Wind power and biodiversity

Taking stock of the wind industry's contribution to biodiversity in France

France Energie Eolienne

Capgemini invent

France Energie Eolienne

Founded in 1996, France Énergie Éolienne (FEE) is a trade association that represents, promotes and supports wind energy in France.

Construction
> 90%

Operation
> 85%

France Énergie Éolienne brings together more than 300 members from the French wind industry, which account for the installation of more than 90% of all turbines installed in the country and the operation of more than 85%.

France Énergie Éolienne is present throughout the country. It brings together all types of industry participants, including developers, operators, turbine manufacturers, component manufacturers and consultancies.

Key figures

of the French wind industry

3d
LARGEST POWER SOURCE IN FRANCE [1]

7,7%
OF FRANCE'S ELECTRICITY USE [2]

N°1
EMPLOYER AMONG RENEWABLE ENERGIES IN FRANCE [3]

25 500
JOBS [4]

8 Mds €
PROVIDED TO THE STATE BY THE WIND INDUSTRY IN 2022–2023 [5]

≈ 9,000
WIND TURBINES INSTALLED THROUGHOUT THE COUNTRY [6]

€ 235 million
IN TAX REVENUE COLLECTED BY MUNICIPALITIES AND REGIONAL AUTHORITIES IN 2021, FOR THE BENEFIT OF ALL [7]

11 ONLY gCO_2eq
EMITTED PER KWH, MAKING IT THE CLEANEST RENEWABLE ENERGY OPTION [8]

206 million
TONS OF AVOIDED CO_{2EQ} EMISSIONS BETWEEN 2000 AND 2019 THANKS TO RENEWABLE ENERGIES [9]

€ 20-30 million
INVESTED EACH YEAR IN FAVOUR OF BIODIVERSITY BY THE WIND INDUSTRY [10]

[1] RTE
[2] RTE
[3] Observ'ER
[4] Wind observatory 2022
[5] Deliberation no. 2022-202 by CRE, the French Energy Regulation Commission
[6] Wind observatory 2022
[7] Wind observatory 2022
[8] IPCC WG3 AR5 Annex III, 2014
[9] Étude des bénéfices liés au développement des énergies renouvelables et de récupération en France [Assessment of the benefits related to the development of renewable and recovered energies in France] (ADEME, 2022)
[10] FEE survey

Foreword

Since the 1990s, the Intergovernmental Panel on Climate Change (IPCC) has been warning of the consequences of human activity on climate change. Human activity is also the third largest driver of biodiversity loss.[1] Its latest report highlighted the dramatic and unprecedented upheaval unequivocally caused by humans.[2] The use of fossil fuels and land take (artificialisation) in particular are leading to adverse consequences that will continue far into the future and will spare no region of the world.

These changes impact not only human societies, but also ecosystems. Biodiversity is bearing the brunt of climate change. The IPCC estimates that up to 30% of terrestrial species would face extinction should global temperatures rise by 3 °C by 2100, which is the current trajectory.[3]

This exceptional crisis experienced by biodiversity is already leading to the sixth mass extinction. The Intergovernmental Science-Policy Panel on Biodiversity and Ecosystem Services (IPBES) has been relentlessly alerting us to the fact that the extinction rate of animal and plant species is "unprecedented" and accelerating, with 1 million species currently facing extinction.[4]

We are facing an emergency – an urgent need to save the existing biodiversity we depend on and to stop damage to the climate – in other words, there's an urgent need to take action.

To do so, we must drastically reduce our greenhouse gas emissions and energy production has a key role to play, through the triptych of sobriety (consume less), efficiency (consume better) and low-carbon energies. The IPCC is adamant: in addition to radical changes in our lifestyles, we must use every technology that can support the energy transition, and, as a first step, renewables (solar, biogas and, more importantly, wind power).[5]

Given their active role in achieving carbon neutrality, renewable energy sources lower human impact on biodiversity. And, thanks to the awareness and commitment of industry players in France, they are contributing to bucking existing trends.

Even so, many misconceptions remain in terms of the quantification and qualification of the negative impacts of wind power on biodiversity, and are even exploited by anti-wind lobbies. For example, the impact on flying animals (bats and birds) is one of the subjects that is acknowledged, addressed and well on track of being properly managed by the wind power industry, science and public authorities. Yet, it is very often thrown around by local and national opponents to wind power, sometimes without even taking into consideration territorial specificities or the state of the art solutions on the topic. It is time to shift away from any ideological antagonism and strive to come up with the best solutions for the environment.

[1] IUCN World Conservation Congress 2021
[2] IPCC, AR6 Climate change 2021: the physical science basis
[3] IPCC, AR6 Climate change 2021: impacts, adaptation and vulnerability
[4] Global assessment report on biodiversity and ecosystem services (IPBES, 2019)
[5] IPCC, AR6 Climate change 2021: mitigation of climate change

Given the emergency in protecting the climate and biodiversity, we cannot continue engaging in these dogmatic objections, which are disconnected from scientific reality. With the intent of offering a better understanding of these complex issues, we deemed it crucial to show how the wind industry has, from the very start, been bringing together an ecosystem of varied and committed players around issues related to biodiversity protection. The wind power sector is indeed fully aware of its strengths as well as its impacts, and, though this is, as of yet, still unrecognised, it already provides many solutions to mitigate many negative repercussions.

This booklet was written in order to meet the three following key goals:

1. Disclosing and broadcasting the actual impacts of wind farms (whether onshore or offshore) on biodiversity.
2. Spelling out how the challenges of biodiversity are taken into account throughout the wind power project lifecycle.
3. Presenting the measures and commitments taken by the French wind industry to keep residual impacts of wind turbines on birds and bats to a minimum.

This document was drafted together with all stakeholders involved in biodiversity issues related to wind power – wind farm builders and operators, consultancies and environmental protection groups. We strongly focus on flying animals, which are the primary and legitimate concern of many citizens during the construction of wind farms.

The goal of this booklet is to provide readers with an understanding of the care taken by the French wind sector to ensure biodiversity preservation. Safeguarding the climate and biodiversity are inseparable struggles, and every single member of the industry is genuinely committed to fighting on both fronts these two battles for our survival.

On behalf of this ecosystem of committed and ardent players which I am honoured to represent, I wish you an insightful read!

Roy Mahfouz

President of the Environment Committee of France Énergie Éolienne

Black kite
© Jérémy Thomas

Wind power and its environmental challenges

© Enercon

The twin crises of climate and biodiversity

The emergency of protecting biodiversity

Biodiversity* refers to all living creatures, the ecosystems in which they live, and the interactions between species and between species and their environment.[1] Scientists currently agree that we are currently experiencing the **6th mass extinction of the planet's fauna**, as more than **1 out of every 8 species is likely to become extinct** in the next few decades.

According to the scientists at IPBES* (an equivalent of the IPCC* for biodiversity), there are 5 key drivers of **biodiversity loss**:[2]

1. **Changes in land and sea use**, with the destruction and fragmentation of natural habitats due to urbanisation, transports, intensive farming, etc.
2. **Direct exploitation of organisms**, in particular the overexploitation of wild species including overfishing, deforestation, and poaching.
3. **Climate change**, which contributes to changing the living conditions of species.
4. **Pollution** (water, soil, and air pollution, as well as light and sound pollution).
5. Invasive alien species.

THE FACTS

Almost 30% of birds living in built environments or farmland in France have disappeared over the course of 30 years[3]

68% of wild vertebrates around the world have disappeared over the course of 50 years[4]

28% of all animal species are threatened with extinction according to the IUCN Red List

[1] Qu'est-ce que la biodiversité [What is biodiversity?] (OFB)
[2] IUCN World Conservation Congress 2021
[3] Suivi des oiseaux communs en France : bilan 1989/2019 [Monitoring of common birds in France: 1989/2019 comparison] (LPO)
[4] Living Planet Report 2020 (WWF)

Climate change, a major threat to biodiversity

Climate change is already the **third-largest cause of biodiversity loss** and may even become the leading driver of this mass extinction in the next few decades. The **impact of greenhouse gas emissions** will first impact **terrestrial plants**, as they will not be able to migrate quickly enough towards regions with a more favourable climate. It will also affect **marine biodiversity**, which is vulnerable to ocean acidification. **All biodiversity** existing on Earth will then be affected, in particular through the knock-on effects on food web dynamics.

Coral reefs killed by warming waters

Protecting the climate and biodiversity: a common struggle

In a joint report, IPBES and IPCC emphasised that **we cannot address the biodiversity crisis independently from the climate crisis**, and lamented that these two problems are all too often considered independently from each other.[5]

In the face of this double systemic crisis, **we can no longer think in silos**: it is crucial that we shift towards a **carbon-free world and a preserved biodiversity**. This is the only framework that should be used to assess whether a technology is relevant or not, fully taking into account its impacts on climate and biodiversity.

[5] IPBES-IPCC co-sponsored workshop report on biodiversity and climate change

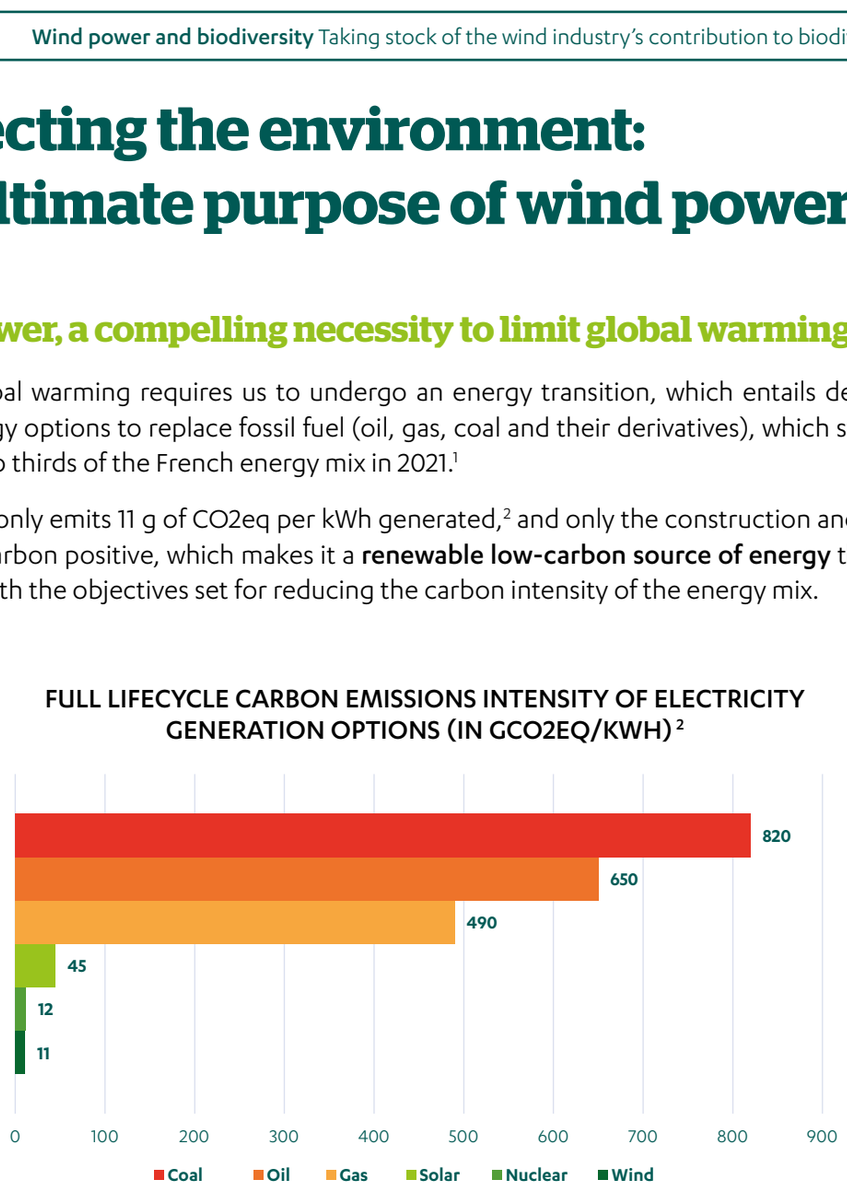
Protecting the environment: the ultimate purpose of wind power

Wind power, a compelling necessity to limit global warming

Limiting global warming requires us to undergo an energy transition, which entails deploying low-carbon energy options to replace fossil fuel (oil, gas, coal and their derivatives), which still amounted to almost two thirds of the French energy mix in 2021.[1]

Wind power only emits 11 g of CO2eq per kWh generated,[2] and only the construction and dismantling phases are carbon positive, which makes it a **renewable low-carbon source of energy** that is entirely consistent with the objectives set for reducing the carbon intensity of the energy mix.

