PV-WIND MONTHLY MARKET UPDATE

Respectable PV and Wind Capacity Growth in February

May 2021

(Data Updates for February 2021)

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

- February PV net capacity additions total 1,129 MW.
- February wind net capacity additions total 1,204 MW.

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

- PV and wind electricity production is 11.0% of total U.S. electricity generation
- Of total U.S. electricity generation, PV is 2.8% and wind is 8.2%

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

- The value of February U.S. PV panel imports is $523 million
- Malaysia, Vietnam and Thailand are the top three suppliers of U.S. panel imports

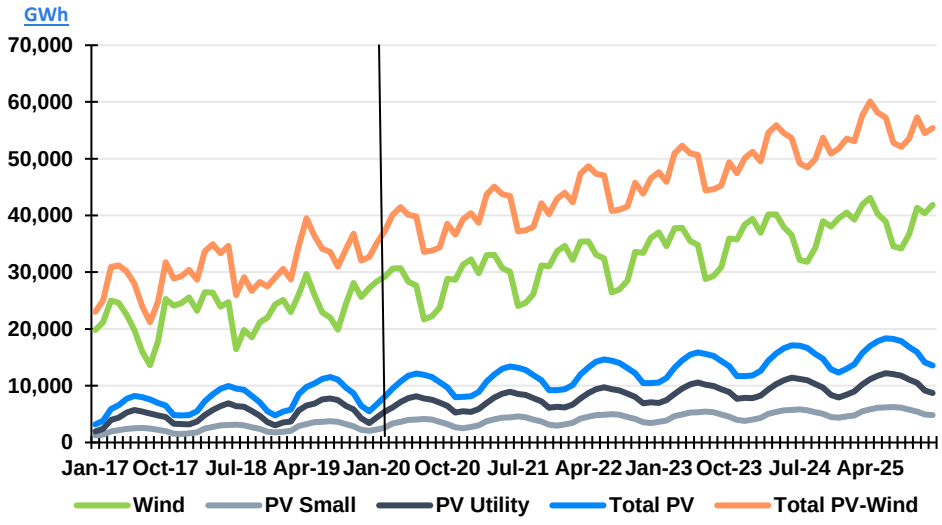
WORLD PV-WIND CAPACITY **2021 World PV and Wind Forecast**

- World PV forecast is 155 GW of capacity additions
- World wind forecast is 60 GW of capacity additions

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

- For April 2021, share price performance of TAN, FAN and ICLN are negative
- For 2021, TAN, FAN and ICLN are underperforming QQQ, SPY and DIA

PV-Wind Electricity Generation: Actual to Feb-21; Forecast to Dec-25



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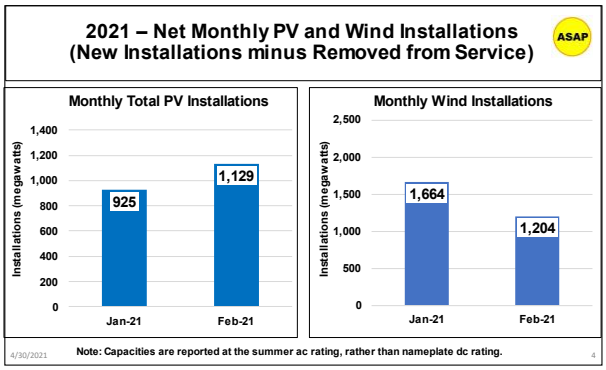
Battery Storage Analysis

Global Warming Update

PV and Wind Capacity

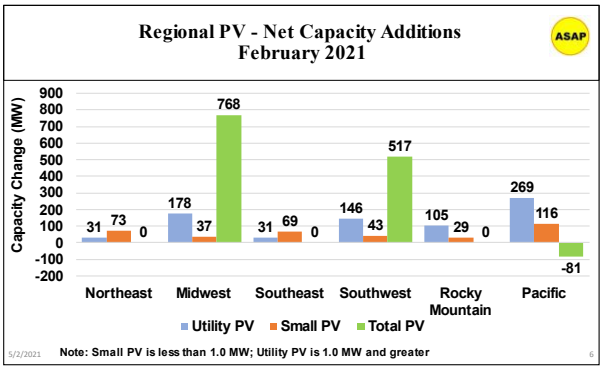
U.S. installs 1,129 MW of PV in February

With 1,129 MW of PV capacity additions in February 2021, the cumulative U.S. PV capacity increases to 75.9 GW. Year-to-date PV installations remain off the pace required to meet the 2021 forecast of 17 GW of PV growth. Through February, the year-to-date pace is 12.3 GW of PV capacity additions.



