



Dust Analysis System 2.0 (DAS 2.0) Introduction

Apr. 11th, 2025

Backgrounds

Soiling Loss & Module Cleaning for PV Power Plant

PV Soiling Loss

- Soiling (or Dust) accumulated on the PV module surfaces can cause a significant energy loss for the PV power plant
- Module cleaning is an important item of O&M activities and can be very costly for the utility-scale PV power plants



PV Cleaning Timing – Current Practices

Practice-I: Scheduled Clean

- Facts
 - Either cleaning too early (**soiling is low**) or too **late (soiling is heavy)**
 - Waste cleaning resources or lose excessive energy (revenue)

Practice-II: Cleaning according to PR drop

- Facts
 - PR drop has many **loss factors** – temperature, irradiance, module degradation, string mismatches, inverter trips, soiling on the module surface, etc. **Soiling is only one of the loss factors**
 - PR is calculated by pyranometer reading; very often, pyranometer is either dirty or not calibrated (PR value is always high!)

If pyranometer was dirty, PR value will be inaccurate

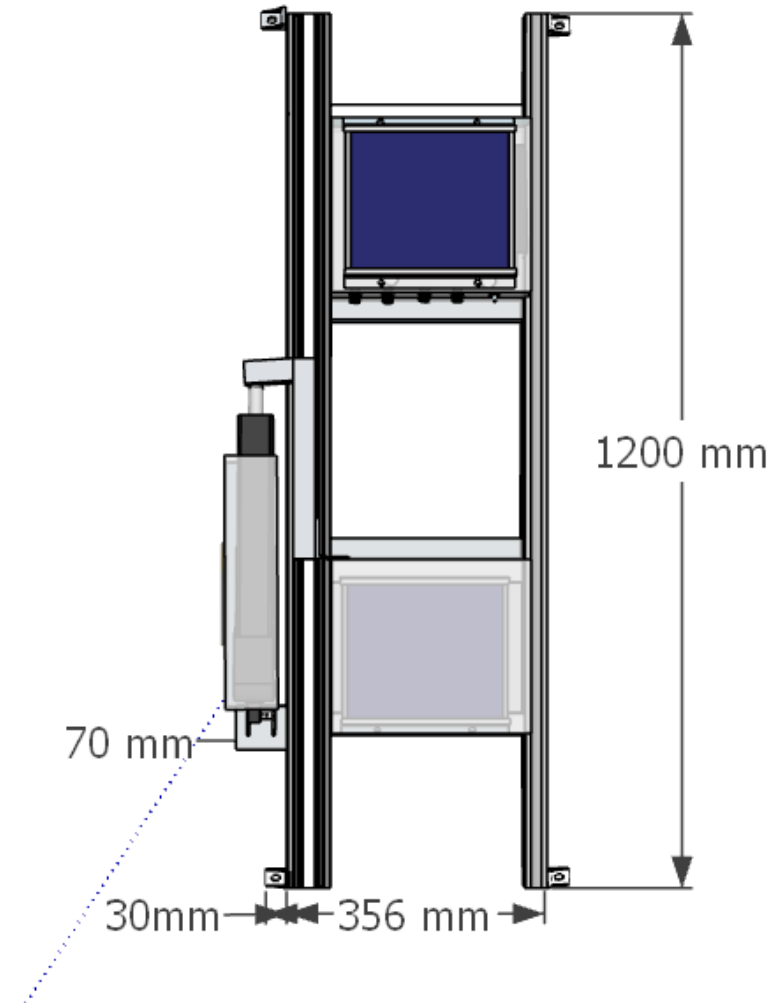
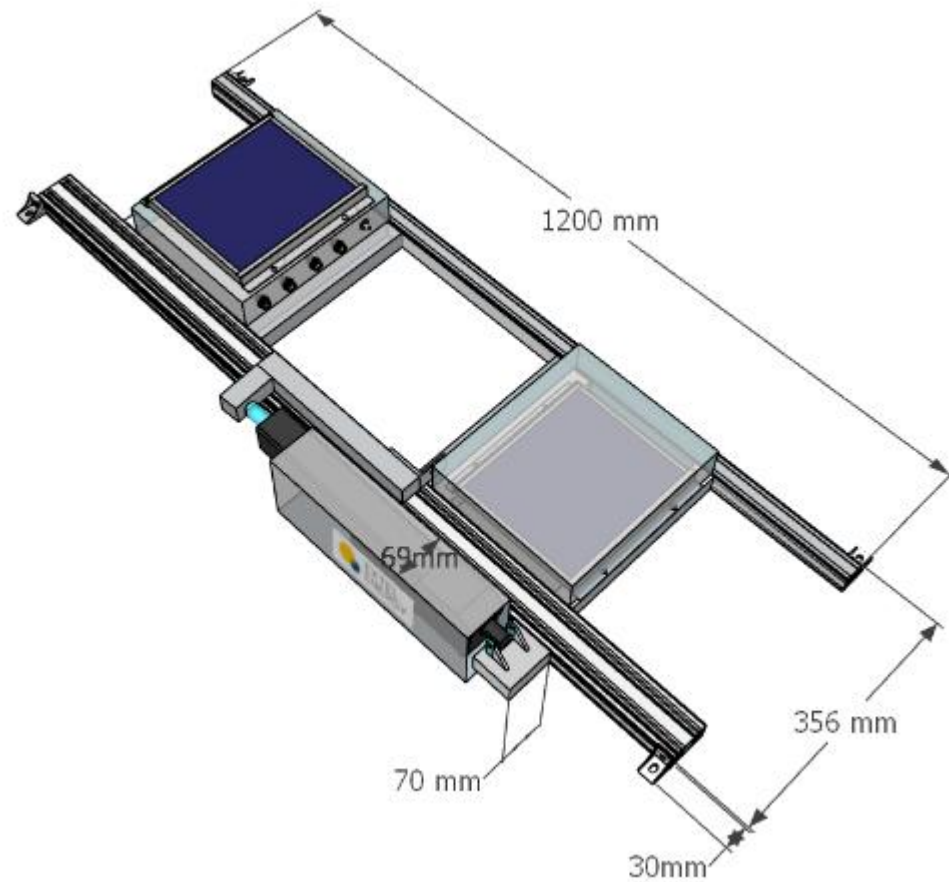
$$PR = \frac{\text{Energy}}{\text{Irradiance}}$$



