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# Global Water Free Cleaning Robot For Photovoltaic Supply, Demand and Key Producers, 2026-2032

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## Abstracts

The global Water Free Cleaning Robot For Photovoltaic market size is expected to reach $ 876 million by 2032, rising at a market growth of 9.9% CAGR during the forecast period (2026-2032).

Water Free Cleaning Robot For Photovoltaic is an automated robotic cleaning system designed to remove dust, sand, loose particles and other dry contaminants from photovoltaic module surfaces without using water during the cleaning process. The system typically integrates a mobile robotic platform, dry brushes or microfiber cleaning components, drive units, sensors, control modules and an onboard or external power supply. Depending on system design, the robot may travel along photovoltaic module rows, rails, tracker structures or predefined paths and can support automatic scheduling, autonomous movement, edge detection, obstacle avoidance, remote monitoring, automatic docking and charging.

## Key Findings

> Global Water Free Cleaning Robot For Photovoltaic production reached approximately 98.2thousand units in 2025

The global average price of Water Free Cleaning Robot For Photovoltaic was approximately US$4,563 per unit in 2025

Fully automatic systems are increasingly adopted for high-frequency cleaning at large photovoltaic stations

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Fixed Type products suit repetitive row-level cleaning while Mobile Type products provide greater deployment flexibility

Centralized photovoltaic stations represent the principal commercial application base for large-scale robotic cleaning

Market Trends

Water Free Cleaning Robot For Photovoltaic is developing from simple mechanically driven cleaning equipment toward autonomous, connected and site-integrated O&M systems. Product development increasingly emphasizes scheduled unattended operation, remote fleet management, self-charging, obstacle detection, predictive maintenance and adaptation to both fixed-tilt and single-axis tracker structures. Cleaning mechanisms are also becoming more differentiated: microfiber and controlled airflow can reduce direct mechanical loading on module surfaces, while optimized brush systems remain important for heavier dust accumulation. Ecoppia currently combines microfiber and controlled airflow with autonomous nightly operation and cloud-based management, while AirTouch has commercialized linear water-free systems combining microfiber cleaning and wind-blowing technology. The long-term direction is therefore not simply toward higher cleaning speed, but toward lower lifecycle O&M intervention, better compatibility with increasingly large PV sites and closer integration between cleaning robots, trackers, site monitoring and asset-management platforms.

# Market Dynamics

## Drivers

The expansion of the global photovoltaic installed base provides the fundamental demand base for Water Free Cleaning Robot For Photovoltaic. IEA PVPS estimates that approximately 698 GW of new PV capacity was installed globally in 2025, bringing cumulative capacity close to 3 TW; utility-scale systems represented about 59% of new installations. As photovoltaic assets expand into desert, semi-arid and high-dust regions, soiling losses and cleaning requirements become increasingly material to plant availability and energy yield. Water-free robotic cleaning can reduce dependence on scarce water resources and repetitive manual labor while enabling more frequent cleaning cycles, making the economics particularly attractive for large, standardized PV arrays.

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## Restraints

Adoption is constrained by initial equipment investment, site-specific structural requirements and differences in module and tracker layouts. Some fixed robotic systems require bridges, docking structures or robot-friendly array designs, increasing engineering work during both new-build and retrofit projects. In areas with low soiling levels or inexpensive labor and abundant water, the economic advantage over periodic manual or wet cleaning can be less compelling. Heavy adhesive contamination, bird droppings or certain industrial pollutants may also be difficult to remove through purely dry methods, limiting the suitability of water-free systems as a universal cleaning solution.

## Opportunities

The strongest opportunities are concentrated in large utility-scale projects, desert PV bases, single-axis tracker installations and increasingly digitalized solar O&M. New projects can be designed around robotic cleaning from the development stage, improving row continuity, docking arrangements and cross-table movement and reducing retrofit complexity. Tracker-compatible robots are particularly important as single-axis tracking gains penetration in utility-scale projects. Ecoppia's T4, for example, is designed for single-axis trackers and can cross neighboring tracker tables through dedicated bridges while operating autonomously. Distributed commercial and industrial projects also provide opportunities for lighter mobile or semi-automatic systems where a single robot can be used across multiple arrays.

## Challenges

The principal challenge is maintaining cleaning effectiveness without damaging photovoltaic glass, anti-reflective coatings, frames or tracker structures during thousands of repeated cleaning cycles. Robots must operate reliably under dust, high temperatures, wind and uneven module alignment while controlling wheel or brush loading on increasingly large and thin modules. Different site geometries also make product standardization difficult, especially when tracker gaps, row discontinuities, module orientation and terrain vary significantly. Long-term competitiveness therefore depends not only on cleaning efficiency but also on reliability, maintenance frequency, module compatibility, fleet availability and total lifecycle cost.

