



Eos Server

**Web application
for photovoltaic
plant monitoring.**

User manual

Rel. 1.2.0

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1 Preliminary remarks

This document must be regarded as an operating manual providing information about the use of the functions available in the Eos Server management and monitoring system.

1.1 EOS-SERVER PURPOSE

Eos-Server is a Web-oriented tool for the management and monitoring of one or more solar energy plants.

It allows to get information about the plant, view daily, monthly and yearly chart trends, export data to CSV and Excel format, send commands to remote devices.

The system can manage the following items:

- Multi-level hierarchical structure:
 - o VMUC device level
 - o Physical plant level
 - o Virtual plant level
- User roles (Administrator, user)
- Device list
- Plant list
- Command management
- Alarms

The main functions are:

- Daily, monthly and yearly monitoring charts of various items, like power, current, voltage, environmental sensor trend
- Detailed information about each plant or device
- Charts for the individual strings or inverters of devices/plants
- Device management function, allowing to aggregate them into actual plants
- Actual plant management function, allowing to aggregate them into virtual plants
- Map displaying in graphic form the world geo-location of registered and licensed VMUC devices
- Alarm panel, with acknowledgement function
- E-mail management from server for actual plants
- Tool for data export into Excel© 2010 standard format

1.2 GENERAL OVERVIEW

It highlights the following items:

1. Reading, interpretation and import process for the data from field devices.
2. Data compression and analysis database.
3. Internet/Web interface for the users (system administrators, analysis users).

1.3 DATA IMPORT PROCESSES

Data are imported by Eos-Server through a specific Web Service implemented at Eos-Server's premises, without resorting to any external hosting architecture

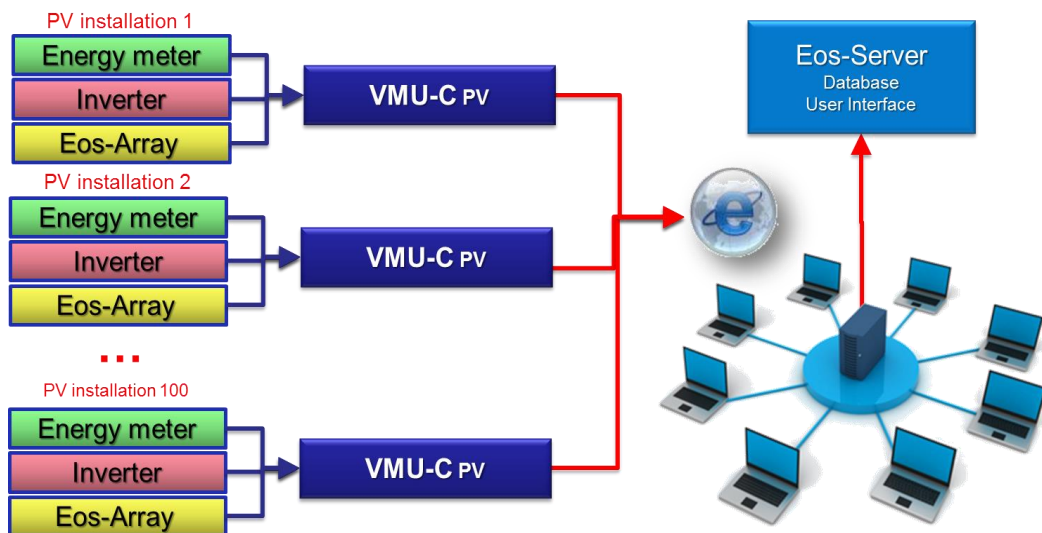


Figure 1: General architecture

Once configured, the field VMU-C PV modules replicate their data to the Eos-Server system.

1.4 USER LICENCE

The Eos-Server software can accept data from the installations only if it is duly equipped with a properly installed licence key. On a daily basis, Eos-Server checks the consistency of the key by connecting through the Internet to the Carlo Gavazzi License Management System on a secure HTTPS port.

In case of licence key inconsistency, or should the software fail to connect to the Carlo Gavazzi servers (for example because outbound HTTPS connections are blocked by a firewall), if the above conditions persist for 4 weeks (28 days), Eos-Server will disable the data reading functions from the field installations. When connection to the License Management System is restored, and if licence keys are consistent, data exchange with the field will resume.

1.5 IT SECURITY

Eos-Server is designed to be as safe as possible from IT security threats. Despite this, you should take into account that IT security is a process which depends on the individual components, on the infrastructures connecting them and on the usage procedures. For this reason the user shall be responsible for implementing all the systems (like firewalls) and procedures required to protect his installation from hacking attempts or malicious software which may affect its security.

2 Virtual Machine Setup

Eos-Server is supplied as a virtual machine including Linux CentOS operating system, PostgreSQL database and Eos-Server application software on DVD media in .OVF format. The Virtual machine (hereinafter referred to as VM) is compatible with the VM hosting software VMWARE® in its different solutions (we recommend that you visit the site <http://www.vmware.com/> for an overview of the solutions and to verify the system hardware requirements)⁽¹⁾ .

The ideal target for server solutions is the VMWARE vSphere⁽²⁾ platform, but it can be installed on any Virtual Machine Host among the VMWARE® solutions which are compatible with the OVF file supplied in the VMWARE release in use (the release may change for reasons associated with technological update and IT security; the user shall ensure that its infrastructure is up-to-date and compatible with the supplied OVF file). Besides, by relying on a standard solution for virtual machines hosting, it is possible to the user to choose from a huge selection of software tools for data backup, infrastructure management and system administration.

To install the virtual machine on vSphere:

File -> Deploy OVF template

Then select the concerned file.

For the first login of the virtual machine on vSphere use the following credentials:

Username: **customer**

Password: **customer**

Note: before the first start-up, please insure of having disabled the Network interface temporarily

The main screen (Desktop) of the virtual machine shall be as shown in the following image.

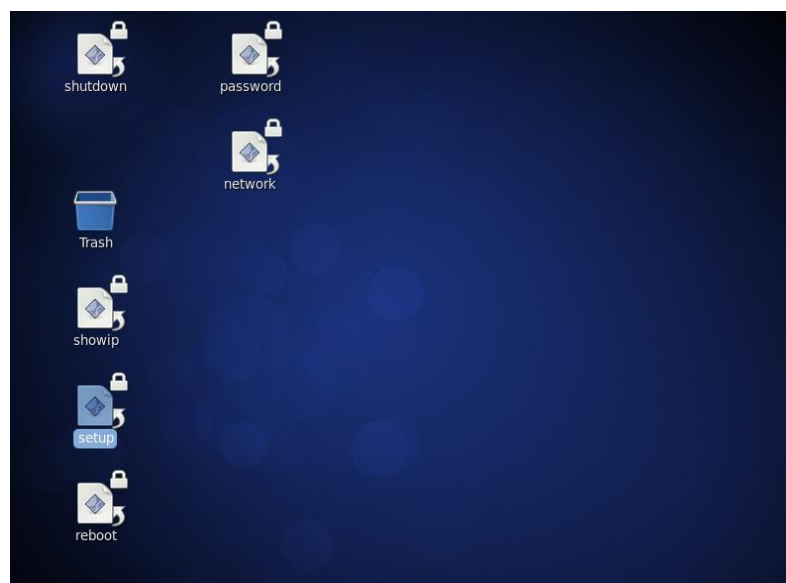


Figure 2: Desktop virtual machine

Eos-Server

Notes;

- (1) Carlo Gavazzi has no technical or business agreement with VMWARE®. This solution has been chosen for its worldwide diffusion
- (2) The instructions below refer to the vSphere hosting platform; the user may decide to use an alternative VMWARE® platform and the installation of the VM in OVF format shall follow the guidelines provided by the VMWARE® documents

The password may be modified from a Linux terminal, through the “password” icon on the desktop. Double-clicking on it will display a screen; click on “Run in terminal” and type the new password twice.

The user owns the permissions required to modify the IP address of the machine.

To modify the network settings double-click on “Setup”.

A screen will be displayed; click on “Run in terminal”.

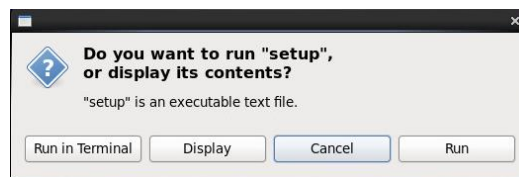


Figure 3: Command execution confirmation

Enter the user password “customer”.

The screen shown in the figure will be displayed:.

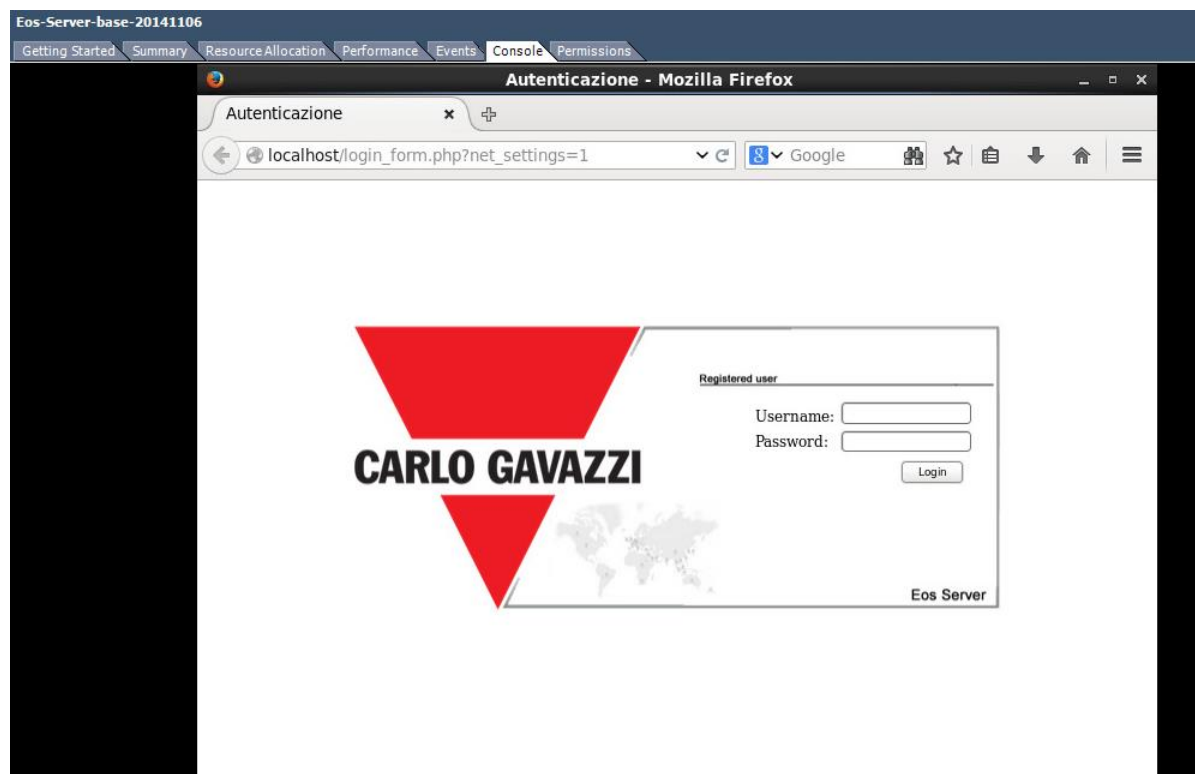


Figure 4: Network setting editing panel

Login with credentials: admin/admin

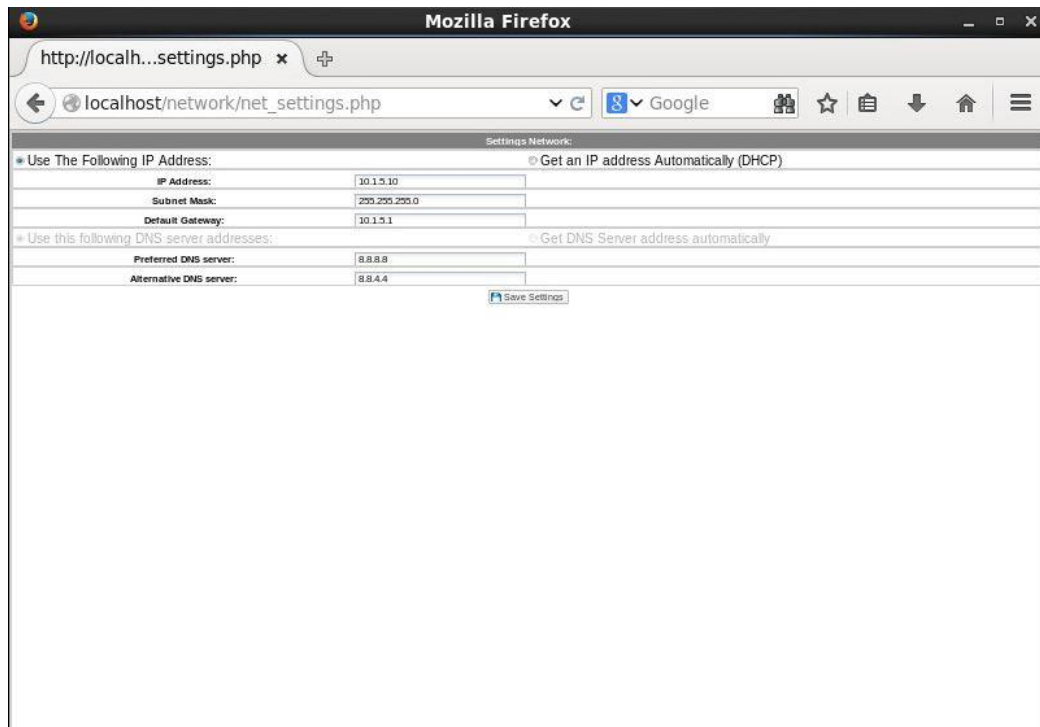


Figure 5: Network setting editing panel – Network parameters

Enter the different network parameters using the arrow keys of the keyboard to navigate between the fields.
After filling in the fields, select SAVE and press Enter.

