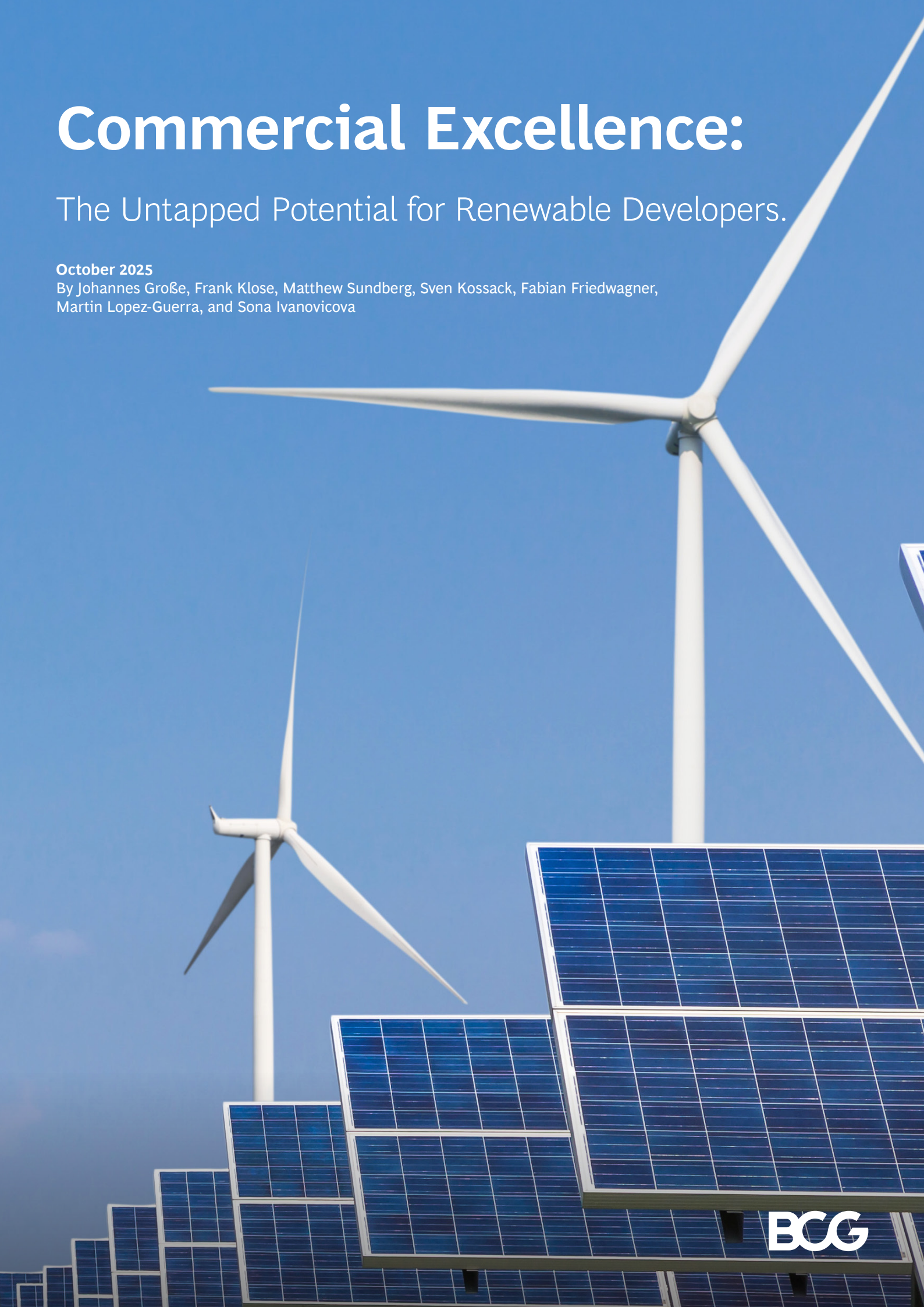


Commercial Excellence:

The Untapped Potential for Renewable Developers.

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A photograph of a wind turbine and solar panels against a clear blue sky. The wind turbine is white and has three blades. The solar panels are blue and are arranged in a grid pattern. The BCG logo is in the bottom right corner.

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Executive Summary

Despite developers focusing mainly on LCOE optimization, **renewables are currently facing strong margin pressure. While some pressures are expected to ease, other factors continue to keep margins thin.**

Renewable assets increasingly need to take on more system responsibilities in countries with a high-RES adoption rate (e.g., no remuneration in times of negative power prices), likely exacerbating challenges for RES developers.

This clearly shows the need to put **more emphasis on commercial excellence**, where substantial margin uplifts are possible which can potentially increase the attractiveness of RES investments. **We have identified three main levers with substantial optimization potential:**

- 1. 0–4 €/MWh additional margin by efficiently firming renewables output into premium green baseload PPA products**, in markets where baseload PPAs are financially viable such as Germany
- 2. 1–2 €/MWh imbalance cost reductions** through more advanced forecasting models and technological and geographical portfolio diversification
- 3. 3–5 €/MWh increase in sales prices via premium offtaker targeting** by addressing less-price-sensitive customers with a higher willingness to pay

To realize this additional value, **pure play developers need to catch up** with integrated energy companies by **becoming “commercial asset optimizers”** who are capable of marketing portfolios rather than individual assets, and therefore able to offer structured PPA products by trading power on the market.

