OUTLOOK FOR THE US SOLAR SECTOR

Uncertainties introduced by potential changes in federal energy policy are combining with existing headwinds for the solar sector. This is happening at a time of accelerating energy demand. These conflicting observations create numerous issues for analysts, investors and managers seeking to analyze and forecast the outlook for the US solar sector.

It is our view that the longer-term outlook for existing US renewable energy generation assets remains robust due to state-level mandates, energy demand and cost competitiveness[1]. We believe that, in the near-term, many renewable energy developers and asset owners face heightened uncertainty and that there may be increased volatility in valuations of assets as a result.

On January 20, 2025, President Trump issued an Executive Order entitled "Unleashing American Energy" ("Energy Order")[2] that aims to encourage the development of certain domestic energy resources, specifically focusing on oil, natural gas, coal, hydropower, biofuels, critical minerals, and nuclear energy.

On 5 February 2025 the US Department of Energy issued a policy statement providing further detail around how the Energy Order would be implemented, including the same list of prioritized energy resources, while also directing the deprioritization of intermittent clean energy resources (i.e. wind and solar) and net-zero initiatives on the basis that they are costly and undermine energy reliability and security[3].

This potential shift in federal energy policy from the previous Biden Administration has created new uncertainties in a sector already dealing with significant headwinds. These include issues such as growing grid connection delays, supply chain disruption, increased construction costs and increasingly variable merchant power prices. In contrast to the prior federal administration's focus on renewable generation, the Energy Order prioritizes the build-out of firm and dispatchable conventional hydrocarbon generation as the primary response to forecast electricity load growth.

There are growing concerns about the electricity grid's ability to manage system resiliency and reliability[4] as the amount of electricity demanded continues to grow. While the Energy Order potentially seeks to overhaul the composition of electric generation resources across the US, it may conflict with the legal and regulatory authority allocated to individual states. This includes the authority to set energy supply regulations, power market rules, and project development requirements which generally resides with state and local decision-makers[5]. This adds a further layer of complexity and uncertainty.

