

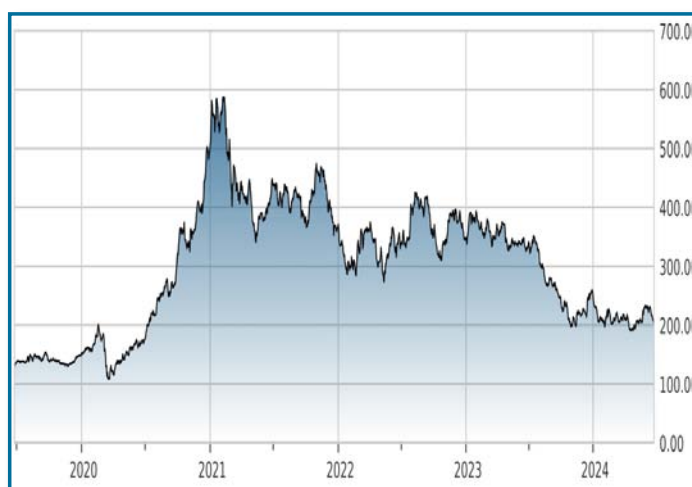
SOLAR SECTOR UPDATE

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MAC Global Solar Energy Index (SUNIDX)



Solar stocks remain on the defensive but solar demand remains very strong

The MAC Global Solar Energy Stock Index fell by -4.2% over the past three months and by -21% year-to-date. The MAC Solar Index saw extraordinary gains of +67% in 2019 and +245% in 2020, settling back by -26% in 2021, -5% in 2022, and -26% in 2023.

Solar stocks have been under pressure over the past year in part from higher interest rates, which raised the cost of solar projects. However, higher interest rates have boosted the cost of other types of electricity plants as well, meaning that solar has fared no worse than its competitors from the standpoint of interest rates.

Solar stocks have also been under pressure from a drop in polysilicon and solar module prices due to a surge in production capacity. That price decline has been a negative factor for the profit margins of manufacturers of polysilicon, wafers, cells, and modules. However, those manufacturers constitute only about 30% of the total weight in the MAC Solar Index. The other 70% of the Index weight is in installers and operators of solar systems, or manufacturers of non-module solar components such as inverters,

solar glass, and solar trackers, sectors that should benefit as lower solar module prices boost demand and unit sales.

Indeed, the sharp decline in solar module prices seen over the past year has a silver lining since it is likely to boost unit sales over the longer term as solar becomes even cheaper than competitors and extends its lead as the most widely chosen source of new electricity capacity in most of the world.

Meanwhile, the European solar sector has been under pressure from an inventory buildup of solar modules. However, this inventory overhang mainly involves the residential and commercial/industrial solar markets, not utility-scale solar, where developers generally order directly from manufacturers. This inventory overhang is expected to be worked off during 2024.

In the US, solar growth has been hampered in recent years by the inability of US installers to buy enough modules to meet very strong demand. There has been a shortage of modules because of high US tariffs on imported solar modules and the US government's blockade of some solar products from China's Xinjiang province.

However, US solar installs are expected to surge over the next few years due to a boom in both US solar demand and manufacturing sparked by the Inflation Reduction Act (IRA), which offers substantial 10-year tax credits for the manufacture and installation of solar products.

US solar stocks have also been undercut by uncertainty ahead of the November US elections. However, even if Republicans were to sweep the presidency, the House, and the Senate, they are not considered likely to fully repeal the IRA because the majority of the law's benefits are actually in red states. Also, it should be noted that the US accounts for only 8% of world solar sales, meaning 92% of world solar sales would not be substantially affected by the outcome of the US election.

Despite the recent factors undercutting solar stock prices, the global solar industry is booming. Global solar installs in 2023 surged by an extraordinary +77% to 445 GW, according to Bloomberg New Energy Finance (BNEF). BNEF forecasts an additional +30% of solar growth in 2024, which should help the solar industry to grow out of its current overcapacity situation.

SOLAR PV GROWTH OUTLOOK

The global solar industry in 2023 grew very sharply by +74% yr/yr to a record 437 GW, according to Bloomberg New Energy Finance (BNEF), the fifth consecutive year of double-digit growth.

During the 5-year period of 2018-2023, solar installs showed a compounded annual growth rate of +33%, making it one of the highest sustained-growth industries in the world.

BNEF is forecasting that solar will continue to show solid growth in the coming years. BNEF is forecasting +30% growth in 2024 and a compounded annual growth rate of +12% over the next five years. For 2030, BNEF is forecasting 887 GW of annual installs, which would be up by a total of +103% from the 2023 install level.

Demand for solar has soared as solar energy becomes cheaper than its competitors and as nations and corporations race to meet their net zero emissions targets. Many countries, especially in Europe, are also taking energy security very seriously and are focused on building domestic electricity infrastructure such as solar to reduce their reliance on foreign oil and natural gas.

The outcome of the United Nations COP28 conference in Dubai in December 2023 was positive for renewable energy after nearly 200 nations agreed to engage in an "orderly transition" away from fossil fuels. The agreement was historic since that was the first time countries explicitly agreed to move away from fossil fuels.

Germany's climate envoy commented, "Every investor should understand now that the future investments that are profitable and long-term are renewable energy -- and investing in fossil fuels is a stranded asset." The COP28 agreement included the goals of tripling renewable energy by 2030 and reaching net zero emissions by 2050.

The long-term outlook for solar looks very bright. There will be a massive \$4.2 trillion of spending on solar equipment through 2050, according to BNEF's 2020 New Energy Outlook. BNEF also forecasts that photovoltaic (PV) solar will account for 38% of world electricity capacity by 2050.

"I see solar becoming the king of the world's electricity markets," Fatih Birol, executive director of the International Energy Agency (IEA), said in 2021 with the release of the IEA's flagship World Energy Outlook report. In that report, the IEA forecasted that solar will easily become the largest source of electricity generation by 2040. The report goes on to say:

"Solar PV becomes the new king of electricity supply and looks set for massive expansion. From 2020 to 2030, solar PV grows by an average of 13% per year, meeting almost one-third of electricity demand growth over that period. Global solar PV deployment exceeds pre-crisis levels by 2021 and sets new records each year after 2022 thanks to widely available resources, declining costs and policy support in over 130 countries."

Demand for solar is expected to surge in the coming years as solar costs decline, and solar becomes even more competitive against fossil fuels and nuclear power. BNEF has determined that solar and wind are now the cheapest sources of new electricity generation in countries that geographically account for 82% of the world's power supply.

Bullish longer-term factors for solar stocks include (1) the global dash to reduce carbon emissions as many countries have adopted net zero emissions goals to add to their Paris climate agreement goals, (2) strong demand for solar by many global corporations that have adopted net zero emissions goals, (3) strong economic demand for solar now that solar is cheaper to build than fossil fuel or nuclear power in most of the world, (4) the pairing of solar with ever-cheaper battery systems to provide a 24/7 electricity solution, and (5) the need for many nations to improve their energy security by building domestic electricity infrastructure such as solar, thus insulating themselves from the risk of importing fossil fuels from hostile areas.

Solar surges in China

Solar energy is a key industry in China. China needs low-priced solar to expand its electricity capacity and support its aggressive economic growth targets. China also needs solar to build that new electricity generation in a way that reduces China's reliance on coal, improves its air quality, and meets its carbon emission reduction targets. Solar is also a national champion industry in China and is strongly promoted by the government.

China installed a massive 260 GW of solar in 2023, surging by +144% yr/yr. That was the fourth consecutive year of massive growth, following annual growth rates of +55% in 2022, +32% in 2021, and +57% in 2020, according to BNEF.

BNEF is forecasting continued strong solar growth in China over the next few years with growth of +17% yr/yr in 2024 and +12% yr/yr in 2025. BNEF is forecasting that China in 2030 will install 426 GW of solar, which would be up by a total of 64% from the 2023 install level.

Not only is solar energy growing rapidly in China, but solar accounts for the lion's share of the addition of new electricity capacity. In 2022, for example, solar accounted for 44% of China's new electricity capacity additions, according to China's National Energy Administration (NEA). Other sources of new electricity in China lag far behind solar. Specifically, fossil fuel electricity (coal, gas, and oil) accounted for only 22% of total Chinese new electricity capacity in 2022, wind accounted for 19%, hydro accounted for 12%, and nuclear power and "other" accounted for 3%, according to the NEA.

The Chinese government is relying heavily on solar to meet its increasingly aggressive climate targets. In October 2021, the Chinese government adopted the goal for carbon emissions to

SOLAR PV GROWTH OUTLOOK (CONTINUED)

peak before 2030 and for carbon neutrality by 2060 as part of its National Determination Contribution (NDC) under the Paris Climate Agreement. To meet its NDC goals, China has adopted a target of generating 18% of its electricity from renewable sources (excluding hydro) by 2025.

