

# Global Solar Market Overview

2022





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1. EXECUTIVE SUMMARY



# Executive Summary

## Solar PV Becoming the Most Popular Renewable Technology

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. 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.

## Solar PV Prices are on a Downward Trajectory

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.

## Evolving Industry Dynamics

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. Closely related to this, is the advent of corporate power purchase agreements (PPA). 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

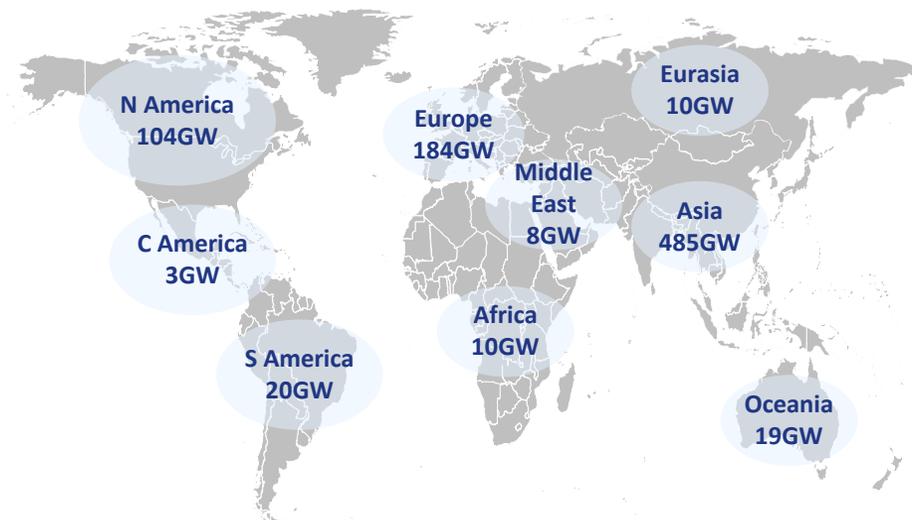
## Regulatory & Policy Support is Vital Going Forward

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.

2. REGIONAL PV OVERVIEW

# Solar PV Penetration by Region

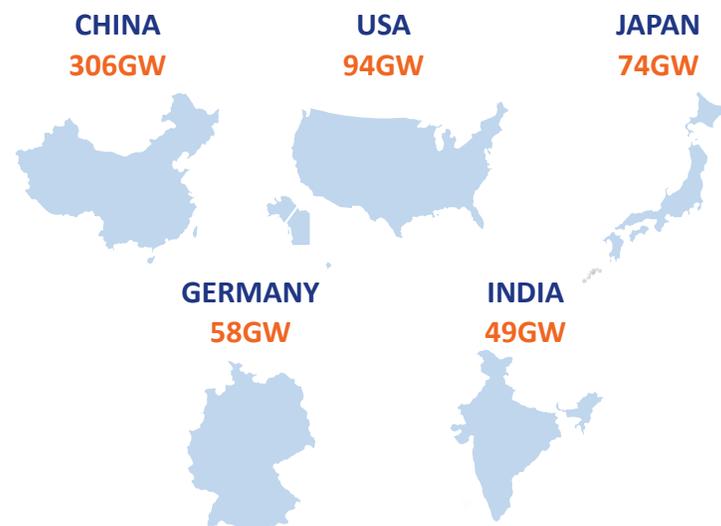
## Installed Solar PV Capacity (GW) by Region in 2021



- 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
- 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
- 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 steps on energy transition are also underway in the otherwise hydrocarbon-rich Middle East region. Solar PV is an important part of the strategy. The region's solar PV project pipeline is largely led by the UAE and Saudi Arabia
- In the South American region Solar PV installed capacity has grown at a CAGR of 52% during 2017-2021. However, among renewable energy sources, solar PV is yet to play any significant role due to the competing options in hydropower and biofuels
- In North America solar PV market is shaped predominantly by the size of US market, which continues to be an important market globally. 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