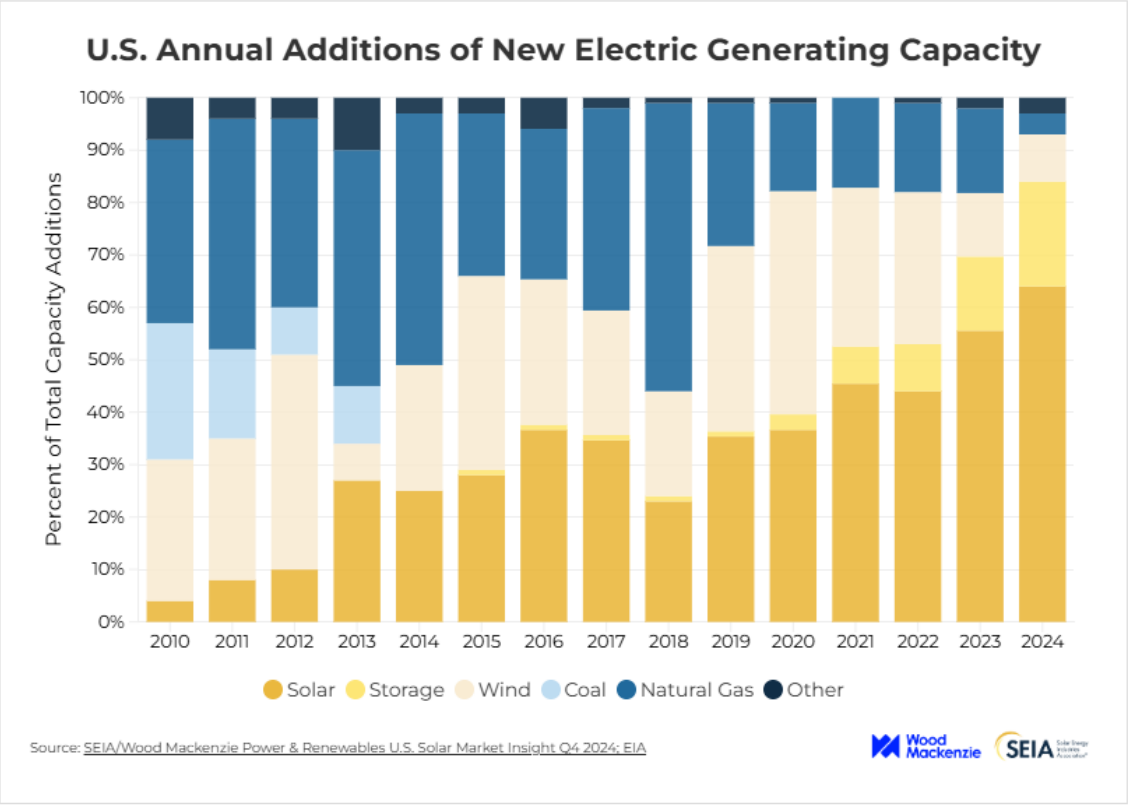
EXISTING HEADWINDS FOR THE SOLAR SECTOR

The US solar market has experienced significant growth in recent years supported by federal tax credit extensions and other incentives provided by the *Inflation Reduction Act* (enacted in 2022) ("IRA"), as well as ambitious and growing state-level renewable energy and carbon emissions reduction mandates. The sector has also benefitted from continually improving competitiveness of renewable energy resources versus traditional fossil-based alternatives.

[1] Solar Energy Industries Association (SEIA), Solar Market Insight Report Q4 2024. Solar Market Insight Report Q4 2024 | SEIA
[2] The White House, "Unleashing American Energy" Executive Order January 20, 2025 (https://www.whitehouse.gov/presidential-actions/2025/01/unleashing-american-energy/).
[3] US Department of Energy, "Secretary Chris Wright Delivers Welcome Remarks to DOE Staff", February 5, 2025 (https://www.energy.gov/articles/secretary-chris-wright-delivers-welcome-remarks-doe-staff).
[4] North American Reliability Counsel 2024 Long Term Reliability Assessment December 2024
[5] See Lawrence Berkeley National Laboratory, "Federal/State Jurisdictional Split: Implications for Emerging Electricity Technologies", December 2016.

During 2024 US solar deployments continued to grow strongly with nearly 50 GW of new solar capacity installed in the US. This includes the highest Q1-Q3 installations on record, with solar representing approximately two-thirds of all new electricity-generating capacity added during 2024[6].

This acceleration in solar development activity is believed to be largely attributed to new and refreshed incentives provided under the IRA, including extensions to federal investment and production tax credits for renewable energy assets ("Renewable Tax Credits"), coupled with an enhanced ability for project owners to monetize these credits via direct transfer to third-party buyers instead of existing complex tax equity structures.



Source: SEIA (Solar Market Insight Report Q4 2024 | SEIA)

Since 2020, power prices applicable to renewable generators have on average risen across the US[7]. For example, pricing for renewables power purchase agreements ("PPAs") have roughly doubled since 2020[8]. Our observations of some of the contributing factors leading to this increase in prices is set out below.

Transmission and distribution constraints: There are physical and system limitations impacting new development, principally related to transmission bottlenecks and the increasing time and cost involved in obtaining grid connection for new projects. While for projects built in the

[6] Solar Energy Industries Association (SEIA), Solar Market Insight Report 2024 Year in Review. Solar Market Insight Report 2024 Year in Review | SEIA
[7] Federal Energy Regulatory Commission, State of the Market Reports for 2020, 2021, 2022, and 2023.
[8] LevelTen Energy, Q4 2024 PPA Price Index, December 2024. PPA Price Index Executive Summary

2000-2007 period, the timeline from initial grid connection request to completion was less than 2-years, this has increased to over 4-years for projects built in 2018-2023, and is expected to increase further with additional growth in grid connection queues[9].

