PV-WIND MONTHLY MARKET UPDATE

Net PV Capacity Additions Are 2,481 MW in June

September 2023 Issue

(Data Updates for June 2023)

U.S. PV-WIND CAPACITY **June 2023 PV and Wind Capacity Additions**

- In June, PV capacity additions total 2,481 MW
- In June, wind capacity additions total 0 MW

U.S. ELECTRICITY GENERATION **June 2023 PV and Wind Electricity Generation**

- PV and wind electricity production is 14.7% of total U.S. electricity generation
- Of total U.S. electricity generation, PV is 7.0% and wind is 7.7%

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

- In June, the value of U.S. PV panel imports decreased 0.2% to $1.5 billion
- Vietnam, Thailand, and Malaysia are the top suppliers of U.S. PV panel imports

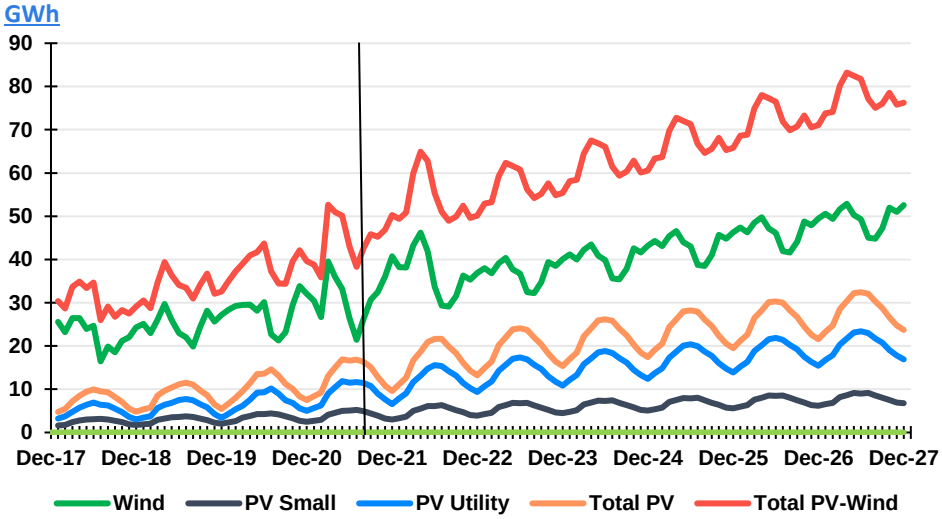
WORLD PV-WIND CAPACITY **2023 Forecast for World PV and Wind Additions**

- U.S. PV forecast for 2023 is 24 GW of capacity additions
- U.S. wind forecast for 2023 is 10 GW of capacity additions
- The world PV forecast for 2023 is 220 GW of capacity additions
- The world wind forecast for 2023 is 50 GW of capacity additions

PV-WIND COMPANY FINANCI2AL PERFORMANCE **August ETF Share Performance**

- For August 2023, TAN (solar) share price performance is a negative 15.0%
- For August 2023, FAN (wind) share price performance is a negative 7.4%

PV-Wind Electricity Generation: Actual to June-23; Forecast to Dec-27



ASAP
American Solar Action Plan

52 Columbia Street
Farmingdale, NY 11735

1·516·474·0502 (telephone)
www.solarplan.org (website)

SOLAR AND WIND MARKET ANALYTICS
Director: James Mason, Ph.D.

