PV Bean Counter - Service Configuration

1   Contents

2   Background to Version 2

2.1   Where it Started - Version1

Version 1 of PV Bean Counter (PVBC) provided three different methods of monitoring various devices; all of which were basically energy meters of some sort.

Inverter Managers were used to monitor the original set of supported inverters. Inverter Managers were hand crafted for each inverter type. Adding a new inverter was labour intensive and there was limited scope for sharing functionality across different inverter types.

Meter Managers were used to monitor meters that were not an integral part of an inverter. As with Inverter managers; each was hand crafted for each meter type. Meter Managers were required because the structure of an Inverter Manager was dedicated to measurement of inverter yield and could not be readily extended to measurement of consumption or other hybrids such as grid net consumption / feed-in.

Device Managers were the third device management type added. Initially supporting a generic implementation of the Modbus serial port protocol. It was quickly extended to provide a generalised method of managing inverters using any serial port protocol. The protocol was defined in a collection of xml protocol and inverter definition files. The Device Manager quickly demonstrated the value of a generalised approach to device management. It was still limited to inverters only. But it provided the basis for the flexibility built into PVBC version 2.

2.2   Major Differences in Version 2

Version 2 of PV Bean Counter uses the .Net Framework version 4.5. This framework is not compatible with Windows XP. It is compatible with Windows Vista, Windows 7 and Windows 8. You will need to download and install the .Net Framework Version 4.5 if it is not already installed on your computer.

Version 2 uses a standard configuration pattern for all supported devices - Inverters, Energy Meters and Gas Meters. The new version has been designed to allow extension to include other device types such as weather stations; temperature monitors etc. It also allows management of hybrid devices that combine multiple measurement types (called "Features" in PVBC v2) in one device.

Version 2 provides an extensible mechanism for management of device reading consolidation. This is important for the production of summaries based on readings taken from a wide range of device types.

In version 2, the "Device Manager" is a software component that controls communication with one or more devices via a common access path. The access path can be:

- A data extraction executable such as SMA's Sunny Explorer
- A single communication port with one or more devices attached
- A database containing readings in some consistent format
- A network address and protocol through which devices can be accessed

Associated with each Device Manager is a collection of "Devices" accessible through that device manager. In general, device configuration involves specifying the device type and access address or identity of the device. Each Device Manager provides a list of the device types supported by that device manager.

Version 2 has completely replaced the old Version 1 method of consolidating readings for dispatch to external destinations such as PVOutput. In version 1 this was all hand crafted code that could only be used with PVOutput. Version 2 introduces a new "Consolidation (Device) Manager". A Consolidation Manager is a

container for any number of Consolidation Devices. A Consolidation Device is a virtual device that calculates summary readings for any number of ordinary devices and / or other Consolidation Devices. Consolidation Devices allow the preparation of device reading summaries. Features provided include:

- Presentation of readings from multiple devices as if from a single source
- Conversion of reading resolution from the resolution specified on the source devices to the resolution specified on / required by the consolidation device
- Ability to present multiple reading types (Yield, Consumption and Net Yield) from a single source

All of the above features allow PVBC to prepare consolidated data in a form suitable for dispatch to PVOutput, regardless of the reading resolution produced by the source devices.

This facility will (in future releases) be used to allow output to alternate targets such as Cosm (formerly Pachube) and generic data export from PVBC.

Note that PV Bean Counter version 2 will not work with MS Access / Jet databases.

3   First Steps

Since you are reading this manual, you clearly have found the PV Bean Counter downloads page. Installation of PV Bean Counter requires a few decisions:

3.1   The PV Bean Counter "Default Directory"

This is the directory that will contain the PVBC configuration file and any log files produced while the PVBC service is running. The default value is "C:\PVRecords".

If you are considering changing this setting, note the following:

- The PVBC service needs full control over this directory
- The PVBC service normally uses a low privilege account named "Local Service"
- Do not try to use a Default Directory that is inside a secured location on your computer. Normally all folders associated with a user login on your computer will be secured against access by the Local Service account and consequently the PVBC service will encounter file access errors

Refer to Section 10 Change the PVBC Default Directory for details of the correct procedure to change this setting after installation is complete.

3.2   Database Type

The default database type is SQLite. This is a light weight database that will be created automatically for you unless you choose an alternative.

Other available database types are Microsoft's SQL Server (or SQL Express) and MySQL. PVBC does not assist with the installation of either of these databases. However once you have the databases installed PVBC, will automatically create the required tables and views in the default database schema associated with the database credentials you supply on the Database Tab.

3.3   First Time Installation

3.3.1   Mandatory First Steps

- Download and install the PVBC version you wish to use
- Open "PV Bean Counter Configuration" and select the "General" tab

  If the PVBC "Default Directory" does not yet exist, PVBC will open the default configuration file that comes as part of the installation. This is your opportunity to modify the location of the "Default Directory". and choose your Database Type. Both of these can be done on the PVBC "General" tab

Database Type	SQLite
Default Directory	C:\PVRecords
First Day	4/10/2013 15

☑ Emit Events (use with PVMonitor)

Service Account	Local Service	Password	☐ Password Required

☑ Auto Start PVBC Service   ☑ Auto Restart PVBC Service

[Setup / Check Environment]

[Auto Setup PVOutput Devices]   ☐ Unlock

- When the" Database Type" and "Default Directory" are set to the required values, click "Save"

This will cause PVBC to create the Default Directory (if it did not exist), it will create the SQLite database if that database type is selected; and it will save the settings_v2.xml file in this directory. It also attempts to set appropriate permissions on the Default Directory and its contents. This is done in an attempt to ensure that the PVBC service has the privileges required to access and modify the Default Directory contents.

Note - Local security settings sometimes prevent some of these security related adjustments. Manual security settings are sometimes required.

- Click "Setup / Check Environment"

  This repeats the environmental checks performed when you clicked "Save". However this option displays a brief log of the checks and actions performed. It will also highlight any problems encountered. This step confirms access to your selected database type. This is useful for confirming that you have correctly configured access to a SQL Server or MySQL database

Environment Configured

Directory Located: D:\PVRecords
Directory Located: D:\PVRecords\Archive
Assigned full control to Local Service on: D:\PVRecords
Assigned full control to Local Service on: D:\PVRecords\Archive
Database read test OK

Configuration Passed Checks

[OK]
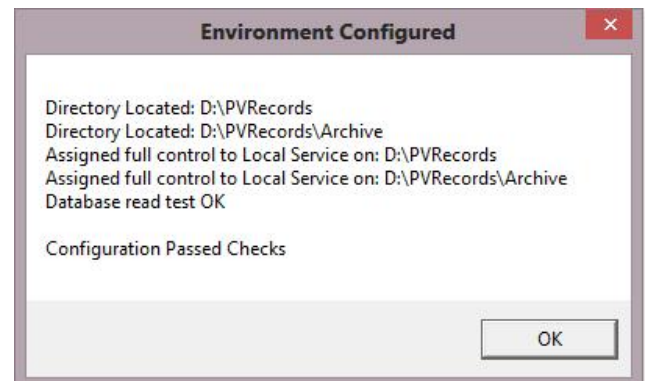
Note that the PVBC service checks the database for the presence of database tables at the correct revision level for use with the installed version of PVBC. If the tables are not found, they are created. If they are at a lower revision level, they are upgraded.

You have now installed the PVBC service and created an initial configuration. You now need to configure the devices to be monitored. This is covered in the following sections.

Complex device installations require careful consideration of the relationship between the individual devices, Consolidation Devices, PVOutput Systems and emitted events (for use with PVMonitor). These systems need to be planned after reading this manual carefully.

3.3.2 Other 'General' Tab Settings

The following settings are available on the General tab. Most users do not need to adjust these settings.

First Day

First Day is used with device types that store a useful (to PVBC) history of readings. This date indicates the earliest day for which history data will be copied into PVBC.

This date is currently used with:

- SMA WebBox connected devices
- SMA Sunny Explorer connected devices
- Owl Energy Meter devices

Emit Events

Check "Emit Events" if you want to view PVBC reading related events through the PV Monitor program. PV Monitor provides a set of desktop gauges that display instantaneous readings from the PVBC connected devices.

Service Account

This is the windows account used to run the PVBC service. The default is "Local Service". This is a low privilege account that normally has adequate privileges to perform the required operations.

On some systems, Local Service has trouble with actions such as controlling bluetooth devices or accessing the required file system folders. Service Account can be used to select higher priority accounts (Network Service or Local System). You can also configure a user account. With a user account a password is usually required.

Password

Enter a password here when using a user account in "Service Account".

Auto Start PVBC Service

When checked, this causes the PVBC service to start automatically when the computer is rebooted. The auto start has a delay to ensure the required system and database services are fully operational before the PVBC service starts.

Auto Restart PVBC Service

When large numbers of errors occur, the PVBC service will automatically stop running. When Auto Restart PVBC Service is checked, the windows Service Control Manager will automatically restart the PVBC service.

Setup /Check Environment

Use this at any time to ensure the default directory and associated permissions are set correctly.

Auto Setup PVOutput Devices

This button is only available after checking "Unlock". This button discards most or all of the existing PVOutput data consolidation configuration and substitutes a "best guess" initial configuration.

This is a useful tool for establishing an "initial" set of PVOutput data consolidation settings. If you have a complex set of devices or you are using multiple PVOutput systems, you will need to modify the settings created here.

3.4   Quick Start Guide for Simple Installs

Most PVBC users just want to monitor a single inverter and they may have an energy meter to monitor household consumption. For these users, the following steps are appropriate:

- Register your system at the PVOutput website. Obtain your PVOutput System Id and the associated API key
- Configure you inverter on the Devices tab as described in Section 5 Device Configuration - Detailed
- If you have consumption meters configure these on the same Devices tab
- Configure your PVOutput System in PVBC as described in Section 7 PVOutput Configuration
- On the "pvoutput.org Settings" tab, check "Unlock" and click "Auto Setup PVOutput Devices"
- Ensure all of your Device Managers, Devices and the PVOutput System are "Enabled"
- Save Settings and click "Start Service"

Check the PVService_yyyymmdd.log file for error messages. These messages can provide an indication of any missing or incorrect configuration settings.

4   Device Configuration - Overview

4.1   New Concept in Version 2 - Device Features

Version 2 introduces the concept of "Device Features". A Device Feature identifies a single part of the device that generates readings over time.

