

Global Solar PV Market Review



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CLEANBRIDGE

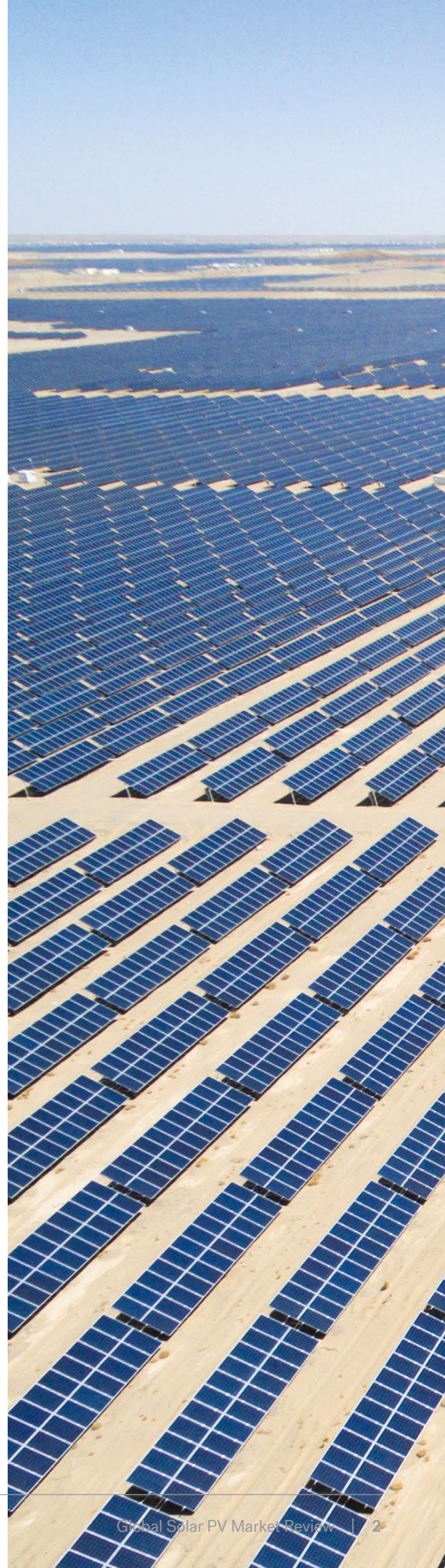
About

The report provides an insight into the Global Solar PV market. The findings of the report are based on research conducted by CleanBridge and its research partner Alchemy Research and Analytics. The report provides an overview of the Global Solar PV industry with insights on prevailing market conditions encompassing recent trends and drivers, challenges, and outlook in major countries across Europe and Americas. The report starts with a high-level view on the dynamics of the industry, touching upon the regional variations and analyzing the implications of the same. It then profiles the major markets country-wise, to provide a holistic view of the state of the industry in these countries, highlighting the growth opportunities, demand drivers and prevalent challenges. Macroeconomic data was sourced from the publications of multilateral institutions such as the International Monetary Fund (IMF). The industry-specific data is attributed to industry associations, Government authorities / statistical departments, Bloomberg New Energy Finance (BNEF) and International Energy Agency (IEA). This was supplemented by news reports, trade journals and related sources.

The report is an outcome of a collaboration between CleanBridge and its research partner Alchemy Research and Analytics and was completed between May and August 2022.

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Introduction

This report's release is in a backdrop of global geopolitical unrest, inflationary pressure, and a sluggish growth outlook. The post-COVID economic growth recovery and its inflationary impact was already a creeping challenge to contend with since end-2021. The Russia-Ukraine conflict compounded it with high energy prices. Meanwhile, the central banks raise interest rates as part of the measures to rein in inflationary expectations, even at the cost of a temporary recession.

A weak growth outlook and the prevalence of high interest rates do not augur well for investors. While the case for renewable energy-led energy transition could never have been stronger, the path to achieving this is not an assured one. Investors and developers cannot be immune to the underlying general inflation and cost of financing. One would only expect that the overall impact on the industry is milder than the recession imposed by the financial crisis. At the very least, this could mean delayed capacity addition in the renewable energy segment.

Weak market conditions do not change some of the gains in the ground covered so far. The solar PV business has progressively achieved market orientation. Utility-scale PV has made gradual inroads towards the grid-parity levels while the residential segment is emerging as a growth driver for the volumes involved. Furthermore, the commercial and industrial enterprise segment finds solar PV a competitive option to hedge energy sourcing options. Such developments indicate a maturing business that till recently was solely dependent on subsidy support.

Yet, a more significant market orientation would also mean a greater vulnerability to volatility. The existing global business conditions set such a stage. Inflationary conditions, supply chain blockages, and regulatory issues in international trade together make for a scenario that can push back ambitious investment plans. The instances of the impact are seen in the delayed utility-scale PV projects due to the spike in polysilicon, the balance of plants, or even

workforce resourcing. The ramifications will be across the value chain.

The market forces, however, balance regardless of short-term transitory shocks. It remains to be seen whether the market adjusts through a price correction, a supply readjustment, or perhaps a combination of both. The long-term fundamental capital flows are aligned accordingly. It is thus our view that the investment commitments are unlikely to change course drastically from the trajectory taken so far.

CleanBridge's Annual Primer series aims to provide a high-level view of the demand drivers, opportunities, challenges, and outlook prevalent in significant markets for the different sustainable technologies such as solar PV, onshore wind, energy storage and electric vehicle.

We hope you will enjoy reading our annual review of the Global Solar PV Market. We look forward to briefing you on other renewable energy technologies in the coming months.



L. Warren Pimm, CFA

Partner, & Sr. Managing Director

CleanBridge

Contents

01	Executive Summary	
		Pg - 05
02	Regional PV Overview	
		Pg - 08
03	Trends and Drivers	
		Pg - 11
04	Outlook	
		Pg - 20
05	Key Regional Markets	
		Pg - 23
	Europe	- 24
	North America	- 73
	South America	- 86
06	About CleanBridge	
		Pg - 96

01

Executive Summary

- 01 Executive Summary
- 02 Regional PV Overview
- 03 Trends and Drivers
- 04 Outlook
- 05 Europe, N. America and S. America
- 06 About CleanBridge

Executive Summary

The current backdrop of global energy crisis apparently brought solar PV to the fore instead of causing a reversal. BNEF projections, revised upwards by 7.5% from those in beginning of the year, suggest 245GW of new PV capacity by end-2022. A slower growth in onshore wind (due to regulatory delays or infrastructure) adds to the equation reinforcing solar PV's position in the evolving energy scenario. The fundamentals for solar PV market are thus being shaped by its relative position in the prevailing economic conditions.

Progressively utility-scale solar PV plants are cheaper than new coal-based generation capacity. As per the International Renewable Energy Agency (IRENA), almost three-quarters of the new competitively bid solar PV projects that are due for commissioning over the next two years will have prices lower than that of a newly built coal-based power plant. Such a cost implication can be understood in the context of a trend that shows 86% decline in the capital cost of solar PV projects during 2010-2021. The trend is likely to sustain with improvements in technologies as well as economies of scale.

The maturity in the business sets a strong ground to phase out the policy support and incentives. The Chinese PV market's planned phaseout of subsidies stands out as the notable example of the shift. In the European Union, all new utility-scale capacity allocations are done solely through the auction route. The unsubsidised merchant-based projects find greater traction than before. In fact, the merchant route of capacities could find a greater interest from investors in a scenario of rising energy prices. Closely related to this, is the advent of corporate power purchase agreements (PPA), wherein commercial and industrial enterprises contract power directly from generators instead of engaging with utilities. Between 2018 and 2021, solar-based corporate PPAs rose by over three times in capacity.

With greater market orientation, developers are trying out different technology configurations. One such trend is the deployment of hybrid projects – involving a battery-based energy storage project paired with solar-based generation unit. In other cases, hybrid projects involve a combination of the wind, solar and battery storage technologies. Recent hybrid auctions such as in India and Germany indicate the



Executive Summary

regulatory acceptance of such configurations. Another technology adoption gaining credence is that of floating solar. Portugal's recent floating solar energy auction yielded a negative price, effectively going opposite to the expected direction of auction-based power procurement. More such developments can be expected as the developers and investors seek ways at operating in an increasingly competitive market scenario.

The demand-pull of solar PV industry is expected to be strong enough to counteract other factors, such as the short-term cost pressures. Most of the leading developers are contending with rise in prices, which in case of auctioned utility-scale projects adversely impacts the already narrow margins. A prime cause of the current price rise is the polysilicon supply constraint. This is however transitory as the supply responds to demand, in terms of new capacities. For many markets, the pricing pressure slowed down the utility-scale PV projects. Small-scale distributed generation meanwhile picked up, being relatively unaffected by such price rises. In fact, the global solar PV capacity addition during 2021 was notable

in certain cases for the role of small-scale distributed generation. In China – a market that was conventionally driven by the utility-scale capacities, over half of the new capacity in 2021 came from distributed generation. This was a first in the Chinese market and could set the stage for coming years.

By most accounts, a predominant share of total global renewable capacity addition in 2022 will be through solar PV. Meanwhile, the market will evolve in varied ways in terms of the technology, business model, demand segments or cost economics. While growth is almost assured, the path will be one of a rapid and often drastic transitions that will necessarily rely on enabling policy and regulatory interventions. Some of the areas of active policy focus requirement include transmission infrastructure (not only capacity but also stability), seamless international trade (ensure globalized manufacturing chains in solar equipment), and power market development/reforms. With different countries adopting their unique routes, it will be interesting to observe the emerging solar PV landscape in the overall energy system and its balance.



02

Regional PV Overview

- 01 Executive Summary
- 02 Regional PV Overview
- 03 Trends and Drivers
- 04 Outlook
- 05 Europe, N. America and S. America
- 06 About CleanBridge

Regional PV Overview: Solar PV Penetration by Region

All regions show a rise in importance of solar PV – whether in terms of the absolute capacity size or in the share of solar PV in total renewable energy basket. The global backdrop of runaway inflation, in which energy prices are catalysts, makes the case for solar PV germane. In fact, the European solar PV market might just witness a spike in investments – the European Commission is considering a higher target (45%) of renewable energy share by 2030 and recently put forth an additional funding requirement worth EUR210 bn to facilitate the accelerated transition.

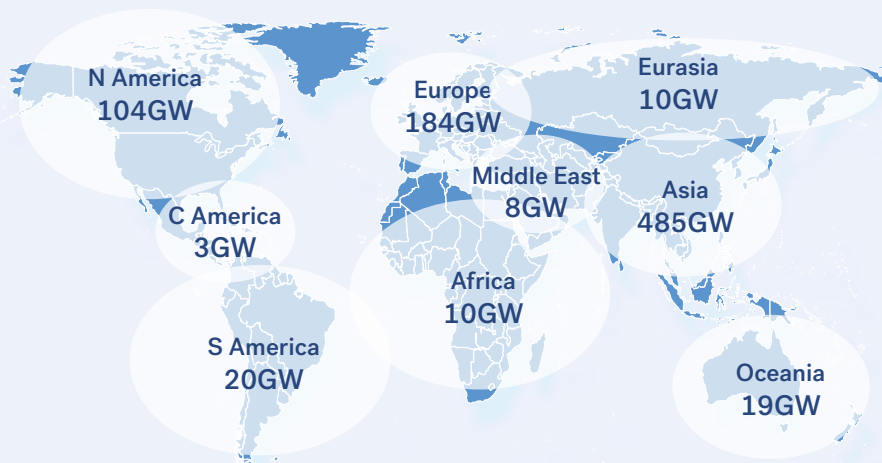
European region's solar PV capacity grew at 14%-15% during 2020 and 2021. While 2020 was an outlier for the disruption from pandemic, the market fundamentals stayed largely unaffected. The region's solar PV share in total renewable capacity has had a consistent rise since 2017. Estimates by IEA and other agencies indicate a strong likelihood of the region exceeding its capacity targets by 2030 – Estonia and Lithuania already reached their National Energy and Climate Energy solar targets, while others such as Poland, Ireland and Sweden are expected to do so by end-2022. Furthermore, a rising number of the countries are registering gigawatt-scale installation in solar capacities.

Adoption of utility-scale solar PV capacities is key to expanding the installed solar PV base. While Europe has been a late adopter of such projects, the Asian PV market has been characteristic of the auction-led utility-scale PV capacities. Over the decade ending 2021, the trend shows a ten-fold rise in solar PV share in total renewable energy capacity. The Chinese PV market's phaseout of state support stands out as the discerning factor, signifying rising maturity in this business, even as there are others such as Japan where feed-in tariffs are under consideration for rooftop solar projects. There is a stronger case for the shift to auction-based allocation route as countries struggle to contain energy costs. Multilateral financing could catalyse such shift in select cases. For instance, the Asian Development Bank's engagement helped Cambodia successfully conduct the 60MW solar PV auction of 2019 and the country plans a long-term transition to renewable energy.

The steps on energy transition are also underway in the otherwise hydrocarbon-rich Middle East region. Solar PV is an important part of the strategy for the region's energy shift – its rich endowment of solar resource and the declining costs in utility-scale projects attract investors' interests. Though operating on a lower base relative to other markets, the installed solar PV capacity in the Middle Eastern countries registered a compound annual growth rate (CAGR) of 39% during 2017-2021. Solar PV's share in total renewable energy basket rose by over five times since 2015. The region's solar PV project pipeline is largely led by the UAE and Saudi Arabia where the recent record low auction prices set the context for the market and global developers/investors. Importantly, the success of the recent capacity auctions is expected to spur other countries as well to adopt the same route. Kuwait, for instance, has been relatively behind in getting the solar PV market. Yet, the authorities are actively considering options to prop up the solar PV market to check the subsidies in the electricity sector.

Similar steps at energy transition are observed in the South American region which otherwise has a high dependence on fossil fuels. The segments of growth however differ across countries. Brazil, which leads in the region's solar PV business, has a focus on distributed generation. The Chilean solar PV market on the other hand is led by the utility-scale projects, driven in part by the availability of solar-rich locations. Reflecting the low base, the growth in solar PV is thus high. During 2017-2021, solar PV capacities grew at a CAGR of 52%. Among renewable energy sources, solar PV is yet to play any significant role due to the competing options in hydropower and biofuels. A contrast is observed in case of North America, where the solar PV market is shaped predominantly by the size of US market. Growth has been sustained in this market so far by the fiscal incentives available at a federal level and the select initiatives and measures at the state level. Globally, the US market continues to be an important one, not only due to the size and weightage of the economy but also due to the steady rise in developers shifting focus away from the fossil fuels in the electricity sector.

Installed Solar PV Capacity (GW) by Region in 2021



Regional PV Overview: Top Countries

China's towering position in the global PV market continues, with a total installed capacity at 306GW by end-2021 – contributing 36% of the capacity deployed globally. Despite raw material shortage and supply disruptions, the capacity growth has been relatively unhindered. Furthermore, it is notable that over half of the incremental capacity in 2021 came from the distributed solar PV segment.

This is the first time that distributed solar took a centerstage in Chinese solar PV capacity addition. The growth ahead will thus be driven by both utility and distributed solar – a marked shift from the historical trend of a predominant utility-scale segment. There are expectations of an outsized capacity growth by end-2022 as many projects were delayed or postponed by developers in 2021 to manage the price rise. As per the China Photovoltaic Industry Association, a capacity addition ranging between 75GW and 90GW is expected by end-2022.

While the Chinese growth stays unchallenged over the years, the position of other countries has changed over time in the top-10 rank by capacity. This is observed in case of the US solar PV market where the capacity ranking rose steadily over time. In 2021, it stood second after China, with an installed PV capacity base of 94GW. In 2018 and 2019 it ranked third. And in the year before, it was at the fourth place. Federal incentives and other state-level support played a role in ensuring a sustained growth.

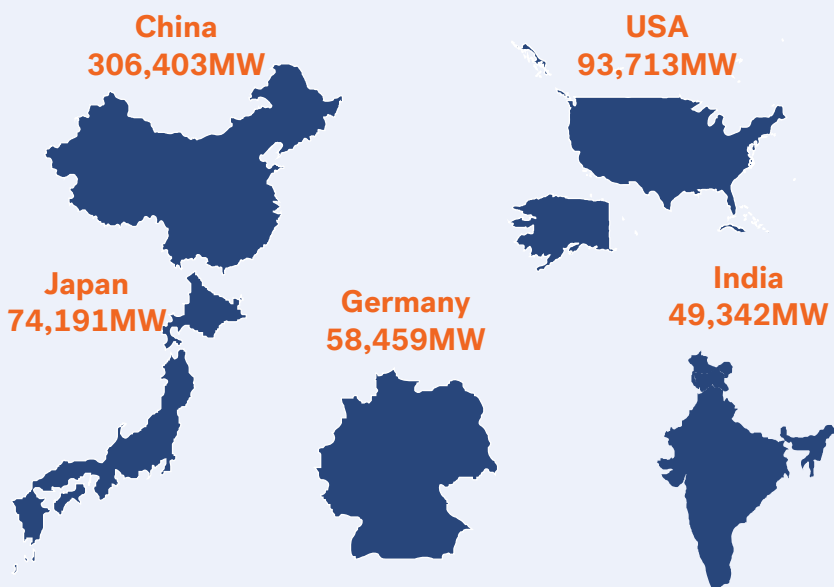
In 2021, the US market's capacity addition was in a backdrop of severe challenges in supply chain, impacting the utility-scale PV segment the most. The issues around trade and import tariffs on equipment didn't help. All the same, the industry managed to register a growth, in part due to the tax credit window. The residential solar segment however was not as much impacted and registered a record 4.2GW capacity installation in 2021. In the US market, residential solar has relatively stronger growth prospect than its counterparts in commercial and utility-scale.

The US market growth in last two years displaced the Japanese market from second position among the top-10. Till 2019, Japan stood second (after China) after which it took the third position. There are active policies and regulatory measures underway to propel growth. One such step is the transition from the feed-in tariff regime to one of feed-in premium, with effect from April 2022. The new regime allows the projects to sell at a premium to the spot market prices. The country's recent capacity auctions attracted significant investor interest, indicating the growth potential in a market where the challenges in land availability or structural stability tends to restrict the scope. The commercial deployment of grid-scale storage and the growth opportunities in battery-based residential solar could help ensure a sustained demand.

Within the European region, Germany and Italy are the two countries figuring among the top-10, at fourth and sixth ranks respectively. Germany's solar PV capacity growth in 2021 is attributed to the rooftop solar projects, which are key to the current policy focus on accelerating the power generation sector's decarbonization process. Residential or small-scale solar units play a similar growth driving role for Italy's solar PV market. Since the phaseout of incentives in 2014, Italy's market is yet to have utility-scale projects in a predominant role. There are expectations that the recent steps at easing procedural approvals should help boost the project pipeline during 2022.

Countries in the Asia-Pacific region are yet to play a significant role in global market. In India's case, the growth continues to be hamstrung by structural issues of power sector or by regulatory challenges. Australia and South Korea are the region's notable examples for the growth in PV capacities. Vietnam is the standalone example, not only in the region, but also globally for the spike in installed PV capacity – from less than 5GW in 2019 to over 16GW by end-2021, reflecting the success achieved in auction-based capacity allocation among other measures.

Top 5 Countries by Solar PV Capacity (MW) in 2021



Top 5 Countries by Growth Rate (CAGR between 2017 and 2021)

Viet Nam	576%
Argentina	230%
Armenia	209%
Uzbekistan	143%
Estonia	129%

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Trends and Drivers

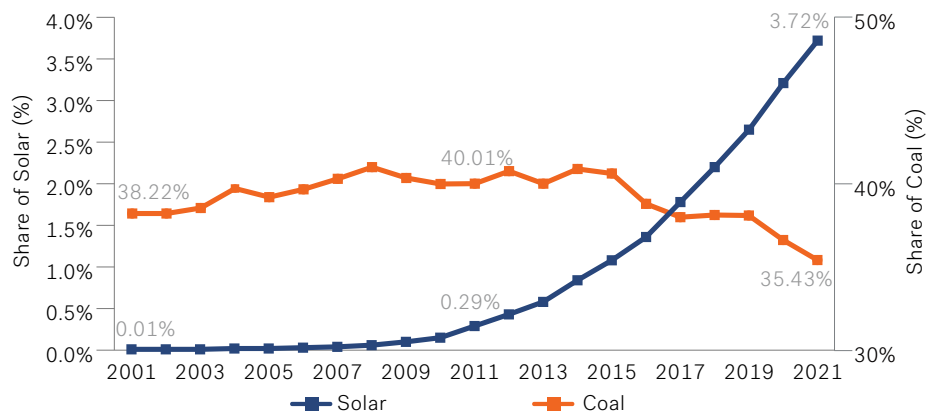
- 01 Executive Summary
- 02 Regional PV Overview
- 03 Trends and Drivers
- 04 Outlook
- 05 Europe, N. America and S. America
- 06 About CleanBridge

Trends and Drivers

Globally, solar PV has emerged as a catalyst in the renewable capacity growth. IEA's report of April 2022 (Renewable Energy Market Update) estimates solar PV to account for 60% of the capacity addition by end-2022. Stronger policy environment in China and European Union, together with a relative decline in other competing renewable technologies (such as wind power) makes for solar PV assuming a leadership position. Though solar PV is far from making a dent in the hydrocarbon-skewed energy mix globally, the long-term trend about growing share of solar in total electricity generation points to the transition underway.

IEA's report of April 2022 estimates solar PV to account for 60% of the capacity addition by end-2022

Share of Solar Compared against Coal in Global Electricity Generation



Source: Ember

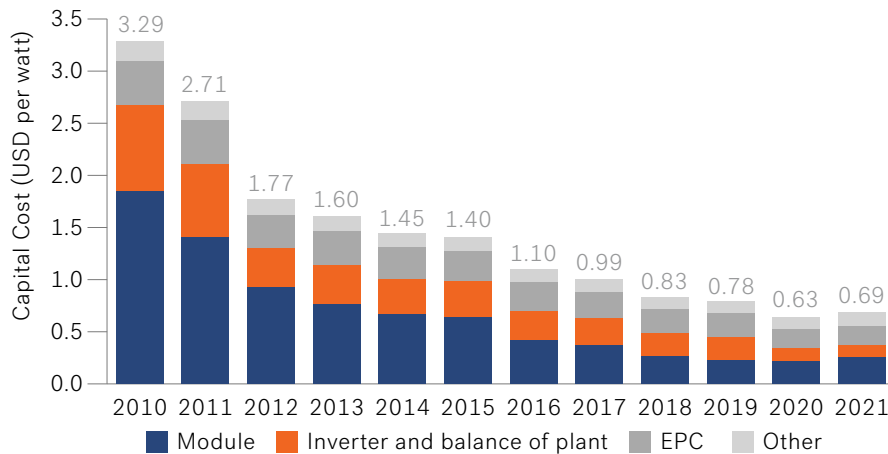
Note: The above data is inclusive of Solar CSP and PV technologies

Cost competitiveness continues to be the focal point in solar PV market fundamentals. It is a critical factor for utility-scale PV projects that seek advantages of economies of scale through higher unit sizes and the efficiencies in project development and equipment sourcing. Distributed generation projects (especially residential solar), in contrast, are not so much dependent as engineering, procurement and installation (EPC) costs are insignificant in such installations. It is thus pertinent that the trend shows an 86% decline in the capital cost (USD per watt) of solar PV projects during the period of 2010-2021. For solar PV projects, the capital costs are typically 80%-90% of the levelized cost of energy.

The consistently declining trend in solar PV capital costs also points to notable developments in other cost segments. Progressively, between 2010 and 2021, the share of PV modules in total capital cost declined from 56% to 36% — suggesting capacity expansion in the industry's backward linkage including the key raw materials and equipment. During the same period though, the share of EPC in total capital cost rose steadily, from 13% in 2010 to 26% in 2021 — indicating rising complexities/challenges in execution in a scenario where competitively bid projects face a compressed commissioning and delivery schedule. Most of such projects are bound by fixed price contracts, whether through power purchase agreements (PPA) or feed-in tariff arrangements.

Trends and Drivers

Trend in Solar PV Capital Cost (USD per watt)



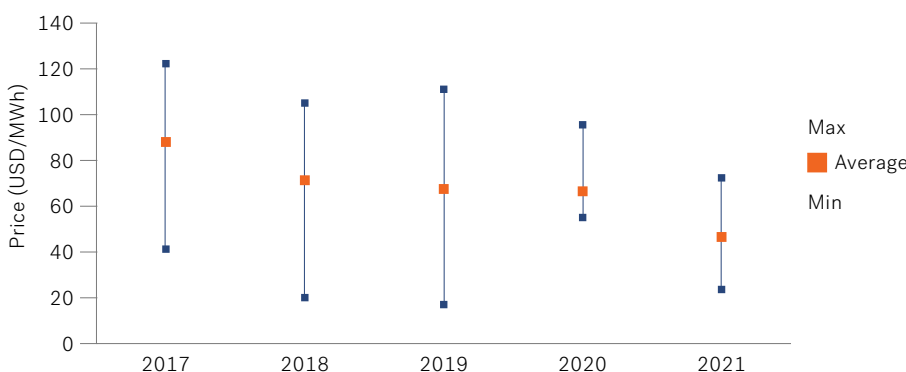
Source: BNEF
 Note: EPC: Engineering, Procurement and Construction

Over the years, competitive bidding has been the most important enabler among the market orientation measures undertaken by policy and regulatory authorities

Over the years, competitive bidding has been the most important enabler among the market orientation measures undertaken by policy and regulatory authorities. The capacity allocation done in this route yields the price discovery of utility-scale PV generation vis-à-vis the prevalent energy mix connected to the grid. To be sure, each winning bid price is specific to the local context (technology, irradiation, development costs, policy support available, etc.) and should thus be observed in such context. Portugal' auction for solar PV (floating panels in dam reservoirs) yielded a negative bid price – a first time ever globally. The previous such record low price could be traced to Saudi Arabia, where a 600MW solar PV project won the winning bid at USD0.013/ kWh (as of April 2021). On the whole, the average auction bid prices appear to be largely stable with a downward bias.

The cost-economics of utility-scale PV projects is undergoing further changes with the commercialisation of battery-based storage technologies. Developers are combining battery-based storage to enhance grid dispatchability and utilise the plant generation to cater to specific time-slots of demand (such as peaking power). The trend is a recent one. By end-2021, as per BNEF estimates, just 4% of the utility-scale PV projects had batteries. Yet the growth is a sharp one – between 2017 and 2021, the number of such projects rose by almost three times, while the corresponding PV capacity has about a 10-fold jump in the same time period. Even the installed PV projects are valid for retrofitting where a storage option can help mitigate cases of revenue loss from low bulk power prices and curtailment. The existing pipeline of the retrofit projects is limited to US and Chinese solar markets.

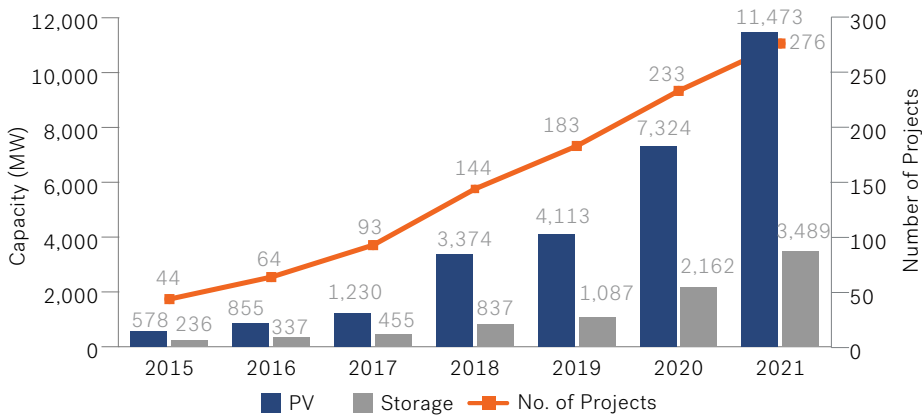
Trend in Price Discovery Range of Solar PV Auctions



Source: BNEF

Trends and Drivers

Trend in Solar PV Hybrid projects with Storage Capacity



Source: BNEF

Note: Data illustration based on the storage-based projects tracked by BNEF

From the perspective of authorities/utilities, auctions for solar-plus storage projects are meant to mirror the role of conventional power plants in power procurement

Most of such projects involve a fair degree of complexity as the business model is impacted by the regulatory framework for power market. The local norms and incentive structures are thus important. Most of the projects are awarded in auction structure comprising either solar/renewables plus storage, or technology neutral renewable auctions or an entirely technology-neutral auction. From the perspective of authorities/utilities, auctions for solar-plus storage projects are meant to mirror the role of conventional power plants in power procurement.

The improving cost competitiveness and maturity of the solar PV market helps the case for reducing the dependence on direct subsidy support. Across all markets, the shift to auction-based capacity allocation is taking place in combination with a phaseout of subsidies or related government budgetary support. China, the leading solar PV market, ended its subsidies from 2022 (though select provinces extend variants of support to renewable projects including solar PV). In the European Union, all new utility-scale capacity allocations are solely through auction route, while distributed solar PV still has incentive support (such as in terms of fiscal benefits). In the US, solar PV projects can avail of investment tax credits till 2023-2024.



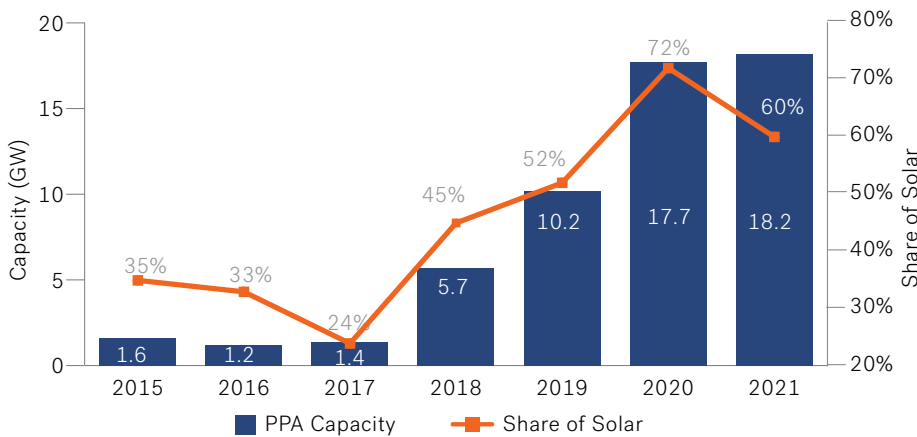
Trends and Drivers

Unsubsidised merchant-based projects find greater traction than before. Europe in fact has been leading the trend in commissioning of merchant-based renewable projects. In December 2021 for instance, the developer Photon Energy commissioned its first merchant PV projects in Hungary, wherein the energy sale will be done at the power market spot prices instead of one involving contractual agreement. Various other developers have taken the PPA route for the merchant power projects. It is also notable that in the ongoing backdrop of rising energy prices, the merchant route could find a greater interest from investors.

A key manifestation of the developers' subsidy-free power sale arrangement is the rise in corporate PPAs. In such arrangements, commercial and industrial entities source renewable power directly from the project developers / promoters. Such a sourcing not only helps rationalise the total energy costs but also serves to meet their environmental and related objectives in the business operations. Solar PV has been a key choice of technology in this context, as observed in the trend. Between 2018 and 2021, the solar PV capacity contracted in corporate PPAs rose by over three times.

A key manifestation of the developers' subsidy-free power sale arrangement is the rise in corporate PPAs

Trend in Corporate PPA Capacity based on Solar PV



Source: BNEF



Trends and Drivers

Transmission Infrastructure

The timely availability of transmission connectivity is critical for utility-scale projects. This is more so, as such projects often tend to be situated in locations far away from grid network. Such dependency poses risks of bottlenecks for developers seeking project financing – an absence of transmission linkage is often a barrier for financial closure. Furthermore, transmission infrastructure for many countries is in need for significant upgrades as the share of intermittent renewable energy rises in total grid dispatch.

