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Renewable Energy

Zero carbon goals bring spotlight on renewable energy sources – A Perspective

December 2022

Executive Summary

The renewable energy market has received increased attention from governments and corporations and is therefore a promising opportunity for players to create a stronghold

Focus areas	Key findings and observations
Industry trends	➢ Solar and wind energy dominate the new power generation capacity, while hydropower slows down ➢ Increase in investments and **M&A activity** is observed in clean energy technology ➢ Decrease in renewable energy prices has positively impacted the industry
Macroeconomic impact	➢ An increase in raw material prices is pushing up the wind and solar building costs ➢ Players have introduced metal **recycling solutions** to build supply chain resilience ➢ Strong **government support** in the sector is cushioning the impact of slowing global economic growth
Solar	➢ **Installation cost** has significantly decreased in the past decade, making it competitive with conventional sources ➢ The market is moderately fragmented, with the top 4 players accounting for ~35% global market share ➢ Reduced storage capital costs along with investment tax credits have increased demand for **panels with battery storage**
Hydrogen	➢ Hydrogen is a cleaner energy source and has a better **energy-to-mass ratio** than lithium-ion batteries and gasoline ➢ Potential opportunities for players to build/ join consortiums and develop a robust hydrogen ecosystem ➢ Players have partnered with the **end-user industries** to develop multiple hydrogen use cases
Wind	➢ **Turbine manufacturers** have heavily invested in R&D to improve capacity and reduce building/ installation costs ➢ Favorable policies in the US/ EU region and high demand for wind power have led to public-private partnership (PPP) opportunities ➢ Offshore wind space has seen players collaborate with large **Oil & Gas firms** for their expertise in offshore operations

Renewable Energy Industry Overview

Major investments from Oil & Gas players, battery storage innovations and decrease in solar prices are catalysts for growth in the renewable energy space

Key Trends

- Oil and gas industry has seen **increased investments** in clean energy technologies. In 2021, these investments accounted for **~5%** of O&G players global capital expenditure, up from 1% in 2019. For example, in Feb 2022, Chevron acquired Renewable Energy Group
- Nations have implemented policies to reduce dependency on **fossil fuels** and develop renewable energy sources. The Middle-East and Russia have lagged behind in the renewables space; they aim to dominate in hydrogen energy
- **Vanadium flow batteries** have gained attention as they are non-flammable, last longer and can hold larger amounts of energy than lithium-ion batteries. Currently these are in early stages of development
- Battery storage has gained emphasis to help **balance the grid** and improve **power quality**, especially when combined with solar or wind power plants. Battery prices have also dropped by **89%** from 2010–2021
- Though hydropower holds a majority share of the global renewable generation capacity, its growth continues to slow down[1]. **Solar and wind** dominate the new generating capacity, adding **~88%** in 2021

"Long term success of the solar industry depends on the cost-effective integration of battery storage (BS). The BS market is expected to reach $12Bn in 2026"

Chandra Kishore Thakur, CEO, Sterling and Wilson Renewable Energy Limited

Key Demand Drivers

- **Volatile crude oil prices** – crude oil spot prices have fluctuated from $14/bbl (April 2020) to $133/bbl (after the Russia-Ukraine conflict). New entrants capitalize on the supply of renewable energy at stable prices to counter oil
- Decrease in **renewable energy prices** due to overall lower material costs has led to new entrants in the space. Costs for electricity from utility-scale solar energy fell **85%** between 2010 and 2020
- The increased emphasis around *'responsible investment'* is driven by **ESG**[2] targets which include investments in the renewables market. Sustainable investments have grown **15%** in 2020-2022 in major financial markets

"In Jan 2022, we launched an asset rotation programme to dispose of our combined cycle gas turbine assets. Why? Because we want to transform ourselves into a pure renewable's player, which means wind and solar"

