PV-WIND MONTHLY MARKET UPDATE

U.S. PV and Wind Capacity Additions Are Off-Pace in 2021

September 2021

(Data Updates for June 2021)

U.S. PV-WIND CAPACITY **June 2021 PV and Wind Capacity Additions**

- In June, PV capacity additions total 1,288 MW.
- In June, wind capacity additions total 1,628 MW.

U.S. ELECTRICITY GENERATION **June 2021 PV and Wind Electricity Generation**

- PV and wind electricity production is 11.6% of total U.S. electricity generation
- Of total U.S. electricity generation, PV is 4.5% and wind is 7.1%

TRADE – U.S. PV IMPORTS/EXPORTS **U.S. PV Panel Imports Decline in June**

- In June, the value of U.S. PV panel imports is $605 million
- Malaysia, Vietnam, and Thailand are the top suppliers of U.S. PV panel imports

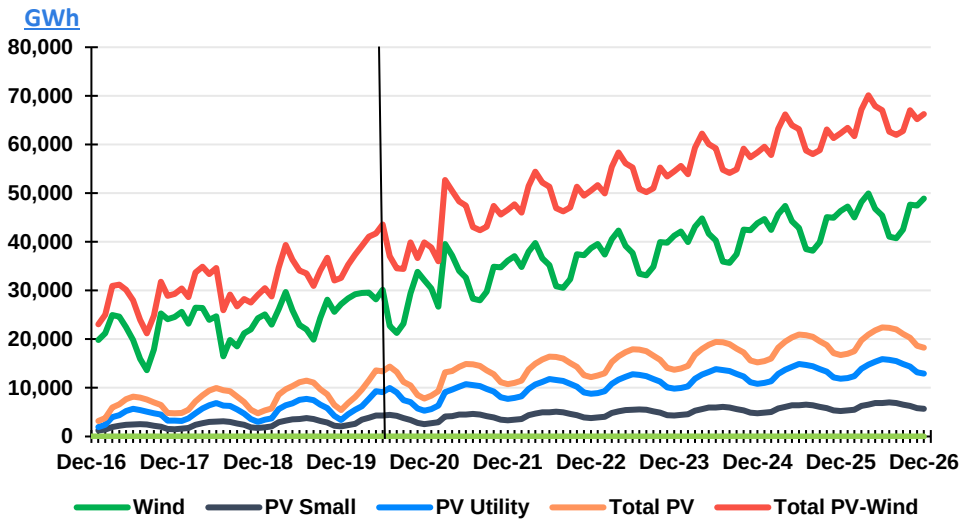
WORLD PV-WIND CAPACITY **2021 World PV and Wind Forecast**

- The world PV forecast is 143 GW of capacity additions
- The world wind forecast is 70 GW of capacity additions

PV-WIND COMPANY FINANCIAL PERFORMANCE **August 2021 ETF Performance**

- For August 2021, share price performance of TAN is negative and FAN is positive
- For August 2021, QQQ, SPY and DIA outperform TAN

PV-Wind Electricity Generation: Actual to June-21; Forecast to Dec-26



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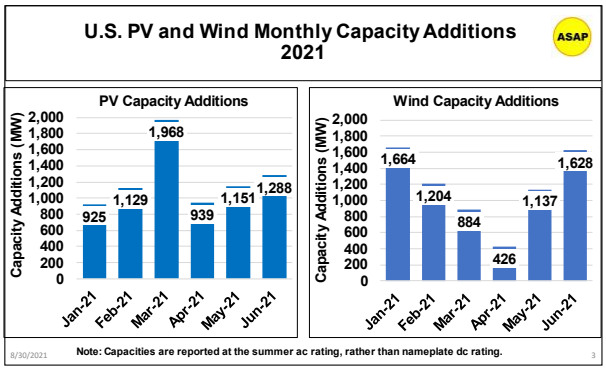
Battery Storage Analysis

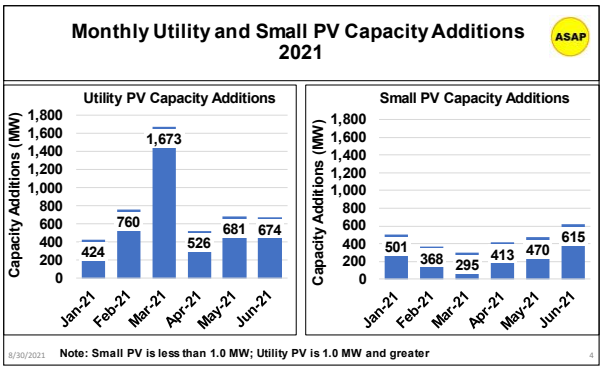
Global Warming Update

U.S. PV and Wind Capacity

June U.S. PV capacity additions total 1,288 MW

In June, the U.S. cumulative PV capacity increased to 81.2 GW with 1,288 MW of PV capacity additions. June utility scale PV capacity additions totaled 674 MW, which is 52% of total new PV. In contrast, small PV capacity additions totaled 615 MW. Through June, the annualized pace for PV capacity additions is 14.8 GW. Year-to-date PV installations remain off the pace required to meet the 2021 forecast of 17.0 GW of PV growth.



