Global Wind Asset Owners Database Report Update 2024

GWEC
GLOBAL WIND ENERGY COUNCIL

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I. INTRODUCTION

Globally, with new installations reaching 117 GW and the cumulative installations passing 1TW by the end of 2023, the wind industry has achieved the scale and become mature. Wind is increasingly being seen as a solution to not just climate change, but energy security, economic development, and the quality jobs creation. Wind is now competitive, affordable, predictable in price (compared to the volatility of hydrocarbons) and chosen by many governments and companies for investment.

The imperative to reduce both pollution and national dependence on foreign fuel supplies means that political pressure is mounting on energy generation companies to integrate renewable energy (RE) in the supply mix. That pressure greatly increased in 2015 when 195 countries committed to the Paris Agreement, reached in December at the 21st meeting of the Conference of Parties (COP) under the UN's Framework Convention on Climate Change. The agreement sent a clear and strong signal to the world that the global transition to clean energy is inevitable.

Countries accounting for nearly 3/4th of global CO_2 emissions and GDP have committed to reaching net zero (usually by 2050) in 2021-2022; many countries are now working on following through on those commitments. It became clearer than ever that the era of fossil fuels is coming to an end, and the global energy transition is here to stay.

With all those commitments, however, global CO_2 emissions grew to all-time high in history in 2023 (IEA). Increased coal use and global shortfall in hydropower generation due to droughts were the main factors driving up emissions.

During the COP28 in 2023, nearly 200 countries agreed to triple renewable energy by 2030 and accelerate the energy transition onto a Paris Agreement trajectory. For wind, this means tripling the total global installations from current 1TW to 2.75-3.5 TW by 2030 (projected by IEA and IRENA in their latest net zero roadmap reports). However, under current policies scenario, GWEC forecasts that we are only set to reach 2 TW of wind installed capacity by 2030.

The top 15 asset owners-operators accounted for 39% of total global wind power capacity installed by the end of 2023 (1021 GW), an 0.6% increase from 2022.

While the large players continue to dominate global installations– will this continue? As more and more pressure is created by governments, corporates and industries (C&I) to decarbonize, will this bring even more players into the market and reduce the current dominance of the big players? It is going to be an interesting transition to watch and GWEC will cover this topic moving forward in future report.

There are currently no oil & gas companies in the top 15 globally (or in the top 10 for offshore) – will they continue their push into renewables or will the increased revenues from oil & gas slow their moves ?

The recent increases in hydrocarbon and other commodity costs, as well as high inflation, increased interest rates and supply chain challenges have really squeezed developers and OEMs. How long will this situation last? And what impact will they have on developer appetite to take on increased risks is yet to be seen? And will the dominant players be able to manage these risks better than the smaller players? GWEC Market Intelligence is following this closely.

II. TRENDS IN WIND ASSET OWNERSHIP

With more diversification of the ownerships and investors of wind assets, there are common drivers to invest in wind energy among the owners: stable investment with a predictable return over the lifetime of twenty or more years combined with a comparatively low risk profile. These drivers apply to greenfield investments in new capacity but also to the investment in already operating assets for the onshore and offshore wind market.

Type of investors and asset owner	Motivation	Examples
Utilities active beyond their home market	Policy-driven motivation to integrate and increase the share of wind energy in the market's energy mix Due to the size of large utilities, balance-sheet financing is feasible, especially for offshore projects Offering sustainable supply opportunities to (retail) customers Willing to invest in home markets and abroad	Iberdrola, NextEra, EDP, EDF, ENEL, RWE, Orsted, SSE, Vattenfall, EnBW, Enbridge, China Energy, SPIC, Huaneng, Huadian, Datang, CTG, CGN
Local utilities	Increasing share of wind energy for their local portfolio Seeking attractive investment opportunities with stable returns	Stadtwerke München (Germany), Duke Energy (USA), Eneco (Netherlands), Guangdong Energy, TaiPower (Taiwan)
Independent Power Producers	Seeking long-term purchase agreements with offtakers Focus on greenfield development of projects to own projects over the majority of the project lifetime Willingness to open markets	Acciona, Mainstream Renewable, RES, Parkwind (JERA), Skyborn, Invenergy, Northland Power, Pattern Energy, Eurus Energy, CR Power, RENOVA
Community/citizen-owners	Often only feasible due to government-supported programs to ensure involvement of local community along side with an investment opportunity for small-size investors Very low risk appetite and require high involvement of developer/ operator Focus on greenfield small-scale projects in the mature onshore markets	Community-based wind development is spreading in countries in Europe and in the U.S., Canada
Global oil companies	Broaden portfolio and alternative investment opportunity compared to existing portfolio in the oil business Utilizing existing capabilities, e. g. large-scale project management and working in deep water, for offshore wind, but also interested in onshore wind	Equinor, Shell, TotalEnergies, BP, Eni, Repsol, Petronas
Regional oil companies	Similar to global oil companies, utilizing local opportunities to broaden portfolio of assets	CNOOC (China), Petrobras (Brazil), Gulf Energy (Thailand)
Institutional investors (pension funds/ insurance funds)	Long-term investment opportunities with stable returns and low risk Entering projects in different development stages, often close to COD, with small stake and willingness to increase stake over project lifetime	PensionDenmark, PGGM, Allianz, Munich Re, Caisse de Depot et Placement du Quebec
Infrastructure investors	Long-term investment opportunities with stable returns and low risk, also seeking opportunities in new and emerging onshore and offshore wind markets Similar to infrastructure investors, entering projects during different development stages with small stake-ownership and plan to increase share of ownership as project matures	Macquarie (Green Investment Group/Corio Energy), Borealis, Copenhagen Infrastructure Partner (CIP), Global Infrastructure Partners (now BlackRock), The Renewables Infrastructure Group (TRIG)
Self-supply industrial end-users	Securing stable prices and steady supply by-passing public market conditions with possible shortage of supply and volatile prices Solid understanding of corporate's own energy needs and the business case provided by investing in wind projects Focus on onshore markets with market-based capacity-allocation mechanism (Green certificates, auction/tenders)	YPF (Argentina), Norsk Hydro (Norway)
Sovereign wealth funds	Long-term investment with low risks Investments must comply with wealth funds' missions in terms of social responsibility and sustainability	Masdar (UAE), PIF (Saudi Arabia), Norwegian Government Fund (Norway)
Private equity companies	Higher risk profile compared to institutional investors Evaluating investment strategy including exit point and optimization of value	Blackstone (USA), Partners Group (Switzerland)
Corporate investors	Long-term investment goals Securing stable supply over lifetime of the project Fulfilment of sustainability goals and carbon neutral targets	Google, Amazon, Meta, Microsoft, Walmart, BASF, Ingka (IKEA owner)

Source: GWEC Market Intelligence, July 2024

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See the table for a summary of the different types of asset owners, their motivations and some example companies in the category.

