

McKinsey Direct

Europe's €10 billion savings opportunity to deliver onshore wind and solar

With Europe's demand for wind and solar photovoltaic (PV) power set to more than double by 2030, the industry will be hard-pressed to scale up in time—unless it finds a new way to deliver capital projects.

This article was a collaborative effort by Antoine Engerand, Alessandro Gentile, Jochen Latz, Igor Stepanishchev, and Benjamin Thaidigsmann, reflecting views of McKinsey's Operations practice.



© Getty Images

The total EU capital expenditure for the energy transition could reach €1.7 trillion by 2030, with around 45 percent going towards onshore wind and solar photovoltaic (PV) capacity. Accordingly, between 2023 and 2030, annually installed onshore wind capacity would need to more than double over the levels achieved between 2018— and 2020—and solar PV capacity would need to more than triple.

Companies involved in capital projects for these renewables would likewise need to double or triple their project pipeline in a very short time—and do so efficiently. Can the construction industry manage this unprecedented growth? Today, Europe's renewables construction sector is facing serious challenges. These must be overcome if the region is to meet its energy transition targets.

Challenges facing the renewables ramp-up

Ramping up organizations quickly often comes at the cost of productivity. Added to this is the fact that onshore wind and solar PV are not yet fully mature industries, with limited examples of successful, quick ramp-ups. To achieve fast scale-up, companies can no longer rely on individual experts to deliver results—instead, they need a more standardized approach so that best practices can be consistently followed in capital project delivery.

There is a talent [shortage](#) for the scale-up of renewables projects in the European Union (EU).¹ By 2030, the full-time equivalent (FTE) requirements for renewable energy sources (RES) in the EU will be triple the 2020 levels. Additionally, the renewables sector faces high competition with other growing infrastructure sectors that have similar FTE skill requirements, such as grids, telco, and rail.

Alongside the talent scarcity, there are also land [shortages](#) for wind and solar farms, as well as long and unpredictable timelines for obtaining relevant development permits. Large-scale grid infrastructure is equally important: renewables projects may wait for

months or even years before getting connected to the grid.²

The entire supply chain, including original equipment manufacturers (OEMs) and engineering, procurement, and construction (EPC) firms, faces those ramp-up challenges as well as added pressures. Scarcity of hard-to-substitute rare-earth metals—such as neodymium and praseodymium, used in wind turbines—raises prices and slows production. Price spikes for more common materials, such as copper, silicon, gallium, and iron, further strain budgets. For solar in particular, [supply constraints](#) add to the complexity of meeting the ever-growing demand.³ In 2020, the EU estimated that China accounted for more than 70 percent of the global value chain for solar components value chain, including 89 percent of global production of solar wafers.

Given these challenges and the massive ramp-up in the industry, any expectation that capital expenditure in the industry would decrease as technologies develop appears misplaced. The remaining lever available for companies looking to accelerate profitable growth in renewables is to push further on project delivery performance. In this article, we focus on how to bridge the performance gap between existing and best practices, which recent benchmarking has identified.

The performance gap

We recently performed an EPC benchmarking analysis that revealed where capital expenditure performance can improve in Europe. Around two gigawatts (GW) of onshore wind and two GW of solar assets were analyzed in detail to assess capital expenditure on a cost-per-megawatt (MW) basis (see sidebar, “Methodology”).

Finding the €10 billion opportunity

The study, conducted using data from 2020–21 (before the sharp rise in inflation across much of

¹ “Renewable-energy development in a net-zero world: Overcoming talent gaps,” McKinsey, November 4, 2022.

² “Renewable-energy development in a net-zero world: Land, permits, and grids,” McKinsey, October 31, 2022.

³ “Building resilient supply chains for the European energy transition,” McKinsey, October 17, 2022.

