

Caractérisation des innovations technologiques du secteur de l'éolien et maturités des filières

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RAPPORT FINAL

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Abstract

This study on wind power innovation aims at characterizing the technological and cost evolutions, and the related industrial opportunities. It looks across three types of wind power: onshore wind, bottom-fixed offshore wind and floating offshore wind. The study highlights sixty-four innovations that reduce cost of energy and evaluates their impact in 2020, 2025 and 2030, in a French context.

The first conclusion is that overall cost of energy reductions are significant in the case of onshore wind and even more so in offshore wind.

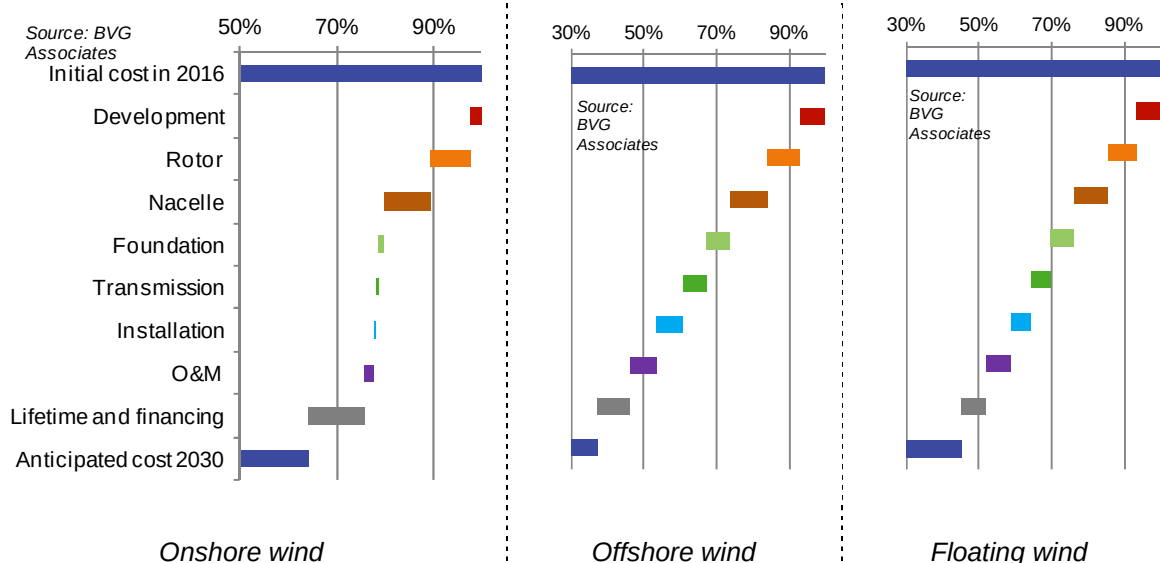
The most important impact comes from innovations facilitating the increase of turbine rating and rotor size. These will bring significant economies of scale, especially in offshore wind where the main limitations are technical (as opposed to human impact).

Other significant innovations include:

- during the project development phase: the multi-variable optimisation of array layouts and the improvements in resource characterisation and modelling;
- for the rotor: blade aerodynamics and aeroelasticity, optimization of the blade pitch control, improvement of blade materials and the progress of workshop verification testing;
- for the nacelle: the progress of the wind turbine controller design and direct-drive trains;
- for the foundations: the optimization of the design and manufacture of fixed foundations and the progress of the floating turbine foundations and moorings;
- for the electrical connection: the weight reduction of offshore substations, the progress of high voltage direct current (HVDC) transmissions;
- during the installation phase : reducing sensitivity to meteorological conditions and rough sea conditions and improving conditions for the transport of personnel to offshore wind turbines;
- during the operation and maintenance phase: the integration of wind farm wide control strategies on a wind farm scale, the development of conditional maintenance and the improvement of the maintenance strategy.

Finally, extending the lifetime of wind turbines is also major cost reduction factor: it results from a process of innovation in design that has a major impact.

Figure 3 : Potential cost reduction breakdown including the supply chain effect by innovation group for wind technologies by 2030



Under the hypothesis of technological innovations, lifetime extension and WACC (stable for onshore wind, decreasing to 7% and 7.5% for fixed offshore and floating offshore wind respectively), as well as uncertainty in the initial offshore CAPEX and OPEX, the study shows that the costs of the three sectors are approaching cost levels that can be competitive without a support mechanism by 2030.

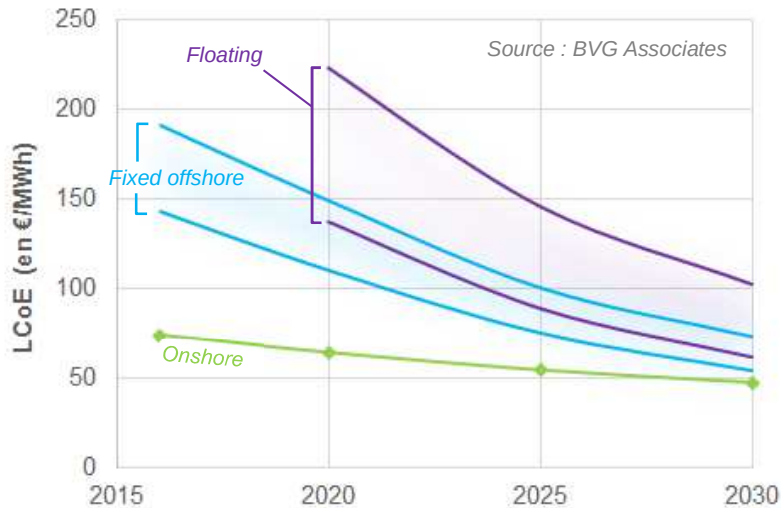


Figure 4 : Comparison of LCOE by technology

The study includes an analysis of the innovators in the French wind sector to prioritize the innovations, which support the industrial development of the sector. This analysis takes into account the special features of the French situation: a country without major wind turbine original equipment manufacturer (OEM), but with local developers and a dynamic supply chain, large industrial projects for offshore wind and some pre-commercial floating wind projects in development.

The industry will benefit from the competitive advantages given by these prioritised innovations if their development is successful, which may require support. This support includes financial and other types of actions by public authorities and private actors.

The key actions for development of industry in France are identified as:

- funding demonstration projects,
- promoting collaborative research partnerships in innovation, fostering cooperation and technology transfer with other technical industries, encouraging large companies to partner with SMEs, facilitating the preparation of test sites, encouraging shared access to intellectual property,
- improving the national organization: enabling suppliers to participate with innovative alternatives when tendering, facilitating the development of sea areas for new projects so that the latest technology can be implemented in France, dedicating specific areas to innovative projects in the development of large offshore wind farms, improving innovation financing mechanisms and risk sharing of innovation development by developing synergies between networks, improving regulation, defining a clear strategy for standards, finally giving long-term visibility to the industry.

Thus armed, the French wind sector could successfully shape itself for a strong future of reducing cost of energy and increasing value-added activity in France itself.