Corporación Instituto de Tecnologías Limpias (ITL)
Antofagasta
Carrera #1615

CHALLENGE TITLE

Soiling on photovoltaic modules

CHALLENGE DESCRIPTION

Solar power plants in northern Chile, a region with the highest solar radiation on the planet, face a critical operational challenge: the rapid accumulation of dust and dirt (soiling) on photovoltaic modules. This phenomenon severely reduces the transmissivity of the modules, leading to significant energy generation losses. The problem is exacerbated because the conventional cleaning method requires large volumes of water, a particularly scarce resource in this arid region, making this approach unsustainable over time. Consequently, this situation directly impacts both the expected performance and the financial viability of the projects.

GENERAL OBJECTIVE

The overarching objective of this challenge is to develop and implement innovative technological solutions that enable the rapid determination of soiling levels on modules across the solar field and effectively mitigate its accumulation. The aim is to minimize generation losses and optimize the profitability of solar power plants in northern Chile by reducing or eliminating the dependency on water resources for their cleaning.

SPECIFIC OBJECTIVES

1. Design of new technologies to reliably and rapidly determine the soiling levels of photovoltaic modules across the entire solar field.

2. Co-development of technologies for the autonomous and rapid cleaning of solar modules, with minimal or zero water consumption.
3. Co-development of intelligent algorithms and systems capable of processing module soiling data to enhance the cleaning management system.
4. To reduce the costs and water consumption associated with cleaning processes.

EXPECTED RESULTS

- Development of automated prototypes for photovoltaic module cleaning.
- Development of automated soiling measurement prototypes for industrial implementation.
- Design, development, and field validation of the technologies.
- Development of validated simulation models and tools for determining and predicting soiling levels.
- Creation of new management methodologies to enable the reduction of water consumption and costs in solar module cleaning processes.

SCOPE

Includes:

- Demonstrations in a controlled, relevant environment, along with semi-industrial and operational piloting and validation.
- The prototypes are expected to be capable of operating in utility-scale solar power plants.

Does not include:

- Proof of concept and/or laboratory-scale testing (TRL ≤ 4).
- Solutions that pose risks to the safety of workers, equipment, or the environment.
- Technologies that increase the consumption of strategic resources such as water or energy.
- Interventions that alter or interfere with the continuity of the power generation process.

KEY PERFORMANCE INDICATORS (KPIs)

1. Soiling measurement accuracy across the solar field.
2. Person-hours invested in soiling measurement and solar field cleaning processes.
3. Modules cleaned per hour.
4. Cleaning costs and water consumption per cleaned module.

DESIRABLE CONTRIBUTION TO ITL CAPACITY BUILDING

- Development of intelligent algorithms and systems for soiling detection.
- Building capabilities in the areas of simulation, modeling, and soiling prediction.
- Prototypes and testing infrastructure for the generated technology.

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