METHODOLOGY

Fifteen companies and their recent onshore wind and solar projects—around four gigawatts in total—across the EU were assessed, with a focus on both qualitative and quantitative components. The qualitative component included an assessment of each company's operating model and practices. This was measured across eight EPC value levers: contracting strategy; risk-based decision-making; design-to-value; market intelligence; sourcing strategy; optimized terms and conditions; contract execution; and risk and claims management. The quantitative assessment compared capital-expenditure performance based on three main steps:

1. *Scope delineation.* To ensure data comparability, all study participants used the same definitions of cost categories across their plants.
2. *Normalization.* A should-cost methodology was used to scale the cost of each of the assets on a granular, sub-cost-category level. This enabled a true like-for-like comparison between projects, by adjusting for drivers that cause significant differences in cost without being under full control of the asset owner—such as labor-cost differences across countries, cost of raw materials over time, or the size of the plant. For example, if the reference point is a plant with 50MW capacity and the grid interconnect cost is 20 percent lower per MW for a project with 100MW, the 20 percent cost advantage needs to be removed from the 100MW plant to make the two plants comparable in the benchmark.
3. *Benchmarking for a broad set of metrics.* The focus of the study was the performance based on capital expenditure per MW along the main cost categories. After the projects were normalized, they were all compared using normalized capital expenditure on a granular level. Capital expenditure performance was analyzed not only as total capital expenditure but also by cost category, such as collector systems and grid interconnection. Other key performance metrics analyzed alongside this were schedule adherence and contingencies, and safety performance.

the world), found a wide variance in capital expenditure performance between top-quartile and bottom-quartile averages—about 20 percent for onshore wind and more than 30 percent for solar PV in Europe. If lower performers could improve their capital expenditure performance in line with top performers, onshore wind projects could save around €6 billion, and solar PV projects could save roughly €4 billion—a total of about €10 billion a year at an industry level in Europe (Exhibit 1).

In onshore wind, the variance in performance between top- and bottom-quartile performers is mainly caused by the large variability in wind turbine generator (WTG) cost and balance of plant (BoP) cost. For solar PV, BoP—including electrical and mechanical installation

cost, piles, trackers, and the like—shows the highest deviation among the cost categories, despite being smaller in absolute terms than costs for PV equipment (primarily modules and inverters).

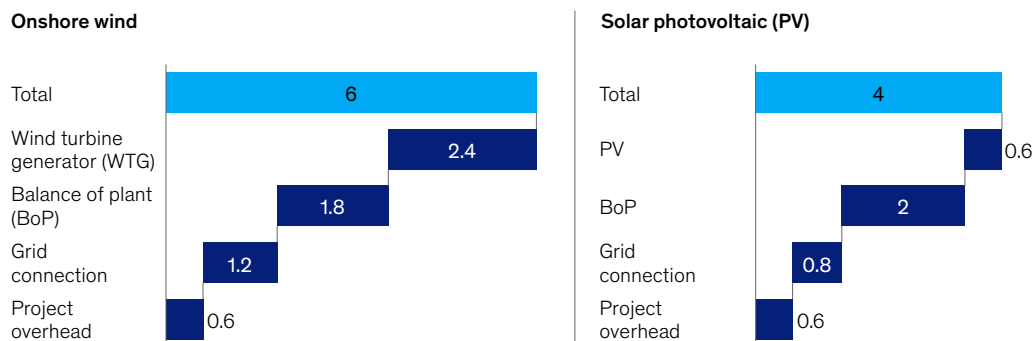
Choosing the right capital-expenditure delivery model

Another key finding of the study was that, on a project-by-project basis, top performers use delivery models that are consistent with their internal capabilities. Under the most advanced owner-integrated models, companies acquire in-house capabilities and invest heavily in capability-building. Organizations that do not have in-house skills, and don't plan to ramp up internal capabilities, usually do better with turnkey models.

Exhibit 1

European onshore wind and solar photovoltaic projects show a €10 billion annual capital expenditure opportunity.

Average capital expenditure (capex) opportunity by project category,¹ € billion (estimated)



¹Gap between average capex and top-quartile capex of projects commissioned 2019–2021; value per category estimated based on total capex opportunity and relative contribution per category; based on projects commissioned 2019–2021.
Source: McKinsey Onshore Wind and Solar PV EPC Benchmark, EU wave

This means there is no silver-bullet model—it is possible to be a top performer in terms of capital expenditure both with an owner-integrated model and with a turnkey model (Exhibit 2).

Avoiding a one-size-fits-all approach across their portfolio better accounts for internal capabilities in different regions and asset types, and achieves higher, more consistent results. Companies that selectively chose their operating model all scored in the first or second quartile, while those that chose a default operating model ran the full range of performance from top to bottom.

