IHS Markit®

10 Cleantech Trends in 2022

Technologies to reduce emissions and confront climate change

IHS Markit's 10 Cleantech Trends in 2022			
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2	Distributed generation consolidates to represent 45% of all new Solar PV additions	7	Corporates accelerate their investments in renewable assets
3	Supply chain challenges, trade barriers and geopolitics drive new solar PV manufacturing capacity closer to the end markets	8	2022 becomes a tipping point for Green Hydrogen, triggered by upcoming policy quotas
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5	Floating offshore wind reaches commercial scale	10	CCUS gains traction as a decarbonization solution for a wider group of regions and industries

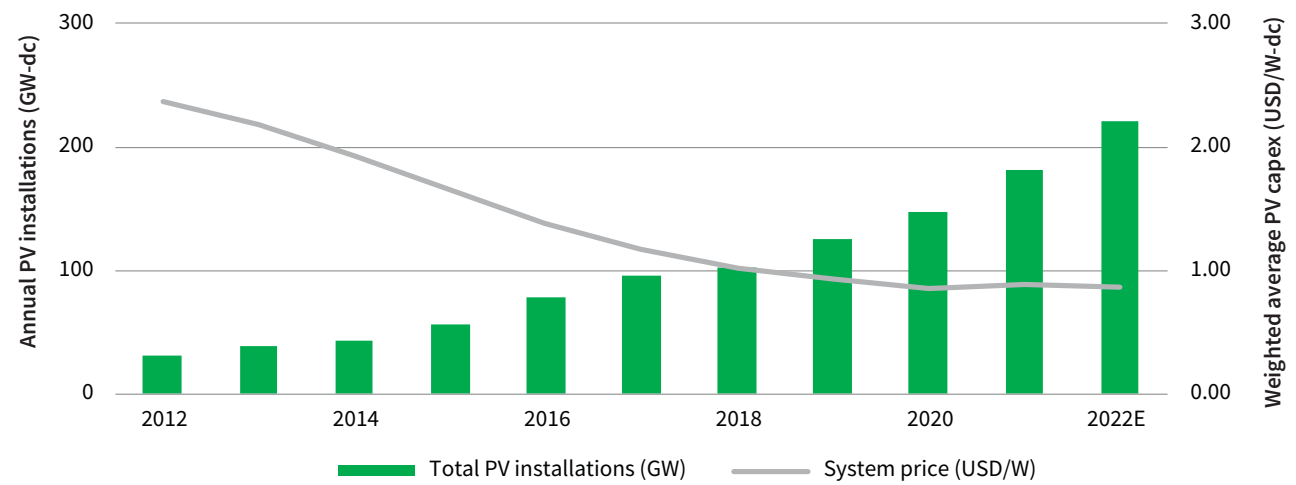
1 A new paradigm emerges – Renewables grow despite higher than anticipated capex

Renewables are already the cheapest source of new power generation in most markets across the world. Cost declines due to technology evolutions and rapid policy advancements have triggered new investments, leading to further capacity additions and price drops. In the case of solar PV, investors and governments have come to expect continuously lower capex. In recent years however, as the technologies have matured, the capex of solar and wind has declined at a slower pace and become subject to temporary supply chain hurdles, such as the past year's escalating shipment costs, rising module prices and escalating steel costs.

As the penetration of renewables increases, it is not so much about the cost, as it is about the value provided to the system. In a moment of high volatility, the predictability in operating renewables is valued. Financiers and investors also value investments in renewables as a step to meet climate commitments and de-risk portfolios. The consolidated banking experience with renewables, alongside a strong push for green financing, has also brought down the cost of capital for renewable power projects. Recent spikes in electricity prices have also improved the captured prices for renewables. These perceived values counterbalance the industry's higher-than-expected capex and underpin the continued build-out of new renewables capacity.

Supply chain risks and increasing costs remain a major concern for the renewables industry, and companies throughout the value chain will need to mitigate and hedge these risks to remain successful. Despite these concerns, the value of renewables remains high enough to sustain a healthy growth rate of renewables additions.