Land and planning constraints: This physical constraint also extends to reduced availability of viable land for development due to local and state restrictions and resistance to new renewable development. A recent study by Columbia Law School found that there were approximately 400 local-level restrictions to new renewable energy development across 41 US states, in addition to 19 state-level restrictions, that may materially hinder or block renewable energy development in impacted areas, representing a material increase from the prior year's study[10].

Trade policy: Rising applicable and mooted tariffs, reinforced by deglobalization trends, are impacting global supply chains for solar modules and related equipment. To give one example, in January 2025, imported solar cells and modules faced tariffs and duties of up to 51% depending on country of origin, particularly impacting imports from China and Southeast Asia[11] – and China presently accounts for more than 80% of global polysilicon solar manufacturing capacity[12], meaning potential bottlenecks to importing significant volumes from other countries. These tariffs maintain bipartisan support, and face significant potential for increase under the Trump Administration's planned and proposed tariffs. While the IRA has encouraged significant investment in new US domestic manufacturing capacity for solar modules (for example, a total of approximately $40 billion of new investment in US solar manufacturing capacity has been announced since the enactment of the IRA in 2022, of which approximately $9 billion relates to now operational facilities[13]), this new domestic capacity is not yet sufficient to replace the volume of imports from foreign producers. While US domestic solar module manufacturing capacity now exceeds 50GW, which is enough to satisfy approximately all forecast US domestic demand in 2025[14], this domestic capacity remains heavily reliant on imported wafers and cells, and as such analysts expect the US solar industry to remain dependent on imported inputs and components for a number of years to come[15].

Construction costs: Additional constraints relate to the wider construction supply chain and construction costs. In addition to pricing pressures from solar tariffs, supply chain constraints continue to impact the cost of developing new solar projects more broadly. For example, according to data from SEIA, transformer costs for solar projects increased by approximately 25% in 2023 alone due to supply shortages[16], and transformer order lead times have more than doubled increasing from an average of around 50 weeks in 2021 to around 120 weeks in 2024[17]. Increasing labour and engineering costs are also impacting delivery costs, with construction labour costs and engineering costs for utility-scale solar projects increasing approximately 23%

[9] Lawrence Berkeley National Laboratory, Queued Up – 2024 Edition. (Grid connection backlog grows by 30% in 2023, dominated by requests for solar, wind, and energy storage | Energy Markets & Policy (lbl.gov))
[10] Columbia Law School, Opposition to Renewable Energy Facilities in the United States – June 2024 Edition. (Opposition to Renewable Energy Facilities in the United States: June 2024 Edition | Sabin Center for Climate Change Law (columbia.edu))
[11] Clean Energy Associates, Potential Impacts of the 2024 Antidumping and Countervailing Duties on the U.S. Solar Industry. (PowerPoint Presentation (acore.org))
[12] Wood Mackenzie (China to hold over 80% of global solar manufacturing capacity from 2023-26 | Wood Mackenzie)
[13] Solar Energy Industries Association, Solar & Storage Supply Chain Dashboard, as of February 2025 (Solar & Storage Supply Chain Dashboard – SEIA)
[14] Solar Energy Industries Association, Solar & Storage Supply Chain Dashboard, as of February 2025 (Solar & Storage Supply Chain Dashboard – SEIA)
[15] Wood Mackenzie (China to hold over 80% of global solar manufacturing capacity from 2023-26 | Wood Mackenzie)
[16] Solar Energy Industries Association (SEIA), Solar Market Insight Report Q2 2024. Solar Market Insight Report Q2 2024 | SEIA
[17] Wood Mackenzie (Supply shortages and an inflexible market give rise to high power transformer lead times | Wood Mackenzie)

and 22% respectively over 2023[18]. As noted above, while significant investment in domestic supply chains is ongoing, this will not be an immediate solution to the pressures noted above and will take many years to fully play out.