Access the VMWARE machine settings and enable the network BEFORE rebooting.

The initial screen will be displayed; select "Save&Quit" and press Enter.

Once the process is completed you need to restart the machine to apply the changes. On the desktop double click on reboot; the system will be restarted.

After rebooting run the "Show IP" application to display the current machine IP (If set to DHCP it allows to identify the IP it received).

Now access the portal through the Browser

http://xxx.xxx.xxx.xxx

The user is also authorised to shut down the Linux virtual machine, by double-clicking on the "Shutdown" icon.

3 Eos-Server

3.1 ACCESS TO THE SYSTEM

Eos-Server basically operates through TCP/IP communications, by means of an highly interactive user interface based on a Web Server, and communicates with the VMU-C PV devices through a Web Service.

Eos-Server has no preset address; once the virtual machine is initialised, connect to the system by typing in the browser the relevant IP address specified by the provider in case of Internet access; if the VM has been installed inside an intranet, use the LAN IP to connect;

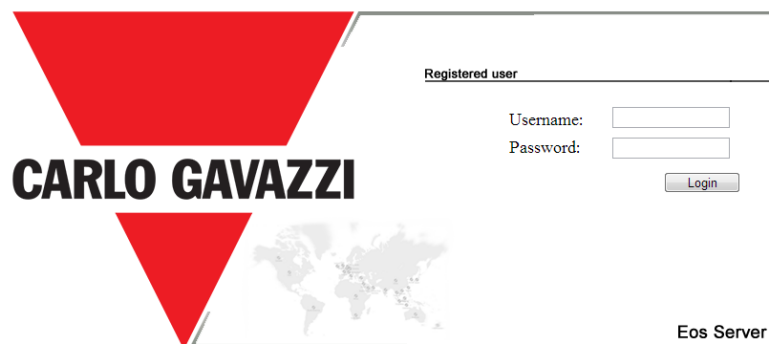


Figure 5: Login Page

The following are the default username and password:

Username	Password	User type
admin	admin	Administrator

It is essential that you modify the default password, as otherwise unwanted users might be able to access the system, above all when using an Internet connection.

3.2 PRELIMINARY INFORMATION

3.2.1 REMOTE DEVICE

"Remote device" indicates the VMU-C PV field module constantly replicating data to the Eos-Server server.

3.2.2 PHYSICAL PLANT

Eos-Server

A physical plant is an aggregation of one or more VMU-C PV remote devices. A VMU-C PV may only belong to a single physical plant⁽¹⁾.

3.2.3 VIRTUAL PLANT

A virtual plant is an aggregation of one or more physical plants. A physical plant may belong to one or more virtual plants.

3.2.4 PLANT HIERARCHY

The Eos-Server system is based on a three-level hierarchy, where a virtual plant may contain physical plant, which in their turn may contain VMU-C PV. Hybrid aggregations with a different order are not allowed.

3.2.5 INDUSTRIAL MONITORING

The Eos-Server system provides full management of distributed photovoltaic installation monitoring, allowing to manage through a centralised Web interface the field data read by the VMU-C PV devices.

3.2.6 FIELD DATA READING

This term indicates a datum or a set of data directly read by the VMU-C PV. The VMU-C PV transmits its data and alarms by PUSHing⁽¹⁾ them on a secure Web-Service provided by Eos-Server. The user shall be responsible for ensuring that the VMU-C PV and Eos-Server network connection allow reliable communications, with a properly sized bandwidth.

3.2.7 EOS-SERVER

This term indicates the central server where all data shall be replicated. The installation must be accessible from the Internet to allow the communication with the remote VMU-C PV. The user shall be responsible for properly and securely configuring the network infrastructure (including routers, firewalls, modems and any other required device).

(1) PUSH based communication is used to avoid typical firewall hassles due to Internet data traffic blocking

3.3 HOME PAGE

The figure below shows the Eos-Server home page:

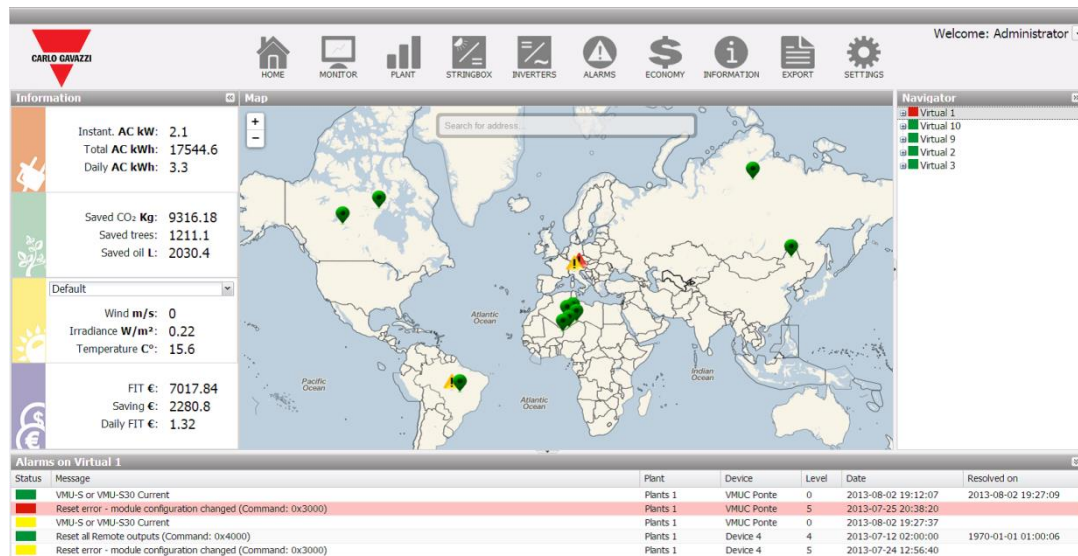


Figure 6: Home page

In particular, we have highlighted the following items, which are always available while using the software:

- Main Menu: It includes the Navigation Menu
- Lh Frame: Starting from the top there are:
 1. Production data. (Automatic data update)
 - Instant AC power – Instant power (kW) generated by the plant. The piece of data comes from the reference Energy meter (either real or virtual), depending on the settings included in the “Energy Meters Configuration of the selected VMU-C PV”.
 - Total AC energy – Total energy delivered by the plant since its switch-on. The piece of data comes from the reference Energy meter (either real or virtual), depending on the settings included in the “Energy Meters Configuration of the selected VMU-C PV”.
 - Daily AC energy – Energy delivered by the plant since the beginning of the day. The piece of data comes from the reference Energy meter (either real or virtual), depending on the settings included in the “Energy Meters Configuration of the selected VMU-C PV”.
 2. Environmental data. (Automatic data update)
 - Saved CO2 emissions – The calculation refers to the Total AC Energy generated by the plant (see ‘Total AC Energy’ in “Production data”). Measuring unit: kilogram (kg).
 - Calculation: A kWh used by the final user, produced by a thermoelectric plant, corresponds to an emission into air of about 0.53kg of CO₂. We can thus state that a kWh produced by a photovoltaic plant prevents the

emission into air of 531g of CO₂. We'll thus have: Saved CO₂ emissions = 0.531 x Total AC Energy (kWh).

- Equivalent trees - The calculation refers to the Total AC Energy produced by the plant [see 'Total AC Energy' in "Production data"].
 - Calculation: *Equivalent Trees = Saved CO₂ Emissions x 0.13*
- Saved Oil - The calculation refers to the Total AC Energy produced by the plant [see 'Total AC Energy' in "Production data"]. Measuring unit: Litres (L).
 - Calculation: Saved oil = TEP x 7.33 x 159
TOE = [0.187 x Total AC Energy (kWh)]/1000
1 TOE (Tonne of Oil Equivalent)= 7.33 oil drums
1 oil drum = 159 litres of oil
- 3. Environmental sensor data. (Automatic data update)
 - Solar Radiation (W/m²) hitting the reference Solar radiation sensor.
 - Module Temperature – Temperature (°C) read by the reference temperature probe.
 - Wind Speed – Wind Speed (m/s) read by the reference sensor.
- 4. Economic Data. (Automatic data update)
 - Total Incentive – Total Amount (€) received as an Incentive. (x €/kWh), x Amount paid for each kWh of produced energy.
Calculation: *Total Incentive = Total AC Energy x Incentive*
 - Total Saving on bill / Total Amount of Sold Energy (€) – this depends on the settings made in "System Data" → "Economic Data" Self-consumption / Sale
 - Calculation: *Total Saving on bill = Total AC Energy x Cost of 1 kWh of Energy*
 - *Total Sold Energy Amount = Total AC Energy x Amount paid for the sale of 1 kWh of Energy*
 - Saving on bill for the current day/ Amount of Sold Energy (in the current day) (€) – this depends on the settings made in: ""Settings/Plant/Edit Plant/Financial Highlights"
 - Calculation: *Daily incentive (saving on bill) = AC Energy of the current day x Cost of 1 kWh of Energy*
 - Total revenue (€) – this depends on the settings made in: "Settings/Plant/Edit Plant/Financial Highlights"
 - Calculation: *Total Sold Energy Amount = Total AC Energy of the current day x Amount paid for the sale of 1 kWh of Energy*
- Rh Frame (Navigator): It provides a tree view of the hierarchy existing in Eos-Server on three levels:
 - Virtual plant
 - Physical plant
 - VMU-C PV device

- Alarm Frame: It provides the list of recent alarms for the selected item. If you select a device or a plant in the portal, for example, the alarm panel is updated with the alarms associated with the selected item.
- Map Frame: It provides a map showing the location of the different VMU-C PV at international level. The map has an automatic zoom function allowing to display in a single screen all the monitored devices.

3.3.1 NAVIGATION MENU

Home

It allows to return to the main page. Clicking a further menu will restore the screen which was displayed before clicking “Home”.

Monitor

It allows to display the production data in graphical form, comparing Solar Radiation, Temperature, Powers and Efficiencies.

Plant

It allows to display in graphical form all the acquired system data.

StringBox

It allows to display in graphical form all the string boxes

Inverters

It allows to display in graphical form all the inverters

Alarms

It allows to display the alarms that have been raised in the plant.

Money

It allows to display in graphical form the equivalent monetary value of incentives, sales and savings.

Information

A tab displaying the plant characteristics.

Export

It allows to stored data to xls format.

Configuration (Only available for Administrator users)

It allows to access the system configuration menu.

Note: An online manual is available as a WebHelp inside the User Menu in the top right section of the screen

3.4 MONITOR

The section is devoted to production data analysis, to provide a quick glance of the current operating conditions of the plant. With the help of chart comparisons on such data as power, solar irradiation, temperatures and efficiencies, the system allows to analyse the relationships between the typical productivity elements of a photovoltaic system.

Clicking on the “Monitor” menu will display a window initially displaying a chart with the trend of the power delivered by the plant during the current day and during the previous one, with a sample resolution of 5 minutes. (the displayed data have a delay which is equal to the time the remote VMUC takes to send the data to the server).

Graphic functions:

Charts consist of an X-axis, showing day hours from 05:00 a.m. to 10:00 p.m., and of as many Y-axes as the number of dimensions to be shown in graphical form. Each Y axis has its own full scale appropriately sized for the dimension it refers to. To enable or disable a curve, simply click on the name of the variable the curve refers to, located below the X axis. The curve is immediately displayed or removed without any page refresh.