Annual PV installations and PV capex evolution



Source: IHS Markit

2 Distributed generation consolidates to represent 45% of all new solar PV additions

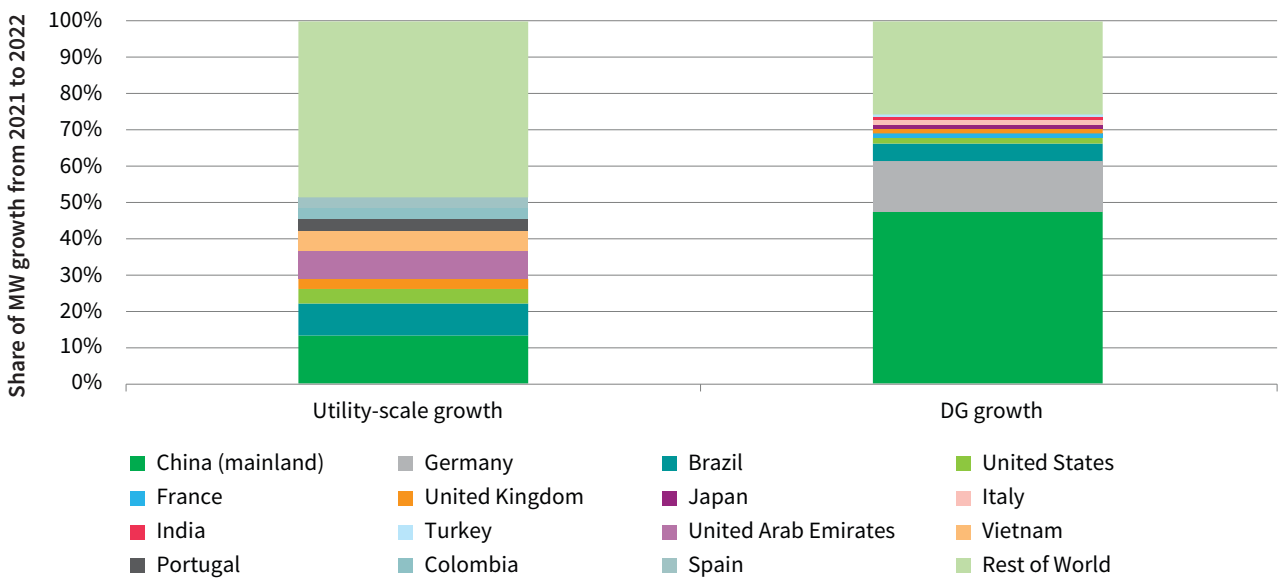
The distributed generation (DG) segment – defined by IHS Markit as PV systems below 5 MW dc – is forecast to grow by 20% in 2022. The segment has demonstrated strong resilience through the pandemic and the challenging high-cost environment. While many utility-scale PV projects were delayed or even cancelled in 2020 and 2021, due to a combination of logistics and higher than expected project costs, the DG segment did not lose traction. This difference reflects both the DG policy push of individual markets and many consumers' concern over high electricity prices and the climate footprint.

More than 60% of the DG segment's year-on-year growth in 2022 will come from systems installed in mainland China and Germany. Both markets are pursuing policies to make distributed generation a key part of meeting renewables' targets. Brazil is another high-profile DG market, as net-metering systems installed through 2023 remain exempt from grid charges. On a global scale, national and state governments, sometimes on a city level, increasingly deploy policies to support the build-out of rooftop PV, including energy-efficiency mandates and grants. Overall, rooftop installations tend to be less conflictive than ground-mount installations, particularly in areas with reduced land availability.

Other DG growth markets in 2022 include already consolidated markets, like the United States and France, and a multitude of newer, but rapidly growing smaller DG markets. PV installers, retailers and electricity distributors offer an increasing range of PV solutions to residential and commercial electricity consumers. Even at higher capex levels, DG systems generate electricity that remains competitive with retail electricity prices across many markets, meaning the DG segment is less price sensitive than utility-scale PV. Concerns about surging electricity prices as seen over the past year also fuel further demand for solar PV, particularly in locations where little PV has been installed to date.

