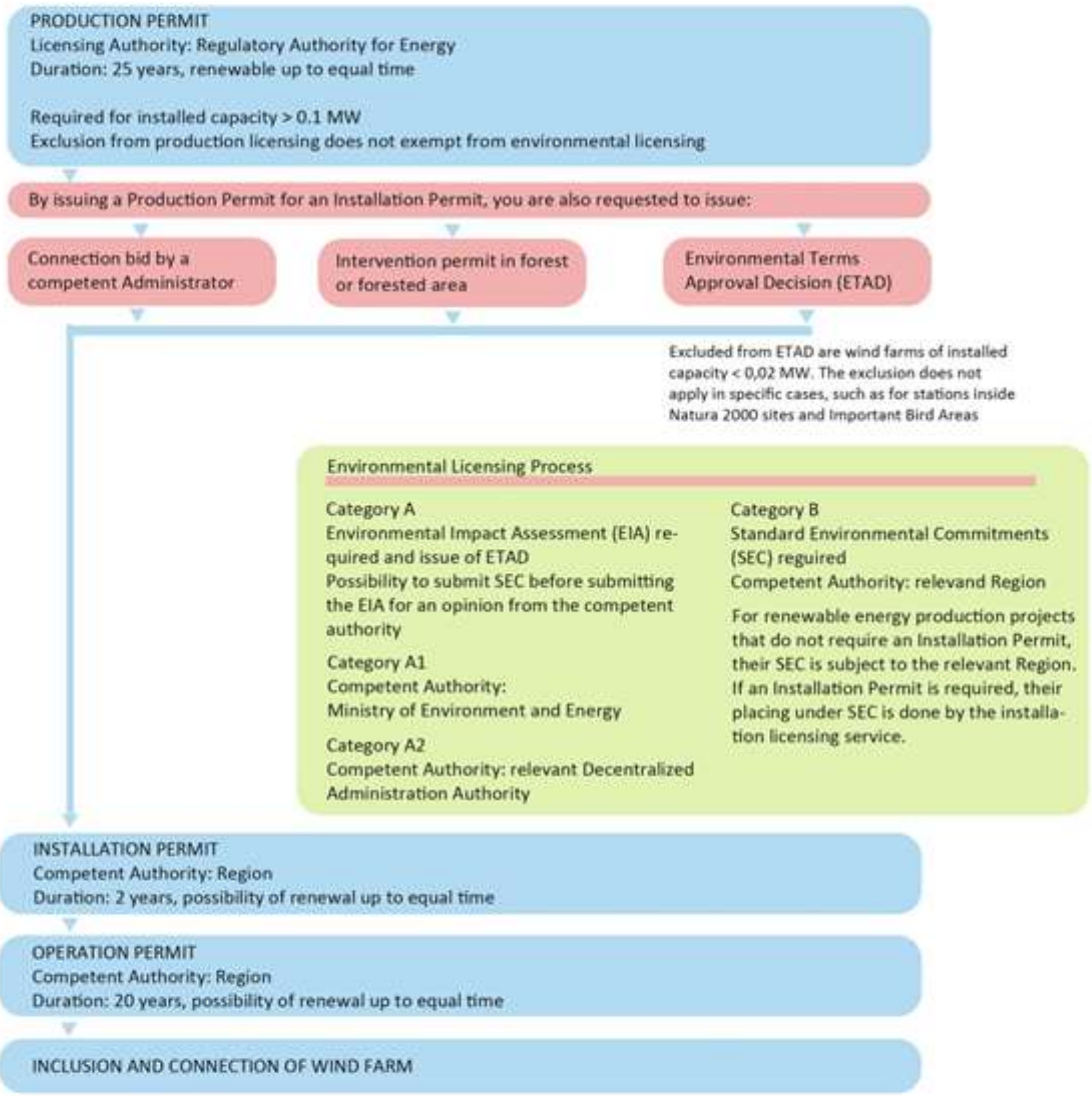


Figure 6. Brief description of wind farm licensing process in Greece.

Consultants

Consultants play an essential role in the protection of biodiversity, because through their contribution the competent authorities need to evaluate the status of an area and to a large degree rely on the impact mitigation measures and monitoring proposed in the Appropriate Assessments to elaborate the environmental terms.

The information about the available technologies and methods to mitigate the impact of wind farms on flying fauna can provide the potential for planning of measures, when required, which are both efficient for the protection of the biodiversity and cost-effective.

In accordance with MD 170225/2014, Article 3 Appendices, a consultant or a team of consultants, appointed by the wind farm investor, is required to follow particular specifications for the implementation of the EIA and AA for Category A projects and activities. In general, the contents of the studies (Annex 2, “Basic Specifications for EIA of projects and activities of Category A”), once the framework of application and the survey area have been identified, refer to:

- description of the current state of the natural environment,
- assessment and evaluation of potential impacts,
- proposal on mitigation measures to address potential impacts: the proposed measures should aim to address the environmental impacts in the following order: a) prevention and avoidance, b) reduction of intensity and extent, and c) restoration. The proposed measures should, as much as possible, involve measures that are easy or feasible to incorporate into the design of the project. The proposed measures are distinguished according to the projects’ phase, such as the design phase, the construction phase, the operational phase, and the decommissioning and restoration phase,

Source: Andreas Trepte, www.photo-natur.de

- environmental management-monitoring, which includes the monitoring of all significant environmental parameters related to the impacts of the project, as these were assessed. This stage involves the recording and maintenance of data, which document the implementation of the environmental terms and allow for the evaluation of their efficiency.

Furthermore the Appendix 3.2 “Specifications of the EIA study” of the same Ministerial Decision refers to the obligation of a consultant to propose and document the compensatory measures which need to be applied according to the Article 10 (4) of Law 4014/2011 (implementation of a project for imperative reasons of overriding public interest) in cases where there are no alternative solutions and despite the consideration of the mitigation measures the integrity of the concerned Natura 2000 site and the conservation objectives are estimated to be adversely affected.

The same Annex also refers to the Monitoring Program of the impacts on the structure and functions of the Natura 2000 site during the construction phase and/or during the operational phase of the considered project, which may be proposed by the consultant aiming at an effective protection of the environment. The information on data recording which must be included in the Monitoring Program is also provided the same Annex.

Moreover, it should be noted that according to JMD 8353/276/2012, Article 5B, for projects within SPAs with specific territorial and/or colonial trigger species[2], listed therein, the AA must also elaborate a project exclusion buffer zone around their nests and colonies.

For projects and activities of Category B, where EIA is required, a consultant is obliged to follow the specifications set out in the MD 52983/1952/2013 (Government Gazette 2436 /B/27.09.2013), Article 4 “Compilation data and Specifications of Appropriate Assessment for projects and activities of Category B”, and Article 5 “Wind farms for electricity production-SPA”.

Source: CRES

[2] Colonial species: bird species nesting in large groups, where nests are very close to each other and in places with no or almost no other resource than the nesting site.
Territorial species: species of non-colonial avifauna.

Potential Impacts of Wind Energy projects on Biodiversity

This chapter presents the potential impacts of wind projects on the flying fauna. The information provided in the chapter originates from a wide range of published scientific studies and reviews with the main reference source the European Commission's Guidance Document "Wind Energy Developments and Natura 2000", and the literature cited therein, [1].

Source: CRES

It is a fact that wind energy, as a renewable energy source, is expected to have a long-term positive impact on biodiversity by reducing the threat and the impacts of the climate change. Despite the promising indications and efforts of countries, the global energy supply remains dominated by fossil fuels that contribute to climate change and air pollution.

In addition, as generally accepted, well-designed and sited wind farms do not pose a threat to the biodiversity and are characterized by a limited scale impacts.

There are also cases where wind farms have brought benefits to the biodiversity, particularly in areas where the natural environment was degraded.

An example is the case of Black Law, in Lanarkshire, Scotland, a mountainous area which, prior to the installation of the wind farm, was degraded by mining. The investor, Scottish Power, following the planning preconditions, designed and implemented a habitats management plan for the area in consultation with the Scottish Natural Heritage, RSPB Scotland, Lanarkshire Farmland, the Wildlife Advisory Group and the University of Stirling [1].

+ IMPACTS OF WIND PROJECTS ON BIODIVERSITY

The management plan and its implementation benefited a wide range of wildlife species such as breeding waders, farmland birds, etc. The management plan involved crops planting to provide winter food source, transformation of an old mine into a shallow wetland, clearance of conifers for regeneration of the region's blanket bog and others. However, even if the installation of a wind project can, in particular cases have positive effects on biodiversity, the obligation to implement EIAs and AAs (which is an integral part of the EIA) for Natura 2000 sites remains.

In ecologically sensitive areas, proper siting and designing of wind farms and their associated projects (e.g. access roads, electricity transmission power lines, meteorological masts) can primarily reduce the possibility of adverse effects on biodiversity. If potentially significant impacts are identified, these should be minimized or avoided completely, especially when affecting rare or threatened species and habitats of community interest. The use of modern methods and technologies for the recording and collisions avoidance of flying fauna at wind farms, wherever considered necessary, may play an important role in the conservation of the protected species.

- IMPACTS OF WIND PROJECTS ON BIODIVERSITY

Box 2 presents the types of potential impacts of wind farms on wildlife. It is important to note that, because of varying the actual impacts among different wind projects, the assessment of the impacts and their mitigation needs be carried out on a case-by-case basis. To a large extent the types and scale of impacts depend on the species involved, their ecology and conservation status, as well as on the location, the size and the design of the wind farm.

Box 2 | Types of potential impacts of wind farms on wildlife

There are five types of potential impacts of wind farms on wildlife and habitats:

- Collision risk, leading to direct mortality,
- Disturbance and/or displacement of sensitive species,
- Habitat loss or degradation,
- Barrier effects, causing changes in flight patterns,
- Indirect effects on species habitats and prey species.

The above impacts may be significantly enhanced by cumulative impacts of multiple wind farms or other developments or human activities within the same region.

Table 3 presents the potential impacts of wind farms and their importance on bats.