DEMAND GROWTH

On the demand side, new deployment continues to be supported by ambitious renewable energy mandates in many US states, with 24 US states having net-zero electricity targets, 13 of which are mandated by state legislation,[19] alongside the continued cost competitiveness of solar and other renewable generation versus fossil fuel resources[20]. The multifaceted appeal of solar generation is evidenced by the top three US states for new solar installations since 2022: California, Texas and Florida. California has set ambitious clean electricity goals at a state level, with a 2045 net-zero target. While renewable energy targets for Texas are limited, and Florida has no binding target, the growth in solar is a result of local and corporate renewable objectives or solely driven by the competitiveness of solar versus other generation resources. While the implementation of the Energy Order could potentially disrupt some of these mandates, much of the legal authority and jurisdiction to set energy supply rules and regulations sits with state and local governments, and not the federal government[21], reinforcing the durability of these mandates.

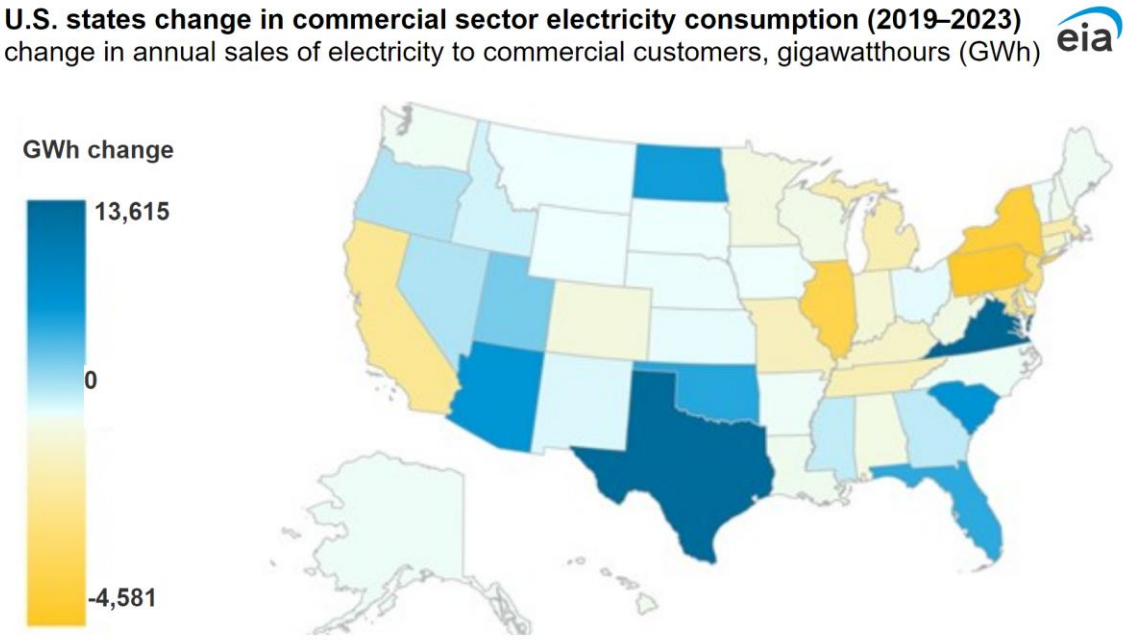
Like many other advanced economies, and consistent with existing deglobalization themes, bipartisan US industrial policy is presently focused on encouraging onshoring industrial capacity, as well as investment in domestic manufacturing and technology[22], albeit with some differences in preferred strategies to achieve these goals.

Recent resource planning documents from major US utilities indicate that significant investment in data centres, manufacturing and other electricity-intensive facilities is forecast to drive increases in medium-term load growth forecasts in the US. For example, in 2023, US 5-year load growth rate forecasts increased by approximately 81% year-on-year (from 2.6% over 5-years for the 2022 forecast to 4.7% for the 2023 forecast), reflecting a forecast increase in national peak demand by 38GW for the 2024-2028 period[23].