SMA inverters accessed via Sunny Explorer have only one feature:

- Inverter Yield AC   (Inverter AC Yield - Energy and Average Power)

For single phase inverters typical features would include:

- Yield AC   (Inverter AC Yield - Energy, Power, Voltage, Current and Temperature)
- Yield String 1   (Inverter DC String 1 Readings - Usually Voltage and Current)
- Yield String 2   (Inverter DC String 2 Readings - Usually Voltage and Current)

For three phase inverters typical features would include:

- Yield AC - Phase 0   (Inverter AC Yield - Energy, Power, Voltage, Current and Temperature)
- Yield AC - Phase 1   (Inverter AC Yield - Energy, Power, Voltage, Current)
- Yield AC - Phase 2   (Inverter AC Yield - Energy, Power, Voltage, Current)
- Yield String 1   (Inverter DC String 1 Readings - Usually Voltage and Current)
- Yield String 2   (Inverter DC String 2 Readings - Usually Voltage and Current)
- ....
- Yield String n   (Inverter DC String n Readings - Usually Voltage and Current)

For generic meters such as Current Cost devices:

- Energy AC   (Energy AC - Energy, and Power)

Generic devices acquire the nature of their reading through their involvement in Consolidations or Events, where a generic set of Energy readings are configured to be interpreted as Yield or Consumption.

Devices that capture three phase AC energy values need to be have all three phase features consolidated into a single set of readings for display at PVOutput.

Some devices use a three phase capable device definition for both three phase and single phase devices. When this happens (SunnyRoo, Effekta), the single phase readings are provided on the Phase 0 feature.

4.2   The "Device Managers" Tab

The Device Managers tab is used to create and modify configuration entries that allow PVBC to take readings from many devices and store these readings in the PVBC database.

The Device Managers tab appears as shown below:
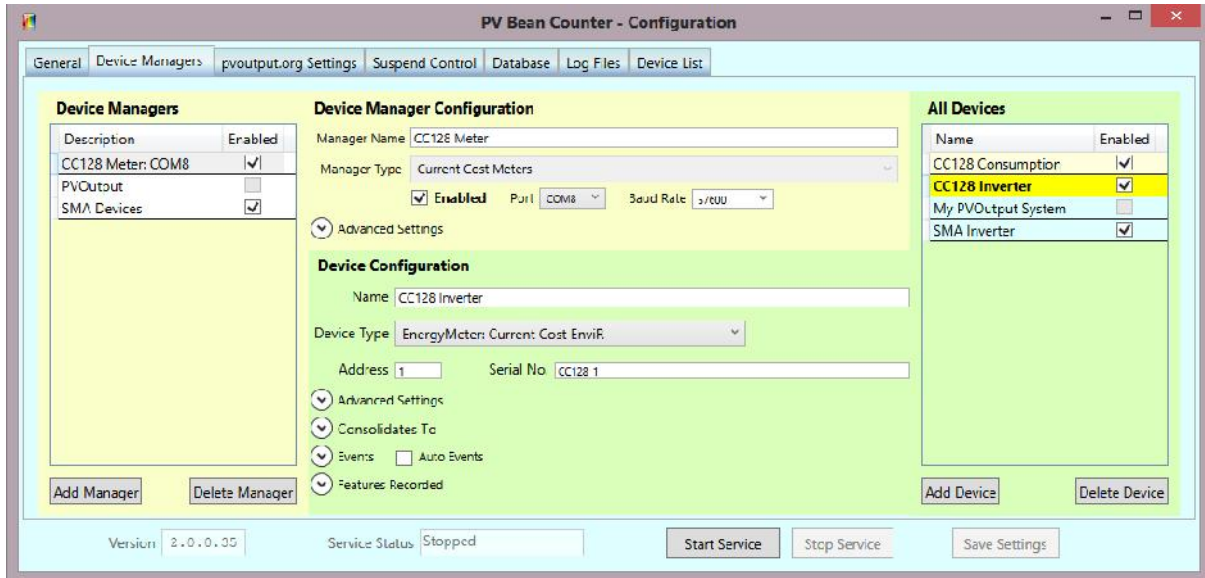
This tab is divided into four panels:

- A list of all Device Managers currently configured on the left
- A list of all Devices currently configured on the right
- Detailed configuration details for the currently selected Device Manager in the top centre
- Detailed configuration details for the currently selected Device in the bottom centre

4.3   The "Device Managers" List

The Device Manager List (on the left hand side of the Device Managers tab) is shown below:

This list shows all Device Managers you have configured for use with PVBC. The list shown contains device managers for:

- A Current Cost Energy Meter connected to COM8
- SMA Inverters accessible via Sunny Explorer
- A collection of one or more PVOutput Consolidations

Device Managers that manage "real" devices run in a dedicated "thread" on the computer. These "threads" can be either enabled or disabled.

In the list shown, both the Current Cost Energy Meter and the SMA Sunny Explorer device manager are "Enabled".

The list also contains a PVOutput Consolidation Device Manager. Consolidation device managers do not manage real devices. They are simply a container to hold the "virtual" consolidation devices. Consolidation device managers do not use a dedicated thread and they cannot be enabled or disabled. They are used to define how the data sourced from "Real" devices is consolidated / summarised for presentation through an output mechanism such as PVOutput and device events.

The Add Manager button adds a new Device Manager to the list.

The Delete button deletes the currently selected Device Manager and all associated devices.

When a new device manager is "Added" or when any device manager in the list is selected, the details of that device manager are displayed in the Device Manager Configuration panel in the top centre portion of the Device Managers tab.

When a device manager is selected, all devices in the Device List (on the right hand side) that are owned by the selected device manager are coloured to show that they are associated with the selected device manager.

4.4   The "Device Manager Configuration" Panel

The Device Manager Configuration Panel displays the detailed configuration for the selected device manager.

A device manager configuration panel is shown to the right. This panel allows you to provide your own name for the device manager and to select the appropriate device manager "Manager Type".

The manager type determines the types of devices that will be managed by this device manager.

Device Manager Configuration

Manager Name SMA Devices

Manager Type SMA Sunny Explorer

☑ **Enabled**

⌄ Advanced Settings

The selection above ("SMA_SunnyExplorer") indicates that this device manager will access SMA inverters using the SMA supplied program named "Sunny Explorer".

The device manager configuration panel shown here has been configured to access Current Cost energy meters on serial port COM8 at a data transfer rate of 57600 baud.

The device manager configuration panel automatically hides configuration options that are not relevant to the selected manager type.

Device Manager Configuration

Manager Name CC128 Meter

Manager Type Current Cost Meters

☑ **Enabled**   Port COM8   Baud Rate 57600

⌄ Advanced Settings

PVBC uses "Expander Controls" to allow specific aspects of more complex configurations to be exposed or hidden from view. Clicking on the Current Cost "Advanced Settings" expander reveals extra settings as shown here.

Opening one expander automatically closes all others to conserve on-screen space.

Device Manager Configuration

Manager Name CC128 Meter

Manager Type Current Cost Meters

☑ **Enabled**   Port COM8   Baud Rate 57600

⌃ Advanced Settings

Parity   Data Bits Stop Bits Handshake   History Hours
None   8   One   None   24

Manager Device   DB Int
EnergyMeter: Current Cost EnviR

4.5   The "All Devices" List

The "All Devices" list is on the right hand side of the Device Managers Tab. This list shows all configured devices.

The Add Device button adds a new device to the currently selected Device Manager.

The Delete Device deletes the currently selected device.

Selecting a device in this list automatically selects the associated device manager in the Device Managers list, and also displays the detail of that device manager in the Device Manager Configuration panel. The new device is displayed in the Device Configuration panel.

4.6   The "Device Configuration" Panel

4.6.1   Simple Settings

The "Device Configuration Panel" provides access to device specific configuration settings. It always displays the details of the device that is currently selected in the "All Devices" list.

4.6.2   Advanced Settings

"Advanced Settings" is an expander that exposes the low level settings for this device. On some device types, these settings are automatically populated. On others, the Advanced settings must be manually applied.

The device displayed is an SMA inverter accessed through an SMA_SunnyExplorer Device Manager.

These devices do not require manual setting of Serial No, Make and Model. These are set automatically when PVBC accesses the inverter for the first time.

4.6.3   Make, Model and Serial Number

The readings produced by the devices managed by PVBC are stored in a database using a unique device identifier. This unique identifier is made up of Make, Model and Serial Number.

Many devices provide all three of these values as part of the device readings information provided to PVBC by the device. For these devices, Make, Model and Serial No. are visible but disabled. You do not need to enter any values into these settings when the device provides all three. These values are populated for you after the PVBC service communicates with the inverter for the first time.

Note that you need to close and reopen the PVBC Configuration program to see the Make, Model and Serial Number values extracted from the devices by the PVBC service.

Make and Model Default Values

For all devices, PVBC will provide default Make and Model values if these values are not available from the monitored device. If Model is not provided by the device, the default value is "Unknown". The default value of Make is set based on the selected device type.

This means that you never need to set Make and Model. PVBC will always provide suitable values either from the device itself or from the selected device type.

When using generic meters such as Current Cost or Watts Clever meters to monitor specific devices, you can override the Make and Model in the Advanced Settings so that these values reflect the type of device being monitored. When doing this you must ensure that you do not use a combination of Make, Model and Serial No that duplicates these values from another device monitored by PVBC.

Serial Number Is Always Required

As stated earlier, many devices provide their Serial Number automatically. Where the device does not provide a serial number, you must enter one into the device settings. It does not need to be a real serial number. It just needs to be unique when combined with Make and Model.

If entry of a serial number is required, the Serial Number entry control will be enabled so that entry is possible.

4.6.4   Consolidates To

"Consolidates To" is an expander that exposes the list of consolidation devices to which this device contributes readings. You will create one Consolidation Device for each PVOutput "System ID" to which you want to load readings.

If you have multiple inverters and you want those inverters to be summarised at a single PVOutput System ID, you will consolidate those inverters to the same Consolidation Device. If on the other hand you want to use a different PVOutput System ID for each inverter, you must consolidate each inverter to a different Consolidation Device.

You can consolidate any individual device to any number of Consolidation Devices.

Device Configuration

Name: SMA Inverter

Device Type: Inverter: SMA via Sunny Explorer

Serial No. 2100342318

⌄ Advanced Settings
⌃ Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
My PVOutput System	Inverter Yield AC		Inverter Yield AC		Add	

Add   Delete

⌄ Events   ☐ Auto Events
⌄ Features Recorded

4.6.5   Events

The "Events" expander exposes event settings used to configure event publication. Event publication is only required if you are using PVMonitor for a live display of yield and consumption power levels.

