CFRA

Industry Surveys

Alternative Energy

MAY 2023

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CHARTS & FIGURES

NEW THEMES

What's Changed: We believe raw material prices will begin to return to normal levels in the second half of 2023 and expect industry participants' gross margins to benefit. See page 15.

What's Changed: The collapse of Silicon Valley Bank has spooked some investors in the solar space, but we think the recent selloff appears to be an overcorrection, thus presenting investors with buying opportunities. Read more on page 15.

EXECUTIVE SUMMARY

CFRA has a positive outlook for the Alternative Energy industry. Here are the key themes we are focused on, mainly for two key segments in the industry, solar and wind, with additional discussions on hydroelectric, biomass, biofuel, and geothermal.

Solar: Beginning to Shine Through the Storm Clouds

CFRA has a positive fundamental outlook on the solar space, despite fear circulating around tighter lending conditions following the collapse of Silicon Valley Bank earlier this year. We expect supply chain related headwinds to begin to abate in the second half of 2023, leading to lower pricing (aiding the value proposition of solar). We expect U.S. solar capacity to rise 34% in 2023 to 27 GW. Solar continues to dominate new alternative energy ramps in Europe as the region battles an energy crisis that is here to stay and likely does not improve in 2023. Also, solar firms remain leveraged to California that has its own host of problems (NEM 3.0, Rural Protests, etc.), which will slow growth in the region in 2023. We like First Solar (due to protectionism as the U.S. has restricted the import of conflict panels from China) and SolarEdge Technologies as its exposure to utility scale projects leaves it better off than peer Enphase Energy, which is more oriented toward roof top installations.

Consumer Sentiment Shifting Towards the Goal of Grid Independence

Microinverter companies (Enphase Energy and SolarEdge Technologies) are diversifying their product offerings to include full service grid-independent systems. Microinverters (pieces of electronic equipment that change the waveform of an electrical current from direct current to alternating current) remain the flagship products for these companies, but these companies are offering systems for residential, commercial, and installer customers in different tiers from “only solar” to “completely energy independent.” This gives homeowners or businesses the ability to control energy from a phone app by pulling solar power that is powering a building to charge batteries, charge EVs with the home charger, or even sell power back to the grid when electricity costs are high and the utilities are in need. Putting money back into the pockets of consumers has always been a powerful selling point and this is evident in the growth estimates for these companies that are expected to grow revenue with a ~32% CAGR from 2021 through 2025.

The Inflation Reduction Act: A New Dawn for the Investment/Producer Tax Credits

We view the investment tax credit (ITC) as the life blood of the solar industry, and with the passage of the Inflation Reduction Act, both the ITC and the producer tax credit (PTC) have been extended at 30% for the latter of 2032 or when greenhouse gas emissions from U.S. electric generation are reduced 75% from 2022 levels (PTC = $0.04/watt for Thin Film [First Solar] and Crystalline PV, $12/square meter for PV wafers, $3/kg for solar grade polysilicon, and $0.07/watt for solar modules), which we view positively as it removes a possibly overhang on solar names and aids pricing into the next decade. We note a wildcard possibility of potential removal of tariffs placed on solar goods manufactured outside of North America but we would expect Biden to veto this attempt.

Wind Power Looks to Expand… With Headwinds in the Way

CFRA’s outlook on the wind segment is positive. Demand for wind power continues to increase, and cumulative installed capacity through 2025 (globally) will likely see a healthy growth rate of about 8% per year, although the two biggest adherents of wind power, China and the U.S., are likely to grow by 7.5% and 6.0%, respectively, trailing the rest of the market. It’s good news, in our view, that other countries are joining the wind power movement in a bigger way, such as Japan (which recently instituted an offshore wind law meant to jumpstart its geographical advantage as an island country with ample winds), as well as Mexico, Brazil, Argentina, Canada, Germany, and India. The bad news – at least for providers – is that pricing is likely to come down as well. The advent of competitive auction markets for wind power in a number of these countries is bringing down the price per megawatt hour (MWh, equal to 1,000 kilowatt hours) and recent estimates suggest that prices may go lower still. However, lower prices in the near term could provide the market incentive needed to hasten more cost reductions, which, in the long run, would be a positive development. Offshore development in the U.S., the U.K., Germany, and China can also help to drive capacity growth.

CFRA **Industry Snapshot** www.cfraresearch.com

ALTERNATIVE ENERGY

Outlook: Positive

U.S. RENEWABLE ENERGY CONSUMPTION*

RANK NO.	ENERGY SOURCE	TRILLION BTU
1	Wind	3,845
2	Biomass	2,593
3	Biofuel	2,419
4	Hydroelectric	2,317
5	Solar	1,870
6	Geothermal	214

*Data for the year 2022.
Source: U.S. Energy Information Administration (EIA).

ETF FOCUS

ICLN iShares Global Clean Energy	AUM ($M) 4,573	Expense Ratio 0.40
TAN Invesco Solar	AUM ($M) 2,214	Expense Ratio 0.69
ACES ALPS Clean Energy	AUM ($M) 468	Expense Ratio 0.55
FAN First Trust Global Wind Energy	AUM ($M) 283	Expense Ratio 0.60

BY THE NUMBER

15% U.S. residential solar PV – cumulative capacity CAGR for 2023-2030E

160,000 tons/year Capacity plants opened in China

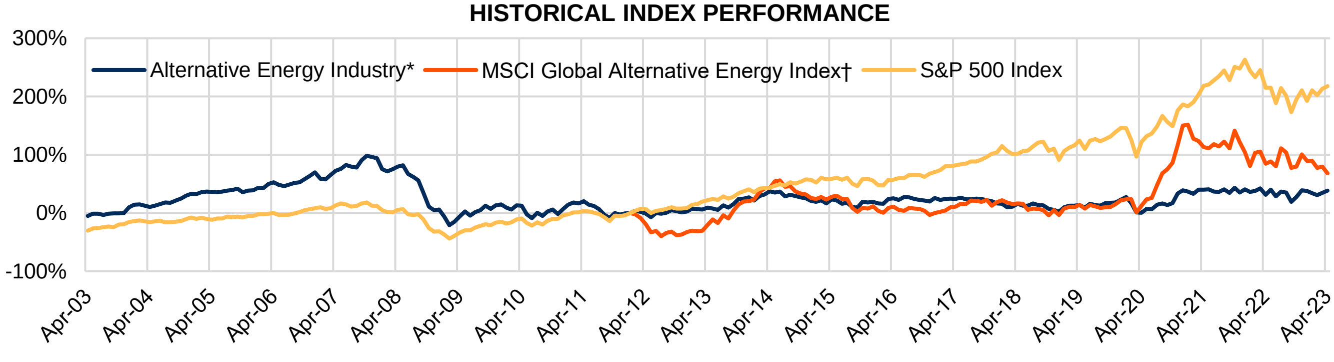
$33.5/kg Polysilicon prices in March 2023

34% Expected increase in U.S. solar PV capacity in 2023

83% Decrease in World Container Index from peak as of March 2023

5.6% Increase in wind PPA prices in 2023 compared to 2022

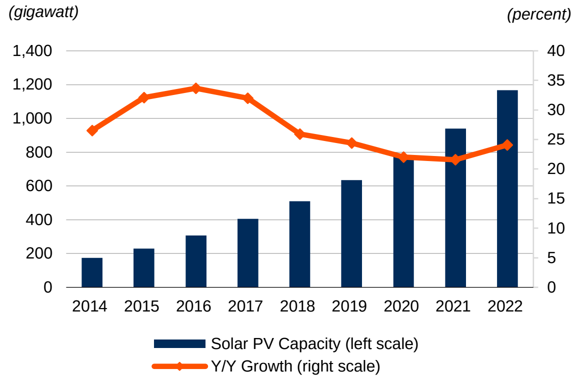
HISTORICAL INDEX PERFORMANCE



*Market-cap weighting of pure-play renewable companies listed in the *Comparative Company Analysis* section of the survey. †Index launched on January 1, 2012.
Data through April 30, 2023.
Source: S&P Global Market Intelligence.

KEY INDUSTRY DRIVERS

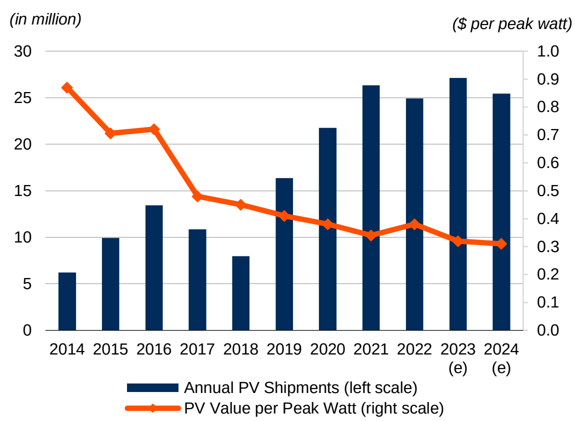
Global Solar PV Capacity



Source: CFRA, Statista.

- Global solar PV capacity has more than doubled in four years from 509 gigawatts (GW) in 2018 to 1.2 terawatts (TW) in 2022. The same figure is expected to reach 2.4 TW in 2026, according to Statista. The growth was made possible by strong government fiscal policy such as the investment tax credit (ITC), as well as an increase in demand for green energy.
- Solar is one of the leading growth drivers in renewable energy, representing about 36% (behind wind, 51%) new renewable energy capacity installed in 2022.
- Amid a more mature solar landscape, in the long term, we expect manufacturing capacity growth to be better aligned with demand, reducing boom-bust periods witnessed in the past and creating more manageable pricing declines.

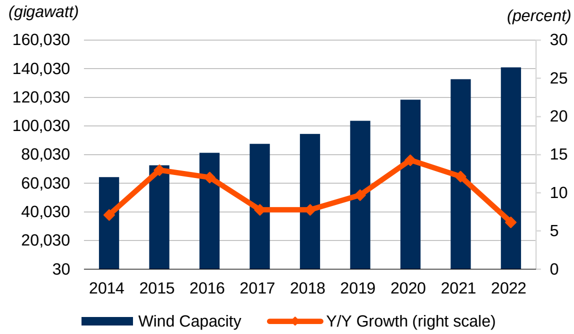
Annual PV Module Shipments and Average Cost of PV Modules in the U.S.



e-Estimate.
Source: CFRA, U.S. Energy Information Administration.

- Module prices have come down considerably over the last decade, as cost per watt improvements and lower raw material prices have been passed on to consumers. However, prices have recently gone up, due to the Russia-Ukraine war and surging raw material prices, coupled with the already disrupted supply chain. We think the industry's gross margins will be affected in the short to medium term.
- In the long term, system prices will be driven by technological advances and the shift to mono-crystalline cells from multi-crystalline cells, thereby offering more efficiency, albeit at relatively higher prices, in our view.
- We estimate module prices to decrease in 2023 on higher competition and lower input and shipment costs compared to 2022.

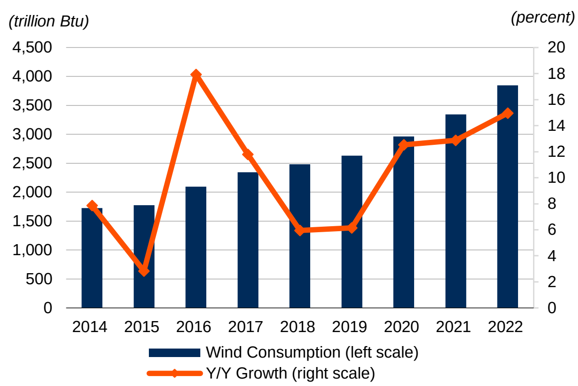
U.S. Wind Capacity



Source: U.S. Energy Information Administration.

- ◆ Wind power capacity has been on the rise and will likely continue to increase in the coming years, in our view. Reductions in levelized cost of supply have made it easier for wind to compete with fossil fuels, a trend we see continuing.
- ◆ However, wind is likely to be susceptible to the "law of large numbers" problem, as supply growth begins to level out in the high-single-digit per year range. Wind power is not fully scalable because the primary input (wind!) is variable across geographies and, as shown in Texas in 2021, can be taken offline by extreme weather (cold).

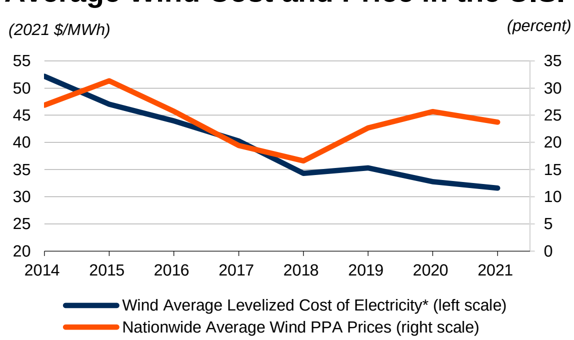
U.S. Wind Consumption



Source: U.S. Energy Information Administration.

- ◆ Wind power consumption has been on the rise for two reasons, in our view. One is via taking market share from fossil fuels – coal, in particular. There is to some degree a regional nature to wind power consumption and the interior of the country is the nerve center for it.
- ◆ The second source of consumption is likely from the ITC. The 2022 extension of the ITC for wind from the IRA provides additional backing. Furthermore, in October 2022, the Biden administration announced plans to scale up offshore wind energy projects, setting a bold target of deploying 30 GW of offshore wind by 2030 and allocating $30 million from Biden's Bipartisan Infrastructure Law to fund research and development projects on wind energy.

Average Wind Cost and Price in the U.S.



*Only includes land-based cost (e.g. excludes offshore wind).

Source: U.S. Department of Energy - Berkeley Lab, National Renewable Energy Laboratory.

- ◆ Average wind cost improved dramatically in a short period of time, but this is not uncommon, in our view, as immature technologies reach adulthood. We think further cost improvements are likely.
- ◆ The biggest wildcard for average wind cost, in our view, is the potential for continued tariffs on Chinese wind power equipment, particularly steel, and potentially tariffs on European-made wind equipment to hurt U.S. wind power producers.

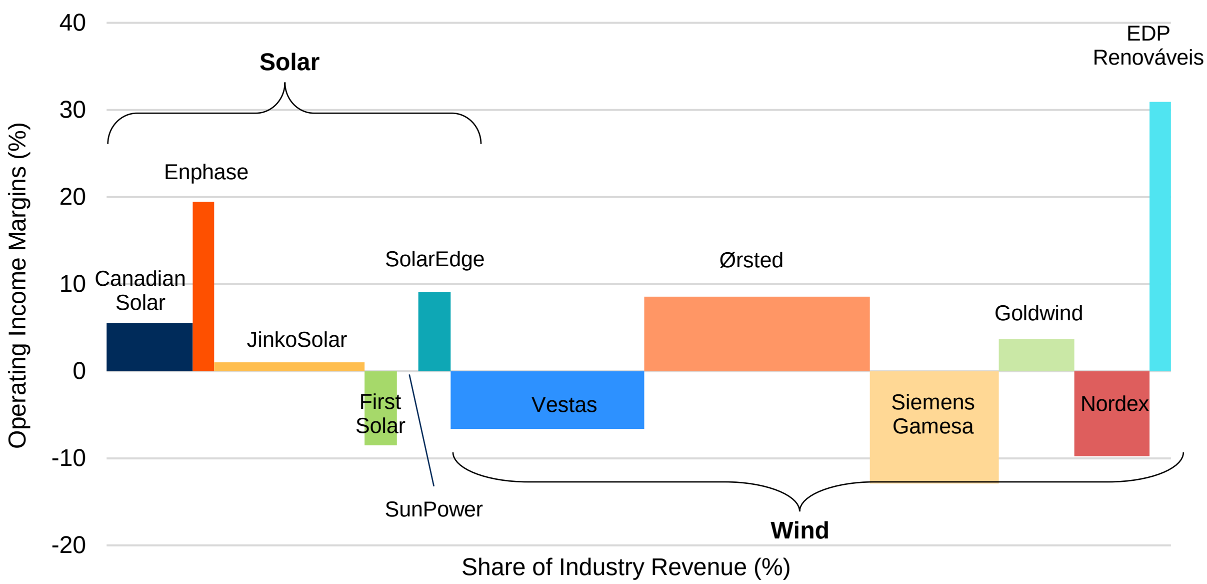
INDUSTRY TRENDS

Competitive Environment

Solar energy still has enormous potential for growth, according to CFRA analysis, and will likely continue to have the highest compound annual growth rate (CAGR) among renewable sources, considering planned capacity additions in the future. As wind shows the second-highest growth potential, we focus our attention on the solar and wind segments for our profit pools and Porter's Five Forces analysis below.

Profit Mapping of the Solar and Wind Segments
Our profit pool analysis comprises major pure-play solar and wind energy players. Among these companies, wind companies are much larger in terms of revenue compared to solar players. Among the six global solar companies, China-based JinkoSolar ranked highest in terms of revenue share. While Enphase continues to take the top spot in terms of operating margin in 2022, it generated the least industry revenue. Wind energy companies typically earn a larger portion of revenue due to scale, with Vestas and Ørsted A/S capturing the largest revenue share. On the other hand, EDP Renováveis contributed the least revenue while having the highest operating margin.

PROFIT SHARE MAP OF MAJOR GLOBAL SOLAR AND WIND PLAYERS*

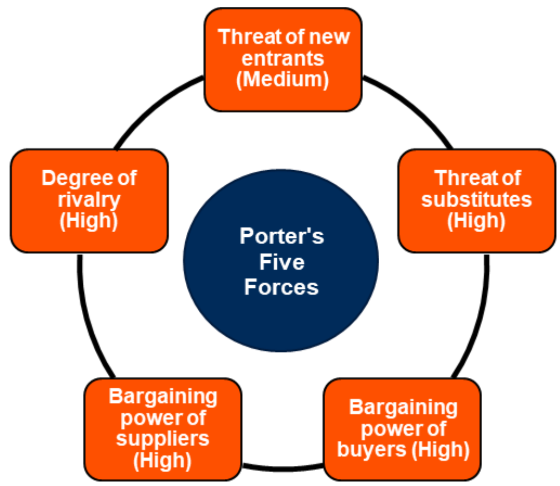


*For the year 2022.
Source: CFRA, company reports.

PORTER'S FIVE FORCES

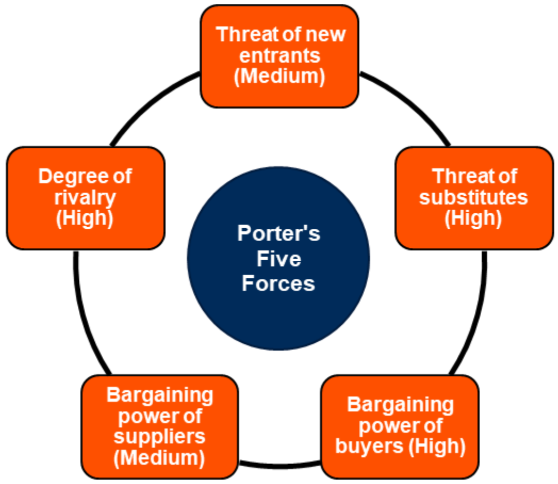
Porter's Five Forces, which provide a framework for industry analysis, were formulated by Michael E. Porter of Harvard Business School in 1979. Below we describe the five parameters on which an industry can be analyzed, and how these apply to the solar and wind power business.

Solar Energy Segment



Threat of new entrants (Medium)	Given the capital-intensive manufacturing requirements of solar modules and the lower subsidies now being offered by governments across many countries, we think barriers to entry across the supply chain are increasing. However, we forecast new technological advances could create the need for niche players across both the supply chain and services side of the business.
Threat of substitutes (High)	There are many other types of alternative energy sources that can be great substitutes for solar energy. As technology advances, cost reductions and storage capabilities are likely to enhance the competitiveness of other renewable sources. Apart from that, the cost of electricity from coal and natural gas is still much lower than solar. Hence, solar companies will need to focus on price and efficiency innovations to remain competitive.
Bargaining power of buyers (High)	The solar industry is fairly distributed with many suppliers, granting customers the flexibility to choose. Also, the low product differentiation of solar power (differentiated based only on cost/KW efficiency) has resulted in higher bargaining power for buyers.
Bargaining power of suppliers (High)	The suppliers for the solar industry have high bargaining power. The low concentration of solar manufacturers decreases the bargaining power of suppliers, but the limited number of suppliers for key solar components plus the growing solar demand increases bargaining power for solar suppliers. CFRA expects suppliers' power to weaken in the future as the cost of solar inputs continues to decrease and more solar companies are likely to consolidate. Additionally, the shortage of semiconductor chips is making life harder for solar module producers.
Degree of rivalry (High)	The emergence of new pure-play solar companies and increased solar investments from established companies have intensified competition. As prices for solar inputs continue to drop, many firms are scaling up their operations to increase generation capacity to meet demand, boosting the competitive rivalry among solar players. Going forward, we forecast the competition within the industry will diminish as the industry matures. In addition, less efficient manufacturers with significant scale but unattractive balance sheets could find themselves out of business.

Wind Power Segment

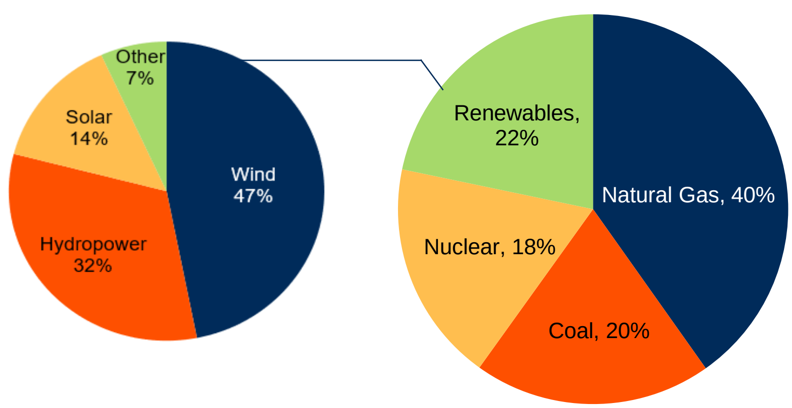


Threat of new entrants (Medium)	The companies that manufacture wind power equipment include business units of larger conglomerates (*e.g.,* Siemens, GE, Mitsubishi) but also include a growing number of smaller, pure-play entities (*e.g.,* Vestas SA). Wind power has moved from a nascent technology to a more established one, and the improvement in the cost profile has pulled down prices with it. This provides even further incentive for more innovation by suppliers. Nonetheless, in terms of operating capacity, the industry is somewhat top-heavy and led by the Siemens and GEs of the world.
Threat of substitutes (High)	The biggest users of wind energy (utilities) typically have a portfolio of electricity-generation assets and can therefore shift among them, depending on the nature of the generation (*e.g.,* baseload vs. peak). We see wind growing as an important source for such generation, and as the cost profile shifts lower, that should boost wind's perceived merits. We think offshore wind, while more expensive than onshore, has longer lead times (3-5 years) and less risk of substitution once installed.
Bargaining power of buyers (High)	Wind power developers are more fragmented – in terms of U.S. operating capacity – than their wind power supplier counterparts. On that dimension alone, wind power suppliers ought to have the better end of that business relationship. However, the threat of substitution to alternative energy sources is real, and we note that a recent switch by buyers to auction-based pricing (from the former cost-based pricing) is putting more pressure on suppliers than ever before and weighing on margins.
Bargaining power of suppliers (Medium)	The suppliers for the wind industry have moderate bargaining power. CFRA expects suppliers' power to weaken in the future as the cost of wind power inputs falls. We would not be surprised to see more consolidation emerge, especially with the ITC for small wind projects set to expire by 2023.
Degree of rivalry (High)	The appearance of new pure-play wind power companies and increasing investments from established companies have intensified the competition within the industry. We note that the continuation of the ITC for small wind projects – but not for large ones – may incent a rising share of smaller projects led by smaller firms.

Renewable or alternative energy sources have gathered global attention in recent years. As energy investors clamor for more capital allocation towards renewables and as global efforts to reduce greenhouse gas emissions expand, many countries and governments are looking toward alternative energy sources for replacement. Additionally, the deepening concern of climate change and global warming led to increased pressure to use clean energy.

According to the U.S. Energy Information Administration (EIA), in 2022, approximately 4.24 trillion kilowatt-hours (kWh) of electricity was generated at utility-scale electricity generation facilities in the U.S. Nonrenewable energy accounted for about 60% of the electricity generation, which includes natural gas (39.8%), coal (19.5%), and petroleum and other gases (0.6%). Nuclear energy accounted for about 18.2% and renewable energy sources generated 21.5% of the electricity generation. The EIA expects renewable power generation growth in the U.S. to outstrip natural gas power generation by 2045.

U.S. ELECTRICITY GENERATION BY SOURCE (2022)



Source: U.S. Energy Information Administation.