Hovering the mouse over the chart area will show a window displaying the relevant value of each variable.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

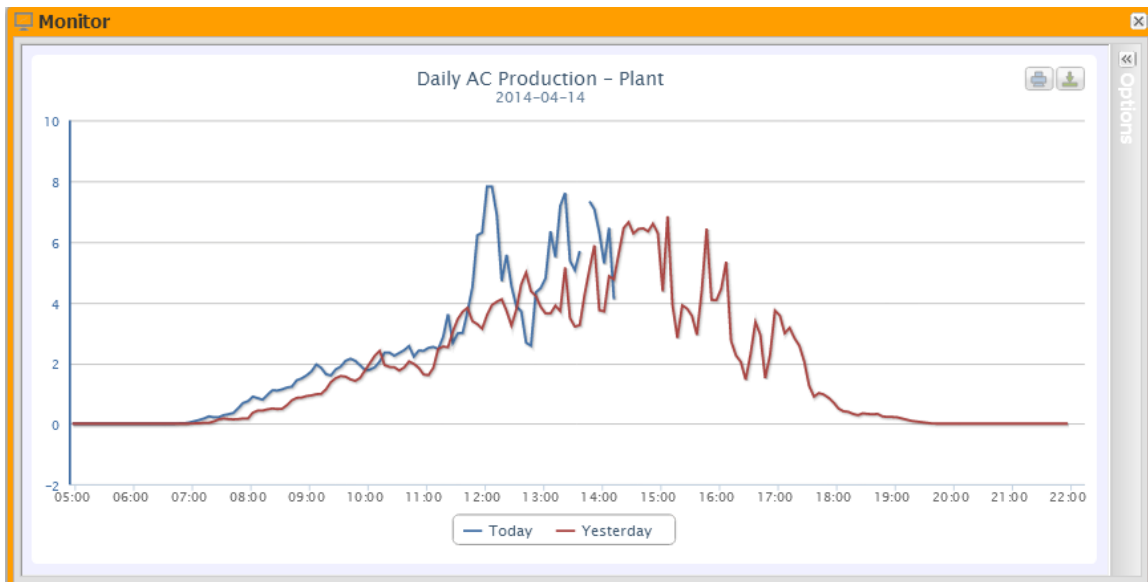


Figure 7: Monitor Window- AC Production Chart

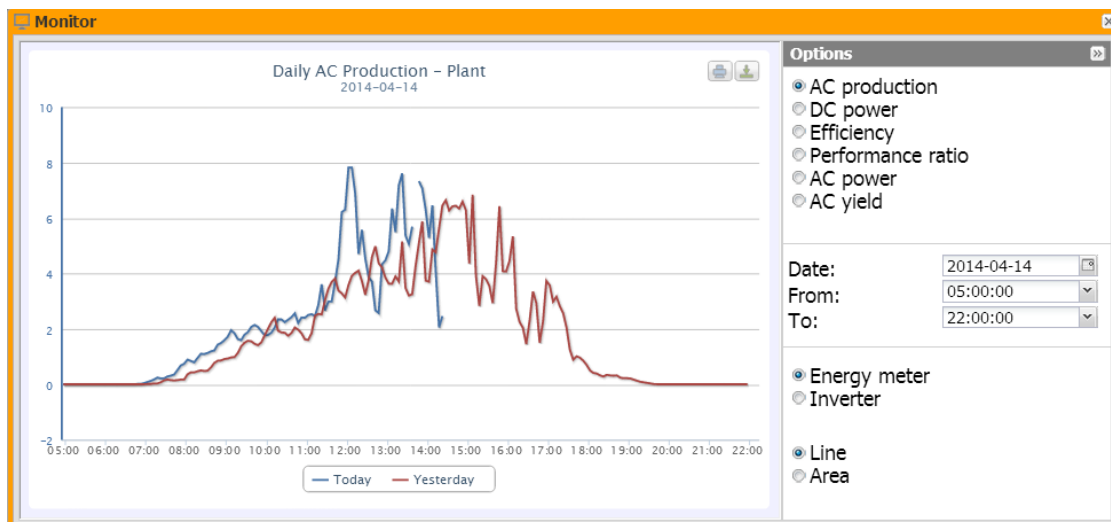


Figure 8: Monitor Window; Configuration panel

The system is monitored in its two parts:

- a) direct current part - monitored by VMU-S string controls
- b) alternating current - monitored by production meter or, if not available, directly from inverters.

The charts displayed in this section are:

- AC Production
- DC power - the direct current part upstream of VMU-Ss is analysed (string control)
- Efficiency – the different efficiencies are compared.
- Performance – *The system displays* the ratio between the produced energy (AC) and the energy which can be produced (AC).
- AC power - the alternating current part is analysed.

- AC Yield – the analysis compares the produced energy value (kWh) with the maximum design power value (kWp).

The paragraphs below provide a description of each individual chart.

3.4.1 AC PRODUCTION

As stated above, the AC production chart is automatically opened when clicking for the first time on the Monitor window.

The user may customise the graphical analysis by setting the Date and the start/end time.

Production may be analysed by displaying in the chart both the production of the meters and that of the inverters.

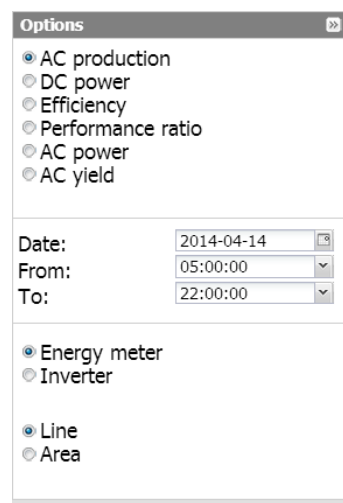


Figure 9: Monitor Window; Detail of settings

The chart can be displayed in “Line” or “Area” mode by selecting the keys on the bottom side.

If the user selects the current date, a check box will be displayed at the top; it allows to disable the chart automatic refresh, which is enabled by default.



Figure 10: Monitor Window; Detail of automatic refresh lock

Figure 10 shows a sample of the chart in question.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

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- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.4.2 DC POWER

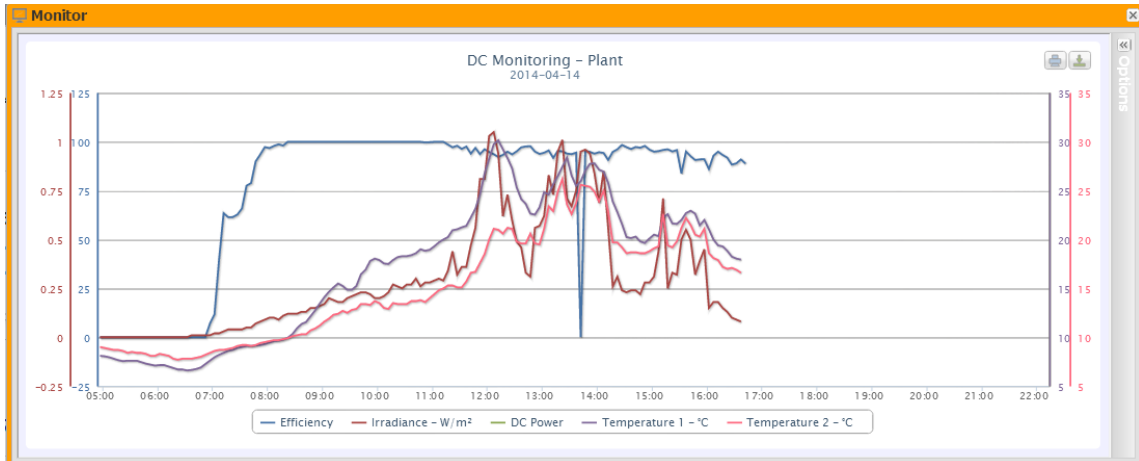


Figure 11: Monitor Window; DC Production Chart

If displayed on a VMUC device, this chart is strictly linked to the area selected in the left panel. If displayed on a plant (Physical or Virtual), instead, it isn't related to the selected item.

The chart displays 5 dimensions:

- a) *“Total efficiency”*: the total string efficiency is a percentage value derived from the ratio between a theoretical production value and the value really measured by VMU-S string control.

To calculate the theoretical production value, temperature and solar irradiation are necessary; if these environmental sensors are not available, the theoretical value considered is the max string power value among the read ones (calculation by comparison).

VMU-C PV can calculate string efficiency in three different ways, according to its configuration.

- Calculation with solar irradiation and temperature sensor located on module.
- Calculation with solar irradiation and room temperature sensor.
- Calculation without solar irradiation and temperature sensor.

Note: String efficiency calculated can exceed 100% under low solar irradiation condition, thus power delivered by modules. The value higher than 100% must be understood like an error due to measure resolution or solar irradiation sensor position.

Note: temperature and solar irradiation sensors used to calculate string efficiency must be configured like reference sensors.

- b) *“DC power”* : The direct current power is expressed in kW and is the result of the sum of all the power values read by the INVERTERS.
- c) *“Solar irradiation”*: The solar irradiation is expressed in W/m^2 and acquired by reference solar irradiation sensor.

- d) “*Temperature*”: The temperature is expressed in °C and acquired by reference temperature sensor. (There are two sets of data, T1 and T2).

Note: The chart sampling frequency (irradiation, temperature and power), depends on the storage interval set on the VMU-C PV. It can be: 5,10,15,30,60 minutes. For the Efficiency chart calculation is averaged every 60 minutes.

Note: **all the data displayed in graphical form are calculated in the VMU-C PV as an average of all the samples acquired by the system in the storage interval.**

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.4.3 EFFICIENCY

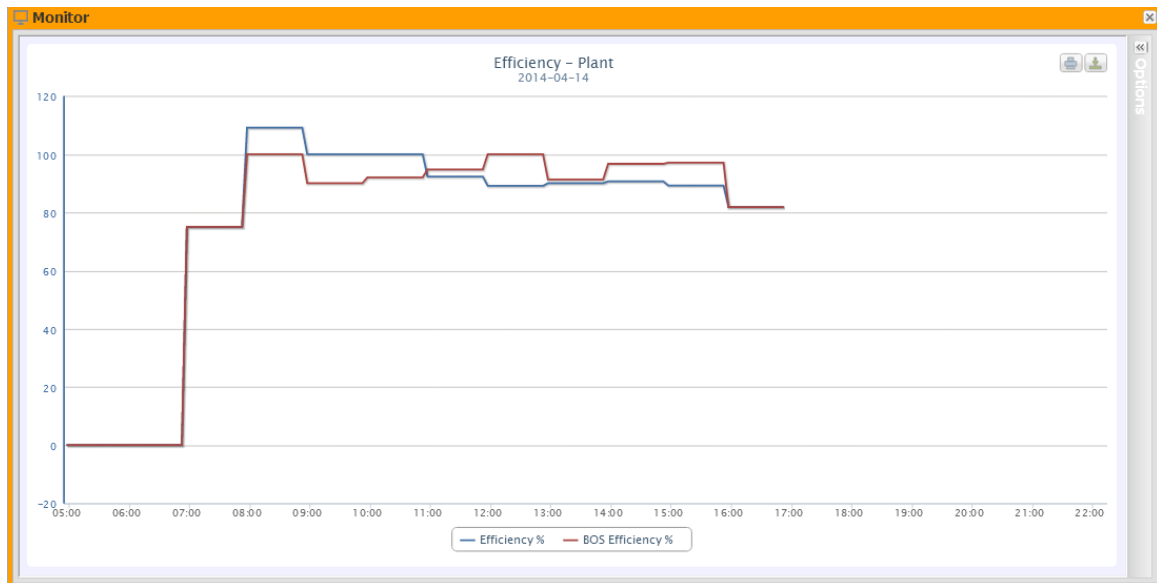


Figure 12: Monitor Window; Efficiency Chart

The chart compares 2 dimensions:

- “*Total efficiency*”: This is the value shown in the “*DC power*” chart (Fig. 11).
- “*BOS efficiency*”: BOS (Balance of system) is calculated by comparing two energy values within the same time interval: value of AC energy acquired from reference production meter and DC energy value acquired by VMU-S string control.

The time interval between samples on the chart is 60 minutes.

Note: “*BOS efficiency*” can only be calculated if a main reference energy meter is inserted into the plant.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.4.4 PERFORMANCES

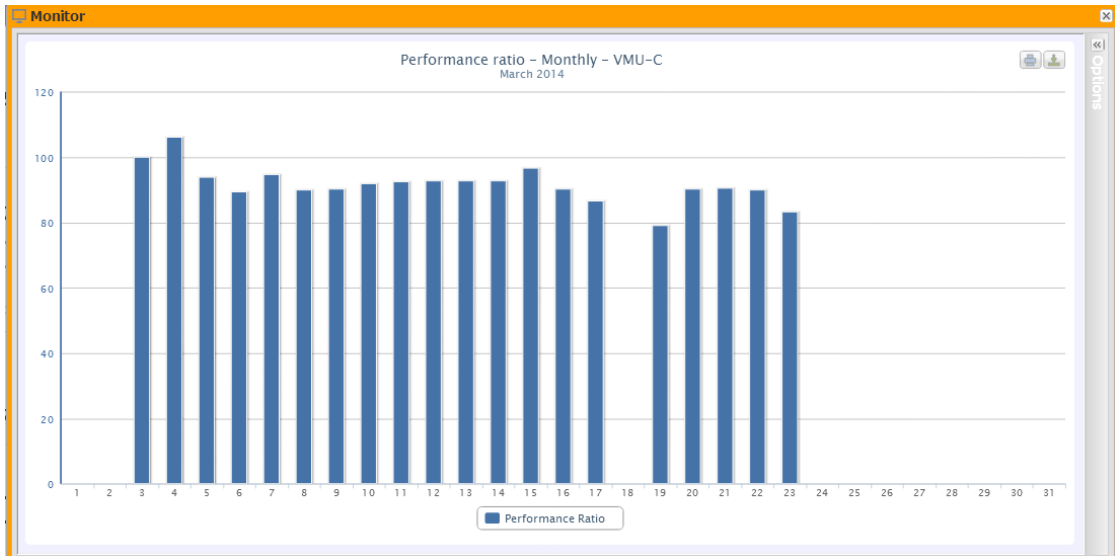


Figure 13: Monitor Window; Performance Chart

The chart allows to display the performance index for each individual day of the selected month.

