GWEC | GLOBAL WIND REPORT 2026

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Michael Hannibal
Chair of Global Wind Energy Council

Wind delivers secure, affordable power and strategic autonomy

The fundamentals for wind power are indisputable: with **165 GW** of new installations in 2025, wind continues to scale at pace across regions and markets. It is no longer an emerging solution or technology – but rather is a cornerstone of modern energy systems. Wind is delivering affordable, reliable power at scale, supporting millions of jobs globally, and strengthening energy security for economies at every stage of development.

Wind is now being built faster and at lower cost than new fossil generation in most countries, both onshore and offshore. It is already keeping the lights on for more than **937 million households**, and its role is expanding rapidly as electricity demand accelerates. The task ahead is not to prove that wind works, but to continue to convert ambition into projects on the ground – and into resilient, integrated energy systems capable of powering electrified transport, digital infrastructure, industrial production, and the rapidly growing AI ecosystem. System integration capability is becoming just as critical as pure megawatt deployment.

Recent geopolitical developments, including renewed instability in the Middle East, have once again exposed the fragility of global energy supply chains. Against this backdrop, wind and other renewables offer something fundamentally different and critical: strategic autonomy. By relying on domestic, inexhaustible resources, countries can insulate themselves from geopolitical shocks, reduce exposure to volatile fuel prices, and deliver lower, more predictable energy costs for consumers and industry alike.

Over the past year, the global conversation around wind has evolved noticeably. The question is no longer whether wind can underpin secure and affordable power systems – it already does. The focus has shifted to speed, scale and reach. People are asking how quickly we can deploy and scale, how we open new markets, and how we mobilise effective public–private cooperation, joint-industry action and blended finance to scale deployment in mature markets and enable first projects in emerging markets.

The technology is ready. From mature onshore wind to bottom-fixed – and, increasingly, floating – offshore wind, the sector is opening up deeper waters and vast new resource areas. Floating offshore wind is no longer an experiment. It is industrialising and becoming a core pillar of future power systems.

Success, however, brings scrutiny. As wind becomes system- critical infrastructure, it also becomes a target of vested fossil interests and organised disinformation campaigns. This is a measure of progress. Wind is mainstream, system-critical technology, delivering reliable power and creating more jobs per dollar invested than fossil fuels. As an industry, we share a responsibility to respond with facts, with realworld project experience, and with narratives that connect wind energy to everyday lives, communities and economic opportunity.

The pathway forward is well-understood: stable and credible policy frameworks, transparent auction design, timely investment in grids, ports and supply chains, and the smart use of public capital to crowd in private investment at scale. Where these conditions are in place, wind delivers – quickly, efficiently and competitively.

This year's Global Wind Report brings together the evidence, lessons learned and practical solutions that can accelerate progress worldwide, reinforced by GWEC's work programme in 2026. The remaining question is not one of technology or finance, but of ambition: whether we are prepared to match what wind can deliver with the political will and public support this moment demands.

Wind is ready to carry the load

The global energy sector is experiencing one of its most critical transformations in human history. Several credible forecasts have found that energy demand could rise by as much as 50% between 2035 and 2050, and the two major factors driving this transformation are rampant digitisation and climate change. This edition of the Global Wind Report confirms that we are indeed entering the age of electricity. And as the world moves towards integrated energy, wind will undoubtedly be the backbone of modern energy systems.

AI upsurge

Artificial Intelligence has prompted a rise in a new energy-dependent system – data centres. What's interesting is that this energy demand is concentrated in certain pockets of the world, depending on where the data centres are located.

For instance, the United States, Europe, and China are expected to experience a boom in such energy demand because they will have a large chunk of the world's data centres. In Ireland, data centres are already demanding 21% of the nation's total electricity, while India is gearing up to host more global data centres with investments worth billions of dollars already announced by Google and Microsoft.

Based on recent findings, global data centres are likely to consume more energy than Japan, a tech-advanced country, by 2030. This is a massive opportunity and a challenge for humanity. Because while the demand is concentrated, the energy we use to run these data centres will determine how clean the rest of the world is.

Climate and change

The second factor driving up energy demand is the volatile weather conditions caused by climate change.

> This edition of the Global Wind Report confirmed that we are indeed entering the age of electricity.

We are experiencing extreme cold, extreme heat, and extreme monsoons – all of which are changing our lifestyle and habits. Cooling and heating devices have gradually become necessities, now accounting for over 40% of global energy consumption. Moreover, rapid urbanisation in many regions is further adding to the demand.

The solution for both these challenges is, in fact, wind energy, which is enabling corporations and economies to scale while keeping their emissions in check.

Energy security

The ongoing geopolitical conflict is pushing economies tied to fossil fuel volatility to the brink of crises in their factories and households. Wind is decentralised and domestic. It ensures countries don't rely on fossil imports from a handful of geographies. It stabilises the grid by generating power consistently, making clean power more predictable. It aligns with the energy consumption profile of countries with peak demand in the evening, including all of Europe. It is low-cost, which makes it especially important in integrated energy systems, as it reduces the need for expensive storage.

Wind is ready to carry more of the load. We have the technology, the machines, the data, and the skills to scale wind installations now more than ever. While the challenge is evident, so is the solution. As Vice Chairman of GWEC, I remain optimistic about wind energy's prospects for making nations energy-independent and look forward to living in a world transformed by renewables.

Girish Tanti
Vice Chairman, Suzlon Group

SUZLON
POWERING A GREENER TOMORROW

Jorge Pedrón
Head of Global Power Business at Iberdrola

Powering a secure, competitive and electrified future

As the world navigates a period of heightened geopolitical uncertainty, marked by supply-chain tensions, shifting alliances and increasing exposure to global fuel markets, energy security has become a critical priority for all countries. National economies have been shown to be highly vulnerable when dependent on imported fossil fuels, with global price volatility rapidly translating into **domestic instability. By accelerating the deployment of renewable energies**, countries can strengthen their autonomy, reduce exposure to external shocks and build more resilient, self-reliant energy systems that support long-term stability and prosperity.

Electrification is unstoppable. For the first time in 30 years, electricity demand has grown faster than global GDP. This trend is expected to intensify as electricity consumption increases more than twice as fast as total energy demand through 2030. As electricity becomes the engine of modern economies – powering mobility, digital services, buildings and industry – **access to clean and affordable electricity** has emerged as a central policy priority, underpinning industrial competitiveness, resilience, economic growth and national security of supply.

Businesses play a decisive role. Access to competitive clean electricity isa core factor determining where companies invest, innovate and grow. Early adopters of renewables-based electrification can enhance productivity and resilience. Achieving this requires removing barriers to electrification, including **targeted fiscal incentives** that boost industrial competitiveness and accelerate clean-technology adoption.

A world leader in clean energy, Iberdrola has more than 46GW of renewable capacity in operation and a commitment to allocate €17 billion to renewables under its Strategic Plan 2025-2028, with 76% dedicated to wind.

Wind power is already a cornerstone of industrial ecosystems worldwide, driving investment, innovation and longterm value across global supply chains.

Offshore wind is opening new markets and creating global industrial value chains that strengthen countries' ability to lead in clean-tech innovation. Large-scale deployment stimulates activity across ports, steel manufacturing, logistics, digital services, engineering and high-skilled jobs.

As electrification accelerates across industry, transport and buildings, economic resilience will increasingly depend on the ability to access abundant and affordable clean electricity. Wind is indispensable to meet this need at scale, enabling lower and more predictable prices for consumers and businesses while reducing exposure to volatile fossil fuel imports.

Capturing the full value of wind requires an enabling environment built on stable, predictable and long-term regulation. Policymakers must send durable market signals and articulate coherent energy and industrial strategies that provide clarity and confidence to investors. Crucially, countries must **de-risk investments for developers**, reducing exposure to regulatory uncertainty and market volatility.

Speeding up and scaling **investment in electricity grids** is essential to connect industry, enable electrification and support renewable energy deployment at the required pace. This requires attractive regulatory and grid-financing frameworks, including faster permitting, predictable and fair grid connection costs, and improvements in finance and investment conditions.

Promotion of long-term electricity offtake contracts (PPAs), especially for industrial customers, is also crucial. Public risk-reduction instruments can help improve bankability, reduce exposure to market volatility and stimulate investment in clean energy projects. By expanding access to stable, long-term electricity contracts, countries can enhance price stability, support renewable energy deployment and strengthen industrial competitiveness.

Countries worldwide now face a defining opportunity to make wind energy one of the pillars of a secure, competitive and electrified global economy. By accelerating deployment, ensuring stable regulation, de-risking investments through robust auction design, supporting electrification with fiscal measures and strengthening grids and long-term offtake frameworks, nations can place wind at the heart of their industrial strategies – and secure a safer, more resilient and more prosperous future for all.

EXECUTIVE SUMMARY

The Data and the Story: Wind in 2025

Ben Backwell
CEO, Global Wind Energy Council

The global wind industry entered 2026 with confidence, as a foundational pillar of the emerging Electrotech era. In 2025, the sector delivered another record year, installing 165 GW of new capacity worldwide. Wind power is increasingly a pivotal technology of the modern electricity system, the only clean energy source with proven scale, reliability and geographic versatility to anchor grids, meeting surging industrial demand and delivering energy security simultaneously. It is already doing so across economies where power demand is rising, digitalisation is accelerating and industrial competitiveness demands clean, reliable and secure energy.

This report is published at a moment of profound geopolitical fracture and sustained volatility in global energy systems. The escalating conflict in the Middle East, including the closure of the Strait of Hormuz, have once again exposed the fragility of fossil fuel-dependent economies – triggering supply disruptions, price shocks and cascading economic consequences across regions. This is not an anomaly but a recurring feature of the global energy system, seen from the oil crises of the 1970s to today: reliance on concentrated, trade-dependent fossil fuels is a structural vulnerability.

The story of wind in 2025 is about more than record installations: It reflects the continued maturation of a technology that delivers long-term value across the real economy, strengthening energy security, enhancing system reliability and underpinning industrial growth in both established and emerging markets. This progress has taken place against a challenging backdrop of volatile fossil fuel prices, commodity pressures and rapidly rising electricity demand driven by digital infrastructure and new manufacturing.

This year's Global Wind Report explores how wind is gaining ground globally, outlines the conditions required to sustain momentum and – in the Markets to Watch section – highlights the success stories of markets where implementation and delivery are beginning to match ambition.

Many of the most compelling stories are emerging from Asia. China installed nearly 120 GW in 2025, almost matching the entire world's 2024 total wind additions, while India reclaimed its position as the world's third-largest wind market with a record 6.34 GW of new onshore capacity, an 85% increase from the previous year. In South Korea, Vietnam and the Philippines, decisive regulatory reforms are translating political will into investible pipelines, with each market demonstrating that the intention to achieve right policy architecture can rapidly shift the conditions for deployment. Meanwhile, the Middle East and Central Asia are becoming substantial wind energy markets driven by giant-scale projects and highly competitive prices.

Energy security is being redefined. It is no longer measured by access and affordability alone, but by resilience, diversification and sovereign control over supply. In this context, the energy transition has become a strategic imperative as much as a climate one. At scale, domestic wind power delivers across all of the four "A"s that frame energy security: availability, accessibility, affordability and acceptability. By reducing reliance on imported fuels, wind power stabilises long-term electricity costs and offers a politically and socially acceptable pathway toward cleaner energy systems. Countries that recognise this are not only accelerating decarbonisation – they are positioning themselves more competitively in an increasingly volatile global landscape.

Wind installations in 2025 pushed cumulative global capacity past 1,299 GW, as wind cemented its role as a **cornerstone energy source** of the world's major economies and growth markets. China's record installations brought its cumulative total to over 640 GW, a testament to wind's position at the heart of the largest power system globally. India's record additions reinforce wind's centrality to the world's fastest-growing economy.[1,2] In Europe, Germany added 5.7 GW (onshore and offshore), while Brazil contributed 2.3 GW, underscoring that wind remains the workhorse of the energy transition in the largest economies of every region.

Beyond the established powerhouses, some of the fastest year-on-year growth came from newer markets that successfully demonstrated wind's

expanding strategic appeal. Saudi Arabia more than quadrupled its annual installations to 1.5 GW – crossing the 2 GW cumulative threshold and signalling that the MENA region is no longer on the periphery of global wind development – while Egypt also maintained momentum and surpassed 3 GW cumulative. Türkiye added 2.1 GW, consolidating its position as one of the most active onshore markets in the region with nearly 16 GW cumulative capacity. Sweden and Romania posted some of the sharpest year-on-year growth rates in Europe, while Chile tripled its annual additions to over 1.1 GW. Critically, GWEC projects that the Asia-Pacific region excluding China will consolidate as the third-largest offshore wind growth market globally through 2030.

The broader picture reflects an important structural shift: Wind is no longer the preserve of a small group of mature economies but increasingly recognised by governments across every continent as a strategic asset for energy security, industrial development and long-term economic prosperity.

The global wind industry remains committed to the pace of growth required to deliver the UAE Consensus goal set at COP28, which aims to triple global renewable energy capacity by 2030. This year's Global Wind Report shows a steepening curve towards a 1.5 °C-aligned trajectory for wind, but significant further acceleration needs to take place to get us close to the objective.

At the same time, a broader reality is becoming clear: The energy transition is shaping the next phase of global economic competition. Governments increasingly recognise that the infrastructure and industries built today will define their competitiveness and autonomy tomorrow – and wind energy is at the centre of that transformation.

Wind power is an **engine of growth.** Onshore wind spreads investment across rural and regional communities through land leases, construction activity and long-term operations and maintenance. Offshore wind drives major infrastructure upgrades, from port modernisation to high-voltage transmission and specialised vessels, while **floating offshore** wind will open new deep-water markets and expand industrial opportunities and innovation even further.

As deployment grows, wind is playing an ever more central role in **transforming power systems**.[3,4,5] Expanded transmission networks, smarter grid operations and flexible resources such as storage, demand response and hybrid renewable projects are becoming essential to integrate larger volumes of variable renewable energy generation.[6,7] Integrated and co-located wind-solar-storage projects are already demonstrating how complementary generation profiles can stabilise output and improve system performance, while regional interconnections are turning national wind resources into shared energy assets and joint achievements.[8]

The wind industry has also embraced the use of **advanced technology and innovation** in the Electrotech era. Artificial intelligence (AI) and advanced data analytics are now embedded in the value chain, from resource assessment to power market optimisation, allowing turbines and fleets to operate more efficiently and reliably. Meanwhile, advances in manufacturing, materials and turbine technology continue to improve performance and sustainability across the industry.

With growth and rapid acceleration comes greater scrutiny, to which the sector is responding by working towards shared standards across its supply chains. Frameworks such as GWEC's **Wind Sustainability Initiative** aim to establish ESG and traceability standards that reinforce the industry's commitment to responsible growth and a just energy transition.

The **narrative around wind and public trust** is increasingly contested. The current US administration – backed by incumbent fossil fuel interests, has played an active role in promoting false narratives around wind energy, despite the continued success of wind technology in its domestic market. They have attempted – largely unsuccessfully – to pressure governments and institutions to reduce their commitments and support for wind and other renewables. Meanwhile, organised disinformation campaigns are seeking to cast doubt on the reliability, costs and wider system benefits of renewables. As the production and distribution of false narratives, data and images becomes cheaper and more sophisticated, the need for proactive, evidence-based communication has never been

1,2. News on Air, OECD Report: India Remains World's Fastest-Growing Major Economy, 27 March 2026, https://www.newsonair.gov.in/oecd-report-india-remains-worlds-fastest-growing-major-economy/
3. Ørsted, Ørsted achieves first power at Greater Changhua 2b and 4, Ørsted, July 23, 2025, https://orsted.tw/en/news/2025/07/chw2204_firstpower
4. Vattenfall Group, Our energy sources: wind power, Vattenfall, Accessed: April 8 2026, https://group.vattenfall.com/our-operations/our-energy-sources/wind-power/
5. Enbw Press, EnBW to supply green offshore wind power to Google in Germany, Enbw, Feb 5 2026, https://www.enbw.com/press/enbw-ppa-offshore-wind-power-google.html
6. IEA, Electricity 2026: Global electricity demand set to grow strongly to 2030, IEA, Feb 6, 2026, https://www.iea.org/news/global-electricity-demand-is-set-to-grow-strongly-to-2030-underscoring-need-for-investments-in-grids-and-flexibility
7. IRENA, Renewable Power Generation Costs in 2024, IRENA, Accessed: April 8 2026, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2025/Jul/IRENA_TEC_RPGC_in_2024_Summary_2025.pdf
8. IEA, Breakthrough Agenda Report 2025: Power, IEA, Accessed: April 8 2026, https://www.iea.org/reports/breakthrough-agenda-report-2025/power

greater. The most successful wind markets in 2025 were those that did not use these pressures as excuses to slow down, but instead combined ambition with action. They created tailored, market-specific winning formulae for wind: stable policy frameworks, efficient permitting, coordinated grid and wider infrastructure planning.

At the same time, **protectionist trade measures** globally threaten to fragment supply chains, through their impact on both commodities like steel and on wind components specifically. As supply chains become increasingly politicised and securitised, regional cooperation is playing a growing and critical role. However, while trade between some countries has declined sharply, the global volume of trade has remained steady, with changes in trade patterns driving sharp increases in bilateral trade among diverse sets of countries. Meanwhile, while US-led tariff wars dominated the headlines, regions and countries are signing new free trade deals, including EU-Mercosur and EU-India. Cross-border initiatives are helping align project pipelines with supply chain and infrastructure development – demonstrating that coordinated industrial and trade policy, pursued with like-minded partners, offers the most credible path to supply chain resilience in a disrupted world.

Despite the headwinds, the wind industry can look forward to a bright future, driven by strong and improving economics.[9] No amount of trash-talking and disinformation can undermine this fundamental truth. The war in the Middle East is further eroding the economics of fossil fuels for the vast majority of the world – almost 80% of the world's countries are net fossil fuels importers, while even exporters are exposed to rising consumer prices – and is driving a rapid uptick in adoption of electro-tech such as EVs and demand for clean energy.

More importantly, this latest oil and gas shock has once again delivered an object lesson to governments: They simply cannot allow their economies and populations to be exposed to volatile and unreliable fossil fuels. As GWEC and its sister organisation the Global Renewables Alliance have argued in countless media stories and campaigns, the world is realising that ''Energy Security = Renewables.''

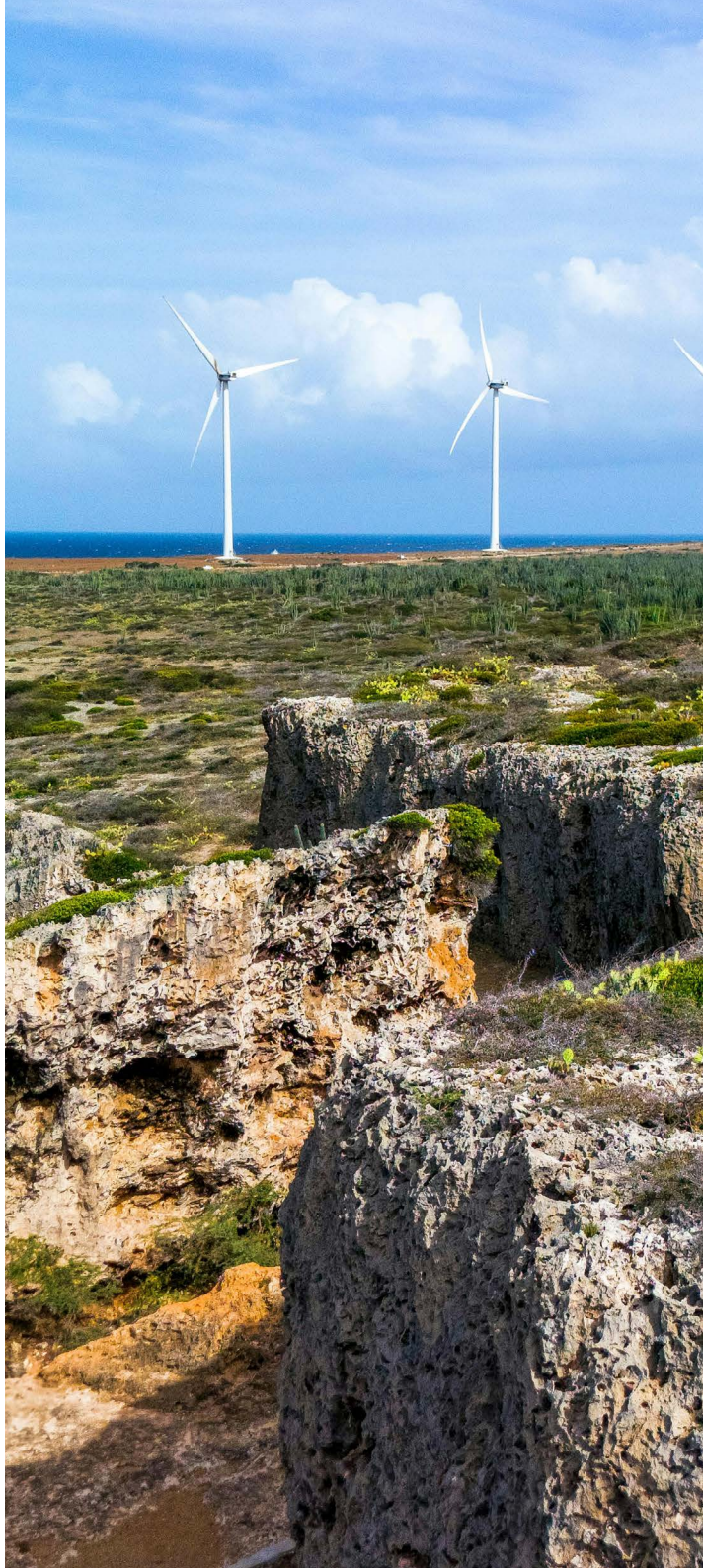
The wind industry and renewables are in a much stronger position to respond to the current uncertainty compared to previous crises. Starting from a much higher installation base, renewables are already shielding countries and consumers from the damage to affordability and availability being wreaked by the crisis, allowing those countries with high amounts of renewables in their system to maintain lower wholesale prices, and providing the power for electrification solutions for industry, transport and heat.

This report reflects these perspectives. Wind power is no longer simply an environmental solution; it is a strategic infrastructure asset delivering economic, industrial and energy security benefits. There has never been a more important moment to sustain this momentum, unlocking wind's full potential as a driver of power system transformation and of an energy paradigm shift.

In the age of electricity, wind is becoming one of the central pillars of the global energy system. The markets that have recognised this are already forging ahead, attracting investment, strengthening supply chains and delivering secure, affordable power to their citizens. The challenge is to extend that momentum globally by accelerating the deployment of wind power worldwide.

This was the mission of GWEC when it was created just over 20 years ago. That mission is even more important today.

9. Bloomberg NEF, BloombergNEF Finds Global Energy Transition Investment Reached Record $2.3 Trillion in 2025, Up 8% from 2024, Bloomberg NEF, Jan 26 2026, https://about.bnef.com/insights/clean-energy/bloombergnef-finds-global-energy-transition-investment-reached-record-2-3-trillion-in-2025-up-8-from-2024/



INTRODUCTION: WINNING WITH WIND IN THE ELECTROTECH ERA

Introduction

The renewables revolution has moved from ambition to execution, as the world economy looks to a likely 40% increase in 2035[10]. This is producing an explosion in clean power adoption, rapid digitalisation and industrial booms in new and existing markets.

Global promises such as the UAE Consensus abound on the need to ramp up renewables and squeeze out more efficiency – all crucial to staying as close as possible to a 1.5°C temperature rise. The period between 2026 and 2030 demands delivery: wind power is already doing so confidently at an unprecedented pace – with unmatched scale, cost leadership and system-level benefits. Most importantly, wind is an indigenous resource, giving markets a credible path towards energy security and long-term resilience.

In this Electrotech era, power systems are strategic assets, as electricity underpins vehicle fleets, data centres, advanced manufacturing and the production of critical minerals. The strength and flexibility of the power system have come to directly shape national competitiveness. Grids have become instruments of economic policy, determining the destinations for capital and industry, and which markets secure supply chains and technological leadership.

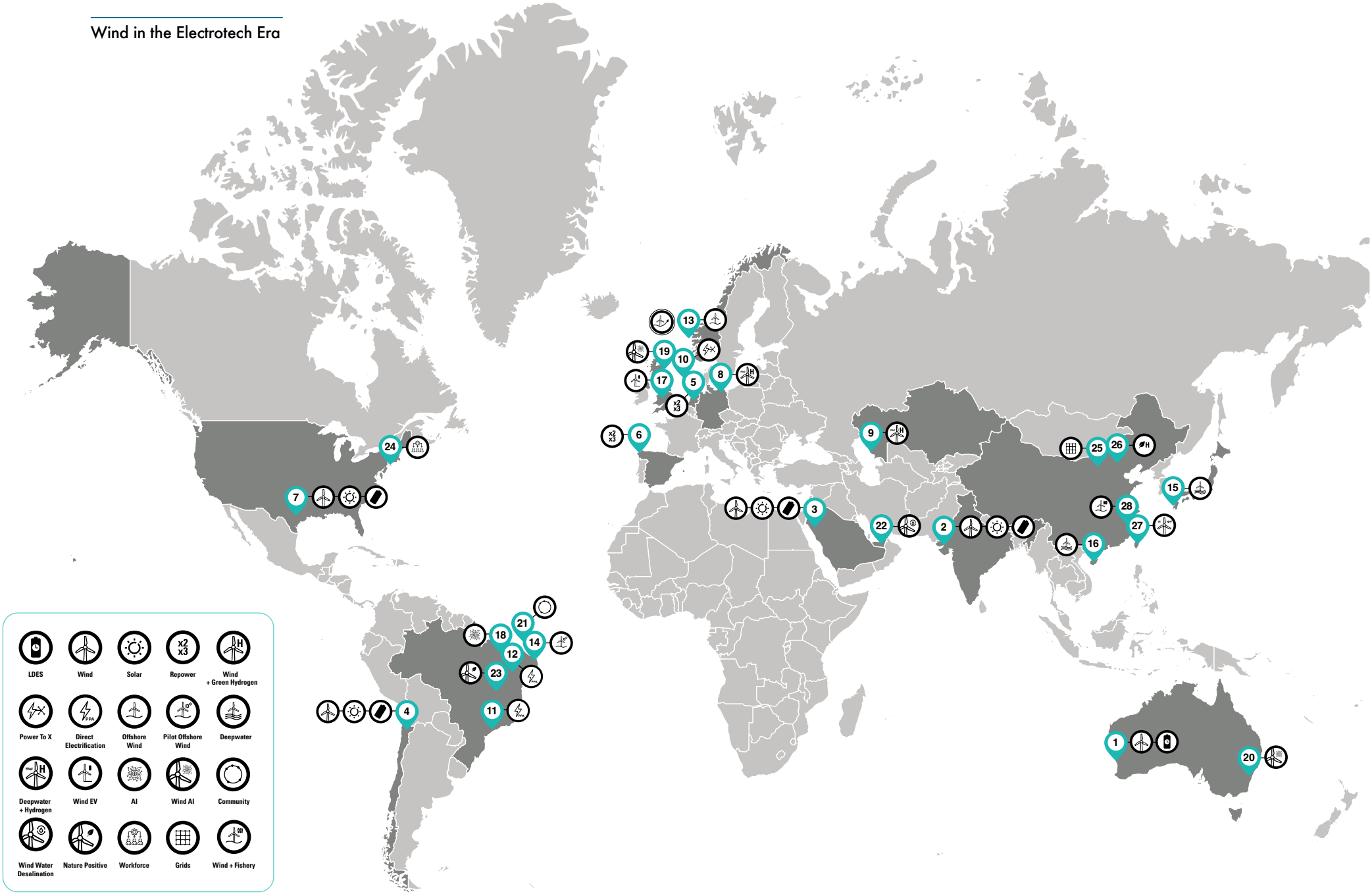
Wind delivers system-wide value, whether a country prioritises economic growth, industrial competitiveness, energy security, community revitalisation – or more practical concerns such as system balancing to complement rapid solar build-out. It is scalable, domestic and proven, anchoring resilient grids while generating whole-of-economy dividends that extend far beyond the power sector. Now is the time for policymakers, industry and partners across business and civil society to lean decisively into wind power as the reliable workhorse of the age of electrification.

From new supply chain considerations driven by changing global trade dynamics[11] to disinformation and residual macroeconomic headwinds, the challenges are real and must be acknowledged. But they are risks that can be anticipated, allocated and managed through open and transparent dialogue. The countries that treat wind as a strategic, long-term pillar of their energy system are already pulling ahead, shifting the role of wind farms from standalone assets to fully integrated power ecosystems.

Across continents, wind is anchoring AI infrastructure through dedicated power purchase agreements (PPAs), delivering renewable power to electric vehicles and heat pumps, directly electrifying industrial loads, enabling power-to-X fuels, giving back to the community, and using technology to improve forecasting, dispatch and grid integration. Where a whole-system approach is taken, progress accelerates. In that system, wind is not a supporting technology – it is a foundational infrastructure for competitive, secure and future-ready economies.

This report sets out to demonstrate that wind is not a future bet; it is already winning in the age of electricity. Across emerging and high-growth markets, wind is accelerating through techno-industrial transformation, while energy policy is developed in parallel with industrial policy to strengthen national competitiveness. The sections that follow show what works in practice and highlight a clear formula for governments and industry to continue to win with wind during this pivotal decade of delivery.

10. IEA, World Energy Outlook Stated Policies Scenario, IEA, https://www.iea.org/reports/world-energy-outlook-2025/stated-policies-scenario
11. Such measures include but are not limited to the implementation of the EU Carbon Border Adjustment Mechanisms, export controls on critical minerals, the US trade tariffs and intensification anti-dumping measures in Brazil.


LDES
Wind
Solar
Repower
Wind + Green Hydrogen
Power To X
Direct Electrification
Offshore Wind
Pilot Offshore Wind
Deepwater
Deepwater + Hydrogen
Wind EV
AI
Wind AI
Community
Wind Water Desalination
Nature Positive
Workforce
Grids
Wind + Fishery

Wind + long-duration energy storage

1. **Dinner Hill Wind Farm + Harvest Battery Energy Storage System (BESS) (OX2)**
   Stage: Development (COD 2032)
   Country: Australia
   Description: wind + battery storage

Hybrid wind–solar–storage

2. **Bachau, Gujarat (ArcelorMittal)**
   Stage: Development (COD 2028)
   Country: India
   Description: wind + solar + battery storage

3. **NEOM (NGHC)**
   Stage: Construction (COD 2027)
   Country: Saudi Arabia
   Description: wind + solar + hydrogen/ ammonia

4. **Las Salinas (PV) + Sierra Gorda Este (wind) (Enel Green Power)**
   Stage: Construction (COD XXXX)
   Country: Chile
   Description: wind + solar + battery storage

Repowering projects that double or triple output

5. **Windplan Groen**
   Stage: Operation
   Country: Netherlands
   Description: repowered wind farm, from 168 to 500MW

6. **Malpica (Statkfraft)**
   Stage: Operation
   Country: Spain
   Description: went from 69 turbines to 7, doubling the electricity output to 65.9 GWh/year

7. **Forest Creek (RWE)**
   Stage: Operation
   Country: USA
   Description: Extend wind farm's life more 30 years

Wind-powered green hydrogen hubs (onshore + offshore)

8. **HyTech HafenRostock (RWE)**
   Stage: Construction (COD 2028)
   Country: Germany
   Description: wind (onshore + offshore) + solar + green hydrogen

9. **Hyrasia One (SVEVIND)**
   Stage: Construction (COD 2030)
   Country: Kazakhstan
   Description: wind + solar + green hydrogen

Power-to-X projects: e-fuels, green ammonia, green methanol for shipping and aviation

10. **eFuels Rotterdam (Power2X)**
    Stage: Development (COD 2030)
    Country: Netherlands
    Description: production of (eSAF) and other low-carbon fuels

Direct electrification of industrial loads (steel, cement, chemicals) backed by dedicated wind PPAs

11. **Complexo Eólico Babilônia Centro (Casa dos Ventos)**
    Stage: Operation
    Country: Brazil
    Description: Wind power to produce steel

12. **Ventos de Sao Zacarias (Macquarie)**
    Stage: Operation
    Country: Brazil
    Description: Wind power to produce low-carbon aluminium

Offshore wind powering offshore assets (platform electrification, ports, desalination)

13. **Hywind Tampen (Equinor)**
    Stage: Operation
    Country: Norway
    Description: Offshore wind to power offshore oil and gas installations

Pilot offshore wind farms in new markets

14. **Sítio de Testes (SENAI-RN)**
    Stage: Development
    Country: Brazil
    Description: Pilot offshore wind project

Floating offshore wind demonstrators unlocking deep-water regions

15. **GOTO (Consortium)**
    Stage: Operation
    Country: Japan
    Description: Japan's first commercial floating offshore wind farm

16. **Hainan Wanning (Power China)**
    Stage: Construction (COD 2026)
    Country: China
    Description: China floating offshore wind farm

Hybrid offshore wind + interconnectors enabling cross-border power trade

Wind-powered EV charging corridors and heavy-duty transport hubs

17. **Checkley Wood (AWGroup)**
    Stage: Operation
    Country: England
    Description: wind farm + EV charging station

Data centres and AI infrastructure anchored by wind-based 24/7 clean energy contracts

18. **Dom Inocencio (Casa dos Ventos)**
    Stage: Development (COD 2027)
    Country: Brazil
    Description: PPA focused on data centers

AI-optimised wind farms improving forecasting, dispatch, and grid integration

19. **Aberdeen Bay (Vatenfall)**
    Stage: Operation
    Country: Netherlands
    Description: AI to avoid bird collision on wind turbines

20. **Nullagine Wind Project (Fortescue)**
    Stage: Construction (COD 2027)
    Country: Australia
    Description: first project to have self-erecting tower system using AI, delivering a hub height of 188 metres

Community-owned or shared-benefit wind projects

21. **Serra Branca (Voltalia)**
    Stage: Operation
    Country: Brazil
    Description: Contractual model for an equitable allocation of benefits and financial compensation for the entire community where the project is based

Wind powering water: desalination and wastewater treatment

22. **RENEWABLE ENERGY SEAWATER DESALINATION PROGRAMME (Masdar)**
    Stage: Operation
    Country: UAE
    Description: Pilot project to use renewable energy to desalinize seawater

Nature-positive wind projects integrating biodiversity and ecosystem restoration

23. **Serra do Assuruá (Engie)**
    Stage: Operation
    Country: Brazil
    Description: investing in the restoration of natural springs in the community where the project is

Workforce transition hubs linking wind manufacturing, ports, and skills development

24. **Attentive Energy (Corio and TotalEnergies)**
    Stage: Development
    Country: USA
    Description: turn the gas-fueled power plant into a clean energy hub in NYC

First Integrated Generation-Grid-Load-Storage Project with Direct Green Electricity Connection for Data Centers in China

25. **Ulaanqab Low-Carbon Data center (CICC)**
    Stage: Operation
    Country: China
    Description: wind (200 MW) + solar (100 MW) + battery storage (45 MW / 180 MWh) integrated with dedicated data center load

Green Hydrogen & Ammonia Project

26. **Chifeng 1.52 Mt Green Hydrogen & Ammonia Project (Envision)**
    Stage: Phase I in Operation (Commissioned July 2025)
    Country: China
    Description: World's largest green hydrogen–to–ammonia project (1.52 Mt total capacity). The first 320,000 t phase converts renewable power into green hydrogen and ammonia using Envision's integrated wind, storage, AI-enabled grid, electrolysis and ammonia synthesis technologies, marking the start of commercial-scale green ammonia production. he facility operates off-grid using a combined wind and solar generation capacity of about 1.43 GW paired with energy storage to supply electricity for green hydrogen and ammonia production. 850 MW wind

Wind-to-Hydrogen-to-Ammonia Integrated Demonstration Project

27. **Da'an Wind-to-Hydrogen-to-Ammonia Integrated Demonstration Project – North Zone 300 MW Wind Farm**
    Stage: Operation
    Country: China
    Description: A dedicated 300 MW wind farm supplying electricity directly to the Da'an green hydrogen and ammonia chemical complex without grid export. The project adopts a fully integrated "green electricity green hydrogen green ammonia" model .

Fixed-bottom offshore wind–fishery integration

28. **Mingyu No.1**
    Project Type: Fixed-bottom offshore wind–fishery integration
    Stage: Operation
    Country: China
    Description: The world's first intelligent offshore wind–aquaculture integrated unit combining a 12 MW wind turbine with a jacket foundation structurally integrated with fishery. Designed for dual-use marine space, it produces over 45 GWh of electricity annually while supporting fish farming (e.g., grouper and golden pompano) with an annual aquaculture output of around 75 tonnes.

Note: The list of projects mentioned are non-exhaustive.

Political economy of the Electrostate

How can countries leverage wind power to take advantage of techno-industrial shifts?

The world is undergoing a 'hegemonic transition' where geopolitical power centres are shifting and giving rise to a fragmented, multipolar world of emerging and competing blocs.[12] This dynamic competition is converging with two major global energy trends.

First, the energy system is undergoing rapid electrification, digitalisation and decentralisation. Second, the global power mix is shifting towards the dominance of renewables, which already out-compete new coal and gas plants on production cost in nearly every market worldwide.

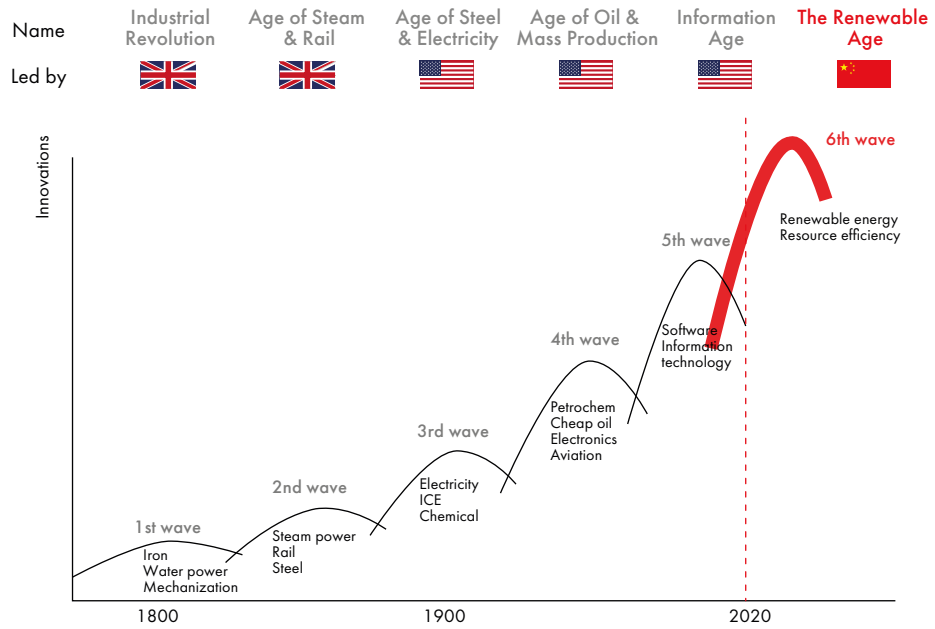
A multi-speed transition is unfolding across different regions, against a backdrop of growing insecurity in the international context. This is a historical pattern: the successful adoption and utilisation of techno-industrial complexes as a result of energy innovations have reshaped global power structures, as they allow countries to redefine the material conditions and the rules of global governance.

In the current Electrotech era, analysts have pegged China as the first 'Electrostate' with a fully functional techno-industrial system based on renewable energy.[14] This system is the result of decades-long industrial policies to build an economic model based on the refining of critical minerals, renewable energy supply chains, electrification, industrial transformation and grid modernisation. The recent 15th Five-Year Plan recommends making China a "strong energy nation" with global competitive advantages driven by the integration of renewable energy and industrial innovation.[15] China already possesses huge capacity to supply affordable clean energy for its own economy and outbound foreign direct investment (FDI) capacity in global renewable value chains, constituting strategic leverage on the world stage.[16]

Though ahead in terms of production capacity, China is by no means the only aspiring Electrostate in the global economy. Beijing's lead is already followed by other centres of global power, particularly Brussels (EU) and Delhi (India). Several developing economies are adopting the Electrostate model, given the significant strategic advantages offered by electricity systems that leverage affordable, domestic renewable energy.

For instance, Brazil is primed to take advantage of its position as Latin America's largest economy with a power mix made up of nearly 90%

A view of past and present technology revolutions



Source: Carlota Perez (first five), RMI (renewable age). Note: This is a third-party graphic used to illustrate technology leaps. GWEC acknowledges that the advancements and innovations that led to the age of renewables have been driven by many different countries across the last few decades.