Table 3. Potential impacts of wind farms on bats (with the most significant effects marked with *), [table adaptation from 4, 5].

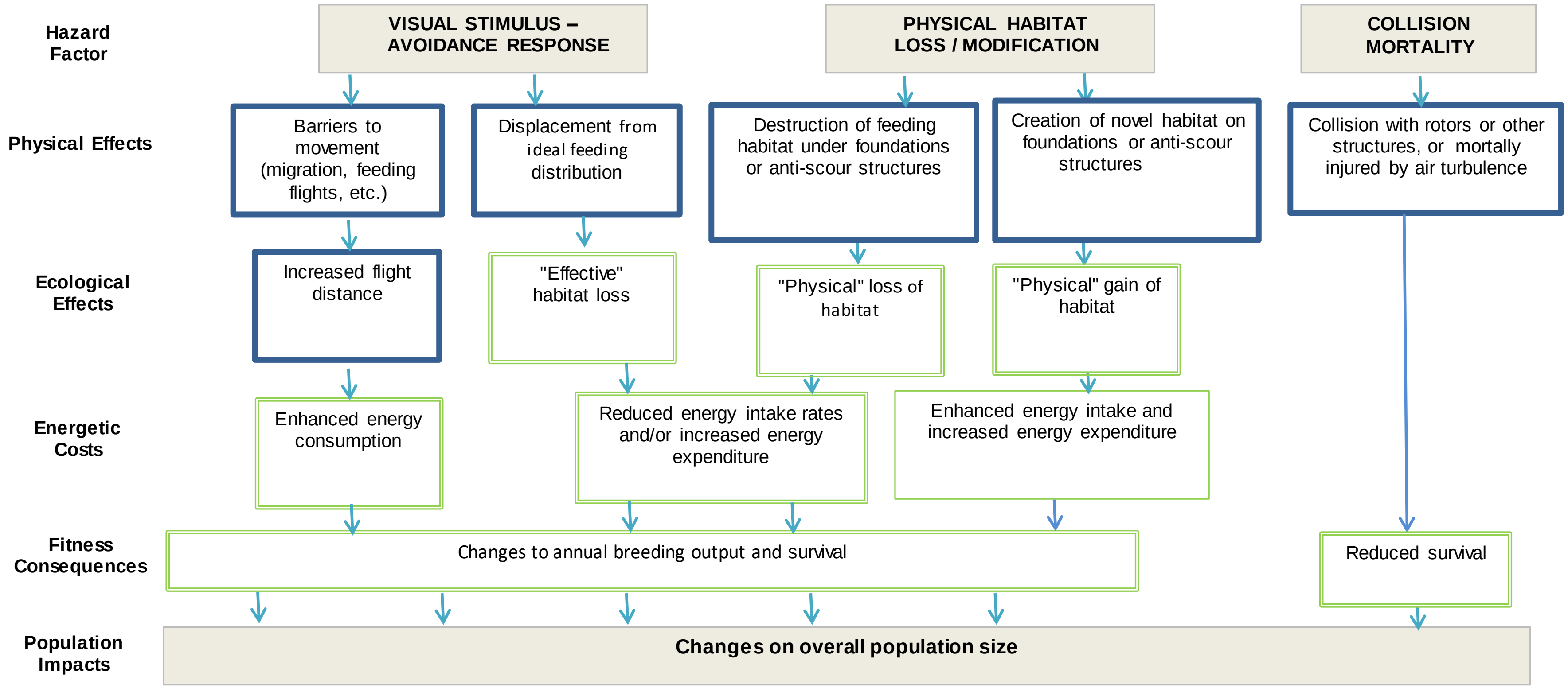
Impact	Summer time	During migration
Impacts related to siting		
*Loss of hunting habitats during construction of access roads, foundations, etc.	Small to medium impact, depending on the site and species present at that site	Small impact
*Loss of roost sites due to construction of access roads, foundations, etc.	Probably high or very high impact, depending on the site and species present at that site	High or very high impact, e.g. loss of mating roosts
Impacts related to operation		
*Loss or shifting of flight corridors	Medium impact	Small impact
*Collision with rotors	Small to high impact, depending on the species	High to very high impact
Loss of hunting areas, due to avoidance of the area by bats	Medium to high impact	Probably a minor impact in spring, a medium to high impact in autumn and hibernation period

Correspondingly, Figure 7 shows the flow path of potential risk factors for avifauna by wind farms. Although the flow chart from its source focuses on birds at the offshore environment (offshore wind farms), the approach can be applied more widely [6], [1].

The diagram outlines the way on which the three potential risk factors (visual stimulus, habitat loss/modification and collision mortality), likely to be caused by wind farms, affect birds, their survival and reproduction and finally can cause changes in their total population. Boxes in bold blue indicate measurable potential effects, while green-colored boxes indicate procedures that need to be modeled. The impacts described, particularly with regard to potential collision of birds on a wind turbine, vary in intensity depending on the bird species, the area and the season.

Source: NevadVe (Nevad Veljkovic), www.depositphotos.com

Figure 7. Flow chart of the possible hazard factors (shaded boxes) on birds caused by offshore wind farms, [6]



The integrated planning and assessment for the prevention and reduction of potential impacts of wind farms on nature and wildlife, especially for the protected areas, is important and includes:

1. Strategic planning and siting based on good practice protocols for avoidance of sensitive sites.

2. Environmental impact assessment, including baseline studies, impact assessment and post-construction monitoring.

3. Integrated, inclusive and iterative project development, fully considering and adapting to the nature conservation interactions.

Strategic planning is the first step to avoid inappropriate wind energy development siting, that can cause significant impacts to flying fauna, as well as cause unforeseen difficulties and delays during their licensing process (see previous section).


Source: NCC

Evaluation and Monitoring

One of the key issues of the environmental impact assessment process is the assessment of the **significance of impacts**, which plays a crucial role in whether or how the development project will proceed. The impacts of each project are unique and must therefore be assessed on a case-by-case basis. Good research, based on the best scientific knowledge and good consultation from the very start of the development planning allows for a smoother project decision making process.

Significant impacts are those which undermine the conservation objectives of the site's integrity. The first step for the assessment of the impact significance is the identification of impacts likely to be significant and need to be further examined. In the case of Natura 2000 sites this can be determined based on the site's qualifying species and habitats, their conservation status and the overall conservation objectives of the sites. Significant impacts may also occur in association with other wind energy developments or human activities in an area through cumulative impacts.

The **Appropriate Assessment** provides the framework for assessing of impacts which are likely to have a significant effect on the protected area. The prerequisite for this assessment is the availability of sufficient, sound scientific and objectively verified information and best scientific knowledge, which allows for the determination of likelihood and significance of impacts, based on which it can be justified that the project will not cause significant impacts and may proceed (Box 3). In many cases this may demand field surveys to collect the required data.


Source: CRES

There is a number of good practice guidelines which provide detailed specification on optimal implementation of field surveys to collect **baseline information** (e.g. [1, 3, 5]), taking into consideration the required data quality for the impact assessment, as well as the limited timeframe available for the conduct of surveys. A list of good practice methodologies for assessment of flying fauna in relation to wind farms is provided in Table 4.

These methodologies include (1) different variations of direct visual observations for birds, (2) carcass searches for bird and bats, as well as (3) a series of advanced technologies which were made available and are being increasingly used in the data collection at wind farms.

Box 3 | Types of biological information required for impact assessment in Appropriate Assessments

Biological information required for the assessment of impacts within the framework of an Appropriate Assessment includes the best available scientific knowledge on the qualifying species and habitats of the Natura 2000 sites, and in particular [1,12]:

- ✓ Area, representativeness and conservation status of priority and non-priority habitats in the site.
- ✓ Population size and density, conservation status, degree of isolation of the species of Annex II of the Habitats Directive, Annex I of the Birds Directive, and regularly occurring migratory species not listed in Annex I of the Birds Directive present in the site.
- ✓ Conservation objectives of the site: (a) ecological requirements, (b) conservation status on national and EU level, (c) threats and (d) national and EU importance of the of site's qualifying species and habitats for Natura 2000 sites, as well as (e) role of the site within the broader biogeographical region and in the coherence of the Natura 2000 network.
- ✓ Conservation status of Natura 2000 qualifying species and habitats.
- ✓ Reference values.
- ✓ Main threats and pressures.
- ✓ Ecological structure and function.
- ✓ Evolution of the site without the realization of the proposed project.

Table 4. Overview (non-exhaustive) of surveys methodologies commonly used in field surveys for wind farm impact assessment and monitoring (based on [1, 3, 7]). New technologies and devices are continuously being developed and applied improve wind farm planning and operation.

Type	Method	Birds	Bats	Onshore	Offshore	Pre-construction	Post-construction	Disturbance & displacement	Collision	Barrier Effect	Habitat changes	Impact mitigation
Direct visual observations	Area searches	✓		✓				✓				
	Standardized area searches	✓		✓				✓				
	Point counts	✓		✓				✓				
	Playback calls	✓		✓				✓				
	Territory mapping	✓		✓		✓	✓	✓				
	Line transects	✓		✓		✓	✓	✓				
	Ship-based transects	✓			✓	✓	✓	✓				

Type	Method	Birds	Bats	Onshore	Offshore	Pre-construction	Post-construction	Disturbance & displacement	Collision	Barrier Effect	Habitat changes	Impact mitigation
	Aerial transects	✓			✓	✓	✓	✓				
	Vantage point records of flight movements	✓		✓		✓	✓	✓	✓	✓		✓
Carcass searches	Carcass collection	✓	✓	✓	✓	✓	✓		✓			✓
Advanced technologies	Bat detectors (manual/automated)		✓	✓	✓	✓	✓	✓	✓		✓	✓
	Bat trapping		✓	✓		✓	✓	✓				
	Flight calls recording	✓		✓	✓	✓	✓	✓	✓	✓		
	Microphone registration	✓							✓			
	Radar surveys	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Thermal imagery	✓	✓	✓	✓		✓		✓	✓		
	HD Video cameras	✓		✓	✓	✓	✓		✓			✓
	Bird/bat-borne telemetry	✓	✓	✓	✓	✓	✓	✓	✓	✓		

These technologies are also applicable for post-construction monitoring, in order to verify the potential impacts of a wind farm on biodiversity, as predicted in EIA/AA, as well as to monitor the effectiveness of the mitigation measures. The scope of post-construction monitoring is in general more limited in relation to the collection of baseline data, as it focuses on the species, which have been identified to be at risk of wind farm construction or operation. However, wind farms should be designed in such a way to ensure for the detection of short- and long-term impacts and to allow for their mitigation. The collection of baseline information, as well as monitoring, should address all the potential impacts of the wind farm (see Box 2), along with the effects on the species populations.