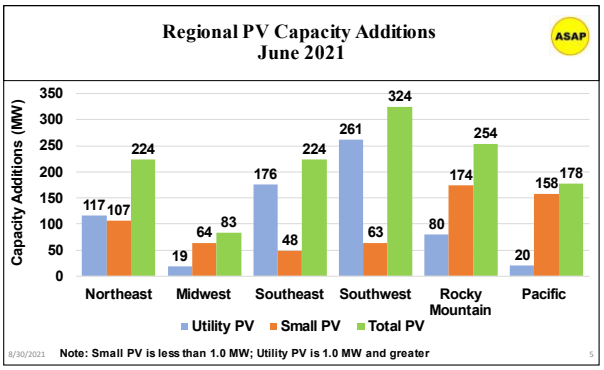


Southwest and Rocky Mountain regions led in June PV capacity additions

An important factor confronting the PV market is price inflation due to tightness in polysilicon supply and shipping issues. In response, companies report the possibility for 2021 project slippage into 2022. The prospect for project slippage due to high PV prices is most likely to occur for large utility scale PV projects. This poises a significant headwind to meet the 17.0 GW PV capacity additions forecast for 2021.

The 2021 PV forecast is 17.0 GW of capacity additions

On a regional basis, the Southwest and Rocky Mountain regions set the pace with 324 MW and 364 MW of PV capacity additions respectively. The Northeast and Southeast regions followed with 224 MW of PV capacity additions each. Small PV installations dominated in the Rocky Mountain, Pacific, and Midwest regions. For utility PV capacity additions, Arizona, Texas, and Virginia led the nation with 150 MW, 111 MW and 99 MW respectively. For small PV capacity additions, Colorado and California set the pace with 153 MW and 147 MW respectively.



The 2021 PV forecast of 17.0 GW is supported by the extension of the federal PV investment tax credit. The solar investment tax credit (ITC), which was scheduled to drop from 26% to 22% in 2021, will stay at 26% for two more years. This means that solar projects in all market segments — residential, commercial, industrial, utility-scale — that begin construction in 2021 and 2022 will still be able to receive a tax credit at 26%. In 2023, all PV markets will drop to a 22% tax credit. Beginning in 2024, the solar tax credit

is ended for the residential market, while the commercial and utility markets have a permanent 10% solar tax credit. The wind industry also received a limited extension of its production tax credit.

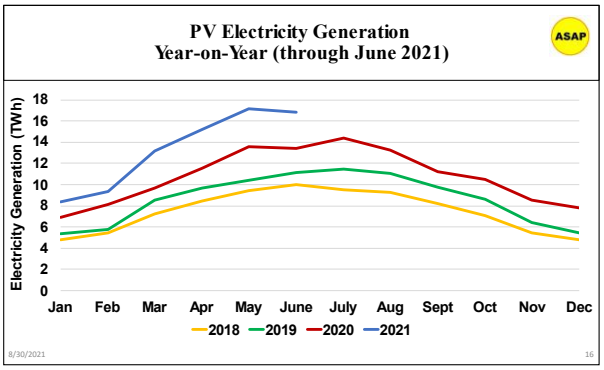
June wind installations are 1,624 MW

Wind installations in June were a healthy 1,624 MW, which raised the annual pace for wind installations to 13.9 GW. However, wind installations are still shy the pace to meet ASAP's 2021 wind growth forecast of 15.0 GW. Wind capacity additions in June were in the Southwest and Midwest regions with 1,045 MW and 584 MW respectively. The leading states for wind capacity additions were Texas with 904 MW, Michigan with 384 MW, Minnesota with 200 MW, and New Mexico with 141 MW.

PV-Wind Electricity Generation Update

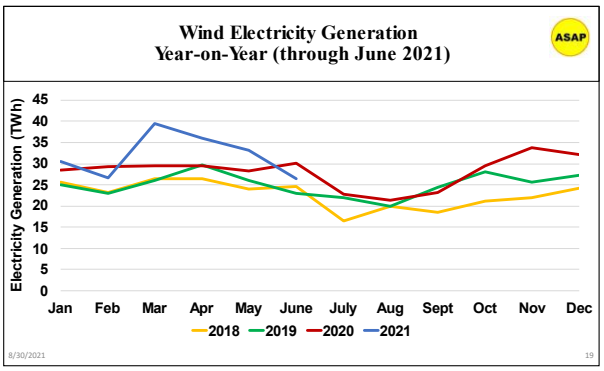
June combined PV and wind electricity generation is 11.6% of total U.S. electricity generation

In June, PV electricity generation was 16.9 TWh (-1.5% MoM), and wind electricity generation was 26.4 TWh (-20.5% MoM). Combined PV and wind electricity generation was 11.6% of total U.S. electricity generation in June. PV contributed 4.5%, and wind provided 7.1%. For the full year of 2021, combined PV and wind electricity generation should be well over 12% of total U.S. electricity generation.



