Interreg Europe

Co-funded by the European Union

BIOWIND

Activity A3.2

Summary Report

of the workshop on elements of a comprehensive environmental plan and effective systems for biodiversity monitoring

MARCH 2024

Contents

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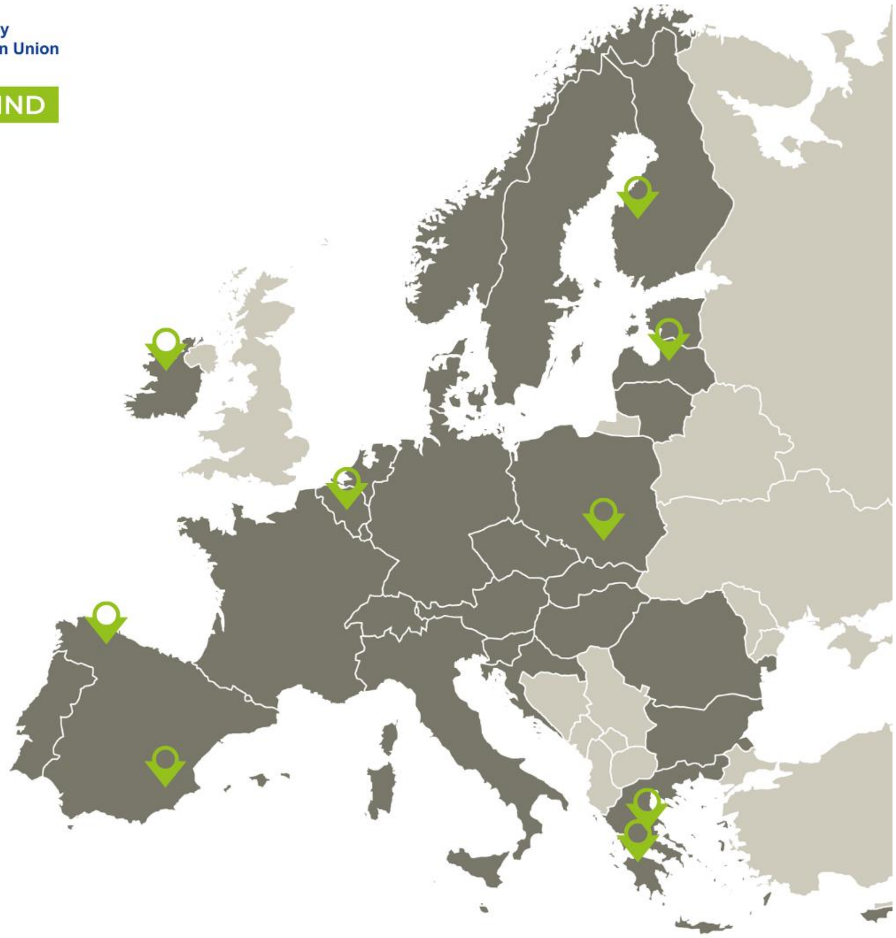


- Province of Flemish Brabant (PVB)
- Regional Council of South Ostrobothnia (RCSO)
- Region of Western Greece (RWG)
- University of Patras (UoP)
- Central Danube Development Agency Nonprofit Ltd (CDDA)
- Northern & Western Regional Authority (NWRA)
- Zemgale Planning Region (ZPR)
- Marshal Office of Świętokrzyskie Voivodeship (MOSV)
- Asturias Energy Foundation (FAEN)
- Autonomous Community in the Region of Murcia, General Directorate of the Natural Environment (CARM)

Advisory Partner

- PROMEA - The Hellenic Society for the Promotion of Research & Development Methodologies

Chapter A. - Background

BIOWIND Project Activity A3.2

Activity A3.2 of the BIOWIND project was led by the Latvian partner, Zemgale Planning Region (ZPR), and took place from 20th – 21st February 2024 in Jelgava, Latvia. The activity comprised a workshop on early warning systems in wind farms for biodiversity conservation, followed by a site visit to the Laflora wind farm project under development.

The workshop's activities aimed to provide partners and invited stakeholders the opportunity to discuss common challenges and identify gaps in environmental policies that potentially inhibit the deployment of wind farms in their territories, while also jointly elaborate on effective biodiversity management and conservation systems for wind farm areas.

The visit to Laflora wind farm currently under development, aimed to provide partners with planning insights and knowledge from Laflora' Environmental Impact Assessment (EIA).

Biodiversity Management in wind farms

While wind farms occupy less land per unit of power generated compared to other renewable energy sources, they still have significant effects on biodiversity and ecosystems within and around their operational areas. These impacts can be categorized as follows: a) direct impacts, which result from planned project activities and operational decisions and can be predicted with knowledge of local biodiversity; b) indirect impacts, which arise from project activities or their by-products within the project's area of influence; and c) cumulative impacts, which result from the combined effects of existing, planned, and reasonably anticipated future human activities along with the development impacts of the project.

Commonly identified impacts of wind developments include bird collisions with turbine blades and transmission lines, and in the case of offshore wind farms the collision of mammals and sea turtles with wind farm associated vessels. In addition, wind farms can impact biodiversity through habitat fragmentation, alterations of the prey-predator dynamics, noise disturbance, and changes in microclimates. These impacts disrupt habitat connectivity, stress species, alter ecological relationships, and create barriers to resource access.

Wind farm project developers and operators rely on three key elements to ensure environmentally responsible planning, construction, operation, and decommissioning of wind projects: the Environmental Impact Assessment (EIA), the Environmental Management Plan (EP), and the Environmental Management Systems (EMS). The first one, Environmental Impact Assessment, is a systematic process that identifies and evaluates potential environmental impacts of proposed wind projects during the planning phase. It aims to assess the direct and indirect effects of a project on various areas (including air, water, land, and biodiversity), but also to determine alternatives to reduce or mitigate identified negative impacts. The EU Directive 2014/52/EU specifies in detail the minimum elements to be included in any project.