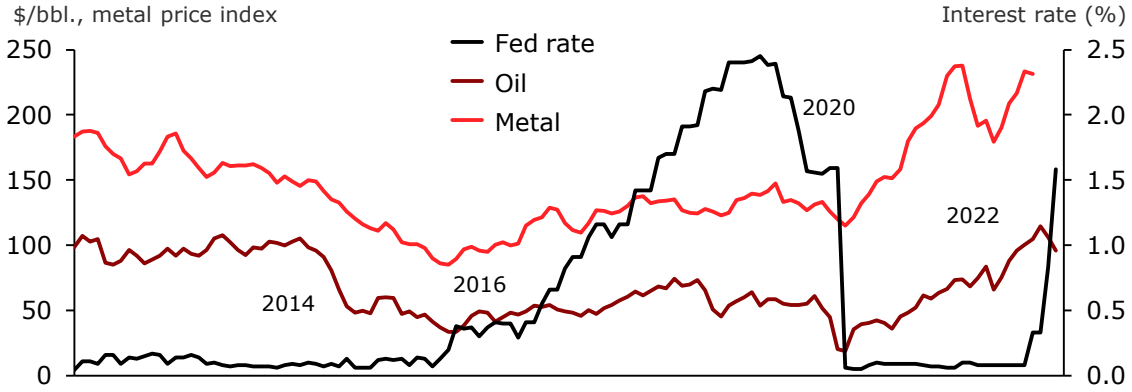
Paolo Luigi Merli, CEO, Eduardo Raffinerie Garrone (ERG)

1. International Renewable Energy Agency 2. Environmental, social and governance factor

Macroeconomic Impact and the supportive Government Policies

Favorable long-term state policies may reduce the effect of increasing interest rates and commodity prices of steel, silicon, aluminum etc.

Fed rate, crude oil and metal price impact



Fed rate, crude oil price and base metals[1] price index (2012-2022)

Since 2020, PV-grade silicon prices have increased ~300%, steel ~50%, copper ~60% and aluminum ~80%. However, manufacturers may be relieved of metal price hikes for **~12 months** due to Fed rate hikes

To counter volatile energy markets, in 2021 corporations invested **$165bn** in clean-tech globally to develop sustainable technologies and capitalize on the net zero emissions theme

The combination of high borrowing rates and recession may derail renewables in the short term. However, with strong **policy support** - in US, Europe, Australia and India - the blow will be softened in the long term

Players are working on metal recycling solutions - improving long-term resilience to price shocks and supply constraints

State policies performing the role of a catalyst

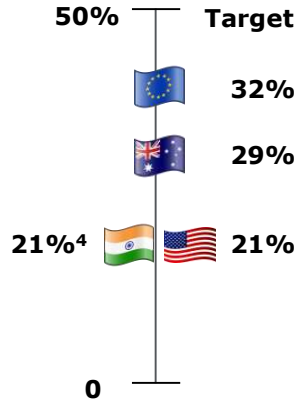
- ✓ The President set a goal to produce **100% carbon pollution-free electricity** by 2035
- ✓ The DOE[2] announced pledges from **90+ organizations** to slash emissions by 50% within 2030

- ✓ The main electricity grid is proposed to surpass **50% renewables** by 2025, and will surge to 69% renewables by 2030
- ✓ Projected to achieve a 30% reduction in emissions on 2005 levels by 2030

- ✓ Proposed to derive 45% of the EU's energy mix from renewables by 2030 and **climate neutral** by 2050
- ✓ Planned a massive increase in solar and wind power, and a short-term boost for coal, to end its reliance on Russian oil and gas as fast as possible

- ✓ The government aims to achieve **50% renewables** by 2030 i.e., a 500GW target production capacity

Renewable energy progress (2021)



1. Metals consist of iron ore, aluminum, cobalt, copper, lead, molybdenum, nickel, tin, uranium and zinc 2. Department of Energy 3. Environmental Protection Agency 4. 2020

Solar Energy - Key Industry Trends

Increased consciousness towards cleaner energy, government incentives and reduced solar costs fuel the 23% CAGR in the global solar energy market