In order to help meet its aggressive renewables goals, China has begun work on a massive set of solar and wind projects in its desert regions. The first phase of 97 GW of solar and wind started in 2021 and ran smoothly, thus leading the government to expand the project. The Chinese government announced another 455 GW of desert solar and wind projects, with 200 GW slated to be built by 2025 and another 255 GW to be built by 2030. The electricity from those plants will primarily be delivered to the populated eastern regions of the nation.

Chinese solar growth was strong in 2020-23 despite the disruptions caused by the Covid pandemic and the transition in China to a solar market without national subsidies. Developers showed strong interest in subsidy-free solar projects since they can still earn attractive internal rates of return. The Chinese government has added benefits to subsidy-free projects, such as a guaranteed price for solar electricity output and priority on the grid. Moreover, solar projects can still qualify for subsidies at the local level.

The move away from national subsidies should be a long-term positive factor for the Chinese solar industry since the industry should grow more predictably with stable profit margins, as opposed to the boom-bust days of the past that were caused by erratic government subsidy policies.

Without subsidy volatility, the solar industry should be able to more closely match end-user demand, thus eliminating the small and less competitive players that can only compete when there are generous subsidies. The current trend should therefore accelerate, with the solar industry increasingly dominated by large players having the best technology and lowest production costs.

By contrast, the Chinese solar market in previous years was buffeted by erratic subsidy policies that caused upheaval in the industry. For example, Chinese solar installs in 2017 soared by 76% to a then-record high of 53.0 GW as developers took advantage of very generous government subsidies.

In response to that 2017 install surge, however, the Chinese government, on May 31, 2018, announced a sharp cut in most of its solar subsidies, with utility-scale solar capped at 40 GW and roof-top distributed generation capped at 10 GW in 2018. China's subsidy phase-out plan was referred to in the industry as the "China-531 order" after the announcement date.

The government was forced into its China-531 action partly by the big backlog of unpaid subsidies that reached \$23 billion by the end of 2018. The China-531 curtailment of subsidies caused a sharp drop in Chinese solar installs by -17% to 44.3 GW in 2018

and -25% to 33.1 GW in 2019.

US solar demand remains very strong as IRA kicks in

US new install solar growth in 2023 soared by +49% to a new record high of 35.2 GW from 23.6 GW in 2022, according to BNEF.

BNEF is forecasting that new US solar installs in 2024 will grow by another +15% to 40.6 GW. BNEF is forecasting that US solar installs will grow by a total of 63% to 57.6 GW by 2030.

Solar energy accounted for 53% of all new US electricity-generating capacity in 2023, marking the fifth consecutive year that solar energy took first place, according to Wood Mackenzie. Solar was far ahead of an 18% share for natural gas, a 13% share for wind, and a 15% share for "other."

US solar growth in 2023 was led by the utility sector, with a +77% spike in installs to 22.5 GW, according to Wood Mackenzie. The utility solar sector, which accounted for about 70% of all new US solar installs in 2023, benefited from strong demand and the increased availability of modules as the markets learned to deal with module import restrictions imposed by the US government. In 2024, utility solar will show another year of strong growth of +26% yr/yr, according to Wood MacKenzie.

Utility-scale solar accounted for 4.1% of total US electricity generation in 2023, according to the US Energy Information Administration (Short-Term Energy Outlook, Table 7d). The EIA is forecasting that utility-scale solar's share of total US electricity generation will increase to 5.6% in 2024 and 6.9% in 2025. The relatively low solar penetration rates seen thus far mean that there is plenty of headroom for solar to grow rapidly in the coming years to meet new electricity demand and replace more expensive options like fossil fuels.

US residential solar installs in 2023 rose by +12% to 6.8 GW, according to Wood Mackenzie. The residential sector was boosted in 2023 by strength in California installs as homeowners tried to beat the step-down in California's net metering rules. In 2024, Wood Mackenzie is predicting a -13% decline in solar installs for the residential sector due to California's reduced net metering rules.

The US commercial sector showed +19% yr/yr growth in solar installs in 2023 to 1.9 GW as more corporations sought to capture the benefits from solar of lower cost and zero emissions. By contrast, community solar saw growth of only +3% to 1.1 GW in 2023, hamstrung by permitting and interconnection delays. For 2024, Wood Mackenzie is forecasting strong growth of 19% yr/yr for the commercial sector and +15% for the community solar sector.

SOLAR PV GROWTH OUTLOOK (CONTINUED)

US solar is booming due in part to IRA stimulus -- The US solar industry received a huge boost in August 2022 when Congress passed, and President Biden signed, a \$369 billion climate bill, representing the single biggest climate investment in US history. The bill was named the "Inflation Reduction Act" since it was partly designed to reduce consumer healthcare and energy costs.

The US solar industry no longer needs any subsidy help from the US government since solar is now the cheapest form of new utility-level electricity capacity on an unsubsidized basis and is self-sustaining without any subsidies. Nevertheless, the new policy support from the US government gives the solar industry an extra boost.

The solar industry was ecstatic about Washington's passage of the Inflation Reduction Act. The Solar Energy Industries Association called the new law "a massive catalyst for the solar industry." JPMorgan Chase analyst Mark Strouse called the climate legislation "the largest policy change in US history to accelerate growth in what we have viewed as an already inevitable energy transition to renewables."

The surge in US policy support for solar has put other governments on notice that they need to boost their own policy support or see the US win the lion's share of new solar manufacturing production outside China in the coming years. Since the US passed the IRA, countries that have boosted their support for solar include EU countries, Canada, and South Korea, among others.

Specifically, the energy provisions of the Inflation Reduction Act raised the solar investment tax credit (ITC) to 30% from 26% and implemented a 10-year extension of the 30% ITC tax credit through 2032, with step-downs to 26% in 2033 and 22% in 2034. The ITC also has "adders" that can boost the ITC to as much as 50%, including credits for paying "prevailing wages," creating apprenticeship programs, using solar modules produced in the US, and building solar projects in brownfield sites traditionally linked to fossil fuels such as coal.

Also, the ITC now has a "direct pay" provision. This allows developers without sufficient tax liabilities to claim a direct payment from the federal government in the form of a tax rebate, which is much more valuable to the solar industry than the old system, which required equity investors with sufficient tax liabilities to claim the ITC credit. Previously, a shortage of tax equity limited the solar industry's ability to take full advantage of ITC credits.

The US solar industry now has a decade of ITC certainty for project development. Previously, the US solar market went through various booms and busts as developers tried to stay ahead of short-term ITC windows and step-downs.

Before the Inflation Reduction Act was passed, the solar industry was operating under the legislation in the pandemic aid bill passed in December 2020, whereby the ITC was set at 26% for 2020 and

2021, with a step-down to 22% in 2023. For 2024, the ITC under the previous law would have fallen to 10% indefinitely for large-scale solar projects and to zero for small-scale solar projects.

The Inflation Reduction Act also established an ITC for battery storage for the first time, giving solar-plus-storage a big boost.

The Inflation Reduction Act also provided a big boost for residential solar by providing a 30% tax credit for residential solar systems installed from 2022 through 2032, with a step-down to 26% in 2033 and 22% in 2034. The new credit also applies to residential battery storage systems installed in conjunction with a solar system. The previous residential tax credit was set at 26% for 2022 and 22% in 2023 before ending in 2024, and did not include battery storage systems.

To support US domestic solar production, the Inflation Reduction Act also provided \$30 billion to implement a new production tax credit (PTC) for US solar manufacturers through 2035. The solar PTC will help the US build a larger solar manufacturing base and reduce its reliance on imported solar modules.

Manufacturing tax credits are specified for solar products built in US-based facilities, such as modules, thin-film or crystalline PV cells, wafers, backsheets, and solar-grade polysilicon. There is also a manufacturing tax credit for DC-to-AC inverters, which has prompted some inverter companies, such as Enphase, to announce they will build new manufacturing plants in the United States.

The IRA's ITC and production credits have led to a surge of announcements by various global solar companies about their plans to build new factories in the United States. New solar plant announcements have come from First Solar, Canadian Solar, Hanwha Q Cells, Meyer Berger, Enel, Waaree Energies, JA Solar, Maxison, NexTracker, SolarEdge, Enphase, and others.

The IRA program has already resulted in a near doubling of US solar module manufacturing to 16.1 GW in 2023 from only 8.5 GW in 2022, according to Wood Mackenzie. The rapid US solar manufacturing build-out is expected to continue in 2024. Clean Energy Associates (CEA) expects US annual solar module capacity in 2024 to more than double to 35 GW from 2023, implying the US could meet as much as 85% of its expected 2024 solar installs with domestically-produced modules.

