



OPPORTUNITIES IN THE ENERGY TRANSITION

RENEWABLE ENERGY OPERATIONS & MAINTENANCE

Q2 2023

Exploring opportunities in the energy transition

As renewable energy becomes an increasingly important component of the energy landscape, the reliability of generation assets is critical. To minimize downtime and intermittency and maximize supply and returns, wind and solar operators must have reliable operations and maintenance (O&M), creating significant opportunity for both providers and investors.

Where are we today?

- Current wind and solar O&M market landscape
- Historical strategic and private equity investment in the sector

Where are we headed?

- Market sizing and strategic outlook
- Major market trends and focus areas

Key considerations for investors

- Opportunities and risks in the sector
- Key characteristics and drivers of value

Scope

- For the purposes of this discussion, we have focused exclusively on the United States market.

Overview of renewable energy O&M

Operations and maintenance is a broad category that includes essential services throughout the life cycle of an asset, from the point of commissioning through end-of-life management.



Commissioning

Preventive Maintenance

Asset Management

Break-Fix Maintenance

Testing, Inspection, & Compliance

End of Life

Beginning-of-life services to test generation assets and connect them to the grid

Ongoing services to maximize uptime and efficiency and avoid costly repairs

Technology and services to support portfolio monitoring and identify and address issues in real time

Technician-driven services to rapidly address issues and get assets back online

Certified experts testing and inspecting assets to ensure compliance with safety standards and regulatory requirements

Safe and efficient decommissioning and removal of assets to prepare for upgrade or replacement

- A necessary step in the development of new generation sources
- Beginning of the life cycle and the catalyst for future services

- Extends the life of assets and limits unexpected downtime
- Spend in this category can lessen break-fix maintenance costs

- Minimizes downtime and maximizes productivity and profitability
- Driven by technology advancement and continued investment in renewable energy

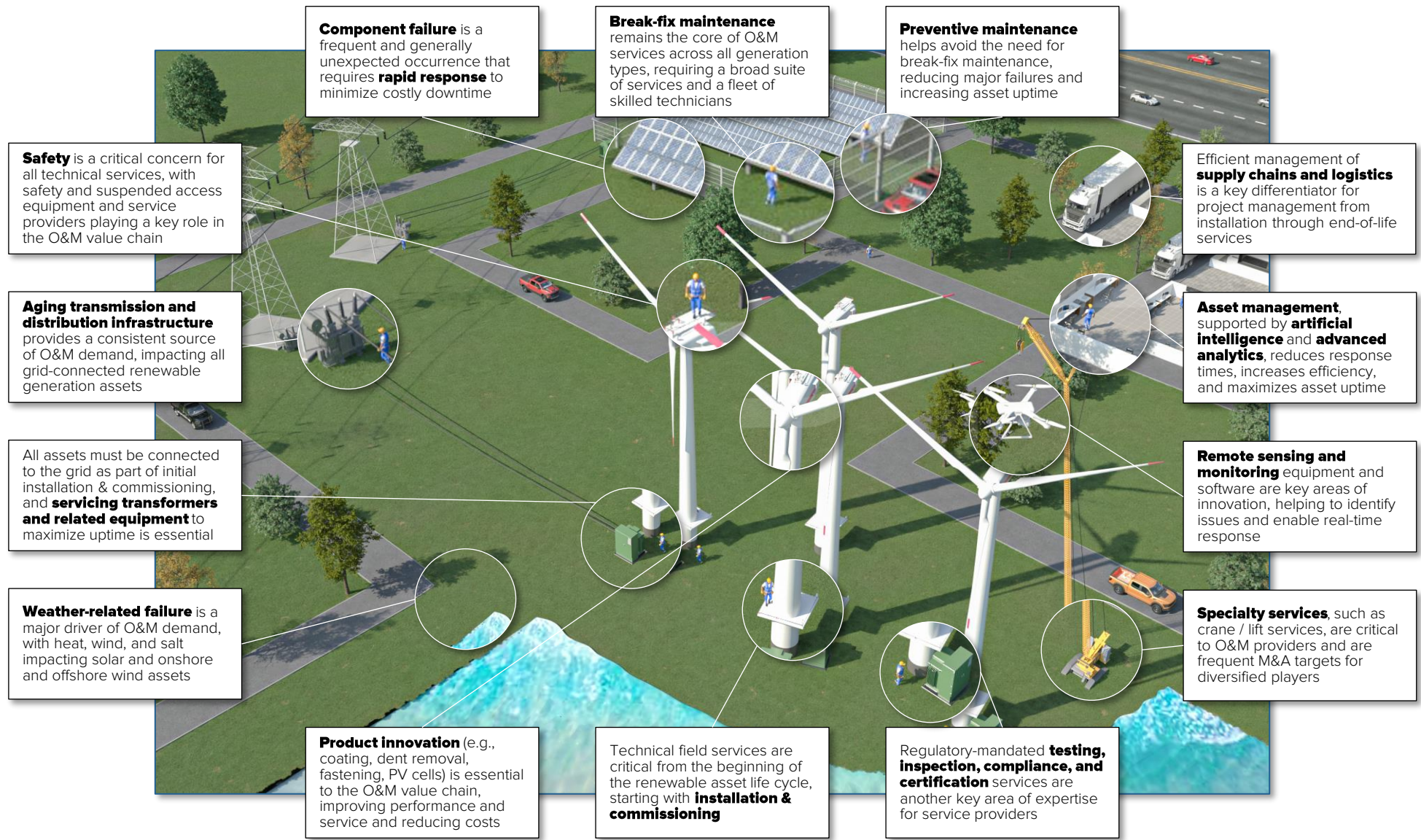
- Mission-critical repair services across the renewables landscape
- Essential to the productivity and longevity of critical power infrastructure

- Ensures compliance with legal statutes and safe / effective use
- Protects the workforce and assets through standardized monitoring

- Dismantling and replacement of large and complex assets
- Specialized services and equipment due to the unique nature and location of renewable assets

Exploring the breadth of renewable O&M services

The wide range of renewable energy O&M services contributes to the fragmentation of the industry and enhances the scarcity value of integrated providers of scale.



