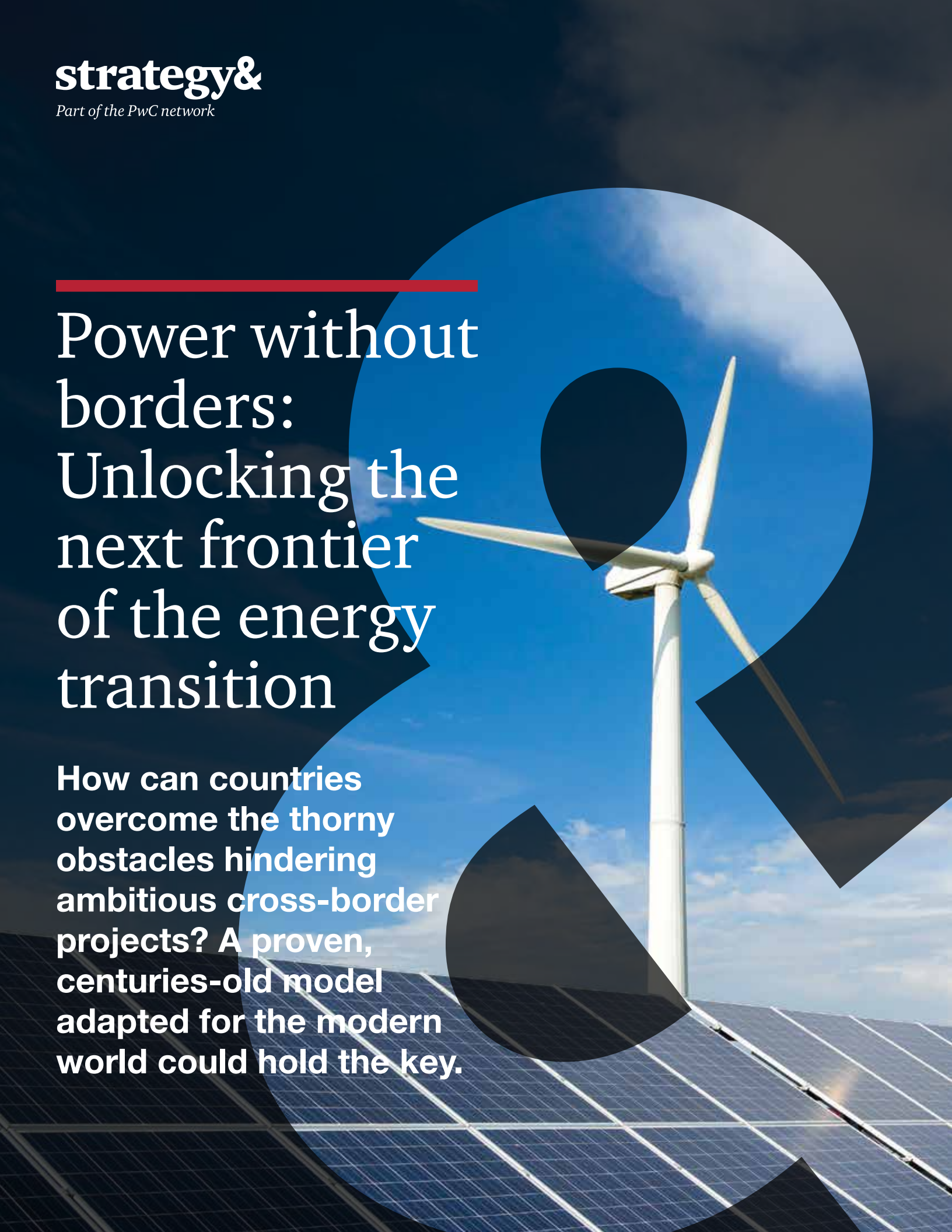

Power without borders: Unlocking the next frontier of the energy transition

How can countries overcome the thorny obstacles hindering ambitious cross-border projects? A proven, centuries-old model adapted for the modern world could hold the key.



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EXECUTIVE SUMMARY

The global energy transition has reached a major turning point. Renewables are scaling rapidly, reshaping markets, investment patterns, and the architecture of global power systems. Indeed, 585 gigawatts (GW) of new capacity was added in 2024 alone, accounting for nearly 93 percent of all new generation.¹

Yet, paradoxically, the more the world builds, the more energy remains stranded. Thousands of gigawatts of clean electricity are now curtailed (that is, intentionally reduced) each year for lack of transmission. Germany curtailed 1,389 gigawatt-hours (GWh) of solar power in 2024—enough to supply 400,000 homes, based on our analysis.² Similar waste occurs in China’s northwest, California’s Central Valley, and Saudi Arabia’s deserts.³

This mismatch between renewable generation growth and transmission capacity has become the defining constraint of the energy transition. Whether the next stage of decarbonization succeeds will depend less on how much renewable capacity is installed than on how effectively nations connect it to demand.

Electricity trade across borders—power without borders—offers one solution. It links surplus with scarcity, balances renewable intermittency across time zones, and turns stranded generation into tradable value. This solution can resolve a part of the cross-border energy imbalance while complementing other, more focused, solutions, such as locating energy-intensive industries closer to renewable energy sources.