Largely based on the findings and recommendations of the Environmental Impact Assessment, the Environmental Management Plan outlines the strategy developed by the wind farm developer, including actions, measures and protocols, to manage, mitigate, and monitor the identified environmental impacts during project implementation. Overall, the Environmental Management Plan includes measures to prevent or minimize adverse effects, delineates roles and responsibilities, and sets up monitoring and reporting mechanisms. Although, there isn’t a specific EU-wide guidelines document exclusively dedicated to Environmental Management Plans, several directives and regulations incorporate elements relevant to environmental management planning across different sectors, including the Environmental Liability Directive (2011/92/EU), the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC).

Finally, the Environmental Management System provides a structured framework or management strategy for integrating environmental considerations across all operations of a wind energy development. It is a comprehensive system that includes policies, procedures, and practices designed to identify, manage, control, and improve an organization's environmental performance. The Environmental Management System emphasizes continuous improvement, compliance with legal requirements, and the promotion of sustainable methods, typically adhering to either the ISO 14001[1] standard or, alternatively, the Eco-Management and Audit Scheme (EMAS).

[1] ISO 14001: The International Standardisation Organisation's standard for environmental management systems

Chapter B. - Workshop Outcomes

Presentations

Overview & Objectives of the Workshop, Artūrs Penčura, Zemgale Planning Region, Latvia

During his presentation Mr. Penčura introduced the workshop's objectives and concisely presented the Background Study supporting the BIOWIND activity A3.2. Building on Mrs. Brūniņa's opening speech, he noted that the workshop aimed to provide a platform for discussion where participants will have the opportunity to exchange experience and discuss common challenges in moving forward with wind deployment while protecting the environment and conserving biodiversity in wind areas. They will also be able to elaborate on ideas regarding effective approaches and state-of-the art biodiversity management and conservation systems in wind farm areas.

Briefly summarising the Background Study, Mr Penčura referred to the three broad types of wind farms' impacts to biodiversity and ecosystems: direct, indirect, and cumulative impacts. He then gave an overview of the main elements that contribute to ensure responsible environmental stewardship within a wind energy project: the Environmental Impact Assessment, the Environmental Management Plan, and the Environmental Management System. Mr. Penčura underlined the pivotal role of monitoring technologies in assessing and managing the environmental impacts of wind projects on local ecosystems, complimented by mitigation actions to counterbalance those impacts. Lastly, Mr. Penčura, referred to the commonly recognised barriers and enablers of effective Environmental Management Plans in wind energy projects which will smoothly integrate the preservation of local wildlife, habitats, and ecological processes in the wind farm's life cycle.

"Role and potential of wind power in Latvia energy sector", Gunārs Valdmanis, The Ministry of Climate and Energy, Latvia

Mr. Valdmanis' presentation discussed the current policy framework that shapes the green transition in Latvia, focusing particularly on wind energy (both onshore and offshore) and hydrogen. He highlighted that the expansion of wind energy is a political priority for Latvia's energy sector, as it is a much more promising renewable energy source than solar energy. He noted that it is estimated that Latvia has a reserved wind capacity of 6000 MW, which could both provide energy security to Latvia by covering the country's own energy demand, but also allow for energy exports to neighbouring countries.

Discussing the Latvian policy framework for onshore and offshore wind, Mr. Valdmanis noted that although the country's National Energy and Climate Plan prioritises the expansion of the offshore wind sector, at the moment the respective regulations do not support such infrastructure developments, mainly due to policy gaps regarding protection zones, grid connection and transmission tariffs, and constructions related issues. However, a set of important legislative instruments are under amendment to align with the country's renewable energy vision.

Finally, talking about the policy framework regarding hydrogen, Mr. Valdmanis explained that although hydrogen is a highly promising energy resource, it still remains to be seen which production and transportation technologies are the most efficient. However, Latvia, is in the process of creating the necessary policy framework (including, the amendment of the Energy Law, and drafting a National Hydrogen Strategy Planning Report) to support the introduction of hydrogen to the country's energy mix.

"What to consider when planning, building, and operating wind farms to take biodiversity into account", Zanda Segliņa and Alise Ozoliņa, Nature Conservation Agency, Latvia

Mrs Segliņa and Mrs Ozoliņa's presentation outlined the main consideration's regarding environmental conservation and wind farm construction in Latvia from the perspective of the Nature Conservation Agency (NCA). The country's territorial characteristics were emphasised, including large forest areas of high biodiversity which are relatively untouched by infrastructure development compared to other EU countries, and a mosaic landscape fostering complex interactions among neighbouring ecosystems. In addition, Latvia's protected areas are home to protected species and habitats of EU significance.

The guest speakers briefly discussed the observed impacts of wind farms on Latvian birds and bats, highlighting the country's dedicated management plans for owls and woodpeckers and the recently (2022) published guidelines for assessing the impact of wind farms on bats. They also talked about additional impacts of wind farms on landscapes including deforestation and land fragmentation, both affecting various species.

From the Nature Conservation Agency's perspective, three potential areas of intervention to ensure biodiversity protection and conservation in wind farm developments were identified. Firstly, the application of compensatory measures to address cumulative impacts of current and future projects in affected areas. Secondly, ensuring transparent and accessible information for the public about wind energy developments, including benefits and drawbacks for the environment and local communities. Lastly, considering wind project development within the framework of green infrastructure, such as planning them on brownfield sites (degraded quarries) or alongside existing roads. However, Mrs. Segliņa and Mrs. Ozoliņa highlighted that Latvia currently lacks the necessary regulatory framework to promote such alternatives in wind project siting.

“The challenges of assessing the impact of wind farms on natural values and mitigation planning”, Oskars Beikulis, Estonian, Latvian & Lithuanian Environment LTD, Latvia

Mr Beikulis’ presentation focused on the main challenges in integrating environmental impact assessment and mitigation into wind energy spatial planning. He referred to both direct and indirect impacts of wind farms, as well as cumulative impacts that arise from different wind developments in relative proximity.

As Mr. Beikulis noted, the number of planned wind farms has grown noticeably over the past five years, with most of wind farms planned on forest land or landscape mosaics[2]. However, there is little knowledge available to assess the cumulative impacts of wind farms’ expansion on habitats, birds, and bats. Moreover, there is also limited capacity of assessing even direct and indirect impact of a single wind farm on bats and forest species. Mr. Beikulis also referred to the lack of monitoring technologies and mitigation measures to protect forest birds and bat species living in undisturbed forest areas.