Why O&M matters: Key reasons generating assets fail

As renewable energy generation increases, optimizing and maintaining the performance of renewable assets becomes essential to ensuring a reliable power supply.

Risks to Renewable Assets are Constant...¹

? Component Failure

Operating assets rely on precise design and manufacturing of mission-critical components to operate properly. Components must be manufactured correctly to avoid unexpected downtime and repair costs

? Fatigue Failure

Operating assets can experience failure due to extensive use without the appropriate level of preventive maintenance and monitoring

? Weather-Related Failure

Renewable operating assets are generally susceptible to outages and damage related to extreme weather events, given that these assets generate power through their exposure to the elements

? Supply Chain

Renewable component manufacturing has been slowed by the same supply chain obstacles facing manufacturers across all industries

? Aging Infrastructure

As renewable energy gains momentum and more generation assets are built and connected to the grid, it is essential to maintain and update legacy assets



...Driving Demand for Innovative Solutions and Consistent Care

✓ Product Innovation

Artificial intelligence, robotics, new raw materials, improved maintenance measures (e.g., coating, bolting), and software innovation all contribute to strengthening operating assets and avoiding issues in the field

✓ Preventive Maintenance

Investing in a robust preventive maintenance plan can extend an asset's useful life and work to minimize unexpected downtime and significant repair costs

✓ Enhanced Asset Monitoring

The use of enhanced asset monitoring through drones and tech-enabled platforms, when combined with careful site selection, can ensure operating assets are operating as close to capacity as possible

✓ Strength of Supply Chain

As supply chain conditions improve, streamlined production channels could accelerate renewable generation growth and improve grid resiliency

✓ Resilience and Connectivity

Infrastructure upgrades, modernized equipment, and consistent maintenance and repair allow for gradual grid expansion and hardening as new assets are brought online

Aging infrastructure will enhance the need for O&M

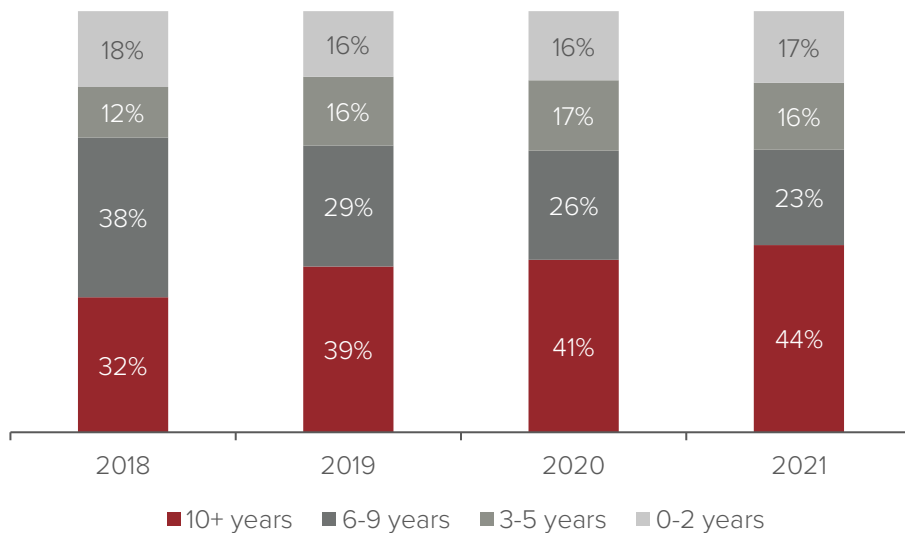
As generating assets age, they become gradually less effective and may require increased servicing due to fatigue failure, component failure, weather-related failure, or routine break-fix events, driving increased O&M costs.

- While new capacity comes online every year, the existing installed base is aging quickly as the first generation of wind and solar assets reaches the end of its useful life¹
- As generating assets age, they can gradually lose efficacy, with wind turbine output declining approximately 1.0% per year of service²
 - By the time a turbine is 15-20 years old, it averages roughly 75% of its early-year performance³
 - As these assets age, failures become more common, meaning O&M costs increase as performance decreases³
- As wind turbines reach their retirement age, they can be replaced with newer, more efficient turbines; this results in more energy generation over the same area, but creates demand (and challenges) around decommissioning, new installation, and turbine recycling
- Utility-scale solar PV infrastructure also sees a performance decline with age, with the average plant capacity factor declining ~1.2% for each year of service
- While solar assets see a similar decline to wind assets, the installed base is younger in the aggregate, with the average plant just ~4.6 years old

Aging Wind Infrastructure¹

(age of installed wind turbine base as of year-end)