Combined with supportive policies, the economics of DG enable continued strong growth of the DG segment, as well as accompanying battery solutions, beyond 2022.

Ten largest growth markets as a percentage of total segment growth



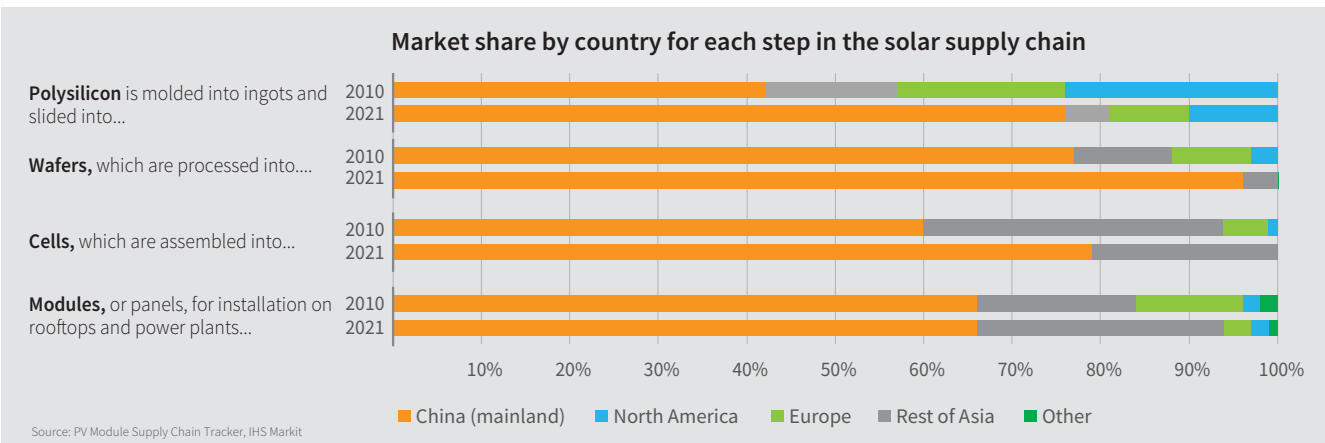
Source: IHS Markit

3 Supply chain woes, trade barriers and geopolitics drive new solar PV manufacturing capacity closer to end markets

IHS Markit projects that the supply chain tightness will persist and maintain high prices in 2022, particularly in the first half. Despite this challenging scenario, there are some positive developments that will alleviate the current supply-chain challenges:

- The ramping up of new polysilicon capacity is coming earlier than planned and the aggressive decrease of conversion rates (g/W) from wafer players implemented this year will also help to improve polysilicon availability.
- The entrance of new wafer players in the market will also contribute to increase price competition at the wafer level.
- The central economic work conference in mainland China has outlined the new guidelines for the energy consumption and energy intensity, stating that the manufacturing of renewable supply chain's materials will be excluded from the "Dual-control on energy intensity and total energy consumption level" requirements and will not face power restrictions. This exception, given the low-carbon nature of renewables, is clearly aligned with recent ambitious announcements to develop solar PV in China as a pillar of the new decarbonization agenda of the national government.

Trade barriers and geopolitics will continue being at the center of the industry and start to reshape the global manufacturing map. Policy developments to reduce dependence from international module imports in major solar installation markets like India, where the Government has launched the Production Linked Incentive (PLI) scheme or the United States, currently discussing Build Back Better infrastructure bill could become an important driver to incentivize domestic manufacturing of solar PV. Leading Chinese manufacturers with growing restrictions to export to the US and Indian market (second and third largest solar PV installations markets, respectively) will face mounting pressure to build new capacity outside of mainland China to continue selling into these international markets. This year we already saw announcements for new ingot, wafer, cell, and module capacity in India, the United States, Europe, and Southeast Asian countries that will continue in 2022 as the supply chain continues growing and adapting to the new international trade environment.