Lastly, to align wind energy spatial planning with biodiversity and ecosystem conservation, Mr. Beikulis highlighted the need for strict mitigation requirements applied at each wind farm, regardless of whether it is in the proximity of other wind farms or planned on forest land. Wind farms posing threats to migratory birds and bats must compulsory be equipped with radar systems and automatic-shut down operational mode.

“The impacts of wind power on birds”, Jānis Priednieks, University of Latvia, Latvia

Mr. Priednieks presentation regarded the ongoing project “"Wind farms and birds – methodology for impact assessment and risk map", which is conducted by the

[2] Landscape mosaic is a heterogeneous area, composed of different communities or a cluster of different ecosystems.

University of Latvia in co-operation with the Nature Conservation Agency, and it is financed by the Latvian Environmental Protection Fund. The project is expected to be finished by the end of February 2024 providing valuable methodological ground for Environmental Impact Assessments.

To which end, Mr. Priednieks' presentation focused on the main threats to birds and potential solutions to mitigate them. Regarding the former, he highlighted the various impacts of wind farms' construction and operation on birds during the breeding season, namely loss of suitable nesting areas, reduced feeding sources, and fatal collisions with turbine blades. Similarly, during migration periods, wind farms' construction and operation can lead to fatal collisions of birds with wind turbines' blades and limit suitable feeding and resting areas.

Lastly, discussing possible mitigation measures, Mr. Priednieks referred to the importance of proper planning of wind farms taking into account both special areas for birds (such as habitats of protected species, and areas of concentration of birds during migration) and the assessment of cumulative effects due to the other planned or existing wind farms in the area. He highlighted the need for wind turbines to be equipped with modern technologies for shutdown under certain circumstances, as well as the proper documentation of birds population and predators in the wind farm's area to gain a good understanding of species dynamics.

Questions & Answers Session

Following the presentations of guest speakers, participants had the opportunity to pose questions to speakers seeking clarification on points raised during the talks or delving deeper into specific topics.

Question 1: Are there plans to review the existing constraints concerning the construction of wind farms, including regulations such as the distance requirement from residential areas (currently set at 800 m), the prohibition on development in agriculturally significant lands, as well as the individual regulations set by local governments regarding placement and permitted capacities?

Answer by G.Valdmanis: Yes, there is a plan to review the constraints, as well as create new regulations regarding the development of wind farms in Latvia. Agriculturally significant lands constitute a small proportion of about 3% of Latvian territory, however there are already negotiations on the matter with the Ministry of Agriculture.

Question 2: Why doesn't Latvia utilize hydroelectric energy more extensively despite having numerous rivers?

Answer by G.Valdmanis: We believe that hydropower's peak capacities have been reached, and small hydroelectricity stations are not efficient. It is not a political priority, even taking into account the requirements of the environment and nature.

Question 3: What about control mechanisms of operation of wind farms in terms of compliance with environmental and biological diversity requirements?

Answer by Z.Segliņa: Currently, there are no established rules and procedures governing the control of wind farm operators regarding their impact on birds, bats, and other environmental factors. This issue is undergoing discussions within the Ministry of Climate and Energy.

Question 4: Regarding Environmental Impact Assessments, is there consideration given also to cumulative impacts and forecasting, i.e. not only from one wind farm, but collectively of all such installations at the national or regional level?

Answer by Z.Segliņa, O.Beikulis: No, at the moment there are no methods and plans about evaluation of cumulative effects, but it is recognized as a very important issue.

Question 5: Have you considered conducting a national level research to evaluate cumulative environmental impacts?

Answer by G.Valdmanis: Yes, we have such an idea, and it is possible that such an assessment will be announced soon. Key aspects to be considered include:

- wind farms in forest lands (which means afforestation, fragmentation thus more risks on biodiversity),
- lack of control mechanisms in place,
- cumulative impact assessments,
- new methods/technologies for birds/bats protection.

Roundtable Discussions

Roundtable Discussion 1 – "Collaborative efforts and policy options"

The first roundtable discussion was moderated by Krista Pētersone of the Latvian Non-Governmental Organisation "Green Liberty". The discussions evolved around two main topics:

- State of play in BIOWIND countries: wind energy planning, permitting, and acceleration area.
- Civic participation in wind farm development: public hearings, conflict resolution, and social acceptance.

Prior to the discussion, Mrs. Pētersone briefly presented the BIOWIND project partnership, and the two main challenges stalling wind energy expansion addressed by the project's activities, namely the convoluted permitting procedures, and local opposition to wind energy projects.

Moving forward with the activity, participants were organised in three working groups (WG), each one representing a different wind energy stakeholder group, namely civic society (WG1), public administration (WG2), and businesses (WG3). The details of each working group's synthesis are given below:

- Working Group 1 – Civic Society – Belgium, Hungary, Ireland, Latvia, Spain
- Working Group 2 – Public Administration – Belgium, Greece, Latvia, Poland
- Working Group 3 – Businesses – Belgium, Greece, Ireland, Spain

The groups were presented with three distinct tasks and were asked to discuss and provide their input to all or some of them, depending on the relevance of the topic and the expertise of the participants to the stakeholder group being represented. The tasks available for discussion included:

- **Task 1** – Define the main levers of change in territorial policy instruments and identify points of overlap and/or difference in partners' countries.
- **Task 2** – Evaluate the situation and perspective of different stakeholders regarding impacts of wind farms on biodiversity and identify differences and commonalities among project countries.
- **Task 3** – Suggest up to 5 action points for collaboration with stakeholders from one of the three sectors (administration, citizens, businesses) relevant in all project countries.