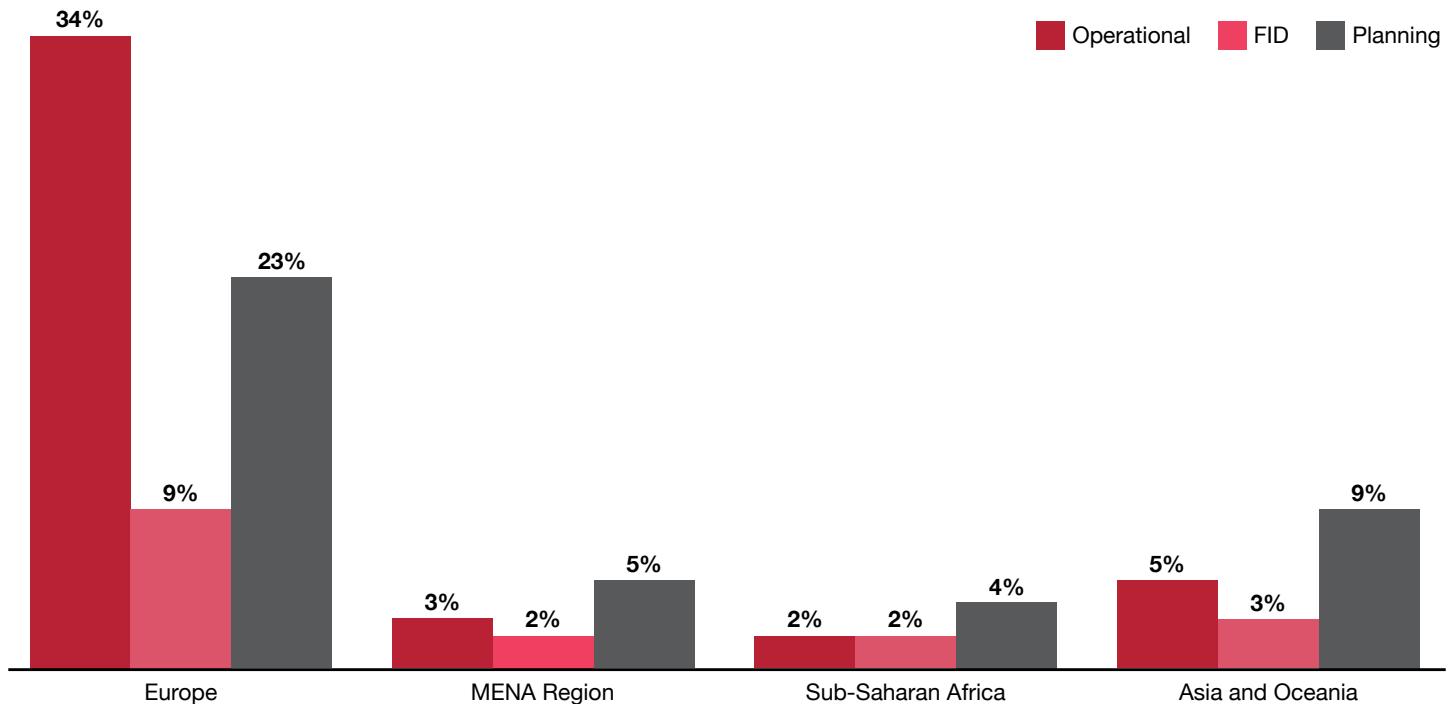
These links could redefine energy geopolitics if policy and financing align. Solar power from the deserts of Arabia could supply regional or European demand; hydropower from central Africa could stabilize southern grids; and Asian interconnections could underpin the region’s manufacturing expansion.

Realizing this vision will require more than technology. Conventional project finance was not designed for multi-country, multi-decade infrastructure of this scale. Cross-border power exports will require financing models that combine sovereign backing, long-term horizons, and shared risk—in essence, a form of “Victorian financing” adapted to the realities of today’s energy transition. The Middle East and North Africa (MENA) region is uniquely positioned to conduct pilots for this model and could be at the vanguard of a cross-border energy revolution.

THE PROMISE AND PERSISTENT GAP OF CROSS-BORDER PROJECTS

A global pipeline of interconnectors is forming, but progress varies widely by region (see *Exhibit 1*). Europe's Projects of Common Interest and Projects of Mutual Interest (PCI-PMI) initiative aims to install more than 40 GW, which is projected to save consumers €26 billion (US\$30.7 billion) a year starting in 2040 through more efficient cross-border dispatch.⁴ In Asia, the ASEAN Power Grid seeks to integrate 10 national markets, targeting about 18 GW of transmission capacity by 2040,⁵ while Africa and the Middle East are advancing export corridors to Europe as well as intra-regional trade through emerging power pools such as the West African Power Pool (WAPP) and Southern African Power Pool (SAPP).