Each histogram represents the daily performance of the specified day. The “Performance” value (also called “Performance Ratio”) defines the ratio between the actual energy yield (actually produced AC energy) and the possible theoretical yield (Energy which can potentially be produced in the same period). This value will indicate the quality of the plant operation. This doesn't depend on the installed power value, nor from the panel orientation, nor from different irradiation values. For this reason, through this parameter you can compare photovoltaic plants connected to the network and located in different parts of the world.

You can also choose the display on a yearly basis, where each individual histogram will represent the yield of the specified month (next figure).



Figure 14: Monitor Window; Yearly Performance Chart

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Also there is a further display scale, called "all years" in which each individual histogram represents the performance of the year in question.

Note: "Performance" can only be calculated if a main reference energy meter is inserted into the plant and if in the meantime the DC energy value is made available by the installed VMUS modules.

3.4.5 AC POWER

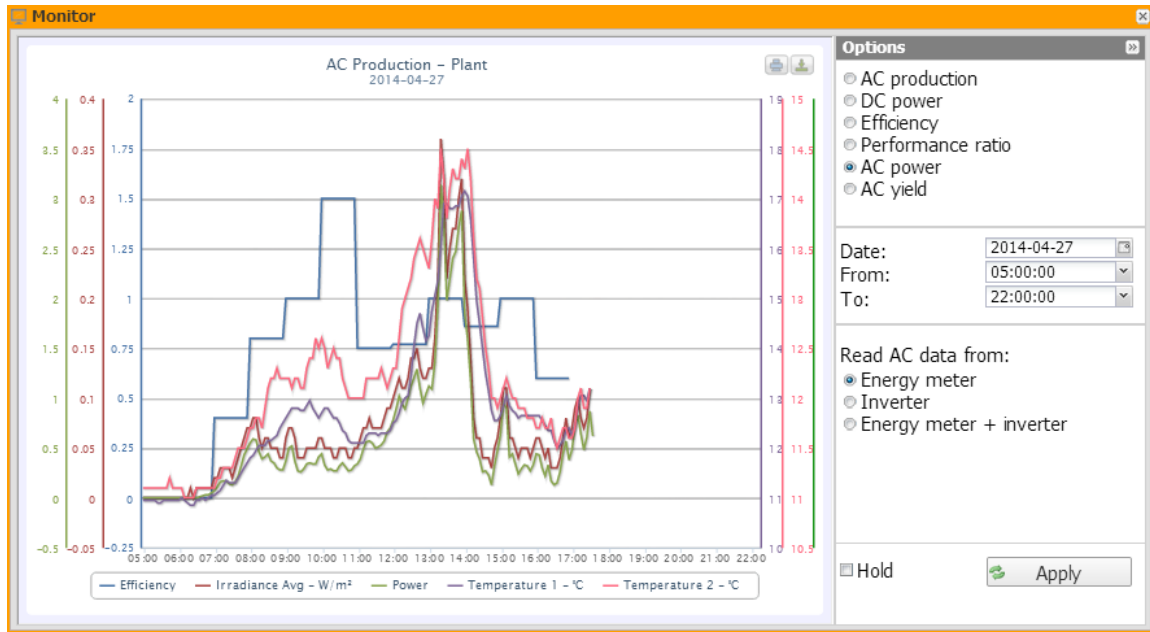


Figure 15: Monitor Window; AC Power Chart.

The chart displays 5 dimensions:

- a. “*Total efficiency(%)*”: the total efficiency is a percentage value derived from the ratio between a theoretical production value and the value which is really measured by AC production meter or inverters.
The system uses the values from the meter or from the inverters.
To calculate the theoretical production value, temperature and solar irradiation are necessary; **if these environmental sensors are not available, the total efficiency cannot be provided for.**

Note: Total efficiency calculated can exceed 100% under low solar irradiation condition, thus power delivered by modules. The value higher than 100% must be understood like an error due to measure resolution or solar irradiation sensor position.

- b. “*AC power*”: Power in alternating current expressed in kW. Through the menu shown in Fig.18 you can set the data source. The AC power data can be read from:
 - Main energy meter (set up like a reference meter in configuration phase)
 - Inverter
 - Main energy meter +Inverter (with two distinct curves)

Read AC data from:

- Energy meter
- Inverter
- Energy meter + inverter

Figure 16: Monitor Window; AC Power Chart – data source selection.

- c. “*Irradiation*”: The solar irradiation is expressed in W/m^2 and acquired by reference solar irradiation sensor.
- d. “*Temperature*”: The temperature is expressed in $^{\circ}C$ and acquired by reference temperature sensor. (There are two sets of data, T1 and T2).

Note: The chart sampling frequency (irradiation, temperature and power), depends on the storage interval set on the VMU-C PV. It can be: 5,10,15,30,60 minutes. For the Efficiency chart calculation is averaged every 60 minutes.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5 PLANT

The Plant section is devoted to historic data analysis; it allows to fully analyse the trend of plant performance along time and the behaviour of the individual devices (Inverters, string controls, meters and sensors).

In this section the system displays in graphical form all the data acquired by VMU-C PV read from the different devices or aggregated into physical or virtual plants.

As for the Monitor section, the window content depends on the plant selected in the Navigator or on the map.

Figure 19 below shows the chart opened by default when clicking on “Plant” in the main menu. It is “AC production – All inverters”.

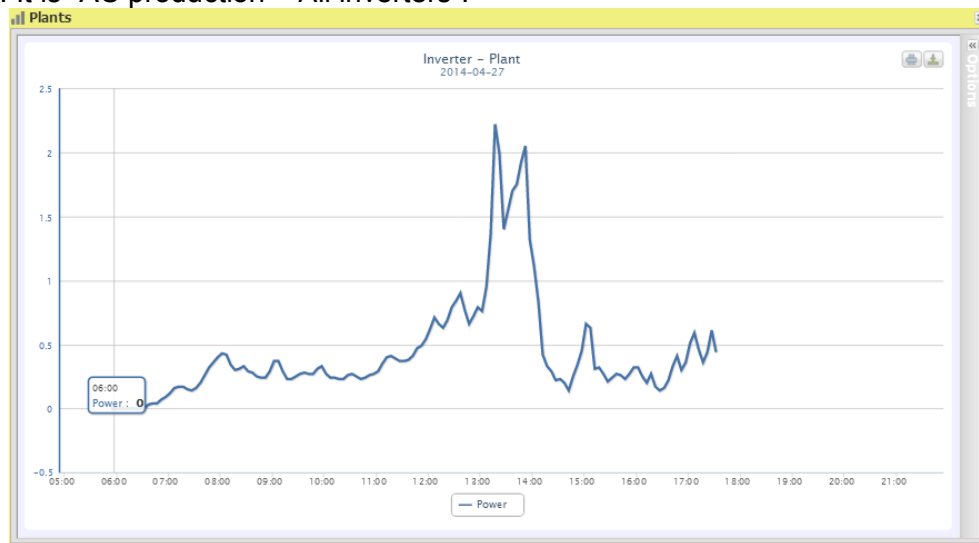


Figure 17: Plant Window; Inverter Chart

Clicking on the left arrow in the top right will open the option panel.

Supported chart display types are:

- Line
- Area
- Bars

Available charts are:

1. “*AC PRODUCTION*”: For Inverters and Energy Meters
2. “*DC PRODUCTION*”: For Eos-Array string control.
3. “*EFFICIENCY*”: Dedicated to efficiencies: Total, Eos-Array, Inverter, BOS.
4. “*SENSORS*”: Dedicated to environmental sensors.

The chart options shall be discussed in each dedicated sub-section.

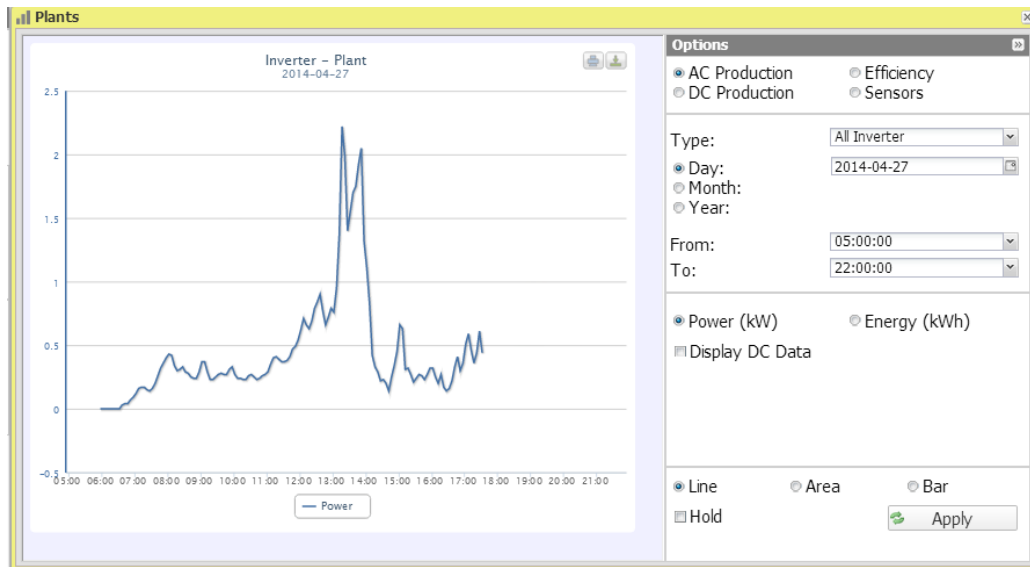


Figure 18: Plant Window; Inverter Chart – Option selection

3.5.1 AC PRODUCTION - ALL INVERTERS

The power/energy curve represents the addition of all contributions from inverters monitored on the system, within the time interval selected. .

An example is shown in 19.

Figure 20 shows the selection options for the display type:

- Daily: it shows the daily trend of power or energy on the selected day. (To choose the day use the special calender which can be accessed through the button next to the date field)
- Monthly: it shows the average daily power or the total produced energy, for each day of the selected month. (To choose the month and year use the special selection menus)
- Yearly: it shows the average monthly power or the total produced energy, for each month of the selected year. (To choose the year use the special selection menu)

After selecting the display type press the “Apply” button.

The next section includes two selectors:

- i. The buttons allowing to choose the type of data to be displayed in graphical form: Power or Energy.
- ii. The check box enabling the display in the chart of the DC power measured by the inverter.

On the abscissa axis (X) the chart displays time; the dimension (hours, days, months) depends on the selected display type (daily, monthly, yearly). On the ordinate axis (Y) the chart displays power in kW or energy in kWh, with a full scale appropriately sized according to the plant peak power.

In the top left of this section there is a menu allowing to select the graphical display mode: Line, Area, Histograms.

Note: we recommend that you use the “Line” or “Area” display for the daily Power data and the Histograms display for the monthly and yearly energy data.

Note: The chart sampling frequency depends on the storage interval set on the VMU-C PV. It can be: 5,10,15,30,60 minutes.

Hovering the mouse over the chart area will show a window displaying the relevant value of the variable.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5.2 AC PRODUCTION – SINGLE INVERTER

As you access the page, the system will display the daily trend of the power delivered by each individual inverter monitored by the system in the specific plant. Each curve has a different colour and can be identified by legend on chart bottom. Using the “Inverter” menu, in the bottom section of the option panel (see figure 21), you can also display the production curve of a single inverter. This view is only available when a VMU-C PV is selected, as the virtual and physical plants allow to display a single “aggregated inverter” of all the inverters of the devices in the underlying hierarchy.

Figure 19: Plant Window; Inverter Chart – Option selection for Single Inverter.

The figure shows the selection options for the display type:

- Daily: it shows the daily trend of power or energy on the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the average daily power or the total produced energy, for each day of the selected month. (To choose the month and year use the special selection menus)
- Yearly: it shows the average monthly power or the total produced energy, for each month of the selected year. (To choose the year use the special selection menu)

After selecting the display type press the “Apply” button.

Note: Comparing production trends of various inverters allows to easily identify any production abnormalities on the system.

The next section includes three selectors:

- i. The buttons allowing to choose the type of data to be displayed in graphical form: Power or Energy.
- ii. The check box enabling the display in the chart of the DC power measured by the inverter.
- iii. Inverter selection list:

- The list of all the names assigned to the inverters included in VMU-C PV; when selecting an individual inverter, only the relevant curve will be displayed.
- The “ALL” item, allowing to simultaneously display all the inverters existing in the plant.

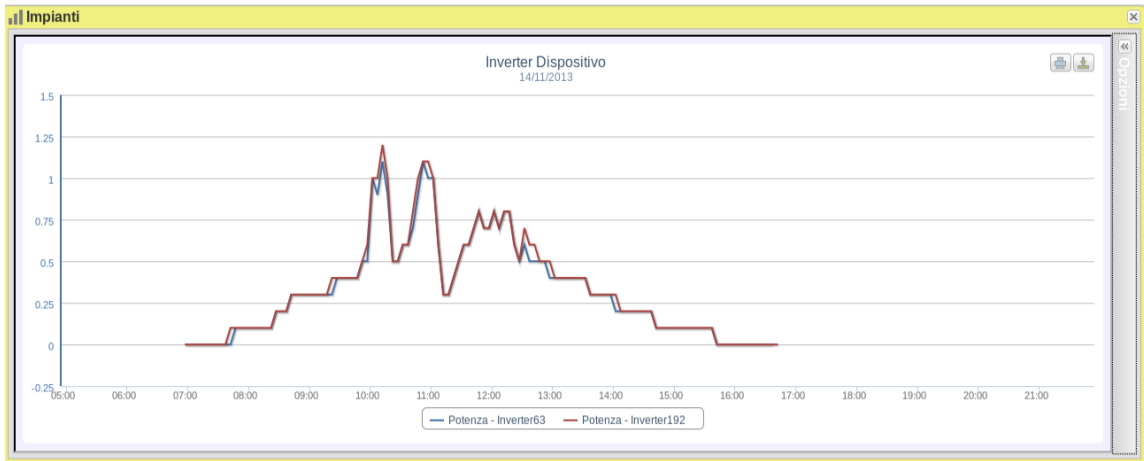


Figure 20: Plant Window; Inverter Chart – Option selection for Single Inverter.