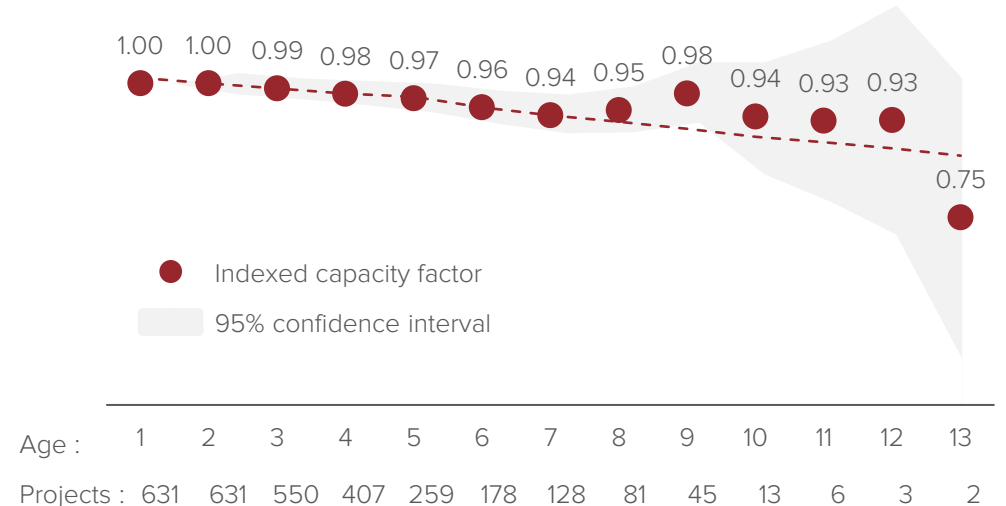
While improving technology and new capacity additions may flatten the curve going forward, the existing installed base is aging quickly and underscoring the need for reliable O&M service providers



Solar Performance Declines with Age⁴

(indexed capacity factor by year of service, current utility-scale installed base)

While the utility-scale solar installed base is relatively young, it also exhibits declining performance with age at a -1.2% annual rate



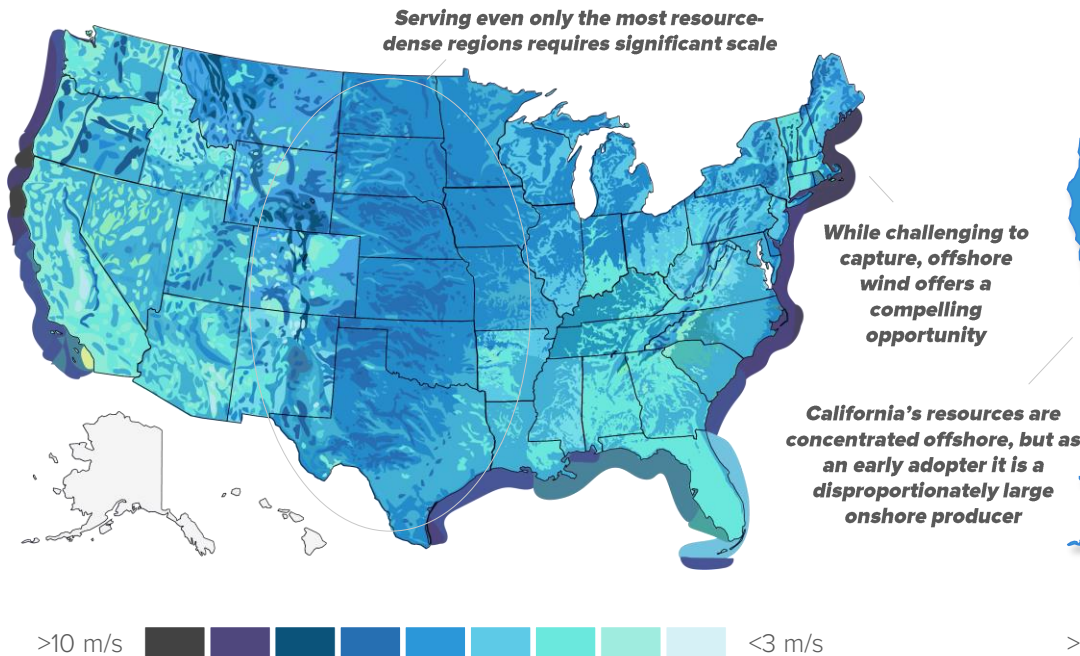
Why scale matters (wind)

Renewable generation resources are distributed across the United States, with wind and solar assets allocated differently based on the prevalence of those resource types, creating substantial value for scale players that can service a variety of generation types across a broad footprint.

- Wind generation is a truly national endeavor, with wind speeds (and thus power generation opportunities) concentrated on the coasts and in the center of the country
- Coastal resources are concentrated offshore, where high wind speeds offer remarkable power generation potential
 - The drive to capture these resources has led to an inflection point in the offshore wind market; there is over 40,000 MW of offshore wind capacity in the current U.S. project pipeline, compared to less than 50 MW of installed capacity¹
 - Exposure to the elements makes offshore operation particularly demanding on hardware and equipment, requiring enhanced monitoring and maintenance services
- Service providers with the reach to cover a national footprint and the capabilities to service onshore and offshore assets and related equipment are scarce; providers that can also service solar, storage, and distributed generation assets are rarer still