EXHIBIT 1
Global interconnection pipeline by region, 2025

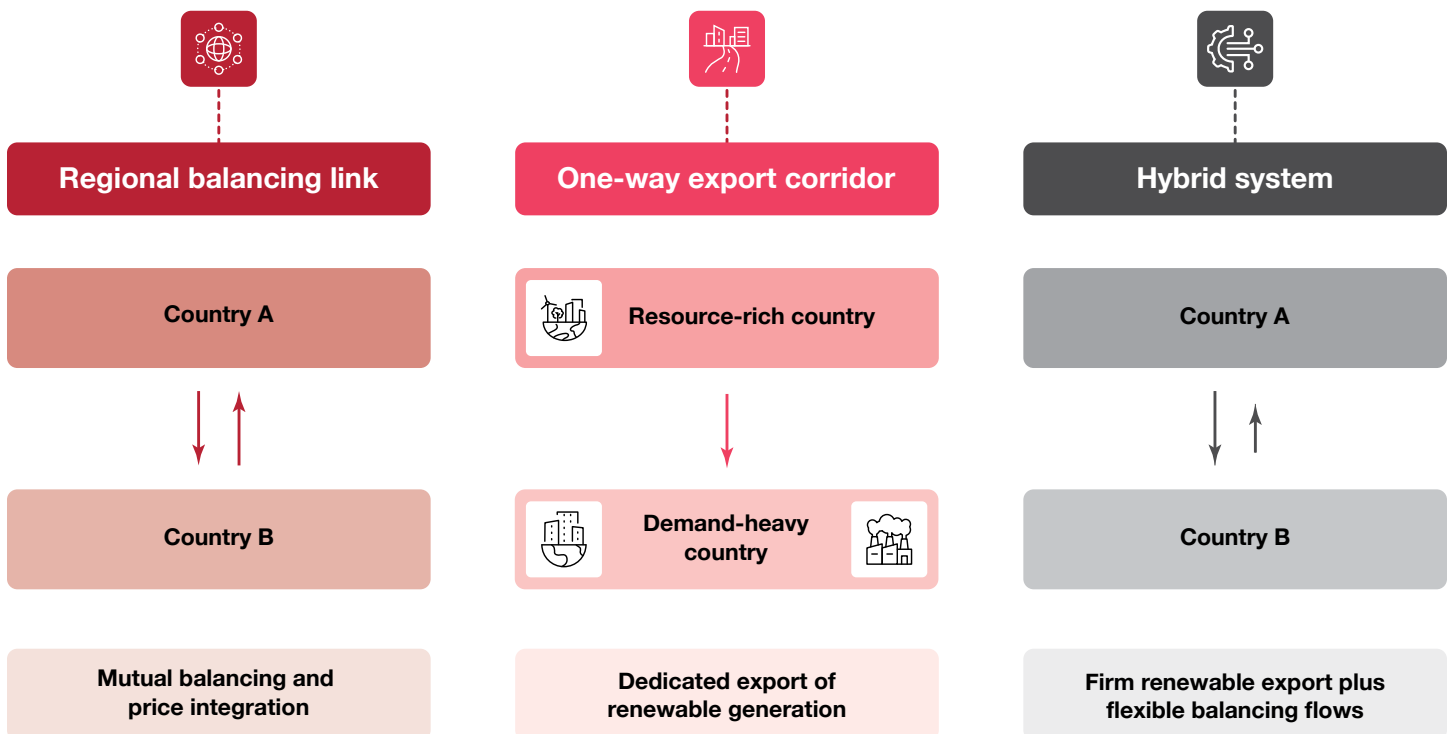


Note: FID = final investment decision.
Source: Strategy&

These projects follow three distinct archetypes (see Exhibit 2).

- Regional balancing links: Two-way connections that enhance reliability and price stability.
- One-way export corridors: Long-distance, high-voltage links dedicated to moving renewable power from resource-rich zones to demand centers.
- Hybrid systems: Flexible arrangements combining domestic balancing with cross-border trade.

EXHIBIT 2
Three archetypes of power export models



Source: Strategy&

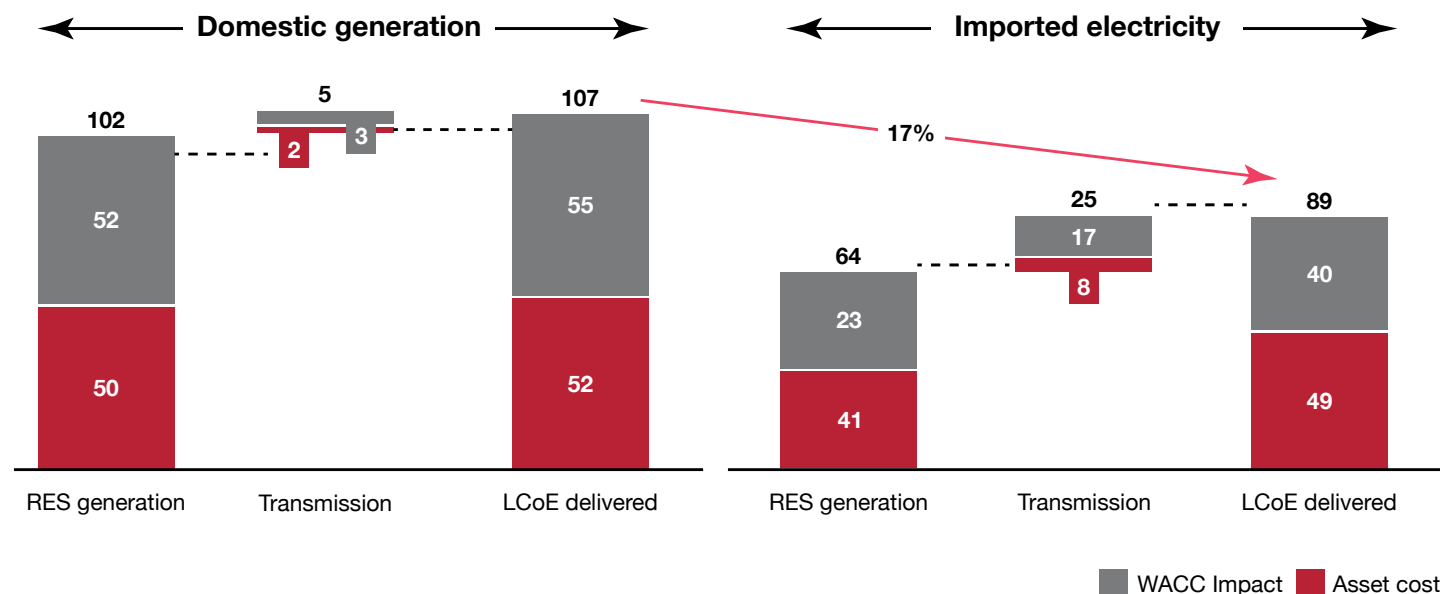
The economic benefits of power without borders