The 2021 PV forecast is 17.0 GW of capacity additions

Looking ahead to 2022, the U.S. PV forecast is 22 GW. For perspective, China installed 38 GW of PV in 2020 and plans to install 60 GW/year in the 2023-2025 period. For the U.S. to become a world leader in PV technology, then at least a quadrupling of annual PV additions is in order. This task is made difficult for the U.S. due to stiff opposition from oil and gas interests. Can the U.S. national interest to address climate change triumph over oil and gas interests?



The Pacific and Midwest regions led in February PV and wind capacity additions

Capacity additions of utility PV exceed additions of small PV by a large margin in February. Utility PV growth is 760 MW or 67% of total PV growth. Growth in small PV is 368 MW or 33% of total February PV growth.

On a regional basis, the Pacific and Midwest regions set the pace with 269 MW and 178 MW of PV capacity additions respectively. The Southwest region has 145 MW of net capacity additions with Arizona idling 109 MW of existing PV capacity. Texas led the nation with 255 MW of PV capacity additions and is followed by California with 219 MW of PV capacity additions.

The 17.0 GW PV forecast 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.

February wind installations totaled 1,204 MW

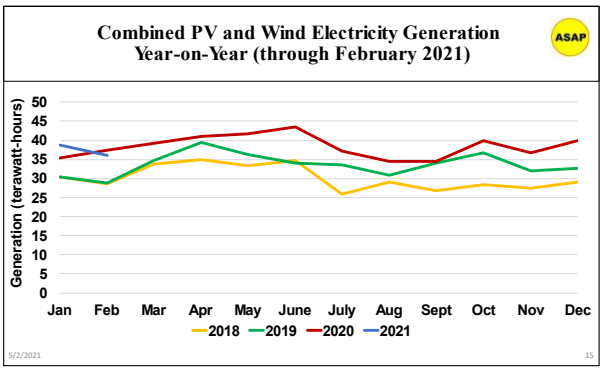
Wind installations in February are a respectable 1.2 GW. The annual pace for wind installations is 17.2 GW, which is greater than ASAP's 2021 wind growth forecast of 15.0 GW. This is the second consecutive year that ASAP expects PV additions to surpass

wind additions. As expected, February wind capacity additions are concentrated in the Midwest and Southwest regions. The Midwest added 768 megawatts of wind capacity, and the Southwest installed 517 megawatts. The leading states for wind capacity additions are South Dakota (309 MW), Kansas (161 MW), and Michigan (150 MW). In the Southwest, Oklahoma led with 352 MW of wind capacity additions is followed by New Mexico with 165 MW of new wind.

PV-Wind Electricity Generation Update

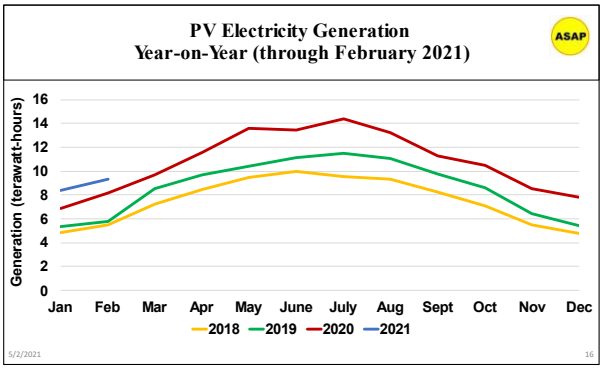
In February, combined PV and wind electricity generation is 11.1% of total U.S. electricity generation

In February, PV generated 9.3 TWh of electricity, and wind generated 26.7 TWh of electricity. Total PV and wind electricity generation is 36.0 TWh in February, which is 11.0% of total U.S. electricity generation. PV contributed 2.8%, and wind provided 8.2%.