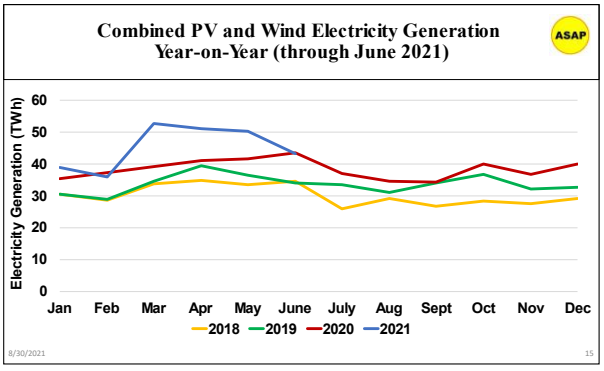
Year-on-year, PV electricity generation increased 25.7%

Year-on-year, June-20 to June-21, PV generation increased 25.7%, and wind generation declined 12.5%. Year-on-year, combined PV and wind electricity generation for the month of June declined -0.7%. Weather conditions in June suppressed wind electricity generation in the U.S. interior.



Year-on-year, U.S. wind electricity generation decreased in the Midwest, Southwest and Pacific regions

In June, the Pacific region led the nation in PV electricity generation with 6.0 TWh and is followed by the Southeast region with 3.5 TWh and the Southwest region with 2.9 TWh. California is the leading state with 5.6 TWh of PV electricity generation, which is 33% of total U.S. PV electricity generation in June.

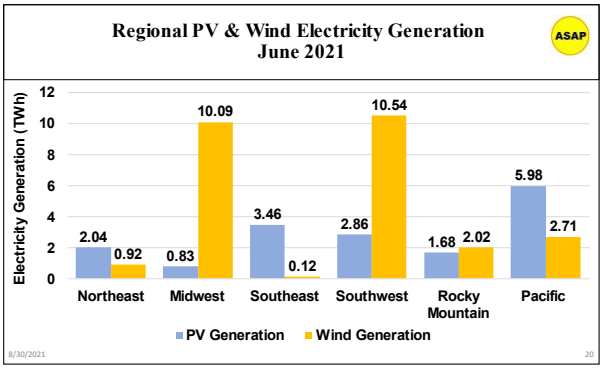


The Pacific region leads the nation in PV electricity generation

Texas is second with 1.6 TWh. Filling out the top five states are North Carolina with 1.1 TWh, Arizona with 1.0 TWh, and Florida with 0.9 TWh.

The Midwest and Southwest regions dominate U.S. wind electricity generation

Wind electricity generation in June is greatest in the Southwest and Midwest regions, which combined produced 78% of total U.S. wind electricity in June. The Southwest region leads with 10.5 TWh of electricity generation and is followed by the Midwest region with 10.1 TWh. The Pacific region is a distant third with 2.7 TWh of electricity generation. Texas is the nation's leader with 7.3 TWh of wind electricity generation and is followed by Iowa with 2.3 TWh, Oklahoma with 2.3 TWh, and Kansas with 1.7 TWh.



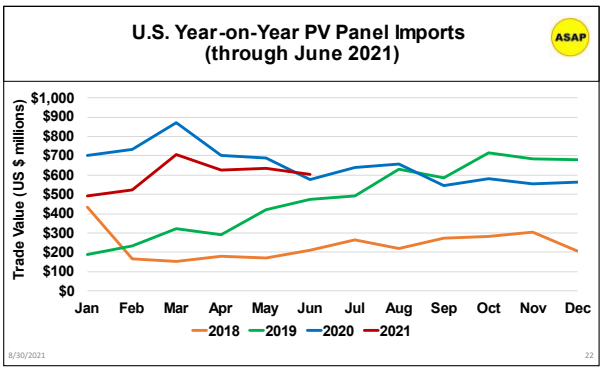
Year-on-year, June-20 to June-21, U.S. wind electricity generation declined 3.8 TWh (-12.5%). YoY, Midwest wind electricity generation declined 1.0 TWh (-9.0%), and Southwest wind electricity generation declined 2.4 TWh (-18.6%).

To state the obvious, seasonality combined with variations in weather patterns have significant impacts on month-on-month and year-on-year changes in PV and wind electricity generation.