As one regional example, Duke Energy, which serves North Carolina and South Carolina, in its latest resource planning documents projected forecast peak load to increase during the 2024-2028 period by approximately 6% to 35.8GW, whereas its previous planning forecasts from 2021 indicated virtually zero growth for the corresponding period[24]. Duke indicated that the forecast load growth was due to anticipated development of manufacturing and technology projects within the Carolinas. Duke intends to satisfy these increasing load requirements with a mix of hydrogen-capable natural gas plants and solar and storage assets, with an ongoing corporate target for

[18] Solar Energy Industries Association (SEIA), Solar Market Insight Report Q2 2024. Solar Market Insight Report Q2 2024 | SEIA
[19] North Carolina Clean Energy Technology Center at NC State University, Renewable Portfolio Standards & Clean Energy Standards, as of December 2023 (Detailed Summary Maps - DSIRE)
[20] Lazard, Levelized Cost of Energy Analysis – Version 17.0. Lazard LCOE+ (June 2024)
[21] Lawrence Berkeley National Laboratory, "Federal/State Jurisdictional Split: Implications for Emerging Electricity Technologies", December 2016.
[22] US Department of Treasury, Unpacking the Boom in US Construction of Manufacturing Facilities. (Unpacking the Boom in U.S. Construction of Manufacturing Facilities | U.S. Department of the Treasury)
[23] Grid Strategies, The Era of Flat Power Demand is Over (December 2023). National-Load-Growth-Report-2023.pdf (gridstrategiesllc.com)
[24] Grid Strategies, The Era of Flat Power Demand is Over (December 2023). National-Load-Growth-Report-2023.pdf (gridstrategiesllc.com)

carbon neutrality by 2050[25]. This trend is also reflected in the chart below prepared by the US Energy Information Administration (EIA) which indicates that the highest levels of electricity demand growth from pre-pandemic levels has occurred in states with the highest levels of computer facility and data centre build-out over that period[26].



Source: EIA (Commercial electricity demand grew fastest in states with rapid computing facility growth)

All things being equal, faster buildout of new solar capacity would be expected to place downward pressure on renewable energy prices, due to the gradual improvement of panel efficiencies, and the over-supply of electricity during daylight hours. These factors could therefore be potentially value destructive for existing generation facilities. Conversely, further headwinds which deliver less new solar capacity on the grid versus current expectations, would likely increase prices (and drive valuation of existing generation facilities).

NEW CHALLENGES

The change in federal administration with the second term of President Trump has introduced significant policy outlook uncertainty for US renewables. Among other things, the Energy Order rescinds some of President Biden's energy and environmental-related Executive Orders, and the new administration plans to rescind others. These include, for example, Executive Orders relating to federal net zero energy and emissions reduction targets, and to pause the distribution of funding appropriated through the IRA and the Infrastructure Investment and Jobs Act of 2021 ("IIJA"). The

[25] Duke Energy, 2023 Carolinas Resource Plan – IRP Load Growth Update (January 2024). january-24-fact-sheet.pdf (duke-energy.com)
[26] U.S. Energy Information Administration, Commercial electricity demand grew fastest in states with rapid computing facility growth - U.S. Energy Information Administration (EIA)