Global

According to GWEC Market Intelligence, 116.6 GW of new wind power capacity was added into the power grid worldwide in 2023, 50% more than in 2022, bringing total installed wind capacity to 1,021 GW (includes 75.2 GW offshore wind) by the end of last year, a growth of 13% compared with 2022.

For the next five year 2024-2028, Global wind power installation growth will continue to rely on three market support mechanisms: 1) 'grid-parity' scheme (China); 2) tax credit (PTC and ITC) and technology- neutral credits in the US; and 3) wind-specific, technology-neutral, renewable and hybrid auctions (Europe, Latin America, Africa & Middle East and Southeast Asia). In addition, corporate/private power purchase agreements (PPAs) will drive wind energy growth in the next five years.

BNEF noted that the investments in new renewable energy (RE) projects, which includes wind, solar, biofuels and other renewables, grew 8% to $623 billion in 2023. Global offshore wind investment reached a record $76.7 billion in 2023, a 79% year-on-year (YoY) jump, although several project cancellation reported in the US. This offset the 17% YoY decline from the onshore segment accounting to slow procedures for onshore wind permitting and grid connection, especially in Europe and North America. To stay on track for the 1.5 °C pathway, energy transition investment must immediately triple, which is on average $4.8 trillion a year for the rest of this decade.[2]

Significant new investments must be made, but the source of which is not yet clear as wind power may face competition for the funding.

It is not clear what the required investment growth will unfold for the types of companies that invest in wind, what they invest in (directly in projects, infrastructure funds, etc.), how they are structured, and if the current class of top asset owners by markets will continue to dominate.

Rarely in history has such a rapid scale up of relatively new types of investments and technologies occurred at the speed that renewables and clean tech are seeing now – and the energy crisis triggered by Russia's invasion of Ukraine has provided further impetus for this scale up for energy security. A key question: can the existing players scale up fast enough, or will there be openings for new players with new structures and business models ?

The answer is clear, to reach the tripling renewables target by 2030 and long-term net zero targets, which require tripling of the annual global new wind installations over the course of the decade from the level achieved in 2023, existing investors need to accelerate the current investment in wind while new players

[2] BNEF January 2024 and February 2024 Update.

need to be motivated to bring new "blood" into this sector.

North America

Although new installed onshore wind capacity increased by 70% in Canada in 2023, total onshore wind additions in North America dropped to 8.1 GW last year, 16% lower than 2022 primarily due to the slowdown of onshore wind growth in the world's second-largest wind power market – the US.

Despite the slowdown in US, the situation is expected to change in 2024, with a strong onshore market expected to return from 2025. The US has implemented what has been called the largest investment in climate action the world has ever seen – the IRA (Inflation Reduction Act), helping to not only deliver new clean power over 2023-2032, but also to create a local supply chain, jobs and society-wide benefits.

The US had two utility-scale commercial offshore wind projects – Vineyard Wind 1 and South Fork Wind – under construction last year, but no offshore capacity was fully commissioned in 2023. Nevertheless, with 42 MW offshore wind capacity in operation by the end of 2023, the US remains the only market with offshore wind in operation outside of Europe and APAC.

Challenges such as inflation, increased capital costs and supply chain constraints – including for vessels and foundations – created uncertainty in the US offshore wind sector last year. By January 2024, 13 US offshore wind projects off the east coast totalling nearly 12 GW were affected; of these, developers of nine projects, totalling 7.7 GW, either terminated offtake agreements or ceased the whole project development, which triggered multi-billion-dollar write-down by large European and US developers.

However, the US federal and states governments and developers have retained their commitments to develop offshore wind. Last six months have witnessed some key policy strides in a bid to correct the course of the offshore wind sector, marked by key announcements, regulatory levers, strategic planning initiatives and inclusion of an indexed pricing option in the new state level solicitations. As of Q2 2024, four projects with a combined capacity of 4.3 GW were currently under construction with another 50 GW of offshore wind projects in the development and planning stage. Although GWEC Market Intelligence downgraded its outlook for the US offshore market, it looks realistic that 15 GW can be built in this country by 2030.

North America had 167 GW of wind power capacity in operation by the end of 2023, of which 90% is located in the US. Looking at the ownership structure of the existing wind assets in the US, it is concentrated heavily among the top owners. According to ACP 2023 annual statistics, the top 25 asset owner-operators controlled 72% of total installed wind power capacity in this country. Of the top 25 companies, half are utilities and collectively they made up nearly 50% of total installations in the US.

The 2023 statistics also show that long-established local owners and operators like NextEra Energy, AES and Xcel Energy continue to lead in land-based wind ownership in this country. Many of the European companies that helped establish the U.S. wind industry, such as Iberdrola (via its 100% owned subsidiary Avangrid), EDP, Enel, RWE, ENGIE continue to rank in the country's top 15 owner-operators list.

In the nascent US offshore wind sector, European based utilities such as Ørsted, Iberdrola, EDP, EDF and ENGIE and oil companies including Equinor, BP, Shell and TotalEnergies are playing the leading role in project development. Of the 22 GW of offshore wind capacity that has been procured through the state-level solicitations in 2017-2023, around 80% is owned by this group as the scale and technological challenges of offshore wind makes it difficult for small players to gain entry, favouring large players with experience and large balance sheets.

