Asia-Pacific Economic Cooperation

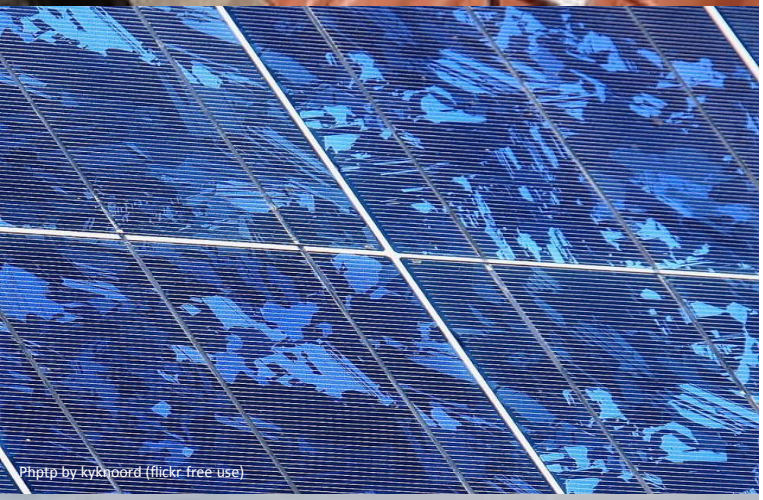
Rooftop Solar PV System Designers and Installers

Training Curriculum

APEC Secretariat

March 2015


Phptp by marufish (flickr free use)


Phptp by kyknoord (flickr free use)


Phptp by thomas kohler (flickr free use)

SYSTEM MONITORING

Training of PV Designer and Installer

APEC
Asia-Pacific Economic Cooperation

Cu International Copper Association
Copper Alliance

castlerock consulting

Why Monitoring

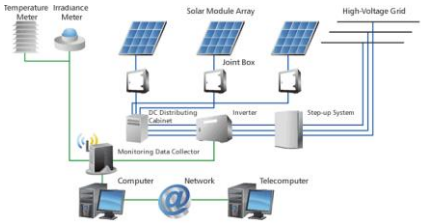
A monitoring system is important because:

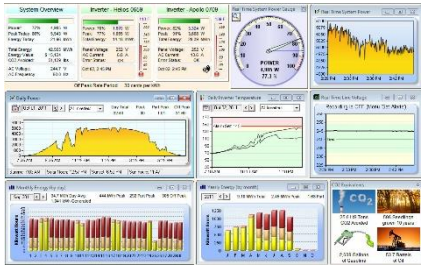
- A solar PV system is an investment because it is able to produce electricity. When the electricity production falls below expectation, it affects the investment value

- Many of the failure modes are gradual rather than sudden, and when caught early enough can be repaired quickly

How do We Monitor

1. Manual monitoring:
   The simplest type, this is where the technician observes and measures a set of data and records it on a log book
2. Local monitoring:
   Often as simple as a display screen for the components such as the grid inverter and/or battery inverter
3. Remote monitoring:
   Requires that a monitoring system is installed along with the solar PV system as well as an internet connection
4. Remote monitoring with reporting:
   Similar to a remote monitoring system, it has the added capability of periodic reporting and often immediate alerts that can be set up ahead of time





Manual Monitoring

Asia-Pacific Economic Cooperation

Often this method is the most cost efficient and the most appropriate for a smaller system. Especially applicable for small home systems because the components often do not have an option for a display.

Small home system's components are usually low cost and therefore do not normally come default with a display if it even has that option.

Lack of monitoring and proper maintenance are the two main causes for premature failures of many small home systems throughout the world. Even a manual monitoring method where the user records basic information about the system and the weather conditions can help predict failures before they become severe.

With the right information recorded by the user, the NGO donors or the government entity who funded the small home system can devise an early warning method for the system's failure and if caught in time can apply for warranty from the manufacturer or the supplier.

