

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

### PROBLEM

When solar panels are soiled, they produce less electricity, and soiling can lead to photovoltaic module damage. 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, and can effectively restore photovoltaic performance and extend asset lifespan—especially when accounting for factors such as weather, cleaning costs, and ideal scheduling.

### OUTCOME

AI-powered asset management platform solutions eliminate 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. A 2019 study estimated the global cost of PV project soiling might rise to as much as \$6.4 billion by 2023, due to more extensive deployment in locations such as China and India, where solar panels tend to be positioned in highly isolated, dust-prone environments, and where electricity costs less, reducing the economic incentive to clean them more often.

## 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

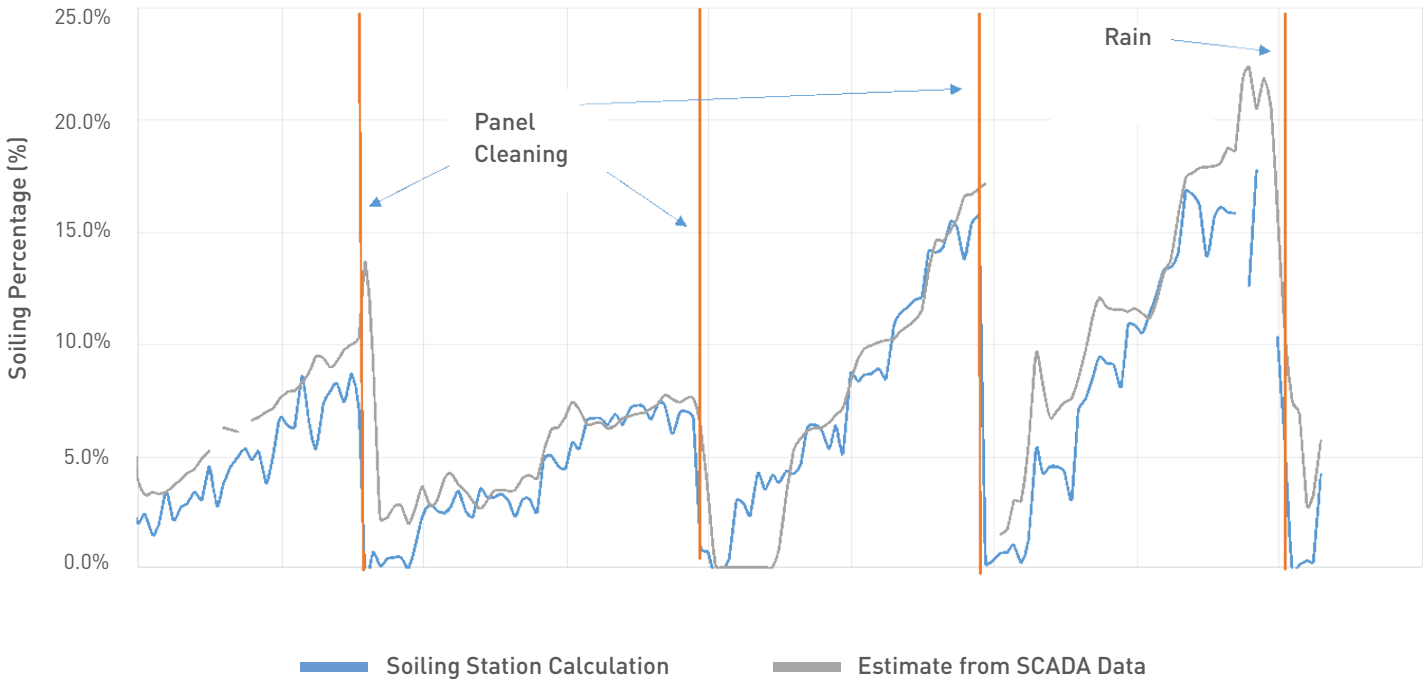
A better solution for managing the problem of soiling over a large, and/or remote solar panel operation will take advantage of artificial intelligence (AI) technology.

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

SparkCognition Industrial AI Suite for Renewables 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.

Industrial AI Suite for Renewables 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. Industrial AI Suite 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, Industrial AI Suite for Renewables harnesses the power of AI and machine learning to optimize maintenance tasks, like cleaning solar panels, for maximum ROI.

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

### ABOUT SPARKCOGNITION

SparkCognition’s award-winning AI solutions allow organizations to predict future outcomes, prescribe next actions, empower people, and protect assets. We partner with the world’s industry leaders to analyze, optimize, and learn from all types of data, augment human intelligence, drive profitable growth, and achieve operational excellence. Our patented AI technologies include machine learning, deep neural networks, natural language processing, generative AI, and computer vision—enabling productivity, innovation, and accelerating digital transformation. Our solutions solve critical problems, prevent unexpected downtime, maximize asset performance, deliver net-