



Colliding winds

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The Baltic offshore wind narrative is often expressed and calculated in gigawatts installed (or at least planned). Even more so, it will be industrial logistics, executed under narrow permitting and seasonal constraints, that will define the coming decade. Plans of transmission system operators for Baltic offshore grids speak of the scale of change: reaching roughly 27GW by 2030 implies some 3.0GW/year of installations in the second half of the 2020s. At the same time, the market is facing tender failures and revised subsidy models across Europe, making revenue design and auction conditions central to bankability. In the Baltic, factors above are amplified by port limitations, special installation vessels and handling assets in short supply, and seasonal ice conditions that may narrow construction-work windows.

Furthermore, turbine growth in size and installation complexity must be presented as a planning part instead of an already installed, desired baseline. Several environmental impact assessments for projects in the Baltic indicate 10-25-megawatt maximum turbine ratings, supporting the claim that consenting and layout studies increasingly assume 20-25MW upper plans. However, connected offshore turbines in Europe averaged ~10.1MW in 2024, while that year saw an average of ~14.8MW in orders, pointing to a scaling transition rather than a desired 20-25MW standard.

Third, foundations and seabed types should be understood as a portfolio of engineering solutions instead of separate factors. Monopiles remain central to fixed-bottom projects (especially off the Polish coast). Jackets and gravity-based

foundations (GBF) stand as important alternatives where depth, soil, and noise constraints set different requirements. Lastly, projects in the north of the Baltic face seasonal ice constraints, which requires site-specific design and scheduling.

Tomorrow's offshore wind is a systematic energy transition project that requires substantial infrastructural investment. And in the Baltic Sea, two elements will weigh in on the ultimate success: port (network) development and regulatory coordination.

The south | north divide

The Baltic Sea is often seen as a single development area. From an engineering standpoint, it is far from it. In the southern and central Baltic – including Estonian, Latvian, Lithuanian, Polish, and parts of Swedish waters – sea depths typically range between 20 and 50 meters. The seabed is

predominantly sandy and clay, with sedimentary formations. These geotechnical conditions are suitable for jacket foundations, particularly for turbines in the 15-20MW range, which are now becoming standard in the region.

Jacket foundations comprise a steel lattice structure fixed to the seabed using driven or drilled piles at each leg. Installation typically involves transportation by a heavy-lift ship or barge, putting in place with dynamic positioning vessels, pile driving or drilling through sediment layers, and grouting and structural fixation. This process requires stable weather windows and precise marine operations (fortunately, sedimentary seabeds facilitate penetration and anchoring).

In contrast, the northern Baltic and the Bothnian region (particularly along the Finnish and Swedish coasts) presents a very different set of conditions. Water depths are



Parameter	Monopile	Jacket	GBF
Soil	Soft	Medium	Rock
Depth [metres]	<40	25-60	10-40
Noise	High	Medium	Low
Port demand	Medium	High	Very high
Wave resistance	Low	Medium	High

often shallower (10-35 m), but the seabed is mainly rocky or glacial till-based. Although monopiles remain dominant in many markets, GBFs are becoming more technically viable. These are concrete structures (given seabed up to 80 m in the Northern Bothnia region and desired turbine size, a GBF could weigh up to 7,000 tonnes/piece), placed directly onto prepared seabed surfaces. They rely on weight and friction rather than pile penetration. Installation typically includes seabed levelling and preparation, transportation of prefabricated concrete structures, float-out and controlled ballasting, and bottom-fixing via gravitational load. This type of installation reduces pile-driving noise and is better suited for a rocky seabed. However, it requires extensive onshore casting facilities and large port lay-down areas for prefabrication and curing (if components are made on-site).