The US is well on its way to CEA's forecast for 35 GW of production capacity by the end of 2024, considering that the Solar Energy Industries Association (SEIA) reported that US solar module manufacturing capacity increased to 26.6 GW by the end of Q1-2024, up +71% from the comparable year-earlier level.

Higher US manufacturing capacity is making more modules available to US buyers and is helping to reduce some of the premium on US solar module prices relative to world prices that

SOLAR PV GROWTH OUTLOOK (CONTINUED)

has been caused by US government import restrictions. Solar modules in the US can cost as much as twice the module price elsewhere in the world due to various US government restrictions.

Yet estimates for new US solar manufacturing capacity have been trimmed in recent months due to the sharp drop in global solar module pricing, which poses profitability challenges for new US solar facilities. For example, CubicPV in February canceled its plans to build a large US wafer factory based on current technologies, and instead decided to focus on newer and more efficient technologies. While there may be more cancellations of proposed US solar manufacturing facilities in the coming months, the US is still on its way towards sharply reducing solar module imports and alleviating the shortage of solar modules seen over the past several years.

US government relies on solar import tariffs to help build domestic solar manufacturing base -- The US government, over the past decade, has used import tariffs to promote US solar manufacturing. However, the import tariffs have restricted the supply of modules available to US solar developers and have raised the price of US modules relative to world price levels.

US tariffs on imported solar products go back to 2012 when the Obama administration imposed Section 301 tariffs on solar modules and cells imported from China to address concerns that Chinese solar manufacturers were dumping subsidized products in the United States. The Biden administration in May 2024 then doubled the Section 301 tariffs on Chinese solar modules and cells to 50% from the original level of 25%.

The higher 50% Biden tariff will have little impact since the US imports virtually no solar modules or cells directly from China due to the original Obama tariff. However, the Biden administration has exempted solar manufacturing equipment from the tariff so that companies building manufacturing facilities in the United States can import the factory machinery they need to build their US factories.

Some Chinese companies responded to the original 2012 Chinese tariffs by building new factories in Southeast Asia to import solar components from China and circumvent the US tariff. To address this concern, the US Department of Commerce (DOC) in August 2023 imposed anti-dumping and countervailing duty (AD/CVD) tariffs on four companies that the DOC concluded were circumventing the Chinese tariffs. Those factories were located in Malaysia, Thailand, Vietnam, and Cambodia.

That AD/CVD investigation, which began in March 2022, sparked a flurry of order cancellations and project delays by US developers in 2022 due to uncertainty about how extensive the tariffs would be. However, the Biden administration announced in June 2022 that any tariffs from the investigation would be suspended until June 2024, thus giving US solar developers time to migrate their solar module purchases to other sources. The

Biden administration recently announced that the tariff suspension would not be extended beyond June 2024, meaning the US will now begin to collect that AD/CVD tariff on US solar imports from those four companies.

The US Department of Commerce (DOC) in June 2024 then began a new and more extensive AD/CVD investigation against solar factories located in the countries of Malaysia, Thailand, Vietnam, and Cambodia to see if those companies are dumping subsidized products in the United States. A group of US solar manufacturers requested the investigation to see if they could get protection from their competitors in Southeast Asia. Many observers believe it is likely that the DOC, in the coming months, will impose new AD/CVD tariffs on at least some solar products imported from those Southeast Asian countries.

Separately on the tariff front, the Biden administration, in February 2022, extended the Trump administration's Section 201 tariffs on imported solar modules at 14.25% until February 2025 and 14.0% from February 2025 until February 2026. The Section 201 tariffs apply globally with limited exemptions for countries such as Canada, Mexico, Indonesia, Jordan, South Africa, and others.

However, in its 2022 extension of Section 201 tariffs, the Biden administration kept open two big loopholes. First, the Biden administration in 2022 exempted the first 5 GW of imported solar cells from the Section 201 tariff.

Second, the Biden administration maintained the exemption for bifacial modules, which was first introduced by the Trump administration. The bifacial module exemption provided a big break for US solar developers and buyers since large utility-scale projects widely use those modules. Bifacial modules allow light to be absorbed by both the front and back of the module as light bounces off the ground.

In early 2024, the Biden administration then tightened up the Section 201 duties by removing the exemption for bifacial panels, which will now be subject to the 14.25% duty. However, the Biden administration kept in place the 5 GW of exempted cell imports to give US module factories the ability to import the solar cells they need to assemble into their solar panels. In addition, the Biden administration indicated that it would likely raise the solar cell exemption to 7.5 GW if necessary to ensure that US factories have enough duty-free cells to assemble their modules.

Regarding the history of the US 201 tariffs, the Trump administration, in January 2018, imposed a Section 201 tariff of 30% on imported solar cells and modules in an attempt to protect the few existing US solar manufacturers. The initial Section 201 import tariff of 30% for 2018 stepped down to 25% in February 2019, 20% in February 2020, and 15% in February 2021. The tariff was set to expire in February 2022, but as mentioned earlier, President Biden in 2022 then extended the tariff until 2026.

SOLAR PV GROWTH OUTLOOK (CONTINUED)

US solar importers deal with Xinjiang restrictions -- US solar imports and installs have been disrupted over the past several years by the US government's action to block some solar imports from the Xinjiang region of China due to allegations of forced labor at some companies located in Xinjiang. However, that situation is being resolved as solar companies meet US government documentation requirements or acquire the modules they need elsewhere.

The Xinjiang issue began for the solar industry when the US government in June 2021 imposed a "Withhold Release Order" that blocked the import of polysilicon products produced by five companies based in China's Xinjiang province due to allegations that the companies were associated with government-run forced labor programs of the Uyghur Muslim minority. China's government denied the forced-labor allegations and objected to what it said was US interference in its internal affairs.

The targeted companies were hamstrung in trying to defend themselves against the forced labor allegations by China's Anti-Foreign Sanctions Law, which makes it illegal for Chinese companies to comply with US requirements to avoid sanctions. The Chinese law makes it difficult for Chinese companies to defend themselves against allegations of using forced labor without getting themselves into trouble with the Chinese government.

Going beyond the initial Withhold Release Order, the US Congress in December 2021 then passed the Uyghur Forced Labor Prevention Act (UFLPA), which was signed into law by President Biden and took effect in June 2022. That law bans importing products made in Xinjiang unless the importer can provide convincing evidence that the products were not made with forced labor. The UFLPA does not impose a total ban on importing goods from Xinjiang but rather imposes only a "rebuttable presumption" of a ban that can be overcome with proper documentation.

The Xinjiang restrictions were significant for the global solar industry because factories in the Xinjiang region produced about 45% of the world's solar-grade polysilicon as of 2020, according to Bernreuter Research. Factories in Xinjiang do not assemble any significant number of solar modules, but they do produce a significant amount of polysilicon.

However, there has recently been a sharp increase in the number of polysilicon factories built outside Xinjiang. As a result, Wood Mackenzie says that the share of the world's polysilicon that came from Xinjiang factories in 2023 dropped to less than one-quarter in 2023.

The global solar industry has also adjusted to Xinjiang labor issues by diverting supplies away from Xinjiang and doing a better job of ensuring transparency and documenting their supply chains to allow the importation of modules into the United States.

Also, about 175 solar companies from around the world signed

a pledge sponsored by the Solar Energy Industries Association (SEIA) to ensure that their supply chains are free of any forced-labor products (see ["Solar Companies Unite to Prevent Forced Labor in the Solar Supply Chain"](#)). The SEIA also released a Supply Chain Traceability Protocol that helps companies prove that their supply chain is free of any products that are potentially connected with forced labor (see ["New Traceability Protocol Allows Solar Companies to Ensure Ethical Supply Chain"](#)).

The US ban on importing undocumented solar products from Xinjiang caused some supply-chain disruptions for US solar developers, who have had shipments detained by US Customs until they provided the necessary documentation. However, the overall impact of the ban has been reduced by the fact that the US only buys a small portion of China's solar module output in the first place due to the decade-long US tariffs on Chinese solar products.

Europe is also taking steps to block products that are tied to forced labor. In June 2024, the European Parliament approved a forced labor ban. That proposed legislation is now awaiting final approval by the EU Council. However, even after the legislation receives final approval, the ban will have little near-term impact because EU countries will have three years to apply the new rules.

Other US solar policy support -- Elsewhere on the solar policy front, President Biden, on June 6, 2022, took executive action by announcing that the administration would invoke the Cold War-era Defense Production Act to gain greater powers to support US solar manufacturing.