Participants during **Task 1** discussions (the main levers of change in territorial policies regarding wind energy) concluded that Belgium, Ireland, and Spain have already implemented clear deadlines for compensation mechanisms in their territorial policies concerning wind energy. These countries have also developed to some extent educational measures to promote wind energy developments, and have established funding policies to enhance such developments. However, participants highlighted that it is essential to enhance public engagement, which could be achieved through participatory mechanisms for active public involvement in wind energy planning and project permitting. Participants stressed the importance of policy makers and wind project developers prioritising clear communication and involving the public throughout the life cycle of a wind farm, using both appropriate language for non-technical experts and various communication channels to reach a wider public audience.

Addressing **Task 2** participants of Working Group 1 – Civic Society employed SWOT (Strengths-Weaknesses-Opportunities-Threats) analysis to document the current situation regarding the impact of wind farms on biodiversity and further identify opportunities and threats for the future as viewed from the perspective of civic society. Currently, considering it as strength, participants recognised the influential potential of local communities on authorities, stemming partially from the unity spirit characteristic of local communities. Regarding present weaknesses, participants identified the lack of understanding among local communities concerning the process and the benefits from wind energy expansion, as well as the overall vision for wind energy at the EU level. They also referred to the limited power granted by national legislation to local communities in policy making discussions about wind power. Looking into the future of wind energy, participants recognised that there is currently a rise of civil movements which combined with the pressing issue of energy independence in EU countries, could enhance civil involvement in wind energy planning and permitting. On the opposite side, participants drew attention to the risk of the public's disengagement due to numerous reasons, including lack of offered benefits from the development of local wind projects. They also stressed the importance of a robust regulatory framework to support civic participation in wind energy development, preventing disenfranchisement of local communities resulting from the lack of consultation mechanisms and the difficult access to information.

Finally, regarding **Task 3**, participants representing Public Authorities (Working Group 2) concluded that key areas for collaboration among public administration, businesses, and civic society include developing spatial planning constraints for wind projects, establishing energy strategies to ensure policy stability, and facilitating the establishment of energy communities to enable citizens' financial participation in energy transition. On the other hand, regarding the same task participants representing Civic Society (Working Group 1) advocated for informal meetings among public authorities, project developers, and local communities, as well as for the development of education programs about wind energy for schools. They also recognised the effectiveness of establishing compensation schemes to provide financial benefits to local communities or citizens hosting wind turbines on their land. Finally, they noted the importance of ensuring power distribution balancing to ensure that electricity supply consistently meets demand.

Roundtable Discussion 2 – "Effective approaches for biodiversity conservation in wind farms"

The second roundtable discussion was moderated by Eirini Stergiou (University of Patras, Greece) and Alexandros Papageorgiou (PROMEA, Greece). The discussions evolved around three interconnected topics:

- Emerging technologies for early warning systems in wind farms.
- Risk mitigation measures and technologies.
- Tools and approaches to monitor the impact of wind farms on biodiversity.

Participants were organised in three groups to enhance individual participation and exchange of ideas. A moderator was assigned to each table and participants were asked to discuss and document their inputs to three tasks using post-it notes:

- **Task 1** – How can we improve data analysis and modelling tools to provide more accurate/informative assessments?
- **Task 2** – Synergies between non-governmental organisations and wind farm developers for more efficient monitoring.
- **Task 3** – Most effective mitigation strategies diminishing bird/bat collision.
- **Task 4 –** Types of technologies for early warning systems and policy (national/regional) measures to promote them.

Addressing the **first task**, partners identified two key areas of intervention, data science and education, aimed at improving data analysis and modelling tools for more accurate impact assessments of wind farms on biodiversity.

Firstly, to harness the potential of artificial intelligence to improve data collection and analysis. However, they noted that there is a lack of professionals skilled in both AI and nature conservation. To address this gap, participants suggested the introduction of specialised university courses and/or programmes to equip future graduates with the required combined skills and knowledge.

Secondly, participants discussed the alternative of dedicated scholarship to encourage university students majoring in the fields of ornithology, zoology, and biodiversity. Another idea discussed was the collaboration between the private sector and public universities, wherein companies could fund graduate studies and research relevant to biodiversity conservation and wind energy projects.

Moving on to the **second task**, participants stressed the potential of employing artificial intelligence tools to enhance biodiversity monitoring in wind farms. They also referred to the potential of collaboration between non-governmental organisations and wind farm developers to map areas suitable for building wind farms, a concept known as wind energy zoning.

Regarding the **third task**, participants brought forward several mitigation strategies that they considered effective in reducing bird and bat collisions with wind turbines. They highlighted the importance of adaptive mitigation strategies tailored to the specific characteristics of each wind energy project and local biodiversity. In this regard, continuous monitoring and risk assessment were noted as essential. Moreover, participants discussed the effectiveness of collision risk modelling, advocating for public-private partnerships to combine the expertise of non-governmental organisations with the advanced computational capabilities of technology companies. Participants also emphasised the effectiveness of shutdown on demand strategy for minimising collision rates, particularly during nesting periods, but also every time bird or bat movement is detected using sonar technology. Finally, participants, underlined the need to further engage citizens in biodiversity conservation through citizen science initiatives. They also brought attention to the need to reassess wind farm establishment criteria in light of the technological advancement of cumulative impact assessments supported by artificial intelligence.

Lastly, in the **fourth task** participants discussed various technologies to support early-warning systems in wind farms. The common idea was to apply shutdown on demand in wind farms in the detection of presence of moving animals such as bats and birds. To detect such motion participants suggested the use of thermal cameras and sonar radars. They also proposed the option of painting one wing of the turbine black to serve as a warning signal for birds. Furthermore, addressing the impacts of mechanical noise form wind turbines' operation, participants referred to options for soundproofing the turbine's nacelle. Finally, concerning the policy measures to promote early warning systems in wind farms, they suggested predictive environmental impact assessments based on historical data and taking into consideration the migration roots of birds should become mandatory for wind farms.

Chapter C. - Study Visit Outcomes

On the day following the workshop, participants went on a guided study visit to the Laflora wind farm in the Livbērze parish, Jelgava county. The site visit comprised two parts, upon arrival a short presentation of the project which was followed by a site tour of the current peat mines and the peat factory guided by Laflora project's representatives.