Building—or acquiring—capabilities

Although choosing the most suitable operating model based on in-house capabilities is a powerful way to increase capital expenditure performance, the analysis shows that companies with better in-house skills do tend to attain higher capital expenditure performance; capabilities and performance correlated directly across both the wind and solar industries in Europe (Exhibit 3). Scaling up wind and solar plants is therefore not just a question of growing the physical assets—

growing team capabilities matters, too, whether by reskilling and upskilling employees, hiring the right people, or exploring international

Actions to fill the performance gap

By focusing their capital performance strategies and execution on levers that help them bridge the gap to top-quartile performance, companies can reap large benefits while sustaining growth.

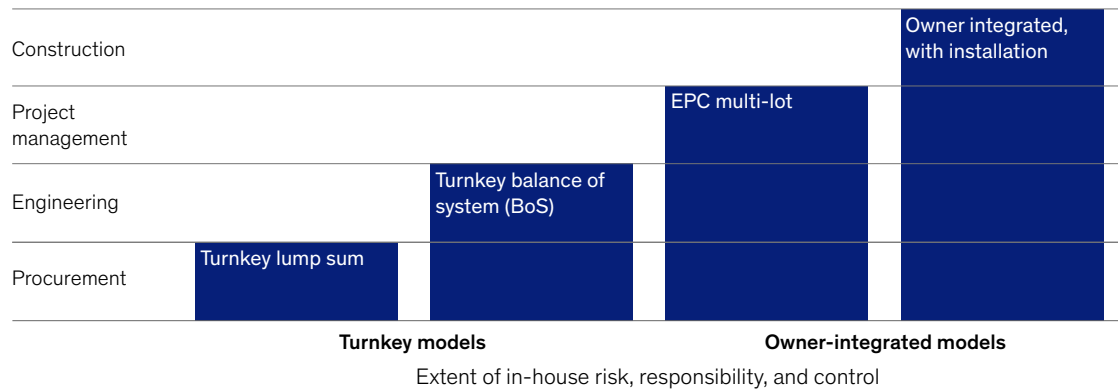
Expanding workforce. Companies can leverage multiple solutions to expand their workforces amid labor shortages. For example, they can attract talent by partnering with schools and universities to develop tailored research programs and by providing mentoring and internship opportunities. Reskilling employees in adjacent industries that are scaling down, such as coal, could also be a pathway for increasing the talent pool. Companies can also play an active role in training their own workforces and those of their key contractors. For example, joint investments in manufacturing capacity—perhaps accompanied by volume guarantees—can provide critical support for contractors to achieve scale. Another option is to co-invest with partners in training facilities that are tailored to the partners' respective project pipelines.

Exhibit 2

There is a wide spectrum of engineering, procurement, and construction (EPC) contract models, involving varying levels of risk and required capabilities.