The renewable energy industry has been around for a very long time but has only started gaining traction over the last decade as technological advancements have allowed for more competitive cost and pricing for renewables. According to EIA data, in recent years, solar consumption in the U.S. has experienced the fastest growth rate among other alternative energy sources, with a five-year CAGR of 19.2%.

U.S. RENEWABLE ENERGY CONSUMPTION BY SOURCE
(in trillion Btu)

SOURCE TYPE	2017	2018	2019	2020	2021	2022	MARKET SHARE 2017	MARKET SHARE 2022	5-YEAR CAGR (%)
Hydroelectric Power	2,765	2,661	2,562	2,501	2,225	2,317	24.7	17.5	-3.5
Geothermal	210	209	201	203	205	214	1.9	1.6	0.3
Solar	777	915	1,016	1,211	1,519	1,870	6.9	14.1	19.2
Wind	2,342	2,481	2,633	2,963	3,344	3,845	20.9	29.0	10.4
Biomass									
Wood	2,264	2,356	2,341	2,171	2,229	2,182	20.2	16.5	-0.7
Waste	495	487	442	440	430	411	4.4	3.1	-3.7
Biofuels	2,364	2,355	2,376	2,136	2,331	2,419	21.1	18.2	0.5
Total Consumption	**11,217**	**11,464**	**11,572**	**11,625**	**12,283**	**13,258**	**100.0**	**100.0**	**3.4**

Source: U.S. Energy Information Administration (EIA)

Operating Environment

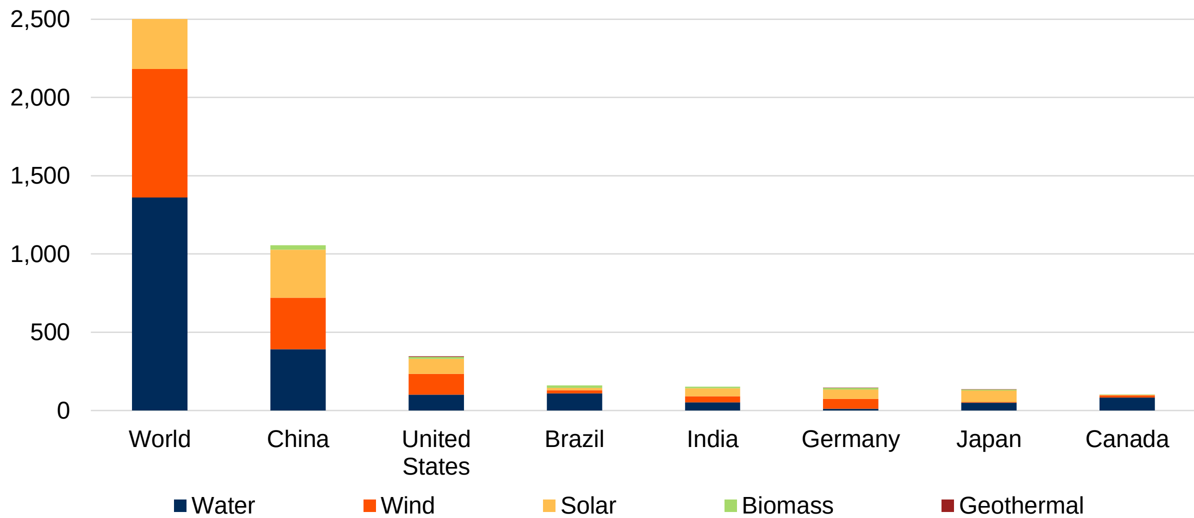
As the world becomes increasingly concerned about the threat of global warming, many countries have taken steps to encourage and drive energy consumption from renewable sources. Exxon Mobil forecasts that global primary energy demand will reach 660 quadrillion Btu by 2050, driven by policy, technology, and consumer preference. While oil and gas will remain large components of demand, wind and solar are expected to grow the fastest at an average annual growth rate of 6.2% from 2019 to 2050.

A Country-by-Country Breakdown

In terms of generation capacity, based on the latest data from the International Renewable Energy Agency (IRENA), China had the largest installed capacity in 2021, more than double the amount for the U.S. Other countries with meaningful renewable capacity include Brazil, Germany, India, Japan, and Canada. In total, these seven countries accounted for about 66% of global renewable installed capacity.

TOP COUNTRIES WITH LARGEST RENEWABLES CAPACITY

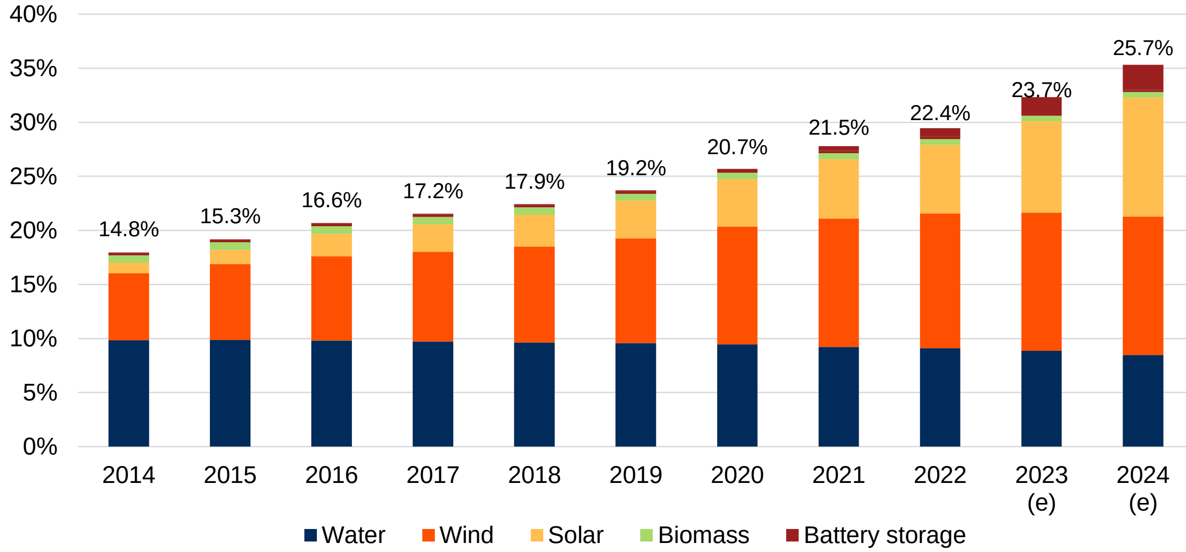
(for 2021, in gigawatt)



Source: CFRA, International Renewable Energy Agency.

In the U.S., the total share of installed energy capacity that comes from renewable sources increased to 29.5% in 2022 from 14.8% in 2010, according to our analysis based on EIA data. Wind energy is a large contributor to this growth, increasing from only 3.9% in 2010 to 10.9% in 2022 of total installed capacity. In terms of growth rate, solar emerged as the energy source with the fastest growth rate (10-year CAGR of 36.9%) but represented an estimate of only 6.3% of total installed capacity in 2022. In 2023, another 35 MW of new generating capacity is expected to be added to the U.S. grid. Wind and solar dominated the new additions, accounting for 21.9% and 77.8%, respectively, according to the EIA.

INSTALLED CAPACITY IN THE U.S. BY RENEWABLE ENERGY SOURCE
(percent)



Source: CFRA, S&P Global Market Intelligence.

Expected Power Plant Additions in the Next Few Years

U.S. electricity demand growth is expected to remain below 1% between 2022 and 2050, according to the EIA's Annual Energy Outlook 2023 (AEO2023). Slow growth in electricity demand can be attributed to older, less-efficient appliances, heating, ventilation, cooling units, and capital equipment being replaced with newer, more-efficient devices and production processes. That said, renewable electricity generation is expected to increase faster than electricity demand in the U.S. through 2050, with the share of renewables in U.S. electricity generation projected to grow to 61.7% in 2050 from 38.0% in 2022.

Over the past decade, carbon dioxide (CO_2) emissions declined because of a shift toward less carbon-intensive generation sources, low natural gas prices, and federal tax credits for renewables and state-level renewable portfolio standards. CFRA thinks natural gas-fueled generation capacity will continue to rise as EPA regulations surrounding sulfur and nitrogen emissions encourage companies to switch out of coal.

Shown below are the projections for U.S. power plant capacities through 2032:

U.S. POWER PLANT CAPACITY PROJECTIONS
(all regions, in gigawatts, arranged by 2022 capacity)

Fuel	2022	SHARE (%)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	SHARE (%)	10-YEAR CAGR *(in percent)*	TOTAL CHANGE 2022-2032
Gas	62.7	47.0	63.4	64.1	66.0	67.4	67.7	67.7	67.7	67.7	67.7	67.7	30.2	0.8	5.0
Wind	37.4	28.0	42.1	45.7	47.0	47.4	47.4	47.4	47.4	47.4	47.4	47.4	21.1	2.4	10.0
Coal	14.5	10.9	14.5	14.5	14.5	14.5	14.5	14.0	14.0	14.0	14.0	14.0	6.2	(0.4)	(0.6)
Solar	12.2	9.1	25.8	54.3	81.3	86.6	88.8	89.0	89.0	89.0	89.0	89.0	39.7	22.0	76.9
Nuclear	5.1	3.8	5.1	5.1	5.1	5.1	5.1	5.1	5.1	3.9	3.9	3.9	1.7	(2.7)	(1.2)
Water	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.0	0.0
Biomass	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	2.2	0.1
Oil	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0
Other Nonrenewable	0.4	0.3	0.6	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.6	11.8	0.9
TOTAL	**133.2**	**100.0**	**152.5**	**186.0**	**216.2**	**223.3**	**225.9**	**225.5**	**225.5**	**224.3**	**224.3**	**224.3**	**100.0**		**91.0**

Note: Future capacity is based on actual planned and under construction projects, and not based on any projections of unreported new developments or retirements.
Source: CFRA, S&P Global Market Intelligence

Wind Power, Solar, and Other Generation Additions

Wind and solar generation both have low rates of capacity utilization – only one-third to one-fifth as much as fossil fuel technologies, according to Public Utilities Fortnightly, a trade publication. Because of this, three to five times as many megawatts of renewables capacity must be installed, compared with the megawatts of fossil fuel capacity being replaced, to produce equivalent megawatt-hours of electrical energy.

During the 2010-2022 period, electric utilities did not build many coal plants in the U.S. Most notably, coal generation capacity shrank by 97,892 MW over that 12-year period due to the retiring of coal plants outpacing capacity additions. Most new electric generation capacity in 2023 is likely to come from renewables. The EIA estimates that solar (13.6 GW, or about 70.8% of the 19.3 GW of total added capacity) and wind (4.7 GW, or 24.5%) dominate the new additions. CFRA notes that the time frame to get new wind and solar plants from concept to operations is much shorter than for large combined-cycle natural gas plants, meaning that many more renewable projects than natural gas can be added in a given time period.

While the current market prices for coal and natural gas show that the average existing coal-fired power plant and the average existing natural gas combined-cycle power plant generate power at similar costs, we think natural gas prices would have to remain above $7 per million British thermal unit (MMBtu) for a sustained period to encourage the building of new coal plants. In 2022, natural gas prices averaged $6.45/MMBtu, more than triple the 2020 levels. The EIA expects natural gas prices to average $2.94/MMBtu in 2023 and $3.71/MMBtu in 2024.

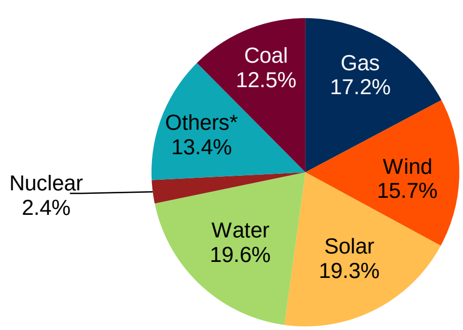
The cost to build new coal plants today is far higher than those built in the 20th century – due to pollution control requirements, elevated prices for construction materials, higher labor costs, and other inflationary pressures.

The EIA also projects in the AEO2023 that natural gas prices will stay below $4.0/MMBtu for most of the period through 2050. The decline in natural gas prices and rising penetration of renewable electricity generation led to lower wholesale electricity prices, in our view.

Aside from the declines in coal capacity and nuclear capacity, petroleum capacity is also expected to decline in the coming years, contributing to the market's increased reliance on natural gas, solar, and wind.

POWER PLANTS UNDER CONSTRUCTION IN EARLY AND ADVANCED DEVELOPMENT

(for units slated to enter service through 2032)



Total: 844,975 MW

*Others include Geothermal (0.3%), Other nonrenewable (0.4%), and Biomass (0.3%).

Source: CFRA, S&P Global Market Intelligence.

Rising Raw Material Prices Could Challenge Growth in 2023

The input costs of raw materials for solar modules rose substantially in 2021, driven by elevated demand as world governments are trying to ramp up their efforts to fight climate change. The price for polysilicon (a key raw material for solar cells) continued to rally in the first three quarters of 2022, reaching $45.7 per kilogram in September, surging more than 600% compared to its low of $7 in the second quarter of 2020, before crashing hard in the fourth quarter as more manufacturing capacity is expected to come online in 2023. The average polysilicon price dropped to the $20+ range in January 2023, before recovering to the $30+ range in March as demand rises amid the reopening of China. We expect polysilicon price volatility to continue to be elevated in the first half of 2023 before resuming its longer-term downtrend in the second half. We believe that the heightened volatility was brought on by an extreme amount of inter-segment competition for profits among solar value chain participants as the expectations for lower solar project pricing going forward begin to set in for the industry. We expect this battle to continue in the first half of 2023 as polysilicon producers compete to gain an advantage with their customers (wafer makers) in the environment of declining prices. The alleviation in price movements should add confidence to investors' ability to forecast the supply chain in the second half of 2023, removing some pressure on share prices for supply chain participants.

On top of the raw material prices, the freight rates for many routes out of Asia have come down considerably from their Covid-19 highs, as fewer containers were making the return journey to China due to Covid-19 restrictions. The average composite index of the World Container Index (WCI) surged significantly, peaking at $10,361 per 40 ft container in September 2021 before declining to $1,716 in March 2023, down over 80% from its peak. We believe raw material prices will begin to return to normal levels in the second half of 2023 and expect industry participants' gross margins to benefit.

Bright Outlook for Solar Energy

CFRA has a positive long-term view on the solar space. Despite a disappointing solar installations growth in the U.S. in 2022 (-16% growth) and fears circulating around tighter lending conditions hurting the value proposition of solar following the collapse of Silicon Valley Bank (SVB), we have begun to view solar in a net positive light. The collapse of SVB has also spooked some investors in the solar space with rooftop installers like Sunrun and SunPower Corp. being in the worst position on a relative basis since their success depends on their ability to raise capital (tax equity, debt, etc.) to finance deployments of new solar energy systems, and the fear of tighter lending conditions does not aid growth prospects or give investors confidence in relation to forecasting the space. This uncertainty was already pressuring the space coming into 2023 because of the aggressive increase in interest rates from the Federal Reserve, as higher interest rates (or credit spreads) may adversely impact the solar industry's ability to offer attractive pricing as it reduces the present value of customer payment streams, consequently reducing the value of investor equity funds.

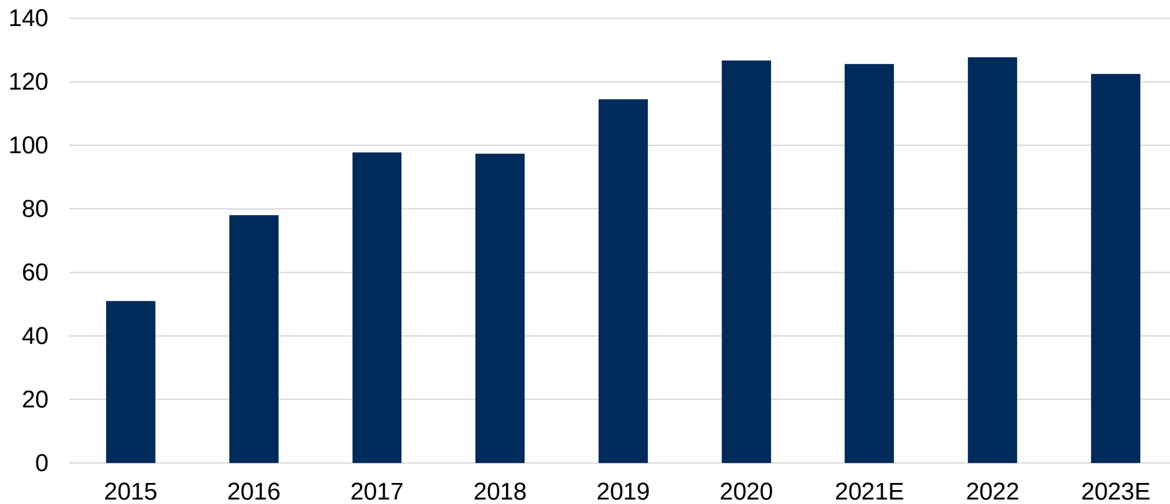
However, we think the recent selloff in solar industry participants following the collapse of SVB appears to be an overcorrection, presenting investors with buying opportunities. Looking pass the near-term headwinds, we forecast U.S. photovoltaic (PV) solar installations to grow 34% in 2023 to 27.02 gigawatts (GW) and 22% in 2024 to 32.9 GW, following the 15.8% decline in installations in 2022 to 20.2 GW. Additionally, according to the Solar Energy Industry Association (SEIA), U.S. solar cumulative installed capacity is expected to reach 700 GW by 2033, nearly 5x the current level (142 GW) in the next 10 years.

China as the largest solar market have installed 87.4 GW of solar, a more than 60% growth from 2021. India, a top-three solar country and one with aggressive targets, increased its capacity by 27% in 2022.

Europe is a bright spot, but comparisons get tougher. Under a renewable energy directive signed in 2018, the European Union (EU) set a target of 32% of all energy from renewable resources by 2030. While Sweden generates the largest percentage of its energy needs from renewables (more than 50%), the biggest drivers to solar growth come from Germany and Spain. Spain has committed to an ambitious scheme to switch to 100% renewable electricity by 2050 and plans to add about 3 GW of wind and solar power every year. Also, in late 2018, the EU abolished the Minimum Import Price mechanism with China. The combination of aggressive country renewable mandates, lower cost of capital, and better access to cheaper panels will likely continue to support growth in the region.

Our chart below provides an overview of the PV demand per region from 2007 to 2021.

GLOBAL PV DEMAND
(in gigawatts, GW)



Source: Statista.

Lower Solar Prices Open Up Opportunities for Greater Geographic Distribution
We note that most of the demand for the solar industry in recent years has come from growth in China, the U.S., and India (we estimate over half of total installations in 2022). In fact, growth in these markets over the last several years helped alleviate the boom-bust period that took place in Europe earlier this decade. But we expect Europe to be a big growth story in 2023 and moving forward following a mammoth 25% solar power capacity growth in 2022 (a record-breaking 41.4 GW in solar capacity addition in 2022).

Germany is likely to be the biggest purchaser of solar in Europe while Spain and the Netherlands also contribute. We think India, currently the third-largest solar market behind China and the U.S., has the biggest growth potential over the next three years, given the backing from that country's government to promote solar growth. We note that contributions from new emerging markets across the globe (*e.g.,* South Africa, Latin America, and the Middle East, among other areas) will represent most of the growth for the industry over the next decade. Many of these regions are unsubsidized but will likely begin to invest heavily in solar as the lower price points become more comparable to traditional fossil fuel prices – especially where electricity prices are high and access to solar energy is more abundant.

Technological Advances – the Silicon Carbide Revolution
Silicon carbide (SiC) is seeing widespread adoption not only in the automotive space, but also in the industrial and energy space, most notably with solar. SiC is capable of reliability and efficiency for the most demanding power applications – for solar, its adoption can offer up to 30% lower losses, up to 50% higher power density, and up to 10% system cost savings. The adoption of SiC by the solar industry has been brought on by its increased energy production when higher voltages are paired with storage along with surge and backup capabilities that are much more scalable when the pair is built on SiC rather than silicon. Smart grids are also adopting SiC due to improvements in on-premise storage solutions, DC

microgrid, and solid state transformers. Solar microinverters, modules, and battery storage systems are adopting SiC alongside EV chargers and other renewable systems like wind.

Microinverter companies like Enphase Energy and SolarEdge Technologies are diversifying their product offerings to include full-service grid-independent systems. A microinverter is a piece of electronic equipment that changes the waveform of an electrical current. The inverter changes direct current (DC) into an alternating current (AC). Microinverters have taken over the market share for solar panel systems from legacy string inverters; with string inverters, there can be a single point of failure for the entire panel system, whereas with microinverters, if one fails, it only brings the one solar panel attached to it offline rather than the entire system. These microinverters are the flagship products for companies like Enphase Energy and SolarEdge Technologies, but these companies are offering systems for residential, commercial, and installer customers in different tiers from “only solar” to “completely energy independent.” This gives homeowners or businesses the ability to control energy from a phone app by pulling solar power that is powering a building to charge batteries, charge EVs with the home charger, or even sell power back to the grid when electricity costs are high and the utilities are in need. Putting money back into the pockets of consumers has always been a powerful selling point and this is evident in the growth estimates for these companies that are expected to grow revenue with a ~32% CAGR from 2021 through 2025. In addition, with the Inflation Reduction Act and continued traction in EV adoption, we view this as a conservative base scenario for growth estimates.

The energy saved per car using SiC is undeniably the more efficient resource for battery-powered EVs. If, in 2030, 35 million battery EVs (which is a very conservative number) are on the road using SiC (rather than silicon for an EV since this comparison is not between an internal combustion engine and an EV), in that one year, the savings would amount to $8.2 billion in electricity (owners would save ~$233 of electricity) and 192 million barrels of oil (5.5 barrels of oil per sedan), and the lifetime greenhouse gas emissions would be $2.7 billion gallons of gas, assuming the U.S. average residential electricity price is $0.137/kWh. These savings are hard to argue against with automobile manufacturers looking to reduce emissions and produce more ecologically friendly automobiles.

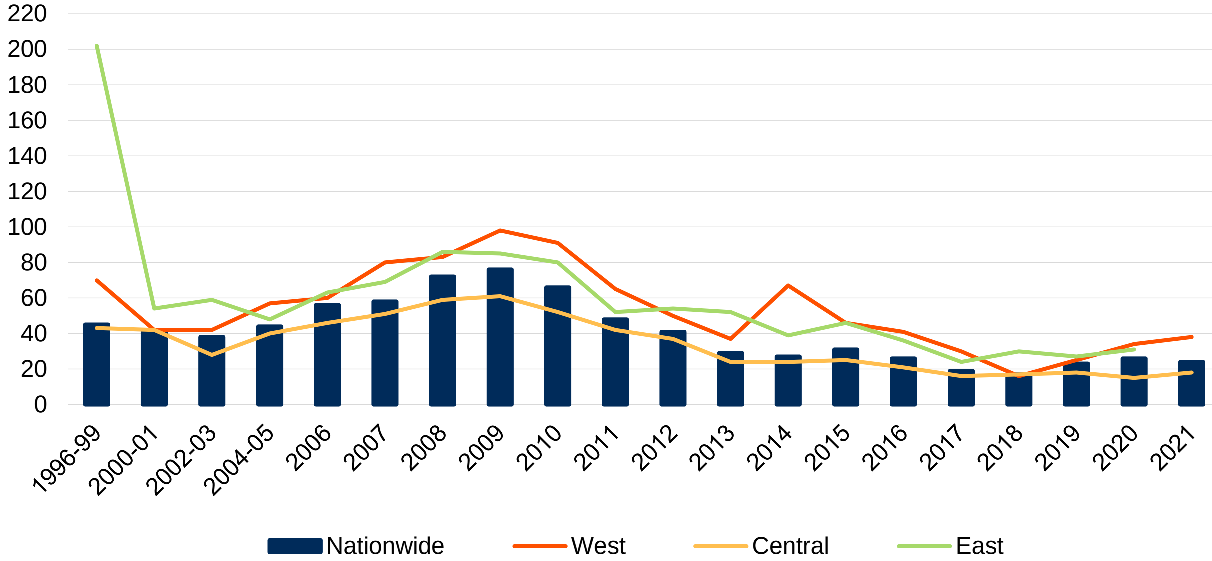
Wind Power Operating Costs Rising – Slightly

The first incarnations of U.S. wind power projects started in 1998, and like many nascent technologies, operating costs back then were not where they are now. In fact, operating costs for new wind power installed between 1998 and 2005 rose over time through 2009, peaking at an average of roughly $75 per kilowatt. Subsequent “vintages” of wind projects, however, have gotten considerably cheaper. For example, for projects installed between 2006 and 2011, average costs stayed remarkably stable in the $20-$25 per kilowatt range. The last vintage of wind projects, since 2012, are slightly more expensive, in the high-$20, low-$30 per kilowatt range. Still, this is far cheaper than projects used to be.