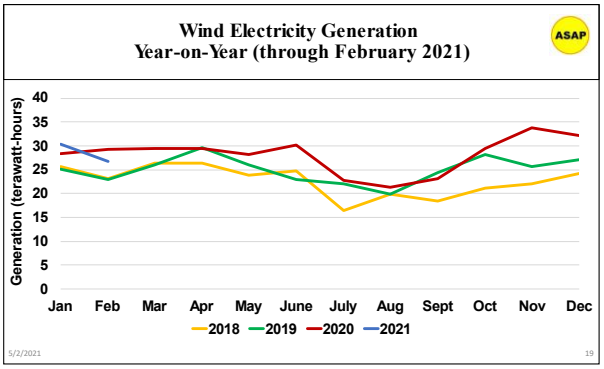
Year-on-year, PV electricity generation increased 15%

Month-on-month, PV electricity generation increased, while wind electricity generation decreased as shown in the graphs. Year-on-year, February-20 to February-21, PV generation increased 14.2%, and wind generation declined 8.8%. YoY, combined PV and wind electricity generation declined 3.8%.



The Pacific region leads the nation in PV electricity generation

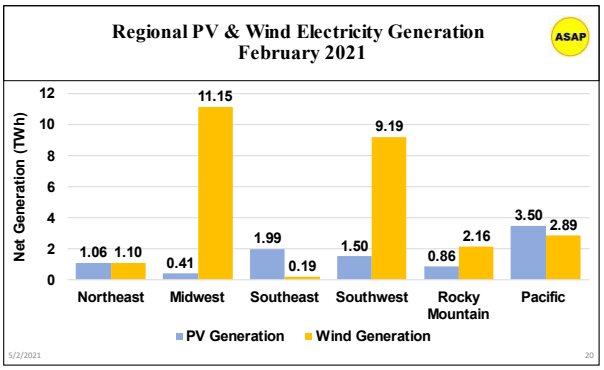
In February, the Pacific region led the nation in PV electricity generation with 3,495 GWh and is followed by the Southeast region with 1,987 GWh and the Southwest region with 1,502 GWh. California is the leading state with 3,258 GWh of PV electricity generation, which is 35% of the U.S. total PV electricity production in February. Texas is second with 778 GWh. Filling out the top five are Florida with 661 GWh, North Caroline with 592 GWh, and Arizona with 576 GWh.



Wind electricity generation in February is greatest in the Midwest and Southwest regions, which combined produced 78% of total U.S. wind electricity. The Midwest leads with 11.1 TWh of electricity generation and is followed by the Southwest with 9.2 TWh. The Pacific region is a distant third with 2.9 TWh of electricity generation. Texas is the nation's leader with 6.3 TWh of wind electricity generation and is followed by Iowa with 2.8 TWh, Oklahoma with 2.0 TWh, and Kansas with 1.4 TWh.

Year-on-year, wind electricity generation declined 8.8%

Year-on-year, February-20 to February-21, wind electricity generation declined 2.57 TWh (-8.8%). YoY, Midwest wind electricity generation declined 605 GWh (-5.1%), and Southwest wind electricity generation declined 1,837 GWh (-16.7%).

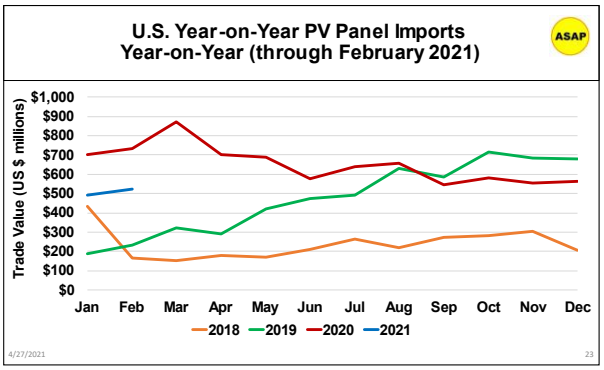


It should be noted that seasonality combined with variations in weather patterns have significant impacts on month-on-month and year-on-year changes in PV and wind electricity generation.

PV Trade

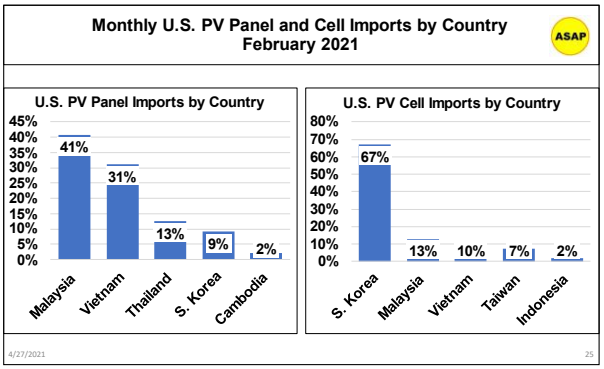
The value of February 2021 U.S. PV panel imports is $523 million

The value U.S. PV panel imports rebounded in February to $523 million, which is a 6.8% month-on-month increase. The annual 2021 trajectory for U.S. PV panel imports is $6.1 billion, which is well below the 2020 level. As stated last month, trade headwinds continue to affect the global PV market. The causes of concern are PV price increases due to downstream polysilicon production shortages and a shortage of shipping containers. These factors are expected to curtail PV trade flows through the second quarter of 2021. The issues should be resolved by the beginning of the third quarter.