The North American power market can also be named as the most mature when it comes to corporate PPAs Corporate buyers have become an increasingly important driver of clean energy demand in the US. According to ACP annual statistics, the share of corporate PPA (C&I) among the PPAs announced in 2023 dropped for the first time since 2019, from 61% in 2022 to 36% in 2023. This is mainly due to large technology companies nearing achievement of clean energy procurement goals with cumulative purchase agreements signed from the past 10 years. Nevertheless, in total clean power procurement between 2000 and 2023, C&I purchasers have become the 2nd largest group of clean power off-taker in the US by the end of last year, going from procuring 0% of operating capacity in 2000 to 21% in 2023.

In terms of total signed operational onshore wind capacity by the end of last year, Google is the largest C&I users followed by Amazon, Meta, Microsoft and Walmart.

In addition to onshore wind corporate PPA, trends in contracting for offshore wind is something to watch as the newly leased offshore projects move through the development stage.

Europe

Europe is accelerating renewables development to achieve energy security in the aftermath of Russia's invasion of Ukraine. The continent has started turning its ambitious targets into actions from 2023. As of end of 2023, a total of 272 GW wind power capacity was installed in Europe.

Progress was also made in wind auction in Europe last year. The total onshore wind volume awarded in 2023 amounted to 6.4 GW in Germany, nearly double the volume awarded in the previous year. This progress is credited to a higher ceiling bid price and the implementation of EU emergency measures that improve and streamline permitting to further accelerate RE projects. However, to shed the EU's dependence on Russian fossil fuels while meeting climate targets, the current volume of annual wind power auctions in Europe is not enough and its pace needs to speed up further.

The European wind market has the highest level of maturity compared with other region, with owner and investor structures similar to the North America. In this continent, utilities, including state-owned and smaller regional/local utilities, take the lead in wind project development together with IPPs and developers with their long-standing experience.

European Pension funds and institutional investors joined by their counterparts from North America and Australia have a solid position as they seek stable investment opportunities (PFA, PKA, Copenhagen Infrastructure Partners, PGGM, Caisse de Depot et Placement du Quebec, Macquarie).

Additionally, wind Corporate PPAs have gained high momentum in Europe as cost pressures increased and buyers want certainty. Corporate PPAs for RE in Europe hit a record of 10.4 GW in 2023, a significant growth from the 6.7 GW of deals in 2022, according to data from RE-Source, a European platform from corporate RE sourcing. The multi-buyer PPAs, enabling smaller companies to procure renewables, are becoming more popular in Europe and the offtakes were mainly led by heavy industry followed by ICT, retail, telecoms and engineering and technology in this region.

In 2023, Finland and Greece reflected strong M&A activity as investors diversify beyond established regions. Key deals in Finland include acquisition of 8 GW of onshore wind projects led by PE firms and developers like Eolus and OX2, Enel's €2bn transactions in Romania and Greece, and Ingka's €200mn acquisition. In Greece, ~6 GW of wind and solar deals occurred, with Macquarie and Motor Oil making significant acquisitions.

Moreover, with the goal of reducing price volatility for consumers and accelerating investments in renewables, [EU Legislation is in progress] to reform the EU electricity market. [EU Wind Power Package] is further expected to have a positive impact on permitting, finance, and auctioning mechanisms, crucial aspects for expanding wind energy and reinforcing European energy security. In the UK, the new elected government has just lifted the ban on onshore wind which means additional growth would come from UK's onshore wind auctions in coming years.

Europe, the birthplace of offshore wind industry, has a total of 34 GW offshore wind capacity installed by the end of last year. On top of a promising offshore wind projects pipeline up to 2030, more than 40 GW offshore wind capacity is expected to be awarded through auctions in 2024 and 2025. Additionally, at least 46 GW of new offshore wind auctions capacity is expected to be announced between 2024-2030 according to GWEC Market Intelligence's wind energy auction database Q2 2024 update.

For the European offshore market, the trend is toward more joint ownership and investment. In the earlier days, utilities such as Orsted, Vattenfall and RWE took on offshore projects financing through their balance sheets. As offshore wind in Europe is proving its position as large-scale and cost-competitive energy source, utilities are joined by institutional investors, for example Macquarie/GIG/Corio Energy, Global Infrastructure Partners (now BlackRock) and Copenhagen Offshore Partners, Sovereign wealth funds like Masdar and big oil companies such as Shell, Equinor, TotalEnergies and Eni and BP.

China

In China, the largest wind power market in the world, a majority of wind assets are owned by state-owned utilities. Out of the top 10 wind farm owner-operators in China, nine companies are state-owned companies, and they account for more than 60% of China's total wind power installations at the end of 2023. This situation is expected to continue moving forward.

Following the "30-60" pledge made in September 2020, the Chinese government updated its Nationally Determined Contribution (NDC) commitment to achieve 25% non-fossil fuel generated energy in the primary energy mix and boost its solar and wind capacity to more than 1,200 GW by 2030. Following this pledge, China's major state-owned power companies have set goals of installing a total of 600 GW of additional solar and wind power during the 14th Five-Year Plan period (2021-2025). Based on current annual installation rate, it is expected that China could hit 1,200 GW solar and wind target by 2024, six years ahead of schedule.

China has started working on the long-term goal of creating a new type of power system with renewables at its core. Speaking at the 20th Party Congress Report in 2022, the President said that the planning and construction of the new energy system should be accelerated.

China led the world in annual offshore wind installations for the sixth year in a row. From 2022, the central government has ceased subsidies for offshore wind, but a small portion of financial support from provincial authorities is still available in provinces like Guangdong, Shandong and Zhejiang for the next 2-3 years to support the local offshore wind industry to reach grid-parity by 2025. As offshore wind projects require high levels of capital investment, large state-owned utilities and provincial energy companies such as Guangdong Energy (previously Yuedian) and Zhejiang Energy are expected to play the crucial role to ensure the stable growth of Chinese offshore wind market.