Developers who aim to advance their operating model to achieve commercial excellence need to focus on **five key development areas:**

- 1. Put stronger emphasis on customer relationship and sales management**, such as customer segmentation and tailored product offerings, etc.
- 2. Set up comprehensive risk management and governance** with clear guidelines on what (merchant) risk exposure is considered acceptable.
- 3. Establish central RES portfolio management**, which involves developing CAPEX plans as well as assets that complement the existing portfolio.
- 4. Gain market access by building up a commercial trading function** (such as in-house and external services) with the needed capabilities, resources, and IT systems.
- 5. Move from project-by-project SPV financing to corporate balance-sheet financing** to better handle merchant exposure.

(1) Value Creation Through RES Commercial Excellence

Current Market Pressures Are Compromising Renewable Energy Development.

Historically, renewable energy developers created value mainly through cost optimization. Over more than a decade, steady advances in technology, site selection, and O&M practices drove significant reductions in the levelized cost of electricity (LCOE).

This has enabled renewables to compete with conventional power sources. Solar PV benefited most from rapid gains in module efficiency and economies of scale in manufacturing, resulting in an overall LCOE reduction of about 85% between 2010 and 2020¹. Onshore wind saw improvements from capacity factor increases and digitalized operation and maintenance (O&M), leading to an overall LCOE reduction of around 56% over the same period.¹ Offshore wind progressed more slowly in the early 2010s due to higher capital requirements and supply chain complexity. Post-2015 reductions, on the other hand, accelerated significantly as large auctions, turbine scaling, and O&M innovations kicked in, achieving an overall LCOE reduction of roughly 48% between 2010 and 2020¹. These cost declines were underpinned by strong renewable energy ambitions and supportive government policies, including feed-in tariffs, renewable portfolio standards, and later auction systems, which provided long-term revenue certainty and helped accelerate deployment at scale.

Since the early 2020s, however, these **cost-reduction drivers have largely plateaued or even reversed.**

Rising interest rates, persistent supply chain bottlenecks, inflationary pressures, and high OEM margins have pushed costs upward, eroding the tailwinds that once supported the sector. At the same time, wholesale power prices have stabilized, while capture prices remain structurally depressed due to cannibalization effects from higher renewable penetration. For instance, the value of a solar profile in Germany dropped from around 90% to around 65%² in just two years compared to a baseload, resulting in an 87%³ drop in the solar PPA deal volumes signed.

Revenues of renewables producers have been squeezed compared to the temporary windfall years of elevated prices during the energy crisis.

Looking ahead, some of these headwinds may gradually ease due to more favorable market conditions. However, **structural challenges remain.** These include intensifying competition from new entrants such as infrastructure funds, tightening IRR expectations from investors, the need for RES assets to take on more system responsibility, and increasing price cannibalization as RES capacity expands given the strong correlation of RES load factors, particularly for solar. In addition, most offtaker contracts still lack inflation-adjusted pricing terms.

This combination of effects has put **severe margin pressure on renewables developers**, in some cases (e.g., offshore wind in Germany) even expecting negative margins until 2035 (see exhibit 1).

1. IRENA (2025), *Renewable Power Generation Costs in 2024*.

2. Aurora Energy Research (2025).

3. Pexapark (2025).

RE developers facing strong margin pressure

EXHIBIT 1 | German power market prices vs LCOE

Power prices in Germany, wholesale, capture, and LCOE by technology (€/MWh)



1. Capture prices curtailed below zero

Source: Aurora Energy Research; Wood Mackenzie; KYOS

Unlocking Revenue Potential:
Commercial Excellence Is Now a
Core Strategic Differentiator for
Margin Defense and Value
Creation.

While cost levers remain important⁴, especially in regulated and auction-based markets where best-in-class efficiency determines competitiveness, they are no longer sufficient on their own in merchant environments. Future value creation will increasingly depend on commercial excellence and topline optimization, requiring developers to actively manage revenues rather than rely on more favorable market conditions. By doing so, developers need to emphasize three key levers to achieve revenue and margin uplifts of up to 11 €/MWh (see exhibit 2).

- a) Firming to baseload products (0–4 €/MWh)
- b) Imbalance cost optimization (1–2 €/MWh)
- c) Premium offtaker targeting (3–5 €/MWh)