4 Wind technology innovation focuses on larger turbines and recyclable materials

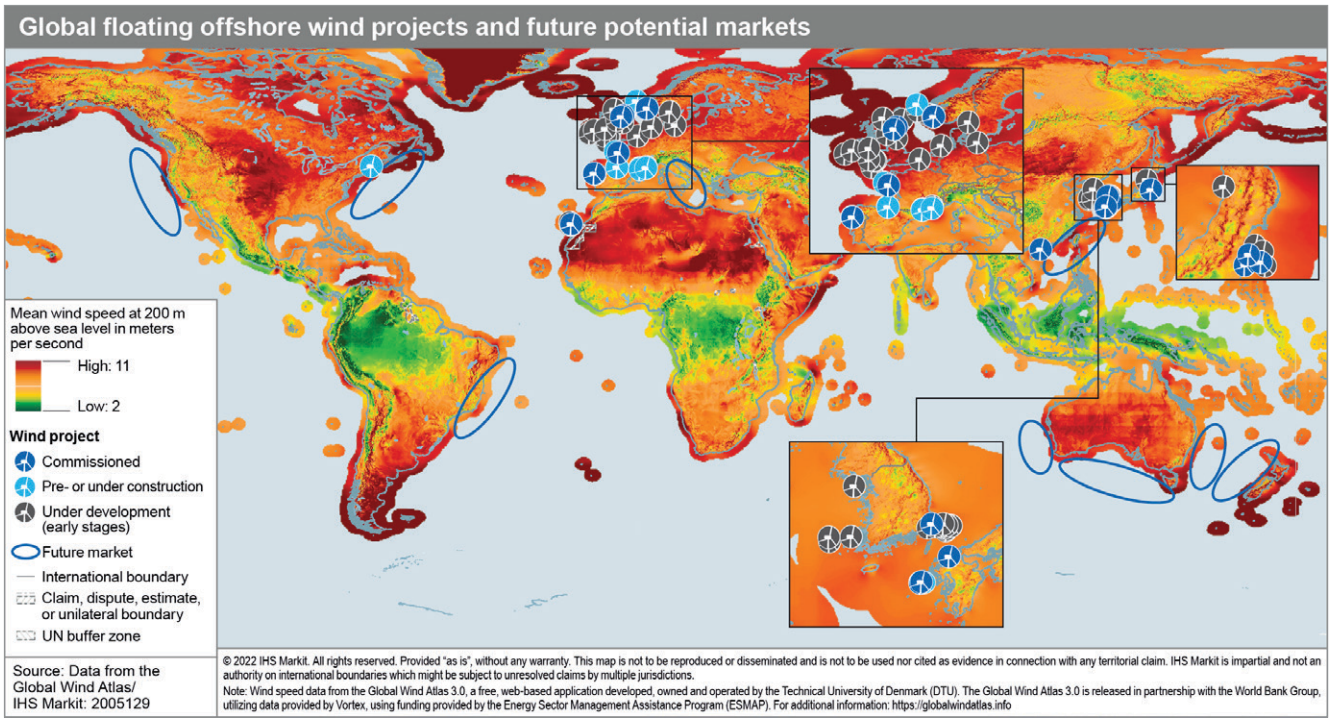
Despite tighter purse strings due to ongoing supply chain woes, wind turbine manufacturers have continued to invest in R&D to further scale their wind turbines. In 2021, onshore and offshore turbines broke the 7 MW and 15 MW mark, scaling up by almost 50% compared to models announced just three years ago. The technology trajectory will hold its current path with the offshore sector awaiting its next big turbine announcement. For onshore, the challenge will be not to simply scale up, but also increase the number of options available as markets demand increasingly tailored technology options.

Stricter self-imposed sustainability goals mean wind turbine manufacturers are increasingly exploring new material combinations to boost circularity in manufacturing, minimize waste, and improve recyclability. With growing concerns surrounding landfilling turbine blades, there was a frenzy of industry collaborations (e.g. DecomBlades, Zebra Project, GE-Veolia) focused on tackling this issue in 2021. By September, Siemens Gamesa had launched its first recyclable blade while other players like Vestas had invested in further boosting recyclability of other components (i.e.: Modvion wooden towers). With markets including Netherlands and Germany banning landfill of turbine blades, and France introducing recyclability conditions in upcoming offshore tenders, the recycling sector is expected to gain further traction in the coming years. Among others, some key challenges will include fostering adoption, deciding the role policymakers can play, and developing revenue streams.