Since the potential of Chinese offshore market is huge, it is becoming increasingly attractive for non-Chinese investors such as EDF, which bought the stakes in two Chinese offshore wind projects from China Energy in Q1 2019 and signed a new contract with China Energy in 2023 on energy island demonstration project. Most recently, an offshore wind farm jointly developed by BASF and Mingyang has obtained the approval from the authority in China. The majority of the power generated from this 500 MW wind farm will supply renewable electricity to the BASF site in Zhanjiang, Guangdong Province.

Latin America

Total wind installations have reached 51 GW by the end of 2023 in LATAM and more than 60% of it is located in Brazil. Wind assets in this region are mostly owned by utilities, both international and national, and IPPs. As wind power has had very competitive prices in the region (thanks to the excellent wind resource) and public auctions organized by governments have slowed down in recent years (like Brazil, Mexico and Argentina), capacity is increasingly allocated outside the regulatory schemes in so-called "private auctions" or long-term "private PPA's scheme" pushing the growth of C&I owners share in certain markets (e.g. MATER in Argentina, private PPAs in Brazil and the former self supply scheme in Mexico). However, state government-controlled assets ownership is strongly present in Uruguay by UTE, and to smaller extent in Mexico, where the Federal Electricity Commission (CFE) owns and operates a couple of projects.

LATAM's listed IPPs and utilities have been leading the onshore wind M&A activity since 2020. Strategic shift towards corporate investments (PPAs) and platform takeovers for large development pipelines are driven by growing investor and institutional confidence in the region especially in Brazil. In the region, regional entities like Omega Energia are targeting operational assets and international firms like AES acquired development assets. Utilities like EDF are becoming the primary acquisition targets due to their mature projects up for divestments. On the other hand, Private Equity firms like KKR acquire operational assets for immediate revenue and early movers like Brookfield are divesting initial investments.

GWEC Market Intelligence expects ~29 GW of onshore wind to be added in this region in the next five years and believes that private/corporate PPAs will continue to be one of the key growth drivers in this region.

Overall, the role of international utilities and IPPs in emerging and developing market as owners and investors of assets is crucial. They are not only responsible for the largest share of capital flows into the region, but their experience and insights, e.g. in bringing projects through the complicated permitting process, also enable new opportunities for wind energy. There is a strong collaboration in many of the most relevant Latin America markets where IPPs and developers are working closely with the regulators to define solutions best suited to the specific markets.

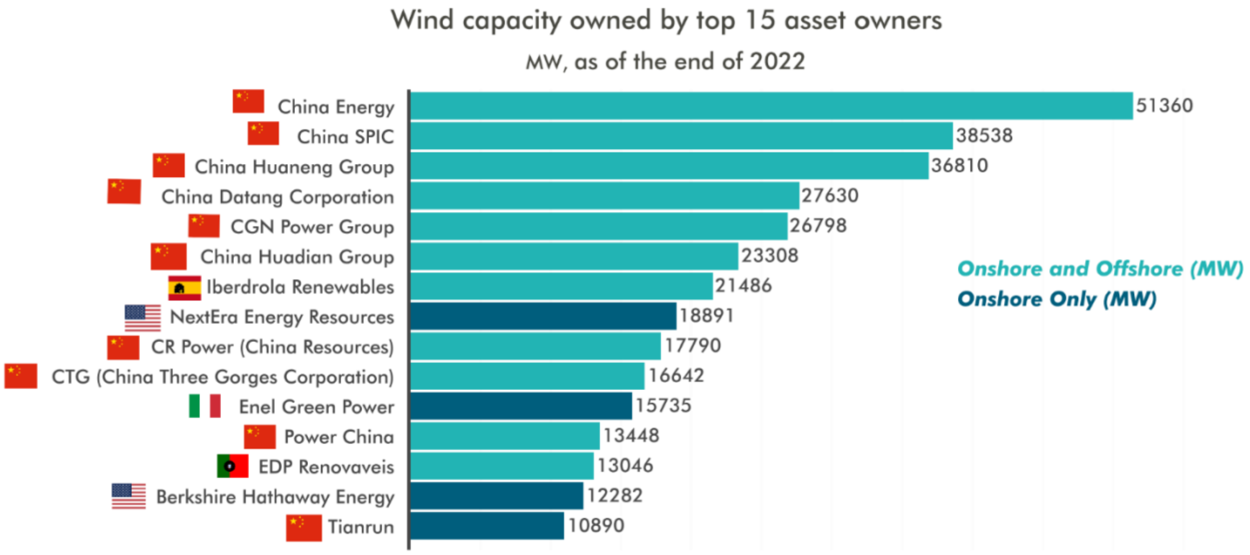
III. GLOBAL TOP 15 WIND PLANT OWNER-OPERATOR RANKING

The dominance of power generation companies as the key players in wind plant ownership has grown in the past 10 years, especially as wind has become an increasingly affordable energy source and governments have recently stepped-up policies and mandates in support of low carbon development to address the twin challenges of ensuring secure and affordable energy supplies and meeting climate targets.

The chart lists the world's top 15 wind farm owner-operators. Established energy utilities, many of which are state-owned power generators in China, have shown most interest in wind power investment.

By the end of 2023, the top 15 wind farm owner-operators held 39% of total 1.02 TW onshore and offshore assets. Of their total owned wind assets, 7.6% is offshore wind.

Although half of Chinese utilities on the top 15 list own wind assets in Europe, most of the assets held by the 10 Chinese state-owned power generators are located in Asia Pacific, and the vast majority of those in China. Nevertheless, Chinese ownership of overseas wind assets is expected to increase because of the country's "Belt and Road" foreign policy initiative to revive the centuries-old trading routes linking Asia, Europe,



Source : GWEC Market Intelligence, July 2024

China Energy is by far the world's largest wind asset owner and operator followed by China SPIC, China Huaneng, China CGN Power Group, China Data and China Huadian Group. The non-Chinese top asset owners active globally include - Iberdrola, NextEra, Enel Green Power, EDPR, and Berkshire Hathaway Energy.