For inquiries, please contact us:
james.mason@solarplan.org

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PV-Wind Monthly Slideshow

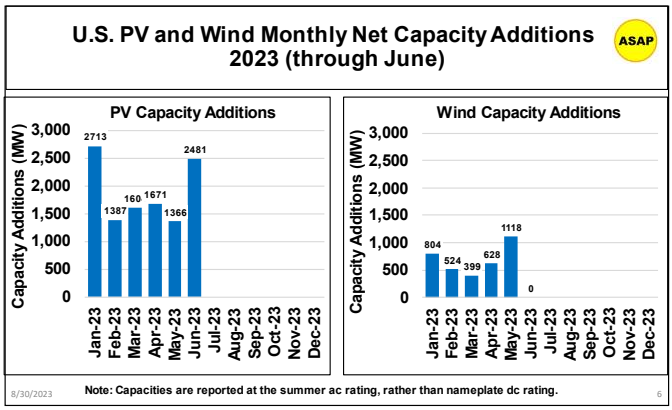
Battery Storage Analysis

Global Warming Update

U.S. PV and Wind Capacity

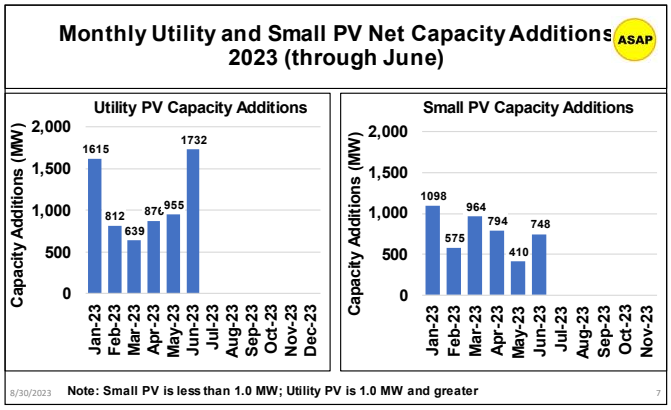
June U.S. PV capacity additions total 2,481 MW

In June, U.S. PV net capacity additions total 2,481 MW, which brings cumulative capacity to 121.3 GW. Utility scale PV capacity additions are 1,732 MW, which is 70% of new PV, and small PV capacity additions are 748 MW. The annual pace for PV capacity additions is 22.4 GW, which is close to the pace needed to meet the 24.0 GW forecast for 2023. Robust PV import levels are supporting growth in U.S. PV capacity growth.



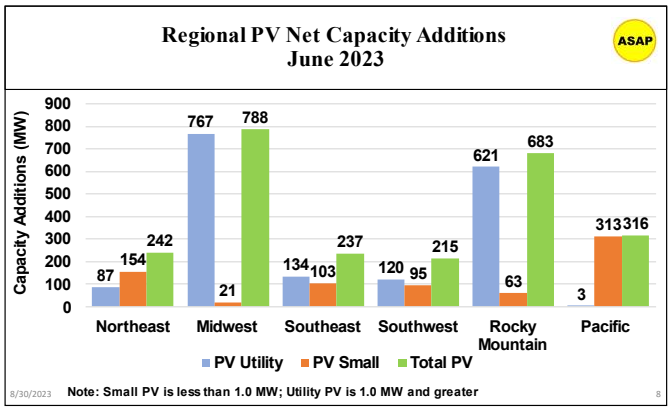
June wind capacity additions total 0 MW

On a regional basis, the Midwest region led in June PV capacity additions with 788 MW. The Rocky Mountain and Pacific regions followed with 683 MW and 316 MW respectively. The top three states for PV capacity additions are Colorado, Indiana, and California with 615 MW, 468 MW, and 296 MW respectively.



The 2023 forecast for PV capacity additions is 24 GW, and the wind forecast is 10 GW

Wind installations in June total 0 MW, which brings cumulative wind capacity to 144.4 GW. The full year pace for U.S. wind capacity additions is 6.9 GW, which is off the pace needed to meet the 10.0 GW forecast. The wind industry is facing numerous headwinds, which include manufacturing and permitting issues. The problems are expected to persist into next year. One of the major problems is growing political opposition to wind installations in the Plains states.