The US market shows one example of transmission bottleneck typical in high growth renewable energy scenarios. As per the Lawrence Berkeley National Laboratory, about 700GW worth of renewable energy capacity (as of October 2021) was stuck in a transmission interconnection queue and just 13% of it had a firm interconnection agreement. Majority of such capacity is based on either solar PV or battery storage. The challenge is unlikely to abate any time soon as new transmission lines are subject to local procedural norms and delays. Lately this has been taken up at the federal regulatory level, with initiation of proposal for transmission planning reforms.

The European region faces a similar urgency in undertaking reforms in transmission network planning. To meet its renewable energy targets, the region's transmission system operators must ensure the network availability for upcoming generation capacities. The operators also need to ensure grid stability. By 2035, the share of intermittent energy could reach 60% of the region's total installed generation capacity. On the other hand, share of grid's dispatchable generation assets (coal and nuclear power) are being phased out, making it a progressively narrow margin of network balance. The regional power market balance will have an impact from such developments as additional factors such as grid-scale storage come into play.

The draft ten-year network development plan for 2022 by the European Network of Transmission System Operators for Electricity (ENTSO-E) indicates a portfolio of 141 transmission and 23 storage projects. The investment commitments will be significantly high. The network development plan for 2020 had capital expenditure requirements at EUR153 billion for projects till 2030. Another segment of the infrastructure is the sub-transmission or distribution network, vital for the rooftop or off-grid solar projects. A study by the industry bodies Eurelectric and E.DSO projected investment requirement ranging EUR375-EUR425 billion till 2030 to expand or upgrade the European distribution network.

The need for network upgrade is high even for China which leads the global renewable energy market. The State Grid Corporation of China, the country's predominant transmission operator, plans investment worth USD350 billion during 2021-2025 to strengthen the infrastructure for renewable energy integration. Similar policy focus can be observed in the Indian market. As of January 2022, the Indian government gave approval for USD1.6 billion worth of investment to prioritise transmission corridors related to renewable energy projects.

Transmission infrastructure for many countries is in need for significant upgrades as the share of intermittent renewable energy rises in total grid dispatch

Trends and Drivers

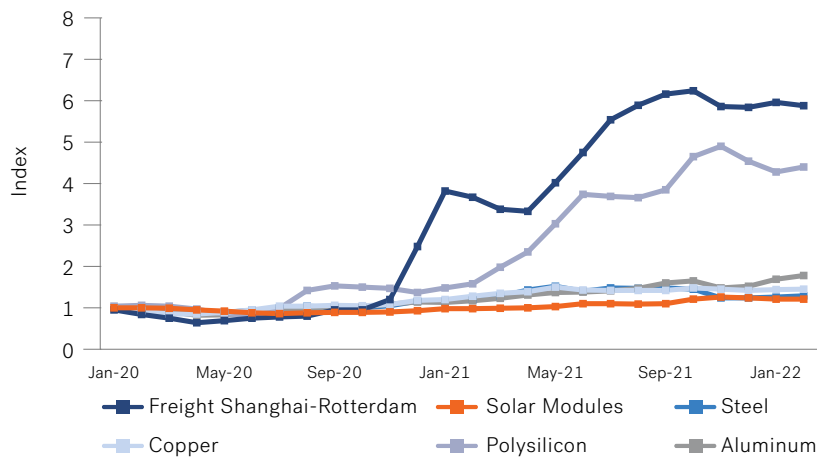
Price Rise

The global inflationary pressure in energy and commodity impacts the solar PV sector as well. Most of the solar PV manufacturers and developers continue to grapple with a rising price of PV modules and other components in the value chain since early 2021. While the PV industry's demand was largely unabated through 2020 and 2021, the supply lagged. The pressure of demand-supply mismatch was compounded by other concurrent developments including pandemic-led supply chain disruptions, spike in freight rates in the post-pandemic phase and the global commodity price rally.

The price of Polysilicon tripled since 2020. It is the most important feedstock for the wafers of crystalline silicon cells. The Chinese power crunch together with the restrictions due to pandemic prevented the new capacities from coming online. The elevated Polysilicon prices are thus expected to persist through 2022. Pricing pressure is evident in other components too. With rise in the cost of natural gas and tin, the price of antireflective ultra-clear glass (used in front cover of solar modules) is under pressure. Price of materials for balance of plant including aluminium, galvanized steel and copper rose by over 30% since last year.

Solar PV manufacturers and developers continue to grapple with a rising price of PV modules and other components in the value chain since early 2021

Price Movement Since the Beginning of 2020



Source: BNEF Global PV Market Outlook Q12022

As a result of the rally in raw material and equipment prices, developers have been delaying procurement to tide over the short-term price rise as much as possible. This is mostly valid for the utility-scale solar PV projects where the competitively-bid project mandate drastically narrows the business margins. The short-term impact of the ongoing price pressure will have to be borne by the developers and equipment manufacturers as the demand stays strong. However, it remains to be seen just how long the market can sustain such prices in absence of a commensurate supply response.

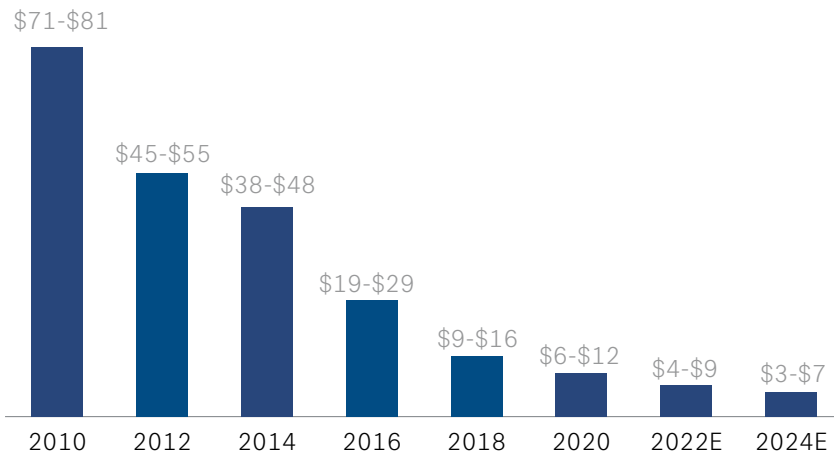
Trends and Drivers

Energy Storage Costs

With a sustained investment in the battery technologies and the rising economies of scale, storage costs are on a declining trend. This holds for both grid-connected and off-grid battery-based storage systems. The demand for grid-scale storage systems, based predominantly on Lithium-Ion technology, has been strong due to the integration of renewable energy systems and the gradual rise in auctions of hybrid renewable energy projects. As per IEA, spending on such battery systems rose by over 60% by end-2020 despite the pandemic-led slowdown globally.

Lithium-Ion batteries rose by 10%-20% during the latter half of 2021

Trend in Grid-scale Storage Costs (USD/MWh)



Source: NextEra

Note: The above data is based on 4-hour battery storage at 25% of nameplate solar capacity

While the long-term trend is favourable to the adoption of grid-scale storage systems, the prevalent macroeconomic cost pressures could impact the growth. As per IHS Markit data, the price of Lithium-Ion batteries rose by 10%-20% during the latter half of 2021. This is especially the case for Lithium Iron Phosphate (LFP) battery cells that are preferred for grid-based energy storage.

The price rise is attributed to the cost of raw materials and the competing high demand from the automotive industry. Thus, the expectation is that the grid-scale battery storage costs are unlikely to witness any further decline in prices till the LFP battery cell production capacity expands to accommodate the demand. As various ongoing production plans indicate, it could be 2025 by when the capacity expansion comes onstream to relieve the pricing pressure.

Trends and Drivers

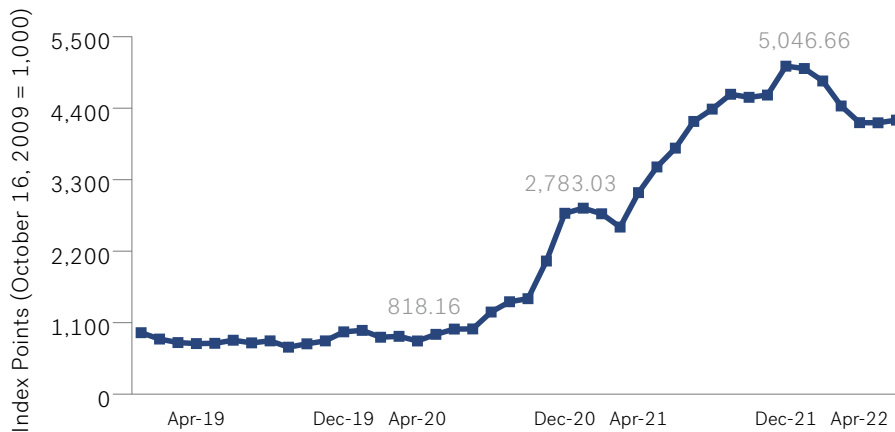
Supply Chain Challenges

The global supply chain disruption that took effect since mid-2020 has had the maximum contribution to the solar industry's cost pressures. Despite a gradual post-pandemic recovery worldwide, the imposition of stringent restrictions in China stifled the supply. The country's repeated lockdowns to check incidence of COVID-19 infections stalled supply of practically everything, and particularly the solar panels, batteries, and inverters.

The severe impact even imperils the growth projections in several key markets. For instance, as per estimates of consulting entity Rystad Energy, higher shipping and equipment costs could potentially postpone or cancel 56% of the global utility-scale solar projects that are otherwise due for commissioning in 2022. One of notable metrics highlighting this is the Shanghai Freight Index – tracking the price of sending a container from Shanghai to a set of ports globally. This index rose by about six times from the pre-pandemic level.

Higher shipping and equipment costs could potentially postpone or cancel 56% of the global utility-scale solar projects that are otherwise due for commissioning in 2022

Trend in Shanghai Containerized Freight Rate Index



Source: Statista

In certain solar markets such as in the US, the supply chain issues are a culmination of factors including the imposition of anti-dumping duties and the trade restrictions for forced labour or religious persecution. For other markets, while the degree of dependence varies, the impact in terms of costs and delays is the same. A recent IEA report highlighted the same concern that the global solar industry's supply chain concentration in China is a major vulnerability that should be addressed to meet the 2030 targets. This is unlikely to change soon. In 2021, China held 79% share of global polysilicon manufacturing capacity.

04

Outlook

- 01 Executive Summary
- 02 Regional PV Overview
- 03 Trends and Drivers
- 04 Outlook
- 05 Europe, N. America and S. America
- 06 About CleanBridge

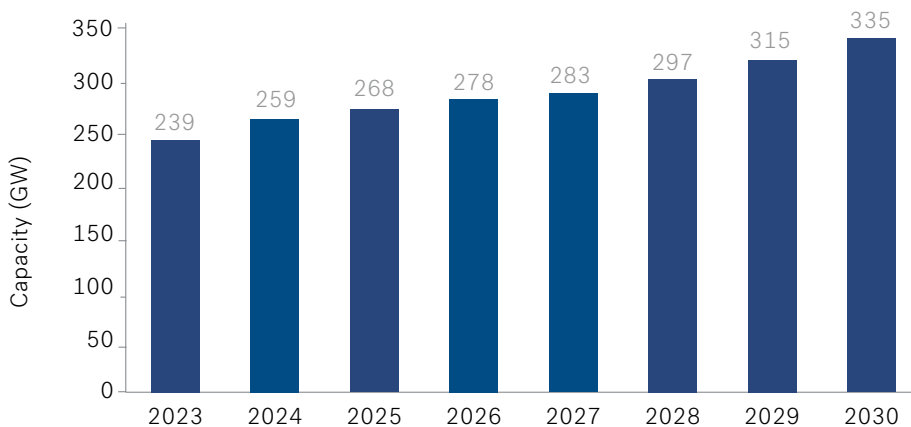
Outlook

The global solar PV outlook points to a sustained momentum in capacity growth. While challenges persist in the supply chain, equipment/component production capacities as well as in shipping/freight costs, the project pipeline remains strong. Projections vary across even as growth direction is clear – BNEF estimates a capacity addition of over 200GW by end-2022, while the same from IEA suggests 190GW. Solar PV is expected to be the catalyst in global renewable capacity growth in 2022 – accounting for about 60% of the increase (IEA). In about less than a year (or earlier) global installed solar PV capacity could be exceeding 200GW for the first time.

While the phaseout of upfront subsidies and related incentives is a continued theme, steady policy makes the difference in capacity growth. Thus, China's capacity outlook is aligned to the government's solar PV targets for 2030. Similarly in Europe, the rapid implementation of previously announced targets helps drive the growth. In contrast, the US market faces a lower capacity addition in 2022 and 2023, due to a lack of visibility on support measures (after expiry of production tax credits) and the trade restrictions on PV imports.

The global solar PV outlook points to a sustained momentum in capacity growth. While challenges persist in the supply chain, equipment/component production capacities as well as in shipping/freight costs, the project pipeline remains strong

Projected Solar PV New Builds



Source: BNEF Global PV Market Outlook

Note: The data refers to BNEF projection under a 'low-growth' scenario

Globally, the post-pandemic economic recovery together with geopolitical challenges (Ukraine conflict in particular) is fueling an inflationary pressure. Price rise in critical inputs such as polysilicon makes solar PV modules costlier than before. As of February 2022, the price of solar-grade polysilicon reached USD39.3 per kg – the highest since 2011. Though transitory, equipment manufacturers regard the current higher prices to continue for the next 1-2 years, if not longer. Prices will subsequently ease once raw material supply (predominantly polysilicon) expands and the global supply chain constraints ease. This, together with a sustained demand outlook suggests that the developers and investors may need to accommodate higher prices for the upcoming projects, especially for those pending procedural approvals.

Outlook

The cost considerations are especially important for the utility-scale PV projects considering the scale and narrow margins involved in the auction bids. For now, the recent developments indicate that the demand pull (arising from bulk auctions announced by respective governments) and the economies of scale (size of the projects as well as the capacity allocations by regulatory authorities) ensure that the costs stay as competitive as before.

One recent example of competitive price discovery is found in Portugal's floating solar energy auction – in April 2022 the winning bid by EDPR Renewables yielded a negative price implying that the company will be, in effect, paying the utility for the capacity developed. The profitability of the project however rests on a hybrid configuration, involving wind, solar and energy storage. Similar premise is likely for various other upcoming utility-scale solar PV projects, as developers would seek various options in existing technologies to manage project profitability.

Hybrid projects progressively account for a rising share of the emerging global solar PV pipeline. In many cases, the hybrids involve pairing a battery-based energy storage project with the solar-based generation. Hybrid project auctions such as those in India and Germany are notable examples of their acceptance in the regulatory framework of capacity allocation. In several solar PV markets, batteries are an integral part of the projects for developers seeking approvals. In California, US for instance, majority of the planned large-scale solar power capacity is linked with battery storage. In several cases, the hybrid projects include a combination of wind power. Europe's largest hybrid wind-solar project planned at Portugal includes a 365MW PV unit, 264MW wind power and 165MW battery storage. The growth drivers could vary across factors such as operational flexibility, federal tax credits or others.

While utility-scale dominates the solar landscape, the distributed generation segment maintains a steady growth in volumes. Subject to the country-specific context, solar PV is emerging as the preferred choice for both residential and the commercial/ industrial consumers to rationalise their total energy costs. The residential solar segment is in fact a major demand driver for rooftop storage-based solar PV across the countries. Such small-scale solar projects, being largely insulated from the overall price rise in PV modules, are more likely to sustain the growth in terms of number of installations.

Hybrid projects progressively account for a rising share of the emerging global solar PV pipeline

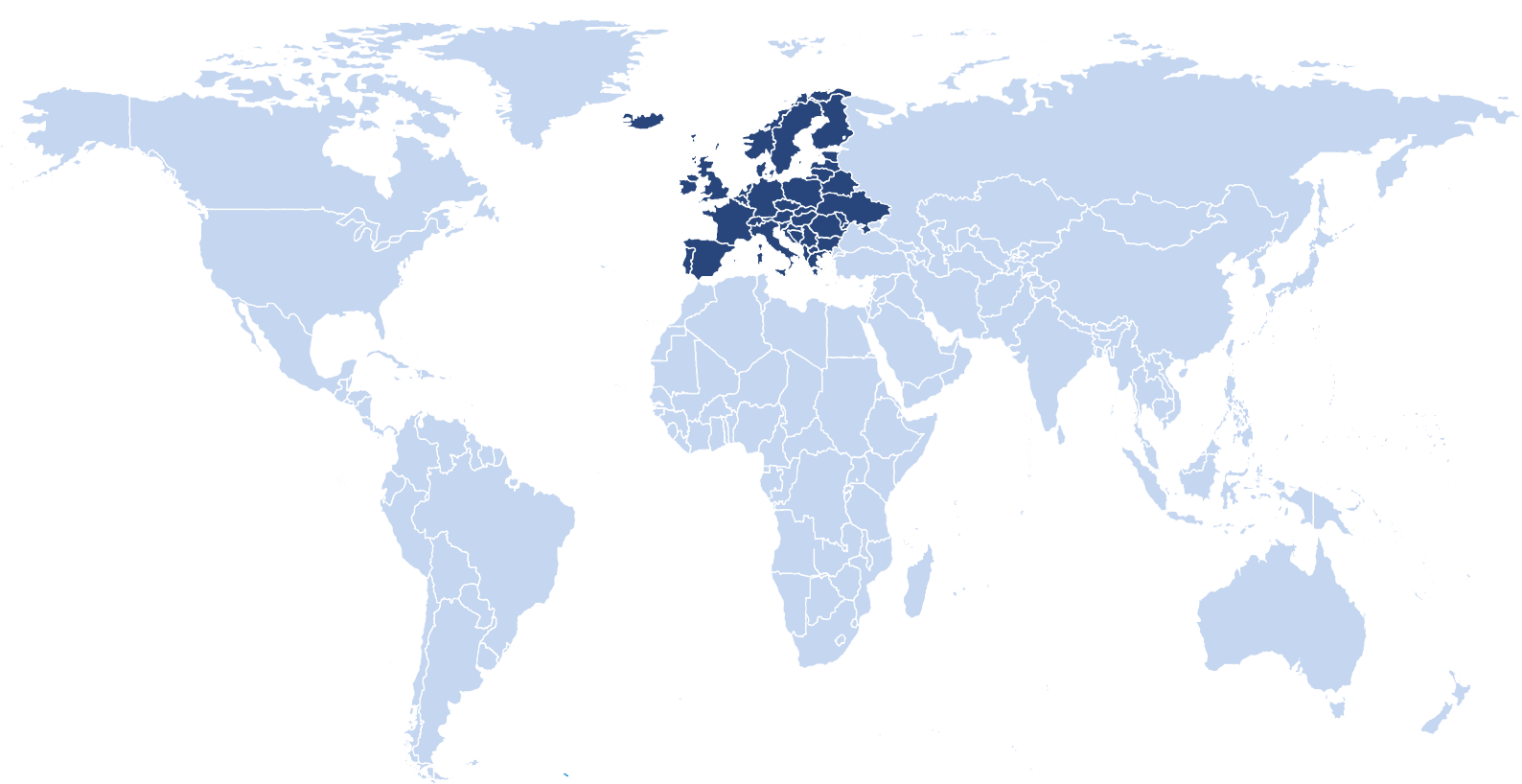


05

Key Regional Markets

- 01 Executive Summary
- 02 Regional PV Overview
- 03 Trends and Drivers
- 04 Outlook
- 05 Europe, N. America and S. America
- 06 About CleanBridge

Key Regional Markets - Europe



Denmark

Denmark has always been a frontrunner in terms of deploying renewable sources. The green transition in the country began with the oil crisis back in the 70s and decades of development have made it a renewable energy leader. Currently 50% of electricity in Denmark is supplied by wind and solar power. Aligned with EU objectives, Danish parliament passed the Climate Act in 2020 with the aim to achieve clean economy. The Act specified the short-term targets of renewable energy to cover 100% of electricity and 55% of overall consumption by 2030. The country also seeks to cut greenhouse gas emissions by 70% in 2030, from the 1990 baseline, and achieve climate neutrality by 2050.

GDP (Current Prices) USD (2021)	395.71bn
GDP Growth Forecast (constant prices) (2022-2026)	1.88%
Currency	Danish Krone
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2021)	10.3GW
Solar PV Share in Renewables (2021)	15%
Renewable Energy Target	2030 target of reducing GHG emission by 70% from 1990 level along with renewable energy share to be 100% in electricity generation and 55% in overall consumption

GDP Source: IMF WEO, S&P and IRENA



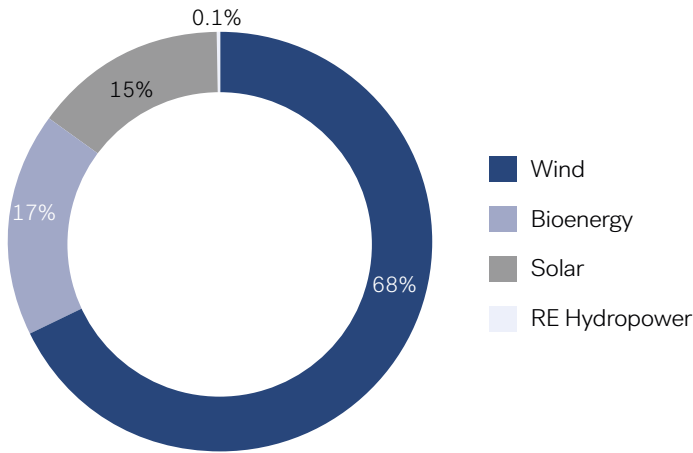
1.5GW Solar PV Capacity

- ✓ **Interim objectives of renewable energy to be achieved by 2030**
- ✓ **Growing unsubsidized utility solar projects indicating growth to be market driven**
- ✗ Shorter days during winter resulting in smaller energy harvesting
- ✗ Potential introduction of grid fee causing uncertainty among investors

Denmark

Renewable Energy Mix

Current Renewable Energy Mix

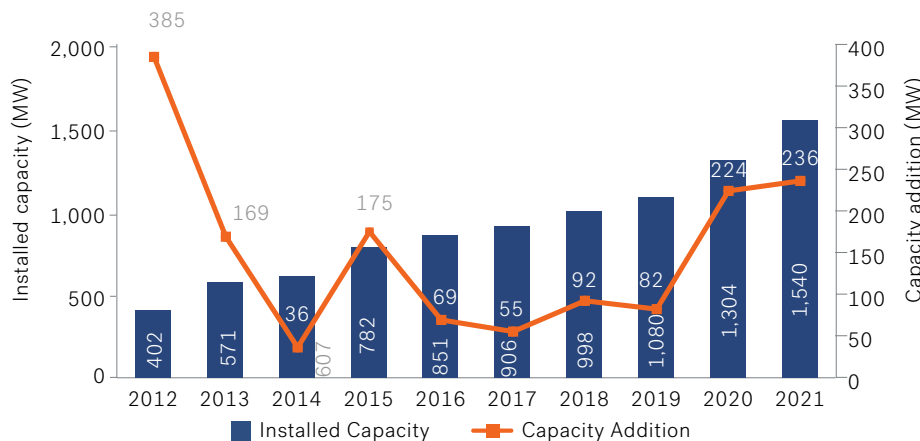


Source: IRENA Renewable Capacity Statistics April 2022

Wind energy has been the dominant renewable source in Denmark, accounting for 68% share in the renewable mix in 2021. In case of solar energy however, slower growth rate was observed in the country. In 2019, the share of solar energy in the renewable mix was 12%, which expanded to 14% in 2020 and to 15% in 2021. The increasing level of solar radiation in Denmark has paved the way for profitable future of the sector in coming years.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Although the main PV market in Denmark is BAPV (Building Applied Photovoltaics) and BIPV (Building Integrated Photovoltaics), in last few years the utility-scale solar systems in the country have experienced significant growth.

Between 2012-2021, the cumulative solar PV capacity of Denmark grew at CAGR of 16%, with highest annual addition of 236MW taking place in 2021. The COVID-19 outbreak in 2020, fortunately, had limited impact on the renewable energy market in the country, supported by affirmative

market activity. Notably, the capacity additions in 2020 experienced steeper growth owing to regulatory efforts which maintained the expansionary trend. The annual capacity additions, however, experienced flatter growth in 2021 with total solar PV capacity in Denmark reaching 1.5GW.

Demand Drivers

In Denmark, electricity from renewable sources is promoted through a premium tariff and net-metering, which ensures strong development levels, especially for commercial and industrial projects. However, the 2020 climate act for energy and industry pushes for the transition to market-driven expansion of solar power and onshore wind. The agreement involved the allocation of DKK2.5 billion in form of subsidies for electrification and energy efficiency improvements in industry, and DKK2.9 billion for low-carbon gases. It also introduced tax incentives for the use of renewable electricity to heat buildings while increasing the tax on fossil fuels used for the same.

In case of utility-scale PV segment, lately there have been a rapid proliferation of the unsubsidized projects in the country. Among all the PV systems deployed in 2021, the unsubsidized solar PV accounted for the lion's share while commercial and industrial PV represented the rest. The backbone of this segment is the corporate bilateral PPAs, which solve a dual purpose of ensuring long-term price stability while increasing renewable energy share, which

is crucial for company's image and success. Few notable developments that took place in the country include Meta signing a 300MW solar PPA with German energy firm Luxcara and Belectric signing a 500MW+ partnership agreement with Encavis for the construction of PPA solar plant projects.

The renewable tendering has been another helpful tool boosting the participation of the developers. The response for technology-neutral renewable auctions held by Danish Energy Agency in 2018 and in 2019 was affirmative. In 2018, 20-year PPAs were awarded to three solar plants involving combined capacity of 104MW, while in 2019, solar capacity of 83MW and solar-wind hybrid capacity of 93MW were awarded. However, the latest technology neutral auction held in 2021 turned out to be a failure as no bid was submitted. The primary reason behind this is potential introduction of a grid fee for renewable energy power plants, starting from 2023, thereby creating uncertainty among potential investors.

Market Opportunity

The electricity sector in Denmark has fostered competition, prioritized clean energy, and met long-term demand while keeping costs down. Supporting the same cause, in H2 2021, European Commission approved the Danish aid scheme of EUR400 million for the production of electricity from renewable energy sources including solar PV. This aid will be provided under competitive tendering, creating an opportunity for the projects to present themselves and receive funds. The process will continue till 2024 and aid can be paid out for a maximum of 20 years after the renewable electricity is connected to the grid.

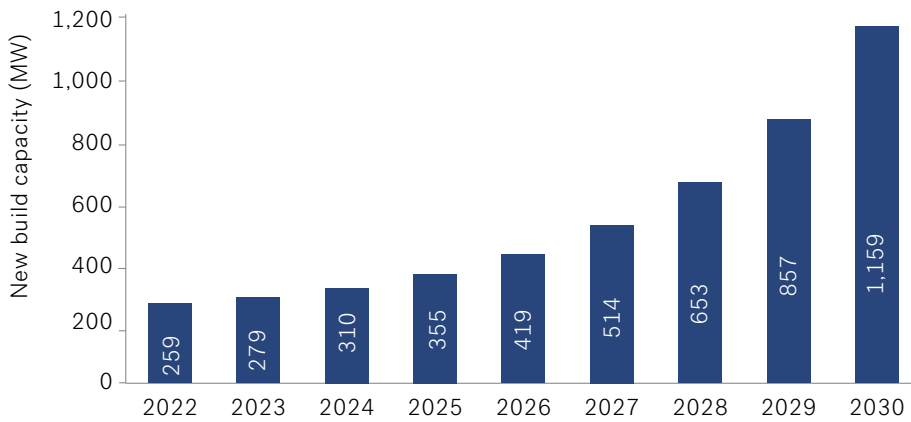
The fact that solar PV has reached grid parity and LCOE of PV plants is stable, helping the case of building solar parks without subsidies. Among others, Danish renewable energy developer, European Energy, has been an active participant in Danish solar sector, accounting for significant market activity. On the other hand, another renowned developer

Better Energy announced new solar PPA with 12 Danish companies in the beginning of 2022, seeking to build a subsidy-free solar plant. The plant will commence operations from 2023 and will produce around 70,000MWh annually.

Along with the utility scale segment, there is significant opportunity for potential investment in the rooftop segment as well. While the current net metering rules are ensuring decent development levels, especially for commercial and industrial projects, the volumes in the residential segment would be driven by attractive incentives for heat pumps as the government is pushing for more heating powered by renewables. The scheme is open to companies specializing in district heating and offers rebates covering up to 15% of the total investment made to buy and install a heat pump, with developers being eligible for a maximum of DKK5 million (€672,000) for each project.

Outlook

Denmark's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

According to IEA insights, Denmark's renewable electricity capacity is expected to increase by 55% during 2021-2026, led by wind and solar PV. Notably, the unsubsidized utility scale solar projects are expected to drive the solar market in coming years, while real-time self-consumption models are expected to be catalysts in the process of reaching the decarbonization target.

The solar PV build in Denmark is forecasted to maintain a steady upward trend over the period of 2022-2030. It is expected to expand at CAGR of 21% during the same period, while fastest annual growth is expected to take place in 2030 with annual solar PV builds reaching 1.2GW. As solar PV has reached grid parity, utility scale solar projects are expected to have the lion's share in the market in 2022 and 2023.

Denmark is currently on the verge of promoting energy technologies through a combination of market mechanisms and political regulation. While the present balance of achievements in the country's renewable agenda is positive and the ambitions for the future are high, there are also significant challenges ahead.

One of the challenges faced by Danish Solar sector is the relatively expensive solar cells in relation to their efficiency. These cells typically convert only 15-20% of the solar energy into electricity, which questions the worth of investing in them. Another major challenge is intermittency caused primarily by longer summer days and shorter days in winter. Deployment of energy storage solutions along with PV plants have come up as the most viable solution to counter the issue. As a result, a flurry in grid-scale energy storage systems can be seen in the country. Another innovative storage solution in this regard is energy storage in salt project, developed by Seaborg Technologies Aps.

Denmark is widely recognised as a global leader in integrating variable renewable energy while at the same time maintaining a highly reliable and secure electrical-power grid. Moreover, the government has established 13 climate partnerships for different sectors of industry, including one for energy and utilities. The Climate Partnership of Denmark forecasts 71TWh of renewable energy demand by 2030. Naturally, there would be significant demand for solar generation buildouts in the country, catalysed by ambitious environmental targets and the rapid expansion of new consumers driven by electrification and green fuels. However, increased efforts from government and private sector to domestically manufacture more efficient solar PV equipment is imperative for the sector to flourish.

Finland

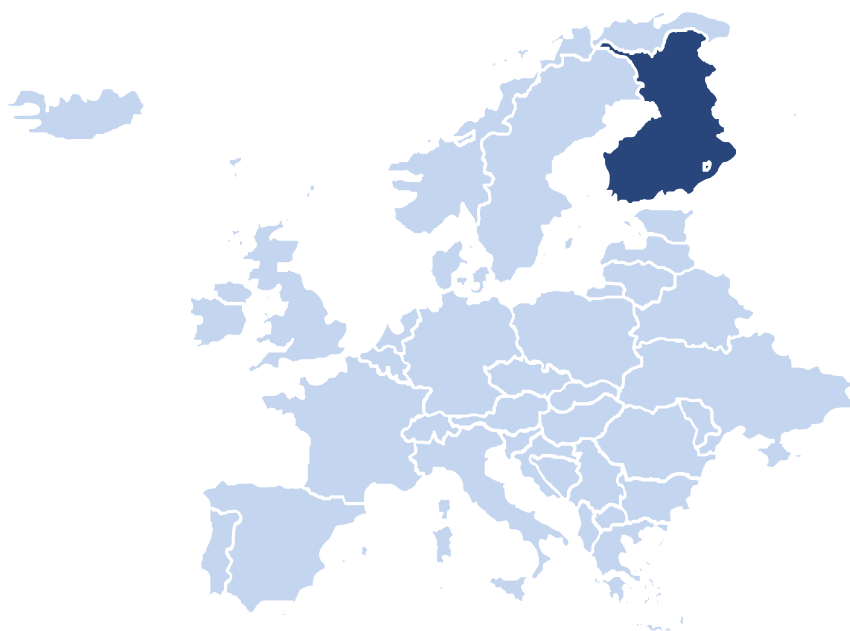
Finland has a clear policy direction of implementing a carbon-neutral energy transition plan that entails, among other things to ensure a nearly emission-free power generation industry by 2030. The emphasis on renewable energy is thus significantly high. It is in this context that solar PV assumes significance. The rapid growth witnessed in the Finnish solar PV capacity reflects both the low base and the untapped opportunity.

