

### HOW CAN SOLAR OPERATORS REDUCE ENERGY PRODUCTION LOSS CAUSED BY SOILING?

#### PROBLEM

Soiled solar panels produce less electricity; soiling can also lead to photovoltaic module damage. In fact, soiling reduces current global solar power production by at least 3-4% annually, creating multi-billion dollar revenue losses.

#### SOLUTION

An optimized soiling mitigation strategy using artificial intelligence maximizes production improvement at the lowest cost. This can effectively restore photovoltaic performance and extend asset lifespan—especially when accounting for factors such as weather, cleaning costs, and scheduling.

#### OUTCOME

An AI-powered asset management platform eliminates the need for expensive soiling stations, helping solar operators implement optimized cleaning intervals that maximize their energy production at the lowest possible cost.

#### QUANTIFYING THE COST OF SOILING

Natural accumulation of dust, pollen, dirt, algae, bird droppings, and other debris reduces the ability of photovoltaic (PV) panels to turn solar energy into electric power. In addition to the problem of energy reduction, uneven soil patches affecting some, but not all, cells of a PV module can disrupt the flow of current throughout the entire module. That can create hot spots that eventually damage sensitive components, shortening their lifespan.

This unavoidable challenge for the solar power industry, known as soiling, leads to lost income for operators due to energy generation inefficiencies. Soiling also creates higher operating costs because of constant equipment monitoring and cleaning, and replacing of damaged assets.

Factors contributing to the impact of soiling include site-specific conditions like local weather patterns and events, the remoteness of the location, and the method and frequency of cleaning. Scientists studying the problem of soiling for solar panels estimate that energy loss annually can exceed as much as 7% in parts of the United States. In more arid regions of the world, like the Middle East, energy output reductions due to soiling can range up to 50% per year. In a

2023 report, the International Energy Agency's Photovoltaic Power Systems Programme estimated that while global soiling losses came in around \$3.2 billion on the low end in 2018, the amount will drastically rise as the number of solar installs around the world continues to grow. The agency pegged 2023's solar energy soiling losses at between \$4.3 billion and \$7.6 billion. The energy losses will only keep rising.

#### LIMITS OF CURRENT SOILING MITIGATION METHODS

To measure the degree of soiling occurring on panels, operators have commonly relied on soiling stations. This method uses sensors installed on a PV panel that are regularly cleaned, while 'control' panels are untouched and allowed to become soiled. The two panels are then compared to learn how quickly soil builds up with and without intervention. Operators use this data to set cleaning schedules, because they don't want to clean too often, which wastes maintenance resources, nor do they want to go too long between cleanings, which costs them energy efficiency.

The problem with the soiling station approach is twofold. First, these stations add unnecessary cost to projects. And second, different parts of a large-scale solar panel array collect soil at different rates. Soiling stations don't always account accurately for these variances.

As a result, analysis produced by soiling station data runs the risk of over or underestimating actual levels of soiling. Furthermore, unless the soiling mitigation strategy accounts for expected precipitation, an unnecessary cleaning that adds cost but does not increase production might be performed.