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## Industry Chain Analysis

The upstream supply chain includes electric motors and drive systems, lithium batteries, photovoltaic charging components, brushes and microfiber materials, sensors, controllers, communication modules, wheels and transmission components, structural metals and engineering plastics. Midstream manufacturers integrate mechanical structures, motion control, cleaning mechanisms, navigation algorithms, charging systems and remote management software into complete robotic platforms. Fixed systems generally require deeper integration with module rows, trackers, bridges and docking stations, while Mobile Type products place greater emphasis on portability, cross-site utilization and operating flexibility. Downstream users include centralized PV power stations, distributed commercial and industrial PV projects, solar asset owners, EPC contractors and O&M providers. Value is progressively shifting from standalone robot hardware toward integrated equipment, control software, fleet monitoring and lifecycle maintenance.

Segment Insights

By deployment type, Fixed Type products are particularly suited to large standardized photovoltaic stations where robots can remain permanently or semi-permanently assigned to specified rows or tracker sections and conduct high-frequency cleaning. Their advantages include low daily labor requirements and predictable cleaning schedules, although initial deployment intensity is relatively high. Mobile Type products can service multiple rows or arrays with fewer robots, reducing hardware quantity but generally requiring more transfer, navigation or operator involvement, making them more suitable for sites where permanent robot deployment is less economical.

By automation level, Fully Automatic products are increasingly important in large centralized projects because cleaning can be scheduled outside generation hours and coordinated through fleet-management platforms. Semi-automatic products remain relevant where site layouts are fragmented or equipment is shared among multiple arrays. By cleaning method, Brush Cleaning remains a mainstream technical route because of its relatively strong dust-removal capability, while Airflow Cleaning and hybrid dry-cleaning systems are attractive where low mechanical contact and module-surface protection are prioritized. Ecoppia's commercial systems demonstrate the use of soft microfiber combined with controlled airflow, while SolarCleano's robotic platforms demonstrate the continuing importance of brush-based dry cleaning.

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Downstream Market Opportunities

Centralized photovoltaic stations provide the principal opportunity because large, repetitive module arrays offer favorable conditions for autonomous and high-frequency robotic cleaning. IEA PVPS estimates that centralized or utility-scale PV accounted for approximately 59% of global new PV installations in 2025, supporting a substantial addressable base for robotic O&M equipment. Desert and semi-arid utility projects are particularly attractive because high dust accumulation coincides with limited water availability and large site areas, increasing the operational value of automation.

Distributed Photovoltaic Station applications are more selective because rooftops and commercial sites often have fragmented arrays, obstacles and lower individual project capacities. However, large industrial rooftops, logistics facilities and other standardized distributed projects can support Mobile Type and semi-automatic products, particularly where one machine can service several arrays. As distributed PV reached approximately 288 GW of new installations globally in 2025, the addressable base remains substantial even though robotic penetration is likely lower than in centralized projects.

## Regional Insights

Asia represents the largest underlying opportunity because it contains the world's largest photovoltaic installation and manufacturing base. China alone accounted for around 60% of global new PV installations in 2025, while other major Asian markets continued to expand. Large utility-scale projects in dry and dusty areas provide particularly favorable conditions for fixed fully automatic cleaning systems. The Middle East is another strategically important market because strong solar resources, desert environments and water constraints create a high economic rationale for water-free cleaning, especially at large centralized power stations.

Europe and North America offer more heterogeneous opportunities. Large utility projects can support fully autonomous systems, while distributed and commercial installations create demand for flexible mobile equipment. Regional adoption therefore depends less on photovoltaic capacity alone and more on the interaction between soiling intensity, water cost, labor cost, site standardization and local O&M practices.

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## Competitive Landscape Analysis

The Water Free Cleaning Robot For Photovoltaic market combines specialized robotic-cleaning companies, photovoltaic O&M technology suppliers and Chinese intelligent-equipment manufacturers.The major participants are Ecoppia, Airtouch Solar, SolarCleano, SERBOT AG, HyCLEANER, Washpanel, Solar Cleaning Machinery (SCM), sunbrush, WJ-Robot, Sunpuretech, Jiangsu Huibo Roboties Technology, Cooper (Tianjin) Technology, Nanjing Tetraelc Electronics Technology, Xiamen Lanxu Intelligent Technology, Langfang Sol-Bright Photovoltaic Technology, Suzhou Radiant Photovoltaic Technology, Innovpower, Trinasolar, Shandong Tianyi High-Technology, SHENZHEN KWUNPHI ROBOT, Bayrobot, Zhengzhou Derui Intelligent Technology, Shanghai Sun Ocean Marine Equipment and Ifbottech, etc. Competition is becoming differentiated between fixed fully autonomous systems optimized for large utility-scale projects and flexible Mobile Type equipment intended to serve multiple arrays. Key competitive factors include cleaning effectiveness, module safety, tracker compatibility, robot weight, environmental durability, autonomous navigation, remote fleet management, installation complexity and lifecycle O&M cost rather than hardware price alone.