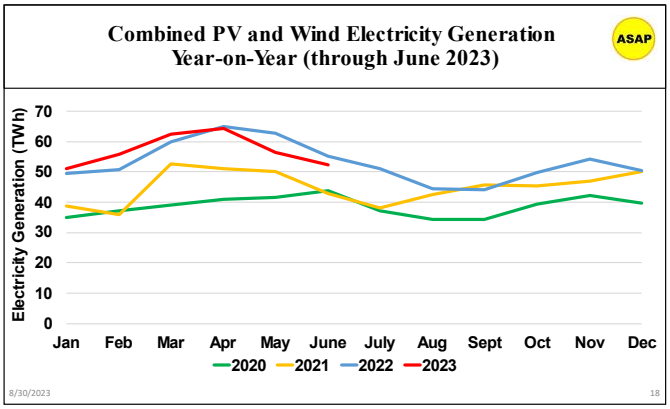


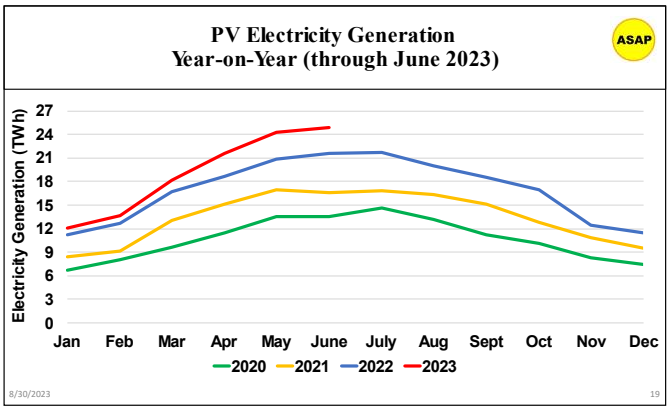
The PV forecast is supported by a two-year freeze on PV import tariffs for Malaysia, Vietnam, and Thailand. In addition, the forecast is supported by PV incentives that are included in the Inflation Reduction Act passed by the 2022 Congress. The wind forecast is constrained by headwinds for wind development and transmission in the Southwest, Midwest, and Rocky Mountain regions. Atlantic offshore wind projects are under construction and will enable a modest increase in wind capacity additions going forward.

U.S. PV-Wind Electricity Generation Update

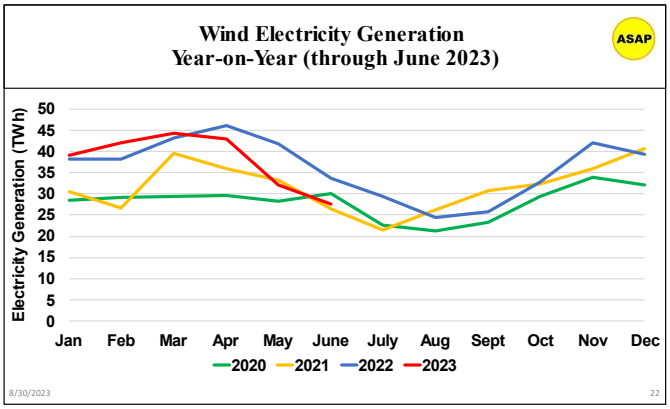
In June, combined PV and wind electricity generation is 14.7% of total U.S. electricity generation

In June, PV generated 24.9 TWh of electricity, and wind turbines generated 27.5 TWh of electricity. For June, combined PV and wind electricity generation is 14.7% of total U.S. electricity generation. PV contributes 7.0%, and wind provides 7.7%. ASAP projects PV to generate 5% and wind to generate 12% of total U.S. electricity generation in 2023.





Year-on-year (YoY), June-22 to June-23, PV electricity generation has increased 15.1%, and wind electricity generation has decreased 18.5%. YoY, combined PV and wind electricity generation declined 5.4%. Note that climate variability influences annual and monthly comparisons.



The Pacific region leads the nation in PV electricity generation, and the Midwest region leads in wind electricity generation

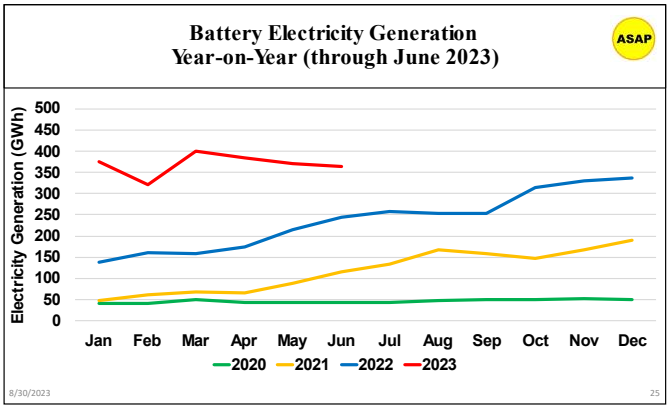
In June, the Pacific region led the nation in PV electricity generation with 7.7 TWh and is followed by the Southeast region with 5.3 TWh and the Southwest region with 4.8 TWh. California is the leading state with 7.1 TWh of PV electricity generation, which is 29% of total U.S. PV electricity generation in June. Texas follows with 3.3 TWh, Florida 1.7 TWh, North Carolina 1.3 TWh, Arizona 1.2 TWh, and Nevada 1.2 TWh.