An executive from the Solar Energy Industries Association (SEIA) noted that the Biden administration's increased powers under the Defense Production Act "can be used to drive federal procurement, establish project labor agreements, community benefit agreements and master support agreements, develop loan programs, create partnerships and establish other programs that address the emergency need for clean energy."

The invocation of the Defense Production Act gives the US Energy Department increased latitude to make loans to US manufacturing companies for the purpose of building domestic solar plants. Under that authority, the Energy Department has already announced a \$56 million program to reduce US dependence on imported solar modules by supporting R&D for non-silicon thin-film solar and perovskite solar cells.

Under the Defense Production Act, the Biden administration is also boosting the ability of the federal government to directly purchase domestically-produced solar modules by applying domestic content standards.

Early in his term, which began in January 2021, President Biden took a number of executive actions on the climate front. On his first day in office, President Biden announced that the US would

SOLAR PV GROWTH OUTLOOK (CONTINUED)

rejoin the Paris Climate Accord. That confirmed that the US would resume its global leadership position in trying to meet the Paris Climate Accord's goal of keeping global warming to less than 2 degrees Celsius above the pre-industrial level, and preferably less than 1.5 degrees Celsius. President Biden also pledged to reach a 100% carbon-free electricity sector by 2035 and reach net-zero greenhouse gas emissions by 2050.

The Biden administration, in April 2021, announced a new "Nationally Determined Contribution" (NDC) under the Paris Climate Agreement of a reduction in US greenhouse gas emissions by 50-52% by 2030 from 2005 levels. That was nearly double the previous commitment made by the Obama administration of a 26-28% cut in greenhouse gas emissions by 2025 from 2005 levels. The Biden NDC also included the target of the US economy having net-zero carbon emissions by 2050.

In December 2021, President Biden signed an executive order to cut the federal government's emissions by 65% by 2035 and make the government carbon neutral by 2050, the same year that carbon neutrality is targeted for the US economy as a whole. That order also directs the US government to achieve 100% carbon pollution-free electricity by 2030, which is only six years away.

The White House explained the order: "The federal government will work with utilities, developers, technology firms, financiers, and others to purchase electricity produced from resources that generate no carbon emissions, including solar and wind, for all its operations by 2030."

European solar expected to show continued strong growth

European solar installs in 2023 grew sharply by +40% yr/yr to a record 56 GW, according to industry association SolarPower Europe in its report, "EU Market Outlook for Solar Power: 2023-2027." That was the third consecutive year of annual growth of at least +40%.

EU solar installs in 2024 will grow by +11% to 62 GW, followed by 19% growth in 2025 and +14% growth in 2026, according to forecasts from SolarPower Europe.

Demand for solar in Europe is expected to remain very strong in the coming years, although solar installs may be curbed somewhat if Europe adopts import barriers and reduces the number of solar modules available to installers.

European countries with the largest solar installs in 2023 were Germany with 14.1 GW, Spain (8.2 GW), Italy (4.8 GW), Poland (4.6 GW), and the Netherlands (4.1 GW). Solar installs were widely diversified across the EU, with 14 of the 27 EU countries installing more than 1 GW of solar in 2023.

Solar energy's share of total electricity generation in Europe

rose to 9.1% in 2023, up from 7.6% in 2022 and 5.7% in 2021, according to energy thinktank Ember.

European solar growth has soared in recent years after Europe, in late 2018, scrapped its previous reliance on tariffs and a minimum import price (MIP) scheme that sought to protect domestic solar manufacturers but instead meant that developers had few reasonably-priced modules to buy. European solar install growth has soared since Europe dropped the MIP scheme, although Europe is importing about 90% of its modules to meet demand.

The end of the MIP scheme, combined with the sharp drop in solar module prices seen in recent years, allowed solar to reach grid parity in much of Europe. As a result, many solar projects in Europe are now being installed on an unsubsidized basis.

European solar growth is also receiving a boost from the EU's pandemic stimulus plan, approved in July 2020, which totaled 750 billion euros, since almost one-third of those funds were targeted for fighting climate change. That added to the EU's 7-year budget, which had 1 trillion euros of funding to help EU countries meet their emission-reduction goals under the Paris climate accord.

European solar growth is expected to show solid growth in the coming years due to the need to meet the EU's renewable energy targets. In September 2022, the European Parliament approved an increase to 45% by 2030 of the share of renewables in the EU's energy mix, up from 40% in June 2022 and the previous target of 32%. The new 45% target was set by the European Commission as part of the REPowerEU plan to cut the EU's dependence on imported Russian natural gas. The actual target is 42.5% but a 2.5% "indicative top up" allows for a 45% target to be reached.

The EU is relying on its renewables target to meet its pledge under the UN Paris climate agreement to cut its greenhouse gas emissions by at least 55% by 2030 from 1990 levels, and for net zero emissions by 2050.

Europe was thrown into an energy emergency after Russia invaded Ukraine in February 2022, which forced Europe to slash its dependence on Russian oil and gas. Russia's invasion of Ukraine brought the importance of domestic energy security to the forefront once again, much as it was in the 1970's when OPEC's oil embargo caused long gasoline lines and a global recession. Fossil fuels often come from hostile and inhospitable places, making them an expensive, unreliable, and risky source of energy for importers.

As a result of Russia's attack on Ukraine, the EU formulated a new plan called REPowerEU to slash its dependence on Russian fossil fuels. A key strategy of REPowerEU is to rapidly build more renewable electricity to replace natural gas and coal. The REPowerEU proposal seeks to ensure that 740 GW of cumulative solar capacity is in place by 2030, which would require about 500 GW of new solar to be installed during the 7-year period of 2024

SOLAR PV GROWTH OUTLOOK (CONTINUED)

to 2030.

The REPowerEU strategy includes several key measures for accelerating the installation of solar, including larger government solar auctions, government help in identifying land sites, streamlined permitting, and streamlined solar Power Purchase Agreements (PPAs) to make them more attractive for small and medium-sized companies.

While solar is already growing rapidly in Europe and has strong policy support, the passage of the IRA law in the US caused near panic among European policymakers that the new US manufacturing incentives will make it difficult for Europe to expand its solar manufacturing base.

US passage of the IRA law galvanized European policymakers into taking more aggressive action to build a domestic solar manufacturing base. The European Commission formulated the "Green Deal Industrial Plan," which is focused on the four pillars of regulation, financing, skills, and trade.

As part of the Green Deal Industrial Plan, the EU in June granted final legislative approval of the "Net-Zero Industry Act (NZIA)," which is focused on the goal of obtaining 40% of its clean energy deployment with European-manufactured products. The NZIA imposes domestic content requirements for European public auctions and tenders for renewable energy capacity, thus seeking to support European manufacturers. The NZIA also seeks to promote training of workers for solar manufacturing plants and ease regulatory burdens on European solar manufacturers.

There is heavy pressure on European governments to protect what little solar manufacturing exists in Europe. Germany has said it is considering tariffs to block cheap Chinese solar imports. That move is opposed by European solar installers and project developers, who account for the lion's share of solar employment in Europe.

India's solar demand expected to remain very strong

India's government is pushing very hard for solar to help modernize its infrastructure, boost its global business competitiveness, expand electricity access in rural areas, and meet its climate goals.

India is pursuing national goals of 450 GW of renewable capacity by 2030 and net zero emissions by 2070. India's government has also set an aggressive goal of more than tripling its cumulative solar capacity to 293 GW by 2030.

Solar is already the biggest source of new electricity in India, accounting for 56% of new annual electricity capacity additions in 2023, according to the Institute for Energy Economics and Financial Analysis (IEEFA). That means that solar energy in India is easily beating other sources of new electricity generation such

as wind, natural gas, coal, and nuclear.

In 2023, India installed the fifth most solar of any country in the world, behind China, the US, Brazil, and Germany. In 2023, India installed a 13.6 GW of solar, down -25% yr/yr, according to BNEF. That followed the banner year in 2022 of +48% growth to a record 18.3 GW.

India's solar installs in 2023 were undercut by commissioning delays and the lack of enough modules to meet demand because of the Indian government's restrictions on solar module imports. However, the supply situation is expected to improve in 2024 and beyond as new domestic production comes online.

As a result of the expected increased supply of domestic modules, BNEF is forecasting that India's solar install growth rate will be strong at a compounded annual rate of +20% over the next five years and will more than triple to an annual install rate of 46 GW by 2030.

India's domestic solar manufacturing capacity is already growing quickly. Mercom reports that India added 20.8 GW of solar module production and 3.2 GW of solar cell production in 2023. That brought India's cumulative solar module manufacturing capacity to 64.5 GW and solar cell capacity to 5.8 GW as of December 2023. Mercom is forecasting that India will more than double its solar module manufacturing capacity to at least 150 GW by 2026.