# Top Countries

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



Top 5 Countries by CAGR between 2017 and 2021

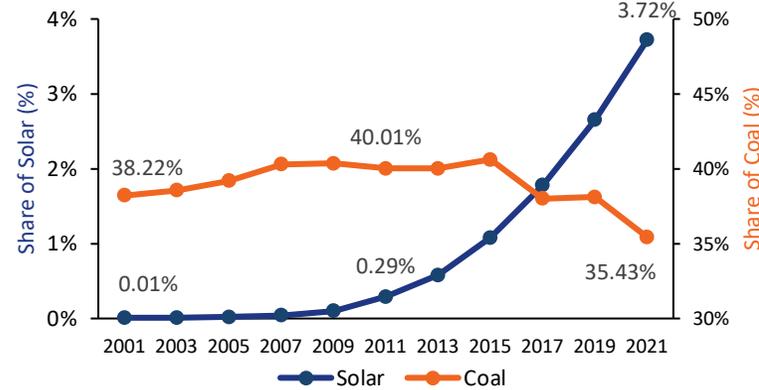
 VIETNAM	576%
 ARGENTINA	230%
 ARMENIA	209%
 UZBEKISTAN	143%
 ESTONIA	129%

- Despite raw material shortage and supply disruptions, 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
- US stood against after China in 2021. Federal incentives and other state level support played a role in ensuring a sustained growth in the country
- Japan got displaced from second position by the US market growth in last two years. Japan is in transition phase from the feed-in tariff regime to one of feed-in premium, with effect from April 2022
- Within the European region, Germany and Italy are the two countries figuring among the top-10, at fourth and sixth ranks, respectively. In both the markets residential or small-scale rooftop solar projects are playing most significant role to drive growth
- Countries in Asia Pacific are yet to play a significant role in global market. India's growth continues to be hamstrung by structural issues of power sector or by regulatory challenges
- While Australia and South Korea have registered notable growth in PV capacity, Vietnam has emerged as standalone example, not only in the region, but also globally for the spike in installed PV capacity

3. TRENDS AND DRIVERS

# Trends & Drivers

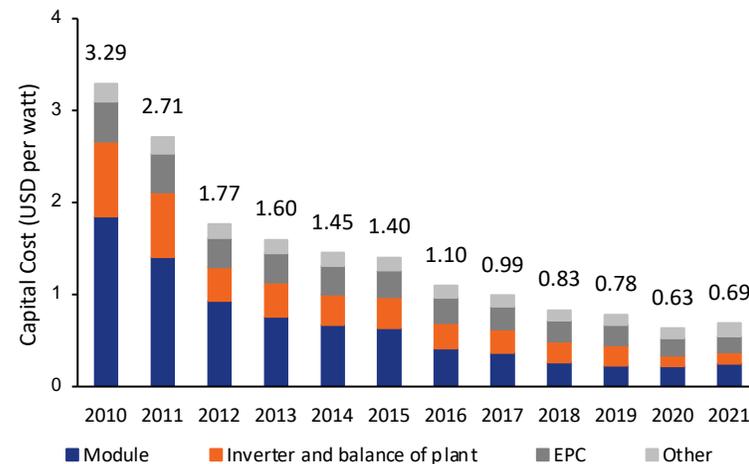
## Share of Solar Compared against Coal in Global Electricity Generation



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

- Globally, solar PV is has emerged as a catalyst in the renewable capacity growth. IEA report estimates solar PV to account for 60% of the capacity addition by end-2022
- Long-term trend about growing share of solar in total electricity generation points to the transition underway
- 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
- In contrast reduced capital cost is not so important for distributed generation projects as EPC costs are insignificant in such installations