FULL LIFECYCLE CARBON EMISSIONS INTENSITY OF ELECTRICITY GENERATION OPTIONS (IN GCO2EQ/KWH) [2]



The success of the energy transition can only be achieved by scaling up wind electricity generation. In its report on "Energy Futures 2050", RTE, France's transmission system operator, demonstrates the need for expanding installed wind power capacity by a factor of 2.5 to 4, in all scenarios considered (including under strong assumptions regarding energy sobriety and an increased use of nuclear power).

Wind power development is therefore key in achieving carbon neutrality,* and contributes to preserving a climate that is supportive of biodiversity.

[1] Chiffres clés de l'énergie [Key energy figures], 2021 edition

[2] IPCC WG3 AR5 Annex III, 2014

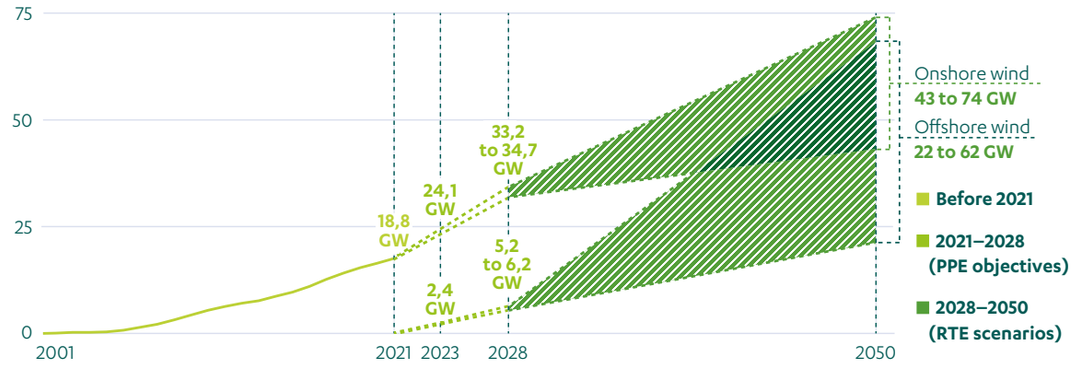
Ambitious objectives must be achieved

The need for increased wind power use has been enshrined in various laws and regulations, including:

> The Energy Transition for Green Growth Act (adopted in 2015), which set the goal of getting the **share of renewable energies in total power generation to 40%** by 2030, amounting to a twofold increase in the share of renewables over 15 years.

> The multiannual energy plan (PPE), which defines concrete objectives to be achieved by the industry for successive five-year periods. The upcoming deadline, in 2023, calls for a grid-connected capacity of **24.6 GW for onshore wind and 2.4 GW for offshore wind**. As at 31 December 2021, however, **only 18.8 GW of onshore wind capacity had been commissioned, while no offshore turbine was yet installed**.[3] A rapid acceleration in the deployment of wind power is therefore needed.

TRENDS AND PROJECTIONS FOR CONNECTION WIND POWER IN FRANCE (IN GW)[4]



What is the net impact on biodiversity?

By addressing global warming, **wind power therefore has an indirect positive impact, globally and in the medium term, on biodiversity**. It also has direct, local and immediate impacts on the environment, which may be positive or negative.

By reviewing the positive and negative impacts of wind power, and how any negative impacts are mitigated by industry players, this booklet will help readers understand the net effect of wind power on biodiversity, and on birds and bats in particular.

[3] Electricity report for 2021, RTE

[4] Electricity report for 2021, RTE; Energy futures 2050, RTE

Impacts of onshore wind: sorting true from false

Misconception n° 1

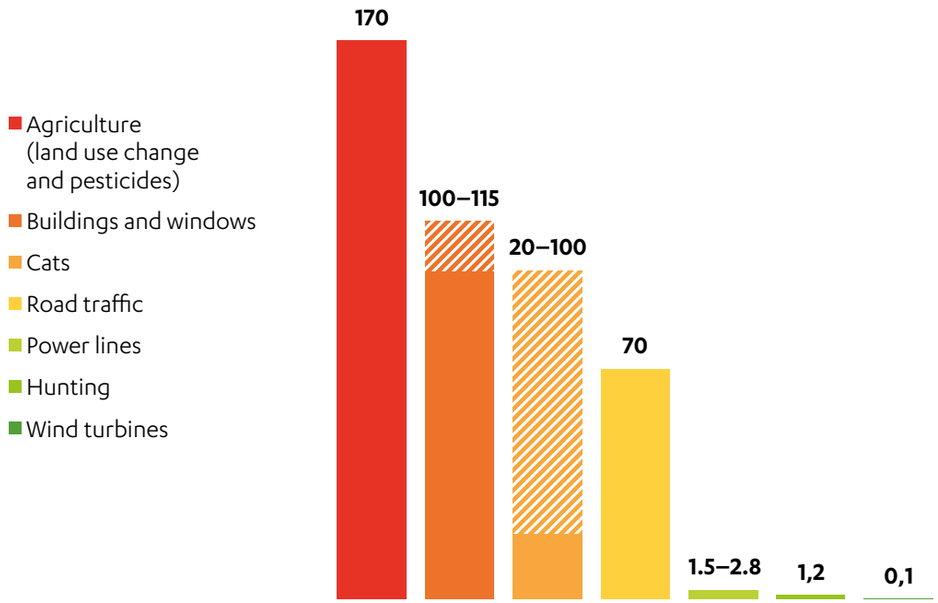
"Wind turbines devastate flying animals..."

Depending on local circumstances, wind power may have direct and indirect impacts on birds and bats. For instance, habitat changes can affect how these animals feed (by impacting prey numbers) and disturbances can lead bird populations to avoid or move away from wind farm sites.

There is also a risk of collision with rotor blades. According to the French League for the Protection of Birds (LPO), a single wind turbine can cause the death of 0 to 18 birds per year.[1]

The impact of wind turbines is nevertheless much lower than that of other human activities:

ANTHROPIC CAUSES OF AVIAN FATALITIES IN GERMANY[2]
(IN MILLIONS OF INDIVIDUALS KILLED PER YEAR)



[1] Éoliennes & Biodiversité : Synthèse des connaissances sur les impacts et les moyens de les atténuer [Wind turbines & biodiversity: current knowledge on impacts and how to mitigate them] (LPO, 2019)
[2] Das große Vogelsterben [The great killing of birds] (NABU, 2018)

Misconception n° 2

"Wind turbines damage our landscapes..."

In France, almost two thirds of the energy we use is imported[3] (in the form of coal, oil or gas and their derivatives). The means of production of these resources are therefore removed from the sight of the population. The current energy crisis has highlighted our dependence in this area. Succeeding in achieving the energy transition while enjoying a certain amount of self-sufficiency therefore implies bringing electricity generation closer to home.

Wind farms have thus become strictly necessary. They must be made to better fit into the landscape, however. For this reason, **landscape studies are mandatory** for all wind projects, ensuring the best possible integration of wind turbines within the landscape, notably by reflecting on how wind turbine locations can be adapted based on the characteristics of the landscape and ensuring that they are not visible from any major heritage sites. **Taking the landscape into account is thus a crucial aspect of any wind project, on the same terms as biodiversity.**

Misconception n° 3

"Wind turbines degrade soils..."

Wind power doesn't pollute the soil, as the Portland cement that is used to build turbine foundations is an inert mineral material. In greater detail, during construction, some earthworks are required over a typical surface of around 500 m². In addition, it is sometimes necessary to widen or create pathways, both to allow access to vehicles during the construction phase and for maintenance purposes. Existing regulations indeed provide that "the site is equipped with an access road providing vehicular access on a permanent basis, in order to allow for the intervention of fire and rescue services."[4] But, ultimately, **wind turbines have a small physical footprint** – once installed, only at most 0.5 ha remain uncultivable in the vicinity of each turbine. Finally, when a wind farm is dismantled (entirely at the expense of the company operating it), all the concrete foundations (which are, incidentally, recyclable) are systematically excavated and the soils are restored. **Where wind power passes, grass grows back!**

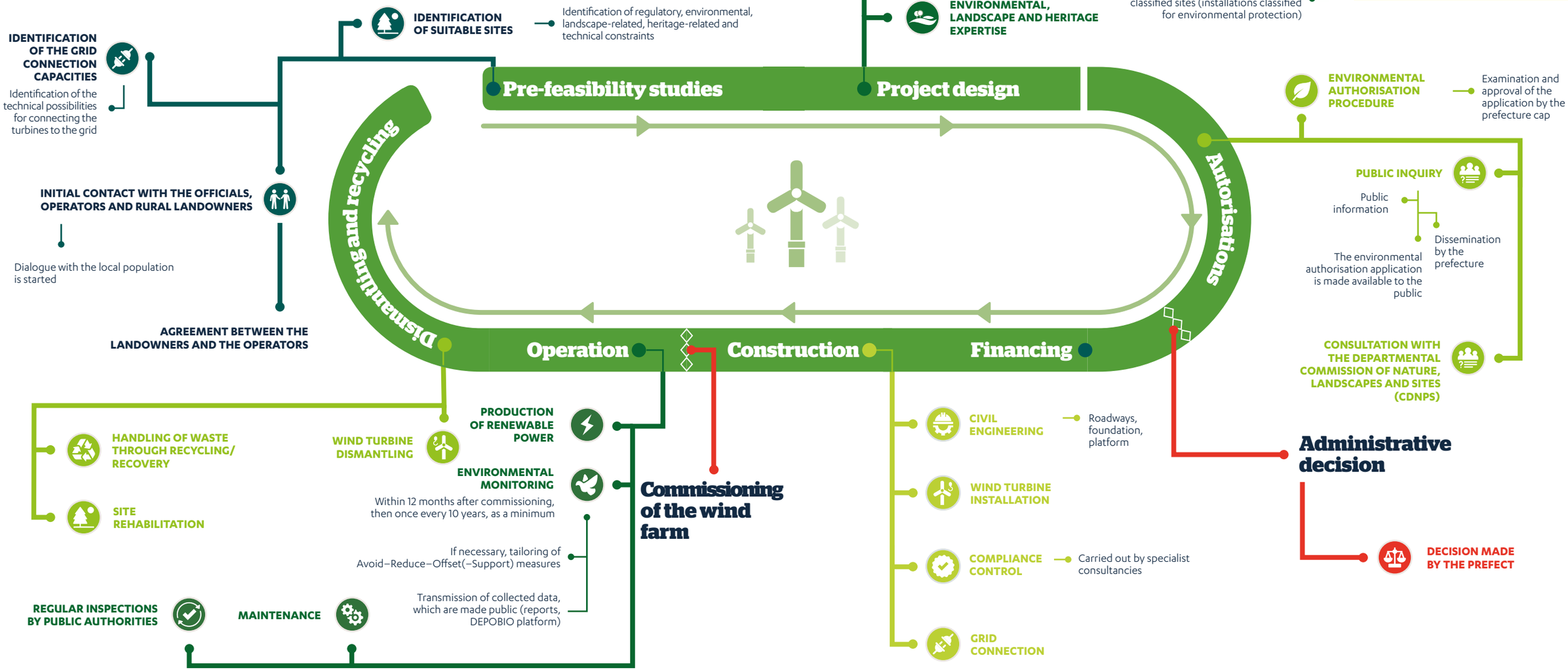
[3] Chiffres clés de l'énergie [Key energy figures], 2021 edition (French Ministry of Ecological Transition)
[4] French ministerial order on ICPE installations of 26 August 2011