On the abscissa axis (X) the chart displays time; the dimension (hours, days, months) depends on the selected display type (daily, monthly, yearly). On the ordinate axis (Y) the chart displays power in kW or energy in kWh, with a full scale appropriately sized according to the plant peak power.

In the top left of this section there is a menu allowing to select the graphical display mode: Line, Area, Bars.

Note: we recommend that you use the “Line” or “Area” display for the daily Power data and the Bar display (for histograms) for the monthly and yearly energy data.

Note: The sampling frequency depends on the storage interval set on VMU-C PV. It can be: 5,10,15,30,60 minutes.

In the top right section, two icons are displayed in the chart area:

- **Print chart**

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- **Export**

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5.3 AC PRODUCTION – TOTAL ENERGY METER

As you access the page, the system will display the daily trend of the power measured by the TOTAL meter or by the virtual meter representing the sum of all the values read by the partial meters installed in the specific plant. When building this curve, obviously, the system will only consider the energy meters whose field “AC energy totaliser contribution” is set to “YES”.

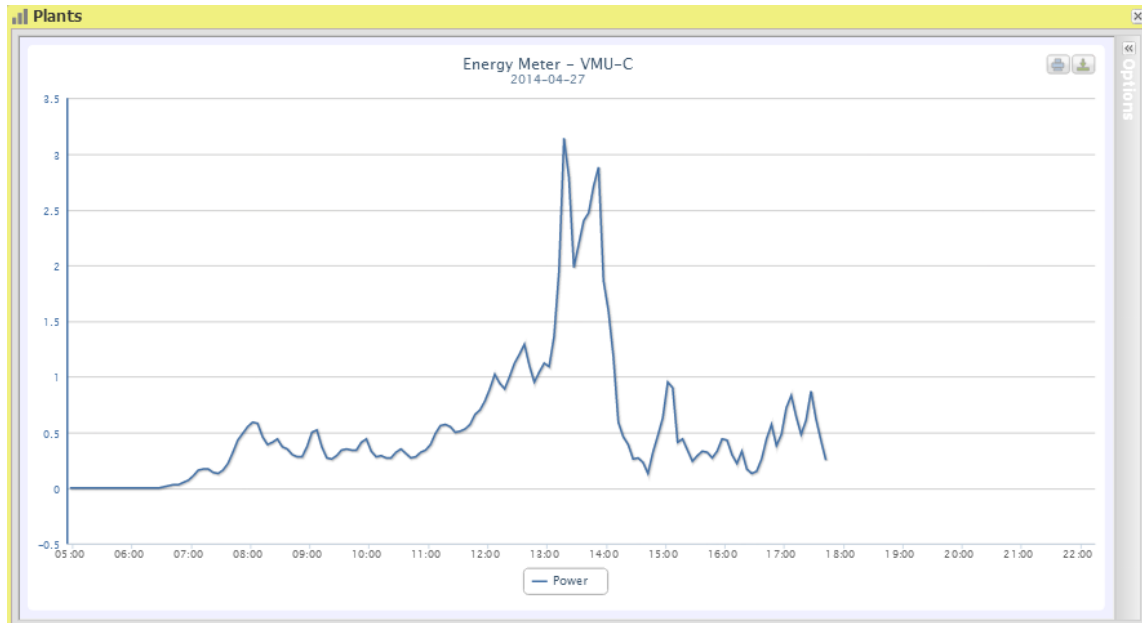


Figure 21: Plant Window; Energy Meter Chart– Option Selection for Total Energy Meter.

Figure 24 shows the selection options for the display type:

- Daily: it shows the daily trend of power or energy on the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the average daily power or the total produced energy, for each day of the selected month. (To choose the month and year use the special selection menus)
- Yearly: it shows the average daily power or the total produced energy, for each month of the selected year. (To choose the year use the special selection menu)

After selecting the display type press the “Apply” button.

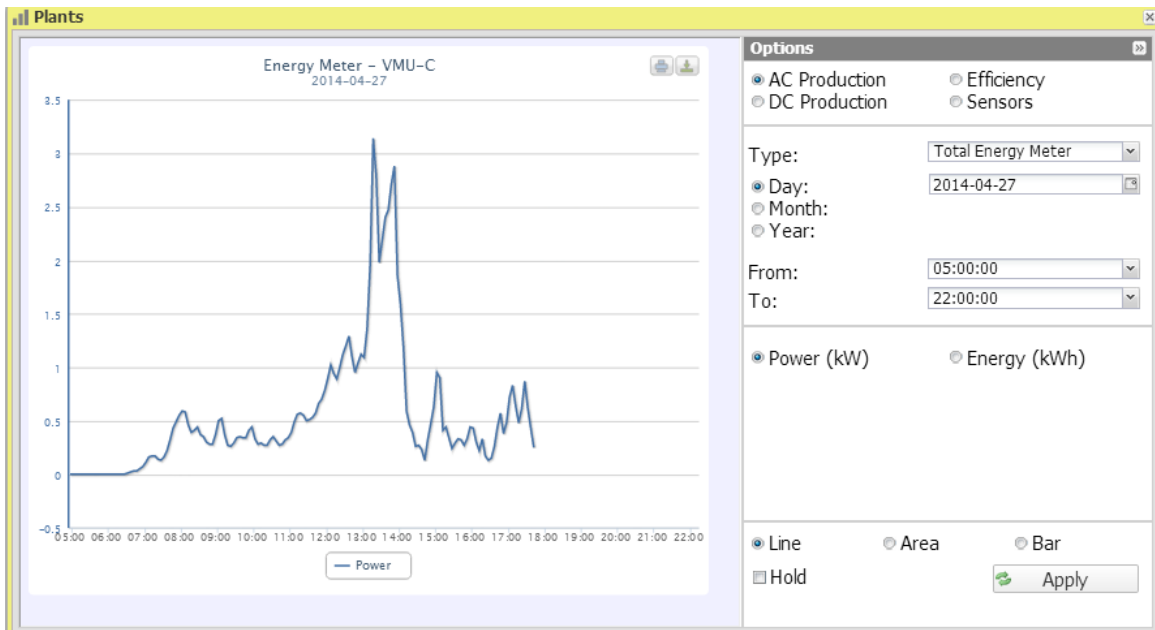


Figure 22: Plant Window; Energy Meter Chart

The next section includes two selectors:

- i. the keys to select the type of dimensions to be drawn, Power or Energy.
- ii. The check box enabling the display in the chart of the DC power measured by the energy meter.

On the abscissa axis (X) the chart displays time; the dimension (hours, days, months) depends on the selected display type (daily, monthly, yearly). On the ordinate axis (Y) the chart displays power in kW or energy in kWh, with a full scale appropriately sized according to the plant peak power.

In the top left of this section there is a menu allowing to select the graphical display mode: Line, Area, Bars.

Note: we recommend that you use the “Line” or “Area” display for the daily Power data and the Bar display (histograms) for the monthly and yearly energy data.

Note: The chart sampling frequency depends on the storage interval set on the VMU-C PV . It can be: 5,10,15,30,60 minutes.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5.4 AC PRODUCTION – PARTIAL ENERGY METER

As you access the page, the system will display the daily trend of the power measured by each individual energy meter monitored by the system in the specific plant. Each curve has a different colour and can be identified by legend on chart bottom. Use the “Energy meter name” menu to display the production curve of a specific instrument, as well.

Figure 25 shows the selection options for the display type:

- Daily: it shows the daily trend. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

After selecting the display type press the “Apply” button.

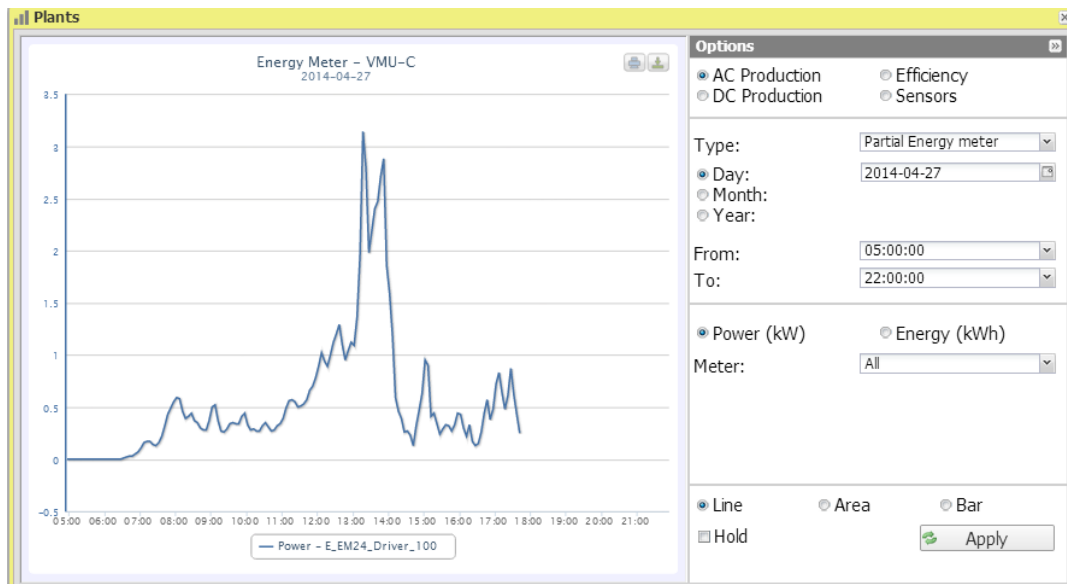


Figure 23: Plant Window; Energy Meter Chart– Option Selection for Partial Energy Meter.

The “Instrument” selector allows to display:

- The list of all the names assigned to the energy meters included in VMU-C PV; when selecting an individual meter, only the relevant curve will be displayed.
- The “ALL” item, allowing to simultaneously display all the energy meters configured and existing in the plant.

Note: Comparing the measurement trends of the different energy meters allows to easily identify any production abnormalities on the system.

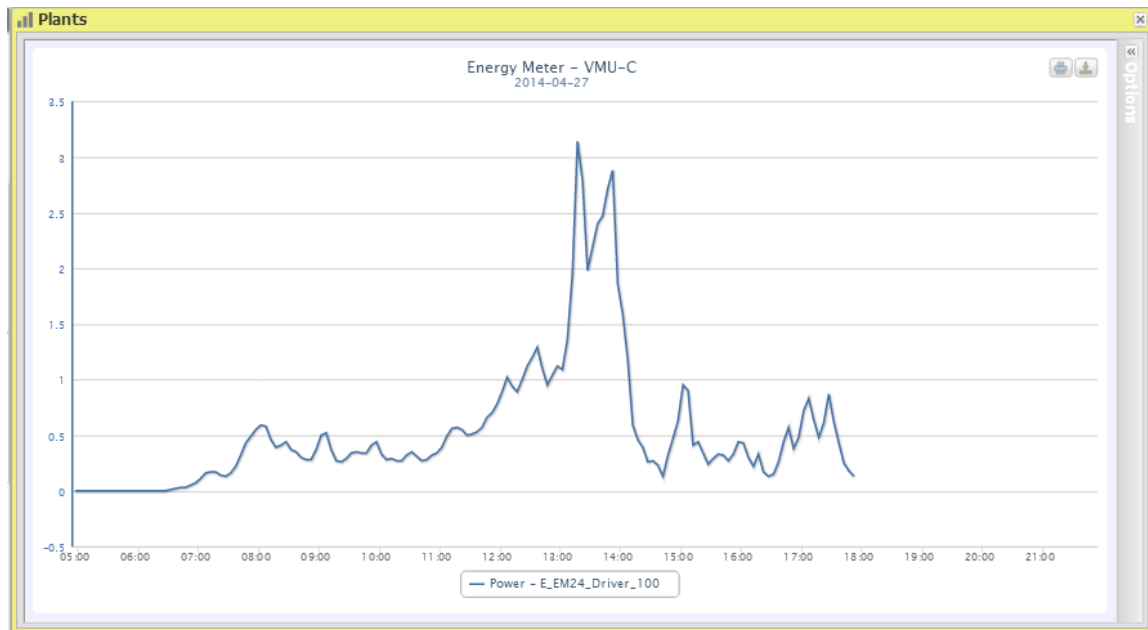


Figure 24: Plant Window; Partial Energy Meter Chart

On the ordinate axis (Y) the chart displays power in kW or energy in kWh, with a full scale appropriately sized according to the plant peak power. In the top left of this section there is a menu allowing to select the graphical display mode: Line, Area, Bars.

Note: we recommend that you use the “Line” or “Area” display for the daily Power data and the Bar display (histograms) for the monthly and yearly energy data.

