

5 powerful reasons to involve a coating expert when designing offshore wind farm foundations

Power of Less



Offshore wind farms represent a significant investment, where surface-level specifications can mask hidden costs. In this paper, we go deeper –literally – as a vast amount of the total project budget is tied to the foundation alone. Ensuring that this critical and highly exposed component is properly protected is essential, not just for durability but for financial viability as well. Getting coating experts involved early is crucial to ensure optimal protection strategies to prevent costly corrections. Prioritising the right coatings and defining the optimal coating process from the start minimises the risk of coating failures, extends the foundation’s lifespan, and secures long-term efficiency.

The initial planning stages of an offshore wind farm project come with several unknown factors. Site data and turbine loading information might still be limited, and as a foundation designer, you must ensure that no critical details are overlooked. Accurately predicting the effectiveness of protective measures is crucial for reducing the maintenance costs later.

One often underestimated aspect is the protective coating systems for the foundation. Not only is this section exposed to waves and weather, but parts of it

are also submerged in seawater, totally buried, making it prone to varying levels of corrosion.

And the consequences of inadequate coating protection can be severe, as remedying coating failures offshore is significantly more expensive than addressing them onshore. In some cases, coating repairs have cost up to 20 times the price of the original installation, creating unexpected financial strain and operational setbacks¹.

Fortunately, there are ways to minimise the hidden cost associated with vague coating specifications. Many expenses are avoidable if experts with both experience and deep knowledge of coating selection and project optimisation, from design to operation, are consulted early in the process.

So, if you ask a coating expert why you should involve them early in the design conversation, we give you our five compelling reasons to ensure the profitability, durability, and sustainability of your foundation design.

Read on to learn how you:

1. Boost productivity and efficiency gains,
2. Lower total lifecycle cost,
3. Extend the asset value of your foundation investment,
4. Minimise maintenance needs and
5. Enhance the sustainability profile.

¹ <https://www.twi-global.com/media-and-events/insights/better-coatings-can-substantially-reduce-the-cost-of-offshore-wind-energy>



PROFITABILITY

1. Boost productivity and efficiency gains

When a project is already behind schedule, there's a risk that one of the last steps in the process, the paint work, gets rushed to compensate for lost time. However, an often-overlooked key factor in overall productivity is the coating process. The quality of the surface preparation, the coating thickness, and, not least, the skills of the workmanship are all variables that require strict quality control. But also, the curing times and ease of application can impact the speed of production. And delays during fabrication and installation of wind foundations can have serious commercial consequences, not to mention the cost of

needing to remedy rushed coating failures later, once the turbines are installed.

Coating suppliers can, of course, help you select the right coating for the job from the start, preventing unnecessary product testing. But coating experts, such as Hempel, can also help you improve the project planning altogether. Hempel has the technical insights on curing times, surface preparation needs, and helping project managers set realistic schedules. Hempel coating experts can also help plan the application process that fits with the workflows of a team in the workshop, reducing delays.

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[...] good protection will only be possible with proper quality control, carried out by well-educated painting inspectors [...] and with proper documentation of the whole painting operation processes from the bare steel to the finished construction.²

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² <https://forcetechnology.com/-/media/force-technology-media/pdf-files/unnumbered/corrosion-protection/corr-white-papers/eurocorr-2011—corrosion-protection-of-offshore-wind-farm-structures—present-understanding-and-future-challenges.pdf>



PROFITABILITY

2. Lower total lifecycle cost

Financial risks and project viability are major concerns in offshore wind projects. Investors need to prioritise reliable cost forecasts and minimal unexpected expenses.

And every design decision affects the cost across a wind turbine's lifespan. While premium coating might seem like a higher upfront investment, it can significantly reduce long-term operations and maintenance spending, ultimately improving asset uptime. By specifying the right systems early – and applying them correctly – you minimise downtime, the need for mid-life repairs, and avoid extensive offshore work. Not least, an optimal coating system will result in minimal material use and less waste.

By considering an optimal protective coating system from the start, operators can create more financially sustainable projects that align with lifecycle cost expectations.

Determining profitability in offshore wind turbine projects is complex, making durability optimisation even more crucial. Reducing unplanned maintenance through optimal corrosion protection is essential to preventing costly repairs and prolonging the lifespan of offshore wind turbine foundations.⁵

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“If repair work must be done offshore due to premature failure of the corrosion protection, the cost can be 40–60 times higher [than the cost of painting the component in the workshop].³”

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³ <https://www.windsystemsmag.com/technology-39/>

⁵ <https://forcetechnology.com/-/media/force-technology-media/pdf-files/unnumbered/corrosion-protection/corr-white-papers/corrosion-issues-and-monitoring-techniques-for-offshore-wind-turbine-foundations.pdf>


Zero bids in major offshore wind farm tender

Even with its small size, Denmark, boasts an extensive coastline and has pioneered its first offshore wind farm as early as 1991.