GDP (Current Prices) USD (2020)	271.62bn
GDP Growth Forecast (constant prices) (2021-2025)	1.87%
Currency	Euro
Country Credit Rating (S&P)	AA+
Renewable Energy capacity (2021)	9.6GW
Solar PV Share in Renewables (2021)	4%
Renewable Energy Target	Emission-free power generation industry by 2030 and carbon-neutral position by 2035

GDP Source: IMF WEO, S&P and IRENA

0.4GW Solar PV Capacity

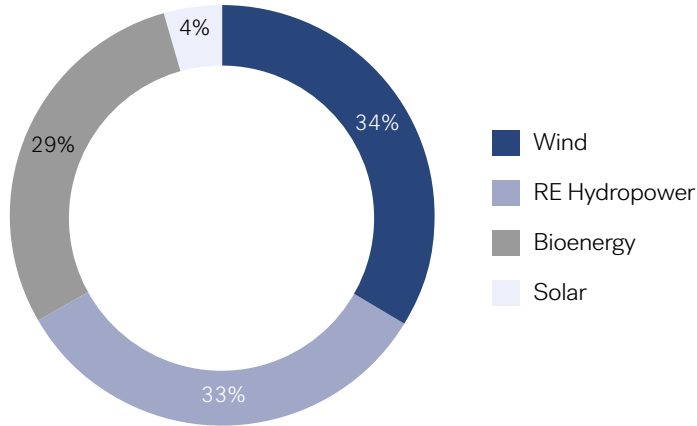
- ✓ **Climate policy aiming to achieve a carbon-neutral position by 2035**
- ✓ **PPAs and similar subsidy-free projects leading the renewable market**
- ✓ **Rooftop solar PV projects a key growth driver for residential and commercial segments**
- ✗ **Present power transmission connectivity insufficient to meet the upcoming renewable energy capacities**
- ✗ **Geographical inequality in grid connections and related procedures**



Finland

Renewable Energy Mix

Current Renewable Energy Mix

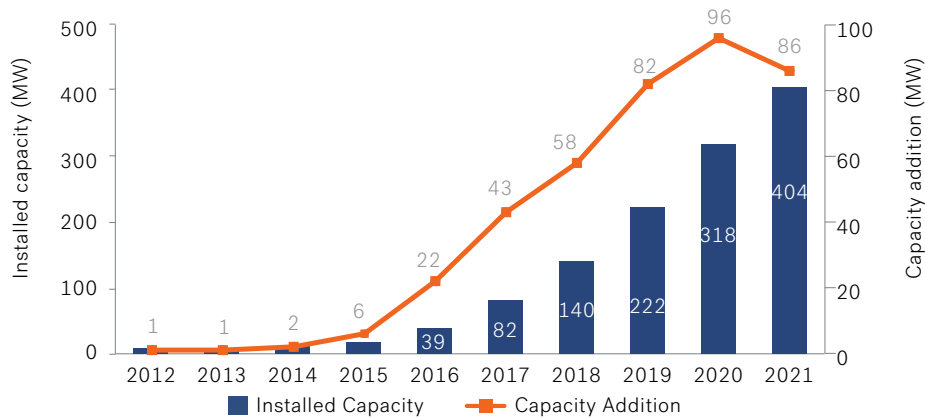


Source: IRENA Renewable Capacity Statistics April 2022

The existing renewable energy mix is skewed towards hydropower and wind. The current share of solar PV cannot make a dent, even though the progress has been sharp (in 2016, solar PV share was 0.6%). In terms of the total quantum of energy supply/consumption, solar PV's contribution is at only 4% (as of 2021). However, such a share is understandable in a context – conventional options such as nuclear, cross-border imports, and cogeneration account for about three-quarters of total power consumption.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Finland's installed solar PV capacity trend shows an accelerated phase of growth. Capacity almost doubled between 2019 and 2021, with an average 88MW of annual increment. The predominant share of capacity growth lies with the small-scale projects (unit size below 1MW) in the residential and commercial segments, especially the former. As per the grid connectivity norms, the PV plants are typically connected to the local distribution system operators.

Beyond the grid-connected capacities, as reported in officially

published statistics, there are off-grid solar PV units to consider. As per the grid operators, over 50,000 detached homes or holiday homes have installed off-grid solar PV units. Such capacity is estimated to be worth 20MW (as of 2020). It is not tracked or reported officially due to a lack of grid connectivity obligations.

Demand Drivers

Finland's stated climate policy is to achieve a carbon-neutral position by 2035, involving faster emission reduction in all the economic sectors. Most importantly, it entails a nearly emission-free electricity sector by 2030. Enforcing such a policy roadmap would require a focus on solar as among the renewable power generation options.

The Finnish renewable market is led by PPAs and similar subsidy-free projects, as new renewable energy auctions for onshore wind or solar PV are unlikely. Due to the limited scale of solar PV so far, the PPA market is led predominantly by wind power projects. Yet, demand for solar PV is gradually finding acceptance in corporate PPAs, among other merchant power arrangements.

The policy focus on climate change, coupled with Finland hosting a significant share of industries and data centres with high energy intensity, makes PPAs an attractive option for solar PV projects' offtake. Further, it is not just the

physical PPAs that find acceptance. Other PPA models such as financial PPAs or virtual PPAs are also finding traction in keeping with similar trends in other European markets. The growth and maturity in the PPA market through larger enterprises (with significant offtake) could help the case for the participation of smaller ones as well.

A progressive decline in solar PV cost (both capital and variable) helped drive the adoption rates. Thus, Rooftop solar PV projects became a key growth driver for residential and commercial segments. In many cases, tax credits against the upfront costs for the solar PV installation enabled the residential demand for solar projects. Grid connectivity ensures that the excess generation gets injected into the network. Finland's installed capacity is thus mainly based on such small-scale solar PV projects.

Market Opportunity

The investment opportunity in Finnish solar stems from the energy transition underway. Investors and the developers are finding greater scope in the Finnish solar power market, that otherwise faces rather stiff competition against wind energy.

In April 2022, Octopus Renewables Infrastructure Trust announced a Finnish renewable energy development platform for solar and wind power projects. An investment worth EUR3.5 million is planned in his regard to develop capacities amounting to 400MMW (both solar and wind). Furthermore, a similar investment commitment will be available from another fund managed by Octopus Renewables. The proposed platform, to be set up as Nordic Renewables Limited, will have an exclusive joint development arrangement with the UK-based developer Nordic Generation Limited.

While most capacity growth is based on small-scale projects, large utility-scale projects are finding traction for potential investors. As of September 2021, an international consortium evaluated the feasibility of a 500MW solar park, together with a wind power project in Palloneva. The proposed project (solar and wind) will entail a potential investment of EUR400 million. Once the power purchase agreements are secured from local utilities and energy-intensive business units, it could also involve more investors. While the project is yet to get a financial closure, the estimated leveled cost of energy, at EUR0.04/kWh, places it in a competitive position against the wind power capacities in the pipeline.

Progressively, many utility-scale PV projects could also be modeled on the hybrid wind-solar structure. In October

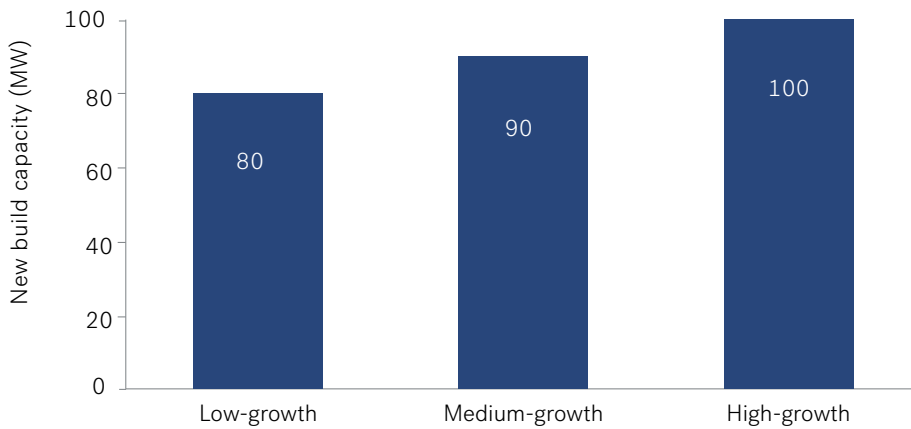
2021, renewable energy developer VSB Uusiutuva Energia Suomi Oy and solar power developer Solarigo Systems reached an agreement for a hybrid project at Kalajoki. This pilot project will involve testing multiple technology configurations, including those of smart grid and energy storage systems. Once developed, it could be the country's first hybrid energy project with a storage facility.

Lately, several solar PV projects have been commissioned to meet the energy requirements of industries or commercial enterprises. This trend appears to be gradually gaining momentum. In March 2020, the shopping centre at Ylöjärvi had a rooftop solar plant installed. Since then, the plant meets about a quarter of the total power consumption at the location. Another leading example is Atria Finland, one of Europe's top meat and food companies. The company's solar plant for the Nurmo production unit was commissioned in 2018 and ranked as the country's largest industrial solar plant segment. As of July 2021, the company announced a 5MW expansion of this plant, together with the developer Nurmon Aurinko, amounting to a total cost of EUR2.7 million.

With the rising penetration of renewable power generation in the power network, the country's transmission system operator (TSO), Fingrid, is planning capacity addition in the bulk power transmission assets. The TSO's Grid Development Plan, 2022-2031, shows a planned investment spending of EUR2 billion for both new capacity and upgrades of existing ones.

Outlook

Finland's Average Annual Projected Solar PV Build during 2022- 2030



Source: BNEF Global PV Market Outlook

Finland's solar PV outlook is one of accelerated capacity addition. Such an expectation arises from the indicative picture of some of the leading developers' capacity pipelines. For instance, companies such as Solarigo and Kaskisten Tuulivoima are involved in Solar Park projects that tentatively aggregate to about 1GW or more. Similar momentum is also found in demand from energy-intensive enterprises – Amazon recently announced its planned investment in wind and solar power projects. The power purchase agreement route is also in consideration for enterprises adding solar power in their renewable power procurement. As reflected in the BNEF projections, a high-growth scenario of the solar PV market could result in an annual 100MW worth of PV capacity builds during 2022-2030. The capacity pipeline appears to add credence to a high-growth scenario.

Despite a promising capacity pipeline, some factors could be barriers to growth. For instance, the power transmission connectivity is not adequately placed to meet the upcoming renewable energy capacities. Uncertain grid connectivity impacts the commercial viability and commissioning schedule for utility-scale projects. Other factors include a wide regional variation in grid connection and related procedures, limited or negligible subsidy support, and inconsistent utility pricing.

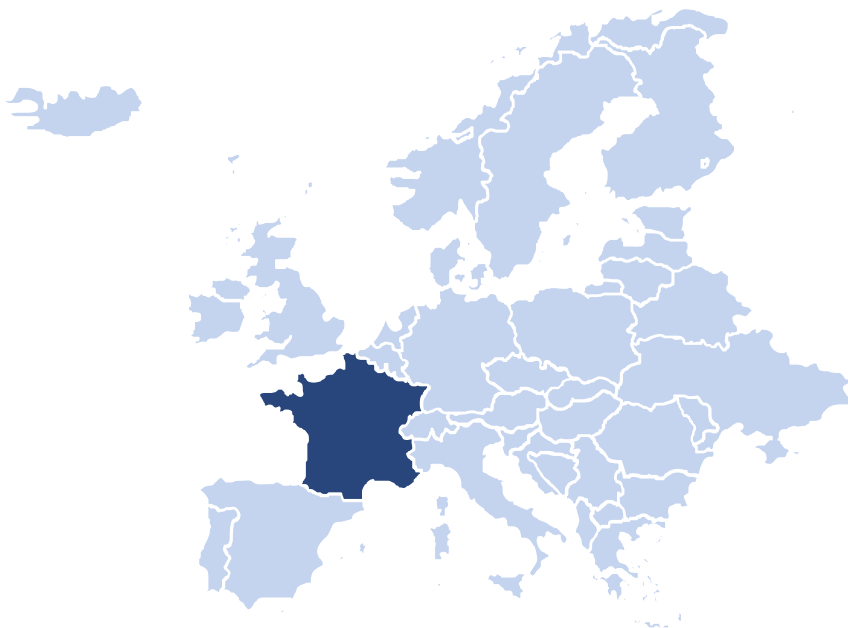
Beyond the implementation challenges, the Finnish solar PV market trajectory will also be impacted by the relative competitive position of renewable energy technologies. As Finland progresses toward the energy transition objectives, the choice will be based on the commercial feasibility of achieving higher renewable energy penetration.

France

France has lagged in solar PV market, despite introducing eco-friendly laws and targets earlier than most of its peers. However, in last couple of years, the country set short-term targets harmonized with its capability. During pandemic outbreak as well as in aftermath, France continued steady march towards its decarbonization goal and has paved the way for acceleration in coming years by creating healthier fiscal environment.

GDP (Current Prices) USD (2021)	2,935.49bn
GDP Growth Forecast (constant prices) (2022-2026)	1.74%
Currency	Euro
Country Credit Rating (S&P)	AA
Renewable Energy capacity (2021)	59.5GW
Solar PV Share in Renewables (2021)	25%
Renewable Energy Target	Achieve carbon neutrality by 2050 and 100GW of solar PV capacity by the same year

GDP Source: IMF WEO, S&P and IRENA



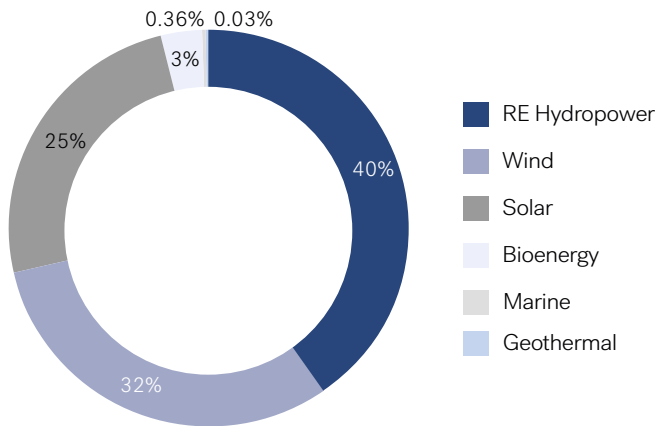
14.7GW Solar PV Capacity

- ✓ **Regulatory objective to phase out coal and reduce share of nuclear energy**
- ✓ **Growing traction in solar PPA market**
- ✗ **Time lag between the proposed plant and its implementation**
- ✗ **Lack of adequate transmission and distribution infrastructure**

France

Renewable Energy Mix

Current Renewable Energy Mix

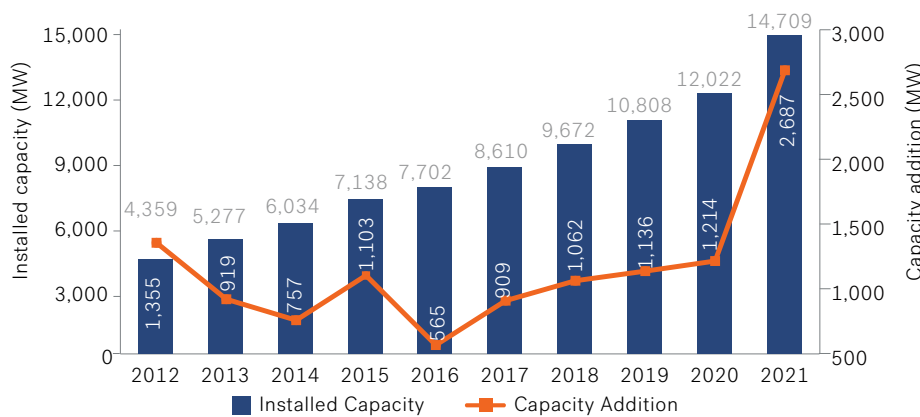


Source: IRENA Renewable Capacity Statistics April 2022

Hydropower has been dominating the renewable mix since last ten years, however, its share seems to be weakening due to government efforts towards installation of solar and wind energy capacities. Share of solar energy is expanding at steady rate in the mix, showcased by growth from 18% in 2017 to 25% in 2021.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

2050 goal of carbon neutrality set by French government serves the base for growing renewable energy adoption in the country. In the 2019 Energy and Climate Law, the government committed to close its remaining coal-fired power plants by 2022 and reduce the share of nuclear power in energy mix to 50% by 2035 by closing 14 nuclear reactors, subject to country's dependency on the inflated electricity demand, while boosting renewable energy generation three-fold.

To support the set target, in H2

2021, European Commission (EC) approved French aid scheme with provisional budget of €30.5 billion. The scheme provides grants to renewable operators (including ground mounted and rooftop solar PV), awarded via competitive tenders for a cumulative new renewable capacity of 34GW that would be organised between 2021 and 2026. The scheme is estimated to mobilize a total of €5.7 billion till 2026 to increase the capacity of renewable solar energy by 3.7GW.

In the aftermath of COVID-19, the government focused on upscaling solar and wind energy penetration in electricity generation. The undertaken investment rejuvenation, thus, pushed the share of renewable energy in electricity generation mix above 22%, and is expected to expand further up to 27% by 2023.

France continued to boost ecological transition by deploying more renewables, despite economic downfall caused by pandemic outbreak. In H2 2020, the French government introduced 'France Relance Recovery Plan' to support industries. Out of total budget of €100 billion, €30 billion were dedicated to sustainable recovery objectives, speeding up the transition.

Solar PV capacity in France maintained a steady growth trend during 2020. The net additions in the capacity during the year increased to 1.2GW from 1.1GW in 2019. The trend continued in 2021, with addition of 2.7GW annually, highest since 2010. From the year 2021 solar PV sector of France officially entered an acceleration phase, in line with the announcement made by the Government that solar energy is one of the strategic pillars in terms of renewable electric energy.

Demand Drivers

The renewable energy auctions along with fiscal incentives offered by government have been key tools to drive demand in France. The auctions take place every year, shedding light on projects that can boost renewable energy capacity in the country and prove beneficial for long term goal. In terms of fiscal benefits, during October 2021, the government extended its support by allowing for fixed feed-in tariff (FIT) to all PV systems up to 500kW in size. The eligibility criteria in terms of CO₂ emission encourages producers to upgrade their systems and thus march towards decarbonization goal. Notably, within two months since announcement, around 9,000 project application were received representing total capacity of 650MW.

The measures are perfectly placed to provide the required tailwind to French solar PV sector to change the scale implied

by the objectives of the Multi-Annual Energy Programme (MAEP). The program calls for an installed PV production capacity of 35 to 44GW by 2028, which translates into annual installation of 3 - 4GW of new PV capacity.

Power Purchase Agreement (PPAs) in France are proving to be another important demand driver. The renewable PPAs are gaining popularity among the renewable energy developers on account of lower renewable energy prices against soaring fossil fuel prices. In 2021, market recovery was reflected in expanded PPA base, cumulatively adding solar PV capacity up to 600MW. The positive trend showcased improved demand from premium offtakers nourished by evolving market conditions, thereby encouraging further expansion.

Market Opportunity

The government seeking to reduce its dependence on nuclear power for electricity generation in favour of renewable energy, provides investment opportunity. The assistance by European Commission being available, the private players' projects are welcomed under the subsidy schemes provided by French government. Although France added a record 2.7GW of solar PV capacity in 2021, it is not quite enough to meet the ambitious mid-term target of 20GW of PV capacity by 2023 as envisaged by the country's multiannual energy program.

So far renewable energy tendering has proved to be a tool to expand the project base. In the auctions held by end of 2021, French government selected around 820 projects in the procurement exercise with generation capacities ranging from 100kW to 8MW.

To accelerate further deployment, the government is planning to launch tenders in the coming months for a new feed-in premium (FiP) on top of market prices, replacing existing tender frameworks. This is supported by the European Commission aid scheme. The plan is to allocate 3.8GW of PV capacity in 2022.

Notably, small scale rooftop PV developers received a long-awaited boost when the government published the new PV

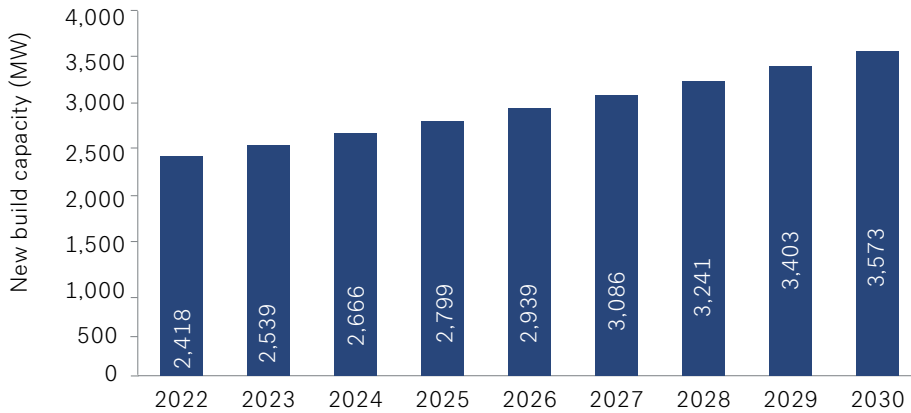
tariff order on October 6, 2021, that raises the threshold of the open window proceeding to 500kWp. Only two months after the implementation of this measure, nearly 9,000 project applications have already been submitted, representing a total installed capacity of 650MW.

The private investment is strengthening in French solar market with entry of new players as well as expansion of projects under existing players. By end of 2021, TotalEnergies launched its largest photovoltaic solar power plant in France with generation capacity of 64GWh per year. Some other notable deals include Hanwa Q cells' potential acquisition of RES Group's French business RES Mediterranee and Baywa's acquisition of French solar developer Enerpole. The private investors are even taking the route of building larger projects without subsidies, bypassing the tender requirement.

Agri solar and floating solar are the two areas which are predicted to have greater activity, especially because they can both bypass the land contention issue imposed by tender criteria which limits project sizes to 30MW except on degraded land or as combined Agri solar. Notably, in February 2022, Canadian renewable energy developer Boralex commissioned its first floating solar farm in southern France. The plant is expected to produce around 22GWh annually.

Outlook

France's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

In line with its decarbonization goal of 2050, France has set an ambitious target to reach minimum 100GW of solar PV capacity by the same year, which calls for addition of more than 5GW of capacity every year. However, to achieve these objectives, France needs to expand the investment base in the country, thus speeding up the low carbon technology deployment.

The solar PV capacity in France is projected to maintain a steady growth trend, reaching 3.5GW of annual capacity addition in 2030, growing at CAGR of 5% during 2022-2030. However, to reach the target of 100GW, the annual additions forecasted are insufficient, thus a massive investments injection supported by strong regulatory measures are needed to be introduced in the country.

One of the major challenges faced by investors, in this regard, is the time lag between the proposed plant and its implementation. The widespread permitting challenges delay the further course of action, exceeding the targeted period set for capacity achievement and at times derailing the entire project. Moreover, the stringent tender criteria to keep the carbon impact of PV modules below 500 kg carbon/kW is resulting in limited choice for developers and increasing costs.

Grid development is another area which demands substantial efforts at both transmission and distribution levels to accommodate high share of renewables towards 2050. The scope of work would entail strong proactive steps and public engagement in long-term planning to assess costs and side by side working towards social acceptance of new infrastructure. In order to alleviate current grid connection issues, France has developed a special legal framework for the development and connection of renewable energy sources, known as S3RenR scheme, to share the costs at the regional level among the renewable project operators and partially by the transmission and distribution system operators.

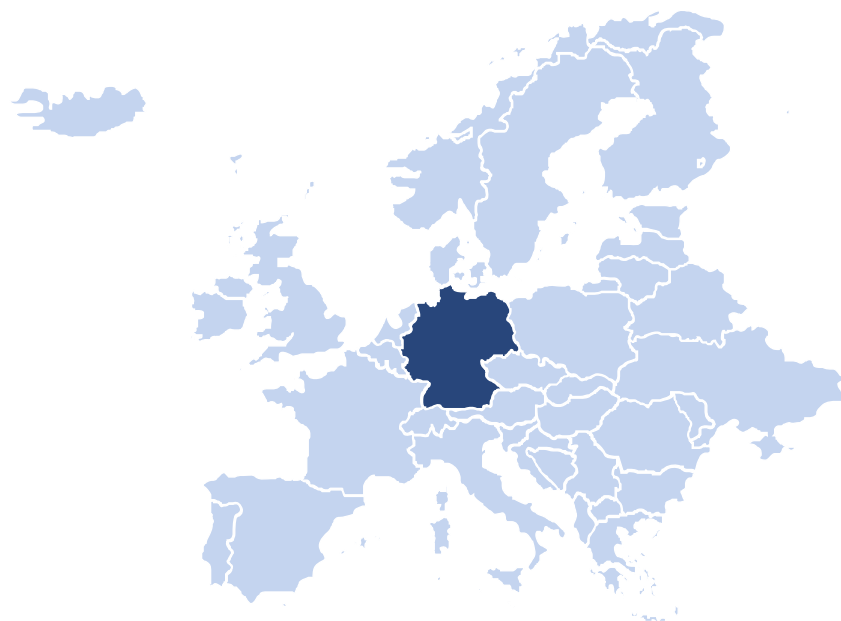
Overall, France has started year 2022 with expanded target showcasing the more focused approach it plans to have. However, to achieve the same, the country needs to work towards implementing more renewable friendly regulatory norms, especially with regards to utility scale projects. Nevertheless, France seems to have boosted moral to march towards end goal of clean energy economy.

Germany

Germany is one of the largest solar power producers globally despite having inadequate sunshine hours. The country ranked fourth worldwide, after China, USA and Japan, with an installed capacity of ~58.5GW, producing about 51TWh of solar power in 2021. Germany's total renewable power generation stood at 138GW as per IRENA by 2021. Wind and solar energy continued to dominate the renewable energy mix in Germany, having shares of 46% and 42%, respectively.

GDP (Current Prices) USD (2021)	4,225.92bn
GDP Growth Forecast (constant prices) (2022-2026)	1.78%
Currency	Euro
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2021)	138.2GW
Solar PV Share in Renewables (2021)	42%
Renewable Energy Target	80% share of renewables in total power generation by 2030 and 100% by 2035

GDP Source: IMF WEO, S&P and IRENA



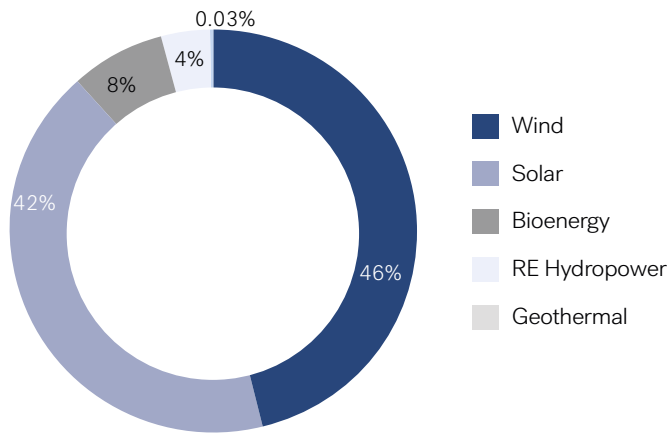
58.5GW Solar PV Capacity

- ✓ Revised regulatory target of having 80% renewable share in power generation by 2030
- ✓ Reducing battery prices and shrinking FiTs
- ✓ Renewable auctions new pivotal tool in market expansion
- ✗ Issues related to funding caps and investment barriers
- ✗ High solar photovoltaic system prices and reduction in FiTs making small solar systems unfeasible

Germany

Renewable Energy Mix

Current Renewable Energy Mix



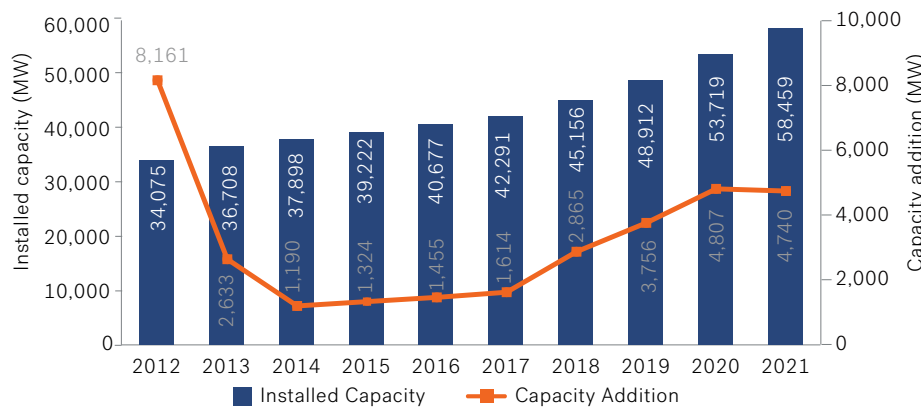
Source: IRENA Renewable Capacity Statistics April 2022

Solar PV annual capacity addition in Germany has picked up since 2018, peaking at 4.8GW in 2020, before easing off marginally to 4.7GW in 2021. However, the pace of capacity expansion has been inadequate to meet the country's net-zero obligation and complete the renewable transition by 2035. The new government has revised its target to achieve 80% share of renewable in power generation by 2030 and 100% by 2035 from the previous year's target of 65% in 2030. To achieve the amended target, the federal and state

authorities are taking multiple initiatives such as mandatory rooftop solar installation for residential and commercial set-ups, subsidising solar PV coupled with energy storage systems, financial support for new installations, and higher tax exemptions.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Reduction in project cost and increased residential PV rooftop enabled steady growth in the solar PV segment in Germany. New solar PV projects are already more economical than legacy, conventional power plants and the difference is expected to widen as the price of carbon certificates increases to more than €100 per ton by the end of this decade. Germany added 4.7GW of solar capacity in 2021, taking the cumulative installed capacity to ~58.5GW. Capacity addition has accelerated since 2018, spurred by

step declines in solar LCOE prices.

Increased tax exemptions under Germany's Renewable Energy Act have galvanized residential solar PV installation. The law currently provides an exemption to residential photovoltaic units up to 30KWh from 10KWh. Additionally, the liberal FiT scheme and more accessible financing options from KfW bank have supported the growth of solar PV in Germany's commercial & industrial (C&I) and residential segments.

Demand Drivers

The new coalition government in Germany has revised its earlier target to achieve 80% share of renewables in power generation by 2030 as a part of the “Easter Package” released in April 2022. This was previously set at 65% by the Angela Merkel government. The country aims to increase its solar installed capacity to 215GW through increased deployment of rooftop panels. German policy makers have set a target of 22GW in annual capacity addition from 2026. This implies that 45GW solar capacity needs to be added between 2022 and 2025, at an annual average of 11.25GW, almost 2.5x the current levels of annual capacity addition.

There is a strong push on the policy side to achieve these ambitious targets. New provisions in the ‘EEG Easter Package’ envision greater participation of municipalities in existing solar and wind parks, suspension in the phaseout of FiTs till the start of 2024, streamlined approval process, mandatory solar rooftops and the Agri-PV initiative which supports farmers setting aside up to 15% of their farmland for solar projects are likely to accelerate expansion of the solar power market.

Electricity storage systems are gaining consumers’ acceptance on account of a substantial decline in battery prices and falling FiTs. Reports suggest that ~90% of Germany’s new rooftop solar installations were combined

with a home storage system during 2019-20. Almost 70% of residential solar PV are coupled to a battery energy storage, representing 2.3GW of installed capacity by the end of 2020. Multiple subsidies/frameworks are provided at the central and state levels to support the installation of such storage systems. Increased acceptability of storage systems for residential and commercial use has been a key factor in driving the expansion of the solar power market in Germany.