With China being the largest wind market and its carbon neutrality commitment, it is no surprise that Chinese utilities continue their dominance in the top 15 ranking of wind asset owners (10 of the top 15 in 2023, up from 9 in 2022 and 8 in 2020).

and Africa. The related Silk Road Infrastructure Fund and Asia Infrastructure Investment Bank are expected to provide financial support to assist Chinese state-owned EPC contractors and energy investors/developers to build energy infrastructure abroad.

GWEC Market Intelligence foresees a continuous dominance by the Chinese asset owners of the global wind assets, as the Chinese onshore and offshore market is expected to stay strong over the next decades.

IV. STRATEGIC TRENDS OF LEADING WIND PLANT OWNER-OPERATORS

GWEC Market Intelligence team has been closely following the market trends in the asset owner-operator sector. This section gives a snapshot of latest strategies pursued by medium and large asset owner operators in order to stay in the game.

a) Merger and acquisition

Merger and acquisition - merging with competitors, acquiring operating assets and project pipelines from competitors or the entire fleets owned by competitors- remain an important growth strategy for large wind project developers, operators, and owners, complementing their organic growth.

Two decades ago, several European utilities and industrial groups entered the wind sector through acquisitions of pure play wind companies. Indeed, many European utilities, including Iberdrola Renewables, EDF Energies Nouvelles and E. ON Renewable (RWE), relied on mergers and acquisitions (M&A) to expand their existing wind project portfolios and to enter the North American market.

As market matured, the trend in M&A activities continues. Key examples of such Mergers and acquisitions (M&A) from year 2023 include:

- Bridgepoint acquired stake in Windar Renovables and acquisition of Energy Capital Partners;
- CIP acquired US-based onshore wind developer Liberty Renewables;
- Repsol acquired ConnectGen (has 20 GW RE projects in pipeline) to enter US onshore wind market;
- Hydro Rein acquired 80% stake in 2.4 GW of wind power projects from IOWN Energy;
- Enel acquired Julia Creek Renewables Project in Queensland;
- Eolus acquired SeaSapphire for floating offshore wind;
- Mitsubishi acquired 20% stake in European Energy (has 60 GW RE pipeline);
- Octopus Energy invested in Partners Group project and Germany and UK offshore wind projects;
- Masdar enters Greece through 67% stake in Terna Energy;
- Infroneer Holdings acquired Japan Wind Development from Bain Capital.

M&A helps in going global for tapping clean power generation demand growth opportunity. This is one of the reasons, large European utilities, IPPs and investors have been expanding their portfolio globally in emerging markets such as eastern Europe, Latin America, and Asia. This means applying the competencies, capabilities, knowledge about cost structures, off-taker agreements and overall experience in a new and developing market setting which clearly benefit regulators, governments and local players in market development, or vice versa. For example:

- Brookfield Asset Management acquired Banks Renewables in UK, partnered with Axis Energy Ventures to create a RE development platform in India and it is also set to acquire majority share in Leap Green Energy in India.
- 100% acquisition of Alianca Geracao de Energia by Vale in Brazil;
- Octopus Energy acquired Deep Wind Offshore (in Nordics) to enter Norway and South Korea;
- Sembcorp Industries acquired Gelex Group subsidiary in Vietnam.

In addition, higher PPA prices and repowering potential for old assets also drive the onshore wind M&A activity in mature markets. For example:

- Statkraft acquired operational onshore wind assets and some with repowering opportunities in Ireland (from TRIG at 26% premium), France, Germany and Brazil;
- EDPR bought back a 49% stake in its ~1 GW onshore wind portfolio across Europe which has potential for hybridization and repowering of assets; and
- Exus in North America planning to repower the acquired assets from Oppidum Green Energy.

Furthermore, there is a recent surge in investor demand for integrated utility platforms in the US to get exposure of regulated business. For example:

- Global Infrastructure Partners (GIP) and CPP Investments acquired US utility and renewables developer, Allete;
- Iberdrola fully acquired Avangrid and has earmarked €21.5bn for network-based investments in the US, UK, Brazil, and Spain through 2026.

M&A activities that took place in the past 12 months shows that private equity firms and privately funded companies have been significantly effective in the offshore wind sector compared with onshore wind. Mostly Private Equity (PE) firms and PE-backed companies have been the investment driving force in global offshore wind deals with most M&A activities sealed in Europe and the US. For example:

- BlackRock acquired Global Infrastructure Partners (GIP) for $12.5bn which includes large offshore wind projects and RE portfolio;
- Masdar expanded European offshore footprint through acquisition in Dogger Bank South, Baltic Eagle (with Iberdrola), and East Anglia 3 projects;
- Chubu Electric Power enters offshore space by acquiring in Netherlands project with Shell and Eneco.

M&A activities were also noticed by RWE, Ocean Winds, Northland Power (in Taiwan), TotalEnergies (in UK), Orsted, Greencoat Renewables, Stonepeak, and Origin Energy in the past year. GWEC Market Intelligence expects that M&A activities will continue to stay strong going forward driven by gradual coal phaseout, energy security, climate change goals and net zero commitments, but this can produce strong competition for assets and inflation in company valuations and asset prices.

b) Evolving strategies to address macroeconomic challenges

For last couple of years, wind project development is witnessing macroeconomic challenges due to dramatic increase in price inflation, elevated interest rates, and infrastructure (grid, port, logistics etc.) and supply chain constraints. These are in addition to slow-paced growth driven by the war in Ukraine and the subsequent spikes in natural gas prices led twin crisis energy security + climate change. Due to these, many large and medium asset owners have changed the strategic mindsets for growth especially in Europe and US offshore wind.

As a response to 'storm' experienced by the asset owner and operators, especially in the offshore wind sector, players are restructuring their portfolio either through PPA renegotiation, or ceasing project development and divesting to prioritise growth options and capture other favourable markets with the highest potential for value creation and reduce development costs.