5 Floating offshore wind reaches commercial scale

Developments around floating offshore wind are moving this technology to the next phase with the results of the first large-scale commercial auctions in France and the UK to be announced this year. Both auctions attracted most of the traditional offshore wind players, oil and gas companies, power utilities and renewables developers – proving the competitiveness of the sector.

The technology will become a new "game changer" with a significant capacity potential in regions with good wind resources across Europe, Asia Pacific, and the United States. However, the pace of global build-out will depend on the level of permitting activities and how quickly the sufficient dedicated supply chain will be built. In 2021, the floating offshore wind industry reached a new milestone with the commissioning of the world's largest 50 MW Kincardine project off the coast of Scotland. This record is expected to be broken later this year when Equinor's 88 MW Hywind Tampen will begin to power the company's five oil and gas platforms in Norwegian waters.



6 Downward trajectory of Li-ion battery costs to halt, with higher prices for energy storage systems set to continue throughout 2022

Lithium-ion (Li-ion) battery prices have increased by 10–20% in the later months of 2021, impacted by a wide range of both global and industry-specific factors:

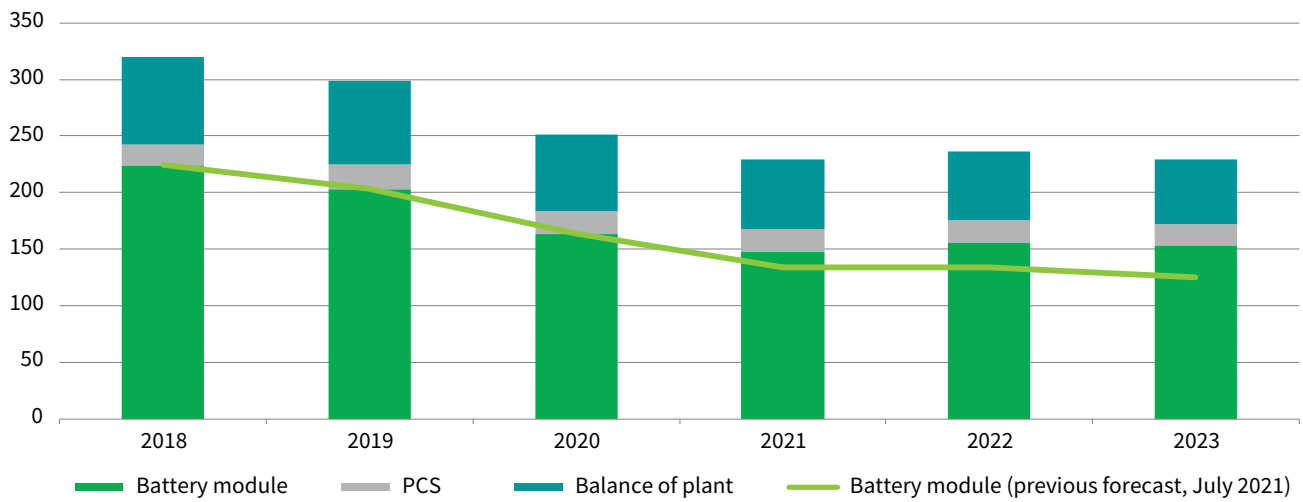
- A surge in raw material prices across the board, with all metals' prices rising significantly throughout 2021
- Greater demand for LFP batteries from the automotive industry as the technology is increasingly adopted in lower cost, shorter range EVs
- Short supply exacerbating the relative lack of purchasing power of energy storage system integrators
- Geographic concentration of LFP supply in China – making it particularly vulnerable to high costs and disruption to logistics

These increases have been predominantly for lithium iron phosphate (LFP) technology, which is the favored technology for grid energy storage systems. Price declines are not predicted to resume again until 2024—and are subject to LFP manufacturing capacity quickly scaling up—and energy storage system integrators securing supply agreements with a wider range of LFP suppliers that are less distracted by the larger electric vehicle (EV) opportunity.