12. Andrew Walter, US-Western European Economic Relations, 1940-1973, London School of Economics, https://personal.lse.ac.uk/WYATTWAL/images/THEUS.pdf
13. BloombergNEF, Global Cost of Renewables to Continue Falling in 2025 as China Extends Manufacturing Lead, BloombergNEF, February 6, 2025, https://about.bnef.com/insights/clean-energy/global-cost-of-renewables-to-continue-falling-in-2025-as-china-extends-manufacturing-lead-bloombergnef/
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15. Christoph Nedopil Wang, China's 15th Five-Year Plan 2026-2030 – A Comprehensive Analysis for China's Green Transition in Climate Emissions, Energy, Industry, Metals, and Finance, Green Finance & Development Center, March 24, 2026, https://greenfdc.org/chinas-15th-five-year-plan-2026-2030-a-comprehensive-analysis-for-chinas-green-transition-in-climate-emissions-energy-industry-metals-and-finance/
16. Giulia Interesse, Mapping China's Outbound Investment (ODI) Shifts: Sources, Destinations, and Sectors, China Briefing, September 16, 2025, https://www.china-briefing.com/news/mapping-chinas-outbound-investment-odi-shifts-sources-destinations-and-sectors/

renewable energy sources.[17] Its Ecological Transformation Plan (2023) aims to foster 'neo-industrialisation' of strategic sectors like green hydrogen and green steel, to ensure Brazil's technological and economic development aligns with its abundant renewable resources and climate resilience. Wind, already the second-largest electricity source after hydropower, will play a significant role in this transformation. The government now aims to leverage its significant offshore wind potential, anchored by the Legal Framework for Offshore Wind Farms that went into force in January 2025.[18]

A similar rationale underpins wind power deployment in Kenya, where President William Ruto has pledged to position the country as Africa's climate leader, targeting 100% renewable electricity generation by 2030.[19] The country's leadership in wind, solar and geothermal energy is intended to serve as the foundation of its power projection strategy in sub-Saharan Africa, positioning Kenya as a regional hub for future-oriented, value-added clean technology industries. This is reinforced by several policy initiatives, including the Nairobi Declaration,[20] the Accelerated Partnership for Renewables in Africa (APRA),[21] and the African Green Industrialisation Initiative Forum (AGII).[22] Collectively, these measures signal a deliberate strategy to align renewables ambition with development policy and regional economic influence.

Notably, while global rules are evolving, these examples show that strategic cooperation, trade partnership and a rules-based order remain essential to leveraging an electrification strategy for regional or international leadership.

The aims of energy policymakers in aspiring Electrostates vary from country to country, but generally centre on boosting domestic economic development and strengthening energy security. In this context, wind power is a fundamental engine of the political economy in the age of electricity.

The strategic advantages offered by wind power development

- Wind power constitutes a national power asset that, once installed and operational, reduces a country's vulnerability to external trade and commodity shocks.
- New offshore and onshore wind plants increasingly outperform fossil fuel plants on affordability,[23] near-term growth potential,[24] and accessibility. For instance, the global average LCOE of onshore wind in 2024 was 53% lower than fossil fuel-based generation.[25]
- Wind power contributes to industrialisation and local economic development, particularly in sectors critical to economic security, including steel production and processing, electrical equipment, and the development of strategic port infrastructure and capacities in coastal regions.[26]
- Modern wind turbines provide frequency control, inertia, voltage support and other ancillary services, helping stabilise systems with high shares of variable renewables.[27]
- Wind resources often complement solar and demand patterns, reducing variability, smoothing output across regions, and lowering the need for costly balancing resources.[28]
- Innovation in the fields of electrification and storage is already seeing wind-generated electricity penetrate the market niches of fossil fuel incumbents, from heavy manufacturing to international transport. For example, China's Ministry of Industry and Information Technology, Ministry of Finance and National Development and Reform Commission jointly launched a pilot programme for the comprehensive application of hydrogen energy harnessed from wind and solar, expanding its use beyond fuel cell vehicles into industry and transportation more broadly.[29]
- Wind power provides strategic advantages in the field of physical security, especially in conflict zones where large, centralised assets are easier to destroy, while distributed renewables, such as wind farms, have proven to be more resilient.[30]

17. International Energy Agency, Brazil – Renewables, International Energy Agency, 2025, https://www.iea.org/countries/brazil/renewables
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21. Accelerated Partnership for Renewables in Africa (APRA), Accelerated Partnership for Renewables in Africa (APRA), April 2, 2026, https://www.aprafrica.org/
22. Africa50, Africa Launches Landmark Green Industrialisation Framework With $100 Billion In New Commitments, Africa50, September 8, 2025, https://www.africa50.com/media/news/article/africa-launches-landmark-green-industrialisation-framework-with-100-billion-in-new-commitments/
23. International Energy Agency, World Energy Outlook 2025, International Energy Agency, 12 November 2025, https://iea.blob.core.windows.net/assets/9753df19-0a71-422a-b725-012c555763b3/WorldEnergyOutlook2025.pdf
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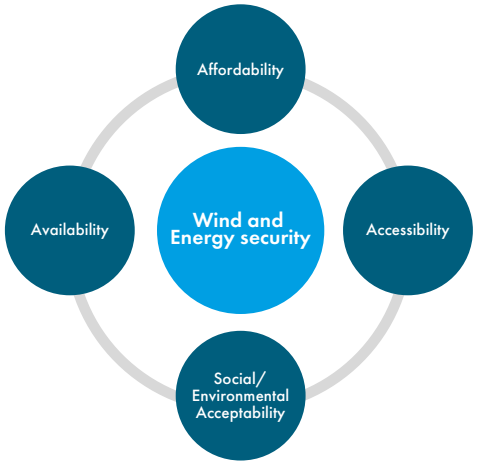
28. Prangon Chowdhury, Nahid-Ur-Rahman Chowdhury & Omar Farrok, Complementarity in Renewable Energy Sources: Insights from Scientometric Analysis, Energy Conversion and Management: X, Volume 26, 2025, Article 100930, https://doi.org/10.1016/j.ecmx.2025.100930
29. Global Times, China launches comprehensive hydrogen pilot program to boost green transition, Global Times, 16 March 2026, https://www.globaltimes.cn/page/202603/1357050.shtml
30. Chris Aylett, Armida van Rij & Michael Bradshaw, Why Renewables and Electrification Hold the Keys to EU Energy Security: The Security Case for Renewables and Electrification, Chatham House (Research Paper), 27 January 2026, https://www.chathamhouse.org/2026/01/why-renewables-and-electrification-hold-keys-eu-energy-security/02-security-case-renewables

The Four As of Energy Security



Source: Asia Pacific Energy Research Centre

Wind at the rising nexus of energy security

From the Philippines to Germany to South Africa, energy security has become a core tenet of national energy planning and economic resilience. Beginning with COVID-era disruptions to energy value chains in 2020 to Russia's invasion of Ukraine in 2022, and now extending to the US/Israel attacks on Iran in 2026, the past five years have demonstrated the need for countries to mitigate the risks of oil- and gas-related price and supply shocks.

Around three-quarters of the world's population live in countries that are net importers of fossil fuels, exposing them to volatile prices and disruptions in supply.[31] Recent events, including attacks on energy facilities in Ukraine and Iran, the US seizure of oil tankers linked to Venezuela, and the disruption affecting the Strait of Hormuz, have made the pursuit of energy security more acute.

Taken together, geopolitical conflict, the weaponisation of energy resources and value chains, economic instability and growing social action on climate change have expanded the pillars of energy security beyond affordability and availability to encompass accessibility and social/environmental acceptability. These are known as the Four As of energy security.

If policymakers' strategic choices are viewed through this lens, it is resoundingly clear that wind power is a solution to the evolving risks and modern threats to energy security. It can reinforce national security by replacing the expense, overexposure and geopolitical vulnerability of imported fossil fuels. For instance, Ember analysis finds that meeting the EU's 45% renewable energy target by 2030 would save EUR 43 billion annually from 2030 by gas imports.[32,33]

Around 80% of the 2,500 GW of non-hydro renewable power capacity installed globally over the last 15 years have been in countries which are dependent on imported fossil fuels. This significant increase of onshore wind, offshore wind and solar capacity has effectively reduced countries' coal imports by 700 million tonnes and natural gas by 400 billion cubic metres, resulting in estimated savings of USD 1.3 trillion since 2010.[34]

The enduring affordability and cost-competitiveness offered by large-scale wind power farms can help countries to power their economies, from single households to complex industrial processes, at relatively low cost. Onshore wind now offers the lowest global average LCOE of any renewable energy technology, with a 70% decrease in cost between 2010 to 2024; offshore wind LCOE has similarly been driven down 62% over this period, due to technology innovations and economies of scale.[35]

Once infrastructure like power transmission and distribution systems have been built, countries can tap into their wind resource for a near-zero marginal cost. This is especially advantageous for countries with energy-intensive sectors like steel and chemicals, which may need affordable renewable electricity to compete in an increasingly decarbonised global economy.

As an indigenous, reliable and limitless natural resource, wind energy also enhances a country's energy security. Advances in short-duration and long-duration energy storage technology are enhancing the accessibility factor of wind energy. The growing focus on round-the-clock renewable electricity – from governments like India, staging tenders for hybrid solar-wind-battery projects, to large corporate consumers seeking to meet their carbon-free power commitments – reflects the reality of wind power and flexibility already working hand-in-hand to reduce countries' dependence on fossil generation.

Together, these factors are positioning wind at the centre of modern-day energy security, ensuring that countries can rely on affordable, accessible, acceptable and available clean electricity to power their economies.

31. UN, Seizing the Moment of Opportunity: Supercharging the New Energy Era of Renewables, Efficiency and Electrification, United Nations, 2025, https://www.un.org/sites/un2.un.org/files/un-energy-transition-report_2025.pdf
32, 33. Ember, Small Step Up for Renewables, Giant Fall for Gas, Ember, 7 December 2022, https://ember-energy.org/latest-insights/small-step-up-for-renewables-giant-fall-for-gas
34. IEA, Renewables 2025, IEA, 7 October 2025, https://www.iea.org/reports/renewables-2025
35. IRENA, Renewable Power Generation Costs in 2024, IRENA, July 2025, https://www.irena.org/Publications/2025/Jun/Renewable-Power-Generation-Costs-in-2024

Where are we on the net zero trajectory?

Wind energy is one of the backbone technologies for the energy transition. The IEA's latest World Energy Outlook (2025) sees wind providing nearly one-third of global electricity generation by 2050 in a net zero emissions by 2050 scenario, with more than 8,000 GW installed worldwide. IRENA foresees a need for wind capacity additions of around 320 GW per year by 2030 to meet the UAE Consensus target to triple renewable energy capacity and keep the world on track to meet Paris Agreement goals.[36]

As GWEC Market Intelligence shows that 165 GW was installed in 2025, a rapid doubling of annual capacity growth is needed to meet the UAE Consensus renewables goal. Under all the scenarios that stay close to the 1.5°C global warming target, wind energy volumes need to undergo a dramatic and global expansion in the next few years.

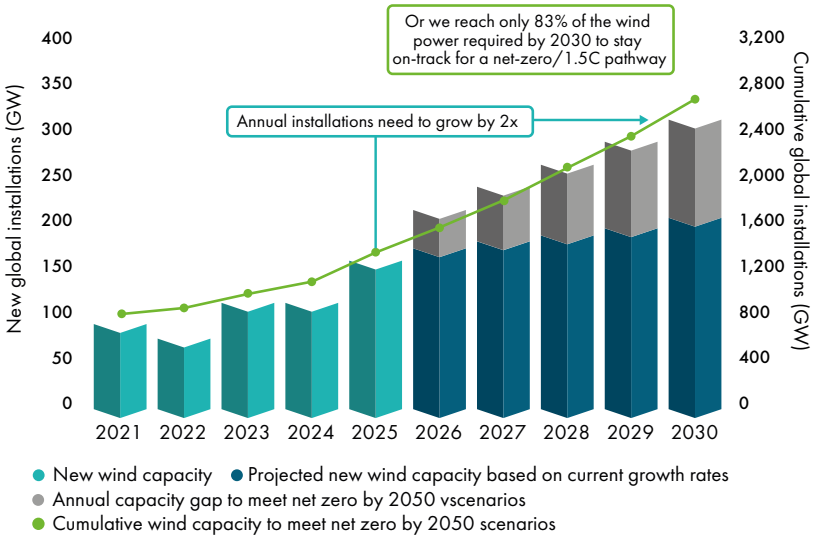
Recently, much has been made of the global net zero agenda being on the back foot. The COP30 conference in Brazil, where representatives from almost every country gathered to advance action on climate change, led to a disappointing outcome. Negotiations fell short of addressing the transition away from fossil fuels in the final summit decision. A UNEP report found that new Nationally Determined Contributions (NDCs), or climate pledges, submitted under the COP process would lead to a 2.3–2.5°C global warming trajectory, even with full implementation.

Initiatives like the Transition Away from Fossil Fuels (TAFF) Roadmap, supported by more than 80 countries at COP30, hold promise in mobilising international climate leadership outside the formal COP process. The Roadmap will emphasise a primary role for wind energy as a large-scale, clean and reliable energy resource to support the transition.

Regardless, the wax and wane of the net zero agenda does not stop the rise of the new economy centred on electrification and clean energy. Momentum behind the 'Age of Electricity' is only increasing: countries that leverage wind power and widescale electrification will come out on top, while those that delay a clean electrification programme risk being left behind. Global investment in clean technologies, including renewable energy and power grids, reached a record USD 2.3 trillion in 2025, with investment in renewable energy outpacing fossil fuel since 2024.[37]

Renewable energy like wind and solar, storage, electric vehicles and grid technologies are now "mainstream technologies with little risk and increasingly well-established business models", according to BloombergNEF.[38] As countries and regions like China, the EU, the US and India embrace a system-wide approach to the energy transition, the fundamental drivers for wind energy deployment will be rooted in economic demand and supply, rather than net zero alignment.

Wind installations need to double by 2030 to limit global warming to 1.5 C



Source: GWEC Market Intelligence; IEA Net Zero by 2050 Roadmap (2023); projected new wind capacity from 2026-2030 assumes a ~5.2% CAGR, which is based on GWEC's Q1 2026 Global Outlook; capacity gap figures are estimations based on the IEA Roadmap milestone for 2030. This data represents new and cumulative capacity and does not account for decommissioned projects

36. International Renewable Energy Agency (IRENA), Delivering on the UAE Consensus: Tracking Progress Toward Tripling Renewable Energy Capacity and Doubling Energy Efficiency by 2030, IRENA / COP30 Presidency / Global Renewables Alliance, October 2025, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2025/Oct/IRENA_COP30_GRA_Tracking_the_UAE_Consensus_2025.pdf

37. BloombergNEF, BloombergNEF Finds Global Energy Transition Investment Reached Record $2.3 Trillion in 2025, Up 8 % from 2024, BloombergNEF, January 26, 2026, https://about.bnef.com/insights/clean-energy/bloombergnef-finds-global-energy-transition-investment-reached-record-2-3-trillion-in-2025-up-8-from-2024/

38. Ibid.

Renewed optimism in the global wind industry

Reflecting the momentum for renewable energy, a Q1 2026 survey of GWEC's wind and renewable industry association members around the world canvassed perceptions of short-term and long-term challenges to wind growth across areas like permitting timelines and grid bottlenecks. The outcome shows that the global wind industry is generally optimistic about long-term growth prospects, and perceives the shorter-term challenges within the next five years as moderate, with a few exceptions of more acute areas.

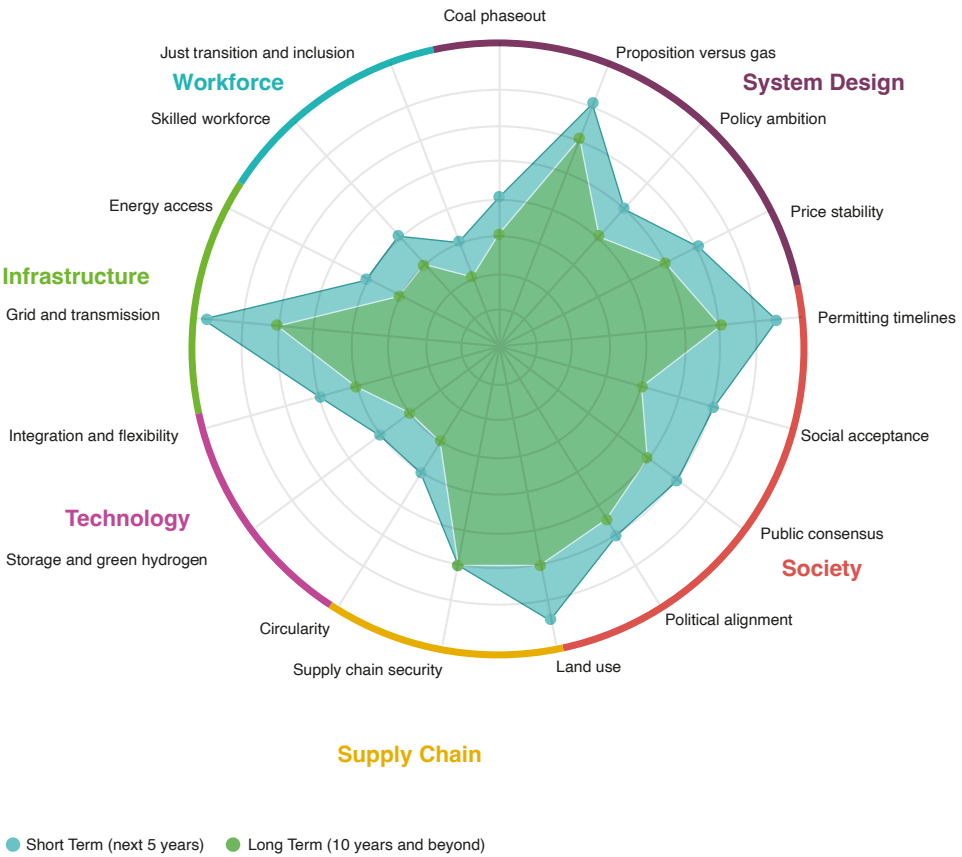
Long-term optimism on growth is driven by factors like growing public ambition for renewable energy in the face of a rising energy security and energy independence agenda, as well as progress in the commercialisation of storage and implementation of integration/flexibility technologies. Across all six major risk areas (Market Design, Society, Supply Chain, Technology, Infrastructure and Workforce), risk perception decreased from the short to long term – indicating confidence that present challenges would be overcome as the energy transition advances.

Interestingly, when compared to survey results from the same global wind and renewable associations in 2022, the industry appears more bullish about wind growth in the short and long term. The greatest increase in risk perception was seen in short-term supply chain and market design challenges, which may reflect increased sensitivity to supply chain security, commodity price volatility and macro investment environment issues, due to geopolitical and trade conflicts over the last four years.

> The global industry's falling risk perceptions signal a wave of renewed optimism for wind energy expansion.

From both 2022 and 2026 surveys, the priority challenges remain the same: the policy landscape vis-a-vis natural gas, permitting timelines, land availability, and access to grid and transmission. Nonetheless, the global industry's falling risk perceptions signal a wave of renewed optimism for wind energy expansion in mature and emerging markets.

The wind industry is optimistic about growth and its ability to overcome challenges in the long term



Short term (within next 5 years) and long term (more than 10 years ahead) challenges which could slow down deployment of wind energy. Nodes closer to the outer circle are considered more severe challenges, while nodes closer to the centre are considered low or moderate challenges.

Source: GWEC Market Intelligence and a survey of GWEC's national and regional wind and renewable energy industry association members, Q1 2026. This graphic is not inclusive of all challenges and factors impacting the growth of wind energy in different markets, and is meant to be used as a general guide to transversal issues.

System Design	**Coal phaseout:** The pace of countries exiting and retiring coal-based generation.
	Proposition versus gas: The enabling policy environment for wind energy versus natural gas/LNG, based on market and socioeconomic value.
	Policy ambition: The visibility and predictability of countries' wind energy growth targets, and the reflection in transparent and long-term procurement schemes and enabling market design, including auction design and access to a bilateral/corporate market.
	Price stability: The shift away from a "lowest cost approach" to wind procurement via long-term revenue stabilisation and other mechanisms, and looking towards a system value framework.
Society	**Permitting timelines:** The ease of obtaining the necessary permits, licenses and approvals for wind project deployment, including legal challenges.
	Social acceptance: The scale of support versus opposition encountered by wind projects in host communities.
	Public consensus: Public education and awareness about climate change and the needs of the energy transition, including the impact of disinformation on social and political support for wind energy.
	Political alignment: The prospect of continued political alignment with the energy transition.
Supply Chain	**Supply chain security:** The cost-effective and accessible supply of materials, minerals, metals and other inputs to the wind energy supply chain, as well as the efficient organisation of production capacity on a global basis, amid potential trade barriers, scarcity events and geopolitical factors.
	Circularity: The reuse, repurposing, recyclability and recovery of wind farm components including wind turbines, and the reduction of waste and environmental impacts generated in the wind project lifecycle in line with a circular economy approach.
Technology	**Storage and green hydrogen:** The pace of cost reduction and commercialisation of enabling storage and green hydrogen technologies, which will boost demand for wind energy.
	Integration and flexibility: The pace of cost reduction and integration of enabling balancing and flexibility technologies, such as demand-side response tools, which will enable large-scale integration of wind energy.
Infrastructure	**Grid and transmission:** The pace and scale of grid reinforcement, buildout and modernisation, ensuring sufficient grid availability to increase wind deployment.
	Ports and transport infrastructure: The availability of enabling infrastructure, including ports and connective links, to enable wind project development.
Workforce	**Skilled workforce:** The availability of a ready and able workforce with the necessary training and skills for the wind industry.
	Just transition and inclusion: The socioeconomic welfare of stakeholders concerned with the energy transition, and the development of a diverse and inclusive workforce which can harness all talents to grow the wind industry.

CHAPTER 1: GAINING NEW GROUND WITH WIND

Enabling system-level changes

A mismatch between electricity supply and demand is one of the reasons why variable renewable energy sources have not been deployed at the scale required to meet net zero commitments, and why they have become targets of disinformation. In practice, this mismatch shows up as grid congestion, higher curtailment and volatile electricity prices in markets not yet prepared to absorb large volumes of variable generation.

Enabling power markets to overcome structural bottlenecks and scale up reliable clean electricity supply will rapidly align growing electricity demand with renewable energy generation. To achieve this, the focus must be on three areas: grid infrastructure, flexibility of clean electricity supply, and integrated/hybrid project models.

Grid investment is the top factor enabling economy-wide electrification. Expanding grid capacity so green electrons can travel a greater distance gives large energy consumers more flexibility in location, reducing the need to fund site-specific infrastructure. The Baltic states' synchronisation with continental Europe is a good example of the importance of grid investments. By reinforcing interconnections, upgrading dotmestic networks and modernising system-control capabilities, Estonia, Latvia and Lithuania expanded access to balancing resources and strengthened electricity security at the system level.[39]

Flexibility is the set of technical, operational and market capabilities that lets power systems scale wind power while keeping electricity delivery reliable and affordable. Since wind speeds vary by hour and season, power systems need mechanisms to continuously balance generation and consumption without wasting energy or relying on reserve capacity from fossil fuels. This is where flexibility becomes decisive, thanks to storage (batteries, pumped hydro, thermal storage) and/or demand-side response solutions (dynamic tariffs, automated load shifting) that reduce curtailment, smooth peaks and maintain reliability. This increases the system's ability to absorb wind power, improving the investment case for renewables.

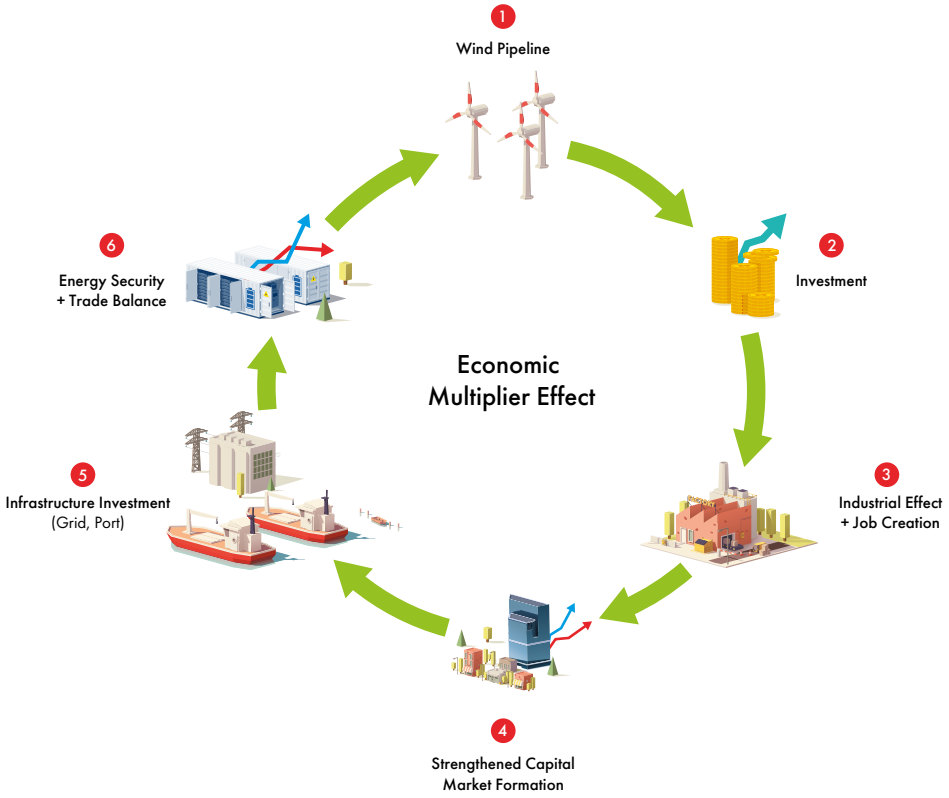
Integrated projects combine two or more renewable energy sources (wind, solar, hydro, etc) in the same site, optimising the use of resources, such as the substation. By combining wind with another renewable source and sometimes storage, hybrid plants can deliver a smoother production profile by switching between resources when one is inactive, which improves the stability of the electricity supplied and reduces operational uncertainty. Hybrid projects usually share a single grid connection point, which increases the utilisation of that access capacity through complementary generation profiles. This approach can accelerate project commissioning by avoiding the need to secure a new grid access point, improving project bankability and unlocking further investment.

39. European Commission, Baltic States Join the European Continental Electricity Grid After Fully Disconnecting from Russian and Belarusian Networks, European Commission Press Corner (Press Release IP/25/436), 9 February 2025, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_436

Investment and economic prosperity

Across the world, wind power has evolved from an environmental initiative and climate solution into a pillar of industrial strategy and economic resilience. The more wind projects are deployed globally, the more evident it becomes that this technology is an engine of economic growth – extending beyond the turbines and substations to ports, factories and hubs, as well as training centres, logistics networks and regional infrastructure corridors.

The multiplier effect: from land to sea



Through a wider, more holistic lens, we can see that wind delivers emissions reductions, energy security, supply chain resilience and economic expansion. At scale, these investments translate into measurable macroeconomic outcomes. Wind deployment contributes directly to GDP growth through construction, services and long-term operations.

Each wind project initiates a chain of economic activity that extends beyond the initial capital expenditure (Capex) associated with it. Wind development stimulates further activities across supply chains, workforce and local economies, generating multiplier effects that differ for onshore and offshore wind based on geography, scale and industrial footprint.[40]

Onshore wind often represents the first phase of large-scale deployment within countries, as onshore wind farms tend to be smaller than offshore wind projects, but deploy faster and across wider geographies. By reaching rural regions, agricultural communities and inland provinces, wind power investment catalyses growth and community revitalisation through land lease payments, the use of local construction, O&M and logistic providers, and domestic industrial capacity. Onshore wind builds industrial confidence and technical capability that enable long-term competitiveness.

The capital intensity of offshore wind, on the other hand, produces multiplier effects of a different magnitude: it drives large-scale investments into port modernisation and upgrading, high-voltage transmission systems, subsea cable systems, marine logistics and installation vessels, as well as fabrication yards.

Floating offshore wind can further amplify the multiplier effect by expanding the industrial footprint to heavy fabrication, advanced marine engineering and specialised maritime services. If onshore wind provides the industrial foundation, and fixed offshore wind brings deeper and concentrated industrial capacity anchored by multi-decade infrastructure investment, floating offshore wind can extend this trajectory even further. It can unlock new deep-water regions, activate advanced marine engineering ecosystems, and expand the scale and sophistication of domestic supply chains.

Wind development is not a one-off expenditure. It builds productive assets, strengthens supply chains and supports sustained employment across regions. Capital circulates domestically

40. GWEC, Offshore Wind for Coastal Development Socio-Economic Impact Study, GWEC, March 17 2026, https://www.gwec.net/reports/offshore-wind-for-coastal-development-socio-economic-impact-study

rather than being used for recurring fossil fuel imports. As domestic assets are built and financed, capital markets deepen through green and infrastructure bonds, equity investments and more blended finance vehicles. Over time, this expanded economic activity will also expand the tax base, generating more government revenues – which become available for public services.

Port and grid infrastructure upgrades benefit broader sectors of the economy, transferring skills to the local labour force and making them available to other industries such as manufacturing and maritime services. Induced effects arise when the wages and revenues generated from wind development activities are spent back into the broader economy as workers spend on housing, food, education and other local services.

While decarbonisation and resilience remain its central objectives, wind power also contributes **to broader outcomes that matter the most to households, businesses and communities.** The growth story of wind translates to tangible prosperity reflected in national statistics and felt in everyday livelihood.

Economic Impacts Per Major Activity Across the Wind Value Chain

Major Activity / Industry	Onshore Wind	Offshore Wind	Economic Impact
Component manufacturing	Large volumes of main and sub-components that are manufactured and/or procured across hundreds of suppliers	Same as onshore, but generally with larger component sizes	Factory jobs, supplier partnerships and contracts, technology transfer, export potential
Operations and maintenance	Locally supplied jobs over the long term (average 25-year project lifetime) that require advanced skills in service technicians	Same as onshore with scope for specialties in marine environments and potential for reskilling offshore oil and gas workers	Upskilling or reskilling of local workforces, creation of local service hubs, local community revitalisation
Steel and fabrication	Tower production and basic structural components, supporting regional steel demand	Monopiles, jackets and large foundations built in coastal fabrication yards Floating: floating foundations and advance mooring systems and anchors, heavy fabrication yards	Demand for domestic steel, new fabrication facilities, skilled welding and engineering jobs
Ports and logistics	Transport hubs and road access improvements to move com-ponents inland	Port upgrades, heavy-lift facilities and marshalling yards to handle offshore compo-nents	Port modernisation, increased trade activity, long-term logistics employment
Grid infrastructure	Inland substations and transmission upgrades to connect projects to the grid	Offshore substations, subsea cable Floating wind requires more robust dynamic subsea cables	Stronger networks, reduced congestion, improved reliability for busi-nesses and households
Marine and installation vessels		Specialised vessels and marine engineering services	New shipbuilding orders, maritime engineering jobs, growth of coastal service industries
Rural and community economy	Land lease income, local contractors, O&M bases; benefits spread across regions	Jobs concentrated in coastal hubs with higher technical spe-cialisation	Stable income for landowners, local tax revenues, small business growth, long-term service jobs

CHAPTER 2: CREATING A WINNING FORMULA WITH WIND

Building a strong support base for wind

Wind energy is becoming a foundational pillar of the Electrotech era driving industrial growth, energy security and electrification. However, its continued expansion depends not only on economics and technology, but equally on public and political support. Social acceptance and political durability shape the speed, cost and long-term stability of deployment. Strong community and stakeholder backing provides the demand visibility and investor confidence required to scale projects, particularly across new markets and high-growth regions.

The next phase of expansion hinges on a sustained and credible public narrative that clearly articulates the economic, environmental and societal value of wind. In recent years, mis/disinformation campaigns have actively targeted the sector, with fossil fuel interests and narratives questioning wind's reliability, costs and environmental impacts. As these narratives have become more sophisticated, often reframing fossil fuels as pragmatic 'transition' solutions, the need for rigorous fact-checking, full system context and clear communication of long-term economic and climate impacts has become more pressing.

Mis/disinformation campaigns have tangible consequences, causing project delays and cost overruns, and creating uncertainty that undermines industrial planning and fuels a vicious cycle of further dissatisfied communities. In some European and North American markets, local opposition fuelled by misleading claims has delayed permitting, adding months or even years to project timelines. In emerging and developing economies (EMDEs) with limited awareness of wind energy, unchecked narratives can erode public trust and slow deployment, causing significant damage in regions where rapid electrification is most necessary.

This challenge is particularly acute in the current geopolitical context. As concerns over economic growth, cost of living and national security reshape political priorities, renewable energy policies are increasingly politicised.

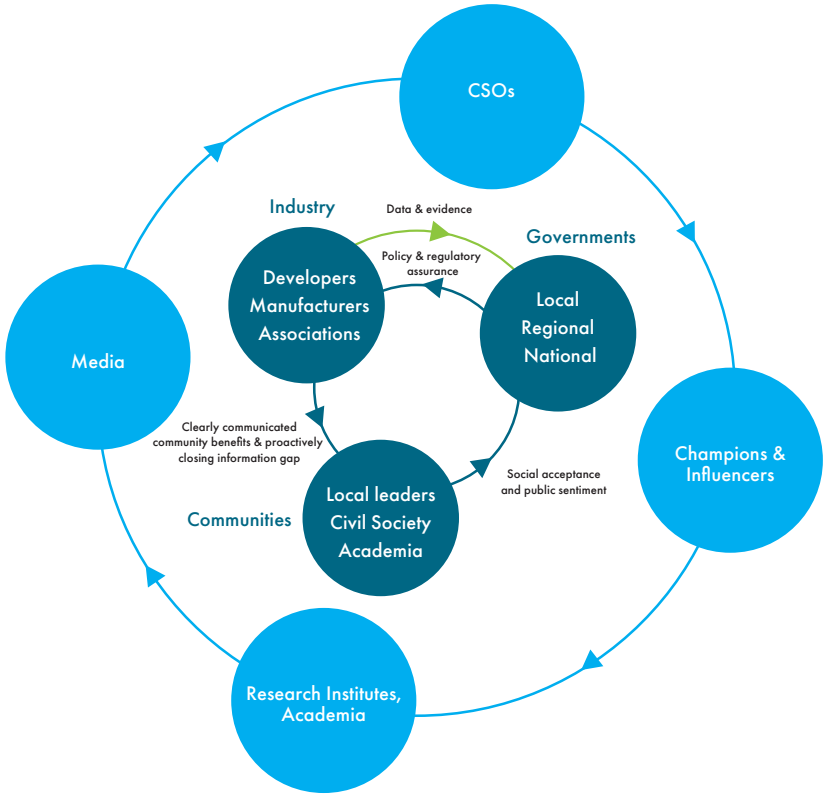
Countering the 'gas as a transition fuel' narrative

Gas is often promoted as a lower-emission energy solution – one that helps with system flexibility and energy poverty, especially in developing countries, and is a safe bet for grid reliability.

While flexible generation can help balance the energy system, the evidence shows:

- Methane leakage in the exploration and production of gas significantly increases its CO2 footprint
- Investing in inflexible CCGTs locks gas in financially and contractually, delaying the energy transition
- In many markets, wind combined with solar and battery storage already offers a lower-cost alternative.

Wind energy narrative ecosystem



The value of wind power in providing whole-of-economy dividends and system-level benefits must be reinforced by broad-based societal support. Winning with wind requires securing public trust and political resilience beyond electoral cycles – alongside the traditional arguments based on economic or environmental reasons.

Strengthening public trust through evidence-based communication

Securing durable public support for wind energy requires a coordinated effort across the broad ecosystem of key actors. Industry, governments and communities all play a central role in shaping the public narrative on wind energy through evidence-based and transparent communication. Efforts to counter misinformation must be proactive and sustained, rather than only reactive. When supported by a wider network of stakeholders including media, academia, civil society organisations and public champions, the industry can amplify credible information and reinforce trust. Evidence-based data, proactive engagement and consistent messaging are critical to strengthening long-term public support.

Build capacity and awareness across governance levels

While public acceptance is shaped locally, political durability is built systemically. Coordinated action by industry, governments and institutional partners at every level is necessary to strengthen both.

At the district and municipal level, developers and local authorities must prioritise early engagement, participatory planning and clear benefit-sharing mechanisms to reduce opposition and build trust. Durable local support is secured through community ownership opportunities, transparent land-use processes and rigorous environmental standards.[41] Projects gain traction when communities see tangible local value in terms of job creation, investment in communities, high-quality service delivery and economic benefits.

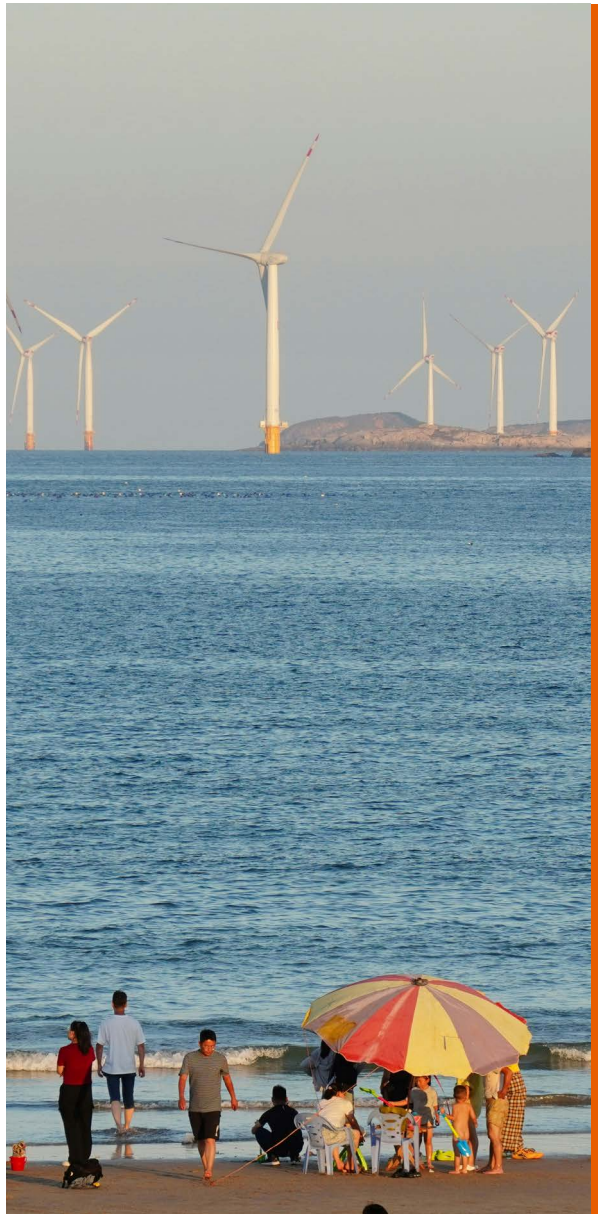
At sub-national and national levels, governments must work to strengthen institutional capacity. Efficient permitting systems, coherent spatial planning frameworks and well-designed, deliverable auction schemes reduce regulatory friction and provide long-term visibility for investors and communities. Successful narratives must align with country-specific priorities – from energy security and independence in Germany and South Korea, to industrial competitiveness and domestic manufacturing expansion in India, to job creation and green industrialisation in emerging markets such as Brazil and South Africa.[42]

At regional and global levels, industry associations, international organisations, multilateral development banks and governments must work together to share best practice and counter cross-border mis/disinformation. Collective action at this scale strengthens credibility and reinforces political resilience across markets.

As wind energy scales towards 2 TW this decade, success will depend as much on political resilience as on economic competitiveness. In an era defined by electrification and digitalisation, wind energy offers scale, cost efficiency and energy security – qualities that position it as a cornerstone of national energy strategies. Sustaining deployment momentum hinges on the ability to effectively and credibly communicate these advantages to the relevant communities.

The socioeconomic case for wind energy is strong, but it is no longer sufficient on its own. Securing durable public trust and political resilience will ensure that wind can deliver clean energy at scale in the age of electricity.

41. Global Wind Energy Council, Ensuring the Social License for Wind Projects in Latin America, Global Wind Energy Council (Policy Paper), October 2024, https://www.gwec.net/reports/latam/ensuring-the-social-license-for-wind-projects-in-latin-america
42. Global Offshore Wind Alliance (GOWA), Resources, Global Offshore Wind Alliance (GOWA), https://gowa-energy.org/resources/



Case Study - WindSHIFT: winning the battle for sustained offshore wind narratives in the Philippines

The Philippines has emerged as a cornerstone of offshore wind (OFW) development in Southeast Asia, acting as a critical theatre for the global ambition to triple renewable energy capacity by 2030. This momentum is grounded in decisive policy actions, most notably the issuance of Executive Order 21 in April 2023, through which the Philippines mandated a whole-of-government streamlined approach to the OFW permitting process and removed foreign ownership restrictions for renewable energy projects. These reforms signalled to the international investment community that the Philippines is open for business. Moving from high-level policy to the complexity of project development, the industry is facing up to a challenge that technical roadmaps alone cannot solve: the battle for the narrative.

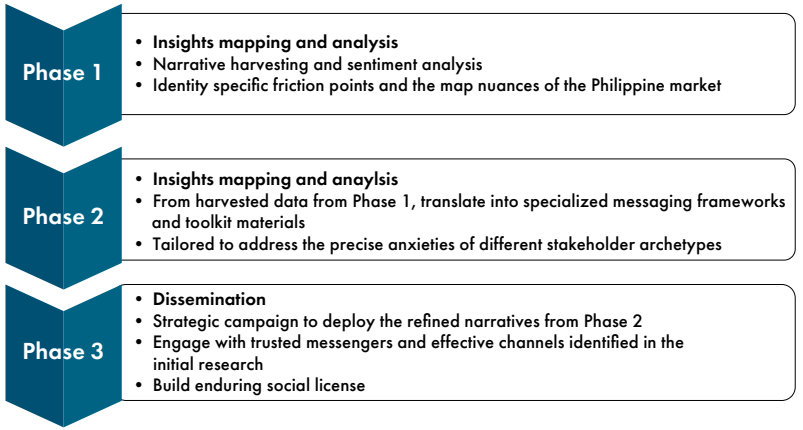
As the global experience in mature OFW markets demonstrates, project viability is no longer determined only by wind speeds or grid proximity. The social license to operate has become a decisive factor. In the Philippines, the benefits of large-scale infrastructure are being measured against immediate concerns such as cost, coastal livelihoods and environmental preservation. Without a proactive strategy to manage these perceptions, the OFW sector risks being defined by its critics before it can prove its value.