The design of field surveys and the selection of optimal survey methods must reflect clear objectives of the studies. While the pre-construction survey must provide the required data input for EIA or AA, the surveys for projects that have obtained planning permit must be adapted to the specific requirements of the site and associated species [3]. The design of field surveys is highly dependent on the species present. The surveys must provide data that allow **reliable and robust statistical analysis** for comparison between different wind farm development stages, between different sites and between the wind farm site and a closely matched reference area with similar environmental characteristics [1, 3].

It is essential that repeatable, standardized study methods are consistently applied before, during and after construction, within the wind farm area and in a nearby reference area (i.e. BACI approach: Before-After Control-Impact), in order to ensure comparability of species distribution and abundance before, during and after the construction, as well as between different sites. This approach ensures greater reliability in detecting changes caused by wind farms, rather than other contemporary reasons thus allowing taking appropriate mitigation measures, if necessary [3].

The duration of field surveys for pre-construction baseline studies must last at least one annual ecological cycle of the priority species present in the area [1, 3]. The data collection must cover all daily (day/night) and seasonal ecological seasons[3] of the target species, as well as all representative weather conditions.


Source: NCC

In accordance with the current legislation and Appropriate Assessment specifications for Category A projects (partially or fully) within Natura 2000 protected areas: (a) in cases where there are adequate, documented, reliable and applicable data and records of the survey area, under specific conditions such as the availability of reliable, sufficient and recent (of the last 10 years) data, no fieldwork is required, while (b) in cases where such data is not available, the field surveys are required, covering the ecological requirements of one annual cycle**,** depending on the seasonal presence of the species in each area, while the **duration** of the field surveys for Category A1 projects is between 20 and 60 days, depending on the type of the species or the habitat types under consideration, as well as the size and type of the project, while for Category A2 projects the duration is between 10 to 30 days.

[3] breeding, migration and wintering

The objective of the post-construction monitoring ("Monitoring Program"), if required, is to determine the actual impacts of wind farms on the flying fauna. These may include changes in distribution due to displacement, changes in species abundance or composition, changes in behavior, including avoidance and collision mortality. The duration of the post-construction monitoring depends on the terms provided by the permit; however it should allow the determination of short- and long-term impacts of the wind farm. As described above, the consistency with methods used during pre-construction surveys is essential for the comparability of pre- and post-construction data. The selection of survey techniques depends on the requirements and their suitability for each individual case.

Visual observations are the most commonly used methods for the assessment of the impacts of wind farms on birds. Area searches, standardized area searches, point counts, line transects, playback calls and territory mapping allow for the assessment of distribution and (some of them) abundance, as well as habitat use of birds in the areas around the proposed wind farm location in order to estimate potential displacement impacts onshore. In the case of offshore wind farms, the above concern aerial and ship-based line transects at sea.

Some of these methodologies may be further modified or combined to cover particular species groups during specific ecological seasons or sites, e.g. stopover sites, wintering sites. Recording of flight movements from vantage points reveals flight patterns, which may be used for the assessment of collision risks and barrier effects. **Carcass searches** are visual observations, which record bird or bat fatalities and injuries caused by wind farms and provide direct information on post-construction collision rates.


Source:broker (Rafael Angel Irusta Machin), www.depositphotos.com

Various **advanced technologies** have been developed during recent years that greatly expand survey capabilities and efficiency.

Bat detectors are used for recording the distribution and abundance of bat species and may be applied either at specific locations (e.g. wind turbine nacelle) or record bats along line transects in the area of interest. They have limited range, therefore may be applied in association with other telemetry techniques, e.g. thermal imagery or radar. Similarly, flight call recordings and microphone registration for the identification of bird species provide complementary information to visual observation or telemetry methods (e.g. radar, thermal imagery).

Radar surveys have a wide range of applications both, onshore and offshore, for flying fauna, due to the ability to continuously detect and record flights and flight heights at large distances and under conditions of no or low visibility. Radar is usually associated with direct visual observations or flight call recordings to allow for species identification. Radar data may be utilized for the assessment of displacement, barrier effects and collision risks. The data collected by thermal imagery provides information on avoidance behavior, collisions, flock size and flock altitude of birds and bats in close vicinity of wind turbines at night, when other visual observations are not feasible.

The High Definition (HD) video cameras provide an automated alternative to visual observations. Video cameras can be used either in aerial surveys or as land based surveillance systems in order to estimate collision risks. Additionally, there are commercially available automated shutdown on-demand radar and HD camera systems for the automatic control of the operation of wind farms or individual wind turbines, in order to reduce collision rates (see next section).

Collision risk may be particularly significant for long-living species with low reproductive rate, rare or vulnerable species of flying fauna, because even low levels of mortality may have severe impacts on the populations of these species. In these cases, telemetry projects are particularly useful for the identification of the distribution cores[4] of sensitive species, where their continuous presence makes the siting of wind turbines incompatible. For this reason, various models have been developed for the pre-construction collision risk modeling and post-construction collision mortality assessment, if required, based on the data collected through field surveys, which are particularly useful for the adjustment of wind farm design and operation in order to minimize collision risks of sensitive species (reviews in [3] and [5]). In parallel, the population modeling (e.g. Population Viability Analysis or Potential Biological Removal) may be used to further numerically estimate the impacts of wind farms on sensitive species populations.

Cumulative impacts may occur from multiple wind projects or from wind projects in connection with other projects or activities located in the region or along migratory corridors or as a result of a series of combined impacts of wind farms and/or other activities (industrial installations, etc.).

Even if the impact of a particular project is estimated to be low, cumulative impacts in combination with other projects may be significant and have a significant impact particularly on migratory species, long-lived species with low annual productivity and long adolescence or species which are already rare or endangered. Therefore, cumulative impacts need to be assessed at population or flight route level. Thus, it is necessary to take into consideration the cumulative impacts of all existing or planned projects in the region [8]. As outlined in Annex I of the Directive 2001/42/ EC, the Environmental Impact Assessment, identifies, describes and assesses any significant impacts of the plan or project on the environment, as well as its reasonable alternatives.

[4] “Core area": the central and most important part for conservation, part of the territory of spatial species, where the most (> 50%) of its daily and seasonal activities and movements take place annually.

Among the significant impacts, regarding issues such as biodiversity, this assessment needs to take into account the secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative impacts.

There is a variety of good practice methods for predicting impacts and the assessment of their significance and are set out in EU documents “Assessments of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC” and “Guidance document on Article 6(4) of the ‘Habitats Directive’ 92/43/EEC”, [12, 13]. The methods focus on the following impact levels [1]:

(1) direct and indirect impacts,

(2) short- and long-term impacts,

(3) construction, operation and decommissioning impacts,

(4) isolated, interactive and cumulative impacts.

Some of the most commonly used methods for impact assessment are presented in Box 4. The impact assessment should consider the factors on which the significance of the impacts depends (Box 5).

Box 4 | Methods of predicting impacts [12, 13]

- Direct measurements
- Checklists or matrices
- Flow charts, networks and systems diagrams
- Quantitative predictive models
- Geographical Information Systems (GIS) overlays
- Information from previous similar projects
- Expert opinion and judgment
- Description and correlation
- Carrying capacity analysis
- Ecosystem analysis

Box 5 | Impacts Significance

The significance of impacts depends on factors, such as [1, 3, 13]:

- Character and perceived value of the affected environment.
- Species involved (reproduction strategy, life span, population size, distribution and status).
- Magnitude, type, spatial extent, intensity, frequency, timing, duration and probability of anticipated impacts.
- Cumulative impacts.
- Resilience of the environment to cope with change.
- Degree of scientific accuracy (or uncertainty) in relation to quality, precision and reliability of predictions of change.

Below are provided examples of the application of modern technologies for monitoring of flying fauna before and after the construction of wind projects.

Source: NCC

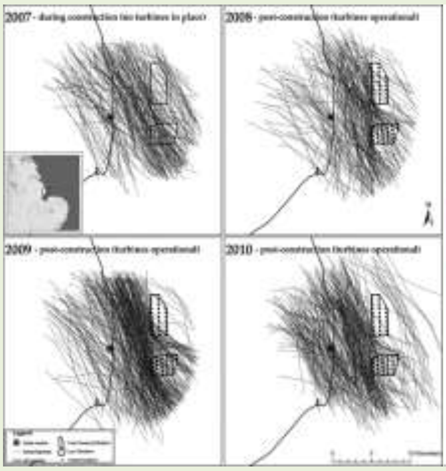
Application Example 1 | Monitoring bat activities at nacelle height [5, 15]

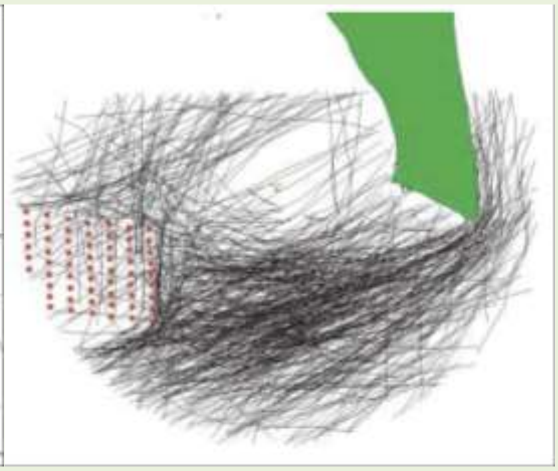
Acoustic monitoring at nacelle height during the **operation stage** of a wind farm is important to assess the bat activity within the area of the greatest potential impact, i.e. rotor swept zone. For this purpose, an automated bat detector system with a microphone mounted in the nacelle, along with analysis software allowing the identification of bat species or species groups are required. Based on the data collected, mitigation strategy can be developed, which specifies the conditions under which particular mitigation measures are implemented, e.g. which periods of the year or night curtailing of turbines is activated [4, 5].