Nonetheless, battery energy storage costs remain competitive with the alternative technologies. The bigger threat to growth is the ability of system integrators to procure the required volumes of batteries

The latest IHS Markit forecasts for battery energy storage capex suggest that average battery module prices in 2022 will be 5% higher than in 2021, contributing to a 3% increase in total battery energy storage system costs. The major contributing factors causing price increases are all set to persist, making it impossible for prices to continue their previous downward trajectory. However, modest price declines will be enabled again from 2023 by a continued scale-up of LFP battery manufacturing and validation of an emerging second tier of Chinese LFP manufacturers.

Battery energy storage system costs (annual average, $/kWh)



Note: System costs based on four-hour LFP Li-ion battery energy storage system in the United States. PCS = power conversion system.
Source: IHS Markit

7 Corporates accelerate their investments in renewable assets

Corporates and small and medium enterprises (SME's) are increasingly expected to step-up their renewable asset investments and source their electricity from clean energy sources in 2022, for a variety of reasons. These include offsetting their carbon emissions to avoid penalties down the line, lower their day-to-day electricity costs and, as they get more energy savvy, to de-risk their business from the current energy market volatility. While this growing class of renewable investor is concerned about the internal rate of return (IRR) of a renewable project, they are increasingly recognizing the importance of protecting their share price and business by improving their environmental, social and governance (ESG) credentials and investing in renewable assets.

This trend is already building on the sizeable investment that has occurred in recent years by first time corporate purchasers in major markets such as the United States, Europe and key markets in Asia. The pool of companies who will be renewable energy off-takers or owners is expected to diversify with a range of interest from different industries such as technology, retail, mining, manufacturing, accommodation, and heavy industries.

Corporates are pursuing different strategies to procure their renewable energy needs. Some companies may choose to build renewable assets such as solar, wind, hydrogen and energy storage on their own sites in behind-the-meter applications while others are expected may source via corporate power purchase agreements (PPA's) from third party providers. The growing trend among off-takers will be to try to fulfil their energy requirements with 24/7 renewable energy supply. This will increasingly require developers and renewable asset owners to build hybrid power plants (for example, mix of solar, wind and/or energy storage) that are located close to customer load centers to fulfil their energy needs.

8 2022 becomes a tipping point for Green Hydrogen, triggered by upcoming policy quotas

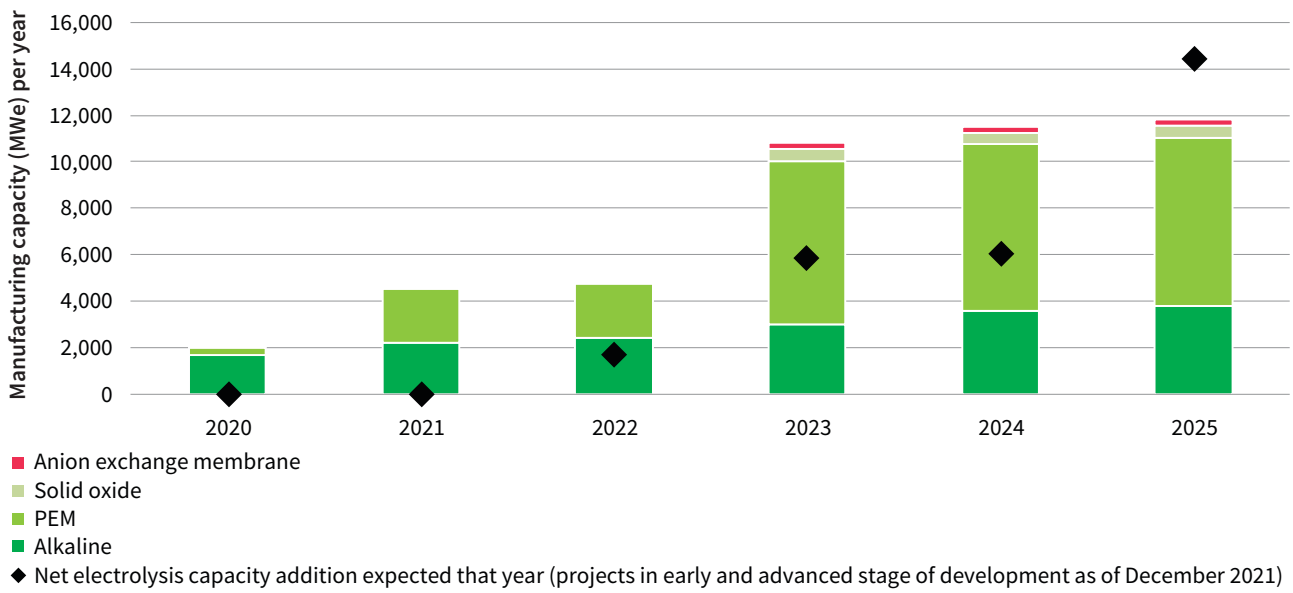
Greater policy clarity has driven large increases in the pipeline for green hydrogen (and associated products). According to the IHS Markit P2X tracker, projects accounting for almost 250 GW of electrolysis capacity were proposed in 2021 compared to 70 GW in 2020 and less than 15 GW in 2019.

