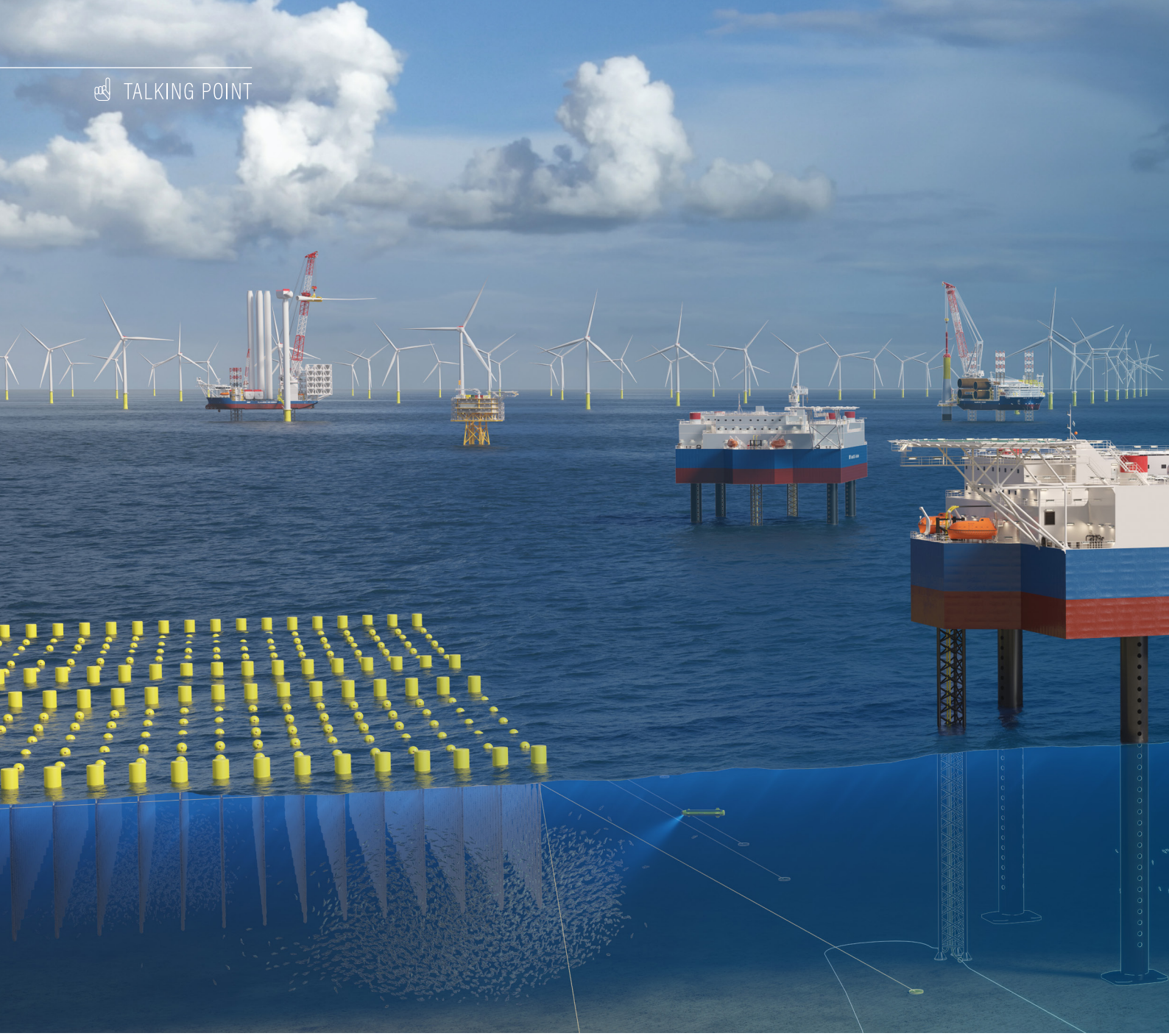


Offshore data centres: where digital infrastructure meets offshore energy

As artificial intelligence drives rapid growth in computing demand, offshore energy infrastructure could take on an entirely new role. Locating data centres close to offshore wind generation could reduce pressure on congested grids, provide a new source of long-term electricity demand and help turn the North Sea into an integrated energy and digital infrastructure hub.



The rapid growth of artificial intelligence (AI) is creating an infrastructure challenge that extends far beyond the technology sector. Training increasingly sophisticated AI models requires enormous computing capacity, while using those models across a growing range of applications creates a substantial and continuous demand for electricity.

At the same time, many European countries face constraints on where that computing infrastructure can be built. Electricity grids are congested, suitable industrial land is limited and large data centres place additional demands on local power and cooling infrastructure.

This raises a question that would have seemed unconventional only a few years ago: rather than bringing all electricity generated offshore to shore, could part of the computing infrastructure be brought offshore instead, towards the renewable energy source?

From energy production to energy ecosystems

The offshore industry has repeatedly reinvented itself in response to changing energy markets. Decades of engineering for offshore oil and gas created a highly specialised maritime supply chain. Since around 2010, much of that knowledge, equipment and engineering capacity has increasingly been applied to offshore wind.

The offshore wind market is evolving again, with turbines continuing to increase in size and wind farms moving into deeper and more challenging waters. As a consequence, turbine foundations are becoming larger and heavier, placing additional requirements on installation vessels, lifting equipment and logistics.

At the same time, inflation, higher financing costs and supply chain pressures have affected offshore wind projects across several markets. For developers investing in projects with operating lives measured in decades, predictability is just as important as engineering capability.