Acoustic monitoring can be further supported by **thermal imagery** with the use of thermal cameras, which can detect and record bat activity within rotor swept zone, as well as bat collisions with the wind turbine [14]. The radar may also be potentially effective for recording and tracking bats, onshore, as well as offshore.

Application Example 2 | Monitoring displacement and barrier effect using radar

Radar has proved to be a very useful tool for the continuous and simultaneous monitoring of large number of birds at long distances and in conditions of low or no visibility. One of its applications is the assessment of bird avoidance of wind farm infrastructure which is the result of barrier effect or displacement. Given below are two examples of monitoring result on the avoidance of a wind farm (red dots) by migratory waterbirds (black lines), (adopted from [15], [16]).



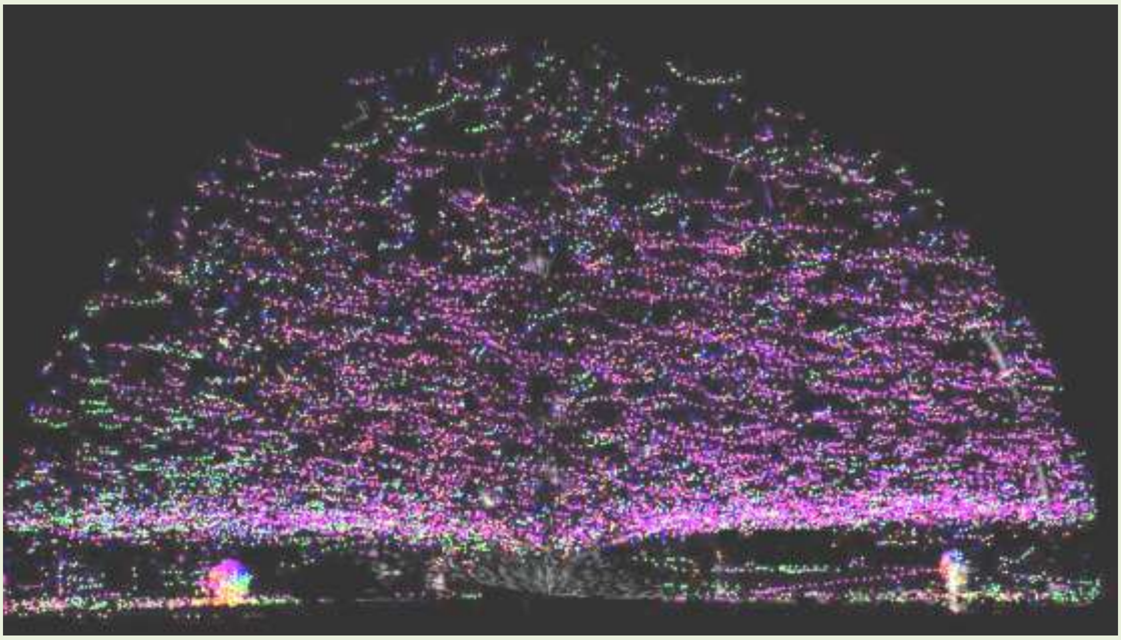


Application Example 3 | Monitoring migration using radar

Apart from the monitoring of horizontal movements (see Example of Application 2), the radar also allows the assessment of the vertical profile of bird or bat movements. This is particularly useful during assessment of nocturnal migration of passerines, where the radar is the most powerful tool available.

Radar surveys allow for the assessment of migration fluxes, i.e. number of individuals or groups of individuals per kilometer per hour, as well as flight altitudes, to determine the proportion of birds at rotor swept zone height, which allows for quantitative estimation of collision risks.

Provided below is an example of migration as recorded by radar at a near-coast wind farm in the Netherlands [17]. The offshore wind farm consists of 32 wind turbines with nominal capacity of 3 MW each, and 90 m rotor diameter (Image adopted from [17]).



Impact Mitigation Measures

In case the EIA or AA have identified that negative impacts, which cannot be avoided, may be caused by a wind farm project, measures[5] need to be applied, in accordance with the mitigation hierarchy (see above), either (a) to explore and apply feasible alternatives which minimize the impacts or (b) to apply appropriate mitigation measures which eliminate the impacts or at least minimize them to an insignificant level. The mitigation measures should be selected on the basis of sound scientific principles that will ensure their efficiency [1].

There is a wide variety of good practices for the avoidance or mitigation of impacts of wind farms on flying fauna. In general they can be classified into the following categories [3]:

Installation of a video surveillance system
Source: CRES

(I) Modification of site design and layout of the wind farm,

(II) Modification of turbine design and operation,

(III) Modification of species activity with proper management,

(IV) Modification of human activities,

(V) Modification of habitats, i.e. within or outside the wind farm, and

(VI) Mitigation measures for offshore wind farms.

A non-exhaustive overview of available mitigation measures is provided in Table 5.

IMPACTS & MITIGATION MEASURES

[5] According to the MD 170225/2004, the consultants carrying out EIAs/AAs, if considered necessary, must propose measures for the significant adverse of the environmental impacts of the project. The proposed measures should aim at (a) prevention-avoidance, (b) reduction of intensity and extent of the impact and (c) restoration. In regard to EIA of wind projects (entirely or partially) within NATURA 2000 protected areas (SPA, SAC, SCI or pSCI), if despite the examination of measures, the integrity of the site continues to be undermined (paragraph 4, Article 10, L.4014/2011), the consultants may propose specific compensatory measures.

Table 5. Overview (non-exhaustive) of avoidance and mitigation measures to reduce impacts of wind farms on flying fauna [3, 5]

Measure	Birds	Bats
Modification of site design and layout		
Design of the site	Adjustment of orientation, spacing, location, number of turbines and micro-siting to minimize impacts, e.g. establishment of minimum distances from sensitive species nests.	Siting of wind farms away from habitats associated with higher bat activity, e.g. migration or commuting routes, close to bat roosts. Re-siting of individual wind turbines may be considered. Avoid sensitive areas, e.g. woodlands.
Design of infrastructure	Adjustment of access road, hard-standing (onshore) and scour protection (offshore) to minimize impacts. Avoid use of guy lines in areas sensitive to collisions.	Minimization of bat habitat disturbance by wind turbines and associated infrastructure design.
Layout at a landscape	Orientation of wind turbine rows in the same direction as main bird routes. Organizing wind turbines in discrete groups while leaving transit corridors between groups of wind turbines.	
Power lines	Power lines should be underground where possible, otherwise use best practices to minimize bird collision mortality.	
Repowering	Replacement of the existing turbines with fewer larger ones to reduce collision and/or displacement whilst maintaining or increasing power output.	
Modification of turbine design and operation		
Turbine design	Selection of appropriate turbine design, e.g. tower type, nacelle height and blade length to reduce potential risks. Removal of elements which could attract birds (as potential perch or nest sites).	
Remodeling the site	Removal or relocation of wind turbines to less sensitive sites in case of proven high mortality.	
Minimizing non-operational periods	Minimization of non-operational periods (e.g. for maintenance) to reduce risk of birds using wind turbines as perching or nesting sites.	
Cut-in speed	Increase of cut-in speed at minor reduction of energy production may reduce collision risks of birds which are more likely to collide at low wind speeds, e.g. soaring birds.	Increase of cut-in wind speed to avoid wind conditions of highest bat activity and blade feathering.
Operational modification	Application of temporary shutdown, seasonal shutdown or shutdown on demand to reduce collisions at peaks of bird activities. Shut down should be a measure of last resort.	Application of temporary shutdown, seasonal shutdown or shutdown on demand to reduce collisions at peaks of bat activities (e.g. migration, swarming). It should be a measure of last resort.
Modification of species activity		
Visual measures	Careful design of lighting options is needed to minimise potential attraction effects, for example, through the use of intermittent rather than continuous navigation lighting.	-
Deterrence	Acoustic deterrence has been suggested as an option, although there are good reasons why this is likely to be unsuccessful.	Acoustic, visual (light) and electromagnetic deterrents have not yet been proven to be effective at preventing bats from approaching wind farms.
Modification of human activities		

Measure	Birds	Bats
Employment of ecological staff	Employment of specialized ecologists/biologists together with implementation of Environmental Management Plan (see below) to ensure the least damage is caused during construction, operation, and maintenance or decommissioning.	Employment of specialized ecologists/ biologists together with implementation of Environmental Management Plan to ensure the least damage is caused during construction, operation and maintenance.
Methods used	Implementation of good practices set by Environmental Management Plan (see below) to minimize habitat loss or damage, noise and other sources of disturbance during construction, operation, maintenance or decommissioning.	Destruction of bat roosting sites prohibited. Avoid demolition work or tree felling during sensitive periods, e.g. maternity, hibernation season.
Timing of activities	Avoidance or minimizing of disturbance during most sensitive periods, e.g. breeding season or if foraging birds are present in the area.	Avoidance of activities during periods when bats are most sensitive to disturbance (e.g. maternity, hibernation), as well as commuting and foraging based on the local knowledge.
Design solutions	If appropriate, use of screens to hide regular activity from birds, restriction of access to sensitive areas and adjustment of routes used by staff or vehicles to minimize disturbance.	
Modification of habitats within or outside the site		
Site Management Plan	Elaboration of Environmental Management Plans. Elaboration of measures of avoiding or mitigating impacts may be required for particular project.	
Minimize fragmentation and habitat disturbance	Avoidance of habitat fragmentation and disturbance.	
Buffer zones around important habitats or features	Use of buffer zones around key bird areas, e.g. breeding, roosting, foraging to reduce collision, displacement and disturbance risks.	Use of buffer zones around key bird areas, e.g. 200m buffer zones around habitats specifically important to bats.
Deterrence or avoidance of attraction	Use of deterrence measures or management measures to reduce attraction of bird to the areas within wind farm.	Prevention of roosting in nacelles. Reduction of factors which may attract flying insects which are bats prey though light, nacelle heating, wind turbine colour and acoustic effects. Use only of necessary lighting and use of lighting that does not attract insects. Prevention of retention of wastes, growth of weeds and new shrubs in the vicinity of wind turbine construction area. New hedges, lines of shrubs or tree and forests should not be established within 200 m of wind turbines.
On-site habitat enhancing	Habitat loss or displacement may be mitigated through on-site enhancement. However these measures need to be taken with caution not to increase other risks, e.g. of collisions.	
Off-site alternative habitat creation	Creation of alternative habitats outside wind farm could mitigate for on-site habitat impacts, e.g. displacement. This should not be confused with compensation or enhancement.	
Mitigation at offshore sites		
Enhancement of bird populations	Off-site implementation of measures to improve productivity and survival of birds.	