For example, Ørsted, the world's largest offshore wind asset owners, has made assets portfolio changes by exiting several offshore markets including Norway, Spain, Portugal and Vietnam, deprioritising development activities in Japan and India, ceasing development of Ocean Wind 1 and 2 projects in the US while acquiring full stake in the 924 MW Sunrise Wind offshore project after a successful OREC[3] rebidding. Other large asset owner operators who made similar strategical adjustments include EDPR, Shell, bp and Equinor.

Players like Brookfield, Blackstone, Octopus Energy, Equitix Group, and Greencoat are directing their investments towards operational assets in established European markets like the UK, Germany, and the Netherlands.

Concurrently, investors such as Ingka Group and GIP are redirecting their attention to developmental assets in emerging markets like the offshore wind in Nordics.

c) Reversed strategies by Oil and Gas giants

Carbon neutrality commitments and growing environmental, social, and governance (ESG) pressure have made not only utilities and developers but also oil and gas (O&G) producers to heavily invest into wind and other renewable and low carbon technologies. European oil companies such as BP, Shell, Total Energies, Equinor, ENI and Repsol have released their net zero commitments, in turn, modified corporate growth strategies and investment portfolios.

The O&G companies leveraging its offshore working expertise invested heavily in offshore wind project development in last five years. However, the recent trend shows

[3] Offshore Wind Renewable Energy Certificates

reverse activities by O&G companies, which was driven by the short-term revenue gain strategy through new investment in a more profitable oil and gas portfolio.

For example, to stay profitable, Shell is doubling down on its oil and gas operations and scaling back some investments in renewables. It has pulled out of the South Coast offshore wind project in the US. In Europe, it divested from French floating wind development platform EOLFI, cancelled the FOW pilot project off the coast of Brittany in France, and exited from the partnership with the Simply Blue Group to develop two Irish FOW projects. In Asia, it exited the joint-venture with CoensHexicon for the 1.3 GW MunmuBaram floating project in South Korea and is now seeking partners who can invest in its Indian business Sprng Energy.

Similarly, TotalEnergies explores sale of a 50% stake in a portfolio of renewable projects in the US and Europe. Most recently, bp pauses new offshore wind investments and will consider to investing in some low-carbon technologies which can generate high revenue in short term.

This approach aligns with a wider trend of strategic asset reallocation among these O&G giants. Thus, it is worth to keep a track that growth of the capital-intensive technologies like offshore wind doesn't get disrupted by such low-carbon business restructuring.

d) Corporate PPAs for increasing clean energy mix

Net zero commitments for cleaner productions and increasing 24*7 power demands by almost all segments of industrial sectors, data centres and OpenAI platforms have spurred the demand from C&I sector for electricity generated from RE sources. GWEC expects incessant increasing trend of Corporate PPAs to accelerate wind and renewable energy off-take globally.

India, Chile and Germany led the activity in 2023, accounting for majority of the Industrial off-take, as energy-intensive metal, steel and chemical industries are taking an advantage of recent fall in power prices to lock in long term PPAs to hedge against future volatilities. India has great ease of doing business in RE sector and encouraging market incentives for corporate PPAs. For Germany it is a result of recent dynamic bidding processes, which required developers to pay for concessions. Additionally, the Netherlands has experienced a notable uptick in activity, as IPPs are motivated to pursue corporate PPAs due to the country's shared risk model between developers and the government for offshore wind development.

Recent examples include:

- EnBW signed sixth long-term corporate PPA for the 960 MW He Dreht offshore wind farm in Germany with German railway operator Deustche Bahn;
- a European packaging company Ardagh Group signed 10-year PPA with RPC for 161 MW wind project in Sweden;
- Eneco, has signed a long-term power purchase agreement

(PPA) with Albert Heijn to supply the company with power from the 760 MW Ecowende offshore wind farm in the Netherlands;
- Two Dutch companies operating in the food and agro industries, Plukon and De Heus, have decided to buy electricity from the Hollandse Kust West Site VI;
- BASF partnered with Vattenfall on German offshore wind farms Nordlicht 1 and 2 to supply clean electricity to its chemical production sites across Europe, in particular Ludwigshafen; and
- Vibrant Energy proposed 198 MW wind farm for Amazon India.

Also, most of the global tech giants have net zero commitments in most cases by 2030 for running their overall operations and data centres through clean energy. North America, a hub of data centers, witnessed spurring clean power demand through PPAs, especially from offshore wind, for tech giants operating globally.

Large number of corporate PPAs witnessed in US during 2023 were by regional grid operators ERCOT & PJM. PJM noticed increasing demand from technology firms who are expanding their data centre operations in the region.

- The US-based software giant, Microsoft teamed up with AGL Energy to procure renewable energy certificates from Rye Park wind farm in Australia; signed the largest corporate renewable PPA ever to off-take over 10 GW of power in the US and Europe from Brookfield; and signed PPA with European Energy, Shell and Repsol to increase its clean energy use in Europe. Microsoft currently operates data centers accounting for more than 5 GW+ of power consumption, and expects to increase this power demand by more than 1 GW over the next six months, followed by another 1.5 GW in the first half of 2025. The tech giant is also looking to be considering a 5 GW supercomputer for OpenAI.
- Other top off-takers in US include Amazon and Google; and top asset owners who caught these deals are NextEra Energy (targeted steel and chemical companies) and Engie. Similar deals noticed in Europe are- Google’s 478 MW PPA with Shell and Eneco for offshore wind projects in Netherlands; and Amazon secured portion of power supply from 882 MW Moray West wind farm in UK in early 2024. Two months later, Amazon and Iberdrola expanded their long-term global clean power partnership by signing a power purchase agreement (PPA) for 159 MW of the 1.4 GW East Anglia Three offshore wind farm in the UK; It is encouraging that Amazon achieved its 100% renewable energy target in 2023 ahead of 2030 timeline, which means all of the electricity consumed by Amazon’s operations, including

its data centers, was matched with RE supply.

e) Innovative Financing to fund green growth

Innovative financing instruments and strategy plays an important role to manage healthy debt-to-equity ratio for large asset owners and operators. It also helps in expanding capabilities, de-risking and investing into next generation renewable energy technologies such as floating offshore wind, green hydrogen, and power to X.