Biodiversity at the heart and core of wind power projects

The construction of a wind project viewed through the prism of biodiversity

The environment and biodiversity are taken into account at all stages of wind power projects. They involve many different stakeholders and, during the public inquiry, any citizen can express their views regarding the conditions around the wind farm development and any issue that must be taken into account in that process.

During the project design phase, co-construction can be set up between the wind farm developer and biodiversity conservation groups. Furthermore, the French Office for Biodiversity (OFB) (see the text box on the opposite page) can come in at each stage of the wind project in order to ensure full compliance with applicable environmental standards.



ZOOM ON THE FRENCH OFFICE FOR BIODIVERSITY (OFB)

OFB is a public institution dedicated to protecting biodiversity. It has 1,600 environmental inspectors and is vested with the authority to ascertain violations and issue summons.

Companies may be held accountable for failing to meet commitments relating to biodiversity.

Taking biodiversity into account in wind projects

Wind farm site selection isn't random. First of all, given that they are ICPE classified sites (installations classified for the environmental protection), they cannot be located less than 500 m away from housing.

In areas subject to such obligations, wind developers must review a large number of environmental, technical and landscape-related constraints.

Taking biodiversity into account to determine the location of a wind farm entails preparing an impact assessment study with the intention of reporting on the impacts of the project on the environment. The feasibility study as well as the impact assessment study take an average of one year to be prepared, in order for wildlife species to be monitored over their full annual lifecycle.[1]

The IPCE regulation also requires operators to carry out actions relating to the dismantling and recycling of the components that make up the wind turbines (their generators and rotors). Wind farm maintenance and monitoring operations are defined within this framework.[1]

PARAMETERS TAKEN INTO ACCOUNT IN WIND FARM SITE SELECTION

[1] Guide relatif à l'élaboration des études d'impacts des projets de parcs éoliens terrestres [Guidelines for the preparation of impact assessments for onshore wind farms] (French Ministry of Ecological Transition, 2020)

In order to make it easier to take environmental issues into account in projects, the **Avoid–Reduce–Offset method** was developed. It provides a standardised framework for the assessment and reduction of the impact of any project, including wind projects.

This method has been enshrined in the French Environmental Code since 1976 and lays out a shared methodological approach.

It defines a mitigation hierarchy of biodiversity protection measures which are prioritised as follows:

1. **Avoid** negative impacts by making changes to the project.
2. **Reduce** the extent of the impacts that couldn't be avoided.
3. **Offset** any residual impacts that couldn't be avoided or sufficiently reduced (by providing gains that are at least equivalent to the losses).

These three stages may be supplemented with supporting measures:

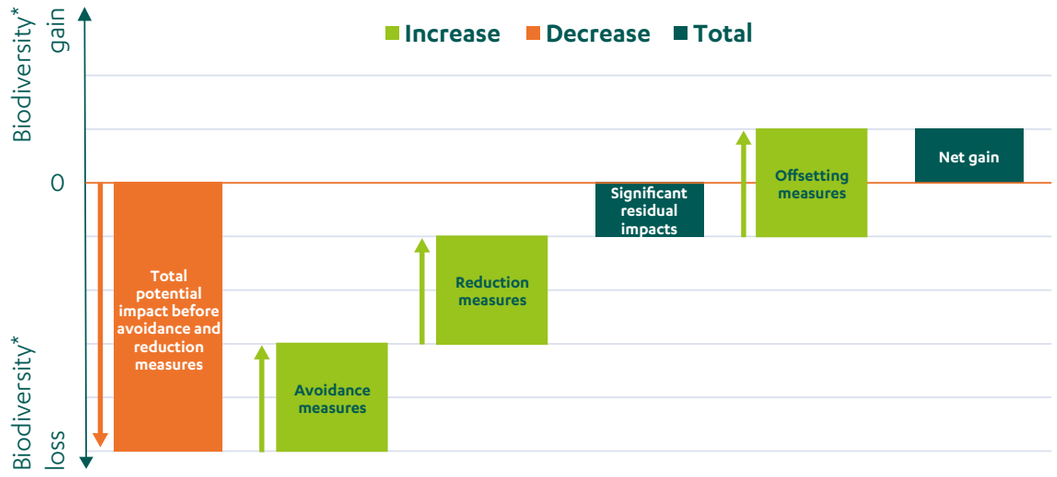
4. **Support** the efficiency of Avoid–Reduce–Offset measures with additional measures in order to provide additional guarantees for success.

Strict adherence to this sequence allows for proper consideration of biodiversity challenges. Each wind developer then has a capacity to justify specific measures tailored to each step of the Avoid–Reduce–Offset approach.

Once this method is applied, there must be assurance that there is no net biodiversity loss, or even a biodiversity gain, for a project to be considered.

In addition, **environmental monitoring** allows for adaptive management of risks and impacts during operating stage. Environmental monitoring studies are conducted within 12 months after commissioning, then once every 10 years, at a minimum. Protocols are defined as early as the environmental authorisation stage in order to provide a methodological framework to these monitoring programmes and ensure that outcomes can be compared with the baseline environmental situation. The findings are systematically reported to the DREAL (Regional Departments of the Environment, Planning and Housing). If any marked discrepancies between actual and estimated impacts are identified, the Avoid–Reduce–Offset measures will be adapted, possibly also supplementing them with new ones.

ENVIRONMENTAL ASSESSMENT USING THE AVOID–REDUCE–OFFSET APPROACH[2]



[2] Approche standardisée du dimensionnement de la compensation écologique [Standardised approach for sizing compensatory mitigation] (French Ministry of Ecological Transition, 2021)

Avoidance measures

DEFINITION

"An avoidance measure changes a project or action set out by a planning document in order to eliminate an identified negative impact that this project or action would have generated. This could be "doing or not doing", "doing less", "doing elsewhere" or "doing in another way." An avoidance measure targets a specific impact. Reduction or offsetting measures only come in when that negative impact hasn't been completely eliminated or reduced."[1]

Avoidance measures are the only ones that can entirely eliminate the impact on biodiversity from a project. They therefore have precedence over reduction and offsetting. Avoidance can be implemented in both:

- **The construction phase**, by carrying out measures to avoid, to the largest extent possible, the impacts of the construction of a wind farm.
- **The operation phase**, by anticipating, from the design phase, measures that will avoid producing possible impacts once the wind farm is in operation.

There are 4 major types of avoidance measures:[2]

Early-stage avoidance ("doing or not doing", "doing less"):
Define the development needs as accurately as possible in order to limit its impact.

e.g. removal of one or more turbines planned in areas involving significant issues.

Spatial avoidance ("doing elsewhere", "doing less"):
Change the layout, location or accesses of a project in order to avoid having a negative impact on a biodiversity hotspot.

e.g. relocating turbines to avoid wetlands or areas that are favourable for a protected species, plotting accesses that avoid removing cavity trees, which have value for bats.

Temporal avoidance ("doing at another point in time"):
Shift nuisances in time (construction noise or lighting for example) when they'll have no impact.

e.g. adapting the construction schedule to the biological cycle of birds and bats (avoiding nocturnal work, work during breeding seasons, etc.)

Technical avoidance ("doing in another way"):
Make the appropriate technical choices (on protective devices for instance) in order to eliminate identified adverse impacts.

e.g. undergrounding overhead lines.

[1] Lignes directrices nationales sur la séquence éviter, réduire et compenser les impacts sur les milieux naturels [National guidelines on the application of the Avoid–Reduce–Offset sequence to impacts on natural environments] (French Ministry for Ecology, Sustainable Development and Energy, 2013)

[2] Approche standardisée du dimensionnement de la compensation écologique [Standardised approach for sizing compensatory mitigation] (French Ministry of Ecological Transition, 2021)

Reduction measures

DEFINITION

"A reduction measure is defined after the avoidance stage and aims to reduce any negative impacts, whether temporary or permanent, of a given project on the environment, during the construction stage or operation. It can act by reducing the duration of the impacts, their intensity, their extent, or a combination thereof."[3]

Reduction measures are not fundamentally different from avoidance measures. They often take the same form in the field, and a given measure can be either an avoidance measure (if it completely eliminates the impact) or a reduction measure (if a residual impact remains), depending on how effective it is.

Unlike avoidance measures, they don't significantly change the programming given that they often come in later, and serve to reduce the impacts of a project that has already been approved.

There are 3 major types of reduction measures:[4]

Spatial reduction ("doing elsewhere", "doing less"):
Changing the location, footprint or alignment of a project in order to limit its impact on a sensitive area.

e.g. placing wind turbines away from the edge of hedges or forests in order to reduce the impacts on flying animals, increasing the distance between turbines in order to minimise any barrier effect.

Technical reduction ("doing in another way"):
Make the appropriate technical choices (on protective devices for instance) in order to eliminate identified adverse impacts.

e.g. grounding power poles that have stork nests to make them safe for the birds, acoustic deterrent devices, static curtailment (the turbine is pre-programmed to stop under certain conditions) or dynamic curtailment (the turbine is stopped when a flying animal is detected) of wind turbines to lower collision risks.

Temporal avoidance ("doing at another point in time"):
Shift nuisances in time (construction noise or lighting for example) when they'll have no impact.

e.g. shift disturbances in time (construction noise or lighting for example) based on the life cycle of species.

[3] Évaluation environnementale : Classification des mesures ERC [Environmental assessment: Classification of Avoid–Reduce–Offset measures] (French Ministry for an Ecological and Inclusive Transition, 2019)

[4] Évaluation environnementale : Guide d'aide à la définition des mesures ERC [Environmental assessment: Helping guide for defining Avoid–Reduce–Offset measures] (French Ministry for an Ecological and Inclusive Transition, 2018)

Offsetting measures

DEFINITION

"The purpose of offsetting measures is to compensate any significant negative impacts, whether direct or indirect, that couldn't be avoided or sufficiently reduced." (French Environmental Code)

They ensure that there is no net biodiversity loss or even a net biodiversity gain.