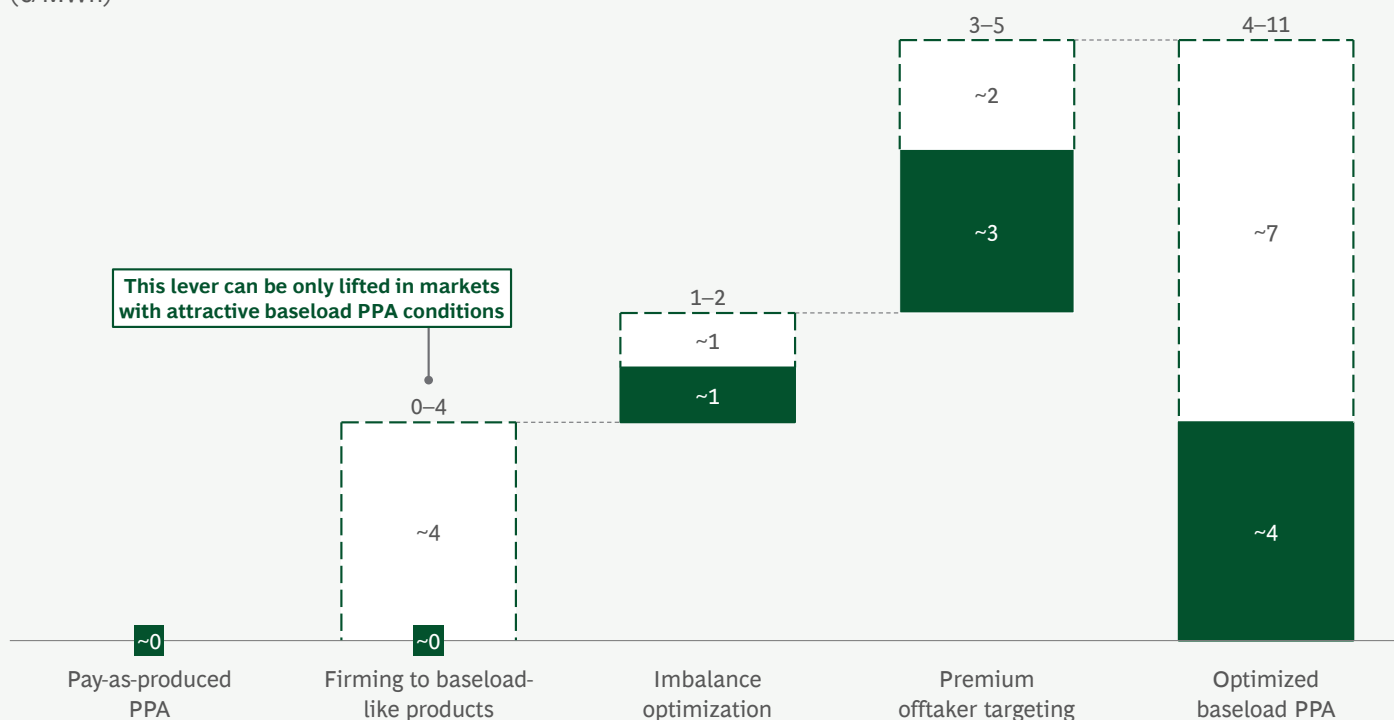
4. BCG 2025, *Win-Cost: A Playbook to Improve Offshore Wind Viability*.

Value creation will increasingly depend on commercial excellence and topline optimization

EXHIBIT 2 | PPA margin optimization bridge

Potential revenue uplift by lever

(€/MWh)



1. Including cost of risk

Source: Aurora Energy Research; Wood Mackenzie; IEA; ISO-NE; BCG

(a) Firming to baseload products

Moving beyond pay-as-produced PPA structures, **developers can create additional margins of up to 4 €/MWh⁵ in certain markets that are typically characterized by a high difference in capture and baseload prices by offering premium baseload-like products that better align with customers' needs.**

PPAs were originally designed as revenue stabilizers for developers, emulating the guaranteed income of feed-in tariffs and thereby enabling project financing. Yet, as renewable penetration grows and markets mature, the risks that simple as-produced structures transfer to buyers become increasingly visible, making them less attractive.

The shift toward structured PPAs is rooted in customer demand: Corporate buyers increasingly value predictability and are willing to pay a premium for firm supply that matches or comes closer to their consumption profiles. This is evident in the growing uptake of baseload PPAs in advanced renewable energy markets such as the Nordics or Spain, where PaP PPAs are increasingly rare⁶. These

products also transfer to the seller some of the risks inherent to PPAs: volume (variability in output), profile (timing mismatch between output and demand), and price risk (exposure to market volatility, including negative prices).

In addition, baseload-like products also align more naturally with market conventions, as they mirror standard traded products, making them easier to hedge and integrate into corporate procurement strategies. At the same time, predictable hourly supply profiles enable companies to credibly match consumption with renewable generation in line with emerging reporting requirements for clean energy, such as 24/7 carbon-free electricity (CFE) sourcing. As-produced PPAs overstate corporates' electricity consumption from renewables, since they typically balance annual volumes rather than hourly supply, leaving gaps covered by uncertified grid power whenever demand exceeds renewable generation. **Structured PPAs, on the other hand, enable a high degree of hourly generation-demand matching**, while minimizing the need for oversizing or reliance on additional wholesale purchases that are exposed to price volatility.