Installation of video surveillance system, Source: CRES

VIDEO SURVEILLANCE SYSTEM

The measures to mitigate impacts of wind projects according to the Greek legislation, are presented in detail in JMD 8353/2012, which is the amendment and supplement of the JMD 37338/1807/2010, in order achieve conservation and restoration of species and avifauna habitats in Special Protection Areas (SPAs) through the establishment of specific measures, conditions, procedures and interventions effective protection.

According to Article 5B, “Special protection measures for the installation and operation of Wind Power Stations”, paragraph 4, of the above JMD, the Environmental Terms Approval Decision, issued in accordance with the relevant provisions of L.4014/2011, for the installation and operation of the Wind Power Stations within SPA areas, include:

- The obligation to use underground power lines or, wherever this is not feasible, twisted insulated aerial power lines for grid connection,
- The obligation to regularly inspect the site (weekly and/or more frequent), and remove dead animals (mainly livestock), the presence of which could attract birds of prey.
- The assessment of the possibility of installing an audible, visual or other type of marking according to the wind farm layout, its distance from the cliff edge and nesting, feeding and roosting sites, its scale and size.
- The installation of an automated shut-down system for wind turbines and activation of deterrents

for bird protection and accident avoidance at wind farms located within SPAs and flyways-bottlenecks[6]. The areas that have been identified to date as such are the "Evros Delta" GR1110006, "Kythira and the surrounding islets" GR3000013 and "Antikythira and the surrounding islets" GR3000012, "South Mani" GR2540008, according to the paragraph 4.2. of Article 4 of JMD 37338/1807.

Bat Detector, Source: CRES

BAT DETECTORS

[6] It does not apply for wind farm power projects implemented in areas to be classified as migratory passages, as long as at the time of the site designation; these projects have received a positive opinion during the stage of the Preliminary Assessment of Environmental Impacts or Environmental Terms Approval Decision, according to the relevant provisions of Law 4014/2011.

Below several case studies of application and study of modern techniques for the avoidance or reduction of the impacts of wind projects on biodiversity are presented, as reviewed in the literature and according to the experience gained through the LIFE project by the application of technologies and methodologies at CRES Demonstration Wind Farm-PENA, at Keratea, Attica, as well as at other wind farms and areas in Greece.

Video Surveillance system, Source: CRES

Case Study 1 | Mitigation of collision mortality of soaring migratory birds: Surveillance program and shutdown on demand at Tarifa, Spain [18, 33]

The Straits of Gibraltar is the main point of concentration for soaring birds migrating between Europe and Africa. On the other hand numerous wind farms are located in the area. A study [19] was carried out at thirteen (13) wind farms at Tarifa, Cadiz, Spain, before (2006-7) and after (2008-9) selective turbine stopping programs were carried out to mitigate bird mortality. Griffon vulture (*Gyps fulvus*) was the most-frequent species involved in wind farm caused mortality. The study area hosts 300 pairs of vultures, while other breeding populations are present in the surrounding areas. During autumn migration (October-November), vultures from Northern Spain and across Europe concentrate in the area before crossing the Straits of Gibraltar to Africa. Up to 1,800 birds can gather in the area waiting for suitable weather condition to cross to Africa.

Before mitigation measures were taken (2006-7) a total of 135 vultures were killed at particular wind farms, however few wind turbines were responsible for high mortality rates. The 10 most dangerous wind turbines were in 6 different wind farms. During years 2008-9, ten (10) wind farms (with a total of 244 wind turbines) applied selective stopping, while three (3) (with total of 52 wind turbines) did not. The established surveillance programs were utilized to control wind turbine operation. If an observer identified that the trajectory of a vulture could potentially result in a collision with a wind turbine, the observer would call the wind farm control office to stop the wind turbine within a maximum of 3 minutes.

The surveillance program focused on approximately 10% of the wind turbines which have been identified as most dangerous. Through this **shutdown of demand procedure the Griffon vulture mortality was reduced by approximately 50%**. This was achieved through 4,408 turbine stops per year (during 2008-9), equivalent to a mean of 18.06 stops per turbine. The median duration of stops was 22min and 11s or on the average 6h and 20 min per year. This leads to an average **reduction of energy production by only 0.07%.**

This case **demonstrates that shutdown on demand involving a limited number of wind turbines** posing the greatest collision risk to birds **can greatly reduce collision mortality, with a minor reduction of overall energy production.**

Case Study 2 | Mitigation of collision mortality of raptors: Radar surveillance, deterrence and shutdown on demand system at Torsa's El Pino Wind Park, Spain [19]

An **automated radar system** supported by field observers was installed at Torsa's El Pino Wind Farm in Spain in order to mitigate Griffon Vulture collisions. Based on the radar, observer (detection of large soaring birds) and meteorological data (wind direction and cloud ceiling height) were collected. The radar system was trained to assess the collision risks for the birds detected and allows for the automated decision making steps in relation to measures, i.e. deterrence or turbine shutdown.

The mitigation strategies applied by the system involves the activation of **Long Range Acoustic Device** (LRAD), emitting a focused 160dB sound beam with an effective range to 1.5km to deter birds from approaching wind turbines. If after the use of LRAD the risk of collision still exists, a Supervisory Control and Data Acquisition **(SCADA) system** will shut down specific turbine to prevent collision. Currently the turbine stop-restart is carried out manually, based on the data provided by the **radar and observers.**

Case Study 3 | Mitigation of collision mortality of soaring migratory birds: Radar assisted shutdown on demand at the wind farm Barão S. João, Portugal [20], [21]

The 50 MW Barão S. João wind farm, consisting of 25 turbines, is located along a migratory flyway that is used by approximate 5,000 individuals with more than 30 species of soaring birds. A mitigation program involving a Radar Assisted Shutdown on Demand (RASOD) protocol is applied to reduce bird collision risks.

The mitigation system involves a series of observers positioned along the perimeter of the wind farm (2 observers with binoculars and telescopes within the wind farm and 5 observers at a distance of 2-5km from the wind farm), assisted by a marine surveillance radar which detects soaring birds approaching the wind farm.

A set of pre-defined criteria are used to identify wind turbines which should be temporarily stopped, either after the request of the monitoring team to the wind farm staff (initially) or directly by the monitoring team (from the 4th year of application of RASOD protocol). On the average 3,400 soaring bird movements involving 27,000 individuals were recorded annually in the wind farm area. Among these **72% of movements and 43% of individuals were recorded at flight altitudes that pose risk of collision**. During the period 2010-13, **a minimum of 570-1,550 birds were at high risk of collision with wind turbines,** however within these 4 years of the RASOD operation **no soaring birds were killed** at the wind farm.

The use of radar increased the observer detection efficiency by 3-4 times. It is **capable of detecting birds at larger distances and in conditions of poor visibility.** The early detection and tracking of birds by radar improves the predictions of flight routes and their behavior in relation to the wind farm, this assisting in assessing whether and which turbines need to be stopped. Almost 40% of all turbine shutdowns resulted from birds being first detected by radar.

The total shutdown period was equivalent to 0.5-1% of the annual wind farm operation period. Almost half of shutdowns took place at wind speeds below 5m/s thus, leading to low energy production reduction.

The radar, even in its basic operation, can be very useful, which can significantly improve the detection and tracking capabilities of a surveillance system and greatly improve the efficiency of shutdown on demand collision mitigation.

Case Study 4 | Mitigation of bat collision mortality: Increasing cut-in speed [22], [23], [24]

The **increase of wind turbine cut-in speed** (the velocity at which the wind turbine starts operating) and changes in blade feathering (changing the angle of the blade preventing rotor rotation in low wind) are considered to be the most effective mitigation measures for the reduction of bat collision mortality [24]. The reduction of cut-in-speed is achieved by varying the blade feathering, in order to prevent rotation of the wind turbine rotor at low wind speeds of around 3.5 m/s.

A study carried out in the U.S. has estimated that increasing cut-in speed from 3.5-4.0m/s to **5.0-6.5m/s reduces bat mortality by 3.6-5.4 times** (or 44-93% fewer fatalities) at minor annual energy output reduction of ≤ 1%, [25]. A wind turbine curtailment (i.e. operational mitigation) of increasing wind turbine cut-in speed for 4.0m/s to 6.0m/s was applied at Sheffield Wind Facility, Vermont, U.S. from June to September 2012-13. The curtailment protocol was based on the wind speed and air temperature which affect bats activities. Each night 8 randomly selected wind turbines out of a total of 16 were curtailed from half an hour before sunset until sunrise when the wind speed was lower than 6.0m/s and air temperature was greater than 9.5^{o}C. **The results showed that the bat mortality at fully operational wind turbines was 1.5-2.7 times higher than the mortality at curtailed wind turbines [25].**

However, it is noted that any intervention in the operation and production of wind turbines is not easily feasible and requires the manufacturer's approval.