This creates two parallel challenges. Offshore infrastructure needs to develop greater capacity without costs increasing indefinitely, while wind developers need sufficient certainty that electricity produced by future projects will have a reliable market.

Making better use of existing offshore technology

The conventional response to larger offshore components has usually been to increase vessel size and lifting capacity. However, there are practical and economic limits to such an approach. New vessels require major capital investment, and shipbuilding costs have risen significantly in recent years.

Instead, upgrading existing vessel concepts with improved cranes, jacking systems, deck arrangements and other critical equipment can be more attractive. Increasing payload utilisation and improving installation efficiency can also reduce vessel voyages, costs, fuel consumption and emissions.

This emphasis on making better use of established offshore technologies is equally relevant when considering new applications at sea.

One example is GustoMSC's proposed self-elevating offshore platform equipped with modular data centre infrastructure.

Moving the consumer closer to the generator

Offshore wind farms are typically designed around transporting electricity to shore. Once there, electricity enters a transmission system already under increasing pressure from the electrification of industry, mobility, heating and other sectors. Large data centres add another major load.

Locating computing capacity offshore creates the possibility of consuming part of the electricity closer to its point of generation. Part of the electricity generated offshore could be used directly at sea, reducing the amount transported to shore and easing pressure on the onshore transmission network.

This does not eliminate the need for grid infrastructure, nor does it mean every data centre should move offshore. But it introduces another tool for balancing generation, transmission and consumption.

The platform can be fully equipped and commissioned in a controlled environment before being towed offshore. Once onsite, legs are lowered to the seabed and the platform is elevated above the waterline, creating a stable operating environment for the computing equipment.

Subsea cables provide power and high-capacity digital connectivity. Depending on its configuration and computing capacity, such a platform could have a footprint comparable with a football pitch.

Cooling is another potential advantage. Data centres produce substantial quantities of heat and require reliable thermal management. Offshore installations have direct access to seawater, reducing dependence on freshwater resources for cooling. Designs must, of course, ensure that thermal discharge and other environmental effects remain within acceptable limits.

None of these individual technologies is fundamentally unfamiliar to the offshore industry. The innovation comes from combining established offshore engineering with data centre architecture and energy infrastructure. The engineering challenges are significant, although many draw on existing offshore expertise. The more difficult questions may ultimately concern regulation, permitting and the architecture of the offshore electricity system.

A new direct consumer for offshore wind

Perhaps the most important aspect of offshore computing is not the data centre itself, but what it could mean for offshore wind economics.

Wind projects depend on confidence in future demand and revenues. Connecting major industrial consumers directly or indirectly to offshore wind farms could provide an additional source of long-term electricity demand.

AI makes this particularly interesting. Training advanced models can create extremely large, sometimes variable computing loads. Inference, the use of trained models to provide services to users and businesses, also creates ongoing demand for computing capacity, although loads can fluctuate.



From an energy system perspective, a large consumer with a relatively stable load profile can become a valuable source of demand for variable renewable generation. Combined with grid connections, storage and potentially other energy carriers, offshore computing could become part of a more integrated system.

Rather than viewing an offshore wind farm simply as an electricity generator connected to shore, future projects could develop into multi-user energy hubs. Electricity generated offshore might be distributed between the onshore grid and offshore consumers, such as data centres, energy storage systems and, where economically viable, hydrogen or other applications. This could increase value in an energy market characterised by variable generation, changing electricity prices and constraints in transmission capacity.

Connecting electrons and data

The North Sea already contains an extensive network of energy infrastructure, while its digital infrastructure is becoming increasingly important. The next step could be to design these systems together.

An offshore energy and digital hub would combine power generation, large-scale electricity consumption and high-capacity data connections. Instead of treating electricity cables, fibre connections, wind farms and industrial consumers as separate developments, they could be planned as interconnected parts of the same system.

Europe is simultaneously investing in renewable energy, expanding AI computing capacity and seeking greater resilience in critical digital infrastructure. Offshore data centres could help meet all three objectives.

Locating computing infrastructure within a country's exclusive economic zone would introduce strategic considerations around jurisdiction, physical security, access and resilience. Together with appropriate European requirements covering ownership, continuity, cybersecurity and data governance, offshore infrastructure could contribute to broader ambitions for European digital autonomy.

Let's shape regulation alongside engineering

As offshore technologies evolve, regulation should evolve with them. Existing North Sea frameworks cover shipping, fisheries, nature conservation, energy, cables and pipelines. The regulatory treatment of offshore computing infrastructure needs clarification.

This is an opportunity for stakeholders to work together from the start. Governments, grid operators, offshore developers, technology companies, researchers, public interest organisations and the maritime sector can help address these questions.

The offshore sector has considerable experience of integrating complex systems in demanding environments. That expertise could now help bring renewable energy, computing, storage, hydrogen and subsea digital networks together in connected offshore hubs.

Offshore data centres remain an emerging concept, but many of the required capabilities already exist, including offshore platforms, subsea cables, marine cooling, modular construction and remote monitoring.

The opportunity is to apply decades of offshore engineering experience to a growing infrastructure need. However, future developments must respect the North Sea's ecological limits, with careful consideration given to marine ecosystems, biodiversity and the wider environmental effects of offshore construction and operation.

Together, we can explore how the North Sea might become more than an energy region: an integrated hub for offshore energy and digital infrastructure, where innovation and economic development remain firmly within the sea's ecological boundaries.

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