

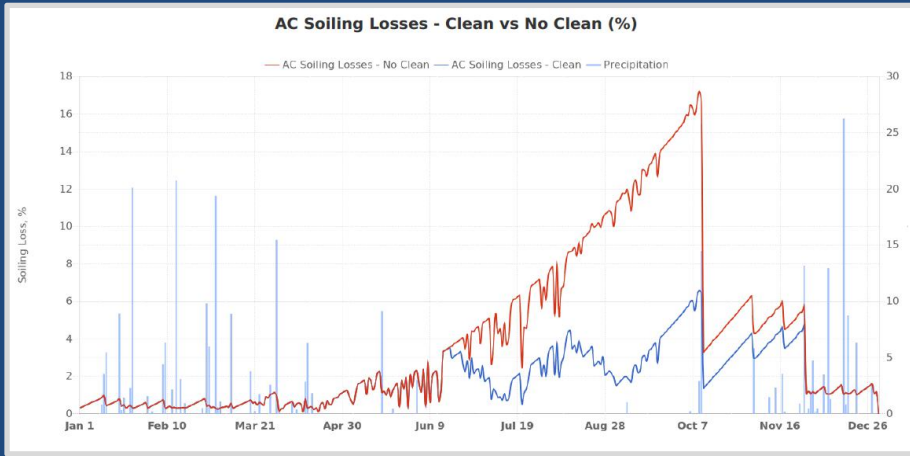


PV SoilSayer Clean Cycle Analysis Software

Soiling Management for PV Plants

- Soiling Losses in arid regions can exceed 60% in a single month
- Cleaning costs can amount to over 35% of total O&M costs
- Knowing when to clean the PV system is key to minimizing costs and maximizing system performance
- Accurate estimations of soiling losses during project development are critical to project valuation and financing





PV SOILSAYER

The *PV SoilSayer* takes the guesswork out of when to clean the PV System and helps owners and operators minimize operational costs and maximize PV system performance:

- Improve the accuracy of baseline performance models and increase asset valuation
- Estimate optimal clean cycles based-on cost trade-offs
- Estimate soiling losses as a function of sun angle and site-specific weather conditions
- Align performance models and O&M budgets with optimal clean cycles





Create a Site

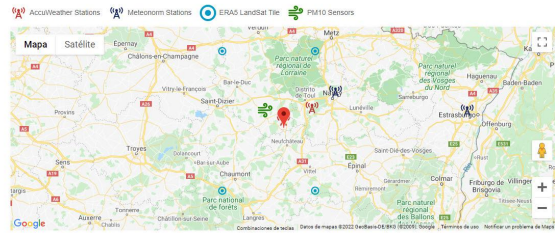
- Each new site requires an initial configuration and soiling analysis which can then be automatically updated with long-term weather forecasts
- Sites can be edited or viewed at any time by clicking on the site name
- Email alerts can be configured when Reports are ready to be viewed

The screenshot displays the 'PV SoilSayer' interface. At the top, there is a navigation bar with the 'enlighten energy' logo and the title 'PV SoilSayer'. Below the navigation bar, there are several tabs: 'Manage Sites', 'Weather Resources', 'PV System Info', 'Soiling Profile', 'Cleaning Configuration', 'Report', and 'Wash Dashboard'. The 'Manage Sites' tab is active, showing a 'Sites' section. A message states: 'Your license allows you to have 15 reports. You can add 0 sites.' Below this is a table with the following columns: 'Site Name', 'Location', 'Step', and 'Last Changes'. The table contains 10 rows of site data. At the bottom of the table, there is a 'Create Site' button and a pagination control showing '1' and '2'.

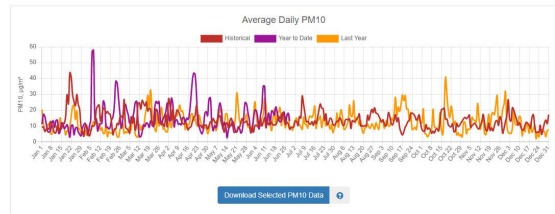
Site Name	Location	Step	Last Changes
Coronal Tulare - Tropic	23219 Avenue 24 Delano, CA 93215	Report Ready	2 days ago
Porterville	Porterville, CA 93257, USA	Report Ready	3 weeks ago
Nicolis	23219 Avenue 24 Delano, CA 93215	Report Ready	2 days ago
Hanford	Hanford, CA 93230, USA	Report Ready	2 days ago
Coronal Tulare	6900A Avenue 228 Tulare, CA 93274	Report Ready	2 days ago
Farmersville, CA	401 Terry Avenue Farmersville, CA 93223	Report Ready	2 days ago
Lost Hills	Lost Hills - 16383 Twisselman Rd, Lost Hills, CA 93249	Report Ready	2 days ago
Avalon	915 E. Pima Mine Rd. Sahuarita AZ 85629	Report Ready	2 days ago
Cal Flats North	Parkfield, CA	Report Ready	2 days ago
Mt. Signal 3 - Measured Daily Soiling	Calexico, CA	Report Ready	1 month ago

