

Wind Repowering
Report

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White Paper
For Wind Farm Owners

1. Executive Summary

The Iberian wind fleet, like much of Europe's, is reaching maturity. In the Iberian Peninsula, more than 50% of installed wind turbines are over 15 years old, and many have already exceeded 20. This results in lower performance, higher maintenance costs, and a loss of competitiveness compared to new projects with more efficient technology. **Repowering** — replacing old wind turbines with newer, more powerful models — **offers an immediate opportunity** to increase production, reduce costs, and extend asset lifetime.

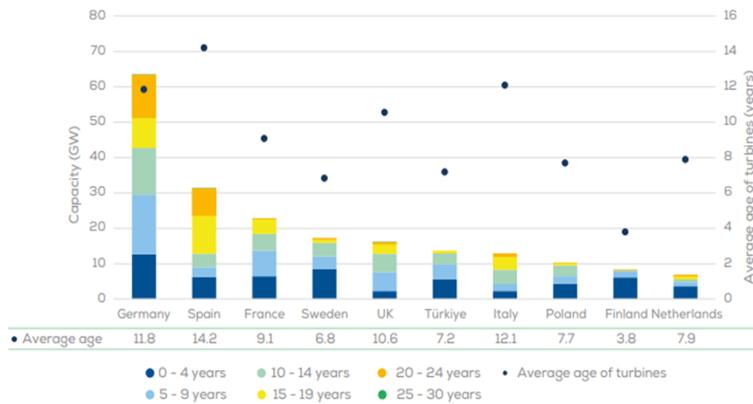


Figure 1: Wind farm age by country (2024 data). Source: "Wind Energy in Europe. 2024 Statistics and the outlook for 2025 – 2030" by Wind Europe.

The objective of this White Paper is to clearly and practically demonstrate **why now is the right time to assess the feasibility of repowering** and how to benefit from the regulatory changes transforming the sector.

2. Company Profile

SÓLIDA is an independent company with more than 18 years of experience offering engineering and consultancy services with high added value in the renewable energy sector, with offices in Spain, Brazil, Chile, México, Italy and Portugal, as well as activities in more than 50 countries, including UK, Ireland, Poland, Romania, Saudi Arabia, EAU, South Africa, Australia, Peru, Colombia, among others.

SÓLIDA stands out for its clear technological vocation, having integrated innovation, digitization and process automation into its DNA. However, the added value lies in the capabilities and experience of its excellent human team made up of more than **300 highly qualified professionals**, who have enabled SÓLIDA to become a benchmark in these technologies today. SÓLIDA has accumulated experience of more than **200,000 MW** in renewable energy projects (photovoltaic, solar thermal, wind, biomass, storage, hydrogen and hybridization) and its evacuation infrastructure.

SÓLIDA's Technical Advisory unit specializes in **Independent Wind Energy Yield Assessments** among other renewable energy services, **with a track record exceeding 7.7. GW of wind EYA experience worldwide**. We carry out resource and production studies to fine-tune revenue forecasts and project cash flows for the financial model.

3. The Challenge and the Opportunity

As wind farms age, their performance and technical availability typically declines while operation and maintenance costs increase. At the same time, the energy market rewards those who generate more hours with greater flexibility.

In this context, **repowering has become a strategic necessity**. It enables higher production with fewer turbines, reduces visual and environmental impact, and leverages existing infrastructure such as substations and access roads. All this comes with a **lower investment** compared to a new greenfield project.

Furthermore, **the regulatory framework is evolving in this direction**. At the national and European levels, Directive (EU) 2023/2413 will bring major changes: reduced permitting times (up to 6 months for repowering projects), a single digital window, and recognition of repowering as an activity of overriding public interest. Both **Spain and Portugal** are in the process of adapting this directive, which will lead to more agile procedures, lower administrative costs, and greater legal certainty.

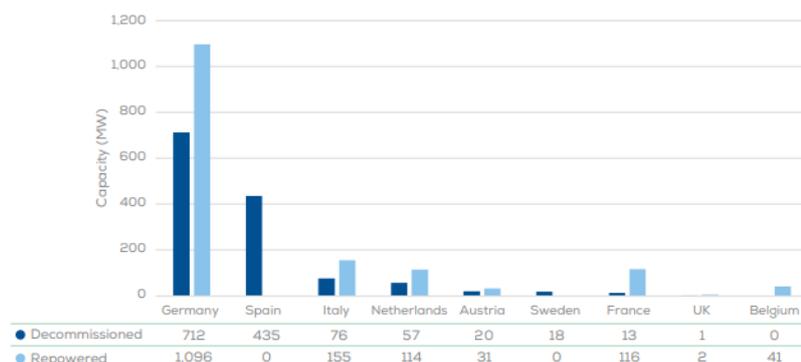


Figure 2: Repowering and decommissioning capacity (MW) by country (2024 Data). “Wind Energy in Europe. 2024 Statistics and the outlook for 2025 – 2030” by Wind Europe.