Laflora wind project presentations

"From Conventional to Regenerative: Experience of Laflora Ltd.", Anda Zakenfelde, Public Relations Manager, Laflora Ltd., Latvia

Mrs. Zakenfelde's presented the vision of Laflora Ltd responsible peatland management. For over 25 years Laflora Ltd has been Latvia's biggest company in the sector of peat extraction, and is well established in the field of peat substrates production. Peat products are widely used in agriculture, and at the moment Latvia provides 31% of EU demand for peat substrates in professional horticulture. Due to meteorological conditions in the country, national peat resources increase on a yearly basis. However, Laflora Ltd. has taken the decision to transform its operation aiming to reach climate neutrality by 2050. The company has developed a transition plan to support the balancing and offsetting of emissions from peat extraction and processing with renewable energy production and natural capital restoration actions. The first part of the transition includes the development of the Laflora Wind Park to be completed and become operational by 2026. The second part, to be completed by 2030, foresees the development of a green industrial area, including a greenhouse complex and new product development with higher carbon sequestration capacity.

"Wind Park LAFLORA", Aleksejs Mitušovs, Project Developer, SIA Windy, Latvia

Mr Mitušovs presentation provided an overview of the Laflora wind park project currently under development, outlining the milestones achieved to date. The wind park is owned by SIA "Laflora Energy" a subsidiary of Laflora Ltd. It is developed on part of land of the Kaigu peat bog owned by Laflora Ltd under long term land lease agreements. The developing company expects the wind park to be operational in 2026. The project's Environmental Impact Assessment was initiated in mid-2018, was published in 2021, and approved later the same year. The report included assessments of the wind park's expected impact on bird and bat populations in the area, as well as on local biotopes, considering various elements of the park's infrastructure and operation such as flickering and traffic security. Mr Mitušovs highlighted the developer's engagement strategy whereby a series of informative sessions and site visits to the project area were organised for the general public and local residents. Moreover, based on finding of the Environmental Impact Assessment report, the company has moved forward with wildlife monitoring initiatives. Local eagles have been equipped with ring markings and Global Positioning System (GPS) trackers to monitor their population, while artificial nests have been created to support their protection.

Laflora wind park site visit

During the expert-led walking tour of the area earmarked for constructing the Laflora Wind Park, participants were provided Mr. Mitušovs with additional details about the project development stages. During the interactive discussions key points that emerged were the effect of the COVID19 pandemic which slightly stalled the Environmental Impact Assessment process, and the additional corrective measures applied based in the Assessment's findings. In detail, the 110 kV cable will be installed underground to mitigate potential impacts to avian species in the area, while nearby households affected by wind turbine flickering will be financially compensated.

Chapter D. - Discussion

Conclusions

The workshop highlighted the urgency for wind energy expansion to be aligned with biodiversity conservation efforts. Safeguarding biodiversity and local ecosystems needs to become an integral part of spatial planning for wind areas, as well as a key consideration throughout a wind farm's lifecycle, from planning and sitting to operation and decommissioning. Efforts should focus on assessing impacts of wind farms on local species and habitats, monitoring local biodiversity during a wind farm's life cycle, and employing effective mitigation strategies to minimise adverse impacts on local biodiversity and ecosystems.

Policy makers, environmental specialists, and civil society representatives agreed that while assessing the direct and, in most cases, also the indirect impacts of wind farms might be feasible by employing currently available scientific knowledge and technology, **predicting cumulative future impacts** poses several challenges. It requires an in depth understanding of species populations and interactions, as well as temporal and spatial predictive analysis of local developments. Local developments to be considered include infrastructure to be constructed (telecommunication towers, roads, transmission lines, etc.), land use changes, and new renewable energy projects (solar and/or wind). Particularly in forest areas, in the margins or the outer regions of which wind turbines are often installed, the former issue becomes even more complicated due to insufficient data on local species populations and/or exact locations of nesting areas, concentrated habitats etc.

However, **artificial intelligence offers promising tools** to tackle the challenges of developing cumulative impact assessments. Big data analytics and modelling tools can predict changes in land use patterns and species populations, future collision risks, and consequently the identification of high-risk areas, supporting informed decision-making regarding wind zoning and wind turbine placement.

Artificial intelligence coupled with **advancements in detection technologies** can also enhance biodiversity conservation in operating and planned wind farms. Early warning systems, including thermal cameras and sonar radars, can reduce bird and bats fatalities resulting from collisions with wind turbines, since they can be used to trigger a shutdown of the turbines upon detection of movement. In addition, advanced sensors and data mining techniques can improve the identification of migratory patterns and nesting behaviours.

At the same time, it is essential to address the lack of professionals with adequate knowledge and experience in both data science and biodiversity. Consequently, relevant courses need to be included in university curricula in order to bolster the capacity of professionals in the sector to assess the cumulative impacts of wind farms in biodiversity and develop effective monitoring and mitigation measures by employing state-of-the art modelling tools.

Lastly, the workshop brought to attention the **untapped potential of civil society and non-governmental organisations** in contributing to local biodiversity conservation plans. Both local residents and environmental organisations are able to provide valuable insights into local ecosystems, including nesting areas, migratory routes, and species interaction. Their knowledge can be valuable in environmental impact assessments and developing appropriate monitoring and mitigation strategies. It should be noted, that engaging the local community and non-governmental organisations, employing consultation mechanisms, establishing participation schemes, and using clear and transparent communication channels can also enhance wind energy project acceptance at local level.

Lessons Learnt

Guidelines to determine biodiversity protection requirements in wind farms

The green transition necessitates an improved understanding of the biodiversity, wind energy, and land use nexus. These intricate relationships are marked by complex synergies and occasional conflicts. Leveraging advancements in information and technology science, developers and operators of wind farms can gain valuable insights into the effects of such projects on local biodiversity and subsequently establish robust measures to safeguard biodiversity effectively. Key points to be considered by project developers are outlined below:

Cumulative Environmental Impact Assessments: The dimension of time should be incorporated in environmental impact assessments to account for the effects of past, present, and foreseeable future actions. Recent advancements in data science, including advanced predictive modelling algorithms and data visualisation tools and techniques, can enhance the accuracy of the assessment process and thus support informed decision making. Coupling historical data analysis with simulations of the various policy, climate change, and land use development scenarios can lead to improved understanding of the adverse multifactorial risks under different scenarios. Particular emphasis should be placed on assessing habitat loss, habitat fragmentation, blockage of migration routes, and disturbance to wildlife populations.