The merchant power market is developing as subsidies are progressively scaled back in the solar PV market. The steep decline in solar power makes fixed-price PPAs an attractive proposition for offtakers, especially as conventional energy prices continue to be high and volatile. The corporate PPA market in Germany, for long stymied by the attractive support scheme, is set to change as key amendments signal a shift towards auction-derived prices, as opposed to reference prices earlier. The first solar PPA was signed in 2019, and the trend has picked up in recent years. Towards the end of 2021, RWE signed a PPA with Enerparc for a 57MW solar project, and Airbus Helicopters purchased a solar project in Donauwörth, Bavaria, from GP Joule. Further, material manufacturer Covestro and EnBW signed a long term corporate PPA for solar electricity. Under the agreement, Covestro has secured 63MW of capacity from EnBW’s 187MW “Weesow-Willmersdorf” solar farm in Brandenburg.

Market Opportunity

Germany has based its scaleup plans for solar PV installed capacity based on rooftop solar, both residential and C&I segments. A study by the transport and infrastructure ministry (BMVI) estimates that an additional 150GW of solar capacity can be installed in buildings in the country. Rooftop solar is being mandatory across new residential buildings, starting with the state of Baden-Wuerttemberg from May 2022. Rooftop solar coupled with battery energy storage is helping push adoption of the technology among residents, particularly in the aftermath of the Ukraine war and escalating energy prices. The federal and state governments are providing multiple subsidies to enhance the use of energy storage systems (ESS) integrated renewable installations. The “Energy Storage Photovoltaic Program” in Bavaria provides €500 to homeowners for a 3kWh electricity storage unit and €100 for each additional kWh of storage capacity. In Berlin, the “EnergiespeicherPLUS” program provides €300 euros per kWh of storage capacity, funded up to €15,000. KfW Development Bank is the primary institution promoting PV systems and battery storage at the federal level. Despite the disruption due to COVID-19, energy storage added 1,357MWh in 2021, where home storage systems accounted for 93% of the installations. Germany accounted for 70% of the home batteries installed among European countries.

The growing demand for solar power has been evident in

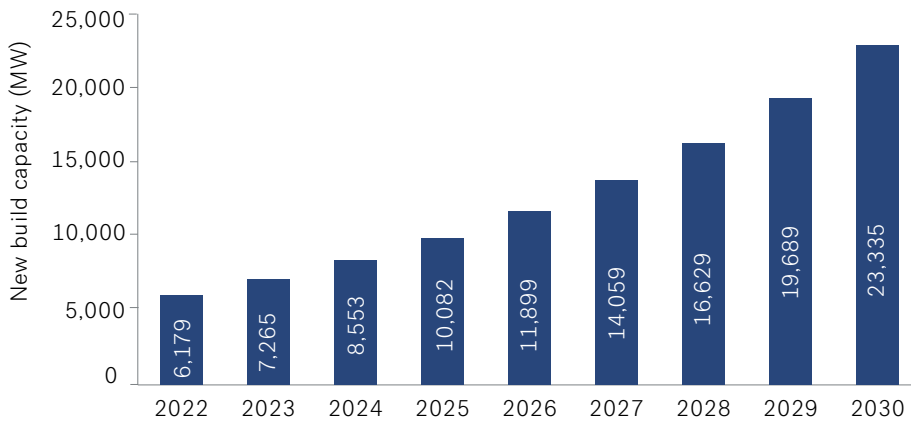
the latest auction held in April 2022. Although the auction volume was revised upwards to 1,108MW, from 617MW earlier, total bids were higher at 1,116MW. A proposal for mandatory solar rooftop installation for new commercial and private buildings is likely to create more growth opportunities. The states of Baden-Württemberg and North Rhine-Westphalia (NRW) have already implemented solar PV obligations for selected construction projects. Similar laws have been passed in Berlin, Rhineland-Palatinate, and Hamburg and are due to come into force from 2023.

The Russia-Ukraine conflict has spurred further investment into the renewables sector, particularly solar and onshore wind, amid an unprecedented energy crisis in a country where 50% of German households depend on gas for heating. Policymakers are trying to expedite the enactment of the Renewable Energy Sources Act (EEG) which envisions suspending subsidy cuts for rooftop solar panels in 2022. It also plans to increase solar tenders to 20GW by 2028 from 5GW currently, and maintain that level till 2035.

The German government is also planning to use CfD (Contracts for Difference) as a funding tool to reduce industrial carbon dioxide emissions. The draft plan proposes that companies committing to cutting carbon dioxide emissions by more than half using innovative technologies could be permitted to operate on the basis of 10-year CfDs.

Outlook

Germany's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The government's vision to exit coal and nuclear-based power generation by 2030 from the previous target of 2038 led to multiple policy framework alterations in the recent past. Wind and solar energy being the leading segment in the renewable energy sector will lead the way towards a zero-emission path.

The Ministry for Economic Affairs and Climate Action (BMWK) aims to add around 7GW solar PV capacity in 2022, further scaling up to 9GW in 2023, 13GW in 2024, 18GW in 2025 and 22GW from 2026 onward until 2030 to reach the total installed capacity target of 215GW. This revised target will also drive power purchase agreements and increase annual auction volumes. Cumulative target till 2035 is set at 325GW.

High solar photovoltaic system prices and reduction in FiTs are making small solar systems unfeasible in Germany. The payback time for systems below 10kW is increasing, EUPD research estimates that the payback time for new residential projects could get extended up to 22 years. This will make residential projects viable only through the highest self-consumption rate. To strengthen the PV market, the federal government must investigate measures such as raising tender limit for rooftop PV systems, removing political barriers, expanding the tax-free self-consumption of solar power and establishing long-term planning security for system operators.

Funding caps and investment barriers have also deterred accelerated expansion of the solar PV market within the C&I segment. Eligibility for subsidy for larger solar systems over 300kW requires successful participation in tenders, which is challenging for many potential participants. In addition, a dearth of skilled manpower to install solar panels acts as a bottleneck to the sustained growth of the solar PV industry.

Italy

Italy is one of the major players in the European renewable energy space and solar PV is the fastest growing source of renewable energy in the country. Italy's National Integrated Energy and Climate Plan ("PNIEC") sets solar PV target of 50GW - 52GW to be reached by 2030, along with which the country also pledges to have renewable energy share to increase to 55% in the electricity generation and 30% in total energy consumption by the same year. As of 2022, Italy adheres to the same goal by boosting the solar PV capacity additions and in turn increasing the share of solar PV in renewable energy mix.

GDP (Current Prices) USD (2020)	1,891.06bn
GDP Growth Forecast (constant prices) (2021-2025)	2.59%
Currency	Euro
Country Credit Rating (S&P)	BBB
Renewable Energy capacity (2021)	57.0GW
Solar PV Share in Renewables (2021)	40%
Renewable Energy Target	Reach up to 52GW of solar PV capacity by 2030 along with renewable energy share of 55% in electricity generation and 30% share in total energy consumption

GDP Source: IMF WEO, S&P and IRENA

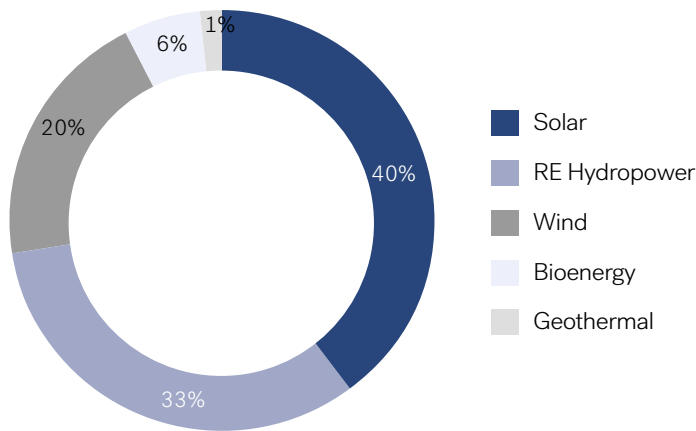
22.7GW Solar PV Capacity

- ✓ Efforts to simplify permit allocation process through introduction of Simplification Decree
- ✓ Private PPAs are key enablers for unsubsidized solar PV projects
- ✗ Limited availability of land for large scale, ground-mount solar
- ✗ Persistence of lengthy procedures and costly permits



Renewable Energy Mix

Current Renewable Energy Mix

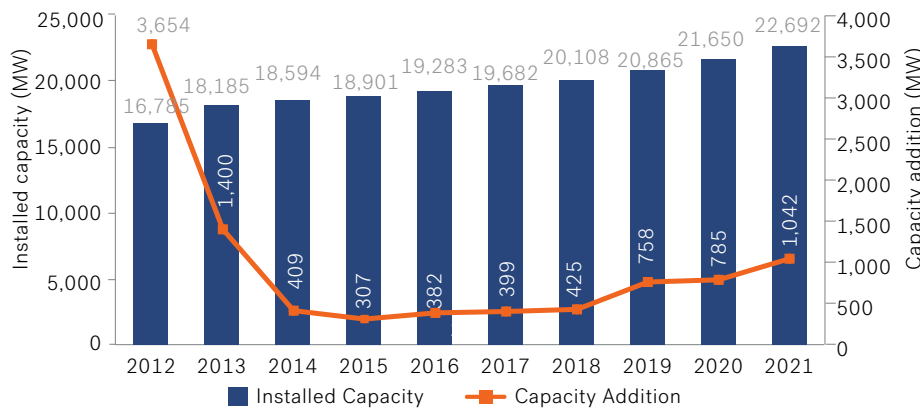


Source: IRENA Renewable Capacity Statistics April 2022

The share of solar PV in Italy's total renewable energy mix stagnated at 38% since 2016. In 2020, however, the share increased to 39% being unaffected by the COVID-19 pandemic and in 2021 it went further up to 40%. The growth, though marginal, is result of increased efforts by government, especially during the pandemic outbreak and in aftermath. The policy focus on energy efficiency along with improved investment injection by private players are some of the key trend setters in this regard.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Solar PV is one of the key sectors to boost the energy transitions of Italy. Despite the economic sluggishness caused by pandemic outbreak in the country, government maintained stable growth trend in terms of solar PV capacity additions. In 2020, the capacity additions increased by 4% annually, while spike of 33% was observed in 2021. North Italian regions such as Lombardy and Emilia Romagna continued to lead the market in 2021, maintaining the stable growth trend.

The inclusion of energy efficiency as one of the focus areas in COVID-19

recovery plan was one of the major reasons for stable growth in solar PV additions. The tax rebate offered at 110%, known as super bonus, to support the economy in 2020 can be considered as major demand driver. The scheme involves tax credit on installation of rooftop solar panels tagged to building renovation. The extension of this fiscal support till end of 2022 would act as a major growth driver for the residential PV segment.

Demand Drivers

Expansion of the solar PV market is supported by various government investment allocations as well as incentives. Since 2019, the efforts became more focused towards energy transition, which were reflected in implementation of short-term budgetary allocations to reach the set solar PV target. As the primary pillar of the country's renewable mix, the solar PV sector will also be benefitted from the "Green Revolution and Ecological Transition" as part of the "National Recovery and Resilience Plan". The Scheme allocates a total of €68.6 billion with the main goal of improving the sustainability and resilience of the economic system and ensuring a fair and inclusive environmental transition. This includes €1.5 billion measure to support solar in Italy's agricultural sector which entails installation of 375MW of PV panels on buildings in the sector, including agro-industrial sites.

The Italian government has begun the process of loosening permits for large-scale renewables, which has historically been a major bottleneck for project development and

construction. Streamlining of approval processes through "Simplification Decree" are followed by accelerated grid investments. In this regard, grid operator Terna has pledged to invest \$21.5 billion over the next ten years to improve transmission links.

Power purchase agreement (PPA) is proving to be the key enabler for unsubsidized solar PV projects. The proliferation of corporate offtakers is the main reason behind the surge in PPA market in the country. In Italy solar PV accounts for approximately 67% of the PPAs.

The renewable energy auctions are in expansionary phase in Italy, with solar capacity on the lead. In January 2022, the seventh clean energy auction in Italy had total allotted capacity of 975MW, of which 710MW were awarded to solar capacity covering 60 locations. Of these projects, 49 had capacity of less than 10MW and the remaining 11 projects ranged in size from 13.2MW to 92.4MW. Overall, Italy has allocated around 1.2GW of solar through its auction scheme till date.

Market Opportunity

Commercial & Industrial (C&I) and residential solar, coupled with storage systems, is being actively promoted by the National as well as regional governments. In September 2021, regional government of Lombardy allocated €20 million in addition to already allocated €20 million to support residential PV plus storage facilities. The added fund enabled government to finance all 921 projects which applied for the support. These projects are categorised into two kinds, installations of PV systems linked to storage systems, and the deployment of standalone storage systems linked to existing solar arrays. Through DL Energia Decree, the Central government has decided to allocate €267 million in the form of rebate to help the SMEs to deploy PV systems for self-consumption. The Decree has also introduced new provisions such as extreme simplification of permits to install commercial rooftop PV systems with a capacity between 50kW and 200kW, which in Italy are allowed to operate under the net metering scheme.

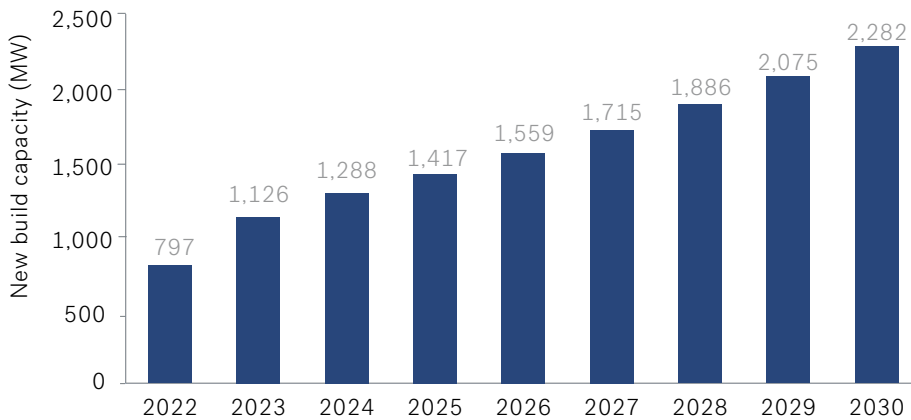
Investor sentiment should be boosted from the notable growth observed in recently held clean energy auctions in terms of number of tenders received and expanded investment value. The seventh cleaner energy auction in Italy marked improved market in the country, with price discounts offered at 2.0% - 3.5%, compared to first auction's discount ranging between 2.3% - 20%.

Since the beginning of 2022, existing players in Italy have started expanding their renewable portfolio. A recent rush of project applications in Sicily and Puglia has caused a backlog in permitting. Notably, Italian energy company ERG SPA has announced the addition of 2.2GW of capacity to its renewable fleet by 2026, about a third of which will come from the solar PV segment. Germany's STEAG Solar Energy Solutions and investor KGAL recently expanded a 440MW solar project in western Sicily to 700MW, creating the largest ever solar project in the country.

With rapid deployment of Solar PV projects, the market for solar panels is also expected to grow significantly and thus provide a lucrative opportunity for the panel manufacturers. Anticipating the growing demand for solar panels, Italian energy leader Enel has signed a grant deal with the European Commission to scale up a solar panel Gigafactory it owns in Sicily. The project worth €600 million involves development of 3Sun panel factory which is expected to raise the production fifteen-fold to 3GW from current capacity of 200MW.

Outlook

Italy's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The green transition amid heavy dependence on fossil fuels, especially natural gas, has put pressure on Italian economy. The country seeks to reduce the dependence on imported gas, especially from Russia, owing to geopolitical tensions as well as to encourage ecological transition. However, the investment deployments are not sufficient to support the set clean energy target. At a low investment scenario, BNEF projections are pointing towards annual PV capacity build of little over 2.2GW by 2030, while it is imperative that capacity installation increases to 3GW/year to achieve the clean energy goal of 2030.

Albeit slowly, the country is making positive strides towards its decarbonization goal. The solar PV market is expanding with support of various strategic schemes available at national as well as regional level. The limited impact of COVID-19 on solar energy sector was reflected in higher annual capacity additions in 2020 than in 2019, and further expansion in 2021. The reasons for this growth were government's attempts to maintain the stable activity in the sector and the inclusion of energy targets in the recovery plan.

However, the path is not smooth as various challenges faced in the country are holding solar sector back to reach its full potential. One of the major challenges is the land trade-off between the solar PV sector and agriculture. Promoting the large scale solar PV facilities, subject to the minimum loss of agriculture land, has become a challenge for developers. However, the government has tried to find golden mean by encouraging agrovoltaic on one hand and supporting use of roof top solar in agriculture on the other.

Another major challenge faced by developers is the lengthy procedures as well as costly permits especially for utility scale solar facilities. This has discouraged solar producers to participate in the subsidy auctions, thus slowing down the expansion rate. The simplified procedures are, hence, needed in the country to achieve short-term solar PV targets, enabling smoother long-term transition.

The Netherlands

The de-carbonization goal of 2050 has encouraged massive renewable energy deployment in the Netherlands. The country aims to phase out major fossil fuels such as coal and natural gas by 2030 and replace them by renewable energy. Additionally, it has set the target to reduce carbon footprint by 95% by 2050 compared to 1990 levels. Dutch policymakers are banking on solar and wind energy as the two primary renewable energy technologies that will help achieve these targets.

GDP (Current Prices) USD (2021)	1,018.68bn
GDP Growth Forecast (constant prices) (2022-2026)	1.96%
Currency	Euro
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2021)	23.0GW
Solar PV Share in Renewables (2021)	62%
Renewable Energy Target	Reduce carbon footprint by 95% by 2050 from 1990 level

GDP Source: IMF WEO, S&P and IRENA



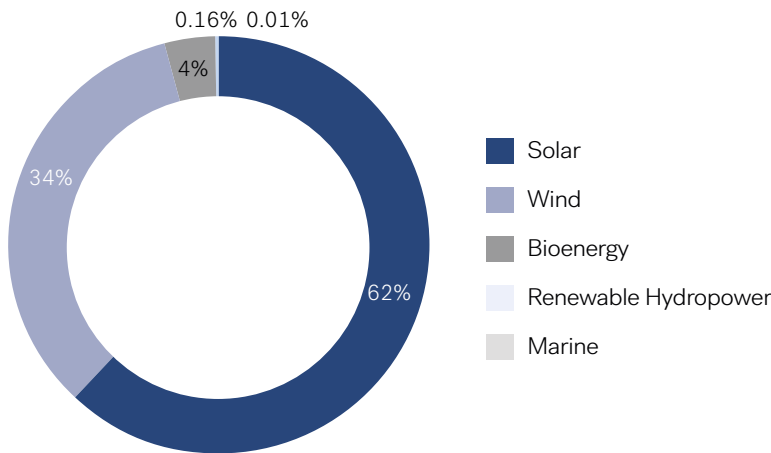
14.2GW Solar PV Capacity

- ✓ **SDE++ program introduced to support solar capacity buildout momentum**
- ✓ **Incentivized focus encouraging investment in renewable sector**
- ✓ **Net-metering rules to remain in place till 2030**
- ✗ **Grid connectivity issues highlight the need for expansion and upgradation**

The Netherlands

Renewable Energy Mix

Current Renewable Energy Mix

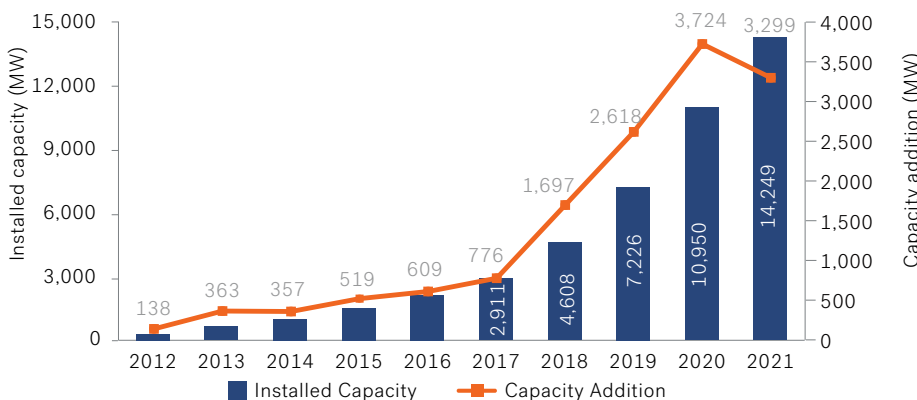


Source: IRENA Renewable Capacity Statistics April 2022

The share of solar PV in the Netherlands' renewable energy mix has increased steadily over the past decade, from 5% in 2011 to 30% in 2016 and 62% of overall renewable installed capacity of 23GW in 2021. Solar replaced wind as the dominant renewable energy technology in 2017 and the gap has widened in subsequent years to the extent that its installed capacity is now 1.8x that of wind energy. Expanded solar PV installed capacity has been the primary contributor behind renewables' share in electricity generation growing from 27% in 2020 to 33% in 2021.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Solar PV installed capacity in the Netherlands has expanded in two phases of growth over the last decade to 2021. Till 2017, annual capacity addition averaged 460MW, albeit at a steadily increasing pace. Annual capacity addition has almost quadrupled to 2.8GW since then as a result of the Dutch Stimulation of Sustainable Energy Production (SDE+) subsidy scheme. Growth was driven by sharp expansion in rooftop solar and utility scale solar parks.

Supportive policy framework has helped the Netherlands emerge as

one of the key solar PV markets in Europe. Annual capacity addition of 3.3GW in 2021 made it the third best performing country in Europe after Germany (4.7GW) and Spain (3.4GW) in terms of annual capacity addition. The Netherlands was ranked second in Europe in 2020, having added 3.7GW installed capacity, only after Germany (4.7GW). Its cumulative installed capacity of 14.2GW is the fourth largest in Europe after Germany (58.4GW), Italy (22.7GW) and France (14.7GW) and the country is poised to overtake France this year.

The solar market in the Netherlands has shifted from residential rooftop to ground-mounted utility scale solar and commercial rooftop solar. In 2020, 70% of the capacity addition was attributable to utility-scale and C&I rooftop solar segments. The SDCE+ and SDE++ schemes have been particularly effective in mobilizing C&I solar capacity addition.

Demand Drivers

Supportive policy framework and fiscal incentives have been the key drivers for the development of the solar market in the Netherlands. In 2020, the Dutch government replaced its 2nd installment of Sustainable Energy Transition subsidy scheme (Stimulerend Duurzame Energietransitie) i.e. SDE+ scheme by its 3rd installation SDE++. In December 2021, the Dutch Ministry of Economic Affairs and Climate Policy organized the first round of SDE++ tenders with a budget of €5 billion. Higher than anticipated demand required an increase in budgetary outlay to €12 billion. The tender round attracted 4,109 applications representing cumulative solar PV capacity of 4.1GW.

The Dutch government also introduced various fiscal incentives encouraging investments in the renewable sector. Energy Investment Allowance (EIA) is one of such tax benefit provided to support investments in energy saving equipment and sustainable energy. The businesses eligible for EIA are benefitted by deduction of the investment cost of energy

saving equipment from taxable profit up to 45.5%. Similarly, Environmental Investment Deduction (MIA) offers up to 45% deduction of the investment cost for environmentally friendly investments. In case of Arbitrary Depreciation of Environmental Investments (Vamil) scheme, businesses can write off 75% of the investment costs.

In case of energy storage, the association of national and regional electricity and gas network operators are calling for phasing out of the net metering scheme that was altered in 2020. According to the operators, the grid bottlenecks faced in the solar sector, especially for the low-voltage network, can be curtailed through the use of battery technology for energy storage and thus will facilitate expansion. The net metering scheme is, however, forecasted to remain in action until 2030. The net metering payments for the overabundance of power fed back into the grid are planned to drop in value by 9% per year.

Market Opportunity

Renewable energy tendering is one of the tools which create lucrative market opportunity, backed by government funding. The upcoming renewable energy tender round under SDE++ scheme has an expanded budget of €13 billion awarded over a period of 12-15 years, subject to the technology used in the project. The scheme will be open to green hydrogen facilities that are directly connected to wind or solar parks, and industrial electrification projects based on hybrid glass furnaces.

Attractive incentive schemes have attracted participation from domestic and overseas players alike. Solarfields Nederland has planned to build a 14MW solar PV power project, the Hardenberg Solar PV Park 2 in Overijssel. In March 2021, RWE announced its plan to develop its first floating PV project having an installed capacity of 6.1MW on a lake near the Amer power plant in Geertruidenberg. RWE is also building a 2.3MW peak ground-mounted PV project on the site of its Amer power plant. In November 2021, BayWa r.e. AG, a German renewables developer, announced its plan to build a 7MWp rooftop solar array in the Netherlands for Goodman Group, an Australian industrial real estate developer. In December 2021, Germany-based Pacifico

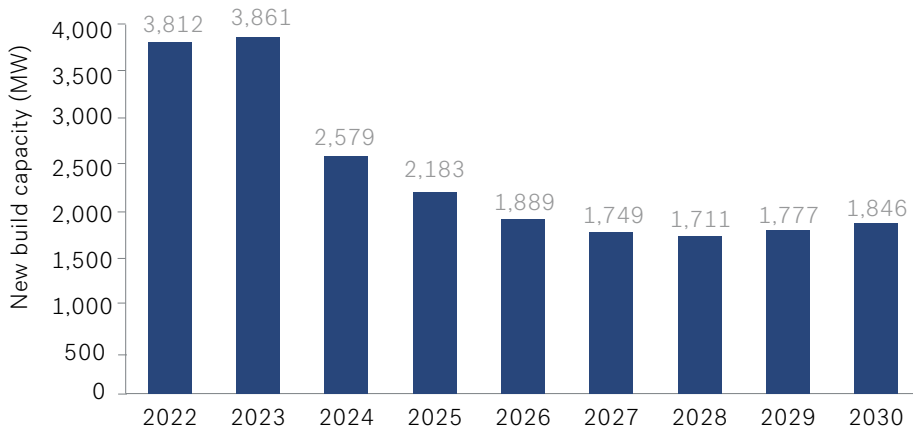
Renewables, acquired a portfolio of six ground-mounted and rooftop solar projects having cumulative installed capacity of 100MW.

Development of the renewable energy market has also spurred expansion in battery storage projects. In June 2021, the Dutch energy utility, Eneco, in collaboration with a battery provider, Giga Storage, revealed plans to install a 24MW / 48MWh battery, named the Giga Buffalo. The project, supposedly the largest battery in the Netherlands, is expected to be operational after the summer of 2022 and will be instrumental for grid balancing applications.

Power purchase agreements (PPAs) are also gaining traction as some developers look beyond the SDE+ programme for implementation of large-scale solar projects. Vattenfall is in the process of planning a 16.8MW solar facility in Almere in the Netherlands, with construction start slated for 2024. The existing subsidy scheme is designed to work in conjunction of the corporate PPA market, enabling producers to hedge their residual price risk exposure.

Outlook

The Netherlands' Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The prevailing subsidy scheme is likely to sustain continued growth in solar PV capacity addition. The Netherlands Environmental Assessment Agency (PBL) has estimated cumulative installed capacity of 27GW by 2030. BNEF expects annual capacity addition to continue increasing till 2023, after which it will moderate and stabilise at a more sustainable sub-2GW range from 2026 onwards, factoring in a phased shift away from subsidies to one based on merchant power.

Technological innovations have the potential to drive future growth of the solar PV industry. The Dutch government has announced an investment commitment of €15 billion to develop next generation renewable technologies such as green hydrogen and e-fuels. Rising energy prices have made green hydrogen more economical than fossil-based hydrogen. Dutch network company Alliander and renewable developer GroenLeven have opened the first solar PV-green hydrogen plant in the Netherlands in March 2022 while Dutch energy provider Essent has signed a cooperation agreement with Dutch solar developer Solinoor for the construction of a 5MW electrolyzer to enable production of green hydrogen. Similar innovations in floating solar and solar power-based mobility options like Lightyear are indicative of the growth potential of the technology in the Netherlands.

Grid connectivity has been a major challenge to the sustained expansion of solar power generation in the Netherlands. The recent surge in installed solar capacity has exacerbated the issue of grid congestion, leading to delays in new supply coming online. The situation might require regulatory intervention to accelerate the network permitting process and ensure greater transparency in the grid connection process.

Norway

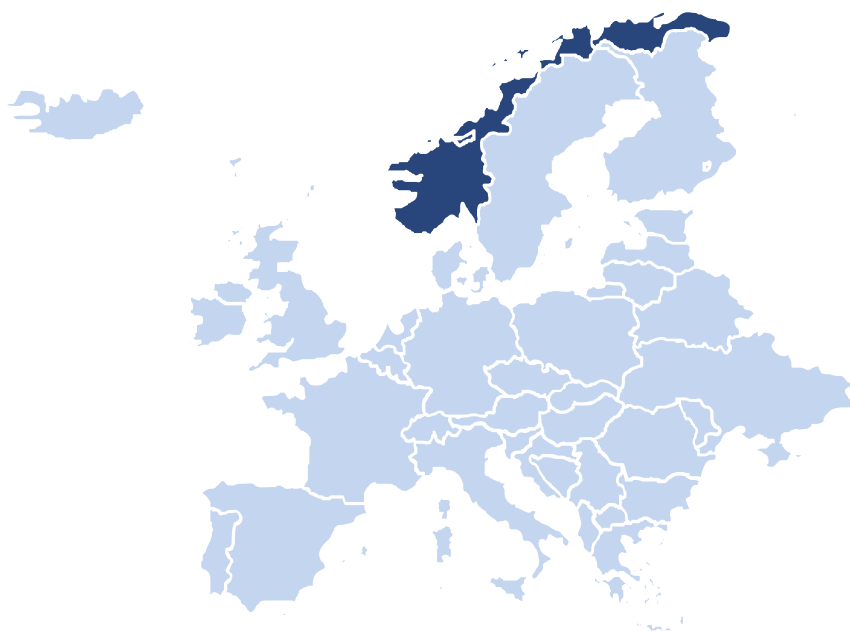
Over the years, Norway has been expanding its renewable energy base, except for that of solar energy. This far in north country has set the target of carbon neutrality by 2050, in which, wind and hydro would have much bigger roles to play than solar, evident from the current renewable energy mix. The smaller day time and darker winter season are the prime factors keeping Norway from becoming a major solar energy participant. However, the general perspective towards solar is changing with technological advances spurring, especially in the wake of skyrocketed energy prices owing to surging oil and gas prices, exacerbated by the war in Ukraine.

GDP (Current Prices) USD (2021)	482.44 bn
GDP Growth Forecast (constant prices) (2022-2026)	2.33%
Currency	Norwegian Krone
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2021)	39.8GW
Solar PV Share in Renewables (2021)	1%
Renewable Energy Target	Achieve carbon neutrality by 2050

GDP Source: IMF WEO, S&P and IRENA

0.2GW Solar PV Capacity

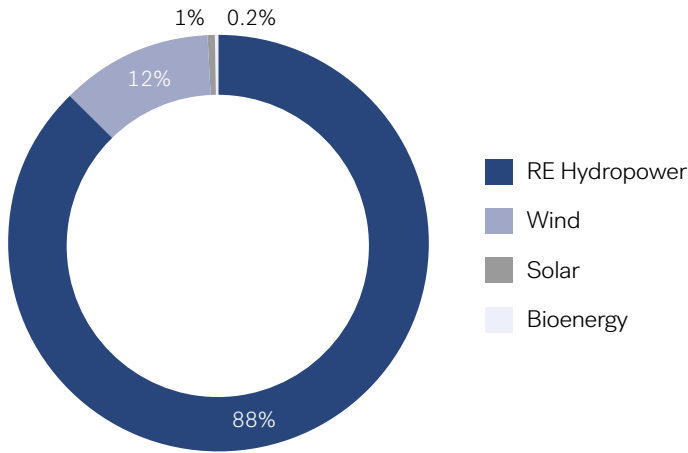
- ✓ **Seasonality of energy demand requires solar PV to fill for hydropower**
- ✓ **Untapped solar energy potential owing to geographical position**
- ✗ **Limited sunlight hours restricting utility solar activity in market**
- ✗ **Financial barriers including initial high costs and limited availability of capital for private sector**



Norway

Renewable Energy Mix

Current Renewable Energy Mix

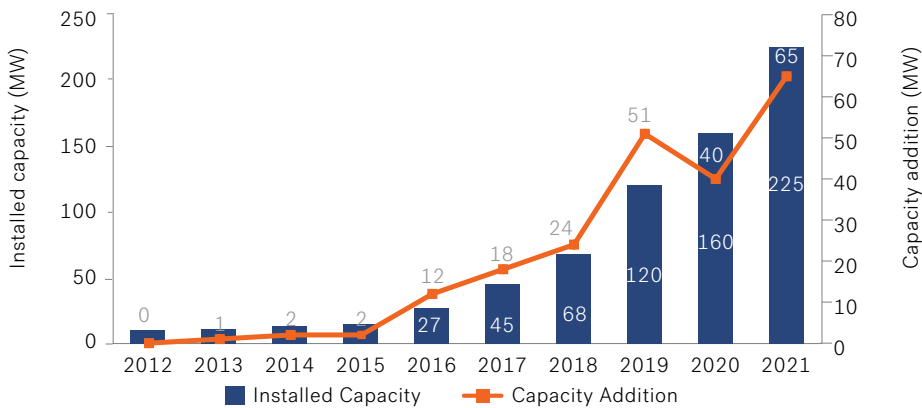


Source: IRENA Renewable Capacity Statistics April 2022

The renewable energy mix of Norway is dominated by hydropower; however, its share is tempering annually in favour of wind energy. Share of solar energy in the mix, on the other hand, has been minimal. In 2021, Solar accounted for 1% of the renewable energy mix of Norway, which was an upgrade from previous year's share. Owing to less favourable environment for solar sector, additional government efforts are made to enable capacity additions.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Over the years, solar capacity additions in Norway had stable upward trend. However, compared to its European peers, the country is not considered as major player in solar energy with overall lower installed PV capacity. Nevertheless in 2019, the solar PV capacity additions in Norway spiked by 70%, supported by government incentives. During 2015-2019, the capacity additions increased at CAGR of 58%, growing from 15MW of capacity in 2015 to 120MW in 2019.