Manual Monitoring

Asia-Pacific Economic Cooperation

Logbook for Recording PV Output Energy

PV System Address			
PV Size in kW		Module Type	
PV Array Orientation		Array Tilt Angle	
Inverter Type		Power of Inverter kW	
PV Installation Date		Meter Installation	

Date	Time	Inverter Reading Total kWh today	Inverter Reading Total kWh to date	Electricity Export Reading to date (option)	Electricity Import Reading to date (option)

Copyright© 2011 Regen Power Pty. Ltd.

Sample log book form for manual data recording. Match the columns for the data recording with the capability of the user/operator. Also need to add the time of data collection as well as weather.

Ideally different sets of data need to be taken in the late morning and in the evening. In the late morning (11:30am-1pm), the array voltage and current need to be recorded as well as the time and the weather.

At night (1 hour after official time for local sunset), the battery voltage and current need to be recorded.

Local Monitoring

Appropriate for slightly larger systems than small home systems, a local monitoring method simply involves solar PV components with a data display included during the initial installation and commissioning.

In most cases, the data display stores the system's performance information for up to 128 days so that the operator/user do not need to record the data on a daily basis. However, the information still need to be recorded on a regular basis.

Local Monitoring

End-of-Day Screen

Today 000Ah 00.0kWH 011Vp 00.0Ap 0.00kWp MAX 14.7 V ABS 01:00 MIN 14.6 V FLT 00:00	**Day (up to 128 days)**	Today 000Ah 00.0kWH 011Vp 00.0Ap 0.00kWp MAX 14.7 V **ABS 01:00** MIN 14.6 V FLT 00:00 — **Accumulated Absorb Time**
Today **000Ah** 00.0kWH 011Vp 00.0Ap 0.00kWp MAX 14.7 V ABS 01:00 MIN 14.6 V FLT 00:00	**Accumulated Amp-hours**	Today 000Ah 00.0kWH 011Vp 00.0Ap 0.00kWp MAX 14.7 V ABS 01:00 **MIN 14.6 V** FLT 00:00 — **Minimum Battery Voltage Obtained**
Today 000Ah **00.0kWH** 011Vp 00.0Ap 0.00kWp MAX 14.7 V ABS 01:00 MIN 14.6 V FLT 00:00	**Accumulated kWh Total Power**	Today 000Ah 00.0kWH 011Vp 00.0Ap 0.00kWp MAX 14.7 V ABS 01:00 MIN 14.6 V **FLT 00:00** — **Accumulated Float Time**
Today 000Ah 00.0kWH **011Vp** 00.0Ap 0.00kWp MAX 14.7 V ABS 01:00 MIN 14.6 V FLT 00:00	**Peak Input Voltage**	
Today 000Ah 00.0kWH 011Vp **00.0Ap** 0.00kWp MAX 14.7 V ABS 01:00 MIN 14.6 V FLT 00:00	**Peak Output Current**	
Today 000Ah 00.0kWH 011Vp 00.0Ap **0.00kWp** MAX 14.7 V ABS 01:00 MIN 14.6 V FLT 00:00	**Peak Output Power in Kilowatts**	
Today 000Ah 00.0kWH 011Vp 00.0Ap 0.00kWp **MAX 14.7 V** ABS 01:00 MIN 14.6 V FLT 00:00	**Maximum Battery Voltage Obtained**	