Secured equity financing instead of debt markets has increased to reduce the effects macroeconomic challenges for offshore wind. However, as most offshore wind projects are financed through project finance (equity-debt combinations), this trend is likely to continue.

To counterbalance the higher refinancing costs and raise funds for short time debt maturities, US Utilities and IPPs NextEra, Algonquin Power & Utilities, PG&E and Southern Company are selling their liabilities which in turn created a unique opportunity for European Utilities and IPPs to diversify their portfolios in US and internationally.

Tax equity financing is not a new concept, however, when it is clubbed with tax credit transferability provisions under IRA in US, players are not only gaining high ROI in short term but there's been a significant amount of growth for RE finance among private equity and debt funds in financing renewables in US. In turn, it is also helping in portfolio diversification; for example, ENGIE expanding its RE portfolio in US; other deals noticed were from CIP/Iberdrola, Geenbacker, Innergex and TransAlta Corp.

Divestment strategy has been helping firms in reducing debts, recycling the capital, rebalancing and optimizing the portfolio for higher returns, for example Macquarie Asset Management divested from around nine projects in UK; Orsted divested French onshore renewable ventures in the UK, Ireland, Germany, and Spain; Vattenfall divested the Norfolk Offshore Wind Zone to RWE; CIP divested 303 MW of two US onshore wind projects in Texas to TC Energy; Enel sold Greek renewables stake to Macquarie and divested its stake in the Romanian power business to Greek utility, it will focus on net debts reductions and on power grids investments in the next 3-years and investments in selective renewables amid rising interest rates and input costs.

Also, finance instruments such as green bonds, bank loans, subordinated hybrid capital instruments, and revolving credit facility have been supporting the large offshore wind projects globally. Examples include:

- Statkraft raised €1bn through the issuance of dual-tranche green bonds to support Eligible Projects outlined in its Green Finance Framework.
- Following to Iberdrola's agreement with IFC, it has signed more than thousand million loans with the EIB to accelerate the construction of

its significant portfolio of solar and wind in Italy, Spain, Portugal and Germany.
- GIP-backed BrightNight secured $375mn credit facility to fund its 31 GW US renewable portfolio while Orsted secured $784mn sustainability-linked revolving credit facility from a consortium of banks (JP Morgan, BNP Paribas and First Commercial Bank) for its 7.5 GW offshore wind portfolio in Taiwan.

GWEC's Global Offshore Wind Report 2024 has explicitly emphasised on role of blended finance as an instrument and how it can be more effective in combination with other instruments to address a broader range of risks, especially in countries deemed to be high-risk (many emerging markets and developing economies).

GWEC Maret Intelligence expects that increasing global trend of ESG, push for tripling renewables target by 2030 and carbon credits will require huge investments, and the role of blended finance, equity based green bonds and insurances would be critical to support it for capital intensive RE technologies such as offshore wind, green hydrogen (+ammonia) and power to X.

f) Partnerships for security against risks

Historically, most small offshore wind projects have been constructed on the balance sheets of large European utilities such as Ørsted, Vattenfall and RWE. This strategy enabled them to maintain full control over risks and returns through construction and operation.

However, as projects grew in both size and complexity, a single equity investor was no longer able to shoulder the costs and risk alone, and joint ventures became the norm.

In most cases, two or more utilities joined forces to build and operate a large offshore project, a practice particularly seen in the third and fourth round of the UK's CfD auction, the ScotWind seabed lease auction, the most recent ones are 4 GW Dutch Offshore Wind Tender (where Noordzeker Consortium consisting of Vattenfall and CIP won the tender) and the French floating offshore wind tender (a consortium of BayWa re and Elicio won the tender). In APAC, Macquarie and Ørsted formed a partnership for the landmark Formosa 1 offshore wind project in Taiwan.

Forming strategic partnerships and consortiums further help in knowledge building and de-risking in new markets, for example, RWE and WhiteRock Renewables formed a partnership to accelerate renewables development in the US. The German utility also entered the Japanese market through a consortium and most recently won a large offshore wind project from Japan's 2nd fixed bottom auction.

Due to the turbulence created by macroeconomic challenges, however, few partnerships were broken in US offshore wind market in the past 12 months. Several players decided to go solo to pursue their respective priorities under their corporate strategies. For example, Equinor has entered into a swap transaction with bp, under which Equinor will take full ownership of the Empire Wind lease and projects and bp will take full ownership of the Beacon Wind lease and projects; and Ørsted completed the acquisition of Eversource's 50 % share of Sunrise Wind Project in New York.

g) Owner-Operators compete with Independent Service Providers

In the US and other mature wind markets, major wind farm owner-operators are competing with Independent Service Providers to provide O&M not only for their own wind assets, but also to wind farms owned by a third party. This strategy demonstrates their O&M capabilities and confidence in their ability to control costs and quality, thereby increasing revenues. Further, having assets consisting of different turbine types, and even other renewable assets, allow them to create synergies and therefore keep costs under control. Typical examples of this trend are utilities EDF, EDP, RWE, EnBW and NextEra and IPPs such as Invenergy and ReNew Power whose renewable arms are offering IPS-type services in the marketplace.

h) Offering asset management and enhancing cybersecurity

Another strategic trend driven by digitalisation is the offering of asset management and asset optimization. Leading utilities from Europe, United States and China have been building their own digital platforms to manage their renewable assets in recent years.

The core business of utilities offers relatively lower margins, so to increase their margins they are forced to broaden their offerings. This includes capabilities to trade electricity or offer asset management/lifetime extension programs. Digitalisation is therefore a major driver and utilities often acquire smaller, but specialised niche players with high levels of competency for asset management.