In June, the leading regions for wind electricity generation are the Southwest with 12.4 TWh and the Midwest with 9.2 TWh. These two regions combined produced 79% of total U.S. wind electricity in June. The Pacific and Rocky Mountain regions are distant third and fourth with 2.9 TWh and 2.1 TWh of wind electricity generation respectively. Texas is the leading state with 9.0 TWh of wind electricity generation and is followed by Oklahoma 2.2 TWh, Iowa 2.1 TWh, Kansas 1.6 TWh, and Illinois 1.3 TWh.

U.S. Utility Battery Storage

In June, battery storage capacity additions are 140 MW

U.S. battery storage capacity additions total 140 MW in June, which increases cumulative battery storage capacity to 9.7 GW. The pace for full year 2023 battery capacity additions is 2.4 GW, which is far off the pace to meet ASAP's 8.0 GW forecast.



U.S. cumulative battery storage capacity increases to 9.7 GW in June

The reported June average monthly battery utilization factor is 5.2%, which is a daily average of 1.2 hours. The implied battery electricity generation is 363 GWh. From company battery installation announcements, four hours of battery storage capacity is becoming the norm but is not being fully realized. At present, stored battery electricity is applied to shaving peak demand electricity generation rather than the replacement of fossil fuel power plants.

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 capacity 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, 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 at approximately 22 GW going forward.

In June, the average battery utilization factor is 5.2%

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 hydrogen fuel-cell heavy Class 8 transport trucks. Other PV and wind storage technologies are molten salt and compressed air energy storage systems. Molten salt storage at solar thermal concentrating power plants and compressed air energy storage are basically being ignored in the U.S. with only power plant of each technology in current operation. Looking ahead, one compressed air energy storage project in Texas using salt dome compressed air storage is permitted and is slated to begin construction in 2024.

PV Market Outlook 2023

Global PV prices are declining, which supports market growth going forward

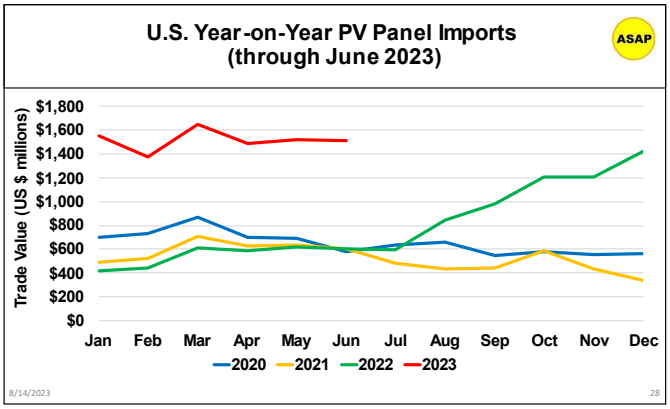
China polysilicon and PV prices are declining. China spot polysilicon prices have plunged 30% since the end of 2022, and PV module spot prices are down 20%. Along with the suspension of U.S. import tariffs for Vietnam, Thailand and Malaysia, the groundwork is in place for robust global growth in PV capacity additions in 2023.

China spot polysilicon prices plummeted in June to $9.60/kg (64 RMB). With the large growth in capacity, the key question confronting polysilicon producers is the price level to clear inventories, which is being played out in 2023. With declining supply chain prices, the global PV market should experience healthy growth in 2023.

U.S. PV Trade

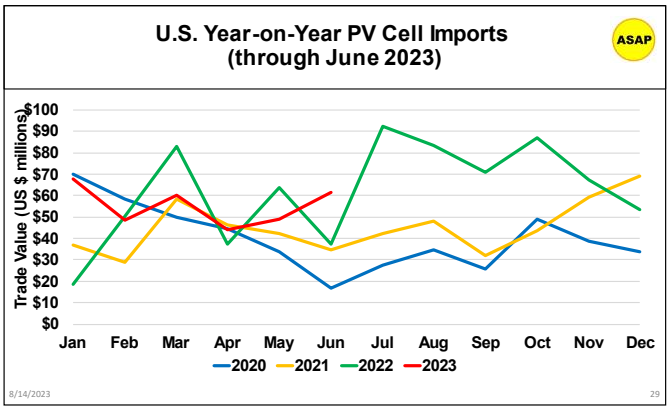
In June, the value of U.S. PV panel imports is $1.5 billion