PV Trade

The value of June 2021 U.S. PV panel imports is $604 million

In June, the value of U.S. PV panel imports decreased month-on-month 5.0% to $605 million. With the year-to-date value of U.S. PV panel imports standing at $3.59 billion, the annual trajectory for U.S. PV panel imports is $7.1 billion. PV trade is facing headwinds caused by increasing PV prices due to tight polysilicon supply, increases in PV module prices, and high transport costs.



Malaysia, Vietnam and Thailand are the top three sources of U.S. PV panel imports in June

Monocrystalline polysilicon prices fluctuated in August from $26.30/kg at the beginning of August to $28.50/kg in mid-August to an August close of $26.70/kg (China average PV grade polysilicon spot prices). The polysilicon market will remain tight until new production plants come online with sufficient capacity to balance supply and demand, which is not expected to occur before the middle of 2022.

Even with increases in polysilicon production in late 2021, supply in the upstream polysilicon market is expected to remain tight until the middle of 2022 due to strong market demand for mono-silicon PV driven by global carbon neutrality commitments by all major economies. Hence, PV module manufacturers are increasing prices to offset the increased costs. Published China spot market PV module prices are up about 15%. While underlying demand for solar energy remains strong driven by ambitious public and private sector targets, there is an observed increasing price elasticity of demand, which holds the prospect for some utility PV projects to be delayed until 2022.

Malaysia, Vietnam, and Thailand are the top three countries for U.S. PV module imports and together account for 80% of U.S. imports. Malaysia leads the market for U.S. PV panel imports with a 37% market share in June. Vietnam's share of the U.S. PV panel import market fell to a 28% share in June. Thailand rounds out the top three with an 16% share. Year-to-date, Malaysia leads with a 35% market share, Vietnam has a 32% market share, while Thailand follows with a 17% market share.

South Korea dominates the U.S. PV cell import market in June

Turning attention to U.S. imports of PV cells, the total value of June U.S. PV cell imports declined 18.7% month-on-month to $34.5 million. South Korea dominates U.S. supply of imported PV cells in June with a 42% share and a YTD 58% share. Malaysia and Vietnam round out the top three sources for U.S. PV cell imports.

In terms of U.S. exports, the value of U.S. PV panels exports in June declined to $2.3 million. Year-to-date, the value of U.S. PV panel exports is $10.1 million, and the annual pace is $20.3 million. For full year 2021, the value of U.S. PV panel exports is expected to be $25.0 million, which is 16.7% lower than the $30.0 million value of U.S. PV panel exports in 2020. In essence, the U.S. PV panel export market is minimal.

The value of U.S. PV panel and cell exports are minimal

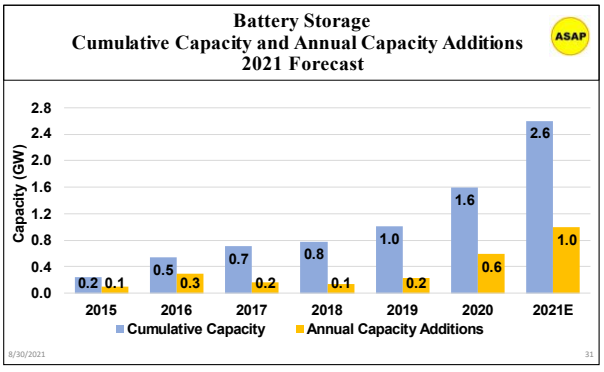
The value of U.S. PV cell exports in June increased to $3.4 million. YTD the value of U.S. PV cell exports is $12.6 million and is on an annual pace of $25.2 million. The 2021 forecast for U.S. PV cell exports is $23 million.

China is dominant in the PV industry space. China's upstream polysilicon manufacturing base supplies about 80% of the world's PV-grade polysilicon demand. With announced expansion plans by Chinese firms, China is likely to control 90% of world PV-grade polysilicon supply by 2024. Both Europe and the U.S. are exploring ways to compete with China in the PV market. A bill introduced in the U.S. Congress is the Solar Energy Manufacturing for America Act, which aims to accelerate domestic manufacturing by offering tax credits at all stages of the solar supply chain. The fully refundable tax credit would allow companies to front-load capital expenditure and rapidly scale production domestically for components and materials, including photovoltaic cells and modules.

Utility Battery Storage

U.S. cumulative battery storage capacity increases to 2.39 GW in June

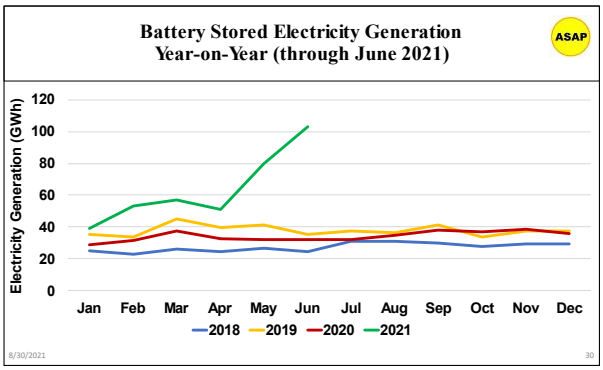
U.S. battery storage capacity additions totaled 435 MW in June, which increased cumulative battery storage capacity to 2.39 GW. Year-to-date, battery capacity additions total 792 MW. The annualized pace is 1.58 GW, which is well over the 1.0 GW annual forecast.