Adaptive assessment: Biodiversity protection targets are expected to change over time due to a number of factors, including technological advancements, evolving regulatory requirements, improved scientific understanding, and shifting environmental parameters. While cumulative Environmental Impact Assessments can offer insights into anticipated future threats to biodiversity within and around the wind farm, and guide initial protection requirements, wind farm operators should re-evaluate these assessments at regular intervals to sufficiently account for regulatory, infrastructure, land-use, and environmental changes potentially not foreseen in the prior assessment. By observing trends in long-term monitoring data, wind farm operators can make the necessary adjustments to conservation targets to address emerging threats or prioritise conservation efforts in different areas.

Mitigation hierarchy: Any biodiversity protection requirement as well as related targets should consider the mitigation hierarchy, in other words wind farm developers should prioritise avoiding or minimising over restoring or offsetting harm to biodiversity during construction, operation, and decommissioning of the farm.

Involve local stakeholders: Wind farm developers and operators should seek input from local stakeholder during the process of determining biodiversity protection requirements and related targets. Groups to be consulted and engaged in the process include local environmental groups, civil society organisations, nature and mountaineering clubs, as well as environmental non-governmental organisations. These stakeholders possess valuable local knowledge and insights including seasonal habitats, migration routes, and potential risks faced by local species and habitats, which may not be easily acquired through external assessments alone. Consequently, wind farm developers can develop biodiversity protection requirements that address specific local needs and concerns.

General guidelines for wind farm operator monitoring and environmental compliance requirements during the operation of the wind farm

The expansion of wind energy needs to align with biodiversity preservation and conservation efforts. Therefore, it is essential for wind farm operators to implement robust environmental management systems. These systems should not only ensure compliance to pertinent regulations but also actively contribute to the achievement of biodiversity protection goals established by the wind farm. Key points to be considered by wind farm operators are outlined below:

Adaptive Management: Wind farm operators are encouraged to adopt an adaptive management approach aiming to optimise wind farm's performance over time. By iteratively analysing on-going monitoring data, assessing the outcomes of previous biodiversity management decisions, and taking into consideration feedback from stakeholders, they can refine their monitoring protocols and mitigation action plans to effectively address the operational challenges and the evolving threats posed to local biodiversity by the wind farm's operation, both within and around the project's area.

Early warning systems: Ornithological radars, thermal cameras, video surveillance systems, and bio-acoustic monitoring systems offer enhanced monitoring capabilities to wind farm operators, allowing them to improve their understanding of the continuous changes in local ecosystems while also gathering large amounts of data to perform big data analysis and identify behavioural, seasonal, and combinational patterns of species (particularly avian ones) in the area. In addition, early warning systems allow for targeted shutdown on demand of wind turbines in the presence of birds or bats, to reduce their mortality rates.

Mapping of migration routes: Research and detailed mapping of migratory corridors can improve wind farm operators understanding of bird behaviours and inform evidence-based mitigation strategies to facilitate compliance with biodiversity conservation requirements and related targets. Telemetry is a promising technological solution for collecting spatial data about the movements and behaviours of various species within and outside the boundaries of the wind farm. Using telemetry devices such as Global Positioning System (GPS) trackers and radio tags on targeted members of wildlife populations, wind farm operators can collect real-time data on their spatial distribution, habitat use, migration patterns, and interactions with the wind farm infrastructure.

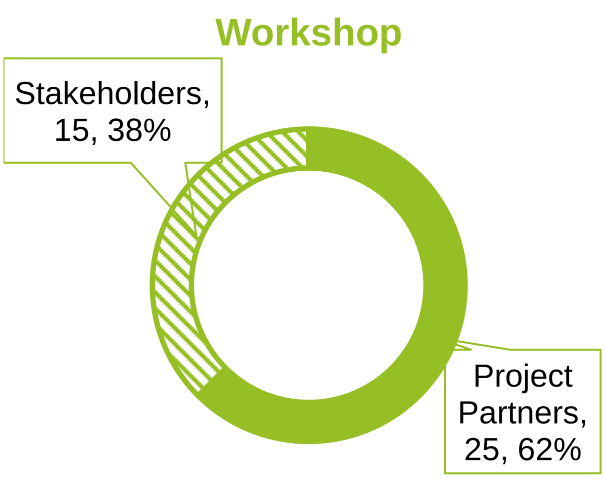
Emergency response plans: Wind farm operators should develop comprehensive emergency response plans to address potential unexpected incidents, including extreme weather events and wind turbine fire breakouts, which could pose additional stresses to local biodiversity. These plans should also encompass staff training to ensure they have the needed knowledge and skills to implement the plans.

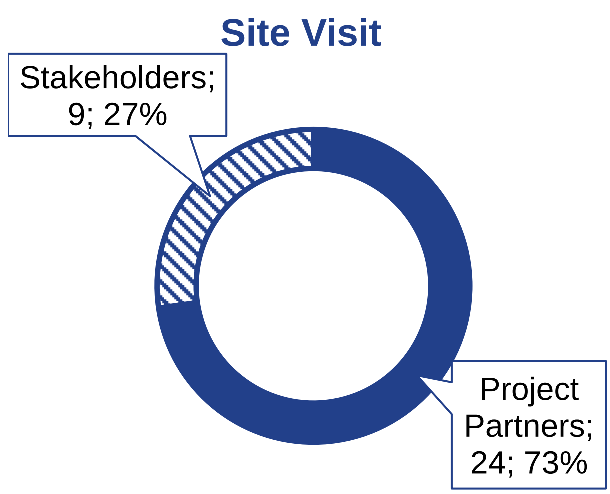
Collaborative initiatives: Wind farm operators are encouraged to collaborate with local conservation organisation and community groups to facilitate the design and implementation of effective biodiversity monitoring schemes, as well as conservation and restoration projects. Moreover, collaboration with educational institutions is also encouraged with the aim of educating younger generations in environmental protection and emphasising the importance of wildlife and plant conservation.