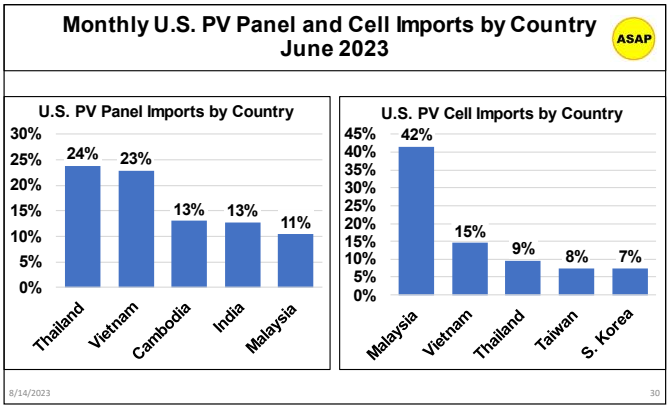
In June, the value of U.S. PV panel imports decreased 0.2% month-on-month to $1.5 billion. The full year pace for U.S. PV panel imports is $18.2 billion, which is far above the pace to meet the $10.0 billion annual forecast. U.S. PV imports are well above record pace in 2023 due to supportive U.S. policies such as the two-year freeze on U.S. import tariffs for PV modules and cells produced in the Southeast Asian countries of Malaysia, Vietnam, and Thailand are lowing PV prices.



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

Thailand, Vietnam, and Cambodia are the top three countries for U.S. PV panel imports in June. These three countries account for 60% of total U.S. PV imports. Thailand leads the market for U.S. PV panel imports in June with a 24% market share. Vietnam has a 23% share of the U.S. PV panel import market, and Cambodia rounds out the top three with a 13% share. India is a newcomer to the top tier countries for U.S. PV panel imports and is expected to be a growing source in future years.





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

Turning attention to U.S. imports of PV cells, the total value of June U.S. PV cell imports increased 25.2% month-on-month to $66.5 million. Malaysia leads U.S. supply of imported PV cells in June with a 42% share. Vietnam and Thailand round out the top three sources for U.S. PV cell imports with 15% and 9% market shares respectively. These three countries account for 66% of U.S. PV cell imports in June.

In terms of U.S. exports, the value of U.S. PV panel exports in June increased 107% month-on-month to $1.9 million. Year-to-date, the value of U.S. PV panel exports is $10.0 million, which is an annualized pace of $20.0 million. U.S. PV panel exports are on pace to meet the $20.0 million forecast for 2023.

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

The value of June U.S. PV cell exports decreased 38% month-on-month to $1.4 million. Year-to-date, the value of U.S. PV cell exports is $8.2 million, which is an annualized pace of $16.3 million. The projected pace for PV cell exports is on the pace needed to realize the $15.0 million annual forecast for U.S. PV cell exports in 2023.

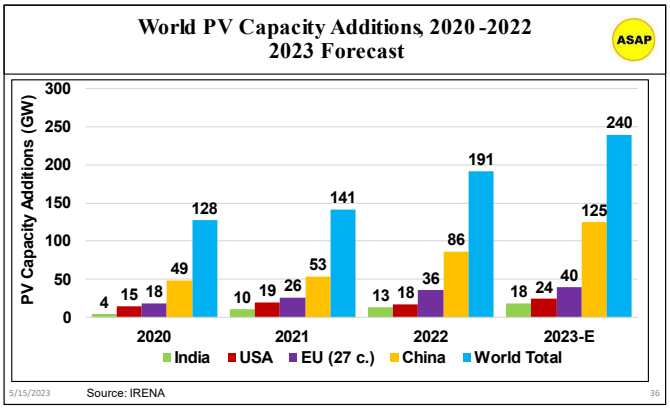
Global PV demand has been constrained by polysilicon shortages and high prices. Large additions to polysilicon production capacity are expected to provide price relief in 2023. China silicon prices have plummeted from $46/kg in the fourth quarter of 2022 to $10.05/kg at the end of July 2023. Whether low silicon prices are here to stay or rather a short-term inventory clearing signal is clear. However, without question China's silicon prices are declining and will continue to support strong global market demand for silicon-based PV. Silicon PV holds a 95% share of the global PV market with only marginal growth in thin film PV technologies.