5. BCG PPA Optimizer Tool and BCG project experience incl. expert interviews.

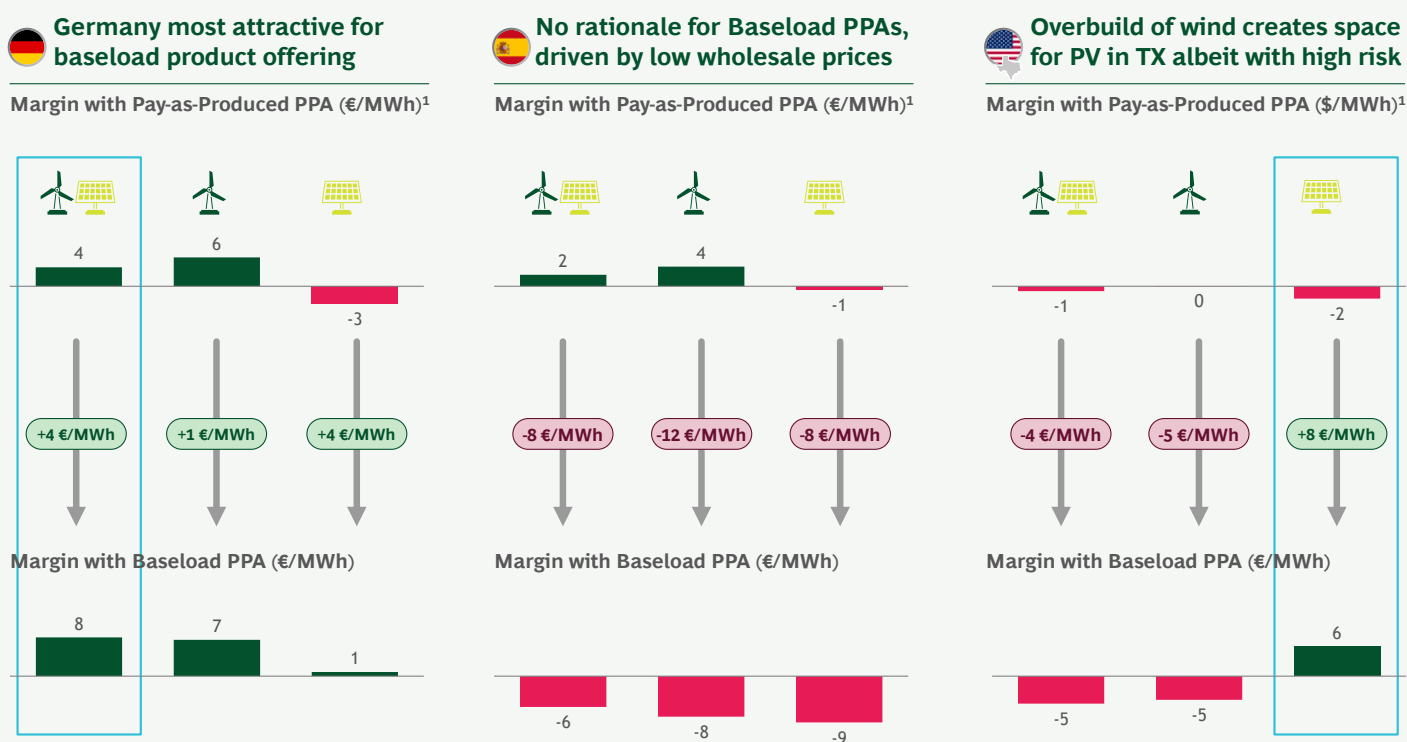
6. Pexapark report – Deconstructing Baseload PPA.

However, offering structured PPAs is not financially viable in every market and thus must be carefully assessed (see exhibit 3). In general, markets with a high renewables penetration that result in low capture prices (e.g., solar PV in Germany) and markets with a high average wholesale power price, typically driven by high gas prices, benefit from offering baseload PPAs. In other words, the absolute gap between wholesale and capture prices needs to be large enough to cover shaping and imbalance costs as well as the risk premium (5% assumed⁷) that is added on top of the LCOE and structuring costs. Moreover, baseload PPA become more beneficial when capture prices are close to or even below LCOE, as this makes pay-as-produced PPAs increasingly unattractive (e.g., in the US ERCOT market).

If baseload PPAs are financially viable in an underlying market, developers need to optimize their asset mix, by diversifying their existing portfolios to deliver baseload-like products in a profitable way. This requires determining the optimal asset mix with the lowest possible generation and shaping cost; for example targeting a 95% hourly matching 100 GWh baseload contract. For the purpose of this analysis, an optimization was conducted for three large renewable energy markets – Germany, Spain and ERCOT in the US (Texas/ERCOT) – taking into account solar PV, onshore wind, offshore wind and batteries as technologies⁸.

Unlocking margin uplift from baseload products requires selecting the right markets and RE asset mix

EXHIBIT 3 | Margin potential of a baseload PPA vs. pay-as-produced PPA across markets



7. Based on Expert interviews.
8. BCG PPA Optimizer Tool.

In Germany (see exhibit 4), thanks to the strong PV build-out in recent years, capture rates are substantially below the wholesale price, resulting in a gap of over 20 €/MWh⁹. This is the foundation to optimize towards a baseload PPA offering. By combining 20 MW solar PV with 36 MW (post-EEG) onshore wind assets, a baseload PPA could generate a margin of 8 €/MWh, which is well above the 4 € margin for a PaP PPA. So, in total, **a baseload PPA in Germany could generate an additional margin of ~4 €/MWh**. A PV-only or onshore wind-only baseload PPA would be also profitable, yet comes with substantially higher merchant market exposure, especially for solar PV. A Pay-as-Produced PPA is only feasible for onshore wind (6 €/MWh margin), as solar PV generation costs are already slightly above capture prices (-3 €/MWh margin).

In Spain, which is characterized by substantially lower wholesale power prices than Germany, structuring costs are too high to offer a profitable baseload PPA. With capture prices being equal or slightly above generation costs, slim margins can still be generated with Pay-as-Produced PPAs (up to 4 €/MWh), especially with onshore wind assets. Given the strong PV build-out in recent years,

building PV assets has become increasingly unattractive, with expected capture prices of 35 €/MWh¹⁰ in line with solar PV LCOE.