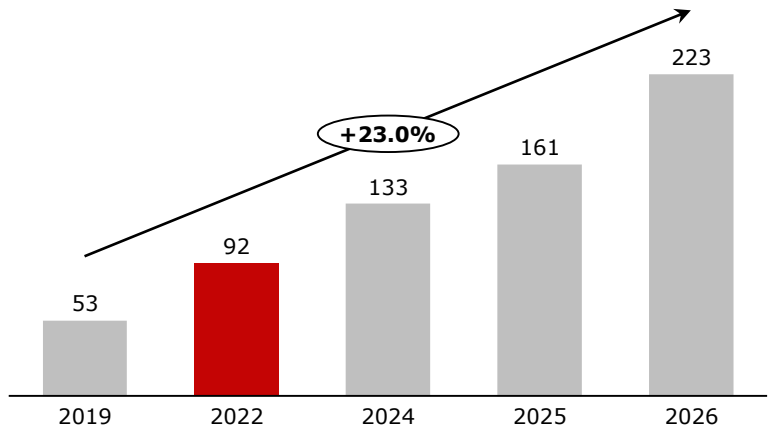
Trends

- **Solar market growth:** Global solar market has grown exponentially in 2021, with **~33%** growth over the last decade. Solar achieved the highest growth in renewable energy, with over half of the 302GW of renewable capacity installed globally in 2021
- **Government incentives:** Incentives and tax rebates such as the **Investment Tax Credit** introduced by the US government enables solar power operators to write off 26% taxes associated with building a plant through 2020. This is scheduled to reduce to 22% by 2023
- **Reduced installation costs:** The average cost to install solar panels has dropped **~70%** since 2014 due to improved manufacturing processes, reduced labor costs and enhanced module efficiency
- **Reliance on major manufacturers:** As the pandemic disrupted the solar supply chain and showed over-reliance on a few major manufacturers, US-based solar panel manufacturers have aggressively increased their **market share globally**
- **Demand for cleaner products:** Demand for **solar powered** products as compared to traditional powered products such as generators, portable smartphone chargers, outdoor motion sensor lights, backpacks, and cookers has increased

"As batteries have become more efficient and more affordable, the benefits they offer outweigh the means. From a utility perspective, batteries help stabilize the grid and reduce wasteful production. From the homeowner perspective, batteries allow the homeowner to store power for power outages and/or peak shave when utility rates are at their highest"

Robbie Mcnamara, National Renewable Business Development Manager, City Electric Supply

Global solar energy market (USD, Bn)[1]



Government plans

EU countries aim to achieve 1,000GW of Solar Energy by 2030

Committed to reduce cost of solar electricity by 50% between 2020 and 2030. Targets to reduce the levelized cost of energy to less than $0.03/kWh in utility-scale PV systems

Aims to achieve 300GW of solar energy capacity by 2030

1. Allied Market Research

Competitor Dynamics

Solar energy market is moderately fragmented; the top 4 players (primarily dominated by Asian companies) account for ~35% of the global market share

Major Players

Market Leaders

ENPHASE, First Solar, XYS, Trinasolar

JinkoSolar, GCL, SolarEdge, Atlantica Sustainable Infrastructure, SMA Solar Technology, CanadianSolar, SUNPOWER, Yingli Solar

Brookfield Renewable

In January 2022, Brookfield Renewable acquired Urban Grid, a U.S.-based renewable energy developer for **$650mn** to triple Brookfield Renewable's development pipeline to **~31GW** in the US

AXIUM INFRASTRUCTURE

In May 2022, Axium Infrastructure acquired BlueWave Solar, an energy storage and community solar developer which will enable Axium to pioneer in storage development

Renewable. Reliable.

In 2020, LT Renewables acquired Enerray, a solar installation company to add **240MW** of solar capacity and take advantage of the actionable opportunities in the European solar markets

SUNPOWER

In 2021, SunPower acquired Blue Raven Solar, a residential solar provider in the US for **$165mn** to leverage its geographic footprint and serve more customers in underpenetrated areas

Market Dynamics

The global solar energy market is **moderately fragmented** as the leaders control **~35%** of the market, with a slim market share for numerous small players

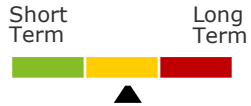
Small installers form consortiums to increase market share and compete with larger players in the industry. There were a record **126 M&A deals** in the solar sector in 2021

Region Dynamics

- China dominates the solar market, producing **~80%** of the solar panels globally in 2021 through lower labor, land and operating costs to boost manufacturing
- US and Europe strengthen ties with other **low-cost manufacturing** Asian countries such as India to diversify their solar supply chains and reduce reliance on Chinese-made solar panels
- First Solar, a US solar panel manufacturer acquired $500M in debt financing to set up a **3.3GW** vertically integrated solar module manufacturing facility in Tamil Nadu, India
- US and Europe imposed **trade tariffs** on imported solar panels in order to move away from China to other Asian countries and boost local manufacturing companies

Headwinds and Tailwinds in the Solar Energy Industry

Innovation in batteries and floating solar panels may mitigate headwinds such as transmission losses and scarcity of appropriate land