In 2020, COVID-19 outbreak impacted the capacity additions by slowing down the annual growth. The reduction in annual capacity additions, by 22%, was observed first time in years, as lockdown measures implied project delays. In 2021, on the bright side, the capacity additions jumped by 60%, showcasing market recovery, enabled by relief packages. Accordingly, the total solar PV capacity in the country reached 225MW by end of 2021.

Demand Drivers

Norway seeks to expand the usage of renewable energy to be in line with EU emission reduction target, while supporting lucrative oil and gas sector, which contributes about 40% of Norway's exports and 14% of its GDP. The country, being one of the biggest producers of oil and gas, aims to develop the sector further but also have extended regulatory support towards renewable energy options. Although, the shift towards green energy would be gradual in Norway, the government has already clarified its intention towards continued development of the clean energy sector, stating it would honour a plan to raise the country's carbon tax to 2,000 Norwegian kroner (\$230) per tonne.

Seasonal demand of energy is another factor that drives the development of solar energy in Norway. Especially during winter season hydropower alone fails to fulfil the soared electricity demand, resulting in the country resorting to import energy generated from coal, oil and gas. This emphasizes the importance of alternative clean energy sources like solar even more.

In case of renewable energy auctions, Norway has accentuated efforts in wind energy, while solar energy auction is still the uncharted territory for the country. Despite geographic location, the solar energy harvesting at residential level is growing in Norway, but utility scale installations face disadvantages. Thus, the solar auctions are not popular among the renewable energy developers and hence the

country is not focusing on them as such. The Norwegian state-owned enterprise Enova which manages the assets in the Energy Fund invests more than NOK3 Billion of public resources annually in solutions to promote a shift towards more environmentally friendly consumption and production, as well as development of energy and climate technology. It provided support to 9,115 projects through subsidy in 2020. Electricity generation, mainly linked to installing solar cells on the home accounted for 18% of all grants.

Renewable energy power purchase agreements (PPAs) have gained popularity in Norway as they provide certainty to the projects despite volatile market forces. However, solar is not yet preferred technology to enter in to a PPA in Norway, unlike that of wind energy and hydropower. On the other hand, even though solar energy has limited market in the country, Norwegian solar energy developers are increasingly entering into PPAs with international entities to build up projects in the countries with ample of the respected energy is available. Thus, though not at home, but the energy companies of Norway are expanding the solar market, supporting the global cause. Notably, in 2019, Equinor pledged to invest more than \$15 billion into solar and wind in the next ten years and utility company, Statkraft also announced its plan to invest about \$7-8 billion in same technologies within next eight years.

Market Opportunity

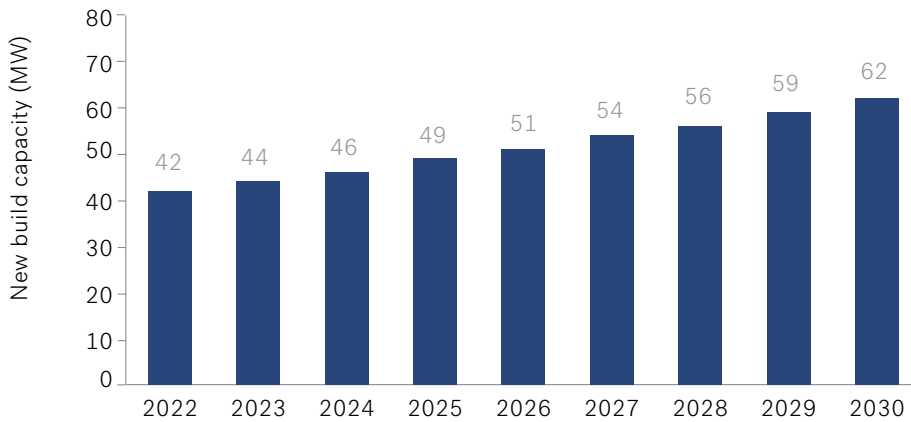
Although, the geographical constraints have resulted in one of the lowest solar energy penetrations in the world in Norway, various research results point to a great potential of solar energy in the country. It has been found that the energy output per square meter of solar in the southern Norway (1,000kWh per square meter annually) can be comparable to that of Germany. Furthermore, the cold climate is beneficial for solar energy production, as it prevents PV panels from overheating. This brings a great market opportunity to capitalize. The utility scale projects do face resource hurdles, but the rooftop solar demand in the country is growing, supported by boosted incentivize efforts by Norwegian government and strong silicon industry which is the main component in PV panels.

Floating solar is another solution to the stagnant solar sector of Norway offers attractive investment opportunity. The hydropower reservoirs can be utilized to generate power with floating solar. Moreover, the advantage of having a transmission infrastructure is already in place. Notably, Ocean Sun, one of the Norwegian companies specialising in floating solar, has developed a patented solution consisting of silicon solar modules installed on large floating structures.

In the beginning of 2022, the government granted additional NOK750 million to renewable energy agency Enova, on top of annual funds of NOK3 billion, which has enabled company to rebate its existing scheme for residential solar installations. The agency plans to increase the size eligibility from 15kW to 20kW with expanded subsidy amount from NOK1,250 to NOK2,000 per kW installed. Additionally, the agency planned to introduce new subsidies up to NOK10,000 for energy management systems often installed along that of solar.

Outlook

Norway's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

Solar energy accounts for smaller part than wind and hydro in renewable energy related government initiatives. Yet the capacity additions in the country saw speedy growth since 2019 and is expected to maintain the stable growth trend in coming years. The solar PV annual builds projections in Norway indicate the stable growth with CAGR of 5%, with expected increase from 42MW in 2022 to 62MW by 2030.

Though the rooftop solar market is growing, the utility scale solar has not established its presence in Norway. The naturally put hurdles in the solar sector have compelled Norwegian government to focus more on other renewable energies like wind and hydro. Yet it tries to boost at least the residential / industrial usage of the energy, contributing towards the clean economy cause. A co-investment solution with public, private, people partnership (PPPP) can help. By solving financial barriers with regards to (i) high initial cost, and limited financial support for the people sector (ii) limited access to capital for the private sector; and (iii) uncertainty surrounding risks for the private sector, a co-investment solution based on PPPP can promote a larger PV market.

Nevertheless, Norway seeks to expand the solar market. Though the expansion rate of the solar PV capacity is projected to be slower, it is expected to maintain a stable growth by improving its share in the renewable energy mix and achieve the 2050 goal of decarbonization.

Poland

The infrastructural developments coupled with policy regiment supporting Poland’s march towards carbon neutrality has brought in brighter prospects for solar energy. As a result, Poland has recorded one of the strongest solar performances in Europe, showcasing the growing adoption of the technology. As of 2021, in terms of total capacity installations, Poland ranks among the top 10 countries in Europe.

GDP (Current Prices) USD (2021)	674.127 bn
GDP Growth Forecast (constant prices) (2022-2026)	3.25%
Currency	USD (\$)
Country Credit Rating (S&P)	A-
Renewable Energy capacity (2021)	15.4GW (2021)
Solar PV Share in Renewables (2021)	41% (2021)
Renewable Energy Target	2030 target of limiting share of coal in power generation to 56% while improving share of renewable energy to 23% along with reducing GHG emissions by 30% from 1990 level.

GDP Source: IMF WEO, S&P and IRENA

6.3GW Solar PV Capacity

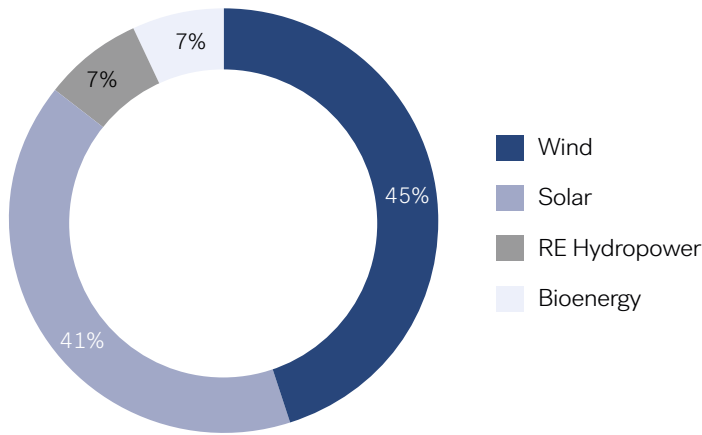
- ✓ **The RES auctions timeline extended till 2027 providing greater market expansion opportunity**
- ✓ **Expanding subsidy free market mechanism**
- ✓ **Prevailing 'My Electricity' program included battery storage system for subsidy allocation**
- ✗ **Growing pressure of supply uptick on prevailing grid network calling for expansion**
- ✗ **Regulatory policies to discourage participation in solar sector limiting the growth**



Poland

Renewable Energy Mix

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics April 2022

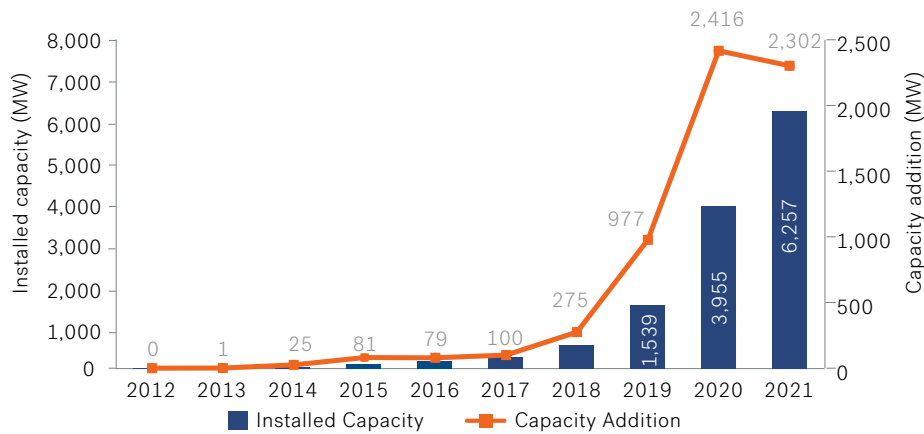
The Energy Policy of Poland - 2040 (PEP) has laid out the framework for the energy transition in the country by setting the interim targets. By 2030, Poland aims to limit the share of coal in power generation to 56%, while improve renewable energy's share to 23% in the same regard. The country also seeks to reduce GHG emission by 30% from 1990 level.

Wind energy has been the largest contributor in the renewable energy mix of Poland, with 45% share recorded in 2021. Solar PV holds

the second major position with 41%, which is a substantial improvement over its negligible share prevailed during 1st half of the decade. Solar sector's contribution has seen rapid growth in last five years, with CAGR exceeding 100% during 2017-2021.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

During the beginning of the decade, annual solar capacity additions in the country had the slowest growth, with no significant uptick recorded. However, the boosted regulatory support pulled the sectoral activity up, resulting in exponential growth rate observed since 2018, which continued in the pandemic period and beyond, resulting in 6.3GW of cumulative installed capacity by end 2021.

Demand Drivers

The fiscal support in terms of subsidies and tax benefits paved the way for solar PV sector expansion in Poland. The most successful scheme of all is the *Mój Prąd* (My Electricity) program, that was introduced during H2 2019 with budget of zł1 billion to provide subsidies up to zł5,000 per PV micro-installations with a capacity of 2kW-10kW at home. The subsidy amount was kept lower to leverage investment. As a result, funding amount of zł132 million launched the investment of zł815 million during the first round of application between August-December 2019.

The tax benefits for the solar sector were also introduced in the program which provided VAT reduction to 8% from standard 23% for solar power systems with less than 50kW, to encourage residential solar PV. Additionally, the subsidy for installation of energy storage system was included as part of fourth round of My Electricity program. The budget for the fourth round is zł350 million.

Additionally, the green certificate scheme established in 2005 have boosted the adoption of the renewable energy in Poland. The scheme requires the electricity suppliers to obtain the certificates from the project commencement till next 15 years. The share of the required certificates, which determines the minimum amount of the energy to be produced from renewable resources is directed annually, currently which is 18.5% in 2022 down from 19.5% in 2021. The companies with annual electricity demand also need to obtain these certificates proportionate to their demand. Though the period has been extended, they are no longer issued to the projects commissioned post July 2016.

Apart from the subsidy program, the net metering program, active since 2016 has expanded the benefit earning of the solar energy producers. The scheme allowed owners of PV system up to 10kW capacity to inject 80% of their power into grid, while 70% injection is allowed for the PV system in size between 10kW – 50kW. However, since 2022, the scheme added the clause of energy bill to be submitted by producers, which then will be used to calculate the price applying a special model. The new meter model is expected to be valid till 2024.

The renewable energy auctions in Poland have been an effective tool in driving the utility scale solar segment, which has been the winner in all the auctions conducted between 2016-2021. So far, the auctions have provided support to 6.1GW of solar PV capacity as per IEA. Notably, the results of the latest RES auctions held by end of 2021 had largest combined capacity of 870MW awarded to solar. Owing to response, the timeline for RES auctions has been extended from 2021 to 2027, that has provided the opportunity to facilitate the country's effort to fulfil its climate commitments.

Another major demand driver in the sector is power purchase agreements (PPAs), which facilitate the merchant solar segment. The international as well as domestic players are actively participating in the Polish solar market activity. Notably, the subsidy free solar projects are gaining momentum, as reflected in an upscaled response in the auctions, which indicate the growing attractiveness of the PPA segment.

Market Opportunity

The Polish government has been deploying investments to support the renewable sector in wake of economic recovery. By the end of H1 2022, European Commission (EC) endorsed the Polish National Recovery and Resilience Plan (NRRP) that amounts €34.5 billion, which will be granted under Recovery and Resilience Facility (RRF). The significance of the plan is underlined in its aim to secure country's green and digital transition by making the energy supply sovereign with improved share of renewable energy.

The financial aid provided by international institutions is an indication of attractiveness of the Polish solar sector, which has resulted in rampant activity taking place in recent times. In Q2 2022, European Bank for Reconstruction and Development (EBRD) announced its lending plans worth zł212 million for the construction and operation of Poland's biggest solar PV plant at Zwartowo. The plant will have the total capacity of c.286MWp.

The strong PPA activity has enhanced the competitiveness of the solar market in Poland, with unsubsidized projects leading the way since 2021. The largest subsidy free solar park, the 64.6MW Witnica Solar Park became operational from H1 2021 under the corporate PPA signed by BayWa

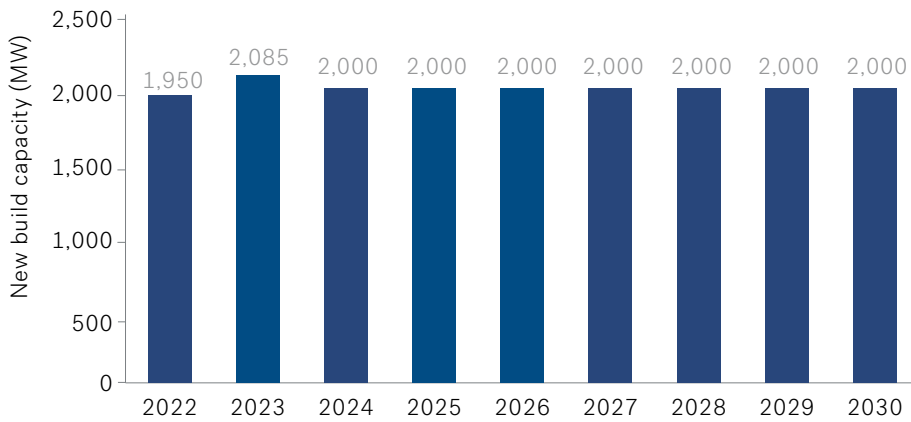
R.E. and Górażdze Cementa. The similar development has continued in the country in 2022 as another PPA is signed for unsubsidized 36MW solar park between Statkraft and Better Energy with expected time to start generating electricity from 2023.

Unlike long terms PPAs, short term PPAs continue to be under explored space by solar sector players, which thus provides a market opportunity. The 5-7 years PPAs are getting the reputation of lucrative options as they are considered safer than 10 -15 years PPAs, subject to dynamic market. However, the rigid framework of the financial institutions is stranding in the way of their development. Yet the energy developers are venturing into various possible settlement options to achieve the optimum results.

As reflected in the regulatory adaptations, the energy storage segment is expected to boom in the Polish renewable market. As the system stabilizes the energy supply, its use on the grid also seems a beneficial option. The amendment to the National Energy Law in terms of incentivizing the energy storage has laid the foundation of extensive market participation in the coming years in Poland.

Outlook

Poland's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook

Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The rapid deployment of solar PV in recent times has improved the overall penetration of renewable energy in the country. The BNEF forecasts of the solar PV builds indicates the overall stable trend that is expected to take place in coming years. The steepest builds are expected to occur in 2023, post which the builds are expected to maintain the steady flow till 2030, showcasing the stable market in future.

The strong performance of solar PV in terms of increasing market participation of the prosumers and energy communities have posed some serious challenges as well, major being the slower coping rate of the required infrastructure. The sudden and rapid expansion of the PV market in terms of uptick in the production and consumption has put pressure on the grid. The slower enhancement rate of the grid network to handle the increased energy supply, has availed the risk of system failure. However, on the bright side, the long-delayed upgrades in the Polish grid are expected to kick start with speedy development of the work in progress.

The Polish government, considering the down-side of the rapid expansion of the solar PV sector, has introduced the new law which is expected to limit the participation. The net metering/billing system under the new law amended the payment system, which regulates the prosumers to sell excess power to the grid at market prices, and to buy back any needed electricity also at market rates unlike earlier when they could take back 80% of the power they put into the grid for self consumption at no charge. Thus, it is no longer as beneficial as it used to be.

These efforts to curb the development of PV sector, thus, are met with opposition across the country with major arguments being the ability of solar energy to safeguard people from soaring electricity prices while supporting the country to wean off the conventional energy sources. Thus, in wake of stronger role that renewable energy would need to play in the economic transition, this curbing of the demand might create an unhealthy market in Poland, putting the prospects of net zero future in jeopardy.

Overall, the solar sector has made its mark in the Polish renewable market, yet there are key areas which need attention to maintain the momentum. The promising growth of the sector is expected to play a decisive role in the Poland's energy transitions and thus needs all the support it needs on regulatory as well as private and communal front.

Portugal

Portugal has progressed remarkably in the renewable energy space, owing to the well-balanced planning and implementation in the country. In the country's renewable mix solar is placed at third place behind hydropower and wind. Nevertheless, geographical location of the country is expected to bring in better prospects for the solar PV sector in near future, subject to the regulatory response.

GDP (Current Prices) USD (2021)	250.053 bn
GDP Growth Forecast (constant prices) (2022-2026)	2.51%
Currency	USD (\$)
Country Credit Rating (S&P)	BBB
Renewable Energy capacity (2021)	15.1GW (2021)
Solar PV Share in Renewables (2021)	12% (2021)
Renewable Energy Target	Improving share of renewable energy in power generation to 80% till 2026, while reducing GHG emission by 45%-55% by 2030.

GDP Source: IMF WEO, S&P and IRENA



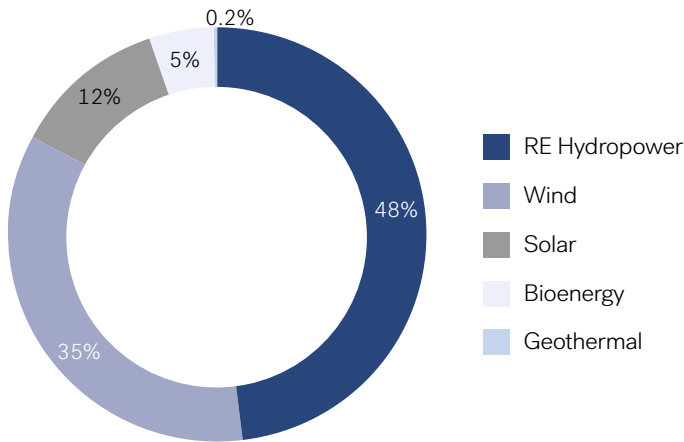
1.8GW Solar PV Capacity

- ✓ **Coal free Portugal since 2021 expanding renewable market opportunities**
- ✓ **Sustained auction process in solar sector throughout economic volatility**
- ✓ **Increasing independence of solar sector over government subsidies**
- ✗ **Complex licensing process discouraging participation in solar sector**
- ✗ **Insufficient infrastructure limiting the sectoral expansion**

Portugal

Renewable Energy Mix

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics April 2022

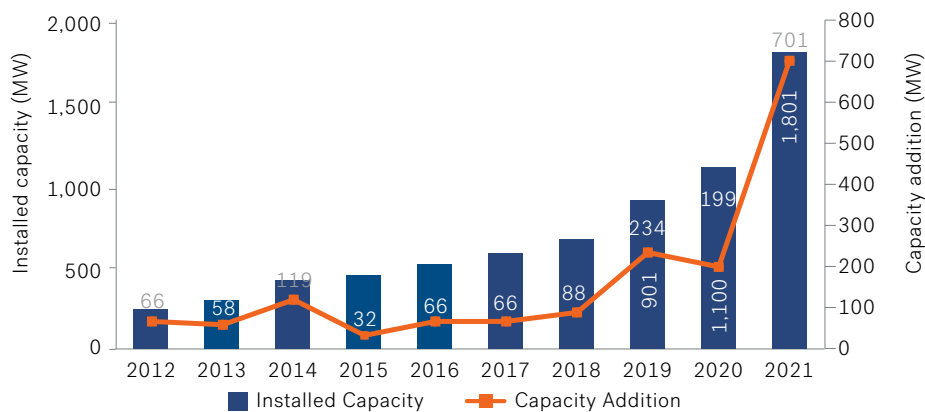
The country seeks to achieve the 2050 net zero target with shorter term targets to boost the overall transformation of the economy. Initially Portugal set a 2030 goal of reducing the GHG emission by 45% - 55% compared to 2005 level, along with expanding renewable energy's share in electricity generation to 80% from current level of 60%. However, the timeline for the latter is upgraded to 2026, indicating the rampant efforts the government plans to take. Notably, adhering to the phase out of the conventional resources, by end of 2021, Portugal

became coal free country, ahead of its targeted timeline, by shutting down the last coal-fired power plant in November.

Renewable hydropower bears the strongest position in Portugal's renewable energy mix with 48% share as of 2021. Solar PV represented the 12% share in the mix in 2021, growing from 2% in 2011. In wake of rapid growth of wind sector, solar sector saw years of comparatively lower activity in the country, although it has potential to play more significant role in the transformation.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

The total solar capacity in Portugal has seen stable but slower growth over the years. Since 2012, the annual solar capacity additions have experienced sluggish trend, with lowest additions taking place in 2015. The slower trend continued till 2020, when the pandemic outbreak hit the overall economic activity in Portugal.

In 2020, the Portuguese government, through recovery plan, tried to contain the fall in the overall renewable sector. Amidst pandemic led dipped economic growth, Portugal launched energy efficiency

plan in the context of Economic and Social Stabilisation Program during H2 2020 with budget of €4.5 million to promote the energy efficiency of the country. These resilience measures supported the solar sector as well, resulting in uptick in annual capacity additions in 2021 thereby taking the cumulative installed capacity to 1.8GW.

Demand Drivers

The sunny weather coupled with the comparatively cheaper PV system in combination with attractive financing costs has led to significantly reduced levelized cost of energy for solar PV in Portugal. The new rules introduced in 2019 to support rooftop solar PV systems in the country continued to boost the market demand even two years later. While, on budgetary side, to facilitate the solar usage in agriculture, the ministry of agriculture allocated around €10 million for solar projects under its Small Investments in Agricultural Exploration programme. Such investment deployment is expected to pull hybrid business in the country, in a way deepening the penetration of the energies involved.

Among other schemes, solar tendering with state-guaranteed feed-in-tariffs have been among the major demand drivers of the sector. The scheme supports the smaller PV systems, micro and mini by allowing the sale of excess power to the grid in accordance with electricity market tariffs. Second of such beneficial scheme is 'self-consumption scheme' that encourages installation of PV systems for individual as well as for collective consumption.

In Portugal, auctions process has been used historically to encourage participation in the solar sector. Despite wind being the second major sector in the renewable space, the extensive energy generation, driven by FiT lasted during until 2012, as it got scraped as soon as the financial crisis hit the Portuguese economy. Since then, the wind sector activity deemed, with more focus provided to repowering the existing projects rather than developing the new ones. However, during the tough times, government maintained

the steady capacity allocation in solar PV sector through auctions and the trend continues.

The auctions process has imparted competition in the Portuguese solar market by achieving most economic prices during the tendering process. Additionally, the government implied leeway showcases the availability of the support whenever needed, such as timeline extension till 2021 to complete the project licensing for the winning bidders of 2019, due to COVID 19 outbreak led disruption. In the recent renewable auction held for Floating PV projects, total capacity of 183MW was awarded, of which 56% i.e. 103MW was awarded under contract-for-difference regime. The auction recorded most competitive prices in two slots, €0.04103/kWh and €-0.0413/kWh, equivalent to 110% discount on the ceiling price initially set by the government. EDPR, Finerge, Voltalia and Endesa were among the winners of the auction, with major solar PV project plans for Portugal.

Power purchase agreements supporting the merchant solar in the country hold promising prospects, as reflected in the recent growth in the participation. The international players are actively participating in the PPAs and are setting up unsubsidised solar parks. The energy developers such as Axpo Iberia, Newcon Energy along with others are entering the Portuguese solar space, which as of Q1 2022 has around 80 solar PPA projects with a volume of approximately 17GW on the platform of the Directorate General for Energy and Geology (DGEG).

Market Opportunity

The investment injected by Portuguese government in support of international institutions is broadening the spread of the solar activities in the country. In June 2021, European Commission (EC) endorsed Portugal's €16.6 billion recovery and resilience plan, of which €13.9 billion are in the form of grants and €2.7 billion are in the form of loans. The 38% of the proposed budget will be allocated to the climate objectives such as improving the energy efficiency by promoting the usage of renewable energy including solar PV.

The sector specific targets set in the country are expected to be the major driver of the market activity in coming years. The country aims to reach 9GW of the solar capacity by 2030 from current level of 1.8GW, which requires at least 1GW of the annual capacity installation. This ambitious renewable energy target coupled with fiscal support brings in best of the scenarios for the participation in the solar sector.

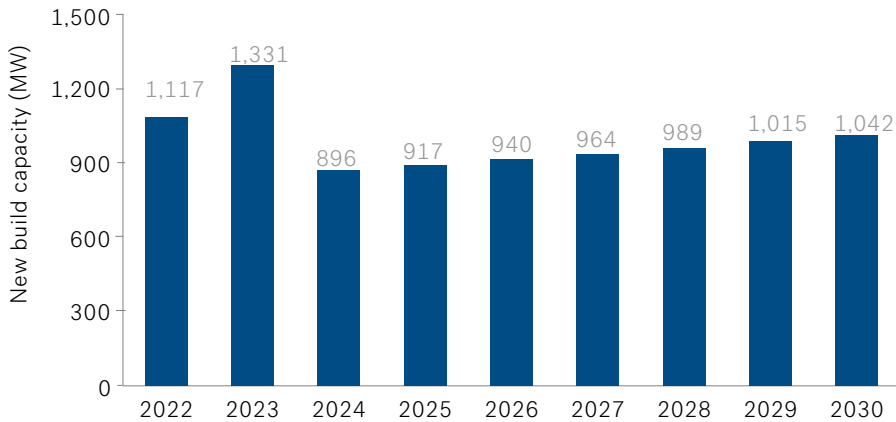
High solar irradiation level of Southern Portugal has already captured attention of energy developers and thus country's

major solar development has taken place in the region. Portugal's largest unsubsidized power plant, Riccardo Totta Photovoltaic Plant, with capacity of 219MW, is situated in Algarve region and became operational since Q4 2021. Another major project that is coming online in H2 2022 is the floating solar park built on Alqueva reservoir with an ability to generate 7.5GWh annually with lithium batteries that can store 2GWh. The presence of such projects has added to the attractiveness of the region with the prevalence of competitive price mechanism.

PV projects with battery-based energy storage presents attractive market opportunity in Portugal, due to it being in expansionary phase. By end Q1 2022, Endesa Generación Portugal got the connection rights to develop renewable energy park with solar - 365MWp and wind - 264MWp, that also comprises 168.6MW BESS. Going forward, such multi-technology hybrid parks seem to be the preferred choice for the renewable developers.

Outlook

Portugal's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

Portugal has taken up the development of supportive infrastructure for solar PV sector, with a view to pave the way for scope of expansion. Accordingly, in 2019, the process to connect to the electricity grid was amended which involved reservation of the grid network capacity for the electricity generation projects beforehand. The objective behind the amendment was to foster renewable deployment ensuring the sufficient grid support. However, the reform could not bring in expected development in the grid network as the problem of insufficient infrastructure persists.

The BNEF forecasts of solar builds in the country indicates the overall expansion in the sector during 2022-2030. After the highest solar PV builds expected to take place in 2023, the activity is projected to dip in 2024. Nevertheless, thereafter till the end of the forecast period, slower yet stable growth in the PV builds is estimated to occur. However, the level of solar PV builds by 2030 is projected to be lower than the level achieved in 2023.

One of the major challenges faced by the solar PV sector is the complexity of the licensing process, which has limited the investment base in the solar space by discouraging the developers' participation, impacting the overall energy demand in wake of ambitious net zero target. Thus, there is an urgent need to provide more simple process for such licensing, which will be beneficial for whole renewable sector.

Overall, the solar PV sector in Portugal is underdeveloped as it lags in supportive infrastructure as well as regulatory measures. Solar PV being regarded as the prospective primary contributor to Portugal's net zero goal, a cohesive strategy is required to unlock the full potential of the sector. This includes publishing a timetable for solar PV auctions, setting higher auction volumes and accelerating deployments to boost investor confidence.

Spain

Spain has made a major commitment to green energy for the next decade and beyond. Under the National Energy and Climate Plan, Spain seeks to reduce greenhouse gas emission by 23% by 2030 compared to 1990 level. The country also aims to increase share of renewables in energy end-use to 42% along with 74% share of the renewables in electricity generation by the same time period. To this regard Spain has envisioned a three-pronged strategy: i) the promotion of large generation projects; ii) deployment of own consumption and distributed consumption; and iii) measures to integrate renewables into the electricity system and market. In support of the second strategy, the Spanish government is working towards having solar capacity of 9GW under self-consumption segment by 2030, which can also increase to 14GW if the market optimism stays up.