## Trend in Solar PV Capital Cost (USD per watt)

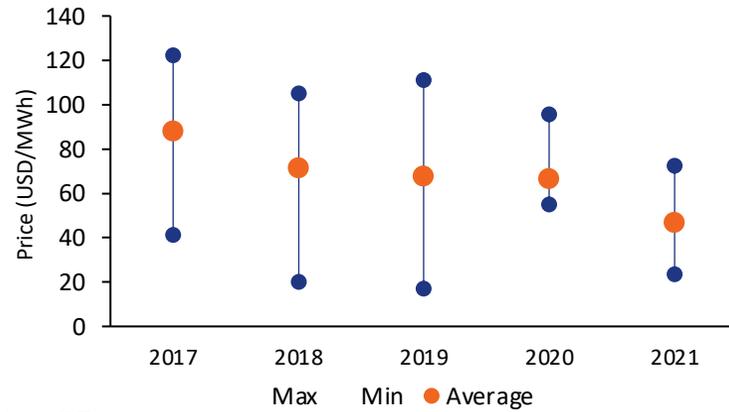


Source: BNEF  
 Note: EPC: Engineering, Procurement and Construction

- The trend shows an 86% decline in the capital cost (USD per watt) of solar PV projects during the period of 2010-2021
- 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, the share of EPC in total capital cost rose steadily, from 13% in 2010 to 26% in 2021 — indicating rising complexities/challenges in execution
- Over the years, competitive bidding has been the most important enabler among the market orientation measures undertaken by policy and regulatory authorities

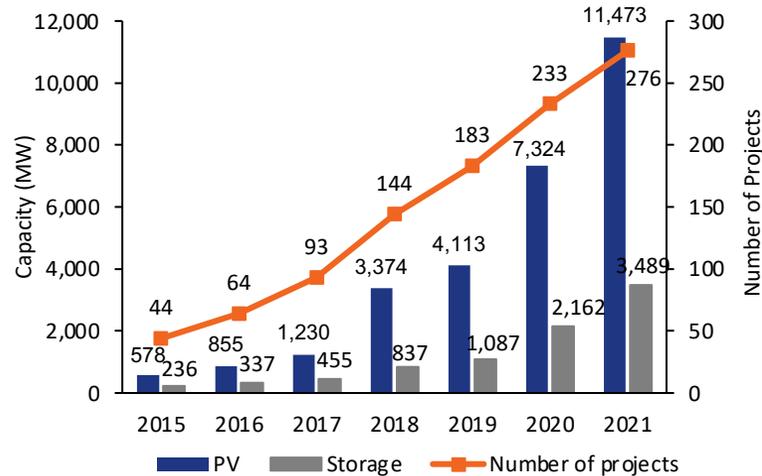
# Trends & Drivers

## Trend in Price Discovery Range of Solar PV Auctions



Source: BNEF

## Trend in Solar PV Hybrid projects with Storage Capacity



Source: BNEF

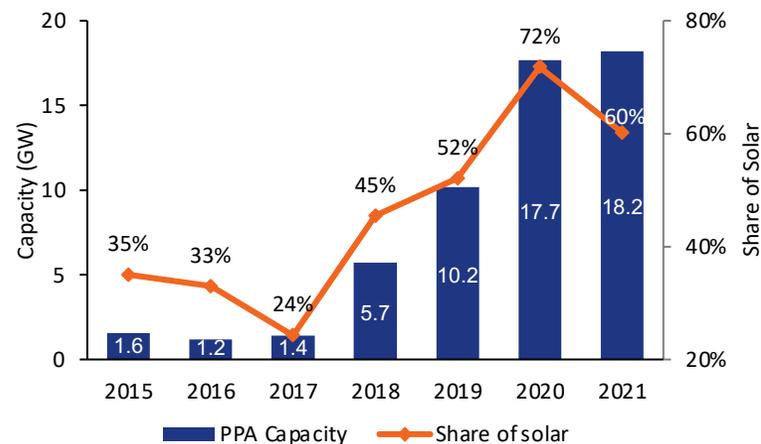
Note: Data illustration based on the storage-based projects tracked by BNEF