Regular reporting: Wind farm operators are encouraged to regularly report environmental monitoring data, regulatory compliance actions, and implemented mitigation measures. These reports should use a standardised format and also include comparative data to effectively communicate conservation efforts to relevant stakeholders and regulatory bodies.

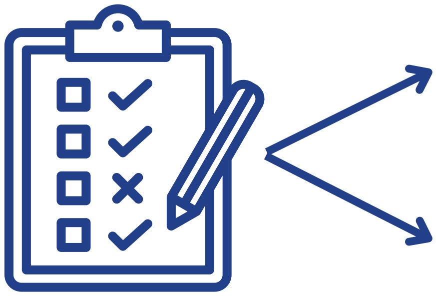
Chapter E. - Activity Participation & Evaluation

Participation Metrics



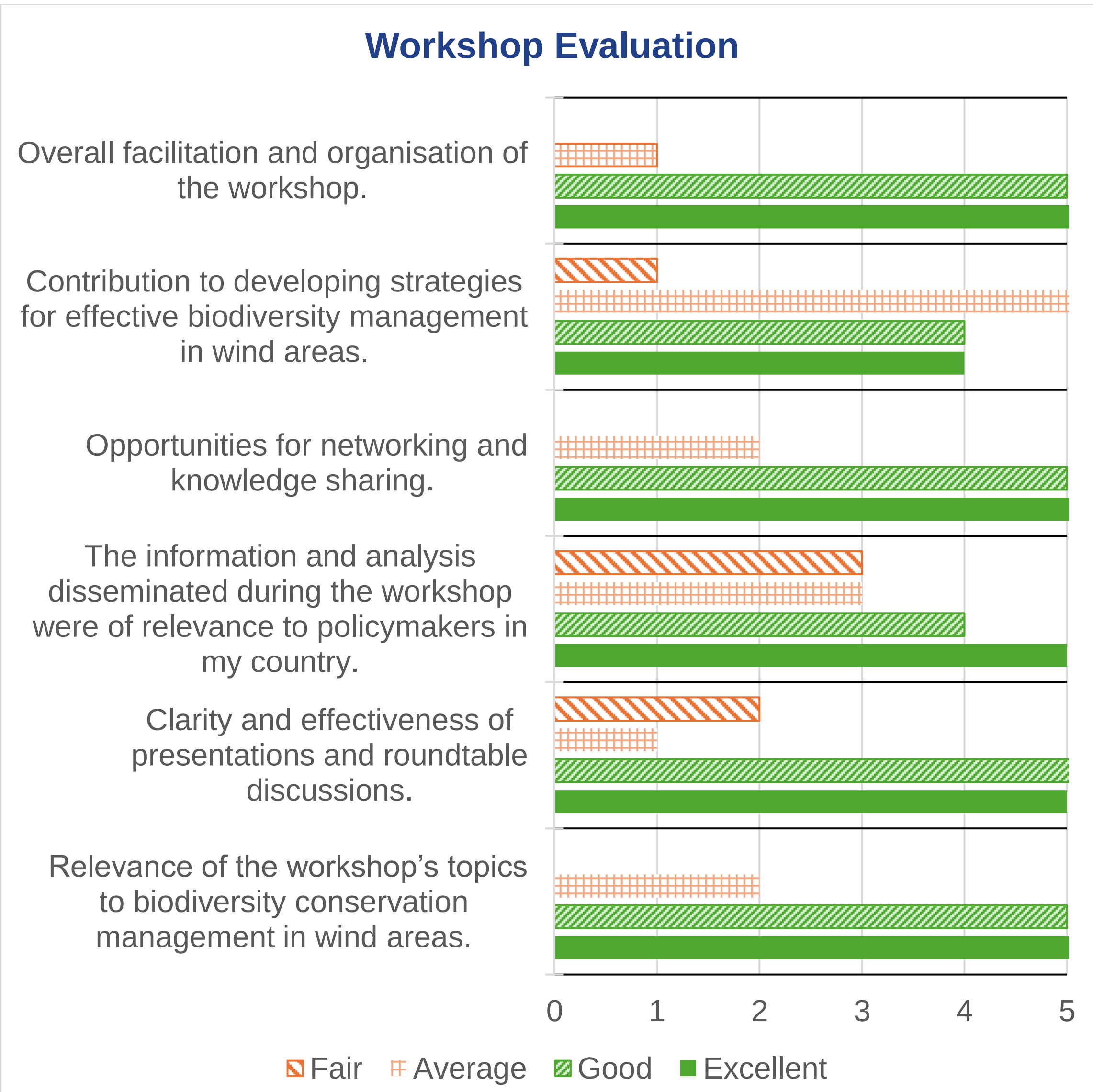


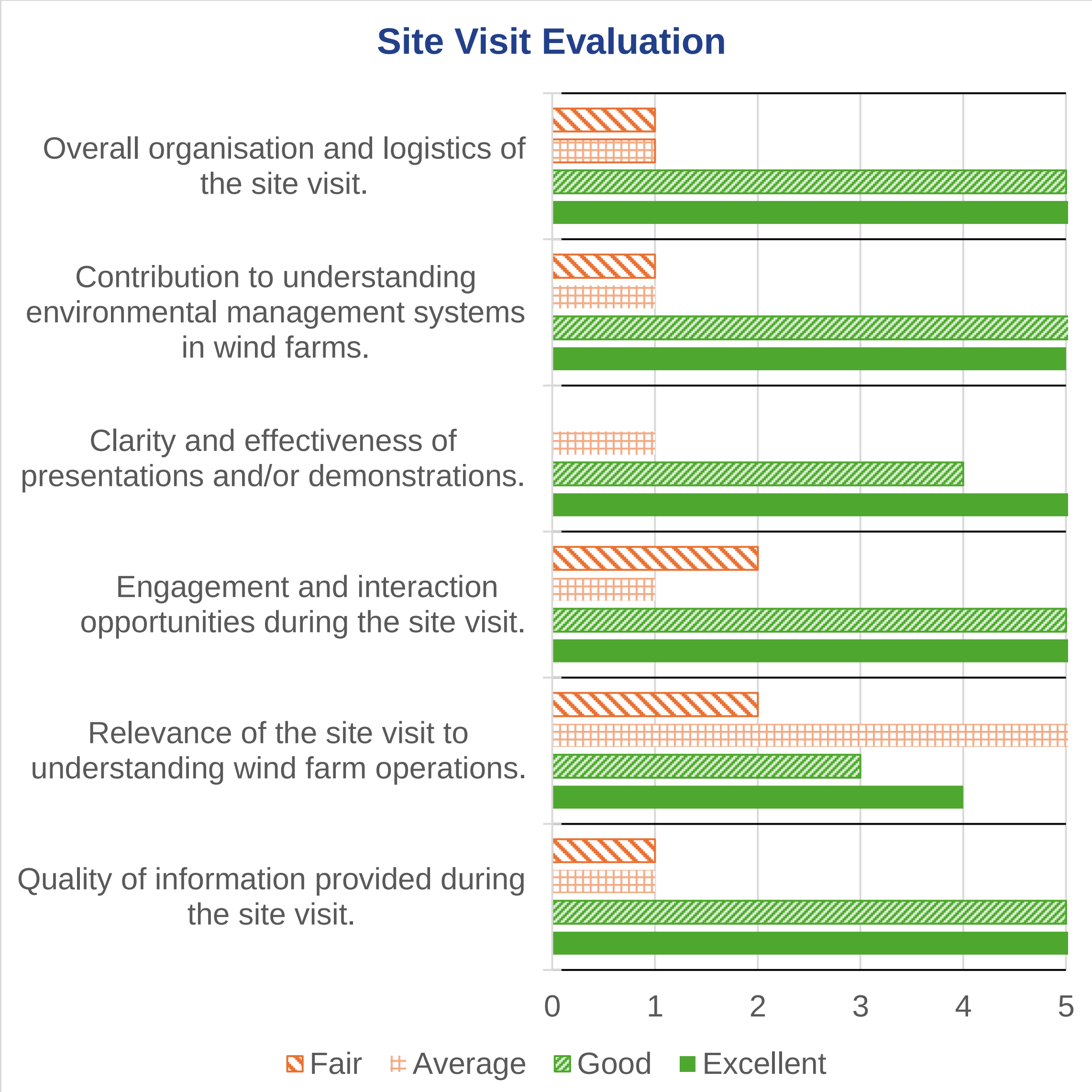
Evaluation



9 Project Partners

6 Regional Stakeholders




Site Visit Evaluation
Overall organisation and logistics of the site visit.
Contribution to understanding environmental management systems in wind farms.
Clarity and effectiveness of presentations and/or demonstrations.
Engagement and interaction opportunities during the site visit.
Relevance of the site visit to understanding wind farm operations.
Quality of information provided during the site visit.
0
1
2
3
4
5
Fair
Average
Good
Excellent

Chapter F. - ANNEXES

Annex I - Workshop Agenda

Venue: Silve Hall, Latvia University Of Life Sciences And Technologies, Lielā Iela 1, Jelgava, Latvia

Moderator: Līga Brūniņa, Association “Baltic Coasts”, Latvia

09:00 – 09:30: Arrivals & Registration

09:30 - 09:40: Opening of the Workshop, by Zemgale Planning Region, Latvia

09:40 – 10:00: Overview & Objectives of the Workshop, by Artūrs Penčura, Zemgale Planning Region, Latvia

10:00 – 10:20: “Role and potential of wind power in Latvia energy sector”, by Gunārs Valdmanis, The Ministry of Climate and Energy, Latvia

10:20 – 10:40: “What to consider when planning, building and operating wind farms to take biodiversity into account”, by Zanda Segliņa and Alise Ozoliņa, Nature Conservation Agency, Latvia

10:40 – 11:00: “The challenges of assessing the impact of wind farms on natural values and mitigation planning”, by Oskars Beikulis, Estonian, Latvian & Lithuanian Environment LTD, Latvia