GDP (Current Prices) USD (2021)	1,426.22bn
GDP Growth Forecast (constant prices) (2022-2026)	2.99%
Currency	Euro
Country Credit Rating (S&P)	A
Renewable Energy capacity (2021)	61.5GW
Solar PV Share in Renewables (2021)	26%
Renewable Energy Target	2030 target of GHG emission reduction by 23% along with renewable target of having 42% in energy end use and 74% in electricity generation

GDP Source: IMF WEO, S&P and IRENA



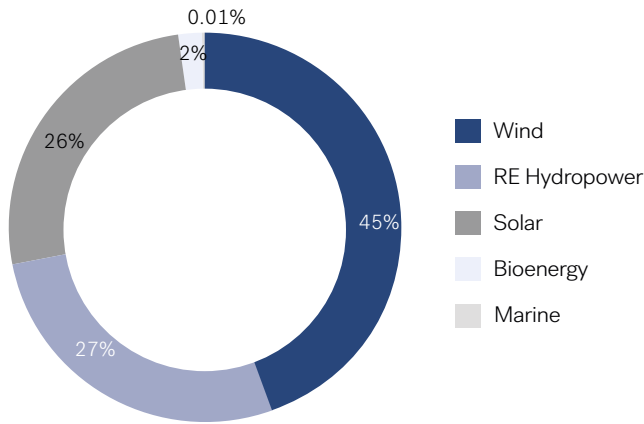
13.6GW Solar PV Capacity

- ✓ **Government objective of having 9GW - 14GW solar capacity under self consumption**
- ✓ **Increasing financial backing for renewable PPAs**
- ✗ **Permitting bottlenecks hampering project timeliness**
- ✗ **Transmission and distribution networks in need of more regulatory focus**

Spain

Renewable Energy Mix

Current Renewable Energy Mix

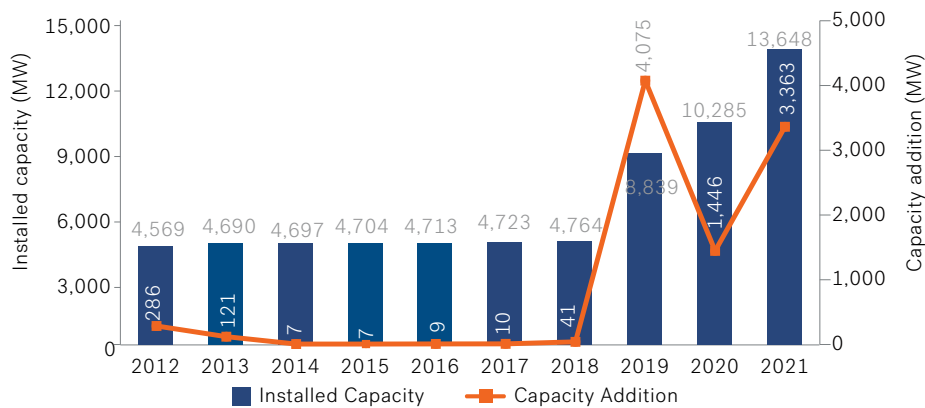


Source: IRENA Renewable Capacity Statistics April 2022

The share of solar energy in the country's renewable energy mix seemed to have gained momentum. Solar energy's share stabilized at 15% till 2018, but elimination of the sun tax by newly formed government drove the demand up, resulting in its improved share of 20% in 2019. The share grew further to 22% in 2020 and in 2021, solar energy's share in renewable energy mix reached 26%.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Spain is one of the renewable energy leaders in Europe, in terms of solar PV capacity additions. However, unlike other European front runners such as France and Italy, COVID-19 did have an adverse impact on the capacity additions in the country. The lockdown measures implemented during pandemic outbreak in 2020 pushed the energy demand down, leading to annual drop of 65% in the capacity additions. Additionally, the ongoing projects as well as new entries faced delays in implementation, which discouraged the capacity further

compared to that of in 2019.

Nevertheless, Spanish government took efforts to bring in recovery in the renewable energy sector. For instance, government allotted a package of EUR181 million for renewable projects including solar PV out of the total renewable support budget of EUR316 million introduced in H2 2020. Such monetary support provided in the country during tough times led to an annual jump of more than 100% in solar PV capacity additions during 2021. Through the recovery obtained during aftermath of pandemic outbreak, total solar PV capacity in Spain reached 13.6GW by end of 2021.

Demand Drivers

Spanish government is encouraging self-consumption of renewable energy to expand the penetration at individual consumer level. Solar energy, notably, is the most preferred renewable source for the self-consumption in the country on the backdrop of soaring electricity bills and cost-effective nature of the resource. The incentives provided by the government include zero extra cost for energy generated and consumed by solar panels installed in homes, enabled by elimination of 'sun tax'. Secondly Spain has also sanctioned grants for solar projects as well as battery system projects along with other renewable energy projects to spur the investment injections.

Renewable energy auctions play a vital role in energy transition and hence Spain reintroduced the auctions for period of 2020-25. After the gap of three years two auctions were held in 2021. In the January auction, out of 2.9GW allocated capacity around 2.03GW was awarded to solar PV projects, with an average price at €24.47/MWh. While in the October auction, total 3.1GW capacity was allocated to wind & solar, out of which 2.3GW corresponding to wind and remaining 0.8GW to solar power. The winning solar projects had tariff ranged between €0.0244 per kWh and €0.0349 per kWh, which is quite competitive with conventional technologies. Overall, the government plans to auction

around 5GW of renewables capacity annually between 2020-2025, with solar PV accounting for the largest share.

Although, auctions are considered to be the main policy support tool for the development of renewable technologies in the country, this alone would not be sufficient to reach the ambitious capacity targets embodied in the NECP for the period 2021-30. Additional capacities are likely to come from corporate PPAs, utility bilateral contracts or self-consumption. Solar energy, being the dominant sector in PPA contracts, accommodates wide range of industries' active participation such as food and telecom. In 2021, Spain dominated the European PPA market, with around 4GW capacity contracted. The rise of unsubsidized solar power projects and the advent of merchant projects helped to boost confidence of the banks to provide financing and attract investor interest in the industry. However, considering the price volatility caused unstable PPA environment, Spain, In February 2022, proposed European Investment Bank (EIB) to provide financial backing to scale up the PPAs bilaterally. Additionally, Spanish government also has requested EIB to develop EU-wide instruments to enable private banks to finance local renewable solutions.

Market Opportunity

During the pandemic outbreak as well as in the aftermath, Spanish government continued the investments and funded injections in the renewable energy market. The Recovery, Resilience and Transformation Plan of Spain has the total budget of EUR72 billion to be utilised during 2021-2023, of which 37% is dedicated to ecological transition.

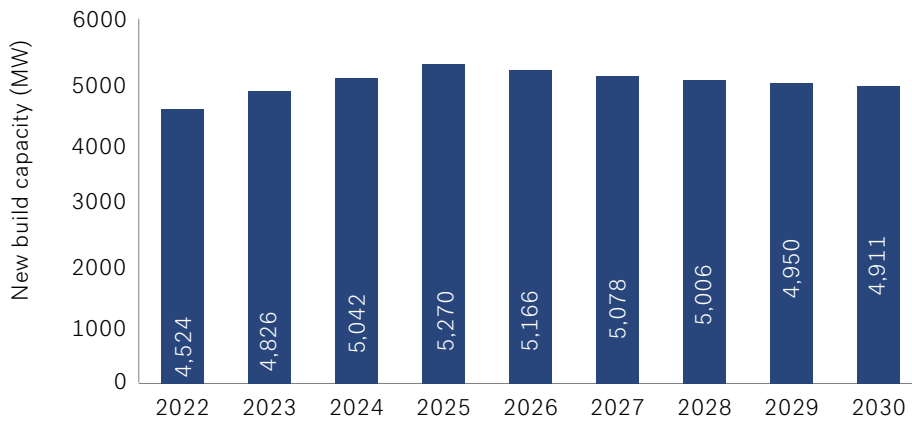
European Investment Bank (EIB) has extended support to the renewable sector by providing EUR100 million to alternative investment management firm Ben Oldman in form of unitranche loans for the construction of solar PV and onshore wind projects in the Iberia region. This financial backup is expected to generate around 430MW of renewable energy along with bringing in economic benefits. These new projects will contribute to job creation and will help improving energy supply in the countries. The agreement holds during 2021-2024, without PPA to receive the agreed finance.

The Spanish government's planned phaseout of coal and nuclear power plants to reduce the over dependency on fossil fuels, coupled with efforts to bring down the high wholesale electricity price on the back of high gas and carbon prices would bring in attractive opportunities for the renewable sector to deploy additional capacities at pace. By 2030, four of seven nuclear reactors in Spain are scheduled to shut down, with which the opportunity to generate clean energy of about 4GW will be presented.

Among the latest notable developments in the solar PV sector, Spanish power utility Iberdrola plans to commission the 590MW Francisco Pizarro project in Caceres, Extremadura, the largest solar farm in Europe. Through materializing its sizeable development pipeline, the utility plans to double its renewable energy capacity in the region to 5.5GW by 2023.

Outlook

Spain's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

Post pandemic outbreak, more focused institutional approach towards clean energy provided momentum to the solar PV sector in Spain. The steady expansion in the market continued, owing to soaring energy prices and thus spiked demand for the renewable resources. On the other hand, reducing technology prices and growing economies of scale placed solar PV as the most viable backbone of the “de-carbonisation” of Spanish energy supplies.

In case of Solar PV builds, data projections show steeper growth till 2025, when it reaches the peak. However, thereafter the annual PV builds start declining, albeit at slower pace till forecasted period of 2030. Nevertheless, by 2030, the capacity builds are projected to exceed current level, highlighting improved penetration of the technology in the country's energy mix.

Despite all the encouragement given to the solar projects, one major challenge faced by participants is the procedural delays. Due to permitting bottleneck, many development-stage projects either get delayed or derailed from the targeted timeline. However, to address the issue, recently Spanish government has upgraded its environmental rules to accelerate the development of solar projects. One of the major changes under implementation includes speeding up the permit process of solar projects with capacities up to 150MW. These streamlined processes are expected to halve the time it takes to receive permits to around two years, thus supporting the growing demand in the sector.

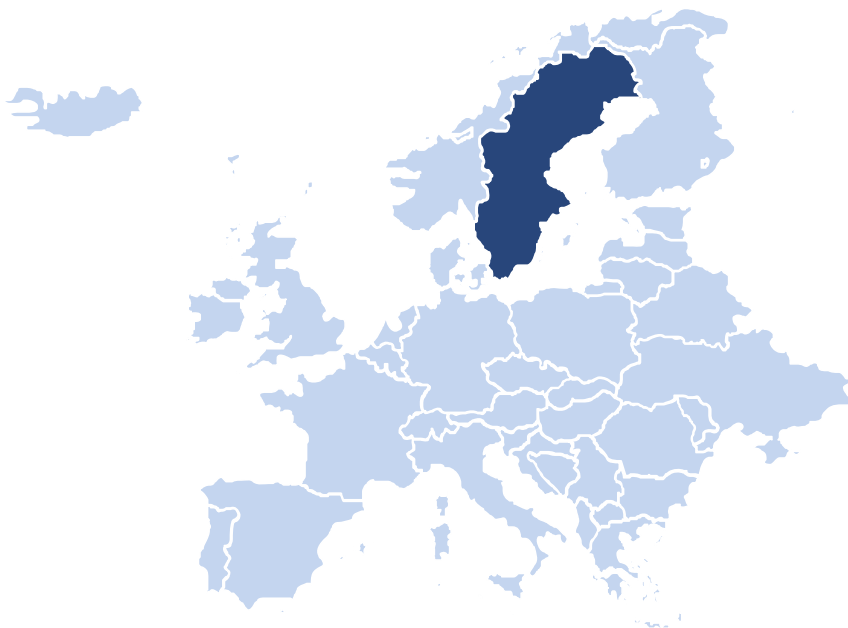
Development of adequate transmission and distribution networks is another key area to address to integrate new renewable capacity into the grid. Spain has begun to pass through a new 2021-2026 plan for transmission networks aimed at facilitating an increase in installed and supply capacity for new renewable energy facilities. However, that will entail significant investment from public and private sector.

Sweden

Among the European Union (EU) countries, Sweden ranks highly for the focus on renewable energy. It is one of the three EU countries where renewable energy is over a third of the total electricity consumption. The country also topped World Economic Forum’s Energy Transition Index 2021 for the progress toward a zero-carbon economic setup. The growth of the Swedish solar PV market has evolved in such a context.

GDP (Current Prices) USD (2020)	627.44bn
GDP Growth Forecast (constant prices) (2021-2025)	2.41%
Currency	Swedish Krona
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2021)	34.5GW
Solar PV Share in Renewables (2021)	5%
Renewable Energy Target	Net Zero Economy by 2045 and by 2040 complete decarbonization of power sector

GDP Source: IMF WEO, S&P and IRENA

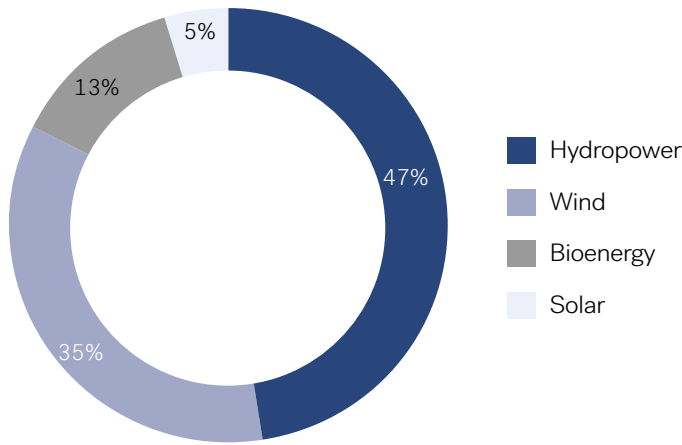


1.6GW Solar PV Capacity

- ✓ **Zero-carbon economic setup to boost solar PV market**
- ✓ **Strengthening budgetary support and tax benefits**
- ✓ **Growing share of rooftop solar in residential and C&I segment**
- ✗ **Over dependence on hydropower and nuclear energy for generating electricity**
- ✗ **Issues regarding timely grid connectivity**
- ✗ **Procedural delays hindering the expansionary trend of solar PV market**

Renewable Energy Mix

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics April 2022

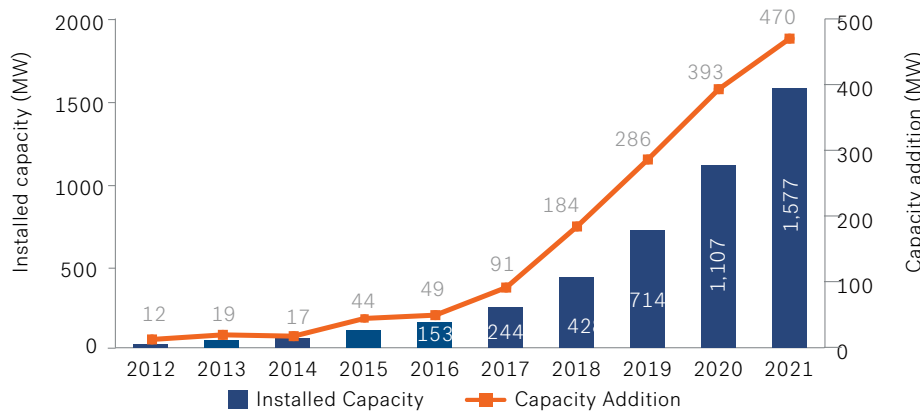
Solar power has a relatively minor share in contributing to Sweden's renewable energy generation – the bulk of it being through hydropower and wind. Thus, there is a broad scope to explore for potential investors and developers. The interest from developers is reflected in developers lately seeking solar power parks in the country's southern region, as the north appears skewed and saturated for renewable capacities.

The trend in solar PV share in total renewable capacity highlights the

rising significance of solar. Between 2012 and 2015, the share of solar power was 0.2% - 0.6%. By 2018 it rose to 1.5%, and by end-2021, it held 4.5% of the total installed renewable energy capacity. A combination of factors contributed to such a trend. The subsidies and fiscal benefits helped incentivize the market. At the same time, subsidy-free merchant-based utility-scale capacities show a gradual rise.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

The trend shows a sharp acceleration in capacities since 2017. Incremental capacity addition rose from less than 100MW in 2017 to 470MW by the end-2021, marking the previous year as the best one yet. The spike in capacity deployments could also be related to the post-pandemic backlog that arose from delayed construction at sites (due to which an extension was granted in the projects considered for Solar Rebate Scheme).

The capacity growth achieved is also notable because over half of them are from projects with unit sizes less

than 20kW. The ones with sizes ranging between 20kW and 1MW have a relative share of 42% of total installed capacity. The utility-scale projects, which have unit sizes of 1MW and above, are just 8% of the total installed base.

Sweden's solar PV capacity is thus characterized by small-scale systems deployed for residential and commercial/industrial consumer segments. Growth in this segment can be attributed to the government's Solar Rebate Scheme, which actively incentivized this segment. However, it remains to be seen how the market will respond since the scheme was closed in 2021 to be replaced with some tax breaks.

Large-scale PPA-linked solar PV projects are gradually picking up in the market, as observed in the recent announcements by developers and investors. As per a study from Chalmers University of Technology and Uppsala University, the Levelized Cost of Energy for unsubsidized solar PV plants stood at an estimated €0.027 - €0.049/ kWh in 2019-20. Revenues of such plants are based on the spot power market sale and/or the tradeable certificates.

Demand Drivers

Under the Solar Rebate Scheme, the government had a policy of subsidizing the residential PV systems. The scheme closed for new applications in July 2020 and was replaced by offering tax reduction for such technologies that reduced the PV systems' cost by 14.5% of the total capital cost for private persons. In addition to this, there has been a tax credit scheme available since 2015 for PV systems with a unit size up to 69kW.

In April 2021, the Swedish government announced an additional SEK260 million of budgetary allocation towards residential PV systems under the country's Solar Rebate Scheme for rooftop solar. The subsidy support announced was meant only for private citizens and added to the similar amount of allocation done in December 2021 for municipalities and businesses. The Swedish Energy Agency devoted about SEK4.8 billion to the Solar Rebate Scheme that ran during 2009-2021 and was instrumental in propping up the country's solar PV capacity growth.

Rooftop solar continues to be the market driver, whether it is for the residential or commercial/industrial segment. The growth of distributed solar PV systems spurred the short-term power market in Sweden – with utilities and short-term traders competing for power supply available from residential or commercial PV systems. With the effective implementation of smart metering systems, households and commercial units become micro-level producers of power bought at attractive rates by various market participants.

Sweden's smart grid initiatives, though underway at a limited scale, could potentially boost the case for the solar PV market. Among recent notable examples is the deployment of such technology in the city of Ludivika where PV panels, thermal energy storage and heat pumps were installed in retrofitted buildings and interconnected through a micro-grid. This led to a "prosumer" cluster of residential buildings that produced instead of just consuming power. When replicated at a scale, this could open a vast opportunity for residential solar PV systems.

Market Opportunity

The merchant power segment is slowly finding traction. In March 2022, the Finnish renewable energy investment company Korkia and Swedish developer Recap entered a joint venture for 200+MWp of solar PV capacities in Sweden to be installed over the next four years. The venture aims to sell the projects at ready-to-build status to long-term investors. The energy sale is planned in either a full merchant revenue mode or through the corporate power purchase agreement (PPA) route.

Large corporate entities seek solar PV as one of the options for their energy requirements in the business. In April 2022, Swedish retail group Axfood announced plans for a rooftop solar plant at one of its facilities. The company will be procuring the output of this 8.9MW plant under a 25-year PPA.

In 2021, the renewable energy firm HP Solartech announced a deal with SunSpark, with the latter funding the installation of 40 solar energy parks in the country's southern region. The project assumes significance because the country's energy consumption is primarily based in the southern part.

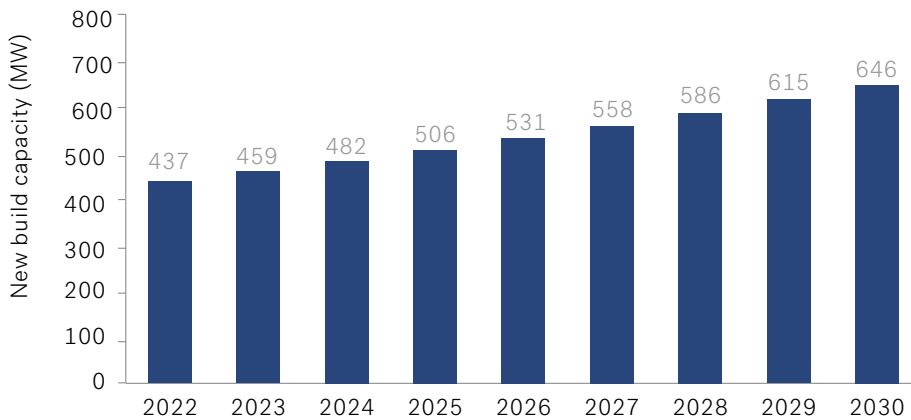
In contrast, most power generation capacities are skewed towards the north. The planned solar parks are slated for commissioning between 2023 and 2024.

The investor interest in the upcoming southern region capacities appears to be picking up. In March 2022, the Switzerland-based special fund FP Lux Investments announced the acquisition of 90MW worth of solar park projects to enable entry into the Swedish solar market. The capacity was acquired from SunSpark, and the commissioning could be expected over the next two years.

Accelerated deployment of solar PV parks is driving expansion in the power transmission network. In January 2022, the transmission system operator Svenska Kraftnat put forth its plans for USD1 billion worth of investment towards adding transmission lines for the northern region where the network faces an impending strain due to industrial demand and the renewable energy projects (wind and solar). The planned investment is tentatively for three new transmission lines and converter stations.

Outlook

Sweden's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook

Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

Sweden's Solar PV market outlook is characterized by the advent of solar PV parks and rooftop solar systems in residential/commercial segments. While the rooftop solar segment is likely to find traction in fiscal incentives, the solar parks will be led by opportunities in the merchant power market.

The rise in merchant/unsubsidized solar capacity is essential in expanding the project pipeline. In August 2021, the Swedish PV developer Helios Nordic Energy announced 500MW of new unsubsidized projects in Southern Sweden, bringing its pipeline to about 1GW. Other similar examples of unsubsidized power projects being picked up include the solar developer Alight's 8MW solar park with a 10-year PPA and 18MW part with a Swedish restaurant and catering specialist entity.

While there is a broad scope to enhance the role of solar PV in Sweden's energy consumption basket, the predominant share of hydropower and nuclear energy leaves little in terms of a long-term opportunity. Furthermore, the country's renewable energy segment is dominated by wind power, while solar entered the fray much late. It will thus be an important consideration ahead as to what opportunities are laid out for the prospective investors.

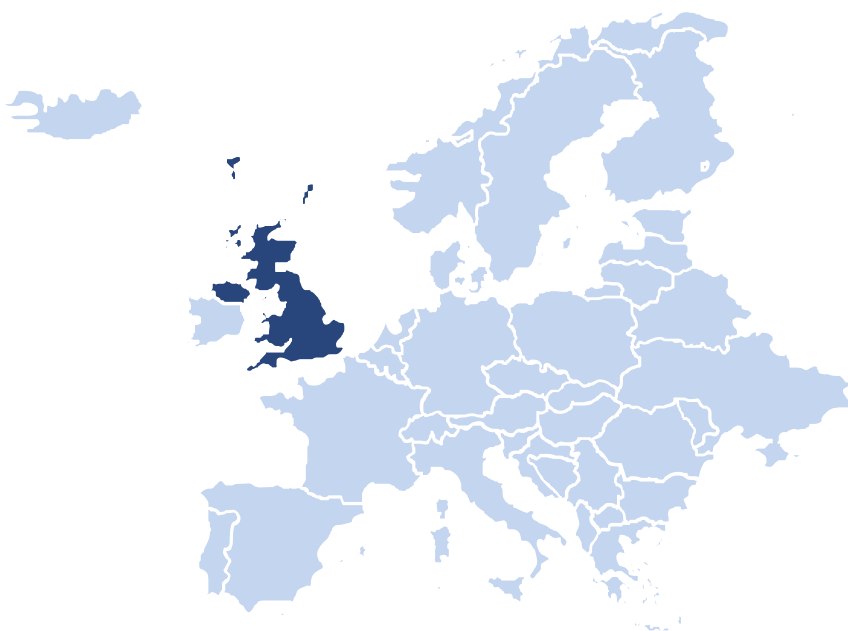
The large-scale solar PV market is ripe for tapping into the unsubsidized or merchant power market. It is yet to pick momentum, as has been the case in the wind power market. Part of the issues hindering this market segment is the challenges in securing timely grid connectivity and the delays in obtaining permits from many local authorities. Such uncertainties often make it difficult to draw up a financially viable business case that can appeal to prospective investors. The ongoing initiatives by the transmission system operator for enhancing grid capacity will thus be keenly watched.

United Kingdom

By end of 2021, UK's total renewable energy-based power generation, at 121.9TWh, was about 40% of the total power generation injected in the network. The contribution appears marginally lower than that of the previous year's 43%. With wind energy as the predominant source, solar PV ranks at the second place in terms of total capacity share.

GDP (Current Prices) USD (2020)	2,758.87bn
GDP Growth Forecast (constant prices) (2021-2025)	3.22%
Currency	Pound Sterling
Country Credit Rating (S&P)	AA
Renewable Energy capacity (2021)	50.3GW
Solar PV Share in Renewables (2021)	27%
Renewable Energy Target	Net-zero emissions by 2050

GDP Source: IMF WEO, S&P and IRENA



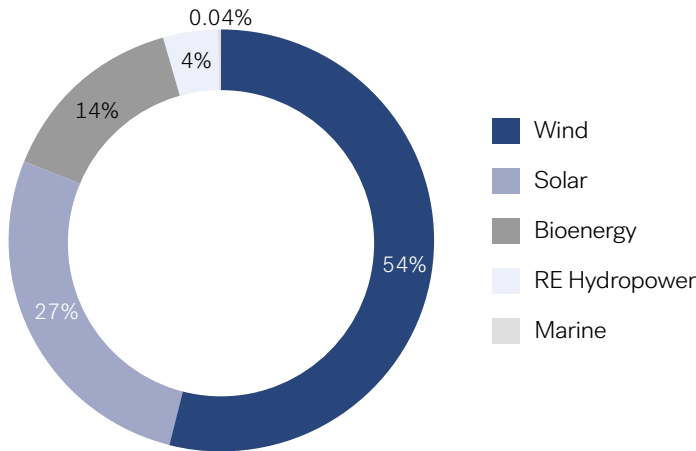
13.7GW Solar PV Capacity

- ✓ CfD auctions play significant role in market expansion
- ✓ Growing support of local governments for solar PV
- ✓ PPAs are emerging as viable alternative for developers
- ✗ Solar sector has been devoid of required policy support
- ✗ Issues related to network bottlenecks

United Kingdom

Renewable Energy Mix

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics April 2022

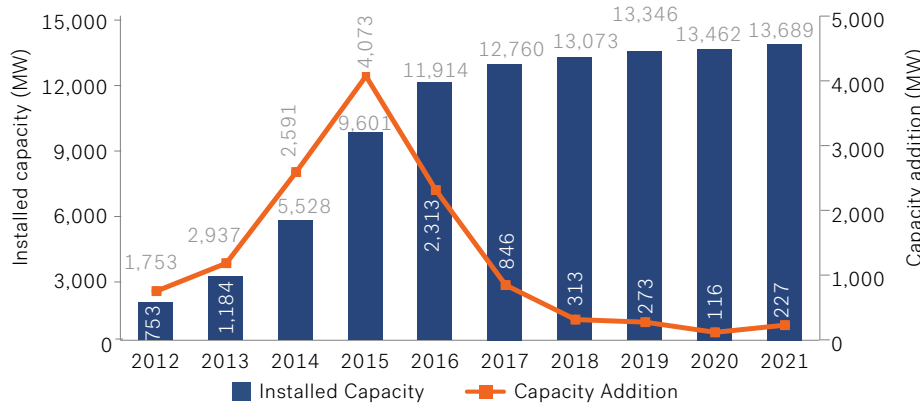
The trend shows a declining contribution of solar PV in UK's total renewable energy mix. The fall has been consistent – from about 34% in 2016 to 27% currently. This could be a culmination of several factors such as the pandemic-led disruption in construction of utility-scale capacities, the rationalisation in subsidy support and the relative competitiveness in other technology options.

All the same, a recovery is underway, reflected in the relatively stronger incremental capacity of 2021. Rise

in subsidy-free projects indicates the shift away from the conventional subsidy-led model to one based on commercial strength. Also important is the renewed push at utility-scale projects, that will help improve the otherwise stagnating capacity trend. It also helps that the CfD auctions resumed in December 2021, strengthening the solar PV case.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

The trend in solar PV capacity points to a sluggish growth, after a phase of acceleration. Between 2018 and 2021, on an average about 230MW of capacity was added. This rises marginally if the year 2020 is ruled out for the pandemic restrictions. Yet, such a capacity addition rate contrasts with the phase during 2013-2016, when average annual capacity addition exceeded 2,000MW. The rationalisation in subsidy support has been one of the factors that impacted the project pipeline.

All the same, the industry shows

signs of turning a corner. In 2021, the capacity addition was a subsidy free one and was led by growth in all the segments including residential, commercial/industrial and utility-scale. The growth in utility-scale projects, many of which were impacted by the disruption from pandemic, is important for the capacity growth.

The steady growth in capacity pipeline of large-scale projects indicates a possible recovery in capacity addition. By end of 2021, the UK had around 900 solar farm sites (each project at 5MW and above) adding to about 37GW capacity. There was a spike in the number of planning applications submitted for solar PV projects in 2021, reaching 3,542 against the 931 in previous year.

Demand Drivers

The 'Contracts for Difference' (CfD) is the main instrument of UK government's funding in low-carbon electricity generation. CfD auctions involve power generators bidding for a strike price of the power they will supply. Any difference against the day-ahead wholesale price gets compensated for by the government (in case of a higher strike price) or the generator (higher wholesale price). The fourth round of capacity auctions opened in December 2021, wherein solar was included for the first time since 2015. The allocated budget was capped at GBP10 million annually. Typically solar PV projects greater than 5MW can bid for the competitive government funding under CfD.

With limited policy support over the years, the onus of promoting solar power is on local authorities and the private entities. For instance, the GBP500 million Local Authority Delivery scheme, which includes solar PV as an eligible technology, seeks upgrading of 50,000 homes in terms of their energy efficiency. It is part of the GBP2 billion Green Homes Grant scheme, to aid the local authorities energy residential units' energy efficiency upgrades.

Regulatory requirements have helped promote the residential solar segment. The new Part L Building Regulations specifying a 31 % improvement in sustainability is a crucial element of the required Uplift to Energy Efficiency requirements in new homes from June 2022. Rooftop solar is seen as one of the easiest routes to ensure compliance by housebuilders. Furthermore, in March 2022, the government exempted the value-added taxes on solar modules related to residential PV systems, reducing it to zero from 5% earlier. Such exemption

will be valid for next five years, after which it will revert to the original 5% level.

Of late, the corporate PPAs are finding traction for financial returns (and not just for energy cost or renewable energy objectives). This refers to the rise in virtual corporate PPAs, wherein, the corporate buyer doesn't own the asset (or the energy generated), but instead avails of the cash flow under certain terms as well as the renewable energy certificates (REC) as applicable. In February 2022, Barclays signed a 10-year PPA with BP for solar/wind-based energy sourcing in its UK business. The PPA entails purchasing up to 250GWh of energy annually together with RECs arising from new-build capacities due by 2025. During the same period, the solar developer and asset management company NextEnergy Capital signed a virtual PPA with Goldman Sachs for three UK-based solar projects due in 2023. For Goldman Sachs, the PPA-linked capacity is aimed at addressing both its UK electricity demand as well as the renewable energy sourcing commitment.

The commercial viability of the battery-based storage technology complements the solar and other renewable energy projects for enabling grid supply commitments. Solar-plus-storage is thus an emerging segment of upcoming solar PV investments. An example in point is co-development agreement between Public Power Solutions and Hive Energy and Ethical Power (as of January 2022) for 250MW worth of large-scale solar and battery projects in the UK. Of this, the first one is a 45MW co-located solar and battery storage project.