Increased production is allowing Indian solar manufacturers to not only meet domestic demand, but also to export a significant number of modules to other countries, such as the US, where buyers are looking to avoid tariffs on Chinese modules.

In order to build a domestic solar manufacturing industry, India's government provided a hefty \$3 billion of funding for its solar PV manufacturing "Production Linked Incentive" (PLI) scheme. That program provides subsidies to companies that build large PV manufacturing plants in India.

India's government has also used tariffs to block imports of Chinese solar modules and encourage Indian solar installers to buy Indian modules. Effective April 1, 2022, India's government imposed a basic customs duty of 40% on certain imported solar modules and a 25% duty on imported solar cells.

As another trade protection mechanism, India maintains an "Approved List of Models and Manufacturers" (ALMM) of solar modules that are approved for installation in India. That list was originally designed as a minimum quality requirement, but it is actually a domestic content requirement since there are no non-India solar manufacturers on the list.

The Indian government, from March 2023 through March 2024, temporarily suspended the ALMM list to allow the use of foreign modules since there simply weren't enough modules produced in

SOLAR PV GROWTH OUTLOOK (CONTINUED)

India to meet demand. However, the government reimposed the ALMM list restrictions as of April 2024 to clamp down again on foreign imports.

Japan's solar slows while much of the rest of Asia/Pacific is soaring

Solar installs in Japan in 2023 fell by -3% yr/yr to 6.0 GW, the third consecutive annual decline, according to BNEF. Japan's solar installs in 2024 will fall by another -9% to 5.5 GW, stabilize in the mid-5 GW area during 2025-26, and then see double-digit growth in 2027-28, according to forecasts by BNEF.

Japan's expected annual install level of around 5-6 GW over the next few years would mean that Japan's total cumulative solar capacity would grow by 5-7% per year. That would push Japan's cumulative solar capacity up by a total of nearly +50% to 134 GW in 2030 from 90 GW in 2023.

Japan's annual solar installation growth is currently slowing due to reduced subsidies. Yet, the Japanese government's subsidy support for solar will continue in the coming years with a FIT (feed-in tariff) program for residential and commercial-industrial projects.

For large-scale solar projects, the Japanese government, in April 2022, launched a new feed-in-premium (FIP) support program. The new FIP program gives solar electricity producers a premium over wholesale electricity prices as an incentive, unlike the old FIT system that specified a fixed electricity price. The new system aims to transition the Japanese solar market to unsubsidized parity.

The Japanese government is pursuing aggressive solar targets to help meet its emissions goals. In July 2021, the Japanese government almost doubled its solar target to a cumulative capacity of 108 GW by 2030. The government raised its solar target to help meet Japan's carbon target of cutting greenhouse gas emissions by 43% by 2030 from 2013 levels and achieving net zero carbon emissions by 2050.

Solar in Japan should also see support in the coming years from Japanese corporations that want to sign solar power purchase agreements to meet their corporate renewable energy goals. Corporate demand is expected to be a key factor driving the development of subsidy-free solar in Japan in the coming years.

Elsewhere in Asia/Pacific, Taiwan is expected to see strong solar installs in the coming years as the government promotes solar to meet its climate goals. Solar installs in Taiwan in 2023 rose by +29% to 2.6 GW and showed a strong compounded annual growth rate of +21% in the five years through 2023, according to BNEF. BNEF expects Taiwan's solar installs to fall by -12% to 2.3 GW in 2024 but then grow by +30% to a record 3.0 GW in 2025.

There is strong solar demand in Taiwan from corporations looking to meet their renewable energy goals. Also, there is rising demand for solar power in Taiwan to replace the coming closure of coal plants to meet the government's goal of net zero emissions by 2050.

Taiwan's government is targeting a 25% renewable energy supply by 2025. The government has announced an aggressive cumulative solar capacity target of 20 GW by 2025, which would be about 60% higher than the current cumulative capacity.

South Korea is another promising solar spot in Asia. Solar installs in South Korea in 2020 grew sharply by +51% to a record 5.6 GW, although installs have since fallen back and in 2023 fell by -15% to 2.8 GW, according to BNEF.

Corporate demand for solar power is expected to grow sharply after South Korea's government in January 2021 revised its electricity laws to allow clean energy developers to sell electricity directly to corporations with power purchase agreements.

The South Korean government is considering a proposal to require that 21.5% of electricity generation capacity be derived from renewable sources by 2030. The South Korean government, in 2021, raised its nationally determined contribution under the Paris Climate Agreement to a 40% cut in emissions by 2030 from 2018 levels.

In Australia, solar installs in 2023 showed strong growth of +18% yr/yr to 5.6 GW and showed strong +22% compounded annual growth over the last ten years.

Australia's government has pledged to reduce emissions by 43% by 2030 from the 2005 level and reach net zero emissions by 2050. However, Australia needs to install 1.9 terawatts of solar to meet its net-zero target by 2050, according to a report entitled "Net Zero Australia" issued by researchers at the universities of Melbourne, Queensland, and Princeton. The government is also targeting 82% renewable generation by 2030, up from the current level of 27%.

Latin America comes on strong with Brazilian dominance

Latin America has become a major player in the solar industry due to rapid growth in Brazil, Mexico, and Chile.

Annual solar installs in the fifteen largest Latin American countries in 2023 rose by +13% to 21.0 GW, adding to the growth rates of +34% seen in 2021 and +69% in 2022, according to BNEF. Solar growth in Latin America has shown a compounded annual growth rate over the last five years of +38%.

Solar growth in Latin America is heavily concentrated in Brazil. Brazil not only accounted for 80% of Latin American solar installs in 2023 but also rose to third place in the world for installed solar,

SOLAR PV GROWTH OUTLOOK (CONTINUED)

behind China and the US.

Brazil's annual solar installs in 2023 rose +19% to 16.9 GW and showed a compounded annual growth rate over the last five years of +63%.

Chile was the second largest Latin American solar player in 2023, with 2.2 GW of solar installs, accounting for 10% of total Latin American installs. Chile's solar installs showed annual compounded growth of +36% over the last five years.

Mexico was the third largest solar player in 2023, with 1.2 GW of installs, accounting for 6% of total Latin American installs.

SOLAR PV ANNUAL NEW INSTALLATIONS

New global solar PV installations in 2023 soared by +74% to a new record high of 437 gigawatts (GW), according to Bloomberg New Energy Finance (BNEF). That added to the strong growth rates of +39% in 2022 and +25% in 2021. Global solar installations grew by a compounded annual rate of +33% in the five years through 2023 and rose 24-fold since 2010.