- The capacity allocation done through competitive bidding yields the price discovery of utility-scale PV generation vis-à-vis the prevalent energy mix connected to the grid
- The cost-economics of utility-scale PV projects is undergoing further changes with the commercialisation of battery-based storage technologies
- Overall, the average auction bid prices appear to be largely stable with a downward bias

- Between 2017-2021 utility-scale solar projects with battery-based storage rose by almost three times
- Developers are combining battery-based storage to enhance grid dispatchability and utilise the plant generation to cater to peak demand period
- The local norms and regulatory structure is highly important for these hybrid (solar + storage) projects as most of such projects involve a fair degree of complexity related to the existing regulatory framework

## Trends & Drivers

### Trend in Corporate PPA Capacity based on Solar PV



Source: BNEF

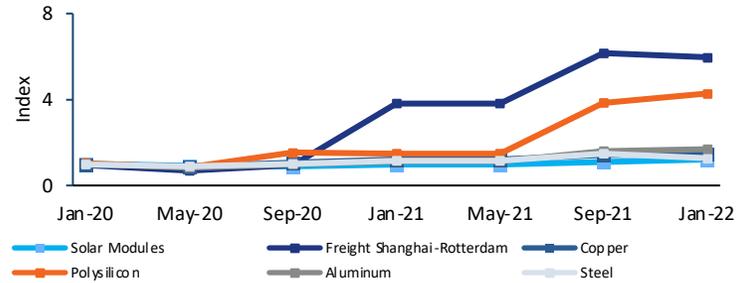
- Across all markets, the shift to auction-based capacity allocation is taking place in combination with a phaseout of subsidies or related government budgetary support
- Unsubsidised merchant-based projects find greater traction than before, and Europe is leading the trend in this regard
- A key manifestation of the developers' subsidy-free power sale arrangement is the rise in corporate PPAs
- 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

### State of Transmission Infrastructure

- Utility scale projects are highly reliant on the timely availability of transmission connectivity. Such dependency poses risks of bottlenecks for developers seeking project financing – an absence of transmission linkage is often a barrier for financial closure
- In the US as of October 2021 about 700GW worth of renewable energy capacity (mostly solar & storage) was stuck in a transmission interconnection queue and just 13% of it had a firm interconnection agreement
- The European region faces a similar urgency in undertaking reforms in transmission network planning. Upcoming new renewable generation capacity coupled with planned phase out of dispatchable generation assets like coal and nuclear power are progressively narrowing the margin of network balance and in turn grid stability
- 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, which entails a capital expenditure requirements of EUR153 billion for projects till 2030
- The scenario is same in China. The State Grid Corporation of China plans investment worth USD350 billion during 2021-2025 to strengthen the infrastructure for renewable energy integration. Similarly in India USD1.6 billion worth of investment has been approved to prioritise transmission corridors related to renewable energy projects

# Trends & Drivers

## Price Movement Since the Beginning of 2020



Source: BNEF Global PV Market Outlook Q12022

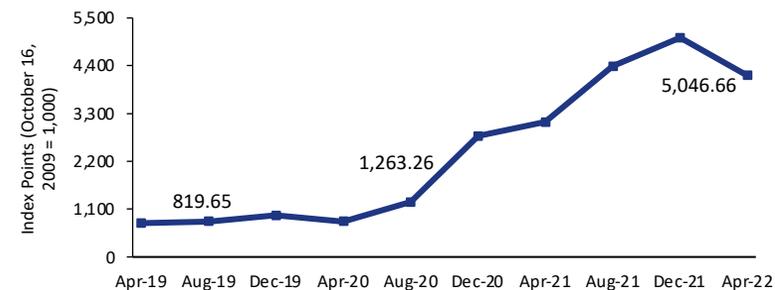
## Trend in Grid-scale Storage Costs (USD/MWh)