The 2021 forecast for battery storage capacity additions is 1.0 GW, which will bring cumulative battery storage capacity to 2.6 GW. Looking ahead, ASAP expects annual battery capacity additions to exceed 5.0 GW in 2025. From company battery installation announcements, four hours of battery storage potential is becoming the norm.

The reported June average monthly battery utilization factor is 6.0%, which implies battery electricity generation of 103.1 GWh. Year-on-year, June-20 to June-21, battery

electricity generation has more than doubled. Battery electricity capacity and supply will continue to increase at an exponential rate with a significant scale-up in annual battery capacity additions going forward.



The June average battery utilization factor is 6.0%

Obviously, variability in PV and wind electricity production requires electricity storage to convert PV and wind into a dependable supply of on-demand electricity. At present, the U.S. has approximately 800 GW of fossil fuel power plants, which implies the need for hundreds of GW of storage if PV and wind electricity is to replace fossil fuel power plants. At present, the large-scale storage options are pumped hydro, batteries, hydrogen, molten salt for thermal solar, and underground compressed air energy storage. Currently, pumped hydro is the largest storage technology with over 22 GW of installed capacity. Due to siting constraints, it is expected that pumped hydro storage capacity will remain in the 22 GW neighborhood going forward. On the other hand, battery storage is gaining traction for PV storage.

There are several green hydrogen projects on the drawing board with hydrogen produced from water using PV, wind, and hydro electricity. Green hydrogen is being discussed as a fuel for fuel-cell heavy transport trucks. Molten salt storage for solar concentrating plants and compressed air energy storage are basically being ignored. There is a permitted compressed air energy storage project in Texas using salt storage that is slated to begin construction in 2022.

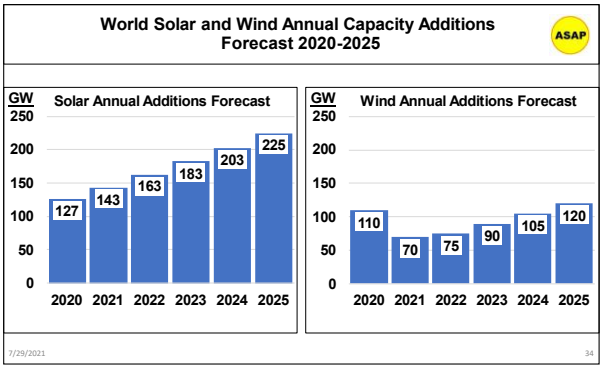
World PV and Wind

The world PV forecast for 2021 is 143 GW

The world wind forecast for 2021 is 70 GW

World cumulative PV capacity is expected to surpass world wind capacity in 2021

ASAP's 2021 forecast for global PV capacity additions is 143 GW, which is 12.6% annual growth. The 2021 forecast for wind capacity additions is 70 GW, which is 9.6% annual growth. Wind installations are generally much larger in terms of capacity and require more regulatory hurdles than PV installations. Therefore, the record 2020 wind installation rate is not expected to be replicated in 2021. However, wind installations are expected to return to the 100 GW mark in 2024 and rise to 120 GW in 2025.



At the end of 2020, world cumulative solar capacity was 707 GW and world cumulative wind capacity was 732 GW. Based on the annual solar and wind forecast, the cumulative capacity of solar is expected to surpass that of wind in 2021. The cumulative capacity of PV is set to cross the terawatt (TW) threshold in 2022, and the cumulative capacity of wind will reach the TW mark in 2024.

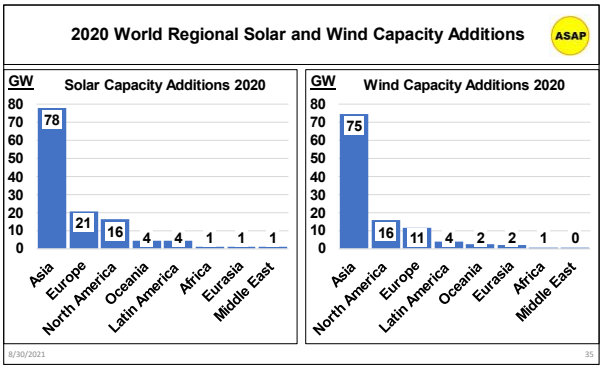
The 2025 forecast for cumulative PV capacity is 1.62 TW. The 2025 forecast for cumulative wind capacity is 1.19 TW. The annualized growth rate, 2020-2025, for PV capacity additions is 18.1% and for wind capacity additions is 10.2%.