Impact	Trend	Description	Longevity of Impact
Descending order of impact ↓ **Tailwinds**	**Newer Solar Technologies**	• Solid-state batteries on the consumer side and molten sodium liquid batteries on the industrial side can unlock the future of solar • Companies explore **floating solar photovoltaic** plants as the new means to harness solar energy as appropriate land for solar use remains a scarce resource • Building-integrated photovoltaics uses photovoltaic building materials within the architecture to generate a greater amount of energy	
	Government Initiatives	• Several government policies are launched to support the solar PV manufacturers through subsidies and other schemes, which helps minimize the **R&D** and **installation costs**	
	Blockchain and AI	• Companies explore the potential of **blockchain technology** to digitize, automate, and decentralize the operation of the electricity grid • **ML and AI** are also utilized to get better forecasts, manage grids and schedule maintenance in a timely manner. AI also helps identify failures and optimize the PV plant performance	
Descending order of impact ↓ **Headwinds**	**Supply Chain Disruptions**	• Supply chain delays from China due to import tariffs and closure of factories have led to a **silicon shortage** and other raw materials, resulting in production delays • Shipping constraints due to the pandemic and trade instability have led to a **40%** price solar module increase between August '20 and November '21	
	Increased Costs	• **Transmission** and **distribution** losses which typically account for ~40%, add to the overall cost which makes the deployment of solar PV unfeasible in certain areas	
	Land Scarcity	• Availability of **appropriate land** for solar use remains a challenge in the solar sector as solar PV plants require constant sunlight with minimal disruptions to achieve the desired level of energy	

Legend
Short term: <18 months | Mid term: 18-36 months | Long term: >36 months

Possible Future Opportunities - Solar Energy

The benefits of battery storage and floating solar panels in regions with a shortage of appropriate land will provide immense growth in the industry over the next decade

Battery storage paired solar systems

- ✓ Solar systems paired with **battery storage** will likely experience increased demand from end-consumers as they offer cost synergies, operational efficiencies, and opportunities to reduce storage capital costs with solar investment tax credits
- ✓ Still in its nascent stage, battery storage paired solar systems account for **~11%** of all new solar systems in 2021, however, this number is expected to reach 29% by 2025
- ✓ 45GW of utility-scale solar projects have been commissioned in 2022

Floating solar photovoltaics

- ✓ Although a nascent technology, **floating solar photovoltaics** continues to gain attention in the solar markets, as several developers explore projects combined with hydropower, which could benefit from a shared substation and transmission
- ✓ Companies plan to build floating solar panels on ponds and reservoirs, which could help address concerns over shortage of **appropriate land**
- ✓ Floating solar photovoltaics produce more energy as compared to standard land installations

Expansion of community solar projects

- ✓ Shared solar power can enable homeowners to achieve energy **cost savings** and overcome hindrances such as insufficient sun and lack of appropriate land
- ✓ 22 states in the US have already established policies for community solar. This model can be uniquely positioned to aid recovery from the pandemic as it provides new employment opportunities and helps to curb costs

New solar technology applications

- ✓ Urban areas can utilize solar-powered **LED streetlights** to cut down carbon emissions and energy bills
- ✓ PV **noise barriers** along highways can produce electricity for nearby communities, at the same time make them more habitable

Corporations may want to capitalize on solar panels paired with battery storage and floating panels to create a stronghold and increase market share in the future

Hydrogen Energy - Key Industry Trends

Green hydrogen is recognized as the cleanest and most versatile fuel, with applications that range across many industries

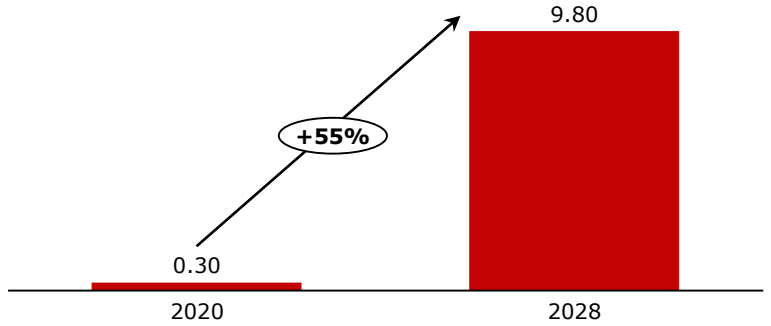
Trends

- '*Net zero'* carbon goals of major nations have propelled the need to develop carbon neutral forms of energy. Currently, hydrogen accounts for <1% of the total energy consumption globally
- World's largest oil exporter, Saudi Arabia, has heavily invested in hydrogen projects, with an aim to become the largest hydrogen exporter. Similarly, the US, EU, India, Japan, Russia and China have passed their own green hydrogen goals
- Governments, infrastructure corporations, oil and gas corporations, and existing players partner, invest and co-develop solutions to advance the hydrogen value chain
- Slow development of the **hydrogen value chain** due to high costs and an absence of infrastructure has impeded widespread adoption
- Green hydrogen is currently expensive to produce, however, in recent years with the decline in the cost of **renewable electricity** (solar and wind), the investment in electrolytic generation of hydrogen is rising
- Major players plan to develop **blue hydrogen**[1] centers in the next few years to fulfil the demand until green hydrogen can be produced at scale