Note: The chart sampling frequency depends on the storage interval set on the VMU-C PV . It can be: 5,10,15,30,60 minutes.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5.5 DC PRODUCTION - ALL STRINGS

The power/energy curve represents the sum of all contributions from the individual strings monitored in the system, within the selected time interval.

The figure shows the selection options for the display type:

- Daily: it shows the daily trend. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

After selecting the display type press the “Apply” button.

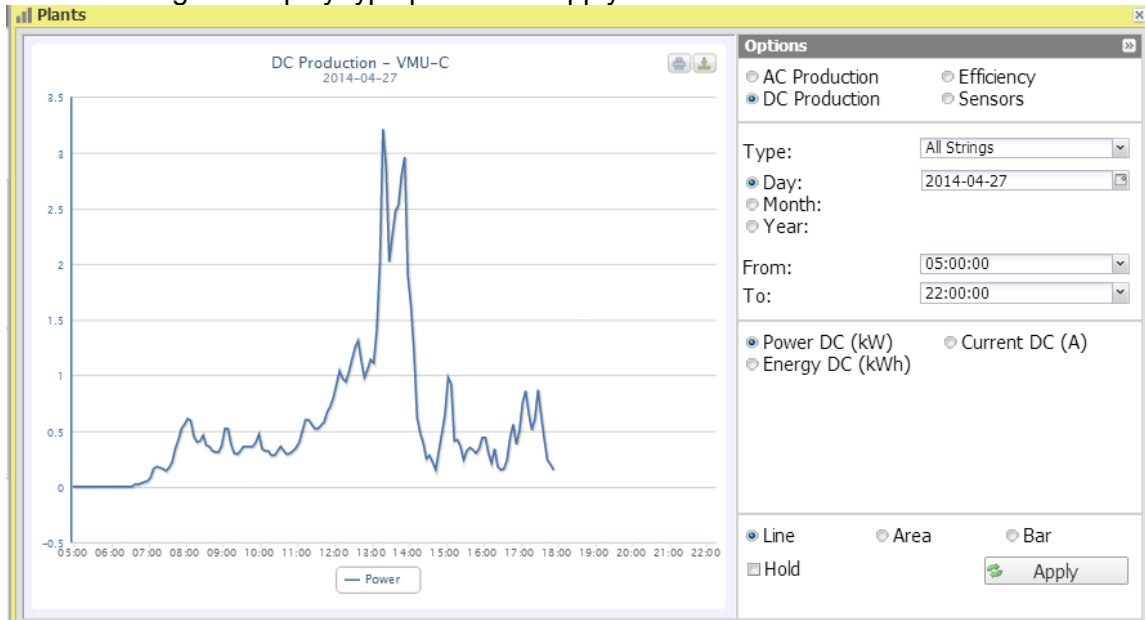


Figure 25: Plant Window; DC Production Chart – Option Selection for “All strings”.

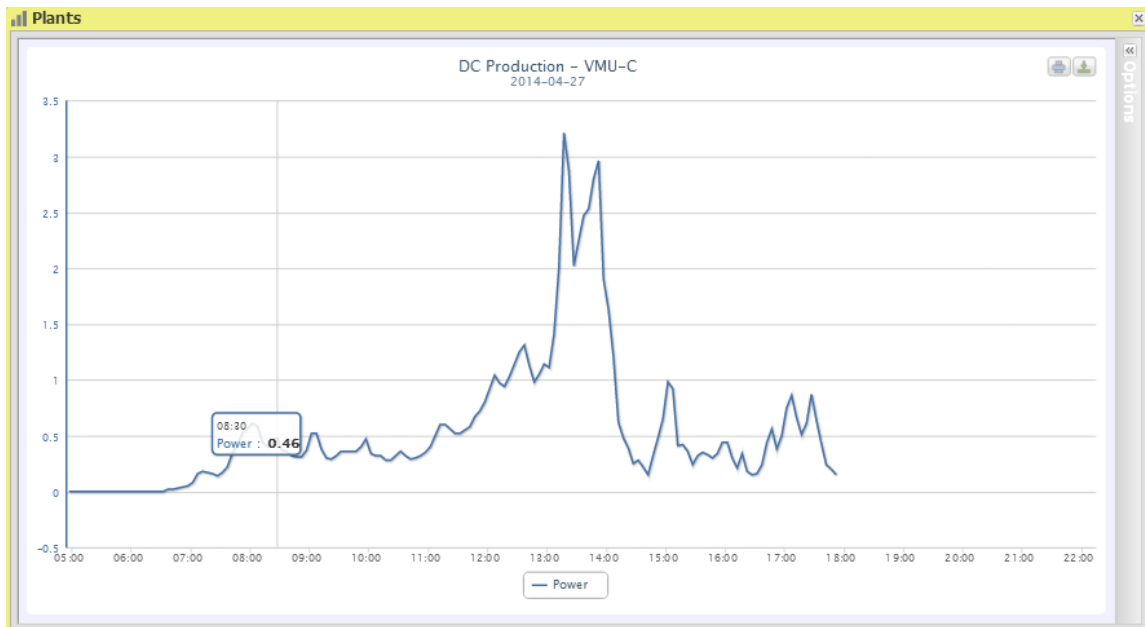


Figure 26: Plant Window; DC Production Chart – All strings”.

The buttons in the bottom section of the option panel allow to select the type of data to be displayed in graphical form: Power, Energy and Current.

On the abscissa axis (X) the chart displays time; the dimension (hours, days, months) depends on the selected display type (daily, monthly, yearly). Y-axis shows power in kW or energy in kWh or current in A with a properly-dimensioned scale end.

In the top left of this section there is a menu allowing to select the graphical display mode: Line, Area, Bar.

Note: it is recommended to use “Line” or “Area” display for daily data and Bar (Histograms) display for monthly and yearly data.

Note: The chart sampling frequency depends on the storage interval set on the VMU-C PV . It can be: 5,10,15,30,60 minutes.

In the top right section, two icons are displayed in the chart area:

- *Print chart*

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5.6 DC PRODUCTION – SINGLE STRING

As you access the page, the system displays the daily trend of the power delivered by each individual string of a specific group (Eos-Array) monitored by the system. Each curve has a different colour and can be identified by legend on chart bottom.

In this page you can watch the trend of the electric values (kW, kWh, A and V) of the individual strings controlled by the on-field VMU-S modules. In particular, two display types exist:

1. Chart with aggregated data from multiple VMU-S string controls (belonging to the same Eos-Array group).
2. Chart with data from a single VMU-S string control (single VMU-S module).

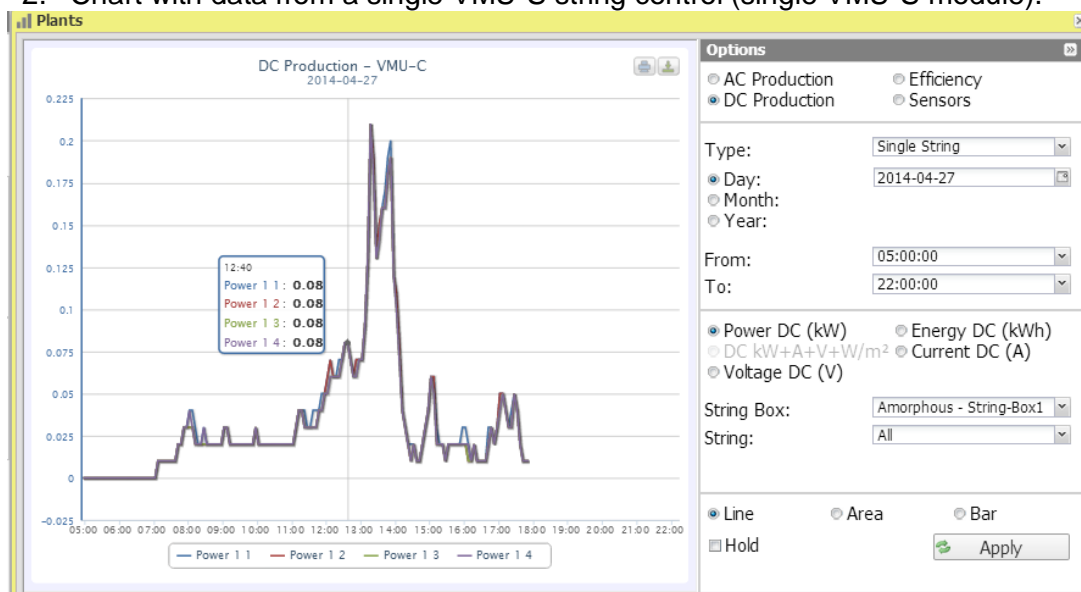


Figure 27: Plant Window; DC Production Chart – Option Selection for “Single String”.

- Chart with data coming from several VMU-S string controls.

This section displays data from all VMU-Ss under the VMU-C PV or a specific VMU-M. Data can be selected through (see figure 28):

- a) (All) - Several curves, one for each VMU-S selected, displayed at the same time.
- b) (Single string) - A single curve built using the data from the individual VMU-S specified through the menu shown in the figure under "String".

“All” is the default mode and it shows all the tracks of the strings belonging to the selected VMU-C PV or VMU-M at the same time. Comparing various curves allows to easily identify any production abnormalities on a specific string. The bottom legend allows finding the relevant VMU-S.

Follow the sequence of operations below to search and graphically view the electric dimension required:

1. *Selection of the VMU-C PV or of the VMU-M connected to it*

The special menu shown in Figure - **StringBox** allows to select the desired VMU-C PV or VMU-M. The VMU-C PV or the VMU-M must be selected to identify all VMU-Ss under it, to be monitored and compared.

2. *Selection of date/month/year of display*

This screen includes the buttons allowing to select the display range:

- Daily: it shows the daily trend of DC power or DC energy or DC current on the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it displays the DC power, the DC current or the total DC energy produced for each day of the selected month. (To choose the month and year use the special selection menus)
- Yearly: it shows the DC power, DC current or total DC energy produced for every month of the selected year. (To choose the year use the special selection menu)

3. *Selection of electric dimension required*

Use proper menu in Fig. 29 to select the desired electric dimension.

Note: “DC Power+Current+Voltage+Solar Irradiation” selection is disabled for the display of aggregated data from more VMU-S string controls. It will only be enabled for charts with data from a single VMU-S string control.

the electric dimensions which can be selected are:

- “DC Power (kW)” : chart shows the trend of power in kW within the time interval chosen.
- “DC Energy (kWh)” : chart shows the trend of delivered energy (kWh) within the time interval chosen.
- “DC Current (A)” : chart shows the trend of current in A within the time interval chosen.
- “DC Voltage (V)” : chart shows the trend of voltage in V within the time interval chosen.

4. Display of the desired chart

Press “Refresh chart” to view the desired chart.

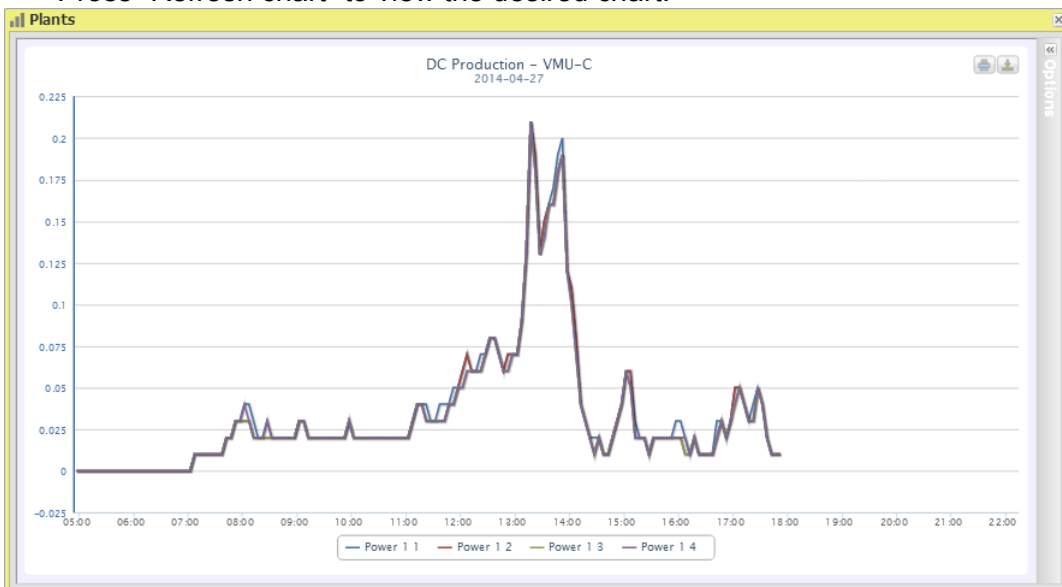


Figure 28: Plant Window; DC Production Chart – Selection for “Single String”.

- Charts with data coming from a single VMU-S string control.

To draw chart of a specific VMU-S string control, follow the sequence below:

1. Selection of the VMU-C PV or of the VMU-M connected to it

The special menu shown in Figure allows to select the desired VMU-C PV or VMU-M. VMU-M must be selected to identify all VMU-Ss, to be monitored and compared.