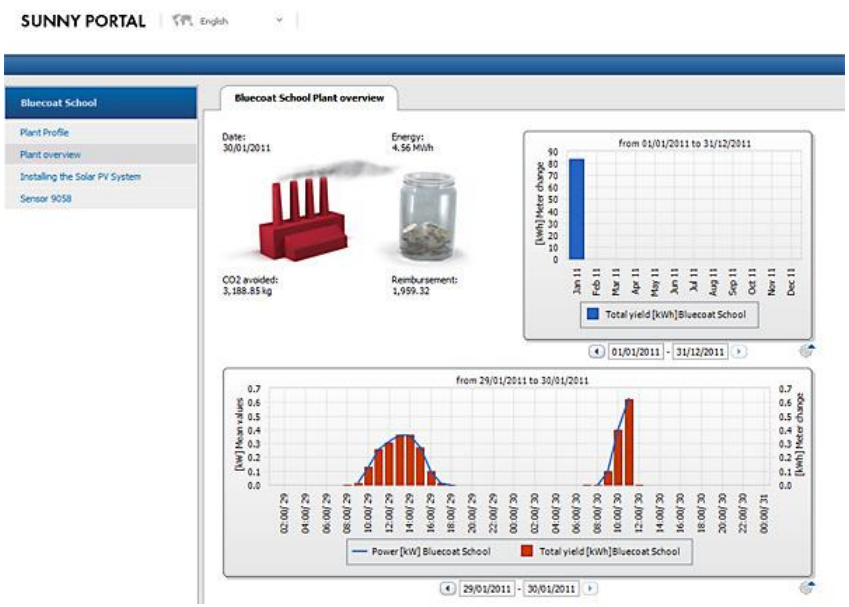
Remote Monitoring

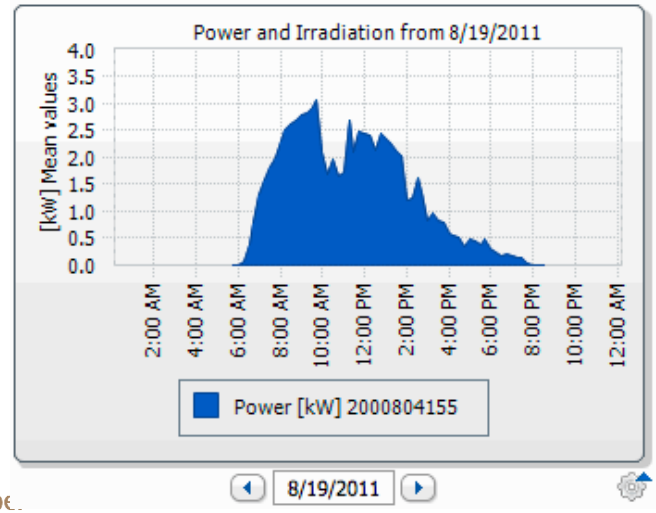
Asia-Pacific Economic Cooperation

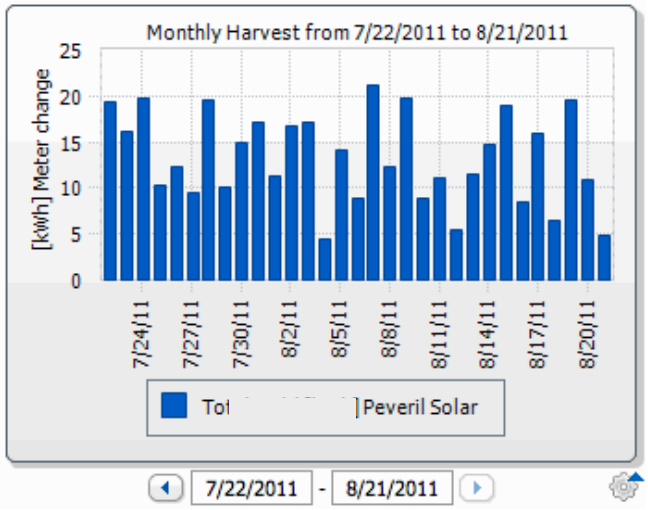
Larger system components (>1000 Watt peak) normally have a data display built in and an option to send the data to a centralized server. The server can be within the network of the user or to an external cloud storage server via internet.

Often the data display has the ability to connect to USB, Bluetooth or Ethernet connection for the data transfer. Some even have built in web servers that can be accessed directly to display the information via an http connection. These webservers usually have a usable to great user interface for the information.