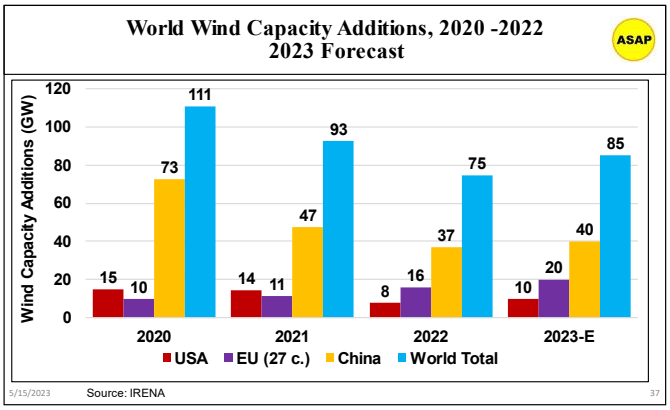
Both Europe and the U.S. are exploring ways to compete with China in the PV market. The U.S. Inflation Reduction Act aims to accelerate domestic solar manufacturing by offering tax credits at all stages of the solar supply chain. The tax credit incentives allow companies to front-load capital expenditures, which hopefully will enable companies to rapidly scale domestic production of PV system resources and components.

World PV and Wind

In 2022, world PV capacity additions were 191 GW, and world wind capacity additions were 75 GW.

In 2022, world PV capacity additions exceeded expectations at 191 GW, while wind capacity additions were a disappointing 75 GW. Global PV is poised for significant growth over the next couple of years. The PV forecast for 2023 capacity additions is 240 GW. On the other hand, wind project developments are facing headwinds, and the 2023 forecast for wind capacity additions calls for a 13% increase to 85 GW.

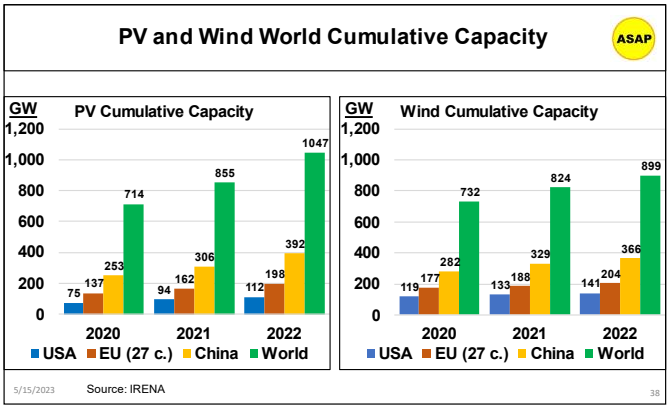




A few trends are evident as we move forward with the transition to renewable energy sources from fossil fuels. Photovoltaics (PV) and wind are proving to be the work horse in the clean energy transition. In 2022 PV passed the 1.0 trillion watts of cumulative installed capacity, and wind is not far behind at 925 GW of cumulative installed capacity. In 2023, two important global PV targets will be realized. Annual PV capacity additions will exceed 200 gigawatts (GW), and China will become the first

country to install over 100 GW of new PV capacity. Also, wind is expected to pass the 1.0 trillion watts of cumulative installed capacity threshold in 2023.

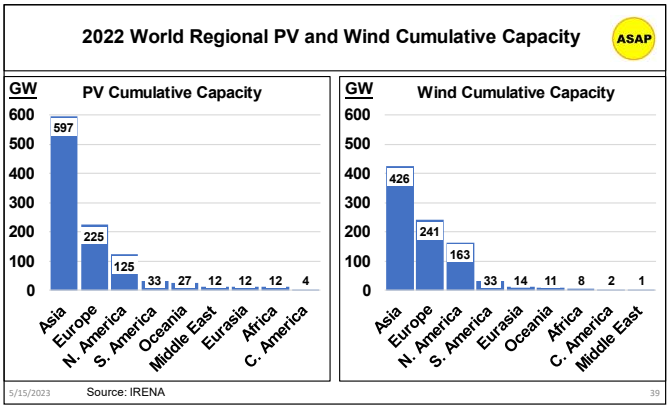
While topping 200 GW of PV capacity additions in 2022 is significant, the 200 GW is far short the 600 GW of annual global PV capacity additions needed to achieve climate change mitigation targets. China is the only country that is on pace to meet climate change goals. The U.S., Europe, and India are lagging far behind.