Today, the Danish government remains committed to its ambitious goal of reaching 14 GW by 2030⁴, reinforcing the nation's role as a global frontrunner in renewable energy since the 1970s.

However, despite this vision, the Danish Energy Agency reported no bids across three major offshore wind farm tenders in 2024, highlighting the complexity of securing the right lifecycle cost and investment case.

⁴ <https://maritime-executive.com/article/denmark-disappointed-as-it-receives-no-bids-in-new-offshore-wind-tender>



DURABILITY

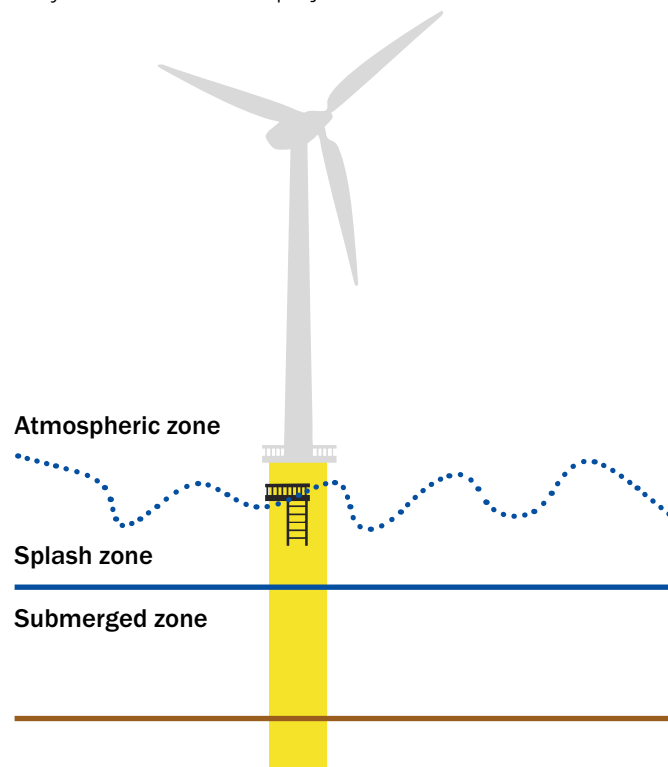
3. Extend the asset value of your foundation investment

Wind foundations must endure decades of exposure to saltwater, wave impact, and dynamic loading. Coating systems are the first line of defence, and when chosen correctly, they extend the usable life of critical steel components.

The foundation is exposed to many different conditions, which makes this particularly tricky to select a coating for. How much oxygen, salt, or moisture a foundation is exposed to depends on which zone the part is in: the atmospheric zone (exposed to air), the splash zone (exposed to both water and air, thus the most severe corrosion risk), and the submerged zone. All these different conditions have different corrosion risks and need to be considered when choosing the coating system.⁶

And the foundation is not only exposed to these conditions from the outside. Internal surveillance has shown that the foundation is not a closed compartment, even though it has been designed

to be airtight. Due to earlier assumptions, the inside of the foundation has often been left uncoated, instead, surfaces were equipped with Impressed Current Cathodic Protection (ICCP), which actively delivers a controlled electrical current through anodes to counteract corrosion. But since then, it has been widely discovered that the inside has been exposed to both water and air, resulting in corrosion found on the inside of foundations as well, which is why coating protection from the inside should be considered for your future offshore project.



⁶ <https://forcetechnology.com/-/media/force-technology-media/pdf-files/unnumbered/corrosion-protection/corr-white-papers/eurocorr-2011-inspection-and-monitoring-of-corrosion-inside-monopile-foundations-for-offshore-wind-turbines.pdf>

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As an example, oxygen levels have been measured above water level in 36 foundations of a 5-10 year old wind farm [in northern Europe]. Only 3 of these foundations (8%) can be characterised as oxygen-free and appear fully closed, whereas 25 (70%) of the foundations can be characterised as aerated with oxygen levels above 15%.⁷

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To ensure your turbine foundations resist the harsh marine environment, you need a coating expert who can evaluate exposure zones, corrosion risks, and internal coating requirements specific to your site. With the right expertise, you can maximise durability, reduce maintenance costs, and protect your investment for the long term, avoiding unnecessary risk and expenses.

Investing in the optimal coating technology creates ...