Wind Power Cost Curve Has Had a Gravitational Pull on Prices

As projects got cheaper to install, providers could compete downwards on price, benefiting customers. Since peaking in 2009, prices have dropped by more than 80%. Prices in the interior of the country are generally cheaper than elsewhere (possibly reflecting higher costs for offshore projects).

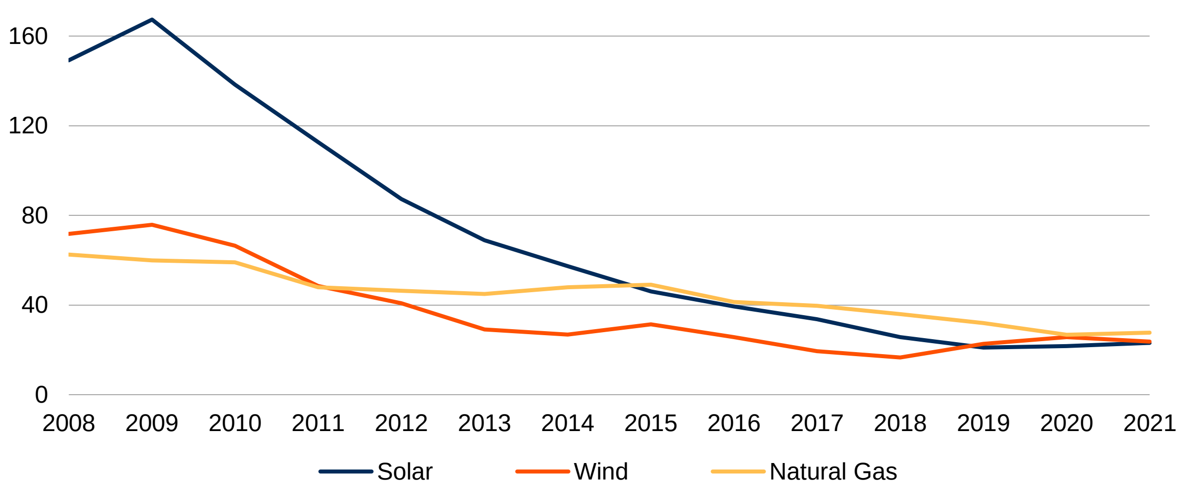
NATIONWIDE GENERATION-WEIGHTED LEVELIZED WIND PPA PRICES
(by PPA execution date, in 2021 $/MWh)



Source: U.S. Department of Energy - Berkeley Lab.

Lastly, wind and solar are very competitive with natural gas projects today (and have been, for a few years running). Based on data from the Department of Energy, wind power crossed below natural gas on pricing in 2012, and solar followed suit in 2016. The bigger issue for these renewables is intermittency, but if that problem gets resolved by technology, we think renewable adoption will be strongly enhanced.

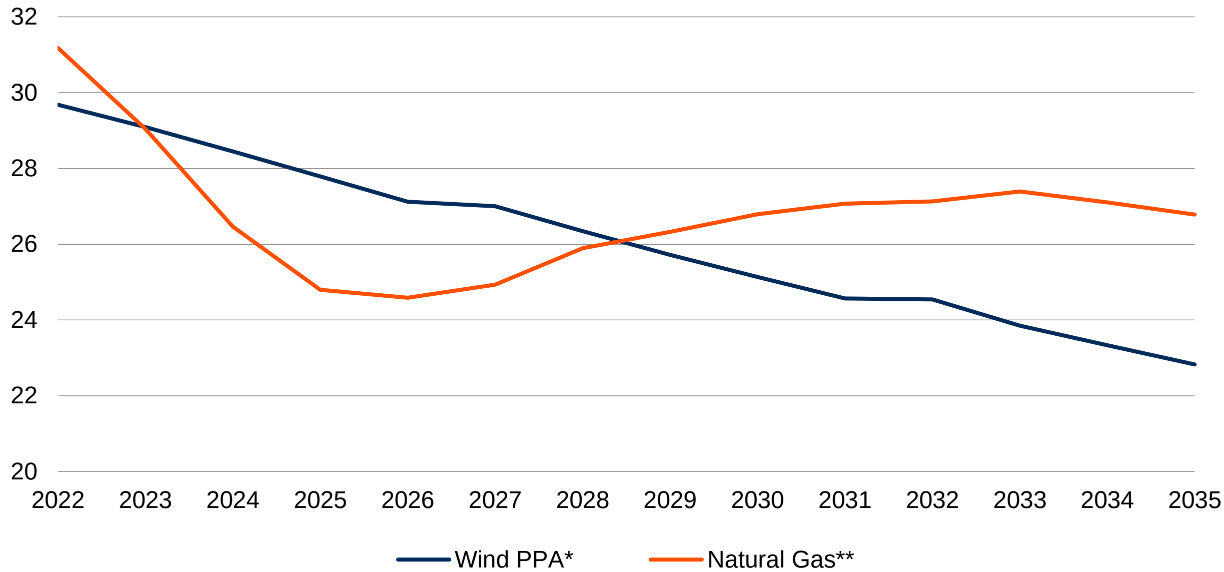
LEVELIZED WIND, SOLAR, AND NATURAL GAS PPA PRICES
(in $ per MWh)



Source: U.S. Department of Energy - Berkeley Lab.

Looking ahead, we see wind increasingly able to exact a price advantage over natural gas through the medium term.

FORECAST WIND PPA PRICES VS. FORECAST U.S. NATURAL GAS PRICES
(2022-2035, $ per MWh)



*Wind PPA prices are based on the difference between the 90th and the 10th percentile aggregate wind PPA prices among 39 PPAs executed 2022.
**Forecast natural gas prices represent Reference Case in EIA's Annual Energy Outlook 2022.
Source: U.S. Department of Energy - Berkeley Lab, U.S. Energy Information Administration.

Energy Storage Investments Essential for Low-Carbon Strategies

Due to the intermittent nature of wind and solar resources and a mismatch between the timing in daily peak supply and peak demand, utilities pursuing the change to largely or 100% carbon-free generation will have to invest in energy storage assets.

Solar generation output typically peaks at noon as that is when the sun is highest in the sky and then starts to fall off after 3 p.m. quickly. In addition, solar radiation is highest in June but starts to fall off by August. Wind generation is intermittent, but on average, wind speeds tend to temporarily peak in the late afternoon and then see a solid peak from 7 p.m. through 1 a.m. Additionally, wind speeds tend to be lower during the summer months. Electric demand, on the other hand, typically peaks in the mid-afternoon during the summer months of July through September.

The mismatch between supply and demand will require the use of grid-tied energy storage to match hourly demand loads with supply. However, to date, very few regulated battery storage assets have been built, and we forecast substantial investment will be required as utilities move towards a low-carbon or carbon-free future.

Demand for Diesel Improves Outlook for Biofuels

The increase in demand for diesel post-Covid-19, especially in regions such as Indonesia and Brazil, has led to an improved outlook for renewable fuels (*i.e.,* biofuels) as countries around the world remained strongly committed to renewable fuel mandates. Despite an improved outlook, challenges remain as total demand will likely stay below 2019 levels while the world recovers from the pandemic.

Renewable identification number (RIN) prices have been elevated, affected by rising global demand for the agricultural feedstocks, which drove fuel ethanol and biomass-based diesel prices higher, pushing their corresponding RIN prices to new highs.

One strategic move now being pursued by many independent refiners is the expansion of renewable diesel. Such diesel, which fits into the D4 category, has a few advantages. First, as a so-called “drop-in fuel”, it can be easily moved within existing diesel infrastructure such as storage tanks or pipelines and can be consumed in engines that take regular diesel with no modifications needed. Second, it has low sulfur content, which is relatively climate-friendly. Third, assuming the pricing gap between D4 and D6 persists, it will help pay down the expense associated with D6 needs on gasoline production.

Renewable diesel earns premium RIN points as well. Each gallon of renewable diesel produced by a refiner earns it 1.7 RINs (because of its higher energy content), which can be used to offset the obligations on blending needs for gasoline. So, if a refiner produces a gallon of renewable diesel and a gallon of gasoline, it can meet its volume obligation on gasoline with its own renewable diesel and still come out 0.7 RINs ahead.

Renewable diesel production also earns federal tax credits that bridge the higher cost of producing biodiesel. In December 2019, President Trump extended the Blender’s Tax Credit through 2022, and made it retroactive and applicable to 2018 and 2019 production. The tax credit stands at $1.00 per gallon and thus improves the economics of all biofuels including renewable diesel. To put this credit in perspective, a gallon of B99 biodiesel (99% pure biodiesel) averaged $3.73 per gallon in the U.S. in October 2021, according to the Alternative Fuels Data Center, a unit of the Department of Energy. By comparison, a gallon of diesel retailed for $3.10 per gallon nationally. Since biodiesel is more expensive to produce (before tax credits), the tax credit extension gives refiners a bit more incentive, at least through 2022, to produce biodiesel.

A major incentive to use renewable diesel is the low-carbon fuel standard (LCFS), which we think could expand under the Biden administration. According to the Alternative Fuels Data Center, most renewable diesel today is consumed in California (a little bit in Oregon), where there is an LCFS in place.

Hydropower Remained Stagnant Throughout the Past 40 Years

Hydropower was once one of the most important sources of electricity in the U.S. with well-known projects throughout the country, including Hoover Dam and Niagara Falls. In 1950, hydropower accounted for over 30% of total power generation in the U.S.; however, in 2022, this fell to about 6% of total generation and 0.5% of total U.S. capacity. Hydroelectric output generally grew through the mid-1970s but has since remained relatively flat while generation capacity from other nonrenewable and renewable sources increased.

Run-of-river and dam hydropower use water as a free fuel to create electricity, which makes them attractive to run as baseload power plants (these plants run 24 hours a day, 7 days a week). The pumped storage plants, however, use electricity as a fuel to move water from a lower reservoir or river to a higher reservoir during off-peak times. Then, during peak electric demand periods, water is released to generate electricity in the same way a dam creates electricity.

Regulatory Updates

The regulatory and legislative environment remains, for now, the most important factor for the alternative energy industry, from CFRA's perspective. Given the high cost and relatively lower margin of many renewables, regulatory mandates and government incentives have been driving the demand for renewable energy sources over the years. We will discuss the major regulatory trends in the U.S., followed by regulation targets and developments in other geographies – like China, India, Europe, and Japan – with a large renewable presence.

UNITED STATES

ITC Remains the Lifeblood of Solar Demand

As a major piece of climate legislation, the recently approved Inflation Reduction Act (IRA) has garnered a lot of attention. Many of the renewable energy provisions in the IRA are similar to provisions that were originally proposed in the Build Back Better Act, which failed to gain legislative traction at the end of 2021. The IRA is a significant step in the United States' decarbonization and climate resilience efforts. Beyond the green movement, the legislation also marks a major investment in American competitiveness and innovation. According to the White House, by 2030, U.S. greenhouse gas emissions will have decreased by nearly 40%, or one gigaton.

One significant inclusion in the IRA was the extension for the investment tax credit (ITC) and production tax credit (PTC). The ITC is extended through 2024 for the existing 30% rate for solar, qualified fuel cell, waste energy recovery, geothermal, and other specified electricity generation facilities. Under the previous law, the 30% ITC for solar energy property was scheduled to phase down between 2020 and 2023. Certain solar projects placed in service before 2022, however, may qualify only for a 26% ITC. The second extension is related to the current PTC for eligible hydropower, wind, biomass, landfill gas, trash, and other designated energy producing facilities through 2024. Prior legislation phased down the PTC for wind farms between 2017 and 2021. On top of the extension, there are two new tax credits for projects that will commence after 2024 – the Clean Electricity Investment Credit and the Clean Electricity Production Credit. These credits operate similarly to the existing ITC and PTC but are technology neutral.

While environmentalists may dream of a day when oil and gas wells are plugged and abandoned, and the transportation fleet is electrified, using power generated from renewable sources, the near-term reality, in our opinion, is that the U.S. will only be taking baby steps towards renewables as a share of energy production. Thus, although President Biden has previously announced major plans for renewable energy moonshots (such as the IRA mentioned above), we think that the president will have to work with the tools he has at hand, settling for singles and doubles rather than home runs.

Some of the work has already been done for him during the Trump administration. In late December 2020, the ITC, which stood at 26% in 2020 and was due to step down to 22% in 2021, was extended at the 26% level for two more years and would not see a decline until 2023. However, with the recent IRA effective on August 2022, the ITC will see its rate increase back to 30% with a further extension through 2024.

We view the ITC as the lifeblood for solar demand in the U.S. At the federal level, the ITC has gone through several cycles of enactment and expiration over the last 30 years. In 2015, Congress extended the 30% ITC for both residential and commercial solar installations through 2019. In February 2018, the ITC was modified by replacing the requirement to place solar projects in service by a certain date with a requirement to begin construction by a certain date. In June 2018, the IRS released new guidance to determine when construction has started on a solar project. As a result, projects that began construction in 2019 would be eligible for the 30% ITC. Then in 2022, the IRA instituted a new dawn for not only the ITC but the PTC as well.

The IRA extended the ITC at 30% through the latter part of 2032 or when greenhouse gas emissions from U.S. electric generation are reduced 75% from 2022 levels. The IRA also extended the PTC at 100% of its current levels ($0.04/watt for Thin Film [FLSR] and Crystalline PV, $12/square meter for PV wafers, $3/kg for solar grade polysilicon, and $0.07/watt for solar modules) through the latter part of 2032 and when greenhouse gas emissions for U.S. electric generation are reduced 75% from 2022 levels. The IRA also added 10% PTC/ITC kicker if domestic content requirements are met and for certain projects up to 20% ITC kicker in energy communities or low-income communities.

What do we think President Biden will have to work on? First, we think he could reinstate the auto emissions waiver for California that was rescinded by the Trump administration in 2019. Interestingly, that process, led by President Trump and supported by four major automakers, just saw its first desertion, as General Motors (GM) took a very public about-face and now supports California emissions as well as larger climate goals. We think this adheres to a shift in strategy for GM that promotes more electric vehicles. Given the importance of the California market to the nation as a whole, we could see a reinstated waiver helping to drive (over the long term) more vehicle innovation and potentially greater proliferation of electric vehicles in the U.S. It also dovetails nicely with GM's recent announcement that it would no longer sell cars with internal combustion engines after 2035.

Second, President Biden has already rejoined the Paris Climate Accord. The appointment of John Kerry to the post of special envoy for climate change is instructive since, as noted by the science journal Nature, it was Kerry who served as Secretary of State under Obama and helped craft the Paris Accord in the first place. The Obama-Biden administration was very effective, in our view, in supporting new renewable initiatives and placing limitations on carbon pollution. In 2015 (signed in 2016), the former administration helped adopt the Paris Agreement (total of 197 countries participate), with the intent to mitigate greenhouse gas emissions. Under the Paris Agreement, each country must determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming. In June 2017, President Trump announced his intention to withdraw the U.S. from the agreement.

Third, Biden could use existing legislative tools in his arsenal. The Clean Air Act (CAA), for example, gives Biden the latitude to regulate emissions from a wide variety of sources. Foreign Policy magazine notes that the CAA provides authority for Biden to scrutinize emissions from power plants, autos, as well as methane emissions from the oil and gas industry. His rejection of the Keystone XL pipeline is one example. Of course, more stringently applying the existing laws on the books also opens up the possibility of legal action, and so we would also expect that any major industry shakeups that occur from a more climate-friendly Biden administration could result in Supreme Court scrutiny down the road.

Additionally, in November 2021, President Biden signed the bipartisan Infrastructure Investment and Jobs Act (IIJA) into law. Seen as more of a compromise (a lot of climate-related issues are addressed in Build Back Better), the $1.2 trillion IIJA includes $550 billion in new spending divided between improving surface transportation and core infrastructure. However, there were some appropriations for alternative energy. This includes $8 billion for hydrogen hubs and $1 billion for electrolysis (the process of using electricity to split water into hydrogen and oxygen), funds for renewable energy demonstration projects ($100 million for wind; $80 million for solar), and incentives for hydropower, among other topics.

It is also worth thinking about actions we do NOT expect Biden to take. For one, we doubt Biden would impose a ban on fracking in oil and gas, for one simple reason: jobs. A ban on the use of fracking, in our view, would decimate the oil and gas industry in Texas, Oklahoma, North Dakota, Pennsylvania, and Colorado. We note that Biden's ambitious energy plan talks about lots of high-paying jobs in green energy, and killing jobs in the oil industry (before the green jobs ultimately arrive en masse, which itself is a rosy assumption) is likely a non-starter.

Second, Biden is likely to be just as tough on China as Trump has been in terms of tariffs. In January 2018, President Trump imposed a 30% tariff on all silicon solar cells and modules produced outside the U.S. The tariffs declined over five percentage points in each of the subsequent three years (implies a 20% tariff in 2020 and 15% for 2021). We note that the first 2.5 GW of imported cells are excluded, which may help support some module manufacturing by Chinese players as they look to circumvent tariffs. However, the effectiveness of the tariffs began to dissipate in 2019 due to strong demand in the U.S. solar market and an exemption that was given for bifacial solar modules. The Section 201 tariffs were scheduled to be phased out on February 7, 2022. However, the Biden administration decided to extend the tariffs for another four years with several terms eased. The four-year extension exempts bifacial solar panel, a technology sought by many big developers, and doubles on the allowance for import solar cells. Furthermore, a duty-free supply from neighboring countries such as Canada and Mexico was also introduced in the extension. The extension may prove to deviate Biden administration's goal of clean energy and decarbonization by 2035 as the U.S. panel manufacturing capacity is nowhere near meeting the industry demand. However, we think the exemption of bifacial solar panels and the allowance for import solar cells will provide a much-needed boost for the industry.

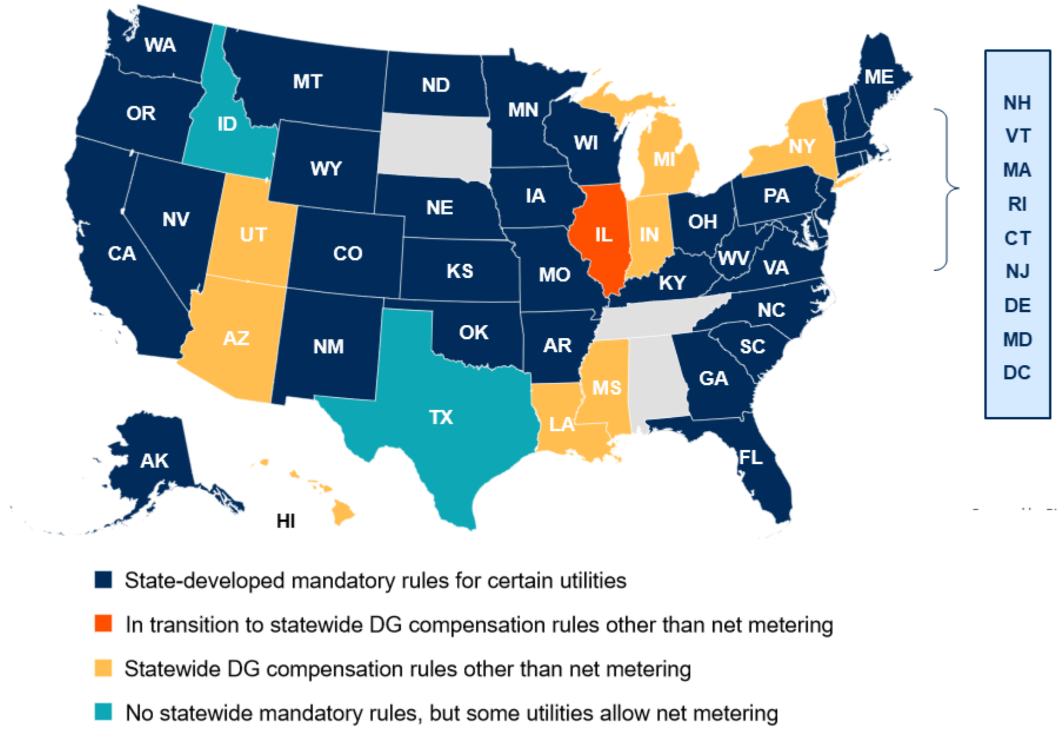
In June 2022, President Biden waived tariffs on solar panels from four Southeast Asian nations (Cambodia, Malaysia, Thailand, and Vietnam). However, U.S. House of Representatives committees voted restoring the tariffs in April 2023, setting the resolution up for a vote by the full House. CFRA believes this measure will pass the House and die in the Senate. In the unlikely event it passes the Senate, it's a near-certainty Biden will veto it, and Congress is very unlikely to override the veto.

In addition, the IRA's new direct pay and transfer options also allow more organizations to utilize clean energy tax credits for equipment placed in service on or after January 1, 2023 and through December 31, 2032.

Net Metering Rules to Encourage Growth in Distributed Solar Generation

Net energy metering (NEM), or net metering, is a billing system that credits owners of distributed energy generation (DG) systems for excess electricity that they add to the utility's electric grid. For example, when a homeowner installs a PV solar system on the roof and generates more electricity than the consumption of the home during certain times of the day, the excess electricity is exported to the grid and the owner is only billed for the "net" energy used over the entire day.

NEM customers are generally compensated for excess electricity on a per kWh basis and the level of compensation differs by location depending on state and local policies. Currently, 39 states, Washington D.C., and four territories offer net metering policies. Also, there are utilities that voluntarily offer NEM arrangements to customers in states, like Idaho and Texas, without mandatory NEM policies.



Uncertainty with NEM 3.0 in California

Net metering has played a large role in renewable energy generation growth in California. Under the current system (NEM 2.0), which came into effect in 2016, customers receive full retail rate credits for energy exported to the grid during a 12-month billing cycle. However, an evaluation found that NEM 2.0 negatively impacted non-participating customers (disproportionately impacting low-income ratepayers), and that the costs of NEM 2.0 exceeded its benefits. In December 2021, the California Public Utilities Commission (CPUC) issued a proposal to be voted on in January 2022. The proposal included a monthly residential grid participation charge and reduced solar credit, which we think would reduce the return on investment for homeowners investing in solar and adversely impact solar adoption. However, in February 2022, amid widespread controversy over the proposal, the CPUC delayed its decision indefinitely.

In March 2023, North Carolina regulators approved a net-metering plan, which will lower the future value of rooftop solar systems for Duke Energy customers. Under the new net-metering plan, customers who decide to add rooftop solar in the future will be hit with new minimum bills. Solar customers of Duke Energy Carolinas will have to pay a minimum monthly bill of at least $22, and customers with Duke Energy Progress a minimum of $28. In addition, future new solar customers under these new plans will be charged between 5.6 and 7.7 cents per kilowatt-hour during the periods of highest solar generation, but as high as 17 to 19 cents per kilowatt-hour during mornings and evenings, when Duke's grid is facing the highest demand for electricity, compared to the current existing flat rates for electricity, which average 11 cents per kilowatt-hour. Duke estimates that the current average monthly bill savings of $80–$98 for solar customers will fall to $40–$68 under the new plan. CFRA believes the decision is not favorable toward rooftop installers' growth, but it should drive the adoption of solar-plus-storage installation.

Solar Expansion Hindered by Rural Protest

The solar market has experienced the fastest growth rate in renewable energy and is expected to accelerate over the coming years. The global solar capacity has more than doubled over the past four years, with the annual growth averaging around 20%. With the price of solar panel equipment dropping in recent decades, solar is able to compete with fossil fuels. Solar panels are now a common sight in housing areas, businesses, and some government infrastructure. But analysts expect most of the solar energy production in the near future to come from utility-scale projects, in part because of the savings that come with massive installations.

While solar energy promotes a greener solution to global warming, green fields are being destroyed left and right to achieve it. Solar advocates are pushing for a cleaner alternative to fossil fuel, with massive solar projects constructed across the U.S. On the other hand, people who live near the solar projects watch in horror as fields are filled with rows of silicon solar panels, damaging ecologically sensitive areas.

To put it in perspective, the Solar Star project in California boasts 1.7 million panels spread over 3,000 acres, one of the largest solar energy facilities in the world. A natural gas power plant, on the other hand, produces the same amount of energy on just 122 acres. Solar projects require a huge amount of land to operate, and this is increasingly becoming one of the top barriers for solar expansion.

Against the backdrop of declining solar panel equipment prices in recent decades, solar was made possible to compete on the same stage as fossil fuels. Solar panels are now a common sight on houses, businesses, and some government infrastructure.

According to NBC News, there have been 57 cities, towns, and counties across the U.S. where residents have proposed solar moratoriums since the start of 2021, and not every proposed ban gets local news coverage. At least 40 of those approved the measures. Other localities did so in earlier years. In addition to that, local governments in states such as California, Indiana, Maine, New York, and Virginia have imposed moratoriums on large-scale solar farms, as the nation's push for cleaner energy has collided with complaints about how the projects affect wildlife and landscape. The protests proved to be very effective as more than 1.7 GW of proposed solar capacity was dropped in 2021, according to Wood Mackenzie's analysis.