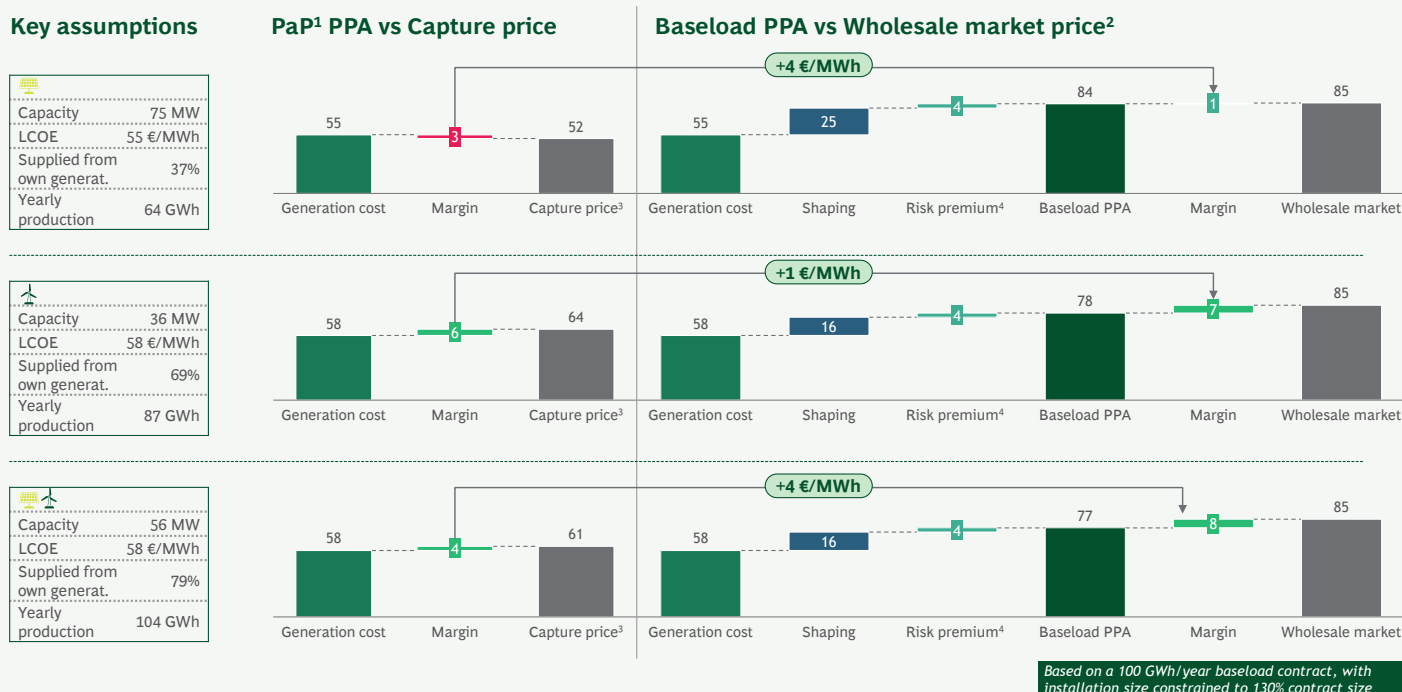
In the ERCOT (Texas, US) market neither PaP nor baseload PPAs generate a positive return due to the small gap of less than 10 €/MWh between wholesale and capture price¹¹, with one exception. A baseload product based on PV can achieve a positive margin of 6 €/MWh thanks to very low shaping costs and a reasonable delta of 15 €/MWh between wholesale and capture price. However, as only 42%¹² of the baseload profile can be covered with own PV generation assets, suppliers would be significantly exposed to merchant market prices. As a result, it is highly unlikely that many players are willing to offer such a high-risk product.

While batteries (4 h) and offshore wind assets were also taken into account for the PPA structuring optimization, they were never chosen given their high LCOE. For batteries additional revenue streams such as ancillary services were excluded.

Combined PV and wind portfolio can yield 4 €/MWh margin uplift in Germany by transitioning to baseload PPAs

EXHIBIT 4 | Achievable margin uplift for portfolio with Pay-as-Produced and Baseload PPA

Overview of best asset mix to maximize margin from baseload products in Germany (€/MWh)



1. Pay-as-Produced 2. Based on a 100GWh/year baseload PPA with hourly matching 3. Assumed to equal Pay-as-Produced market price

4. Risk premium estimated at 5% of generation and shaping cost

Source: Aurora Central scenario; WoodMackenzie; Expert Interviews; BCG

9. Aurora Energy Research, Central scenario

10. Aurora Energy Research, Low scenario

11. Aurora Energy Research, Central scenario

12. BCG PPA Optimizer Tool.

(b) Imbalance cost optimization

Even the most balanced and optimized renewable portfolio cannot perfectly follow a fixed baseload delivery profile. This inherent mismatch forces renewables developers to procure supplementary volumes from the wholesale market, leading to additional imbalance costs besides the normal imbalance cost stemming from the mismatch of nominated and produced volumes. **In Germany, typical imbalance costs for renewables range 2–5 €/MWh¹³**, with solar PV generally incurring the highest levels and offshore wind the lowest. **These costs can be reduced by up to 50% (1–2 €/MWh in savings¹⁴)** through measures such as more accurate forecasting and portfolio diversification across both technologies and geographies. Additionally, flexibility assets such as batteries can further mitigate imbalance costs by shifting generation across hours and thereby smoothing deviations from the delivery profile.