"'It is green hydrogen that will bring new and diverse participants to the market. It will diversify routes and supplies and shift power from the few to the many. With international co-operation, the hydrogen market could be more democratic and inclusive, offering opportunities for developed and developing countries alike"

- Francesco La Camera, Director-General, IRENA

Green Hydrogen Market Size (USD Bn)[2]



Government plans

REPowerEU set a target of 10 million tonnes of domestic hydrogen production and 10 million tonnes of hydrogen imports by 2030

$8bn is being provided to develop ~4 Regional Clean Hydrogen Hubs with an aim to create jobs and expand the use of clean hydrogen in the industrial sector

Target to produce 5 million metric tonnes of green hydrogen by 2030, from a total announced capacity of 255 thousand mt/year currently[3]

1. Hydrogen produced from natural gas 2. Allied Market Research 3. Hydrogen Production Assets database of Commodity Insights

Industry Map - Hydrogen

The hydrogen value chain is currently at a nascent stage with opportunities for players to grow in the production and transportation of green hydrogen

Industry structure

Source	Upstream	Midstream	Downstream	Fuel conversion
Green hydrogen				
Renewable Energy Sources	**Plants - Electrolysis**	**Storage**	Power generation	Hydrogen fuel cells
		Pipelines	Heavy industries	
			Heating buildings	
Blue hydrogen		**Transportation**	Transportation	
Natural Gas or Fossil fuels	Steam methane reforming & carbon capturing		Export	

- Many corporations in the process to set up **blue hydrogen** plants (non-renewable) as they are less expensive as compared to green hydrogen
- Today, **grey hydrogen** (non-renewable) accounts for ~95%[1] of global hydrogen production and is mostly used for oil refining and fertilizer production

Players shift their focus to **develop, acquire or partner** with solar/ wind farms to source energy for their 'to-be developed' green hydrogen plants

- Harder to **store** and **transport** due to a low boiling point
- Has a small molecular size that may **leak** from existing pipes and fittings

New pipelines, storage facilities and transportation vehicles are required

- Hydrogen is clean, versatile and has a high power/ mass ratio which will enable wider use across industries
- Development of specific solutions for chemicals, power, iron & steel and mobility industries is at a nascent stage
- Compressing and storing hydrogen in a tank, and converting it back into electricity, is currently inefficient and causes a loss of energy

1. University of Calgary: Energy Education Canada

Competitive Dynamics

Competitors increase investments across the green hydrogen value-chain with some players present across the chain

Hydrogen ecosystem players

Partnerships / JVs

- JV to produce industrial scale renewable hydrogen electrolyzers in Europe
- 31 energy infrastructure operators aim to accelerate Europe's decarbonization journey and showcase the critical role of hydrogen infrastructure

M&A / Investments

- Acquired Joule Processing, for hydrogen liquefaction
- Acquired H2V Normandy, developer of a 200MW flagship green hydrogen project, which is expected to complete by 2025

Traditional incumbents

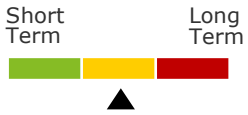
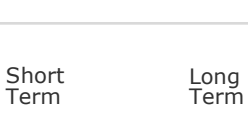
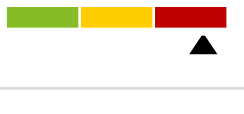
- RIL has committed $9.38Bn for renewable energy over 3 years and declared a three-pronged strategy which involves solar power, hydrogen production, e-fuels, and energy storage
- Agreed to invest $50Bn over the next 10 years in India to develop a green hydrogen ecosystem to cut reliance on fossil fuels and transition to zero net carbon emissions
- BP will buy a 40.5% stake and operate an Australian renewable energy project to become a global leader in green hydrogen

Green hydrogen's potential has provoked players to co-develop solutions to use hydrogen in various industries, through partnerships, joint-ventures and consortiums

Legend
Upstream presence: Hydrogen production
Midstream presence: Storage, transportation, distribution, and electrodes
Downstream presence: Hydrogen fuel cells and applications

Headwinds and Tailwinds in the Green Hydrogen Industry

Currently, green hydrogen is in a nascent stage, however, hydrogen's significant advantages and hard to emulate properties will make it imperative for global adoption