Offsetting measures aim at responding to a significant residual impact, that is to an impact that remains in existence after implementing avoidance and reduction measures and that is likely to harm the ecosystem, for instance through the destruction of alteration of species or habitats.[1]

Offsetting consists in:

1 objective: achieving a net biodiversity gain:

4 criteria must be met:[2]

Effectiveness
The measure has a performance obligation.

Continuity
The measure must have a lasting effect, through land acquisition, for example.

Functional proximity
The measure must be implemented on the impacted site, or in its vicinity, in order to ensure its functionality.

Temporality
The measure must be effective from the outset of construction.

There are 3 major types of offsetting measures:

Restoration and rehabilitation measures:
Action on a degraded environment (due to human activity or natural evolution) in order to bring it to a state that is more conducive to its effective operation and/or biodiversity.

e.g. rehabilitating a wetland in order to benefit the flora and fauna.

Creation measures:
Creating a habitat on a site where there was initially none.

e.g. creating artificial shelters or feeding areas for wildlife.

Management measures:
Action that ensures the optimal management of an environment, species, or their habitat.

e.g. giving up or substantially reducing pesticide use.

[1] Évaluation environnementale : Guide d'aide à la définition des mesures ERC [Environmental assessment: Helping Guide for Defining Avoid–Reduce–Offset measures] (French Ministry for an Ecological and Inclusive Transition, 2018)
[2] Approche standardisée du dimensionnement de la compensation écologique [Standardised approach for sizing compensatory mitigation] (French Ministry of Ecological Transition, 2021)

Supporting measures

DEFINITION

Supporting measures aren't regulatory obligations. They are "measures aiming at improving the efficiency or providing additional guarantees of success to offsetting measures."[3]

Take care, however, as supporting measures aren't by themselves sufficient to offset impacts.

Supporting measures are comprised of measures that can't be traced back to avoidance, reduction or offsetting, such as additional actions aimed at improving knowledge (research on certain animal or plant species) or preservation.

The commitment of wind power companies in implementing supporting measures reflects their goodwill for biodiversity protection. Indeed, implementing supporting measures is optional, though, when they're listed in the authorisation applications, project owners are then required to implement them, as is the case for all other measures mentioned in the application, whether they're specifically included in the authorisation decree or not.[3]

8 main types of supporting measures:

- Experimental actions
- Safeguarding the land
- Governance and awareness raising
- Lasting offsetting measures
- Landscape development
- Rehabilitating wildlife habitats
- Expanded resources for offsetting measures
- Funding research, public policy...

[3] Évaluation environnementale : Guide d'aide à la définition des mesures ERC [Environmental assessment: Helping Guide for Defining Avoid–Reduce–Offset measures] (French Ministry for an Ecological and Inclusive Transition, 2018)

Monitoring actions

DEFINITION

The monitoring of Avoid–Reduce–Offset measures is mandatory and form part of the impact assessment of wind projects. Its purpose is to determine the effective impact of the actions taken and therefore to ensure that the objectives that have been laid out are indeed achieved, namely that there ultimately is no biodiversity loss or even a biodiversity gain.

Monitoring must be carried out for every planned Avoid–Reduce–Offset measure.

Monitoring measures consist in carrying out a series of data collections repeated over time, thus informing outcome indicators.

It is important to note that the project owner has an obligation to **provide situation reports**: several assessments must be carried out according to a predetermined schedule, verifying both the effectiveness of the Avoid–Reduce–Offset measures and their continuity over time.

Environmental monitoring

The **monitoring of Avoid–Reduce–Offset(–Support) measures** shouldn't be confused with **environmental monitoring** (as defined by the French ministerial order on ICPE installations from 26 August 2011), which aims, in particular, to estimate the number of bird and bat fatalities caused by the presence of wind turbines.

Except in special cases, environmental monitoring must begin within 12 months after the wind farm is commissioned in order **to ensure that assessments are made over a full, continuous biological cycle tailored to issues of concern for bats and birds**. These monitoring assessments are renewed within 12 months when any assessment shows that there is a significant impact and that it is necessary to verify the effectiveness of any corrective measures. At a minimum, the monitoring process is renewed every 10 years of operation. If any marked discrepancies between actual and estimated impacts are identified, the Avoid–Reduce–Offset measures are adapted, with the possibly of also supplementing them with new corrective measures.

The monitoring carried out by the operator must comply with the monitoring protocol recognised by the French state.

The raw data collected as part of the monitoring process is then entered into the DEPOBIO tool, thus contributing to an important national database for the knowledge of wildlife.

The 3 key objectives of environmental monitoring:

Building and maintaining a national database for a comprehensive and continuous overview of the impact of French wind farms on biodiversity

Assessing the magnitude of the wind farm's impact on wildlife

Objectively comparing the mortalities generated from one year to the next or between wind farms

Common kestrel
© Boris de Wolf

The pediment before, during and after construction work. © Enertrag

European bee-eaters dig out nesting burrows in steep exposed sandbanks or bluffs.
© Enertrag

Focus on...

The Goudelancourt-lès-Pierrepont wind farm (02)

7 turbines | 16.8 MW installed capacity | September 2019 Commissioning

ENERTRAG

CONTEXT

In 2018, thirty or so **European bee-eaters** (*Merops apiaster*) were identified in the vicinity of the future Goudelancourt-lès-Pierrepont wind farm.

Enertrag then committed to introduce actions in support of European bee-eaters over the next 15 years.

ACTIONS TAKEN

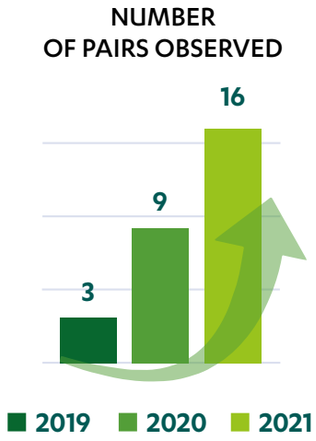
These measures primarily consisted in developing areas that are conducive to the nesting of bee-eaters. Enertag contributed to the restoration of an exposed bluff in which nests had been observed, and to the creation a pond in order to **improve the appeal of the site for flying insects** for bee-eaters to feed on.

Protection measures for the nesting site have also been put in place, in particular, to avoid any excessive disturbance of the birds.

OUTCOMES

The monitoring carried out following these actions revealed **a strong increase in the number of breeding pairs** using the site, which rose from 3 pairs in 2019 to 16 in 2021.

European bee-eater
© Robin Dixon



Sources:
Goudelancourt-lès-Pierrepont wind farm, Wind power impact assessment, May 2021
2021 assessment of the Goudelancourt-lès-Pierrepont site regarding the preservation of the European bee-eater colony, March 2022

Focus on...

The Saint-Congard wind farm (56)

4 turbines | 8.2 MW installed capacity | 2014 Commissioning

BayWa r.e.
ERG

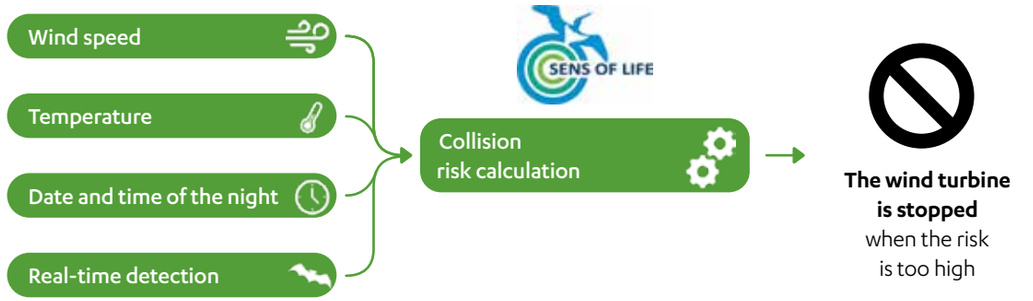
CONTEXT

The wind farm is surrounded with a bocage landscape that hosts many bats. Following environmental assessments in 2017 and 2018, BayWa.r.e., which operates the wind farm on behalf of ERG, decided to experiment with an **innovative device to reduce bat collision risks**.

ACTIONS TAKEN

BayWa.r.e. implemented the ProBat device (developed by Sens Of Life), which allows for the curtailment of the wind turbines, combining a predictive system with the real-time detection of bats.

The ProBat system takes into account parameters influencing the likelihood of the presence of bats, including **wind speed, temperature, the date and the time of the night**. In addition, the real-time detection of bat activity is carried out on two of the wind farm's turbines in order to optimise the curtailment.



OUTCOMES

After a successful experiment over a full year, the device has been **permanently installed since 2020**. Regulating the four turbines of the wind farm **with the approval of relevant public authorities**. It makes it possible to regulate the four turbines in the wind farm by making a trade-off between renewable energy generation and biodiversity preservation. **Over 90% of bat activity is then preserved at the expense of a production loss of under 1%** (compared with over 4% estimated using static curtailment techniques).

Sources:
Rapport ProBat – suivi de l'activité chiroptérologique en altitude [ProBat report – monitoring of altitude bat activity], TrackBat, Sens Of Life and BayWa.r.e. (February 2021).
Presentation on the detection/prevention of bat collisions and testing of devices on the Brittany wind farm at the 2019 Colloque National Éolien.
Contact point for further information: jerome.dumont@baywa-re.fr

Focus on...

The Saint-Pierre-de-Maillée III wind farm (86)

8 turbines | 24 MW installed capacity | 2017 Commissioning

eurocape New Energy

CONTEXT

The wind farm is located in open farmland, but some turbines are located close to the edge of woodland or hedges. During the impact assessment, a critical point relating to bird and bat issues was exposed. The wind farm is indeed located close to a **migration corridor for common cranes (*Grus grus*) and 18 bat species** were identified.


Common cranes
© Mathieu Aubry

ACTIONS TAKEN

In order to protect flying animals, several measures were implemented:

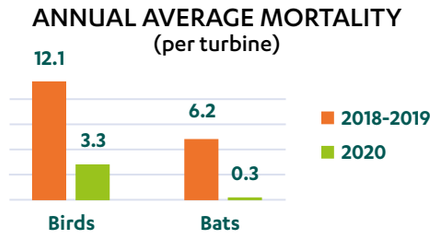
Halting the wind turbines entirely when common cranes are migrating through the area.

Turbines are curtailed during periods of agricultural activity (harvesting, ploughing, mowing) that are attractive to birds and during nocturnal periods, when bats are most active, based on precise parameters (time of the day or night, wind speed, temperature, etc.).

Prairies were restored some distance away from the wind turbines (so as to avoid increasing the likelihood of collisions) and certain plots of land were left fallow in order to ensure that the site remains appealing for any species already present there.

OUTCOMES

The progressive actions introduced by Eurocape have greatly reduced the impact of the wind farm on birds and bats to levels well below national averages.