Siting new solar projects on farmland is essentially another chapter in the U.S. culture wars and, as developers eye larger and larger projects, resistance is likely to accelerate. We expect most of the solar energy production in the near future to come from utility-scale projects, retailers' and businesses' roof tops, and car parks.

EPA's New Rules and Policies Scrapped By Court

The Clean Power Plan (CPP), originated under the Obama administration, aimed to reduce nationwide carbon emissions by an estimated 32% below 2005 levels by 2030. Power plants are said to be the largest stationary source of carbon pollution in the U.S. Hence, the CPP was enacted to limit the carbon emission for new and reconstructed power plants.

In June 2018-2019, the U.S. Environmental Protection Agency (EPA) enforced a new rule, known as the Affordable Clean Energy (ACE), to replace Obama's CPP. According to the EPA, the final ACE rule establishes emission guidelines for states to use when developing plans to limit greenhouse gas emissions from existing coal-fired electric generating units (EGUs). The rule was issued by the EPA on June 19, 2019, and would cover about 600 coal-fired EGUs in 300 facilities, according to the EPA. Concurrently, the CPP, which exceeded the EPA's statutory under the Clean Air Act, was formally repealed. Most notably, under the proposed ACE rule, carbon emission guidelines are established by the federal government, but states will have the flexibility to determine their own emissions standards for coal-fired power plants.

In January 2021, however, the EPA's ACE rule was overturned by the United States Court of Appeal for the D.C. Circuit. Both the CPP and ACE use the best system of [CO_2] emission reduction (BSER). The CPP adopted a broad BSER system definition that included power generation shifting between coal, gas, and renewable electricity units, while the ACE applied only to coal-fired generating units, ignoring oil, renewables, and natural gas, limiting the coverage for emission reduction. The ruling will give Biden's administration an opportunity to implement a more holistic and stringent rule to achieve its goal of clean energy and decarbonization by 2035.

On June 30, 2022, the U.S. Supreme Court's conservative majority filed a motion to limit the EPA's ability to control greenhouse gas emissions from currently operating power plants as the court found that the Obama-era Clean Power Plan, a 2015 rule that never went into effect, adopted an approach to curbing power plant emissions that exceeded the agency's authority.

Tax Equity Investing in Wind Projects Remains Robust

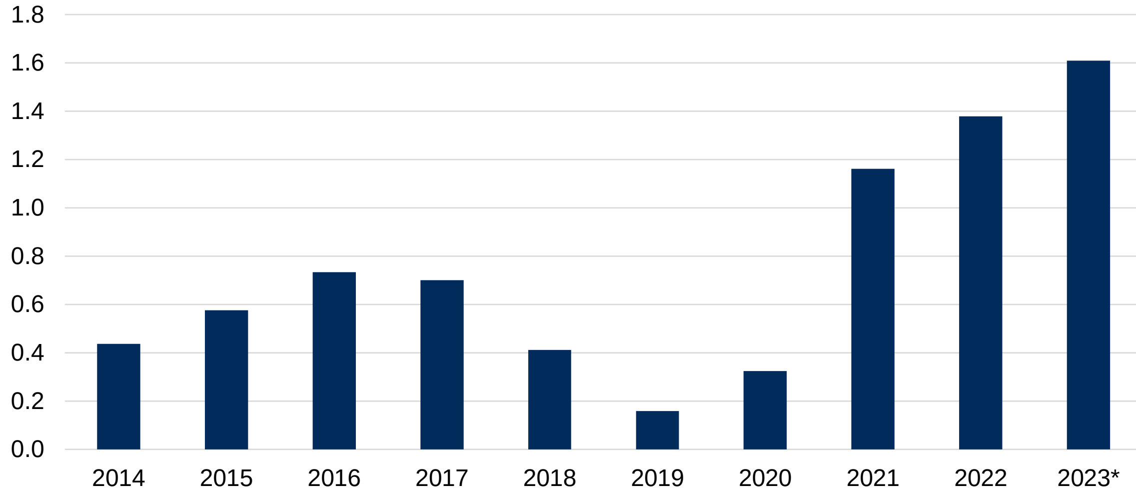
According to our estimates, the U.S. wind market raised $9.3 billion in new tax equity financing in 2020, which is higher than that of prior years. Notably, tax equity yields of 4% near year-end 2018 suggest that there is plenty of competition among investors seeking stakes in wind projects, in our view. Meanwhile, industry publication Project Finance Newswire's "Cost of capital: 2022 outlook" suggested that tax equity flip yields for utility-scale wind projects ranged from 6% to mid-7% range in 2021, up from mid-6% range and below from 2020, which, although higher than year-end 2018 levels, are still reasonable in our view.

In August 2022, the IRA was introduced, and with it comes an extension for the PTC to wind projects that begin construction before the end of 2024. This three-year extension to the PTC for wind projects comes with other qualification requirements not previously included under Section 45. Any wind project put into service after December 31, 2021 will no longer be subject to the PTC phaseout; however, any wind project put into service before January 1, 2022 will still be subject to the present PTC phaseout. As a result, wind projects commencing after December 31, 2021 are eligible to receive tax credits at full value, rather than the reduced values under the old law.

Biofuels: Which Industry Group Has the Best Lobbyists?

In August 2019, the Trump administration approved exemptions from the Renewable Fuels Standard (RFS). The exemptions permit 31 small refineries to refrain from purchasing renewable identification numbers (RINs) that would normally be required for blending ethanol into the U.S. fuel supply – which means less outlay for these RINs, and lower volumes of ethanol being blended. These waivers apply to the 2018 RFS requirements and amount to almost 7.5% of the pre-exemption levels (about 1.43 billion gallons of 19.32 billion gallons of ethanol in the RFS mandate for 2018), the highest level of exemption granted in the last five years. The announcement of the exemptions helped to drive the price for so-called D6 RINs (the largest category of renewable fuels) to just $0.11 per gallon, down from a prior $0.20 per gallon. With no exemption granted since 2019, we note that RIN prices have increased substantially, driven by both the return of gasoline demand and rising global demand for agricultural feedstocks.

AVERAGE D6 RIN PRICE
(by year of transfer, in $/gallon)



Data through February 2023.
Source: U.S. Environmental Protection Agency.

Ethanol (in the U.S.) is made mainly from corn. According to the U.S. Department of Agriculture, four states have produced over 1 billion bushels of corn each in 2020: Iowa, Illinois, Nebraska, and Minnesota. For these four states (and others, to a lesser degree), regulation-mandated demand for corn-based ethanol has been a massive tailwind. Those RIN costs fall on the shoulders of the buyers, mostly refiners, and roughly half of all refining capacity in the nation is in the Gulf Coast states of TX, LA, and MS. It seemed that the Gulf Coast refiner lobbyists were eating the lunches of the Corn Belt lobbyists because exemptions under Trump had been far higher than normal. D6 RIN prices rallied following Election Day (November 3, 2020) on the belief that a Biden administration would result in stronger enforcement of biofuel mandates, which we believe will continue.

CHINA

Auction Mechanism and Subsidy Cuts for Renewable Projects

China's rapid growth in renewable energy has made it the largest producer of wind and solar energy. Beijing set an annual cap on solar subsidies, in efforts to limit the capacity of subsidized solar projects and to ease the billions RMB worth of payment backlogs on subsidies. In August 2021, China halted subsidies for new solar power stations, distributed solar projects by commercial users, or onshore wind projects from the central government budget in 2021, given strong capacity growth in China. In November 2021, China's Ministry of Finance set the 2023 renewable power subsidy at $410 million, with $220 million for solar and wind, and the rest for biomass.

INDIA

Solar Safeguard Duty – Detrimental to India's Long-term Solar Target

In July 2018, India imposed a 25% safeguard duty on solar imports from China and Malaysia for two years to prevent the complete erosion of the local solar manufacturing industry, noted by India's Directorate General of Trade Remedies. The full 25% duty took effect from July 30, 2018 to July 29, 2019; it was then lowered to 20% through January 29, 2020, and then again to 15% through July 29, 2020. On July 29, 2020, the Indian government announced a further extension of the duty at 14.9% until January 28, 2021 on solar cells and modules imported from China, when it reduced to 14.5% until July 29, 2021. In March

2021, India further imposed a 40% safeguard duty on solar modules and 25% on solar cells from April 1, 2022, replacing the previous 15% safeguard duty imposed on imports from China and Malaysia.

The duty, however, sparked much criticism from industry players as solar projects would now cost more. India's heavy reliance on China for solar parts goes so deep that made it almost impossible for domestic manufacturers to replace imports within two years given their current technology. The cost of China's solar cells would still be cheaper than India's even after factoring in the 25% safeguard duty, according to pv magazine. Hence, many solar developers have chosen either to stall planned projects to avoid the duty period or to source other, cheaper solar imports from other Southeast Asia countries like Singapore, Vietnam, and Thailand.

Thus, we think India's ambitious target of reaching 500 GW of solar capacity by 2030 is rather challenging. We note that India has missed its 175 GW target in 2022, with only 121 GW installed. We think the number will have to grow significantly more during the remaining years to achieve the 2030 target.

JAPAN

Japan's Promoting Wind Power

Despite Japan's potential for generating wind energy as a nation of islands, wind power generation was rather immaterial, at only 0.87% of total power generated in 2021, according to the Institute for Sustainable Energy Policies (ISEP). However, we think an offshore wind law (passed in November 2018) will drive momentum for offshore wind investments by: 1) extending potential development zones from port areas only to general sea areas; 2) lengthening occupancy allowance of wind farms to 30 years; and 3) implementation of an auction process for better cost-effectiveness and capacity efficiency.

One possible wildcard on this front occurred in late August 2020, when Prime Minister Shinzo Abe resigned. We suspect that because the ruling Liberal Democratic Party is retaining power, prior policies for renewable energy are still likely to remain in place.

The Japan Wind Energy Association estimated that by 2030, 10 GW of offshore wind capacity will be installed, which will cut CO_2 emissions by 70 million tons and generate up to 90,000 new jobs. Considering Japan's offshore wind energy capacity was just 0.14 GW in 2021, according Statista, these goals will certainly be challenging to achieve.

M&A Environment

The renewable energy industry has grown significantly on the back of government incentives and escalating environmental concerns. Many established companies from various verticals (*e.g.,* technology, industrial, oil & gas, and utilities) have been focusing on reducing carbon emissions from their operations. They are now looking toward mergers and acquisitions (M&A) for further investments in renewables.

Solar Players to Consolidate
We see many reasons for increased concentration as the solar industry begins to mature. Primary drivers for industry consolidation include greater balance sheet flexibility, cost advantage via economies of scale, and brand awareness.

Industry leaders also took lessons from the failure of others (*e.g.,* Suntech and Yingli) and are adopting a more asset-light approach to enhance liquidity and to avoid excessive spending in areas such as cell and polysilicon manufacturing, which are much more capital intensive. One of such examples includes U.S. solar panel maker SunPower, which spun off its manufacturing operations in August 2020 to focus on commercial and residential solar and storage installations in the U.S.

While most leading solar producers are in a net debt position, there is still no cause for concern for the time being, in our view. The top producers have all generated a significant scale, which has allowed them to gain a cost advantage relative to peers. Rising demand in China has supported higher production from the manufacturers, as we note non-China-based companies have had an extremely tough time benefiting from a higher volume in this geographic region. We forecast the scale from these companies is now too great for new entrants to overcome. The industry leaders have also developed significant partnerships with key solar developers and suppliers, as their brand position will help support further share gain.

Finally, we note that the ability of some players to take advantage of the various federal tax credits remains driven by a thriving tax equity market.

Tech Companies in the Green
In the U.S., large technology companies are becoming an important consumer for the renewables space. For example, in March 2019, Microsoft, together with leading U.S.-based sustainable energy solutions developer Invenergy, agreed to construct a 74 MW solar project in North Carolina estimated to bring Microsoft's renewable energy portfolio to more than 1.3 GW. In July 2020, Microsoft further signed with another leading national solar energy firm Sol Systems to develop 500 MW of U.S. solar projects. Amazon has also committed significant investments toward clean energy with its announcement of three new renewable projects totaling 229 MW in Ireland, Sweden, and the U.S. in April 2019. As of the end of 2022, Amazon had over 400 renewable energy projects globally, with more than 20 GW of electricity production capacity globally. We note that Apple, at this point, essentially meets all its energy needs utilizing renewables.

Additionally, technology investor SoftBank Group aims to build as much as 220 GW of solar capacity in Saudi Arabia and India by 2030 – equivalent to approximately half of the global solar capacity today. However, we view this as an ambitious target given that the group has only been able to secure the contracts for approximately 3 GW in India and 700 MW in Japan.

Conventional Energy Companies Testing Unconventional Waters
The traditional oil & gas companies are also involved. For example, in the last decade, ExxonMobil invested about $250 million in biofuels research, including research into using algae as a biofuel. Chevron's alternative energy portfolio includes investments in solar, wind, geothermal, biofuels, and renewable diesel. Similarly, in September 2020, BP made a more than $1 billion investment in wind power.

In terms of their collective response to the threat of renewables, the supermajor oils (the biggest fossil fuel producers on the planet) are acknowledging renewables' rising importance. What used to be largely a PR exercise to pretty up the annual report is now – in some cases – a real strategic interest.

Interestingly, NextEra Energy, the world's biggest provider of wind and solar energy, briefly surpassed ExxonMobil in market capitalization in early October 2020. Outside the U.S., Enel, Iberdrola, and Ørsted are now more valuable than comparable oil majors, underlining how mainstream clean energy bets have become for investors. Enel SpA has become Europe's biggest utility and it is rapidly expanding its clean energy portfolio outside the continent. The company also plans to exit coal generation by 2027 and gas generation by 2040.

Renewable energy can come in many forms, and the VC-like approach taken by some of many of these supermajors is a smart strategy, in our view. Rather than investing solely in one area, supermajor oil companies are diversifying their renewable exposure, which we think has two advantages. First, because many types of renewable energy are fairly new, there are question marks around which ones will be the most commercially scalable, which ones have the most opportunity for cost reductions, and which ones will see the fastest adoption by customers. Second, since regulatory policy matters a great deal for renewables, a diversified strategy should make it easier for these firms to expand more quickly in areas that receive favorable regulatory treatment.

As the renewables industry begins to mature, the risk-return profile of alternative energy investments is becoming clearer and more predictable. Also, government incentives are expected to continue (albeit decreasing) in the near term, further encouraging more investments in this space.

HOW THE INDUSTRY OPERATES

Renewable or alternative energy generally refers to the energy that comes from natural sources and processes that are unlimited – such as sunlight and wind. Although these sources are likely to exist forever, they often have a limited amount of energy that is available per unit of time, as described by the U.S. Energy Information Administration (EIA).

Based on EIA data, we categorize renewable energy sources into six major types: hydropower, geothermal, solar, wind, biomass (wood and waste), and biofuels. Among these, biomass is the largest consumed renewable source at 37.8%, followed by wind (29.0%), hydropower (17.5%), and solar (14.1%).

An overview is provided for each of the energy sources and a general description of how each works.

SOLAR

The sun produces solar energy, and it has been used by humans for warmth, to grow crops, and to dry foods. As technology advances, we are now able to collect and store solar energy and convert it into heat energy and electricity for other uses.

Solar Photovoltaic Systems
Solar or photovoltaic (PV) cells convert sunlight directly into electricity and can be used to power different things depending on the size of these cells. Small PV cells can power small electronic devices such as calculators and watches. Larger PV systems such as PV panels (made from multiple PV cells) and PV arrays (an arrangement of multiple PV panels) can produce enough electricity for a house or even an entire neighborhood. There are also PV power plants (solar farms) that can have thousands of panels that can generate enough power for thousands of homes.

Advantages and Disadvantages of Solar Energy
One of the advantages of solar energy systems is that they do not produce any greenhouse gases or other air and water pollutants while generating electricity. If they are responsibly mounted, solar panels have a minimal harmful environmental impact. However, large solar power installations can harm or kill birds that get too near the mirror arrays.

An inherent problem of solar energy is the inconsistency of sunlight that reaches the surface of the earth. Factors such as location, time of day, seasons, and weather conditions could affect the efficiency and effectiveness of solar systems. Also, solar technologies can be costly to deploy since they often require a huge surface area to collect a useful amount of energy.

Concentrated Solar Power
In contrast to PV technology, concentrated solar power (CSP) technology is an indirect method of producing electricity that uses reflective materials to concentrate light onto receivers that are placed at the focal point. These receivers collect and convert solar energy into heat, which is ultimately converted into electricity via a steam turbine. CSP has two main categories currently in operation: parabolic trough and power tower.

- **Parabolic trough.** Uses long arrays of single-axis tracking, curved parabolic mirrors to reflect sunlight onto a receiver tube that consists of fluid used for heat transfer. This heated fluid passes through a heat exchanger to transfer the heat into water, creating pressurized steam, which is then used in a conventional turbine to generate electricity.

- **Power tower.** This system uses tracking mirrors called heliostats to track the sun on two axes, concentrating sunlight onto a receiver at the top of a tower to heat fluid. When water is used as the working fluid, it is heated to create high-temperature steam used in a conventional turbine to generate electricity. It is also possible to use a mixture of molten salts, which, after absorbing heat from concentrated solar energy, produces high-temperature, pressurized steam in a heat exchanger. The molten salts can be used to store heat in a tank until needed to make steam later.

CSP currently accounts for less than 5% of installed PV generation capacity globally due to its higher total costs relative to PV, especially given ongoing industry price declines, according to CFRA analysis. Additionally, CSP requires specific geographic conditions and direct solar radiation to operate, while PV cells can be used, albeit with varying levels of productivity, even in locations with relatively weak direct solar radiation.

Distributed Generation vs. Utility-Scale

The solar industry can be broken down into two types of systems – distributed generation (DG) and utility-scale. A DG system refers to a variety of technologies that generate solar at or near where it will be used, while the utility-scale solar system refers to large-scale solar generation, usually driven by mandates such as renewable energy goals and renewable portfolio standards. DG systems can be offered to residential and commercial customers, while the utility-scale solar system will only be offered to the wholesale utility customer.

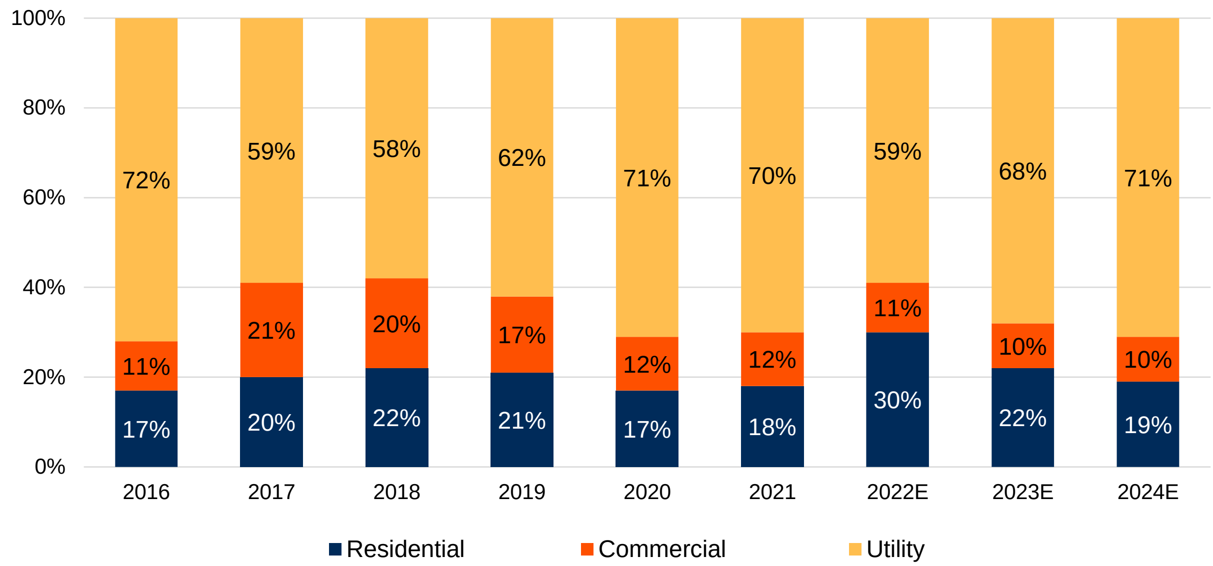
What distinguishes utility-scale solar system from the DG system is the project size, system costs, average price per watt, as well as the payment structure. For a utility-scale solar system, it is designed for large-scale project sizes of at least 1 MW but has the lowest system costs and average price per watt as compared to the DG system.

	Distributed Generation		
	Residential	Commercial	Utility
Market Share	About 20%	10% to 15%	65% to 70%
Average Size	5 kw to 10 kw	10 kw to 100 kw	> 1 megawatt
System Costs	High	Medium	Low
Average Price	$2.50 to $3 per watt	$1.50 to $1.75 per watt	$1 to $1.25 per watt
Payment Structure	Cash/Loan, Leasing or PPA's	Cash/Loan, Leasing or PPA's	PPA's
Source: CFRA			

U.S. Market Segment Trends

The utility PV market has led the overall U.S. solar market in terms of installed capacity since 2015. The utility PV market dropped its capacity by 16% to 20.2 gigawatts-direct current (GW_{dc}) in 2021 compared to 2020 due to the uncertainty surrounding the anticircumvention investigation and numerous solar equipment detentions by Customs and Border Protection (CBP) that constrained industry growth, according to the Solar Energy Industries Association (SEIA). Solar accounted for 50% of all new electricity-generating capacity added in the U.S. in 2022. The residential PV market is the second-largest market in the U.S. after seeing substantial growth in recent years, and is expected to quadruple in size from 2023 to 2033. On the other hand, the community PV installation reached 1 GW_{dc} in 2022, a 16% drop year-over-year, while the commercial PV installation shrank 6% year-over-year.

U.S. PV INSTALLATION MARKET SHARE BY CUSTOMER SEGMENT



Source: CFRA, Wood Mackenzie Power & Renewables.

Solar Financing Options

To reduce the cost of the utility bill, customers will choose a simple and low-maintenance financing option for installing a solar system on their property. Solar projects are usually done either via financing options like solar loans, solar leases, or solar power purchase agreements (PPAs).

- **Solar loans**
  With a solar loan, customers are required to make monthly payments over time, in amounts generally smaller than a typical utility bill, according to the U.S. Solar Energy Technologies Offices. Unlike solar leases or solar PPAs, a solar loan allows customers to own the system outright and benefit directly from the tax credit upon completion of all the payments.

- **Solar leases vs. solar PPAs**
  Similarities: Solar leases and solar PPAs are the financial agreements where a developer installs a solar system on a customer's property at little to no upfront cost. Generally, the contract term usually lasts 20 to 25 years. Under the arrangements, the developer who owns and maintains the solar system is entitled to income from sales of electricity, tax credit benefits, and any other incentives.

  Differences: Solar leases and solar PPAs are very similar in practice; however, there is a key difference between the two. With a solar lease, customers agree to pay a fixed monthly "rent" for the solar system. With solar PPAs, instead of paying to "rent" the solar system, customers agree to purchase the power generated by the system at a set per-kWh fixed price.

Each of the solar financing options allows customers to enjoy immediate utility bill savings every month. Below, we outline the benefits of using cash, solar loans, solar leases, and solar PPAs. To sum up, customers will enjoy more benefits when adopting cash or solar loans as their financing tool.

	Cash / Loans	Leases/ PPAs
$0 Down Option	Yes	Yes
Savings From Day 1	Yes	Yes
System Performance Guarantee	Yes	Yes
Warranty	Yes	Yes
Monitoring	Yes	Yes
No Annual Escalator	Yes	No
Ease of Home Resale	Yes	No
Home Value Appreciation	Yes	No
No Prepayment Fees	Yes	No
Maximum Financial Benefits	Yes	No
Federal / State Tax Credits	Yes	No
Source: CFRA.		

WIND

Wind is a phenomenon that exists due to differences in atmospheric pressure that are caused by uneven heating of the earth's atmosphere. Since air exerts a pressure of about 14 to 15 pounds per square inch at sea level, it contains kinetic energy that can move the blades of a wind turbine. As the blades move, they turn a shaft attached to an electric generator to produce electricity. Total electricity generated from wind in the U.S. has increased considerably from approximately 6 billion kilowatt-hours (kWh) in 2000 to about 435 billion kWh in 2021, according to the EIA. We note that new technologies and government incentives have contributed to the growth of this energy source.

Location of Wind Power Plants

The location and positioning of wind power plants must undergo thorough planning as factors such as wind speed and wind frequency can significantly affect the efficiency of the power plant. Generally, small wind turbines are best operated at places with an annual average wind speed of 9 miles per hour (mph), while large utility-scale turbines are most efficient at wind speeds of 13 mph. Also, it is important to note that wind speeds can change drastically throughout the day and from season to season, which can significantly impact the efficiency of wind generation.