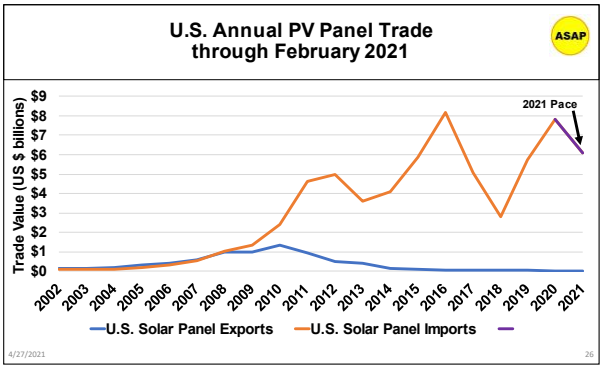
Malaysia, Vietnam and Thailand are the top three sources of U.S. PV panel imports in February 2021

Malaysia is the source of 41% of U.S. PV panel imports in February, while Vietnam holds a 31% share. Thailand rounds out the top three with a 13% share. In total, these three countries account for 85% of February U.S. PV panel imports. Year-to-date, Malaysia holds a 38% share, Vietnam a 32% share and Thailand a 14% share. For full year 2021, Malaysia, Vietnam and Thailand are expected to be the source of more than 80% of U.S. PV panel imports.



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

Turning attention to U.S. imports of PV cells, the total value of February U.S. PV cell imports declined 21.6% month-on-month to $28 million. South Korea dominated the February U.S. supply of imported PV cells with a 67% share and a YTD 60% share. The forecast for the value of PV cell imports in 2021 is $840 million, which averages $70 million per month.



The value of 2021 U.S. PV panel and cell exports are expected to be minimal

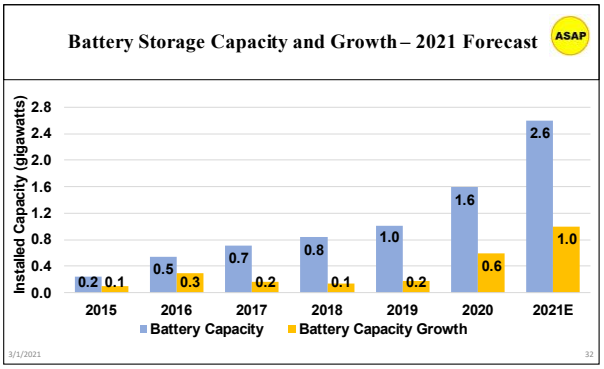
In terms of exports, the value of U.S. PV panels exports in February is a meager $1.2 million. Year-to-date, the value of U.S. PV panel exports is $1.6 million. For full year 2021, the value of U.S. PV panel exports is expected to be $25.0 million, which is 16.7% lower than the $30.0 million value of U.S. PV panel exports in 2020. In essence, the U.S. PV panel export market is minimal.

The value of U.S. PV cell exports declined in February to $1.7 million, which is a 24.2% decrease compared with January U.S. PV cell exports. YTD the value of U.S. PV cell exports is $4.0 million. The 2021 forecast for U.S. PV cell exports is $23 million, which is 12.5% lower than the value of 2020 PV cell exports.