Cybersecurity is of a great concern in the energy sector. Major generation asset owner and operators are already boosting the number of cybersecurity experts in-house to safe guide the operation. Managing, controlling and storing wind assets operational data under their own digital platforms have become a critical solution to ensure the security. To address associated geopolitical concern and data security, EU member states have decided to make more use of prequalification criteria in critical areas such as cybersecurity to raise the bar on which turbines can be built in Europe. Similarly, Government of India's policy think tank Niti Aayog has also raised cybersecurity issues stemming from importing the wind turbine components.

i) Seeking opportunities with hybrid or co-located projects

Hybrid or co-located projects are not new, what is new is that asset owners, including utilities, are seeking more and more of these types of projects to optimise their return opportunities. The combination of wind energy with another renewable energy sources and/or a storage solution is most common due to complementarity. It is also to bring the level of maturity, about how to implement circularity, systems integration, grid reliability and eco-innovation.

This trend is visible across markets and not specific to any one region, but countries like the US, Australia, and India are currently taking the lead in relying on this technical solution to support its energy transition. Utilities profit here from their experience in managing different assets of different scales jointly and providing the ancillary service.

In India, to provide 24*7 power and serve peak power from any corner of the country, new tenders such as RTC (round-the-clock) and FDRE (firm and dispatchable renewable power) require similar set up of projects. Since 2018, India has awarded cumulative capacity of ~27 GW hybrid, RTC and FDRE tenders, of which wind is an important part, and ~21 GW tender capacity is at various stages to be awarded.

GWEC Market Intelligence expects that this trend will continue as value optimisation and optimisation of revenue opportunities are becoming increasingly important for asset owners. The recently passed IRA that offers tax incentive for hybrid/storage projects as well as India's innovative tenders with policy incentives are likely to further boost the growth in this business category.

j) Enabling Technology Diversification: floating offshore wind, green hydrogen and Power-to-X

The future clean energy systems under tripling RE target by 2030 and 2050 net zero scenarios call for large-scale integration of wind and renewable power, enabled by technological solutions for flexibility, storage at varying durations and responsive management of demand and supply.

Also, most European and Chinese utilities have to meet their growth goals and achieve their net zero commitment. The past several years saw major utilities using a combination of geographical and technological diversification as key to maximising growth opportunities and minimising production risks. For example, Danish utility Ørsted announced in early 2018 that it will invest in other RE technologies, since then, it has also grown full-fledged into floating offshore wind space; and Iberdrola and Masdar expanded their partnership to co-invest €15,000 million in offshore wind and green hydrogen in Germany, the United Kingdom and the United States.

Floating offshore wind technology is gradually maturing and expected to achieve its commercial viability toward the end of this decade. Floating auctions conducted in Europe and US so far saw good participation from various segment of players. For example, successful completion of ScotWind auction in early 2022, the floating offshore wind auction by BOEM in California in December 2022, INTOG auction in March 2023 and French floating offshore wind tender in March 2024 are good examples.

Green hydrogen and Power-to-X are set to become breakthrough solutions which will dispatch green power and green hydrogen to different end-use sectors to reduce their dependency on fossil fuels, from heating to manufacturing to transport (including aviation and shipping).

The past three years saw the investment in green hydrogen and Power-to-X gaining momentum. Projects with leading renewable asset owner-operators and major oil and gas companies (such as Orsted, RWE, Vattenfall, Parkwind, CIP, Shell, Equinor and TotalEnergies) on board, have been reported on both sides of the Atlantic Ocean in the past two years.

Australia is a good example of how a country with extremely good wind and solar resources can transition from exporting coal (it is one of the world's largest coal exporters and a significant LNG exporter) to "green" exports through green hydrogen. The Australian Renewable Energy Hub and other multiple projects are proposed across the country to develop tens of GW of renewable power generation, with the goal of converting it into green hydrogen for export. Korea and Japan are key partners who are looking to import green hydrogen from Australia, and progress here should be closely watched.

In addition, we expect the EU's new energy security strategy, EU Wind Power Package, REPowerEU, and Germany's annual offshore wind-to-green H2 auction in 2023-2028 will accelerate renewable hydrogen deployment on the back of Europe's urgency to replace fossil fuels with renewables to achieve energy security in the aftermath of the Russian invasion of Ukraine. For example, the AquaVentus initiative centred around the North Sea Island of Heligoland aims to get massive volume in Germany's first upcoming offshore wind-to-hydrogen tender; Two of EDPR's main green hydrogen initiatives, a key vector for the energy transition, have been selected by the European Commission to receive funding from the European Union Innovation Funds and the strategic partnership between RWE and Equinor to ramp-up the hydrogen economy with renewables expansion in Norway and Germany are good examples.

GWEC Market Intelligence expects huge investment opportunity in renewable, especially offshore wind, powered green hydrogen and Power to X technologies in coming decades.

V. CONCLUSION

To put the world on a sustainable trajectory to meet the Paris climate goals and eventually to achieve the net zero target, the energy transition not only means that there are more diverse opportunities to generate revenues or to diversify risks, but also mean that asset owners and operators have to increase their current investment in renewable energy and enabling technologies such as green hydrogen and Power-to-X.

Increased clean energy targets with volume visibility, supply chain availability, regulatory support such as permitting and incentives to support investment in ports and grid transmission are undoubtedly pillars for a radical energy transition from fossil fuels to renewable energy and low-carbon solutions. To achieve a systematic transition, digital solutions need to play a key role in managing and optimising the assets including grid, storage, distributed, hybrid/co-located and off-grid, and other energy solutions.

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Disclaimer – Data on operational wind power capacity for the Top 15 wind asset owners is taken directly from the annual reports and financial results of the utilities and IPPs listed or has come directly from contact with those companies. For Chinese asset owners, their operational data is quoted from CWEA's annual statistics. Cross-company ownership of wind assets, plant-owning consortiums and joint-venture ownership have become the norm for some large wind projects, particularly in the offshore wind sector. Individual equity stakes in each investment are taken into account. Where consolidated data (net installed capacity) for specific companies is not available, gross capacity is used.