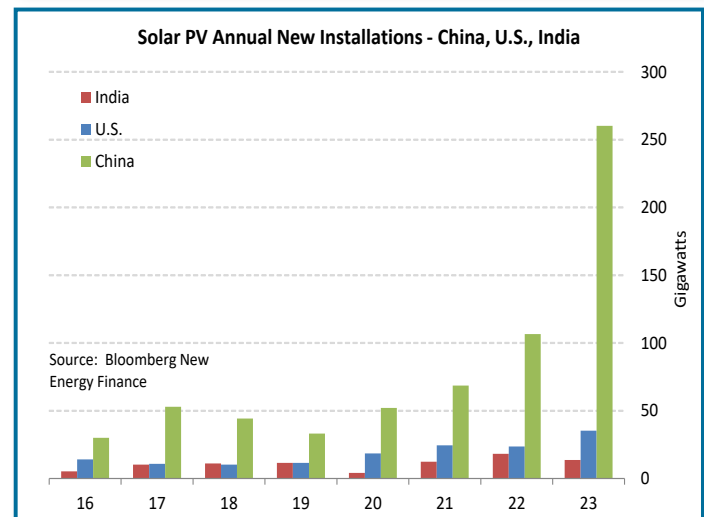
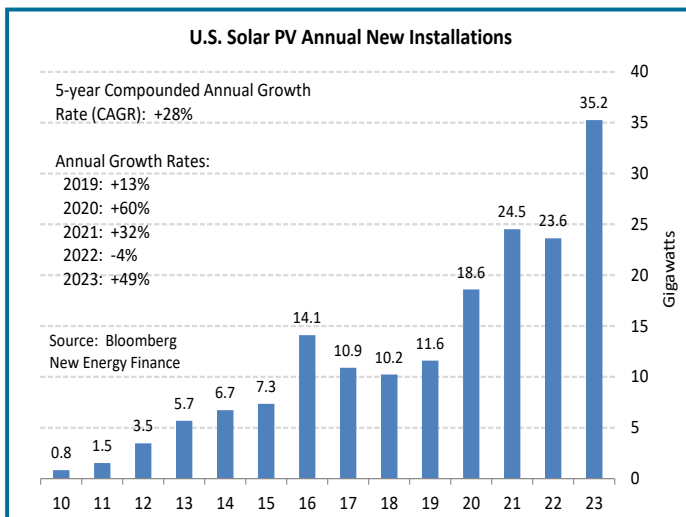
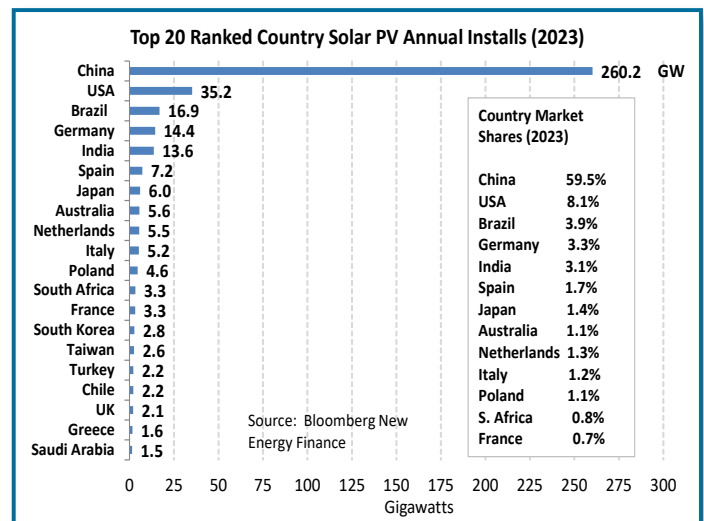
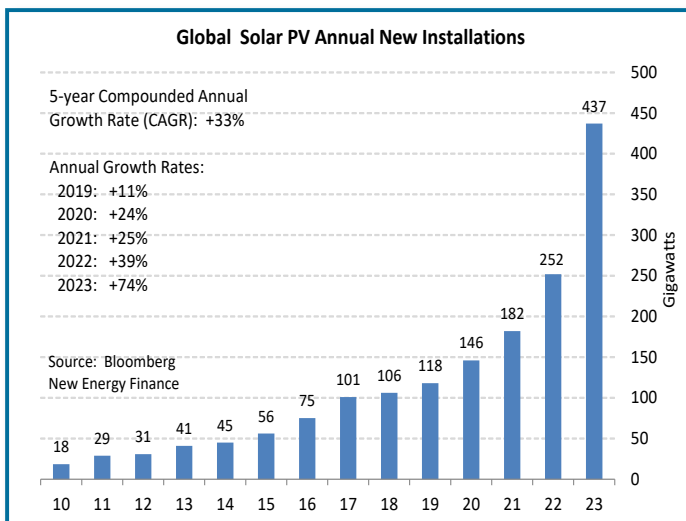
In 2023, China led the world in annual new solar installs for the eleventh straight year with a record 260 GW of installs, up +144% yr/yr, according to BNEF. The US maintained its second-place position with 35.2 GW of installs, up +49% yr/yr. Brazil jumped into third place from fourth place with 16.9 GW of installs, up +19% yr/yr. Germany was in fourth place with 14.4 GW of installs, up +96% yr/yr. India fell into fifth place from third place with 13.6 GW of installs, down by -25% yr/yr. Spain was in sixth place with 7.2 GW of installs, down -8% yr/yr.

There were 24 countries in 2023 with annual installs above

1 GW, more than twice the 10 countries above 1 GW in 2018. That illustrates the spread of solar across the world and the diversification of the industry. Fitch forecasts that 36 nations will install more than 1 GW of solar by 2029.

Solar growth in Europe in 2023 grew sharply by +40% yr/yr, adding to the +37% growth rate seen in 2022. The countries with the largest solar install amounts were Germany with 14.4 GW, Spain with 7.2 GW, Netherlands with 5.5 GW, Italy with 5.2 GW, Poland with 4.6 GW, and France with 3.3 GW, according to BNEF.

US solar PV installations in 2023 rose by +49% to 35.2 GW from 23.6 GW in 2022. US installs grew at a compounded annual rate of +28% over five years through 2023 and rose 42-fold from 2010, according to BNEF. The states with the largest amount of new PV solar installations in 2023 were Texas with 6.5 GW (+87% yr/yr), California with 6.2 GW (+21% yr/yr), and Florida with 3.2 GW (+56% yr/yr), according to Wood Mackenzie.



SOLAR PV CUMULATIVE INSTALLATIONS

Cumulative solar PV electricity generation capacity across the world as of the end of 2023 grew by +36% yr/yr to 1.7 terawatts (TW), according to Bloomberg New Energy Finance (BNEF). In the last five years, global cumulative solar PV electricity generation capacity has increased by more than 3-fold and has risen by a compounded annual growth rate of +26%.

As of the end of 2023, China continued to be the world's leader for cumulative solar capacity at 707 GW, up +61% yr/yr, according to BNEF. As of the end of 2023, China accounted for 42% of the world's solar PV capacity. In the past five years, China's cumulative installed solar capacity soared nearly four-fold and showed compounded annual growth of +32%.

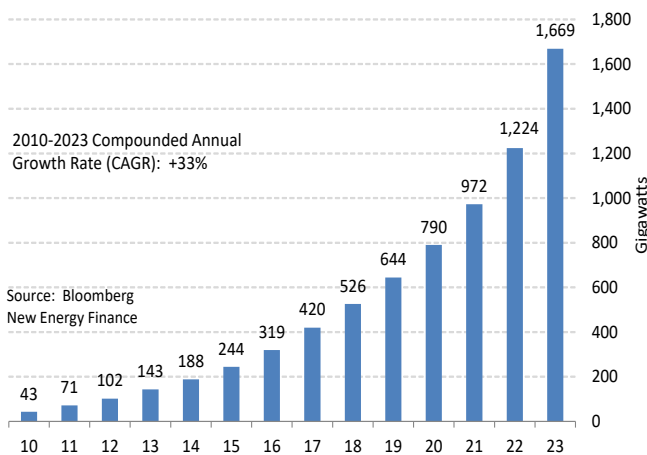
As of the end of 2023, the US remained in second place for cumulative solar installs. US solar electricity capacity in 2023 rose by +25% yr/yr to 176 GW, representing 11% of world capacity.

Over the past five years, US cumulative solar electricity capacity rose nearly three-fold and showed compounded annual growth of +23%.

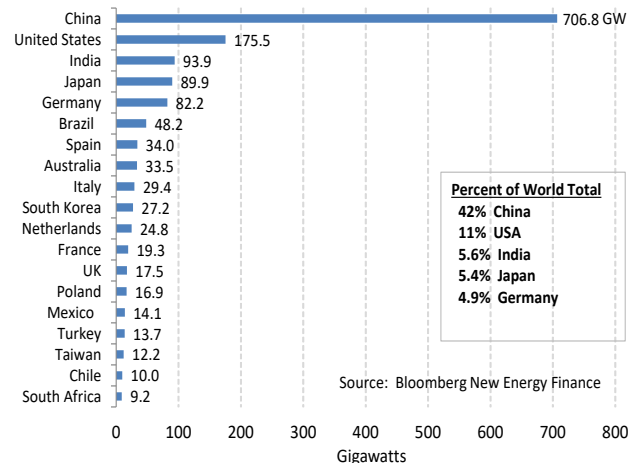
India, in 2023, moved up to third place from fourth place with 94 GW of cumulative solar PV capacity, up +20% yr/yr. Over the past five years, India's cumulative solar capacity rose nearly three-fold and showed compounded annual growth of +24%. India accounted for 5.6% of the world's total solar PV capacity as of the end of 2023.

Japan, in 2023, slipped into fourth place after having been in third place for nine consecutive years. Japan's cumulative solar capacity in 2023 rose by +7% to 90 GW, representing 5.4% of world capacity. Japan's cumulative solar capacity in the past five years rose 1.6-fold and showed compounded annual growth of +10%.