The impact of these regulatory simplifications is already visible in countries like Germany, which has embraced repowering policies aligned with the EU Directive. As shown below, Germany has achieved over 1 GW of repowered capacity compared to 712 MW decommissioned — clear evidence that policy clarity and streamlined permitting directly accelerate wind asset modernization.

In Spain, legislative changes are already being implemented to regulate the repowering and decommissioning of aging wind farms. For instance, in Galicia, *Law 5/2024 on fiscal and administrative measures* establishes that wind farms older than 25 years must submit a repowering or decommissioning plan within 18 months.

This means repowering is no longer optional — it’s a legal requirement to maintain authorization. Other regions are observing this measure and are expected to adopt similar criteria in the medium term.

Moreover, at the national level, Real Decreto-ley 7/2025 of 24 June 2025 explicitly incorporates the definition of repowering and mandates the development, within nine months, of a National Roadmap for Repowering. This roadmap aims to align Spain with European commitments and technical, regulatory, and financial measures to promote repowering.

Portugal is also advancing toward a more flexible framework. Recent guidance from the *Direção-Geral de Energia e Geologia (DGEG)* allows repowering projects to increase capacity by up to 20% and exempts them from a full Environmental Impact Assessment when upgrades remain within the existing wind farm footprint and turbine layout. This clarification provides legal certainty and accelerates the modernization of Portugal's wind fleet.

In summary, **the regulatory environment is evolving toward simplification.** Repowering is emerging as the most effective strategy to adapt to this new context — and **those who begin feasibility studies early will be ready to act swiftly once the new regulations are fully in force.**

4. Business Case: Repower or Maintain

Repowering decisions are not only technical but strategic. Beyond regulatory incentives, the financial rationale is compelling: replacing older turbines with modern, high-capacity units substantially improves energy yield and reduces long-term operating costs. The following example illustrates this clearly.

The table below compares the key technical and financial indicators of a 25 MW wind farm before and after repowering. Despite using 80% fewer turbines, the project achieves a 50% increase in annual energy production (AEP). This improvement results from larger rotors, taller hub heights and higher capacity factors. **Although repowering requires a new capital investment for dismantling and installation, the resulting performance and lifetime gains deliver a substantially stronger long-term return.**

Metric	Original Wind farm	Repowered wind farm	Absolute variation	Relative variation
Unit capacity (MW)	0.85	4.2	+3.35	+394%
N° WTGs	30	6	-24	-80%
Total Power (MW)	25.5	25.2	-0.3	-1%
Rotor (m)	52	150	+98	+188%
Hub height (m)	≈70	≈100	+30	+42%
Capacity factor (%)	21.7%	33%	+11.3 pp	+52%
CAPEX (k€/MW)	0	Dismantle 41.6 + Construction 800	+791.6	—
OPEX (k€/MW)	55	34	-21	-38 %
Remaining life (years)	5	25-30	+20	+100%
AEP (MWh/years)	48,473	72,800	+24,327	+50%
Annual revenues (k€) (50€/MWh)	2,423	3,640	+1,217	+50%

Table 1: Comparison between the original and repowered wind farm. Source: SÓLIDA's own elaboration.

After repowering, the same site operates with six 4.2 MW turbines instead of thirty 0.85 MW units, maintaining a similar total capacity but delivering far higher performance and efficiency. The reduction in OPEX per MW and the 50% increase in generation improves annual cash flow. At an average electricity price of 50 €/MWh, annual revenues grow by more than 1.2 million €, clearly demonstrating the long-term financial advantage of modernization.

5. How to Evaluate It: A Bankable Approach to Repowering Assessment

SÓLIDA applies a proven, standard-aligned methodology for assessing repowering potential based on real operational data. This approach combines engineering precision with financial rigor, ensuring that the results are both technically sound and fully bankable.