Electrolysis production capacity is growing as the pipeline expands. In 2021, several major electrolyzer manufacturers announced new factories and increases to their annual production capacity.

Although capacity is projected to more than double over the next couple of years, a significant supply gap could open up in 2025 if green hydrogen projects currently in pipeline remain true to their timelines. Although there will be periods of misalignment—inevitable in any nascent market—we anticipate that additional manufacturing capacity will be committed in 2022 and 2023 as the electrolysis pipeline matures and more projects take final investment decision.

The development of green hydrogen could have profound implications for renewable development. Looking just at Europe, targets for green hydrogen use in the proposed RED II directive imply the development, by 2030, of up to 250 GW of solar PV, 100 GW of onshore wind or 70 GW of offshore wind either in the European Union or internationally if the hydrogen is imported[1]. Longer term, over 20% of renewable capacity globally could be used for green hydrogen production.

Announced electrolysis manufacturing capacity (MWe) per year



Source: IHS Markit

1 Capacity figures assume entire green hydrogen requirement provided by solar PV, onshore wind or offshore wind. RFNBO hydrogen demand in 2030 = 6.2 million tonnes.

9 More concrete Policy frameworks will open the door for new Hydrogen and CCS investments

The three main barriers to the development of CCS and hydrogen have been the lack of standardisation, affordability, and lack of infrastructure. Since last year, policymakers are targeting all three with measures to provide clarity to corporates and investors and begin to build a framework to allow the progress of large-scale projects.

Definitions are being published for low-carbon or clean investments, for example the European Union's rules for renewable fuels of non-biological origin in the proposed revision of RED II which effectively sets the standard in the region for green hydrogen.

Rising carbon prices, targeted support and quotas are also providing increasing certainty around demand trajectories for CCUS and hydrogen. Contracts for differences (linked to the EU Emissions Trading System price) are under development in the EU and UK with the steel industry expected to be an early beneficiary. In the United States the infrastructure bill allocated $12 billion for CCUS, and $9.5 billion for clean hydrogen quotas requiring substantial use of low-carbon hydrogen and ammonia by the end of the decade have been set in South Korea and the European Union.

Frameworks for the transport of CO2 and low-carbon gas are also under development. To support its ambition to have a minimum of two industrial CCS clusters by the mid-2020s, the UK has developed the regulatory investment model for CO2 transport and storage infrastructure and the European Commission has defined its vision of the structure of a future hydrogen market in its Hydrogen and Gas Market Decarbonisation package.

Through 2022 we expect the policy push will continue. The main elements of future EU frameworks (e.g. revision of RED II, the Hydrogen and Gas Market Decarbonisation Package) will now be negotiated between the Commission, Parliament and the Member States. The UK plans to agree support packages for its first CCS projects this year. Key elements to watch will be the level of hydrogen targets and renewable hydrogen definitions in the final version of RED II, hydrogen business support models in the UK, the format of the contracts for differences in Germany and if tax credits for CCS and hydrogen are picked up in forthcoming legislation in the US.