Capturing these margin improvements requires more than just asset deployment. Developers must also strengthen trading capabilities and invest in advanced forecasting and analytics models.

(c) Premium offtaker targeting

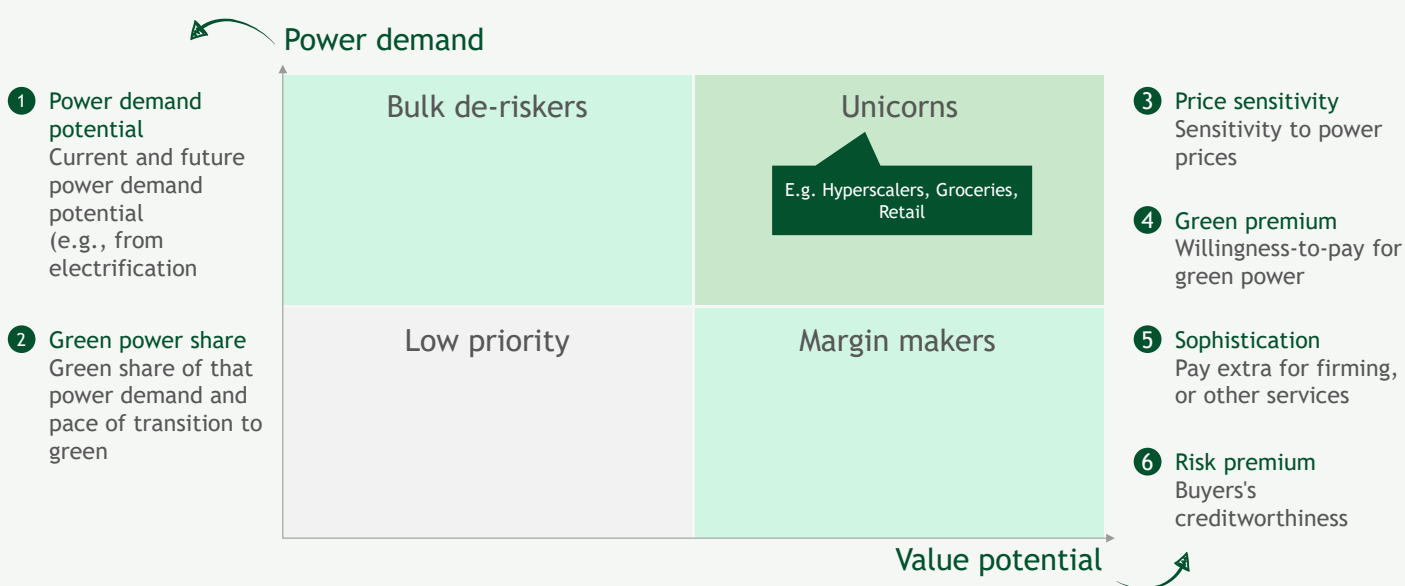
Beyond product design, targeting premium offtakers represents another critical lever. **By focusing on customers with a higher willingness to pay (WTP), developers can increase revenues by 10–15%¹⁵ amounting to ~5 €/MWh.** A customer segmentation analysis that is based on two dimensions—power demand and value potential—highlights hyperscalers, grocers, telcos, and retailers as the most attractive customers, with a high WTP (see exhibit 5). While the first dimension includes the current and future power demand potential and the share of green power as variable, the latter dimension comprises price sensitivity, risk premium, interest for sophisticated products, and willingness to pay a higher price for green power. Furthermore, customers with an interest in structured, more complex products also represent promising segments, since their demand for predictable and credible renewable power translates into higher premiums.

These three levers transform renewables from intermittent generators into credible customer-centric providers of green electrons for their offtakes, strengthening competitiveness in renewable energy markets. Developers that successfully build up the needed capabilities will unlock meaningful upsides, while those that fail to adapt risk margin erosion, unattractive returns, and more limited access to capital.

Hyperscalers, grocers, and retailers are attractive segments for PPAs with a higher willingness to pay

EXHIBIT 5 | Willingness-to-pay analysis

German PPA customer segmentation



Source: Expert interviews; BCG project experience

13. Aurora Energy Research.

14. BCG analysis based on input data from IEA, and ISO-NE.

15. Based on BCG project experience incl. expert interviews.

(2) Operating Model for Commercial Excellence

Historically, renewable energy developers concentrated their commercial efforts on revenue derisking to make projects bankable and scale deployment. The focus was on subsidies, long-term contracts, such as pay-as-produced PPAs or contracts for difference (CfDs), and hedging in forward markets to reduce risks and optimize financing conditions. This was often accompanied by the intention of selling the assets shortly after construction to long-term owners, such as utilities or infrastructure funds. Most developers remain at this stage today, characterized by an asset-by-asset approach and static revenue strategies.

In this model, **pure asset developers** rely on external partners such as utilities and midstream players to commercialize their generation assets through route-to-market agreements. These contracts allow producers to sell their output to a market player, who then manages trading, balancing, and delivery into the wholesale market.