So, even before logistics can start spinning, the Baltic Sea already has foundation strategies split into two: jackets in

sedimentary southern zones and GBFs in rocky northern areas. But that's not all. Unlike the North Sea, the Baltic is seasonally affected by ice, particularly in the Gulf of Finland and the Bothnian Bay. The ice period typically spans from January to March, though variability is increasing due to climate fluctuations. Ice thickness can reach 40-70 cm in severe winters. More importantly, ice movement, driven by wind and currents, generates pressure loads on installed foundations. As for offshore wind, this brings additional requirements for structural reinforcement, increased foundation design loads, more precise installation windows, and the need for ice-class vessels for logistics. Installation windows must therefore be carefully sequenced around seasonal constraints. Ports supporting northern projects must maintain ice-management capabilities and winter navigation strategies. Though the Nordic maritime industry has decades of ice navigation experience, and though ice and winter challenges are

detectable and, with good preparation, can be solved, they add complexity that must be integrated early into project planning.

Opportunity understood

Contrary to some simplified narratives, Baltic ports are not unprepared as of 2026. Many ports across Estonia, Finland, Latvia, Lithuania, and Poland are actively investing in infrastructure upgrades. For example, in Klaipėda (a 21-hectare-big, 12-m-deep terminal with a bearing capacity of up to 40t/m²); Paldiski (13.5-m-deep, 310-m-long quay, 10-ha of 200-400kN/m² bearing capacity storage area, plus adjacent 15 ha, equipped with a 9,000kN ro-ro ramp; the facility obtained its operational permit this February); and Gdańsk (the 21-ha offshore/ro-ro extension of the Baltic Hub container terminal). ORLEN's Offshore Wind Terminal in the Port of Świnoujście came online in mid-2025, offering 12.5 m of quay depth across two berths (one 250-m-long for handling incoming components, the other



Photo: Swinoujście Offshore Terminal/ORLEN



Photo: Argo Viikvald/Port of Tallinn

246-m-long for loading partly assembled turbines), 16 ha of storage yard, and up to 50t/m² of bearing capacity.

In parallel, the Port of Raahe is actively positioning itself for North Bothnia offshore wind developments, advancing heavy-load quay reinforcement, plans for a marshaling area, and ice-resilient operational concepts to support bottom-fixed foundations and regional logistics integration in the Gulf of Bothnia. An important logistics point is that different strategies can allow shallower ports to participate: a major supply chain analysis notes that ~12-m-berth depth is often a reasonable starting point for fixed-bottom marshaling operations and that feeder barges can access shallower berths, reshaping Baltic port network capacities.

Seaports have understood the opportunity that lies in offshore wind development. Most of them managed to create strong business cases and find financing tools to prepare the infrastructure. They are positioning themselves openly as marshaling hubs, operations & maintenance bases, or component handling/storage harbors. Worth mentioning is that several ports/terminals are also faring well in serving the onshore wind energy market.

One port to build them all?

From a map-design perspective, competitiveness could also be defined by network density. A competitive Baltic-Nordic marshaling scope usually requires tier-1 hubs (marshaling and integration) spaced

approximately 300-450 km apart (tightening to 250-350 km in the ice-affected Bothnian corridor), complemented by tier-2 (feeder or satellite) ports every 150-250 km. Such spacing allows for at least two port options remaining within 200-250 km of sailing distance of each major development site.

Offshore wind projects in the Baltic are growing in turbine size and installation complexity, which will require bigger areas and upgraded infrastructure for heavy components. If several projects are being executed in parallel and across different countries in the region, port capability issues may arise, especially when installation timelines are not regionally combined during the planning phase.

Moreover, foundation type differences (jackets vs. GBFs) require different staging solutions. The former projects demand steel storage, pile handling, and heavy-lift transfer interfaces. The latter require concrete casting yards and massive storage areas. Not all ports can support both models simultaneously.