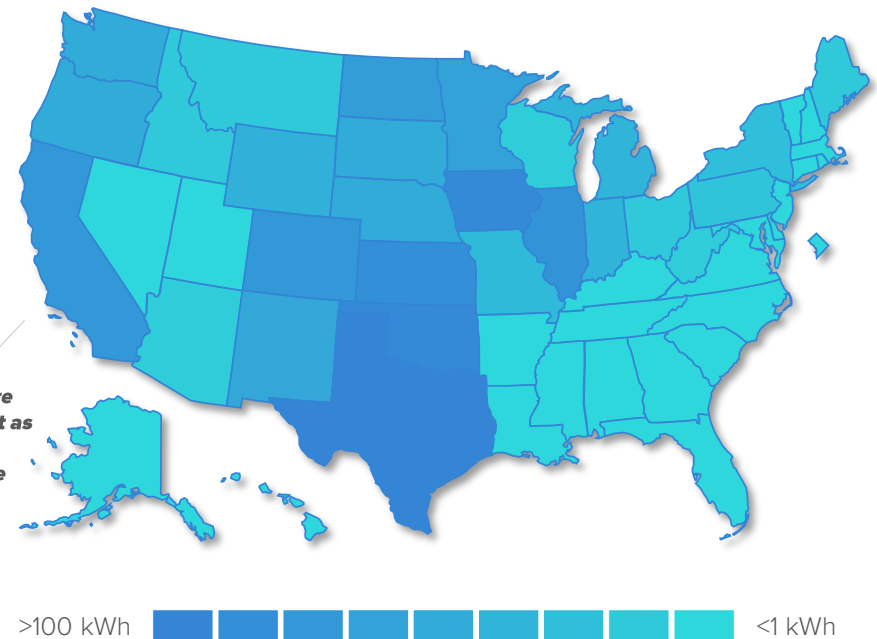
Wind Resource Distribution²

(average wind speed in meters / second at 100M altitude)



Wind Generation by State³

(billion kWh, 2021)



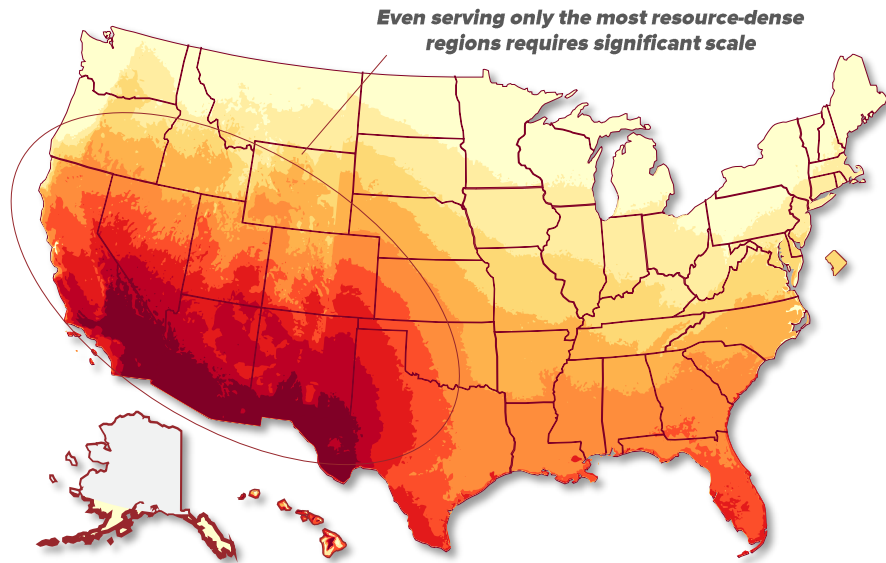
Why scale matters (solar)

Renewable generation resources are distributed across the United States, with wind and solar assets allocated differently based on the prevalence of those resource types, creating substantial value for scale players that can service a variety of generation types across a broad footprint.

- While peak solar irradiance is largely concentrated in the U.S. South and Southwest, utility-scale solar is distributed nationwide
 - Policy differences at the state level have created differing incentives for developers, leading to a mismatch between resource distribution and solar generation in some areas (notably in the South, where generation lags relative resource distribution, and in the Northeast, where generation exceeds relative resource distribution)
- As with wind assets, the broad distribution of generating assets makes scale immensely valuable
 - Utilities with large regional footprints and developers and EPCs with regional or national footprints must mix and match O&M providers across their service areas
- While there is no corollary in the solar industry to the increase in capacity and complexity coming with the expected surge in offshore wind generation, the proliferation of distributed generation and community and residential solar promises a significant upturn in the breadth and distribution of solar O&M demand

Solar Resource Distribution¹

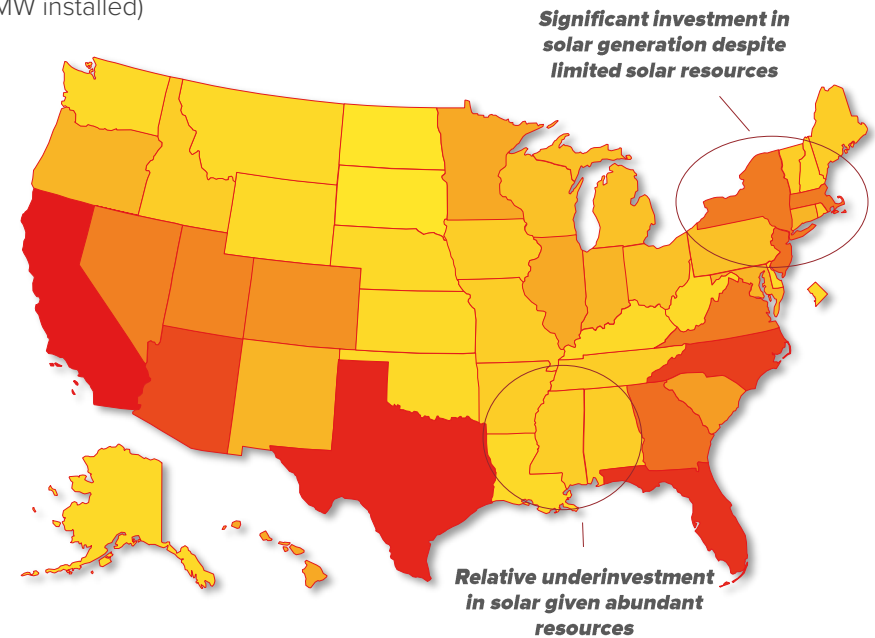
(horizontal solar irradiance; kWh/m²/day)



>5.75 kWh/m²/day <4 kWh/m²/day

Solar Generation by State²

(MW installed)



>30,000 MW <100 MW

Exploring technology and innovation across the industry



Renewable energy O&M is a hotbed of innovation, with new technologies consistently enhancing the ability of providers to offer effective service while creating opportunities for investors to capitalize.