Plant Location

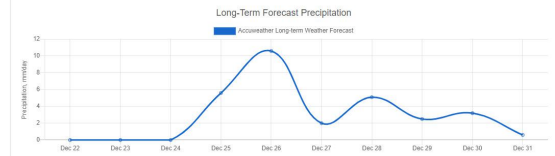
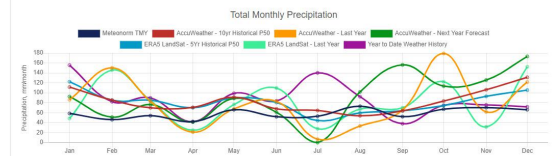
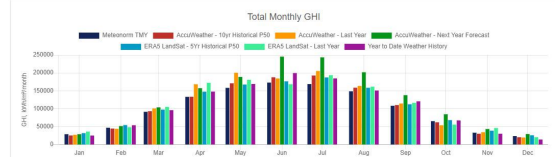
Location of Plant : 48.47389, 5.655278



Weather Resources



Select a Weather Resource Database



WEATHER RESOURCES

- Users can select from available weather resource services or upload data from an alternative source
- Comparisons of weather resources provide users with insight into selection of suitable weather data
- Historical weather data is updated with long-term forecasts to plan optimal cleanings
- Daily or Weekly report updates keep users informed of changes to the calculated cleaning schedule
- An interactive map indicates the location of weather stations and sensors





PV SYSTEM INFO

- Users can create a Project Name which is displayed on the Reports for easy reference
- PV System Design specifications determine system performance and soiling loss parameters
- PV System Losses determine system performance derates and calculated annual energy production
- An interactive Annual Energy Production chart provides users with DC and AC production estimates

Enlighten energy **PV SoilSayer**

Manage Sites Weather Resources PV System Info Soiling Profile Cleaning Configuration Report Wash Dashboard

PV Project Name

Name: Chula Vista, CA

PV System Design

DC System Size: 10000 kWp Max Tracker Angle: 55 deg
AC System Size: 8000 kWp Tracker Stow Angle: 15 deg
Module Type: Glass/Backsheet Elevation Angle: 0 deg
Cell Type: Mono c-Si Azimuth Angle: 180 deg
Array Type: 1-Axis True Tracking

Albedo: 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2

PV System Losses

Mismatch: 1 % Light-Induced Degradation: 1.5 %
Wiring: 2 % Nameplate Rating: 1 %
Connections: 0.5 % System Degradation: 0 %
Availability: 1.5 %

Shading %: 0 0 0 0 0 0 0 0 0 0 0 0

Snow %: 0 0 0 0 0 0 0 0 0 0 0 0

Inverter Efficiency: 98 % Ground Coverage Ratio: 0.4

Annual Energy Production - No Soiling

Month	DC Energy Production (kWh)	AC Energy Production (kWh)
Jan	1000	800
Feb	1200	1000
Mar	1500	1300
Apr	1800	1600
May	2200	2000
Jun	2400	2200
Jul	2300	2100
Aug	2100	1900
Sep	1800	1600
Oct	1500	1300
Nov	1200	1000
Dec	1000	800

Calculate Annual Energy

Currency: \$ (US Dollar)

Proceed

Soiling Losses

Please Select From One of the Following Soiling Loss Calculation Options:

Use the Soiling Loss Calculator to Estimate Soiling Losses Throughout the Year

Calculate Soiling Losses as a Function of Weather Resources, Air Quality, and PV System Design Parameters

Localized Soiling:

Use DC Soiling Losses Measured Over a Dry Period to Estimate Soiling Losses Throughout the Year

Use Average Daily Soiling Rates to Calculate Soiling Losses

Clean Cycle Start Date: 01/2021 Starting DC Soiling Ratio: 0 %

OR

Please Select From One of the Following Soiling Loss Upload Options:

Upload Measured Hourly Soiling Losses

Upload Daily Soiling Losses measured at Solar Noon

Angular Losses

Calculate Soiling Losses due to sun angle

Calculate Losses due to direct / diffuse light only

Rainfall Clean Events

Minimum Rainfall Clean Amount (Wet Season): 2 mm/hr

Advanced

Rainfall Clean Quality: 1 %

Advanced

Maximum Rainfall Clean Amount (Dry Season): 5 mm/hr

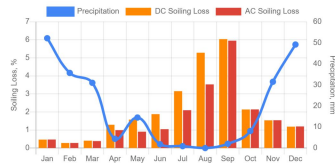
Advanced

Calculate Soiling Losses

Monthly Average DC Soiling Losses:

Jan	0.5	%	Feb	0.3	%	Mar	0.4	%
Apr	1.3	%	May	1.6	%	Jun	1.9	%
Jul	3.2	%	Aug	5.3	%	Sep	6	%
Oct	2.1	%	Nov	1.5	%	Dec	1.2	%

Annual Soiling Losses vs Precipitation:



Next

SOILING PROFILE

- Users have several options to calculate soiling losses or upload measured soiling loss data
- Rainfall Clean Event thresholds define the effects of precipitation on soiling losses
- Monthly average soiling losses and precipitation throughout the year are displayed on a interactive chart for easy reference
- A table of Monthly Average DC Soiling Losses enable users to view or modify calculated soiling loss values





CLEANING CONFIGURATIONS

- Users can choose from multiple options for calculating clean cycles and resulting financial returns:
 - Calculate the optimal cleaning cycle resulting in the greatest financial gains
 - Calculate clean cycles, soiling losses and resulting revenues based-on specified cleaning thresholds or frequencies
- The number of days required to clean the PV system determines the losses throughout extended cleaning periods
- The Cost of Cleaning and Value of Energy produced by the PV system determines the financial losses and gains for a given clean cycle

enlighten energy **PV SoilSayer**

Manage Sites Weather Resources PV System Info Soiling Profile **Cleaning Configuration** Report Wash Dashboard

Clean Cycle Configurations

Please select from one of the following clean cycle configuration options:

- Calculate Optimal Clean Cycle
 - Calculate Optimal Clean Cycle in order to minimize costs and maximise PV System performance
 - Minimum Value of Energy Gain: \$ 5000 / per clean
 - Daily Resolution Weekly Resolution
- Specify Year to Date Manual Clean Events
- Calculate Clean Cycle Based-on Specified Thresholds
- Calculate Soiling Losses Based-on a Specified Clean Cycle

Manual Clean Quality: 0.5 % Number of Days Required to Clean: 15 days

Value of Energy

- Use Average Annual Price of Energy
- Use Average Monthly Price of Energy

Use Average Monthly Price of Energy to calculate The Value of Energy Loss/Gain:

Jan	\$ 0.055 / kWh	Feb	\$ 0.063 / kWh	Mar	\$ 0.062 / kWh	Apr	\$ 0.071 / kWh
May	\$ 0.075 / kWh	Jun	\$ 0.082 / kWh	Jul	\$ 0.81 / kWh	Aug	\$ 0.86 / kWh
Sep	\$ 0.061 / kWh	Oct	\$ 0.64 / kWh	Nov	\$ 0.055 / kWh	Dec	\$ 0.056 / kWh

Cost of Cleaning

- Input the Total Cost of Cleaning per PV System or Power Block

Cost of Cleaning the PV System: \$ 20000 / Clean
- Cost of Cleaning Based-on System Size

Proceed

Total Annual Events

Total Rainfall Clean Events	Total Muddy Rain Events	Total Sandstorm Events	Total Manual Clean Events
8	0	0	5

Total Annual No Clean Losses

Total Amount of AC Energy Produced No Clean	Avg AC Annual Soiling Loss % No Clean	Total Amount of AC Energy Lost No Clean	Total Cost of AC Energy Lost No Clean
270,786,769.77 kWh	5.83%	16,760,571.96 kWh	\$2,310,659.28

Total Annual Clean Losses

Total Amount of AC Energy Produced Clean	Avg AC Annual Soiling Loss % Clean	Total Amount of AC Energy Lost Clean	Total Cost of AC Energy Lost Clean
283,914,360.61 kWh	1.26%	3,632,981.12 kWh	\$490,692.11