EPC models, by internal capabilities

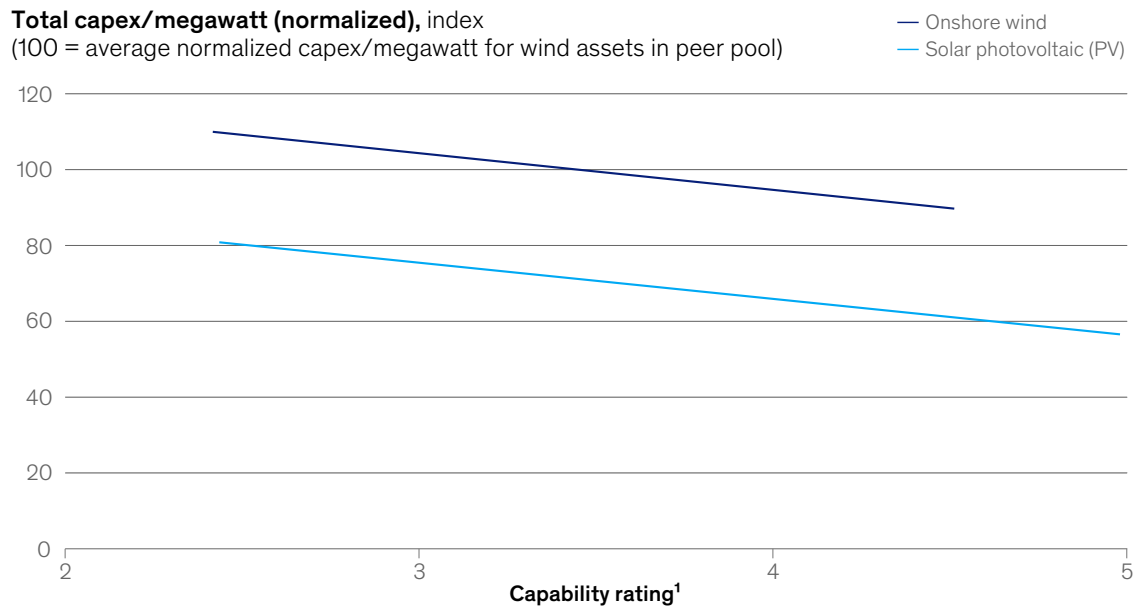
Full spectrum



Source: McKinsey Onshore Wind and Solar PV EPC Benchmark

Exhibit 3

Capabilities matter in both onshore wind and solar photovoltaic.



Source: McKinsey Onshore Wind and Solar PV EPC Benchmark

Design excellence. Design processes could be further standardized to reduce reliance on the small groups of individuals who have, so far, been responsible for progress. The digitization of these processes would enable advanced analytics, adding to performance improvements while making more effective use of the resources needed to deliver. Optimizing from a total cost of ownership (TCO) perspective— using value engineering at the portfolio level, for example— allows for more informed trade-offs between individual project performance and overall portfolio value.

Procurement excellence. The development of more flexible framework agreements, rather than requiring rigid price and delivery terms, can secure supplies, reduce lead times, and enable productivity enhancements, such as design standardization. In parallel, this helps suppliers attain scale benefits, such as advanced planning for procurement and manufacturing capacity, which makes their work smoother. Best-practice expediting processes include closely monitoring supply chains and manufacturing at contractor sites to manage supply chains and avoid surprises on delays and extended lead times.

Collaborative contracting models. Newer [collaborative contracting models](#) can drive productivity as well—and involve a mindset shift from “owner and contractor trying to individually optimize their results” to “we can only win together”. Here, both sides need to make continuous efforts to establish collaborative ways of working across project execution, for example by aligning incentives arrangements in which cost and schedule overruns and underruns are shared, instead of focusing on claims.

Project execution. Lean construction and project portfolio management can be injected into all projects. Stage-gate processes can be enhanced to enable cross-functional visibility and minimize waste. Construction activities can be optimized and standardized to upgrade performance across contractors. Additionally, claims management can be upgraded, enhancing claims defense and the effectiveness of counterclaims.

End-to-end digitization. Data can be used for meaningful conversations about performance, especially by digitizing the project stage-gate process with an eye on creating value and driving cross-functional collaboration. It can also help companies benchmark their projects as a basis for continuous improvement. Through a [digital project control tower](#) and a digital backbone, the necessary elements can be provided to all stakeholders, including suppliers.

The build-up of onshore wind and solar PV projects is a major lever to keep pace with EU decarbonization plans. This once-in-a-lifetime growth opportunity for companies also comes with challenges that require organizations to find quick solutions and scale up their capabilities. Missing the boat on tackling those challenges now, as a joint effort across the EU, will put at risk all EU decarbonization targets. With the expected boom in demand for renewable energy, and the need to increase supply it infers, the time to assess and improve capital expenditure performance is now.

Antoine Engerand is an associate partner in the Düsseldorf office, **Alessandro Gentile** is an associate partner in the Rome office, **Jochen Latz** is a partner in the Cologne office, **Igor Stepanishchev** is an associate partner in the Chicago office, and **Benjamin Thaidigsmann** is an expert associate partner in the Berlin office.

The authors wish to thank Stefano Bergami, Florian Kühn, Karthik Kumarasamy, Holger Klärner, Andreas Schlosser, Lorenzo Moavero Milanese, Alberto Bettoli, Alexander Weiss, and Humayun Tai for their contributions to this article.