



# ECOPPIA'S E4 ROBOTIC CLEANING SOLUTION

The autonomous and water-free E4 cleaning solution optimizes photovoltaic panel performance in solar parks while cutting operational costs. Using a water-free microfiber and airflow cleaning system, the E4 solution removes over 99% of dust daily, keeping the panels at peak production in the harshest desert conditions.

## Effective & Fully Automatic Cleaning

The E4 cleaning solution is designed to clean your entire solar park every night using a fleet of cleaning robots, each assigned to a row of PV panels. The soft yet powerful microfiber elements along with controlled air flow, utilize gravitation to move dust particles downwards and off the panels.

The robots move along a rigid aluminum frame using wheels coated with polyurethane to ensure smooth movement and no load on the solar panel's surface. Each cleaning robot is powered by five electrical motors – two motors driving the horizontal movement along the solar panel row, two motors powering the vertical up-and-down movement, and one motor operating the rotation of the microfiber elements.

To maintain a smooth sustainable upward and downward movement, the E4 robot uses a sophisticated winch system with two flexible coated silicon rubber wires that operate angularly from opposite sides of the winch cylinder to the center point of the microfiber cylinder frame.

Cleaning is performed at a rate of 54 square feet per 30 seconds, and typically takes place during the early hours of dark to avoid shading during electricity generation hours.

### WHY E4?

#### EFFECTIVE

Removing over 99% of dust daily, the E4 cleaning solution keeps solar panels at top production levels - even in harsh desert conditions.

#### EFFICIENT

Eliminating manual labor and water waste, each E4 cleaning fleet is remotely managed from a dashboard or mobile app.

#### ENERGY INDEPENDENT

Each robot uses a dedicated solar panel to charge onboard batteries, requiring no external power supply

#### ECOLOGICAL

Our patented Eco-hybrid mechanism increases energy efficiency by capturing potential energy, while self-cleaning mechanisms decreases the need for maintenance.

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## Energy Independent and Ecological

The E4 cleaning system requires no external power source, drawing power from its own on-board batteries that are charged via each robot's dedicated solar panels. Charging occurs during the day while the robots are docked, with a full battery charge typically supporting 3 sequential cleaning cycles - ensuring that the E4 will be available to clean even during extended cloudy periods or dust storms.

Ecoppia's patented Eco-hybrid technology further increases the energy efficiency of the system by capturing potential energy of the robots during their descent on the solar panels and converting it to kinetic energy, decreasing lost energy and extending the useful battery life.

After each cleaning decent, the E4 robot performs a rapid auto-clean of the micro fiber elements before ascending the panel again. An additional self-cleaning routine is carried out at the end of the cleaning cycle, before the robot returns to its docking station.

## Certified and Built to Last

All E4 components are built from tier-1 suppliers, passing through rigorous stress tests in high temperatures (over 65 °C) and desert conditions to ensure stability over time.

The impact on solar panels over time was independently tested by the world-renowned PI Berlin Institute, which found no power degradation or change in electroluminescence of solar panels after over 20 years of daily cleaning by Ecoppia E4 robots.

When not cleaning, the robots are securely locked in their docking stations outside of the solar PV row, protected from the elements and strong winds.

## Efficient Management

The entire solar park cleaning operation is managed through the E4 master application, allowing operators to schedule cleaning, add an ad-hoc cleaning cycle, disable or enable individual robots, or instantly send all robots back to base. In addition, all relevant data is projected through web-based dashboards allowing authorized users to manage, monitor and analyze the cleaning process.

Remote management and control is also enabled via a mobile device using API-based commands.

The remote management of robots is enabled using on-board RF transceiver, which store cleaning scenarios and communicates with the master application. Four electronic sensors embedded into each E4 cleaning robot ensure optimal cleaning performance with accurate measurement and monitoring of vertical and horizontal movement.



Empowering Solar

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