Source: SPDM3 2020 annual report, environment section, 29 January 2021


© wpd

Focus on...
The Le Chemin d'Avesnes wind farm (60)

11 turbines | 39.6 MW installed capacity | July 2019 Commissioning

CONTEXT

Before the installation of the wind farm, a **major breeding ground for common gulls** (*Larus canus*) was identified in the vicinity of the site. It was observed that the birds regularly fed in the project area. Escofi and wfd therefore took measures to ensure that the **gull population would develop soundly** while also encouraging them to **feed far from the wind turbines** in order to minimise collision risks.

ACTIONS TAKEN

A contract was signed with a local farmer to ensure that **60 ha of farmland would be continuously cultivated** with crops **benefiting common gull feeding habits** over the entire service life of the wind farm. Escofi and wpd decided to invest in 50 additional hectares on top of the recommendations of the consultancy they hired.

Several gull population surveys were carried out in 2018, 2021 and 2022. The presence of the wind farm has therefore allowed updating local knowledge on the species and checking the effectiveness of the actions taken concerning their diet.


Common gull

OUTCOMES

The implemented action demonstrated its efficiency given that gulls have been repeatedly been observed to feed in the plots that were intended for them.

In addition, an **increase in the breeding population of common gulls was observed**, increasing from 2 to 3 pairs in 2014 to around ten pairs in 2021.

Sources:
The Le Chemin d'Avesnes wind farm, Monitoring of common gull populations during the 2018 breeding season (April 2019)
The Le Chemin d'Avesnes wind farm, municipalities of Avesnes-le-Sec and Iwuy, Monitoring of common gull populations (February 2022)

Focus on...

The Les Hayettes wind farm (60)

3 turbines | 7.05 MW installed capacity | October 2020 Commissioning

Alterric

CONTEXT

An in-depth study of bat activity on site **recorded at least 13 bat species** in the vicinity. The Les Hayettes site is therefore considered an important hotspot for bats.

ACTIONS TAKEN

In addition to Avoid–Reduce–Offset measures, Alterric has committed to funding a measure creating **strong ecological added value** – closing an underground cave system to the public in order to preserve its functionality in terms of **hosting bat populations**. The cave system was selected and the technical implementation of the measure planned in close collaboration with a conservation group. The system's 8 entrances were closed off to humans in 2020, on funding provided by the wind farm operator.

Horseshoe bat
© Boris de Wolf

OUTCOMES

This measure allowed bats to occupy the cave system **in complete tranquillity**. **Scientific monitoring is carried out by the environmental conservation group** to ensure the site remains attractive and that the species present hold up well.

The main objectives of the development of the bat sites are to:

- **Preserve the tranquillity** of the animals during the hibernation period.
- Allow the bats to use the caves as a **breeding site and to rear their young**.
- Ensure the possibility of carrying out **scientific monitoring**.

Source:
Environmental section of the preliminary impact assessment to the installation of a wind farm, Municipality of Lassigny, Les Hayettes wind farm

© Boris de Wolf

Co-constructing projects for biodiversity conservation

Co-construction: opportunities for our country's biodiversity

What is co-construction?

Co-construction with individuals

Co-construction workshops involving individuals serve as a participatory, open, and friendly form of dialogue, which is accessible to all: local residents, elected officials, technicians or just about anyone who's curious about the process.

Everyone takes part on an equal footing, in meetings with agendas that are often defined in advance by the participants themselves. These meetings allow for collective thinking about a local wind farm development project or about the best way of bringing in wind turbines in the municipality.

Thanks to their diverse backgrounds and their local knowledge, participants often help generate better solutions.


© Siemens Gamesa

Co-construction with non-profit groups

Co-construction can also involve non-profit groups or institutions. A project (wind farm development, implementation of Avoid–Reduce–Offset measures, deliberations on the wind industry, etc.) that makes use of co-construction will then benefit from the experience and expertise of biodiversity protection groups or public institutions such as ADEME (the French agency for the ecological transition) or ministries.

The 3 key advantages of co-construction:

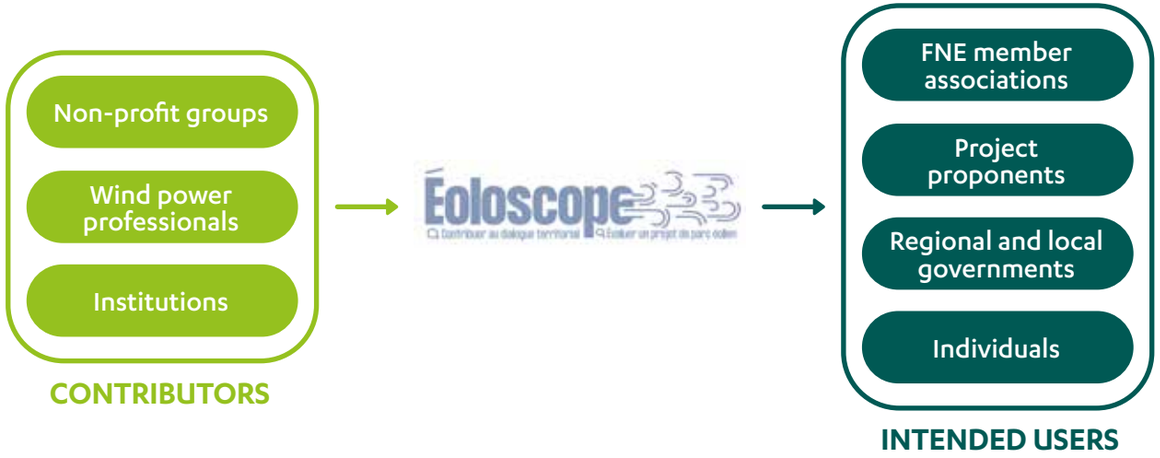
1. Helps make projects more relevant
2. Engages in local democratic activity
3. Brings stakeholders together around the project

An example of co-construction with a conservation group: Éoloscope

The Éoloscope is a booklet that includes an analytical framework that can serve as a common standard for evaluating the integration of environmental issues in a given wind project.

Published by France Nature Environnement (FNE) in 2020, it allows everyone to:

- Discover or deepen their knowledge of issues related to onshore wind power
- Facilitate dialogue with local stakeholders
- Position themselves in relation to a specific onshore wind farm project.



The Éoloscope lists:

"good practices"

and "critical points"

that must be implemented or managed at all stages of the project, based on different categories (planning, the sharing of information, etc.). A comprehensive dashboard can then be developed for the wind project, providing a framework that facilitates dialogue and the environmental assessment of the project.

FRANCE NATURE ENVIRONNEMENT

is a federation bringing together 5,837 grassroots organisations involved in nature conservation and environmental protection throughout the country, both in Metropolitan France and in overseas territories.

Onshore and offshore

Since 2021, Éoloscope also exists in an offshore version, based on the same principle and developed in collaboration with ENGIE, RTE and ADEME.

Éoloscope offshore

Focus on...

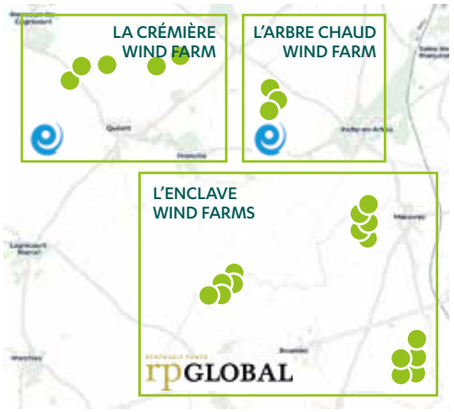
The monitoring of harrier broods (62)

THE L'ENCLAVE WIND FARMS

15 turbines | 49.5 MW installed capacity | October 2016 Commissioning

THE LA CRÉMIÈRE AND L'ARBRE CHAUD WIND FARMS

8 turbines | 26.4 MW installed capacity | June 2019 Commissioning



CONTEXT

The L'Enclave, L'Arbre Chaud and La Crémière wind farms are located less than 10 km from one another.

Over the territory of these farms, **a large population of harriers was identified** (Montagu's harriers, western marsh harriers and hen harriers). In order to protect these raptors, RP Global and Eurowatt both implemented a shared monitoring system and commissioned the conservation group **Groupe Ornithologique et Naturaliste (GON)** to put it in action.

The objective of the monitoring was to identify harrier pairs in order to establish **measures for the conservation and protection of broods**.

© Eurowatt

Harrier nest
© Eurowatt

ACTIONS TAKEN

1 Surveys

The spotting of harrier nests lasts for almost a month and a half and is carried out using a drone in order to limit the disturbance of the broods.

2 Risk assessment

If the chicks are too young to fly away before the harvest, **protective measures** are put in place with the concerned farmers in order to **save the nest from destruction** during the harvest.

3 Protective measures

Protective measures are implemented jointly with farmers when harrier nests are identified on their land. They consist in delineating a **5 by 5 meter area around the nests, which will remain unharvested**. The protection of the broods is facilitated by the wind operator, who offers **financial compensation to the concerned farmers for the crop** around the nest that won't be immediately harvested.

4 Inspections and monitoring

After the harvest, **several inspections are carried out** to monitor the development of the brood until they leave the nest. The western marsh harriers that were spotted by GON over the course of the project are ringed as part of a European ringing programme.

OUTCOMES

On the L'Enclave site, the number of Montagu's harrier pairs has been stable for the past few years and the protective measure has allowed 45 juveniles to take flight since implementation. Similarly, on the L'Arbre Chaud and La Crémière sites, **the number of harrier nests has increased significantly since 2017**. These measures have thus been able to effectively protect the local population of these threatened raptors.

Juvenile Montagu's harrier
© Jérémy Thomas

Sources:
Monitoring of harrier nests in the vicinity of the 3 wind farms in L'Enclave (RP Global) between 2017 and 2020 by GON
Monitoring of harrier nests in the vicinity of the La Crémière and L'Arbre Chaud wind farms (Eurowatt) between 2019 and 2021 by GON

A story of a successful partnership between a conservation group and a wind operator

Wind power operators sometimes work with biodiversity professionals in implementing Reduce–Avoid–Offset measures. These joint actions provide an opportunity to create a relationship of trust based on the complementarity of roles.

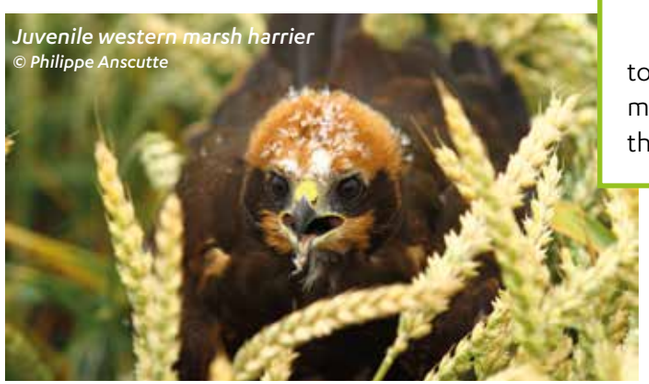
Victoria Bicchieray (Eurowatt) and Florent Bastianelli (GON) work together on monitoring the harrier populations of the wind farms of L'Arbre Chaud and La Crémière.

The monitoring of harrier populations was initiated by Groupe Ornithologique et Naturaliste (GON) as early as 2017, before the wind farms were set up. **The partnership that was subsequently developed with Eurowatt allows for the financing of actions** that were already taking place.