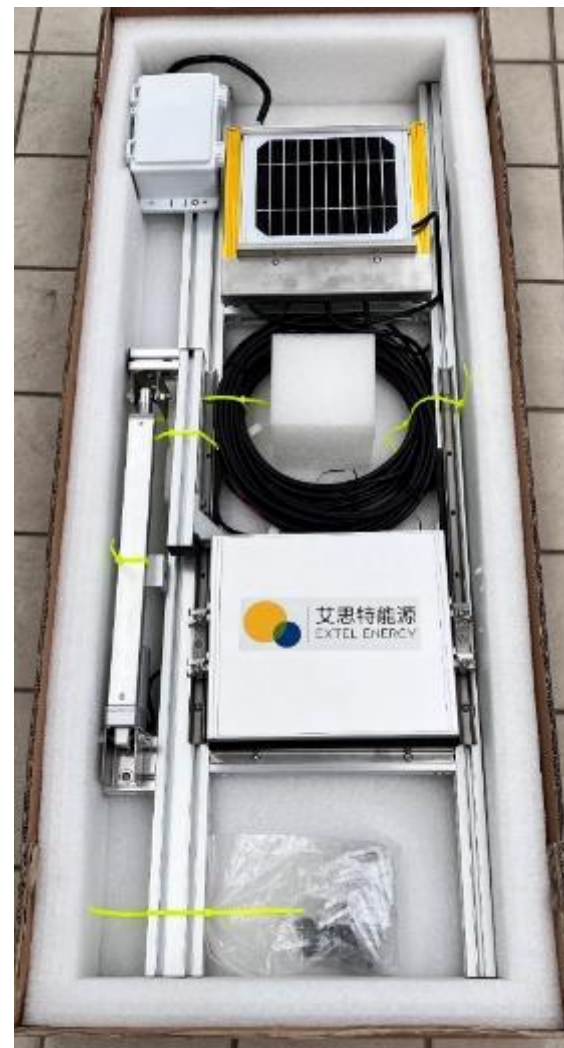
Introduce

Dust Analysis System (DAS 2.0)