Utility Battery Storage

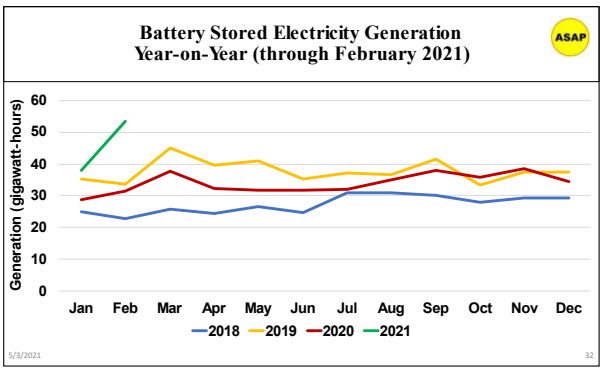
U.S. cumulative battery storage capacity for February is 1.6 GW

Battery storage capacity additions totaled 25.0 MW in February. Hence, U.S. cumulative battery storage capacity increases to 1.6 GW. The 2021 forecast for battery storage capacity additions is 600 MW, which will bring cumulative battery storage capacity to 2.2 GW. ASAP expects 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 February average battery utilization factor is 4.9%

The reported February average monthly battery utilization factor is 4.9%, which implies a battery electricity supply of 53.4 GWh. Year-on-year, February-20 to February-21, battery electricity supply has increased 67%.



Battery electricity capacity and supply will continue to increase with a significant scale-up in annual battery capacity additions going forward.

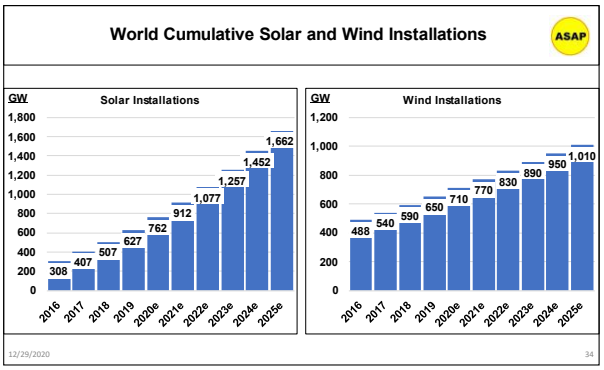
Obviously, variability in PV and wind electricity production requires electricity storage to convert PV and wind into a dependable supply of on-demand electricity. At present, the U.S. has approximately 800 GW of fossil fuel power plants, which implies the need for hundreds of GW of storage if PV and 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, underground compressed air energy storage. Currently, pumped hydro is the largest storage technology with over 22 GW of installed capacity. However, 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. Due to siting constraints, it is expected that pumped hydro storage capacity will remain in the 22 GW neighborhood going forward.

World PV and Wind

The world PV forecast for 2021 is 155 GW

ASAP's 2021 forecast for global PV capacity additions is 155 GW, which is 10.7% greater than 2020 PV additions. The global wind forecast for capacity additions is 60 GW, which is 35% lower than the reported 2020 wind additions. 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, global annual wind installations are likely to approach 100 GW in 2025.



The annual world addition of PV and wind capacity is expected to total 330 GW in 2025

Year-end 2020, the global cumulative PV capacity is approximately 766 GW. World PV installations are expected to approach 230 GW in 2025. ASAP expects the global cumulative PV capacity to more than double by year-end 2025 to over 1,700 GW. For this to occur, the global annual growth rate needs to be a robust 17%. The PV growth forecast is consistent with growth over the past five years. For example, in 2020 the cumulative world PV installations is 766 GW, which is more than double the 308 GW of cumulative PV capacity in 2016.

China is the world leader in PV manufacturing and annual installations. The 2021 forecast for China PV capacity additions is 55 GW. By 2025, China's annual PV installation rate is expected exceed 60 GW, which is 50% greater than the average 2017-2020 level.

The U.S. is the second largest installer of PV systems and is expected to increase the annual installation rate to 25 GW by 2025, which is a 10% annual increase. Based on China's performance, a U.S. commitment to increase annual PV installations 60 GW by 2030 appears to be a reasonable goal. In addition, ASAP's 2030 forecast calls for wind installations of 30 GW and PV/wind storage capacity additions of 10 GW.

To meet the international goal of limiting the increase in average global temperature to below 2.0 degrees Celsius, climate change analysts state that the world needs to install at least 400 GW/annum of zero emissions energy systems over the next twenty years. To achieve this goal will require the U.S. to approach 100 GW of annual PV and wind installations as soon as possible.