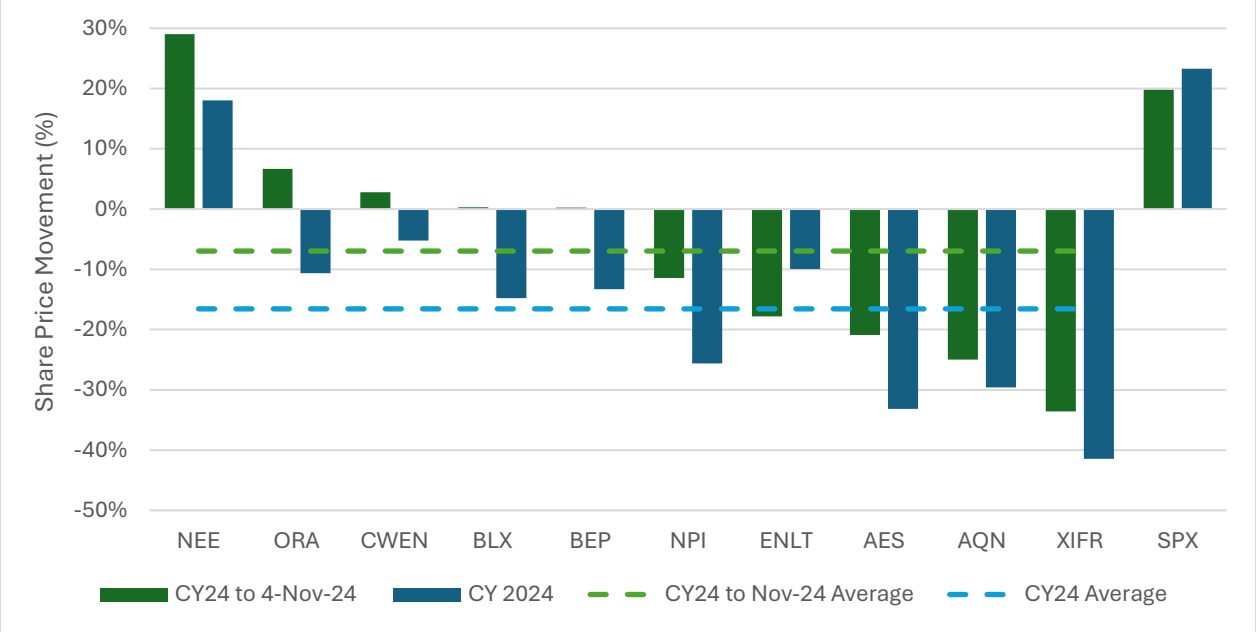
Project 2025 policy document, on which many of the new federal administration's policies are based, calls for the full repeal of both the IRA and the IIJA[27].

While much of the detail around the implementation of these actions is still to be determined, the onus has initially been placed on the heads of various government agencies to review the alignment of their current programs to the revised policy objectives. This review is expected to be completed by mid-April 2025. To date, the Energy Order has not impacted the accrual and monetization of Renewable Tax Credits. Given many Republican-leaning states are major beneficiaries under the existing federal tax credit regime for renewable energy development, Renewable Tax Credits are expected to survive any changes to the IRA, albeit in a potentially narrower form[28].

RECENT PERFORMANCE OF PUBLIC MARKETS

While individual performances within the US renewables infrastructure peer set has varied, public market valuations for the group as a whole has underperformed the broader market since the start of 2024 including during the periods before and after the US federal election in November 2024.

Share price movement % Full Year 2024 vs. to Nov 24[29]



The number of US-listed renewable energy yieldcos has declined from a peak of seven[30] to just two. There are also a number of US-listed energy companies and independent power producers

[27] The Heritage Foundation, Project 2025 (Chapter 12), as of January 2025. (2025_MandateForLeadership_CHAPTER-12.pdf)
[28] Utility Dive, "Basin Electric urges Congress to support clean energy tax credits", 6 March 2025 (Basin Electric urges Congress to support clean energy tax credits | Utility Dive)
[29] Public market data as of 1 March 2025.
[30] See Mauricio Mitidieri, "The Evolution of the Yieldco Structure in the United States" April 13, 2020 (https://www.stern.nyu.edu/sites/default/files/assets/documents/Mitidieri_Glucksman%20Paper_final_200526.pdf)

("IPPs") with sizeable renewable energy generation fleets that are significant contributors to earnings. Overall, nine of the ten companies within the peer set have registered negative share price performance over the 2024 calendar year versus double-digit returns for the broader market (as measured by the S&P 500 index)[31].