Impact	Particulars	Description	Longevity of Impact
Descending order of impact ↓ **Tailwinds**	**Government incentives**	• Governments provide **subsidies** and **tax benefits** to develop green hydrogen production facilities, refueling systems, storage systems and transportation infrastructure	
	Renewable energy costs	• Reduction in the cost of renewable power will make green hydrogen production cheaper • Solar energy costs have reduced by **85%** between 2010 and 2020. Wind turbine costs have dropped **~50%** between 2016 and 2021	
	Benefits of hydrogen	• Hydrogen has the potential to **decarbonize** hard to abate sectors such as chemicals, steelmaking and refineries. It is lighter, has smaller space requirements and will have various applications where space constrains exist, for example, long haul vehicles, aircrafts, rockets and others • Hydrogen has the highest **fuel to mass** ratio amongst the current power sources; it can generate 100x more energy per kg than lithium-ion batteries and almost 3x more than gasoline	
Descending order of impact ↓ **Headwinds**	**High production costs**	• Currently, green hydrogen is very expensive**,** with the price being $5.5 - 6/kg[1]. To be economically viable, costs need to reduce by **50-80%** which will require technological improvements • Presence of cheaper alternatives such as lithium-ion batteries, blue and grey hydrogen may affect/ delay adoption	
	Absence of infrastructure	• Hydrogen cannot be distributed in existing natural gas pipelines due to its chemical properties, hence there is a need to install new **pipelines** along with distribution/ refueling stations • There is an absence of infrastructure in the hydrogen ecosystem; currently green hydrogen incurs significant **energy losses** at each stage of the value chain	
	Lack of demand	• Due to absence of efficient **hydrogen fuel cells** and applications, there is low industrial demand, equating to minimal adoption • Currently, hydrogen accounts for **<1%** of the total energy consumption globally	

Legend
Short term: <18 months | Mid term: 18-36 months | Long term: >36 months

1. Investment Information and Credit Rating Agency

Possible Future Opportunities – Green Hydrogen

The industry has no established players or ecosystem | The battlefield is open for players to make strategic plays and dominant moves to capture and develop the value chain

Offshore hydrogen plants

- ✓ Opportunity for companies to explore offshore hydrogen plants powered by offshore wind turbines or solar cells that have unlimited water supply that produce uninterrupted industrial hydrogen. For example, Lhyfe inaugurated the worlds first offshore hydrogen plant in Sept. ’22
- ✓ Players can produce clean hydrogen and oxygen gas by **forward-osmosis/ desalination** followed by electrochemical water splitting of salt water. Harvard and Stanford researchers have developed **anti-corrosive** electrodes to be used for salt water

Strategic partnerships and geographical establishments

- ✓ Establishments near seaports in geographies such as India and Australia will prove to be advantageous owing to the countries’ green hydrogen export goals aided by government funding and incentives
- ✓ Players may **acquire** and/ or **partner** with electrolyzer plants which are near solar and wind farms to source uninterrupted clean energy
- ✓ Future demand for hydrogen vehicles and equipment refueling may create opportunities for **strategic partnerships** with state governments to lay down refueling stations and pipelines in select geographical areas

JV collaboration of specific hydrogen use cases

- ✓ Furnaces in steelmaking, raw material in chemicals, de-sulfurization of crude oil in refineries, engines in long haul transport, marine and aerospace, and heating buildings will benefit majorly by the adoption of green hydrogen solutions

Ecosystem play

- ✓ Players can build a hydrogen value chain through **consortiums** (infrastructure players, energy providers and other stakeholders) in geographies like US, Brazil, India, Israel, Spain and Australia. For example, in Europe, 31 energy infrastructure operators founded the European hydrogen backbone in 2020 to partner and develop a hydrogen infrastructure
- ✓ Participation in the hydrogen value chain may generate additional revenue opportunities for players

Green hydrogen is the future of clean energy, thus first mover advantage will ensure market leadership, revenue and profitability upliftment in the long term

Wind Energy - Key Industry Trends

Increase in turbine efficiency and reduction in installations costs are prime drivers for the 9% CAGR till 2030 in the wind energy market globally