11:00 – 11:20: “The impacts of wind power on birds”, by Jānis Priednieks, University of Latvia, Latvia

11:20 – 11:40: Q&A session

11:40 - 12:00: Coffee Break

12:00 – 13:30: 1st Roundtable discussion "Collaborative efforts and policy options"

- Moderator: Krista Pētersone, NGO Green Liberty, Latvia
- Topics:
  - State of play in BIOWIND countries: wind energy planning, permitting, and acceleration area.
  - Civic participation in wind farm development: public hearings, conflict resolution, and social acceptance.

13:30 -14:30: Lunch Break

14:30 – 16:00 *2nd* Roundtable discussion II "Effective approaches for biodiversity conservation in wind farms"

- Moderator: Eirini Stergiou, University of Patras, Greece & Alexandros Papageorgiou, PROMEA, Greece
- Topics:
  - Emerging technologies for early warning systems in wind farms
  - Risk mitigation measures and technologies.
  - Tools and approaches to monitor the impact of wind farms on biodiversity.

16:00 - 16:20: Coffee Break

16:20- 16:40: Outcomes & Lessons learned from the workshop

16:40 - 17:00: Workshop wrap-up Next steps & upcoming activities, by Zemgale Planning Region, Latvia

19:00 – 21:30: Social dinner in hotel “Jelgava” restaurant (Lielā street 6, Jelgava)

Annex II - Site Visit Agenda

10:20 – 11:00:	Departure from "Hotel Jelgava" the Liela Street 6 (from the side of Jānis Čakste boulevard). Arrival to "Laflora" Kaigu peat bog Livbērze parish, Jelgava county.
11:00 – 12:00:	Laflora wind farm project: overview and insights (planning and development, experience and knowledge of the environment management plans and biodiversity protection measures), Laflora wind park, LV.
12:00 – 14:30:	Site tour together with a question-and-answer session with the representative(s) of the wind farm (Factory, Kaigu mire, Drabinu mire)
14:30 – 15:00:	Lunch / Networking
17:00 – 18:30:	Guided tour of the Jelgava city (*non-official*)