PML | Plymouth Marine Laboratory

Research Tool Synopsis
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ORIES Offshore Renewable Impacts on Ecosystem Services

A decision-support tool to facilitate the environmentally sustainable expansion of offshore wind energy

The Offshore Renewable Impacts on Ecosystem Services (ORIES) tool is an innovative database and decision support system developed by Plymouth Marine Laboratory (PML) and the UK Energy Research Centre (UKERC). ORIES summarises the effects of offshore wind farm (OWF) construction and operation on ecosystem services, providing critical scientific evidence on the environmental and societal impacts of OWFs on biodiversity and ecosystem services.

This tool addresses a pressing need in the global energy transition. Offshore wind capacity in UK waters is projected to increase five-fold by 2030 and potentially ten-fold by 2050, mirroring expansions planned in many other countries. To achieve global net-zero emissions by 2050, installed offshore wind power worldwide needs to grow from 35 GW in 2020 to 2000 GW. This monumental expansion will require around 5000 new turbines annually, covering over 500,000 km² of ocean by 2050.

However, the impact of this growth on marine ecosystems and broader socio-economic, health, and cultural aspects remains unclear. A comprehensive understanding of these effects is essential for developing effective policies, such as Marine Net Gain and Environmental Impact Assessments. The ecosystem services approach embedded in ORIES helps evaluate the benefits people derive from nature and places ecological impacts in a societal and economic context.

By providing a database of UK and global research on OWFs, ORIES facilitates the critical analysis needed to support environmentally sustainable expansion of offshore wind energy. This tool is designed to help policymakers, researchers, and industry professionals navigate the complex interplay between renewable energy development and marine ecosystem preservation.

Key benefits

Up-to-date, comprehensive evidence for planning and consenting: The current 4-year planning and consenting period for offshore wind development is likely to be amended to a 1-year process under the UK Energy Security Bill. ORIES supports this by providing ready-to-use data on summarised ecological and ecosystem service outcomes.

User friendly: ORIES provides an accessible portal with links to the most relevant publications and data, including over 1,300 pieces of evidence on offshore wind impacts, making scientific data readily available in a user-friendly format.

Peer reviewed data: The tool is underpinned by more than 10 years of robust scientific data. It uses peer-reviewed primary and grey literature evidence, ensuring that decisions are based on robust, unbiased information.

Positive impacts and trade-offs: ORIES database tool highlights potential positive and negative impacts of offshore wind developments on biodiversity and ecosystem services, helping policy makers evaluate trade-offs and maximise benefits

Spatial mapping interface: GIS Spatial visualisation portal and summary statistics of OWF and ecosystem service interactions to aid in interpretation of data.

The ORIES platform enables assessment of ecological and societal impacts from developments, supporting evidence-based decisions by evaluating trade-offs between different outcomes.

The ORIES tools

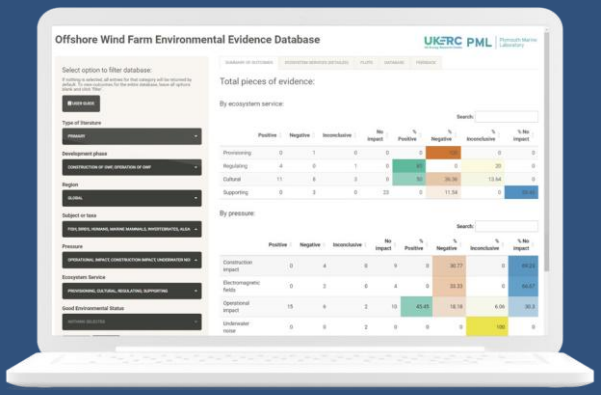
Offshore Renewable Impacts on Ecosystem Services (ORIES) is a set of innovative decision-support tools designed to promote the environmentally sustainable expansion of offshore wind energy. This open-source platform enables users in the renewable energy sector to evaluate the effects of offshore wind farms on marine habitats, biodiversity, and ecosystem services, facilitating informed decision-making that balances clean energy production with environmental preservation.

At its core, ORIES houses a comprehensive database containing over 1,300 pieces of evidence on the environmental impacts of offshore wind, drawing from scientific and grey literature. Users can access this information through a web-based GIS interface, offering interactive maps and statistics on wind farm-ecosystem interactions. This visual approach enhances understanding and supports effective planning in the offshore wind sector, making ORIES an invaluable resource for sustainable development.

Download our comprehensive step-by-step guide to the ORIES tools, featuring detailed explanations of functionalities, expert tips for optimal results, and clear instructions on interpreting your output.