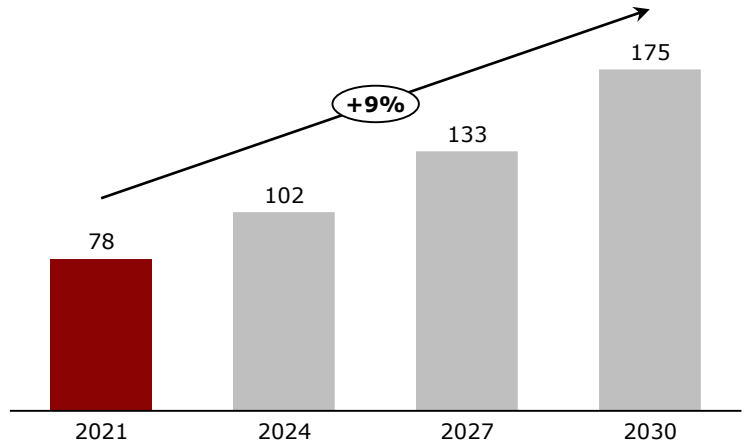
Trends

- **Wind energy infrastructure development**: In 2019, wind energy accounted for **~5%** of global electricity. Infrastructure growth in developing regions will boost demand during 2021-2030
- **Increase R&D in investments**: Manufacturers invest to increase efficiency and reduce noise pollution of wind turbines, with the objective of making bigger, better and cheaper turbines that last longer; costs have come down **~50%** between 2016-2021
- **Upstream integration**: Major players are engaged in collaboration/ acquisition of raw material and component manufacturers to strengthen supply and reduce overall costs. New offshore wind turbine costs have reduced from **$155** to below **$50** per MW/hr. during the period 2015-2022
- **Growth in turbine capacity**: Installation costs of onshore and offshore wind projects globally are projected to decline due to growth in turbine capacities. Forecasted capacity growth in typical turbines from 2014 to 2030 is **1.9 to 3.25 MW** for onshore and **3.4 to 11 MW** for offshore
- **Grid modernization**: The growth of battery storage goes together with grid modernization efforts. This includes the transition to smart grids powered by AI, blockchain, and predictive analytics which can provide greater flexibility in electricity transfer

Climate change effects

- **Lower wind speeds**: EU experienced a 'wind drought' as speeds slowed **~15%** below the annual average in 2021. The UK experienced its lowest wind speeds in 60 years, producing only 2% of the nations power through wind energy in Sept. 2021 as compared to 18% in Sept. 2020
- **Lower winds in the Northern hemisphere**: Utilizing several climate scenarios from IPCC reports, data indicates a change in weather patterns will cause an **8-10%** drop in wind across the Northern hemisphere by 2050

Global wind energy market (USD, Billion)[1]



Government plans

Plans to achieve 480GW of wind energy output by 2030 i.e., 35GW of new wind energy needed p.a.

Committed to deploy 30GW offshore wind energy by 2030

Plans to achieve ~450 GW of electricity generated from solar and wind power

1. Precedence Research

Competitor Dynamics

The top 5 players account for ~60% of the wind energy market, however smaller manufacturers attempt to gain market share with efficient and innovative offerings

The wind energy market is concentrated with the top 5 players accounting for more than 60% of the global installed capacity

Recent acquisitions and investments

In April 2022, Ørsted, the world leader in offshore wind, acquired an **80%** stake in the **100MW** Salamander floating offshore wind development project on the Scottish coast, entering a JV with Simply Blue Group

In April 2022, Iberdrola acquired a **1,000MW** onshore wind farm in Queensland, Australia. The company now has a portfolio of more than **3,000MW** in the region which also has the potential to become a major green hydrogen hub

In April 2022, SSE Renewables purchased Siemens Gamesa portfolio of onshore wind projects for **$610mn,** capable of generating **3.9GW** of electricity. This acquisition expands SSE's business in Southern Europe

New innovations

VORTEX — The wind turbine structure does not include any blades which allows it to always be oriented to any wind directions; this structure is without gears, oil, and has less foundational material

UPRISE ENERGY — Portable wind turbine that is economical, provides 10kW of energy and is efficient in low wind speeds. The turbine is easily towable and sets up in an hour without the need for site improvements

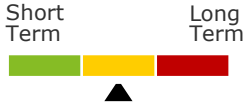
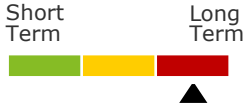
WorldWideWind — Offshore floating wind turbine with 2 counter-rotating turbines which are tilted with the wind like sail boats. These turbines improve area efficiency by 4x compared to conventional technology

Turbit — Provides software for wind turbines which reduces costs that are related to damage or operational stops and can improve wind-farm energy output by ~5%

1. Relatively specialized players focusing primarily on wind farms 2. Players that operate in different renewables (wind, solar, tidal, hydrogen etc.)