In practice, when a harrier nest is spotted and the decision is made to implement a protective measure, Eurowatt and GON work together on identifying the farmer working on the land where the nest is located. Eurowatt offers **financial compensation** for the patch of land that won't be harvested as a result, which helps with the **acceptance of protective measures by farmers**.

Carrying out the monitoring of harrier populations also helps **raise awareness among farmers regarding the protection** of flying animals.

Groupe Ornithologique et Naturaliste (GON) is a wildlife protection group with a focus on birds. One of its primary goals is to protect wildlife and to expand knowledge surrounding wild animals. It assists and advises local actors within the territory in their projects.



Juvenile western marsh harrier
© Philippe Anscutte

Montagu's harrier
© Philippe Anscutte

"These are more than mere opportunities for co-construction; there's an absolute necessity that we work together."

Florent Bastianelli

Through their experience in implementing protective measures geared at birds and bats, Victoria Bicchieray and Florent Bastianelli share the belief that wind power players are increasingly mobilising across biodiversity protection topics. There are, of course, regulatory obligations

throughout the life cycle of wind farms, however, some monitoring actions (as in this instance with the harrier population) are fully voluntary commitments undertaken by wind operators.

Beyond field activities in support of wild birds, wind power companies work on improving our understanding of impacted species and develop impact reduction solutions. "Regarding bats, a great deal of approaches were implemented nationally, including research in which the wind industry has contributed", according to Victoria Bicchieray.

This is one example of a partnership that demonstrates in concrete terms the commitment of the wind industry in taking into account biodiversity issues.

Nevertheless, in order to achieve a more effective conservation of biodiversity, all protagonists operating throughout the country should be taking similar commitments.

We wish to thank Victoria Bicchieray, head of development at Eurowatt, and Florent Bastianelli, research officer at GON, for their testimonials.

Focus on...

Corporate philanthropy in the Deux-Sèvres department (79)

CONTEXT

In addition to the measures implemented on each of its wind projects, developer **Q ENERGY routinely finances actions for biodiversity on a philanthropic basis**, especially for flying animals.

ACTIONS TAKEN

In 2020, Q ENERGY financed **27 consecutive days of bird ringing by the conservation group SYLATR** on the La Trimouille site, which is particularly appealing for migrating species flying through the south of the Deux-Sèvres department.

Bird ringing consists in capturing birds in order to attach a small metal ring with a unique code to individual birds.

This technique was selected out of all the existing forms of marking (ringing, nasal saddles, wing tags, tracking beacons) as it offers the best compromise between ease of application, convenient tracking and low inconvenience for the birds.

18 mist nets
deployed over 240 m

3,885
inged birds

33
people trained in bird ringing

OUTCOMES

Ringing birds allows for the study of many variables describing the biology of species, including migration patterns, duration of stay on a site, survival rates, sex and age ratios, etc. These studies help expand knowledge on the biology and ecology of birds and **identify effective means of protection**.


© SYLATR

Source: report on the ringing of migrating birds on the La Trimouille site by the conservation group SYLATR

Focus on...

The extension of the Seuil de Bapaume wind farm (60)

5 turbines | 15 MW installed capacity | 2020 Commissioning

CONTEXT

The surroundings of the extension of the Seuil de Bapaume wind farm host 7 bat species. As part of the extension of the wind farm, Boralex therefore committed to implement supporting measures in favour of certain bat species.

ACTIONS TAKEN

A 6-year partnership was formed with the conservation group Picardie Nature in order to:

- **Raise awareness among local residents on bat-related issues**, in schools and leisure centres, as well as directly with residents.
- **Carry out a wildlife inventory in order to detect bat maternity roosts** in the nearby localities.
- **Engage in dialogue with the owners** of the house where bat maternity roosts are located. They are offered the opportunity to be **accredited as bat refuges**, which commits them to ensure those roosts are protected.
- **Working with local authorities** to arrange that public buildings will host bat refuges.


Long-eared bat
© Jérémy Thomas

OUTCOMES

Three maternity roosts were identified: two of them in private homes and one in the Villers-au-Flos church. The church was accredited as a bat refuge, protecting the long-eared bat maternity roost present on the site over the long term and ensuring that the local bat population is therefore preserved. **These positive outcomes were communicated to the local residents** through an article published in the local press.

Source: 2021 report on the progress on the "protection of the maternity roosts of bats that are highly susceptible to wind turbine impacts" project, Picardie region, Nature & Vents du Bapalmois SAS

The wind industry is committed to promoting biodiversity

An industry that invests in jobs and knowledge

A significant financial contribution to the understanding and protection of our biodiversity

Regulatory studies (namely pre-installation impact assessments, sizing of Avoid–Reduce–Offset measures and environmental monitoring studies) require significant financial investments. According to a FEE survey, the budget allocated by a sample of 14 wind power operators (representing more than 5 GW installed, i.e. nearly 30% of France's installed capacity) amounted to almost **€8 million**.[1]

In addition to this, wind operators each spend **several tens or even hundreds of thousands of euros** in funding non-mandatory, proactive actions (such as research, training or R&D).

In total, extrapolating to the national scale, **20 to 30 million euros** are allocated each year by the onshore wind power sector to studying local biodiversity, which is **equivalent of the budget of a research laboratory**.

Actions that create non-relocatable jobs

Conducting these studies accounts for almost **2,000 full-time jobs**,[2] distributed among the **wind farm operators** themselves and the **consultancies** commissioned on these topics, not to mention the **administrative officials** in charge of oversight and volunteers from the environmental conservation groups coming into play throughout the project life cycle.

Nationwide knowledge sharing

Since the Biodiversity Act of 8 August 2016, the data collected during the mandatory studies must be, by law, uploaded to a platform called DEPOBIO. In 2021, ICPEs (primarily wind power farms) accounted for **57% of the 600 studies and 1,400 datasets submitted**, making wind power the **leading national contributor to knowledge about biodiversity** on this platform.

[1] FEE survey (2022)

[2] Wind observatory 2022

Recent examples of studies funded by the wind industry

Bat flight activity at wind turbine blade height: what are the determinants of the variation of this activity in space and time? (K. Barré, 2021)

Carried out by the French National Museum for Natural History (MNHN) and entirely funded by FEE, this study points to factors related to **the landscape, climate, time and wind turbine** operations on bat activity. Further research is projected in 2022-2023, with a second study that will look into applications in terms of curtailment rules that can minimise collision risks.

Greater mouse-eared bat
© Jérémy Thomas

Western marsh harrier
© Boris de Wolf

MAPE project (Reduction of Bird Mortality in Operating Wind Farms) (2020-2023)

This multi-stakeholder, collaborative research project conducted by **CNRS and Maison des Sciences de l'Homme** with a **€900,000 budget**. The project has 3 objectives: understanding the causes and consequences of bird mortality related to onshore wind farms, **generating knowledge** that will contribute to improving the efficiency of bird detection systems and **informing public policy changes**.[3]

Monitoring of bird activity during farming activities in the Nouvelle-Aquitaine region (CERA Environnement, ENCIS Environnement and NCA Environnement, 2022)

Farming activities can provide a large quantity of food for birds, and thus increases the appeal of wind farms located in their vicinity. This study helped **qualify and quantify bird activity before, during and after farm activities** in order to reduce collision risks by adapting curtailment protocols.

[3] More details on https://mape.cnrs.fr/

Feedback from a specialist biodiversity consultancy

Ludivine Doyen is director of studies and head of Biotope's Centre–Bourgogne branch. Drawing from 15 years of experience in the consultancy, her role as the national resource person for wind power has allowed her to witness a real change in the way biodiversity issues are taken into account in wind projects. She also has observed an increased concern by stakeholders of wind power projects for biodiversity conservation.


© wpd

Biotope has developed an expertise on topics related to biodiversity and wind power, both onshore and offshore. The environmental consultancy follows projects from end to end, from pre-diagnosis to dismantling.

One of the positive effects of the development of wind power is job creation within environmental consultancies. These roles can be generalist or highly specialised (focused on bats for instance).

> ***"Over the span of the 15 years I have been working in the field, I've witnessed a real change in the way biodiversity is taken into account in wind projects."***
>
> **Ludivine Doyen**

Founded almost 30 years ago by enthusiasts committed to the preservation of nature, Biotope has emerged as the European leader in environmental engineering and consulting.

Through its branches located throughout the country and internationally, Biotope carries out and supports projects and actions on 6 continents and 5 oceans. Working as close as possible to the various territories and their challenges, Biotope supports both public and private operators in developing their projects.


© wpd

1,300 studies
conducted on renewable energy projects in the past 5 years

European leader
in environmental engineering

35%
of its revenue generated thanks to renewable energies

Part of Biotope's activity has to do with advising project holders on the siting of wind power projects and ensuring the feasibility of Avoid–Reduce–Offset measures. The consultancy must make sure that projects are fully compliant with the law and that there is no net biodiversity loss due to the wind farms.

On this subject, Ludivine Doyen has observed a major shift in practices. In the past, the precise location of the wind turbines could be defined by the project owners, prior even to working with an environmental consultancy. This doesn't happen anymore. Wind developers don't financially commit to new wind farms without having environmental assessments available. This enables Biotope and other environmental consultancies to have real scope in their recommendations regarding the precise location of the wind farm. Ludivine Doyen indeed stresses that "environmental consultancies are now called in the very initial stages of projects and developers anticipate the duration of wildlife and flora studies in their development timelines."

We wish to thank Ludivine Doyen, head of Biotope's Centre-Bourgogne branch, research director, national coordinator for altitude monitoring from wind masts and fatality monitoring and national resource person for wind power for her testimonial.

Technology at the service of biodiversity

Technologies are crucial for protecting biodiversity on wind farms, whether by anticipating the potential impacts of turbines or limiting the adverse effects of wind farms once they operate, both during the design stage and the operational stage. Below, we present existing digital technologies for the protection of flying birds and bats. Some of the most promising systems leverage sensor-based data collection, process the signals to recognise the detected species, and then set off a deterrent to scare any flying animals away or curtail the turbines.

Wind power lifecycle	Use cases	Existing technologies
Wind project development	Diagnosis of bird and bat populations present in the projected location for the wind farm	(Nano)sensors:* sound, ultrasound, cameras, thermal imaging cameras, etc. IoT* Machine learning* Drones
Wind farm operation	Bird and bat deterrence	(Nano)sensors:* sound, ultrasound, cameras, thermal imaging cameras, etc. IoT* Edge computing* Control systems: sound emissions, bio-acoustic emissions, lasers, etc.
	Static curtailment	Data processing algorithms Control systems: wind turbine start-up/shutdown
	Dynamic curtailment	(Nano)sensors:* sound, ultrasound, cameras, thermal imaging cameras, etc. IoT* Machine learning* Control systems: wind turbine start-up/shutdown

The very fact that all these technologies have been developed reflects the high level of concern that the wind power industry has for issues related to biodiversity conservation. By furthering the research in that field, novel and increasingly effective solutions will be developed in order to better balance the generation of low-carbon renewable energy and the conservation of local or migratory wildlife.

Focus on...