Cross-border systems have a compelling economic rationale. For instance, countries such as Saudi Arabia and the United Arab Emirates (UAE) currently generate solar power at less than US\$15 per megawatt-hour (MWh)⁶—among the lowest costs in the world. In some importing regions, wholesale prices have averaged US\$45 to US\$75 per MWh, with spikes exceeding US\$110 per MWh during fossil fuel disruptions.⁷ Even after accounting for transmission and balancing costs, imported renewables can still be 5 to 20 percent cheaper than domestic generation (see Exhibit 3). Regions with an arbitrage advantage can also benefit from lower financing costs in stable investment climates, superior solar irradiance, and project scale, all of which further reduce delivered prices.

EXHIBIT 3

The delivered cost waterfall illustrates that imported energy can be less expensive than domestic generation (The unit of all the figures in this chart is USD/MWh)

Illustrative example



Note: RES = renewable energy source. LCoE = levelized cost of energy. WACC = weighted average cost of capital. Source: Strategy& analysis, expert input, and ENTSO-E reports (<https://www.entsoe.eu/>)

Challenges impede the leap from ambition to reality

Few of these ambitious projects have reached financial close. CASA-1000, intended to deliver central Asian hydropower to south Asia, remains unfinished more than a decade after inception because of political instability and shifting donor priorities.⁸ ASEAN's regional grid integration, launched more than 20 years ago, has achieved less than 20 percent of its planned capacity,⁹ slowed by tariff disparities and uneven regulatory harmonization. Desertec, once envisioned as a 40 GW solar corridor from North Africa to Europe, collapsed after investors and governments failed to align on governance and risk-sharing.¹⁰

Even high-profile private ventures have faltered: Sun Cable, linking Australia to Singapore, entered administration in 2023 following shareholder disputes. Similarly, Xlinks has yet to secure the government contract for difference (CfD) required for bankability.¹¹

Together, these examples reveal a consistent pattern: Visionary concepts are created, but rarely translated into execution.



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Although regulation remains uneven, the foundation exists, and regional frameworks for cross-border trade are taking shape. Europe’s ENTSO-E market-coupling model harmonizes dispatch and balancing. In Africa, SAPP and WAPP are embedding regional trading rules.

OVERCOMING THE OBSTACLES

Delivering cross-border power exports at scale depends on five critical enablers: technology, regulation, execution, stakeholder alignment, and financing (see *Exhibit 4*). The first three are largely mature, but the last two, stakeholder alignment and financing, remain decisive barriers.



EXHIBIT 4
The five enablers of power export delivery maturity



Note: HVDC = high-voltage direct current.
 Source: Strategy&

Technology—proven and bankable

The engineering challenge has largely been solved. Strategy& analysis finds that high-voltage direct current (HVDC) systems now transmit 3 GW across 1,000 km with less than 3 percent losses, and subsea cables exceeding 700 km are routine.¹² Projects such as NordLink (Germany–Norway), Viking Link (U.K.–Denmark), and China’s ultra-high-voltage direct current (UHVDC) network prove that multi-gigawatt interconnectors can be built on schedule and can perform reliably. Suppliers have accumulated deep experience, and our analysis indicates that costs have fallen about 30 percent since 2015.

Regulation—evolving but functional

Although regulation remains uneven, the foundation exists, and regional frameworks for cross-border trade are taking shape. Europe’s ENTSO-E market-coupling model harmonizes dispatch and balancing. In Africa, SAPP and WAPP are embedding regional trading rules. And in Southeast Asia, the ASEAN Power Grid has proven that even partial alignment enables bilateral flows. Progress now depends on extending these models across regions.

Execution—capability exists, coordination trails

Global engineering, procurement, and construction (EPC) players have delivered projects whose complexity is comparable to that of interconnectors, such as pipelines, liquefied natural gas (LNG) terminals, and high-speed rail. Although the capacity to build exists, a lack of coordination often slows progress. Multi-country permitting, supply chain synchronization, and sequencing across jurisdictions still create friction. As a result, execution challenges tend to stem from coordination gaps rather than from any limitation in technical or construction capability.

Stakeholder alignment—the missing foundation

In our experience, lack of alignment among stakeholders remains the most common reason projects stall. Cross-border power exports involve multiple governments, regulators, utilities, investors, and communities, each with distinct incentives. For instance, exporters seek revenues and influence, importers focus on cost and stability of supply, financiers demand predictable revenues, and citizens expect tangible local benefits.