DAS 2.0 Dimensions (1.2 m x 0.4 m)



DAS 2.0 Package Box



10 m AC cable

Weight 20 kg

DAS 2.0 Hardware Design

Small & compact

Easy installation on any
existing PV array frame

Plug & Play

Soiling data upload to
Cloud database



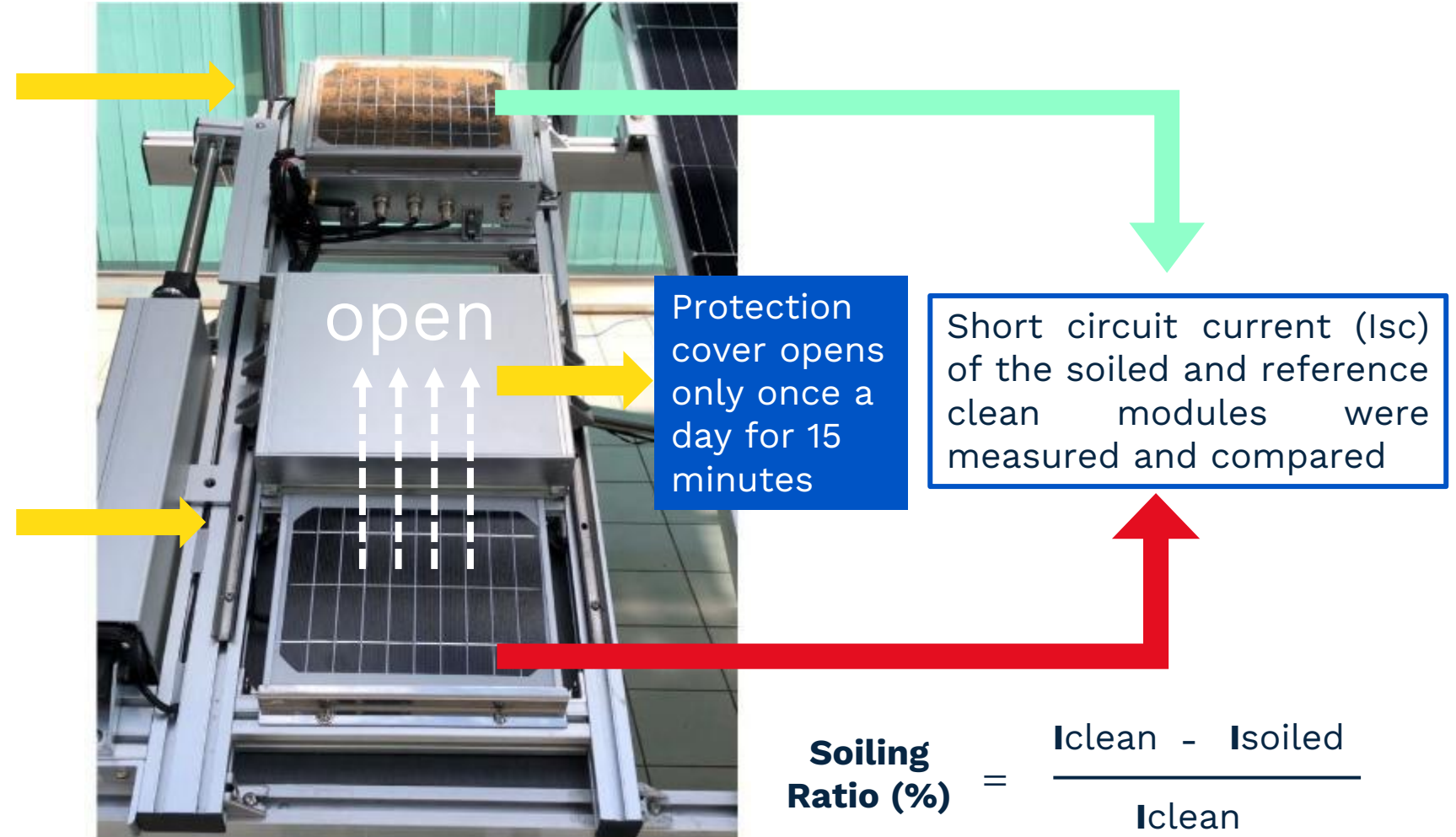
DAS 2.0 Working Principle

Soiled Module

- Exposed to the outdoor environment to collect dust (same conditions as the power plant)

Clean Reference Module

- Kept underneath a protection cover to maintain surface clean



4G / RTU – Flexible Data Transfer Options

DAS 2.0 provide two data interfacing options

- 4G data transmission and customized webpage display (provided by Kiwa ExTEL)
- Modbus/RTU direct communication with on-site SCADA



Modbus/RTU

ExTEL Webpage display



PV site SCADA display

DAS2.0 Webpage Display (1/2)

- Dedicated webpage for customer to view the soiling level of all PV sites and to manage the cleaning activities for yield optimization

The screenshot displays the DAS2.0 Webpage interface. On the left, a sidebar lists sites under 'Taiwan'. The main area shows a table of site data. A Google map on the right shows the locations of several sites. Red arrows point from blue callout boxes to specific elements in the interface.