Key Trends Relevant to Renewable Energy

Offshore wind growth



Offshore wind capacity is expected to grow rapidly in the United States, driving growth and demanding innovation as offshore assets have unique demands requiring specialized services and technology

Asset management and remote monitoring



Innovation in monitoring and management software helps generation assets run more efficiently and reduces long-term operational costs

Product innovation



Product improvements, including advanced turbine coatings, improved solar panels, lift tech, industrial bolting, dent removal equipment, and advanced drone technology are improving O&M capabilities and reducing costs

Artificial intelligence



Artificial intelligence uses large data sets to find patterns that help increase efficiency, reduce downtime, and lower operational costs

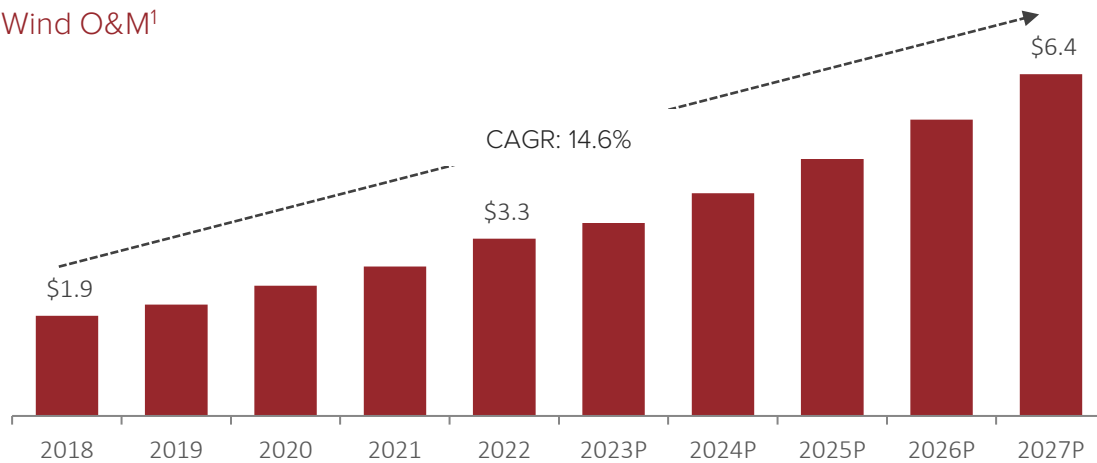
Renewable O&M offers enormous near-term opportunity

Public and private spending has remained focused on advancing the energy transition, and recent legislation will act as a catalyst for sustained growth in adjacent markets like O&M.

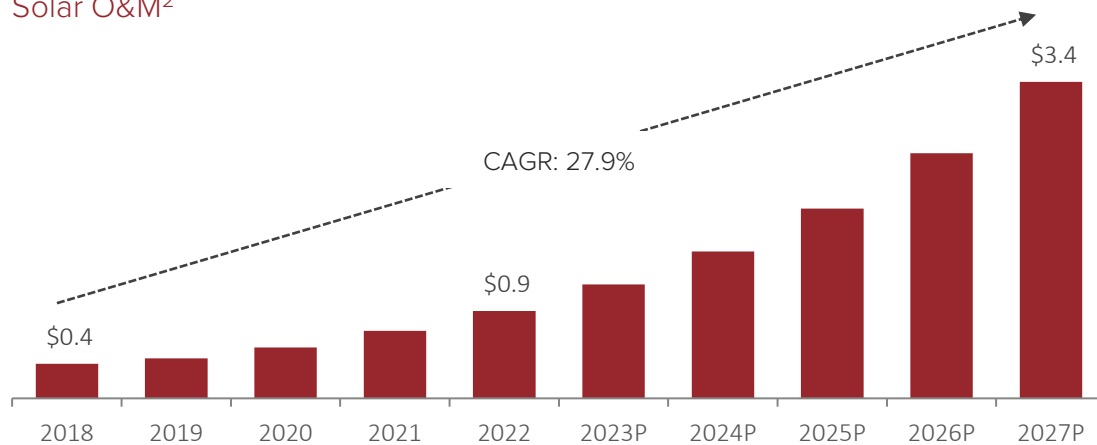
Renewable Energy O&M Spending^{1,2}

(\$ in billions)

Wind O&M¹



Solar O&M²



Key Drivers of Renewable Energy O&M Spending Growth

Renewable Generation Growth	Focus on Sustainability
<ul style="list-style-type: none"> The global shift away from fossil-based energy production and consumption is driving demand for efficient energy management services, which is driving renewable energy sources to become a larger portion of total U.S. generation 	<ul style="list-style-type: none"> Aggressive state, federal, and private decarbonization goals and increasing investor appetite for sustainability create new opportunities for climate-friendly innovation and adjacent O&M activities to support new technology and infrastructure
Increasing Grid Complexity	Aging Grid Infrastructure
<ul style="list-style-type: none"> The ongoing electrification of the U.S. grid and the proliferation of related advancements like EVs, microgrids, and distributed generation are creating a greater need for improved grid reliability and resilience 	<ul style="list-style-type: none"> Aging energy infrastructure and the simultaneous buildout of grid-connected assets require substantial investment in O&M to ensure functionality and extend longevity
Federal Funding	Digitalization of the Grid
<ul style="list-style-type: none"> Adoption of the IJJA³ and IRA⁴ has acted as a catalyst for investment in renewable energy and is driving adjacent spending in O&M 	<ul style="list-style-type: none"> Technology advancements have been a major driver of growth as more tech-enabled assets are connected to the grid