In addition to being built on land, wind turbines can be built offshore. As the wind speeds are higher offshore relative to on land, offshore wind projects are typically able to generate more electricity per installed capacity but can be more expensive to install. China (80%) and the United Kingdom (11%) were the top markets for new offshore wind installations in 2021, according to the Global Wind Energy Council.

Wind Turbines

The two types of wind turbines are the horizontal-axis turbines and vertical-axis turbines.

- **Horizontal-axis turbines** look like the propeller engine of an airplane and have three blades. According to the EIA, the common horizontal-axis turbines are around 20-stories high with blades exceeding 100 feet. Presently, most operational wind turbines are horizontal-axis turbines.

- **Vertical-axis turbines** generally look like eggbeaters with their blades attached to the top and bottom of a vertical rotor. However, there are very few vertical-axis wind turbines currently active due to their inferior performance relative to the horizontal-axis turbines.

We note that wind turbines come in many sizes, but the length of their blades are the biggest determinant in terms of electricity generation capacity. Generally, smaller wind turbines that have a generation capacity of 10 kW can power a single home, whereas the largest operational wind turbines have electricity generating capacity of close to 10,000 kW.

A cluster of many large turbines forms a wind farm or wind power plant, which can generate large amounts of electricity to power up electricity grids. For example, one of the largest wind farms globally – the Horse Hollow Wind Energy Center in Texas – consists of over 400 wind turbines and spans 47,000 acres. Horse Hollow boasts electricity generating capacity over 700 MW, according to the EIA.

Advantages and Disadvantages of Wind Energy

Wind is considered a renewable and clean energy source like solar. Use of wind turbines does not cause any air or water pollution apart from the manufacturing of the turbines. By replacing other traditional nonrenewable energy sources with wind power, harmful emissions can be reduced to healthier levels. Offshore projects have an advantage that wind speed tends to be more uniform than it is over land.

However, although a clean energy source, the turbines that are used to harness wind energy could pose some level of risk to the environment. Although uncommon, there were occasions where some turbines have caught fire and have leaked harmful lubricants. Some environmental and wildlife groups complain about the harm to birds and bats as the blades strike them. In addition, some residents near wind farms have complained about the noise the blades produce as they turn.

Offshore wind projects, in addition, have a special disadvantage of note: logistics costs. A study in 2010 by the National Renewable Energy Laboratory (part of the Department of Energy) estimated that turbine-related costs comprised 70% of onshore wind projects, but just 45% of offshore projects. When something breaks on an offshore wind project, fixing it requires the hiring of vessels (possibly with large new hardware to replace).

Finally, as alluded to earlier, wind speed over land is more variable. If more states replace more conventional fossil fuel plants with wind energy, there is a risk that the supply of wind power could be insufficient, and like most things that experience a shortage, prices rise. On August 14, 2019, a Reuters article noted that spot prices for electricity in Texas briefly soared to the cap of $9,000 per MWh, and next-day spot prices averaged $315/MWh, versus $114.25/MWh one day earlier. Although the Reuters article did not specifically attribute the price rise to a shortage of wind (certainly hot weather helped on the demand side of the ledger), another article from 2018 by S&P Global noted that Texas electricity prices briefly spiked to $5,800/MWh in January 2018 as wind output dropped 15%.

HYDROPOWER

Hydropower or hydroelectric power is one of the earliest sources of mechanical and electrical energy and was used to power grain and lumber mills before steam became available in the U.S. It has also been the largest renewable source of energy for electricity generation in the U.S., accounting for approximately 6.2% of total U.S. utility-scale electricity generation in 2022.

Hydroelectric Power

The energy from moving water is converted into hydropower through hydroelectric power plants. Water descending from high points carries significant energy that can be used to push or turn the blades of a turbine to generate electricity. According to the U.S. Department of Energy, there are three main types of hydropower plants: impoundment, diversion, and pumped storage.

- **Impoundments** are the most common type of hydroelectric power plant, using dams to raise the water level, creating a reservoir. Once at the required water level, the water flows through a pipe or penstock to spin the turbine of a generator and typically operates 24 hours a day, seven days a week.
- **Diversion,** also called run-of-the-river system, channels a portion of the river water to flow through penstocks to spin the turbine of a generator. These systems also typically run constantly.
- **Pumped Storage** works like a battery that stores electricity for later use. A pumped storage system involves two reservoirs with different elevations. The lower reservoir will pump water uphill into a higher reservoir to store energy during periods of low electricity demand. When more electricity is needed, water in the higher reservoir is then released through penstocks to generate electricity.

Tidal Power

Tides are formed by the gravitational forces of the moon and sun acting against the earth's rotation. These tides produce tidal energy that can be harnessed to generate electricity. Generally, tidal energy systems can be differentiated into tidal barrages, tidal turbines, and tidal fences.

- **Tidal barrages** are like dams and are used to capture water flowing in and out of an ocean bay.
    - Ebb generation barrages use sluice gates to allow a tidal basin to fill on incoming high tides. The water is stored, and once the tide recedes, channels are opened to allow the water to flow through turbines to generate electricity.
    - Two-way generation barrages generate power during both flood and ebb tides to constantly turn the turbines. This barrage system produces less energy than ebb generation, but the electricity is produced over longer periods of time.
- **Tidal turbines** look and operate like wind turbines but are placed on the seabed with strong tidal flow. Tidal turbines generally cost more to manufacture than wind turbines, but they can generate more electricity with blades of the same size.
- **Tidal fences** are also mounted on the seabed like tidal turbines. However, tidal fences consist of vertical axis turbines that are arranged in a fence-like structure to capture the energy from the water passing through the turbines.

Wave Energy

The waves formed through wind movements across the ocean surfaces are a huge source of energy. According to the EIA, the theoretical annual energy potential of waves off the coasts of the U.S. are estimated to reach as much as 2.64 trillion kWh or 64% of total U.S. electricity generation in 2021. Wave energy can be harnessed by focusing waves into a narrower channel to increase their size and power to spin the turbines or by channeling them into a reservoir where water flows into a turbine at a lower elevation.

Ocean Thermal Energy Conversion (OTEC)

OTEC systems leverage the temperature difference between waters at the ocean surface and deep ocean to power a turbine. The warmer surface water is pumped into an evaporator to vaporize a working fluid with low boiling points, such as ammonia, that will spin the turbine and generate electricity. The vaporized fluid will then be cooled in a condenser with the cold deep ocean water.

Advantages and Drawbacks of Hydropower

Although hydropower generators do not directly cause air pollution, the construction of these hydropower generators such as dams or reservoirs can disrupt river and coastal ecosystems and surrounding communities. For example, a dam will impact and alter the ecology and physical characteristics of a river and can have an adverse effect on native plants and animals surrounding the area. Sometimes a dam will also require the relocation of nearby neighborhoods and can cause distress for the impacted residents.

Besides that, the greenhouse gases emitted by reservoirs (*e.g.,* CO_2 and methane) can contribute to concerns about man-made global warming. The EIA estimates that the greenhouse effect from reservoirs may be equal to or greater than the greenhouse effect of the CO_2 emissions from an equivalent amount of electricity generation with fossil fuels. Hydro-Québec estimates that greenhouse gas emissions from reservoirs in its system rise temporarily after impoundment of the water, but after 12-14 years, emissions are similar to levels given off by neighboring lakes and rivers.

For tidal power, tidal stations can affect the environment near the inlets of the tidal basin. Tidal barrages will alter the tidal level and increase the number of suspended solids in the water (turbidity).

BIOMASS

Biomass is a source of renewable energy obtainable from plants and animals and can be used to create energy by direct burning (*e.g.,* solid biomass) or by converting them into biofuels. For this section, we will be focusing on solid biomasses, consisting mainly of wood and waste. Biofuels such as ethanol and biodiesel will be discussed in the following section, under Biofuels.

Wood

EIA data shows that wood (*e.g.,* bark, sawdust, wood chips, wood scrap, and paper mill residues) represented roughly 2% of total U.S. annual energy consumption in 2021. Industrial users, especially wood products and paper manufacturers, account for the majority of wood energy demand. This is followed by the residential sector as wood is commonly burned in homes for heating purposes.

Apart from heating, there are some power plants that generate electricity mostly from the burning of wood. There are also several coal powered plants that burn wood along with coal in an effort to reduce the emissions of harmful substances.

Waste

Like wood, municipal solid waste (MSW) or garbage can also be collected and burned to produce heat energy to create steam for electricity. Generally, MSW covers biomass/biogenic materials (*e.g.,* paper, food waste, and leather products), non-biomass combustible materials (*e.g.,* plastic), and noncombustible materials (*e.g.,* glass).

Waste-to-energy plants are power generation plants that burn MSW to generate electricity and/or heat energy. There are also many large landfills that capture methane gas (produced from decomposing biomass) and use it as a fuel to generate electricity.

In addition to generating electricity, burning MSW could significantly decrease the amount of waste buried in landfills and will contribute to a cleaner environment.

Implications of Biomass

The burning of wood, waste, or traditional fossil fuels releases CO_2 and other gases, which contributes to global warming. Additionally, increased particulate matter and sulfur and mercury emissions are harmful to the environment. However, as plants are the underlying source of wood and some wastes, their absorption of CO_2 during photosynthesis almost offsets the amount emitted when burned. Hence, using renewable biomass as a source of energy can reduce and replace the burning of fossil fuels, thus lowering the overall amount of CO_2 released into the atmosphere.

Nevertheless, employing wood and waste as alternative sources of energy has negative implications as well. The harvesting of wood can lead to the thinning of forest or even deforestation, which will affect the habitat of some animals. Also, the smoke and ashes released from the burning of wood or MSW contain toxic substances like carbon monoxide and chemicals that can be harmful to the environment and poisonous to people. For that reason, the EPA placed strict environmental rules on power plants involved in the burning of waste to control the release of dangerous pollutants.

BIOFUELS

Biofuels are recognized as a carbon-neutral renewable energy source as the plants that are used as feedstock (raw material to make a product) absorb CO_2 when they undergo photosynthesis and will offset the CO_2 emissions when biofuels are produced and burned. For that reason, biofuels are encouraged to be used as transportation fuels to help reduce the harmful greenhouse gas emissions to the environment.

In 2007, the U.S. government signed a Renewable Fuel Standard (RFS) that calls for the production of 36 billion gallons of biofuels by 2022. Every year, the EPA would set the target of biofuel volumes that oil companies must blend with their petroleum-based products. The EPA finalized a blending mandate of 20.82 billion gallons for 2022, an increase from 20.63 billion gallons of 2021's target.

Closed-loop biomass plants, *i.e.,* plants burning organic material from vegetation planted exclusively for use in power generation, received a federal production tax credit of $2.6 cents per kWh of generation in 2022.

According to the EIA, biomass fuels accounted for approximately 39% of total renewable energy consumption in the U.S. in 2022. Of that 39%, 50% were biofuels, 42% were wood and wood-derived biomass, and 8% were biomass in municipal wastes. Within biofuels, ethanol represents the majority of biofuel consumption, followed by biodiesel and other renewable fuels.

Ethanol

Ethanol is an alcohol that can be made from different types of feedstocks through fermentation or breaking down the cellulose in plant fibers. Fuel ethanol feedstocks are usually grain and crops with high starch and sugar content like corn, barley, and sugar cane. Another form of ethanol is known as cellulosic ethanol and can be produced by breaking down cellulose in plant fibers of trees, grasses, and agricultural residues.

Ethanol is commonly used as a fuel in mixtures of other petroleum-based gasolines. Generally, most ethanol content in motor gasoline does not exceed 10% of its total volume. E10, E15, and E85 are terms used to refer to gasoline with ethanol content of 10%, 15%, and 51% to 83%, respectively. Currently, all gasoline vehicles can use E10, while only light vehicles with model year newer than 2001 can use E15. E85 gasoline is defined as an alternative fuel and can only be used by flexible-fuel vehicles.

Biodiesel

Biodiesel is a renewable fuel produced from vegetable oils and animal fats and can often be used in the same equipment as petroleum-based diesel fuel. Like ethanol, biodiesel is normally blended with petroleum diesel in 2% (B2), 5% (B5), and 20% (B20) ratios, but can also be used as pure biodiesel (B100). The excellent lubrication properties of biodiesel can enhance engine performance and have led to the popularity of low-level blends like B2 and B5 in the trucking industry.

Advantages and Disadvantages of Biofuels

Pure ethanol and biodiesel are both nontoxic and biodegradable and are good substitutes to reduce environmental pollution. These biofuels are considered to be carbon neutral as their absorption of CO_2 during photosynthesis offsets the CO_2 that forms during the production and burning of these biofuels for energy.

However, the use of plants for fuel has sparked many debates as numerous people think plants should be used for food instead of burning them for fuel. Also, many large areas of vegetation and forest have been cleared to make space for growing plants used to make biofuels. This can have severe adverse implications to nature and animals inhabiting these lands, and its negative effects could even be greater than the potential environment benefits of using renewable biofuel. Newer alternative methods encourage the use of inedible materials like sawdust and wastepaper that can reduce the usage of food crops for biofuel production.

GEOTHERMAL

Geothermal energy is a source of renewable energy that comes from the heat produced within the earth and is commonly used for direct heat energy and to power heating systems, geothermal heat pumps, and electricity generation. This energy source can be found at geothermal reservoirs, volumes of hot rock located deep underground. The geothermal reservoirs can be accessed by drilling production and injection wells and injecting water into the reservoir.

The “Ring of Fire” that encircles the Pacific Ocean is one of the most active geothermal resource areas in the world. Due to this, most of the geothermal power plants in the U.S. are in the western states, with 94% of U.S. geothermal generating capacity in California and Nevada. The U.S. had 2.6 MW of operating geothermal capacity as of 2022, about half of which came online in the 1980s, according to the EIA.

Geothermal differs from other renewable technologies because it is not dependent on seasonal factors (precipitation, wind, or sun exposure), and it provides a constant source of energy. Geothermal power plants tend to have high and flat capacity factors year-round. However, the technology also has relatively high capital costs and carries investment risk because of long payback periods. Geothermal installations have slowed because of geographical limitations, declining wholesale electricity prices, and declining costs for other renewable technologies.

Geothermal Electricity Generation

Geothermal energy is used to generate electricity via geothermal power plants that are built on top of geothermal reservoirs. The three basic types of geothermal power plants are dry steam, flash steam, and binary cycle power plants.

- **Dry steam plants** most often use steam created from water in a geothermal reservoir to rotate generator turbines. The water is condensed after turning the turbine and reinjected into the geothermal reservoir for reuse. On occasion, steam that naturally vents to the surface is used to turn a turbine.

- **Flash steam plants** convert hot water within the earth to steam to rotate generator turbines. The condensed steam is recycled back into the earth to be reheated and used again. Most geothermal plants are flash steam plants.

- **Binary cycle power plants**. The hot water from geothermal sources is used to heat another liquid, which turns it into steam to power generator turbines. The water used to heat the liquid is most often reinjected into the ground.

Currently, the U.S. generates more electricity from geothermal sources than any other country in the world. According to the EIA, there were seven U.S. states with geothermal plants in 2022, which cumulatively generated approximately 17 billion kWh or 0.4% of total U.S. utility-scale electricity generation. (Of course, the U.S. dominance comes in part due to its size. Iceland, a far smaller country with a total population of only about 340,000, gets 100% of its energy from renewable sources; the majority of it comes from hydropower with about 10% from geothermal sources.)

Geothermal Heat Pumps

Geothermal heat pumps use the consistent temperature of the earth (generally 10 feet below ground) to heat and cool buildings during winter and summer. As the temperature within the earth's surface is usually warmer than the air in winter and cooler in summer, these pumps can be used to transfer heat from the earth into buildings during winter and vice versa during summer. The EPA indicated that geothermal heat pumps are presently the best system (in terms of energy efficiency, environmental impact, and cost-effectiveness) for heating and cooling all types of buildings.

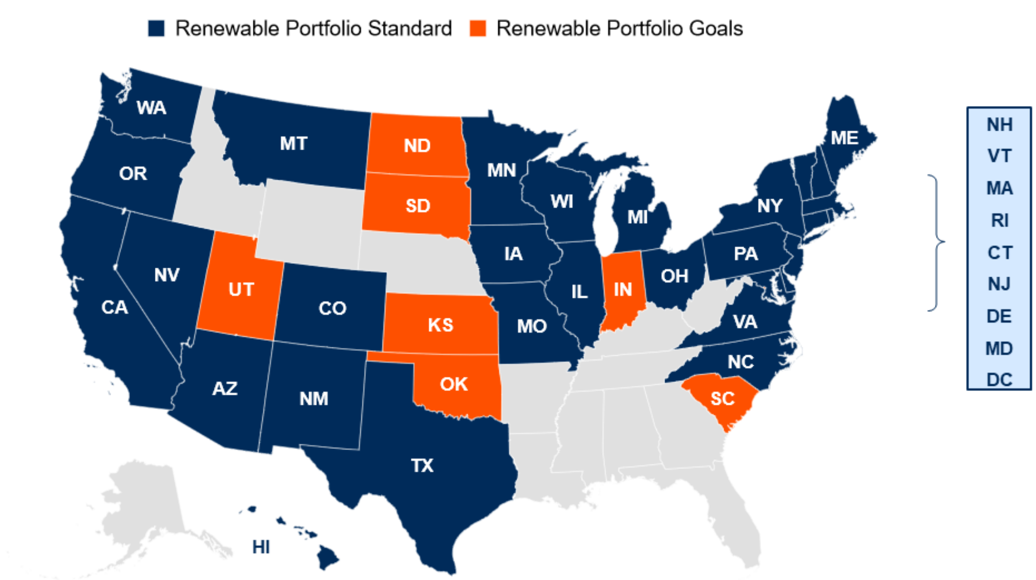
Benefits of Geothermal Energy

The use of geothermal energy as an energy source has significant benefits for the environment. Heating applications and geothermal heat pumps have very low or close to zero negative effects on the environment while being able to reduce the usage of other harmful energy sources. Further, the emission of geothermal power plants contains low levels of air pollutants compared to other fuel burning power plants (97% less acid rain-causing sulfur compounds and 99% less CO_2 than fossil fuel plants, according to the EIA).

RENEWABLE ENERGY TARGETS ACROSS THE GLOBE

United States

According to the National Conference of State Legislatures (NCSL), 30 states, Washington, D.C., and three territories have renewable portfolio standards, while seven states and one territory have renewable energy standards. Fourteen states have standards that require more than 50% of electricity to come from renewable sources.



Source: National Conference of State Legislatures

RENEWABLE PORTFOLIO STANDARDS AND GOALS BY STATE

STATE	REQUIREMENT	TARGET YEAR		STATE	REQUIREMENT	TARGET YEAR		STATE	REQUIREMENT	TARGET YEAR	
AZ	15%	2025		ME	40%	2017		OR	80%	2030	
CA	44%	2024		MD	50%	2030			90%	2035	
	52%	2027		MA	7%	2020			100%	2040	
	60%	2030		MI	15%	2021	*	PA	18%	2021	*
	100%	2045		MN	27%	2025	*	RI	15%	2019	*
CO	30%	2020		MO	15%	2021	*		39%	2035	
CT	44%	2030		MT	15%	2015		SC	2%	2021	
DE	28%	2030		NV	25%	2025		SD	10%	2015	
	40%	2035		NH	25%	2025		TX	10,000 MW	2025	
HI	30%	2020		NJ	50%	2030		UT	20%	2025	*
	40%	2030		NM	40%	2025		VT	75%	2032	*
	70%	2040		NY	70%	2030		VA	100%	2045	*
	100%	2045		NC	13%	2021		WA	15%	2020	*
IL	25%	2026	*	ND	10%	2015	*		100%	2045	
IN	0.1	2025		OH	13%	2026		WI	10%	2015	
IA	105 MW		*	OK	15%	2015	*	DC	20%	2020	
KS	20%	2020							100%	2032	

*Denotes states that have renewable portfolio goals and not renewable portfolio standards.

Source: CFRA, National Conference of State Legislators

As time passes, the costs for new renewable sources (construction, installations, permits, etc.) decline. Meanwhile, many lawmakers back renewable energy in the face of increasing concerns of a climate emergency on the planet due to the burning of fossil fuels and other human activities.

China

In May 2019, China's National Energy Administration (NEA) issued a final policy paper on the country's renewable portfolio standard (effective 2020 for five years). It assigned renewable consumption targets at a provincial level and distributed mandates for such achievement among responsible parties, namely load-serving entities. The renewable portfolio standard aims to increase the country's share of non-fossil fuels to 15% of primary energy consumption by 2020 and 20% by 2030. In 2021, NEA further increased the share of non-fossil fuels in primary energy consumption to around 40% by 2030 from the 25% earlier. According to Sino-German Energy Partnership, clean energy represented 14.3% of primary energy consumption in 2021 (latest available).

Europe

Under a renewable energy directive termed the European Green Deal, signed in 2018, the EU set a target of 32% of all energy from renewable resources by 2030, with a clause for a possible upward revision by 2023. It required the EU to achieve at least 20% of all energy needs with renewables by 2020. The European Economic Area proves that the EU achieved a total share of energy consumed from renewable sources of 22.1% in 2020 from 19.9% in 2019, reaching its 2020 headline target (20%).

In terms of the solar industry, the EU saw a record-breaking 41.4GW of PV capacity installed in 2022, up 47% year-over-year. On top of that, Europe is stepping on the gas to reduce emissions with its installment of "fit for 55" legislative package introduced back in December 2021, a plan that aims to reduce emissions by 55% by 2030.

India

According to the Ministry of New and Renewable Energy (MNRE), renewable energy in India accounted for 42.26% of total installed generation capacity as of October 2022. India has the fourth global position in both the wind and solar power deployment, the government said.

In 2015, the government of India set renewable energy targets of 175 GW of installed capacity by 2022. India has also set a target of 450 GW renewable energy capacity by 2030. As of the end of October 2022, India's installed capacity for renewable energy stood at 172.7 GW.

At the United Nations Framework Convention on Climate Change (UNFCCC) Climate Conference in Spain in December 2019, the MNRE announced plans to set up a $100 million Green Window for financing renewable energy projects, which will be hosted by the Indian Renewable Energy Development Agency (IREDA). Prime Minister Modi also announced India's commitment beyond the 2022 target and install 450 GW of installed capacity. Hence, we think the IREDA green window would provide a significant boost to the renewable energy market and could achieve the new target easily.

Japan

After the Fukushima Daiichi nuclear disaster on March 11, 2011, Japan's 30% reliance on nuclear energy was immediately cut off. The disaster drove the country to depend more on imported fossil fuels to meet energy demands. Japan currently has a renewable energy goal to reach 22% to 24% of total power generation by 2030, a rather conservative ambition given that renewable sources accounted for 22.4% of total energy generated in 2021, according to data from the Institute of Sustainable Energy Policies (ISEP).

On August 26, 2011, The Act on Special Measures Law Concerning the Procurement by Electric Power Companies of Renewable Energy Electricity (amended to "Renewable Energy Law") was enacted, and it introduced the feed-in-tariff (FIT) program to spur the development of Japanese renewable energy projects. Under the FIT program, electricity from renewable energy sources is guaranteed a sale at a fixed price (tariff rate) to electric power companies. During the early phases of the FIT program, the tariff rates were set at attractive levels, leading to the rapid development of the renewables industry in the country. For example, tariff rates for non-residential solar-based electricity were 40 yen/kWh but have gradually decreased to 13 yen/kWh for systems between 10kW and 50kW and 12 yen/kWh for systems between 50kW and 250kW starting from April 2020.

On May 25, 2016, Japan's government passed an amendment to the Renewable Energy Law. The amendment made several modifications to the FIT program, including a three-year deadline from facility certification to power generation and the requirement to participate in a bidding system to promote competition.

HOW TO ANALYZE A COMPANY IN THIS INDUSTRY

This survey is different compared to other CFRA industry surveys as it does not strictly adhere to the Global Industry Classification Standard (GICS), as there are many different types of companies from other industries that are also involved in alternative energy. In general, CFRA identifies two major type groups: a) the pure-play renewable energy players and b) companies that have significant investments in renewable energy but for which it is not a core business operation. Many of the large renewable players are i) power providers to the electric utilities industry or ii) solar manufacturers that have operations and structure similar to semiconductor companies (and are classified, from a GICS perspective, as chip companies).

CFRA recommends that investors look at profit growth prospects and valuations of individual companies versus peers. Investors should be aware of valuations of other sectors and the broader market.

Industry Drivers

◆ **Key demographic and housing statistics.** Demographic trends can influence the customer base of a company in the alternative energy industry. New household formations and the rate of new housing construction are sources for residential customer growth, which is a driver for energy demand. The U.S. Census Bureau reports household formations, while the U.S. Department of Commerce reports housing starts monthly.