Source: NextEra

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

## Trend in Shanghai Containerized Freight Rate Index



Source: Statista

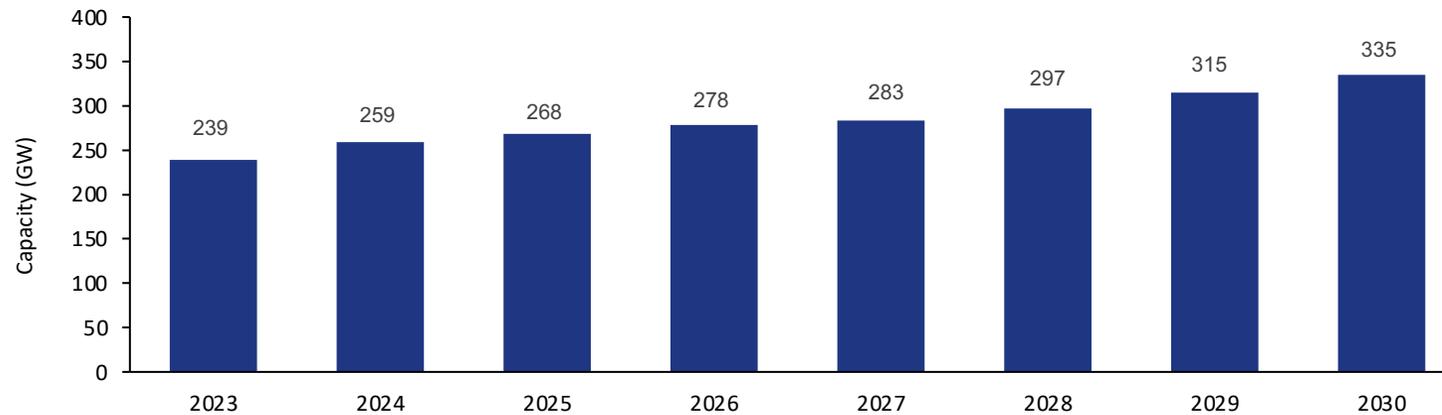
- Most of the solar PV manufacturers and developers continue to grapple with a rising price of PV modules and other components in the value chain since early 2021
- There has been a clear mismatch between demand and supply as demand remained steady during the pandemic period while supply lagged
- This has been 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

- With a sustained investment in the battery technologies and the rising economies of scale, storage costs are on a declining trend
- As per IEA, spending on grid-scale storage systems, based predominantly on Lithium-Ion technology rose by over 60% by end-2020 despite the pandemic-led slowdown globally
- However, the prevalent macroeconomic cost pressures could impact the growth of grid-scale storage systems

- The global supply chain disruption that took effect since mid-2020 has had the maximum contribution to the solar industry's cost pressures
- Over dependence on China is a major supply chain issue for major solar markets across the globe. Notably, China holds 79% share of global polysilicon manufacturing capacity
- 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