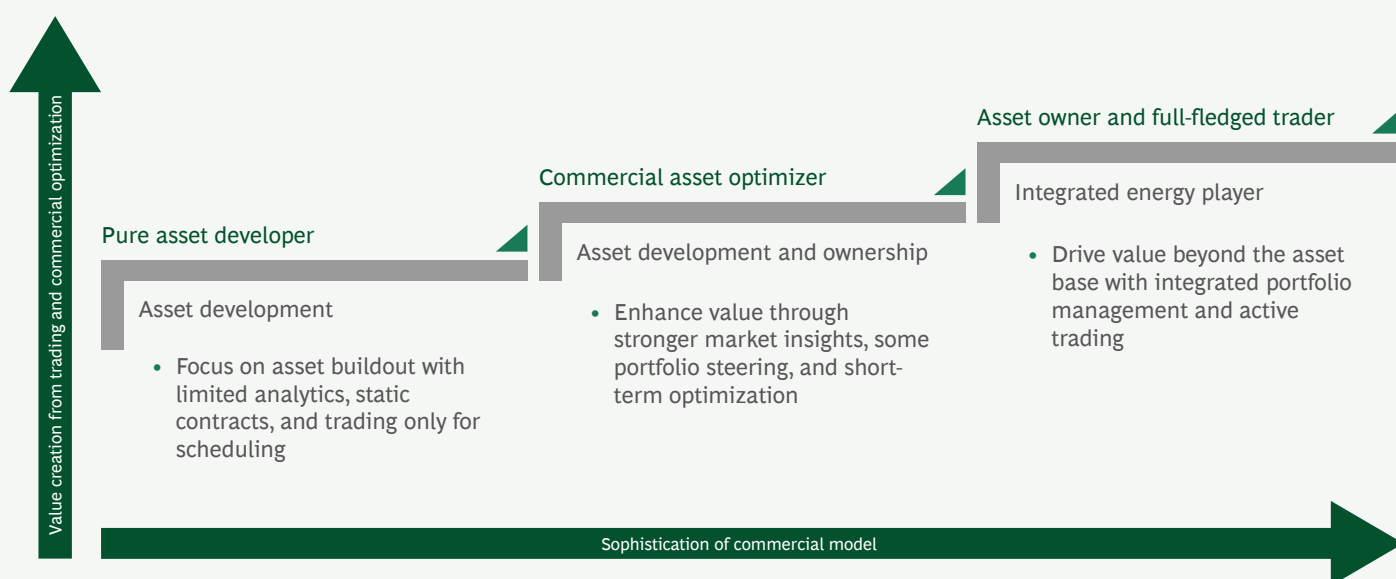
While this helped to secure market access in the early phase of renewables growth, it also means that external partners capture most of the commercial upside beyond the scope of these agreements. Today, this approach is increasingly insufficient in the current context of shrinking margins and tightening investor return expectations.

Developers that rely only on bankable revenues through pay-as-produced structures risk being outperformed by more sophisticated peers who actively monetize value through trading, portfolio steering, and dynamic revenue management. This is pressuring developers to build up or acquire some of these capabilities themselves.

Commercial operating models reflect varying levels of commercial sophistication, ranging from pure developers that are focused on project delivery to fully fledged traders who manage large, integrated portfolios. While not all approaches are equally relevant for every developer, understanding this spectrum provides a roadmap for the capabilities required to move toward commercial excellence (see exhibit 6).

RE developers have evolved different operating models to manage assets and capture value from markets

EXHIBIT 6 | Typical archetypes for RE players



Source: BCG

Commercial asset optimizers represent the next stage of maturity. Beyond simple volatility reduction, they place a strong focus on extracting value from their asset base. This includes active asset-backed trading in intraday and balancing markets as well as developing structured products such as baseload-like PPAs or shaped contracts that better match customer demand and capture price premiums. At this stage, companies typically move from project-by-project SPV project financing to balance-sheet financing. SPV models require fully bankable revenues and are therefore incompatible with merchant exposure. By contrast, balance sheet financing enables these risks to be managed at the corporate level, providing the flexibility needed to structure baseload-like products. They additionally emphasize active portfolio management, diversification, and risk management, selectively capturing value from market fluctuations within strict limits. They generally don't take trading risk in-house, though some already pursue limited proprietary trading opportunities to enhance margins.

Asset owners and full-fledged traders advance by making trading an independent lever of value creation, diversifying revenues, and capturing upside from market volatility. In addition to robust derisking and asset-backed trading, they internalize trading risk by contracting their own volumes and managing market exposure directly rather than relying on external partners for market access. This includes diversifying beyond their immediate generation assets and positioning trading and structured products as a core part of their customer offering.

In summary, pure developers concentrate on revenue derisking through long-term contracts to make projects bankable. Commercial asset optimizers build on that by driving asset-level value creation through structured products, short-term trading, and imbalance optimization, while full-fledged traders go further by steering diversified portfolios and capturing additional value beyond their own asset footprint.

The increasing sophistication of these operating models translates directly into trading's share of total revenues. For pure developers, trading typically accounts for less than 10%, mostly even being 0%¹⁶, while for commercial asset optimizers, the share rises to around 10–15%¹⁶. Asset owners and full-fledged traders push this to 20–25%¹⁶, turning trading from a support function into a central profit engine.

But this raises important questions: How can developers evolve their operating models to capture these opportunities? What capabilities are required to unlock the identified value potential and defend margins in increasingly competitive markets?

16. BCG Trading Benchmark.

(3) Roadmap to commercial excellence

Realizing the full commercial value potential of renewable energy projects requires developers to evolve their operating models. Success depends on moving beyond traditional project-level approaches and building the capabilities needed to lift the value potential of the three commercial levers.