2. Selection of date/month/year of display

This figure shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)

- Monthly: it shows the maximum DC power, maximum DC current, maximum DC voltage or total DC energy produced for every day of the selected month. (To choose the month and year use the special selection menus)
- Yearly: it shows the maximum DC power, maximum DC current, maximum DC voltage or total DC energy produced for every month of the selected year. (To choose the year use the special selection menu)

3. Searching for the VMU-S required

Through the “String” menu, select the VMU-S module you wish to analyse. The “DC Power+Current+Voltage +Solar Irradiation” selection becomes active.

Note: The list contains some numbers corresponding to the position of the VMU-S in the chain of the devices under the VMU-C PV or VMU-M. If the “VMU-S” list is empty that means under the VMU-M selected at point 1 there is no VMU-S.

4. Selection of electric dimension required

Use proper menu in Fig. 33 to select the electric dimension to be shown in graphical form.

Selection keys available are the following:

- “DC Power (kW)” : chart shows the trend of power in kW within the time interval chosen.
- “DC Energy (kWh)” : chart shows the trend of delivered energy (kWh) within the time interval chosen.
- “DC Current (A)” : chart shows the trend of current in A within the time interval chosen.
- “DC Voltage (V)” : chart shows the trend of voltage in V within the time interval chosen.
- “DC Power+Current+Voltage+Solar Irradiation” : chart shows the four dimensions at the same time, within the chosen time interval. The chart type for this selection is as shown in Fig. 31.

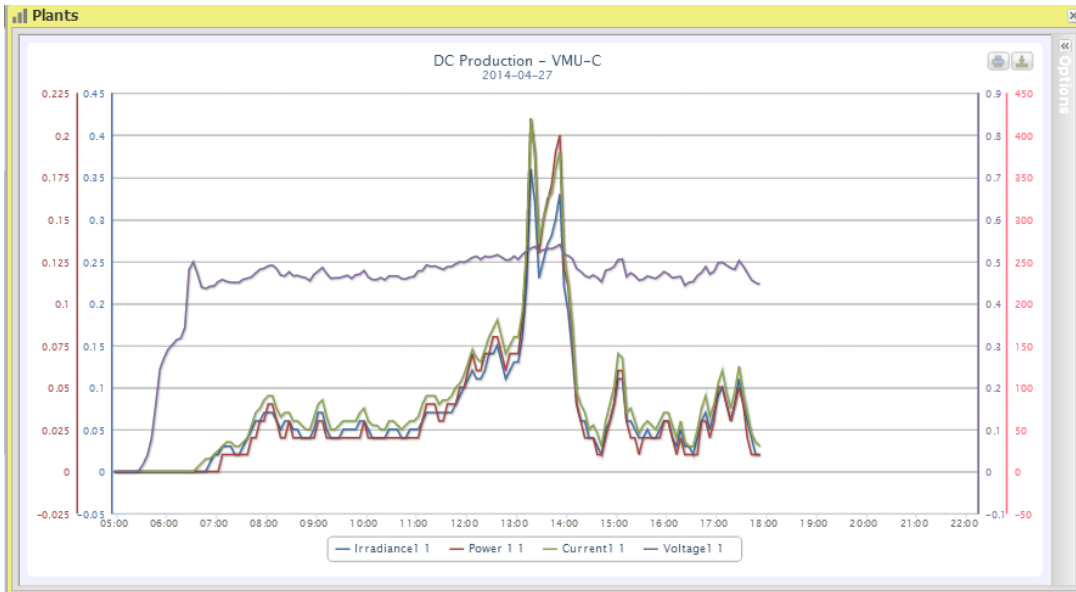


Figure 29: Plant Window, DC Production Chart “Single String – KW+A+V+W/m2”.

As already mentioned above, this type of chart allows to show or hide curves by clicking on the legend located at the bottom of the relevant axis.

To display another VMU-S among those available with the same criteria, click again “String” and select the desired item from the VMU-S list. On the contrary, to change the electric dimension type, repeat the sequence starting from point 3.

In the top left of this section there is a menu allowing to select the graphical display mode: Line, Area, Bars.

Note: it is recommended to use “Line” or “Area” display for daily data and Bar display for monthly and yearly data.

- Time distance between two following samples

The chart sampling frequency depends on the storage interval set on the VMU-C PV . It can be: 5,10,15,30 or 60 minutes.

- Graphic display of value

Place the mouse above the chart area to show the relevant frame showing the type of dimension, date it refers to, relevant value expressed in the measure unit shown on Y-axis.

In the top right section, two icons are displayed in the chart area:

- Print chart

Clicking on the “print” button located in the top right section of the chart area you can specify which printer shall be used to print the chart .

- *Export*

Clicking on the “Export” button located in the top right section of the chart area, you can export the chart data in the following formats:

- SVG
- CSV

3.5.7 EFFICIENCY – TOTAL

The total efficiency is the result derived from the ratio between a theoretical production value and the value which is really measured by AC production meter or inverters. The system uses the values from the meter or from the inverters according to the setting made in the plant configuration menu.

To calculate the theoretical production value, temperature and solar irradiation are necessary; **if these environmental sensors are not available, the total efficiency cannot be calculated.**

Note: temperature and solar irradiation sensors used to calculate total efficiency must be configured like reference sensors.

From the “EFFICIENCY” menu, click on the “TOTAL” item; the system will display the page shown in Fig. 28. As soon as you access this page, the chart shows total efficiency trend for the current day; select another date or a time interval such as monthly or yearly, use the special section on top and press the “Apply” key.

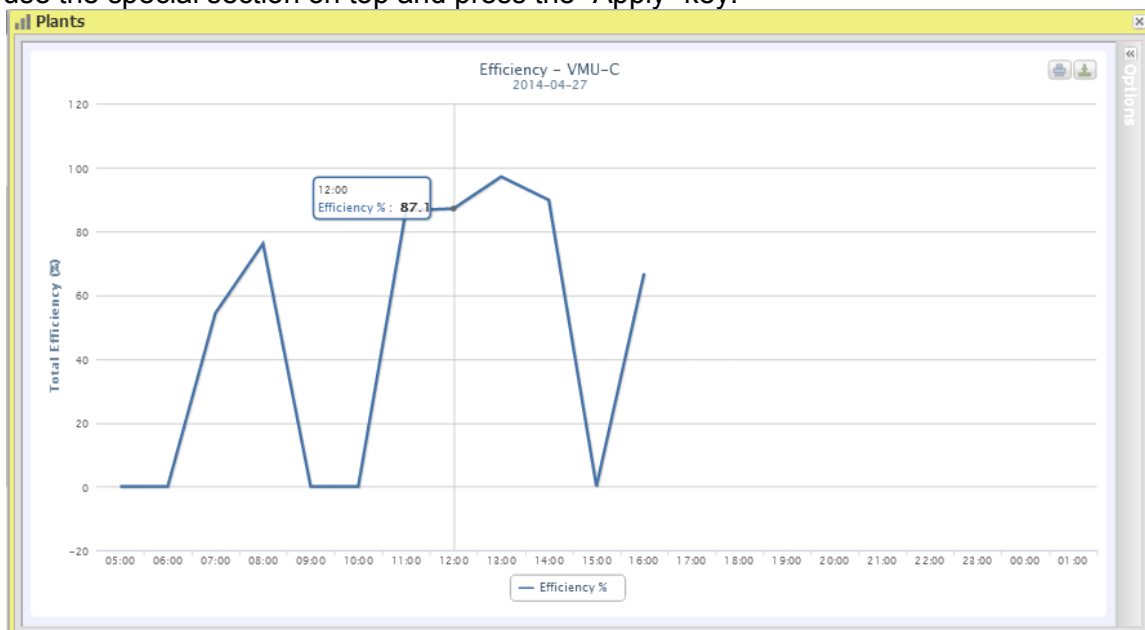


Figure 30: Plant Window; Efficiency Chart "Total".

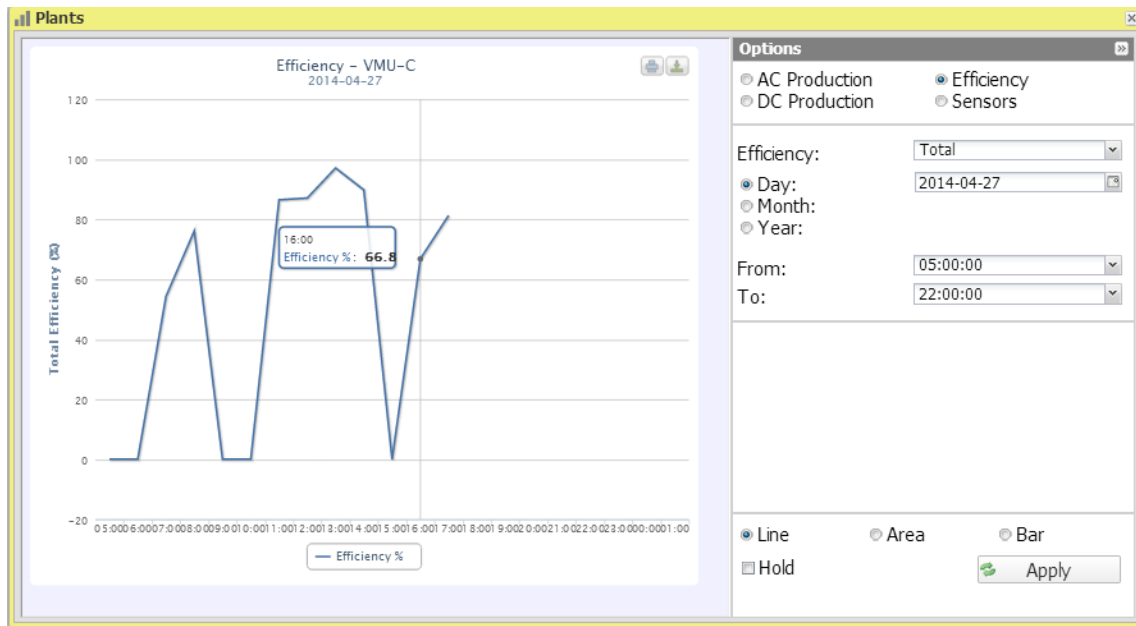


Figure 31: Plant Window; Efficiency Chart "Total" - Options Panel.

Note: The sampling frequency is fixed to 60 minutes and cannot be modified.

Fig.33 shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

3.5.8 EFFICIENCY – ALL STRINGS

String total efficiency derives from ratio between production technical value and direct current power value really measured by VMU-S string controls. To calculate theoretical production value, temperature and solar irradiation are necessary; **if these environmental sensors are not available, the string total efficiency cannot be calculated.**

Note: temperature and solar irradiation sensors used to calculate total efficiency must be configured like reference sensors.

Note: The calculated total string efficiency can exceed 100% under low solar irradiation condition, thus power delivered by modules. The value higher than 100% must be understood like an error due to measure resolution or solar irradiation sensor position.

From the "EFFICIENCY" menu, click on the "All Strings" item; the page shown in Fig. 34 will appear. As soon as you access this page, the chart shows total efficiency trend for

the current day; select another date or a time interval such as monthly or yearly, use the dark grey section on top and press the “Apply” key.

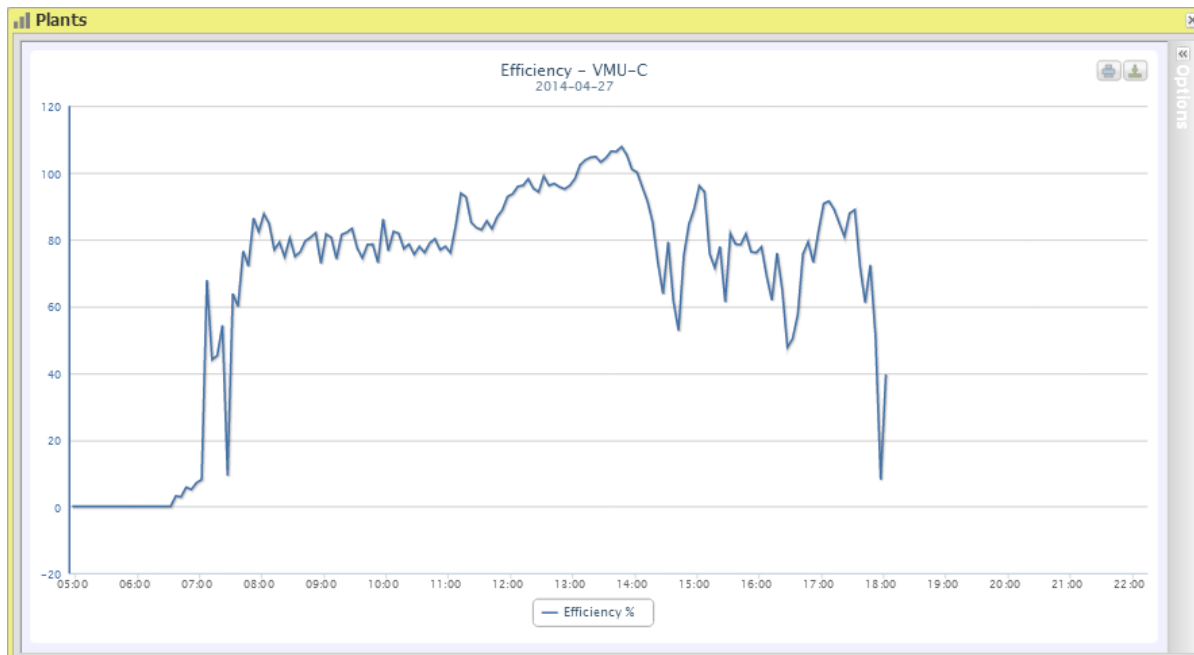


Figure 32: Plant Window; Efficiency Chart "All strings".