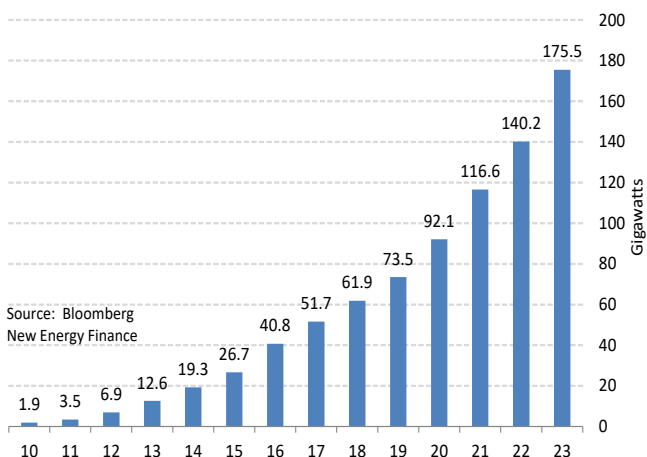
Global Solar PV Cumulative Installations



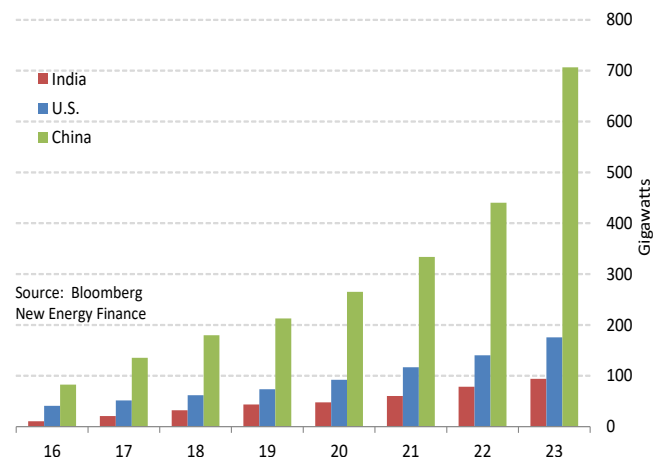
Top 20 Country Solar PV Cumulative Capacity (through 2023)



U.S. Solar PV Cumulative Installations



Solar Cumulative Installation - China, U.S., India



LEVELIZED COST OF SOLAR ELECTRICITY

Solar electricity's cost is cheaper than fossil fuels and nuclear

The median levelized cost of electricity (LCOE) for newly-built US utility-scale crystalline solar PV plants as of June 2024 rose slightly by +2% to \$61 per MWh from \$60 in 2023, according to Lazard's annual "Levelized Cost of Energy Report 17.0," released in June 2024. Lazard's solar LCOE costs ranged from a low of \$29 per MWh to a high of \$92 per MWh.

Lazard's solar median LCOE of \$61 in 2024 was up from the record low of \$36 seen in 2021 due to higher costs stemming from higher interest rates and higher pandemic-related inflation costs for material and labor. Notably, nuclear and fossil fuel LCOEs have also been on the rise in recent years.

The Lazard LCOE figures are calculated with the assumption of no subsidies. In real life, however, there are substantial subsidies that make solar even cheaper than the figures mentioned above. US utilities have substantial subsidies at their disposal to reduce the price of new solar plants.

The median LCOE for utility solar of \$61 per MWh in 2024 is substantially below the median LCOE costs of \$76 per MWh for natural gas, \$118 for coal, and \$182 for nuclear. That illustrates the easy economic decision for utilities to choose solar or wind for new electricity plants, since those plants are now cheaper to build than fossil fuel or nuclear power plants.

Moreover, the lower end of the LCOE range of \$29 per MWh for building a new utility solar plant is below the Lazard median marginal costs for operating an existing plant of \$32 for a nuclear plant, \$71 for a coal plant, and \$30 for a natural gas plant.

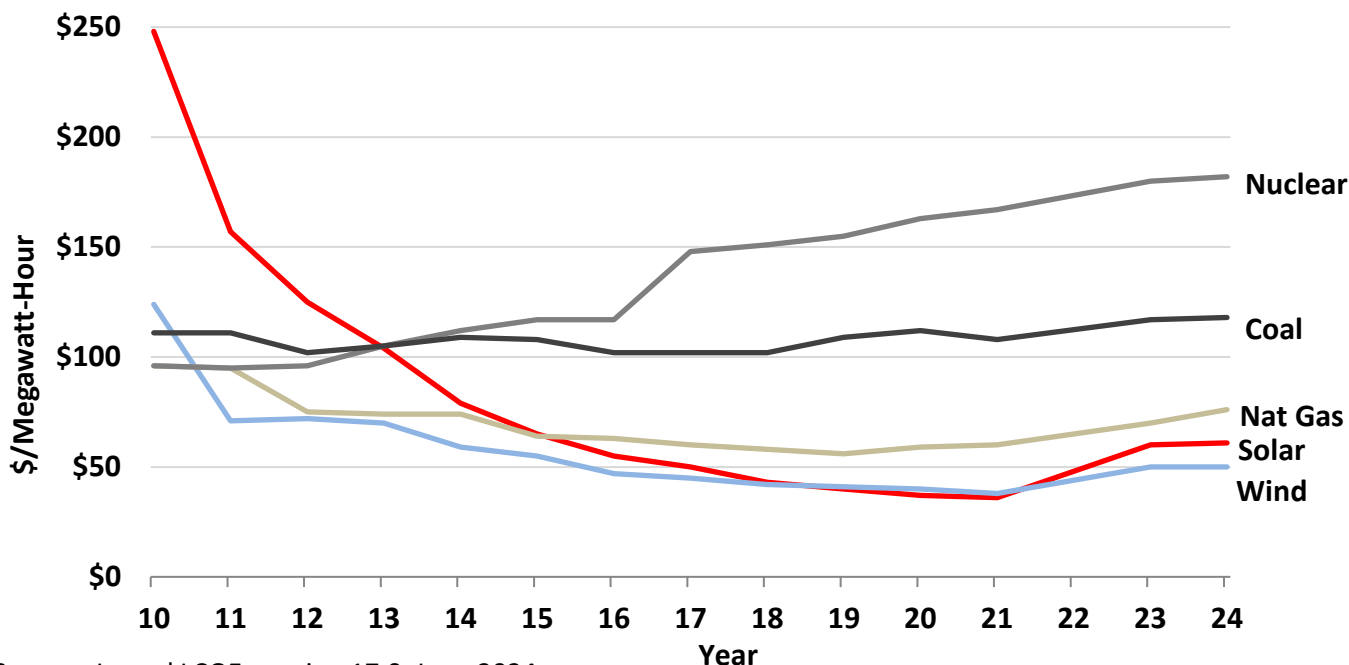
That means that if a utility can construct a solar plant near the lower end of Lazard's LCOE range, there is an incentive for the utility to mothball existing nuclear, coal, and natural gas plants and replace them with a new solar or wind plant.

Solar has big potential as a replacement technology since many coal and nuclear plants are reaching the end of their useful lives. The average US coal plant is 45 years old, and the average US nuclear plant is 40 years old, according to the US Energy Information Administration. As coal and nuclear plants are retired, many utilities will decide to switch to building new solar and wind plants simply because they are cheaper.

The low cost of solar is a global phenomenon. Utility-scale solar and wind "are now the cheapest sources of new electricity generation in countries accounting for 82% of the world's power supply and 85% of global GDP," according to BNEF ("Renewables Now Undercut Fossil Fuels in Most Countries, Bloomberg New Energy Finance, 6/8/2023).

BNEF reports that renewables are now the cheapest form of electricity generation in 16 of the G-20 countries, i.e., all G-20 countries except for Indonesia, Russia, Saudi Arabia, and South Korea.

Levelized Cost of New U.S. Utility-Scale Electricity (unsubsidized)



Source: Lazard LCOE, version 17.0, June 2024

PRICING - SOLAR MODULES, CELLS, AND POLYSILICON

Solar module prices have edged to record lows. The world price of standard monocrystalline silicon modules has fallen to a new record low of 10.3 USD cents per watt, according to PV Infolink. Monocrystalline silicon modules have fallen by -50% yr/yr and by an overall -94% since 2010.

Meanwhile, the price of thin-film modules has edged to a record low of 18.4 cents per watt, according to PV Insights. Thin-film module prices have fallen by -18% yr/yr and by an overall -86% since 2010.