Configuring events for a device involves:

- Adding a new event
- Selecting the device feature that will drive the event
- Selecting or entering an Event Name
- Selecting an Event Type
- Indicating whether or not this event will contribute to the "Feed-In" gauge in PVMonitor

Device Configuration

Name SMA Inverter

Device Type Inverter: SMA via Sunny Explorer

Serial No. 2100342318

⌄ Advanced Settings

⌄ Consolidates To

⌃ Events

☑ Auto Events

Feature	Event Name	Event Type	Feed-In
Inverter Yield AC	Inverter Yield ⌄	Yield	☑

Add   Delete

⌄ Features Recorded

The default Event Names provided in the drop down list correspond to the PVMonitor gauge names that these events will populate.

For Event Names "Inverter Yield" and "Meter Yield" the event type must be set to "Yield".

For Event Name "Consumption" the event type must be set to "Consumption".

If you have both yield and consumption events. Checking "Feed-In" on both events will cause the power readings from those events to be combined to produce the values in the "Feed-In" gauge in PVMonitor.

If you create custom Event Names. PVMonitor will create custom extra gauges to display readings for that event name. The Event Type on these custom events is only used to choose the background style for the custom gauge.

If you check "Auto Events", the events list will be populated with a default configuration if one is available. Default configurations are not available for generic energy meters. Generic meters require manual event configuration as the meters do not indicate whether the readings are yield, consumption or some other energy measurement.

4.6.6   Features Saved

The "Features Saved" expander exposes a list of the features that can produce reading records for this device. When readings are recorded in the database, one reading record is written for each Feature Type / Feature Id combination that is checked in the Features Recorded expander.

For inverter devices, the Yield DC features can be unchecked without affecting normal operation of PVOutput reading publication. The Yield DC features generally record DC voltage and current readings for each string of PV panels on an inverter.

Device Configuration

Name Aurora Original

Device Type Inverter: PowerOne Aurora

Address 1   Serial No.

⌄ Advanced Settings

⌄ Consolidates To

⌄ Events   ☐ Auto Events

⌃ Features Recorded

Feature	Save	Feature Type	Feature Id
Yield AC	☑	YieldAC	0
Yield DC - String 1	☑	YieldDC	0
Yield DC - String 2	☑	YieldDC	1

5   Device Configuration - Detailed

5.1   SMA Devices via Sunny Explorer

5.1.1   Create a PVBC Compatible Sunny Explorer Configuration File

Run Sunny Explorer from the Windows Menu.

- Choose "Enter a new plant"
  - Set "Plant name" to "SunnyExplorer" .
    - o   DO NOT use any other name
    - o   DO NOT short cut this by renaming and existing "sx2" file. The Plant Name will then mismatch

    Ensure that this is entered exactly as spelt here. Putting an incorrect value here is by far the most common reason people have difficulty configuring this Device Manager

  - Set "Directory" to "C:\PVRecords". This must match the "Default Directory" setting on the PVBC General Tab
  - Click "Next"
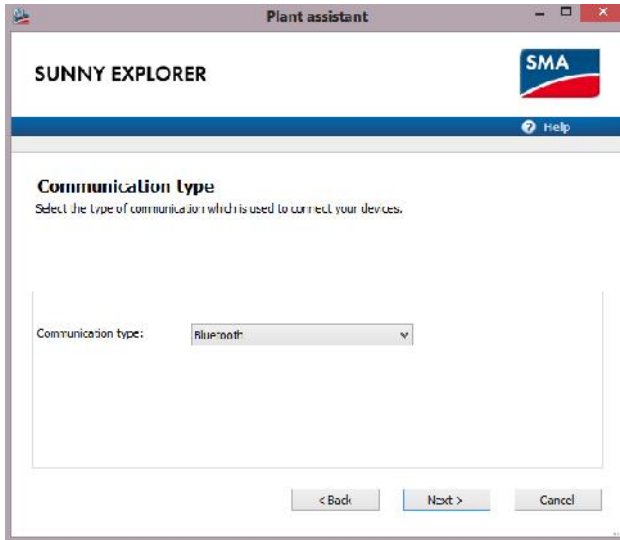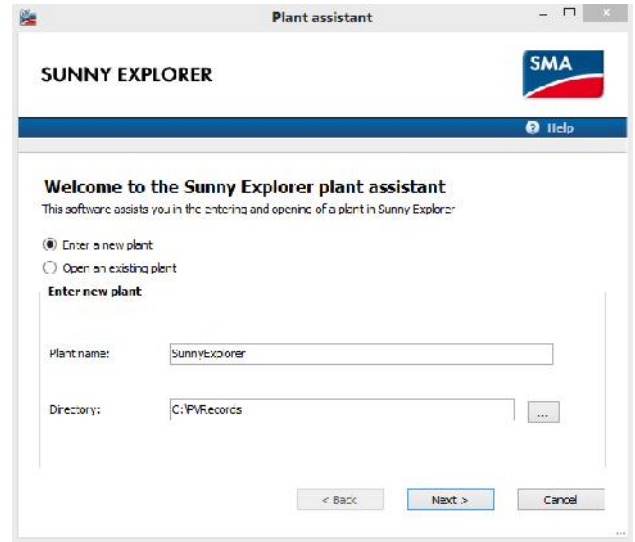
- Select communication type:

  Bluetooth or SpeedWire

- Choose the required NetID - Usually there will only be one listed
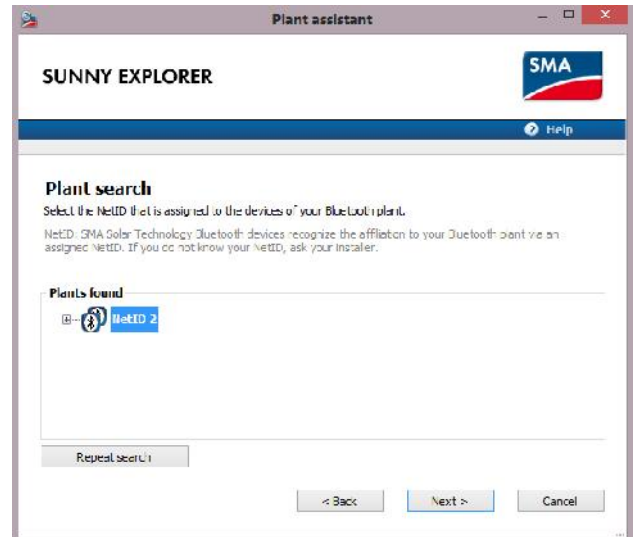
- Enter the "Plant Pasword". This is usually "0000" which is the PVBC default

Sunny Explorer will now access the inverters on the identified NetID and display the inverter details as shown below.
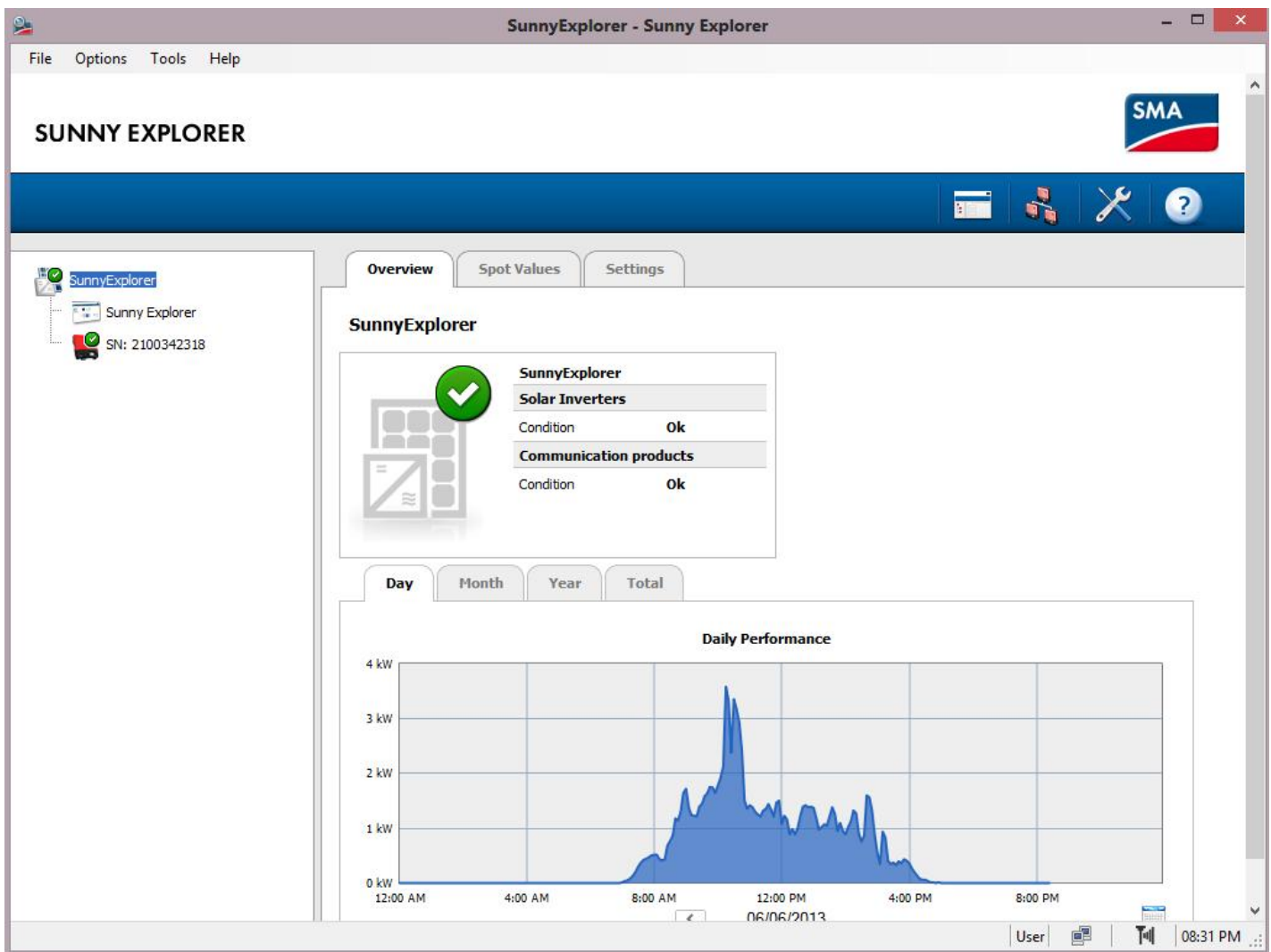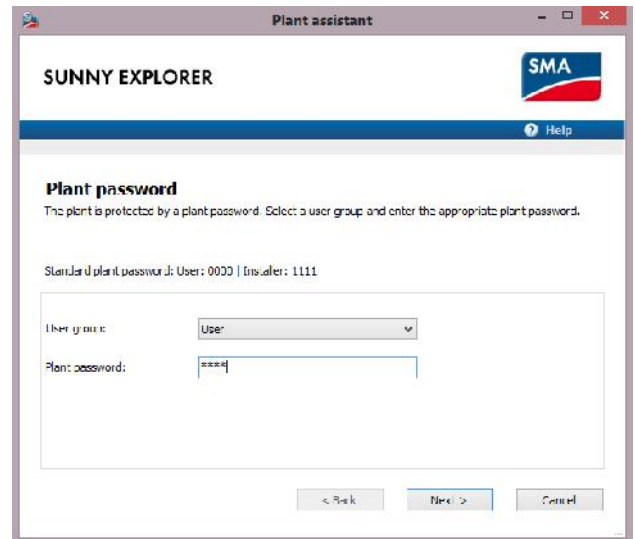
This configuration has now been saved in a file named "C:\PVRecords\SunnyExplorer.sx2". This is the Sunny Explorer configuration file that will be used by PVBC to access the SMA inverters.