4. OUTLOOK

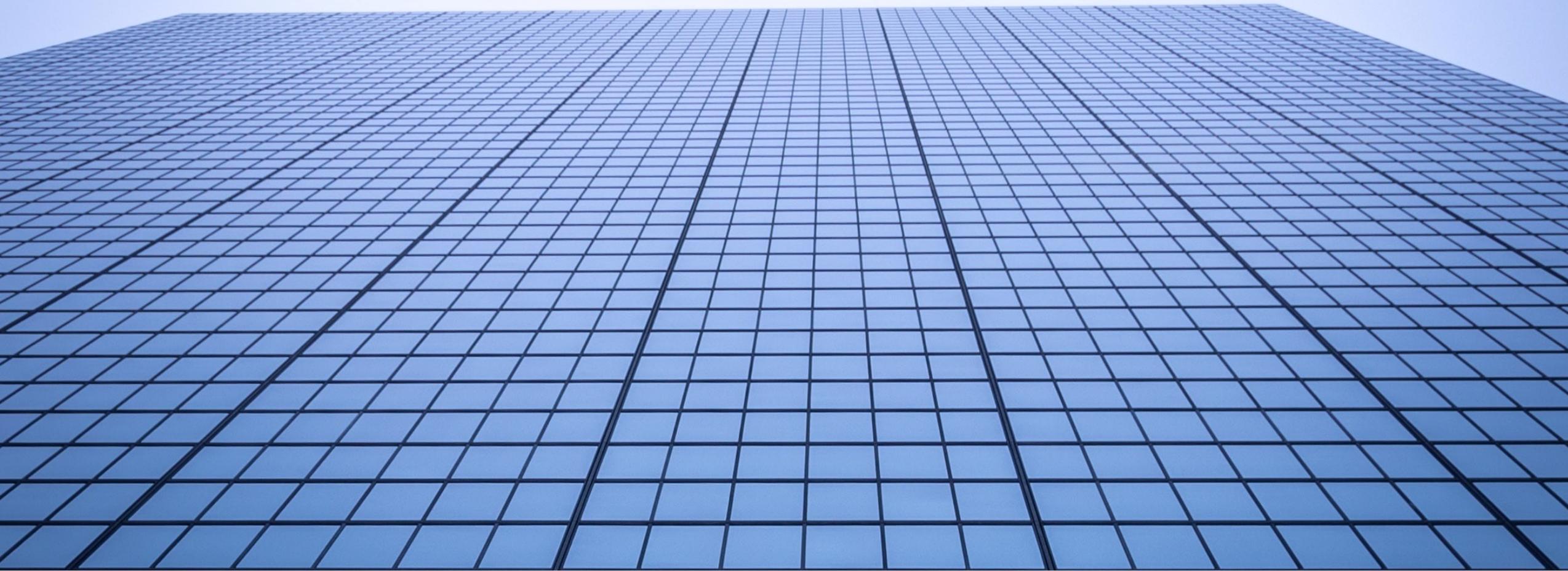
## Projected Solar PV New Builds



Source: BNEF Global PV Market Outlook

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

- 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
- While the phaseout of upfront subsidies and related incentives is a continued theme, steady policy makes the difference in capacity growth
- 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. This will subsequently come down once raw material supply expands and the global supply chain constraints ease
- 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. In several cases, the hybrid projects include a combination of wind power as well
- Subject to the country-specific context, solar PV is emerging as the preferred choice for both residential and the commercial/industrial consumers to rationalize their total energy costs. The residential solar segment is in fact a major demand driver for rooftop storage-based solar PV across the countries



Our core team has a wide range of experience in advising on transactions within the new energy sector, both at the project level, and in working with institutional investors and co-investors



## Trusted Advisory Team

Our team consists of independent, experienced, and global professionals working to mobilise institutional capital at scale into the energy transition, and global movement towards a low carbon economy. We push and support each other to become the best at what we do — helping business leaders, and management teams build long-lasting and impactful companies.

- Our group provides significant experience and deep financial expertise in M&A advisory, project finance, debt & equity capital raising, and restructuring. Recognizing the strategic importance of optimizing capital structure and securing proper funding for these corporate transactions, Pan American Finance seeks to leverage its relationships with debt and equity providers globally to raise capital for our clients.
- Our team possesses an in-depth understanding across our targeted industry sectors, local economies and cultures, thereby enabling us to assist our clients to identify and pursue strategic alternatives, devise strategies to enhance shareholder value, raise capital to meet growth objectives, and develop new ideas and deeper perspective regarding individual companies and relevant industry sectors.

We are independent and client-focused. We are never in a position where our own interests could be in conflict with those of our clients. We operate as trusted senior advisors, providing sound investment banking advice and presenting strategic ideas in our clients best interest.