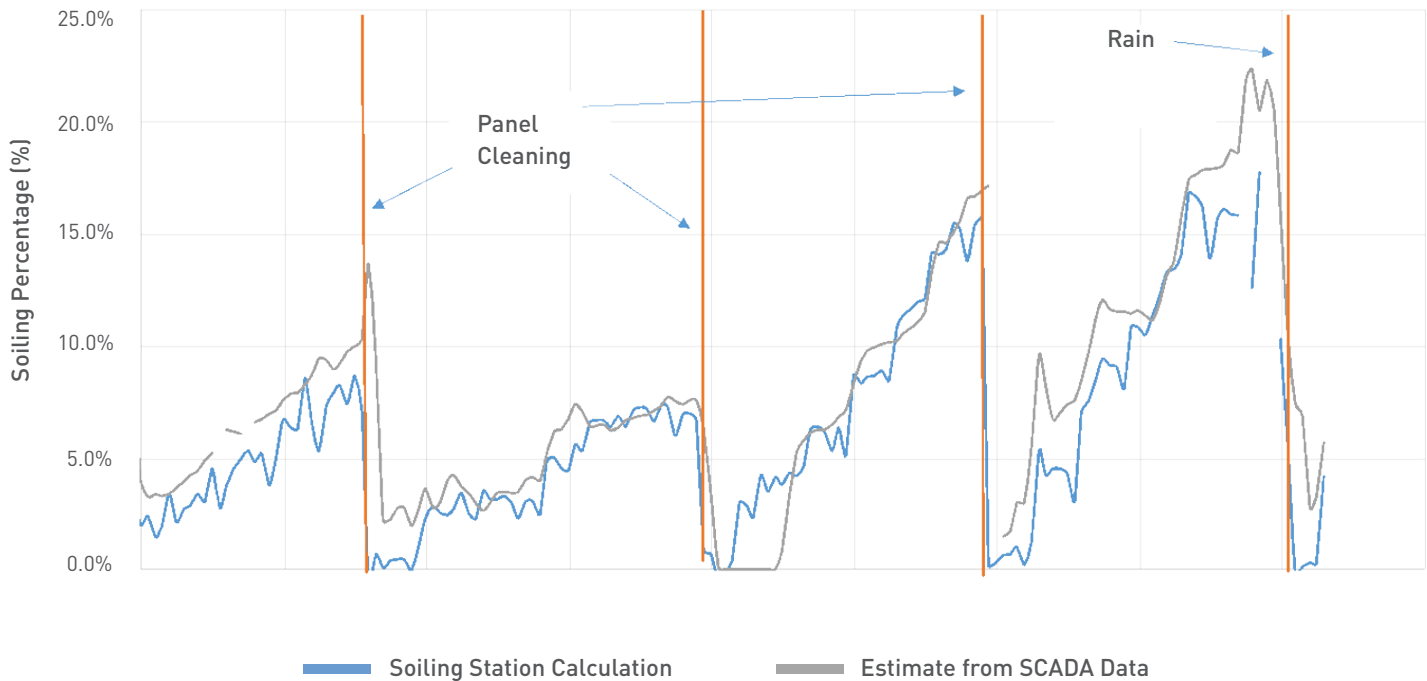
#### HOW AI OPTIMIZES SOLAR PANEL CLEANING

A better solution for managing the problem of soiling over a large, and/or remote solar panel operation will take advantage of artificial intelligence (AI) technology.

Comprehensive, AI-powered asset management platforms are able to ingest the available SCADA data while also contextualizing current and future weather conditions, project capacity, power purchase agreements, curtailment protocols, and other factors. This helps solar power operators quantify the economic value of lost production caused by panel soiling, and identify ways to address it most efficiently.

Leveraging AI and machine-learning to interpret weather forecast data, operators can better determine when a precipitation event of sufficient magnitude to clean the panels will occur. Thus, all contributory sources of data are combined with the actual cost for cleaning the panels at the project, and an optimization process provides the project operator with the ideal time to perform a panel cleaning for maximum project profitability. No soiling stations required.

**FIGURE 1: Correlation of SCADA Data & Soiling Station**



### INCREASE SOLAR ENERGY PRODUCTION AND REDUCE MAINTENANCE COSTS

Avathon is the answer for renewable energy operators looking to optimize the vast streams of data flowing from their assets in order to solve big challenges like soiling mitigation.

Avathon's industry-leading AI software helps solar energy producers put soiling conditions at their plant into clear perspective, by quantifying the effect of energy losses from soiling against the true cost of cleaning panels more, less, or differently. Avathon enables operators to improve both planning and logistics, enabling the creation and implementation of an optimal cleaning schedule that mitigates the persistent losses caused by soiling.

By continuously processing the SCADA data already available from their assets in the field (instead of relying on soiling stations), historical weather data and forecasting, and project-specific criterion like PPA details, capacity limits, and curtailment factors, Avathon harnesses the power of AI and machine learning to optimize maintenance tasks, like cleaning solar panels, for maximum ROI.

Avathon helps the renewables industry increase energy production, reduce operating costs, and maximize operational efficiency with our industry leading, AI-enabled, cloud-based SaaS solution for analytics and asset management.

### ABOUT AVATHON

Avathon, a leader in Industrial AI, extends the life of critical infrastructure while advancing the journey toward full autonomy. Avathon's Industrial AI platform empowers commercial and government customers with scalable, secure, and value-driven solutions that enhance efficiency and resilience across heavy industry.

To learn more about how Avathon's AI solutions can unlock the power in your data, visit [www.avathon.com](http://www.avathon.com).