Location /site name

Soiling level of all sites to prioritize cleaning activity

Site location on google map

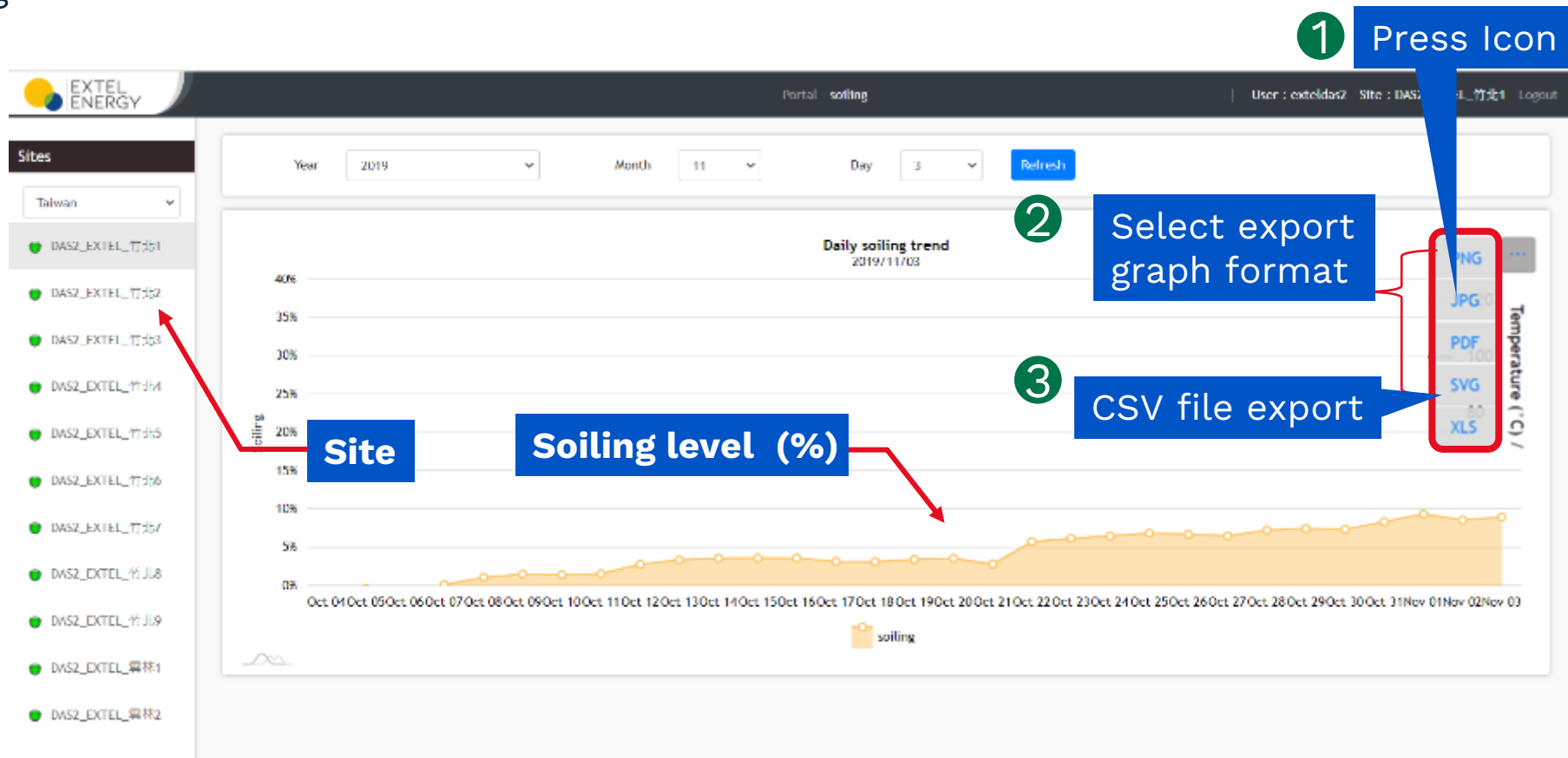
Capacity (kWp) of each site

Last cleaning date for easy tracking

Site Name	Soiling Level	Capacity (kWp)	Last Cleaning Date
DAS2_EXTEL_竹北1	0.3	1.0MW	2020/01/15
DAS2_EXTEL_竹北2	0.5	400kW	2020/01/30
DAS2_EXTEL_竹北3	1.3	600kW	2020/01/30
DAS2_EXTEL_竹北4	1.3	399kW	2020/01/30
DAS2_EXTEL_竹北5	0.8	499kW	2020/01/30
DAS2_EXTEL_竹北6	0.7	399kW	2020/01/20
DAS2_EXTEL_竹北7	1.3	459kW	2020/01/25
DAS2_EXTEL_竹北8	1.9	499kW	2020/01/30
DAS2_EXTEL_竹北9	1.5	499kW	2020/01/30
DAS2_EXTEL_雲林1	1.4	499kW	2020/01/30

DAS2.0 Webpage Display (2/2)

- User can also check the soiling trend of each site, and the data can be exported to a local computer for reporting