Corrosion resistance: An advanced protective barrier against saltwater, high humidity and strong winds prevents degradation

Lower repair costs: The right coating technology prevent damage before it happens, and reduces the need for frequent repairs and replacements, cutting downtime and operational expenses

Improved reliability: Consistent protection means fewer unexpected failures, leading to more predictive maintenance schedules and increased energy production reliability.⁸

⁷ <https://forcetechnology.com/-/media/force-technology-media/pdf-files/unnumbered/corrosion-protection/corr-white-papers/eurocorr-2011-inspection-and-monitoring-of-corrosion-inside-monopile-foundations-for-offshore-wind-turbines.pdf>

⁸ <https://forcetechnology.com/en/articles/new-developments-in-coatings-for-extended-lifetime-for-offshore-wind-structures>



DURABILITY

4. Minimise maintenance needs

Maintaining offshore wind turbines is both costly and complex, requiring specialised vessels, skilled offshore labour, and navigating harsh weather conditions. These factors significantly drive up expenses, making early design-phase strategies to minimise or even eliminate maintenance, ultimately ensuring long-term efficiency and cost savings.

Beyond the significant cost and difficulty of accessing offshore turbines after installation, each inspection poses additional risks. Opening turbine components can expose them to oxygen, humidity, and saltwater, accelerating corrosion and degradation. Additionally, repeated access increases the likelihood of surface cracks, potentially compromising structural integrity over time.¹⁰

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Damage analyses in Germany have [...] shown that faulty processing and/or wrong application have caused between 43% and 68% of premature failures of the corrosion protection in the paint industry.⁹

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⁹ <https://forcetechnology.com/-/media/force-technology-media/pdf-files/unnumbered/corrosion-protection/corr-white-papers/eurocorr-2011--corrosion-protection-of-offshore-wind-farm-structures--present-understanding-and-future-challenges.pdf>

¹⁰ <https://forcetechnology.com/-/media/force-technology-media/pdf-files/unnumbered/corrosion-protection/corr-white-papers/eurocorr-2011--inspection-and-monitoring-of-corrosion-inside-monopile-foundations-for-offshore-wind-turbines.pdf>

Innovative coating solution to reduce maintenance needs in China

The 300MW expansion of the offshore wind farm in Xuwen County, Zhanjiang City is the largest single-unit capacity among offshore wind projects in Zhanjiang in 2023.

The client required highly competitive anti-corrosion coatings that not only provide excellent performance but also offer sustainable properties, which can reduce the impact on the environment and the risk of exposure for workers.

The self-priming epoxy coating Hempaprime Strength 530 provides long-term protection for offshore wind power equipment in splash zones and fully immersive zones and thus reducing the need for maintenance, extending asset durability and optimising long-term operation efficiency.





SUSTAINABILITY

5. Enhance the sustainability profile

Sustainability is the license to operate in offshore wind investment projects. Asset owners generate zero-emission energy exclusively through wind, but they must also ensure their projects are designed, built, and maintained with minimal environmental impact. Leading coating suppliers like Hempel are advancing sustainable protection by developing systems that reduce CO₂ emissions and minimise VOC exposure.

This highlights the importance of selecting sustainable coatings that protect every component.

By enhancing corrosion resistance and protecting turbine foundations from environmental stressors, these coatings extend asset longevity while reducing maintenance needs. The result? Less material consumption, improved material efficiency and significantly lower waste – helping wind energy projects meet sustainability demands while remaining cost-effective.

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[...] if you take a 4.2 MW turbine as an example, there are approximately 50 tonnes of materials that are ‘non-metal’ like the coatings, composites (glass and carbon fibre and epoxy resin), glue, rubber, etc. Materials like that will require dedicated recycling processes to dispose of them.¹¹