Share price ($/share)

Company	Ticker	Currency	31-Dec-23	4-Nov-24	31-Dec-24
AES Corp.	AES	USD	$19.25	$15.23	$12.87
Algonquin Power & Utilities	AQN	USD	$6.32	$4.74	$4.45
Boralex	BLX	CAD	$33.68	$33.78	$28.71
Brookfield Renewable Partners	BEP	USD	$26.28	$26.34	$22.79
Clearway Energy	CWEN	USD	$27.43	$28.20	$26.00
Enlight Renewable Energy	ENLT	USD	$19.14	$15.73	$17.24
NextEra Energy	NEE	USD	$60.74	$78.37	$71.69
Northland Power	NPI	CAD	$24.07	$21.32	$17.90
Ormat Technologies	ORA	USD	$75.79	$80.86	$67.72
XPLR Infrastructure	XIFR	USD	$30.41	$20.19	$17.80
S&P 500 Index	SPX	USD	4,769.83	5,712.69	5,881.63

This extended pressure on public market valuations for listed US renewables companies reflects the current challenges in the sector including from increased uncertainty, higher interest rates, and a more cautious investor base.

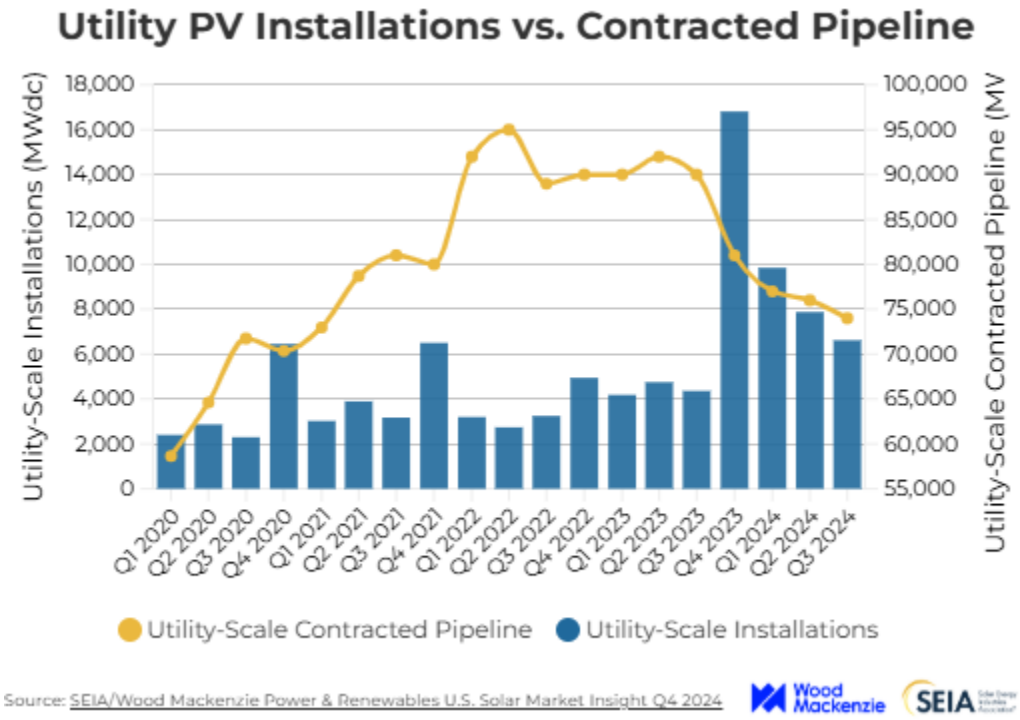
The remaining US renewable energy yieldcos (Clearway Energy & XPLR Infrastructure) have both recently pivoted away from acquisition models supported by new equity issuance and instead now pursue self-funded growth plans to support total return profiles promised to investors[32]. During its Fourth Quarter 2024 earnings call, Brookfield Renewable Partners indicated that while it was still seeing robust private market demand for high-quality operating assets, especially for those with a growth angle, public market sentiment towards US renewable energy remained weak[33]. Additionally, in mid-2024, following pressure from an activist investor to refocus on its regulated utility business to improve its share price[34], Algonquin Power & Utilities announced the sale of its renewable energy fleet and its stake in yieldco Atlantica Sustainable Infrastructure to two energy private equity funds[35].