PV has capital cost, O&M expense, and electricity price advantages compared with other electricity generation options. At present, utility PV is the lowest cost electricity generation technology with a levelized electricity price under $0.05/kWh USD. These factors support PV's high growth rate.

It should be noted that PV is over 99% of total solar capacity since concentrating thermal solar technologies have not proven cost competitive. Therefore, PV is synonymous with solar for the five-year forecast. For wind, onshore wind systems are 95.5% of the world total. Europe's 25 GWs of offshore wind capacity leads the world. In contrast, Asia has 10 GW of offshore wind capacity.

Asia leads the world in both PV and wind capacity

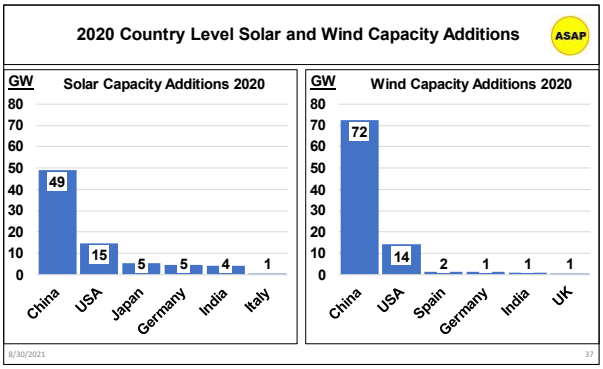
On a world regional basis, Asia, Europe and North America dominate the solar and wind markets. Asia has a substantial lead over Europe and North America as shown in the graphs. In 2020, Asia PV capacity additions were 61.4% of world PV capacity additions. Wind capacity additions in Asia were 67.5% of world wind capacity additions. In terms of world cumulative capacities, Asia accounts for 57% of PV capacity and 45% of wind capacity.



The 2025 forecast for global PV capacity additions is 225 GW and for global wind capacity additions is 120 GW

Europe is second in terms of cumulative PV and wind capacities with 161 GW of PV and 208 GW of wind. Europe's offshore wind capacity is 13% of total European wind capacity. Europe's PV capacity additions are expected to rebound in 2021. Europe's 2021 forecast for PV capacity additions is 12.0 GW. Germany is the top European PV installer and is expected to install 6.4 GW of PV in 2021. Other European countries are also expected to increase PV capacity additions.

On the country level, China is the world leader in both solar and wind. China installed 49 GW of solar and 72 GW of wind in 2020, which is 38.6% of world PV capacity additions and 64.9% of world wind capacity additions. China's 254 GW of cumulative solar capacity and 282 GW of cumulative wind capacity is 35.6% and 38.5% of world solar and wind cumulative capacity respectively.



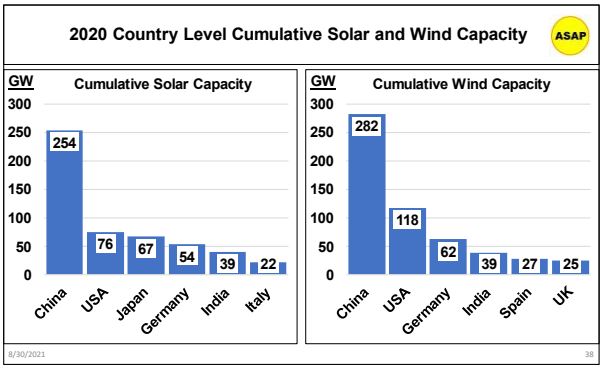
The China 2021 forecast for PV capacity additions is 55 GW. China is increasingly adopting distributed rooftop PV installations with 20 GW of distributed systems planned for 2021. China is positioned to dominate the global PV market at least through 2030.

China's PV manufacturing base is expected to grow from 80% of world total in 2020 to 90% in 2024.

By 2025, China's annual PV installation rate is expected to exceed 60 GW. With China's current scale-up in PV module, cell, wafer, and polysilicon production, it is conceivable that China will cross the 100 GW annual PV capacity additions threshold before 2030. In addition, China has a massive wind resource base and is expected to ramp-up annual wind capacity additions to the 100 MW level over the next five years.