Market Opportunity

The UK government aims to hold CfD auctions every year starting March 2023. This, together with the re-introduction of solar in the auctions of December 2021, makes for an optimistic picture for solar projects. The latest round of auction promotes 3.5GW worth of solar capacity with a budget of GBP10 million per year. While there is a significant scope to expand this, it is regarded as a belated realisation from policy authorities for reviewing solar PV funding.

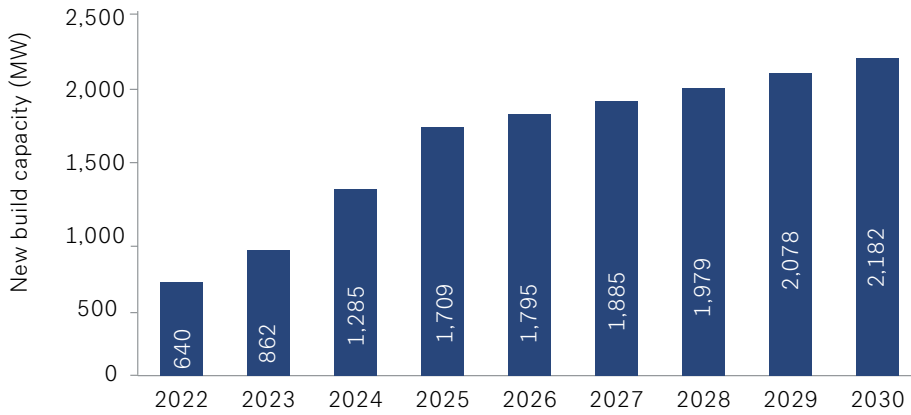
The investments in subsidy-free solar PV appears relatively stronger over the years. In May 2021, Triodos Bank UK announced lending for the subsidy-free 19.2MW Ray Valley project, also marked as UK's largest community-owned solar project. In December 2021, the UK Infrastructure Bank marked its first private sector deal with NextEnergy Capital, for the latter's planned GBP500 million worth of fund, targeted at subsidy-free solar PV projects in the UK. Similar interest is observed from the funding support being raised by other developers. In March 2022, the independent renewable energy company Anesco received a revolving credit facility GBP12 million from Santander UK for its three solar farms (among others) at ready-to-build stage.

The steady project pipeline for solar farms in the UK points to the rising investor interest across the spectrum. In September 2021, the UK pharmaceutical company GSK announced a GBP50 million investment in setting up wind and solar farms (20MW) at its production locations. This is indicative of the role solar PV can play in the industrial energy procurement, as a competitive option to the conventional energy utilities.

Expansion in solar PV project pipeline opens up the scope for leading global developers, among other key players. It is thus pertinent to note that Iberdrola has lately emerged as among the leading solar developers in the UK. Through its UK subsidiary ScottishPower, it has projects worth GBP500 million currently under development. The competitive space meanwhile finds other notable entities marking their presence. Partly reflecting the role of solar PV in energy efficiency, the global green building construction company Multiplex announced (as of November 2021) its plans to set up a 15MW solar farm to power its UK-based sites.

Outlook

UK's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

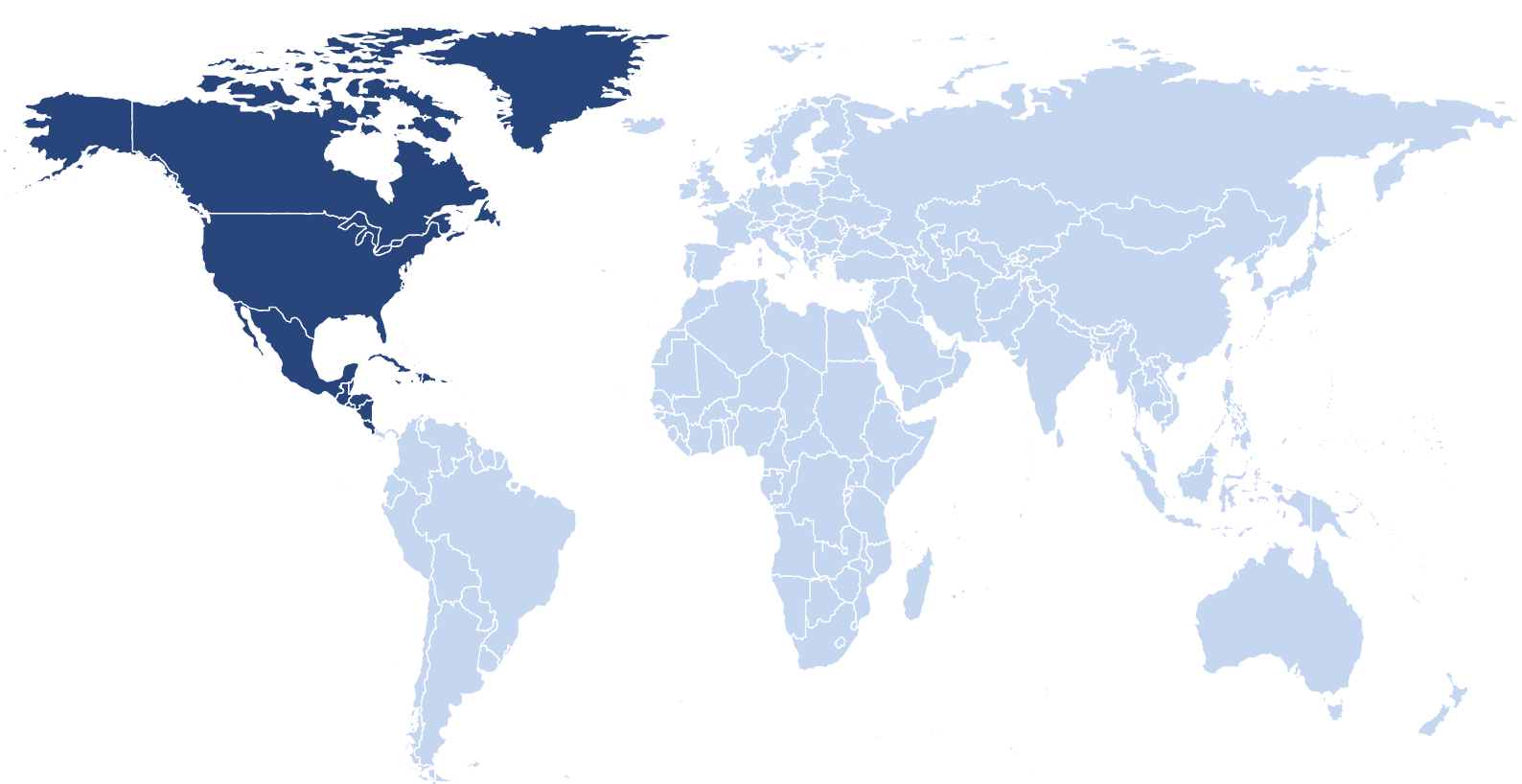
Solar PV will have a key role to play in the UK government's objectives at decarbonization of the power sector by 2025. It is in this backdrop that the sustained recovery of the project pipeline and the rise in subsidy-free projects become important. Government funding, or any such related support is unlikely to be a factor in this regard. Instead, the business case could be shaped by a combination of the costs of utility-scale solar (vis-à-vis the bulk power or wholesale rates) and the complementary battery-based storage options.

Despite a favourable backdrop, the expectations of UK's solar PV industry should also be tempered by its relative position in the overall renewable energy segment. Wind energy shares the predominant share and has been promoted accordingly over the years in policy support. Solar PV was excluded from the CfD auctions in the last six years or so and was included in the latest December 2021 auction. The next line of focus in policy funding appears to offshore wind power projects. Furthermore, the funding support for low-carbon energy now also includes nuclear energy.

At an infrastructure level, the rise in commissioning of renewable energy projects (solar together with others) would necessitate greater provisioning of power transfer capacity in the existing transmission lines' asset base. Network bottlenecks could constrain the project pipeline and investments. Some of the steps underway indicate prioritisation. In May 2021, the National Grid Energy Transmission took to deployment of SmartValve modular power flow technology, due to which about 1.5GW worth of network capacity could be freed up.

Overall, the industry's expected growth will be a function of multiple factors, including the competitive options at play between the renewable energy technologies, relative cost advantage offered by the solar PV projects against conventional energy in wholesale power markets, and the timely availability of requisite infrastructure and approvals for maintaining a steady project pipeline of solar PV builds.

Key Regional Markets - North America



Canada

Canada is a relatively nascent solar market when compared to its neighbour the US. However, commitment towards solar energy is observed to be growing recently to meet its net-zero vision by 2050. Despite considerable challenges posed by the global pandemic, Canada continued to see significant activity in both large-scale solar and wind-energy on the back of significant cost reductions of renewable technologies, technological improvements and growing corporate demand. Federal government and other provinces are collaboratively working towards new policy frameworks, placing renewable technologies at the centre of energy transition.

GDP (Current Prices) USD (2021)	1,990.76bn
GDP Growth Forecast (constant prices) (2022-2026)	2.35%
Currency	Canadian Dollar
Country Credit Rating (S&P)	AAA
Renewable Energy capacity (2021)	102.9GW
Solar PV Share in Renewables (2021)	4%
Renewable Energy Target	Decarbonization of electricity supply by 2035

GDP Source: IMF WEO, S&P and IRENA

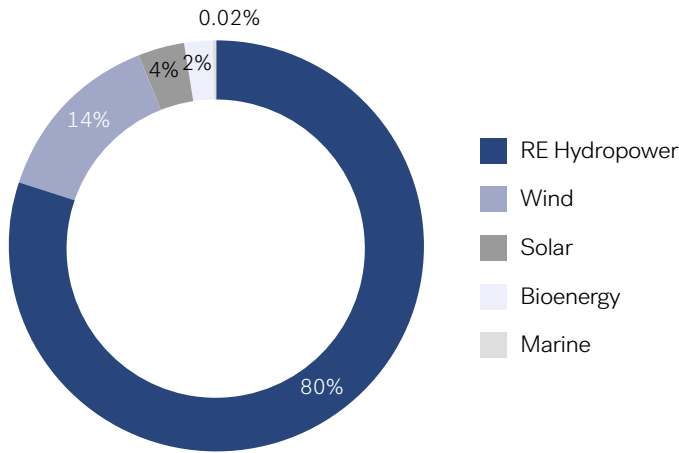


3.6GW Solar PV Capacity

- ✓ **Government funds facilitating private participation**
- ✓ **Growing renewable PPA traction in the country**
- ✓ **Strengthening market opportunity provided by contract-for-difference energy procurements**
- ✗ **Inadequate transmission infrastructure affecting utility solar market growth**
- ✗ **Subsidies still inclined towards conventional sources**

Renewable Energy Mix

Current Renewable Energy Mix



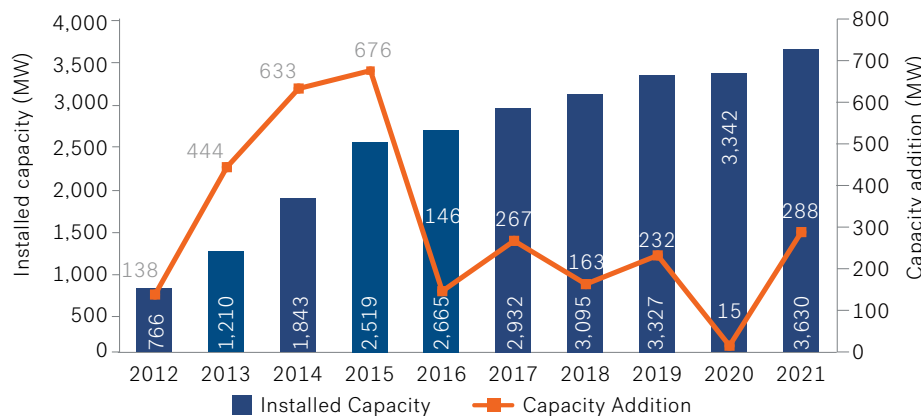
Source: IRENA Renewable Capacity Statistics April 2022

Canada is a world leader in electricity generation from renewable and non-emitting sources. However, the vast majority of the clean power comes from hydropower. As per IRENA data, renewable hydropower accounted for predominant share of around 80% of the total renewable installed capacity in 2021, followed by wind and solar, having shares of ~14% and ~4% respectively. In 2021, Canada commissioned ~677MW of wind energy and ~288MW (IRENA) solar energy, taking the total installed renewable energy capacity in the country

to ~103GW. This marked the highest utility scale solar and wind energy capacity addition since 2015. Driven by increased corporate procurement, Alberta province accounted for more than 60% of the new capacity addition in 2021 followed by Saskatchewan province, accounting for 20%.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Many renewable energy projects were delayed from coming online in 2020 owing to supply-chain disruptions, energy-demand fluctuations, and workforce health concerns caused by global pandemic, resulting in only 15MW of new capacity commissioned during the year. However, in 2021 the sector showed signs of revival and ~288MW of new solar PV capacity was added, thereby taking the total installed PV capacity in the country to ~3.6GW by end of 2021. However, the current rate of PV installation is not enough. Going

forward, Canada would need to have an annual solar installation of 1.6GW to meet its ambitious clean energy goal to decarbonize the electricity supply by 2035 and remove net emissions by 2050. While most of the renewable activity in the country in the last decade was driven by Ontario, Alberta province is set to displace Ontario from the top spot over the coming years, due to phasing out of coal-fired electricity generation, and its replacement with clean technologies. Notably, Canada's biggest solar farm till date was added in Alberta in 2021, the 132MW Claresholm Solar project.

Demand Drivers

Canada is the fourth-largest hydropower producer in the world by capacity. However, not every region has adequate or available hydro resources to supply its needs. Therefore, the onus of promoting non-hydro renewable power including solar is on those provinces like Alberta, Saskatchewan, Nova Scotia etc. who have pledged to make significant investments to deploy renewables at scale in order to decarbonize their electricity systems and electrify their economies.

The federal government is also working in tandem with the provincial governments to achieve the ambitious clean energy goal at the national level. The government has committed more than \$100 billion toward climate action and clean growth since 2015, including major investments in clean power, energy efficiency, industrial decarbonization, clean technology and transportation. Notably, The Canadian Net-Zero Emissions Accountability Act became law in June 2021. This act safeguards transparency and accountability in government's effort towards achieving net-zero GHG emissions by 2050. Moreover, the strengthened climate plan announced in December 2020 and Budget 2021, in which non-hydro renewable is expected to play a central role, sets the context for future solar deployment in the country.

There has been increasing customer interest in solar PV as the technology has proven to be competitive with other sources of generation in recent years based on the levelised cost of electricity. However, incentives are imperative in encouraging solar development. This is testified by the fact that currently most Canadian solar generation is located in Ontario, because it is the only province which offers FIT for solar development.

Of late, the corporate PPAs are finding traction in the country, especially in a backdrop when the commercial and industrial consumer segment faces higher energy costs and are looking for options to reduce energy costs and fulfil renewable energy objectives. The province of Alberta has seen tremendous growth in demand for solar PPAs from multinational corporate consumers including Amazon, Budweiser, and Grupo Bimbo. In 2021 alone corporate buyers have signed PPAs for over 540MW of new utility-scale solar farms in Alberta.

Market Opportunity

Solar energy has substantial untapped potential in Canada. Currently the technology accounts for less than 1% of the overall electricity generation. Minimal penetration in most of the provinces except Ontario provides considerable growth opportunities in other territories, especially in the southern part of Alberta and Saskatchewan where solar irradiation is quite significant. The New climate plan announced by the federal government and Quebec's new electricity strategy will further enhance the prospect of solar deployment.

Through a number of programs and initiatives, the government of Canada is demonstrating its long-term commitment to support provinces and territories in their transition to a renewable dominated energy system. Funding has also been made available to encourage the private sector to decarbonize its energy system. The government has pledged to make available CAD1 billion over five years to leverage private investments toward large transformative clean technology projects. Tax incentives in terms of 50% reduction in the general corporate and small business income tax rates for businesses that manufacture zero-emission technologies have also been proposed in Budget 2021.

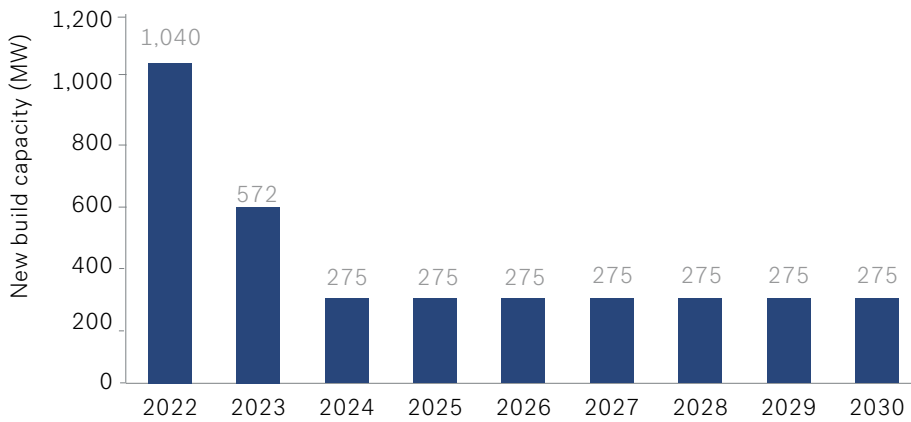
Funding support is available from other sources as well. For example, the Canada Infrastructure Bank plans to invest CAD10 billion in major infrastructure projects across the country, of which CAD2.5 billion would be devoted to clean power generation, transmission, and storage over three years.

Uptake in corporate renewables purchasing coupled with favourable market mechanism in Alberta is providing attractive market opportunities for solar developers. This especially kicked off after several rounds of renewable energy procurements using the contract-for-difference ("CfD") approach that was conducted earlier by the Alberta Government. CfD ensures a set price for the renewable energy produced by a developer, while offering some protection for buyers against future electricity price uncertainty. Moreover, Alberta's deregulated electricity market is unique in Canada which is enabling direct deals between developers and buyers. Notably, Solar Krafte Utilities signed a contract with the Alberta Utilities Commission for the construction of the Solar Krafte Brooks Solar PV Park with 400MW capacity in Alberta.

The commercial viability of the battery-based storage technology complements the solar. Solar plus storage thus has emerged as an attractive segment. Electricity system operators and regulators are actively working on options to integrate storage into the grid, including a review of market rules in Ontario and Alberta, and pilot projects in Quebec and Saskatchewan. At the beginning of 2021, total utility scale energy storage capacity in the country was more than 130MW, 10% of this was added alone in 2020. Further expansion in utility, residential, and commercial ESS was observed in 2021 with continued cost reduction, and emerging regulatory and market frameworks.

Outlook

Canada's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The net-zero proposition would gradually replace the share of conventional fossil fuels in the energy mix with renewables. Therefore, Solar PV would have a key role to play in the government's objective of net-zero GHG emissions by 2050.

In line with 'Emission Reduction Plan 2030', the Net-Zero Advisory Body (NZAB) was launched in 2021. The primary responsibility of the body is to provide advice on guiding principles to inform the development of quantitative five-year targets for caps on emissions from the oil and gas sector.

Further, the Government of Canada has also launched the 'Net-Zero Accelerator Fund' of \$8 billion in order to help large emitters reduce their emissions and help in developing clean technologies, thereby driving green transformation of Canadian industry.

Historically adequate transmission infrastructure has been a major obstacle to the development of utility scale solar PV projects as existing energy infrastructure and power plants are confined to cities, thus large solar farms in the countryside need to move back power to the main cities. However, steps have been taken to address the issue. Major transmission and infrastructure upgrades are planned across Canada, including major lines in British Columbia, Alberta, Saskatchewan, Manitoba and Quebec.

Rooftop solar has not seen much uptake in Canada compared to other countries, given existing access to affordable electricity for ratepayers. As of 2020, LCOE of unsubsidized residential solar PV rooftop ranged between USD 150-227/MWh, while LCOE of conventional source such as coal was USD 65-159/MWh. Therefore, along with transmission infrastructure, grid upgrade and incentivizing renewable roll out on a regional, rather than provincial scale is imperative to encourage solar PV development. However, growing corporate demand, coupled with recent policy commitments made by governments at all levels promise strong and accelerating growth for solar PV in 2022 and beyond.

Mexico

Mexico ranks among the leading countries for the untapped solar potential. Its enabling policy measures of 2013, aimed at liberalizing the country’s energy sector, had resulted in investments from globally leading solar PV developers and related equipment providers. Most significant has been the Mexican solar PV market’s auctions that led to price discovery at world-beating low rates.

GDP (Current Prices) USD (2021)	1,294.83bn
GDP Growth Forecast (constant prices) (2022-2026)	2.05%
Currency	Mexican peso
Country Credit Rating (S&P)	BBB
Renewable Energy capacity (2021)	29.4GW
Solar PV Share in Renewables (2021)	24%
Renewable Energy Target	35% share of renewable energy in total power generation by 2024

GDP Source: IMF WEO, S&P and IRENA



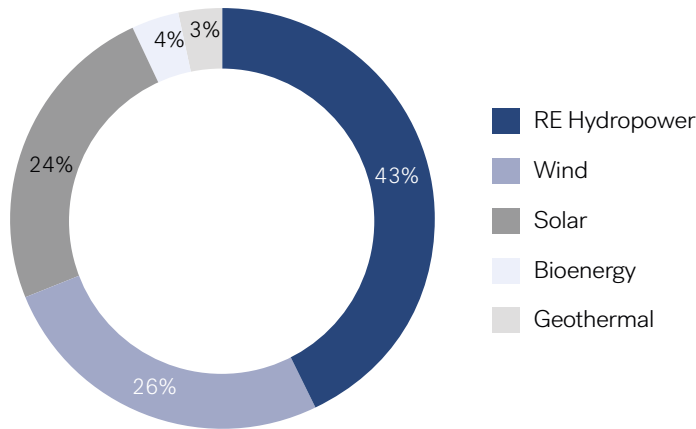
7.0GW Solar PV Capacity

- ✓ **Strengthening utility solar and growing small rooftop solar**
- ✓ **Policy push in the form of a 35% clean energy target to be achieved by 2024**
- ✓ **Steep decline in solar PV system costs has helped drive penetration of solar power**
- ✗ **Regulatory uncertainty on renewables**
- ✗ **Skewed role of public sector in the energy market**

Mexico

Renewable Energy Mix

Current Renewable Energy Mix



Source: IRENA Renewable Capacity Statistics April 2022

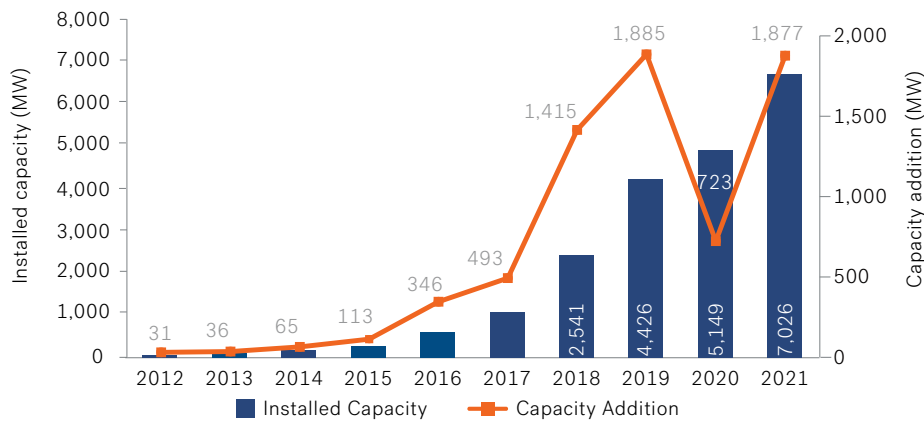
Mexico's bullish market momentum came to a near halt after the government cancelled subsequent phases of auctions and adopted a policy stance of rolling back its previous measures on enabling private sector investments. While the market still has a strong PV project pipeline, the investors are in a wait-and-watch mode for clarity in policy and regulatory framework.

Solar PV competes closely with wind energy in its contribution to the renewable energy mix. Led by the rapid growth in utility-scale

projects, the share of solar power grew sharply in the last five years to 2021 – it was only 5.7% in 2017. As per NREL's latest report, Mexico's solar power segment generated 86.7TWh in 2021, which accounted for 26.7% of the total generation from all renewable energy sources in that year.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Mexico's rapid solar PV capacity growth was led by energy reform that enabled liberalized market entry for private investments. The trend shows that solar PV has been the fastest during this phase among the renewable energy resources available to the country. Between 2016 and 2021, the installed solar PV capacity registered a compound annual growth rate of 62%. The same for total installed renewable energy capacity base is 9%.

Except for the pandemic year of 2020, the Mexican solar PV market has had a significant rise in capacity

addition during 2019 and 2021 – adding an average of almost 1,900MW each year. The jump in solar PV capacity addition can be observed since the end of 2016 – a period after capacity auctions that led to the market entry of leading developers in utility-scale PV projects. In 2018, it added 1,400MW, marking the first time in gigawatt-scale capacity addition.

Despite the several challenges plaguing the country's solar PV market, the current capacity pipeline is strong. Some of the significant PV projects under development include the 160MW Suave Solar (Enel Power), 100MW Cuquio project (Iberdrola), and 120MW San Felipe project. Most importantly, the government recently announced a USD2 billion solar PV project at Sonora as the region's largest solar plant.

Demand Drivers

The policy focus on renewable energy comes from the climate change legislation of 2012. As per the Act, the country commits to ensure a 35% share of renewable energy in total power generation by 2024. By most accounts, this is a modest target. As of end-2021, the percentage of renewable energy in total power generation stood at 26.7%. The country's untapped solar PV potential (along with other renewable technologies) can support a far higher power generation requirement.

As per the US Department of Energy's National Renewable Energy Laboratory (NREL), Mexico has a technical potential of 24,918GW based on solar PV. The report also points to the country's southeast region being particularly rich, with 5,561GW of solar PV potential. Such vast untapped potential is essential for prospective investors and developers seeking projects at locations with competitive costs.

Mexico's previous solar PV auctions attest to the competitive costs that attract investors. There has been a progressive decline in cost. The first auction held in 2016 yielded an

average price of USD47.7/MWh. The price declined to USD33.4/MWh and USD20.5/MWh in the second and third auctions respectively, in 2017. Mexico has some of the best locations for large utility-scale solar PV plants that remain to be commercially exploited for want of an enabling investment environment.

The declining trend in costs also made small-scale rooftop solar PV commercially attractive. For the most part, this segment has grown as part of distributed generation involving off-grid installation. By policy norms, distribution generation refers to the plant capacities up to 500kW. In such cases, there is no requirement for securing permits. Companies investing in renewable energy generation can avail a 30% tax deduction in the first year. The potential energy savings against grid-connected power are a major driving factor beyond the fiscal incentive for commercial and industrial users.

Market Opportunity

Signifying the opportunity in utility-scale PV, in July 2021, the state-owned power utility CFE announced the setting up of the Latin American region's largest PV plant. The planned project will entail an investment commitment of about USD2 billion and could involve a public-private partnership. The project is slated to be in the state of Sonora. In addition, CFE is developing two PV projects aggregating 350MW in the state of Baja California.

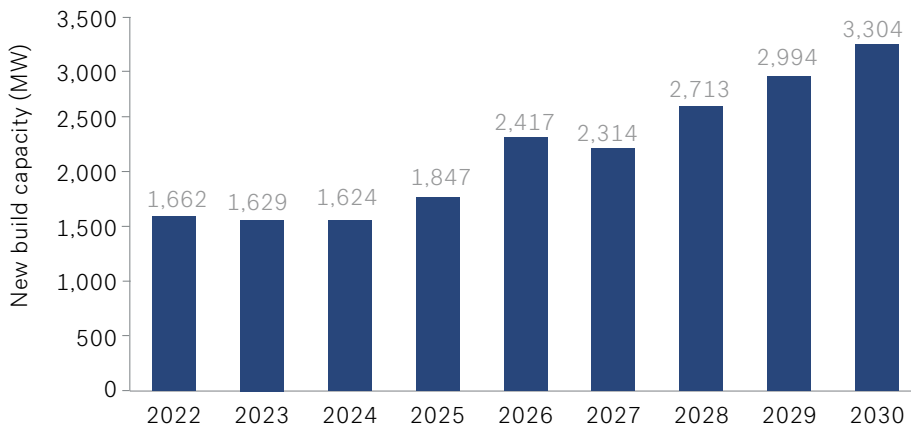
In May 2021, Mexican solar-specific private equity fund Banverde closed a USD57 million syndicated credit facility to finance the acquisition of small-scale solar projects in the country. Banverde collaborates with a certified network of solar developers and funds rooftop solar projects based on the power purchase agreements (PPA). In such an arrangement, the end-user does not have to pay the upfront cost of the PV unit and can own the asset after the PPA expires. Examples of similar investors are observed in MPC Energy Solutions' acquisition of the 15.8MW Los Santos Solar-I project from the developer Buenavista Renewables. This solar project has been in operation since 2017 under a PPA.

Commercial deployment of energy storage solutions could be a catalyst for the Mexican solar PV market, especially in the small-scale or rooftop solar segment. An initiative is underway in this regard. In March 2022, a joint venture enterprise launched 'energy storage as a service' in Mexico. This enterprise is based on a collaboration of companies of Fotowatio Renewable Ventures, Energy Toolbase and Ecopulse. Such offering of battery-based energy storage could be developed and expanded for the off-grid solar projects in the country, considering the easier regulatory requirements in the segment than that of grid-connected ones.

Meanwhile, the grid infrastructure has a significant scope of investment considering the rising demand on the network from varied renewable energy generation resources. As the transmission operator, the state-owned utility CFE's near-term plan (as of June 2021) involves 18 transmission projects with about 3,000 km of new transmission lines. The planned investment spending on transmission and distribution networks was estimated at USD2.3 billion for 2021-2025.

Outlook

Mexico's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook

Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The country has a robust solar PV project pipeline, comprising plants at various stages of development. As per NREL's estimates (as of April 2022), there is 1,641MW worth of projects in the process of pre-commissioning tests. Another batch of projects worth 2,119MW capacity are in the advanced stages of permits, financing, transmission connectivity, or initiating construction. Lastly, projects aggregating 3,580MW are relatively lagging in or are waiting for the requisite licenses, financing, and transmission linkage.

Despite the promise, the Mexican renewable energy market is going through an uncertain and sluggish growth phase due to the recent policy changes. Reversing past years of progressive energy sector reforms, the recently appointed government has sought to make the public sector (the state-run utility CFE) dominant in the power market and make the energy regulatory authorities operate under the government. The proposed new rules would make CFE have at least 54% of the power market and would no longer have to dispatch the lowest cost of power first.

There is a slowdown in the pipeline of private sector projects due to the anticipated risk of contract/permit revocation or renegotiation. Although the proposed legislative changes are far from enactment and contested in the courts, investment momentum is adversely impacted. The longer the current phase of regulatory uncertainty prevails, the worse it will get for the Mexican renewable energy market. Furthermore, the cancellation of the renewable energy capacity auction process adversely impacted the scope of attracting global solar PV majors/developers for utility-scale PV projects ideal for Mexico's solar-rich locations.

United States

The United States passed the milestone of 300GW of renewable energy capacity in 2021 (IRENA Data). However, various policy bottlenecks and regulatory uncertainties continue to pose challenges to sustained growth in the sector. This might prevent the USA from achieving its goal of a zero-emission grid by 2035. In 2021, a 3% decline was observed in clean energy installations compared to the year before. In terms of renewable energy installation capacity, the top three states were Texas, California, and Oklahoma, which added 7.4GW, 2.7GW, and 1.5GW, respectively. Solar was the most dominant technology in 2021 in terms of utility PPAs (Purchase Power Agreements), which accounted for more than 70% of the new capacity announcement.