The WindSHIFT initiative is a narrative-based toolkit designed to build social, political and investor confidence in the Philippine OFW sector. WindSHIFT uses a structured methodology divided into three phases, demonstrated in the graphic below.

Acknowledging that fragmented or overly technical communication efforts are failing to resonate with the concerns of Filipino stakeholders – turning misinformation into political resistance – WindSHIFT establishes a trusted, evidence-based public narrative that articulates the multi-dimensional benefits of OFW. It frames OFW as a pillar of holistic national development in its different facets. These are powerful messages in a country of historically high power costs, extreme vulnerability to global fuel price shocks, and uneven development.

WindSHIFT aims to serve as a blueprint for communicating the value of OFW, ensuring that the transition to clean energy is perceived as a local opportunity rather than an external imposition.

WindSHIFT Methodology



Creating Long-Term Demand Through Policy Clarity

From building projects to sustained delivery

Energy security has long been a major driver of the push for renewables. The energy security imperative of reducing exposure to external shocks and building national resilience shaped the first generation of renewable energy policies. This is true of wind energy, which saw its first major push in Denmark and other countries in the 1970s due to the ongoing oil crisis.

Governments focused on making projects buildable, which required putting in place the right policy foundations, including rules on site access, consents and priority dispatch. Revenue support mechanisms, alongside fiscal and non-fiscal incentives, were introduced to boost investor confidence.

Demand, however, does not materialise automatically. It is created through credible long-term signals, coherent institutional frameworks and structured public-private engagement. Policy clarity is the foundation for investment decisions, supply chain and infrastructure commitments, and financing structures.

Policy clarity extends beyond announcing ambitious capacity targets. It requires visible deployment pathways, predictable and annual procurement/auction schedules, bankable revenue mechanisms – and alignment between permitting, grid development and industrial strategy. And these policies require an ongoing process shaped through dialogue, coordination and learning.

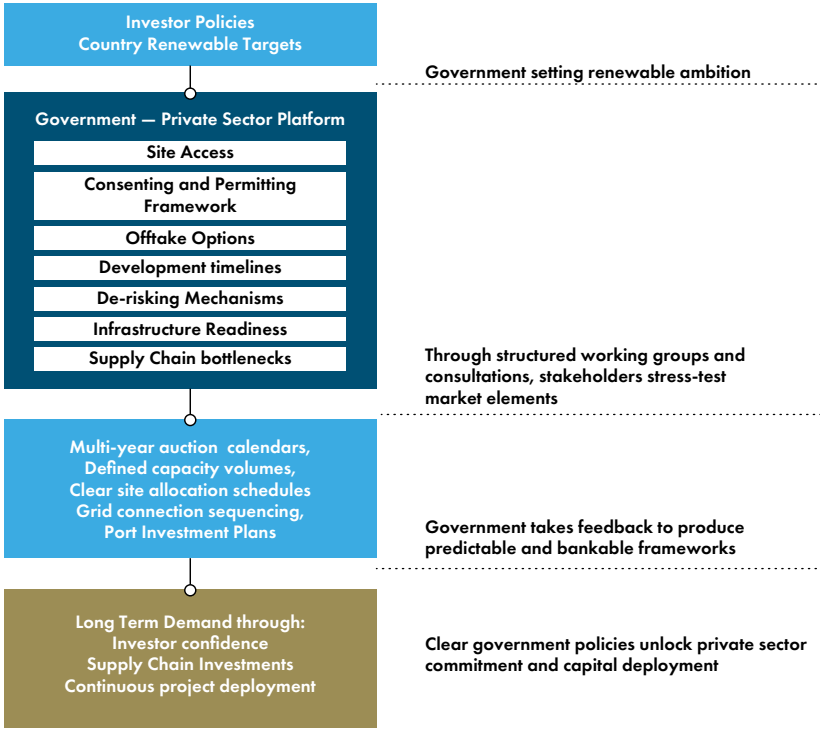
Co-creating policies with stakeholders

The Philippines offers an example of how policy clarity can shape an early-stage market. The country has demonstrated strong ambition for offshore wind development and introduced new policies and reforms to enable greater international participation. Recognising that regulatory fragmentation and institutional misalignment can undermine bankability at later stages, stakeholders have coordinated with government agencies on seen challenges – especially relevant to the auction mechanism.

To support this process, GWEC convened a Technical Working Group (TWG) bringing together key government agencies and industry representatives. The TWG provides a structured platform to address critical issues such as risk-sharing mechanisms, developer pre-qualifications and OFW price cap. By fostering early-stage coordination and technical exchange, the TWG helps ensure that frameworks evolve in a coherent and financeable manner. This approach strengthens regulatory clarity upstream, reducing uncertainty for investors and developers.

Japan, by contrast, exemplifies a different stage of evolution. With OFW targets and a formal auction framework in place, Japan has laid important foundations for long-term growth. However, global inflationary pressures, rising interest rates and supply chain constraints have altered

How industry and government can best collaborate to create long-term demand



cost structures across the industry. In this context, maintaining investor confidence depends not only on targets, but also on the adaptability and transparency of policy frameworks.

To facilitate constructive engagement during this period of transition, the Bridging Forum has been established as a neutral platform bringing together representatives from government, project developers, supply chain companies and financial and legal stakeholders for candid discussion on auction design, market bottlenecks and industrial policy alignment. By creating space for structured dialogue, the initiative contributes to policy stability by allowing challenges to be addressed collaboratively rather than reactively.

Across both markets, a consistent lesson emerges: long-term demand is anchored in credibility. Investors respond to clear signals, visible project pipelines and evidence of institutional coordination. Ambition alone is insufficient if not accompanied by predictable processes and mechanisms that translate policy objectives into implementable projects.

For emerging OFW markets, policy clarity results from a dynamic process that combines long-term vision with structured engagement and iterative refinement. By embedding transparency and coordination into policy development, governments can lower capital costs, strengthen supply chain confidence and accelerate the deployment of offshore wind at scale.

Case Study – Evolution of the UK's offshore wind auction framework

Provided by Renewables UK

Over the past decade, the United Kingdom has developed one of the world's most effective policy frameworks for deploying offshore wind at scale, centred around the Contracts for Difference (CfD) mechanism. This groundbreaking scheme provides developers with long-term revenue certainty while protecting billpayers through competitive price discovery, providing inspiration to other markets since its inception in 2014. As the UK market has matured, the framework has evolved to reflect changing economic conditions, supply chain pressures and the UK's increasingly ambitious clean power targets.

This year's 7th Auction Round (AR7) was a significant milestone. Following a period of global inflation and higher financing costs affecting offshore wind project economics, the UK Government introduced targeted reforms to restore investor confidence and reduce financing costs, while maximising competition to provide value for billpayers.

One of the most significant changes was the introduction of new powers for the Secretary of State for Energy Security and Net Zero to review the bid stack during the allocation process. This allowed the government to assess the prices submitted by developers and determine whether procuring additional capacity would represent good value for consumers.

When approaching AR7, the government was concerned with meeting its 'Clean Power by 2030' objective, requiring approximately 8GW of new offshore wind capacity to be procured each year; and to award projects that would provide value to billpayers. Independent analysis commissioned from Aurora Energy Research and Baringa concluded that offshore wind procured below GBP 94/MWh (USD 124/MWh) would still deliver a net benefit for billpayers.

The headline reform brought forward for AR7 was a huge success, enabling the government to double the budget from an initial GBP 900 million (USD 1,190 million) to GBP 1.8 billion (USD 2.38 billion), unlocking many more new projects. In total, around 8.2 GW of offshore wind capacity was secured through AR7, making it one of the largest offshore wind procurements ever undertaken globally. Strike prices for fixed-bottom offshore wind projects were broadly in the range of GBP 89–92/MWh (USD 117–121/MWh) at March 2026 prices, reflecting both strong competition and the impact of recent policy reforms designed to enhance the competitiveness of CfD bids.

AR7 also continued the UK's long-standing support for floating offshore wind, with a number of floating projects securing contracts. This reflects the country's strategic ambition to remain a global leader in floating wind technology and unlock its significant deep-water wind resources.

A second key reform underpinning the auction's success was the expansion of the eligible project pipeline. For the first time, offshore wind projects without full planning consent were able to participate in the auction, more than doubling the eligible capacity. This change increased the pool of bidders and enabled the government to procurer a larger overall volume.

There were further reforms to ease the pressures of a challenging global environment for project financing. Most notably, extending CfD contract lengths from 15 to 20 years, which provides greater long-term revenue certainty and helps reduce financing costs for developers.

Alongside these changes, the UK Government introduced new supply-chain incentives through the Clean Industry Bonus, which is designed to encourage investment in UK manufacturing, ports and industrial capability linked to offshore wind deployment. By linking additional support to commitments on domestic supply-chain development, the policy aims to maximise the economic benefits of offshore wind for the UK.

Finally, AR7 introduced adjustments to reference pricing arrangements for Scottish projects, recognising differences in wholesale market dynamics north of the border. Taken together, these reforms demonstrate how the UK's CfD framework continues to evolve. By combining greater procurement flexibility, stronger competition, supply-chain incentives and long-term contract certainty, AR7 illustrates how the model can continue to deliver large volumes of offshore wind while maintaining strong value for billpayers and supporting the UK's wider industrial strategy.

renewableUK

Case Study – Regional Cooperation

Provided by Global Offshore Wind Alliance

Why regional cooperation matters

In an effort to maintain investor confidence, governments have responded to economic pressures and evolving market conditions by taking a range of national measures to strengthen the enabling environment for offshore wind. Auction frameworks have been refined, support mechanisms adjusted, permitting timelines streamlined and grid reforms advanced to address higher financing costs, supply chain constraints and shifting power market dynamics.

The Hamburg Declaration, agreed in January 2026 at the North Sea Summit by Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and the UK, is a complementary development within this broader policy response, reflecting as it does a shared recognition that offshore wind deployment in an interconnected basin such as the North Sea involves common infrastructure, maritime spatial planning considerations and integrated electricity systems.

By reinforcing domestic reforms with a clearer framework for regional coordination, participating governments signalled their intent to enhance long-term visibility, improve system efficiency and strengthen supply chain resilience. The North Sea experience illustrates how aligning national ambition with structured regional cooperation can help sustain delivery momentum where markets, grids and industrial ecosystems are closely interlinked.

The Hamburg Declaration: from national ambition to regional delivery

By 2050, signatories aim to deliver up to 100 GW of the 300 GW North Sea target through "cooperation projects", that is OFW projects with transmission links to multiple countries.

Beyond the headline target, what makes the declaration significant is the depth and breadth of cooperation required – from cross-border planning for grids and marine spatial planning, to more coordinated permitting. It also covers measures to improve delivery, including predictable tender pipelines, closer coordination with industry on technical standards and interoperability, and shared efforts to train and recruit for future workforce needs.

Tailored regulatory solutions, including cross-border two-sided Contracts-for-Difference (CfDs) and Power Purchase Agreements (PPAs), are highlighted as vehicles to address investment certainty and the added risks of international projects. The proposed Offshore Financing Framework is designed to identify priority cooperation projects, support cost-benefit sharing, and attract private capital. A parallel Industry Investment Pact signals industry commitment to invest against a clearer pipeline.

Reflecting a broader political shift in how offshore wind is viewed in Europe – not simply as a tool for decarbonisation, but increasingly as a security and resilience priority – under the declaration the parties commit to working together on cybersecurity and infrastructure protection.

Lessons for emerging markets

Turning Hamburg's political ambition into delivery will be the real test. Nonetheless, the regions most likely to drive future offshore wind growth, particularly Asia Pacific and Latin America, can already draw useful lessons. Not only does the declaration demonstrate that regional cooperation can help countries deploy OFW more efficiently. It also provides an approach that can be adapted to local contexts. Its value lies in showing how tailored initiatives – including coordinated planning, aligned standards and stable investment frameworks – can deliver regional solutions and improve investment sentiment. Finally, it underlines that cooperation takes time: the Hamburg Declaration follows two decades of dialogue and trust-building. Regions looking to accelerate should consider a phased, consistent approach that starts with what fits local appetite, capabilities and constraints, and builds from there.

GOWA
Global Offshore Wind Alliance

"We today go further by signing a clean energy security pact with European allies to ensure we maximise the clean energy potential for the North Sea."

Ed Miliband, UK Secretary of State for Energy Security and Net Zero

"The North Sea is a strategic key area for Europe's energy and supply security. By planning expansion, grids and industry together and implementing them across borders, we are creating clean and affordable energy, strengthening our industrial base and increasing Europe's strategic sovereignty. Today's investment pact provides reliable perspectives for the offshore sector, secures creation of value in Europe and brings future-proof jobs.

Katherina Reiche, Federal Minister for Economic Affairs and Energy of Germany

"In these turbulent geopolitical times, Europe must stand strong and united – and choose independence. That means doubling down on clean, safe, home-grown energy. It means building on our natural strengths, and few are greater than the North Sea and its vast offshore wind potential. It means strengthening our interconnections so that affordable energy can flow freely across our continent. And it means securing our industrial leadership while guaranteeing our security. This is Europe's path to true independence."

Dan Jørgensen, European Commissioner for Energy and Housing:

Scaling growth through market enablers

As global economic growth slows and geopolitical tensions rise,[43] the supply chains upon which the wind industry relies are becoming increasingly politicised and securitised, creating uncertainty in future costs and availability. This is of critical importance, as supply chains with sufficient capacity and efficiency are necessary to achieve the economies of scale that make wind power cost-competitive.

From the Net Zero Industry Act and Industrial Accelerator Act in the EU to the Inflation Reduction Act in the US, government priorities are shifting from building reliable trade relations to designing national industrial policies that upgrade and boost core competencies. However, the complex and diversified nature of the wind value chain makes it challenging for most countries to pursue highly localised models of industrial policy and deliver affordable wind power at the same time in the absence of a strong demand driver.

One potential solution is the coordination of wind power policies across blocs and regions based on shared benefits. Institutions such as the WTO[44] and the World Economic Forum[45] – as well as GWEC in its recent supply chain studies – are promoting the regional cooperation of supply chains as a mitigation mechanism for global supply chain risks. Regional cooperation can deliver the efficiency gains generated by the international allocation and segmentation of processes while shielding downstream players from the risks embedded in increasingly unpredictable global supply networks. It will be particularly important for the future growth of the offshore wind sector, where the large scales and technical nature of manufacturing, installation and O&M services all benefit greatly from regional collaboration and cross-border learning.

Government priorities are shifting from building reliable trade relations to designing national and industrial policies that upgrade and boost core competencies.

Regional cooperation works thanks to geographical proximity, infrastructural connections and relative political alignment – already features of regional associations such as the EU, ECOWAS, SADC, MERCOSUR and ASEAN. Salient recent examples include the Regional Comprehensive Economic Partnership (RCEP),[46] the Asia Pacific Economic Cooperation (APEC),[47] and the Indo Pacific Economic Framework (IPEF)[48] – all of which pledge to promote regional supply chain development. These pledges often aim to codify and harmonise rules of origin, reduce tariffs and streamline non-tariff measures. Sector-specific initiatives also play a role, such as the ASEAN Framework for Integrated Semiconductor Supply Chain (AFISS)[49] or the Chips 4 Alliance,[50] both of which resolve to strengthen collaboration and integration in semiconductor production.

The key to building successful regional supply chains for wind power will be a tandem focus on regional demand creation and consistent political commitment and cooperation between governments and industry. Multilateral, multi-stakeholder coalitions comprising governments, the private sector, think tanks, NGOs and the media should collectively push countries to pursue next-generation industrial policy with a regional approach, in line with the following recommendations:

- Develop a concrete plan for demand creation that outlines a long-term and stable pipeline of wind deployment on an annual basis, which can send positive investment signals for component manufacturing and infrastructure buildout

43. International Monetary Fund, World Economic Outlook Update January 2026: Global Economy — Steady amid Divergent Forces, International Monetary Fund, 19 January 2026, https://www.imf.org/en/publications/weo/issues/2026/01/19/world-economic-outlook-update-january-2026
44. World Trade Organization, Global Value Chain Development Report 2025 – Resilience and Reglobalization: Global Value Chain Trends and New Opportunities, World Trade Organization, 15 December 2025, https://www.wto.org/english/res_e/booksp_e/gvcreport2025-02_e.pdf
45. Ruchir Agarwal, Industrial Policy and the Growth Strategy Trilemma, Finance & Development (Analytical Series, International Monetary Fund), March 21, 2023, https://www.imf.org/en/publications/fandd/issues/series/analytical-series/industrial-policy-and-the-growth-strategy-trilemma-ruchir-agarwal
46. ASEAN, Regional Comprehensive Economic Partnership (RCEP), ASEAN – Economic Community: Integration With Global Economy (ASEAN), https://asean.org/our-communities/economic-community/integration-with-global-economy/regional-comprehensive-economic-partnership-rcep/
47. Asia-Pacific Economic Cooperation (APEC), APEC – Asia-Pacific Economic Cooperation, APEC, https://www.apec.org/
48. U.S. Department of Commerce, Indo-Pacific Economic Framework for Prosperity (IPEF), U.S. Department of Commerce, https://www.commerce.gov/ipef
49. Rifki Weno, Heikal Suhartono, Tania Heryanto, Rio Kiantara & Cania Adinda, Strengthening ASEAN's Semiconductor Future: Building a Resilient Regional Supply Chain, ASEAN Business Advisory Council (ASEAN-BAC), 3 October 2025, https://asean-bac.org/news-and-press-releases/strengthening-asean-s-semiconductor-future-building-a-resilient-regional-supply-chain
50. Eric Jung, The "Chip 4 Alliance" and Taiwan–South Korea Relations, Global Taiwan Brief (Global Taiwan Institute), 20 September 2023, https://globaltaiwan.org/2023/09/the-chip-4-alliance-and-taiwansouth-korea-relations/

- Jointly finance key regional infrastructure capabilities such as grid interconnectors
- Pursue targeted investment coordination by identifying supply chain gaps, matching them to countries with relevant industrial capacity, and facilitating public-private investments to fill them
- Create comprehensive regional frameworks across technology deployment, R&D, investment and workforce development to guide industrial strategy and avoid fragility in energy transition efforts
- Contribute to pooled co-investment initiatives to build green infrastructure in less developed regions
- Institutionalise and build capacity around multilateral investment vehicles, based on geopolitically balanced governance structures that can support the green transition
- Identify global manufacturing and raw material needs to direct cross-regional coordination efforts
- Lead or guide the development of component standardisation to achieve economies of scale in the manufacturing process of renewable energy technologies in a manner that addresses cybersecurity, dependence risks and cross-regional interoperability issues.

Case Study – Wind Sustainability Initiative

As global demand for wind energy accelerates, scaling up turbine manufacturing and deployment offers an unprecedented opportunity to reduce emissions, strengthen energy security and drive industrialisation and economic development. For the wind supply chain, this is a pivotal moment, when rapid growth and responsible action must go hand-in-hand. GWEC's Wind Sustainability Initiative (WSI) aims to support resilient and ethical supply chains that fully align with ESG principles. By embedding robust sustainability standards and due diligence processes, the sector can accelerate the energy transition while safeguarding the people and natural environments that make wind energy possible.

The wind industry currently lacks a harmonised sustainability framework applicable across the global supply chain. As a result, ESG due diligence is conducted independently by multiple actors. Original equipment manufacturers (OEMs) carry out supplier assessments and audits, developers seek to procure from manufacturers with transparent and responsible supply chains, and financial institutions look for projects that align with international standards on social and human rights, and environmental expectations.

As regulatory requirements continue to tighten, robust due diligence is becoming increasingly important. By establishing a common, credible standard recognised by all the key stakeholders, due diligence processes can be streamlined and duplication reduced. Most importantly, this would provide a bankable framework for assessing ESG performance and ensuring traceability across the supply chain – in turn, expanding the pipeline of bankable projects and enabling faster deployment of wind energy globally.

In response to this challenge, GWEC in 2024 launched the Wind Sustainability Initiative (WSI), aiming to develop internationally recognised standards for ESG assurance and traceability tailored specifically to the wind industry. Grounded in established international frameworks including the IFC Performance Standards, OECD

Due Diligence Guidance, and the UN Guiding Principles on Business and Human Rights (UNGPs), the WSI seeks to translate global best practice into a practical, sector-specific approach.

As the international body for the wind energy industry, GWEC is uniquely positioned to convene stakeholders and align sustainability expectations across markets and regions. The initiative is therefore being developed through a multi-stakeholder process involving a group of OEMs and developers from GWEC's membership, as well as financial institutions, civil society organisations and standard-setting bodies, ensuring credibility, practicality and broad industry uptake.

The project is currently in the pilot phase, testing the initial draft of the Sustainability Standard. It will then expand its work to develop a traceability framework focused on developing a chain-of-custody mechanism for high-risk materials within the wind supply chain.

Designed to be third-party accredited, the framework will support credibility and comparability across markets, with the ambition to be recognised in procurement schemes, investor due diligence and supply agreements. Through this approach, the initiative seeks to deliver stronger sustainability performance across the industry while enabling faster, more responsible deployment globally.

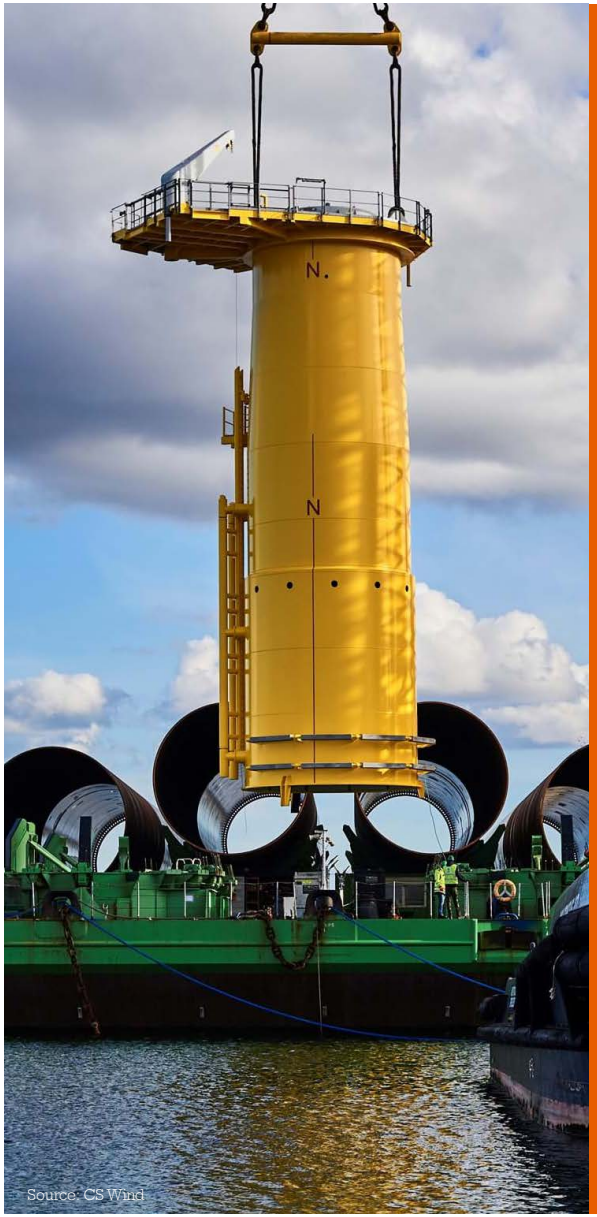
Priority outcomes of WSI

1. Establish harmonised, reliable, third-party accredited standards adopted across the global wind industry
The initiative aims to develop a single, credible framework for ESG assurance and supply chain traceability in wind turbine manufacturing. Through third-party accreditation, the standard will provide consistency and comparability across markets, with the ambition to become recognised in procurement processes, investor due diligence and supply agreements. By aligning expectations across stakeholders, the framework will help reduce fragmentation while recognising existing good practices and providing a clear pathway towards continuous improvement in ESG and chain-of-custody practices.

2. Expand the pipeline of bankable projects and accelerate deployment
By replacing repetitive and time-consuming due diligence processes with a trusted certification framework, the initiative seeks to remove a key bottleneck in project development. Streamlined sustainability assessments can accelerate financing decisions, particularly in emerging and developing markets where project preparation timelines are often longer and more complex. Over time, this is expected to increase the pipeline of bankable projects and support the scale-up of annual wind installations required to meet global targets, including the goal of tripling renewable energy capacity by 2030.

3. Raise the benchmark for sustainability in the energy transition
A core ambition of the initiative is to demonstrate that wind energy is leading in environmental stewardship, labour practices and respect for human rights. By embedding these principles into credible, internationally recognised standards, the initiative aims to strengthen the sector's social licence to operate. This will contribute to an energy transition that is not only faster, but also just and more sustainable.

Note: The WSI is currently supported by a number of GWEC members.



Source: CS Wind

Case Study – Using verified data to support decarbonisation planning and future-proofing

provided by CS Wind Offshore & DNV

ESG frameworks and metrics provide industrial actors with structured tools to navigate climate transition risks, integrate sustainability into core operations and meet rising demands from investors, customers and regulators. In offshore wind supply chains, verified emissions data serves as a key ESG deliverable, enabling evidence-based decarbonisation while signalling proactive risk management.

CS WIND Offshore (CSWO) manufactures offshore wind turbine foundations, and primarily transition pieces. The company operates from its main site in Aalborg, Denmark, supplying projects across Northern Europe, the UK and the Baltic region, and forms part of the CS Wind Group headquartered in South Korea.

In 2025, CSWO partnered with DNV to independently verify its 2024 greenhouse gas (GHG) emissions, covering Scope 1, 2, and 3*. This exercise established a documented baseline of the company's carbon footprint and provided a structured view of the emissions drivers across its operations and value chain. As part of the engagement, DNV delivered a GHG emission verification statement highlighting data gaps and improvement opportunities, enabling CSWO's environmental analysts to refine their methodologies and address inconsistencies.

According to CSWO ESG Data Specialist Lasse Cenholt Jensen, the decision to seek third-party verification was motivated by the need for a reliable foundation for future emissions reporting and target setting. Verification improves confidence in the numbers and supports informed dialogue with customers.

The verification process also contributed to capacity-building within CSWO. Working through the assurance findings strengthened the analytical capabilities of the ESG team and improved internal data governance, enabling management to draw on a clearer evidence base when considering strategic options for emissions reduction. This includes assessing where abatement opportunities lie within CSWO's direct operations versus its supply chain, and understanding how different scenarios could affect long-term competitiveness under ESG-driven market shifts.

In parallel, this process also reinforced CSWO's transparency with

Scope 1, 2 and 3 Emissions

Under the GHG Protocol, corporate emissions are grouped into three categories:

Scope 1 – Direct emissions from sources a company owns or controls (e.g., boilers, vehicles, on-site fuel combustion).

Scope 2 – Indirect emissions from the generation of purchased electricity, heat, steam or cooling that the company consumes.

Scope 3 – All other indirect emissions connected to the company's activities, covering both upstream and downstream emissions across 15 categories (e.g., purchased goods, business travel, use of sold products, end-of-life treatment).

For most organisations, Scope 3 represents most of the overall footprint, often up to 90%. It is also the least visible, the most complex to quantify and typically the hardest to influence, as it relies on activities outside the company's direct control. As a result, businesses invest significant effort in data collection, supplier engagement and customer collaboration to improve accuracy and drive meaningful reductions across the value chain.

Source: CS Wind


Source: DNV Archive

its customers. Although the company is not currently in scope of the EU Corporate Sustainability Reporting Directive (CSRD), it has opted to align with emerging expectations for robust, verifiable climate-related information. This reflects an understanding that value-chain partners increasingly request consistent and independently assured emissions data as part of their own ESG reporting and risk management processes. It also demonstrates efforts to move beyond minimum compliance and towards more transparent and resilient industrial practices.

"CS WIND Offshore is taking an important step by integrating sustainability more proactively into its operations," says Markus Zeitzen, Senior Business Development Manager for ESG at DNV. "This aligns well with our shared ambition to move beyond compliance and support industries in building greater transparency, trust, and long-term resilience."

By establishing a verified baseline and embedding the associated insights into internal planning, CSWO is seeking to prepare for future climate-related regulation and market developments, including the EU Carbon Border Adjustment Mechanism (CBAM) and potential national requirements in Denmark. In doing so, the company illustrates how early investments in ESG data quality and assurance can help offshore wind supply chain actors anticipate policy shifts, respond to stakeholder expectations and integrate decarbonisation into long-term business planning.

Overall, this case demonstrates how going beyond minimum ESG expectations can strengthen internal capabilities, enhance customer value and future-proof a business in the fast-growing and highly competitive offshore wind market.

Note: The reference to the GHG Protocol is included solely for the purposes of this case study and is not intended as an endorsement of any specific reporting framework or methodology being included as mandatory in the project development process. GWEC currently does not have an industry position on this topic.

Case Study – Role of blended finance in wind projects and ancillary infrastructure

Concessional and blended finance can transform the economics of large-scale wind projects in emerging and developing economies by lowering financing costs, improving risk allocation and crowding in private capital, while also funding enabling infrastructure such as ports and grids.[51]

Why concessional and blended finance are needed

Large-scale wind projects in emerging markets often face high-risk premiums, shorter loan tenors, and shallow (or reluctant) local capital markets, which drive up the cost of capital and make tariffs politically or socially unaffordable. Early projects in new markets also carry 'first-of-a-kind' risks associated with untested regulation, inexperienced domestic supply chains and macroeconomic volatility. Commercial lenders price this in through higher interest rates and conservative structures. In this context, concessional finance – public or private capital offered at below-market terms or with higher risk tolerance – acts as a catalyst rather than a permanent subsidy, addressing market gaps where viable wind projects cannot proceed on commercial terms alone, or if they did, would have costs that are politically or socially unacceptable.

Blended finance combines concessional funding with commercial debt and equity in a single capital stack. Public or philanthropic capital takes on risks such as first loss, longer tenor, or local currency, which private investors will not/do not want to bear, thereby improving overall bankability. Development finance institutions (DFIs), multilateral development banks (MDBs), and export credit agencies (ECAs) are central to this approach, offering concessional loans, guarantees and insurance that directly lower financing costs and de-risk projects.

51. International Finance Corporation (IFC), Mobilizing Private Capital: The Role of Blended Finance in a Changing Global Landscape, International Finance Corporation, September 2025, https://www.ifc.org/en/insights-reports/2025/role-of-blended-finance-in-an-evolving-global-context

Role of concessional finance for OFW projects in Vietnam and the Philippines

Source: Innovative Finance Mechanisms for Southeast Asia's offshore wind takeoff, GWEC

Reducing risk and mobilising private capital

Targeted public capital reduces risk at both the macro and project levels, unlocking much larger volumes of private investment.

At the sector or macro level, concessional funding and technical assistance help governments:

- Prepare core infrastructure (ports, grids and maritime access), making project execution more predictable and bankable
- Develop clear policies, auction schemes and permitting frameworks that give investors long-term visibility
- Design bankable offtake and pricing mechanisms, such as PPAs and CfDs, that ensure predictable revenues.

At the project or deal level, concessional and blended instruments address specific financial barriers:

- Concessional loans with lower interest rates, longer tenors and grace periods reduce the weighted average cost of capital (WACC) and thus the levelised cost of electricity (LCOE).
- Guarantees and ECA cover can de-risk up to 80–95% of project debt, extend loan tenors and reduce all-in debt margins by more than 100 basis points, materially improving debt service coverage ratios (DSCRs).
- First-loss tranches, mezzanine finance and grant components can bridge viability gaps where tariffs must remain within regulated ceilings for affordability.

Quantitative modelling for a 500 MW offshore wind project in the Philippines and Vietnam shows that moving from a purely commercial structure to a fully blended structure with concessional debt, grants and ECA guarantees can cut tariffs from clearly unaffordable levels to within the range of national tariff caps, while lowering WACC from roughly 11–12% to around 6–7% and improving DSCRs to robust levels above 2.5x.

Supporting grid, port and supply-chain infrastructure

Many emerging markets lack the grid and port infrastructure necessary for large-scale offshore wind, making early projects more expensive, and raising risk perceptions. Public concessional finance is well-suited to fund and de-risk these shared assets, as they are often owned or regulated by the state and generate broad system benefits. DFIs and MDBs can provide concessional funding and technical assistance for:

- Port upgrades and dedicated offshore wind base ports, including heavy-lift quays, storage and assembly areas
- Transmission expansion and offshore grid connections to integrate large volumes of variable wind
- Supply-chain and vessel investments, sometimes via dedicated regional transition funds that finance service fleets and logistics capabilities.

In the Philippines, ADB is supporting port pre-feasibility studies and environmental and social safeguards for offshore wind, identifying priority ports and underpinning future investment decisions. In Vietnam, regulatory reforms (such as Decree 58/2025) are paired with incentives that lower maritime area fees and commit to long-term power offtake, helping lay the groundwork for grid-connected offshore wind at scale.

Innovative mechanisms for scaling wind and ensuring equitable participation

GWEC analysis shows that innovative, purpose-built financial structures are essential for scaling wind in new markets, where standard project finance struggles to overcome first-mover risks and affordability constraints. Key mechanisms include:

- Layered capital stacks that blend commercial debt, concessional loans, equity, small grant components and ECA guarantees, adjusted over time as markets mature.
- Platform and fund structures (for example, regional transition funds) that pool concessional and commercial capital to support multiple projects or supply-chain investments, rather than one-off deals.
- Climate funds that provide first-loss capital and grants to DFIs and MDBs,

allowing them to stretch mandates and crowd in private financiers at scale.

These mechanisms also support equitable participation in several ways:

- By lowering tariffs through reduced WACC, blended finance helps keep consumer prices within regulated or auction reserve levels, ensuring that low-income households are not priced out of clean power.
- Technical assistance and policy support enable governments to embed local content, labour and community benefit provisions in auctions and PPAs, directing value to domestic firms and workers.
- ECA- and DFI-backed syndications can deliberately include local banks, building domestic financial capacity and giving local institutions a meaningful role in large-scale wind finance.
- Investments in enabling infrastructure (ports, grids) and skills development create long-term economic opportunities in coastal and industrial communities, not just returns for external investors.

Overall, concessional and blended finance do more than close isolated funding gaps; they create a replicable blueprint for turning high-risk, first-of-a-kind wind projects into bankable, affordable assets that anchor new markets. By strategically deploying public and climate capital to reduce risk, mobilise private investment and build essential infrastructure, innovative finance mechanisms become indispensable tools for scaling wind in emerging and developing economies while advancing a fair and inclusive energy transition.

Enabling System-Level Change for Electrification

Grid investment is the top factor enabling economy-wide electrification. Expanding grid capacity so green electrons can travel a greater distance gives large energy consumers more flexibility in location, reducing the need to fund site-specific infrastructure. For example, the Baltic states' synchronisation with continental Europe is a good example of the importance of grid investments. By reinforcing interconnections, upgrading domestic networks and modernising system-control capabilities, Estonia, Latvia and Lithuania expanded access to balancing resources and strengthened electricity security at the system level.[52]

Flexibility is the set of technical, operational and market capabilities that let power systems scale wind power while keeping electricity delivery reliable and affordable. Since wind speeds vary by hour and season, power systems need mechanisms to continuously balance generation and consumption without wasting energy or relying on reserve capacity from fossil fuels. This is where flexibility becomes decisive, thanks to storage (batteries, pumped hydro, thermal storage, long duration underground storage) and/or demand-side response solutions (dynamic tariffs, automated load shifting) that reduce curtailment, smooth peaks and maintain reliability. This increases the system's ability to absorb wind power, improving the investment case for renewables.

Integrated projects combine two or more renewable energy sources (wind, solar, hydro, etc) in the same site, optimising the use of resources, such as the substation. By combining wind with another renewable source and sometimes storage, hybrid plants can deliver a smoother production profile by switching between resources when one is inactive, which improves the stability of the electricity supplied and reduces operational uncertainty. Hybrid projects usually share a single grid connection point, which increases the utilisation of that access capacity through complementary generation profiles. This approach can accelerate project commissioning by avoiding the need to secure a new grid access point, improving project bankability and unlocking further investment.

52. International Energy Agency, Electricity 2026, International Energy Agency, 6 February 2026, https://www.iea.org/reports/electricity-2026

Grids and clean flexibility

The rapid acceleration of wind and solar deployment is reshaping the way power systems work. In many countries, the main constraints for wind power are no longer development costs or licensing issues, but the ability of electricity systems to absorb, transport and balance large volumes of variable renewable energy.[53] As primary bottlenecks to wind power deployment, grid infrastructure and lack of flexibility have become crucial factors in determining whether national electrification strategies can succeed.

Across both advanced economies and emerging markets, insufficient grid capacity is delaying projects, increasing curtailment and prolonging reliance on existing coal and gas assets.[54] Long connection queues, congested transmission corridors and underinvestment in networks are slowing deployment even in countries with strong policy targets and renewables ambition. Rapid growth in electricity demand from new sources, including data centres, electrified transport and heat, and industrial electrification, are further intensifying these challenges, adding strain to already constrained networks. Without decisive action to expand and modernise grids, the pace of wind deployment will remain misaligned with energy security, and economic and climate objectives.

Scaling wind with system flexibility

Grid expansion alone is not sufficient. Power systems with high shares of wind require flexibility to balance supply and demand across multiple time horizons – from seconds and minutes to days and seasons. Clean flexibility solutions, including battery storage, pumped hydro, hydrogen, demand-side response and advanced system operation, are becoming essential components of least-cost, reliable power systems, as they enable large-scale variable renewable energy sources like wind and solar to operate as central pillars of system design by supporting reliability while minimising overall system costs.

A lack of system flexibility is already creating inefficiencies in many regions, causing wind and solar generation to be curtailed[55] while fossil fuel plants remain online to provide balancing services, undermining emission reductions and increasing costs for consumers.[56] In Spain, 19.6% of wind generation was curtailed in May 2025, while France had to curtail 11.2% in August 2025[57] Brazil faced an average curtailment of 20% for wind and solar across all of 2025.[58]

Unlocking clean flexibility enables higher renewable penetration while

reducing the need for expensive fossil backup and overinvestment in fossil generation capacity. Flexibility also improves price stability, dampening volatility in wholesale markets and reducing exposure to fuel price shocks – a growing concern in uncertain geopolitical environments.

Pathways to a clean, modern and flexible grid

Transmission and distribution networks must expand rapidly to connect new wind capacity, reinforce weak nodes and enable power to flow efficiently across regions. This requires substantial investment. Digitalisation and advanced grid management are equally critical to optimise existing assets, improve forecasting and manage increasingly complex power flows. In emerging markets especially, mobilising investment at scale will require regulatory reform, long-term planning certainty and the strategic use of concessional and blended finance to reduce risk and crowd in private capital.

Regional and cross-border cooperation can play a decisive role in strengthening grid resilience and system efficiency. Interconnected power systems allow countries to share renewable power and balancing resources, smooth variability, and reduce overall system costs. This is particularly relevant in regions with complementary wind and solar profiles, or where demand centres are unevenly distributed. A good example is the Iberian Peninsula in Europe, where increased interconnection capacity between Spain and France – including the Bay of Biscay link – is designed to reduce system isolation, enhance renewable integration and improve market efficiency.[59]

Policy and regulatory frameworks must evolve to adopt a system-level approach to building an electrified economy. Grid planning should align with renewable deployment targets, industrial policy and long-term electrification strategies, rather than react incrementally to individual project connection requests.

Streamlined and transparent connection processes, with clear timelines and responsibilities, will reduce uncertainty for developers and investors. A market design that rewards flexibility and system services will ensure that storage, demand response and other solutions can compete on a level playing field.

Grids and flexibility are enabling infrastructure for the electrified era: investment in networks and system capabilities delivers benefits far beyond the power sector, underpinning industrial competitiveness, digitalisation and economic growth. Countries that move early to address grid bottlenecks and scale clean flexibility will be better positioned to capture the full value of wind energy, reduce exposure to fossil fuel volatility and deliver secure, affordable electricity systems.

In the years ahead, winning with wind will depend less on turbine technology and more on system readiness. Grids and clean flexibility are the foundation of the energy transition. Aligning policy, planning and investment around this reality is essential to unlocking the next phase of wind growth and capturing lasting economic and social benefits from electrification.