Case Study 5 | Mitigation of collision mortality of raptors: Video surveillance and deterrence system at Smøla wind farm, Norway [25]

A commercially available High Definition video surveillance and deterrence system was installed at a wind farm on the island of Smøla, Norway, in order to detect and dissuade White-tailed Eagles for which the wind farm poses the greatest risk. In parallel, a radar system and GPS telemetry were applied to collect independent data sets to evaluate the operation and efficiency of the video system. During daytime the system recorded between 76% and 96% of all bird flights within 300m and 150m radius, respectively, or 58-80% of all flight within 24h day. The average number of false positives (triggers not caused by birds) was approx. 1.2 false positives per day, which were equivalent to 40% of all video sequences. About 50% of triggers of warning/dissuasion audio system were due to birds. The results of the analysis of the response of birds to warning and dissuasion signal were inconclusive [25].

The performance could be improved by adapting detection and dissuasion criteria based on additional information for the specific location [26]. It was concluded that the system **allows for monitoring of near-turbine flight behavior in birds** and presents a complementary technique to GPS telemetry and avian radar. Additionally, it may be used as **a collision mitigation measure** [25].

The system was also applied at other sites in Europe for **monitoring, dissuasion and automated shutdown** of wind turbines on demand. It detected between 0.2 -1,575 flights of target bird species per wind turbine per year, resulting in 0.1-20.5 hours of turbine stops per wind turbine per year.

The stops due to false positives were between 1 and 28 stops per wind turbine per year, equivalent to 0.1-1.6 hours of turbine stops per wind turbine per year. **The estimated reduction of energy production due to shutdowns was 0.001%-0.41%** [27]**.**

Case Study 6 | The first autonomous mitigation system in Greece

In Greece, the first autonomous video surveillance system was introduced in 2013 in a wind farm with 34 turbines on Varnountas mountain, at Florina, Northern Greece. The wind farm is built in altitudes between 1,800-2,000 m and consists of 34 wind turbines of nominal power of 850 kW each. The rotor diameter of each wind turbine is of 52 m. The biggest part of the wind farm has been installed near the limits of Natura 2000 areas and specifically of SPA or/and SCI.

The species of concern are the Dalmatian and Great White Pelicans breeding at Prespa National Park, where one of the biggest colonies of Europe exists. The birds cross the Varnountas mountain during their daily movements between the colony and other lakes of northern Greece used as foraging grounds.

A special ornithological study was conducted in order to assess the site sensitivity for the two species and define the siting of the mitigation systems in the wind farm. In order to further clarify the bird movements over Varnountas mountain, an ornithological radar was used and the movements of the birds in the broader area monitored, while a model for the simulation of the creation of thermals in the area and their use by soaring birds was developed.

The system was installed in nine (9) wind turbines in order to cover the whole wind farm and the modules of warning, dissuasion and stopping of the wind turbines were included. During its operation and for the period 06/2013-08/2014 ornithological observations were carried out in order to examine the use of the area by birds, the response of the birds to the dissuasion sounds, as well as the efficiency of the system.

The system during parallel visual observations detected more birds than the team of ornithologists carrying out Vantage Point counts due to the extensive coverage of the area. No fatalities of any bird were recorded during the monitoring period.

It should be noted that in case of wind farms located in extreme environments, in the selection of such systems their resistance to extreme weather conditions, such as extended periods of frost, etc., should be taken into consideration.

Case Study 7 | LIFE Windfarms and Wildlife project experience in the use of an automated video surveillance and bird dissuasion system, CRES Demonstration Wind Farm, Keratea, Attica, Greece

In the framework of the LIFE project, an autonomous video-based bird monitoring and dissuasion system was installed for demonstration purposes at a 750 kW wind turbine with tower height of 46 m and rotor diameter of 48 m, at CRES Demonstration Wind Farm, PENA. The system detects/records movements of flying objects in the area, assesses them and makes decisions to trigger bird collision mitigation measures (sound emission, wind turbine stopping) in real time depending on the risk of impact. The system has been in operation since March 2016 and analyzes of its operation and recordings are carried out, as well as simultaneous bird movements monitoring by field workers to assess the levels of bird detection by the system.

During the first year of its operation in the park, 2,500 birds have been recorded, while the system activations due to false positives were within the manufacturer specifications, two (2) times per day. The warning sound for birds approaching the wind turbine has been activated 720 times (30% of the flights), in 700 cases (30% of the flights), subsequently the dissuasion sound was activated, while in 400 cases (17% of flights) the wind turbine stop control module was activated.

Moreover for the period April 2016 to January 2017, for which meteorological and energy production data were available, the total time during which the wind turbine virtual stop module would be activated for speeds higher than the cut-in speed of the wind turbine (>3m/s) was 4.75 hours. **The corresponding energy loss would be 0.24% of the total wind energy produced during this period.**

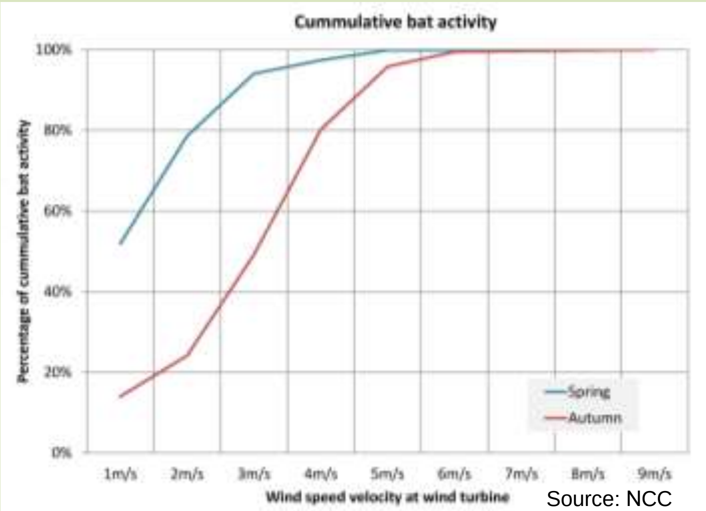

Source: CRES


Source: CRES

Case Study 8 | LIFE Windfarms and Wildlife project experience in the use of automatic ultrasound recording systems to record the activity of bats at rotor height, CRES Demonstration Wind Farm, Keratea, Attica, Greece

A pilot installation of three different models of automated ultrasound recording systems on wind turbines of CRES Demonstration Wind Farm was carried out, in order to examine their ability to record bat activity at the rotor height and to determine the possible need for curtailment of the wind turbine operation in the event of a significant risk to bats. For this purpose, the microphone of each system was mounted on wind turbine nacelles.

The results of ultrasound recording systems pilot operation reveal similar ultrasound detection and recording capabilities for all three different systems. Single or multiple bats were recorded in 86-781 recordings per month per wind turbine, with the majority of recordings occurring between May and October. Up to 178 bats have been recorded per night. In spring, 94% of the bat activity was at wind speeds less than 3m/s. In autumn, bats were active at higher wind speeds with 50%, 80% and 95% of bat activity been recorded at wind speeds of less than 3m/s, 4m/s and 5m/s, respectively. Nearly whole bat activity (> 99%) was recorded at an average daily temperature above 15°C. In total, 6 species or groups of species were recorded out of 34 bat species present in Greece. At the particular wind farm and for the period from spring to autumn, the bat activity at rotor height is highest at low wind speeds, less than the wind turbine cut-in speed and temperatures above 15°C. Therefore, the risk of collision or barotrauma at the wind farm is low, as evidenced by the fact that no dead or injured bats were found throughout the project period.



Source: NCC


Source: CRES

Case Study 9 | LIFE Windfarms and Wildlife project experience in the use of ornithological radar

In the framework of the LIFE Windfarms and Wildlife project, a combination of a marine radar adapted to bird surveillance in conjunction with field ornithologists has been used to record bird species, their abundance and their pathways in both CRES Demonstration Wind Farm-PENA and other wind farms of interest located in mountainous areas with both minimal and abundant high vegetation or near large wetlands.

The radar system is used to detect birds and to monitor their flight paths, while field ornithologists visually determine the species of birds and their flight height. The data collected can be used both during the wind farm design phase, to determine the use of airspace, and its operational phase, to identify birds in a wind turbine collision track and in cases of temporary stopping of specific wind turbines in order to avoid bird collisions.

This system has been successfully used in hilly and mountainous areas with limited and low vegetation, as well as in lowland areas around large wetlands. However, in areas with abundant high vegetation, e.g. forests, or even intense relief, e.g. with many nearby hill or mountain tops or ridges, radar blind areas can significantly limit an effective monitoring of the airspace around the area of interest. In areas where radar use is feasible, this system has proven to be very effective in detecting birds in long-range, from 1-1.5 km for small birds (e.g., passerines) up to 6 km for large species (e.g. pelicans, swans).

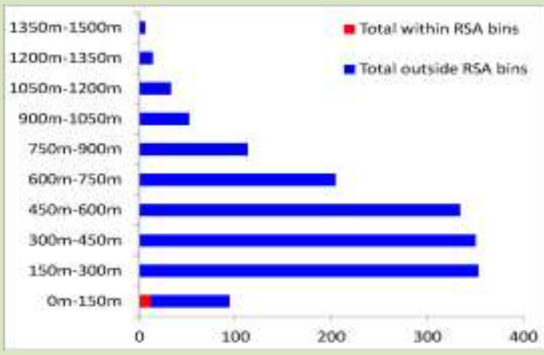
Compared to the conventional bird's visual monitoring, radar recorded 5 to 10 times more birds due to larger detection and monitoring radius 360° around the radar position. Furthermore, the radar is also the only means for nocturnal migration monitoring over a long radius of up to 2 km.