Remote Monitoring







Remote Monitoring

Asia-Pacific Economic Cooperation

OutBack POWER™ member of The alpha Group™

OPTICSRE

Access your solar energy system **anytime**, **anywhere**.

Remote Monitoring with Reporting

Some systems that are capable of remote monitoring can also compile a customized report and/or alerts. These reports and alerts are very useful to automate not only the monitoring efforts but also to compare with previous periods.

An alert can be set up when any of the monitored parameters are outside of the programmed values. Usually the alert is via email and it's possible when there is an internet connection.

Reports can be set up on a daily, weekly or monthly basis as well as annually. These reports can be useful to see trends that are happening to the system. An example would be a tree that is growing to cast a shadow on the array can be seen as a decline in output power.

Remote Monitoring with Reporting

service@sunnyportal.com
to me

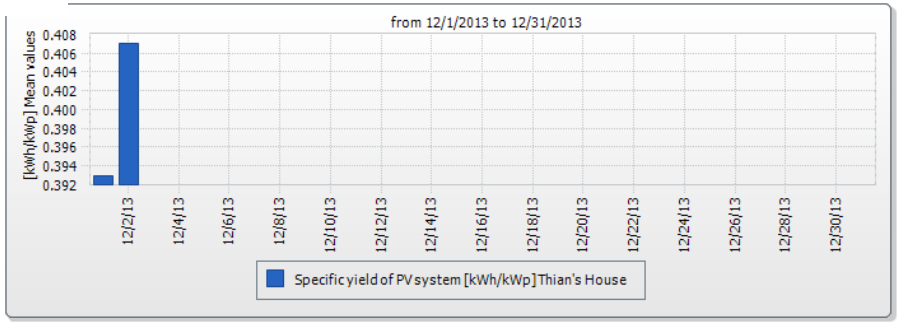
12/2/13

SUNNY PORTAL

Sunny Portal Info Report for plant: for the 12/2/2013

Daily Production: 5.506 kWh
Daily Power (max.): 2.338 kW
Daily Revenue: 7598.28 IDR
Daily CO2 Reduction: 4.174 kg