53. International Energy Agency, Grid Congestion Is Posing Challenges for Energy Security and Transitions, IEA (Commentary), 25 March 2025, https://www.iea.org/commentaries/grid-congestion-is-posing-challenges-for-energy-security-and-transitions
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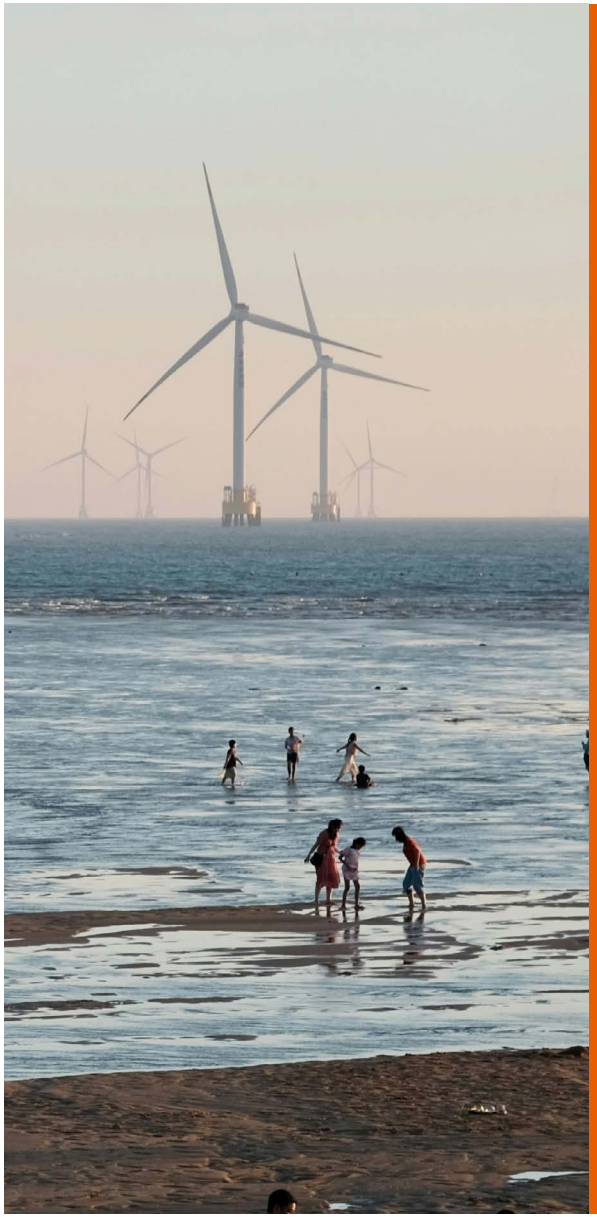
57. Eva Brendel, Spain, France, Germany Curtail a Record Amount of Wind Power, Bloomberg, October 8, 2025, https://www.bloomberg.com/news/articles/2025-10-08/spain-france-germany-curtail-a-record-amount-of-wind-power
58. Alessandra Neris, Brazil Curtails 20 % of Solar and Wind Output in 2025, With Losses at $1.2 Billion, pv magazine International, February 2, 2026, https://www.pv-magazine.com/2026/02/02/brazil-curtails-20-of-solar-and-wind-output-in-2025-with-losses-at-1-2-billion/
59. European Investment Bank, Bay of Biscay Interconnection — PCI, European Investment Bank, 19 June 2025, https://www.eib.org/en/projects/pipelines/all/20230373



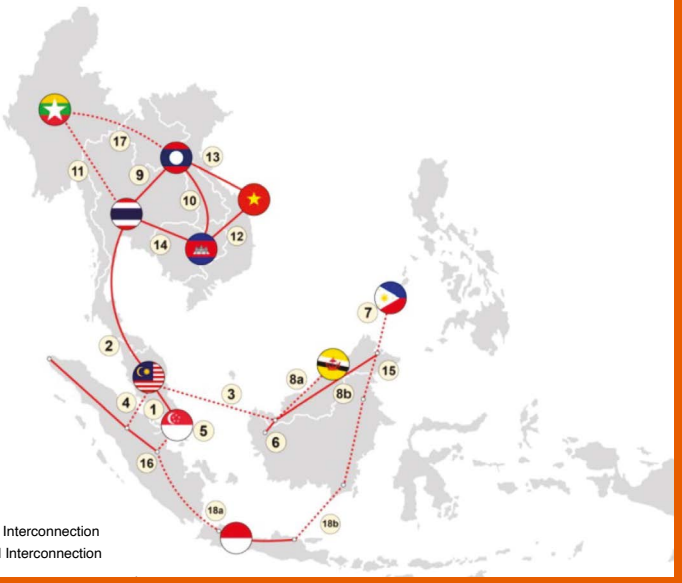
Case Study – Accelerating power grid connectivity in Southeast Asia

Industrialisation, digitalisation and carbon neutrality ambitions are driving electricity demand in Southeast Asia. According to the ASEAN Centre for Energy's estimates, the region's renewable potential stands at 8,119 GW of solar and 342 GW of wind capacity.[60] The region aims for a 32% share of renewables in total primary energy supply (TPES) by 2030 and 52% by 2040, according to the ASEAN Renewable Energy Long-Term Roadmap[61] Harnessing these indigenous sources can leverage new markets. Nevertheless, delivering these commitments while maintaining energy security and affordability will require rapid acceleration of RE development.

Strengthened connectivity plays a crucial role. The ASEAN Power Grid (APG) in overview of the ASEAN power grid capacity, has long been envisioned as a network of cross-border interconnections linking member states. It aims to accelerate resource sharing, reduce system costs and enhance resilience while providing benefits to the region's sustainable growth. APG has proven that electricity trade between nations can happen with its first multilateral agreement, the 2022 Laos-Thailand-Malaysia-Singapore (LTMS) power interconnection project – a strategic enabler of large-scale RE investments and regional decarbonisation. In phase 1 (2022–2024), 100 MW of hydropower was exported to Singapore, with a total 266 GWh of electricity traded over the period. Thanks to its extension to 2026, the LTMS is expected to increase power trading capacity to 200 MW.

Growing renewable electricity demand, pressure to enhance the Renewable Energy Certificate (REC) market, energy security imperatives and increased investment in renewables are strengthening political momentum behind the APG. In 2025, ASEAN endorsed an enhanced MOU for the project, and the ASEAN Centre for Energy was assigned to drive progress, including on fostering MDB participation to

Overview of the ASEAN power grid capacity[62]



60. ASEAN Centre for Energy, ASEAN Power Grid Updates, ASEAN Centre for Energy, 2025, https://aseanenergy.org/
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62. Heads of ASEAN Power Utilities/Authorities (HAPUA), HAPUA Working Group 2 at the 41st HAPUA Working Committee Meeting, HAPUA, 2025, https://hapua.org/
63. ASEAN Centre for Energy & Huawei, Building Next Generation Data Center Facility in ASEAN, ASEAN Centre for Energy & Huawei, 16 May 2024, https://aseanenergy.org/publications/building-next-generation-data-center-facility-in-asean
64. Andrew Tang, Southeast Asia's 2 GW Cross-Border Offshore Wind Scheme Targets 2034 Buildout, Offshore Engineer, October 22, 2025, https://www.oedigital.com/news/531394-southeast-asia-s-2gw-cross-border-offshore-wind-scheme-targets-2034-buildout

support financial viability in an interconnected grid.

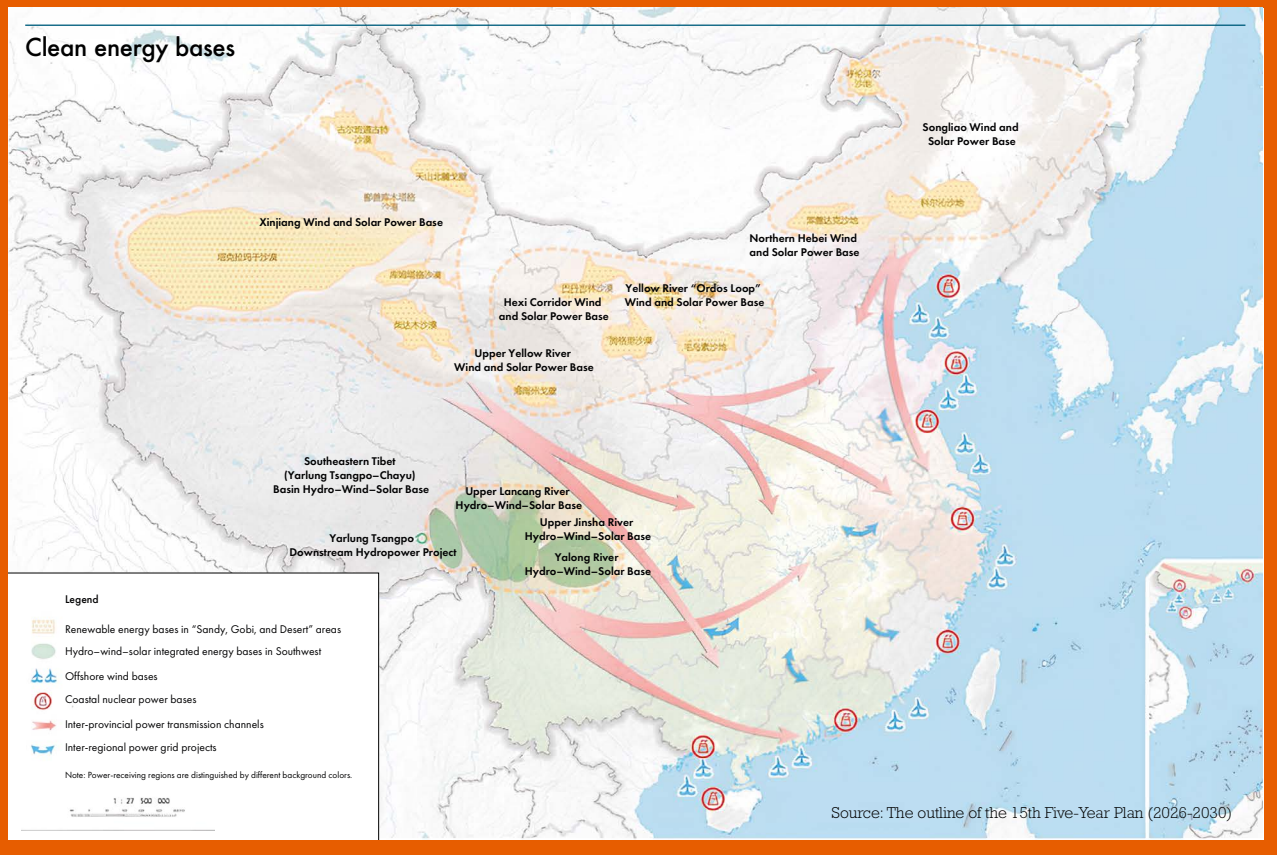
However, a lack of clear cost-sharing mechanisms, social licence, regulatory alignment and a fully integrated regional market remain as barriers. Most national grids in Southeast Asia were designed for domestic markets, not massive cross-border transactions. Policymakers need to prioritise harmonised technical standards and wheeling charges, establish transparent multilateral trading arrangements, and deploy blended finance mechanisms to de-risk strategic interconnectors. The region's consensus-driven governance model lacks a central authority to enforce these regulations effectively. On a more positive note, APG – once seen as a risk to national security – is increasingly recognised for its role in powering the future.

For the wind sector, the benefits of cross-border interconnection are particularly compelling. High-quality onshore and offshore wind supply is concentrated in Vietnam and the Philippines, while major load centres include Indonesia, Thailand, Malaysia and Singapore. The value of ASEAN's burgeoning data centre sector is projected to reach USD 1 trillion by 2050.[63] Malaysia has plans to develop a 2 GW offshore wind project by 2034 linking Vietnam, Malaysia and Singapore for local consumption and electricity export.[64] A strong regional transmission system would allow surplus generation in resource-rich areas to flow to high-demand markets improving system flexibility while lowering integration costs, reducing revenue volatility, strengthening project bankability and mitigating wind curtailment.

The APG offers a pathway to system-wide cost optimisation and resilience while providing the market depth and certainty that investors need to mobilise long-term capital. In this Electrotech era, the technology industry will serve as a catalyst to absorb high renewable penetration. The focus must be on execution – turning regional commitments into clear, workable arrangements.

Case Study – China's system-level power sector transformation under the 15th Five-Year Plan

Since the 14th Five-Year Plan (2020-2025), the development speed and scale of wind power and solar power in China have been unprecedented. By the end of 2025, the total installed wind and solar capacity reached 1.84 TW, accounting for 47% of all power installations, surpassing thermal power and becoming the largest power source in the system, laying a solid foundation for the country to achieve the country's ''30-60'' goals of carbon peaking by 2030 and carbon neutrality by 2060. The Chinese government starts preparing for the system-level transformation for the power sector toward the end of 14th Five-Year Plan period, with preliminarily establishing a 'new energy system' now as its overall goal for the 15th Five-Year Plan period (2026-2030). Although the official 'Five-Year Energy Plan' is not released yet by Chinese NEA, the following action plans presented by the energy policy body through varies notices in the past six months have clearly shown how the country wants to achieve their goal.



Source: The outline of the 15th Five-Year Plan (2026-2030)

15th Five-Year Plan: key areas of focus

Renewable energy development targets	• Wind and solar capacity will continue to expand rapidly. Under China's latest NDC commitment of 3.6 TW of total wind and solar capacity by 2035, at least 200 GW of wind and solar capacity is expected to be added per year in 2026-2030. • Renewable generation will gradually cover the incremental growth in electricity demand, with wind and solar power generation projected to represent over 30% of all power generation by 2030.
Repositioning thermal power in the new energy system	• To support renewables as the backbone of the new energy system, coal-fired power plants are expected to be used primarily for system reliability and flexibility services rather than for generation. • Introducing capacity pricing mechanisms for coal power, regulators will require that at least half of the fixed costs be recovered through capacity payments, providing compensation for the balancing services of thermal power plants.
Policies supporting electrification and power-to-X applications	• The electrification of end-use sectors will continue to expand, with the share of electricity in total final energy consumption expected to increase by around one percentage point per year. By 2030, the electrification rate is projected to reach about 35%, exceeding the OECD average by 8–10%. Policies will promote electrification across industry, buildings and transport. Green electricity consumption will expand in industrial clusters, including through the development of zero-carbon industrial parks that prioritise direct renewable power supply. China plans to establish around 100 zero-carbon parks by 2030. • Policy guidance encourages the development of renewable energy in coordination with local demand and industrial applications. This includes on-site consumption, integrated energy services and renewables-based industrial clusters, helping expand consumption pathways for clean electricity. • Beyond direct electricity consumption, indirect electrification pathways will also expand through power-to-X applications. China is accelerating the development of wind-solar-hydrogen integrated bases, supporting electrolytic hydrogen production and the coordinated deployment of hydrogen storage facilities. These initiatives aim to use renewable electricity in non-power sectors – particularly steelmaking, chemicals and sustainable fuels – through green hydrogen, ammonia and methanol.
Grid infrastructure and system flexibility	• Grid infrastructure and interregional transmission will be significantly expanded. State Grid plans to invest around RMB 4 trillion (USD 600 billion) during the 15th Five-Year Plan period, roughly 40% more than in the previous Five-Year Plan. Construction of new ultra-high-voltage (UHV) transmission corridors will accelerate, with interprovincial transmission capacity expected to increase by more than 30% by 2030. This will support large renewable energy bases in remote regions, as well as hydropower/renewable clusters in southwest China. • New energy storage is among the top six emerging pillar industries in the Five-Year Plan. It will play an important role in providing system flexibility, with capacity projected to reach 300–400 GW by 2030. Pumped-storage hydro-power could exceed 100 GW, providing critical balancing capacity for variable renewable generation. • Policy mechanisms are also evolving to recognise the system value of flexibility resources. In January 2026, China introduced a revised generation-side capacity pricing mechanism that formally includes grid-side independent energy storage. This will allow such projects to receive capacity payments for their reliability contribution to the power sys-tem.

Impact of technology and use of AI

Wind power has already become the leading electricity generation source in major economies. With electrification taking place in hard-to-abate industries and transport, the demand from variable renewable generation is expected to increase rapidly. Wind power is ready to play a pivot role in meeting rising demand. In a renewable energy driven power system, however, the power system is becoming more interconnected and complicated than the current energy system. Higher penetration also brings greater volatility, tighter grid constraints, and stronger market competition. In this evolving environment, artificial intelligence is emerging as a practical enabler and presents a transformative opportunity to address those challenges in a 100% renewable power system. From resource assessment and project development (AI weather forecast model) to intelligent manufacturing (AI products), operational optimization (AI wind farm), and market participation (AI Grid and Trade), AI enhances forecasting accuracy, production quality, asset performance, trade and revenue management, helping wind power integrate more effectively into an increasingly complex energy system.

1. Enhancing Wind Resource Assessment and Site Optimization

In the development phase, AI strengthens wind resource assessment by integrating meteorological data, terrain information, and historical wind records into machine learning models. It can process large-scale meteorological data, including wind speed, direction, turbulence intensity, etc. This leads to more reliable long-term production estimates and helps to increase efficiency during analysis processes. AI also supports site selection and layout optimization by integrating GIS data with multi-criteria analysis. The advanced algorithms simulate airflow interactions between turbines and optimize spacing and layout. By reducing wake effects (upstream turbines lower wind speed for downstream units), the overall site efficiency can increase without additional capacity installation.

2. Improving Intelligent Manufacturing

AI-driven manufacturing can contribute to design optimization and product quality control while increasing production efficiency.For example, genetic optimization can refine blade aerodynamic profiles, improving lift-to-drag ratios, and energy capture efficiency. [65] At the factory level, data analytics enable tighter control over temperature, vibration, and pressure conditions during production, improving quality consistency. Intelligent systems increasingly support automated quality inspection, detecting surface defects and dimensional deviations more accurately than manual checks. At the system level, AI-based simulations identify structural weak points across component interfaces, enhancing overall turbine reliability.[66] Furthermore, AI plays a growing role in supply chain management. Demand forecasting models analyze historical orders, market trends, and customer data to optimize production planning. AI-driven supplier assessment and logistics optimization can reduce delivery risks and transportation costs.[67]

3. Intelligent Operations and Maintenance (O&M): Improving Reliability and Output

AI plays a central role in wind farm

operations and maintenance. AI-enabled predictive maintenance models analyze vibration, temperature, and electrical signals to detect early signs of turbine issues such as gearbox wear, bearing faults, or blade damage. AI can also help optimize maintenance scheduling and spare parts allocation, minimizing unnecessary service interventions and reducing downtime while preventing critical failures.

In addition to fault prediction, intelligent control systems adjust blade pitch, rotor speed, and other operating parameters in real time based on wind conditions and grid requirements. By keeping turbines closer to optimal operating states across varying wind speeds, AI-based control strategies can increase overall energy output compared with conventional control methods.[68]

While drone-based inspections reduce manual workload, their application is largely concentrated on turbine structures such as blades and towers. However, a wind farm includes many other assets — including substations, cable systems, and auxiliary facilities — that cannot be effectively monitored by drones alone. As a result, broader intelligent equipment is required, such as fixed cameras, inspection vehicles, and robotic dogs. Managing these devices and diverse data sources requires an integrated AI-based O&M platform capable of coordinating data collection, analysis, and response actions. Therefore, the value lies not only in individual inspection technologies but in building a unified system that connects multiple monitoring tools into a coherent operational framework.

As wind farm operators and turbine suppliers increasingly rely on advanced technologies and digital solutions, the OPEX costs are being significantly reduced while the broader challenge of labor shortages in this sector is also being addressed due to improved efficiency.[69]

4.Power Market Participation and System Integration

Beyond asset-level performance, AI increasingly influences how wind power participates in electricity markets and interacts with the broader power system. Advanced forecasting models improve the accuracy of electricity price, load demand, and renewable output predictions, providing a stronger basis for both near-term and long-term trading and intelligence dispatch decisions. By combining generation forecasts with price signals, AI can optimize energy storage system (ESS) charging and discharging strategies, being flexible and storing electricity during low-price periods and releasing it during peak demand to improve value capture. AI-driven trading agents further support dynamic bidding strategies, balancing long-term contracts and spot market exposure while enabling participation in ancillary service markets such as frequency regulation.

At the system level, AI enhances grid flexibility and resilience. Real-time load forecasting, power flow analysis, and automated risk assessment significantly shorten dispatch decision cycles, allowing system operators to respond more quickly to renewable variability and sudden demand shifts. AI-supported grid automation improves fault detection and service restoration speed, strengthening system stability. By optimizing coordination among different renewable generation and storage assets, AI reduces curtailment and supports higher renewable penetration. As power systems become more complex, AI functions not only as a revenue support tool for individual assets, but also as an enabling technology for more stable and efficient electricity systems.

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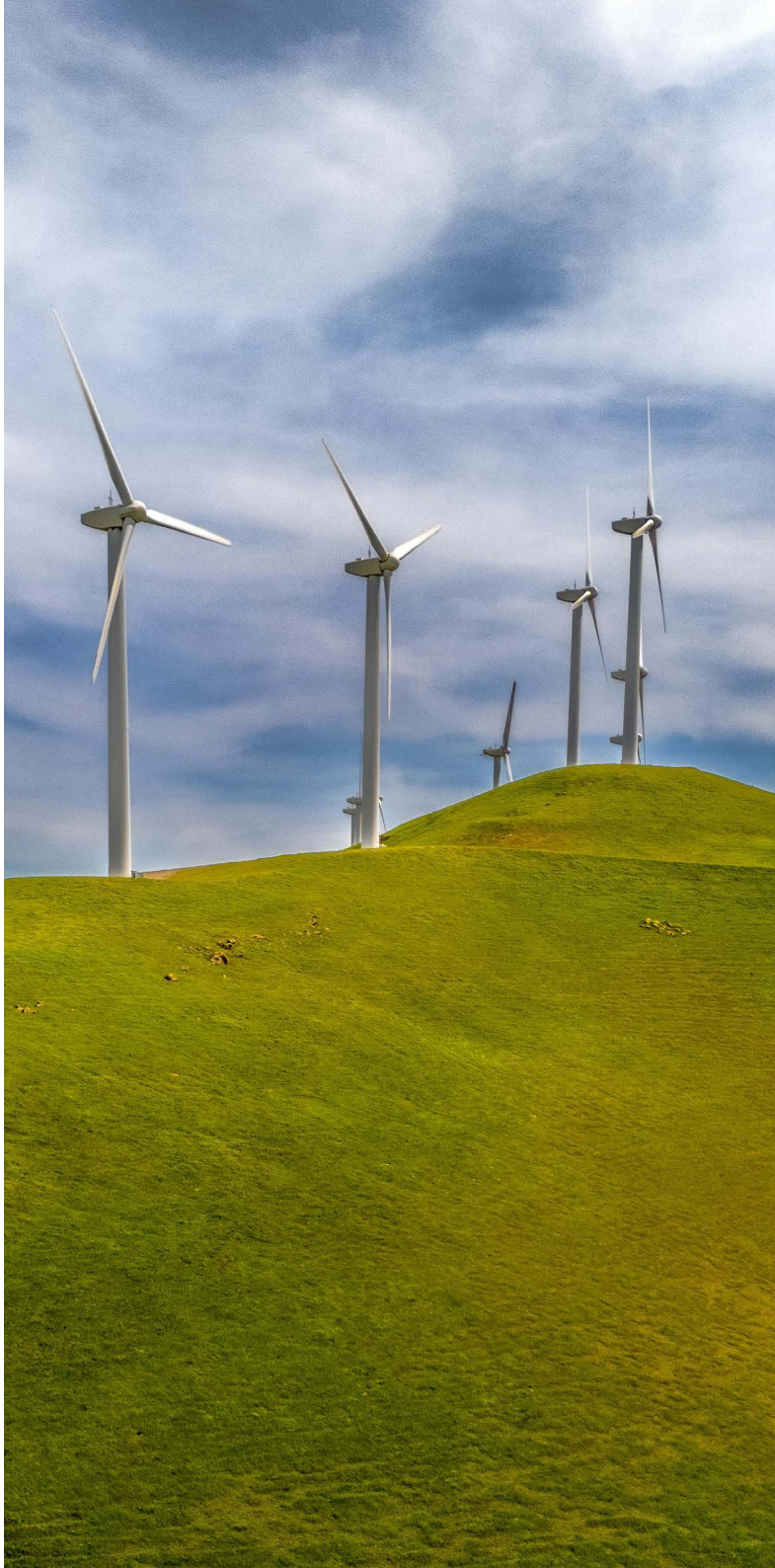


Case Study – Advancing composite innovation through sustainable materials

Provided by Techstorm

Alongside turbine scale and deployment speed, material innovation also strengthens competitiveness, resilience and long-term sustainability. As countries accelerate electrification and industrial decarbonisation, advanced composite materials are becoming a strategic enabler of the energy transition.

Fiber Reinforced Polymer (FRP) composites sit at the centre of modern wind turbine design, enabling lightweight, high-performance and long-lasting components. Recent innovations are accelerating the reduction of FRP carbon footprints.

Historically, thermoset composites have posed end-of-life challenges due to their crosslinked chemistry. Innovation has allowed for recyclable thermoset systems. Achieving 'fit-for-function' recyclable materials without compromising mechanical performance has been demonstrated at industrial scale.

To make circular composites scalable and commercially viable, three system-level innovations must converge:

- Development of recyclable, high-performance resins
- Commercialisation of cost-effective recycling processes, including solutions for low-value materials such as fiberglass
- Adoption of recovered materials in new applications and markets.

Techstorm has developed a vitrimer-based recyclable resin platform coupled with a targeted degradation solution to enable practical recycling. The recyclable epoxy pultrusion system, commercialised in 2024, has so far delivered more than 900 metric tonnes – equivalent to approximately four million meters – of wind turbine blade spar planks.

The innovation directly addresses manufacturing waste streams at pultrusion and blade production sites, turning what was previously a disposal cost into a recoverable resource stream. Vartega, a carbon fibre recycling specialist in Denver, Colorado, has validated the recyclability of Techstorm-based spar planks, demonstrating technical viability. The next phase is a pilot-scale recycling facility exceeding 20 metric tonnes per year, which will quantify energy intensity, validate cost models and optimise pathways towards commercial-scale deployment.

Meanwhile, development continues on recyclable systems for infusion processes, hand lay-up applications and structural adhesives. The objective is to extend recyclability across all major FRP manufacturing methods.

Reducing carbon footprint also involves upstream raw materials. The use of bio-based resins in high-volume structural applications remains limited. The carbon reduction potential of plant-based bio-resins lies in the differential between the CO2 absorbed during plant growth and that emitted during product manufacturing. Techstorm is planning a supply chain shift toward fully plant-based bio-glycerin ECH (epichlorohydrin), enabling up to 50% CO_2 reduction in epoxy systems. Future investigations will establish whether bio-based BPA can be used to further improve sustainability.

Beyond resin systems, structural core materials present additional opportunities for carbon reduction. PET foam cores are already recyclable, and post-consumer recycled rPET further lowers production emissions. Advancements in bio-plastics, partly driven by large beverage industry investments, are expanding opportunities for bio-based structural core materials. TechFoam, a subsidiary of Techstorm, is currently developing a 100% plant-based structural foam core that aims to further reduce the already low carbon footprint of PET foam.

Advancing sustainable composites is complex and capital-intensive. It requires coordinated material innovation, process reflection, continuous investment and market uptake. Yet, in the age of electricity, these investments are not optional; they are strategic.

The convergence of recyclable thermosets, scalable recycling technologies and bio-based feedstocks positions the wind industry to lead not only in clean power generation, but in next-generation materials manufacturing, an example where circularity is paired with performance, and scale with sustainability.

Techstorm remains committed to accelerating this transition, specifically helping ensure that the materials powering the wind industry are as forward-looking as the turbines themselves.

TECHSTORM

Integrated project models: wind, storage and industrial energy systems

As renewable energy penetration grows, the structure of wind projects is changing. For many years, the standard model was simple: build a wind farm, connect it to the grid and sell the electricity. That approach still works in some countries, but is becoming less practical in others as systems become more complex and demand patterns shift.

In power systems with high shares of renewables, the value of a project goes beyond generation output. It also depends on when the electricity is delivered, how predictable the output is, and whether the project can support system operation. This shift in priorities is prompting developers and policymakers to pursue integrated project models that combine wind with storage and flexible demand.

Wind-plus-storage projects are the most visible example. Adding battery storage allows operators to smooth short-term fluctuations, shift output to higher-value demand periods and provide grid services such as frequency response or peak capacity. In markets with price volatility or limited system flexibility, this can improve project economics while reducing the need for fossil-based balancing plants.

Pairing wind with storage helps make projects more dispatchable and bankable, strengthening the role of wind in delivering renewable energy to reach energy security and economic targets. Australia is one of the leaders in this space. In 2025, Swedish developer OX2 acquired the 1.2 GW Dinner Hill wind farm,[70] co-located with the Harvest battery energy storage system (BESS). The BESS project is being developed as a 100 MW/400 MWh four-hour system designed to support grid stability and enable greater integration of renewable generation in Western Australia.

In emerging markets, integrated projects can help overcome grid limitations. Where transmission expansion takes time, co-located generation and demand can enable projects to move forward while broader network upgrades are planned. At the same time, these developments can support industrial activity, local value creation and energy security.

Integrated models to power industry and infrastructure

Integration is also happening across technologies and demand sources. In several countries including China, South Africa and Brazil, wind is being co-located with solar to optimise land use, grid connections and transmission capacity. In India, ArcelorMittal is developing a hybrid portfolio that includes a project in Bachau, Gujarat, combining 250 MW of wind (in partnership with Suzlon), 300 MW of solar, and 300 MWh of integrated battery storage.[71] Once operational, the company estimates the project could avoid around 0.9 million tonnes of CO2 per year by displacing higher-emitting power used in its steel manufacturing operations.

In other cases, wind projects are being developed alongside industrial facilities, including hydrogen production, ammonia plants and other energy-intensive processes. These configurations help match renewable supply with high-demand sectors and

70. George Heynes, OX2 Acquires Co-Located Wind and BESS Developments in Western Australia, Energy-Storage.News, November 19, 2025, https://www.energy-storage.news/ox2-acquires-co-located-wind-and-bess-developments-in-western-australia/

71. Organisation for Economic Co-operation and Development (OECD), Case Study NEOM — ENOWA/NEOM Green Hydrogen Company, OECD CEFIM (Clean Energy Finance and Investment Mobilisation) Case Studies on Green Hydrogen, OECD, 2025, https://www.oecd.org/content/dam/oecd/en/about/programmes/cefim/green-hydrogen/NEOM-case-study.pdf

can reduce pressure on constrained grids. For example, Saudi Arabia's NEOM Green Hydrogen Company (NGHC) combines onshore wind and solar power generation with hydrogen production and ammonia export infrastructure.[72] One of the main advantages is the 30-year offtake agreement with Air Products for all green ammonia produced. What makes this structure attractive is the risk and incentive alignment across the value chain: Air Products is an offtaker, the EPC contractor and system integrator. This setup materially reduces investment risk and supports project financing, limiting the partners' guarantees and liquidity exposure while allocating key delivery and technology risks to parties with the capability and balance-sheet incentive to manage them.

Large electricity consumers are also shaping new project models. Data centre operators, for example, are seeking long-term contracts for reliable clean power to meet emission targets and respond to a surge in demand. Some corporates are pushing for hourly matching as an approach to reporting on electricity consumption and carbon accounting, whereby the volume of electricity demand is met with an equivalent volume of renewable generation at the same time.

This is encouraging the development of wind projects designed around specific demand centres, creating more stable revenue streams and clearer investment signals. For instance, a self-generation arrangement between data centre company Ascenty and Casa dos Ventos, the largest wind energy generator in Brazil, will see Ascenty take an ownership stake in a wind project and a solar project under development.4 In such self-generation contracts, the offtaker generates its own electricity either on-site or through remote generation; as the consumer contributes to expanding installed renewables capacity, it may also qualify for regulatory and tax advantages.

Overall, integrated project models reflect a system-oriented approach to wind deployment. They improve the value of renewable generation, reduce operational risks and help align new supply with the evolving structure of power demand in an increasingly electrified economy. Encouraging these models through appropriate regulation and planning will be important for the next phase of wind growth.

72. Melina Marques, Casa dos Ventos and Ascenty Announce the Largest Energy Contract for Data Centers in Latin America, Ascenty, January 16, 2026, https://ascenty.com/en/blog/news-ascenty-en/casa-dos-ventos-and-ascenty/

Recommendations to incentivise hybrid projects

Efficient grid access
- Create or improve interconnection rules for hybrid plants
- Allow shared grid connection points for multiple assets (wind + solar + BESS + load) under one connection agreement
- Standardise flexible connection contracts to speed up access where grids are constrained

Improve hybrid project economics
- Ensure storage and hybrids can earn revenues in various forms, e.g. energy arbitrage, ancillary services, congestion/local flexibility services
- Clear rules to avoid double-charging for storage charging/discharging
- Allow aggregators and hybrid operators to participate in flexibility markets

Fiscal incentives
- Tax credits for storage and control systems when co-located with a renewa-ble energy source
- Import tax relief for equipment
- De-risk public financing, such as via guarantees, concessional debt or CapEx loans

Streamlined permitting
- One-stop-shop permitting for hybrid projects
- Prioritise hybrids in constrained zones where they relieve grid congestion

Digitalisation
- Require SCADA, forecasting and automated dispatch capability for hybrid sites
- Enable real-time operational coordination between TSOs/DSOs and hybrid operators
- Use digital tools to operate flexible connections and local flexibility markets

Source: Goldwind's wind-powered green methanol project in Xing'an League, Inner Mongolia

Case Study – Shift from LCOE to LCOV: redefining wind power value (Goldwind)

Amid China's deepening power market reform, renewable energy is moving towards full market-oriented trading, fundamentally reshaping the revenue model of wind power projects. Demands from project investors and developers have shifted from generating electricity to integrated objectives such as generation scheduling, market trading, pricing strategies and asset value enhancement.

Goldwind holds that the industry's core focus is no longer the Levelized Cost of Energy (LCOE), but the Levelized Value of Energy (LCOV) – a new benchmark replacing LCOE for measuring project competitiveness. This concept redefines market logic, upgrading wind development from equipment price competition to full-lifecycle value management covering meteorological forecasting, intelligent manufacturing, AI algorithms, and unmanned operation and maintenance (O&M). Project operation has evolved from a stable 'factory model' to a profit-driven 'corporate model', requiring accurate generation prediction, market price coupling and flexible intelligent generation to maximise returns.

To achieve this goal, Goldwind has assembled a professional team of over 200 members and developed a new generation of intelligent power forecasting technology, extending its digital capabilities from 'smart' wind turbines and 'smart' wind farms to 'smart' operation and management'. This technology improves spatial forecasting resolution from kilometre level to 100-metre level and enables deep integration with trading strategies.

At a wind farm in Shanxi province, Goldwind's self-developed Tianji Electricity Trading Cloud Platform integrates meteorological insights with trading strategies to optimise decisions under weather uncertainty, unifying weather-driven and market-oriented trading. As a result, the farm achieves 92% day-ahead power forecasting accuracy, with an average settlement price 120% of the market average, boosting annual revenue by nearly RMB 10 million (USD 1.46 million).

In intelligent manufacturing, Goldwind prioritises a 25% improvement in aerodynamic efficiency over simply enlarging rotor size, developing truly market-oriented turbines that can flexibly adjust output based on electricity price signals. In smart operations, innovations such as the wind-storage integrated system enable peak-valley arbitrage, turning rigid costs into flexible, value-creating assets.

Transforming from an equipment supplier to an energy asset manager, Goldwind leverages full-lifecycle digital management to maximise market revenue. Projects including its wind-powered green methanol initiative in Xing'an League, Inner Mongolia, further extend wind power value into the green chemical sector, demonstrating its strong potential to drive the global energy transition and industrial upgrading amid the electrification wave.

Case Study – Repowering Egypt's Zaafarana wind project

The Zaafarana wind project, located approximately 130 km southeast of Cairo in the Suez Governorate, is Egypt's first utility-scale wind farm. It comprises 700 turbines with a combined capacity of 545 MW, making it one of the largest wind farms in the MENA region. Developed by the New and Renewable Energy Authority (NREA)[73] with support from international partners such as KFW and DANIDA, Zaafarana has significantly contributed to Egypt's renewable energy goals, offsetting approximately 648,000 tonnes of CO_2 emissions annually.[74]

As some of the turbines (Nordex, Gamesa and Vestas) installed in the earlier phases of the Zaafarana project approach the end of their operational life, the government plans to repower the site with a hybrid wind and solar facility totaling 5.2 GW – one of the first wind repowering initiatives in the region.[75] The repowering project has been preliminarily awarded to Alcazar (phases 1–4) and a consortium of Taqa Arabia and Voltalia (phases 5–8).[76] This aligns with the government's broader policy to increase private sector participation and gradually divest state-owned energy assets.[77]

Why repower?
Repowering involves replacing or upgrading existing turbines with newer models that offer higher capacity, improved efficiency and advanced grid compatibility. New turbines typically feature larger rotor diameters, higher hub and tip heights, and more advanced control systems, allowing them to capture more wind energy from the same site. In Zaafarana, fewer turbines could generate much more energy.[78] In addition, Zaafarana's proximity to transmission infrastructure provides an ideal setting for repowering.

Economic considerations
From an economic standpoint, repowering Zaafarana aligns with both cost optimisation and revenue maximisation objectives. Older turbines often incur high maintenance costs and experience frequent downtime, reducing project profitability. In Zaafarana, several turbines have been decommissioned early due to the lack of spare parts for older models. Newer technology delivers higher energy yield per megawatt and longer lifespans, which improves the project's LCOE.

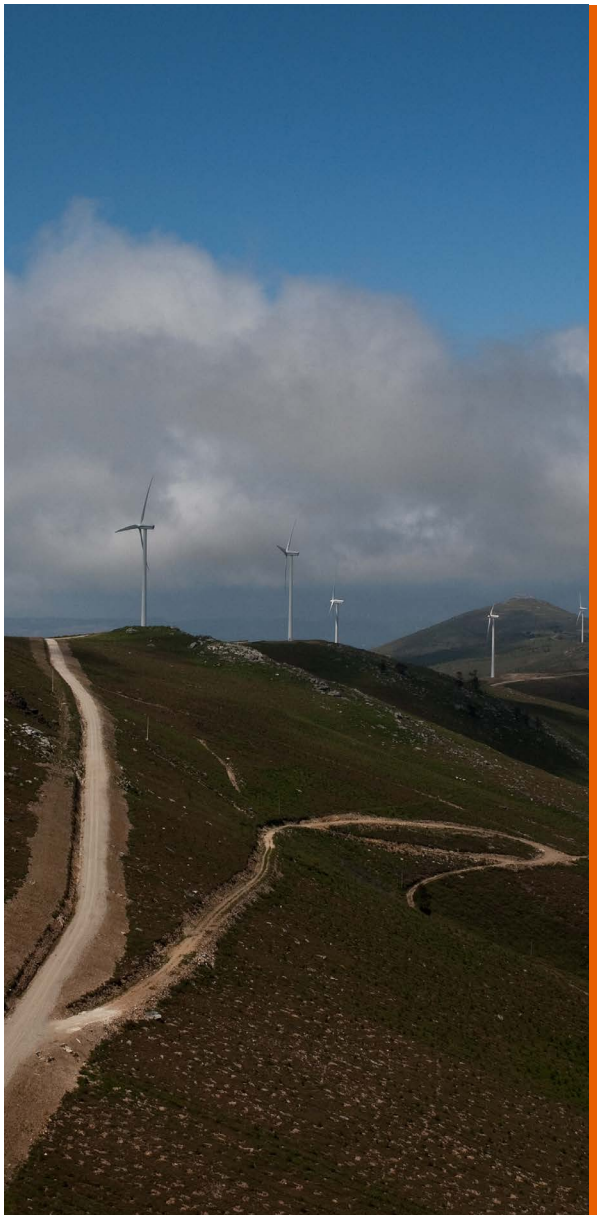
Permitting
In Egypt, permitting is centralised under a single government entity, which is responsible for project approvals and owns ownership rights over renewable energy land plots through a Presidential Decree. This should streamline the repowering process.

Environmental and social impacts
The Zaafarana wind project is located along the Red Sea Rift Valley flyway, a globally important migratory corridor for endangered and vulnerable bird species. As a result, potential impacts on birds represent the primary environmental consideration associated with the site, given the plan to install much taller turbines. The repowered wind farm will require detailed coordination on bird monitoring with the Ministry of Environment and RCREEE through the Active Turbine Management Programme, a national initiative launched in 2015.

The repowering of Zaafarana, along with the transfer of ownership from a government-owned entity to a private sector player, will be the first initiative of its kind in Egypt, and potentially the region. The project will need to move from a PPA between two government entities (NREA and EETC) to a BOO structure with private sector involvement, requiring careful public-private coordination.

As a flagship project, the Zaafarana repowering highlights Egypt's ambition to maximise existing wind sites and boost output to meet the demands of the electrification era.

73. New and Renewable Energy Authority is a governmental entity, initially set up to develop renewable energy projects. It sits under the Ministry of Electricity and Renewable Energy
74. Power plant profile: Zafarana, Egypt, Power-Technology.com, 14 October 2024 (updated), https://www.power-technology.com/data-insights/power-plant-profile-zafarana-egypt/
75. Richard Heap, Voltalia and TAQA Commit to 3.2 GW Zafarana Wind Farm Repowering, Tamarindo, November 15, 2024, https://tamarindo.global/stories/voltalia-and-taqa-commit-to-3-2gw-zafarana-wind-farm-repowering/
76. Framework agreements have been signed for developers to commence development
77. Winter Said & Chao Deng, Saudi Arabia, Gulf Countries Want Better Returns for Bailing Out Egypt, Financial Times, July 12, 2023, https://www.ft.com/content/986f2f92-3aac-4b3f-a748-e515a0127ef1
78. The repowering of Zaafarana is expected to increase the original capacity ten-fold, including both wind and solar



Case Study – Unlocking hidden value in ageing wind fleets through data-driven repowering

Provided by Solida, a Bureau Veritas Company

Wind farms across Europe and other mature markets are reaching 15-25 years of operation and owners are increasingly struggling with declining energy yields, higher corrective maintenance costs, and regulatory pressures to modernise assets. Identifying whether to repower, partial-repower, or continue operating requires a bankable, data-driven assessment rather than assumptions or simple performance heuristics.

Solida, recently acquired by Bureau Veritas, has become part of the company's Global Delivery Platform for Advisory & Engineering. It provides objective analysis to help owners determine the true value and risk profile of ageing wind assets.