Polysilicon shortages are causing silicon PV module price increases

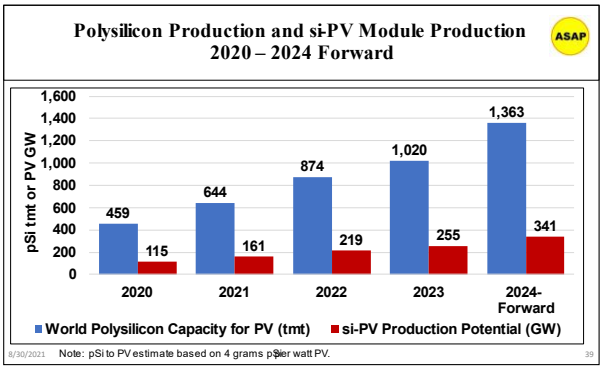
The U.S. has the second largest solar and wind cumulative capacity. The U.S. 2020 cumulative capacity of solar is 76 GW and cumulative wind capacity is 118 GW, which accounts for 10.6% of world solar capacity and 16.1% of world wind capacity. The U.S. is expected to increase annual PV installations from 17 GW in 2021 to 25 GW in 2025, which is a 10% annualized growth rate. Based on China's performance, a U.S. commitment to increase annual PV installations to 60 GW by 2030 appears to be a reasonable goal. The U.S. wind annual capacity additions forecast is 15 GW in 2025 and 20 GW in 2030.



Currently, there is concern about rising silicon PV module prices due to polysilicon shortages. The polysilicon market is tight with prices peaking around $30/kg in July. The high polysilicon prices have caused PV module prices to increase about 15%, which has dampened PV demand. In response to declining demand, polysilicon prices have come down from their highs to settle at $26.70/kg on August 31. With the announced capacity additions in PV wafer, cell, and module production lines that will be ready for commissioning in 2021, polysilicon supply will likely remain tight into 2022.

Significant polysilicon production increases will come online 2021-2023

Polysilicon price relief is in sight by the middle of 2022. There is 192 tmt (thousand metric tons) of new PV-grade polysilicon production capacity slated to come online by the end of 2021, and an additional 230 tmt is scheduled to come online in 2022. Even with project slippage, the polysilicon production additions should be sufficient to balance polysilicon supply with PV module demand by the middle of 2022 and to drive polysilicon prices back towards $10/kg.



By the end of 2023, China's PV-grade polysilicon production capacity is expected to be about 468 mt greater than the 420 tmt production capacity in 2020. The Chinese expansions bring total world PV-grade polysilicon production capacity to 1,020 tmt in 2023. This PV-grade polysilicon production capacity supports about 255 GW of new PV

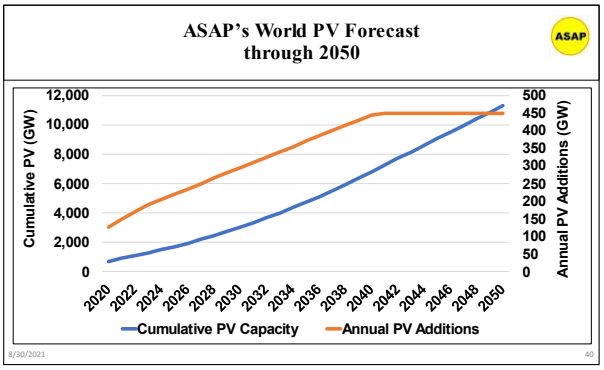
module production, which supports the world forecast for PV annual capacity additions through 2024. Polysilicon producers are planning additional expansions 2024 Forward.

The polysilicon to PV module conversion estimate assumes that PV modules consume 4.0 grams of polysilicon per watt of PV module capacity. Bernreuter Research states that PV modules consume 3.6 grams of polysilicon per watt of PV module capacity. To be conservative, ASAP is using 4.0 g/W (+11%) to account for kerf and defect losses, which may or may not be included in the Bernreuter estimate.

Polysilicon expansions will enable over 300 GW/year of silicon PV module production

Some may doubt the ability of China to increase polysilicon production at the announced rate. However, China has a prior history of building out capital intensive technologies. For example, China successfully commissioned about 4.0 million tonnes of propylene PDH production capacity from 2012 to 2015. China recognizes that initial low plant utilization rates is concomitant with low prices, which breeds demand growth in the years following capacity expansions. With projected world PV demand, China's polysilicon, wafer, cell and PV module plant utilization rates should approach 90% by 2024.

When world non-silicon, thin film PV module production estimates are added to world silicon PV module production estimates, there is a clear path to 350 GW of total world PV module production 2024 Forward. The PV module production estimates lend support to ASAP's PV 2030 forecast of 310 GW of PV capacity additions.



By 2031, the polysilicon and PV supply/demand balance is forecast to tighten once again and to justify another round of polysilicon production expansion. To support ASAP's global forecast of 450 GW of annual PV installations in the 2041-2050 timeframe, the PV material resource cycle needs scaled-up by 400-600 tmt in the early 2030s.

ASAP forecasts 565 GW/year of combined PV and wind capacity additions in 2035

The U.S. has plans to manufacture 50 GW of PV by 2025 and 100 GW by 2030. If these plans materialize, then U.S. polysilicon production will need to be greater than 300 tmt by 2030 to support silicon PV manufacturing. However, ASAP has not been able to confirm these plans, which are contingent on passage of the Solar Energy Manufacturing for America Act by the U.S. Congress. Without sufficient incentives, the U.S. silicon PV market will not achieve fruition.