Source: NCC


Source: CRES:


Source: NCC

Case Study 9 | (continue)

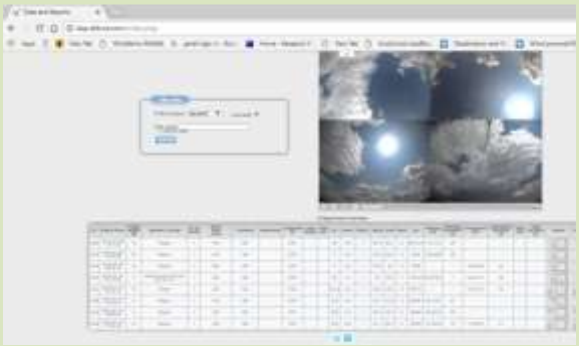


Source: CRES

Case Study 10 | LIFE Windfarms and Wildlife project experience in the use of automated video surveillance and bird dissuasion system, at a wind farm at Thrace, North Greece

In February 2018, in the framework of the LIFE project, an autonomous video-based bird monitoring and dissuasion system was installed on a 2 MW wind turbine, at a private wind farm in Thrace, Greece. The wind turbine has a tower height of 80 m and rotor diameter of 90 m. The wind farm consists of twelve (12) wind turbines of 29.7 MW total capacity. Part of the wind farm is installed within a SPA site (Natura 2000). The video surveillance system autonomously monitors bird daily movements in the vicinity of the wind turbine, through four (4) high-definition cameras installed on the wind turbine, while ten speakers, six (6) and four (4) speakers at two different heights on the wind turbine's tower, emit warning and discouraging sounds when birds are detected approaching the wind turbine, in order to reduce collision risk. All the equipment is fitted with special magnets.

Source: NCC

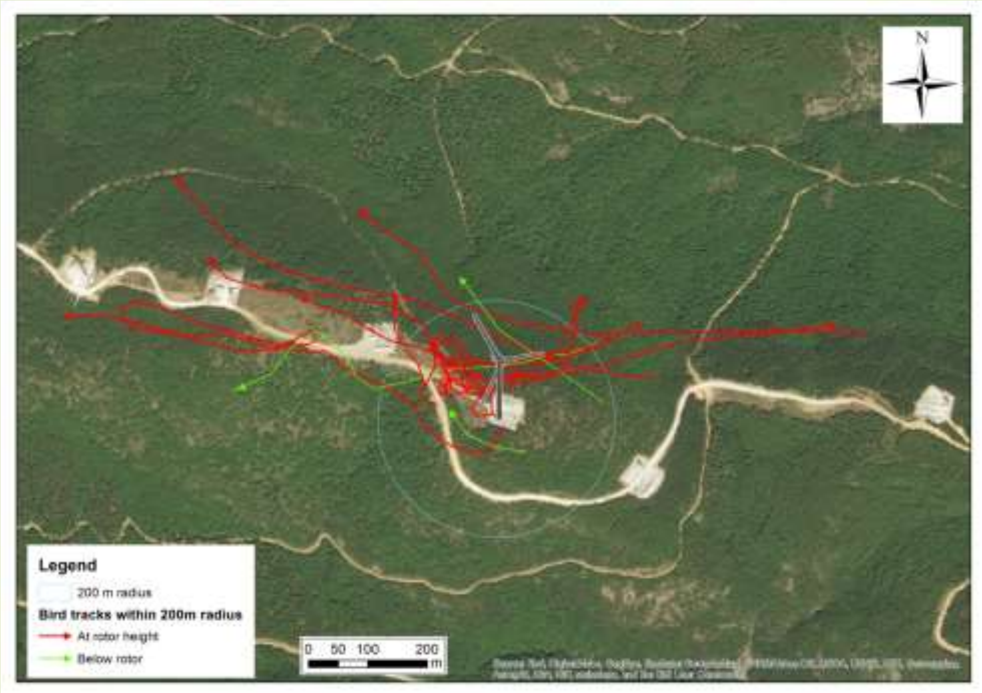


Source: Liquen Consultoría Ambiental,S.L.

The system became fully operational in spring 2018. During the first 49 days of the system's operation in spring and early summer 2018 a total of 275 video records have been recorded, consisting of 151 bird flights involving 164 birds and 124 false positives. The majority of the bird recordings consisted of large and medium sized birds. The false positives were primarily due to transported equipment during maintenance work, large insects and airplanes during low flight.

The warning and discouraging sounds which were activated when birds were detected to fly towards the Moderate Collision Area and the High Collision Area, were triggered on 90 (59.6% of bird flights) and 61 (40.4% of bird flights) occasions, respectively.

Case Study 10 | LIFE Windfarms and Wildlife project experience in the use of automated video surveillance and bird dissuasion system, at a wind farm at Thrace, North Greece (continue)



Fifteen (15) bird tracks recorded within a 200m radius from the wind turbine.

The average number of warning and discouraging per day were 1.84 and 1.23 triggers, respectively, with the average trigger duration of 27.8 s and 35 s, respectively. The frequency of false positive warning and discoursing sound emissions was 0.42 triggers per day. No collisions were detected, neither by video recordings nor by carcass searches carried out around the wind turbine.

The monitoring of the system's operation was carried out by visual observations using telescope and binoculars for a total of 43 observation hours during 7 days. The observation point was located 1 km from the wind turbine carrying the video surveillance system aiming at recording approaching birds within a 500m radius from the wind turbine.

A total of 45 bird flights have been recorded within the observation survey area, including primarily large and medium size raptors and storks. Additionally, 23 bird flights were recorded within the maximum detection area (200 m) of the video surveillance system.

In some cases a small number of bird flights were not detected by the video surveillance system, due to the fact that they were outside the maximum detection area in relation to the birds size (e.g. 100 m for buzzard sized birds) or were flying close to the ground.

Case Study 10 | (continue)

The recording results indicate that all birds recorded by visual observations were recorded within the distance range identified by the manufacturer, i.e. birds with wingspan of >150 cm, 75-150 cm and 25-75 cm were detected at distances of 180-200 m, 100-140 m and 70-80 m, respectively. On the other hand, during the period of simultaneous video surveillance and visual observation recording, the video surveillance system recorded three (3) additional bird flights, which were not detected by the observer, due to the small bird size and the long distance from the observation point (>1 km).

The warning or dissuasion sounds were activated by the video surveilance system in all 15 flights recorded by the system and by visual observations. In twelve (12) cases (80%) there was an immediate sudden change of flight direction away from the wind turbine, while in three (3) cases (20%) there were no visible bird reactions to the system’s sounds.


Source: CRES

Conclusions - Suggestions

The achievement of the EU targets for both renewable energy, towards tackling climate change, and biodiversity protection, is a major challenge at the national and European level. Increasing renewable energy production will contribute to reducing carbon dioxide emissions and, in the long term, to reduce their harmful impact on biodiversity. The need for further development of wind power in Greece and the EU countries should not pose a threat to biodiversity. In this context and in order to contribute to the development of wind energy in accordance with the Birds and Habitats Directives, this Guide presents good practices for mitigating the impact of wind farms on flying fauna through the use of modern technologies.

The impacts of each project are unique and therefore need to be assessed on a case-by-case basis. In-depth research, based on the best available scientific knowledge and expertise from the very initiation of project planning, allows for a smooth decision-making process. The compliance with the environmental terms resulting from the EIA/AA, as well as the monitoring and the inspection of the foreseen measures implementation by the competent bodies, are a basic prerequisite for the development of wind farms, while at the same time limiting their impact on biodiversity.

The available modern technologies allow the collection of important data concerning the movements and space use by flying fauna in greater quantity and quality in relation to the conventional recording methods. This feature of the modern technologies can be utilized during the wind farm design phase to allow better siting and planning not only of the wind farm as a whole, but also of pits arts and even individual wind turbines. Furthermore, during the wind farm operating phase they may contribute to mitigating potential impacts, mainly related to collisions and barotrauma.

Like any method, modern technologies apart from their advantages they have also limitations and special requirements that should not be neglected. Therefore, it should be stressed that:

(a) To date, international data demonstrate that with proper siting and appropriate design, the development of wind energy generally does not pose a threat to biodiversity. Consequently, proper siting is the safest option for minimizing the impact on flying fauna and cannot be substituted by technological solutions.

(b) The use of modern technologies should be considered on a case-by-case basis, taking into account the characteristics of the wind farm and its parts, as well as the sensitivity of each area, the composition of the sensitive fauna and its ecological requirements, and the capabilities and limitations of each technology.

(c) There is no automated system that operates without human intervention. All stages of design, operation and monitoring require the involvement of qualified experts for their proper selection and siting, as well as the assessment of their efficiency for the application of the environmental terms.

(d) Monitoring and evaluation of the efficiency of the technologies selected is required throughout the entire duration of the project.

(e) Continuous training of the personnel of the competent departments and authorities at central and regional level is required, both for the selection of the best technologies to support the licensing process and for monitoring their efficiency during implementation of the environmental terms of the projects.

Based on the results from the use of modern technologies (ornithological radar, video surveillance and collision avoidance, thermal imaging and automated ultrasonic recorders) in the framework of the LIFE project in Greece, and international experience, the following possible uses are suggested during the design and operation phases of a wind farm.

During the design phase of the wind farm

(a) The use of the **radar** system in cases of expected **significant nocturnal passage of migratory passerines** during migration and passage of **large sensitive bird species** during migration or along local movement flyways.

(b) The use of **ultrasonic recording systems and/or thermal imaging** in areas with an expected increased presence of bats or along their migratory flyways. In addition, to better assess the collision or barotrauma risks, the presence of bats may be monitored by an automated ultrasound recording system sited at the height of the wind turbine nacelle (e.g. on a meteorological mast).

During the operation phase of the wind farm

(a) In areas with **large sensitive bird species**, resident or on migration, an **automated visual surveillance system** of the wind farm, combined with **ornithological monitoring program** and **search for dead or injured birds**, can have positive results in mitigation of the collision risk. In case the range of the visual system is not sufficient, it may be replaced by a non-automated radar system, which in turn has its limitations, as described below.

(b) At areas with a large number of large passing birds during migration, the use of a **network of observers guided by simple marine surveillance radar**, for early warning, in direct contact with the wind farm control system for **selective shutdown on demand**. This practice concerns limited application time periods.

(c) The recording of bats with the use of automated ultrasound recording systems and their analysis in conjunction with wind and meteorological data at the wind farm site may provide important information on the bats activity under specific conditions of temperature/wind/season of the year.