A Real-World Case: Revealing the Financial and Technical Upside of Repowering

In 2025, Solida was engaged to assess an ageing onshore wind farm in the Iberian Peninsula consisting of **30 turbines of 0.85 MW**, each in service for nearly two decades. Although the operator expected some degradation, they lacked clarity on:

- the magnitude of long term production losses,
- the root causes (component degradation vs. wake effects vs. terrain misalignment),
- the site's suitability for newer turbine models, and
- whether repowering would be economically viable under evolving regulatory frameworks in Spain and Portugal

Supervisory Control and Data Acquisition (SCADA) Based Diagnostics

A detailed assessment using more than five years of SCADA data across all turbines delivered a fully bankable performance baseline without requiring new measurement campaigns. The analysis covered operational power curve derivation for each turbine, normalisation to 100% availability to isolate true performance behaviour, long-term correlation with reanalysis datasets to remove interannual variability, flow model calibration to identify wake interactions and terrain-induced losses, and simulation of modern turbine layouts to evaluate repowering potential. The methodology was fully aligned with FGW TR6 (Rev.12) technical guidelines and IEC/MEASNET uncertainty principles.

Key Findings

The results highlighted several important trends. First, long-term degradation was more pronounced than initially assumed, with capacity factors declining close to 10 percentage points. This was attributed to a combination of component ageing, blade wear, and compounded wake interactions across the site. Second, the original turbine layout—designed based on early-stage resource assessments and older turbine technology—was found to be suboptimal under current conditions, with wake losses significantly higher than expected.

At a more granular level, the SCADA analysis revealed consistent underperformance in several turbines relative to their original power curves, pointing to mechanical degradation and alignment issues. It also shows that wake effects had intensified over time, particularly under prevailing wind directions, reducing overall wind farm efficiency. In addition, updated flow modeling indicated that local wind conditions at hub height differed from initial assumptions, reflecting the limitations of early measurement campaigns and reinforcing the value of long-term operational datasets.

After calibrating the flow model using operational data, Solida simulated several modern turbine configurations, assessing:

- wake recovery benefits with taller hub heights
- Terrain induced speedup zones
- extreme wind constraints
- grid connection limits
- permitting boundaries

The optimal layout provided a strong improvement in annual energy production (AEP), even when maintaining the existing substation and road infrastructure.

Regulatory Window Strengthens Business Case

The broader policy environment is shifting in favour of repowering. Several European jurisdictions, including Spain and Portugal, have introduced measures to streamline permitting processes with up to 6 month permitting windows for repowering projects, simplify environmental assessments for projects within existing footprints, and in some cases require clear end-of-life or repowering plans for older assets. These changes are shortening development timelines and reducing uncertainty for asset owners, provided that projects are supported by **bankable repowering assessments early.**

This case demonstrates the value of a **data first approach** in playing a critical role in navigating these decisions. Through objective, SCADA based analysis, Solida enabled the windfarm owner to:

- build a bankable understanding of long-term performance trends,
- quantify the upside of modernization,
- plan repowering in alignment with fastmoving regulatory frameworks, and
- reduce uncertainty before committing major investment decisions.

As Solida continues its integration within Bureau Veritas, these capabilities are expected to play an increasingly important role.

Repowering offers a pathway not only to restore and enhance energy output, but also to align ageing fleets with modern technology standards and evolving regulatory frameworks, if decisions are grounded in rigorous, site-specific analysis.

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CHAPTER 3: MARKETS TO WATCH

APAC & Central Asia

China: shifting from capturing scale to creating value

In 2025, China's wind power industry forged ahead as the sector moved to a more market-driven approach, marking a strategic transformation from scale expansion to value enhancement.

New installations reach a record high

Newly grid-connected wind power capacity in China was nearly 120 GW in 2025, surpassing the previous installation record of xxx GW set in 2024. Cumulative installed capacity reached 640 GW (of which 47 GW offshore), accounting for more than half of the world's installed wind power capacity. Together, wind and solar reached 1,840 GW at the end of 2025, overtaking thermal power installed capacity by about 300 GW. Wind power accounts for 11% of the country's total power generation. All renewable energy sources taken together (hydropower, wind power, solar PV, solar thermal and biomass) generated about 4,000 TWh, accounting for 38% of total power generation.

Strong policy guidance

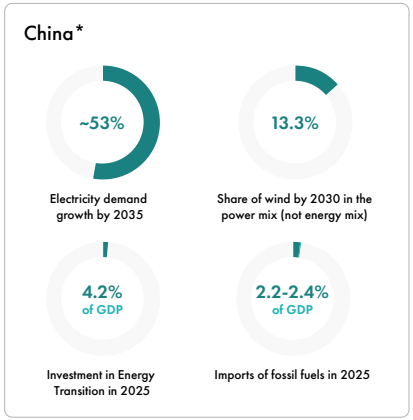
In 2025, national authorities issued a series of policies to drive the industry into a new stage of development. Document No. 136 safeguards project investment returns after new energy fully enters the market by adopting category-specific measures for existing and incremental projects, and by establishing a pricing and settlement mechanism for the sustainable development of new energy.

Integrated development policies promote a new approach to new energy development, construction and operation that affects multiple dimensions. Zero-carbon industrial park policies define key tasks and supporting measures, with an emphasis on a shift from scale expansion to quality improvement. The 'AI+' energy policy sets phased objectives, core tasks and priorities for key technological breakthroughs, accelerating the deep integration of artificial intelligence and the energy sector. Energy equipment policies focus on breakthroughs in core technologies and better operational reliability.

Non-stop innovation

Connecting to the grid its 26 MW offshore wind turbine last November, Dongfang Electric Corporation (DEC) set a new world record.[79]

Digital technologies including AI, big data and cloud computing are now deeply integrated into the wind power industry, turning concepts such as lights-out factories and unmanned wind farms into reality, and injecting new impetus into the intelligent and efficient development of the wind power sector.



New applications of green power

The integrated development of China's wind power has made remarkable progress in multiple fields over the past year. Focusing on key areas such as green hydrogen, ammonia and alcohol, wind-power-aquaculture integration, source-grid-load-storage integration and zero-carbon industrial parks, the industry has accelerated

79. World's first 20-MW offshore wind turbine powers grid in China, Xinhua (China Daily English), February 6, 2026, https://english.news.cn/20260206/6284ae94dd044088b2275dea43abdf6a/c.html — "The 25-MW grid-forming offshore wind turbine has been successfully assembled, the 20-MW floating offshore wind turbine has been hoisted and installed, the 35-kV high-voltage doubly-fed wind generator technology has been officially released, and the 150-meter-scale blade has passed static load testing."

practical exploration. Several projects have been launched, including the supporting wind power project for CESEC Songyuan Hydrogen Energy Industrial Park; Goldwind's wind-solar hydrogen production integrated project in west Inner Mongolia; Envision Energy's 1.52 million-tonne green hydrogen and ammonia project in east Inner Mongolia; and SEWPG's wind power-biomass green methanol integrated demonstration project in Jilin. These projects have not only expanded the application scenarios and development space of wind power, but also provided critical support for decarbonisation in industry, transport and other sectors.

Entering a new era

China has built the world's largest renewable energy system, alongside the most complete new energy supply chain. The wind power community issued the ''Beijing Declaration on Wind Energy 2.0'' at China Wind Power 2025, unanimously agreeing on wind power's key role in achieving the targets of the NDCs. The 15th Five-Year Plan period (2026-2030) expects annual newly installed wind capacity to be no less than 120 GW (including at least 15 GW offshore). China plans to develop strategic projects like wind and solar PV bases in the Three North Regions, integrated hydropower-wind-solar bases in the southwest, and offshore wind power bases. It will also accelerate the development of projects including a network upgrade

programme for electric vehicle charging, integrated wind-solar-hydrogen-ammonia-alcohol bases, zero-carbon industrial parks, and the green transformation of the heating system.

India: exponential wind growth driving decarbonisation and energy security

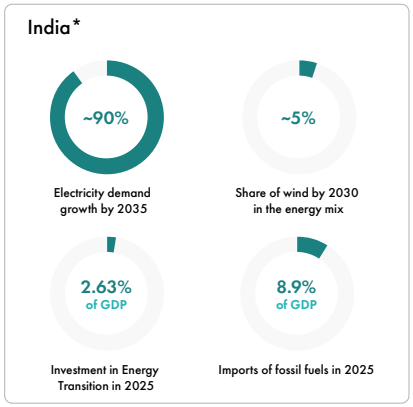
India is one of the world's leading and fastest-growing wind energy markets. Its rapid wind expansion is supported by ambitious renewable energy targets, rising electricity demand, a strong domestic manufacturing base, and the country's broader ambition to pursue a clean, secure and affordable energy transition. With 6.34 GW of new onshore wind capacity added in 2025 – a record high since 2017 and an 85% increase from the previous year – India reclaimed the third position in the global wind market in 2025.

Looking ahead to 2030, India aims to scale its non-fossil fuel energy capacity to 500 GW, of which 100 GW should come from wind, to ensure a balanced and affordable energy mix. To support this objective, the Electricity Amendment Bill 2025 (Draft) introduces the separation of carriage and content (distribution network versus supply) and strengthens competition in power supply. Strengthening Renewable Purchase Obligation (RPO) compliance, improving the financial governance of power distribution companies (DISCOMs), a stronger renewable energy certificate (REC) market, and long-term pipeline visibility are also key priorities.[80]

Support for the domestic supply chain is ramping up too. In the Union Budget 2026, the government announced a concessional customs duty extension on key wind components, such as forged steel rings, to boost localisation. Additionally, wind energy has been included in the National Manufacturing Mandate 2025-2026 to strengthen domestic manufacturing.

Onshore wind – the driving force of India's wind sector

As of January 2026, India had 54.5 GW of installed onshore wind capacity and ranked as the second-largest hub for onshore wind turbine assembly and key component production in the Asia Pacific.[81] New installations are increasingly being driven by hybrid and Firm and Dispatchable Renewable Energy (FDRE) tenders.



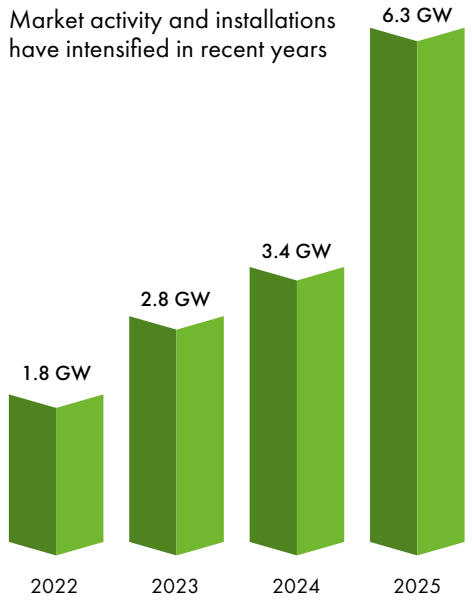
Supportive policy measures include Renewable Purchase Obligations (RPO), the annual 10 GW wind project bidding trajectory, and C&I decarbonisation targets. GWEC Market Intelligence expects more than 40 GW of new onshore wind capacity to be added over the next five years. In parallel, repowering ageing wind farms in states such as Tamil Nadu, Maharashtra and Gujarat is expected to further boost generation from wind.

Despite the momentum, a few challenges must be addressed to meet the 2030 target of 100 GW of wind capacity. State-level operational issues, such as delays in right-of-way approvals, grid connectivity, land acquisition and the finalisation of PPAs, are the key barriers to fast development.

Preparatory steps for offshore wind

Offshore wind remains a critical focus area for the long-term development of renewable energy. The Ministry of New and Renewable Energy (MNRE) aims to harness around 70 GW of offshore wind off the coasts of Gujarat and Tamil Nadu. In 2024, India announced a 4 GW tender in Tamil Nadu and a 500 MW project in Gujarat. To attract private investment, the government approved an INR 7,453 crore (USD 893 million) Viability Gap Funding (VGF) scheme to support 1 GW of offshore project capacity and port upgrades, along with an Inter-State Transmission

Onshore wind installations in India



Source: GWEC Market Intelligence

*Citations

80. NITI Aayog, State Renewable Energy Capacity Addition Roadmap: Action Plan 2022 and Vision 2030, NITI Aayog (Government of India), July 2025, https://www.niti.gov.in/sites/default/files/2025-07/State%20Renewable%20Energy%20Capacity%20Addition%20Roadmap.pdf

81. Government of India – Ministry of Power, Capacity Addition Crosses 50,000 MW in FY 2025-26 (Up to 31 January 2026): Over 11 % Added to Total Installed Capacity in Just 10 Months, Press Information Bureau, February 15, 2026, https://www.pib.gov.in/PressReleasePage.aspx?PRID=2228348

System (ISTS) charge waiver until 2032, aimed at reducing early-stage project risks.

However, progress has been slow. In 2025, the Solar Energy Corporation of India (SECI) cancelled offshore wind tenders totalling 4.5 GW due to limited developer participation. Recent policy signals suggest that efforts are being made to rebuild developer and investor confidence in the sector. There are expectations of offshore wind tenders in 1H 2026 for two projects of 500 MW each, or a single 1,000 MW tender.

To capitalise on its offshore wind potential, India must enhance policy frameworks, invest in grid infrastructure, ensure port readiness, secure vessel availability, streamline permitting, and ensure the availability of a local skilled workforce.

*Citations

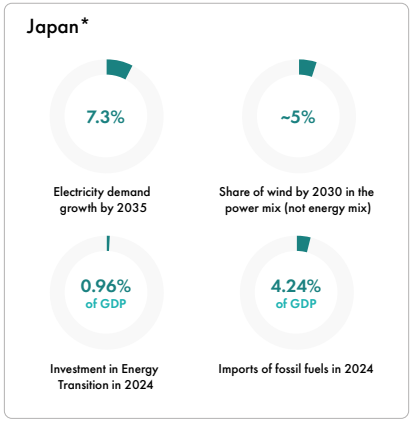
Wind as a pillar of energy security and affordability

Wind energy will play a defining role in meeting India's decarbonisation, energy security and affordability goals toward 2030. The pace of progress over the past year has raised market ambitions, making it essential to accelerate transmission readiness, streamline permitting frameworks, enhance financing mechanisms and ensure timely PPA execution to leverage the current growth momentum.

Japan: strategic realignment to ensure sustained growth

For Japan's offshore wind market, 2025 marked a critical turning point. Despite glaring delays and challenges at the individual project level, the year saw fundamental discussions emerge on the need to reassess policy design and the market's underlying assumptions. Against the backdrop of global inflation, higher interest rates and ongoing supply chain constraints, the business environment surrounding offshore wind projects in Japan became significantly more challenging. These external pressures amplified pre-existing structural issues with the Japanese auction framework.

Developments in Japan's onshore wind sector provide an important point of comparison. While onshore wind has a longer track record in Japan and has gradually expanded under the FIT and FIP schemes, it continues to face its own constraints, including limited suitable land, lengthy environmental assessments, increased local opposition and grid capacity restrictions. This experience underscores the importance of creating a more predictable and bankable framework for offshore wind, which is expected to play a central role in the country's long-term decarbonisation strategy.



In August 2025, a consortium headed by Mitsubishi Corporation officially announced its withdrawal from all three offshore wind sites awarded in the government's first auction round due to soaring costs and supply chain disruptions. This announcement led to renewed discussions across government and industry about the viability of the Round 2 and 3 projects, as well as future auction rounds. A closer examination of the factors behind the difficulties faced by projects in all three rounds focused discussions on auction design, offtake mechanism, and the overall viability of projects under Japan's current framework.

In response, the Japanese government placed top priority on ensuring that awarded projects could be brought to completion and began studying policy measures to stabilise the market – particularly to enable Round 2 and 3 projects to move forward. Key measures discussed included allowing offshore wind projects to participate in the Long-term Decarbonisation Power Source Auction (LTDA)1, extending occupation periods, and introducing other policy adjustments aimed at improving project economics.

Despite the challenging environment, some signs of progress emerged. Several Round 2 projects proceeded with the payment of their third-stage deposits, indicating that conditions were gradually being put in place for development to advance, particularly the increase of qualitative assessment weighting. At the same time, calls from local stakeholders for the re-tendering of certain Round 1 sites grew louder, and discussions on revising Japan's offshore wind auction system are active and expected to evolve in 2026.

GWEC published a white paper on 10 November 2025, calling for revisions to Japan's auction framework, a reassessment of offtake mechanisms, and action to address market bottlenecks. In February this year, GWEC launched a Bridging Forum (BF) as a platform for structured dialogue among key stakeholders such as industry, government, corporate buyers, OEMs and CSOs. The BF meetings, scheduled monthly throughout 2026, will focus on the key issues that BF members believe are damaging project implementation. The BF will make recommendations for policy and regulatory changes that will improve the viability of future auction rounds.

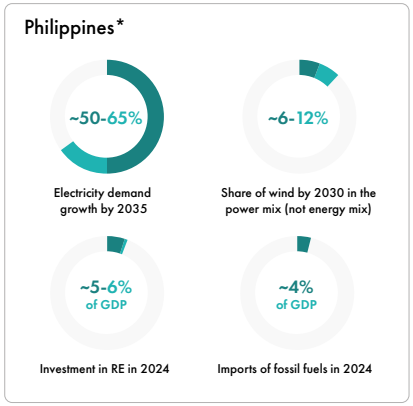
Outside the auction framework, progress has continued on several projects. The Goto Offshore Wind Farm in Nagasaki Prefecture (16.8 MW), developed by the SPC led by Toda Corporation, started commercial operation in January 2026, while the Hibikinada Offshore Wind project in Fukuoka Prefecture is expected online in H1 2026.

Taken together, developments in 2025 suggest that Japan's offshore wind market is beginning to shift from a phase focused primarily on project accumulation towards one centred on rebuilding policy frameworks and restoring long-term viability.

Philippines: powering electrification through wind energy

The Philippine Energy Plan (PEP) 2023-2050 projects that the country's electricity demand will more than quadruple by 2050 as the country moves towards economy-wide electrification. The growth is anchored in the transport sector through upcoming mass rail transit lines and the government's aggressive electric vehicle adoption target of 50% by 2040. Additionally, the government aims to achieve 100% electricity connection for all households by 2028. Electricity's share in the country's total final energy consumption is projected to rise from 21.9% in 2022 to 38.7% by 2050. Meeting this forecasted demand requires reliable, indigenous power: wind energy has emerged as the critical solution, providing the necessary scale to support an electrified nation.

The Philippines has a wind energy technical potential of up to 76.6 GW onshore and 178 GW offshore. By leveraging these indigenous resources, the country can strengthen its energy security and reduce vulnerability to global fuel price shocks.



The Department of Energy's (DOE) 10-year Green Energy Auction Program (GEAP) pipeline provides a structured roadmap for at least 25 GW of additional renewable capacity through 2035. This long-term visibility serves as a powerful signal to the global supply chain and the international investment community. By providing a clear schedule for future auctions, the government enables developers and manufacturers to make necessary long-term capital commitments.

The payoff of the GEAP is evident in the onshore wind sector's long-awaited resurgence. Despite the country's pioneering history, with Bangui wind farm being the first in Southeast Asia, for over a decade, onshore installed capacity remained at around 440 MW. GEAP's introduction has fundamentally altered this trajectory, with GEA-4 alone awarding more than 2.5 GW of

*Citations

capacity. The DOE is expected to announce additional capacities for onshore wind under the GEA-6 and GEA-9 rounds, signalling that the sector has embarked on a phase of rapid, commercial-scale growth.

The ongoing GEA-5 offers 3.3 GW of fixed-bottom offshore wind capacity for delivery between 2028 and 2030. A further 4.2 GW of fixed-bottom and floating offshore wind capacity is due to be auctioned for delivery between 2030 and 2035. This offshore momentum further strengthens the foundation for onshore wind by creating a shared ecosystem of expertise across the entire value chain.

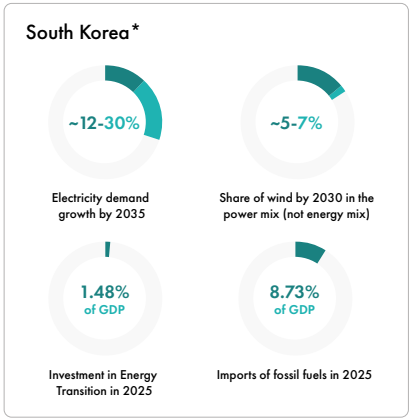
The Philippines' policy framework is designed to de-risk the market. The introduction of policies such as allowing 100% foreign ownership for renewable energy projects and implementing Green Lanes for strategic investments has turned the Philippines into one of the most dynamic markets in Asia. By enabling the convergence of strong policy signals and an expanding auction pipeline , the Philippines is ensuring that wind energy is the primary engine of its electrified future.

South Korea: wind market recalibration supported by political commitment

South Korea enters 2026 with a strengthened commitment to clean energy, driven by the government's ambition to deploy 100 GW of renewable capacity by 2030 while reducing greenhouse gas emissions 53–61% from 2018 levels.

The creation of the Ministry of Climate, Energy and Environment (MCEE) in February 2026 consolidated climate, energy-transition, electricity and grid planning under one ministry, with the aim of streamlining decision-making and accelerating renewable deployment – although the ministry's founding phase caused initial delays. This integrated governance structure guides the country's long-term ambitions, including 12 GW of onshore wind and 25 GW of offshore wind by 2035. In parallel, Korea's clean energy push is shaped by a longstanding energy security imperative: the country imports more than 90% of its total energy needs, exposing it to global market volatility and geopolitical risks – an underlying vulnerability that reinforces the strategic value of accelerating domestic renewable deployment.

Within this context, onshore wind has gained momentum. On 2 February 2026, three wind farms that participated in the H2 2025 onshore competitive tender were selected under fixed-price contracts: the 72.28 MW AWP Yeongyang , the 48 MW Gokseong Cheonji Energy and the 36 MW Yeongam Samho. All three follow a resident participation model designed to strengthen public acceptance by



sharing the economic benefits of wind revenues with local communities These developments support the government's broader goal of accelerating onshore deployment to reach 6 GW by 2030, leveraging streamlined permitting and public-led planning. However, it has been observed that, due to the auctions' low ceiling price, all projects are likely to shift from the national auction scheme to individual PPAs aligned with RE100 requirements.

Despite a downward revision of the 2030 target to 10.5 GW from the previous 14.3 GW, offshore wind continues to be a central pillar of the national energy strategy. The target was lowered to reflect constraints related to port capacity, installation vessels, supply chain readiness and local acceptance.

The Special Act on the Promotion of

Offshore Wind Power Distribution and Industrial Development, passed in 2025 and effective from March 2026, marks a major shift in regulatory design. It replaces developer-initiated site proposals with government-designated planned zones, establishes a cabinet level Offshore Wind Committee, and introduces a one-stop permitting system to reduce development timelines. The H1 2025 offshore auction illustrated the impact of this policy change, as four public-led projects totalling 689 MW were awarded, while no private-led projects advanced, demonstrating the preference for state-coordinated development.

Despite these advances, Korea's offshore wind market continues to face structural hurdles. A prominent example is Equinor's 750 MW Firefly (Bandibuli) floating wind project, the first commercial scale floating wind project to win an offtake contract in Korea's 2024 auction. Although it secured the auction award, Equinor ultimately did not sign the REC contract, reportedly due to concerns that the price level and contract conditions did not sufficiently reflect escalating costs, forex risks and supply chain uncertainties. Under Korea's auction framework, this missed deadline places the project at risk of losing government support and could also lead to a two-year ban on participating in future rounds.

On a more positive note, Korea has achieved a major milestone in renewable energy financing through the Shinan Uido Offshore wind farm, which became the first project supported by the National Growth Fund, a public–private vehicle created to accelerate strategic industries. The 390 MW project, led by Hanwha Ocean, secured approximately USD 511 million in long-term loans from the fund as part of its USD 2.31 billion total financing structure, With the Future Energy Fund already secured and the addition of the Growth Fund, this is the first case of domestic investment in Korea's renewable energy sector, and the country's first large-scale offshore wind financing model based entirely on domestic capital.

The government is addressing nationwide grid constraints through its Special Act on the Expansion of the National Power Grid, enacted in 2025. This accelerates high-voltage (345 kV and above) transmission development and allows up to 35 permits to be automatically approved once a project's implementation plan is validated, helping reduce bottlenecks and mitigate curtailment risks as renewable deployment scales up.

The combination of governance reform renewed onshore wind progress, recalibrated and structured offshore wind pipeline, landmark public–private financing for Shinan Uido and grid expansion measures positions the country to make meaningful strides towards its 2030 and 2035 climate and energy goals.

The Firefly floating project experience underscores the importance of continued refinement in permitting processes, financing frameworks and auction design to ensure that Korea's offshore wind market can scale with confidence. As a market in transition, South Korea is learning early-stage lessons that are helping policymakers and industry strengthen risk allocation, improve bankability and enhance regulatory clarity. As these recalibrations take shape, they will lay a more resilient foundation for the next wave of offshore and floating wind projects, supporting Korea's long-term clean energy ambitions.

Uzbekistan: emerging as Central Asia's wind power hub

The country's renewable energy expansion is anchored in the

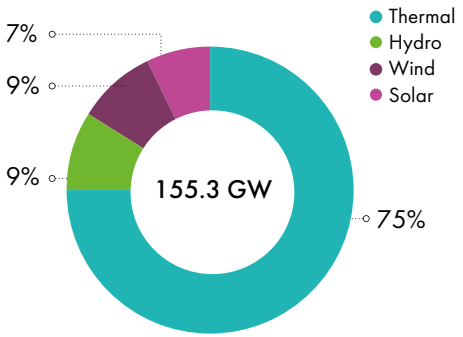
82. Centil Energy Law, Centil Energy Law – Energy & Infrastructure Legal Insights, Centil LLP, https://energy.centil.law/

*Citations

Uzbekistan 2030 strategy, which sets a target for renewables to reach around 40% of total electricity generation by 2030. According to the IEA Electricity Report 2026, power generation in the country increased by nearly 5% in 2024 and is estimated to grow by a further 4% in 2025, reflecting steadily rising electricity demand.

While Uzbekistan's power mix remains heavily reliant on gas-fired generation, the government is pursuing diversification by scaling up renewable deployment. Combined wind and solar capacity is expected to reach around 20 GW by 2030 under current plans, positioning renewables as a structural pillar of the future electricity system rather than a marginal supplement. Studies place the country's wind energy potential at around 520 GW.2 It is expected that, by the end of 2026, Uzbekistan will commission an additional 3GWs of wind.

Uzbekistan's energy mix



Source: https://energy.centil.law/[82]

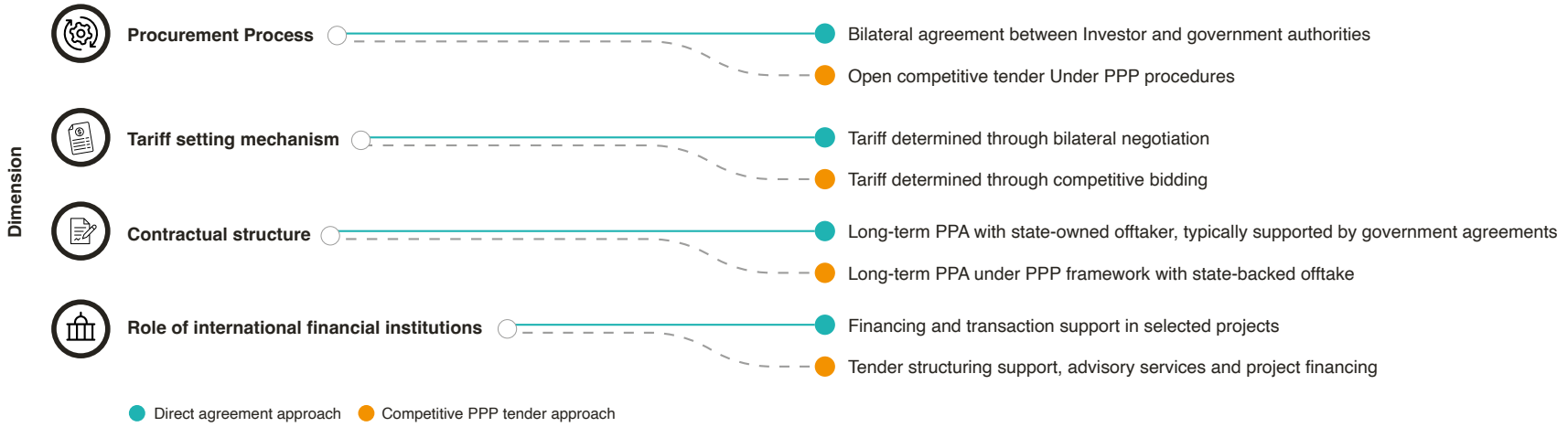
Policy framework and market evolution

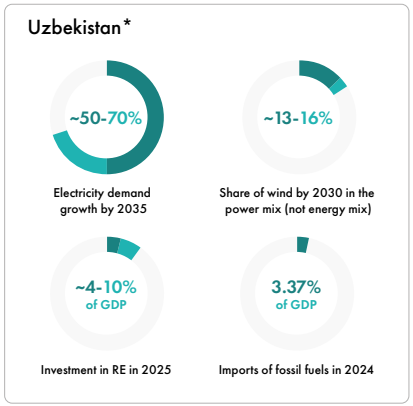
Uzbekistan develops wind projects through two main frameworks: direct negotiation under the Investment Law and structured PPP tenders for larger, infrastructure-intensive projects. While both models provide state-backed PPAs and have attracted foreign developers, their scalability depends on grid expansion and regulatory execution capacity. International financial institutions such as IFC, EBRD and ADB have played a pivotal advisory and financing role, particularly in structuring early wind projects and mobilising private sector engagement.[83]

Flagship projects include the Bash, Dzhankeldy and Zarafshan wind farms, with a combined capacity of 1.5 GW. Both located in the Bukhara region, the 500 MW Bash and 500 MW Dzhankeldy are owned and operated by a consortium comprising ACWA

83. International Finance Corporation, Role of Blended Finance in an Evolving Global Context, IFC Insights & Reports 2025, International Finance Corporation, September 2025, https://www.ifc.org/en/insights-reports/2025/role-of-blended-finance-in-an-evolving-global-context
84. ACWA Power commissions 1 GW wind power plant in Bukhara, Kun.Uz, April 15, 2025, https://kun.uz/en/news/2025/04/15/acwa-power-commissions-1-gw-wind-power-plant-in-bukhara
85. President of Uzbekistan inaugurates 500 MW Zarafshan wind farm, largest in Central Asia, Zawya/Press Release, December 15, 2024, https://www.zawya.com/en/press-release/companies-news/president-of-uzbekistan-inaugurates-500mw-zarafshan-wind-farm-largest-in-central-asia-olzvti42

Key Features of Direct Agreement and Competitive PPP Approaches





Power and China Southern Power Grid International,[84] and supported by Chinese EPC contractor CEEC. The 521.7 MW Zarafshan, which achieved commercial operation in December 2025, is owned and operated by Emirati developer Masdar, and its delivery was supported by SEPCO.[85] Chinese contractors are delivering full-scope engineering responsibilities in the above projects and continue to support equipment supply.

China's expanding role across the wind value chain

China remained the top destination and source of Uzbekistan's foreign trade in 2025, with bilateral trade reaching approximately USD 17 billion, accounting for about 21.2 % of total trade.

Chinese turbine OEMs have established a meaningful presence in Uzbekistan's wind market. To date, cumulative turbine orders awarded to Chinese Turbine OEMs are estimated at around 3 GW, reflecting strong price competitiveness and the ability to deliver large-capacity turbines suited to the country's desert conditions.

Beyond equipment exports, Chinese firms are developing a long-term presence in Uzbekistan. Sany has announced plans to develop up to 1 GW of wind capacity in the Kungrad region of Karakalpakstan, and it intends to establish local production facilities for key components, including towers and blades, aiming to support project deployment. Similarly, Sinoma Blade outlined plans to construct a utility-scale blade manufacturing facility in the Jizzakh region, focusing on the production of large blades.

Future implementation dynamics and grid challenges

Grid constraints remain a major bottleneck for Uzbekistan's energy transition. Much of the transmission and distribution network is ageing and overstretched, resulting in high losses and reliability issues. Without substantial upgrades – particularly new high-voltage links connecting renewable-rich regions to demand centres – new capacity may face curtailment. The government, supported by international partners such as the World Bank, has stepped up efforts to modernise and expand the grid to improve system efficiency and renewable integration through 2030.

Uzbekistan is progressing from nascent wind deployment towards a diversified renewable energy system. With strong policy backing and growing international partnerships, the country is ideally positioned to become a regional wind power hub and a regional exporter of clean energy.

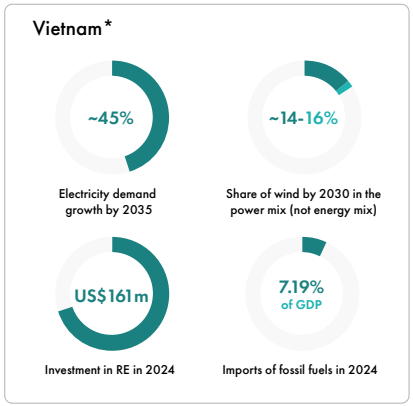
Vietnam: wind power as the workhorse of rising electricity demand

Vietnam continues to consolidate its position as one of the most dynamic wind markets in Southeast Asia, supported by strong political commitment, robust electricity demand growth and clear long-term capacity targets. In 2025, the country is moving decisively from policy ambition towards implementation, with both offshore and onshore wind entering a new phase of regulatory refinement and market structuring.

Offshore wind

Under the revised PDP8 (April 2025), Vietnam targets 6-17 GW of offshore wind by 2030-2035 and 113-139 GW by 2050, placing offshore wind at the centre of the country's long-term energy transition strategy.

Offshore wind policy advanced significantly following the National Assembly's adoption, in December 2025, of a Resolution on national energy development for 2026-2030. The resolution creates a fast-track



mechanism for offshore wind development whereby the prime minister selects developers for several gigawatts of offshore wind projects, providing clear top-level direction for early-phase deployment.

Work is ongoing to finalise competitive investor selection mechanisms and further clarify the PPA structure. Together, these developments are laying the foundations for large-scale, internationally financeable offshore wind projects.

Onshore and nearshore wind

Vietnam's onshore and nearshore wind sector, which reached 5.5 GW of installed capacity by 2025, remains a central pillar of the national energy mix. The revised PDP8 sets an ambitious target of 26-38 GW by 2030 and 113-139 GW by 2050, reflecting

*Citations

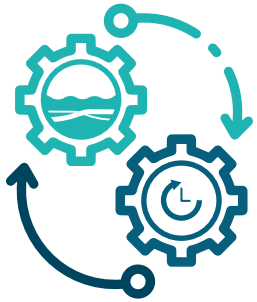
continued confidence in wind power's role in meeting rising electricity demand.

The market is transitioning from the FIT scheme to a competitive auction framework, marking the sector's growing maturity. Decree 115/ND-CP clarifies bidding requirements for projects using non-state capital, while MOIT introduced a price ceiling framework to guide 2025 PPA negotiations. These steps are contributing to a more structured and transparent investment environment.

The government is actively refining site allocation, auction design and PPA arrangements to ensure scalability and long-term sustainability. Ongoing dialogue between policymakers and industry is helping to align regulatory design with international financing practices.

With strong growth projections, high-level political backing and accelerating regulatory clarity, Vietnam is well positioned to translate its ambitious wind targets into sustained deployment and investment in the coming decade.

Supporting regulations are progressively being introduced



Decree **65/2025/ND-CP** establishes a clear framework for seabed allocation and site survey licensing, while a 2025 tariff framework provides initial pricing references across sea zones. Four site survey licences have been awarded to developers so far, with survey lidars expected in the water this year.

An earlier decree, **58/2025/ND-CP** of 3 March 2025, guides the revised Electricity Law and includes specific provisions for offshore wind, such as extending the CfD term to 15 years (minimum 80% contracted capacity), requiring SOE participation in offshore wind projects (over 50% for the pilot project; at least 5% for FDI-led projects), and setting timelines (24 months) for surveys and PPAs with EVN (30 months).

Case Study - Adapting to Next-Generation Wind Turbines: Integrated Execution Models in Southeast Asia

Provided by SMC

As turbine technology advances, higher hub heights, larger rotor diameters and increasing unit capacities are redefining project execution requirements. These developments create opportunities but add complexity, particularly in emerging markets like Vietnam and the rest of Southeast Asia, where specialised infrastructure, equipment ecosystems and local technical capabilities are still maturing.

To succeed in this environment, contractors are increasingly required to evolve beyond traditional construction roles towards integrated technical execution models that align technology, logistics and operations across the full project cycle. SMC Services and Engineering (SMC) exemplifies this approach, demonstrating how regional contractors are adapting to these industry dynamics by developing a cohesive delivery model with end-to-end capabilities spanning the wind project lifecycle.

A key challenge for the industry is to ensure that installation capability keeps pace with turbine innovation. As equipment configurations that supported earlier turbine generations approach their technical limits when applied to newer platforms. In response to this trend, identified through both market analysis and project experience, SMC has adopted a forward-looking equipment strategy centred on high-capacity crawler cranes and modern lifting systems designed to accommodate the turbine platforms likely to enter the markets in this region within the next three to five years.

SMC has expanded its scope by embracing heavy component transportation, infrastructure works, and operations and maintenance (O&M) services such as major component replacement, corrective maintenance and turbine upgrades. Beyond turbine installation, the company has leveraged its capabilities in related industrial sectors, including steel structure fabrication and energy infrastructure projects. This demonstrates how operational integration, technology adoption and strategic foresight can create competitive advantage across high-technology and ever-evolving energy markets.

This integrated execution model delivers multiple strategic benefits:

- **Enhanced coordination** between logistics and installation phases reduces operational risk
- **Optimized asset utilisation** extends the lifecycle and value of specialised equipment
- **Lifecycle service integration** strengthens long-term project performance and supports owners in capturing maximum value from next-generation turbines.

With execution capability an increasingly decisive factor in project and wider market success. SMC's experience in Southeast Asia demonstrates that early equipment readiness, integrated lifecycle services and operational agility are essential to bridge the gap between rapidly advancing turbine technology and regional construction capacity. Such measures will continue to support the sub-region on capitalising on opportunities in the wider regional and global wind energy market.

Middle East & Africa

Egypt: a wind market back in growth mode

Following reforms that have improved economic stability, Egypt's renewable energy programme is also moving forward at pace. The government aims for renewables to make up more than 42% of the electricity mix by 2030 and has plans to raise this target to 60% by 2040, showing a long-term commitment to diversifying the energy mix.[86]

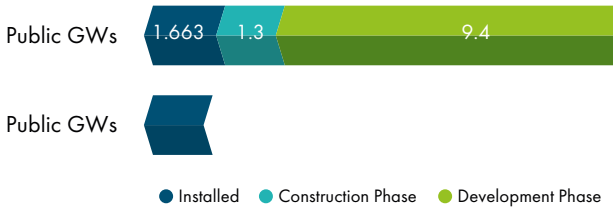
Wind and solar projects continue to progress through competitive tenders and private sector investment, alongside ongoing grid upgrades and expansion to integrate new capacity. While private sector investment is encouraged in energy generation, investment in the state-owned grids still depends largely on public finance. The government is considering new financing models to meet rising demand for an upgraded transmission system.

Wind tender: 1 GW new competitive procurement

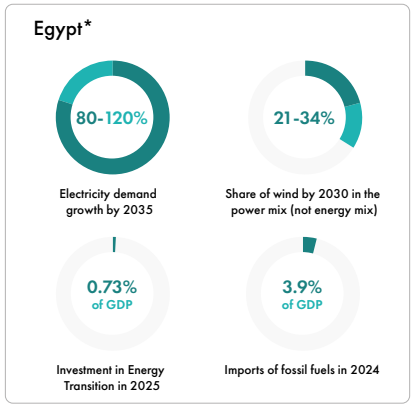
In early 2026, Egypt announced a new competitive tender for 1 GW of onshore wind capacity in the West Sohag area, following a hiatus of more than seven years.[87] This tender represents a strategic pivot away from the policies that led to previous direct agreement projects, which were previously prioritised with the aim of accelerating project development timelines.

The 1GW West Sohag tender will replace the large-scale MoUs signed at COP27, previously targeting around 27 GW of wind, which have been scaled back or cancelled by the government.

Wind Investments



Source: (http://www.nrea.gov.eg)



According to the Request for Qualifications (RfQ), the project will be procured under an IPP framework and implemented under a BOO scheme.

Project commissioning of more than 1 GW

During the second half of 2025, Egypt commissioned 1.15 GW of onshore wind at two projects: the 650 MW Rea Sea - developed by a consortium including Orascom, ENGIE and Toyota Tsusho, and the 500 MW Amunet by Emirati developer AMEA Power.

Egypt has 1.3 GW of wind energy under construction: 1.1 GW by ACWA

86. Renewables Now, Egypt launches 1 GW wind tender in West Sohag, Renewables Now, 15 April 2026, https://renewablesnow.com/news/egypt-launches-1-gw-wind-tender-in-west-sohag-1287854/
87. Egypt Independent, Egypt targets 42% renewable energy share by 2030, rising to 60% by 2040 – PM, Egypt Independent, 13 October 2025, https://www.egyptindependent.com/egypt-targets-42-renewable-energy-share-by-2030-rising-to-60-by-2040-pm/

Power and 200 MW by Infinity Power, while nearly 10 GW is in the development phase.