Two cautionary tales highlight the challenge of getting stakeholders on the same page. As noted above, Desertec collapsed when European utilities and North African governments diverged on tariffs and governance.¹³ Meanwhile, CASA-1000 has endured repeated renegotiations following political transitions in Afghanistan and Pakistan.¹⁴ These cases underscore a simple truth: Trust and institutional alignment largely determine the viability of delivery projects.

Financing—the persistent bottleneck

Financing is often the critical constraint to project viability. Power-export corridors occupy a blind spot in global capital markets: They are too large and require investment time lines that are too lengthy for commercial project finance, yet they are too commercial for concessional aid.¹⁵ A look at potential investors highlights the challenge:

Multilateral development banks (MDBs) offer concessional loans and guarantees but cannot finance multibillion-dollar projects alone.

Sovereign wealth funds have the patient capital but typically invest only once projects are fully de-risked.

Private investors require firm offtake guarantees or regulated tariffs that are rarely available across borders.

The high up-front cost, long payback, and potential political risk collide with investor preferences.

The previously noted failures of the Sun Cable and Xlinks projects demonstrate that without long-term, government-backed revenues, even economically sound projects cannot reach financial close. Until risk allocation evolves, power-export projects will remain structurally unbankable despite compelling fundamentals.

Addressing stakeholder alignment and financing requires rethinking how risk, capital, and commitment are structured.



APPLYING VICTORIAN FINANCING FOR A DECARBONIZED CENTURY

Solving the alignment and financing gap requires a reimagining of how risk, capital, and commitment are structured. History offers a precedent: During the 19th century, the world faced a similar dilemma—massive infrastructure ambitions such as railways, canals, and telegraphs were technically possible but commercially unbankable. A new financial model—Victorian financing—aligned investors, governments, and long-term returns.

That innovation enabled the Industrial Age. Its features could also usher in the decarbonization era.

Learning from history

Two examples illustrate the relevance of Victorian financing for modern times. Both were ultimately successful in building transformative infrastructure, and their underlying financial mechanisms—sovereign guarantees, long-term capital commitments, and shared ownership structures—remain highly transferable to today's cross-border infrastructure projects.

The Indian railways

In the 1840s, the British colonial government in India guaranteed Indian railway investors a fixed 5 percent return,¹⁶ turning a speculative venture into investable infrastructure. Within 25 years, more than 16,000 miles of track had been built across the Asian subcontinent,¹⁷ integrating markets and accelerating trade. However, this structure limited local participation in ownership and decision-making.

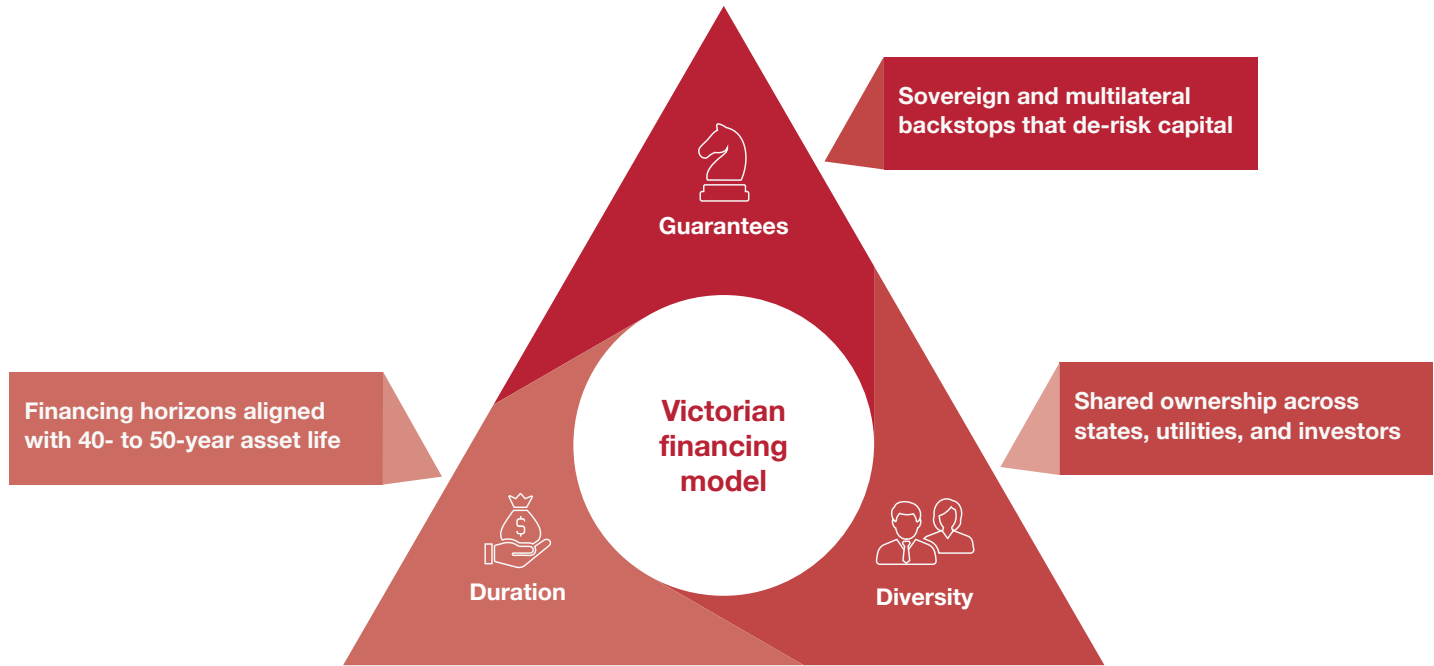
The Suez Canal

Built through a joint-stock company combining French, Egyptian, and later British capital, the Suez Canal had a structure that diversified ownership and risk across states and investors. Despite cost overruns and political opposition, it opened in 1869, repaid its capital within a decade,¹⁸ and redefined global trade routes. The canal's success also underscored the importance of balanced governance and distributed risk among sovereign stakeholders.