GDP (Current Prices) USD (2021)	22,997.50bn
GDP Growth Forecast (constant prices) (2022-2026)	2.16%
Currency	US Dollar
Country Credit Rating (S&P)	AA+
Renewable Energy capacity (2021)	325.4GW
Solar PV Share in Renewables (2021)	29%
Renewable Energy Target	100% clean energy goal by 2035 and net zero emission by 2050

GDP Source: IMF WEO, S&P and IRENA



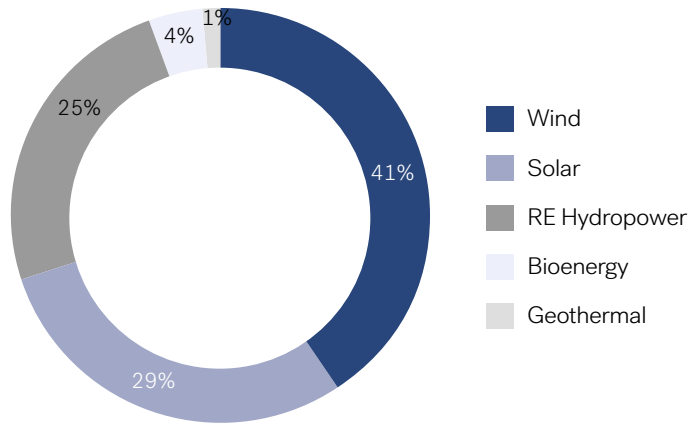
93.7GW Solar PV Capacity

- ✓ Growth in corporate participation
- ✓ Expanding residential solar
- ✓ Advancing technology & commercial viability of battery-based energy storage
- ✓ Fiscal incentives and tax benefits such as PTC
- ✗ Challenges posed by COVID 19 outbreak such as global supply chain disruptions

United States

Renewable Energy Mix

Current Renewable Energy Mix

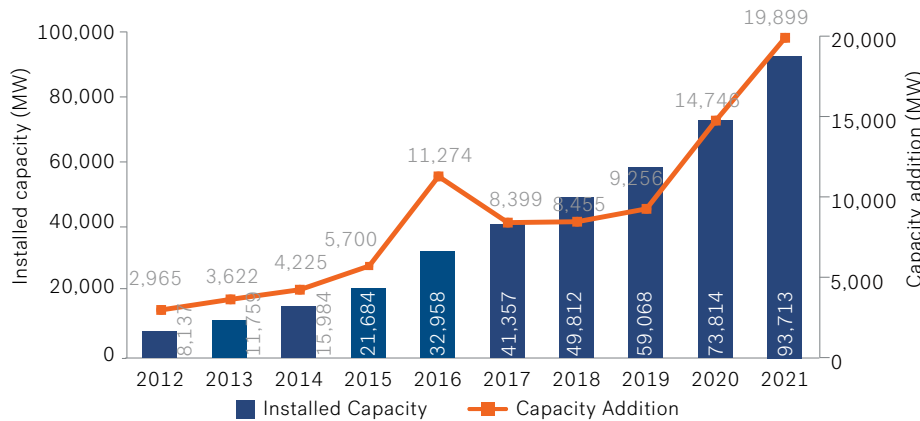


Source: IRENA Renewable Capacity Statistics April 2022

The trend shows a consistent solar PV capacity addition over the last decade in the USA's total renewable energy mix on the back of favourable fiscal incentives, policy frameworks, and reduction in installation costs. Further, corporate solar adoption has increased rapidly over the past few years, resulting in two-thirds of the installed capacity since 2015. Increased residential and commercial installations with growing corporate participation are strengthening the solar PV market in the US

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

For the first time in 2020, renewables surpassed both nuclear and coal-based energy generation as coal based generation continued to trend downwards. Solar accounted for nearly 46% of all new electricity generating capacity added in the US in 2021, the largest annual share in the industry's history for the third consecutive year. California has traditionally been a leader in solar PV, on account of its favourable policy framework, but Texas and Florida have made rapid strides, accounting for the largest share of capacity addition in 2021.

Annual solar PV capacity addition in the US has been on the upswing since 2017. While annual capacity addition averaged 8.7GW between 2017 and 2019, it took off in the pandemic years 14.7GW and 19.9GW in 2020 and 2021 respectively. This has helped expand solar PV's share in the US' renewable energy installed capacity from 18% (2017) to 29% (2021).

The US residential solar market continues to be a major growth driver having added a record breaking ~4.2GW installed capacity across more than 500,000 projects for the first time in a calendar year during 2021.

Demand Drivers

Fiscal incentives have played a pivotal role in shaping up the growth trajectory of the solar PV market in the US. The extension of the ITC (Investment Tax Credit) till 2022, passed by Congress in December 2020 was a key factor in propelling the capacity addition in the last two years. The provision for 22% tax credit on systems installed in 2023 is meant to sustain the growth trajectory.

Further, the expansion of the PTC (Production Tax Credit) attracted funding for US renewable power projects. This scheme enables investors to lower their federal tax obligation. The production tax credit provides USD 0.025 in tax breaks per kWh of power produced. These tax credit initiatives helped the US renewables industry to grow 18 fold over the last 15 years.

Notably, there is heightened interest in solar energy among homeowners following a substantial drop in PV installation costs. The cost has dropped by more than 60% over the last decade, catalysing adoption levels. A mid-sized residential system price halved from USD 40,000 in 2010 to around USD 20,000, while utility-scale system price ranges between USD 16/MWh – USD 35/MWh, in parity with other forms of energy generation. Moreover, the PPA prices for

wind and solar power remained competitive compared to other sources of energy. The weighted average price during H1 2021 from the auction and PPAs for solar PV was USD 31/MWh, while the weighted average wholesale electricity price across US markets was USD 34/MWh during the same time frame.

The electric power market in the US is undergoing significant structural changes. Technological developments and the commercial viability of battery-based energy storage paired with solar energy are growing rapidly in the USA in line with global trends. Falling battery prices and favourable fiscal incentives are driving the growth of this new technology. By 2022-23, PV combined with energy storage systems is anticipated to comprise more than 60% of the new capacity additions.

Commercial solar adoption has been boosted by corporate clean energy goals. Supported by policy frameworks, sustained solar installation by top companies such as Apple, Walmart, Amazon, and Target is expected to reach record levels by 2022. Apple continued to be the leader with ~400MW of installed capacity.

Market Opportunity

The government has placed high priority on clean energy and unveiled multiple legislative measures to help achieve the target of 50% reduction in emission by 2030. Primary among these are the reduction in lease rates and fees for renewable energy projects on federal land, offering a SolarAPP+ tool to expedite rooftop installations and tripling the domestic solar manufacturing capacity by 3x to 22.5GW. Solar power has significantly lagged in some states such as Alabama, North and South Dakota and Tennessee. But the gap can be swiftly bridged through supportive policy framework, as is evident in the case of Florida, where 47% of existing capacity came up after 2020, following the enactment of supportive laws.

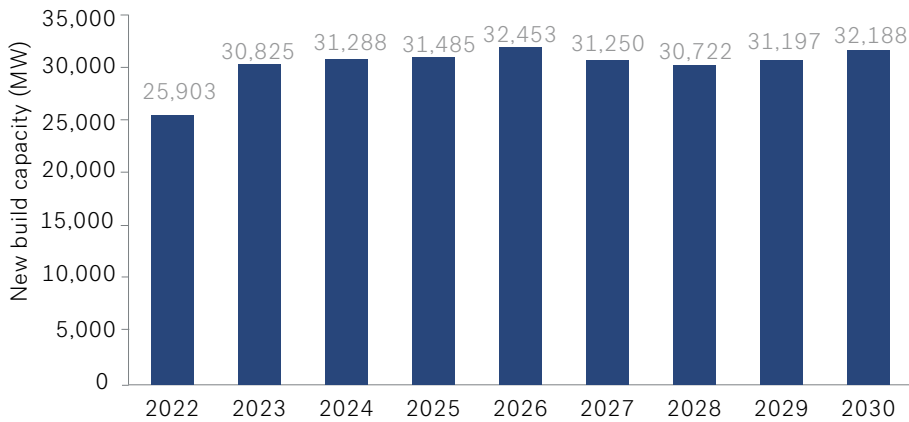
The “Build Back Better” framework, which is stalled at the Senate for lack of requisite support, has key provisions to

expand the adoption of solar energy. The package proposes to increase the ITC from 26% to 30% and extend it by at least 10 years. It also seeks to reduce the cost of installing rooftop solar by 30% and reduce the payback period by five years. This is expected to propel the rate of residential solar installations from 0.75 million in 2021 to 1.5 million by 2024.

Solar systems, paired with battery storage continue to experience traction among businesses and residential consumers. Significant growth opportunities are anticipated in this space. Currently, 11% of the behind-the-meter (BTM) solar systems are installed with battery storage, which is expected to increase to ~30% by the end of 2025.

Outlook

US Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

In the United States, the renewable energy market is dominated by wind and solar power technologies, that cumulatively account for ~70% of the installed capacity base. Hence, to achieve its 100% clean energy goal by 2035 and net-zero emission by 2050, solar PV will play a vital role in the government's plans to decarbonize. A sustainable policy framework along with fiscal incentives, subsidies, and federal project funding will be imperative in meeting near-term climate goals.

Despite a favourable market dynamism, the expectation of the US solar PV industry could be impacted by supply chain disruption and change in policy frameworks. The COVID-19 pandemic posed multiple challenges to the US renewable energy market including solar energy. The utility scale solar market was adversely affected due to global supply chain disruptions and constricted availability of labour which led to highest price levels in three years. These factors resulted in cancellation and delays in several projects.

Further, the proposed Net Energy Metering (NEM) 3.0 implementation by the California Public Utilities Commission (CPUC) would reduce payments granted to solar customers for generation of excess power. As NEM provides substantial financial benefits to solar customers, this measure might decelerate new residential solar installed capacity by more than 40% by 2023-24 in California.

Key Regional Markets - South America



Brazil

Of late, Brazil's renewable energy adoption has been driven by active policy steps toward reducing dependence on hydropower generation. While the country's energy mix has been traditionally low in carbon footprint (due to the predominance of hydropower), sustainability has been a challenge. The policy framework on greenhouse gas reduction and net-zero achievement help set a context for the potential investors keen on tapping into the potential.

GDP (Current Prices) USD (2020)	1,448.55bn
GDP Growth Forecast (constant prices) (2021-2025)	2.21%
Currency	Brazilian Real
Country Credit Rating (S&P)	BB-
Renewable Energy capacity (2021)	159.9GW
Solar PV Share in Renewables (2021)	8%
Renewable Energy Target	35% reduction in GHG by 2025 from 2005 levels

GDP Source: IMF WEO, S&P and IRENA



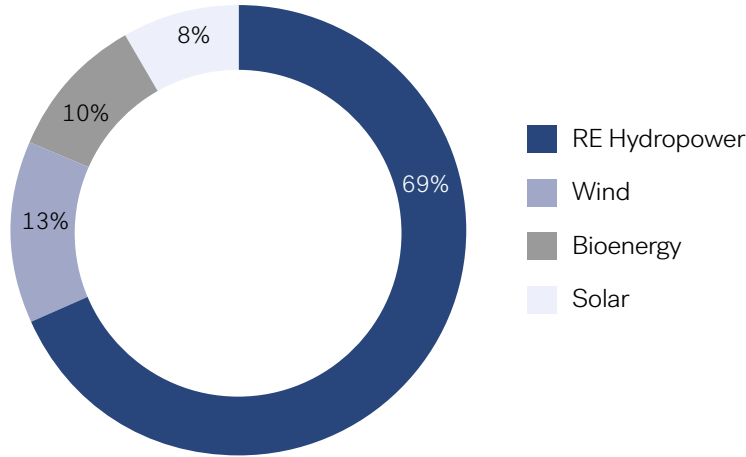
13.1GW Solar PV Capacity

- ✓ Deepening penetration of clean electricity
- ✓ Solar power auctions and financial support from the government and banks
- ✗ COVID 19 led to dip in auction response
- ✗ Domestic currency depreciation against USD posing potential negative effect on sectoral growth

Brazil

Renewable Energy Mix

Current Renewable Energy Mix



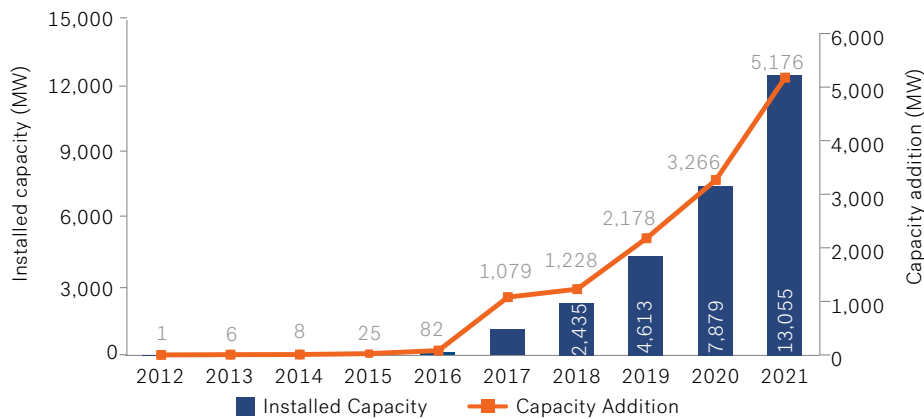
Source: IRENA Renewable Capacity Statistics April 2022

Brazil's electricity generation mix is skewed towards hydropower, which accounted for 69% of the overall generation capacity in the country in 2021. But this has been on a decline due to recurrent droughts and aging assets.

Including hydropower, Brazil generates more than 80% of its electricity from renewable. While solar energy represented only ~8% share of the renewable energy mix in 2021, it has been on the rise having expanded from ~3% share in 2019.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Solar PV is assisting Brazil in expanding its electricity supply while reducing pressure on hydro resources and enabling a reduction in electricity costs. Solar PV cumulative installed capacity in Brazil reached ~13GW at the end of 2021, growing by ~66% over the preceding year. The net solar PV addition has been around 5.2GW during 2021, up from ~3.3GW in 2020. Factors driving the accelerated growth are liberal net metering policy, very high electricity prices and revised industry-friendly regulatory frameworks. In Brazil, all

PV systems not exceeding 5GW and operating under net metering are categorized under distributed generation (DG) segment, which accounts for 8.4GW of the installed capacity while the remaining 4.6GW is attributed to large scale solar plants.

Demand Drivers

An investor-friendly power market and ample natural resources make Brazil a hotspot for renewable energy investment. However, in 2021, the country experienced its worst drought in a century, which led to a steep fall in hydropower's share of generation from around 64% to 52% by September 2021. The situation has shifted focus on renewables to reduce the reliance on hydropower and also control the spiraling increase in power prices. The government is supportive of such a transition, having set a goal to achieve 35% reduction in greenhouse gas (GHG) from 2005 levels by 2025, followed by a commitment to reach net zero by 2050 in COP26.

To accelerate further deployment, the government is working towards ramping up the participation of corporates. Commercial solar installation in Brazil is driven by a convenient net metering policy, PPAs (with installers enabling roof owners to pay off their systems in instalments at lower interest rates compared to banks), and multiple financing options from Brazilian public banks such as Banco Nacional de Desenvolvimento Econômico e Social (BNDES) and Banco do Nordeste.

New regulatory frameworks have helped to promote solar energy in Brazil. In December 2021, the Chamber of Deputies of Brazil approved a revised version of Law 5829 to create a regulatory framework for distributed mini-generation and micro-generation and the Electric Energy Compensation System (SCEE) in Brazil. This law aims to remove some of the grid-access privileges held by distributed generation (DG) projects. Currently, DG systems are exempted from grid charges when they benefit from Brazil's current net-billing scheme. Enactment of the law is expected to trigger an installation rush as such legislation usually have a deadline, post which charges apply.

Further, sustained expansion of the solar PV market is expected as the government formally enacted Law 14.300, which provides a new legal framework for distributed generation segment. This law ensures eligibility for net metering tariff for PV systems below 5MW until 2045. In the post-COVID-19 era, corporate PPAs are gaining momentum in Brazil with bilateral PPAs accounting for 10.7GW or 41% of the country's installed capacity of 26.1GW of solar and wind power.

Market Opportunity

The distributed solar generation segment is expected to retain its pre-eminence, aided by the enactment of Law 5829, which sets out a seven-year transition period to introduce grid access charges in a phased manner. As the grace period extends to 2023, the move is likely to trigger a flood of installations in 2022 and 2023 with distributed generation capacity increasing by 6GW annually.

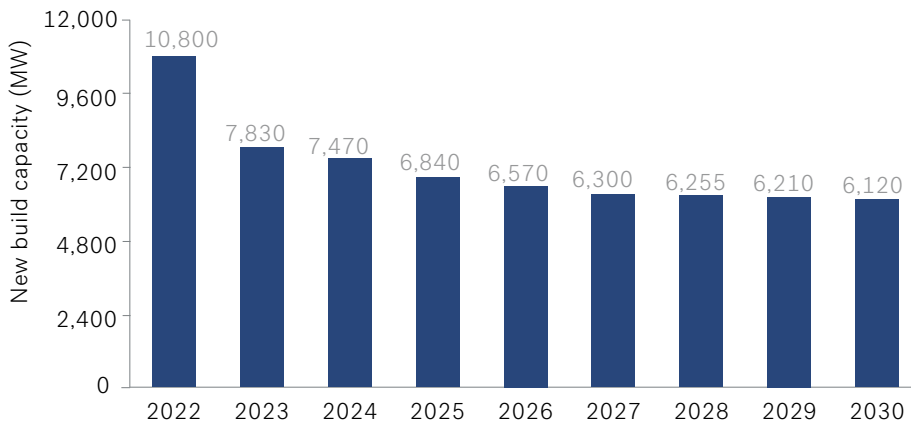
Energy storage is likely to play a crucial role in shaping the growth trajectory of the next phase of the residential solar market in Brazil. Policy changes are on the anvil as ABSOLAR has set up a working group to propose a roadmap for storage, in partnership with two consulting firms. Resolving regulatory bottlenecks, streamlining taxes and establishing a regulatory framework represent the priority areas of intervention. While off-grid energy storage has been prevalent, behind-the-meter energy storage is starting to take off with first commercial

applications coming online. With more than 8GW small and medium scale diesel generator sets connected to the grid, the replacement opportunity for battery storage is massive.

Brazil's solar PV market potential has attracted investments from foreign and domestic players with USD 10 billion in investments lined up in 2022 and 11.9GW of solar capacity is expected to come online. This has, in turn, created massive growth opportunities for companies within the ecosystem. Brazil currently accounts for 9% of Trina Solar's global sales of solar PV modules while solar developer Alexandria registered 1,500% growth in YoY revenues in 2021. International majors like Enel Green Power and Shell are commissioning large solar projects, which highlights the significant growth potential of the market.

Outlook

Brazil's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

Electricity consumption in Brazil is expected to reach 576TWh in 2025, up from 485TWh in 2020, indicating an additional demand of ~91TWh by 2025. During this transition period, renewable electricity generation share (including hydropower) is projected to reach ~90% from ~84% in 2020.

However, from 2030 onwards, growth in hydropower generation is expected to peter out due to increased usage of non-hydro renewable energy and frequent droughts. With a focus on NEP 2050 and reducing fossil fuels fired energy, renewable energy from solar, wind, and bioenergy will gain much-needed support to achieve its net-zero goals.

New policy frameworks and laws will cause a rush in solar PV system applications and installations within a grace period to avoid grid charges. Consequently, 37GW of new PV installation (15GW utility-scale and 22GW distributed generation) is forecasted during 2021-25.

Considerable increase in PV component price caused by supply chain bottlenecks in China during COVID-19 led to multiple delays in project development and commissioning. Moreover, energy auctions held last year failed to garner satisfactory response due to the domino effect caused by the pandemic.

Several other factors, such as local currency volatility, increased shipment costs, and lack of skilled workers, might impact the sustained growth in the PV segment in near future. However, timely commissioning of ongoing projects and installation rush supported by an updated regulatory framework is anticipated to boost solar PV installation capacity over the next few years.

Chile

Chile hosts some of the world’s best solar rich locations, making it an ideal choice for leading developers and investors. The country’s experience with private investments in solar PV has been a positive one, as evident in the bulk capacity allocations attracting leading global developers and driving prices down in aggressive bidding competition. It also helps that the policy and regulatory framework follows a largely private sector-led growth path – one that is devoid of any upfront subsidy or related support.

GDP (Current Prices) USD (2021)	316.86bn
GDP Growth Forecast (constant prices) (2022-2026)	1.67%
Currency	Chilean Peso
Country Credit Rating (S&P)	A
Renewable Energy capacity (2021)	14.9GW
Solar PV Share in Renewables (2021)	29%
Renewable Energy Target	70% share of renewables in energy matrix by 2030

GDP Source: IMF WEO, S&P and IRENA



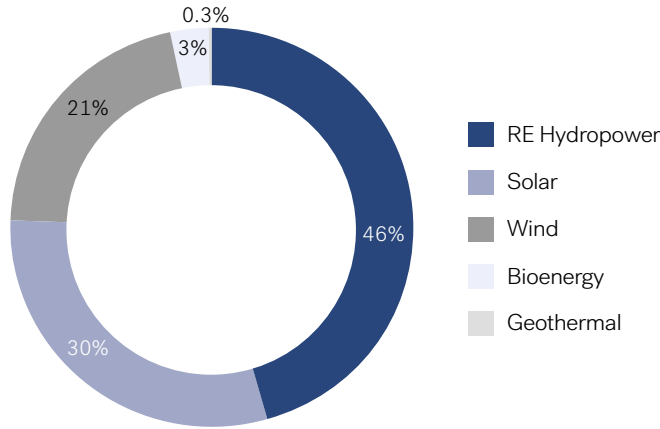
4.4GW Solar PV Capacity

- ✓ **Government objective to close half of the existing coal-based power plants by 2025**
- ✓ **Special regulatory framework such as PMGD for distributed generation projects**
- ✓ **Auctions as catalysts for expansion**
- ✗ **No direct subsidy support for private sector participation**
- ✗ **Concerns around the potential adverse impact of aggressive bidding on prospective investors in coming years**

Chile

Renewable Energy Mix

Current Renewable Energy Mix

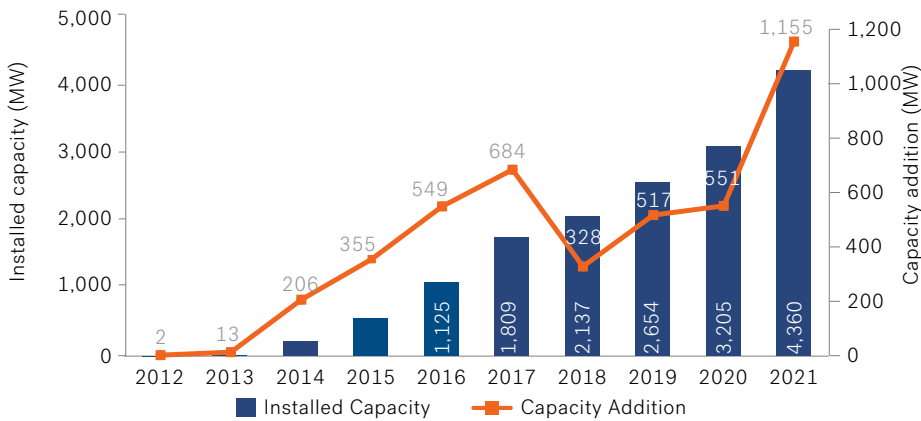


Source: IRENA Renewable Capacity Statistics April 2022

Rapid growth in solar PV has helped place it just next to hydropower, the predominant resource in the country's renewable energy base. With emerging extremities of climate change, Chile is among the countries finding it difficult to rely on hydropower. Furthermore, new solar capacities are cheaper in unit costs than coal-fired ones. The result is a gradual rise in solar PV share, from just 12% in 2016 to about 30% by 2021.

Installed Capacity: Status and Trend

Trend in Installed Solar PV Capacity



Source: IRENA Renewable Capacity Statistics April 2022

Chile's solar PV capacity base registered a compound annual growth rate (CAGR) of 31% during 2016-2021. The country's total renewable energy capacity grew by 10% in the same period. The data reconfirms solar PV's position in Chile's renewable and the overall energy market. Solar PV has been the fastest-growing segment - adding an average of about 500MW between 2016 and 2020, which doubled by end-2021. With a rising number of utility-scale PV projects coming onstream, the annual capacity addition can rise further (due to higher unit sizes involved).

Small-scale distributed generation projects hold a significant role as well. With a framework of stable price under the PMGD scheme, by April 2022, a total of 1,361MW of installed PV capacity was reported for distributed generation segment (as per the industry association). This is over 70% of the total capacity in the segment.

Demand Drivers

In 2021, the government announced plans to close half of the existing coal-based power plants by 2025. In June 2019, an agreement between the government and the power companies laid out the plan to close eight coal-based power plants aggregating to about 1,000MW in capacity by 2024. Six of them were closed in 2020. Most important is the announcement by AES Corporation to retire over 1GW worth of coal-based power generation capacity by 2025. Such voluntary decarbonization measures set the stage for renewable energy, especially solar power generation.

Chile hosts the world's top-ranked locations in solar power. The studies point to the Atacama Desert registering the highest solar irradiance than any other place worldwide. The country's Northern region alone has an estimated 1,260GW of untapped solar PV potential. The available solar resource thus outstrips the different renewable energy resources, including wind energy, by a wide margin. Utility-scale PV projects are therefore the most favourably placed in Chile in terms of the technical parameters of solar generation and efficiency.

The regulatory authority follows an auction route for capacity allocation for utility-scale solar projects. Since 2015, technology-neutral renewable energy auctions were introduced, with essential changes from the previous

structure, such as longer-term and different hourly blocks of energy supply (day, peak or round-the-clock). The results were impressive, with each such auction process yielding the lowest prices discovered globally. In the last auction of August 2021, the regulator allocated 2.3TWh of renewable energy, and the lowest price quoted was USD0.0133/kWh.

Chile has a special regulatory framework for distributed generation projects, also called Pequeños Medios de Generacion Distribuida (PMGD). It covers generation projects with a capacity size between 500kW and 9MW, connected usually to the distribution or sub-transmission level power grid. PMGDs get incentives, including liberal norms in grid connectivity and a separate price determination mechanism that guarantees stable prices. The stabilised price is equivalent to the average value of power purchase agreements valid in the market, adjusting the power market's projected spot market prices.

The response to PMGDs has been high due to the certainty of project returns and easier access to project financing. The engineering, procurement, and construction (EPC) firms often undertake the preliminary works to develop the PMGD projects after obtaining the land and approvals and then sell it to a power generation developer under a ready-to-build model.

Market Opportunity

The government is keen on expediting private sector investment. In November 2021, the Chilean government announced plans to set up a cross-border transmission link to connect potential solar projects in the Atacama Desert to the Asian region. Termed the Antípodas project, the goal is to install a 15,000 km long submarine power transmission cable to enable power transfer of an estimated 200GW – 600GW worth of solar PV capacity. At an estimated cost of USD2 billion, the project is ambitious, entailing complex technical feasibility studies and strategic alliances with multiple countries.

The near to medium term visibility of solar market opportunity is found in the auction plans. In February 2022, the Chilean energy regulator launched an auction to procure 5.25GWh of grid power over 15 years starting in 2027. The last date for final offers was July 1, 2022, and the results

will be announced between July 25 and August 1, 2022. As the experience shows, the auction is significant in attracting global majors to the market. In August 2021, the auction for power procurement attracted 29 leading international developers, of which Canadian Solar emerged with the winning bid.

Even as utility-scale PV projects attract the most attention in capacity addition, Chile's PMGD scheme has been the most popular driving investment. This is primarily because of the guaranteed pricing offered in such projects. Lately, the interest in such projects has picked up as the prices justify small-scale solar PV projects aligned to the pricing in the PMGD scheme instead of the merchant market. Added advantages of liberal approvals help reduce the transaction costs and delays that are otherwise typical for large-scale projects.

Recent Major Investments in the Solar PV projects under the PMGD scheme

Developer / financier	Capacity (MW)	Investment description
Verano Energy	116	Acquisition of 15 solar PV projects, announced in April 2022
Solek Group	200	In February 2022, Solek signed a framework agreement with Blackrock Global Renewable Power Fund III to develop, build and sell PV projects
Nala Renewables	150	Announced an agreement in December 2021 to acquire PV portfolio from Czech developer Solek Holding
Corporación Interamericana para el Financiamiento de Infraestructura	6	Project financing of a PV portfolio, starting with 2 projects, as announced in January 2022
Sonnedit	100	Sonnedit and Natixis closed senior facilities worth USD87 million in June 2020 for PV portfolio

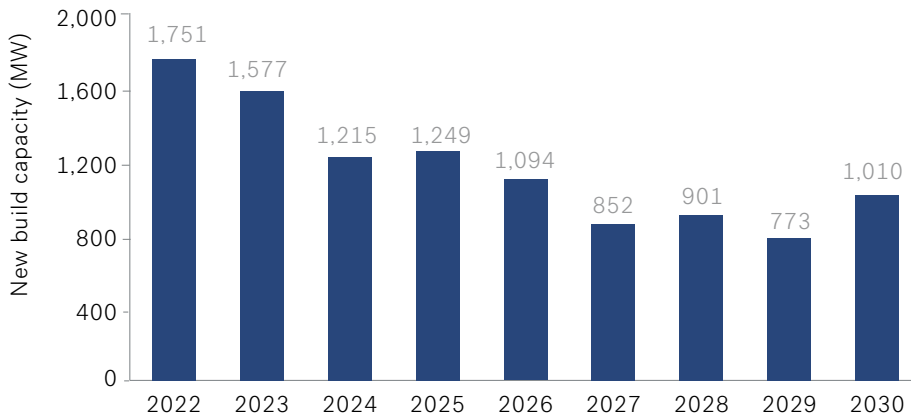
Source: Press releases, RenewablesNow, reNEWS

The progress in decarbonizing power supply through the phase-out of coal-based power generation and the acceleration in renewable energy imposes significant demand on the power transmission network. In April 2021, the energy regulatory authority's report on the transmission expansion plan outlined 46 projects amounting to a total investment of USD511 million. The development of such identified projects could start in 2023.

Projects identified by policy/regulatory authorities will be in addition to potential dedicated transmission lines required for the utility-scale projects allocated in auctions. Furthermore, with rising emphasis on cross-border transmission lines, there is likely to be greater interest in high voltage transmission systems. An example is a consortium selected in August 2021 for the project tender related to a 1,500km 600kV High Voltage Direct Current transmission line in Chile. The project is worth USD2 billion in total investment.

Outlook

Chile's Projected Solar PV Builds



Source: BNEF Global PV Market Outlook
Note: The above data, as sourced from BNEF, are based on a 'low' investment scenario

The size of the solar PV pipeline is driven by utility-scale projects currently under the development stages. As of December 2021, the regulatory authority's estimates indicate an aggregate of 3,579MW of total solar capacity is under development. The pipeline will also expand with the development of projects allocated during the auction of August 2021 since the selected developers are bound to commence supply from 2026.

The upcoming solar PV projects are likely to feature a hybrid model of technology configuration – one that includes options of energy storage and combinations with wind and other renewable sources. An important example of hybrid projects under development is Engie Chile's upcoming 375MW Sierra Gorda plant will be co-located with an operational wind farm at the site. In December 2021, the Chilean power generation company Colbun announced an 8MW/32MWh energy storage system next to a 230MW solar PV project in the Atacama region.

Investors will keenly watch for the response to the recently launched renewable auction. One can expect the upcoming auction to be as competitive as before. Yet, the rising competitive intensity of the market also entails progressively lower prices for the long-term power purchase agreements. There are concerns about the potential adverse impact of aggressive bidding on prospective investors.

The momentum in the Chilean solar PV market is entirely led by the private sector and is devoid of any direct subsidy or similar incentive support from the government. While enabling policy and regulatory measures such as the bulk capacity auctions help sustain the momentum, the growth rate remains muted for a lack of comparable support to other leading PV markets worldwide. Policy level support will also be necessary for critical infrastructural requirements such as power transmission, considering most high solar irradiance locations are remote and desert regions.

06

About CleanBridge

- 01 Executive Summary
- 02 Regional PV Overview
- 03 Trends and Drivers
- 04 Outlook
- 05 Europe, N. America and S. America
- 06 About CleanBridge

About CleanBridge

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Sustainable Energy



Climate Finance



Sustainable Living



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