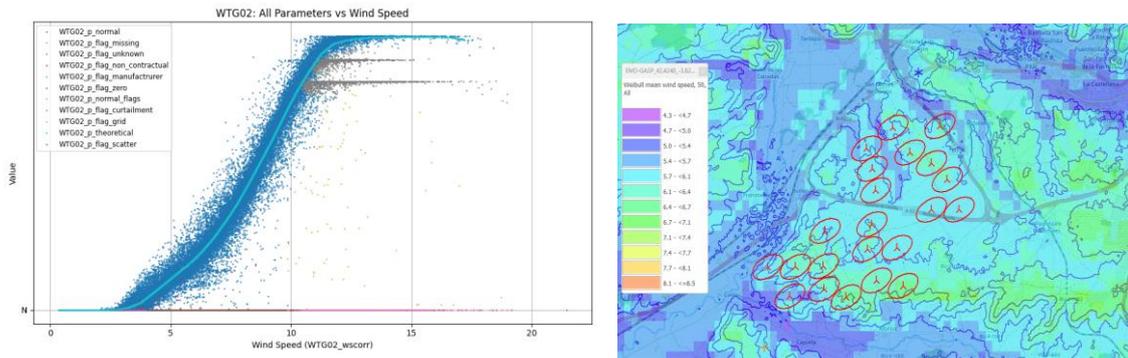
Instead of relying on costly and time-consuming on-site measurement campaigns, SÓLIDA uses the wind farm's own SCADA data to characterize performance and simulate its future potential with state-of-the-art turbines. The process follows the structure established in the FGW Technical Guideline Part 6 (Rev. 12, 2023) — the current European reference for bankable energy-yield assessments based on operational data— while adhering to the data-quality and uncertainty principles defined in the IEC 61400- and MEASNET frameworks.



Figure 3: Repowering EYA methodology. Source: SÓLIDA's own elaboration.

Each step of the methodology is described below in more detail.

- Step 1 – SCADA data processing and operational curve derivation. SCADA records are cleaned to derive operational power curves for each turbine, capturing real in-situ performance.
- Step 2 – Normalization and loss correction: the operational power curves are used to normalize energy production to 100% availability. This ensures that all comparisons and forecasts are based on representative, loss-free data.
- Step 3 – Long-term correlation: normalized production is correlated with long-term meteorological references. The best-fit correlation is statistically selected extending observed performance to long-term conditions.



Figures 4 & 5: Example of power curve degradation and wind map layout. Source: SÓLIDA's own elaboration.

- Step 4 – Existing wind-farm assessment: the WAsP flow model is calibrated with the operational results by scaling the wind data.
- Step 5 – Vertical extrapolation¹: project scaled wind field to new hub heights.
- Step 6 – New (repowered) wind-farm energy assessment: The repowered layout is modelled with the calibrated wind flow model and scaled wind speed at hub height.
- Step 7 – Energy yield: gross and net energy yields are estimated for the repowered layout, including wake, availability, and electrical effects.

While traditional met-mast campaigns require months of permitting, installation, and measurement, often costing €120,000 – €250,000 and covering only a single point in the wind farm, SÓLIDA's SCADA-based approach uses existing turbine data, providing immediate multi-year coverage across the entire site with no new hardware, no permitting, and a fraction of the cost.

Aspect	Traditional met-mast method	SÓLIDA's SCADA-based method
Hardware & permitting	Tower, sensors, civil works	None. Uses existing SCADA data
Measurement period	12 – 24 months	Years of operation already available
Typical cost	€120,000 – €250,000	< 10 % of that cost
Bankability	Accepted after long campaign	Accepted under FGW TR6 framework

Table 2: Comparison of Repowering Methodologies. Source: SÓLIDA's own elaboration.

¹ If old and new WTG heights difference is more than 25%, a 6 months measurement campaign is recommended or additional uncertainty would be included in the analysis.

This methodology results in a bankable repowering study, ready for presentation to investors, authorities, or financing institutions.

By leveraging real operational data instead of new measurement infrastructure, SÓLIDA delivers a faster, more economical, and equally rigorous pathway to evaluate and unlock the full repowering potential of every wind farm.

6. Conclusion: The Time to Act Is Now

The wind sector is entering a new phase. Veteran wind farms now have the opportunity — and in some cases, the obligation — to modernize. With upcoming regulatory simplification and precedents like the Galician law, **acting early is key to maintaining profitability and securing the asset's future.**



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