Sunny Explorer creates the configuration file using a file name that is the Plant Name followed by ".sx2".

5.1.2   Configure a Sunny Explorer Device Manager

SMA devices accessed via Sunny Explorer are managed by a Device Manager with a Manager Type of "SMA Sunny Explorer". One SMA Sunny Explorer Device Manager can access all inverters configured on a single SMA network id.

To configure an SMA Sunny Explorer Device Manager:

- Use "Add Manager" to create a new Device Manager
- Set a meaningful Manager Name
- Set Manager Type to "SMA Sunny Explorer"

Device Manager Configuration

Manager Name | Sunny Explorer
Manager Type | SMA Sunny Explorer
☑ **Enabled**
⌄ Advanced Settings

There are some advanced settings available for this Device Manager. However all available settings default to values that will work if Sunny Explorer is configured to match the default settings.

- Executable Path identifies the location of the Sunny Explorer program on your computer. You should not need to change this
- Plant Name defaults to "SunnyExplorer". This must match the "Plant name" you entered into Sunny Explorer when creating a PVBC compatible Sunny Explorer configuration file

Device Manager Configuration

Manager Name | Sunny Explorer
Manager Type | SMA Sunny Explorer
☑ **Enabled**
⌃ Advanced Settings
☐ Reset First Day   First Day | Select a date | 15
Executable Path | C:\Program Files (x86)\SMA\Sunny Explorer\SunnyExplorer.exe | ...
Plant Name | SunnyExplorer   Hist Days | 64   Password | 0000

- "Hist Days" is the number of days of past history that will be retrieved by PVBC. Change this only if you know the number of days stored by your inverters
- "Password" must be the correct User Password for your SMA network
- Check "Enabled" to activate the device manager when the PVBC service is started

5.1.3   Configure SMA Sunny Explorer Devices

Use the "Add Device" button to create a device for each inverter available on your Sunny Explorer NetID.

No extra settings are required on these devices. The Serial No, Make and Model (on the Advanced Settings Expander) will be automatically completed when PVBC first connects to the SMA network.

Check "Enabled" on this device in the "All Devices" column to activate this device when the PVBC service is started

Device Configuration

Name | SunnyBoy 1
Device Type | Inverter: SMA via Sunny Explorer
Serial No. |

The following will add the SMA inverter into the Yield total sent to PVOutput

- Open the "Consolidates To" expander
- Set "Device" to the consolidation device you want to consolidate to
- Set "To Feature" to "Inverter Yield AC"
- Set "From Feature" to "Inverter Yield AC"

Note - Refer to Section 5.7and 5.8 for updated details of device consolidation configuration

Device Configuration

| Name | SMA Inverter |

| Device Type | Inverter: SMA via Sunny Explorer |

| Serial No. | 2100342318 |

⌄ Advanced Settings

⌃ Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
My PVOutput System	Inverter Yield AC		Inverter Yield AC		Add	

Add   Delete

⌄ Events   ☐ Auto Events

⌄ Features Recorded

5.2   Modbus Devices

5.2.1   Configure a Modbus Device Manager

Modbus devices are managed by a Device Manager with a Manager Type of "Modbus". One Modbus Device Manager can manage multiple Modbus compatible devices connected to a single serial port.

To configure a Modbus Device Manager:

- Use "Add Manager" to create a new Device Manager
- Set a meaningful Manager Name
- Set Manager Type to "Modbus"
- Select the serial port used by this manager to access the devices
- Set the baud rate required for this serial port

Apart from the baud rate, the default serial port settings in PVBC are usually correct. If you believe you need to use custom detailed serial port settings:

- Open the Advanced Settings expander
- Modify the detailed serial port settings to meet your needs
- Check "Enabled" to activate the device manager when the PVBC service is started

5.2.2   Configure Modbus Devices

- Use the "Add Device" button to add a device to the Modbus Device Manager created above
- Provide a meaningful name for the device
- Select the "Device Type" for this device. The example shows an Effekta Inverter selected
- Enter the Modbus address for this device
- Enter the Serial Number for the device. This does not need to be the actual serial number but it must be a non-empty value that is unique within all devices used in PVBC
- Open the Advanced Settings expander and select the Query Interval. This is the frequency in seconds with which the inverter will be interrogated by the device manager
- For Effekta (and SunnyRoo) inverters, the Make and Model are supplied by the inverter

- Select the DB Interval (database storage interval). This is the frequency in seconds with which readings from the inverter will be stored in the database. This value should not exceed 300 seconds (5 minutes) if the readings are to be used with PVOutput
- Check "Enabled" on this device in the "All Devices" column to activate this device when the PVBC service is started
- Open the "Consolidates To" expander
- Set "Device" to the consolidation device you want to consolidate to
- Set "To Feature" to "Inverter Yield AC"
- Set "From Feature" to "Yield AC - Phase 0"

Note - Refer to Section 5.7 and 5.8 for updated details of device consolidation configuration

5.2.3   Modbus Device Types

Following are the devices currently managed using a Modbus Device Manager:

Device Type	Models	Comments
Effekta Inverter		
Growatt (single phase) Inverter		
Growatt (three phase) Inverter		Untested in Version 2
KLNE Inverter	5.02, 5.03, 8.12, 8.13, 8.14	
SunnyRoo		
Xantrex Inverter		Never tested in any version to my knowledge

5.3   JFY Devices

5.3.1   Configure a JFY Device Manager

JFY devices are managed by a Device Manager with a Manager Type of "JFY". One JFY Device Manager can manage multiple JFY compatible devices connected to a single serial port.

To configure a JFY Device Manager:

- Use "Add Manager" to create a new Device Manager
- Set a meaningful Manager Name
- Set Manager Type to "JFY"
- Select the serial port used by this manager to access the devices
- Set the baud rate required for this serial port

Apart from the baud rate, the default serial port settings in PVBC are usually correct. If you believe you need to use custom detailed serial port settings:

- Open the Advanced Settings expander
- Modify the detailed serial port settings to meet your needs
- Check "Enabled" to activate the device manager when the PVBC service is started

5.3.2   Configure JFY Devices

- Use the "Add Device" button to add a device to the JFY Device Manager created above
- Provide a meaningful name for the device
- Select the "Device Type" for this device. The example shows JFY Inverter selected
- Enter the device address for this device
- Open the Advanced Settings expander and select the Query Interval. This is the frequency in seconds with which the inverter will be interrogated by the device manager
- Select the DB Interval (database storage interval). This is the frequency in seconds with which readings from the inverter will be stored in the database. This value should not exceed 300 seconds (5 minutes) if the readings are to be used with PVOutput
- Check "Enabled" on this device in the "All Devices" column to activate this device when the PVBC service is started

- Open the "Consolidates To" expander
- Set "Device" to the consolidation device you want to consolidate to
- Set "To Feature" to "Inverter Yield AC"
- Set "From Feature" to "Yield AC"
- Check "Use Temp" if you want the temperature readings from the inverter sent to PVOutput

Note - Refer to Section 5.7 and 5.8 for updated details of device consolidation configuration

Device Configuration

Name JFY Inverter 1

Device Type Inverter: JFY Inverters (Non-Modbus, PScale=Auto)

Address 1   Serial No.

⌄ Advanced Settings

⌃ Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
My PVOutput System	Inverter Yield AC		Yield AC		Add	

Add   Delete

⌄ Events   ☐ Auto Events

⌄ Features Recorded

5.4   Watts Clever EW4008/4009 Devices

5.4.1   Configure a Watts Clever Device Manager

Watts Clever devices are managed by a Device Manager with a Manager Type of "Watts Clever Meters". One Watts Clever Device Manager can manage all Watts Clever "Appliances" accessed through a single serial port.

To configure a Watts Clever Device Manager:

- Use "Add Manager" to create a new Device Manager
- Set a meaningful Manager Name
- Set Manager Type to "Watts Clever Meters"

Device Manager Configuration

Manager Name: EW4009

Manager Type: Watts Clever Meters

☑ Enabled   Port COM8   Baud Rate 9600

⌄ Advanced Settings

- Select the serial port used by this manager to access the devices
- The Baud Rate will default to 9600 which should be the correct value for this meter type
- Other serial port related settings are available in the "Advanced Settings" expander. These settings should default to the correct value for these meters
- Check "Enabled" to activate the device manager when the PVBC service is started

5.4.2   Configure the Watts Clever Devices

Each Watts Clever Appliance that produces readings can be accessed through a device where the device address is the Watts Clever Appliance Number.

With these devices, Device Address 1 is usually household consumption and Device Address 0 is usually inverter yield.

- Use the "Add Device" button to add a device to the Watts Clever Device Manager created above
- Provide a meaningful name for the device

Device Configuration

Name: EW4009

Device Type: EnergyMeter: Watts Clever EW4009

Address: 1   Serial No. YourUniqueDeviceIdHere

- There is only on "Device Type" for Watts Clever Devices. This is selected automatically
- Enter the device address for this device. This is the required Watts Clever Appliance Number
- Enter a Serial Number for the device. This does not need to be the actual serial number but it must be a non-empty value that when combined with Make and Model, forms a unique device identity within all devices used in PVBC

5.4.3   Optional Advanced Settings

If you open the "Advanced Settings" expander you can access a number of optional settings.