Premium offtaker targeting depends on building structured sales approaches and the ability to design innovative contract structures for corporates with a high willingness to pay. Imbalance cost optimization requires advanced forecasting, real-time dispatch capabilities, and portfolio flexibility to minimize intraday risks. Firming to baseload products, in turn, demands a diversified asset mix, clearly defined merchant risk limits, and access to trading desks to shape structured products; for example, by sourcing volumes from the market.

The capabilities needed to achieve these levers can be clustered into five key development areas that form the foundation of commercial excellence. Customer relationship and sales management is essential to effectively pursue premium offtaker targeting, while risk management and governance, active portfolio management, and the setup of a commercial optimization function are critical to enabling firm product offerings and imbalance optimization, provided they are supported by appropriate balance sheet financing.

The roadmap to commercial excellence requires RE developers building on different capabilities

EXHIBIT 7 | Key development areas to build a commercial optimizer



Source: BCG

1. Customer relationship and sales management.

Premium offtaker targeting relies on strong customer-facing capabilities. Developers must cluster potential customers based on power demand and value potential, prioritize them, and tailor product offerings ideally to those with a higher willingness to pay. At the same time, they must ensure customer demand is systematically matched with the available renewable volumes and products. Consequently, defining a clear PPA product catalogue up front can help with a tailored customer approach based on customer interest and one's own capabilities and asset availability.

2. Risk management and governance. As developers take on more merchant exposure, risk management and governance become central to safeguarding financial stability. This requires not only a clear risk framework and headroom but also a detailed understanding of the most relevant risks. In addition to price, production, and regulatory risk, this also includes credit risk in case offtakers suffer from deteriorating creditworthiness or even an inability to meet their payment obligations. Such situations can directly undermine contracted revenues, potentially resulting in substantial losses. At the same time, margin pressure from aggressive

competitors with optimized portfolios further challenges profitability. Strong governance, robust analytics, and clear accountabilities are therefore essential to ensuring these risks are factored into decision-making, PPA pricing, and managed consistently across the organization.

3. Active portfolio management. Firm product offerings depend on managing portfolios rather than individual assets. Developers must ensure that new assets complement existing ones, diversify by technology and geography, and align with the overall CAPEX allocation strategy. A dedicated portfolio management function should shape investment decisions and conduct regular reviews of the portfolio to balance risk and return.

This also requires transparency on the full pipeline of planned and existing assets and customer demand to effectively match supply with offtaker needs through a close collaboration between the commercial sales and the project development/ asset management team. The best practice is to establish a centralized view on both the project and sales funnel, ideally supported by one centralized database. This enables efficient timing of PPA sales and ensures greater alignment between asset readiness and offtaker requirements.

Furthermore, portfolio buildup can rely on different sources, including PPAs based on self-developed assets and third-party agreements with external generators. Over time, this green portfolio can be optimized by restructuring or reselling PPA contracts, bundling guarantees of origin with full supply contracts, and hedging strategies to stabilize revenues and mitigate price fluctuations. Taken together, these measures allow developers to steer their portfolios dynamically and unlock value beyond asset-level optimization.

4. Commercial optimization function. Imbalance cost optimization and complex PPA structuring require a dedicated trading function. This new commercial optimization function must manage intraday positions, minimize imbalance costs through advanced analytics and forecasting, flexibility optimization, and enable flexible contract structuring via strategic long-term portfolio steering. Over time, it can broaden its scope to capture additional value pockets by tapping into third-party business or proprietary trading activities. To successfully develop such a function, certain elements must be firmly anchored in-house (e.g., forecasting, optimization, intraday trading for imbalance cost optimization, long-term portfolio strategy, and risk management), while other capabilities, such as market access execution or parts of IT and back-office operations, can typically be outsourced.

Building a commercial optimization function requires a stepwise roadmap, which usually takes one to two years: starting with the definition of a clear vision and business case ambition followed by the design of the operating model and IT landscape, before launching the implementation with the right teams and interfaces. Once operational at scale, the function should proactively explore further growth opportunities into new value pools. This structured approach ensures that the commercial optimization function is established on solid foundations to become the backbone of commercial excellence, effectively reducing imbalance and shaping costs and, thereby, maximizing the commercial value of developers' renewable assets.

5. Balance sheet financing. At this stage, companies must move away from project-by-project SPV financing, which depends on fully bankable revenues and is therefore incompatible with merchant exposure. By contrast, balance sheet financing enables these risks to be managed at the corporate level, providing the flexibility needed to structure baseload-like products. However, it also requires careful management of credit ratings, financing costs, debt-to-equity ratios and adjusted return expectations. Navigating this shift is complex and largely uncharted territory for most developers, requiring time and diligent preparation before the implementation.

In summary, to achieve commercial excellence, developers must evolve their operating models across the five key development areas outlined here. In a context where severe margin pressure has become the defining challenge for renewable energy developers, traditional cost reduction levers alone are no longer sufficient. Value creation will increasingly depend on commercial excellence and topline optimization, encompassing the ability to target premium offtakers, manage risks systematically, optimize portfolios dynamically, and deliver firm structured products.

Advancing toward commercial excellence is therefore not optional but a core strategic differentiator for renewables developers. It will determine which players can defend margins, capture new value pools, and secure long-term competitiveness in an increasingly crowded renewable energy market

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