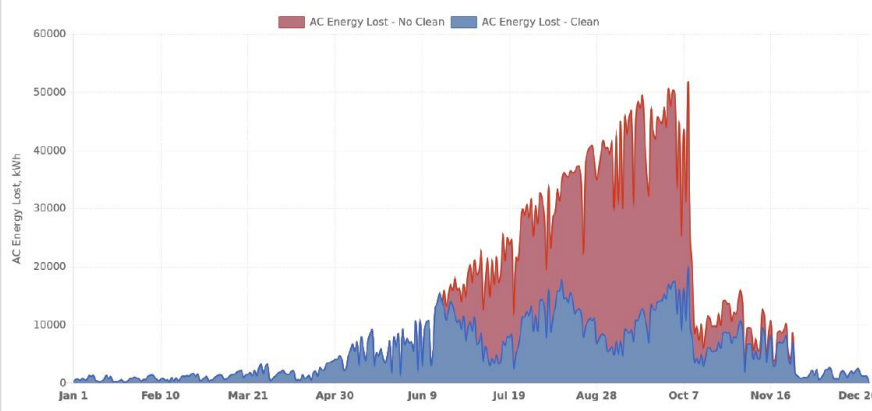
Total Annual Cost Savings - No Clean vs. Clean

Total Amount of AC Energy Gain Clean vs. No Clean	Total Value of AC Energy Gain Clean vs No Clean	Total Cost of Cleaning	Total Net Annual Revenue Gain Clean vs No Clean
13,127,590.84 kWh	\$ 1,819,967.18	\$ 262,830.00	\$ 1,557,137.18

Manual Clean Events

Manual Clean Date	Payoff Date	Total AC Energy Gain	Total Value of Energy Gain
Jun 4, 2020	Jul 1, 2020	621,802.24 kWh	\$ 111,070.78
Jul 4, 2020	Jul 20, 2020	1,620,932.40 kWh	\$ 293,571.62
Aug 3, 2020	Aug 14, 2020	2,525,499.12 kWh	\$ 454,589.84
Sep 2, 2020	Sep 10, 2020	3,819,160.78 kWh	\$ 540,354.18
Oct 7, 2020	Oct 19, 2020	4,540,196.31 kWh	\$ 420,380.75

AC Energy Lost - Clean vs No Clean (kWh's)



REPORTS

- Detailed reports provide users with manual clean events, associated costs and net revenue gains or losses
- Avg Monthly Soiling Rates and Soiling Ratios resulting from calculated clean cycles are calculated
- A clean Cycle Calendar displays dates for calculated manual clean events and rainfall cleans
- Interactive charts provide visualization of calculated data including no clean vs clean AC and DC losses and gains

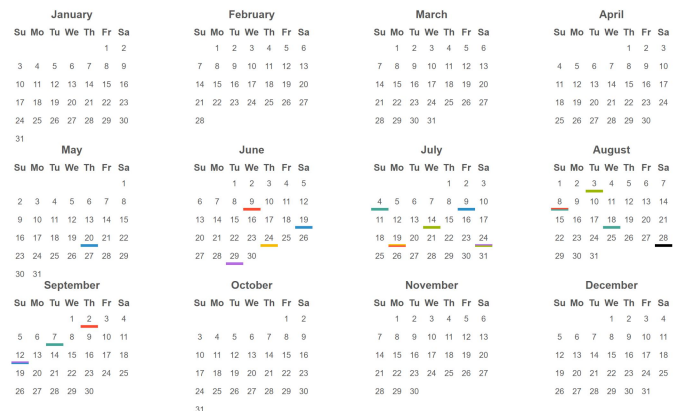


WASH DASHBOARD

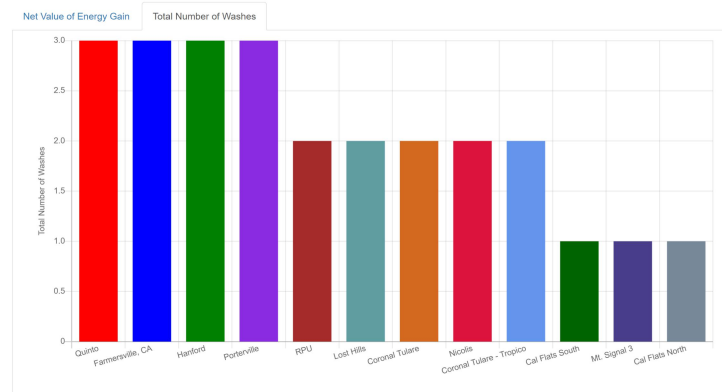
- The Wash Dashboard is automatically updated with scheduled clean events based-on long-term weather forecasts
- The Clean Cycle Calendar summarizes scheduled manual clean events for a portfolio of sites
- Interactive graphics provide easy access to calculated financial returns and linked reports for further analysis
- Wash Charts provide a summary of site cleaning frequencies and estimated financial returns
- Email alerts can be configured to notify users of upcoming scheduled clean events



Clean Cycle Calendar



Wash Charts



Email Alerts

Send an Email Notification for Pending Manual Clean Events

of Days to Alert Prior to Scheduled Clean: 30 days

Save



Contact Us for a Free Trial of the PV SoilSayer.

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