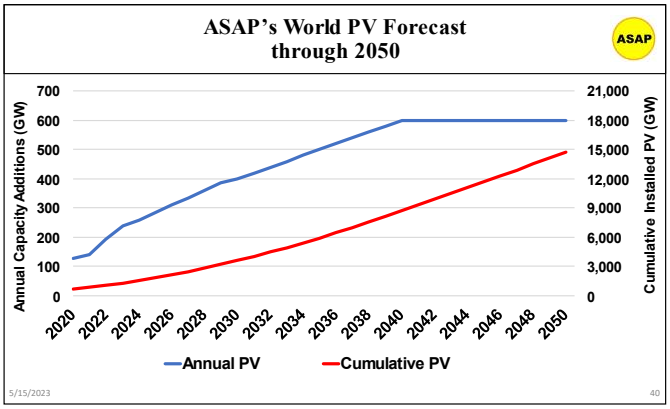


In contrast, global wind energy development is struggling to maintain growth. Wind companies state that they are facing headwinds that include slow permitting, electric grid constraints, and regulatory uncertainty. Such market conditions are, in turn, causing sizeable losses in the wind business, employment destruction and investment constraint. The companies conclude that the sizeable gap between recent installation expectations and targets is endangering the world energy transition.

Annual global PV capacity additions need to reach 500-600 GW by 2030 to meet net zero energy emissions targets

To meet the international goal of limiting the increase in average global temperature to below 2.0 degrees Celsius, ongoing research by the International Energy Agency (IEA) concludes that the world needs to install about 23 TW of PV and wind capacity by 2050 to reach net zero carbon emissions. In addition, the IEA plan calls for 3.0 TW of battery storage and 435 billion kilograms of hydrogen for transportation.





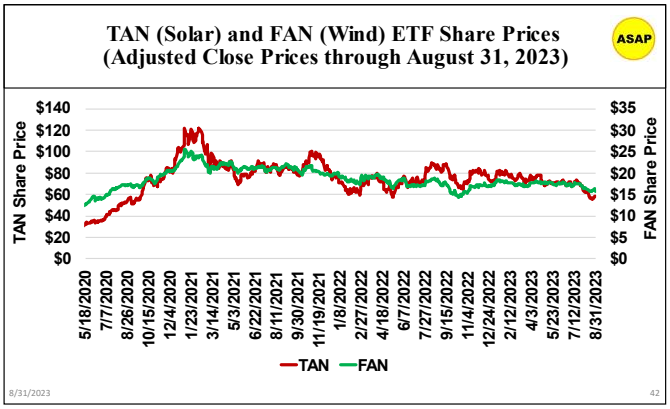
ASAP's PV and wind annual installation forecast achieves the IEA target by scaling annual PV installations to 600 GW and wind installations to 350 GW over the 2040-2050 timeframe. In addition, ASAP estimates the need for 3.3 TW of wind baseload storage capacity and 5.4 TW of PV storage peak storage capacity. ASAP also models PV for electrolytic hydrogen production of 415 billion kilograms per annum in 2050 for transportation use.

Storage is the primary obstacle to achieving complete zero carbon emissions electricity generation with intermittent PV and wind electricity generation. However, battery, underground compressed air energy storage, and green hydrogen offer opportunities for large-scale PV and wind storage systems. ASAP estimates the total cost of a PV and wind with storage energy system, including storage, to be about $3.0 trillion per annum over a thirty-year transition period, 2021-2050, which will comprise about 2.5% of global GDP over the thirty-year transition period. This is a tall order, but it can be done with planning commitments in the international finance industry and governments.

PV and Wind Industry Financial Performance

In August, the share values of the TAN and FAN ETFs declined

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.



For the month of August 2023, the TAN ETF share value declined 15.0%, and FAN declined 7.4%. Year-to-date, TAN is down 20.2%, and FAN is down 7.8%.

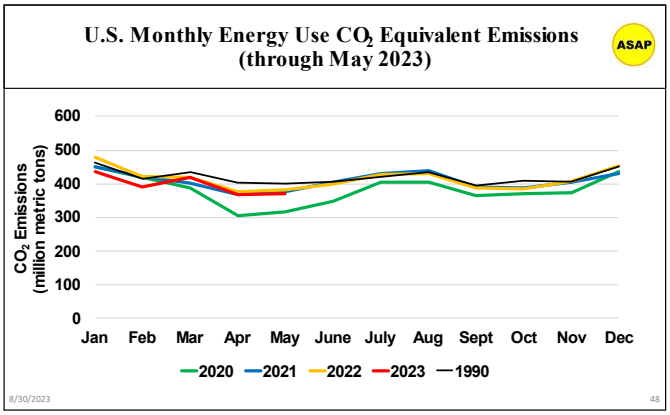
As shown in the graph, the share prices of the TAN and FAN ETFs have had disappointing performance over the past year relative to 2021 highs. From the June/January 2021 highs through August 2023, the TAN share price is down 52.2%, and FAN share price is down 33.6%.