The same principles can now be reinterpreted, more inclusively and transparently, to finance cross-border power exports at scale. Not every interconnection requires this level of financial architecture. For example, conventional bilateral links between neighboring systems built primarily for balancing or reliability can draw on traditional utility investment or standard project finance.

EXHIBIT 5
The modern Victorian financing model

Projects become investable when these three conditions reinforce one another



Source: Strategy&

Three foundational elements

The modern Victorian financing model (see *Exhibit 5*) becomes essential when projects span long distances and multiple jurisdictions, with capital requirements measured in the tens of billions. At this point, conventional financing and single-country governance are no longer feasible. The model features three foundational elements.

Guarantees—embed sovereign continuity

Victorian investors trusted the Crown; modern financiers need governments and multilaterals to provide the same continuity and confidence through institutionalized guarantees.

In practice, this means embedding credit and policy protection into project contracts:

- Sovereign-backed offtake floors that guarantee a minimum revenue stream
- Multilateral political-risk insurance (such as Multilateral Investment Guarantee Agency or multilateral development bank partial-risk guarantees) that protects investors from expropriation, regulatory shifts, or political change across election cycles
- Export credit and MDB co-underwriting that gives lenders confidence in the stability of tariffs, offtake terms, and cross-border regulatory frameworks

These tools do more than reduce borrowing costs by 200 to 300 basis points; they translate political intent into contractual sovereignty. The Saudi Arabia–Egypt 3 GW HVDC link, which was financed with US\$566 million in Swedish export credit agency (ECA)-backed loans,¹⁹ demonstrates how such commitments can mobilize capital and accelerate delivery.

Duration—align horizons across finance and policy

HVDC interconnectors and renewable plants operate for 40 to 50 years, but both financial instruments and political cycles still run within much shorter timeframes. This mismatch erodes both investor confidence and policy stability.

To close the gaps, power-export corridors need structures to institutionalize patience:

- Green infrastructure trusts that pool multiple assets into long-dated, investable portfolios
- Sovereign refinancing windows that convert short-term construction loans into long-term debt once projects stabilize
- Treaty-level frameworks that lock in cross-border commitments and reduce the likelihood of political shifts that insurance cannot fully mitigate

One prototype is the U.K.'s Ofgem cap-and-floor regime, which guarantees interconnector revenues for 25 years. But the challenge goes beyond maturity: Time horizons across finance and policy must be aligned on duration. Projects will endure for 50 years only if the institutions around them are designed to last that long.

Diversity—turn shareholders into stakeholders

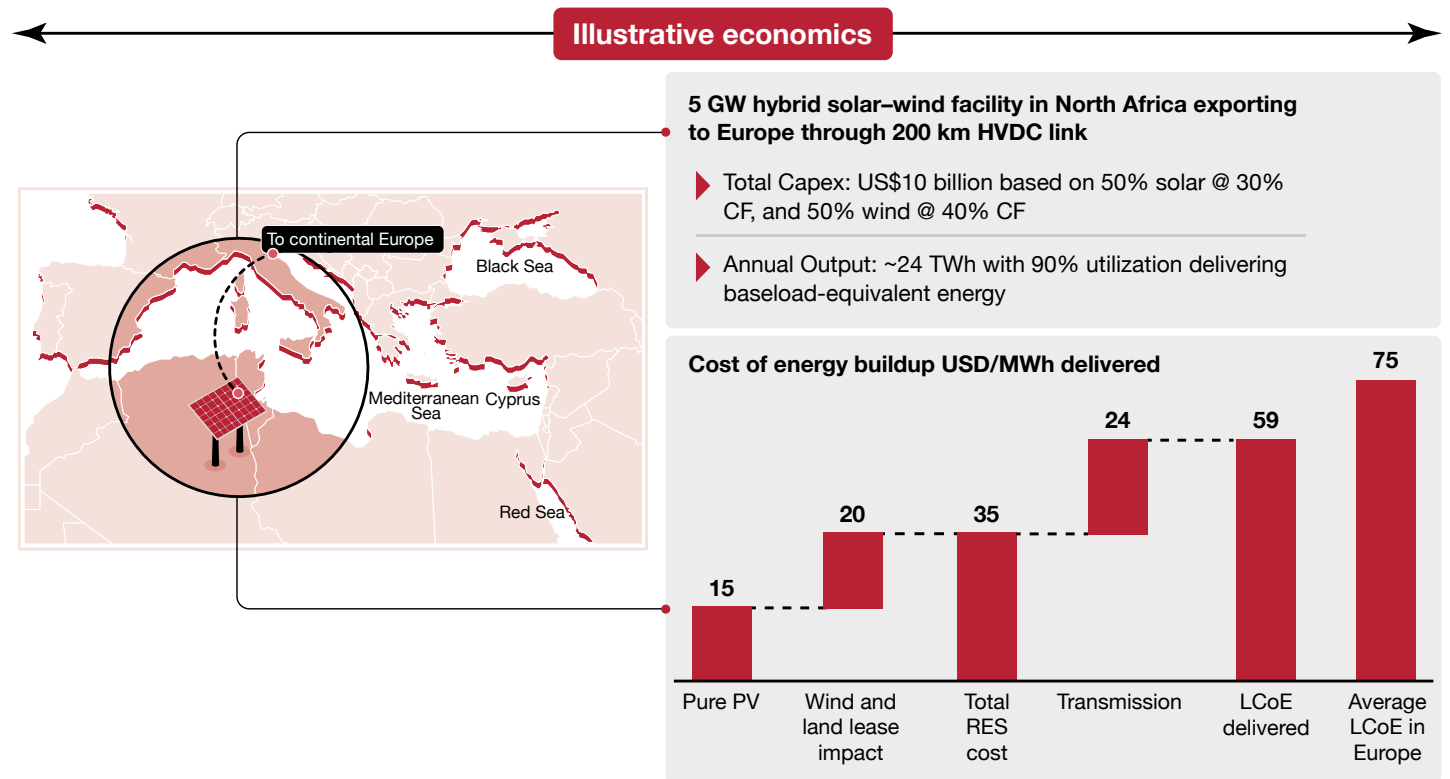
The Suez Canal survived revolutions across stakeholder countries because no single actor controlled it. Modern power-export corridors require the same multi-sovereign governance model, not just a diversified capitalization table. This means joint ownership and joint authority:

- Shared equity across exporting and importing governments, regulated utilities, and institutional investors
- Shared boards and decision rights that give all participants both a financial and a political stake
- Local pension funds and community vehicles with minority shares to anchor domestic legitimacy

Such diversification transforms ownership into alignment by design. Every party has a stake in the project's outcome and a voice in governance, creating a system that can absorb political shocks without derailing projects (see *Exhibit 6*). In a global context where interdependence can feel risky, this model is a source of resilience.

EXHIBIT 6

A Victorian-style capital stack can close the economics gap for cross-border clean-power exports
Illustrative 5 GW corridor from North Africa to Europe (The unit of all the figures in this chart is USD/MWh)



Note: CF = capacity factor.
Source: Strategy& analysis, expert input, ENTSO-E reports (<https://www.entsoe.eu/>)

The capital structure consists of the following components (approximate equity distribution):

- Exporting and importing governments: 30 percent, to signal political and risk sharing
- MDB equity and guarantees: 20 percent, to de-risk sovereign and operational exposure
- Green bonds (sovereign wealth and pension funds): 30 percent, to offer patient capital aligned with sustainability goals
- ECA-backed debt: 20 percent, to provide competitive financing sources

This blend of capital financing can lower the weighted cost of capital by about 2 percent, a level that enables stable and long-term investment at scale. Further, the capital structure for cross-board power projects can deliver an 8 to 10 percent internal rate of return (IRR) (in line with infrastructure-grade returns) and a payback period of 11 years, which is competitive for long-lived assets.

THE MENA REGION'S DEFINING MOMENT

The Middle East and North Africa's endowments make the region uniquely placed to pioneer cross-border power exports. It combines the world's lowest renewable generation costs, sovereign investors with deep capital reserves, and geography that bridges three continents. Where other regions debate feasibility, the MENA region can deliver—if it acts decisively. Five steps can create a viable pathway.

1. Harness natural advantage and strategic location

No other region can match the Middle East and North Africa's wind and solar resources and land availability. Utility-scale photovoltaic power in the Arabian Gulf already produces power at less than US\$15 per MWh—one-tenth of the recent European wholesale average.²⁰

Geographically, the region sits within 2,000 km of both European and South Asian load centers, enabling interconnectors that are shorter, cheaper, and technically less challenging than many of their global counterparts.

The MENA region also benefits from existing transmission corridors, with a regional backbone taking shape. The GCC's unified grid spans six states, and the Saudi–Egypt 3 GW HVDC link is advancing. In addition, new corridors from Saudi Arabia to Jordan and Iraq, along with Morocco's connection to Spain, are extending the MENA region's reach. These projects show that the hardware of regional integration already exists. The next step is to align capital, policy, and governance to scale it.

2. Lead through pilot corridors

To demonstrate the modern Victorian financing model, the MENA region should select two or three pilot corridors where political alignment, resource complementarity, and investor appetite coexist. A few proposed projects hold significant potential:

The MENA–Europe Interconnector corridor would transmit North African renewables to Southern European markets such as Spain and Italy by undersea HVDC links.

The Gulf Cooperation Council (GCC) Super Grid. This project would link Saudi Arabia, the UAE, Oman, and Kuwait to pool capacity, stabilize demand, and create an export platform for the South Asian and East African markets.

The Red Sea Corridor. A multi-terminal HVDC network connecting Egypt, Saudi Arabia, and Jordan, enabling two-way power flows and trade balancing.

