

# EFFILOAT

Efficient From Fabrication to Installation of Large Offshore Assembled Turbine



A MOOI project progress report: year 1



Penholder: Mammoet Holding BV

“The project was carried out with Topsector Energy funding from the Ministry of Economic Affairs and Climate Policy, administered by the Netherlands Enterprise Agency (RVO). The specific funding for this project concerns the 2024 round of the MOOI subsidy programme.”

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Project partners: Baggermaatschappij Boskalis BV, TU-Delft, GustoMSC BV, Royal Roos Holding BV en Heavy Duty Pavement BV.

Project title: EFFILOAT: Efficient From Fabrication to Installation of Large Offshore Assembled Turbines

Penholder: Mammoet Holding BV

Project start date: 01 February 2025  
Project end date: 31 Januari 2029

Project acronym: EFFILOAT  
Project number: MOOI124050

Report date: 27 March 2026

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# 1 Summary

## Background

The offshore wind sector is undergoing rapid scaling in turbine capacity and foundation size in order to meet national and European climate targets. Next-generation wind turbines are moving towards 20 MW capacity, while monopile foundations are expected to exceed 3,000–3,500 tonnes. Although this scale-up increases energy yield per turbine, it significantly intensifies logistical complexity in the transport and installation (T&I) supply chain.

Current marshalling yards, heavy transport systems, offshore vessels, handling equipment, and installation methods were largely designed for smaller components. As component dimensions and weights increase, bottlenecks arise in yard space, quay capacity, soil bearing pressure, transport stability, lifting operations, and offshore installation windows. Without structural supply chain innovation, these bottlenecks risk delaying offshore wind deployment and increasing costs, thereby counteracting the intended reduction in Levelized Cost of Energy (LCOE).

EFFILOAT is based on the premise that future cost reduction and acceleration of offshore wind cannot rely solely on component-level innovation, but require an integrated system approach across the entire logistics chain: from fabrication and storage to transport, handling and offshore installation.

## Purpose of the project

The purpose of EFFILOAT is to significantly contribute to accelerate offshore wind deployment by reducing structural inefficiencies and bottlenecks in the Transport and Installation (T&I) supply chain for large offshore wind components. The project aims to develop, validate and prioritise scalable innovations that improve:

- Time efficiency in marshalling and installation operations
- Space utilisation in storage and yard layouts
- Asset utilisation of vessels, lifting equipment and transport systems
- Safety and operational robustness
- Overall cost performance, contributing to reduced LCOE

Through system innovation, standardisation and industrialisation of logistics processes, EFFILOAT seeks to enable a more predictable, efficient and scalable offshore wind installation chain, aligned with national and European deployment targets.

EFFILOAT is structured around three integrated results (work packages):

1. System innovation for reduction of supply chain bottlenecks,
2. Foundation-related transport and installation concepts, and
3. Wind turbine generator (WTG) assembly-related transport and installation concepts.

The project is executed by a consortium of six partners: Mammoet, Boskalis, GustoMSC, Royal3D (Royal Roos), Heavy Duty Pavements (HDP), and TU Delft, with TechForce as the project coordinator.

## **Actual Status**

During Year 1, the project focused on laying the analytical and technical foundation for future optimization of the offshore wind transport and installation chain.

Stakeholder consultations were initiated by different project partners to further identify and validate bottlenecks in marshalling, transport sequencing and offshore installation. In parallel, the consortium started to structure an integrated logistics approach and to explore which innovation routes may have the highest impact on time efficiency, space utilisation, cost efficiency and asset use.

Initial concept development work started on foundation-related and WTG-related transport and installation solutions.

Overall, The first project year was primarily exploratory in nature (research) and did not yet result in validated technical solutions, but it did provide a shared basis for prioritisation and further development in the next project phase.

## **2 Description of executed activities**

EFFILOAT is structured around a result-based approach with three main result areas. Together, these results address bottlenecks in the offshore wind transport and installation chain and aim to improve efficiency, reduce installation time and support lower costs for future offshore wind deployment.

### **2.1 Result 1 – System Innovation for Reduction of Supply Chain Bottlenecks**

During year 1, activities under Result 1 focused on establishing the analytical base for future optimisation of the offshore wind transport and installation supply chain.

Stakeholder consultations were carried out to improve insight into bottlenecks in marshalling, handling, transport sequencing and offshore installation. In addition, the consortium started to develop an initial logistics framework and a first structure for comparing optimisation scenarios across time, space, cost and asset utilisation.

Scenario planning activities were initiated, and partners explored the requirements for future digital simulation work. These activities remained largely preparatory and did not yet result in validated optimisation outcomes, but they did create a clearer basis for further modelling and prioritisation.

### **2.2 Result 2 – Foundation-Related Transport and Installation Concepts**

During year 1, Result 2 focused on the first exploration of technical concepts related to the storage, transport and installation of large monopile foundations (piles and jackets).

The work mainly consisted of technical assessments, requirement definition and early concept development for reusable storage and transport solutions, alternative support structures, SPMT-based transport concepts and foundation handling methods. Initial analytical work was also carried out on jack-up related installation constraints and alternative monopile installation approaches.

These activities helped to clarify technical boundary conditions, operational constraints and possible optimisation directions. No validated technical solutions were delivered yet, but Year 1 did provide a solid initial basis for further development of different solutions and technical approaches.

### **2.3 Result 3 – WTG Assembly-Related Transport and Installation Concepts**

Within the first project year, activities under Result 3 were still limited and mainly exploratory. The main focus was on initial assessments of storage and transport structures for large wind turbine generator components, with attention to operational constraints, modularity, standardisation opportunities and space efficiency.

Other activities within this result area were not yet started in line with the planned phasing of the project.