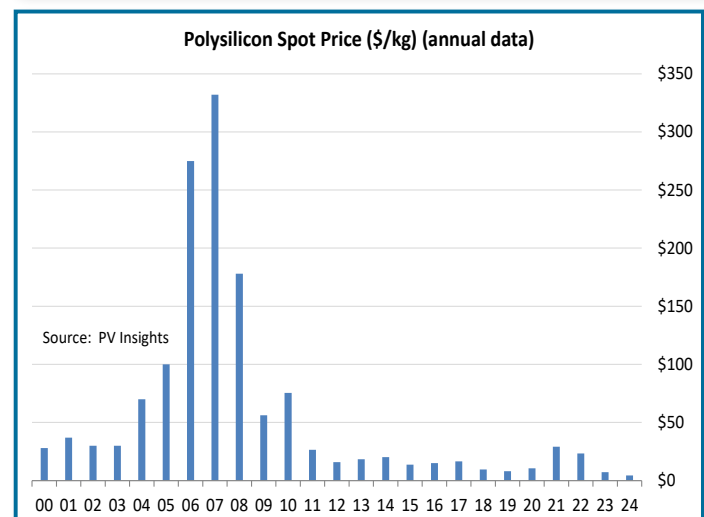
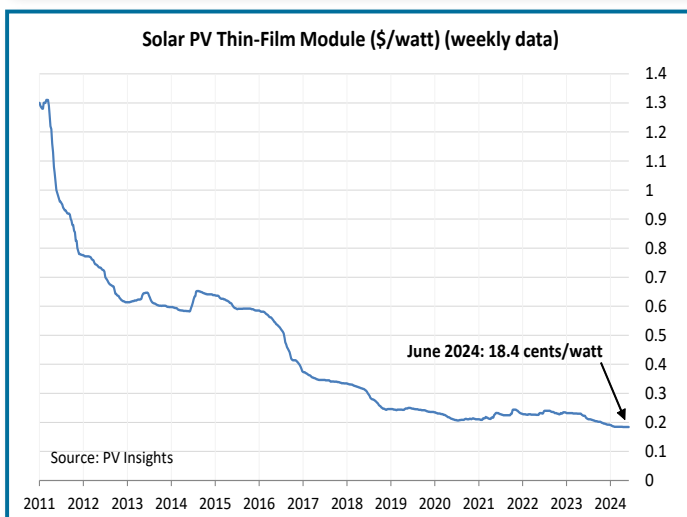
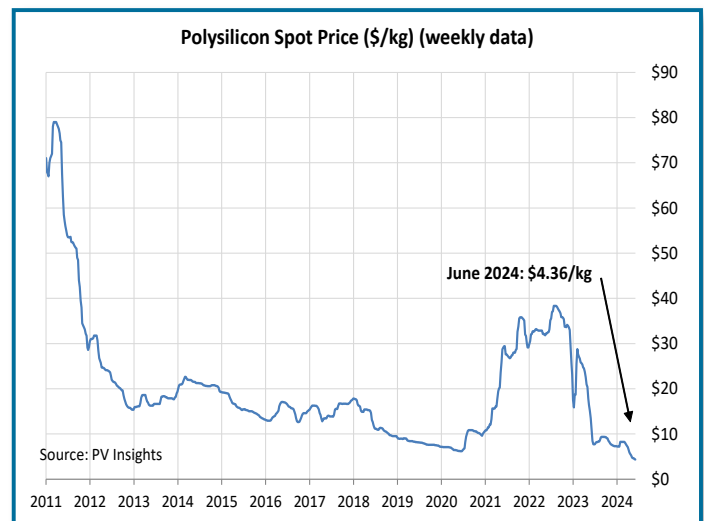
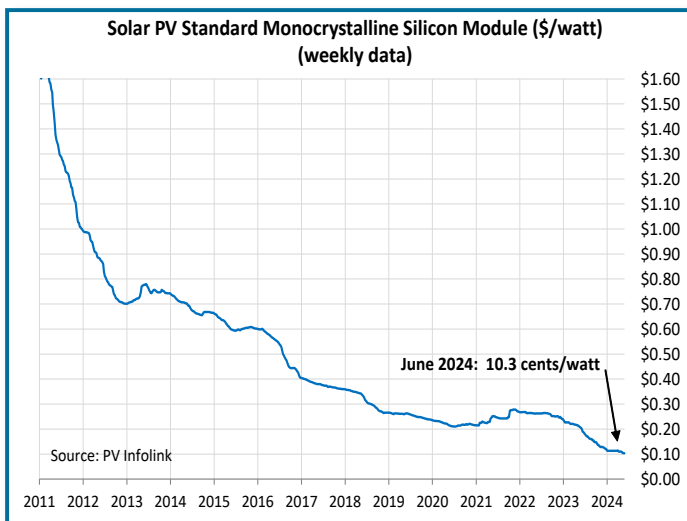
Solar module prices temporarily rose in 2020-21 due to strong demand, high polysilicon input prices, pandemic disruptions, higher costs for other materials, and high shipping costs.

However, the long-term decline in module prices has now resumed due to new production capacity coming online and long-term secular factors such as technological advancements and

manufacturing economies of scale. The decline in module prices should stimulate fresh demand and higher unit sales as solar becomes even cheaper relative to its competitors.

Spot polysilicon prices in June 2024 fell to a new record low of \$4.36 per kg, according to PV Insights. Polysilicon prices have fallen -60% over the past year and are down by a total of -94% from the 2010 level.

Polysilicon prices rose sharply in 2021-22 due to strong demand and various supply disruptions such as fires, flooding, regional power rationing, and avoiding polysilicon from the Xinjiang province. However, polysilicon prices have fallen sharply since late 2022 because a large amount of new polysilicon production capacity has come online and various supply disruptions have abated. The decline in the price of polysilicon, the key ingredient in silicon solar cells and modules, has made room for a drop in module prices.



SOLAR JOBS

US solar jobs, as of December 2022, rose by +3.5% to a record high of 263,883 jobs from 255,037 jobs in 2021, according to the "National Solar Jobs Census" published by the Interstate Renewable Energy Council (IREC). The report is available at www.SolarJobsCensus.org.

The report is based on a survey conducted by the US Department of Energy for the *United States Energy & Employment Report (USEER) 2023* and was administered by BW Research Partnership.

The US solar industry during the 10-year period of 2012-2022 added 144,866 jobs to the US economy, rising by a total of +122% over that period and showing compounded annual growth of +8%.

Solar jobs rose in 2022 as the pandemic faded and solar installs boomed. Residential solar jobs grew by about 9,500 jobs (+11%), outweighing a loss of about 6,000 jobs in the utility sector caused by a shortage of solar modules.

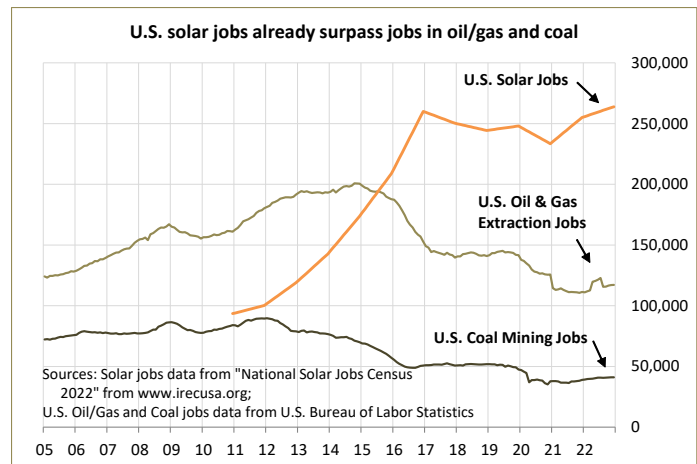
US solar jobs will likely increase sharply beginning in 2023-24 as new US solar manufacturing facilities are built in response to the US Inflation Reduction Act. Over the next ten years, the Solar Energy Industry Association is expecting US solar jobs to nearly double to 475,000, with 100,000 of those jobs in manufacturing.

Regarding the sector breakdown, the survey found that 65% of US solar jobs are at installation and project management firms, 13% at manufacturing firms, 12% in wholesale trade and distribution, 6% in operations and maintenance (O&M), and 4% in a miscellaneous "all others" category.

The number of solar jobs in the US exceeds those in the fossil fuel industries. Specifically, the 263,883 jobs in the solar sector far exceed the 117,200 direct jobs in the oil/gas extraction industry and 41,100 direct jobs in the coal mining industry at the end of 2022, according to figures from the US Bureau of Labor Statistics (see chart on the right).

Meanwhile in Europe, solar jobs in the EU surged by +39% yr/yr to 648,000 jobs as of the end of 2022 from 466,000 the year prior, according to SolarPower Europe in its publication "EU Solar Jobs Report 2023." The lion's share of those jobs (84%) were in the installation sector, compared with only 8% in operation and maintenance, 7% in manufacturing, and 1% in decommissioning and recycling. In its most optimistic scenario, SolarPower Europe is predicting that European solar jobs could reach 1 million jobs as soon as 2025.

Globally, solar PV is a huge employer, with 4.3 million solar jobs worldwide at the end of 2021, up by +8% from 4.0 million at the end of 2020, according to the "Renewable Energy and Jobs -- Annual Review 2022" from the International Renewable Energy Agency (IRENA).



China is far ahead of any other country in solar PV jobs, with a total of 2.7 million jobs due to its large installation and manufacturing solar sector, according to the IRENA report. Other countries with significant solar PV employment include India with 137,000 jobs and Japan with 151,000 jobs, according to IRENA.