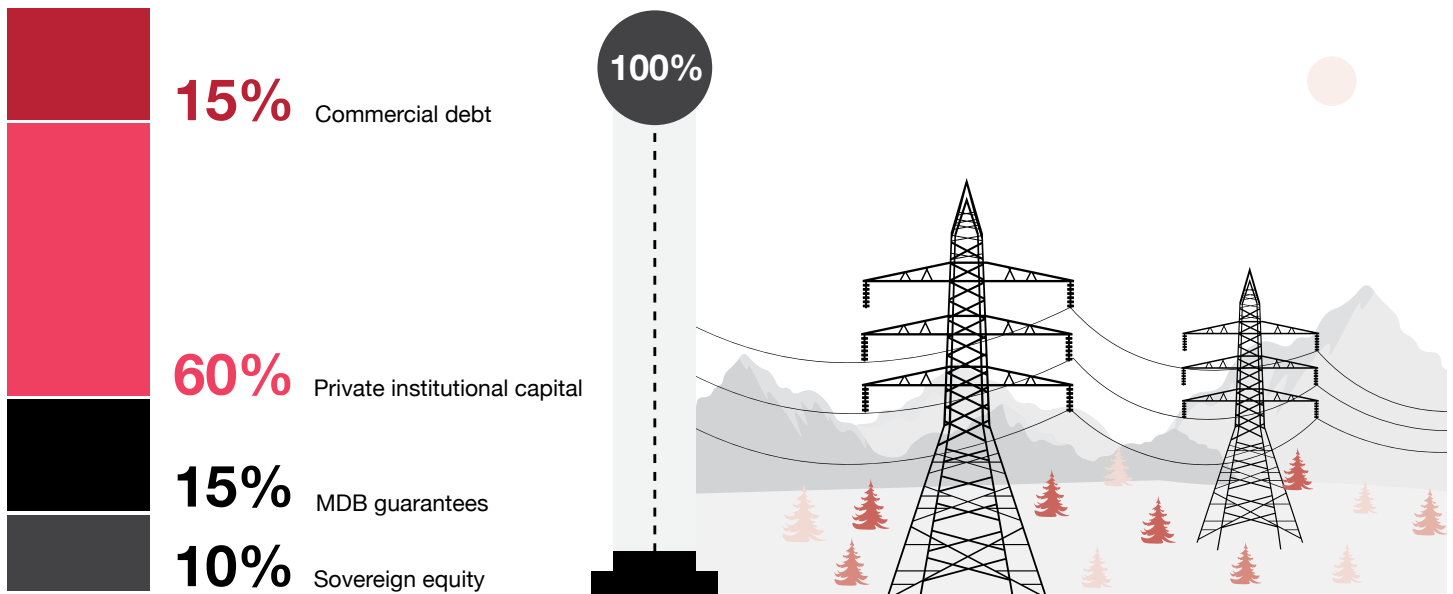
Each pilot should apply the modern Victorian financing model: sovereign continuity (through government-backed offtake guarantees), aligned duration (through 25-year regulatory frameworks), and diverse ownership (governments, utilities, sovereign funds, and institutional investors). Success in even one corridor could redefine bankable projects.

3. Mobilize anchor capital

The MENA region's sovereign funds—PIF, ADIA, Mubadala, QIA, and others—collectively manage more than US\$4 trillion.²¹ Redirecting even 0.5 percent of these assets into early-stage equity could unlock US\$20 billion in blended financing for regional projects.

To channel these funds in a systematic way, the region should establish a green cables facility—that is, a dedicated investment platform blending sovereign equity, MDB guarantees, and private co-investment (see *Exhibit 7*). Such a facility could underwrite early feasibility work, finance permitting, and provide first-loss capital, creating confidence among global investors to encourage them to follow.

EXHIBIT 7
The green cables facility capital structure



Source: Strategy&



4. Institutionalize cooperation

Technical integration across borders will fail without political and regulatory integration. The MENA region should create a regional power exports council, convening ministries, regulators, utilities, and financiers to coordinate planning and standards. This body would:

- Define regional grid codes and reliability standards
- Harmonize tariff and wheeling frameworks
- Publish a shared pipeline of interconnection projects to attract investors
- Embed treaty-level commitments

Such an institution would convert ad hoc diplomacy into a durable framework—the modern equivalent of the ENTSO-E model that underpins Europe’s market coupling.

5. Demonstrate and replicate

Once the first Victorian-model corridor reaches its financial close, the MENA region should focus on transparency and replication through several actions:

- Publicly disclose project economics and risk structures
- Share performance data through a dedicated regional body for power interconnections
- Standardize contracts to reduce transaction costs for follow-on projects

A single successful 5 GW export corridor could generate US\$1 billion in annual electricity revenues, create thousands of skilled jobs, and attract new manufacturing in HVDC equipment and green-industrial supply chains. Just as important, establishing this precedent would lower risk premiums for the next generation of projects—in essence, compounding impact every time the model is replicated.

CONCLUSION

The industrial world was built when financial engineering caught up with technical ambition. Today's decarbonization challenge demands the same creativity. Victorian finance built the railways of industry; its reinvention can contribute to building the cables of decarbonization.

By pioneering the modern Victorian financing model, the MENA region can define the global standard for financing, governing, and operating the infrastructure of the cross-border energy transition. The region already holds the ingredients—low-cost renewables, sovereign capital, and strategic geographic location—needed to pioneer it.

Beyond the economic benefits, power exports can anchor a new era of regional cooperation and soft power. Interconnectors replace vulnerability with interdependence by tying national ambitions to shared prosperity. In the process, the MENA region could move from energy supplier of the past to energy integrator of the future, shaping how electrons, not hydrocarbons, power global trade.

The region has the sunlight, the capital, and the conviction. What remains is to connect them.

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