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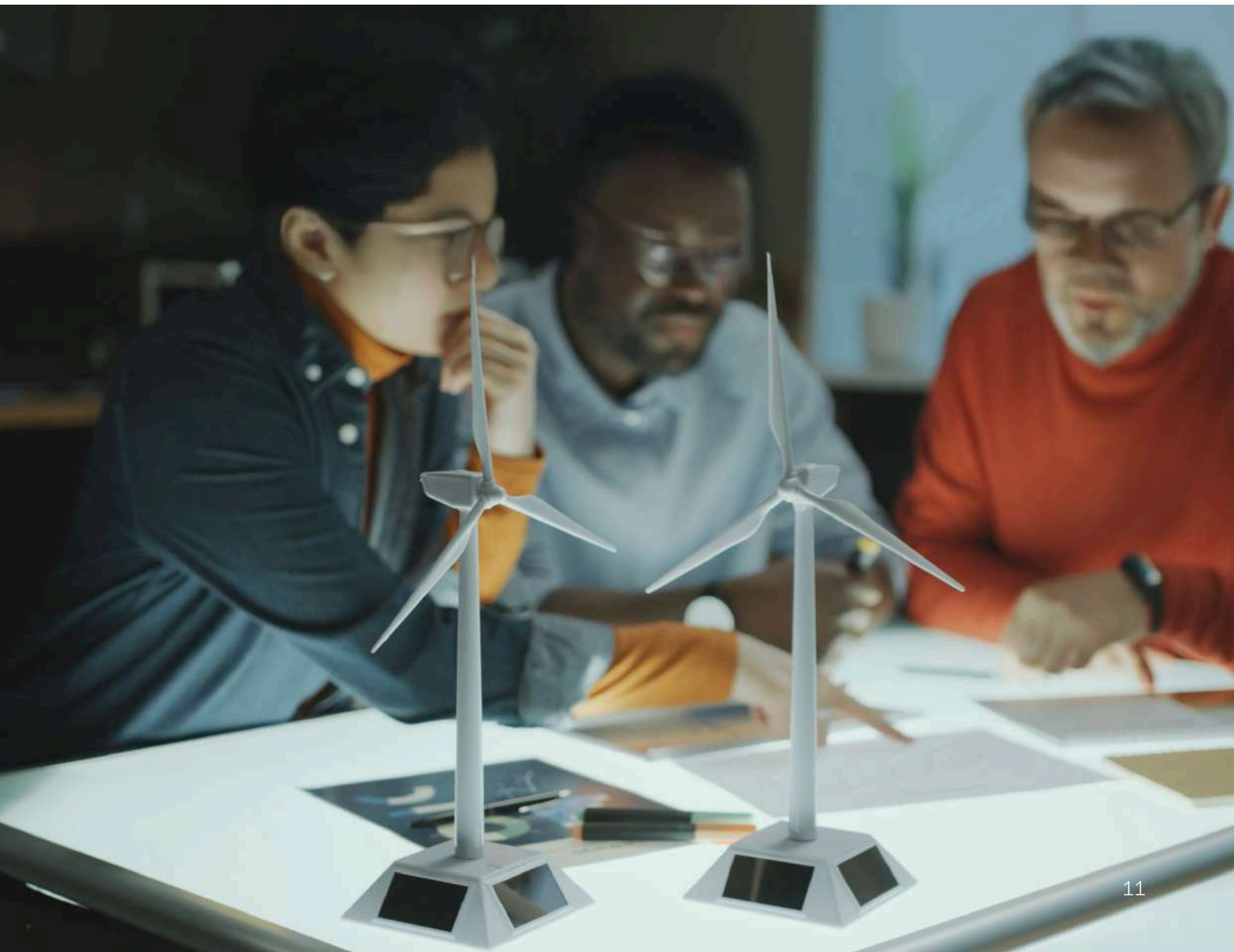
¹¹ <https://www.vestas.com/en/media/blog/sustainability/Zero-waste-turbines-by-2040>

Key consideration

for selecting the most sustainable coating supplier

✓ Low in Volatile Organic Compounds (VOC) for lower environmental impact	✓ Low hazard-products that meet health, safety and environment standards (HSE)
✓ Optimised paint usage to minimise waste and improve efficiency	✓ Compliance with industry standards such as ISO and NORSOK
✓ Low carbon footprint through more sustainable production and material	✓ Enhanced worker safety, with fewer risks and better protective measures
✓ Transparent sustainability data to support responsible sourcing	

Hempel ticks off all the above boxes, with coating systems that comply with industry, environmental, and health standards, while ensuring full transparency of our sustainability data.



Hempel's commitment to sustainable coating includes:



**50-90%
reduction
in VOC**



**20-30%
reduction
in paint
use**



**25-40%
reduction
in carbon
footprint**

With our “Power of **Less**” response to industry demands, Hempel offers optimal protection with minimal environmental impact and reduced material use. With innovative coating, you need fewer layers, leading to less waste and less maintenance.



Let's empower your offshore foundation design

As this paper outlines, designing a wind turbine foundation with optimal protection presents significant challenges. The economic pressure to reduce the levelized costs of electricity (LCoE) further intensifies the difficulty of balancing cost-efficiency, durability and sustainability of your foundation design. But at Hempel, we are here to help you navigate these complexities.

We work closely with wind foundation fabricators and applicators, supported by a best-in-class local team with strategically located stock points close to you. We offer our extensive expertise in corrosion protection challenges encountered on-site, and deep experience in minimising wind turbine maintenance. This enables us to strike the right balance in specifications and help asset owners avoid common pitfalls.

Hempel: Your trusted partner through wind and waves

- More than 40 years of experience in wind industry
- Global supplier of a wide range of coating systems
- Coatings developed to endure for over 25 years
- Low VOC and CO₂, minimising environmental impact

About Hempel Wind

We've been working with the wind industry since 1980. Over the years, we've partnered with innovative OEMs to develop wind turbine coatings and application processes for the entire turbine. Through Power of **Less**, we help customers all over the world minimise material use, ensure less waste and, for those on the field, less physical work.

That's how we believe we can, together, make sure wind becomes the leader in the race to renewable energy sources and production.