- Make and Model will be given default values by PVBC. You can choose your own prior to taking first readings from the device. Do not change these values once readings have been taken as these values locate the existing readings in the PVBC database
- The Query Interval is the period in seconds between readings taken from

Device Configuration

Name: EW4009

Device Type: EnergyMeter: Watts Clever EW4009

Address: 1   Serial No. YourUniqueDeviceIdHere

⌃ Advanced Settings

Make: Watts Clever   Model: EW4009

Query Interval: ⌄   DB Interval: ⌄

Calibrate: 1   Threshold: 0   (zero watts)

the Watts Clever meter. The default is 6 seconds. You can select an alternate value

- The DB Interval is the period in seconds between readings taken from the Watts Clever meter being written to the PVBC database. This value defaults to 60 seconds. You can choose an alternate value. It must be a multiple of Query Interval
- Calibrate is a multiplication factor that can be applied to device readings. A value of 1.1 will increase readings by 10%. A value of 0.9 will decrease readings by 10%
- Threshold is a limit in watts below which readings will be treated as zero. This is useful for pushing inverter values to zero during the periods of no light

5.5   Dutch Smart Meter Devices

PV Bean Counter now supports electricity import and export and gas consumption reading from "Dutch Smart Meters". The meters must comply with "Dutch Smart Meter Requirements Version 3 - 24th March 2010".

The PVBC "Dutch Smart Meter Device Manager" listens on a single serial port for messages in the Dutch Smart Meter format. These messages can be directed to one or two "Devices" defined under the Dutch Smart Meter device manager. One only electricity meter is allowed. Up to 4 Gas Meters can be read from the one Dutch Smart Meter Device Manager.

5.5.1   Configure a Dutch Smart Meter Device Manager

To configure a Dutch Smart Meter Device Manager:

- Use "Add Manager" to create a new Device Manager
- Set a meaningful Manager Name
- Set Manager Type to "Dutch Smart Meter"
- Select the serial port used by this manager to access the devices
- The Baud Rate will default to 9600 which should be the correct value for this meter type
- Other serial port related settings are available in the "Advanced Settings" expander. These settings should default to the correct value for these meters
- Check "Enabled" to activate the device manager when the PVBC service is started

5.5.2   Configure a Dutch Smart Meter - Electricity Meter

- Use the "Add Device" button to add a device to the Dutch Smart Meter Device Manager created above
- Provide a meaningful name for the device
- Select the "EnergyMeter: DSM - Electricity" as the Device Type for this device
- The device address for electricity must be 0
- By default, PVBC will store these readings at a resolution of 1 minute. If you wish to store the readings at an alternate frequency, open the Advanced Settings expander and select the DB Interval. This is the frequency in seconds with which readings will be stored

The DSM electricity meter provides separate readings of grid import and export. These readings can be combined with Inverter Yield to produce a total consumption value. Refer to section 6 for details of how to consolidate grid import / export values for use at PVOutput. This section uses DSM grid readings as the basis for the example.

5.5.3 Configure a Dutch Smart Meter - Gas Meter

- Use the "Add Device" button to add a device to the Dutch Smart Meter Device Manager created above
- Provide a meaningful name for the device
- Select the "GasMeter: DSM - Gas" as the Device Type for this device
- Enter the device address for this device. For DSM Gas Meters this is a value from 1 to 4. 1 is the most likely value
- By default, PVBC will store gas readings at a resolution of 1 minute. If you wish to store the readings at an alternate frequency, open the Advanced Settings expander and select the DB Interval. This is the frequency in seconds with which readings will be stored

Device Configuration

Name: DSM-Device-Gas
Device Type: GasMeter: DSM - Gas
Address: 1   Serial No.
ⱽ Advanced Settings
ⱽ Consolidates To
ⱽ Events   ☐ Auto Events
ⱽ Features Recorded

Gas readings in PVBC are held in cubic metres. There are no facilities at PVOutput specifically designed to display gas or volumetric readings. PVOutput does allow subscribers to use and display 6 extra data values recorded at 5 minute intervals. These are known as ExtendedData(1-6). PVBC allows gas readings to be mapped into these PVOutput extended data values. Refer to section 5.8.2 for details.

5.6   Consolidation Devices

5.6.1   The Consolidation Device Manager

Consolidation devices collect the outputs from multiple devices and consolidates the readings into standard time intervals. A consolidation device is required for each PVOutput system to which you wish to send readings. The Consolidation Device Manager and the associated PVOutput Consolidation Devices are created and removed automatically to match the PVOutput systems you have defined.

Only one Consolidation Device Manager is required. This device manager can contain all Consolidation Devices.

There are no Advanced Settings for Consolidation Device Managers

Device Manager Configuration

Manager Name PVOutput

Manager Type Consolidation

⌄ Advanced Settings

5.6.2   Consolidation Devices

A Consolidation Device is added to the Configuration Device Manager for each PVOutput system you define. The consolidation device name is always the same as the name of the PVOutput system this consolidation device supports.

- Configure a PVOutput System using the" pvoutput.org Settings" tab (refer to PVOutput Configuration)
- Use "Add Device" to create a new device under the Consolidation Device Manager
- Give the device a meaningful name
- Choose the required device type. For PVOutput this must be" AC Energy - Single Phase"
- Set "Consolidation Type" to PVOutput
- Set "System" to the required PVOutput system id
- There are currently no "Advanced Settings" for consolidation devices
- "Consolidates To" can be used to consolidate a consolidation. This feature is not usually required

Device Configuration

Name PVOutput Consolidation

Device Type Consolidation: AC Energy - Single F ▾   Consolidation Type PVOutput ▾

System My System - Id: 66699

⌄ Advanced Settings
⌄ Consolidates To
⌄ Consolidated From
⌄ Events   ☐ Auto Events

- "Consolidates From" allows you to view the list of devices that are consolidated in this consolidation device. This is read only. You cannot manipulate the consolidation links here.

Go to each device that consolidates to this device and use the "Consolidates To" expander to add the source device to this consolidation.

Device Configuration

Name PVOutput Consolidation

Device Type Consolidation: AC Energy - Sinc ⌄   Consolidation Type PVOutput ⌄

System My PVOutput System - Id: YourIdHere

⌄ Advanced Settings
⌄ Consolidates To
⌃ Consolidated From

Device	From Feature	To Feature	Operation	
SMA Inverter (SB5000TL-20)	Inverter Yield AC	Inverter Yield AC	Add	
Effekta Inverter	Yield AC - Phase 1	Inverter Yield AC	Add	
JFY Inverter 2	Yield AC	Inverter Yield AC	Add	
JFY Inverter 1	Yield AC	Inverter Yield AC	Add	

⌄ Events   ☐ Auto Events

5.7   Defining and Viewing the Consolidation Hierarchy

PVBC allows the definition of multiple consolidation hierarchies. Device definitions that represent real devices can contribute readings to multiple "Consolidation Devices".

Consolidation Devices perform two major tasks:

- Adjust Reading Interval - Individual devices record their readings at intervals that are appropriate for the device. When multiple devices are in use, it is likely that each device will use a different recording interval. This is called the "Database Interval" in the device and device manager settings.

   A consolidation creates a new (consolidated) set of readings adjusted to a standard reading interval. PVOutput consolidation devices adjust the readings to suit the reading interval in use at a specific PVOutput system

- Combine Device Readings - Consolidation Devices can be used to add together the readings from multiple inverters or other energy meters producing a set of total energy readings with a standardized reading interval.

   Consolidations operate on selected "Features" of a device. This allows the AC energy readings of an inverter to be consolidated but not the DC energy readings. This allows individual phases of three phase systems to be selected for inclusion in a consolidation.

   Devices of similar type are normally added together in the consolidation however the ability to subtract readings is provided so that Net Export readings can be combined with Yield to calculate total consumption; or with Consumption to calculate total yield

The Device Configuration panel for each device contains a "Consolidates To" expander. This expander allows you to maintain the list of consolidations to which the selected device contributes readings.

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
PVOutput Consolidation	Inverter Yield AC		Inverter Yield AC		Add	

The "Consolidates To" expander shown above provides detailed configuration of consolidation:

- The Add button creates a new empty consolidation entry
- The Delete button deletes the selected consolidation entry
- Device selects the Consolidation Device that this device will consolidate to
- To Feature selects the feature on the Consolidation Device to which this device will contribute readings. PVOutput Consolidation Devices provide two features; Inverter Yield AC and Consumption AC
- From Feature is the feature of the device being configured that will contribute readings to the selected To Feature on the Consolidation Device
- Operation determines the manner in which the readings will be consolidated. Options are Add, Subtract or Custom. Custom is used when the entry is for field mapping only (No energy consolidation is wanted between the two device features)
- To Field, From Field and Field Action are used to map specific data fields into the Consolidation Device Feature. The most common usage of this facility is to choose the source of Temperature and Voltage that will appear at PVOutput. This is explained in the next section

The Device Configuration panel for each consolidation device contains a "Consolidated From" expander. This expander allows you to view all devices that contribute readings to the selected Consolidation Device. This expander does not allow changes. The "Consolidates To" expander on the source devices must be used to make changes to the consolidation hierarchies.

⌃ Consolidated From							
Device	From Feature	From Field	To Feature	To Field	Operation	Field Action	
CC128	Energy AC	Temperature	Consumption AC	TemperaturePVO	Add	Replace	
SMA_SE	Inverter Yield AC		Inverter Yield AC		Add		

The Consolidated From expander shown above has Inverter Yield consolidated from an SMA Inverter and Consumption consolidated from a Current Cost meter. The consolidation is also copying the Current Cost Temperature to the PVOutput Temperature field in the consolidation.

5.8   Using the PVOutput Custom Field Mappings

Apart from displaying Yield and Consumption Power and Energy readings, PVOutput allows you to graph "Temperature" and "Voltage". If you have a PVOutput subscription, you can also graph up to six extra values with the generic names ExtendedData1 through ExtendedData6.

5.8.1   Field Mappings from Energy (Electricity) Readings

As PVBC combines readings from multiple devices into a single PVOutput System and as some devices report multiple temperatures and voltages, PVBC cannot automatically populate Temperature and Voltage at PVOutput. Similarly the ExtendedData values (if used) require manual configuration. This is done using the From Field, To Field and Field Action settings on the Consolidates To expander.

PVBC allows you to connect a consolidation reading source to a consolidation target as many times as you wish. Multiple connections between the same source and target device features do not result in duplicated data consolidations. PVBC ensures that a consolidation between a source and target feature is executed once only regardless of the number of consolidation connections specified in the configuration. This allows more than one field to be mapped from a source device to a target consolidation without impacting the underlying energy / power consolidation.

The Consolidates To expander shown below demonstrates how the Temperature field on a consolidation source feature can be copied to the PVOutput Temperature field on the Consolidation.

Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
PVOutput Consolidation	Consumption AC	TemperaturePVO	Energy AC	Temperature	Add	Replace

Add   Delete

Similarly, when a source device has a Voltage reading, that voltage can be mapped to the PVOutput Voltage field on the consolidation. Extra consolidation entries are created to define each extra field mapping you require.

Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
PVOutput Consolidation	Inverter Yield AC	VoltagePVO	Yield AC	Voltage	Add	Replace
PVOutput Consolidation	Inverter Yield AC	Extended Data 1	Yield AC	Current	Add	Replace
PVOutput Consolidation	Inverter Yield AC	TemperaturePVO	Yield AC	Temperature	Add	Replace
PVOutput Consolidation	Inverter Yield AC	Extended Data 2	Yield DC - String 1	Voltage	Custom	Replace
PVOutput Consolidation	Inverter Yield AC	Extended Data 3	Yield DC - String 1	Current	Custom	Replace
PVOutput Consolidation	Inverter Yield AC	Extended Data 4	Yield DC - String 2	Voltage	Custom	Replace
PVOutput Consolidation	Inverter Yield AC	Extended Data 5	Yield DC - String 2	Current	Custom	Replace

Add   Delete

The Consolidates To expander shown above demonstrates how an inverter with two attached strings of panels can consolidate the inverter yield power and energy readings to a PVOutput Consolidation device; and send all AC and DC current and voltage readings to PVOutput.

The first three entries provide the power and yield accumulation. They also map:

- Inverter Temperature to the PVOutput Temperature field
- Inverter AC Voltage to the PVOutput Voltage field

- Inverter AC Current to the PVOutput Extended Data 1 field

The next 2 entries connect the Yield DC readings for the first string to the same PVOutput consolidation feature. As we do not want to add any DC energy readings to the consolidation, the operation is set to "Custom". This will limit consolidation action to the field mappings only. These entries map:

- String 1 DC Voltage to the PVOutput Extended Data 2 field
- String 1 DC Current to the PVOutput Extended Data 3 field

The last 2 entries connect the Yield DC readings for the second string to the PVOutput consolidation feature. These entries map:

- String 2 DC Voltage to the PVOutput Extended Data 4 field
- String 2 DC Current to the PVOutput Extended Data 5 field

5.8.2   Field Mappings from Dutch Smart Meter Gas Readings

Volumetric readings such as Gas Consumption can be displayed on PVOutput graphs if you have a PVOutput subscription (providing access to Extended Data fields) and you map selected gas readings to specific PVOutput Extended Data fields.

On a DSM Gas Meter device, you can use the "Consolidates To" expander to define your gas data field mappings to the Extended Data fields.

Device Configuration

Name: DSM-Device-Gas

Device Type: GasMeter: DSM - Gas

Address: 1   Serial No.

⌄ Advanced Settings

⌃ Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
PVOutput Consolidation	Consumption AC	Extended Data 1	Gas Consumed	Gas (m3/hr)	Add	Replace
PVOutput Consolidation	Consumption AC	Extended Data 2	Gas Consumed	Gas Total Today	Add	Replace
PVOutput Consolidation	Consumption AC	Extended Data 3	Gas Consumed	Gas Delta	Add	Replace

Add   Delete

- "Device" selects the consolidation device for the PVOutput system on which you want to display gas readings.
- "To Feature" can be either "Consumption AC" or "Yield AC". Both will deliver readings to the same PVOutput data fields.
- "To Field" is the PVOutput extended data field you want to use
- "From Feature" must be "Gas Consumed"
- "From Filed" allows you to select the data to be displayed:
  o Gas (m3/hr) is the rate of gas consumption in cubic metres per hour
  o Gas Delta is the volume of gas consumed in the PVOutput reporting interval
  o Gas Total Today and Gas Total (current meter reading) are also available

6   Grid Import / Export Meters

6.1   Import / Export Calculations Explained

PV Bean Counter now supports energy meters that report energy import and export from and to the electricity grid.

Most devices that connect to PVBC report either energy Yield (generation) or energy Consumption. These measurements align with the generation and consumption energy measures used at PVOutput. Using these traditional devices, your energy surplus (or deficit - negative value) is calculated as Yield - Consumption.

With Import / Export meters your energy surplus / deficit is reported directly by the meter. When expressed as a value where a surplus (energy exported to the grid) is a positive value and a deficit (imported from the grid) is a negative value, this value is the equivalent to Yield - Consumption. In PVBC this value is called Net Export.

Note:
- *If you do not have any electricity generation devices (Yield is always zero), Net Export will be your consumption expressed as a negative value*
- *Consumption can be calculated as Yield - Net Export*
- *Yield can be calculated as Net Export + Consumption*
- *If you know any two of these values, you can calculate the third*

6.2   Using PVOutput with Import / Export Meters

Configure the features that must be recorded by the Import / Export meter. Although other combinations are possible the simplest approach is to record the Net Export feature of the Import / Export meter.

The image to the right shows this selection on the "Features Recorded" expander of a Dutch Smart Meter device.

Feature	Save	Feature Type	Feature Id
Net Export AC	✔	NetExportAC	0
Export AC - Total	☐	ExportAC	0
Export AC - Normal Tariff	☐	ExportAC	1
Export AC - Low Tariff	☐	ExportAC	2
Import AC - Total	☐	ImportAC	0
Import AC - Normal Tariff	☐	ImportAC	1
Import AC - Low Tariff	☐	ImportAC	2

Open the "Consolidates To" expander on the Import / Export meter device and configure the meter Net Export to subtract from the consolidated Consumption.

Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
PVOutput Consolidation	Consumption AC		Net Export AC		Subtract	

Open the "Consolidates To" expander on the generation device (usually an inverter) and configure the Yield to add to both the consolidated Consumption value and the consolidated Yield value.

Consolidates To

Device	To Feature	To Field	From Feature	From Field	Operation	Field Action
PVOutput Consolidation	Consumption AC		Inverter Yield AC		Add	
PVOutput Consolidation	Inverter Yield AC		Inverter Yield AC		Add	

Add   Delete

Open the "Consolidates From" read only expander on the consolidation device used in the above settings.

Consolidated From

Device	From Feature	From Field	To Feature	To Field	Operation	Field Action	
DSM-Device	Net Export AC		Consumption AC		Subtract		
SMA_SE	Inverter Yield AC		Consumption AC		Add		
SMA_SE	Inverter Yield AC		Inverter Yield AC		Add		

This provides visibility of all devices that contribute to the consolidated Yield and Consumption values. In this configuration you can see that consolidated Consumption is calculated as Yield - Net Export, as described in the calculations description on the previous page.

7 PVOutput Configuration

PVBC allows multiple devices to be read concurrently. It allows readings from these devices to be combined and sent to output locations such as PVOutput (other output destinations will be added in the future).

When readings are copied from a device and prepared for use at an output destination such as PVOutput, the reading resolution usually requires adjustment. The process of preparing consolidated readings from multiple devices requires the ability to define the relationship between the source devices and the outputs to which those devices contribute.

PVBC allows the definition of "Consolidation Devices". A Consolidation Device is associated with real devices (and other Consolidation Devices) using the "Consolidate To" settings available on every device defined in PVBC. Consolidation Devices can collect readings from other devices and normalize them ready for use at a specific output destinations (such as a PVOutput System).

Each PVOutput System must have an associated Consolidation Device that will collect and prepare the readings that will be used by that PVOutput system. The Consolidation Devices required for use with PVOutput are created automatically when you define a new PVOutput system.

7.1 Basic PVOutput Setup

In PVBC Version 2 configuration of your PVOutput systems is very similar to that found in version 1.

To use this feature you must first register your PV installation with pvoutput.org. The URL for this is
http://www.pvoutput.org/

When you have registered with pvoutput.org, update your PV Bean Counter configuration as follows:

- Open the PV Bean Counter configuration utility
- Open the "pvoutput.org Settings" tab

- The default PVBC settings contain one predefined PVOutput System. If you need to create extra PVOutput systems, use the "Add System" button to add another PVOutput system to the PVOutput system list
- Enter your pvoutput.org System Id and API Key against each PVOutput system. This is provided by PVOutput.org when you register your system
- Status Interval is the period in minutes between live reading uploads to PVOutput. Set "Status Interval" so that it matches the "Status Interval" value set on your pvoutput.org site settings page

  PVBC defaults to a Status Interval of 10 minutes as this is the default interval for new Systems registered at PVOutput. If you change the settings at PVOutput to 5 minutes, you need to modify "Status Interval" on the PVBC settings for that PVOutput System

  A Status Interval value of 5 is the best match for the output obtained from the Sunny Explorer inverter communication software

- Check the "Enable" checkbox
- A "Consolidation Device" is automatically created for each PVOutput system you define. These consolidation devices allow you to define collections of readings that will be combined for transmission to PVOutput

7.2   Auto Setup PVOutput Devices

The PVBC mechanism mapping individual devices to a PVOutput system is capable of complex device consolidation, including the conversion of net energy export readings into total consumption readings.

Most PV Bean Counter users do not need these features. For users with relatively simple device sets, an automatic configuration feature is available. This automatic feature will only configure a single PVOutput system. If you have multiple systems defined, it will automatically configure devices for the first PVOutput system it finds.

When used this facility will:

- Map all inverters to the Yield readings of your PVOutput system
- Map all generic meters as consumption or yield readings at PVOutput
  Some generic meters have standard usage for some of the Address / Channel values. For Generic Meters the Auto Setup facility will configure:
    - *Current Cost readings from a device at Address 0 as Consumption*
    - *Current Cost readings from a device at Address 1 as Yield*
    - *Watts Clever EW4008/9 readings from a device at Address 1 as Consumption*
    - *Watts Clever EW4008/9 readings from a device at Address 0 as Yield*
  Other Generic Meter address / meter type combinations are ignored and require manual configuration.
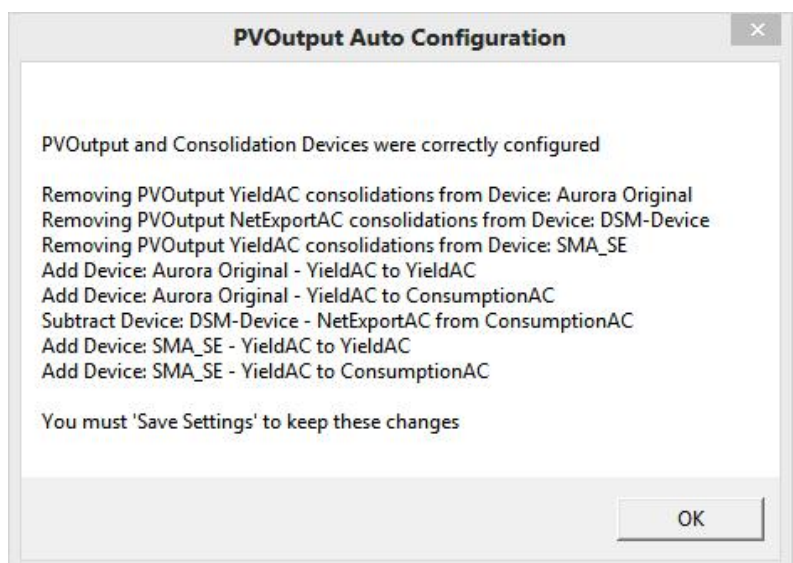
- Map Net Export meter readings together with any available yield readings for use as consumption readings. This only occurs when Net Export features are detected on at least one device.
  Consumption is calculated as Yield minus Net Export.