10 CCUS gains traction as a decarbonization solution for a wider group of regions and industries

The year 2021 solidified the revival of the carbon capture and utilization sector (CCUS) industry, as the global trend towards more ambitious climate goals drives ongoing activity in the CCUS market. The active pipeline for large-scale CCUS projects – those at the construction, design, financing, and planned stages –increased by 26% in 2021, and funding announcements during the year showed that a handful of governments are collectively investing multiple billions of dollars into developing the sector.

As this market continues to gain traction, more projects will be announced in multiple regions and industries. Region diversification is expected to continue in 2022, while North America and Europe will continue to lead the market, countries with net-zero targets, high emissions, and good understanding of storage capacity will likely announce new CCUS projects in 2022.

In terms of industrial diversification, the CCUS active pipeline is signaling a shift away from the traditional natural gas processing facilities, which has historically been the lead sector, to a more diversified pool of projects including heavy industries, hydrogen production and power generation. The increasing demand for low-carbon materials such as cement and steel will accelerate applications of hydrogen/CCUS as key technologies for industrial decarbonization.

Announcements of new CCUS hubs will continue in 2022 aiming to reduce CCUS total project costs. Transport and storage hubs are becoming increasingly important drivers for future carbon capture development allowing multiple industries and small plants to consider CCS as a viable option for decarbonization targets.

Global Clean Energy Technology Service

The IHS Markit Global Clean Energy Technology service provides in-depth coverage of the supply chain economics and outlooks for batteries and energy storage, hydrogen and renewable gas, solar, wind, and carbon sequestration.

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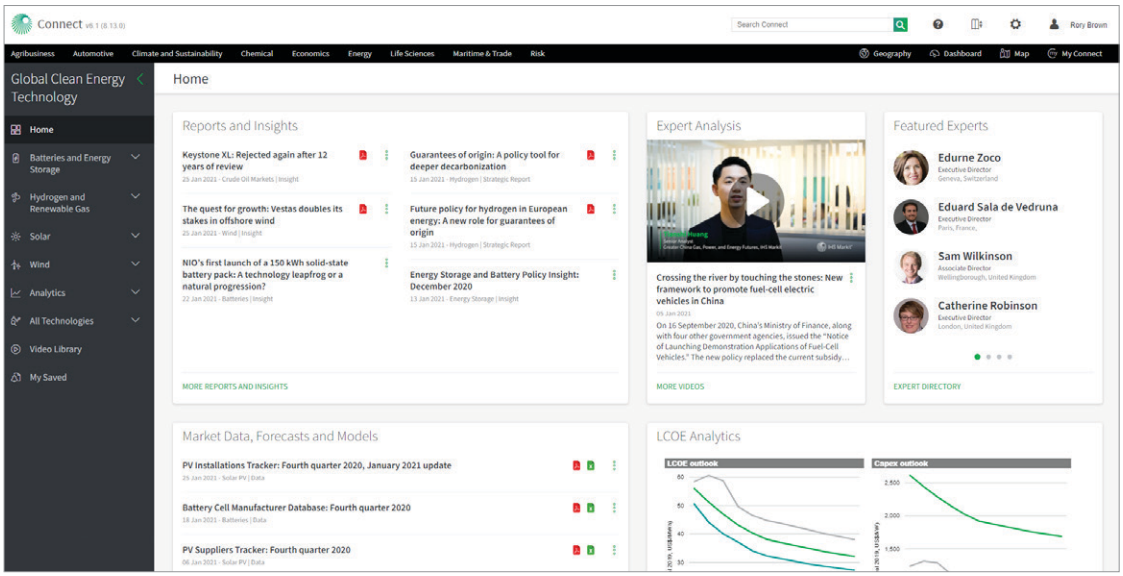
- Capacity outlooks for power generation, storage and hydrogen production
- Emerging trends: drivers and inhibitors on the outlooks
- Corporate strategies and business models
- Global databases of projects



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