s House Specific yield



12/2/2013 12:01:37 PM (UTC) Created by Sunny Portal / SMA Solar Technology AG

www.SunnyPortal.com · **SMA Solar Technology AG**

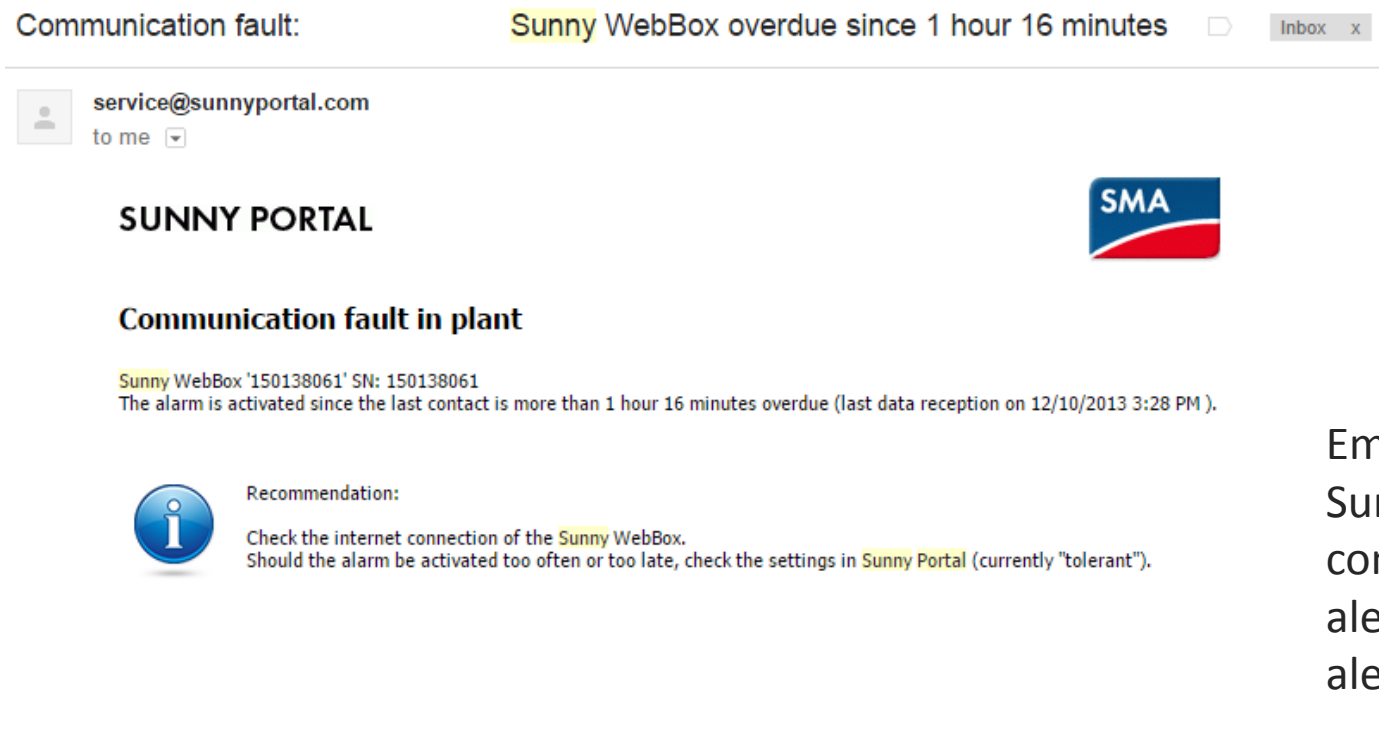
Generated at 12/2/2013 7:01 PM / (UTC+07:00) Bangk

SMA Solar Technology AG
Chairman of the supervisory board: Guenther Cramer
Management board: Roland Grebe, Lydia Sommer, Pierre-Pascal Urbon, Marko Werner
Municipal court Kassel mercantile register dep HRB 3972
Company headquarters: 34266 Niestetal, Germany
USt-ID-Nr. DE 113 08 59 54
WEEE-Reg.-Nr. DE 95881150

Email from SMA Sunny Portal for the daily report. Other information and other intervals are available (weekly, monthly, etc)

Remote Monitoring with Reporting

Asia-Pacific Economic Cooperation



Communication fault: Sunny WebBox overdue since 1 hour 16 minutes Inbox x

service@sunnyportal.com
to me

SUNNY PORTAL

SMA

Communication fault in plant

Sunny WebBox '150138061' SN: 150138061
The alarm is activated since the last contact is more than 1 hour 16 minutes overdue (last data reception on 12/10/2013 3:28 PM).

Recommendation:

Check the internet connection of the Sunny WebBox.
Should the alarm be activated too often or too late, check the settings in Sunny Portal (currently "tolerant").

www.SunnyPortal.com · **SMA** Solar Technology AG

SMA Solar Technology AG
Chairman of the supervisory board: Guenther Cramer
Management board: Roland Grebe, Lydia Sommer, Pierre-Pascal Urbon, Marko Werner
Municipal court Kassel mercantile register dep HRB 3972
Company headquarters: 34266 Niestetal, Germany
USt-ID-Nr. DE 113 08 59 54
WEEE-Reg.-Nr. DE 95881150

Email from SMA Sunny Portal for the a communication fault alert. Other types of alerts are available

Asia-Pacific
Economic Cooperation

Project Number : EWG 22/2013A

Produced By

Andre Susanto
Chitra Priambodo
Castlerock Consulting - http://www.castlerockasia.com/

For
Asia Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

© 2015 APEC Secretariat

APEC#215-RE-03.12