Pan American Finance provides high quality, independent strategic advisory, capital raising, and M&A services to businesses and their owners across the Americas and Europe

 <h3>Introduction</h3>	 <h3>Team</h3>	 <h3>Leadership</h3>	 <h3>Experience</h3>
<ul style="list-style-type: none"> <li>Pan American Finance was founded to advise our clients in achieving their objectives for growth and value creation – through acquisition, investment and capital raising transactions</li> <li>Via <b>PAF Securities LLC</b>, we are a member of <b>FINRA/SIPC</b></li> </ul>	<ul style="list-style-type: none"> <li>Team of investment banking professionals with diversified backgrounds and extensive transaction experience in <b>investment banking, capital raising, private equity, and corporate finance &amp; operations</b></li> <li>Complemented by a prestigious group of highly experienced Senior Advisors</li> </ul>	<ul style="list-style-type: none"> <li><b>Directorial and executive leadership positions</b> in the private and public sectors across the <b>America and Europe</b>, including with banks and leading financial institutions</li> </ul>	<ul style="list-style-type: none"> <li>Deep operating and industry experience, including in <b>power and renewable energy, EV transport, climate finance and sustainable living</b> across Europe and the Americas</li> </ul>

### Focus

<p><b>1</b></p> <p><b>M&amp;A and strategic advisory transactions</b>, often private, complex or cross-border, across the Americas and Europe</p>	<p><b>2</b></p> <p><b>Debt and equity capital raising</b> for businesses, projects and highly differentiated fund managers.</p>	<p><b>3</b></p> <p><b>Sector expertise</b> in infrastructure, power and renewable energy. <b>\$2.2 billion</b> in M&amp;A advisory, project finance and equity capital raising across <b>25</b> transactions</p>
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### Transactional Track Record

Pan American Finance and members of the firm have completed over **300** M&A and capital raising transactions with c. **US\$48 billion** in transaction value. PAF through its affiliate PAF Securities, has completed **80** transactions with **\$4.4 billion** in transaction value.

**\$1.6 billion**

M&A and strategic advisory across **40** transactions

**\$1.4 billion**

Project finance, debt advisory and restructuring across **24** transactions

**\$0.9 billion**

Mezzanine and equity capital raised across **10** transactions

**\$4.5 billion**

Capital placement transactions across **15** fund transactions

# Contact Information

**Ben Moody**

*President & CEO, Partner*

Direct: +1 (305) 722 – 7245

Mobile: +1 (786) 556 – 2273

ben@panamfinance.com

**Edmund R. Miller**

*Senior Managing Director, Partner*

Direct: +1 (305) 722 – 7244

Mobile: +1 (305) 987 – 0995

emiller@panamfinance.com

**L. Warren Pimm, CFA**

*Senior Managing Director, Partner*

Mobile: +44 (0)7593593539

wpimm@panamfinance.com

**Jeffery A. Safford**

*Managing Director*

Direct: +1 (305) 722 – 5528

Mobile: +1 (786) 769 – 8315

jsafford@panamfinance.com

**Robert Hays, CFA**

*Managing Director*

Direct: +1 (305) 722 – 7254

Mobile: +1 (305) 433 – 0347

rhays@panamfinance.com

**Sina Guenther**

*Vice President*

Direct: +49 (151) 11301321

sguenther@panamfinance.com

**Pedro Obregon**

*Vice President*

Direct: +1 (305) 722 – 7255

Mobile: +1 (786) 200 – 0464

pobregon@panamfinance.com

**Alex Medina**

*Associate*

Direct: +1 (305) 722 – 7260

Mobile: +1 (305) 431 – 6638

amedina@panamfinance.com

**Federico Fermin**

*Associate*

Direct: +1 (305) 722 – 7250

Mobile: +1 (786) 354 – 6401

ffermin@panamfinance.com

**Mariano Montaner**

*Analyst*

Direct: +1 (305) 722 – 7243

Mobile: +1 (786) 343 – 7552

mmontaner@panamfinance.com