This feature is provided as a button on both the "pvoutput.org Settings" tab and on the "General" tab. To use this feature you must:

- Configure at least one device (inverter or energy meter)
- Check "Unlock" beside the "Auto Setup PVOutput Devices" button
- Click the "Auto Setup PVOutput Devices" button

This will execute the automatic configuration and it will display a brief report of changes made similar to that shown to the right.

PVOutput Auto Configuration

PVOutput and Consolidation Devices were correctly configured

Removing PVOutput YieldAC consolidations from Device: Aurora Original
Removing PVOutput NetExportAC consolidations from Device: DSM-Device
Removing PVOutput YieldAC consolidations from Device: SMA_SE
Add Device: Aurora Original - YieldAC to YieldAC
Add Device: Aurora Original - YieldAC to ConsumptionAC
Subtract Device: DSM-Device - NetExportAC from ConsumptionAC
Add Device: SMA_SE - YieldAC to YieldAC
Add Device: SMA_SE - YieldAC to ConsumptionAC

You must 'Save Settings' to keep these changes

OK

7.3   Manual Consolidation Settings

- Open the device configuration for each device that is to be reported through this PVOutput system. Add "Consolidate To" entries that associate the individual devices to the Consolidation Device that represents the PVOutput system

  Examples can be found in "Configure SMA Sunny Explorer Devices" on page 18 and in "Using PVOutput with Import / Export Meters" on page 33

- Save your configuration changes - If the service is running it must be restarted

7.4   Other Optional PVOutput Settings

7.4.1   API Version

It is recommended that you leave API Version blank. This selects the latest version recommended for use with PVBC.

7.4.2   Upload Yield and Upload Consumption

"Upload Yield" and "Upload Consumption" are checked by default. These check boxes control whether this PVBC instance updates, yield data or consumption data, or both to the specific PVOutput system. This is useful if you need to use two computers to update the same PVOutput system. Leave these checked for normal usage.

7.4.3   Have PVOutput Subscription

If you have subscribed to PVOutput, check "Have PVOutput Subscription". This modifies the behaviour of PVBC to make use of some extra PVOutput features. If you check this without an appropriate subscription, PVBC may encounter errors when it tries to use facilities or exceed limits that are not available without a subscription.

7.4.4   Live Upload Days

"Live Upload Days" controls the number of days that are monitored for live update to pvoutput.org. If any changes occur in the data that is uploaded to pvoutput.org in the last "Live Upload Days", those changes are sent to pvoutput.org. The default value is 2. Allowable values are between 1 and 14 (this is increased to 90 days if you have a PVOutput subscription).

The oldest live data that can be sent to pvoutput.org is 14 days ago (or 90 days ago with a subscription).

7.4.5   PVOutput Update Days

The PVOutput Update Days table (on the right hand side) displays the days that will be uploaded using the current "Live Upload Days" settings. Note that this list is automatically regenerated using "Live Upload Days" at the start of each day. You do not need to maintain this list.

PVBC will keeps a record of the yield and consumption values that have been sent to PVOutput. It only resends these values if the device readings that are used to update PVOutput have actually changed for some reason.

If you check "Force" in the date list, PVBC will reload all data for that day to pvoutput.org even if the values do not appear to have changed. This setting will only last for 10 minutes. It automatically resets to avoid constantly resending unchanged data to PVOutput.

7.4.6   Enable Auto Backload

The "Enable Auto Backload" checkbox (checked by default) causes yield totals for days stored in the database and over 14 days old (or over 90 days old if you have a subscription) that are not present on pvoutput.org to be uploaded. This occurs when the service first starts. So the service must be restarted for this option to take effect. Once you are sure that all yield history has been uploaded, you should uncheck "Enable Auto Backload" to reduce the load placed on the computer and PVOutput by PVBC.

7.4.7   Power Alternates Min / Max

" Power Alternates Min / Max" is checked by default. With this option checked, the power readings alternate between the minimum power and the maximum power in each successive the interval. This provides a view of the variability of power consumption every two intervals. When this option is unchecked, the power is simply the last power reading recorded during that interval.

Note that changing the above setting will cause all consumption power values at PVOutput to be recalculated. This will cause a large number of updates to be sent to PVOutput. 12 updates per hour for every hour in "Live Upload Days". (12 x 24 x Live Upload Days). This will cause you to reach the 60 update per hour limit at PVOutput. PVBC will eventually complete the uploads and return to normal operation. I recommend setting "Live Upload Days" to "1" before changing this option.

7.4.8   Enable / Disable a PVOutput System

Individual PVOutput systems can be Enabled and Disabled using the checkbox in the pvoutput.org system list or the "Enable" checkbox in the settings body.

The "Enable Upload" checkbox is provided for testing purposes only. It allows PVOutput processing to occur without actually sending any data to PVOutput. For normal use it will have the same setting as the Enable checkbox. PVBC will automatically change Enable Upload when you change Enable.

7.5   Join the PV Bean Counter Team at PVOutput

Consider registering your system with the "PV Bean Counter" team at pvoutput.org. You can do that here: http://pvoutput.org/team.jsp

Team output can be found here:

http://pvoutput.org/listteam.jsp?tid=126

8   Event Configuration and PVMonitor

PVMonitor is a Power Monitoring program that comes with PV Bean Counter. It provides four standard gauges and has the ability to display others if required. PVMonitor can be installed on any computer (not just the computer running the main PVBC installation. It communicates with the main PVBC installation using TCP/IP messages.

The four gauges display the power readings from three different "Energy Events". These events are:

- Inverter Yield   - The current power reading reported by the Inverters
- Consumption   - The current power reading reported by consumption meters
- Meter Yield   - The current power reading reported by an energy meters that are reading Yield

The Feed-In gauge is a special case that displays a value calculated as Consumption - Yield. The yield used for Feed-In is separately selected.

8.1   Configure Energy Events

Every device (including Consolidation Devices) can be used to emit events. Every device has an Events Expander in device configuration that provides access to event setup for that device.

Events Configuration allows you to define a list of events that will be emitted by the device when that device receives a reading. Device readings comprise one or more "Features". Any feature that reports an energy reading can be used to emit an energy event.

All devices can be configured to emit events. Each device provides the ability to trigger events from the "Features" that are specific to the particular device.

PVOutput Consolidation Devices provide both Inverter Yield AC and Consumption AC features. When either of these feature values change, events can be emitted from the device for use by PVMonitor.

Normal devices (not consolidation devices) have features available that reflect the data available from the specific device. In general, you can configure events directly from the device that initiated the data change that triggers the event.

When you need to aggregate values from multiple devices to produce an event with a value derived from multiple source devices, the events need to be defined on a consolidation device that collects data and events from a set of source devices. This is commonly used when:

- you want to produce an Inverter Yield event that reports a single current power readings for a collection of inverters
- you need to combine Net Export readings from an import / export meter with Inverter Yield readings to calculate Total Consumption

8.1.1   Event Configuration - Consolidation Device

The events configured for a device are displayed in a list with four columns. The image below shows the events configuration for a PVOutput Consolidation Device.

- "Feature" is the device feature that provides the values for the event
- "Event Name" identifies the gauge that will display the reading. There are three gauges that display the three standard event names. You can select a standard event name or you can enter a custom event name.

Custom event names cause creation of an extra gauge that displays the power value for the event with the custom event name
- "Event Type" is used to select the background colours for the custom gauges. It does not impact the standard gauges
- "Feed-In" directs the event to the Feed-In gauge as well as the gauge associated with the event name. The Feed-In gauge requires one Yield Event reporting total yield and one Consumption Event reporting total consumption. PVBC ensures that there is no more than one event of each type with "Feed-In" checked.

    The Feed-In gauge displays a value calculated as Yield - Consumption

8.1.2   Event Configuration - Meter Device

Meter devices report energy values that do not have a known purpose. These energy readings can be all household consumption, consumption for a specific energy circuit, yield for one inverter or for multiple inverters. With energy meters, you can associate the readings with one of the standard event names (used to drive the standard PVMonitor gauges), or you can allocate a custom name indicating the type of measure the readings represent.

The image to the right shows an energy meter configured to output the standard PVMonitor Meter Yield event. This also contributes to the PVMonitor Feed-In gauge.

8.1.3   Auto Events

The "Auto Events" checkbox allows PVBC to configure the events for the selected device in a common pattern that is consistent with the device type. This is available on Consolidation Devices and on Inverter devices as the feature types of these devices are understood and PVBC has some basis for deciding how the features should be related to events.

Generic meters and Import / Export meters do not allow auto event configuration. For generic meters, the nature of the reading is unknown. For import / export meters, the values need to be consolidated with other values before they are usable in standard PVMonitor gauges.

9 Service Suspend / Resume Facilities

PVBC has the ability to suspend the computer it is running on and resume normal operation at a later time. This minimises power consumption and can reduce wear and tear on the computer used to monitor devices.

The sample configuration shown below utilises all available suspend / resume features.

Note that all of these settings can be changed and become effective without the need to restart the PVBC service. When you save the changes on this panel while the service is running, PVBC will reevaluate its current status using the new Suspend / Resume rules. This may result in the computer entering a suspended state.

This sample configuration shown above provides the following:

9.1.1 Evening Suspend - (top left hand corner)

- Between the hours of 5:00am and 11:59pm, PVBC will run normally subject to other settings available on the Suspend / Resume Tab
- PVBC will sleep from 11:59pm to 5:00am on the following morning

Enable Evening Suspend activates the settings in the top left hand box on the Suspend Resume Tab.

Evening Suspend - Start specifies the time at which normal PVBC operation will start.

Stop specifies the time at which normal PVBC operation will stop and the computer will be suspended as specified in Suspend Type.

Suspend Type determines how the computer will be suspended. Options are Sleep, Hibernate and Idle. When Idle is selected the computer remains running but PVBC activity ceases.

Note - If "Evening Suspend - Start" is left empty or if (Evening Suspend) "Stop" is less than "Start", the computer will not suspend in the evening

Setting Evening Suspend Type to "Idle" and checking "Auto Resume from Manual Suspend" will cause the computer to remain on in the evening until you suspend it manually. At the "Evening Suspend - Start" time on the following day it will wake automatically and follow the any configured wake / suspend cycle until the following evening, where the computer will again remain awake until suspended manually.