1. U.S. DoE
2. EIA

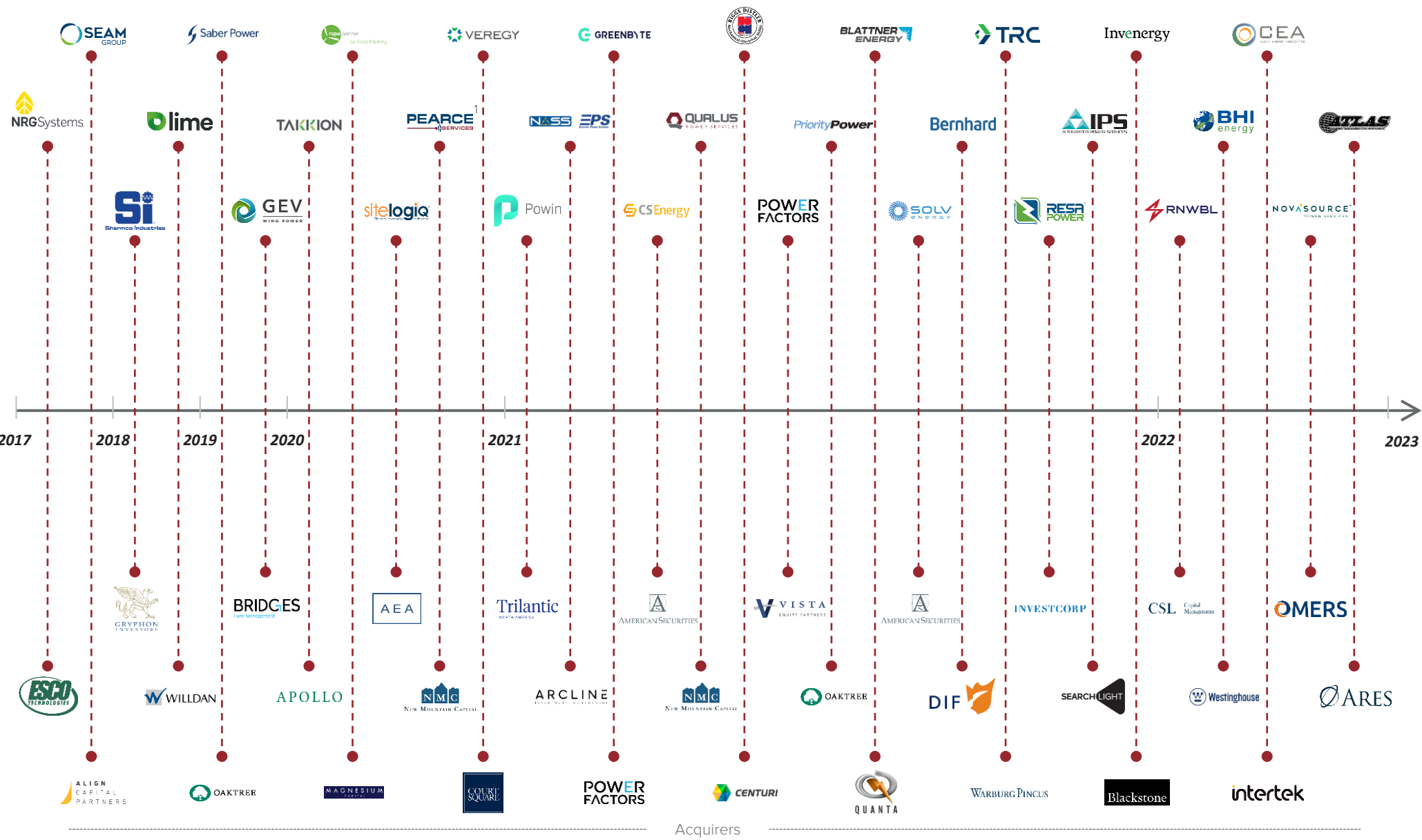
3. IJJA refers to the Infrastructure Investment and Jobs Act
4. IRA refers to the Inflation Reduction Act

Long history of sector M&A

The evolution of the renewable energy O&M market has driven significant M&A activity.