◆ **Gross domestic product (GDP) and GDP growth.** GDP is a broad measure of aggregate economic activity. It is the market value of goods and services produced by labor and capital in any specific country or region. Growth in the economy is measured by changes in inflation-adjusted (or real) GDP. U.S. GDP and GDP growth are reported quarterly by the U.S. Department of Commerce. Reports of actual GDP stats and forecasts of future GDP growth for countries and regions around the world are widely reported.

Changes in demand for energy closely mirror the rate of economic growth. However, weather patterns can cause swings in energy consumption.

Qualitative Factors

An examination of a company's historical results gives a strong indication of management's past success in running an enterprise in various stages of the business and product cycles and is a good initial guide to the future. Given the uncertain nature of renewables, operating results for a company in this industry should be considered within the context of the overall market situation.

For example, operating performance during an industry downturn is an indicator of management's ability to weather storms. How a company performs relative to its competitors is key. Often, industry leaders will use a decline in business conditions to streamline operations and focus on new product offerings. Such activities position a company to outperform its peers during the next upcycle.

Other important factors that affect a company's business position include competitive positioning, business strategy, and the regulatory environment.

Financial Statement Analysis

Ultimately, the qualitative factors discussed earlier will reveal themselves in a company's financial statements. Those firms with experienced management and strong competitive positions in attractive market segments typically will display strong financial profiles.

Looking at the Income Statement

A company's income statement provides a comprehensive review of its revenues, costs and expenses, and earnings during an accounting period. As such, it is an important tool for identifying growth and profitability trends.

◆ **Revenue growth.** Did growth come from a hike in prices? From increased demand? From a new product? From expansion into a new territory? The solar manufacturing business is unusual in that, under normal market conditions, prices fall at a steady rate. Consequently, these companies often report strong growth in unit sales volume, but from time to time may show flat or declining revenue trends. This dynamic increases the difficulty of forecasting future sales.

◆ **Operating expenses.** An improving trend in operating costs usually indicates that a company is focusing on streamlining its operations and controlling costs.

◆ **Margins.** Profit margins for companies in the alternative energy industry vary widely, depending on market segment characteristics and prevailing industry conditions. Other factors that influence margins include capacity utilization, raw material pricing, operational efficiencies, and product mix.

For solar manufacturers, the cost of goods sold generally includes a high level of fixed charges, largely reflecting the significant depreciation charges associated with companies' manufacturing plants ("fabs"). Therefore, profit margins generally move in the same direction as sales, but the magnitude of the change in profits is greater than that of sales. Since variable costs are a small part of the equation, each incremental dollar of sales produces more profit on the bottom line, as fixed costs are spread over a larger sales base. This high degree of operating leverage can result in large swings in earnings as chipmakers move through business cycles. However, the increasing use of chip foundries helps integrated chip manufacturers shift some of the fixed costs of plant ownership from their books, thereby smoothing gross margins and reducing the severity of cyclical swings in earnings.

Looking at the Balance Sheet

The balance sheet, or statement of financial condition, shows the status of a company's assets, liabilities, and shareholders' equity on a given date. With these data, an analyst can determine much about a company's financial health, including its liquidity, asset turnover, and capital structure.

◆ **Liquidity.** Liquidity is an important indicator of a firm's ability to fund its day-to-day operational needs. The simplest measure of liquidity is working capital, or the excess of current assets over current liabilities. Working capital represents a liquid reserve that companies can draw upon to finance the cash cycle of the business. Two other liquidity measures are the current ratio (current assets divided by current liabilities) and the quick ratio (current assets less inventory, divided by current liabilities). These financial ratios show a company's ability to pay its current obligations out of current assets.

Future liquidity may be inferred from the turnover ratios for inventory and accounts receivable. Inventory turnover, calculated by dividing inventory into cost of goods sold, shows how many times a firm's inventory is sold and replaced during an accounting period. Low turnover relative to comparable firms in the manufacturing industry is an unhealthy sign, as it indicates a firm may be carrying excess inventory, which would make it vulnerable to falling prices. Furthermore, excess inventory represents an inefficient use of capital since the investment carries a very low rate of return.

The numbers do not always tell the whole story, however. Chip companies sometimes build inventory in anticipation of rising sales. While this practice may initially result in lower inventory turnover, the bullish sales forecast actually would be a positive indicator for the firm.

◆ **Accounts receivable turnover.** The accounts receivable turnover ratio is obtained by dividing total credit sales by accounts receivable during an accounting period. The ratio, which measures the number of times that the receivables portfolio has been collected during the period, is used to determine bad debt risk. A rising ratio could indicate that a company's customers are facing cash flow problems and cannot pay their account balances. Many renewable companies have significant sales exposure to Asian countries; given the region's history of credit crunches, analysts should keep a close watch on receivables turnover to gauge credit risk.

Watch Out! *Companies can remove accounts receivable from the balance sheet and boost cash flow from operations through securitization activities. To the extent the off-balance sheet receivables remain outstanding at the reporting date, these activities have the potential to distort trends in accounts receivable, cash flow and cash flow growth.*

◆ **Days sales outstanding (DSO).** The wind power industry, especially for larger offshore projects, has a multi-year sales cycle. An increase in unbilled DSOs, per CFRA's Forensic Research team, can be an indication of project execution issues, or potentially a given company being aggressive in the choice of timing of revenue recognition (including, perhaps, revenues of lower quality).

◆ **Days of outstanding inventory (DOI).** Specific to solar manufacturing, the industry constantly faces periods of oversupply and undersupply. Since these periods tend to impact sales and margins, we think it is important to keep a close eye on inventory. Commonly used in the cash conversion cycle, DOI can also gauge inventory health, especially when compared with historical and seasonal averages. It is useful to run the analysis not only for the company under consideration, but also for the companies throughout the supply chain so that investors can watch for inventory build-ups. DOI is calculated by dividing 365 (or the number of days in the period) by the inventory turnover ratio (cost of sales divided by average inventory).

Watch Out! *A substantial increase in inventory may be a leading indicator of an upcoming decline in margins. Specifically, when a company's inventory rises faster than cost of goods sold, CFRA cautions that the inventory growth may be due to the company's inability to sell the inventory (which raises the risk of future obsolescence charges) or that the company may be leaving costs on its balance sheet in the form of inventory rather than expensing these costs on its income statement, raising concerns about the sustainability of earnings and margin growth.*

◆ **Capitalization ratios.** When analyzing a company's balance sheet, pay close attention to the capitalization ratio, which measures long-term debt as a percentage of capital. The main factors influencing the level of debt are the level of capital expenditures, particularly construction expenditures and the cost of debt compared with the value of the company's common stock. (A company will generally not issue new shares if its stock price is relatively low.) Companies with strong balance sheets will have more flexibility to further reduce their debt, invest in their non-regulated businesses, and/or increase their dividends.

Watch Out! *Investors may be misled by the items on the face of a company's financial statements if the company is involved in significant off-balance sheet entities and/or activities. In this way, an investor may not be able to ascertain the true risks and obligations, including cash outflows, associated with all of a company's activities.*

◆ **Debt and debt ratings.** The alternative energy industry is capital intensive, requiring investment in plants and production equipment that can cost billions of dollars. To fund this investment, many companies carry a moderate amount of debt on their balance sheets. Debt can be an important and beneficial tool for firms seeking to fund growth through new product development or expansion into new markets. However, firms with a high level of indebtedness must allocate a large portion of cash flow to debt service. The times-interest-earned ratio (income before interest expense and taxes, divided by interest expense) measures a company's ability to pay its interest charges; this ratio should be closely examined for firms with high debt-to-capital ratios.

A debt rating measures a company's financial position and its ability to repay debt. Investors should look for any trends in these credit ratings over time. Have they changed for the better or the worse?

Although a strong (high) debt rating is usually desirable, it is not always the best news for shareholders. For example, a company that focuses on using earnings (cash) to pay off debt may do so at the expense of common stock dividend payments. As a rule, however, low debt ratings are not desirable. Companies with low ratings often find it hard to raise capital; they also incur high interest payments to finance capital improvements.

Cash Flow

The statement of cash flows reports a firm's sources and uses of cash by category: operations, investments, and financing activities. This is valuable information regarding a company's transactions. The statement illustrates, among other things, how a company generated or used cash from its business, funded capital expenditures, or paid debt.

U.S. accounting standards allow some degree of latitude in how companies can present certain aspects of their financial condition. For example, the rate at which a company depreciates its assets and the method it uses to account for its inventory can have a significant impact on net income. Consequently, analysts often look to the statement of cash flows for a more accurate assessment of financial health. Quite simply, it is cash, not net income, that must be used to repay loans, fund capital spending, and pay dividends.

Free cash flow is defined as cash flow from operations less capital expenditures and changes in working capital. This figure, sometimes referred to as "owners' earnings," represents the cash flow that accrues to the firm after all obligations have been met.

Performance and Valuation Metrics to Consider

Drawing from both the income statement and the balance sheet, two important measures of a company's overall financial performance are return on assets (ROA) and return on equity (ROE). These measures, along with growth projections, provide key indicators for a valuation analysis.

In evaluating the relative attractiveness of a company's current stock price, performance metrics and growth rates should be considered alongside price-related valuation ratios such as price-to-earnings (P/E), price-to-sales (P/S), and price-to-cash flow. The analyst should compare valuation ratios with the company's own historical ratios and with those of peer companies and the overall stock market.

◆ **ROA and ROE.** The two most popular measures of return on investment (ROI) are ROA and ROE. ROA (net income divided by average total assets) measures the operating efficiency of a firm or the return earned on assets under management's discretion. ROE (net income divided by average total shareholders' equity) measures the return earned on shareholders' capital. Both ratios measure management's ability to earn a reasonable profit on the assets and capital entrusted to them.

Watch Out! *Significant and/or recurring use of special charges is a red flag that a company may be using special charges to flatter non-GAAP results. Specifically, we caution that companies may boost non-GAAP earnings in the current period by bundling normal, recurring costs into the special charges.*

◆ **P/E and dividend yield.** To arrive at the P/E ratio of a stock, simply take the stock price and divide by the current year's projected earnings. For a forward projection, one can use the forecasted earnings for the next year. Dividend yield can be calculated by taking the total of the last twelve months (LTM) dividend divided by the company's market cap or the LTM dividend per share divided by the current share price.

To evaluate the current market price of a company's shares, look at the P/E ratio and the dividend yield. Is the P/E ratio greater or less than the expected sustainable growth rate of the company's earnings? How does the P/E compare with the industry average? Investors tend to pay a higher P/E and to accept a lower dividend yield from the shares of a company with earnings that are expected to rise rapidly.

◆ **Price-to-sales.** Dividing the current share price of the company by its projected revenues for the current year on a per-share basis is how the price-to-sales (P/S) ratio is derived. This ratio is used in times when earnings are not available (the company is operating at a loss), or when earnings forecasts are in question.

◆ **Price-to-cash flow.** This ratio is calculated by taking the price of a company's stock and dividing by the sum of the current year's forecasted cash flow. The most used proxy for a company's cash flow is referred to as earnings before interest, taxes, and depreciation and amortization (EBITDA). The real-world use of this ratio is generally derived using the forecast of EBITDA for the next year. This ratio is typically used if a company's earnings are penalized by high capital intensity.

GLOSSARY

Baseload—The minimum constant level of electric power delivered or required in a given time period.

Baseload unit—An electricity-generating plant, or a generating unit within a plant, that normally is operated continuously to meet the system's minimum constant level of electric demand.

Biodegradable—An object capable of being decomposed by microorganisms such as bacteria.

British thermal unit (Btu)—A measurement of heat and is equivalent to the amount of heat required to raise the temperature of one pound of liquid water by 1-degree Fahrenheit.

Carbon emissions—The release of carbon into the atmosphere that is harmful to the environment and a contributor to global warming.

Cost of capital—The sum of the weighted cost of capital for each funding source: long-term debt, preferred stock equity, and common stock equity.

Degree-day—A unit of measure expressing the extent to which temperatures vary from a specific reference temperature (usually 65 degrees Fahrenheit) during a given time period; each degree above or below the benchmark equals one degree-day. Thus, a given period (month, quarter, or year) during which the mean temperature is 55 degrees would be considered as 10 heating-degree-days. This usually would be compared with the prior period and the historical average.

Distributed energy generation (DG) system—A method of generating electricity from sources close to the electricity demand such as residential solar PV systems and small wind turbines.

Electric grid—A transmission system for electricity that delivers electricity from producers to consumers.

Electric transmission—The transportation of bulk quantities of electric energy, via electric conductors, from generation sources to an electric distribution system, a load center, or an interface with a neighboring control area.

Feed-in-tariff—A policy used to encourage investments in renewable energy by offering contracts at favorable prices to renewable energy producers.

Feedstock—A term to describe raw materials that are used for fuel or to convert into other forms of energy.

Generation capacity—The maximum electricity that a generator can produce while running at peak levels.

Generator—A machine that converts mechanical energy into electrical energy; also, a company that uses such machines to generate electrical energy.

Gigawatt—A unit of power or capacity equal to one billion watts.

Greenhouse gas—Gas that absorbs infrared radiation that causes the greenhouse effect. For example, carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons are commonly known greenhouse gases.

Investment tax credit (ITC)—A tax-related incentive that allows individuals or entities to deduct a certain percentage of specific investment related costs from their tax liability apart from usual allowances for depreciation.

Kilowatt—A unit of power or capacity equal to one thousand watts.

Levelized cost of electricity (LCOE)—A measurement used to compare the cost of energy for different energy sources. It is calculated by having the average total lifetime cost of a power-generating system divided by the total lifetime energy output. The LCOE is a benchmark to determine the price needed per unit of electricity for the system to breakeven.

Load—The amount of power carried by a utility system or subsystem, or the amount of power consumed by an electric device at a specified time; also referred to as demand.

Load factor—The ratio of the actual electric energy consumed during a given time period to the consumption that would have occurred at the peak demand level.

Megawatt—A unit of power or capacity equal to one million watts.

Net energy metering—A mechanism that offers credit to consumers that are able generate their own electricity (*e.g.,* residential solar systems) when excess energy is exported back to the grid.

Peak demand—The maximum amount of electricity required during periods of highest usage.

Peak load—The maximum amount of energy carried by a utility system during a specific period. Peak load determines the required system capacity.

Penstock—A gate or pipe that controls the flow of water in hydro turbines or sewerage systems.

Photovoltaic (PV)—A method of converting light energy (photo) from the sun into electricity (voltaic) by using the flow of electrons. A photovoltaic system uses solar modules to generate solar energy, which can be used to power equipment.

Power purchase agreement (PPA)—A legal contract between an electricity producer and buyer where the buyer (generally a utility company) agrees to purchase electricity from the producer.

Pure-play—A company that focuses on a particular industry or product. In this survey, pure-play renewables are companies that operate only in the renewable energy industry.

Rate base—The value of property upon which a utility is allowed to earn a specified rate of return as established by a regulatory authority.

Rate of return (ROR)—The return earned by or allowed a utility enterprise, calculated as a percentage of the utility's rate base.

Renewable identification number (RIN)—A serial number assigned to a batch of biofuel for the purpose of tracking its production, use, and trading as required by the U.S. Environmental Protection Agency's Renewable Fuel Standard.

Solar cell—A device that converts sunlight energy directly into electricity using the photovoltaic effect.

Solar lease—A legal contract between an electricity producer and buyer where the buyer (generally a utility company) agrees to purchase electricity from the producer.

Solar loan—Similar to home improvement loan, the homeowner borrows money from a lender, either a bank or a solar company, and then pays it back with interest through monthly installments.

Solar module—Also known as solar panel that houses an assembly of connected solar cells.

Tariff—Public schedules detailing utility rates, rules, service territories, and terms of service, filed for official approval with a regulatory agency.

Turbine—A machine for generating rotary mechanical power from the energy of a stream of a fluid, such as water. The rotational energy is then used to operate an electric generator or other device.

Utilization rate—The ratio of the actual energy output to the maximum generating capacity of the power-generating equipment or system.

Watt—The basic unit for measuring electric power.

Industry References

TRADE ASSOCIATIONS

Global Wind Energy Council
gwec.net
An international trade association that provides research and analysis on the global wind energy industry.

Institute for Energy Economics and Financial Analysis
ieefa.org
A non-profit institution that conducts research on energy and environmental topics.

Solar Energy Industry Association
seia.org
A national non-profit trade association of the solar energy industry in the United States.

RESEARCH AND CONSULTING FIRMS

BloombergNEF
about.bnef.com
A research organization that helps energy professionals generate opportunities.

Japan Institute of Sustainable Energy Policies
isep.or.jp
An independent, non-profit research organization that focuses on Japan's renewable and sustainable energy industry.

S&P Global Market Intelligence
snl.com
A research firm providing regulatory, financial, market, and M&A data on several industries, including energy.

S&P Global Platts
platts.com
A consulting and publishing firm that collects strategic energy information. S&P Global Platts is a unit of S&P Global Inc.

Statista
statista.com
A German company specializing in market and consumer data.

Wood Mackenzie
woodmac.com
Also known as WoodMac, it is a global energy, chemicals, renewables, metals and mining research and consultancy group supplying data, written analysis, and consultancy advice.

GOVERNMENT AND REGULATORY AGENCIES

China National Energy Administration
ndrc.gov.cn
A department within China's National Development and Reform Commission that is responsible for implementing policies and reforms in the energy sector.

Database of State Incentives for Renewable and Efficiency
dsireusa.org
A source funded by the Energy Department for information regarding renewable energy policies and incentives in the U.S.

India Ministry of New and Renewable Energy
mnre.gov.in
A department within the Government of India that focuses on all issues pertaining to renewable energy.

International Renewable Energy Agency
irena.org
An intergovernmental agency that promotes the global transition to sustainable energy. Publishes information on the global renewable energy industry.

Lawrence Berkeley National Laboratory
lbl.gov
A science lab that is part of the Energy Department and is also known as Berkeley Lab. It conducts research on various scientific topics for the U.S. and publishes valuable insights on wind energy.

National Conference of State Legislatures
ncsl.org
An information center for the status of renewable portfolio standards or goals for all U.S. states.

National Renewable Energy Laboratory
nrel.gov
The Energy Department's primary laboratory on renewable energy and energy efficiency research and development.

Sino-German Energy Partnership
energypartnership.cn
The central platform for energy policy dialogue between Germany and China that aims to accelerate the energy transition in the two countries by continuous political, economic, regulatory, and technological exchange with focuses on energy efficiency and renewable energies.

U.S. Department of Agriculture
usda.gov
A department that develops and executes federal laws related to farming, forestry, rural economic development, and food.

U.S. Department of Commerce
commerce.gov
A department of the federal government that focuses on the economic wellbeing of the country.

U.S. Department of Energy
energy.gov
An executive department of the federal government that oversees national energy policy and manages the research and development of nuclear power and nuclear weapons in the country.

U.S. Energy Information Administration
eia.gov
An agency within the Department of Energy; supplies publications and statistics on the electricity industry.

U.S. Environmental Protection Agency
epa.gov
An independent federal agency that formulates and enforces policies and regulations aimed at the protection of human health and the environment.

ONLINE RESOURCES

Beef2Live
beef2live.com
An online resource that publishes data and industry facts focused on agriculture.

ExxonMobil
corporate.exxonmobil.com
Publishes an annual outlook on energy through 2040.

Hydro-Québec
http://hydroquebec.com
Provides insights on hydropower related topics.

Public Utilities Fortnightly
fortnightly.com
Covers the electric and gas utilities industries.

PVinsights
pvinsights.com
Provides valuable insight on solar spot prices across the supply chain.

pv magazine
pv-magazine.com
Publishes data and insights on solar trends and market developments.

Reuters
reuters.com
Provides economic, financial, and political coverage of countries, regions, and industries.

COMPARATIVE COMPANY ANALYSIS

					Operating Revenues															
					Million $							CAGR (%)			Index Basis (2012=100)					
Ticker		Company	Country	Yr. End	2022	2021	2020	2019	2018	2017	2016	10-Yr.	5-Yr.	1-Yr.	2022	2021	2020	2019	2018	2017
PURE PLAY RENEWABLES																				
CSIQ		CANADIAN SOLAR INC.	Canada	DEC	7,468.6	5,277.2	3,476.5	3,200.6	3,744.5	3,390.4	2,853.1	19.2	17.1	41.5	262	185	122	112	131	119
EDPR		EDP RENOVÁVEIS, S.A.	Spain	DEC	2,284.9	1,797.4	1,870.3	1,842.8	1,730.6	1,923.2	1,534.1	6.3	5.9	35.3	149	117	122	120	113	125
ENPH	[]	ENPHASE ENERGY, INC.	United States	DEC	2,330.9	1,382.0	774.4	624.3	316.2	286.2	322.6	26.8	52.1	68.7	723	428	240	194	98	89
ENT		ENERTRONICA SANTERNO S.P.A.	Italy	# JAN	0.0	41.3	39.9	72.5	41.0	108.1	94.9	NA	NA	NA	0	44	42	76	43	114
FSLR	[]	FIRST SOLAR, INC.	United States	DEC	2,619.3	2,923.4	2,711.3	3,063.1	2,244.0	2,941.3	2,904.6	-2.5	-2.3	-10.4	90	101	93	105	77	101
IBE		IBERDROLA, S.A.	Spain	DEC	57,656.3	44,483.1	40,544.3	40,891.0	40,160.1	37,539.9	30,359.1	4.7	11.5	37.9	190	147	134	135	132	124
JKS		JINKOSOLAR HOLDING CO., LTD.	China	DEC	12,110.5	6,426.7	5,380.9	4,272.1	3,641.1	4,068.6	3,082.2	33.1	25.8	104.6	393	209	175	139	118	132
NEP		NEXTERA ENERGY PARTNERS, LP	United States	DEC	1,211.0	982.0	917.0	855.0	771.0	807.0	772.0	29.3	8.5	23.3	157	127	119	111	100	105
NDX1		NORDEX SE	Germany	DEC	6,084.8	6,191.2	5,689.0	3,686.0	2,815.6	3,695.7	3,583.9	18.1	13.1	4.6	170	173	159	103	79	103
ORSTED		ØRSTED A/S	Denmark	DEC	19,005.3	11,880.6	8,241.9	10,572.4	11,583.1	9,629.5	8,149.0	7.2	17.2	70.3	233	146	101	130	142	118
SEDG	[]	SOLAREDGE TECHNOLOGIES, INC.	Israel	DEC	3,110.3	1,963.9	1,459.3	1,425.7	937.2	607.0	490.0	45.1	38.6	58.4	635	401	298	291	191	124
SPWR	†	SUNPOWER CORPORATION	United States	# JAN	0.0	1,741.1	1,132.0	1,092.2	1,202.3	1,794.0	1,794.0	-3.2	-0.6	53.8	0	97	63	61	67	100
RUN	†	SUNRUN INC.	United States	DEC	2,321.4	1,610.0	922.2	858.6	760.0	532.5	477.1	NA	34.2	44.2	487	337	193	180	159	112
SUZLON		SUZLON ENERGY LIMITED	India	MAR	0.0	859.1	450.3	389.5	718.5	1,240.8	1,958.9	-10.9	-12.5	97.9	0	44	23	20	37	63
VWS		VESTAS WIND SYSTEMS A/S	Denmark	DEC	15,481.5	17,726.6	18,127.2	13,631.5	11,602.9	11,951.2	10,806.5	7.2	7.8	-7.1	143	164	168	126	107	111
002202		XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.	China	DEC	6,732.7	8,012.6	8,618.2	5,492.6	4,177.4	3,862.1	3,801.6	15.2	13.1	-8.8	177	211	227	144	110	102
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS																				
LNT	[]	ALLIANT ENERGY CORPORATION	United States	DEC	4,205.0	3,669.0	3,416.0	3,648.0	3,534.0	3,382.2	3,320.0	3.1	4.5	14.6	127	111	103	110	106	102
D	[]	DOMINION ENERGY, INC.	United States	DEC	17,174.0	13,964.0	14,172.0	14,401.0	11,199.0	12,586.0	11,737.0	3.0	6.4	23.0	146	119	121	123	95	107
DTE	[]	DTE ENERGY COMPANY	United States	DEC	19,228.0	14,964.0	11,423.0	12,168.0	14,212.0	12,607.0	10,630.0	8.1	8.8	28.5	181	141	107	114	134	119
DUK	[]	DUKE ENERGY CORPORATION	United States	DEC	28,319.0	24,201.0	22,951.0	24,658.0	24,116.0	23,189.0	22,381.0	5.0	4.1	17.0	127	108	103	110	108	104
EDF		ELECTRICITÉ DE FRANCE S.A.	France	DEC	153,335.5	96,054.8	84,441.6	80,066.2	78,481.8	77,920.3	75,164.2	7.1	17.2	69.9	204	128	112	107	104	104
ENEL		ENEL SPA	Italy	DEC	147,436.1	94,646.9	77,849.5	88,059.7	84,868.3	87,363.1	73,007.5	5.2	13.7	65.8	202	130	107	121	116	120
EQNR		EQUINOR ASA	Norway	DEC	149,004.0	88,744.0	45,765.0	45,765.0	78,556.0	60,972.0	45,688.0	-14.3	19.6	67.9	326	194	100	100	172	133
EVRG	[]																			
GE	[]	GENERAL ELECTRIC COMPANY	United States	DEC	76,555.0	74,196.0	75,833.0	90,221.0	97,012.0	99,279.0	119,468.0	-5.0	-5.1	3.2	64	62	63	76	81	83
MGEE		MGE ENERGY, INC.	United States	DEC	699.8	593.1	524.5	555.0	545.4	549.0	530.2	2.9	5.0	18.0	132	112	99	105	103	104
NEE	[]	NEXTERA ENERGY, INC.	United States	DEC	20,956.0	17,069.0	17,997.0	19,204.0	16,727.0	17,173.0	16,138.0	3.9	4.1	22.8	130	106	112	119	104	106
OGE	†	OGE ENERGY CORP.	United States	DEC	3,375.7	3,653.7	2,122.3	2,231.6	2,270.3	2,261.1	2,259.2	-0.8	8.3	-7.6	149	162	94	99	100	100
PNW	[]	PINNACLE WEST CAPITAL CORPORATION	United States	DEC	4,324.4	3,803.8	3,587.0	3,471.2	3,691.2	3,565.3	3,498.7	2.7	3.9	13.7	124	109	103	99	106	102
PNM	†	PNM RESOURCES, INC.	United States	DEC	2,249.6	1,779.9	1,523.0	1,457.6	1,436.6	1,445.0	1,363.0	5.3	9.3	26.4	165	131	112	107	105	106
RWE		RWE AKTIENGESELLSCHAFT	Germany	DEC	41,002.5	27,943.8	16,858.7	14,837.8	15,400.7	16,658.3	46,281.0	-2.8	22.6	56.1	89	60	36	32	33	36
TTE		TOTALENERGIES SE	France	DEC	263,310.0	184,634.0	119,704.0	176,249.0	184,106.0	149,099.0	127,925.0	1.2	12.0	42.6	206	144	94	138	144	117
WEC	[]	WEC ENERGY GROUP, INC.	United States	DEC	9,597.4	8,316.0	7,241.7	7,523.1	7,679.5	7,648.5	7,472.3	8.5	4.6	15.4	128	111	97	101	103	102
XEL	[]	XCEL ENERGY INC.	United States	DEC	15,310.0	13,431.0	11,526.0	11,529.0	11,537.0	11,404.0	11,107.0	4.2	6.1	14.0	138	121	104	104	104	103

Note: Data as originally reported. CAGR-Compound annual growth rate.
[]Company included in the S&P 500. †Company included in the S&P MidCap 400. §Company included in the S&P SmallCap 600. #Of the following calendar year.
Souce: S&P Capital IQ.