Another misconception is that each offshore wind project will depend on a single marshaling harbor. In practice, Baltic offshore wind logistics are often distributed across multiple seaports, depending on foundation type, vessel interface requirements, quay capacity, access conditions, and whether operations rely on ro-ro interfaces, heavy-lift load-out, or are delivered from marshaling ports for offshore installation by vessels/barges. As such, foundation

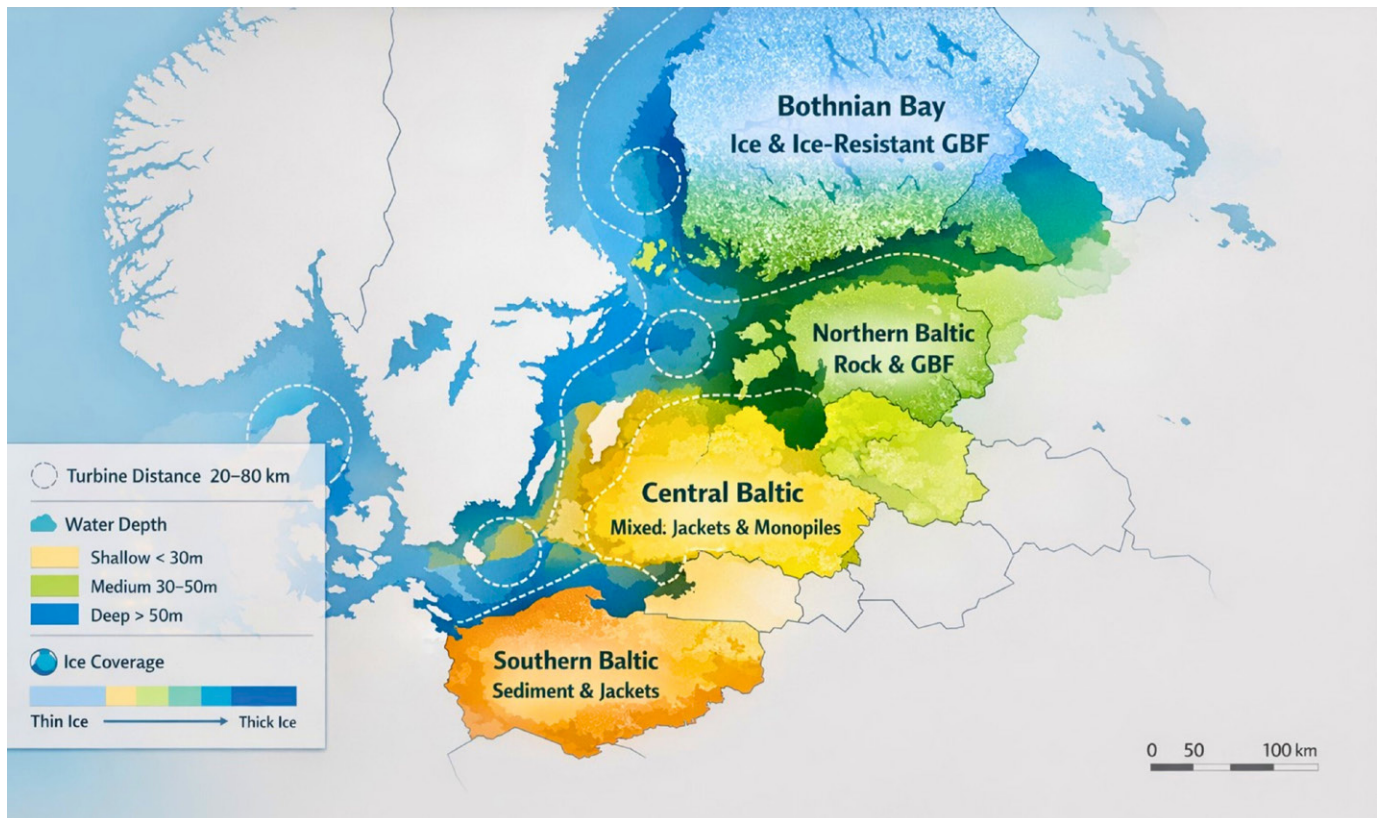
fabrication may take place in one country, the production of secondary steel and transition pieces in another, turbine pre-assembly in a third, and final marshaling – altogether closer to the site.