Wind turbine curtailment

Overlaid images representing the passage of a bird identified by a detection system
© Sens of Life

Collision risks between birds and bats and wind turbines will never be fully eliminated, however, they can be drastically reduced. A frequently implemented measure concerns the **static curtailment** of turbines whereby wind turbines are stopped over a calendar period and/or based on predetermined meteorological conditions. Though it provides strong protection, it nevertheless implies stopping the wind turbines over long periods of time and therefore causes major energy generation losses.

The most promising solution is **dynamic curtailment**, which consists in detecting flying birds and bats in real time and stopping the turbines only when there is a definite collision risk. To date, this is the date best existing trade-off between protecting biodiversity and producing renewable energy.

Differences in how dynamic and static curtailment work

Static curtailment

- Parameters including date, time of the day, wind speed and temperature are taken into account
- Switch-off of wind turbines under pre-established conditions
- No adjustment based on the presence or absence of birds and bats on site

Dynamic curtailment

- Detecting birds and bats in real time thanks to cameras or ultrasound sensors
- Collision risk assessment
- Automatic switch-off of wind turbines in case of collision risk

Many digital solutions are being developed to further improve curtailment performance. Certain technologies, such as the ProBat device implemented in the Saint-Congard wind farm (p. 30), combine static and dynamic curtailment strategies. This helps considerably reduce collision risks, while also limiting losses in electricity production.

Offshore wind, at the forefront of environmental studies

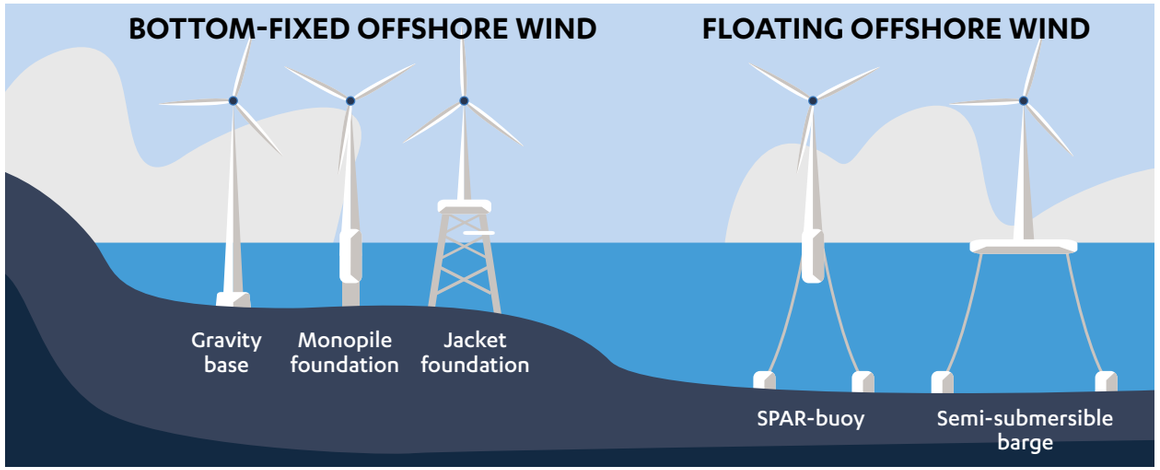
© Saint-Nazaire offshore wind farm – Production CAPA Corporate

Offshore wind, a green energy for the future

France has the **second-largest offshore wind energy potential in Europe**. Offshore wind power, with either bottom-fixed or floating turbines, is therefore a crucial technology to achieve the objectives of the energy transition defined by law. It allows for **tapping into the more powerful and consistent winds** out at sea and achieve loads factors* of at least 40% and up to 65% on average, depending the technology used.

France is **lagging behind the rest of the Europe in terms of offshore wind development**, with only **7 commercial wind farms under development** at present (**with 4 under construction and 3 winning tenders**). Nevertheless, by 2050, it's expected that around fifty offshore wind farms will be in operation, with a **total operating capacity of at least 40 GW**.

The wind from France's two maritime façades will be harnessed using two complementary technologies:[1]



Bottom-fixed offshore wind

Anchored to the seabed, these wind turbines are intended for depths of up to 60–70 m. Currently the most powerful turbines, they can harness strong coastal winds.

- + Mature, robust technology that benefits from a broad base of experience
- + More powerful turbines than onshore (currently up to 14–16 MW per turbine)
- - The technology is limited by bathymetric constraints (sea depth)

Floating offshore wind

With their floating foundation, floating wind turbines are connected to the seabed by anchor lines and can be located further offshore, typically at seabed depths of 50 m to 60 m, but potentially up to 100 m.

- + Can harness stronger winds
- + Lower environmental impacts (installed in sea, with impacts on wildlife and activities decreased as the turbines are installed further away from the coast)
- - The technology isn't currently mature.

[1] info-eolien.fr

Offshore wind projects in France[2]

as at 1st July 2022

[2] eoliennesenmer.fr

The met mast (installed in 2015) helps monitor bird and bat trajectories and the activity of the underwater fauna
© EDF Renouvelables

The first gravity base was installed on 1 August 2022
© Fécamp offshore wind farm – C. Beyssier

Focus on...

The Fécamp offshore wind farm (76)

71 wind turbines | 500 MW installed capacity | 2023 Commissioning

Parc éolien en mer de Fécamp

The Fécamp wind farm will consist of 71 wind turbines spaced out over 1 km from one another and located some 13 km to 22 km offshore over a total area of 60 km². **All possible issues related to the marine environment were anticipated thanks to numerous studies** (in particular on marine mammals, birds and bats), working jointly with many organisations, including IFREMER, the French Office for Biodiversity (OFB), the French League for the Protection of Birds (LPO), the Norman Ornithology Group (GONm), the Norman Mammalogical Group (GMN) and the University of Caen Normandy.

The impact of the wind farm on birds

The wind farm might induce three possible impacts:

1. **Bird avoidance behaviour around the wind farm**, which would only concern a limited area in the case of the Fécamp wind farm given that the various wind turbines are well spaced out.
2. **Bird disturbance** during the construction phase. The vast majority of species return to the site as soon as the construction of the offshore wind farms is completed.
3. **Collisions**, the likelihood of which has been reduced as birds mostly frequent the first 5 kilometres away from the coastline. In addition, 95% of birds that feed on site fly below the height of the blades and migration flights pass well over the turbines.

The impact of the wind farm on marine mammals

The wind farms can have impacts during the construction phase, in particular in terms of noise. To mitigate this disruption, deterrent devices are placed before installing the foundation base and the pile driving operations for the source substations are launched progressively.

The wind farm and bats

The studies conducted on site reveal that the risk of impact on bats is low. Bats indeed rarely venture out to the sea, only flying very low over the sea surface and when winds are very light, when the blades don't rotate or only barely and are therefore easily avoided.

Source : parc-eolien-en-mer-de-fecamp.fr

Impacts of offshore wind: sorting true from false

The impacts of offshore wind in France's specific context (in terms of natural habitats and wildlife species) are little known in spite of extensive impact assessments due to France's considerable lag in that domain. Nevertheless, this situation has a silver lining, as there is now an extensive and well-documented base of experience from other European countries that already have significant offshore wind capacities that can be leveraged in France. As a result, though any concerns remain legitimate, we now have concrete answers that help debunk certain misconceptions.

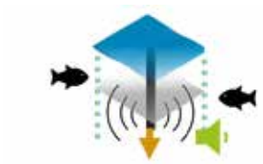
France's offshore wind sector can thus build on the following three solid groundings:

1. A base of experience from other European countries
2. Scientific research
3. Innovative technical solutions

Misconception n° 1

"The noise generated when constructing offshore wind farms is detrimental to marine biodiversity..."

This must be qualified: though the noise generated when installing foundation can disturb local species (depending on the installation techniques used), more recent studies show that the vast majority of species **stay away during construction**, at adequate distances to avoid being impacted.[1] What is more, **many technical solutions are now deployed to reduce the level of vibration being generated:**



Bubble curtains[1]

Gravity base (Fécamp)[2]

Floating offshore wind

ZOOM ON THE FRANCE ÉNERGIES MARINES INSTITUTE

France Énergies Marines is an institute for the energy transition focused on marine renewable energies (MREs). Based in Brest, its mission is to "inform, promote and foster the scientific and technical environment necessary to clear the hurdles faced by the marine renewable energies sector".[3] In collaboration with the other players in the field, their 65-strong staff carry out many R&D projects relating to characterising sites, sizing and monitoring systems, environmental integration, the optimisation of wind farms, etc.

Misconception n° 2

"Offshore wind turbines destroy marine sea bed habitats..."

Initially, the foundations of fixed-bottom offshore wind turbines may bring about a very local biodiversity loss, depending on the environmental characteristics of the seabed. At a later stage, the foundation systems and the submerged parts of the masts attract species that attach themselves to the structures as they would on rocks. **By attracting their predators, these species gradually create a whole new ecosystem, which is sometimes richer than the one that existed previously.** This is the reef effect, which very rapidly compensates the minor impacts of the construction phase according to mathematical analyses of the ecological networks as well as on-site measurements.[1]

Misconception n° 3

"Offshore wind turbines devastate birds..."

This must be qualified, as feedback from offshore developments in the UK and Belgium show that:

- **Sea birds avoid and stay away from turbines**[4]
- **Collision risks between sea birds and offshore turbines is half the expected rate**,as the result of their distance from the coast. For instance, over two years of observation in the Thanet wind farm, only 6 collisions were ever recorded.[4]

In addition, as for onshore wind, the legal Avoid–Reduce–Offset framework guarantees the absence of any significant impact due to residual collisions.

Misconception n° 4

"Offshore wind turbines decimate fish populations..."

On the contrary, the **refuge effect** comes into play as the limited activity taking place within the boundaries of the offshore wind farms and the installation of infrastructure create **protected areas that are conducive to breeding of marine species**. Though some in the fishing industry are concerned that they might lose access to marine resources, **this is in fact a win-win situation**: in the vicinity of the submarine biodiversity reserves that are thus formed, catch rates are much higher than in the open sea,[1] thanks to the **continuous replenishment of fish populations**.

[1] Environmental impacts of offshore wind farms in the Belgian part of the North Sea (Royal Belgian Institute of Natural Sciences, 2020)
[2] Synthèse de la connaissance scientifique sur les effets sonores des éoliennes flottantes sur la faune marine : Contribution au débat public sur le projet de parcs commerciaux d'éoliennes flottantes en Méditerrannée française [Summary report on the present state of scientific knowledge on the impacts of the noise generated by floating wind turbines on marine wildlife: Contribution to the public debate on the commercial floating offshore wind farm project in the French Mediterranean] (2021)es sur la faune marine : Contribution au débat public sur le projet de parcs commerciaux d'éoliennes flottantes en Méditerrannée française (2021)
[3] france-energies-marines.org
[4] ORJIP Bird Collision and Avoidance Study (2018)

Common cranes
© Boris de Wolf

Wind power: an appropriate response to the climate and biodiversity crises

Direct negative impacts → Mitigating negative impacts → Direct positive impacts → Indirect positive impacts

Impacts that should be put into perspective...

Like every other human activity, wind power has negative impacts on biodiversity. Though they are highly localised and immediate in nature, their visibility causes them to be regularly mentioned in the media or brought up by anti-wind lobbies. However, their importance is overestimated in public imagination due to a number of misconceptions. The contribution of wind power to the brutal biodiversity loss we're currently experiencing is minuscule, especially in comparison to other human activities that not only provide few benefits in terms of the crucial environmental and energy transitions, but also don't incur the same level of environmental obligations.