## **3 Results achieved per milestone, bottlenecks and perspective for future application**

### **3.1 Results achieved per milestone**

During year 1, the project primarily worked towards the first milestone: identifying and structuring the most relevant optimisation opportunities in the offshore wind transport and installation chain. This milestone was focused on analysis and preparation rather than on prototype validation or implementation.

The main results achieved in Year 1 were:

- improved insight into bottlenecks in marshalling, transport and offshore installation;
- a first structured framework for assessing optimisation opportunities across time, space, cost and asset utilisation;
- initial scenario definitions for comparing alternative logistics and installation approaches;
- first feasibility explorations of technical concept directions for both foundation-related and WTG-related transport and installation solutions.

These results do not yet constitute validated technical solutions, but they do provide a clearer basis for prioritisation and further development in the next phase of the project.

### **3.2 Bottlenecks in the execution of activities**

During Year 1, most activities were started in line with planning.

One bottleneck encountered in project execution was related to research capacity for modelling activities. A planned research position at TU Delft could not yet be filled during 2025, which meant that the intended modelling depth for Year 1 could not be fully realised. To mitigate this, preliminary work was supported through student involvement, allowing preparatory work on modelling logic and data structuring to continue. At this stage, no structural delay in the overall project objectives is foreseen.

In addition, the broader offshore wind market remained challenging during 2025. Rising capital costs, supply chain pressure and increasing caution in investment decisions created a more uncertain market context internationally. This does not directly affect the relevance of the project; on the contrary, it increases the importance of innovations that improve logistics efficiency and reduce costs.

### **3.3 Perspective for future application**

The perspective for future application of the EFFILOAT concepts remains relevant, although the market context is challenging. Internationally, offshore wind development is under pressure due to cost increases and uncertainty in project pipelines. At the same time, the Netherlands continues to show a

strong and consistent commitment to offshore wind expansion. This provides a stable context for further development and validation of the project results.

The concepts explored in EFFILOAT aim to improve logistics efficiency, reduce installation time and optimise the use of assets in offshore wind projects. These objectives remain highly relevant in a market environment where cost control and implementation efficiency are increasingly important. For that reason, the project continues to offer a realistic perspective for future application, particularly within the Dutch offshore wind programme.

#### **4 Contribution to the Objectives of the MOOI Scheme**

EFFILOAT directly contributes to the objectives of the MOOI (Missiegedreven Onderzoek, Ontwikkeling en Innovatie) scheme under Mission A (Electricity), which focuses on accelerating the energy transition through integrated system innovation rather than isolated technological improvements.

EFFILOAT contributes to the objectives of the MOOI scheme by addressing system-level bottlenecks in the offshore wind transport and installation chain. The project does not focus on a single technical component, but on improving the efficiency of the overall logistics system from marshalling yard to offshore installation. In doing so, it supports the broader MOOI objective of accelerating the energy transition through integrated innovation.

The project contributes in particular by exploring solutions that can improve time efficiency, space utilisation and asset use in offshore wind projects. These themes are directly relevant to the large-scale deployment of offshore wind, where larger turbines and foundations place increasing pressure on available infrastructure, installation capacity and project economics. By investigating more efficient logistics concepts and support structures, the project aims to contribute to lower installation costs and more predictable project execution.

EFFILOAT also supports the MOOI objective of scalable and broadly applicable innovation. The project explores concepts such as reusable support structures, more standardised transport and handling approaches, and improved system-level planning methods. These directions may help reduce dependence on project-specific solutions and improve replicability in future offshore wind developments.

Finally, the project contributes to knowledge development and cross-sector collaboration by bringing together expertise from logistics, offshore installation, engineering, soil mechanics and academic modelling. In that way, EFFILOAT supports both technical innovation and stronger coordination across the offshore wind value chain.

## 5 Spin-off

During Year 1, EFFILOAT did not yet lead to direct market application or externally deployed innovations. This is in line with the project phase, which was mainly focused on analysis, feasibility work and the definition of promising development directions.

Within the consortium, the project did contribute to stronger alignment on key bottlenecks in offshore wind logistics and installation. Partners developed a more shared understanding of where improvements in marshalling, transport and installation may have the greatest impact. The project also helped introduce a more structured way of assessing optimisation opportunities, based on time, space, cost and asset utilisation.

Outside the consortium, no tangible spin-off was realised yet in Year 1. However, the work carried out does provide an initial basis for future broader application, particularly if the identified concepts can be further developed and validated in the next project phases. The relevance of these concepts remains clear, especially in a market where cost efficiency and better use of assets are becoming increasingly important.

Overall, the spin-off of Year 1 was mainly organisational and methodological in nature. Broader technical and sector-level spin-off is expected, if successful, only in later stages of the project.

## 6 Publications

No publications were produced in Year 1. Public dissemination activities will be initiated in later years when validated results become available for external communication.

## 7 Conclusion

Year 1 of EFFILOAT was carried out in line with the planned phasing of the project. During this first year, the consortium established a base for identifying and prioritising promising innovation pathways in the offshore wind transport and installation (T&I) supply chain. The project remains aligned with its objectives under the MOOI scheme.

After one year, the project has:

- Indicated relevant actual bottlenecks in marshalling, transport and installation;
- initiated an integrated logistics framework and KPI structure;
- started scenario planning and preparatory work for digital simulation/twinning of processes;
- initiated concept development for foundation-related and WTG-related innovations;
- established governance and coordination across the project results.

One bottleneck was encountered in the delayed recruitment of a postdoctoral researcher at TU Delft. This was partly mitigated through the involvement of Master's students and preparatory modelling work. At this stage, no structural impact on the overall project objectives is foreseen.

In summary, Year 1 delivered the intended preparatory results and positioned the project for more focused technical development and quantitative validation activities in Year 2.