Barge-assisted transportation may be more suitable for calmer wave heights in the Baltic compared to the North Sea, particularly for shorter offshore distances (often 20-80 km from shore in many Baltic zones). Rather than concentrating operations in a single location, multiple ports could integrate into the supply chain, allowing for broader regional economic development. Such a setup, however, requires regulatory alignment and early cooperation.

The structural bottleneck has shifted over the past two years from a lack of willingness and infrastructural disadvantage to the development of large-scale capability across the Baltic. This progress should be all the more applauded given the kaleidoscopic regulatory pressure.

Regulations-of-indifference

Whereas ports are investing and industry is mobilizing, regulatory frameworks across the Baltic region remain nationally separated. Considerable differences affecting the entire supply chain span from auction schedules, volume timelines, and lease areas to allocation processes. Grid connection models, too, vary significantly across the region. Environmental permitting further separates the countries. Support mechanisms and contract-for-difference



structures also differ substantially, adding another layer of complexity/uncertainty to investment decisions.

Consequently, investors must investigate country by country, a challenge for forecasting regional pipelines. Supply chains cannot scale capacity precisely when auction volumes are irregular or politically delayed. As per the latest example, Sweden rejected 13 Baltic Sea applications on (allegedly) defense grounds (according to WindEurope, however, the move was in reality motivated by appeasing one anti-wind government coalition member, plus to give the cabinet's financial arm time to rewrite the law to start banking on concessions). In September 2024, Vattenfall paused the 640MW Swedish Kriegers Flak (originally expected to generate power in 2028), citing "unviable investment prerequisites in Sweden" (read: grid-connection uncertainty). Lithuania's second tender was annulled after receiving only one bid. Though the European Commission approved the €2.6 billion state aid to boost the construction of Estonian offshore wind farms, the country's cabinet canceled the scheme. No wonder that Japanese partners stepped back from a Latvia-Estonia cross-border project in such an uncertain business climate. In Finland, several offshore wind projects in its exclusive economic zone were paused after authorities declined

exploitation-rights applications, leaving a multi-gigawatt pipeline awaiting a clearer legal and auction framework. By contrast, Poland's first competitive auction is framed as a test case because it offers long-duration, fixed-price visibility, aligning investors' needs with supply-chain feasibility. Just outside the region's border, Norway is aiming to combine ambition (30GW by 2040) with subsidies, with a recent tender allowing for up to NOK35 billion (\$3.45b) in support for a single project (interestingly, the Norwegians are chiefly preoccupied with floating wind farms).

It seems that talking about a single Baltic market from the regulatory angle is also a bit of an overstretch. Clearly, a more coordinated and united regional offshore wind framework would significantly improve investment attractiveness, simplify processes, and present the region as more attractive to (foreign) investors, asset owners, and service providers. Such coordination could include indicative multi-year regional auction calendars that would go in line with lease durations and construction timelines throughout the region. Going to environmental impact assessment – standardized seabed investigation requirements and coordinated environmental data sharing could be regulated, integrating common platforms and shared digital platforms and twin-based planning tools.

Another missing key-to-success factor is cross-border grid-integration planning; the region isn't so big that governments can't sit down and devise a more united way of approaching grid integration. And the last step – clear decommissioning and re-powering policies. The North Sea has already shown the power of coordinated basin-level planning. The Baltic could, too, benefit from a similarly structured strategy.

Known knowns

True enough, the Baltic offshore wind story is different geographically, seasonally, and politically, with many developments being 'first-times.' Yet, there is no reason offshore wind couldn't put down (monopile/jacket/GBF) roots in the region – and do it tomorrow more robustly than it does today. Success is a list of known knowns: alignment between geology and foundation design; installation windows and ice cycles; port investment and project sequencing; and the most important alignment – between national regulatory frameworks. If the Baltic Sea shifts toward coordinated offshore wind governance, jointly planned auctions, and shared infrastructure planning, it can become one of Europe's most resilient and cost-efficient offshore wind regions. The coming decade will determine which path the Baltic Sea region chooses.