According to the experience gained through the LIFE project, the use of radar in Greece has in some areas significant restrictions on the recording of bird paths, as the intense relief and the high vegetation significantly reduce the surveillance area. This may result in the need to use more than one system to adequately cover the wind farm area. On the contrary, this restriction does not apply to the monitoring migratory bird fluxes at higher altitudes, making monitoring with the use of radar the most appropriate way to record nocturnal migration and movements of birds, bats and insects. Additionally, the cost of prolonged radar use or the need for multiple or automated systems is higher than that for other methods and may not be an economically feasible solution. Nevertheless, the radar remains an important early warning tool when combined with other mitigation measures. Correspondingly, the visual monitoring systems are limited to daytime surveillance on a limited bird detection range, which does not exceed a few hundred meters even for large birds, a distance which decreases proportionally to the size of the birds.

Annex

National Legislation on the Environment and RES (reference to the main points of the institutional framework)

L.4447/2016 [7]	Spatial Planning –Sustainable Development and other provisions
L.4203/2013	Renewable Energy Issues and other provisions
L.4042/2012	Protection of the Environment through criminal law - Harmonisation with Directive 2008/99/EU, Waste production and management framework - Harmonisation with Directive 2008/98/EU - Regulation of issues related to the Ministry of Environment, Energy and Climate Change" (A΄ 24).6. (Government Gazette 24/A`/13.2.2012)
L.3937/2011	Biodiversity conservation and other provisions" (GG A'60)
L.4014/2011	Environmental licensing of projects and activities, arbitrary regulation in connection with the creation of an environmental balance and other provisions of competence of the Ministry of the Environment "(A 209), (Government Gazette 209 / A '/ 21.9.2011)
L.3851/2010	On the Acceleration of the Development of Renewable Energy Sources to Mitigate Climate Change" (Government Gazette A' 85/4.6.2010);
L.1650/1986	For the protection of the environment" , (GG A'160/1986)
L.998/1979	Law for the Protection of forests and forest areas in general of the country
MD 2307/2018	Amendment of the MD37674/ 27-7-2016 GG: 2471/B/10-8-2016) on the "Classification of public and private projects and activities in categories and subcategories according to the L.4014/21.09.2011 (A'209), Article 1, par. 4,.."
MD 1915/2018	Amendment of the JMD 48963/2012 (2703/B) and JMD 167563/2013 (964/B) and MD 170225/2014 (135/B), which have been issued under the mandate of Law 4014/2011 (209 / A), in compliance with Directive 2014/52/EU "amending Directive 2011/92 /EU on the assessment of the effects of certain public and private projects of the European Parliament and of the Council of 16 April 2014 '(Government Gazette 304 /B /2.2.2018)
JMD 50743/2017	Revision of National List of Areas of the European Ecological Network Natura 2000", GG 4432/B/15-12-2017
MD 40332/2014	Approval of National Biodiversity Strategy for the years 2014-2029 and Five-years Action Plan, (GG 2383)
MD 170225/2014	Requirements for EIA reports and decision content , Specialization of the contents of the environmental licensing applications for projects and activities of Category A of the decision of the Minister of Environment, Energy and Climate Change with no. 1958/2012 (21/B) as in force, according to article 11 of Law 4014/2011 (209 / A), as well as any other relevant details", (GG 135B/2014)
JMD 1649/45/2014	"Specialization of the procedures of the public opinion and information, and participation of the interested in the public consultation through the

[7] Free translation of the titles of the Laws and JMD, MD titles

	environmental licensing of projects and activities of Category A of the decision of the Minister of Environment, Energy and Climate Change No. 1958/2012 (Government Gazette 21 / A), in accordance with the provisions of article 19 par. 9 of law 4014/2011 (Government Gazette 209 / A), as well as any other relevant details ", (Government Gazette 45 / B '/ 14.1.2014)
MD 167563/2013	Specialization of the procedures and more specific criteria for environmental licensing of the projects and activities of articles 3, 4, 5, 6 and 7 of Law 4014/2011 ... as well as any other related to these procedures, (B 964) (Government Gazette B 2878 / 27.10.2014)
MD 3791/ 2013	Standard Environmental Commitments for Renewable Energy Projects classified in Category B of the 10th Renewable Energy Sources Group of Annex X of Ministerial Decision No. 1958/2012 (B 21), a / a 1, 2, 8 and 9.
JMD 167563/2013	Procedural details, Specialization of the procedures and specific criteria for the environmental licensing of the projects and activities of Articles 3, 4, 5, 6 and 7 of Law 4014/2011, in accordance with Article 2 (13) thereof, of the special forms of the above procedures, as well as any other matter relating to those procedures", (GG 964/B`/19.4.2013)
MD 52983/1952/2013	Specifications of the Appropriate Assessment for projects and activities of category B of article 10 of Law 4014/2011 (Government Gazette 209/A) "Environmental licensing of projects and activities, regulation of arbitrary in connection with the creation of an environmental balance and other provisions of competence of the Ministry of Environment, Energy and Climate Change, (GG 2436/B`/27.9.2013)
JMD 8353/276/E103/23.02.2012	Amending and supplementing of the JMD 37338/1807/2010 -Determination of measures and procedures for the conservation of wildlife and its habitats / nests in compliance with Directive 79/409/EEC.." (B 1495), in compliance with the provisions of the first paragraph of Article 4 of Directive 79/409 /EEC "On the conservation of wild birds, of the European Council of 2 April 1979 as codified in Directive 2009/147/ EC. 2012
MD 1958/2012	Classification of public and private projects and activities in categories and subcategories according to Article 1 paragraph 4 of Law 4014/21.09.2011 (Official Gazette A209 /2011)", (Government Gazette 21/B '/13.1 .2012) (B'21)
MD 48963/2012	Content Requirements, Content of Environmental Terms Approval Decision (ETAD) for projects and activities of Category A Ministerial Decision No. 1958/2012. ... according to article 2 par. 7 of Law 4014/2011
MD 20741/2012	"Amendment of MD 1958/13.12.2012 of the Minister of Environment, Energy and Climate Change" Classification of public and private projects and activities in categories and subcategories according to article 1 paragraph 4 of Law 4014/ 21.9.2011 (209/A)" (21/B)", (Government Gazette 1565/B '/ 8.5.2012)
MD 21398/2012	Publication of decisions on the Internet , Establishment and operation of a special web site for the posting of decisions of the Environmental Terms Approval Decision ETAD, the decisions for the renewal or modification of ETAD according to article 19a of Law 4014/2011 (Government Gazette 209/A/2011) ", (Government Gazette 1470/ B `/3.5.2012)
MD 40332/2012	National Biodiversity Strategy for the years 2014-2029 and a Five-Year Action Plan
JMD 110/1205322/ 2012	Determination of technical specifications for the implementation of studies for the boundaries of the terrestrial sites in NATURA 2000 network - updating, description and demarcation of terrestrial habitat types in Sites of Community Importance", GG 1419B / 30-04-2012)
MD 1958/2012	Classification of public and private projects and activities in categories and subcategories according to Article 1 paragraph 4 of Law 4014 / 21.09.2011 (Official Gazette A209 / 2011) ", Official Gazette 21 /B /13-1- 2012

JMD Φ.15/4187/266/2012	Definition of Standard Environmental Commitments (SEC), by division of activity, at the installation-operating permission, for the activities that fall under the scope of Law 3982/2011 and are classified in Category B of article 1 of Law 4014/2011", (Government Gazette 1275/B`/11.4.2012)
JMD 3137/191/Φ.15/2012	Matching of the categories of industrial and craft and electricity generation activities with the degree of nuisance referred to in the planning decrees, (Government Gazette 1048/B'/4.4.2012)
MD 48963/2012	Content of decisions of the ETAD of projects and activities of category A of Decision No 1598/13.1.12 of the Minister of Environment, Energy and Climate Change (21/B), as in force under with Article 2 §7 of Law 4014/11 (209 / A)", (Government Gazette 2703 / B '/ 5.10.2012)
JMD 37338/1807/E.103/1-9-10)	Determination of measures and procedures for the conservation of wildlife and its habitats / nests, in compliance with the provisions of Directive 79/409 /EEC," On the conservation of wild birds "of the European Council of 2 April 1979, as codified Directive 2009/147 / EC. and amendment 33318/3028/1998 ", (Government Gazette 1495 / B / 6-9-10
MD 15277/12	Specialization of procedures for the incorporation in ETAD or SEC, of the Forest Law on intervention approval, for Category A and B projects and activities of Ministerial Decree 1958/2012 (Government Gazette 21/B/13.1.2012), in accordance with article 12 of Law 4014/2011 "(Government Gazette 1077/B/12)
JMD 37338/1807/.103, 2010E	Determination of measures and procedures for the conservation of wildlife and its habitats / nests, in compliance with the provisions of Directive 79/409/EEC," On the conservation of wild birds "of the European Council of 2 April 1979, as codified Directive 2009/147/EC ", (Government Gazette 1495 B)
JMD Η.Π. 14849/853/Ε103/2008	Amendment of JMD 33318/3028/1998 (B'1289) and JMD No 29459/1510/2005 (B'992), in compliance with the provisions of Council Directive 2006/105 of 20 November 2006 of the European Union, Official Gazette 645B/2008
JMD 49828/8.12.2008	Spatial Planning for Sustainable Development of Renewable Energy Sources, GG. 2464B /3-12-2008
JMD 33318/3028/11-12-1998	Determination of measures and procedures for the conservation of natural habitats and of wild fauna and flora", (Government Gazette 1289 / B / 28-12-98)
MD 414985/18.12/1985	Measures for the Management of Wild Birds, Government Gazette B-757/16-12-1985.

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CRES
19^{th} klm Marathonos Avenue
190 09 Pikermi
Tel.: + 30 210 6603300
Fax: + 30 210 6603301
e-mail: cres@cres.gr
www.cres.gr

NCC Ltd
Gythiou 4, 152 31, Chalandri,
Tel.: +30 210 6743044
Fax: +30 210 6743041
e-mail: info@n2c.gr
www.n2c.grr