## Report Scope

This report studies the global Water Free Cleaning Robot For Photovoltaic production, demand, key manufacturers, and key regions.

This report is a detailed and comprehensive analysis of the world market for Water Free Cleaning Robot For Photovoltaic and provides market size (US$ million) and Year-over-Year (YoY) Growth, considering 2025 as the base year. This report explores demand trends and competition, as well as details the characteristics of Water Free Cleaning Robot For Photovoltaic that contribute to its increasing demand across many markets.

## Highlights and key features of the study

Global Water Free Cleaning Robot For Photovoltaic total production and demand, 2021-2032, (K Units)

Global Water Free Cleaning Robot For Photovoltaic total production value, 2021-2032, (USD Million)

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Global Water Free Cleaning Robot For Photovoltaic production by region & country, production, value, CAGR, 2021-2032, (USD Million) & (K Units), (based on production site)

Global Water Free Cleaning Robot For Photovoltaic consumption by region & country, CAGR, 2021-2032 & (K Units)

U.S. VS China: Water Free Cleaning Robot For Photovoltaic domestic production, consumption, key domestic manufacturers and share

Global Water Free Cleaning Robot For Photovoltaic production by manufacturer, production, price, value and market share 2021-2026, (USD Million) & (K Units)

Global Water Free Cleaning Robot For Photovoltaic production by Type, production, value, CAGR, 2021-2032, (USD Million) & (K Units)

Global Water Free Cleaning Robot For Photovoltaic production by Application, production, value, CAGR, 2021-2032, (USD Million) & (K Units)

This report profiles key players in the global Water Free Cleaning Robot For Photovoltaic market based on the following parameters - company overview, production, value, price, gross margin, product portfolio, geographical presence, and key developments. Key companies covered as a part of this study include Ecoppia, Airtouch Solar, SolarCleano, SERBOT AG, HyCLEANER, Washpanel, Solar Cleaning Machinery (SCM), Skilancer Solar, Greenleap Robotics, Sunpuretech, etc.

This report also provides key insights about market drivers, restraints, opportunities, new product launches or approvals.

Stakeholders would have ease in decision-making through various strategy matrices used in analyzing the World Water Free Cleaning Robot For Photovoltaic market

## Detailed Segmentation:

Each section contains quantitative market data including market by value (US$ Millions), volume (production, consumption) & (K Units) and average price (US$/Unit) by

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manufacturer, by Type, and by Application. Data is given for the years 2021-2032 by year with 2025 as the base year, 2026 as the estimate year, and 2027-2032 as the forecast year.

### Global Water Free Cleaning Robot For Photovoltaic Market, By Region:

United States

China

Europe

Japan

South Korea

ASEAN

India

Rest of World

## Market Segmentation

### Global Water Free Cleaning Robot For Photovoltaic Market, Segmentation by Type:

Fixed Type

Mobile Type

### Global Water Free Cleaning Robot For Photovoltaic Market, Segmentation by Automation:

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Fully Automatic

Semi-automatic

### Global Water Free Cleaning Robot For Photovoltaic Market, Segmentation by Cleaning Methods:

Brush Cleaning

Airflow Cleaning

Others

### Global Water Free Cleaning Robot For Photovoltaic Market, Segmentation by Application:

Distributed Photovoltaic Station

Centralized photovoltaic Station

## Companies Profiled:

Ecoppia

Airtouch Solar

SolarCleano

SERBOT AG

HyCLEANER

Washpanel

Solar Cleaning Machinery (SCM)

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Skilancer Solar

Greenleap Robotics

Sunpuretech

Jiangsu Huibo Roboties Technology

Cooper (Tianjin) Technology

Nanjing Tetraelc Electronics Technology

Xiamen Lanxu Intelligent Technology

Langfang Sol-Bright Photovoltaic Technology

Suzhou Radiant Photovoltaic Technology

Innovpower

LEAPTING

Shandong Tianyi High-Technology

SHENZHEN KWUNPHI ROBOT

Bayrobot

Zhengzhou Derui Intelligent Technology

Shanghai Sun Ocean Marine Equipment

Ifbottech

## Key Questions Answered

1. How big is the global Water Free Cleaning Robot For Photovoltaic market?

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2. What is the demand of the global Water Free Cleaning Robot For Photovoltaic market?
3. What is the year over year growth of the global Water Free Cleaning Robot For Photovoltaic market?
4. What is the total value of the global Water Free Cleaning Robot For Photovoltaic market?
5. Who are the Major Players in the global Water Free Cleaning Robot For Photovoltaic market?
6. What are the growth factors driving the market demand?

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