DAS2.0 Case Studies

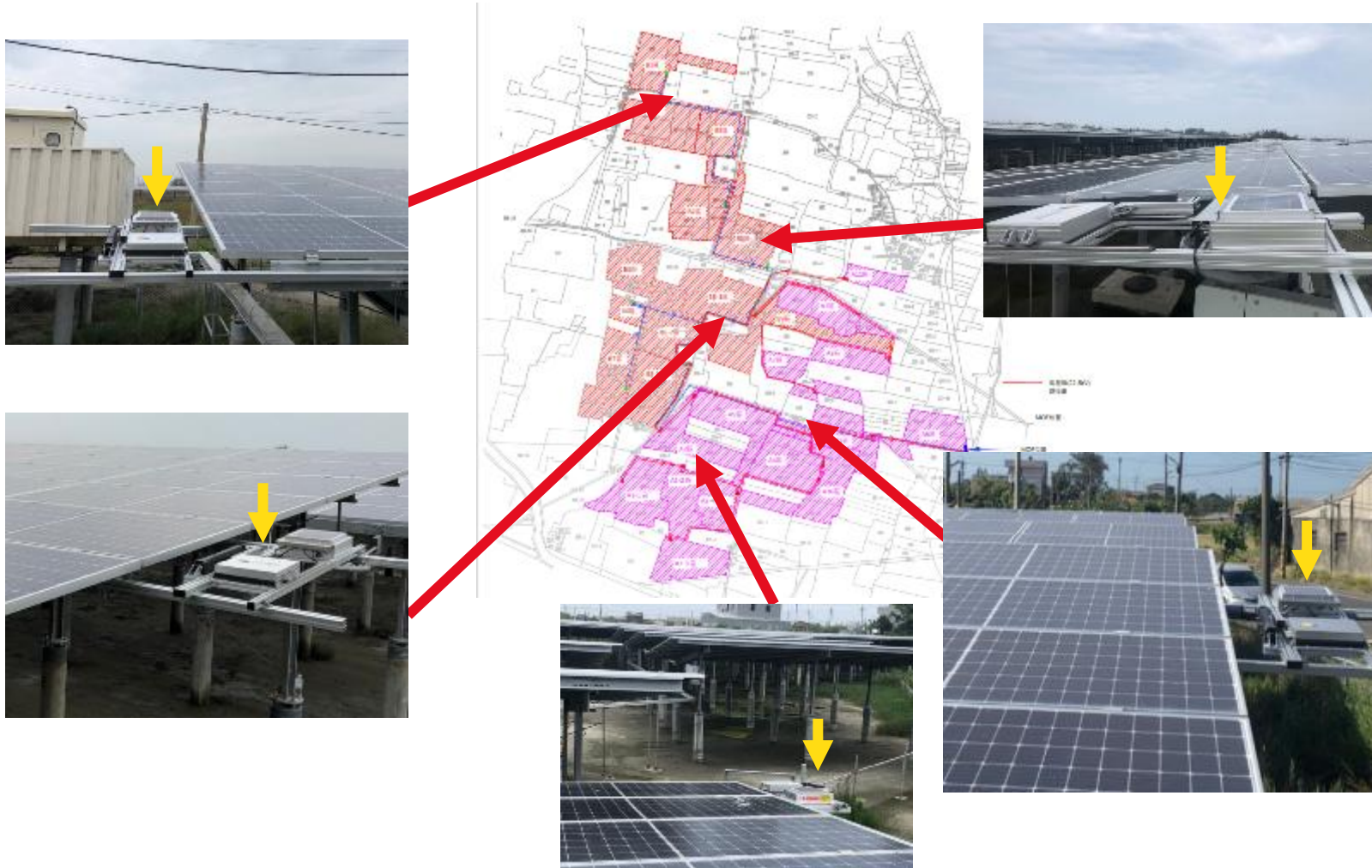
Case – I (C&I Factory Rooftop 500kW)



Case – II (Farmhouse Rooftop 300 kW)



Case-III (Ground-Mount 40MW Power Plant)