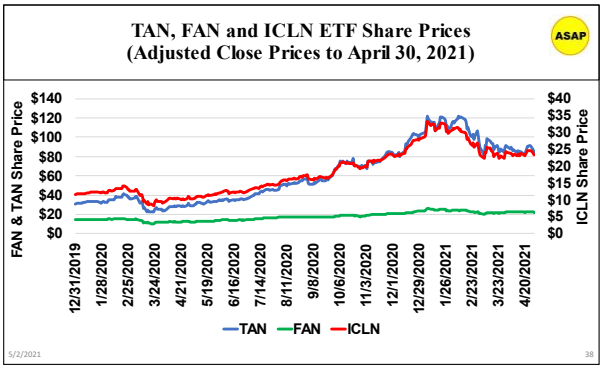
The last decade was a demonstration period for PV, and it has exceeded expectations in terms of cost ($1.00/W installed) and performance (20% efficiency). In many regions of the world new PV capacity is cost competitive with new coal capacity. Storage remains an obstacle to achieving zero carbon emissions electricity generation with PV and wind electricity generation.

PV and Wind Industry Financial Performance

ASAP monitors financial data on sixty-five companies in the PV and wind sector. Twenty-two of these companies are relatively pure play solar and wind companies. Each month ASAP reports the share price performance of solar (TAN), wind (FAN), and renewable energy (ICLN) ETF index funds as a proxy financial indicator of the PV and wind industry. In addition, ASAP summarizes quarterly reports of the twenty-two solar and wind pure play companies.

PV, wind and renewable energy ETFs had share price losses in April

Share prices of the PV, wind and renewable energy ETFs peaked in January and are experiencing a correction through April. From the January highs, TAN is off 32%, FAN is down 16%, and ICLN is down 30% based on April 30 closing share prices.



The share price trajectories of the three ETFs leveled off in the last two weeks of April as shown in the graph. This suggests a possible end to the correction. Global demand for PV and wind installations is growing, which should translate into increasing solar and wind company share prices going forward.

For the third consecutive month, April share prices of the PV, wind and renewable energy ETFs are negative. For the period April 1-30, TAN declined 9.4%, FAN declined 2.8%, and ICLN declined 4.4%. For comparison, the major index funds had positive gains in April. NASDAQ increased 5.9%, S&P increased 5.3%, and DOW increased 2.7%.

ASAP surveyed the fourth quarter and full year financial reports of twenty solar and wind pure play companies. Mixed play energy conglomerates are excluded from the quarterly financial reports. The survey includes four PV manufacturers, three wind manufacturers, two polysilicon manufacturers, four balance of system manufacturers (inverters-3 and trackers-1), and seven PV/wind producers (system operation and maintenance companies). The market capitalization of the twenty companies ranges from $754 million to $34 billion.

Of the companies surveyed, 50% of the companies reported positive net income in the fourth quarter. For full-year 2020, 55% of the surveyed companies reported positive net income. All four of the BOS manufacturers reported positive net income for the full year

Fourth quarter 2020 financial reports indicate

with annual returns on equity ranging from a low of 6.4% to a high of 27.7%. Five of the seven PV and wind manufacturers had full year positive net income. In contrast, only one of the seven PV/wind producers reported positive net income for the full year.

The negative net income reports of producers are expected since rapid growth dilutes the cash balance sheet. Producers have large cash outlays to install PV and wind systems, which creates the potential for negative cash flows and negative net income. As company portfolios of installations mature, company revenue growth outpaces project development expenses, which enables the generation positive cash flows and net income.

Several industry developments occurred in the 4th Quarter 2020. First, the Sunrun and Vivint merger was finalized with Sunrun absorbing Vivint's financials. This merger creates one of the largest U.S. producer companies. Second, the spinoff of the PV manufacturer Maxeon from SunPower was completed with Maxeon added to the list of companies being monitored by ASAP. Coming as a big surprise, Panasonic announced in March that they are abandoning PV manufacturing by the end of 2022. On a final note, the Swiss technology company Meyer Burger is entering the PV manufacturing sector with first production slated to commence in the second quarter of 2021 at plants in Germany.

Meyer Burger has exited its PV manufacturing equipment business to focus solely on inhouse PV manufacturing. The relevant question is whether Europe or the U.S. can manufacture advanced c-Si PV technologies to compete with Asian PV manufacturers? Meyer Burger's attempt is the latest in a long string of false starts. It is well worth watching this development play out.

ASAP Methodology

ASAP benchmarks U.S. historical electricity generation and capacity to the Energy Information Administration (EIA) of the U.S. Department of Energy. The EIA reports all generating capacity in terms of AC capacity, rather than DC rated capacity. ASAP benchmarks historical U.S. trade to U.S. Census Bureau trade data. Global data sources include the International Energy Agency (IEA), European Wind and Solar Industry Associations, China's NEA, and company reports. All forecasts are ASAP generated.