Some of the wind projects in late-stage development are:

- **500 MW NIAT:** Originally awarded to Siemens Gamesa (SGRE) and later acquired by Alcazar Energy Partners, which is to take full ownership and assume overall responsibility for its development and operations. SGRE will remain involved as a strategic partner and supply turbine technology and associated services under the partnership arrangement.[88]

- **900 MW Shadwan:** Scatec signed a 25-year PPA with EETC for the development of the Shadwan wind farm in the Ras Shukeir region. Wind measurement campaigns will continue during the first half of 2026, before the project move to financial close and COD.[89]

- **2 GW Hurghada:** In addition to its 1.1 GW wind project under construction, ACWA Power has signed a 25-year PPA for Hurghada, which is expected to reach financial close in 2026. Once completed, it will be the largest standalone wind project in the country.[90]

Looking ahead

Recent developments indicate renewed momentum in Egypt's wind market. With new capacity coming online, competitive tenders restarting and an ambitious pipeline under development, Egypt's wind sector is moving back to growth. Provided grid expansion continues alongside generation, the country has a solid foundation to scale up wind deployment over the next decade – strengthening energy security, attracting long-term investment and steadily advancing its renewable energy ambitions.

Kenya: wind power driving the clean energy transition

Kenya continued to strengthen its position as one of Africa's most renewables-heavy power systems in 2025, with renewables comprising more than 80% of the power mix.[91] While geothermal and hydropower are the leading electricity sources, wind energy is increasingly playing an important role in diversifying supply and improving energy security. Kenya's total installed capacity for wind is 435.5 MW, making wind the country's second-largest variable renewable source after hydropower. Wind capacity is anchored by three operational projects: Lake Turkana Wind Power (310 MW), Kipeto Wind Power Station (~100 MW) and Ngong Hills Wind Farm (~25.5 MW).

In 2025, wind generation increased by around 13% in the first half of the year, according to the Kenya National Bureau of Statistics, driven largely by strong performance at Lake Turkana. Rising output highlights the value of wind energy's high capacity factors and its contribution to stabilising the renewables-dominated grid.

Upgrades to transmission infrastructure

Kenya achieved a major milestone in 2025 with the signing of Africa's first privately financed power transmission project, valued at KES 40.4 billion (USD 311 million), structured as a public-private partnership between Kenya Electricity Transmission Company Limited (KETRACO), Africa50 Group and Power Grid Corporation of India Limited.

The project, supported by the African Development Bank, FMO and Trade and Development Bank Group, will deliver the design, construction, financing, operation and maintenance of two major transmission lines and establish a commercially viable model for private investment in grid infrastructure. By strengthening the

88. Renewables Now, Egypt launches 1 GW wind tender in West Sohag, 15 April 2026, https://renewablesnow.com/news/egypt-launches-1-gw-wind-tender-in-west-sohag-1287854/
89. Alcazar Energy, Siemens Gamesa and Alcazar Energy Partnership for Renewable Projects, n.d., https://alcazarenergy.com/siemens-gamesa-partnership/ Scatec, Scatec signs PPA for 900 MW onshore wind project in Egypt, 4 February 2026, https://www.scatec.com/en/scatec-signs-ppa-for-900mw-onshore-wind-project-in-egypt/
90. Saur Energy International, ACWA Power signs agreement for 2 GW wind project in Egypt, n.d., https://www.saurenergy.me/acwa-power-signs-agreement-for-2gw-wind-project-in-egypt/
91. Kenya Ministry of Energy, Kenya National Energy Compact, 22 August 2025, https://www.energy.go.ke/sites/default/files/Kenya%20National%20Energy%20Compact%2022AUG2025%20(1).pdf

national transmission network, the initiative will enhance energy security, lower electricity costs and accelerate Kenya's green industrialisation agenda under the Africa Green Industrialisation Initiative (AGII), positioning the country as a continental leader in the clean energy transition.

Open access policy as an opportunity and challenge

Kenya is reforming its electricity market from a single-offtaker model to a competitive wholesale market model. The Open Access Regulations are under formulation to facilitate the transition to a competitive wholesale electricity market that will allow open access to transmission and distribution networks, starting with the introduction of a day-ahead market. The electricity market will be segmented into a wholesale market and retail market – for both capacity and energy. These reforms are expected to enhance market efficiency and attract greater private sector participation. They will also provide a foundation for integrating more renewable energy, supporting Kenya's clean energy ambitions.[92]

The Open Access Regulations, formally the Energy (Electricity Markets, Bulk Supply and Open Access) Regulations 2024, are expected to significantly transform Kenya's electricity market once enacted. They will create new opportunities for wind energy by enabling wheeling of power across the grid, allowing generators to supply power directly to consumers.

This will open the captive supply segment and potential export markets, which are currently constrained. At present, wind deployment is largely limited by the grid operator's ability to absorb power. Drawing parallels from South Africa, where the removal of captive generation limits initiated substantial wind development, Kenya could see similar growth. However, a key challenge is represented by the fact that the country's strongest wind resource areas are located far from major demand centres. It will be critical to prioritise and strengthen the capacity of the transmission system to fully unlock the wind growth potential of open access.

Saudi Arabia: wind energy at the heart of the kingdom's digital future

Saudi Arabia's wind energy journey is marked by flagship installations and growing project pipelines under its renewable energy agenda. Under Saudi Vision 2030, the kingdom has set a target of 50% renewables by 2030, with a specific target of 16 GW of wind energy capacity. The Kingdom's first utility-scale wind farm, Dumat al-Jandal, is its only operational wind project, with 400 MW of installed capacity.[93]

92. Republic of Kenya, National Energy Policy 2025 – 2034.
93. Saudi Vision 2030, Dumat Al Jandal Wind Farm, Saudi Vision 2030, https://www.vision2030.gov.sa/en/explore/explore-more/dumat-aljandal

The pipeline of new wind and renewable projects is expanding rapidly. As part of Saudi Arabia's National Renewable Energy Program (NREP), significant deals signed in 2025 will see the development of seven utility-scale renewable plants totalling 15 GW of capacity. This includes 3 GW of wind energy at two projects: Starah (2 GW) and Shaqrah (1 GW), both in the Riyadh region, supplied by Goldwind turbines. These Price Discovery Scheme agreements, led by a consortium of Saudi entities and Acwa, the Public Investment Fund's (PIF) Water and Electricity Holding Company (Badeel), and Saudi Aramco Power Company (SAPCO), have reached financial close and are expected to come online between 2027 and 2028.[94] It remains to be seen how the 2026 conflict in the Middle East will impact the timelines for these projects.

Workforce challenges remain one of the biggest concerns in Saudi's renewable energy future. Scaling up wind deployment will require accelerated training and workforce development to ensure a pipeline of skilled engineers, technicians and project managers. Building local capabilities will be essential for sustaining the fast pace of deployment and realising Saudi Arabia's ambitions.

List of Projects in the Pipeline

Project name	Status	Exp. Commissioning Year	Capacity (MW)	LCOE (cent/kWh)	Developer
Starah	Development	2028	2000	2.06	AWCA
Al Qirah	Tendered	2029	1500	-	-
Dwadmi	Development	2028	1500	1.33	KEPCO
Al Ghat	Development	2026	600	1.56	Marubeni
Samha	Tendered	2029	800	-	-
Bilghah	Tendered	2029	1300	-	-
Shegran	Tendered	2029	900	-	-
Yunbu	Development	2027	700	1.72	ACWA
Baeyda'a Nathel 1	Tendered	2029	1000	-	-
Dumat al Jandal	Installed	2022	400	2.13	Masdar/EDF

Source: KAPSARC tracker[96]

A globally competitive tariff environment

Saudi Arabia benefits from favourable wind conditions and competitive tariffs. Strong wind resources in the northwest and desert plateau regions are suitable for utility-scale development. The Kingdom also has excellent offshore wind resources, although its development is not currently considered in medium-term government planning.

Recent procurement rounds have achieved globally competitive pricing for wind energy. In the latest tender rounds, wind capacity is built into mixed renewable auctions, including a 1.5 GW project in the Dwadmi region awarded in 2025 at a world-record low cost of about USD 1.338/kWh.[95] Several large solar plants were awarded alongside this wind project in the same round, for a total capacity of 4.5 GW.

The King Abdullah Petroleum Studies and Research Center has introduced analytical tools such as the KAPSARC renewables tracker to support this rapid rollout. These online resources are improving transparency around project auctions, capacity pipelines and competitive pricing across Saudi renewable energy markets. According to the tracker, Saudi Arabia has 12 wind projects that are either installed, under development or tendered.

Scaling back on NEOM and up on AI

Despite progress on the renewable energy front, large futuristic initiatives like NEOM's smart-city vision are being re-evaluated and scaled back due to cost pressures and shifting investment priorities. The NEOM green hydrogen project remains under development, with approximately 250 wind turbines installed and the associated facility reaching 80% completion by mid-2025.[97]

Saudi Arabia aims to become an AI leader through initiatives such as HUMAIN and the large-scale rollout of data centres – heavily dependent on expanding renewable energy capacity. An agreement between NEOM and DataVolt to develop a net-zero, 1.5 GW renewable-powered data centre campus at Oxagon highlights how wind and solar energy are becoming central to powering the Kingdom's digital growth and technological development strategy.[98]

94. Argaam, ACWA Power Co. secures financial close for major wind and solar projects in Saudi Arabia, 27 November 2025, https://www.argaam.com/en/article/articledetail/id/1862338
95. Energies Media, Saudi Arabia awards the 1.5 GW Dawadmi wind project under its national renewable energy programme, 24 December 2025, https://energiesmedia.com/saudi-arabia-awards-wind-project-to-ming-yang/
96. King Abdullah Petroleum Studies and Research Center (KAPSARC), Saudi Arabia Renewables Tracker — Renewable
97. Shawn Beauvais, NEOM's 2.2 GW Green Hydrogen Project Hits 80 % Completion, Poised to Redefine Clean Ammonia Production, HydrogenFuelNews.com, February 21, 2026, https://www.hydrogenfuelnews.com/neoms-2-2gw-green-hydrogen-project-hits-80-completion-poised-to-redefine-clean-ammonia-production/8571076/
98. DataVolt, DataVolt Signs Agreement with NEOM to Design and Develop the Region's First Truly Sustainable Net-Zero AI Factory Campus in Oxagon, DataVolt, December 10, 2025, https://data-volt.com/media/breaking-news/datavolt-signs-agreement-with-neom-to-design-and-develop-the-regions-first-truly-sustainable-net-zero-ai-factory-campus-in-oxagon/

South Africa: anticipating wind progress from targets to delivery

South Africa continued to make meaningful progress in integrating clean energy into its power mix in 2025, with wind energy remaining a central pillar of the country's power-sector transition and energy-security strategy. Policy and market reforms introduced over the past two years began translating into tangible progress across procurement pipelines, grid planning and increased private-sector participation.

For international investors, 2025 marked an important transition from policy design to implementation, with several structural reforms strengthening the regulatory and institutional environment for renewable energy deployment.

Policy and institutional reforms

Government reforms in the electricity sector continued to accelerate following the establishment of the Ministry of Electricity and Energy in 2024, led by Dr. Kgosientsho David Ramokgopa. Throughout 2025, the policy focus was on stabilising procurement pipelines, accelerating grid expansion and implementing transmission-sector reforms aimed at improving market efficiency and enabling greater private-sector participation.

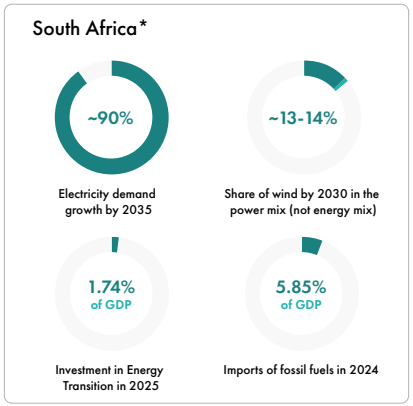
A key enabling instrument is the Electricity Regulation Amendment Act, which provides the legislative framework for restructuring the electricity market. The Act supports the gradual liberalisation of the power sector and establishes the foundation for an independent TSO.

Progress was also made in the ongoing unbundling of the state-owned utility, Eskom. During 2025, the National Transmission Company South Africa (NTCSA) assumed a more prominent role in grid planning, connection processes and transmission development, signalling a shift towards a more independent and transparent transmission system framework.

Integrated Resource Plan 2025

A major milestone for the sector was the approval of the Integrated Resource Plan (IRP) 2025 by the South African Cabinet in October 2025, following several years of consultation. The IRP provides a long-term roadmap for South Africa's electricity generation mix through to 2042 and establishes the strategic direction for power-sector investment and policy.

The plan outlines a diversified energy portfolio aimed at balancing energy security, economic development and emission reduction. It targets more than 114 GW of new generation capacity by 2042 across solar PV, onshore wind, distributed generation, battery storage, gas-to-power and nuclear power.



energy is expected to play a central role with 43 GW of new wind capacity targeted for installation by 2042, representing approximately 49% of the renewable energy component and around 30% of the overall generation mix.

Compared with previous planning frameworks, IRP 2025 significantly increases the role of renewable energy while gradually reducing reliance on coal-fired generation. The plan also provides long-term investment signals for developers, investors and infrastructure providers across the generation and transmission value chain.

Grid capacity and transmission expansion

Addressing transmission constraints remains one of the most critical challenges facing South Africa's renewable energy expansion. Grid capacity limitations in the Western

Cape and Eastern Cape, where the majority of wind and solar resources are located, continue to act as a bottleneck for new project connections.

In response, government and transmission authorities accelerated planning and investment in transmission infrastructure throughout 2025. The Transmission Development Plan (TDP) 2025, published by NTCSA, outlines a significant expansion of South Africa's transmission network to support the integration of new generation capacity. The plan includes:

- Approximately 14,500 km of new high-voltage transmission lines
- Around 133,000 MVA of additional transformer capacity
- An estimated ZAR 440 billion (USD 25.9 billion) investment requirement over the next decade (2025–2034).

Initial funding has been secured for the first phase of implementation. Several priority projects are progressing from planning into early execution, such as expansion of transmission corridors, reinforcement of existing grid infrastructure and construction of new substations. These investments are designed to relieve congestion in key renewable energy zones and enable the connection of new wind and solar generation capacity.

However, the pace of transmission development is expected to lag behind the rapid growth of renewable projects. As a result, grid constraints and curtailment risks may persist in the near to medium term.

Generation connection capacity and curtailment framework

The NTCSA's Generation Connection Capacity Assessment 2025 Update provided further confirmation of grid constraints, indicating that key renewable energy regions, particularly the Eastern Cape and Western Cape provinces, have reached full grid connection capacity under existing infrastructure.

To address this challenge, NTCSA introduced a congestion curtailment framework for the Western and Eastern Cape regions, allowing controlled reductions in renewable generation during periods of network congestion. Under this mechanism:

- Approximately 1.48 GW of additional connection capacity could be unlocked.
- Curtailment levels are capped in accordance with the Sixth Multi-Year Price Determination limits.
- Renewable generators affected by curtailment are eligible for compensation within the approved revenue allocation.

The framework was approved by the National Energy Regulator of South Africa (NERSA) as a constrained generation ancillary service, effective

from 1 April 2025 until 31 March 2028.

Under a moderate curtailment scenario of approximately 4%, estimates suggest that available grid connection capacity in these regions could increase from roughly 5,625 MW to approximately 7,205 MW by 2028, enabling additional renewable projects to connect to the grid while longer-term transmission expansion projects are implemented.

Transition toward a wholesale electricity market

Another significant structural reform underway in 2025 was the development of the South African Wholesale Electricity Market (SAWEM), which is intended to introduce greater competition, transparency and efficiency in electricity trading. SAWEM is being prepared for implementation beginning in Q3 2026.

Industry engagement and capacity-building efforts were prioritised throughout the year. Initiatives such as the SAWEM School provided training and practical guidance to industry participants preparing to operate within a competitive electricity market environment. Through four training cohorts, approximately 162 South African Wind Energy Association (SAWEA) members improved their understanding of market participation requirements, trading mechanisms and risk management considerations associated with the transition from a vertically integrated utility model to a competitive electricity market. GWEC further sponsored three SAWEM School training sessions, and provided support for a fourth cohort.

Looking ahead

By the end of 2025, South Africa remained the largest wind energy market in Africa, with more than 4 GW of operational capacity, approximately 2.8 GW currently under construction, and a growing pipeline of over 60 GW. Of this pipeline, roughly 17 GW of projects are at advanced stages of development, with a significant portion expected to reach financial close or construction within the next five years.

This robust project pipeline, combined with increasing policy certainty, ongoing market reforms and expanded transmission investment, reinforces South Africa's position as one of the most attractive renewable energy markets in Africa for international investors.

Wind energy is expected to remain central to the country's energy transition and future electricity supply, supporting both energy security objectives and long-term decarbonisation goals.

Türkiye: where energy and industrial policy converge – and wind wins

Türkiye's wind sector has entered a new phase of structural expansion. As of January 2026, the country's installed wind capacity reached about 16 GW, following a record annual increase of 2.1 GW in 2025, according to the Turkish Wind Energy Association. Combined wind and solar capacity has now surpassed 40 GW. The government has set a long-term target of 120 GW of wind and solar by 2035, implying annual wind additions of 2–2.5 GW over the coming decade. With the Marmara and Aegean regions leading installations and regulatory reform mechanisms that aim to streamline project approvals, policy signals are becoming more predictable and long-term.

This trajectory reflects a strategic response to rising electricity demand, energy security pressures, and the need to strengthen domestic industrial capacity and to leverage it for exports to Europe, Central Asia and the Middle East. Regulatory reforms aimed at streamlining permitting and enhancing auction design are improving long-term visibility for investors. As Türkiye increases its role in global climate diplomacy and prepares to host COP31 later this year, wind is shifting from a growth sector to core national infrastructure underpinning industrial expansion, grid resilience and economic sovereignty.

Industrial hub serving East and West

A key feature of Türkiye's success is its evolution from a deployment market to an integrated industrial hub. International OEMs from Europe and Asia, alongside domestic manufacturers, are embedding operations in the market instead of focusing on short-term plays.

European manufacturers were among the earliest to establish a structural presence. Nordex, through its subsidiary Nordex Enerji, has maintained long-standing operations in Türkiye, including local service and training facilities. In the 2024 YEKA Res tender, Nordex secured substantial turbine supply contracts, including around 750 MW with Enerjisa Üretim, while sourcing and manufacturing key components domestically in line with localisation requirements.

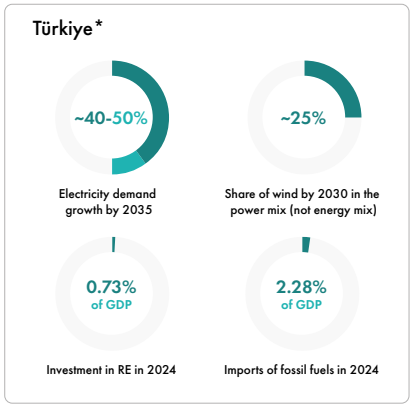
Chinese suppliers are expanding their footprint. Goldwind has been active in Türkiye for 10 years, operating over 400 MW and holding a pipeline of approximately 700 MW across regions including Malatya, Adıyaman and Çanakkale. Beyond project development, Goldwind has aligned with Türkiye's localisation framework by partnering to establish a blade manufacturing facility in Izmir to support YEKA projects.

Beyond capacity expansion, wind-plus-storage integration is further reinforcing Türkiye's competitive edge . The country has granted pre-licenses for roughly 15–16 GW of wind projects combined with battery storage, alongside a simila pipeline of solar-plus-storage projects. These hybrid configurations enhance grid stability, improve dispatch flexibility and reduce curtailment risk, showcasing the critical advantages of an electrified system.

Some landmark developments, such as the 132 MWh battery energy storage system planned in connection with the Göktepe wind farm through cooperation between Polat Energy and Rolls-Royce Solutions, signal that large-scale storage is moving from concept to implementation. As renewable penetration rises, hybrid wind and storage systems are increasingly viewed not as optional add-ons but as essential infrastructure to enhance dispatch flexibility, improve grid reliability and strengthen the long-term economics of wind assets in Türkiye.

Offshore wind

Türkiye is positioning offshore wind as a long-term pillar of its energy transition under the National Energy Plan for 2035 and its 2053 net-zero target. Although the country currently has no installed offshore capacity, it aims to reach 5 GW by 2035, with most of its resource potential suited to floating technology. Inclusion within the updated YEKDEM support scheme demonstrates policy commitment. The next critical step is the issuance of a competitive tender,



which will provide price discovery, investor clarity and concrete momentum. While grid readiness, port modernisation and financing frameworks will determine the pace of deployment, a well-designed tender process would mark a decisive shift from ambition to execution.

Türkiye illustrates what 'winning with wind' looks like in the Electrotech era: sustained capacity growth, embedded industrial development, hybrid system integration and long-term strategic planning. Wind is no longer a supplementary renewable source; it is a foundational infrastructure for economic resilience and industrial competitiveness.

*Citations

Latin America (LATAM)

Brazil: how important offshore wind is to rebalance the power system

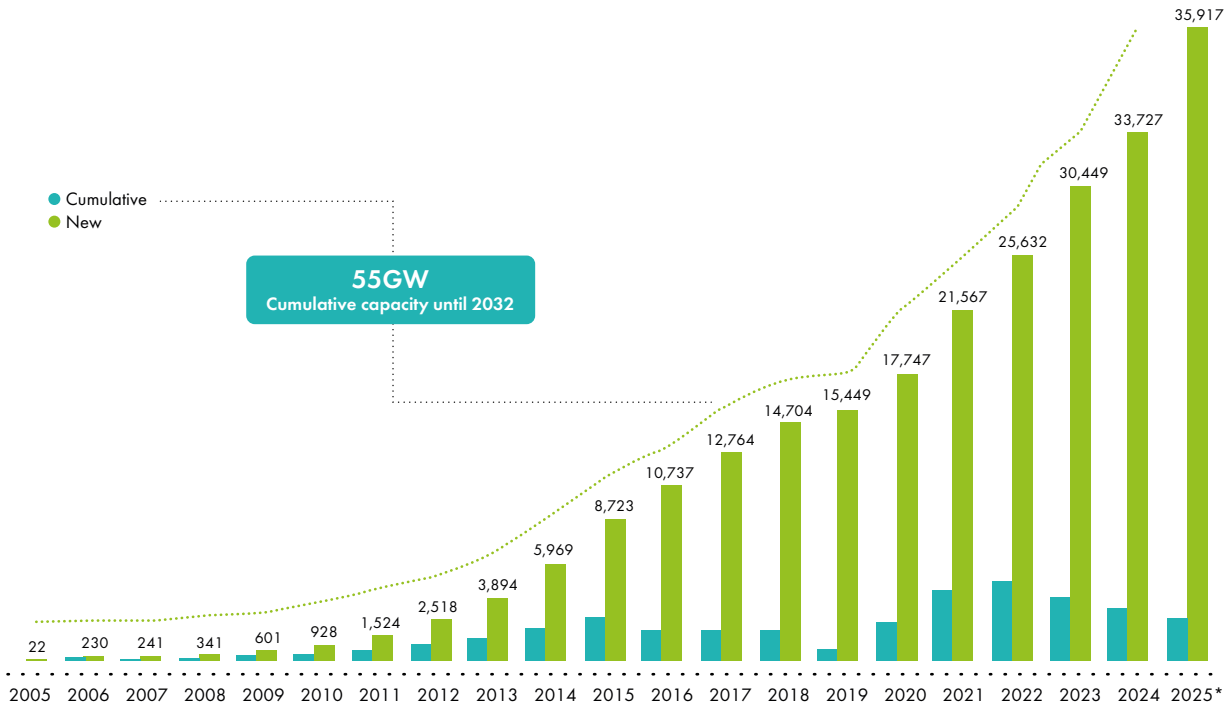
In the current period of transformation, the Brazilian electricity sector sees a mismatch between energy generation capacity and transmission infrastructure. After years of accelerated growth, the sector faces the challenge of balancing energy transmission and generation cuts (curtailment), aggravated by a scenario of reduced domestic demand. In the field of offshore wind, gaps persist in the rules governing the initial concession of areas.

The issue of curtailment has become the main obstacle to new investments. By 2025, generation cuts imposed by the National System Operator (ONS) resulted in losses in the billions.Law No. 15.269/2025 was introduced to mitigate these impacts and restore confidence. The law governs the reimbursement of liabilities accumulated between 2023 and 2025; however, it still needs regulation and application. The legislation also defines guidelines for energy storage – the central element to grid stability in systems with high penetration of intermittent sources, allowing the surplus generated during periods of low load to be used later rather than being discarded, as has been happening in Brazil. The first battery auction, scheduled for 2026, generates strong expectations as a technological solution to this impasse.

However, the true frontier of scale for energy security and Brazilian neo-industrialisation lies at sea. Offshore wind power is positioned as the necessary solution to supply large load centres and new coastal industrial hubs, as GWEC's Renewable Energy Driving Green Industrialisation[99] study illustrates. Although the Offshore Wind Energy Legal Framework (Law No. 15.097/2025 of January 2025) established the legal basis for the transfer of maritime area use rights, no area transfer has yet occurred. There is an urgent need to consolidate complementary regulations for the transfer of permanent and planned areas. Defining clear timelines is fundamental to mobilising the global supply chain and attracting industries to the country, generating jobs, growth and security.

IBAMA issued in June 2025 the first

Evolution of installed wind power capacity in Brazil



Source: Dados ABEEólica - ABEEólica

99. Global Wind Energy Council (GWEC), Study Report: Renewable Energy Driving Green Industrialisation, 2025, https://www.gwec.net/reports/study-report-renewable-energy-driving-green-industrialisation#Download

environmental licence for an offshore wind project – a SENAI Innovation Institute pilot located off Rio Grande do Norte. Another significant advance was the structuring of selection criteria by the Ministry of Mines and Energy, demonstrating that the country is technically ready but lacks the political agility to avoid missing this window of opportunity.

The expansion of offshore wind power is highly aligned with the National Strategy for Decarbonising Industry (ENDI). Growth in electricity demand is the engine that should drive the sector in the coming years. In the short term, industrial electrification and data centres represent the most immediate opportunities.

According to the Ten-Year Energy Plan (PDE) 2035, electricity demand associated with the transport sector should jump from 627 GWh in 2025 to 7.8 TWh in 2035. Accounting for the large role played by sugarcane ethanol in powering vehicles, this is a significant surge and justifies the inclusion of offshore wind in the energy mix.

Looking at the medium-term horizon, green hydrogen emerges as a strategic destination for Brazilian renewable energy, leveraging the network of port hubs and the latent demand from the fertiliser sector.

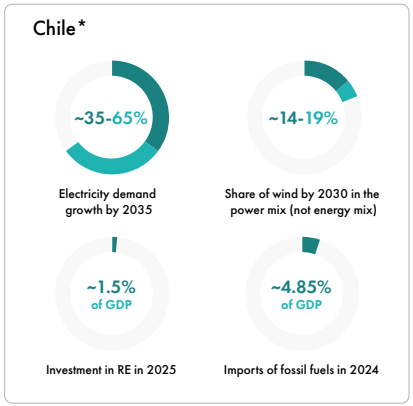
In 2025, Brazil hosted COP30 in Belém, where the global commitment to tripling renewables and doubling energy efficiency by 2030 was reaffirmed, alongside the promise of a roadmap away from fossil fuels. Élbia Gannoum, vice-president of the GWEC board, featured at the event as the special energy envoy, demonstrating the prestige that wind energy holds as a solution to climate change.

As it approaches the end of a crisis cycle, with only 2.3 GW installed in 2025 and severe financial losses made due to curtailment, the Brazilian wind energy sector sees positive signs for 2026. Industry and energy are interdependent: ensuring that clean energy finds productive use is the only way to prevent it from becoming a wasted opportunity for Brazil.

In addition to restructuring the sector and advancing offshore wind, the implementation of the Brazilian Emissions Trading System (SBCE) is expected to add a layer of strategic monetisation for wind assets, valuing the environmental attribute of generation.

Chile: record wind growth anchoring the power system

In 2025, Chile reaffirmed its position among the leading wind markets in Latin America. Alongside solar, wind reached the highest level of supply in electricity generation. Together, they accounted for almost 38% of the total energy injected into the system[100] – a milestone that consolidates variable renewable energy as a central pillar of the country's power mix and reinforces wind's broader impact on the country's economic and industrial development.



Wind installed capacity grew by an average 21% per year over the past five years. In 2025, 1.2 GW of wind capacity was added, representing a 24% increase on 2024. In a landmark year, wind became Chile's second-largest technology in terms of installed capacity, surpassing natural gas. Cumulative wind capacity is nearly 6 GW, with 71 projects in operation, representing 16% of the country's total installed capacity.[101]

Wind energy plays a strategic role in supporting Chile's decarbonisation pathway towards net zero emissions by 2050. It delivers substantial system-wide benefits: reducing emissions and overall generation costs while

*Citations

supplying clean electricity with low operating expenses; attracting investment; and enabling the expansion and modernisation of electrical infrastructure.

Chile benefits from high-quality wind resources along its entire territory – from north to south – positioning wind power as a key pillar of the energy mix and a robust solution to enhance system resilience by ensuring renewable electricity supply during nighttime periods, when solar generation is unavailable.

In 2025, Chile demonstrated a growing technical capacity to operate its power system under high levels of renewable energy penetration making significant progress in solutions such as energy storage – with 1.5 GW in operation, 746 MW in testing, 7.3 GW under construction, and more than 27 GW in other stages of development – grid strength and grid forming capabilities, and decarbonisation policies. Significant challenges remain, including transmission constraints, renewable energy curtailment, and poor regulatory signals for investment. The electrification of demand requires better system resilience, operational coordination, and the structural conditions to allow greater flexibility and security of supply.

The main challenge for Chile resides in consolidating its progress in renewable generation while boosting electricity demand by enabling networks, flexibility and remuneration rules consistent with an increasingly renewable energy system. The emphasis must be on transmission and distribution infrastructure, as well as the electrification of consumption, including mining, data centres and electromobility.

There is a need for stronger policy and regulatory frameworks, especially for the wholesale market and for distribution. The regional integration of transmission networks with neighbouring countries may play a significant role, allowing Chile to evacuate its surplus energy and find new demand.

A clear opportunity for the wind energy industry is deep electrification. In Chile, electricity represents only 24% of final energy consumption. Demand must grow faster to keep up with the pace of renewable energy expansion. Driven by key sectors such as mining (the largest consumer of electricity), data centres (in rapid expansion), and the integration of green hydrogen and industrial heating, Chile may have to increase its capacity beyond the 10 GW of wind projects currently under development to approximately 18 GW of additional wind capacity by 2035.

Offshore wind

Chile possesses one of the world's largest offshore wind resources, estimated at approximately 957 GW, equivalent to roughly 12 times the country's onshore wind capacity. High-quality wind regimes enjoy low seasonality and strong north-south complementarity, particularly in the southernmost regions. From a system perspective, offshore wind represents a strategic opportunity to diversify the renewable portfolio, enhance security of supply and support decarbonisation – especially by contributing clean generation during nighttime periods.

Beyond its contribution to the power sector, offshore wind could become a new industrial and logistical development axis for the country,

100. Coordinador Eléctrico Nacional (CEN)
101. Provided by ACERA by using data from the Coordinador Eléctrico Nacional. * Considers projects in operation

fostering regional value chains in ports, maritime services, manufacturing and assembly, as well as operation and maintenance. Given its scale and high-capacity factors, offshore wind offers potential synergies with the decarbonisation of end uses, including mining electrification, industrial processes, and the production of synthetic fuels and green hydrogen.

The Ministry of Energy is working on an Offshore Wind Roadmap, which must address infrastructure gaps, establish a clear regulatory framework and define market and technical enablers to unlock this strategic opportunity for Chile. Industry and academia are showing growing interest in offshore wind projects, with companies requesting maritime concessions and conducting studies to address the challenges of its development.

Colombia: first offshore tender revitalises wind development

Energy policy priorities shift

An ambitious energy transition programme to reduce fossil fuel dependence and increase the share of non-conventional renewable energies has dominated the country's energy pathway, embracing a shift towards diversifying Colombia's electricity power matrix.

Energy policy has largely been driven by climate drivers, and oriented towards prioritising the social and environmental dimensions of energy deployment to address structural inequalities across the country. The aim has been to enable policies and an adequate governance structure framework to empower so-called energy communities. This would at the same time overcome barriers to energy investment development – enhancing resilience and energy security – while unlocking energy's potential to contribute at scale to Colombia's socio-economic success.

Mainstream renewable energy projects

The current renewable energy project pipeline derives from the auctions run in 2019 under the previous administration. Onshore wind and solar projects were supported by long-term PPAs with distribution companies. However, development has stagnated, with delays, financial losses and faltering investments frustrating both companies and local communities.

Significant progress has been made with small-scale solar PV projects, mostly connected to distribution grids, but utility-scale renewable energy projects connecting to the transmission grid have experienced crippling delays. Only one-third of the 6 GW renewable energy target for installed capacity by end-2026 was achieved by December 2025. The project pipeline of large-scale projects remains effectively paralysed. Social opposition in project areas, delays in environmental and social licensing and grid connection constraints have undermined the investment environment for the development of awarded projects.

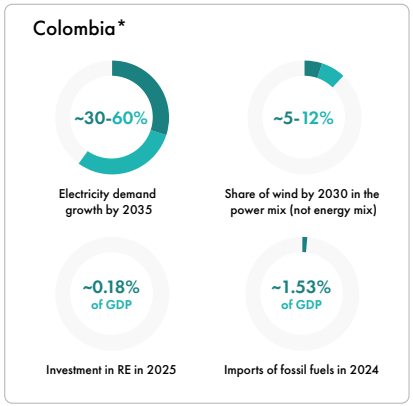
Window of opportunity

In 2025, Colombia endorsed its NDCs 3.0, including a strengthened climate goal to reduce GHG emissions by 51% by 2030, and embedding the target of 6 GW of renewable energy. This opens a clear window of opportunity for large-scale renewable energy to reduce dependency on hydropower and gas. The lack of new generation capacity has been pushing Colombia's security of electricity supply to its limits as power demand grew after COVID, while generation capacity did not.

In order to bring to fruition those generation projects, energy rules must be rewritten to provide legal certainty and security for investors while updating environmental and social permitting to place energy security and decarbonisation at the heart of the country's public interest and policy priorities.

Offshore wind progress

Among the energy policy initiatives aimed at providing energy services to vulnerable population in disadvantaged territories, the current administration has designed and enacted a policy framework for the allocation of seabed areas for OFW.



The first tender, which began in 2025, resulted in the allocation of an area for a temporary exploration permit with a view to deploying up to 500 MW in the Atlantico region. In addition, the policy supports the regulatory framework through a CfD scheme that aims to provide more certainty for future developers and to ensure that development of the allocated area can go forward.

Beyond new auctions for renewable energy, urgent reforms to the electricity market and the permitting procedures are needed to improve the investment environment. Boosting generation capacity to meet demand in the short term is essential, which relies on developing multiple renewable projects simultaneously – in stark contrast with the current implementation standstill.

*Citations

CHAPTER 4: MARKET STATUS

Overview

Wind power added 165 GW of capacity to the grid last year, making 2025 the best year ever for the wind industry. Thanks for outstanding year-on-year (YoY) growth of 40%, total installed wind capacity reached 1,299 GW, up 14% from the year before.

New onshore wind installations surpassed the 150 GW annual milestone, with a record 155 GW connected to the grid in 2025. Offshore, 9 GW of wind capacity was commissioned in 2025, 18% more than the previous year and the third highest volume in history.

Last year saw the Asia Pacific region further consolidate its leading position in wind power development with an 80% global market share. The region's two leaders, China and India, experienced explosive growth, together adding more than 126 GW of wind power.

Thanks to strong growth in Germany and Türkiye, Europe commissioned 19.1 GW of new wind power capacity, a growth of 16% YoY, with 15.1 GW added in the EU-27. Total wind power installations in the European continent passed the 300 GW milestone by the end of last year, making it the second-largest regional wind market.

North America retained third place in both new and cumulative wind power installations, despite a bounce-back that saw installations growth 71% YoY in the US.

Latin America was the fourth-largest market in 2025, but its market share decreased by 24% YoY. Although Chile had a bumper year with new installations surpassing 1 GW for the first time, new capacity in Brazil dropped by almost one-third to 2.3 GW in 2025, the lowest since 2020.

New capacity added in Africa & Middle East increased by 32% last year compared with the previous year. It remained the smallest market by the end of 2025.

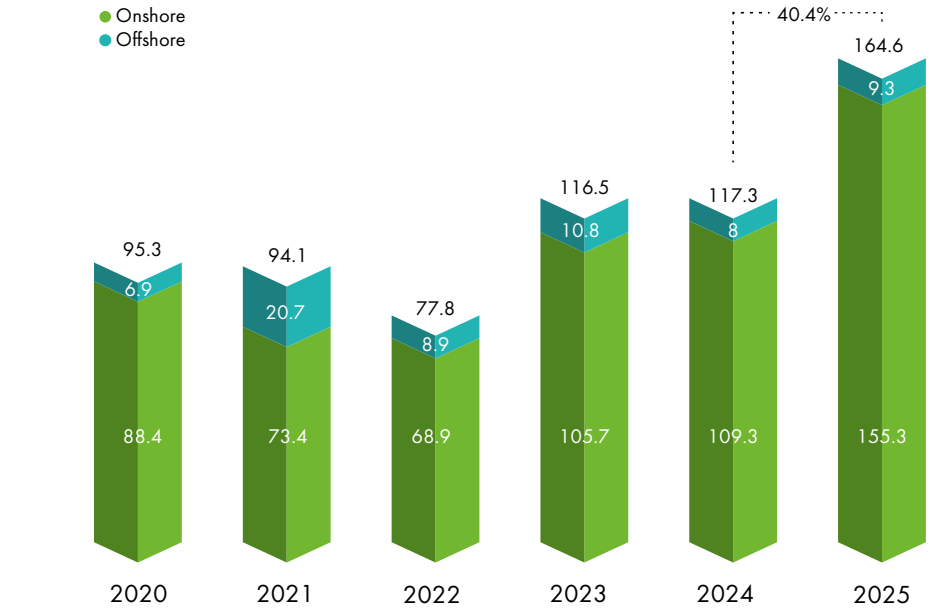
The world's top five markets for new installations in 2025 remained unchanged from the previous year: China, the US, Germany, India and Brazil. Combined, they made up 86% of global additions in 2025, 5% higher than the previous year.

The same five markets also remained the top by total wind power capacity at the end of 2025, together making up 75% of the world's total installed wind power, 2% higher than the previous year.

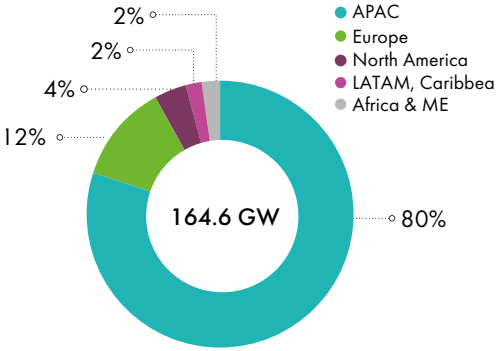
GWEC reports installed and commissioned new wind power capacity in the Global Wind Reports. According to GWEC Global Supply Side data, globally 178 GW of new wind power was mechanically installed in 2025, but only 165 GW was commissioned because more than 13 GW of new installations in China, the US and the US were not grid-connected.

New installations

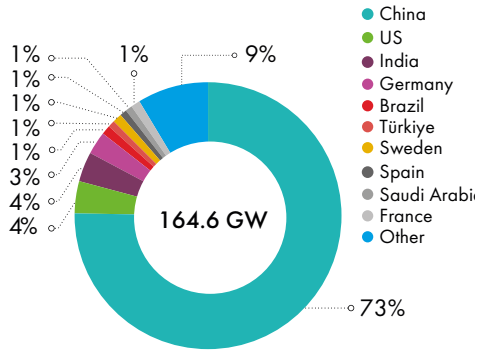
GW



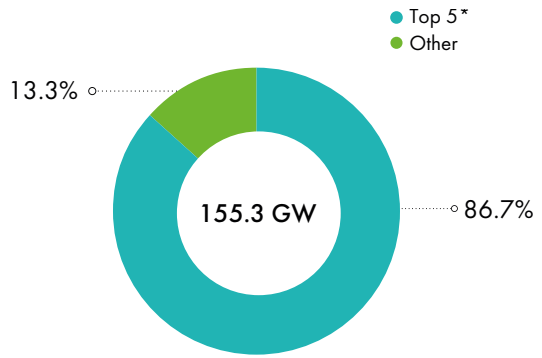
New capacity in 2025 installed by region (%)



New capacity 2025 and share of top 10 markets (%)

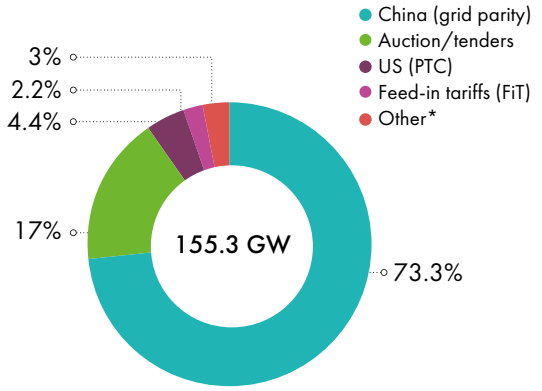


New capacity 2025 and share of top five onshore markets (%)



*China, US, India, Germany and Brazil

New capacity 2025 by market support mechanism (%)



*including merchant/PPA Basis

Onshore Wind Market – Status 2025

With 155 GW of new onshore wind capacity across 55 countries grid-connected last year, 2025 saw an unprecedented level of installations, marking a YoY growth of 42%. Globally, total onshore wind installations surpassed the 1,200 GW milestone.