... and that are already limited in practice

The wind power industry is fully aware of its impacts on biodiversity. Wind companies, similar to the examples presented within this booklet, are already applying their resources towards mitigating their impacts, from the very early stages of the lifecycle of wind farms up to dismantling, thanks to a large range of tools including the Avoid–Reduce–Offset framework, the ICPE status, and environmental monitoring.

Far from imposing themselves to the detriment of biodiversity, wind companies endeavour to minimise their overall impact (in particular on the climate and biodiversity). Among the approaches they use, co-construction and technological innovation enable them to strike a better balance between the generation of low-carbon renewable electricity and wildlife conservation.

Positive impacts that are largely overlooked

Beyond Avoid–Reduce–Offset measures that ensure that wind power projects don't result in net biodiversity losses, wind power has a variety of direct positive impacts.

A direct positive impact on biodiversity

Through supporting measures, wind power operators can voluntarily engage in tangible actions in favour of biodiversity. The Focus sections featured in this booklet have presented an array of concrete solutions that can be adapted on a case-by-case basis to projects and that nevertheless represent only a small fraction of the measures deployed throughout the French territory. Furthermore, offshore wind helps create hotspots of marine biodiversity, in particular thanks to the reef effect and the refuge effect.

Supporting local stakeholders

Thanks to the partnerships formed with conservation groups and environmental consultancies during projects, the development of wind power has generated several thousands of jobs in the biodiversity sector and have funded and supported hundreds of targeted actions in favour of flora and fauna throughout the country. There are infinite possibilities for co-construction, helping local residents to reconnect with local biodiversity.

Contributions to knowledge

When a wind farm is installed, an impact assessment is conducted to collect information on the local biodiversity. On a larger scale, wind power has been instrumental in producing many scientific studies, especially on bats. A total of some 20 to 30 million euros are allocated each year to environmental and biodiversity studies by the onshore wind power sector as a whole, which is equivalent of the budget of an entire research laboratory.

What, then, is the net final impact of wind power on diversity?

All too often, this issue is reduced to the local negative impacts of wind farms. Although we shouldn't discount their existence, the cutting-edge industry practices in relation to biodiversity laid down in this booklet shows how complex the situation is, the constant efforts to mitigate issues, and, above all, the benefits that biodiversity can derive from wind farm installations.

The wind industry has been indisputably earnest and invested in taking into account and preserving biodiversity for many years, although these efforts are still unfortunately poorly recognised. This booklet demonstrates the extent of the imagination and resources that have been deployed by the wind power industry in that field, as well as the efficiency of the measures that have been implemented to date.

Both in the short and long term, wind power is positioning itself as a key response to the twin challenge of the biodiversity collapse and global warming. Far from resting on its laurels, the French wind power industry is pressing ahead in its quest for environmental excellence and, year after year, is strengthening the resources it allocates to biodiversity in order to continue to address the two greatest challenges of the century.

Glossary

Biodiversity: biodiversity can be defined as the "diversity of living species (micro-organisms, plants, and animals) present in an environment." Biodiversity includes diversity within species and between species and the diversity of ecosystems, as well as the interactions between living organisms.[1]

Biodiversity gain: improvement in the state of biodiversity in a site compared to its initial state (rather than a trajectory) generated by rehabilitation, restoration or reparation.[2]

Biodiversity loss: a deterioration in the state of conservation of species, habitats or environmental functions caused by the impact of a project. Such an impact is then deemed significant. A non-significant impact impacts the components of biodiversity without compromising its ability to sustain itself or renew itself, and therefore without calling into question its state of conversation.[3]

Capacity factor: refers to the ratio of the electrical output generated by a wind turbine over a given period and its maximum electrical energy output over the same period. In France, offshore wind's capacity factor stood at over 26% in 2020.[4]

Carbon neutrality: refers to the "balance between carbon emissions and the absorption of carbon from the atmosphere by carbon sinks" that enable emissions to be fully compensated by that absorption. In order to keep global warming below 1.5 °C and comply with the Paris Agreement, carbon neutrality will have to be achieved by 2050.[5]

(Digital) compliance control: a system that collects data and performs automatic controls, either locally or remotely.[6]

Edge computing: an optimisation method used in cloud computing that consists in processing data at the periphery of networks, closer to the sources of data.[7]

Environmental authority: a supervisory authority in environmental matters that issues public advisories on the qualities of evaluations and the integration of environmental considerations in projects, plans and programmes that are subject to environmental evaluations.8 Depending on the type of project, plan, or programme and the kind of contracting authority, this prerogative might rest with:

- the prefects
- the national environmental authority within the General Council for the Environment and Sustainable Development (Ae-CGEDD)
- the Minister for the environment
- the regional missions for environmental authority within CGEED (MRAe).[8]

[1] Qu'est-ce que la biodiversité ? [What is biodiversity?] (OFB)
[2/3] Approche standardisée du dimensionnement de la compensation écologique [Standardised approach for sizing compensatory mitigation] (French Ministry of Ecological Transition, 2021)
[4] info-eolien.fr
[5] What is carbon neutrality and how can it be achieved by 2050? (European Parliament, 2021)
[6] Eurowatt's engineering service
[7] Wikipedia entry on "Edge computing"
[8] Synthèse annuelle 2021 de la conférence des autorités environnementales [2021 annual summary report of the conference of French environmental authorities]

Internet of things (IoT): the interconnection between the Internet and objects, places and physical environments. IoT refers to a growing number of objects that are connected to the internet, thus allowing a form of communication between so-called physical goods and their digital forms. These connections are used to collect large quantities of data that can be used to produce new insights.[9]

IPBES: the Intergovernmental Science-Policy Panel on Biodiversity and Ecosystem Services was created in 2012. Its purpose is to provide an interface between the scientific community and governments. It helps inform public policy by disseminating cross-disciplinary knowledge on biodiversity and ecosystems. It is considered the equivalent of the IPCC for biodiversity.[10]

IPCC: the Intergovernment Panel on Climate Change is a panel of experts that provides assessments about knowledge on climate change and the role of human activity. The IPCC publishes scientific reports that inform governments so they can reach agreements in fighting against climate change.[11]

Machine learning: a field of inquiry of artificial intelligence that builds on mathematical and statistical approaches to give computers the ability to "learn" based on data, that is to improve their capacity to accomplish tasks that they aren't explicitly programmed to solve.[12] Devices using this technology have been developed in order to recognise the species of birds approaching wind farms in real time.

(Nano)sensors: these devices measure physical quantities and convert them into signals. Nanosensors are sensors operating on a nanoscale, whether in terms of size, sensitivity, or interaction distance.[13]

UICN: founded in 1948, the International Union for Conservation of Nature brings together 81 countries, 113 public institutions, more than 850 non-governmental organisations and some 10,000 scientists and experts from 181 countries. Its mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and ensure that any use of natural resources in equitable and ecologically sustainable. It is the largest expertise network on the environment in the world and has assisted 75 countries in preparing and applying strategies relating to biological conservation and diversity.[14]

[9] Wikipedia entry on the "Internet of things"
[10] Qu'est-ce que le IPBES ? [What is the IPBES?] (vie-publique.fr)
[11] Qu'est-ce que le GIEC ? [What is the IPCC?] (vie-publique.fr)
[12] Wikipedia entry on "Machine learning"
[13] According to the Robert dictionary
[14] Based on UICN's About page (uicn.org)

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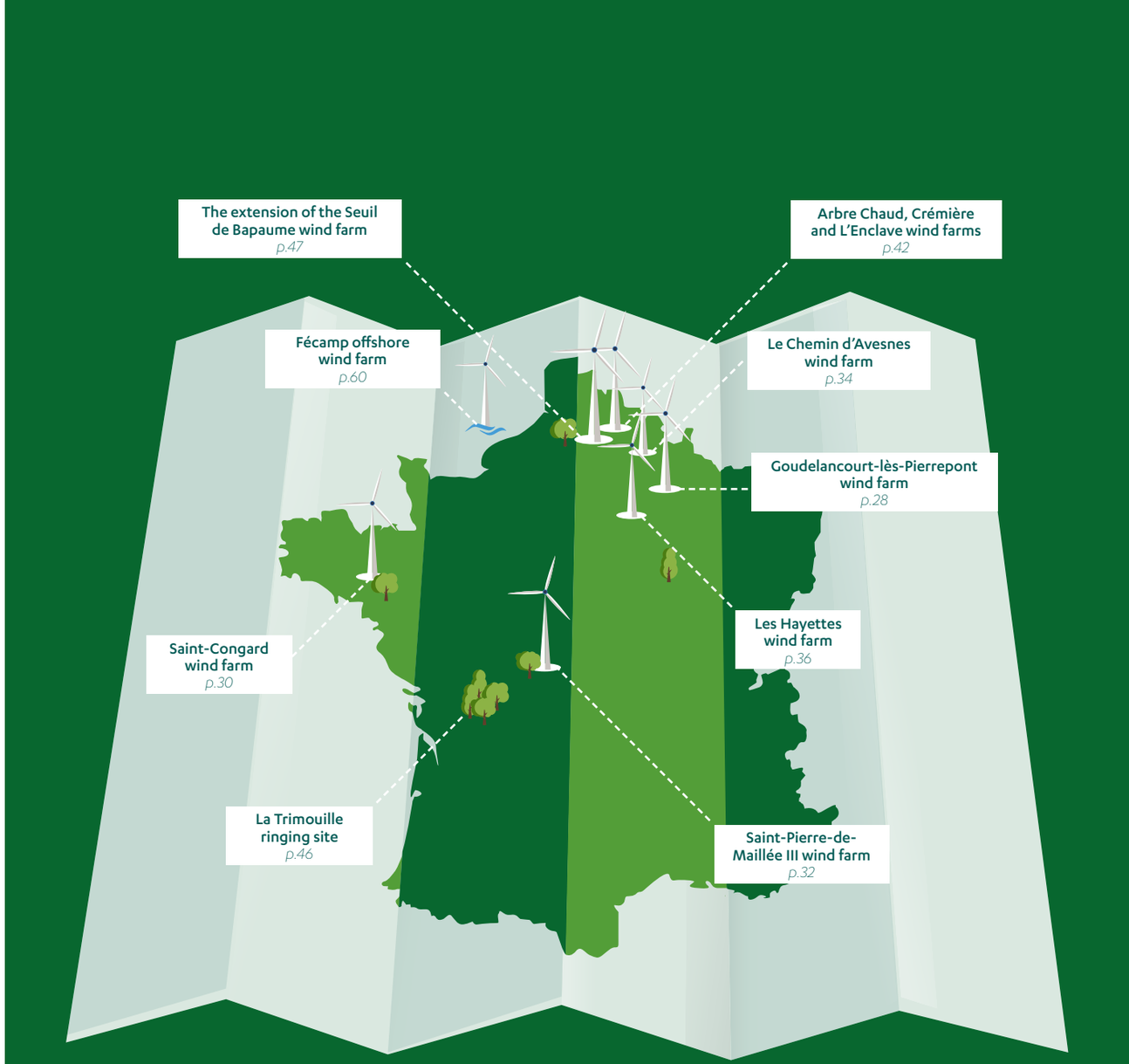

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