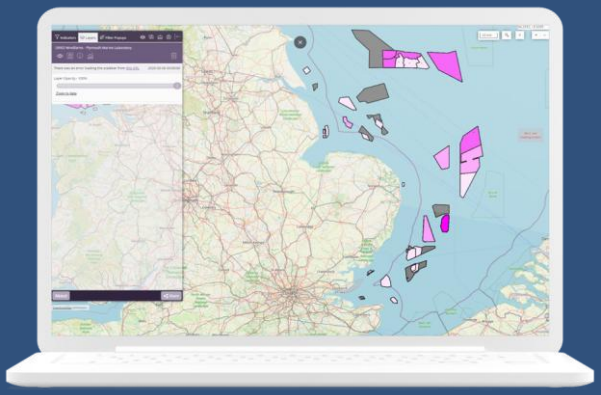
ORIES GUIDE

The ORIES Database & R Shiny Tool



https://ories.pml.space

The ORIES Spatial Visualisation Tool



https://ories.eofrom.space/

Working with decision makers and developers

ORIES was developed and refined with 15 different intended end users including input from the UK offshore wind policy leads (within Defra), the bodies responsible for planning and regulating the use of UK marine space (the Crown Estate and Marine Management Organisation), offshore wind developers (e.g., Orsted, Scottish Power Renewables), conservation agencies and NGOs (e.g. Natural England, Joint Nature Conservation Committee, Blue Marine Foundation), research bodies (e.g., Offshore Renewable Energy Catapult, Centre for Environment, Fisheries Aquaculture Science) and organisations involved in facilitating the transition to net zero (e.g., the Carbon Trust) and the Marine Management Organisation.

Policy implications

The impacts of OWFs on the marine environment are becoming clearer, but further research is needed to understand the overall implications for ecosystem services and biodiversity. As part of ORIES, PML has developed a framework linking OWF environmental impacts with ecosystem services. When applied globally[1] this framework suggests that some human activities may be enhanced by OWFs under certain circumstances, while invasive species spread and impacts on marine mammals and birds show negative associations. Notably, more than 86% of possible OWF impacts on ecosystem services remain unknown.

PML's study on perceived benefits of OWFs[2] and marine net gain revealed that over 80% of participants considered external inputs, such as climate change adaptation options and habitat mapping data, important for Marine Net Gain delivery. The most valued ecosystem services for Net Gain measures were perceived as those related to fisheries, nursery habitats, and climate regulation.

A review of UK grey literature[3] for ORIES showed a heavy emphasis on negative OWF impacts, with little evidence of positive environmental outcomes. PML research highlights an exponential increase in OWF impact literature over the last decade, suggesting that decision-making could benefit from including all available evidence. An overview of this research has been published in The Conversation[4], discussing how policymakers are influenced by reports on OWF impacts.

Related research

Regular updates from related research enhance the ORIES tools and database.

UK Energy Research Centre – Energy, Environment, and Landscapes
PML led this theme which applies ecosystem service and natural capital approaches to understand the environmental implications of changes in the UK energy system, including offshore wind. Using a range of spatially resolved approaches, it is working to provide new tools for decision-makers that allow them to take a whole-systems perspective to help maximise societal benefits.

DREAMS was an integrated project that developed new understanding of marine artificial structures and decommissioning strategies. It successfully explored their influence on marine ecosystem structure, functioning, and dynamics, as well as their impact on ecosystem services from a whole ecosystem perspective.

The **ValMAS** project is assessing how marine artificial structures, including offshore wind, influence biodiversity and food-web processes in UK seas. It evaluates ecological, economic and social benefits and trade-offs across installation, operation and decommissioning to guide nature-positive management.

Future development

The future development of ORIES tools aims to address critical data gaps and expand its scope to encompass a broader range of renewable energy technologies. Currently, the ORIES database faces several challenges, including limited information on various ecosystem services and phases of wind farm development. These gaps, combined with the emerging field of floating offshore wind, highlight urgent research needs that future iterations of ORIES aim to address.

ORIES has now moved beyond its initial focus on offshore wind. The completed ORIES phase 2 incorporates data from other renewable energy sources, including tidal, wave and floating wind technologies. This expansion provides a more comprehensive understanding of the marine renewable energy sector's environmental impacts, ensuring that ORIES remains a cutting-edge resource for researchers, policymakers and industry professionals.

A key area of focus for the future development of ORIES phase 3 is the incorporation of empirical evidence to support decommissioning strategies. Currently, most evidence regarding decommissioning impacts is inferred from construction and operational phases. However, with wind farms having an expected lifespan of approximately 30 years, there is an urgent need for concrete data on decommissioning methods and their environmental impacts[5]. ORIES aims to collect and analyse this crucial information for sustainable decommissioning practices.

The path to clean energy requires an immense institutional, societal and environmental transition. In our urgency to meet net-zero, we must exercise caution to avoid exchanging one environmental problem for another. This project will help to achieve a win-win for climate and biodiversity, enabling a smooth transition to sustainable energy while safeguarding the UK's marine ecosystems.

References

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PML is available to lend their expertise to help users find access and utilise evidence for the environmental and socio-economic outcomes/impacts of offshore renewable developments.

If you would like to talk to the researchers behind this innovative work please contact: impact@pml.ac.uk

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PML Plymouth Marine Laboratory

UKERC UK Energy Research Centre

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