As in the previous year, Asia Pacific and Africa & Middle East both saw record installations, driven by China and India's outstanding performance, a strong recovery in South Africa and remarkable progress in Saudi Arabia.

In 2025, onshore wind additions in Europe and North America increased by 23% and 77%, respectively, compared with the previous year. The uplift in Europe was driven by strong growth in key markets like Germany and Türkiye. New onshore wind additions in Germany reached 5.2 GW, the second highest in history, while Türkiye had a record year with new installations surpassing 2 GW for the first time.

The US was the main contributor to growth in North America in 2025. After experiencing a weak year for installations in 2024, the US saw a strong recovery last year. Conversely, onshore wind deployment continued to drop in South America last year, driven by a 31% drop in new installations in the region's largest wind market – Brazil.

China made up 73% of the world's total onshore installations last year. Since 2021, onshore wind development has been driven by a market support mechanism called 'grid parity', which remunerates the electricity generated from onshore wind at the same regulated price as coal power in every province. To encourage further growth in the renewable energy sector, last February

> With 155 GW of new onshore wind capacity across 55 countries grid-connected last year, 2025 saw an unprecedented level of installations, marking a YoY growth of 42%

China's National Development and Reform Commission (NDRC) and National Energy Administration (NEA) released a market-oriented pricing scheme to replace 'grid parity'.

For projects commissioned before June 2025, the transition will follow a price difference settlement mechanism, aligning grid connection pricing with current policy. New projects coming online after the deadline will have power purchase agreements (PPAs) adjusted dynamically, based on local renewable energy targets, with pricing set through competitive bidding.

To start with, this policy shift created uncertainty about rates of return on investment. However, the wind industry quickly adapted to the new market support mechanism, with 49 GW of onshore wind capacity being commissioned in H1 2025 and 65 GW in H2 2025.

Achieving more than 110 GW of onshore wind additions in a single year is remarkable for both the Chinese wind industry and central government. Such explosive growth demonstrates that the country is seriously committed and ready to deliver its '30-60' targets of peak emissions by 2030 and carbon neutrality by 2060.

In the US, onshore wind power installations bounced back last year with nearly 7 GW commissioned, marking the first rebound after four years of decline. Recent policy changes under the new Administration, however, have hit the wind industry very hard.

The rollback of the Inflation Reduction Act (IRA) incentives through the One Big Beautiful Bill Act (OBBB) has accelerated the phase-out of tax credits for wind power. Projects that begin construction prior to 4 July 2026 can receive full tax credits if they meet safe harbour rules,

while projects that start construction after that date must be placed in service by the end of 2027 to remain eligible for the tax credits.

Although the final guidance on the safe harbour window provides a runway for project execution through nearly the end of 2030, transmission congestion, supply constraints and ongoing uncertainty around permitting, tariffs and Foreign Entity of Concern (FEOC) rules continue to weigh on investor confidence and project timelines.

In addition to China and the US, the other onshore wind markets in the top five for new installations were India (6.3 GW), Germany (5.2 GW) and Brazil (2.3 GW).

Onshore wind projects commissioned in 2025 in China include large-scale wind power bases in the desert, Gobi and barren areas, which were approved under the 'Grid parity' support mechanisms. On that basis, 'Grid parity' and auctions/tenders remain the top-two market support mechanisms behind the onshore wind capacity added in 2025, collectively accounting for a combined 90.3% market share, the same as the previous year.

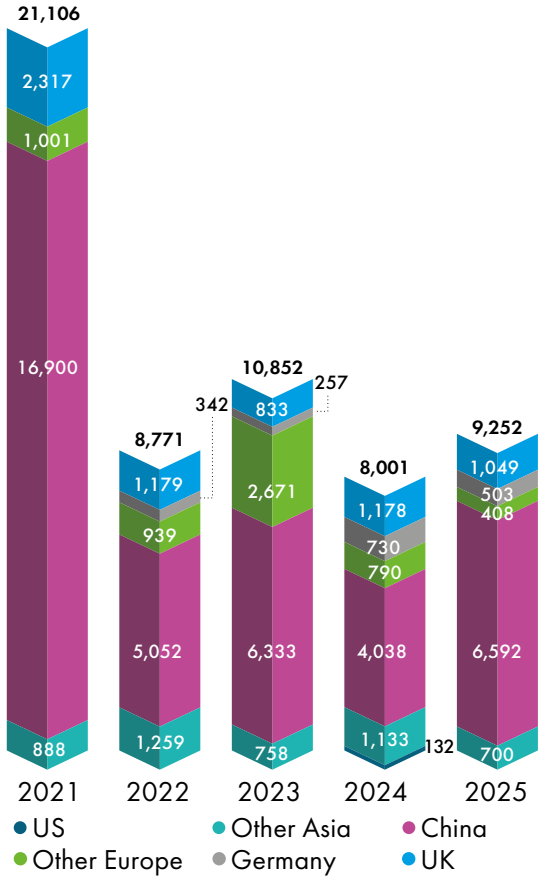
Thanks to the recovery of onshore wind development in the US, tax credits became the third-largest driver of onshore wind growth last year with a 4% market share, followed by other support schemes including merchant and PPA contracts (3%) and feed-in tariffs (2%).

In 2025, excluding China, onshore wind capacity awarded worldwide through wind-specific, technology-neutral, renewable and hybrid auctions was 32.8 GW, 39% lower than 2024. More than half of this was in Europe and around one-third in the Asia Pacific region – primarily in India.

In Europe, the total onshore wind volume awarded last year amounted to 19.2 GW, mainly driven by Germany with 11 GW of onshore wind capacity awarded, the same level as the previous year. Behind Germany were Türkiye (2.4 GW), France (1.9 GW), Romania (1.6 GW) and Italy (1.1 GW). Even though the onshore wind capacity awarded in Europe in 2025 was 13% greater than the previous year, the current pace of annual wind power auctions is insufficient for the EU to achieve its energy security and climate targets.

China approved 124.4 GW of onshore wind capacity under the market-oriented pricing mechanism in 2025, one-third higher than what the previous year, paving the way for the country to achieve its '30-60' targets.

New offshore installations (MW)



The offshore wind market has grown from 1.6 GW in 2013 to 9.2 GW in 2025, bringing its market share in global new installations from 4% to 6%. GWEC Market Intelligence expects the global offshore wind market to continue to grow at an accelerated pace (for details, see Market Outlook).

Offshore wind market – Status 2025

9.2 GW of new offshore wind capacity was grid-connected worldwide in 2025, bringing the total to 92.3 GW by the end of last year. New additions were 16% higher than the previous year, making 2025 the third-highest year for new installations in offshore wind history.

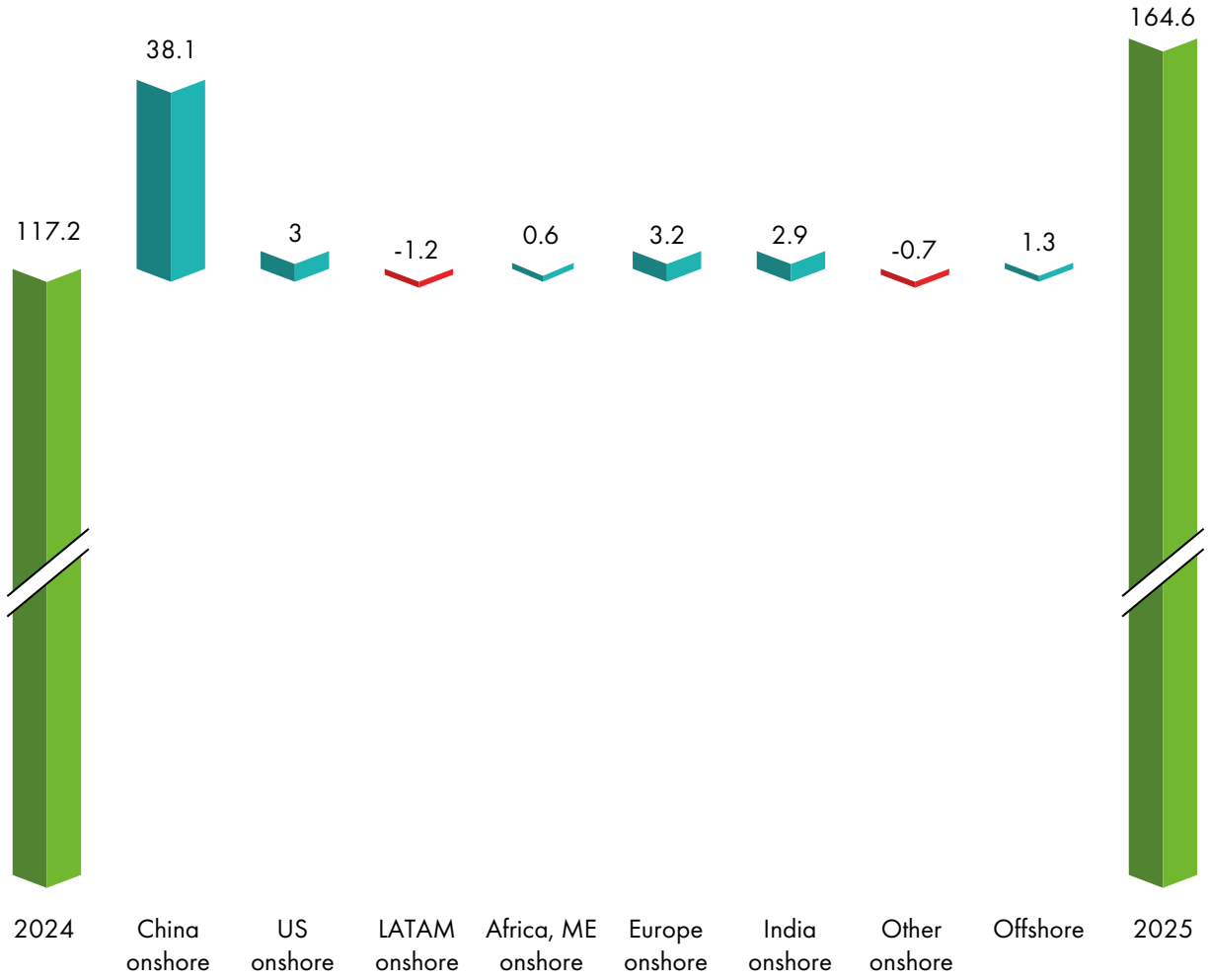
- China's new offshore wind installations were the highest globally for the eighth year in a row. With 6.6 GW new capacity commissioned, the country's total offshore wind capacity stood at 48.4 GW by the end of 2025. Since the end of feed-in tariffs at the end of 2021, China's offshore wind market development has been supported by the 'grid parity' market mechanism. As with onshore wind, grid parity was replaced last year by the market-oriented renewable energy pricing scheme. With 6.6 GW of new offshore wind grid-connected, 2025 was the second-highest year for Chinese installations, with new additions lower than our projection. To bring annual offshore wind growth in China to the next level, greater than 10 GW per year, policies shall be in place to accelerate complex maritime approvals and to support the transition from nearshore to deep-water offshore wind development.
- Europe commissioned nearly 2 GW of new offshore wind from five wind farms across three markets last year, accounting for one-fifth of the offshore wind capacity connected worldwide.
- The UK connected 1,049 MW of offshore wind capacity in 2025, making it Europe's largest offshore market in new additions. The remaining 26 SG8.0-167 turbines at the Neart na Gaoithe wind farm were connected in 2025, bringing this 448 MW project into full operation, while 66 GE Vernova Haliade-X turbines were connected at the 1.2 GW Dogger Bank Phase A, a project that has been further delayed.
- Germany connected 41 wind turbines, totalling 503 MW, in the North Sea last year, including 28 Siemens Gamesa SG11.0-200 wind turbines at the 913 MW Borkum Riffgrund 3 and 13 Vestas V236-15.0 MW wind turbines at 960 MW He Dreiht.
- France commissioned 408 MW of offshore wind at the Îles d'Yeu and Noirmoutier wind farm in 2025. This project, consisting of 61 SG 8.0-167 turbines, is projected to reach full COD in 2026.
- Outside of China, only two other markets commissioned new offshore wind capacity in the Asia Pacific region. Taiwan (China) commissioned 600 MW of offshore wind turbines across the Hailong 2 & 3 and Greater Changhua 2b & 4 offshore wind farms in 2025. Both projects used SG 14.0 wind turbines, but with different rotor diameters.
- In South Korea, the 99 MW Jeonnam 1 offshore wind project comprising 9 SGRE SG11.0-200 turbines, and one 4.3 MW Unison U151-4.3 MW turbine at the Yeonggwang Yaksu offshore wind project were commissioned last year.
- The United States remains the only country in the Americas with offshore wind turbines in operation. The 806 MW Vineyard Wind 1 offshore wind project, comprising 62 GE Haliade-X 13 MW turbines. The project complete construction in March 2026 and is now complete and operational.
- No floating wind capacity was commissioned last year, the first time since 2015. Although all the turbines at the 16.8 MW Goto offshore wind project that won Japan's first floating offshore wind auction in 2021 were installed before the end of last year, commissioning was not achieved until early 2026. Elsewhere, France had a total of 65 MW of floating wind capacity across three projects under construction last year while one 16 MW floating prototype in China was ready for commissioning. The four projects are set to come online in 2026.
- China further consolidated its market leadership for cumulative offshore wind installations last year, accounting for 52% of the global market. The country took over the crown from the UK in 2021. Germany, the Netherlands and Taiwan (China) complete the top five, as last year.
- 11.4 GW of offshore wind capacity was awarded worldwide last year, only one-fifth of the capacity awarded in 2024, which was a record year for offshore wind auctions. The lower

auction awards in 2025 are the result of failed auction rounds in Europe, cancellations in the US and the changed market support mechanism in China.

- Excluding China, where 3.9 GW of offshore wind projects were allocated under the market-oriented pricing mechanism, the remaining 7.5 GW was awarded through auctioning, with 6.8 GW in Europe and 0.7 GW in South Korea.
- In Europe, Poland, France and Ireland awarded 3.4GW, 1.5 GW and 0.9 GW offshore wind capacity respectively last year via two-sided contracts for difference (CfDs), while Germany awarded 1 GW via a negative bidding model. Failed auction rounds, totalling 6.1 GW took place in Germany, France, the Netherlands and Belgium in 2025.
- In the US, no offshore wind capacity was awarded last year. New Jersey's fourth round and New York's fifth round of offshore wind solicitations, both launched in 2024, were cancelled, mainly due to the uncertainty caused by the federal government's opposition to offshore wind. For the same reason, Massachusetts delayed its next offshore wind auction until at least 2026.
- While 1.9 GW of floating wind capacity won auctions worldwide in 2024, nothing was awarded last year.

All regions increased new installations, except Latin America

Changes in new onshore and offshore installations, 2024–2025 (GW)



Annual wind power installations (onshore and offshore combined) increased in all regions except Latin America (LATAM) in 2025, with a YoY growth rate of 40%.

- Onshore wind: Asia Pacific and Africa & Middle East had a record year in 2025 with YoY growth rates at 50% and 32%, respectively. Last year also saw onshore wind additions in Europe increase by 23% (3.2 GW), and in North America by 37% (3 GW) compared with the previous year. Onshore wind installations dropped by 24% (1.2 GW) in LATAM, due primarily to grid transmission constraints, lower-than-expected electricity demand, permitting issues and a poor energy policy environment.

- Offshore wind: Offshore wind capacity additions in 2025 increased by 18% (1.3 GW) against 2024, mainly due to the recovery of the Chinese offshore wind market (+63% YoY). Compared with the previous year, new commissioned offshore wind capacity in Europe decreased by 24% (0.6 GW) in 2025, with delays reported in the UK, Germany and France.

Actuals 2025 vs GWEC forecast

China onshore
2025 was the final year of the 14th Five-Year Plan (2021–2025) period. Several indicators in the previous year pointed to explosive onshore wind installations in 2025, including the record 92.8 GW of onshore wind capacity awarded through the 'grid parity' system and an order intake of more than 150 GW collectively by Chinese turbine OEMs. China commissioned 114 GW of onshore wind capacity in the end, making GWEC's Q3 2025 Outlook a little conservative.

USA onshore
With less than 4 GW of new onshore wind capacity commissioned in 2024 – the lowest in a decade due to the delays caused by insufficient transmission and late guidance on tax rules – GWEC believed that US onshore wind installations would bounce back in 2025. According to ACP, 16 GW of onshore wind projects were under construction by the end of Q4 2024. In addition, final guidance on the safe harbour window provides short-term visibility for projects. Onshore wind capacity commissioned in 2025 was in line with GWEC's Outlook dated Q3 2025.

India onshore
India's onshore wind market surged last year with 6.3 GW of onshore wind commissioned – a record 86% YoY growth. The country has pledged to scale non-fossil fuel capacity to 500 GW by 2030, and its Central Electricity Authority recommends that 100 GW of this should come from wind for a balanced energy mix and consumer affordability. In the light of this, GWEC Market Intelligence had upgraded its 2025 onshore wind outlook to 6.2 GW in the Q3 2025 Outlook.

Germany onshore
Since the release of the WindLandG (onshore wind law) in July 2022, the German onshore wind market has experienced unprecedented momentum, with total awarded onshore wind capacity reaching 6.4 GW in 2023 and 11 GW in 2024. Total permitted onshore wind projects reached 7.6 GW in 2023 and 13.8 GW in 2024. Considering a two-year lead time for construction – and the possibility that some projects may get delayed for various reasons – we expected the country to commission at least 5 GW of onshore wind capacity in 2025, which is in line with the 5.2 GW Germany achieved

Brazil onshore
Primarily driven by the free market through private PPAs, the Brazilian wind industry experienced record growth for onshore wind installations between 2021 and 2023. However, new installations slowed down in 2024 and were expected to continue doing so in 2025–2027, due to weak electricity demand and increased curtailment, as well as the lack of regulatory parity between distributed and centralised generation, which can distort market signals and hinder efficient system integration.

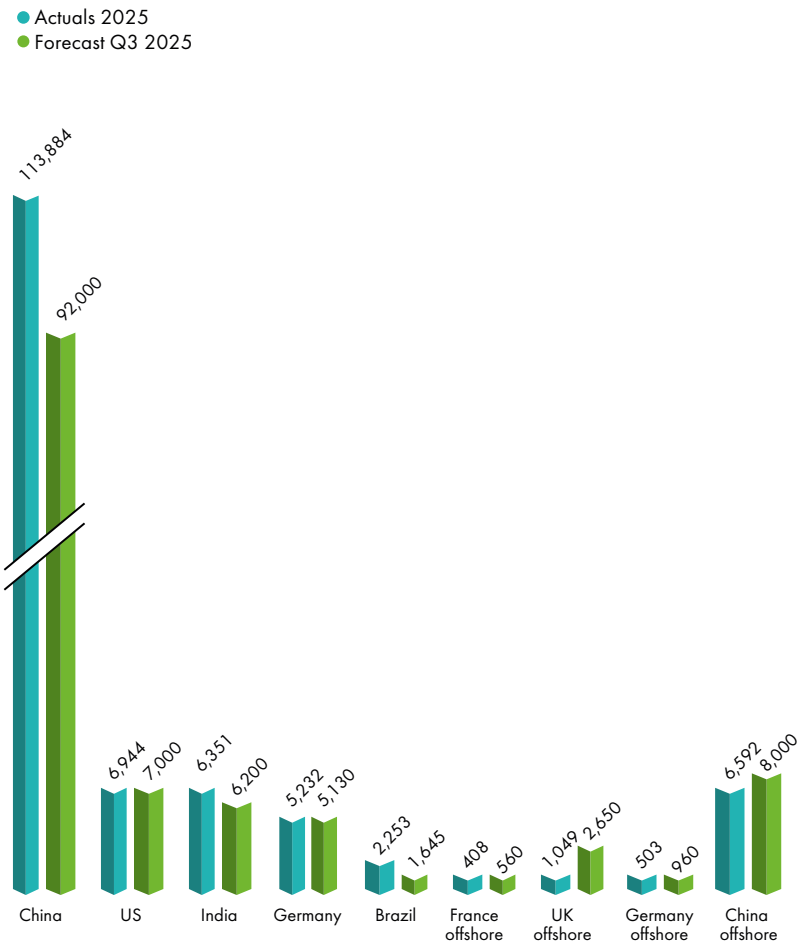
France offshore
The offshore wind capacity commissioned in France in 2025 is 25% lower than our Q1 2025 Outlook. Our projection was based on the scenario that the 488 MW Îles d'Yeu and Noirmoutier wind farm and 65 MW of floating wind capacity across three projects would come into operation in 2025. However, 10 SG 8.0-167 wind turbines were yet to be connected at Îles d'Yeu and Noirmoutier by the end of 2025 – and no floating turbines were commissioned in the end.

UK offshore
GWEC Market Intelligence expected the 488 MW Neart na Gaoithe and the 1.2 GW Dogger Bank A offshore wind projects to reach commercial operation in 2025. It also expected half of the turbines at the 1.2 GW Dogger Bank B and the 1.4 GW Sofia Wind Farm Phase 1 to be commissioned by the end of the year. For various reasons, only Neart na Gaoithe and 66 of Dogger Bank A's wind turbines (834 MW) were commissioned in the end.

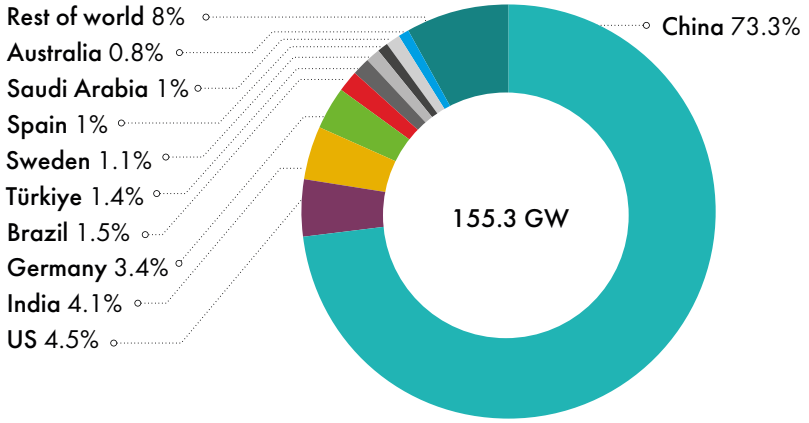
Germany offshore
In Germany, although wind turbine installation at the 913 MW Borkum Riffgrund 3 offshore wind farm was already completed in 2024, the commercial operation date was moved to early 2026 due to delays to the HVDC grid connection that links the project to the German onshore grid, according to the TSO. Our forecast was based on the projection that the 960 MW He Dreiht project would be commissioned in 2025. In the end, 28 Siemens Gamesa SG11.0-200 wind turbines were commissioned at Borkum Riffgrund and 13 Vestas V236-15.0 MW wind turbines at He Dreiht last year.

China offshore
China approved 16.6 GW of offshore projects via the 'grid-parity' market scheme in 2024 while more than 20 GW of offshore wind projects were under construction by Q1 2025, signalling a strong growth potential in 2025. According to the NEA, however, only 6.6 GW of offshore wind capacity was commissioned last year. This is mainly due to delays caused by insufficient grid connections and complex maritime approvals and coordination.

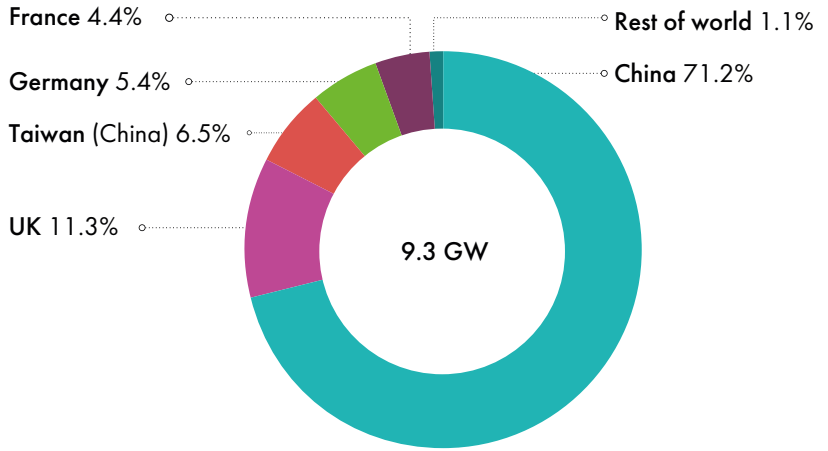
Actuals for 2025 vs GWEC forecast



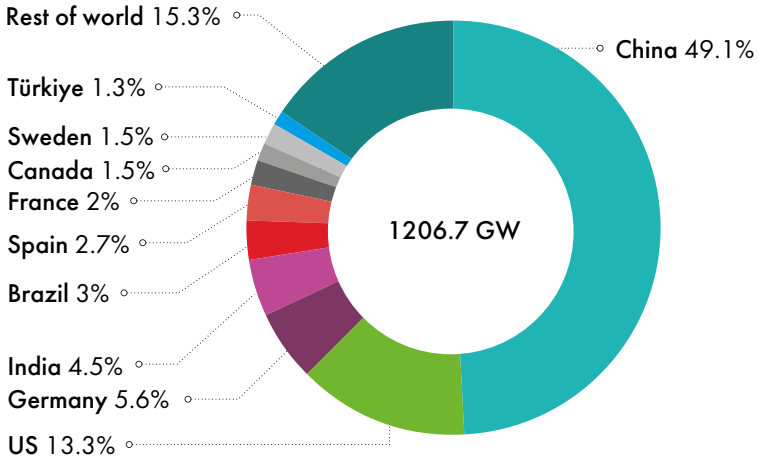
New installations onshore (%)



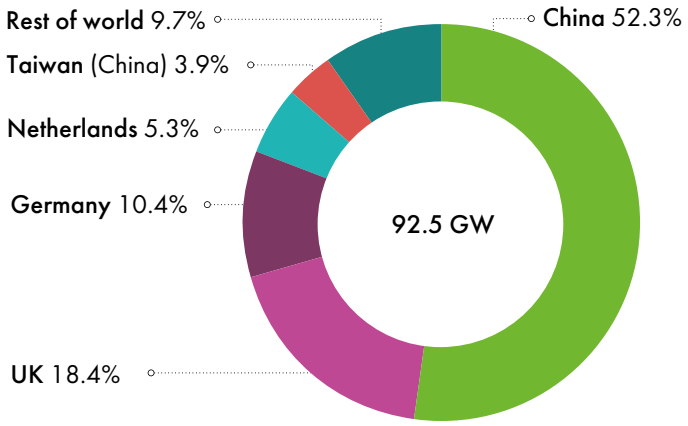
New installations offshore (%)



Total installations onshore (%)

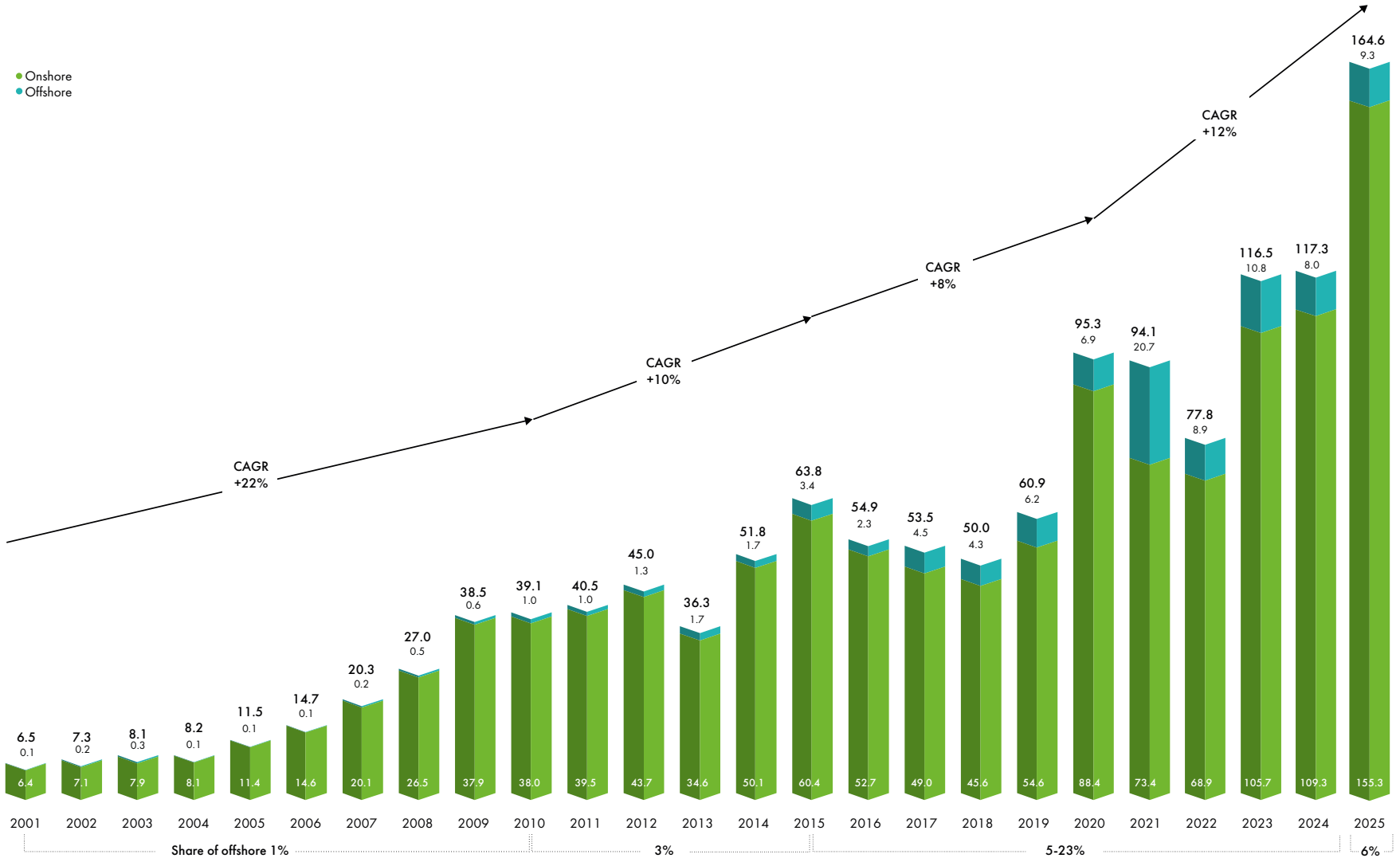


Total installations offshore (%)



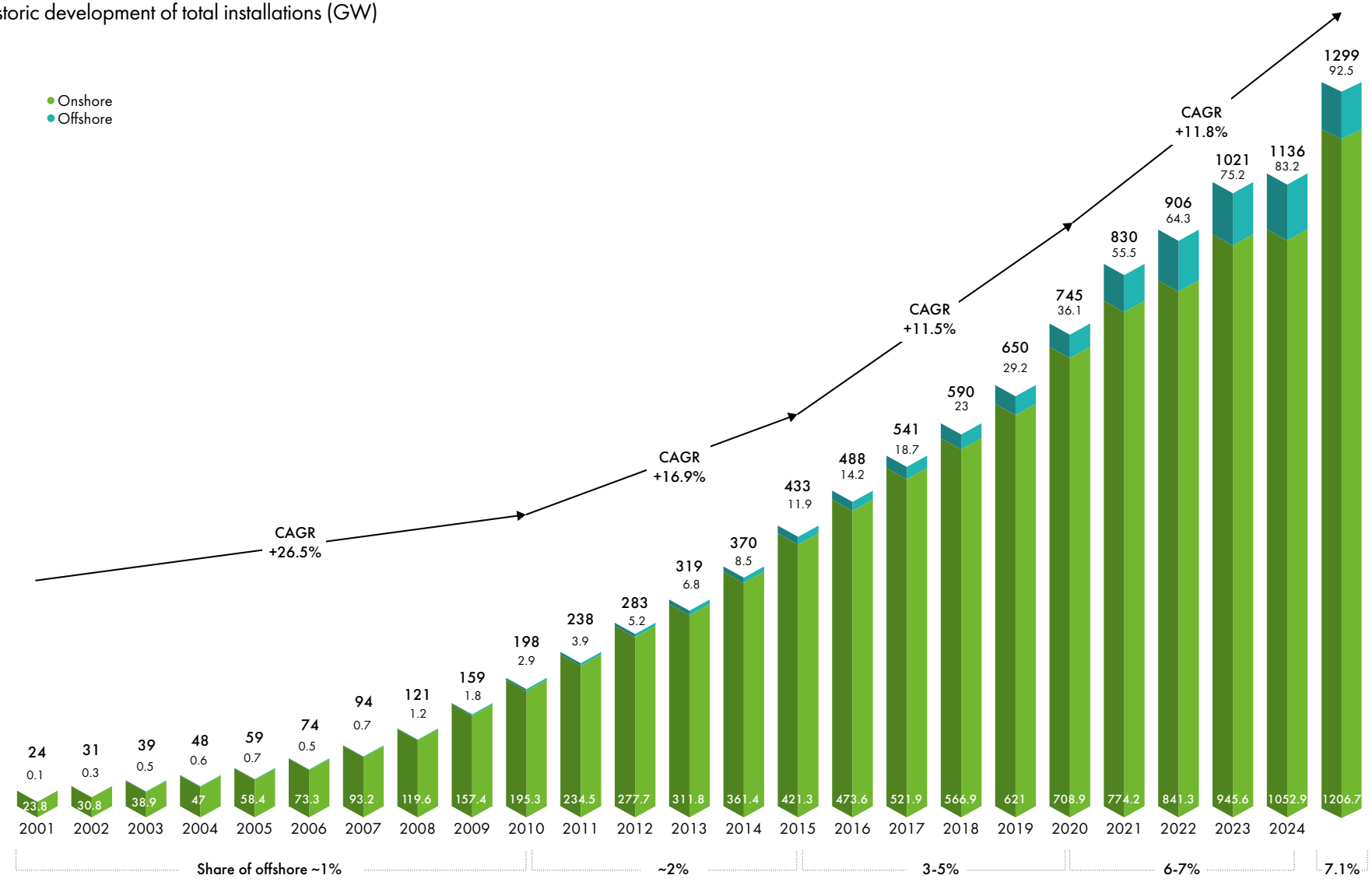
Detailed data sheet available in GWEC's member-only area. For definition of region see Appendix - Methodology and Terminology

Historic development of new installations (GW)



Footnote: GWEC made the adjustments to new installations and total installation in 2023 based on the updated statistics GWEC received. For details see Appendix -Methodology and Terminology

Historic development of total installations (GW)



GWEC made the adjustments to total installations based on the updated statistics GWEC received. For details see Appendix -Methodology and Terminology

Historic development of new and total grid-connected installations

MW.onshore	New installations 2024	Total installations 2024	New installations 2025	Total installations 2025
Total onshore	**109337**	**1052940**	**155340**	**1206691**
Americas	**10266**	**227944**	**10997**	**238939**
USA	3926	154084	6944	161028
Canada	1387	18319	348	18665
Brazil	3278	33727	2253	35980
Mexico	369	7782	30	7812
Argentina	614	4319	176	4495
Chile	307	4884	1152	6036
Other Americas	385	4829	94	4923
Africa, Middle East	**1979**	**12621**	**2616**	**15237**
Egypt	794	2855	242	3097
Kenya	0	436	0	436
South Africa	69	3528	509	4037
Morocco	520	2368	261	2629
Saudi Arabia	390	812	**1512**	2324
Other Africa	207	2622	92	2714
Asia-Pacific	**83152**	**561208**	**124548**	**685080**
PR China	75786	478787	113884	592076
India	3420	48160	6351	54511
Australia	836	12315	1200	13515
Pakistan	58	1875	19	1894
Japan	603	5553	625	6148
South Korea	198	2018	122	2096
Vietnam	239	4163	506	4669
Philippines	0	593	88	681
Kazakhstan	127	1043	387	1430
Other APAC	1885	6700	1366	8060
Europe	**13940**	**251166**	**17179**	**267435**
Germany	3292	63465	5232	68066
France	1134	23540	1006	24464
Sweden	670	16571	1767	18232
United Kingdom	763	15728	201	15912
Spain	1188	31612	1563	33151
Finland	1465	8410	1023	9433
Netherlands	171	6978	91	7054
Turkey	1310	13793	2142	15935
Other Europe	3947	71069	4154	75188

MW.offshore	New installations 2024	Total installations 2024	New installations 2025	Total installations 2025
Total offshore	**8001**	**83222**	**9252**	**92474**
Americas	**132**	**174**	**0**	**174**
USA	132	174	0	174
Asia-Pacific	**5171**	**46258**	**7292**	**53551**
PR China	4038	41813	6592	48405
Japan	100	288	0	288
South Korea	100	246	100	347
Vietnam	0	874	0	874
Taiwan (China)	933	3037	600	3637
Europe	**2698**	**36790**	**1960**	**38750**
United Kingdom	1178	15934	1049	16983
Germany	730	9122	503	9625
France	658	1500	408	1908
Netherlands	132	4870	0	4870
Denmark	0	2652	0	2652
Belgium	0	2262	0	2262
Other Europe	0	450	0	450

GWEC made the adjustments to new installations and total installation in 2023 based on the updated statistics GWEC received. For details see Appendix - Methodology and Terminology

CHAPTER 5: MARKET OUTLOOK 2026-2030

Global wind energy market expected to grow 5.2% annually

Global outlook

Global energy markets are facing unprecedented uncertainty and pressure. While the international community struggles to find a resolution to the Russia–Ukraine war, escalating tensions in the Middle East involving Iran, the US and Israel,and the near-shutdown of the Strait of Hormuz have further destabilised an already fragile landscape.

Since the onset of the US-Israel-Iran conflict, energy markets have been on edge as the volatility threatens both immediate and long-term supplies. Attacks on gas infrastructure directly threaten global energy security, with the economic implications felt worldwide.

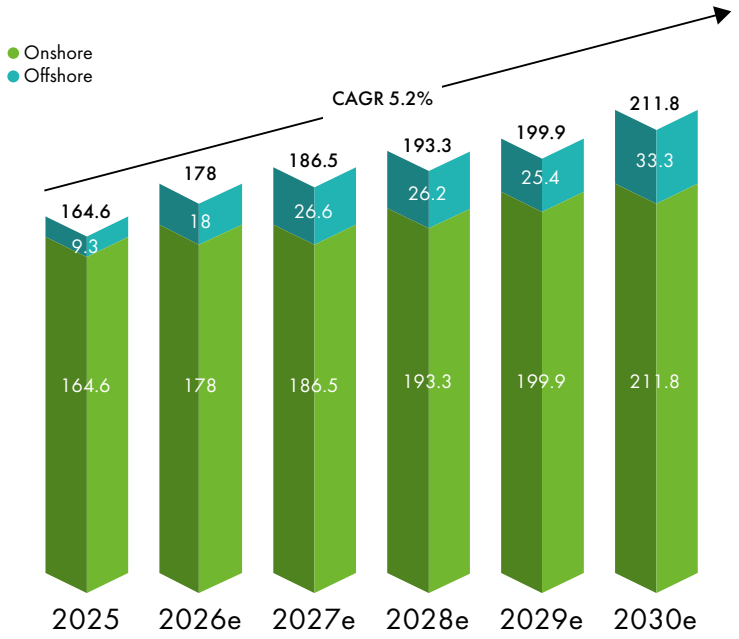
History is repeating itself. We saw similar chaos following Russia's invasion of Ukraine in 2022, during the Gulf War of the 1990s, and throughout the 1970s energy crisis. Navigating these complex challenges requires a deep understanding of the forces at play, but the key lesson of the last half-century is clear: diversifying energy systems is no longer just a climate objective; it is a fundamental pillar of national energy security.

Countries that moved decisively to diversify their energy portfolios and accelerate renewable deployment over the past decade are now better shielded from the fossil fuel price shocks and financial contagion caused by distant conflicts.

As nations assess the impact of oil and gas shortages, it is becoming increasingly evident that doubling down on fossil fuels is the wrong response. Policymakers must implement emergency frameworks to diversify power sources and scale renewable energy at an unprecedented pace. Recent acceleration plans announced by the UK, Egypt, the Philippines, South Korea and Japan demonstrate that there is no time to waste in the pursuit of energy resilience.

Wind is a limitless, affordable, scalable and homegrown power source – crucial to strengthening energy sovereignty. In this environment, we remain more optimistic than ever about the vital role wind energy will play in accelerating the global energy transition.

New installations outlook 2026–2030 (GW)



GWEC's Market Outlook represents the industry perspective on expected installations of new capacity over the next five years. The outlook is based on input from regional wind associations, government targets, tender results, announced auction plans, available project pipeline, industry experts and GWEC members. An update will be released in Q3 2026. A detailed data sheet is available in the member-only area of the GWEC Intelligence website.

GWEC Market Intelligence projects that new installations will surpass previous records, reaching 178 GW in 2026. Under current policies and the global response to the Middle East crisis, a total of 969 GW of new capacity is expected over the next five years, averaging 194 GW annually through 2030.

Despite 2025 seeing the highest installed capacity in history, the projected Compound Annual Growth Rate (CAGR) for 2026–2030 remains a robust 5.2%. We believe the following seven pillars will support this continued success:

- **China's system-level transformation:** The Chinese government remains committed to its '30-60' pledge. A system-level transformation of the

power sector is underway to position renewables at the centre of the energy grid. Under its latest NDC commitment, China aims for 3.6 TW of total wind and solar capacity by 2035, making annual wind power installations of over 100 GW the new norm.