Targets

Acquirers

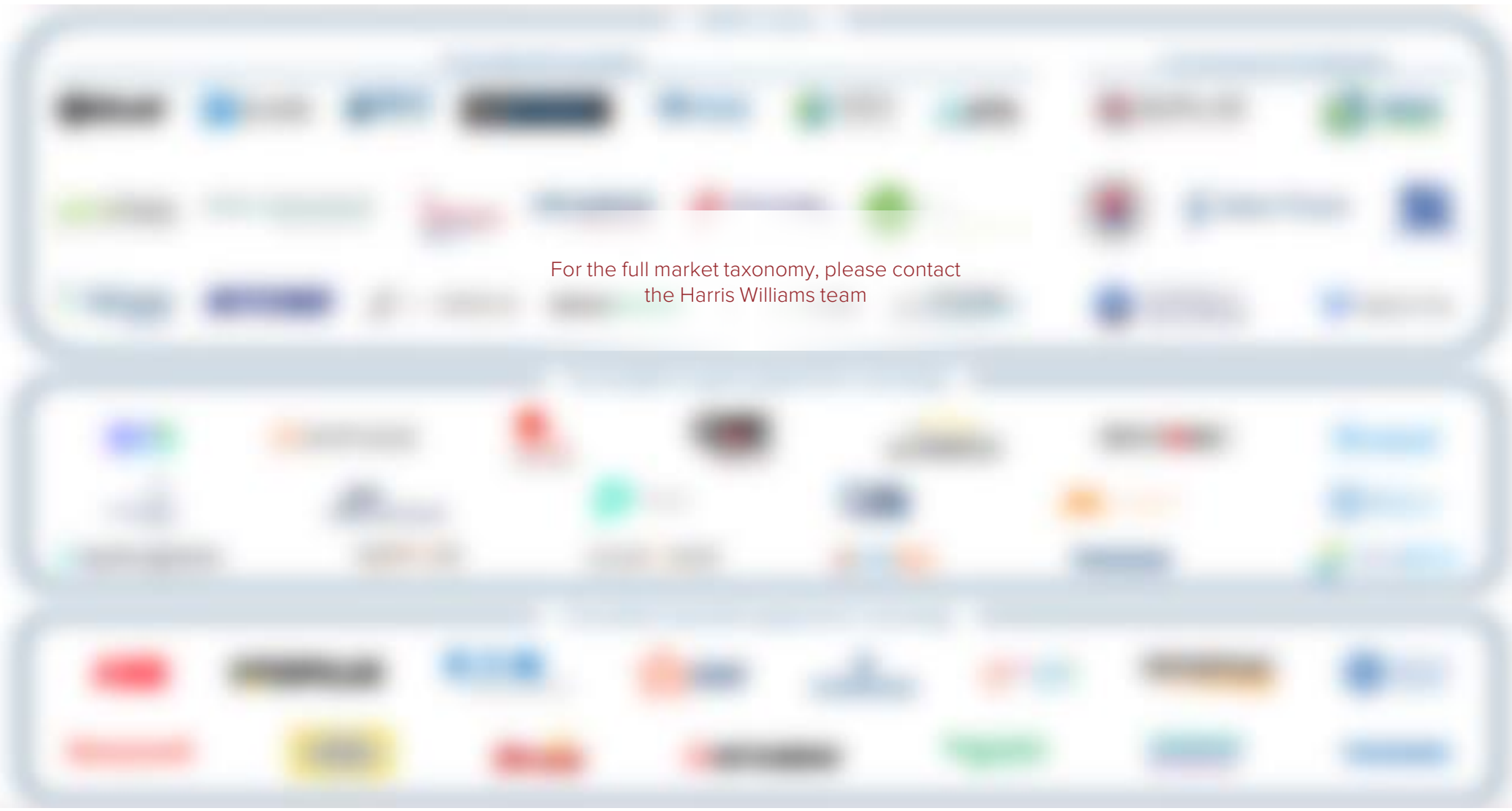


¹ Pearce Services announced the acquisition of MaxGen Energy Services and World Wind & Solar simultaneously with its partnership with New Mountain Capital.

Current renewable energy O&M market landscape

The renewable O&M market remains fragmented, with many market participants focused on specific disciplines and few diversified and mature businesses active in the space.

Renewable O&M Market Participant Taxonomy



For the full market taxonomy, please contact the Harris Williams team

Overview of sponsor-backed companies in the sector

The renewable energy O&M market has seen considerable investment activity from private equity players, with sponsor-backed platforms in pure-play renewable energy O&M, transmission and distribution O&M, and adjacent services.










Select Private Renewable Energy O&M Market Participants

Company	Business Description	Ownership	Headquarters
<p>For the full list of platforms, please contact the Harris Williams team</p>			

Understanding the renewable energy O&M value chain

O&M providers are a critical node in a complex renewable energy value chain that includes equipment OEMs, asset developers and operators, service providers, hardware and software developers, utilities, and end consumers of energy.

Renewable Energy Value Chain Participants

 <p>Equipment and Component Manufacturers</p>	<ul style="list-style-type: none"> Manufacture and distribute key inputs for renewable energy generation assets, including solar panels, wind blades, turbines, motors, and mounting and racking systems
 <p>Developers and EPCs</p>	<ul style="list-style-type: none"> Developers and engineering firms that design and construct renewable energy generation sites and assets
 <p>Operators</p>	<ul style="list-style-type: none"> Companies that own or lease renewable energy generation assets for the purpose of producing and supplying energy to the grid
 <p>Auxiliary Product and Service Providers</p>	<ul style="list-style-type: none"> Hardware and software companies that produce goods and services aimed at the operation, monitoring, management, and protection of renewable energy assets
 <p>Installation & Maintenance</p>	<ul style="list-style-type: none"> Specialized service providers focused on the installation and ongoing maintenance of renewable assets
 <p>Testing, Inspection, and Compliance</p>	<ul style="list-style-type: none"> Specialists who can inspect equipment and certify regulatory compliance and safety
 <p>Distributed Generation</p>	<ul style="list-style-type: none"> Decentralized energy generation using small-site grid-connected devices (e.g., residential solar, microgrids)
 <p>Utilities</p>	<ul style="list-style-type: none"> Utilities manage the transmission and distribution of power across the electric grid, including from solar and wind sites
 <p>Energy Consumers</p>	<ul style="list-style-type: none"> Commercial entities and residences connected to the power grid or to distributed generation assets
 <p>Investors / Financiers</p>	<ul style="list-style-type: none"> Corporations, private equity firms, and other investors focused on deploying capital into renewable energy generation and adjacent products and services
 <p>Government</p>	<ul style="list-style-type: none"> Lawmakers and regulators making and enforcing policy to incentivize and manage renewable energy generation, operation, and maintenance

Considerations for investors in the U.S. renewable energy O&M market

What Should Investors Be Looking For?