					Net Income																
					Million $							CAGR (%)			Index Basis (2012=100)						
Ticker		Company	Country	Yr. End	2022	2021	2020	2019	2018	2017	2016	10-Yr.	5-Yr.	1-Yr.	2022	2021	2020	2019	2018	2017
PURE PLAY RENEWABLES																					
CSIQ		CANADIAN SOLAR INC.	Canada	DEC	240.0	95.2	146.7	171.6	237.1	99.6	65.2	NA	19.2	151.9	368	146	225	263	363	153
EDPR		EDP RENOVÁVEIS, S.A.	Spain	DEC	658.6	745.4	679.7	533.2	358.8	331.3	59.5	17.2	17.4	-6.0	1108	1254	1143	897	603	557
ENPH	[]	ENPHASE ENERGY, INC.	United States	DEC	397.4	145.4	134.0	161.1	-11.6	-45.2	-67.5	NA	NM	173.2	-589	-216	-199	-239	17	67
ENT		ENERTRONICA SANTERNO S.P.A.	Italy	# JAN	0.0	-18.5	-3.3	0.5	-11.3	-2.6	0.5	NA	NA	NA	0	NM	-685	97	NM	-540
FSLR	[]	FIRST SOLAR, INC.	United States	DEC	-44.2	468.7	398.4	-114.9	144.3	-165.6	-416.1	-7.5	-23.2	NM	11	-113	-96	28	-35	40
IBE		IBERDROLA, S.A.	Spain	DEC	4,637.2	4,418.3	4,417.1	3,889.6	3,450.9	3,366.9	2,855.5	4.6	9.1	11.7	162	155	155	136	121	118
JKS		JINKOSOLAR HOLDING CO., LTD.	China	DEC	96.4	113.5	35.3	129.1	59.1	21.8	263.1	NA	36.2	-7.7	37	43	13	49	22	8
NEP		NEXTERA ENERGY PARTNERS, LP	United States	DEC	477.0	137.0	-50.0	-71.0	192.0	-61.0	83.0	40.4	NM	248.2	575	165	-60	-86	231	-73
NDX1		NORDEX SE	Germany	DEC	-532.0	-261.7	-158.7	-81.4	-96.0	0.4	100.7	18.2	NM	116.3	-528	-260	-158	-81	-95	0
ORSTED		ØRSTED A/S	Denmark	DEC	2,173.3	1,676.7	2,563.4	1,078.4	2,799.3	3,134.4	1,142.4	NA	-4.9	38.0	190	147	224	94	245	274
SEDG	[]	SOLAREDGE TECHNOLOGIES, INC.	Israel	DEC	93.8	169.2	140.3	146.5	128.8	84.2	63.5	NA	2.2	-44.6	148	267	221	231	203	133
SPWR	†	SUNPOWER CORPORATION	United States	# JAN	0.0	56.0	-37.4	22.2	-811.1	-929.1	-929.1	NA	NM	NM	0	-6	4	-2	87	100
RUN	†	SUNRUN INC.	United States	DEC	173.4	-79.4	-173.4	26.3	26.7	125.5	75.1	NA	6.7	NM	231	-106	-231	35	35	167
SUZLON		SUZLON ENERGY LIMITED	India	MAR	0.0	-26.3	14.2	-350.9	-220.4	-57.9	132.4	-8.4	NM	NM	0	-20	11	-265	-167	-44
VWS		VESTAS WIND SYSTEMS A/S	Denmark	DEC	-1,680.0	152.4	935.8	790.0	783.1	1,073.5	1,018.7	5.0	NM	NM	-165	15	92	78	77	105
002202		XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.	China	DEC	345.6	587.4	453.9	317.4	467.7	469.5	432.5	31.6	-4.8	-36.1	80	136	105	73	108	109
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS																					
LNT	[]	ALLIANT ENERGY CORPORATION	United States	DEC	686.0	659.0	614.0	557.0	512.0	457.3	371.5	7.9	8.4	4.1	185	177	165	150	138	123
D	[]	DOMINION ENERGY, INC.	United States	DEC	994.0	3,288.0	-401.0	1,358.0	2,447.0	2,999.0	2,123.0	12.7	-19.8	-69.8	47	155	-19	64	115	141
DTE	[]	DTE ENERGY COMPANY	United States	DEC	1,083.0	907.0	1,368.0	1,169.0	1,120.0	1,134.0	868.0	5.9	-0.9	19.4	125	104	158	135	129	131
DUK	[]	DUKE ENERGY CORPORATION	United States	DEC	2,550.0	3,908.0	1,377.0	3,748.0	2,666.0	3,059.0	2,152.0	3.7	-3.6	-34.7	118	182	64	174	124	142
EDF		ELECTRICITÉ DE FRANCE S.A.	France	DEC	-19,172.8	5,814.9	795.1	5,785.0	1,347.6	3,810.0	3,009.6	NA	NM	NM	-637	193	26	192	45	127
ENEL		ENEL SPA	Italy	DEC	1,797.6	3,626.7	3,192.7	2,439.7	5,483.2	4,537.7	2,713.0	21.6	-14.9	-47.3	66	134	118	90	202	167
EQNR		EQUINOR ASA	Norway	DEC	28,746.0	8,563.0	-5,510.0	-5,510.0	7,535.0	4,590.0	-2,922.0	-8.4	44.3	235.7	-984	-293	189	189	-258	-157
EVRG	[]																			
GE	[]	GENERAL ELECTRIC COMPANY	United States	DEC	225.0	-6,520.0	5,704.0	-4,979.0	-22,355.0	-8,484.0	7,500.0	-33.7	NM	NM	3	-87	76	-66	-298	-113
MGEE		MGE ENERGY, INC.	United States	DEC	111.0	105.8	92.4	86.9	84.2	97.6	75.6	5.6	2.6	4.9	147	140	122	115	111	129
NEE	[]	NEXTERA ENERGY, INC.	United States	DEC	4,147.0	3,573.0	2,919.0	3,769.0	6,638.0	5,380.0	2,906.0	8.1	-5.1	16.1	143	123	100	130	228	185
OGE	†	OGE ENERGY CORP.	United States	DEC	665.7	737.3	-173.7	433.6	425.5	619.0	338.2	6.5	1.5	-9.7	197	218	-51	128	126	183
PNW	[]	PINNACLE WEST CAPITAL CORPORATION	United States	DEC	483.6	618.7	550.6	538.3	511.0	488.5	442.0	2.4	-0.2	-21.8	109	140	125	122	116	111
PNM	†	PNM RESOURCES, INC.	United States	DEC	169.5	195.8	172.8	77.4	85.6	79.9	116.8	4.9	16.2	-13.4	145	168	148	66	73	68
RWE		RWE AKTIENGESELLSCHAFT	Germany	DEC	2,903.7	820.0	1,285.6	9,553.4	451.1	2,331.9	-5,965.4	6.8	6.9	276.8	-49	-14	-22	-160	-8	-39
TTE		TOTALENERGIES SE	France	DEC	20,526.0	16,032.0	-7,242.0	11,267.0	11,446.0	8,631.0	6,196.0	4.2	18.9	28.0	331	259	-117	182	185	139
WEC	[]	WEC ENERGY GROUP, INC.	United States	DEC	1,408.1	1,300.3	1,199.9	1,134.0	1,059.3	1,203.7	939.0	9.9	3.2	8.3	150	138	128	121	113	128
XEL	[]	XCEL ENERGY INC.	United States	DEC	1,736.0	1,597.0	1,473.0	1,372.0	1,261.0	1,148.0	1,123.0	6.7	8.6	8.7	155	142	131	122	112	102

Note: Data as originally reported. CAGR-Compound annual growth rate.
[]Company included in the S&P 500. †Company included in the S&P MidCap 400. §Company included in the S&P SmallCap 600. #Of the following calendar year.
Souce: S&P Capital IQ.

						Return on Revenues (%)						Return on Assets (%)						Return on Equity (%)					
Ticker		**Company**	**Country**		**Yr. End**	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**
PURE PLAY RENEWABLES																							
CSIQ		CANADIAN SOLAR INC.	Canada		DEC	3.2	1.8	4.2	5.4	6.3	2.9	2.7	1.3	2.2	3.1	4.8	1.7	13.5	5.5	8.9	12.3	20.8	10.5
EDPR		EDP RENOVÁVEIS, S.A.	Spain		DEC	28.8	41.5	36.3	28.9	20.7	17.2	2.2	3.0	3.1	2.7	1.8	1.7	7.9	8.6	8.1	7.6	5.9	5.9
ENPH	[]	ENPHASE ENERGY, INC.	United States		DEC	17.0	10.5	17.3	25.8	NM	NM	12.9	7.0	11.2	22.6	NM	NM	63.3	31.8	35.4	115.1	NM	NM
ENT		ENERTRONICA SANTERNO S.P.A.	Italy	#	JAN	0.0	0.0	NM	NM	0.7	NM	NA	NA	NM	NM	0.5	NM	0.0	0.0	NM	NM	1,040.3	NM
FSLR	[]	FIRST SOLAR, INC.	United States		DEC	NM	16.0	14.7	NM	6.4	NM	NM	6.3	5.6	NM	2.0	NM	NM	8.2	7.5	NM	2.8	NM
IBE		IBERDROLA, S.A.	Spain		DEC	8.0	9.9	10.9	9.5	8.6	9.0	2.8	2.7	2.9	2.8	2.7	2.5	9.0	8.5	8.4	8.5	7.8	8.2
JKS		JINKOSOLAR HOLDING CO., LTD.	China		DEC	0.8	1.8	0.7	3.0	1.6	0.5	0.6	1.0	0.4	1.9	1.1	0.5	7.8	7.0	2.6	8.8	5.4	2.2
NEP		NEXTERA ENERGY PARTNERS, LP	United States		DEC	39.4	14.0	NM	NM	24.9	NM	2.1	0.7	NM	NM	2.0	NM	8.6	4.5	NM	NM	6.9	4.8
NDX1		NORDEX SE	Germany		DEC	NM	NM	NM	NM	NM	0.0	NM	NM	NM	NM	NM	0.0	NM	NM	NM	NM	NM	0.0
ORSTED		ØRSTED A/S	Denmark		DEC	11.4	14.1	31.1	10.2	24.2	32.5	4.8	4.1	7.9	3.7	10.5	13.3	16.6	11.9	16.6	8.3	23.3	20.6
SEDG	[]	SOLAREDGE TECHNOLOGIES, INC.	Israel		DEC	3.0	8.6	9.6	10.3	13.7	13.9	2.2	5.8	5.8	9.8	13.4	13.1	5.4	14.1	14.8	21.0	26.5	24.5
SPWR	†	SUNPOWER CORPORATION	United States	#	JAN	0.0	3.2	NM	54.6	2.0	NM	NA	3.1	NM	28.9	1.0	NM	0.0	22.2	1.5	280.0	NM	NM
RUN	†	SUNRUN INC.	United States		DEC	7.5	NM	NM	3.1	3.5	23.6	0.9	NM	NM	0.5	0.6	3.2	NM	NM	NM	NM	NM	NM
SUZLON		SUZLON ENERGY LIMITED	India		MAR	0.0	NM	3.2	NM	NM	NM	NA	NM	1.6	NM	NM	NM	0.0	NM	NM	NM	NM	NM
VWS		VESTAS WIND SYSTEMS A/S	Denmark		DEC	NM	0.9	5.2	5.8	6.7	9.0	NM	0.7	4.2	4.9	5.7	8.2	NM	3.0	19.2	21.7	22.0	28.4
002202		XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.	China		DEC	5.1	7.3	5.3	5.8	11.2	12.2	1.7	3.1	2.7	2.1	4.0	4.2	6.3	10.5	8.8	7.6	13.1	14.3
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS																							
LNT	[]	ALLIANT ENERGY CORPORATION	United States		DEC	16.3	18.0	18.0	15.3	14.5	13.5	3.4	3.6	3.5	3.3	3.3	3.2	11.2	11.1	10.9	10.9	11.2	10.8
D	[]	DOMINION ENERGY, INC.	United States		DEC	5.8	23.5	NM	9.4	21.9	23.8	1.0	3.3	NM	1.3	3.1	3.9	3.6	9.9	4.4	2.4	10.1	17.2
DTE	[]	DTE ENERGY COMPANY	United States		DEC	5.6	6.1	12.0	9.6	7.9	9.0	2.5	2.3	3.0	2.8	3.1	3.4	11.3	7.4	8.6	8.4	10.8	11.4
DUK	[]	DUKE ENERGY CORPORATION	United States		DEC	9.0	16.1	6.0	15.2	11.1	13.2	1.4	2.3	0.8	2.4	1.8	2.2	7.3	7.4	2.2	7.8	6.1	7.4
EDF		ELECTRICITÉ DE FRANCE S.A.	France		DEC	NM	6.1	0.9	7.2	1.7	4.9	NM	1.4	0.2	1.7	0.4	1.2	NM	8.2	1.4	10.5	2.8	7.3
ENEL		ENEL SPA	Italy		DEC	1.2	3.8	4.1	2.8	6.5	5.2	0.8	1.5	1.6	1.3	2.9	2.4	12.4	8.9	8.1	7.3	12.7	10.2
EQNR		EQUINOR ASA	Norway		DEC	19.3	9.6	NM	2.9	9.6	7.5	18.2	5.8	NM	1.5	6.7	4.1	61.8	23.5	NM	4.4	18.2	12.3
EVRG	[]																						
GE	[]	GENERAL ELECTRIC COMPANY	United States		DEC	0.3	NM	7.5	NM	NM	NM	0.1	NM	2.2	NM	NM	NM	2.4	NM	19.3	NM	NM	NM
MGEE		MGE ENERGY, INC.	United States		DEC	15.9	17.8	17.6	15.7	15.4	17.8	4.4	4.5	4.1	4.2	4.2	5.3	10.5	10.6	10.1	10.4	10.6	13.0
NEE	[]	NEXTERA ENERGY, INC.	United States		DEC	19.8	20.9	16.2	19.6	39.7	31.3	2.6	2.5	2.3	3.2	6.4	5.5	6.8	6.2	5.5	8.5	17.1	19.4
OGE	†	OGE ENERGY CORP.	United States		DEC	19.7	20.2	NM	19.4	18.7	27.4	5.3	5.8	NM	3.9	4.0	5.9	15.7	19.2	NM	10.6	10.8	17.0
PNW	[]	PINNACLE WEST CAPITAL CORPORATION	United States		DEC	11.2	16.3	15.3	15.5	13.8	13.7	2.1	2.8	2.7	2.9	2.9	2.9	8.2	10.8	10.1	10.2	10.1	10.1
PNM	†	PNM RESOURCES, INC.	United States		DEC	7.5	11.0	11.3	5.3	6.0	5.5	1.8	2.3	2.2	1.1	1.2	1.2	8.2	9.7	9.6	5.2	5.7	5.4
RWE		RWE AKTIENGESELLSCHAFT	Germany		DEC	7.1	2.9	7.6	64.4	2.9	14.0	2.0	0.5	1.7	13.3	0.5	2.8	12.9	4.8	5.1	NM	NM	17.2
TTE		TOTALENERGIES SE	France		DEC	7.8	8.7	NM	6.4	6.2	5.8	6.8	5.5	NM	4.1	4.5	3.6	18.3	14.8	NM	9.6	10.0	7.7
WEC	[]	WEC ENERGY GROUP, INC.	United States		DEC	14.7	15.6	16.6	15.1	13.8	15.7	3.4	3.3	3.2	3.2	3.2	3.8	12.4	11.9	11.5	11.3	11.0	13.0
XEL	[]	XCEL ENERGY INC.	United States		DEC	11.3	11.9	12.8	11.9	10.9	10.1	2.8	2.8	2.7	2.7	2.7	2.7	10.8	10.6	10.6	10.8	10.7	10.2

Note: Data as originally reported. CAGR-Compound annual growth rate.
[]Company included in the S&P 500. †Company included in the S&P MidCap 400. §Company included in the S&P SmallCap 600. #Of the following calendar year.
Souce: S&P Capital IQ.

Ticker		Company	Country		Yr. End	Current Ratio						Debt/Capital Ratio (%)						Debt as a % of Net Working Capital					
						2022	2021	2020	2019	2018	2017	2022	2021	2020	2019	2018	2017	2022	2021	2020	2019	2018	2017
PURE PLAY RENEWABLES																							
CSIQ		CANADIAN SOLAR INC.	Canada		DEC	1.1	1.2	1.2	1.1	1.0	1.0	64.6	81.7	61.7	70.4	75.0	85.5	NM	323.7	NM	895.0	992.7	NM
EDPR		EDP RENOVÁVEIS, S.A.	Spain		DEC	0.7	0.9	0.7	0.6	0.6	0.6	31.9	25.5	29.5	25.2	30.7	30.1	NM	NM	NM	NM	NM	NM
ENPH	[]	ENPHASE ENERGY, INC.	United States		DEC	3.5	3.3	1.7	2.5	1.5	1.4	59.2	68.9	1.0	27.4	91.3	139.3	73.8	93.1	1.2	34.2	108.6	83.5
ENT		ENERTRONICA SANTERNO S.P.A.	Italy	#	JAN	0.0	0.0	0.6	1.1	1.1	1.2	NA	NA	-444.9	111.9	99.0	100.8	NA	NA	NM	473.2	502.6	389.5
FSLR	[]	FIRST SOLAR, INC.	United States		DEC	3.7	4.4	3.6	2.7	4.6	5.9	3.1	3.8	4.1	8.3	8.3	7.8	6.7	9.6	11.0	20.2	15.6	13.5
IBE		IBERDROLA, S.A.	Spain		DEC	0.8	0.9	0.8	0.7	0.8	0.8	38.6	35.9	39.2	39.2	41.3	40.9	NM	NM	NM	NM	NM	NM
JKS		JINKOSOLAR HOLDING CO., LTD.	China		DEC	1.1	1.0	1.1	1.0	0.9	1.0	112.3	138.6	119.2	124.4	142.3	168.3	1,098.8	NM	981.3	4,464.6	NM	NM
NEP		NEXTERA ENERGY PARTNERS, LP	United States		DEC	1.4	1.1	1.2	1.4	0.4	1.4	26.2	34.5	35.0	39.2	33.8	65.5	979.9	3,952.3	6,496.9	3,446.2	NM	3,457.4
NDX1		NORDEX SE	Germany		DEC	0.9	1.1	1.0	1.1	1.2	1.4	6.7	24.8	30.1	42.6	44.7	40.2	-13.6	205.6	NM	324.0	232.2	140.7
ORSTED		ØRSTED A/S	Denmark		DEC	1.5	1.0	1.8	2.0	2.1	2.1	38.8	27.0	26.1	28.7	22.8	26.4	159.7	4,474.7	121.3	NM	NM	74.8
		SOLAREDGE TECHNOLOGIES, INC.	Israel		DEC	3.3	3.3	3.9	2.1	3.0	3.7	22.3	32.2	34.6	0.0	0.6	0.0	31.1	52.4	44.7	0.0	0.8	0.0
SPWR	†	SUNPOWER CORPORATION	United States	#	JAN	0.0	1.2	2.1	1.5	1.5	1.5	NA	14.4	65.5	65.1	102.4	NM	NA	37.9	94.6	221.3	202.6	243.8
RUN	†	SUNRUN INC.	United States		DEC	1.8	1.5	1.3	1.4	1.2	1.3	50.2	45.7	39.5	58.2	55.0	48.4	875.6	1,190.0	2,010.7	1,121.0	1,933.8	1,212.7
SUZLON		SUZLON ENERGY LIMITED	India		MAR	0.0	1.2	1.3	0.3	0.6	0.8	NA	276.7	236.2	-95.0	-426.0	1,528.9	NM	NM	NM	-81.7	NM	NM
VWS		VESTAS WIND SYSTEMS A/S	Denmark		DEC	1.0	1.0	1.1	1.1	1.2	1.2	NM	NM	NM	NM	NM	NM	1,589.6	201.8	52.3	47.6	43.3	33.7
002202		XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.	China		DEC	1.1	1.0	0.9	1.0	1.0	1.1	43.0	41.6	39.0	36.4	45.9	45.6	910.8	NM	NM	NM	1,573.7	515.4
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS																							
LNT	[]	ALLIANT ENERGY CORPORATION	United States		DEC	0.5	0.5	0.7	0.4	0.5	0.4	59.6	57.0	56.6	53.7	56.7	52.7	NM	NM	NM	NM	NM	NM
D	[]	DOMINION ENERGY, INC.	United States		DEC	0.7	0.8	0.6	0.6	0.7	0.4	63.5	61.5	58.0	47.3	59.4	68.1	NM	NM	NM	NM	NM	NM
DTE	[]	DTE ENERGY COMPANY	United States		DEC	0.8	0.5	1.3	0.8	0.7	1.1	66.1	65.7	60.2	60.3	55.8	57.7	NM	NM	NM	NM	NM	4,760.2
DUK	[]	DUKE ENERGY CORPORATION	United States		DEC	0.7	0.6	0.5	0.6	0.6	0.7	59.5	56.8	55.5	56.1	57.1	56.4	NM	NM	NM	NM	NM	NM
EDF		ELECTRICITÉ DE FRANCE S.A.	France		DEC	0.9	1.1	1.3	1.3	1.4	1.4	57.6	44.4	47.4	48.1	49.0	50.4	NM	621.1	308.3	275.9	253.5	239.2
ENEL		ENEL SPA	Italy		DEC	0.9	0.8	0.8	0.9	0.9	0.9	78.1	69.5	60.4	57.1	54.3	47.2	NM	NM	NM	NM	NM	NM
EQNR		EQUINOR ASA	Norway		DEC	1.8	1.6	1.6	1.3	1.6	1.4	33.2	48.8	50.4	34.6	36.4	39.6	75.5	138.8	256.6	416.7	253.6	310.4
EVRG	[]																						
GE	[]	GENERAL ELECTRIC COMPANY	United States		DEC	1.2	1.3	1.6	1.3	2.3	1.9	43.4	42.7	66.8	93.6	72.4	71.5	309.2	214.8	236.9	375.1	129.4	235.9
MGEE		MGE ENERGY, INC.	United States		DEC	1.1	1.7	1.1	1.4	2.0	2.3	39.3	37.7	38.2	38.0	38.7	34.2	3,560.4	760.2	3,075.4	991.5	422.2	245.0
NEE	[]	NEXTERA ENERGY, INC.	United States		DEC	0.5	0.5	0.5	0.5	0.4	0.6	55.7	54.9	50.6	51.0	54.1	54.7	NM	NM	NM	NM	NM	NM
OGE	†	OGE ENERGY CORP.	United States		DEC	0.7	0.6	0.6	0.7	0.6	0.5	44.6	58.3	50.4	45.1	42.0	44.2	NM	NM	NM	NM	NM	NM
PNW	[]	PINNACLE WEST CAPITAL CORPORATION	United States		DEC	1.0	0.9	0.9	0.5	0.6	0.8	58.1	55.7	53.7	47.6	47.2	49.2	NM	NM	NM	NM	NM	NM
PNM	†	PNM RESOURCES, INC.	United States		DEC	0.5	0.5	0.4	0.3	0.6	0.4	67.1	62.3	56.9	63.3	65.5	62.9	NM	NM	NM	NM	NM	NM
RWE		RWE AKTIENGESELLSCHAFT	Germany		DEC	1.2	1.1	1.6	1.4	1.3	1.2	33.7	55.3	16.9	16.2	14.4	57.4	76.3	192.8	32.1	38.2	14.7	489.2
TTE		TOTALENERGIES SE	France		DEC	1.1	1.2	1.2	1.2	1.3	1.5	30.3	32.3	40.2	31.2	29.9	30.2	288.4	316.3	425.1	334.3	266.3	165.1
WEC	[]	WEC ENERGY GROUP, INC.	United States		DEC	0.7	0.7	0.5	0.7	0.7	0.6	62.1	62.5	60.2	56.0	57.6	55.9	NM	NM	NM	NM	NM	NM
XEL	[]	XCEL ENERGY INC.	United States		DEC	0.8	0.8	0.8	0.7	0.7	0.7	59.8	60.9	59.1	58.7	60.0	59.0	NM	NM	NM	NM	NM	NM

Note: Data as originally reported. CAGR-Compound annual growth rate.
[]Company included in the S&P 500. †Company included in the S&P MidCap 400. §Company included in the S&P SmallCap 600. #Of the following calendar year.
Souce: S&P Capital IQ.