To meet the international goal of limiting the increase in average global temperature to below 2.0 degrees Celsius, research by the European Commission, Joint Research Centre (JRC) states that the world needs to install at least 550 GW per year of zero emissions energy systems as soon as possible. ASAP's PV and wind annual installation forecast achieves this target in 2035 with 385 GW of new PV and 180 GW of new wind for combined PV and wind annual capacity additions of 565 GW.

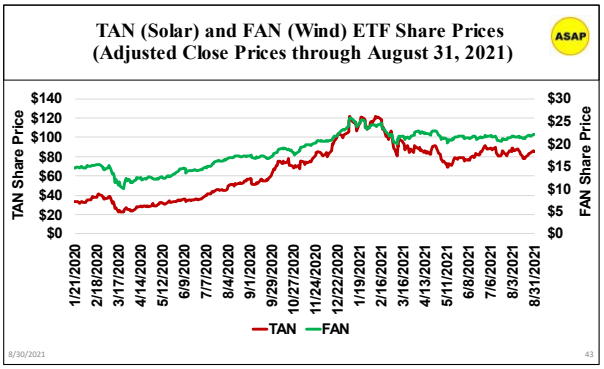
For perspective, world electricity demand will soon reach 30,000 TWh, which is equivalent to about 20 TW of installed PV and wind capacity. If world annual PV and wind capacity additions realize the 565 GW forecast by 2035, then the 20 TW goal of combined PV and wind cumulative capacity can be achieved before 2060. Storage is the

primary obstacle to achieving complete zero carbon emissions electricity generation with PV and wind electricity generation. However, battery, hydrogen, and underground compressed air energy storage systems offer opportunities for PV and wind storage.

PV and Wind Industry Financial Performance

TAN is neutral and FAN gains share price value in August

Each month ASAP reports the share price performance of the TAN (solar) and FAN (wind) ETF index funds as proxy financial indicators of the PV and wind industries. In addition, ASAP evaluates quarterly reports of twenty-two relatively pure play solar and wind companies.



As shown in the graph, the share prices of the TAN and FAN ETFs peaked in January 2021, and a correction continues through August. For the month of August, the TAN share price lost $0.04/share (-(0.05%), while the FAN share price gained $0.68/share (+3.2%). Year-to-date, TAN is down $17.13/share (-16.7%), and FAN is off $1.08/share (-4.7%). Global demand for PV and wind installations is growing at a healthy rate, which should translate into share price increases for solar and wind companies going forward.

Second quarter 2021 financial reports indicate that the PV and wind industries are on relatively sound financial footing

The following summarizes the first quarter 2021 financial reports of twenty-two relatively pure play solar and wind industry companies. Mixed play energy conglomerates are excluded from the summary of quarterly financial reports. The survey includes six PV panel manufacturers, three wind manufacturers, two polysilicon manufacturers, four balance-of-system manufacturers (three inverter companies and one tracker company), and seven PV and wind producers (system operation and maintenance companies). The market capitalization of the twenty-two companies ranges from $610 million to $58 billion.

First, we examine first quarter net income reports. Of the twenty-two companies surveyed 50% reported positive net income. The first quarter net income reports are in line with the fourth quarter 2020 net income reports. GAPP net income is the ultimate bottom line since it is directly related to earnings per share and return on equity. While most of the companies reported returns on equity of less than 1.0%, three companies reported healthy 5.3%, 3.7% and 1.4% returns on equity for the first quarter. Trailing twelve-month earnings per share reports are positive for 59% of the companies surveyed.

Analysis indicates that net income in the first quarter 2021 is tied to company market capitalization. The correlation between company market capitalization and company net income is a positive 0.74. In other words, the greater the market capitalization, the greater the likelihood of positive net income. The affect of market capitalization on net income is likely explained by the realization of production economies-of-scale and firm maturity in terms of beneficial asset amortization schedules.

Secondly, we examine company share price changes. Of the companies surveyed, 68% experienced share price declines from the last day of the fourth quarter 2020 to the last day of the first quarter 2021. Share prices peaked in late January and then declined in

February and March. PV and wind industry cost inflation is likely having an adverse affect on investor sentiments, which explains the share price declines.

Company first quarter revenues and cash balances are mostly on target with guidance. Also, debt/equity ratios are mostly in line with expectations. In conclusion, the PV and wind industries are poised for future growth.

ASAP Methodology

ASAP benchmarks U.S. historical electricity generation and capacity to the Energy Information Administration (EIA) of the U.S. Department of Energy. ASAP benchmarks historical U.S. trade to U.S. Census Bureau trade data. Global data sources include the International Energy Agency (IEA), International Renewable Energy Association (IRENA), European Wind and Solar Industry Associations, China's NEA, and company reports. All forecasts are ASAP generated.