RECENT PERFORMANCE OF PRIVATE MARKET

While recent public company reporting indicated that private market demand and sentiment for US renewable energy assets remains more favourable than public markets, recent market commentary and reporting also indicates that applicable discount rates for such renewable energy

[31] Public market data as of 1 March 2025. Return performance calculation assumes equal weight portfolio.
[32] Public company filings, including XPLR Infrastructure, LP January 2025 Business Update, and Clearway Energy, Inc. Fourth Quarter 2024 Results.
[33] Brookfield Renewable Partners FY 2024 Results release & transcript, January 2025
[34] Starboard Value – Letter to AQN Board, July 2023 (Starboard_Value_LP_Letter_to_AQN_Board_07.06.2023.pdf)
[35] Algonquin Power & Utilities Corp Q2 2024 Results presentation & related public company filings, August 2024

assets have increased by up to several hundred basis points[36] over the past 12 months. This has been attributed to higher-for-longer interest rate assumptions [37], but also due to increased market uncertainty and the growing supply/demand imbalance in secondary markets for operating renewable energy assets[38]. The number of operational projects has increased significantly over the last 24 months.



A surplus of completed projects being offered to the market would likely, all other things being equal, reduce the prices achieved from those sales processes. A significant surplus could even lead to opportunistic behaviour from buyers and a deviation from the fundamental value of those assets.[39]

Developers may see an increasing need to recycle capital from operational projects, due to the need to fund longer and more expensive development cycles[40], as a result of the Energy Order, or from the compounding of headwinds facing the sector. Evidence of this is currently anecdotal but several supporting trends can be identified, as follows:

1. Recent reporting also indicates that developer fees for pre-construction renewable energy assets, and particularly for early and mid-stage assets, declined materially in 2024 versus prior years as perceived development risk increased, and investors turned more cautious[41].

[36] Authors own insight based on private market datapoints
[37] LevelTen Energy, "Renewable M&A State of the Market Report – H2 2024", March 2025, public company filings as of January 2025.
[38] LevelTen Energy, "Renewable M&A State of the Market Report – H2 2024", March 2025
[39] https://doi.org/10.1016/j.tre.2023.103021
[40] LevelTen Energy, "Renewable M&A State of the Market Report – H2 2024", March 2025
[41] LevelTen Energy, "Renewable M&A State of the Market Report – H2 2024", March 2025

2. The transaction volume for US renewable energy development platforms fell sharply from 2023 to 2024, while the transaction volume for the total US renewable energy assets (development and operational) marginally increased in 2024 versus 2023[42]

SECTOR OUTLOOK

We believe that the overall outlook for continued growth in the US solar market remains strong. Solar, along with wind and energy storage, have rapidly become valued parts of the US energy supply system. While the immediate outlook for the development and construction of new solar assets faces heightened uncertainty from potential changes in federal energy policy, the long-term trends related to energy demand and cost competitiveness provide compelling support for the continued build out of solar generation. For existing assets, we believe that renewable energy incentives and state level policies and mandates will encourage existing asset valuations to remain resilient: these assets should continue to play an important role in the US energy system.

Over the near term, our view is that the uncertainty in the market will likely result in higher volatility in the valuations of both development and operational assets. We see this because of potential imbalances in the number of buyers versus sellers within M&A for solar generation assets, greater uncertainty in the timing and returns from development activity and a tougher capital raising environment in both the public and private markets. The rate of build out of new solar development is an area where, in our view, the fortunes of developers and the owners of operational assets deviate. Quicker build out may favour developers and increase the supply of renewable electricity, possibly leading to lower energy prices. Slower build out may have the opposite impact and benefit owners of existing operational assets.

[42] Solar Energy Industries Association (SEIA), Solar Market Insight Report Q4 2024. Solar Market Insight Report Q4 2024 | SEIA