Ticker		Company	Country		Yr. End	P/E 2022	P/E 2021	P/E 2020	P/E 2019	P/E 2018	P/E 2017
						Price/Earnings Ratio (High-Low)					
						2022	2021	2020	2019	2018	2017
PURE PLAY RENEWABLES											
CSIQ		CANADIAN SOLAR INC.	Canada		DEC	13 - 6	41 - 20	22 - 5	9 - 5	4 - 3	11 - 7
EDPR		EDP RENOVÁVEIS, S.A.	Spain		DEC	40 - 27	40 - 24	35 - 12	19 - 14	26 - 19	23 - 16
ENPH	[]	ENPHASE ENERGY, INC.	United States		DEC	114 - 41	247 - 106	170 - 22	NM - NM	NM - NM	NM - NM
ENT		ENERTRONICA SANTERNO S.P.A.	Italy	#	JAN		NM - NM		64 - 24	NM - NM	NM - NM
FSLR	[]	FIRST SOLAR, INC.	United States		DEC	NM - NM	27 - 16	28 - 8	NM - NM	57 - 27	NM - NM
IBE		IBERDROLA, S.A.	Spain		DEC	18 - 13	24 - 16	21 - 14	18 - 14	16 - 14	16 - 12
JKS		JINKOSOLAR HOLDING CO., LTD.	China		DEC	39 - 20	30 - 13	111 - 16	8 - 3	16 - 5	44 - 21
NEP		NEXTERA ENERGY PARTNERS, LP	United States		DEC	15 - 11	NM - NM	NM - NM	NM - NM	16 - 12	NM - NM
NDX1		NORDEX SE	Germany		DEC	NM - NM	NM - NM	NM - NM	NM - NM	NM - NM	5549 - 2080
ORSTED		ØRSTED A/S	Denmark		DEC	NM - NM	60 - 32	33 - 14	44 - 28	11 - 8	9 - 5
SEN		SOLAREDGE TECHNOLOGIES, INC.	Israel		DEC	215 - 114	114 - 63	116 - 25	31 - 11	24 - 11	20 - 6
SPWR	†	SUNPOWER CORPORATION	United States	#	JAN	168 - 47	NM - NM	5 - 2	64 - 30	NM - NM	NM - NM
RUN	†	SUNRUN INC.	United States		DEC	47 - 22	NM - NM	NM - NM	90 - 43	66 - 22	6 - 4
SUZLON		SUZLON ENERGY LIMITED	India		MAR	NM - NM	58 - 13	NM - NM	NM - NM	NM - NM	11 - 7
VWS		VESTAS WIND SYSTEMS A/S	Denmark		DEC	NM - NM	339 - 191	48 - 14	26 - 18	21 - 15	19 - 11
002202		XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.	China		DEC	34 - 19	24 - 13	21 - 12	33 - 18	25 - 10	23 - 12
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS											
LNT	[]	ALLIANT ENERGY CORPORATION	United States		DEC	24 - 18	24 - 18	24 - 16	24 - 18	21 - 17	23 - 19
D	[]	DOMINION ENERGY, INC.	United States		DEC	81 - 53	20 - 17	NM - NM	50 - 41	22 - 17	18 - 15
DTE	[]	DTE ENERGY COMPANY	United States		DEC	25 - 19	31 - 23	19 - 11	21 - 17	19 - 15	18 - 15
DUK	[]	DUKE ENERGY CORPORATION	United States		DEC	36 - 27	22 - 17	59 - 37	19 - 17	24 - 19	21 - 18
EDF		ELECTRICITÉ DE FRANCE S.A.	France		DEC	NM - NM	10 - 7	272 - 117	10 - 6	80 - 54	12 - 7
ENEL		ENEL SPA	Italy		DEC	50 - 24	31 - 21	32 - 18	33 - 24	12 - 9	15 - 9
EQNR		EQUINOR ASA	Norway		DEC	5 - 3	11 - 6	NM - NM	43 - 29	13 - 9	15 - 12
EVRG	[]										
GE	[]	GENERAL ELECTRIC COMPANY	United States		DEC	NM - NM	NM - NM	23 - 9	NM - NM	NM - NM	NM - NM
MGEE		MGE ENERGY, INC.	United States		DEC	28 - 20	28 - 22	32 - 21	32 - 23	28 - 22	24 - 22
NEE	[]	NEXTERA ENERGY, INC.	United States		DEC	44 - 33	51 - 39	52 - 30	31 - 22	13 - 10	14 - 10
OGE	†	OGE ENERGY CORP.	United States		DEC	13 - 10	10 - 8	NM - NM	21 - 18	20 - 14	12 - 11
PNW	[]	PINNACLE WEST CAPITAL CORPORATION	United States		DEC	19 - 14	16 - 12	21 - 13	21 - 17	20 - 16	21 - 18
PNM	†	PNM RESOURCES, INC.	United States		DEC	25 - 22	22 - 20	26 - 14	55 - 41	42 - 32	46 - 33
RWE		RWE AKTIENGESELLSCHAFT	Germany		DEC	11 - 8	39 - 28	21 - 11	2 - 1	43 - 30	7 - 3
TTE		TOTALENERGIES SE	France		DEC	8 - 6	9 - 7	NM - NM	14 - 11	15 - 12	16 - 14
WEC	[]	WEC ENERGY GROUP, INC.	United States		DEC	24 - 18	24 - 20	28 - 19	27 - 19	22 - 17	18 - 15
XEL	[]	XCEL ENERGY INC.	United States		DEC	24 - 18	24 - 20	27 - 18	25 - 18	22 - 17	23 - 18

Ticker	Dividend Payout Ratio (%)						Dividend Yield (High-Low, %)					
	2022	2021	2020	2019	2018	2017	2022	2021	2020	2019	2018	2017
PURE PLAY RENEWABLES												
CSIQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
EDPR	25.2	17.4	19.2	20.8	36.0	33.5	0.5 - 0.4	0.5 - 0.3	0.5 - 0.3	0.9 - 0.4	0.8 - 0.7	0.8 - 0.7
ENPH	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
ENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
FSLR	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
IBE	19.8	14.7	15.6	9.5	4.7	7.9	4.6 - 4.0	4.8 - 3.8	4.9 - 3.2	4.9 - 3.1	5.7 - 3.7	6.5 - 4.1
JKS	NM	NM	NM	NM	NM	NM	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
NEP	133.3	451.8	NM	NM	157.8	NM	6.0 - 3.9	4.7 - 3.2	3.9 - 2.8	6.7 - 3.4	4.7 - 3.7	4.3 - 3.5
NDX1	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
ORSTED	38.2	48.0	31.4	64.8	23.7	16.3	2.5 - 1.8	2.2 - 1.3	1.4 - 0.8	1.8 - 0.9	2.1 - 1.4	2.4 - 1.6
SEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
SPWR	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
RUN	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
SUZLON	0.0	0.0	0.0	0.0	0.0	0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
VWS	NM	170.1	27.3	28.0	36.5	31.1	0.2 - 0.0	1.1 - 0.2	0.8 - 0.5	1.7 - 0.6	1.9 - 1.1	2.7 - 1.9
002202	111.6	65.9	58.6	101.5	58.6	46.5	2.5 - 1.1	2.6 - 1.3	2.2 - 0.9	2.7 - 1.2	2.2 - 1.2	2.3 - 0.8
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS												
LNT	62.4	61.2	61.4	60.5	60.9	63.0	3.6 - 3.0	3.6 - 2.6	3.3 - 2.6	3.8 - 2.5	3.4 - 2.6	3.6 - 2.8
D	222.2	61.9	NM	219.7	89.3	64.4	5.1 - 4.2	4.6 - 2.9	3.7 - 3.1	6.3 - 2.9	5.4 - 4.4	5.4 - 3.6
DTE	63.3	87.2	55.6	59.2	55.4	52.2	3.5 - 3.0	3.4 - 2.5	3.9 - 3.0	5.3 - 3.0	3.5 - 2.8	3.7 - 3.0
DUK	124.7	79.7	204.2	71.2	92.7	80.1	4.4 - 3.8	4.7 - 3.4	4.5 - 3.7	5.9 - 3.7	4.4 - 3.9	4.9 - 4.0
EDF	NM	12.3	77.1	12.6	93.0	21.2	4.8 - 0.0	7.7 - 2.3	2.5 - 0.0	7.5 - 0.0	3.5 - 2.2	8.0 - 2.9
ENEL	298.7	158.1	181.7	182.0	71.9	76.0	8.0 - 6.5	9.5 - 5.3	5.7 - 3.9	6.1 - 3.7	5.9 - 4.0	6.6 - 3.8
EQNR	18.7	21.0	NM	181.3	35.5	32.5	12.0 - 5.7	6.7 - 2.1	3.8 - 1.8	12.0 - 2.1	6.4 - 3.8	4.4 - 3.2
EVRG												
GE	284.0	NM	11.4	NM	NM	NM	0.5 - 0.3	0.5 - 0.3	0.4 - 0.3	0.7 - 0.3	7.2 - 0.3	6.5 - 2.5
MGEE	51.8	51.8	56.0	55.1	54.3	44.8	2.4 - 2.1	2.6 - 1.8	2.3 - 1.8	2.6 - 1.7	2.3 - 1.8	2.5 - 1.9
NEE	80.8	84.6	94.0	63.9	31.7	34.3	2.7 - 2.0	2.5 - 1.6	2.2 - 1.6	3.1 - 1.8	2.7 - 2.1	2.9 - 2.4
OGE	49.5	44.1	NM	69.0	64.0	40.0	4.8 - 4.1	4.9 - 3.8	5.5 - 4.4	6.5 - 3.3	3.8 - 3.2	4.5 - 3.5
PNW	78.3	59.7	63.7	61.2	60.4	59.3	4.8 - 4.3	5.7 - 4.2	5.4 - 3.8	5.0 - 3.0	3.7 - 3.0	3.8 - 3.0
PNM	70.4	57.4	56.7	119.4	98.6	96.7	3.1 - 2.8	3.1 - 2.7	2.8 - 2.5	4.1 - 2.2	2.9 - 2.2	3.1 - 2.3
RWE	22.4	79.8	49.7	6.6	260.2	8.2	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
TTE	37.0	53.3	NM	62.2	45.8	33.8	5.7 - 4.9	6.6 - 4.9	7.9 - 6.0	12.5 - 5.4	6.1 - 4.9	5.7 - 4.5
WEC	65.2	65.7	66.5	65.7	65.8	54.5	3.6 - 3.0	3.5 - 2.7	3.4 - 2.6	3.6 - 2.4	3.3 - 2.4	3.8 - 3.0
XEL	58.3	58.5	58.1	57.7	57.9	62.8	3.3 - 2.7	3.4 - 2.5	3.2 - 2.5	3.4 - 2.3	3.2 - 2.5	3.6 - 2.8

Note: Data as originally reported. CAGR-Compound annual growth rate.
[]Company included in the S&P 500. †Company included in the S&P MidCap 400. §Company included in the S&P SmallCap 600. #Of the following calendar year.
Souce: S&P Capital IQ.

Ticker	Company	Country	Yr. End	EPS 2022	EPS 2021	EPS 2020	EPS 2019	EPS 2018	EPS 2017	TBV 2022	TBV 2021	TBV 2020	TBV 2019	TBV 2018	TBV 2017	Price 2022	Price 2021	Price 2020	Price 2019	Price 2018	Price 2017
				Earnings per Share ($)						Tangible Book Value per Share ($)						Share Price (High-Low, $)					
PURE PLAY RENEWABLES																					
CSIQ	CANADIAN SOLAR INC.	Canada	DEC	3.4	1.5	2.4	2.8	3.9	1.7	29.8	27.8	24.8	22.1	19.3	16.0	47.7 - 22.2	67.4 - 28.8	56.4 - 12.0	25.9 - 14.0	18.0 - 11.4	19.1 - 10.9
EDPR	EDP RENOVÁVEIS, S.A.	Spain	DEC	0.7	0.8	0.8	0.6	0.4	0.4	7.0	8.7	8.1	7.1	6.5	6.6	28.7 - 17.7	30.0 - 18.2	28.6 - 10.3	12.0 - 8.4	10.5 - 7.7	8.8 - 6.8
ENPH []	ENPHASE ENERGY, INC.	United States	DEC	2.8	1.0	0.9	1.2	-0.1	-0.5	3.6	1.0	3.3	1.8	-0.5	-0.2	339.9 - 113.4	282.5 - 108.9	189.4 - 21.5	35.4 - 4.6	7.6 - 1.8	3.5 - 0.7
ENT	ENERTRONICA SANTERNO S.P.A.	Italy	# JAN	0.0	0.0	-2.4	0.0	0.1	-1.4	0.0	0.0	-3.6	0.0	-0.7	-0.7	1.1 - 0.9	1.5 - 0.9	2.2 - 0.8	2.2 - 0.8	3.7 - 1.5	4.9 - 3.6
FSLR []	FIRST SOLAR, INC.	United States	DEC	-0.4	4.4	3.7	-1.1	1.4	-1.6	54.3	55.5	51.4	47.6	48.9	47.9	173.7 - 59.6	123.1 - 67.7	109.1 - 28.5	69.2 - 41.4	81.7 - 36.5	71.8 - 25.6
IBE	IBERDROLA, S.A.	Spain	DEC	0.7	0.6	0.7	0.6	0.5	0.5	3.6	3.7	3.4	3.1	2.8	3.1	12.3 - 9.1	14.3 - 9.8	14.5 - 9.5	10.7 - 7.7	8.2 - 6.5	8.8 - 6.9
JKS	JINKOSOLAR HOLDING CO., LTD.	China	DEC	1.9	1.3	0.8	3.0	1.5	0.7	42.9	32.7	30.0	27.8	26.8	28.8	76.9 - 35.4	76.5 - 28.4	90.2 - 11.4	24.8 - 9.5	25.6 - 7.1	30.5 - 13.7
NEP	NEXTERA ENERGY PARTNERS, LP	United States	DEC	5.6	1.8	-0.8	-1.5	2.9	-1.2	-1.2	-8.1	-5.8	-13.6	-0.8	6.4	86.1 - 61.3	88.8 - 63.5	69.1 - 29.0	53.9 - 39.5	50.7 - 36.8	44.0 - 25.3
NDX1	NORDEX SE	Germany	DEC	-2.9	-1.9	-1.5	-0.8	-1.0	0.0	1.6	3.5	2.2	1.8	1.5	3.7	20.0 - 7.7	33.2 - 14.4	27.6 - 6.8	17.7 - 8.4	13.4 - 7.9	26.0 - 8.5
ORSTED	ØRSTED A/S	Denmark	DEC	5.0	3.7	5.9	2.3	6.5	7.2	29.9	29.3	36.8	30.6	29.6	25.8	132.0 - 81.5	214.2 - 120.9	213.5 - 89.7	104.6 - 63.6	72.6 - 51.0	62.6 - 39.6
	SOLAREDGE TECHNOLOGIES, INC.	Israel	DEC	1.7	3.1	2.7	2.9	2.7	1.9	37.9	21.2	17.0	12.4	10.6	9.0	375.9 - 190.2	389.7 - 199.3	335.8 - 67.0	96.7 - 34.1	70.7 - 30.8	39.9 - 12.3
SPWR †	SUNPOWER CORPORATION	United States	# JAN	0.0	0.3	-0.2	2.5	0.2	-5.8	0.0	2.4	1.4	2.4	0.0	-1.6	28.4 - 12.8	57.5 - 19.3	32.2 - 4.0	16.0 - 4.8	10.0 - 4.6	11.7 - 5.8
RUN †	SUNRUN INC.	United States	DEC	0.8	-0.4	-1.2	0.2	0.2	1.2	11.3	9.4	8.8	7.2	7.5	7.3	39.1 - 16.8	100.9 - 30.3	82.4 - 7.8	21.4 - 9.6	16.4 - 5.1	7.8 - 4.2
SUZLON	SUZLON ENERGY LIMITED	India	MAR	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.2	-0.2	0.2 - 0.1	0.1 - 0.1	0.1 - 0.0	0.1 - 0.0	0.2 - 0.1	0.3 - 0.2
VWS	VESTAS WIND SYSTEMS A/S	Denmark	DEC	-1.7	0.1	1.0	0.8	0.8	1.0	0.0	1.8	2.2	2.4	2.3	2.6	34.8 - 18.9	49.1 - 26.0	49.1 - 15.5	21.1 - 14.6	16.3 - 11.6	20.4 - 11.5
002202	XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.	China	DEC	0.1	0.1	0.1	0.1	0.1	0.1	1.1	1.1	1.1	0.9	0.9	0.9	2.4 - 1.5	3.3 - 1.8	2.3 - 1.4	2.3 - 1.3	2.9 - 1.2	3.0 - 1.6
COMPANIES WITH RENEWABLES AS NON-CORE OR MINORITY OPERATIONS																					
LNT []	ALLIANT ENERGY CORPORATION	United States	DEC	2.7	2.6	2.5	2.3	2.2	2.0	25.0	23.9	22.8	21.2	19.4	18.1	65.4 - 47.2	62.4 - 46.0	60.3 - 37.7	55.4 - 40.8	46.6 - 36.8	45.6 - 36.6
D []	DOMINION ENERGY, INC.	United States	DEC	1.1	4.0	-0.6	1.6	3.7	4.7	21.5	21.4	19.3	25.7	19.1	15.6	88.8 - 57.2	81.1 - 67.9	90.9 - 57.8	83.9 - 67.4	81.7 - 61.5	85.3 - 70.9
DTE []	DTE ENERGY COMPANY	United States	DEC	5.5	4.7	7.1	6.3	6.2	6.3	40.1	33.7	52.8	35.5	39.0	35.4	140.2 - 100.6	145.4 - 108.2	135.7 - 71.2	134.4 - 107.3	121.0 - 94.3	116.7 - 96.6
DUK []	DUKE ENERGY CORPORATION	United States	DEC	3.2	4.9	1.7	5.1	3.8	4.4	36.1	36.1	34.3	34.5	33.4	31.6	116.3 - 83.8	108.4 - 85.6	103.8 - 62.1	97.4 - 82.5	91.4 - 72.0	91.8 - 76.1
EDF	ELECTRICITÉ DE FRANCE S.A.	France	DEC	-5.4	1.5	0.1	1.7	0.2	1.2	3.9	10.2	10.2	9.6	9.3	9.2	12.9 - 7.4	15.4 - 10.9	16.6 - 7.3	17.4 - 10.0	18.2 - 11.3	15.0 - 8.8
ENEL	ENEL SPA	Italy	DEC	0.2	0.3	0.3	0.2	0.5	0.4	-0.5	-0.5	-0.6	-0.6	-0.4	0.3	7.7 - 4.2	10.3 - 7.4	10.5 - 6.3	8.1 - 5.6	6.2 - 4.8	6.7 - 4.6
EQNR	EQUINOR ASA	Norway	DEC	9.0	2.6	-1.7	0.6	2.3	1.4	15.6	10.1	7.9	9.2	10.0	9.4	41.7 - 23.4	28.4 - 16.3	21.8 - 11.1	23.2 - 16.4	27.1 - 19.7	21.6 - 16.6
EVRG []																					
GE []	GENERAL ELECTRIC COMPANY	United States	DEC	-0.1	-6.2	4.6	-5.0	-21.0	-8.3	2.7	4.4	0.3	-8.3	-14.0	-44.4	103.7 - 59.9	116.2 - 83.2	106.1 - 43.8	94.7 - 59.3	155.1 - 53.3	254.7 - 138.0
MGEE	MGE ENERGY, INC.	United States	DEC	3.1	2.9	2.6	2.5	2.4	2.8	29.6	28.0	26.6	24.3	23.3	22.4	86.3 - 61.7	83.0 - 63.0	83.3 - 47.2	80.8 - 56.7	69.0 - 51.1	68.7 - 60.3
NEE []	NEXTERA ENERGY, INC.	United States	DEC	2.1	1.8	1.5	1.9	3.5	2.8	16.9	16.1	16.1	16.5	17.0	13.9	93.7 - 67.2	93.7 - 68.3	83.3 - 43.7	61.3 - 42.2	46.1 - 36.3	39.9 - 29.3
OGE †	OGE ENERGY CORP.	United States	DEC	3.3	3.7	-0.9	2.2	2.1	3.1	21.1	19.6	17.7	20.3	19.8	19.1	42.9 - 33.3	38.6 - 29.2	46.4 - 23.0	45.8 - 38.0	41.8 - 29.6	37.4 - 32.6
PNW []	PINNACLE WEST CAPITAL CORPORATION	United States	DEC	4.3	5.5	4.9	4.8	4.5	4.4	51.2	49.9	47.5	45.7	44.2	42.5	80.6 - 59.0	88.5 - 62.8	105.5 - 60.1	99.8 - 81.6	92.6 - 73.4	92.5 - 75.8
PNM †	PNM RESOURCES, INC.	United States	DEC	2.0	2.3	2.2	1.0	1.1	1.0	22.3	22.0	20.6	17.6	17.7	17.8	49.3 - 43.4	50.1 - 43.8	56.1 - 27.1	53.0 - 39.7	45.4 - 33.8	46.0 - 33.4
RWE	RWE AKTIENGESELLSCHAFT	Germany	DEC	4.2	1.2	2.0	15.5	0.6	3.7	33.9	15.8	21.8	22.3	14.0	-8.4	47.1 - 34.8	43.9 - 32.3	43.4 - 24.6	32.3 - 21.1	25.8 - 17.1	28.0 - 13.9
TTE	TOTALENERGIES SE	France	DEC	7.9	5.9	-2.9	4.2	4.2	3.3	32.1	30.4	26.7	32.3	33.2	38.5	64.6 - 46.6	51.8 - 38.6	62.3 - 25.8	58.7 - 47.9	65.1 - 49.3	59.4 - 50.7
WEC []	WEC ENERGY GROUP, INC.	United States	DEC	4.5	4.1	3.8	3.6	3.3	3.8	26.3	24.9	23.5	22.4	21.3	20.3	108.4 - 80.8	99.9 - 80.6	109.5 - 68.0	98.2 - 67.2	75.5 - 58.5	70.1 - 56.1
XEL []	XCEL ENERGY INC.	United States	DEC	3.2	3.0	2.8	2.6	2.5	2.3	30.3	28.7	27.1	25.2	23.8	22.6	77.7 - 56.9	72.9 - 57.2	76.4 - 46.6	66.1 - 47.7	54.1 - 41.5	52.2 - 40.0

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[]Company included in the S&P 500. †Company included in the S&P MidCap 400. §Company included in the S&P SmallCap 600. #Of the following calendar year.
Souce: S&P Capital IQ.

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