It is important to note that supply chain costs are improving with declining PV prices in the first quarter of 2023. 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 with continuing improvement in supply chain issues.

Carbon Dioxide Emissions

In 2022, U.S. CO_2 emissions fell 2.7% below the target 1990 level

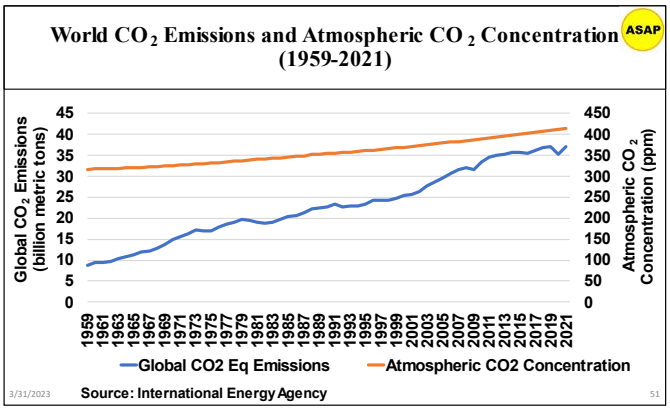
U.S. energy related carbon dioxide emissions have rebounded from the pandemic induced lows of 2020 as shown in the graph. On a positive note, total U.S. 2022 CO_2 emissions are 2.7% less than the 1990 level. For the past twenty-five years the goal has been to reduce energy use CO_2 emissions to below the 1990 level, which the U.S. appears to have finally accomplished. This is just the

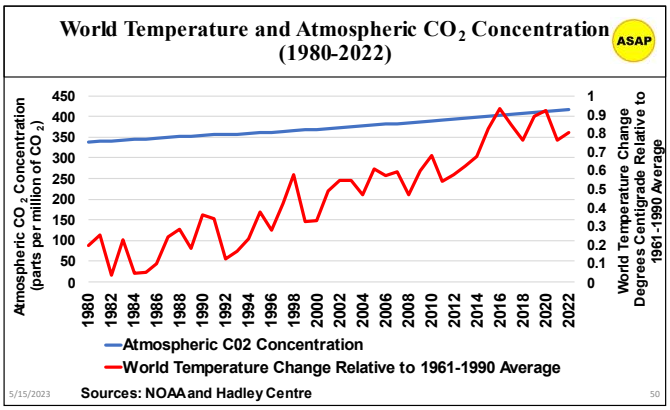


beginning, and it is sobering that it has taken 25 years to achieve this relatively modest reduction in CO_2 emissions.

In 2021, world carbon dioxide emissions set a new record high of 37.1 Gt

World carbon dioxide (CO_2) emissions related to energy consumption and industrial production rose to 37.1 giga-tonnes (Gt) in 2021, which is a new high mark. After a pandemic induced decline in 2020, energy consumption rebounded in 2021 causing the increase in CO_2 emissions. The atmospheric concentration of CO_2 in 2022 increased 0.6% over the 2021 levels to 417 parts per million.





The average global temperature has increased by at least 1.1° Celsius (1.9° Fahrenheit) since 1880 according to NASA's Goddard Institute for Space Studies (GISS). Most of the increase in global temperature has occurred over the past forty years. Further increases in the atmospheric concentration of greenhouse gases will result in higher temperatures. As the average global temperature continues to rise, extreme weather events will become ever more common and with ever greater intensity worldwide.

ASAP Data Sources

ASAP benchmarks U.S. PV and wind capacities and electricity generation to the estimates provided by the Energy Information Administration (EIA) of the U.S. Department of Energy. ASAP reports the EIA net summer capacity changes for PV and wind due to the high cost of supplying summer peak demand electricity. For example, summer PV net capacity is 10%-15% less than nameplate capacity due to heat losses.

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, Taiwan's Infolink, and company reports.