- **European energy security:** In the wake of Russia's invasion of Ukraine, Europe is accelerating renewable deployment to ensure energy security. However, current trajectories remain insufficient to fully insulate the region from fossil fuel volatility. Recent European Commission packages on grids, energy independence and affordability, which include the Clean Energy Investment Strategy, will speed up the deployment of clean energy, deepen market integration and shorten deployment timelines.
- **United States policy mismatch with reality:** The rollback of the IRA via the OBBB has significantly reshaped the American energy landscape. While regulatory headwinds persist for wind under the current administration, it remains a reliable and affordable generation source. With a renewed focus on affordability and a sharp increase in power demand, driven by hyperscale AI, wind will maintain a critical role throughout the forecast period.
- **India's rapid scaling:** Aiming for 500 GW of non-fossil fuel capacity by 2030, India has emerged as one of the world's fastest-growing wind markets. Supported by a strong domestic supply chain and rising demand, wind is poised to be a defining factor in India's energy security and economic growth.
- **Offshore strength despite recalibration:** The offshore sector is recalibrating due to policy uncertainty, macroeconomic headwinds and permitting delays. However, this is an adjustment rather than a retreat, as market fundamentals remain strong. The 2026 Hamburg Declaration (North Sea Summit) signals a new era of government-industry collaboration focused on risk-sharing and delivery.
- **Emerging-market momentum:** Growth in Southeast Asia, Central Asia and the Middle East & Africa is expected to gain significant momentum, with record annual installations anticipated over the next five years.
- **Age of electricity:** The world is accelerating rapidly into the 'Age of Electricity': the necessary technologies are already at our fingertips. Nations that leverage abundant wind resources to lead the transition towards an electrified future will secure their energy independence, catalyse economic growth and gain a decisive strategic advantage. Success, however, demands unwavering political commitment and significant upfront investment in both supply chains and infrastructure.

Global onshore outlook

- **Growth projections:** The onshore CAGR for the forecast period is 2.8%,

with annual installations expected to average 168 GW (totalling 840 GW in 2026-2030).

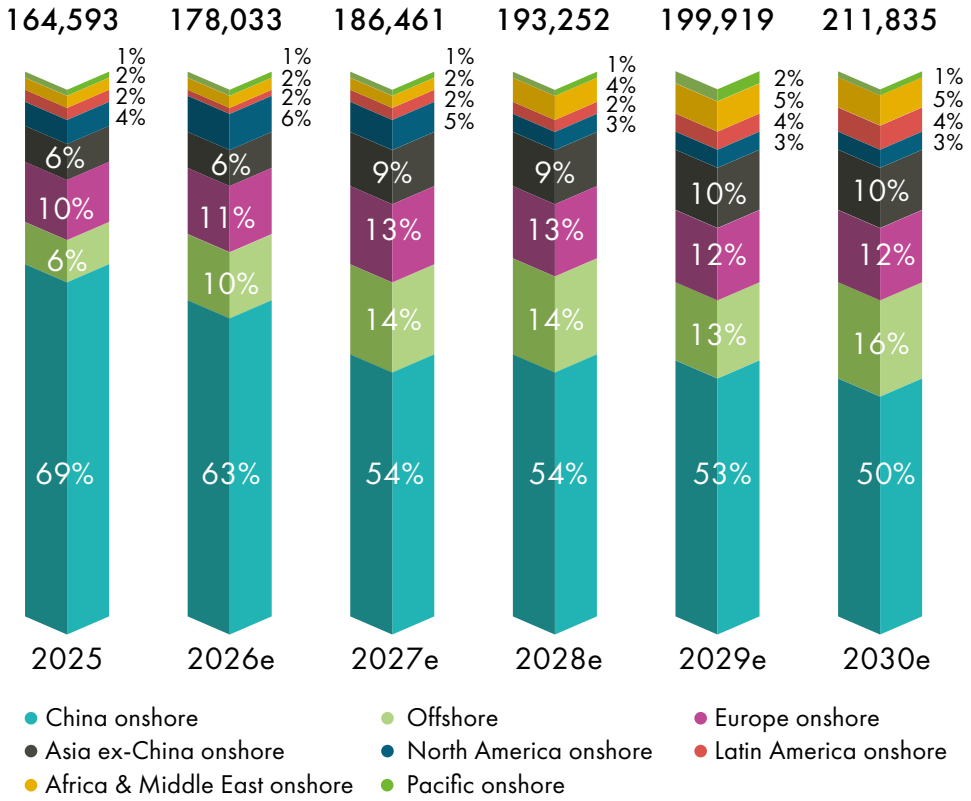
- **Regional trends:** China and Europe remain the backbone of the market, accounting for 77% of total projected capacity. Conversely, North American installations are expected to dip mid-period due to the phase-out of tax credits and broader policy shifts. The Asia Pacific region excluding China will consolidate its position as the third-largest onshore wind growth market in the period with total additions two times higher than North America. Following the expected weak growth in LATAM in 2026-2027, Africa & Middle East is likely to overtake this region as the fifth-largest onshore growth driver for the first time.
- **Diversification:** While China will drive 63% of new installations in 2026, we will see greater diversification by 2030. As a result of rapid acceleration in Southeast Asia, Central Asia and Africa & Middle East from 2027, we expect more than half of global growth to come from markets outside of China by the end of the decade.

Global offshore outlook

- **Exponential growth:** The offshore sector boasts a staggering CAGR of 29%. Annual additions are expected to triple by 2030 compared with 2025 levels.
- **Dominant markets:** China and Europe will command 86% of total new capacity. Despite a challenging policy environment in the US, approximately 6 GW of capacity is slated for commissioning between 2026 and 2028, making North America the third-largest offshore wind market, followed by LATAM,where a 25 MW demonstration project is expected to be built before the end of the decade.
- **Market share:** With annual installations projected to average 26 GW, a total of 129 GW of offshore wind capacity is expected to be added worldwide in the forecast period, of which 56% will come from China, 29% from the EU, 10% from Asia Pacific excluding China, and 5% from the US.

Onshore wind still in the driver's seat while offshore wind gets ready to accelerate after a period of recalibration

New onshore and offshore installations outlook by region (MW, %)



Offshore wind

In line with other infrastructure sectors and energy sources, offshore wind has been dealing with the long tail of the war in Ukraine and associated macroeconomic factors raising interest rates and the cost of capital. Despite governments setting strong targets, the credible pipeline of development has been inconsistent and uncertain, resulting in a lack of effective investment signals. Longstanding issues such as slow permitting, poor auction design in mature markets and increasing policy instability in markets like the US have compounded this effect and led the industry to an inflection point.

In the light of the ongoing energy crisis, the case for offshore wind has never been stronger. Confronting the obstacles to success, however, requires governments and industry working together to recalibrate and urgently evolve policy to support growth. As the sector goes through a period of recalibration, global offshore wind capacity is expected to grow from 9 GW in 2025 to 33 GW in 2030. This would bring its share of new global wind installations from today's 6% to 16% by the end of the decade.

In Europe, more than 37 GW of offshore wind capacity is expected to be fed into the grid in 2026–2030, of which 44% (16 GW) is likely to be installed in the UK, mainly driven by the expected commissioning of projects from CfD Allocation Rounds 3, 4 and 6. With a record offshore wind capacity of 8.4 GW awarded through CfD AR7 in the beginning of 2026, more than one-third of that capacity is likely to be commissioned towards the end of the forecast period.

Germany ranks second in new additions, with 7.6 GW offshore wind capacity expected to be connected in 2026-2030, followed by Poland (6 GW), the Netherlands (3.6 GW), France (1.7 GW) and Denmark (1.4 GW).

Chinese offshore wind deployment bounced back in 2025 from the 36% YoY drop experienced in 2024. Thanks to the world's most mature offshore wind supply chain, the country has already delivered the lowest LCOE among all offshore wind markets. The market-oriented pricing mechanism released last February requires alignment between the local offshore wind industry and investors. The main hurdle to offshore wind accelerating in China is the policy framework around complex maritime approvals and the transition from nearshore to deep-

water offshore wind development. President Xi has explicitly mentioned offshore wind as part of the high-quality development plan for the Chinese marine economy. This is a clear signal that regulations will be in place to facilitate offshore wind growth during the 15th Five Year Plan Period.

As a result, we believe that the country is expected to consolidate its offshore wind leadership in the APAC region with 73 GW to be added in 2026–2030, followed by Taiwan (China) (6 GW), Japan (3.2 GW), South Korea (3.2 GW) and the Philippines (1 GW). No real offshore wind projects are likely to be commissioned in Vietnam before the end of the decade, although intertidal projects will continue to be built in the next five years.

In the US, offshore wind has no future under the current administration. Following the Presidential Executive Order in January 2025 to temporarily withdraw all offshore wind energy leasing within the Offshore Continental Shelf (OCS), the Bureau of Ocean Energy Management (BOEM) cancelled all wind energy areas that it had designated on the Outer Continental Shelf since 2014. The past 10 months also saw orders by the US federal government to halt construction activities at five projects over security concerns. Assuming all of Vineyard 1, Revolution Wind, Coastal Virginia Offshore Wind (CVOW), Empire 1 and Sunrise offshore wind projects are commissioned, 5.9 GW of offshore wind capacity will be added in 2026-2028. Considering the long lead time for offshore wind projects and the shattered investment confidence in the US sector, it is unlikely that new offshore wind capacity will be added in 2029-2030 even if the Democrats win the next election.

China

China connected more than 110 GW of onshore wind to the grid in 2025, almost the same amount of wind capacity as the whole world commissioned in 2024. The scale not only demonstrated the country's commitment to its '30-60' targets but was proof that its domestic supply chain was ready to deliver.

When the market-oriented renewable energy pricing scheme was released by China's NDRC and NEA in February 2025, it engendered fear that return on investment in renewable energy would be affected. Compared with the 'grid parity'-based pricing scheme, which offers long-term price certainty, the new mechanism would expose investors to price fluctuations. However, thanks to wind's greater ability than solar to cope with the pricing dynamics introduced by the new pricing mechanism, the local industry quickly adapted – much as it did in 2021 when feed-in tariffs stopped being the support mechanism for wind energy.

NEA plans more than 50% of total power generation capacity added during the 15th Five-Year Plan period (2026-2030) to be renewable energy. Renewables are expected to provide 30% of China's total electricity demand by the end of this period. Taking all this into account, as well as the 2035 wind and solar installation target under China's latest NDC (Nationally Determined Contributions) commitment, GWEC Market Intelligence believes that 527 GW of new onshore wind could be added to the grid in China in 2026–2030, equating 105 GW of new installations per year until 2030.

Asia excluding China

As the second-largest wind market in APAC after China, India had a record year of onshore wind installations in 2025. Supported by its target of 500 GW renewable energy by 2030, wind-specific Renewable Purchase Obligation (RPO), 10 GW annual onshore wind auctions target in 2023–2027, significant C&I growth and an established local wind energy supply chain, we anticipate record onshore wind installations in the next five years, with total additions of 41 GW in 2026-2030.

Although state-owned utility Vietnam Electricity (EVN) has been negotiating PPAs with investors since January 2023 for installed projects that missed the 2021 COD deadline, only 1,568 MW of onshore wind projects reached

agreements with EVN in 2023-2025. This means that more than 600 MW of installed wind projects are still waiting for grid-connection approval. Additionally,1,575 MW were reported by wind turbine OEMs as new installed capacity in 2022-2025. This means that there are more than 2.1 GW of installed wind capacity still waiting for COD approval. In the current policy scenario, we expect the rest of the capacity installed before 2022 to be approved in 2026. In total, 15 GW of onshore wind capacity is likely to be added in the forecast period, bringing total onshore wind power capacity – including intertidal projects – to 20.5 GW by 2030, making Vietnam the third-largest market in this region.

Elsewhere, strong onshore wind growth is expected tin Japan and emerging markets in southeast and central Asia. The Philippines, Uzbekistan and Kazakhstan are expected to become the region's rising stars (see details in the Market to Watch section). These three markets combined are likely to make up 14% of the new capacity expected in APAC excluding China in 2026–2030.

Pacific

After two years of stagnation, onshore wind installations in Australia bounced back in 2025 with a YoY growth rate of 43%. However, last year saw only four onshore wind projects totalling 857 MW reach FID – a 61% YoY drop.

According to the Clean Energy Council's latest quarterly investment report, 18 onshore wind projects worth 5.4 GW were either under construction or committed at the end of 2025.

The Australian Energy Market Operator (AEMO) has downgraded its forecast for wind capacity by the end of this decade to 26 GW to reflect inflation, planning delays and community opposition. This means that 2.5 GW of new onshore wind capacity is likely to be added annually in 2026-2030. As of Q1 2026, GWEC's Australia project pipeline comprises more than 90 GW of onshore wind projects at different stages of development, including 11 GW that we believe will be added to the grid during the forecast period.

After a record year of installations, no onshore wind capacity was commissioned in New Zealand in 2025. Permitting has been one of the primary reasons for the sector slowing down. As of Q1 2026, only four projects totalling 640 MW are under construction or consented.

Europe

Our onshore wind forecast for Europe is in line with WindEurope's recently released 2026–2030 Outlook, which takes account of the latest developments in EU regulation, national policies, announcements of signed PPAs, project development timelines and the ability of wind to secure further capacity in upcoming auctions and tenders.

Under WindEurope's central scenario, record onshore wind installations of 117 GW are expected from 2026 to 2030, of which 83% or 97 GW is predicted to be in the EU. This equals 19.4 GW of new installations each year until 2030 – 3% higher than WindEurope's 2025 forecast but still much lower than the average growth needed for the EU to meet its 2030 energy and climate targets.

Based on onshore wind capacity awarded through auctions over the past five years, Germany is likely to maintain its leading position in onshore wind development in this region, accounting for 40% of total onshore wind additions in the period, followed by Türkiye (9%), the UK (6,5%), Spain (6,4%) and France (6.1%).

North America

The US federal government's law amendment through OBBB last July has accelerated the phase-out of tax credits for onshore wind power. Projects that begin construction prior to 4th July 2026 can receive full tax credits if they meet the safe harbour rules, while projects that start construction after that date must be placed in service by the end of 2027 to remain eligible for tax credits.

While the industry expected this would result in a short-term rush of

developers eager to secure the subsidies, in reality, the continued challenges around grid connection, permits, supply chain constraints, tariffs and guidance on tax credit rules have caused the industry to lower its expectations in both the short and medium term.

The American Clean Power Association (ACP)'s latest Market Report has 13.4 GW of onshore wind under construction and 15.6 GW in advanced development as of Q4 2025. This represents a 15% YoY growth and indicates no shortage of projects in the pipeline to qualify for tax credits and support near-term growth. But the fate of onshore wind installations after 2027 will depend on how quickly the challenges of affordability and power-hungry AI can boost investment certainty for wind energy.

With all of this in mind, we forecast additions of 40 GW of onshore wind capacity in the 2026–2030 period in North America, of which 75% will in the US and the rest in Canada. According to CanREA's 2025 market outlook report, nearly 5 GW of utility-scale wind projects are expected to come online in 2026-2029.

Latin America

While LATAM is one of the most promising regions for wind energy expansion, less than 4 GW of new onshore wind capacity was commissioned last year – the lowest since 2020.This was primarily due to the slowdown of installations in the region's growth engine, Brazil. In addition to lower-than-expected electricity demand and fewer new-energy auctions, curtailment remains a critical challenge in Brazil, particularly in areas where wind generation exceeds local demand and transmission infrastructure is insufficient. This is compounded by the lack of regulatory parity between distributed and centralised generation, which can distort market signals and hinder efficient system integration. Although annual installations are expected to continue to drop next year, a recent flurry of turbine orders indicates that growth will bounce back in 2028.

Elsewhere in the region, Chile saw new installations triple last year. Driven by a clear commitment to renewable energy – targets of at least 60% of electricity from renewable sources by 2035 and at least 70% by 2050 – Chile's wind energy market has expanded rapidly since 2019. In 2025, 67% of Chile's power generation came from renewable sources. A unified national grid, tax incentives, streamlined permitting and a robust policy framework all align with the country's net zero goal by 2050.

An unsupportive energy policy environment in Mexico, conflicts with indigenous communities and poor grid connections in Colombia, a lack of alignment between policy, financing mechanisms and technical capacity in Argentina are all hindering market growth. Nonetheless, we expect new onshore wind capacity to continue to be built in those markets. In total, we forecast 24.6 GW of additional onshore wind capacity in this region in the 2026–2030 period. Brazil, Chile, Mexico, Argentina and Colombia will be the top five markets, collectively accounting for 93% of additions.

A recent flurry of turbine orders indicates that growth will bounce back in Brazil in 2028

Africa & the Middle East

Africa & the Middle East saw another record year in new installations in 2025, primarily driven by renewed growth in South Africa, the region's market leader in total wind installations, and unprecedented growth in Saudi Arabia. The region, however, remains the smallest for total wind power deployment.

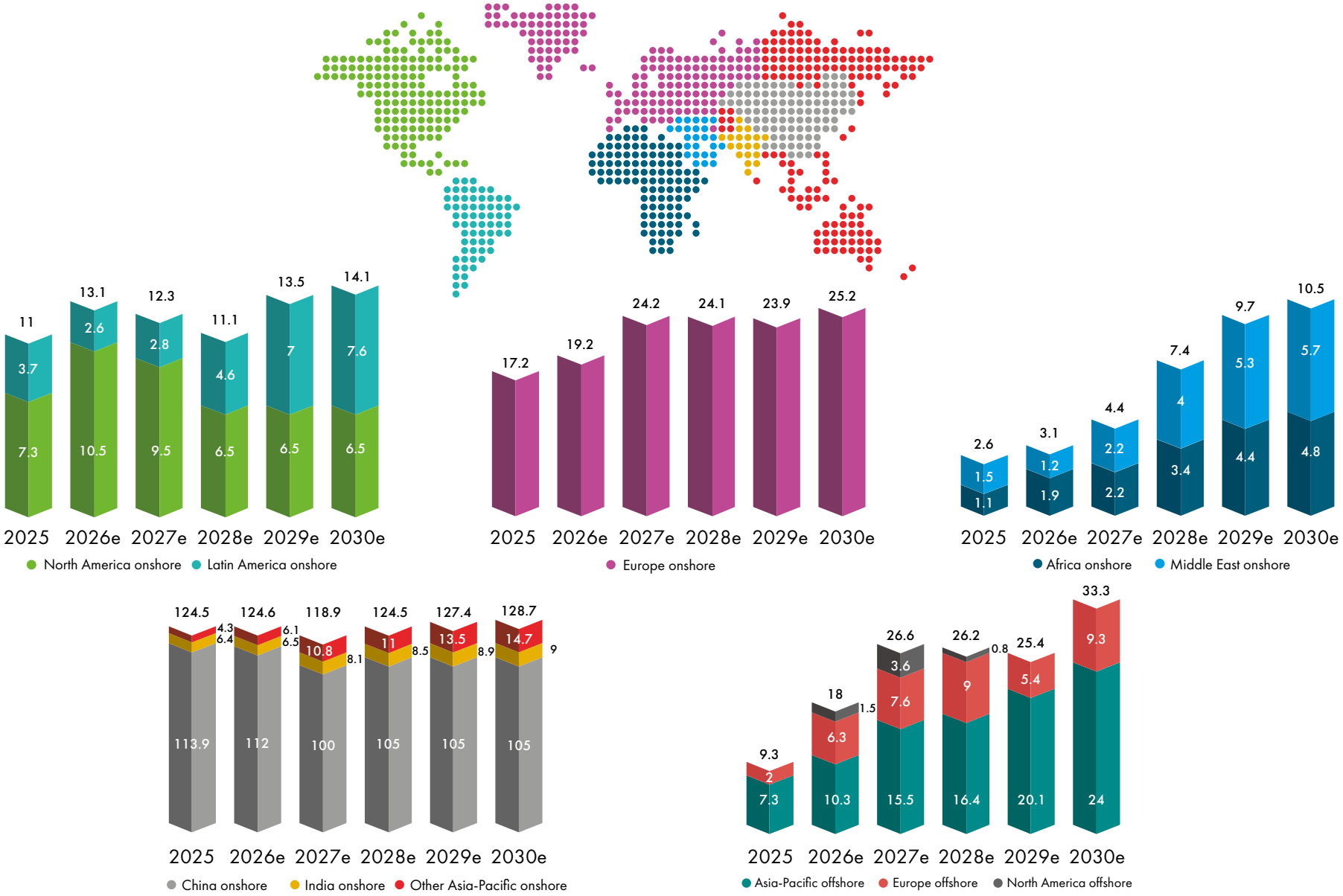
In 2025, several structural reforms strengthened the regulatory and institutional environment for renewable energy deployment in South Africa (see details on page xx). Given that nearly 3 GW of onshore wind capacity awarded through the REIPPPP Bid Windows or contracted under private offtake agreements are in construction and another 17 GW are at advanced stages of development, we believe that South Africa will continue to grow through the 2026–2030 period.

In North Africa, Egypt targets renewables making up more than 42% of the electricity mix by 2030. As of Q1 2026, 1.3 GW of onshore wind is under construction and nearly 10 GW in the development phase. In response to the Middle East crisis, Egypt has signed PPAs for 5,620 MW of renewable energy and storage, including a 900 MW wind project. GWEC Market Intelligence expects Africa to see record installations annually over the next five years.

In the Middle East, last year wind turbine OEMs reported more than 1 GW of new installations in Saudi Arabia. In a scenario where all the projects currently under construction in this region, the 5.3 GW of capacity already awarded through auctions and the announced investment plans in manufacturing facilities in Saudi Arabia and Oman all materialise, the Middle East will add more than 18 GW of onshore wind capacity in 2026–2030.

In total, 35 GW of new capacity is expected to be added in this region during the forecast period, of which 47% will come from Africa and the rest from the Middle East.

Regional onshore and offshore wind outlook for new installations (GW)



APPENDIX

Global Wind Report 2026 Methodology and Terminology

Data definitions and adjustments
GWEC reports installed and fully commissioned capacity additions and total installations. New installations are gross figures not deducting decommissioned capacity. Total installations are net figures, adjusted for decommissioned capacity.

Historic installation data has been adjusted based on the input GWEC received.

GWEC made the adjustments to both new and cumulative installations in 2021-2025 for all the markets where updated statistics are available.

Definition of regions
GWEC adjusted its definition of regions for the 2018 Global Wind Report and maintains these in the 2026 edition, specifically for Latin America and Europe.

Latin America: South, Central America and Mexico

Europe: Geographic Europe including Norway, Russia, Switzerland,Türkiye and Ukraine

Sources for the report
GWEC collects installation data from regional and country wind associations, alternatively from industry experts and wind turbine manufacturers.

Used terminology
GWEC uses terminology to the best of our knowledge. With the wind industry evolving, certain terminology is not yet fixed or can have several connotations.

Acronyms

Abeeolica	Associacao Brasileira De Energia Eolica
ADB	Asian Development Bank
AFISS	ASEAN Framework for Integrated Semiconductor Supply Chain
AGII	African Green Industrialisation Initiative Forum
AI	Artificial Intelligence
APAC	Asia-Pacific
APEC	Asia-Pacific Economic Cooperation
APG	ASEAN Power Grid
APRA	Accelerated Partnership for Renewables in Africa
AR	Action Round
ASEAN	Association of Southeast Asian Nations
Badeel	Water and Electricity Holding Company (Saudi Arabia)
BESS	Battery Energy Storage System
BF	Bridging Forum
BOO	Build, Own, Operate
BPA	Bio-based Polyamide
C4A	Chips 4 Alliance
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CBAM	Carbon Border Adjustment Mechanism
CCGTs	Combined Cycle Gas Turbines
CEEC	China Energy Engineering Corporation
CfD	Contracts for Difference
CoD	Commercial Operation Date
COP	UNFCCC Conference of the Parties
CSOs	Civil Society Organisations
CSRD	EU Corporate Sustainability Reporting Directive
CSWO	CS WIND Offshore
DANIDA	Danish International Development Assistance
DEC	Dongfang Electric Corporation (China)
DFIs	Development Finance Institutions
DISCOMs	Power Distribution Companies (India)
DNV	Det Norske Veritas
DOE	Department of Energy
DSCRs	Debt Service Coverage Ratios
EBRD	European Bank for Reconstruction and Development
ECA	Export Credit Agency
ECH	Epichlorohydrin
ECOWAS	Economic Community of West African States
EETC	Egyptian Electricity Transmission Company
EMDEs	Emerging Markets and Developing Economies
ENDI	National Strategy for Decarbonising Industry (Brazil)
EPC	Engineering, Procurement, and Construction
ESG	Equity Sustainability and Governance
EU	European Union
EUR	Euro
EV	Electric Vehicle
EVN	Electricity of Vietnam
FDI	Foreign Direct Investment
FDRE	Firm and Dispatchable Renewable Energy
FiP	Feed-in Premium
FIT	Feed-in Tariff
FRP	Fiber Reinforced Polymer
G20	Group of Twenty
GBP	British Pound
GDP	Gross Domestic Product
GEAP	Green Energy Auction Program
GHG	Greenhouse Gas
GIS	Geographical Information System
GRA	Global Renewables Alliance
GW	Gigawatt
GWh	Gigawatt hour
GWEC	Global Wind Energy Council
HUMAIN	Saudi AI Leadership Initiative
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
IEA	International Energy Agency
IFC	International Finance Corporation
INR	Indian Rupee
IPEF	Indo-Pacific Economic Framework
IRA (US)	Inflation Reduction Act (United States)
IRP	Integrated Resources Plan of South Africa
ISTS	Inter-State Transmission System
KAPSARC	King Abdullah Petroleum Studies and Research Center
KETRACO	Kenya Electricity Transmission Company Limited
KfW	Kreditanstalt für Wiederaufbau
LCOV	Levelized Cost of Value
LCOE	Levelised Cost of Energy
LTDA	Long-term Decarbonisation Power Source Auction
LTMS	Laos-Thailand-Malaysia-Singapore
MCEE	Ministry of Climate, Energy and Environment
MDBs	Multilateral Development Banks
MENA	Middle East and North Africa
MERCOSUR	Southern Common Market
MOIT	Ministry of Industry and Trade (Vietnam)
MOU	Memorandum of Understanding
MW	Megawatt
NDC	Nationally Determined Contributions
NEA	New Energy Authority (China)
NERSA	National Energy Regulator of South Africa
NGHC	Saudi Arabia's NEOM Green Hydrogen Company
NGO	Non-Governmental Organisation
NREA	New and Renewable Energy Authority (Egypt)
NREP	National Renewable Energy Programme (Saudi Arabia)
NTCSA	National Transmission Company South Africa
NZIA	Net-Zero Industry Act
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
O&M	Operation and Maintenance
OPEX	Operational Expenditure
OFW	Offshore Wind
PDE	Ten-Year Energy Plan (Brazil)
PEP	Philippines Energy Plan
PET foam	Polyethylene Terephthalate Foam
PIF	Public Investment Fund (Saudi Arabia)
PPA	Power Purchase Agreement
PPP Tender Approach	Public-Private Partnership Tender Approach
R&D	Research and Development
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
REC	Renewable Energy Certificate
RE	Renewable Energy
RCEP	Regional Comprehensive Economic Partnership
RfQ	Request for Qualifications
RMB	Chinese Yuan
RPO	Renewable Purchase Obligation
SAWEA	South African Wind Energy Association
SAWEM	South African Wholesale Electricity Market
SAPCO	Saudi Aramco Power Company
SBCE	Brazilian Emissions Trading System
SADC	Southern African Development Community
SCADA	Supervisory Control and Data Acquisition
SECI	Solar Energy Corporation of India
SEPCO	Shandong Electric Power Construction Company
SEWPG	Songyuan Hydrogen Energy Industrial Park
SGRE	Siemens Gamesa
SMC	Services and Engineering
SOE	State-Owned Enterprise
SPC	Goto Floating Wind Farm consortium
TAFF	Transition Away from Fossil Fuels Roadmap
TDP	Transmission Development Plan
TPES	Total Primary Energy Supply
TSO	Transmission System Operator
DSO	Distribution System Operators
TW	Terawatt
TWh	Terawatt Hour
TWG	Technical Working Group
UAE	United Arab Emirates
UHV	Ultra-High Voltage
UK	United Kingdom
UNEP	United Nations Environment Programme
UNGPs	UN Guiding Principles on Business and Human Rights
US	United States
USD	United States Dollar
VGF	Viability Gap Funding
WACC	Weighted Average Cost of Capital
WEF	World Economic Forum
WTO	World Trade Organisation
WSI	Wind Sustainability Initiative
YEKA	Renewable Energy Project Program in Turkiye
ZAR	South African Rand

About GWEC Market Intelligence

GWEC Market Intelligence provides a seriesof insights and data-based analysis on thedevelopment of the global wind industry. Thisincludes a market outlook, country profiles,policy updates, deep-dives on global windsupply chain and offshore wind among manyother exclusive insights.

GWEC Market Intelligence derives its insightsfrom its own comprehensive databases, localknowledge and leading industry experts.

The market intelligence team consists ofseveral strong experts with long-standingindustry experience across the world.

GWEC Market Intelligence collaborates withregional and national wind associations as wellas its corporate members and MI subscribers.

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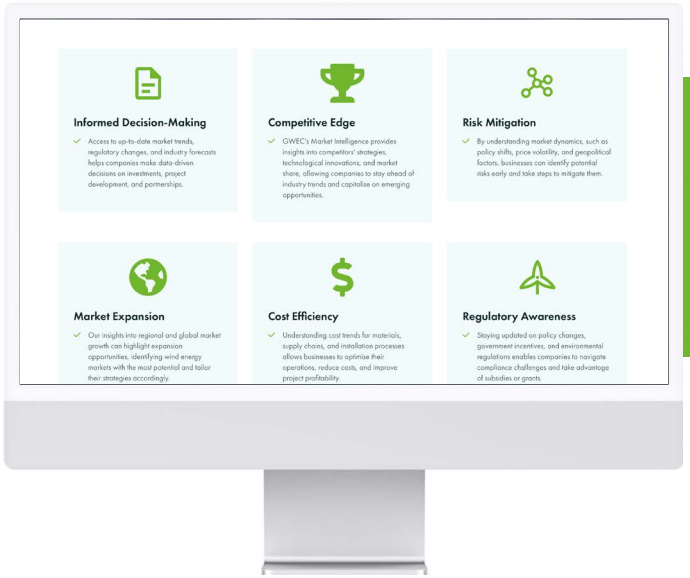
Energy Transition
Shift to value-focused, new wind-based solutions, market design

O&M
ISP - OEM - Self Perform database for key markets



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GWEC Market Intelligence Package 2026

Product	Frequency	Expected Release date
1. Wind Energy Stats/Market Data		
Wind Stats 2025 (historic annual, accumulative, decommision data)	Annual	April 2026
Global Wind Report 2026	Annual	April 2026
Wind Energy Statistics (wind energy penetration rate, jobs)	Annual	April 2026
2. Country Profiles/Policy Updates		
Country Profiles Onshores/Country Profiles Offshore	Annual	April 2026 (onshore) June 2026 (offshore)
Ad-hoc Policy Updates	Ad-hoc	
3. Market Outlook		
Global Wind Market Outlook 2026-2030 (Q1 and Q3) Database + Report	Semi-Annual	April 2025 (Q1 Outlook) November 2025 (Q3 Outlook)
India Market Outlook Report 2026-2030	Annual	TBC
4. Supply Side Data		
Global Wind Turbine Supply Side Data Report 2025 (by OEM, by technology, by turbine ratings, models and drive train, etc)	Annual	May 2026
5. Auctions/Tenders		
Global Wind Auction	Quarterly	Q4 2025 results in March
Auction Trends and Learnings	Quarterly	Q1 2026 in May, Q2 2026 in August, Q3 2026 in Nov
6. Offshore Wind Market		
Global Offshore Wind Report 2026	Annual	June 2026
Global Offshore Project Pipeline (database, in-operatio and under-construction) and summary report	Annual	June 2026
Global Offshore Turbine Installation Vessel Database and Report	Annual	October 2026
7. Components Assessment		
Blades (Q4 2026), Gearbox (Q4 2025), Generator (Q4 2024), Global Wind Supply Chain Deep Dive (Q4 2023), Blades (Q4 2020)	Special Report	December 2026
8. Wind Asset Owners/Operators		
Asset Owners and Operators Database (Onshore & Offshore Ranking)	Annual	September 2026
Asset Owners and Operators Status Report 2026 (including strategical trends)	Annual	
9. O&M		
O&M Service Provider Database (ISP - OEM - Self-perform)	Annual	February 2026
O&M Service Provider Status Report 2026 (including regional trends and strategies)	Annual	
10. Energy transition, Digitalisation, New Technologies		
Auction design, community engagement and social acceptance for permitting, localisation, trade, supply chain and grid associated policy analysis	Special Report/Position Paper	Throughout the year

GWEC Global Leaders

The Global Wind Energy Council's Global Leaders are an exclusive leadership group of decision-makers and top-tier members who form the basis of the Association's Executive Committee, which drives the work programme and plays a major role in shaping GWEC's priorities for its efforts in the short and long-term strategy.

Siemens Energy

We are Siemens Energy – a global leader in energy technology. The energy transition is the greatest challenge our generation faces. How do we reduce emissions while also increasing energy supply? It is an uphill battle. And there is no silver bullet. But finding solutions has always been in our DNA. For more than 150 years our engineers have been spearheading the electrification of the world. Today we are a team of 100,000 sharing the same passion, vision and values. Our diversity makes us strong and helps us to find answers together with our partners. Located in 90 countries, Siemens Energy operates across the whole energy landscape. From conventional to renewable power, from grid technology to storage to electrifying complex industrial processes. Our mission is to support companies and countries with what they need to reduce greenhouse gas emissions and make energy reliable, affordable, and more sustainable. Let's energize society.

Ørsted

The Ørsted vision is a world that runs entirely on green energy. Ørsted develops, constructs, and operates offshore and onshore wind farms, solar farms, energy storage facilities, renewable hydrogen and green fuels facilities, and bioenergy plants. Moreover, Ørsted provides energy products to its customers. Ørsted is the only energy company in the world with a science-based net-zero emissions target as validated by the Science Based Targets initiative (SBTi). Ørsted ranks as the world's most sustainable energy company in Corporate Knights' 2022 index of the Global 100 most sustainable corporations in the world and is recognised on the CDP Climate Change A List as a global leader on climate action.

GE Vernova

Addressing the urgent need to build a more sustainable electric power system while improving the trajectory of climate change emissions are global priorities and we take our responsibility seriously. That is our mission at GE Vernova: continuing to electrify the world while simultaneously working to help decarbonize it. If we want our energy future to be different…we must be different. Our mission is embedded in our name. We retain our treasured legacy, "GE," in our name as an enduring and hard-earned badge of quality and ingenuity. "Ver" / "verde" signal Earth's verdant and lush ecosystems. "Nova," from the Latin "novus," nods to a new, innovative era of lower carbon energy that GE Vernova will help deliver. Together, we have The Energy to Change the World.

Iberdrola

With over 170 years of history behind us, Iberdrola is now a global energy leader, the number one producer of wind power, and one of the world's biggest electricity utilities in terms of market capitalisation. We have brought the energy transition forward two decades to combat climate change and provide a clean, reliable and smart business model, to continue building together each day a healthier, more accessible energy model, based on electricity.

Vestas

Vestas is the energy industry's global partner on sustainable energy solutions. We design, manufacture, install, and service wind turbines across the globe, and with +151 GW of wind turbines in 86 countries, we have installed more wind power than anyone else. Through our industry-leading smart data capabilities and +129 GW of wind turbines under service, we use data to interpret, forecast, and exploit wind resources and deliver best-in-class wind power solutions. Together with our customers, Vestas' more than 29,000 employees are bringing the world sustainable energy solutions to power a bright future.

Equinor

We are looking for new ways to utilise our expertise in the energy industry, exploring opportunities in new energy and driving innovation in oil and gas around the world. We know that the future has to be low carbon. Our ambition is to be the world's most carbon-efficient oil and gas producer, as well as driving innovation in offshore wind and renewables. We plan to reach an installed net capacity of 12-16 GW from renewables by 2030, two-thirds of this will be from offshore wind. With five decades of ocean engineering and project management expertise, focus on safe and efficient operations, in depth knowledge of the energy markets, skilled personnel and a network of competent partners and suppliers, Equinor is uniquely positioned to take a leading role in the offshore wind industry. From building the world's first floating wind farm to building the world's biggest offshore wind farm we are well underway to deliver profitable growth in renewables be a leading company in the energy transition.

CIP

Founded in 2012, Copenhagen Infrastructure Partners P/S (CIP) today is the world's largest dedicated fund manager within greenfield renewable energy investments and a global leader in offshore wind. The funds managed by CIP focuses on investments in offshore and onshore wind, solar PV, biomass and energy-from-waste, transmission and distribution, reserve capacity, storage, advanced bioenergy, and Power-to-X.

CIP manages ten funds and has to date raised approximately EUR 19 billion for investments in energy and associated infrastructure from more than 140 international institutional investors. CIP has approximately 400 employees and 11 offices around the world

SSE Renewables
SSE Renewables is a leading developer and operator of renewable energy, headquartered in the UK and Ireland, with a growing presence internationally. Its strategy is to lead the transition to a net zero future through the world-class development, construction and operation of renewable power assets and it is building more offshore wind energy than any other company in the world. Part of the FTSE-listed SSE plc, SSE Renewables is taking action to double its installed renewable energy capacity to 8GW by 2026 as part of its Net Zero Acceleration Programme, and increase renewables output fivefold to over 50TWh annually by 2031.

Envision Energy
Envision Energy is a world-leading green technology company, providing renewable energy system solutions for global enterprises, governments, and institutions. With the mission of 'solving the challenges for a sustainable future', Envision Energy continuously reduces the production, storage, and synergy costs of renewable energy through technological innovation. Encompassing three major business sectors - Smart Wind Turbines, Energy Storage, and Green Hydrogen Solutions, Envision Energy collaboratively constructs comprehensive solutions for energy transformation. It also manages Envision-Hongshan Carbon-Neutral Fund and owns Envision Racing Formula E team, who conquered the Formula E Teams' Championship in 2023.

Today, Envision Energy leverages its global network of R&D and engineering centers across China, the United States, UK, France, Germany, Denmark, etc. to continuously lead global green technology development. Envision Energy joined the Science Based Targets initiative (SBTi) and committed to achieving the "Business Ambition for 1.5°C" in 2021. It has achieved carbon neutrality across its global operations by 2022 and will achieve carbon neutrality throughout its value chain by 2028.

Envision was ranked second in Fortune's 2021 "Change the World" list and was ranked among the Top 10 of the 2019 'World's 50 Smartest Companies' by the MIT Technology Review.

Masdar
Abu Dhabi Future Energy Company (Masdar) is the UAE's clean energy champion and one of the world's fastest-growing renewable energy companies, advancing the development and deployment of renewable energy and green hydrogen technologies to address global sustainability challenges. Established in 2006, Masdar has developed and partnered projects in over 40 countries, helping them to achieve their clean energy objectives and advance sustainable development. Masdar is jointly owned by Abu Dhabi National Oil Company (ADNOC), Mubadala Investment Company (Mubadala), and Abu Dhabi National Energy Company (TAQA), and under this ownership the company is targeting a renewable energy portfolio capacity of at least 100 gigawatts (GW) by 2030.

Suzlon
The Suzlon Group is one of the leading renewable energy solutions providers in the world with ~20.7 GW* of wind energy capacity installed across 17 countries. Headquartered at Suzlon One Earth in Pune, India; the Group comprises of Suzlon Energy Limited and its subsidiaries. A vertically integrated organisation, with in-house research and development (R&D) centres in Germany, the Netherlands, Denmark, and India, Suzlon's world-class manufacturing facilities are spread across multiple locations in India. With over 29 years of operational track record, the Group has a diverse workforce of over 6,200 employees. Suzlon is also India's No. 1 wind energy service company with the largest portfolio of over 14.7 GW in wind energy assets. The Group has ~6 GW of installed capacity outside India. Suzlon offers a comprehensive product portfolio led by the 2 MW and 3 MW series of wind turbines.

Octopus Energy
At Octopus Energy Generation, we're building green power for the future. From large solar projects to wind farms which harness the abundant wind on land and at sea, to more localised, people-led renewables in the form of the Fan Club, the Collective and onsite generation connected directly to businesses - we're committed to driving the green energy revolution faster than ever before. We've invested in energy projects and energy transition companies spanning 20 countries and 18 technologies. As one of the largest renewable energy investors in Europe, we manage more than 270 large-scale green energy projects with a combined capacity of 3.9 GW. That's enough energy to power 2.6 million homes every year – and we're building more by the minute.

Mingyang Smart Energy
Founded in 2006, Mingyang Smart Energy Group (601615.SL, MYSE.L) is a leading smart energy provider with a diverse portfolio including wind, solar, storage, and hydrogen. We offer cutting-edge equipment, engineering, and services, and have built a robust eco-system for sustainable energy solutions. Recognized among China's top 500 and the global new energy elite, Mingyang partners with clients to drive technological innovation and support a green, low-carbon energy future. Mingyang is steadfast in its corporate mission of "Innovating Clean Energy for All." Leveraging the surging trend of global green and digital economic development, the company is committed to creating "new quality productivity." It reshapes technological innovation and the industrial chain layout, actively steering towards "global clean energy intelligence" and "inclusive clean energy." Mingyang is dedicated to building a comprehensive circle and a cohesive group, completing the layout of the entire industry, ecology, and globalization of new energy. By constructing a high-quality and sustainable industrial ecosystem, Mingyang expands application scenarios and creates a "new model" of energy transformation. This not only aids the green and low-carbon transformation of global energy but also propels Mingyang forward on the global track of the green economy, striving to become a world-class enterprise.

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