9.1.2   Interval Suspend - (top right hand corner)

- Between 7:00am and 6:00pm the computer will run normally for 30 minutes and then sleep for 1 hour 30 minutes. This provides a predictable 2 hour wake / sleep cycle throughout the middle of the day with minimal monitor hardware power consumption
- Outside of these hours, PVBC will operate as specified in Evening Suspend above

Enable Interval Suspend activates the settings in the top right hand box on the Suspend Resume Tab.

Interval Suspend - Start specifies the time at which the Wake / Suspend cycle commences. .

Stop specifies the time at which the Wake / Suspend cycle ceases.

Wake Interval specifies the duration the computer will be awake with PVBC operating during the Wake / Suspend cycle.

Suspend Interval specifies the duration the computer will be suspended during the Wake / Suspend cycle.

Suspend Type determines how the computer will be suspended. Options are Sleep, Hibernate and Idle. When Idle is selected the computer remains running but PVBC activity ceases.

"Interval Suspend - Start" and (Interval Suspend) "Stop" can be used to specify a time window during which Wake / Suspend activity occurs. When specified, "Interval Suspend - Start" must be less than (Interval Suspend) "Stop" and greater than or equal to "Evening Suspend - Start". (Interval Suspend) "Stop" must be less than or equal to (Evening Suspend) "Stop". During the resulting shoulder periods between "Evening Suspend Start" and "Interval Suspend Start", and between (Interval Suspend) "Stop" and (Evening Suspend) "Stop", device monitoring occurs without Wake / Suspend interruption.

Note - If "Wake Interval" is less than 5 minutes, it will be increased to 5 minutes by the PV Bean Counter service when the service starts. This has been done to ensure that both the Sunny Explorer yield extract (normally every 5 minutes) and the pvoutput.org upload have plenty of time to complete successfully .

If "Wake Interval" is left empty, the Wake / Suspend cycle will not operate and the computer will remain operational.

9.1.3   Current Cost History Wake Management - (bottom right hand corner)

- PVBC will be forced to wake between 5 minutes past every odd hour and 25 minutes past every odd hour to allow access to history records emitted from a Current Cost meter.

  This modifies the "Interval Suspend" behaviour to ensure Current Cost meter history is captured. This does not modify the "Evening Suspend" behaviour

CC History Suspend / Resume Control when checked, causes PVBC to wake at appropriate times to ensure that Current Cost Meter history records are captured.

History Start Minute specifies the minute in the hour relative to each odd hour in the day at which PVBC operation will resume. The default value is -2. This causes PVBC to resume 2 minutes before the start of an odd numbered hour.

End Minute specifies the minute in the hour relative to each odd hour in the day at which PVBC operation return to the Suspend / Resume state specified by the Interval Suspend settings. The default value is 29. This causes PVBC to return to the Suspend / Resume state specified by the Interval Suspend settings 29 minutes after the start of an odd numbered hour.

9.1.4   Inverter Monitoring Window - (bottom left hand corner)

- Inverter monitoring will commence at 5:30am and end at 7:30pm. Outside of this time window, PVBC will operate allowing Energy Meters to be read. However the inverters will not be monitored
- If the computer running PVBC is suspended by the user or by software other than PVBC, the computer will resume normal operation at the next wake time configured on the Suspend / Resume tab

Inverter Start is the time at which monitoring of inverters by PVBC commences.

Inverter Stop is the time at which monitoring of inverters by PVBC ceases.

Auto Resume from Manual Suspend when checked, causes PVBC to wake the computer at the next scheduled wake time even if PVBC was not the cause of computer suspension

9.1.5   Wake Delay

"Wake Delay" was added as some users found that after resume from sleep or hibernate, PVBC attempted to access a database (MySQL or SQL Server) before that database had fully restarted. This produced database access errors. This option allows you to add a delay (in seconds) between when PVBC resumes from a suspended state and when PVBC restarts the device monitoring activities. This value defaults to zero seconds (no delay).

10 Change the PVBC Default Directory

When you save your PVBC settings for the first time, the PVBC Configuration program creates the "Default Directory". The standard location is C:\PVRecords. However if you specify a different location prior to saving the PVBC settings for the first time, the PVBC Configuration program will create the directory in the alternate location as you would expect.

Problems arise when you decide to change the Default Directory after initial configuration.

10.1 Background

When PVBC is first installed and not configured, the Default Directory does not normally exist. When the PVBC Configuration program starts for the first time, it looks for a PVBC Windows Registry entry to determine where the settings file is located. At first startup the Windows Registry entry will not exist. When PVBC cannot find the Windows Registry entry, it loads the PVBC default settings from the software installation directory.

When your settings are saved for the first time, the configuration program:

- Creates the "Default Directory" in the specified location
- Saves the PVBC settings in that directory
- Creates a PVBC Windows Registry entry containing the name of the "Default Directory"

When the PVBC Configuration program is subsequently started after creation of the Windows Registry entry, it opens and displays the settings stored at the location specified by the Windows Registry entry.

When the PVBC service is started, it looks for the PVBC Windows Registry entry to determine where the settings file is located. If the Windows Registry entry does not exist, or it specifies a directory that cannot be accessed, the PVBC service loads the PVBC default settings from the software installation directory.

10.2 Consequences

If you move or delete the existing PVBC "Default Directory" without following the correct procedure, the PVBC Service and Configuration programs will be unable to locate the "Default Directory" because the Windows Registry entry will point to a non-existent location. This results in both programs reverting to default settings. PVBC users who experience this typically complain that they have lost their PVBC settings or that the PVBC service has stopped working correctly.

10.3 Relocate the PVBC "Default Directory" - Correct Procedure

1. Copy the current PVBC "Default Directory" and all contents to the new location
2. Open the PVBC Configuration program. This will locate and use the settings stored in the old / current "Default Directory"
3. Change the "Default Directory" in the settings to point to the new directory location
4. Save your PVBC settings. This will write the settings to the new "Default Directory. It will also change the Windows Registry entry to point to the new "Default Directory" location
5. Confirm that PVBC works correctly
6. Delete the old PVBC Default Directory (optional)

11 Log File Controls

The image below shows the default settings on the "Log Files" tab.

11.1 Log File Content

By default, the PVBC log files contain Information, Status and Error messages. If you are having problems with PVBC, we may request that you provide copies of your log files. We will sometimes ask you to turn on extra log options.

- Trace - This provides log messages that record the actions being performed by PVBC
- Detail Trace - This is sometimes asked for in conjunction with Trace. This provides finer grained messages from some high activity parts of the system. This option will create very large logs very quickly and should not be enabled for extended periods
- Message Content - This provides detail of the raw message content that is being received by PVBC via direct communication with a device
- DB Trace - This identifies the database operations being performed
- Event - This traces activities associated with sending events to PVMonitor

The messages produced in the log are generally technical in nature and are intended to help us diagnose problems you may be handling

11.2 The "Thread Trace" Option

Under normal circumstances log messages of the types that are enables are produced by all active "Threads" in PVBC. Each Device Manager and each PVOutput Manager runs in a separate "Thread". When you check "Enable Thread Trace" you are indicating that individual "Threads" can be excluded from the production of the detailed trace messages.

This allows log files to be produced with detailed trace entries from the "Threads" that are the subject of investigation. This can significantly reduce the size of the log files produced by turning off messages from threads that are not of interest.

Each Device Manager and each PVOutput System has an "Enable Trace" check box. When "Enable Thread Trace" is checked on the Log Files tab, you can turn thread participation in the logs on or off using these thread specific "Enable Trace" check boxes.

For Device Managers these check boxes can be found at the bottom of the Device Manager Configuration, Advanced Settings Expander. For PVOutput Systems there is now an "Enable Trace" checkbox on the PVOutput system configuration panel.

11.3 Log File Location and Name

We suggest that you do not change the log file name and we suggest that you leave "New Log File Each Day" checked. By creating a new log file each day and leaving the standard name intact, PVBC will keep a history of old log files and automatically delete them after the nominated number of days.

11.4 Inverter Logs

Inverter Logs is a feature that allows you to capture error and warning codes emitted by your device in a log file that is not cluttered by other PVBC operational messages. To use this facility you must provide the name of the directory to which these logs will be written. We recommend using the PVBC Default Directory.

12 Appendix A - Compatible Devices

Manufacturer	Device	Device Manager	Serial No	Status
CMS	Inverters with serial ports	CMS (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
Current Cost	CC128 (EnviR) and earlier (Envi)	Current Cost Meters	Mandatory	PVBC 1 & 2
Dutch Smart Meter	Dutch Smart Meter	Dutch Smart Meter	Not required (obtained from meter)	PVBC 2
Delta Solivia	All inverters using serial port communications	Delta Solivia	Not required (obtained from inverter)	PVBC 2
Effetka	All inverters using serial port communications	Modbus	Mandatory	PVBC 1 & 2
Fronius	All inverters using serial port communications	Fronius Inverters	Mandatory	PVBC 2
Growatt	Inverters using Growatt serial protocol	Growatt (Non-Modbus)	Not required (obtained from inverter)	PVBC 1 & 2
	Inverters using Modbus protocol	Growatt Inverters (Modbus)	Not required (obtained from inverter)	PVBC 1 & 2
JFY		JFY Inverters	Not required (obtained from inverter)	PVBC1 & 2
KLNE		KLNE (KLNE Modbus)	Not required (obtained from inverter)	PVBC 1 & 2
		KLNE (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
		KLNE Inverters (Modbus)	Not required (obtained from inverter)	PVBC 1 & 2
Owl	Owl Energy Meters	Owl Meters	Mandatory	PVBC 1 & 2
Powercom		Powercom (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
		Powercom Alt (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
PowerOne (Aurora)	All inverters using serial port communications	Aurora	Not required (obtained from inverter)	PVBC 2
Samil		Samil (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
SMA	All inverters accessible via SunnyExplorer	SMA Sunny Explorer	Not required (obtained from inverter)	PVBC 1 & 2
	All inverters accessible via SMA WebBox	SMA WebBox	Not required (obtained from inverter)	PVBC 1 & 2
SunnyRoo		SunnyRoo (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
		SunnyRoo Alt (Phoenixtec)	Not required (obtained from inverter)	PVBC 1 & 2
		SunnyRoo Inverters (Modbus)	Mandatory	PVBC 1 & 2
Watts Clever	EW4008, EW4009	Watts Clever Meters	Mandatory	PVBC 1 & 2
Xantrex		Xantrex Inverters	Not required (obtained from inverter)	PVBC 2 Untested (volunteers?)
		Xantrex (Modbus)	Not required (obtained from inverter)	PVBC 2 Untested (volunteers?)