Technical expertise
and talent hiring,
training, and retention



Breadth of **service offering** across wind and solar assets



Proven **track record** of project execution and organic growth



Sales **pipeline** execution and cross-sell potential



Safety performance



M&A capabilities



Geographic coverage



Business **analytics** and reporting



Hardware and software **innovation**



Depth of **customer relationships**

Explore More Opportunities in the Energy Transition

Observations

Economic Outlook

- While the Fed has stated it remains committed to bringing down inflation, it risks hiking rates into a softening economic backdrop
- Ukraine / Russia conflict is creating heightened geopolitical risk

Buyer Sentiment

- Sponsors are reviewing new opportunities, but the bar is high, and they are increasingly cautious about aggressively pursuing platforms in the current environment
- There is a greater emphasis on small deals and tuck-ins
- Uncertainty in the debt market is acting as a driving force for lower deal activity

Debt Markets

- Debt markets have cooled with a heightened focus on quality and substantial increases to pricing as the rate environment continues to rise
- Given the challenging conditions in the broadly syndicated loan market, direct lenders continue to be active participants in financings

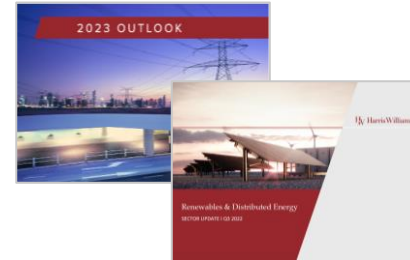
M&A Valuations

- The valuations for high-quality platforms have been less impacted, although leverage multiples are down from this time last year, driving larger equity checks from buyers and compressing the ability to underwrite high valuations

Latest HW Market insights



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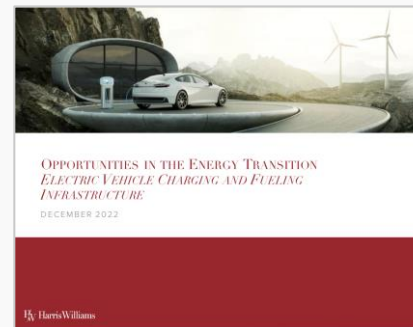


Recent Publications:

Energy, Power & Infrastructure | 2023 Outlook

Renewable & Distributed Energy Industry Updates

Opportunities in the Energy Transition: Electric Vehicle Charging and Fueling Infrastructure [\(click here\)](#)



Insight includes:

- EV and fueling infrastructure today
- Challenges to overcome for EV adoption
- Understanding the EV charging value chain
- The market landscape
- M&A history in the sector
- Key considerations for investors

Sector expertise through industry focus

Energy, Power & Infrastructure (EPI) Group



Vertical Focus Areas

- Energy Management & Technology
- **Renewables & Distributed Energy**
- Infrastructure Services
- Environmental Services
- Engineering & Construction
- Utility & Telecom Services
- TICC

Renewables & Distributed Energy

- Technology, Products & Equipment
- Engineering, Procurement & Construction (EPC)
- Operations & Maintenance
- Professional Services
- Electric Vehicles & E-Mobility
- Software & Climate Tech
- Residential Installers

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Select Renewables & Distributed Energy Transactions

 a portfolio company of has been acquired by 	Leading provider of equipment and services for fueling stations and EV charging infrastructure across the United States	 has been recapitalized by 	Leading operator of a nationwide mechanical services platform offering a host of essential building services	 a portfolio company of has been acquired by a portfolio company of 	Leading provider of maintenance, technical, and radiation protection services to industrial, generation, and government energy markets	 has acquired a portfolio company of 	Market leader in maintenance and testing, systems integration, and related distribution services to C&I and renewables customers	 a portfolio company of has been acquired by 	Leading provider of technical building solutions for the C&I facilities market, delivering services through every phase of a building's life cycle
 a portfolio company of New Mountain Capital has been acquired by 	Leading global consulting, engineering, and construction management firm serving energy, environmental, and infrastructure markets	 a portfolio company of funds managed by has been acquired by a wholly-owned subsidiary of	Leading provider of power and utility services throughout the Northeast and Mid-Atlantic regions	 a portfolio company of has been acquired by New Mountain Capital LLC	Leading provider of engineering and specialized technical field services to utility and private power grid infrastructure	 has acquired portfolio companies of 	Leading integrated electric infrastructure services platform	 a portfolio company of has been acquired by 	Leading services company that designs, engineers, and implements eco-friendly building and system optimizations
 a portfolio company of has been acquired by 	Leading implementation and management platform for energy efficiency programs for utilities, municipalities, and states	 a portfolio company of has been acquired by Innovation and Investment in Energy	A leader in demand response and distributed energy resources in North America	 Shermao Industries a portfolio company of has been acquired by 	Leading provider of testing, commissioning, maintenance, and repair of electrical equipment and power distribution systems	 energy made better a portfolio company of has been acquired by 	Leading provider of peaking and base load capacity solutions to electric utilities, grid operators, and associated electricity markets	 has become a wholly-owned subsidiary of 	Leading designer of power electronics and systems for renewable distributed power generation applications

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