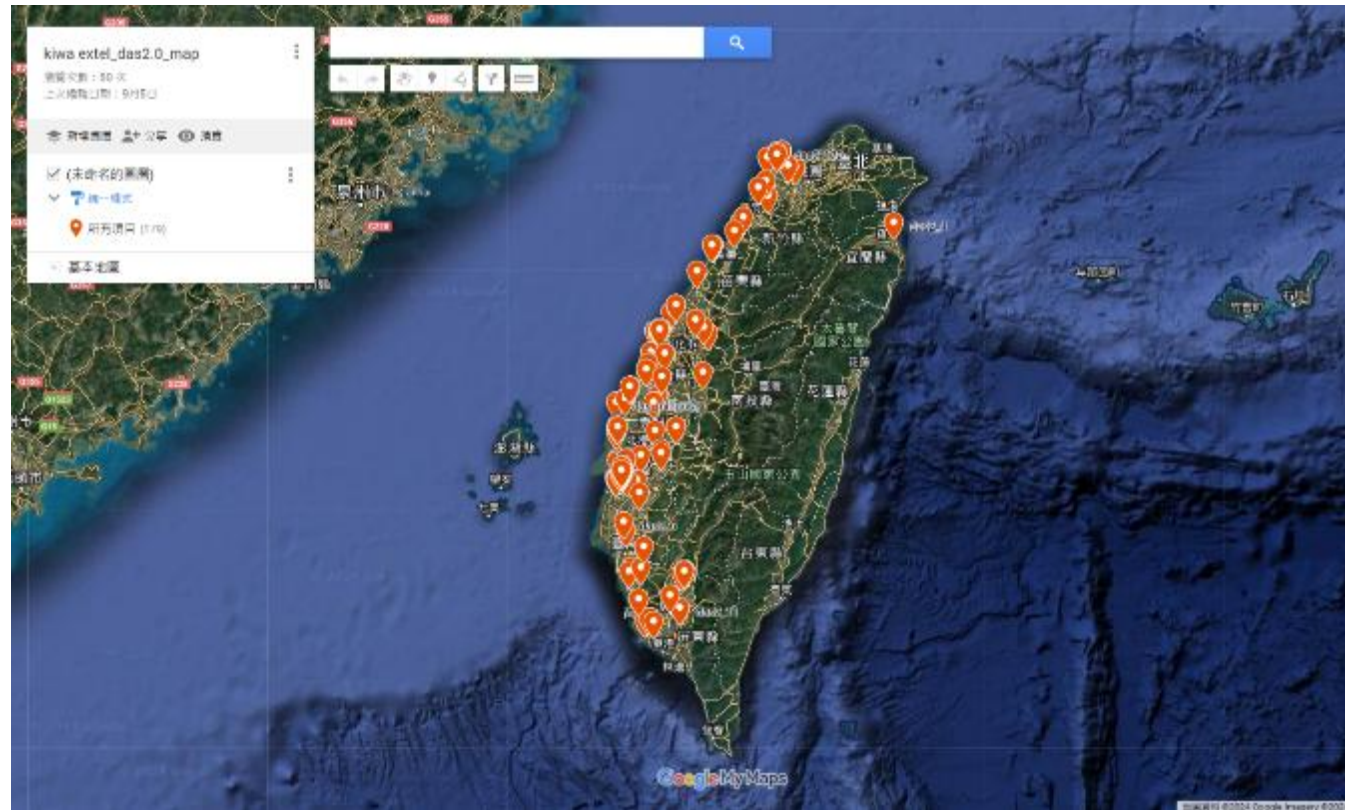
- Zone Partitioning Soiling Monitoring scheme
- X5 units of DAS2.0 installed
- Cleaning can be prioritized by zone (dirtiest → low)
- Not every zone needs to be cleaned (to reduce cleaning costs)

Case-IV (Floating PV 180MW)



DAS 2.0 Installation In Taiwan

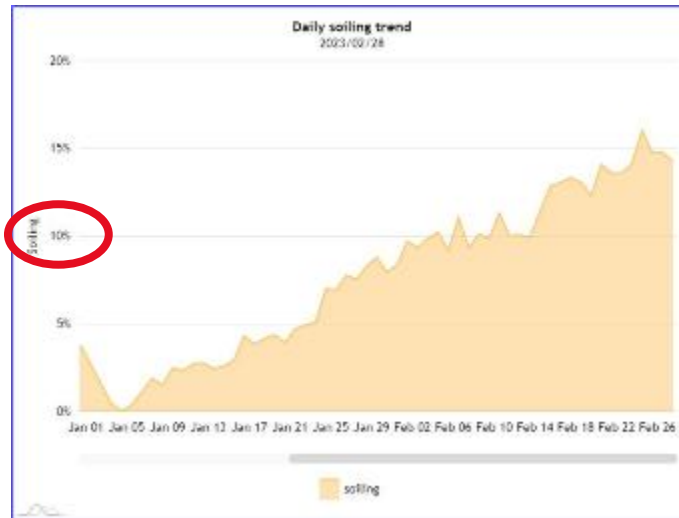
- As of Nov, 2024, more than x200 units DAS2.0 have been installed in Taiwan
- Monitoring soiling loss for over 1 GW PV power plants in Taiwan



Summary

- DAS2.0 is an effective IoT device for monitoring soiling loss of PV power plants
- DAS2.0 can be used to determine the best cleaning timing, and hence **to optimize the power generation** or **to reduce the cleaning costs**

15%
soiling
loss!



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Thank
you for
listening