Headwinds and Tailwinds in the Wind Energy Industry

Innovations such as advanced offshore structures and 3D printed turbines will promote growth in the industry and aim to outweigh price and entry barrier headwinds

Impact	Trend	Description	Longevity of Impact
Descending order of impact ↓ **Tailwinds**	**Floating offshore wind turbines**[1]	• Based on floating structures rather than fixed structures, this new technology allows the deployment of wind turbines in larger and deeper offshore areas with higher wind speeds • Floating Offshore Wind Shot[2] aims to reduce the cost of offshore wind energy by **~70%** by 2035	
	Favorable energy policies	• The development of the wind energy market, especially offshore wind, has been driven by favorable **energy policies** in the US and Europe among others, while also providing **tax incentives** as another mechanism to promote development • The US provides a **30% corporate tax credit** to owners of new wind energy systems of any size	
	3D printing technology	• Companies experiment with 3D printed concrete bases of towers and blades to improve production efficiency. This allows for on-site manufacturing and lowers transportation costs • A 3D printing solution developed by the University of Maine, US promises to reduce lead times by **~6 months** and development costs by **25-50%** for wind turbine blades	
Descending order of impact ↓ **Headwinds**	**Raw material price rise**	• Supply chain delays from China, increased cost of steel and other materials combined have impeded the advancement of wind energy. The cost of steel used for wind turbine blades have risen by **~50%** since the pandemic's start	
	Lower wind speeds	• Researchers indicate that changing weather patterns will cause an **8-10%** drop in wind across the Northern hemisphere by 2050 • The EU experienced a 'wind drought' as speeds **slowed ~15%** below the annual average in 2021	
	High technical barriers to entry	• Offshore wind projects have high technical barriers to entry. This requires expertise to lay foundations, erect turbines, and lay subsea cables which companies cannot develop organically • In most countries, the eligibility assessment process to setup offshore wind farms can typically take years to approve	

Legend
Short term: <18 months | Mid term: 18-36 months | Long term: >36 months

1. Platforms are anchored to the seabed by means of flexible anchors or steel cables
2. Initiative by the U.S. Department of Energy to usher floating offshore wind design, development, and manufacturing

Possible Future Opportunities – Wind Energy

The wind energy market presents a multitude of opportunities in innovative turbine designs and partnerships with oil and gas majors

Collaboration with oil and gas players

- ✓ The unique expertise required in the offshore wind space has meant that except for a select few European developers, almost no participants exclusively hold the requisite technical expertise, commercial expertise and financial strength
- ✓ Companies that seek to invest in offshore wind may need to gain expertise from external sources such as large oil and gas players through **collaborations** or **M&A** to utilize their expertise in the offshore domain

Collaborate with smaller and innovative turbine manufacturers

- ✓ Players have started to manufacture vertical axis wind turbines that are equipped with rotor blades that can pick up wind from any direction. They can be placed close together, capture more energy per square meter, and are easy to transport, set-up and maintain
- ✓ Legacy wind turbine manufacturers can partner with new players to leverage these innovations and improve their offerings

Opportunity for private sector to help achieve US offshore wind growth

- ✓ To meet the 2030 offshore wind energy target (30GW) in the US, BOEM[1] plans to bring together federal leadership in **close coordination** with the private sector to boost the deployment of offshore wind at scale
- ✓ To accomplish this target, there are many upstream/downstream opportunities such as new factories for windfarm components including wind turbine nacelles, blades, towers, foundations, and subsea cables; additional demand of steel; and specialized turbine installation vessels in U.S. shipyards

Investment opportunity to address rising demand in EU

- ✓ In 2022, with higher demand and lower supply in the EU, there is an opportunity to address the investment need. Private players may play a significant role in increasing wind energy development in the EU to meet the growing demand from end users

Players have an opportunity to capture the rising wind energy demand in the US and EU by collaborating with oil and gas majors and smaller innovative players

1. Bureau of Ocean Energy Management

TRANSJOVAN CAPITAL
STRATEGY | M&A | ADVISORY

About Transjovan Capital

Transjovan Capital is an upstream strategy and M&A consulting firm with hubs in New Delhi, Los Angeles, and Sydney. We partner with our clients to create exponential value with high-quality analysis and robust recommendations. Our clients span across industries and feature in top Fortune 50 companies of the world.

Transjovan Capital is industry agnostic with a focus on North America, Western Europe, and APJ regions. Our offerings include development of corporate strategy, business wargaming, M&A strategy, commercial due diligence, and market entry strategy. We focus on delivering tangible results by bringing together consulting expertise and global experience for our clients.

The information contained herein is not intended to substitute for competent professional advice