Note: The sampling frequency is fixed to 60 minutes and cannot be modified.

Fig. 36 shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

3.5.9 EFFICIENCY – SINGLE STRING

The string efficiency derives from ratio between production technical value and direct current power value really measured by VMU-S string control selected. To calculate the theoretical production value, temperature and solar irradiation are necessary; **if these environmental sensors are not available, the string efficiency cannot be calculated.**

Note: temperature and solar irradiation sensors used to calculate total efficiency must be configured like reference sensors.

Note: The calculated total string efficiency can exceed 100% under low solar irradiation condition, when low power is delivered by modules. The value higher than 100% must be understood like an error due to measure resolution or solar irradiation sensor position.

From the “EFFICIENCY” menu click on the “Single String” item; As soon as you access the page, the chart shows efficiency curves of all VMU-S string controls under the VMU-C PV (or under one of the VMU-M connected to it as shown in figure 35); curves can be identified by referring to the legend at the bottom. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press the “Apply” key.

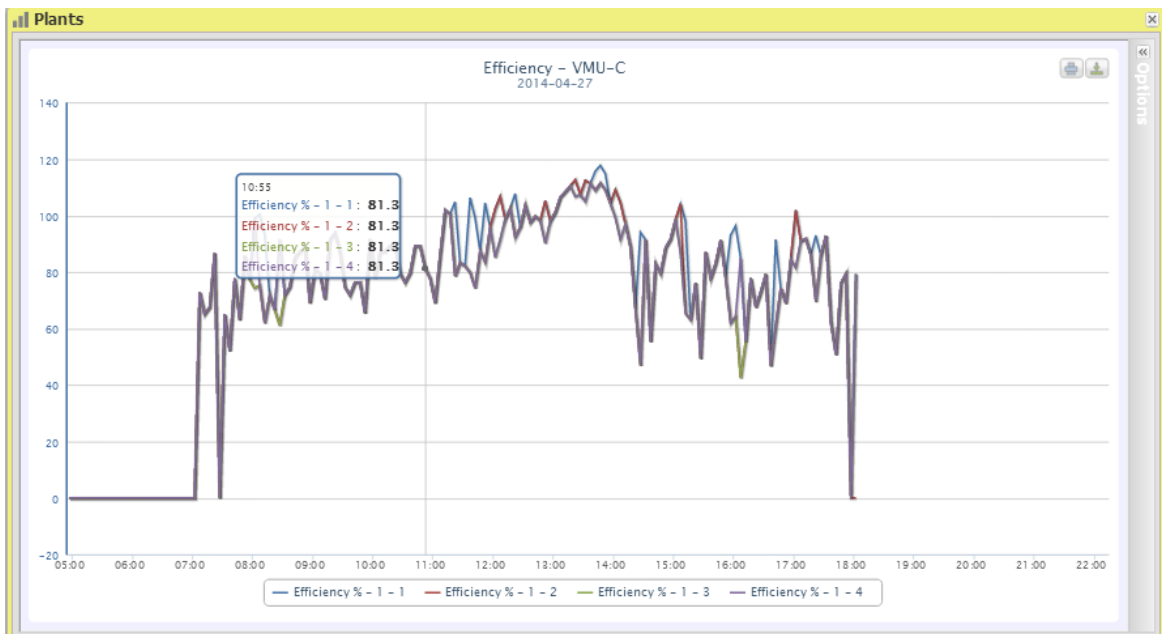


Figure 33: Plant Window; Efficiency Chart "Single string".

Note: The sampling frequency is fixed to 60 minutes and cannot be modified.

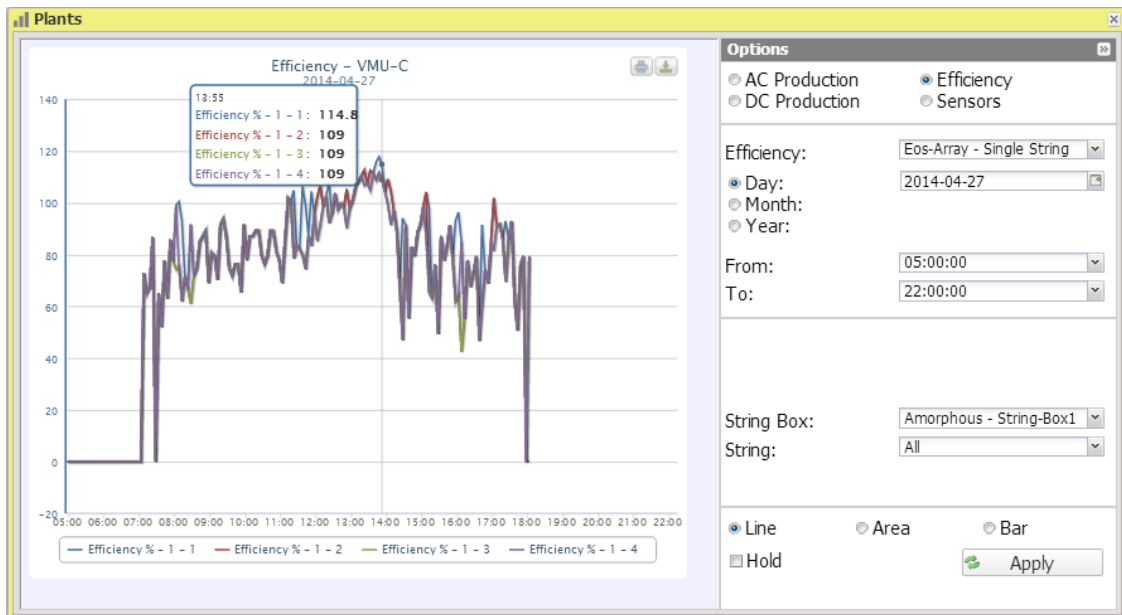


Figure 34: Plant Window; Efficiency Chart "Single String" - Options Panel.

Fig. 36 shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

To display the efficiency of a single string, follow the sequence below:

1. Selection of the VMU-C PV or of the relevant VMU-M

Through the special menu shown in Fig. 36, you can select the VMU-C PV or one of the VMU-M connected to the VMU-C PV for which you wish to conduct a more in-depth analysis. VMU-M must be selected to identify all VMU-Ss under it, to be monitored and compared.

2. Selection of date/month/year of display

Buttons to select the display interval are shown in Section A top side:

- Daily: it shows the daily trend of VMU-S efficiency on the selected day. (To choose the day use the special calendar)
- Monthly: it shows the average efficiency of the selected VMU-S, for each day of the selected month. (To choose the month and year use the special selection menus)
- Yearly: it shows the average efficiency of the chosen VMU-S, for every month of the selected year. (To choose the year use the special selection menu)

3. Searching for the VMU-S required

Through the “String module” menu shown in the figure, select the VMU-S module you are interested in.

The list contains the addresses on Eos-Array local bus, corresponding to the position of the VMU-S in the chain of the devices managed by the VMU-C PV or by one of the VMU-M connected to it.

Select the desired VMU-S → VMU-C PV will process the chart, which will be displayed on-screen after a few seconds.

Note: If the "VMU-S" list has no items, it means there is no VMU-S hierarchically under the VMU-C PV or under one of the VMU-M connected to it.

4. Select the desired graphic mode among the available ones: "Line, Area".

If you wish to display an other VMU-S among the available ones with the same criteria, click again on the “String” menu and select the desired item in the VMU-S list.

3.5.10 EFFICIENCY – INVERTER

The inverter efficiency **is not calculated by VMU-C PV** , but it's the VMU-C PV itself which expects **to receive this piece of data from the inverter**.

Note: Should the efficiency datum not be available, VMU-C PV will show a flat chart (with all the values set to “0”).

From the “EFFICIENCY” menu click on the “**Inverter**” item;

As soon as you access this page, the chart shows the efficiency curve of the individual inverters for the current day. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press the “Apply” key.

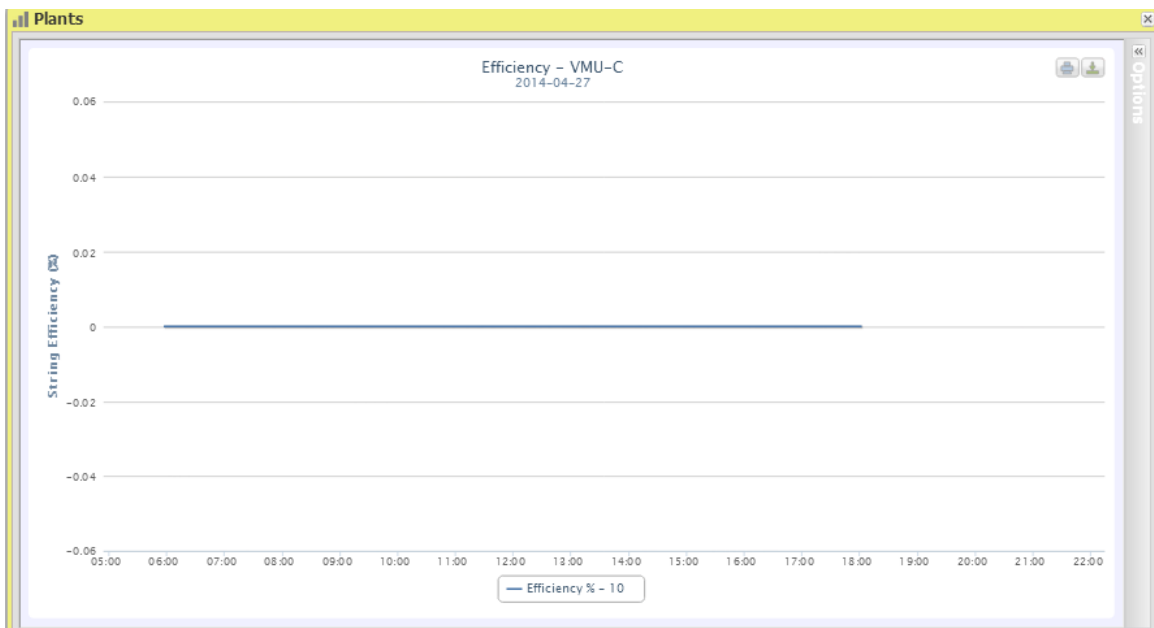


Figure 35: Plant Window; Efficiency Chart "Inverter".

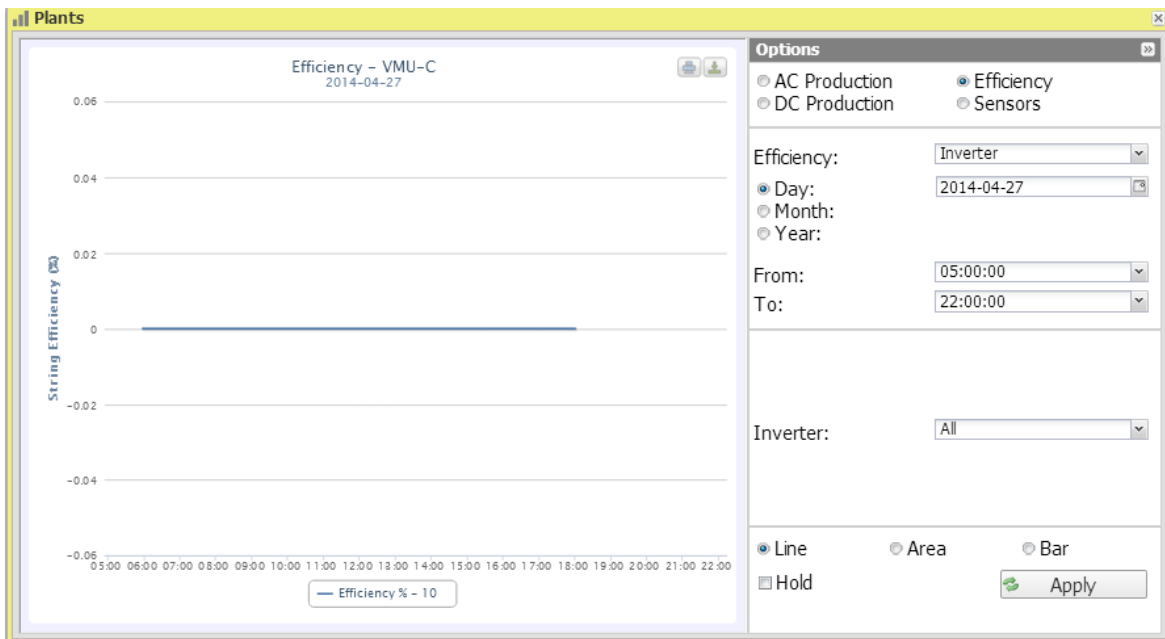


Figure 36: Plant Window; Efficiency Chart "Inverter" - Options Panel.

As you access the page, the chart displays the efficiency curves of all the inverters connected to the VMU-C PV. The curves can be identified through the bottom legend. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press the "Apply" key.

To display the efficiency of a single inverter, follow the sequence below:

1. *INVERTER selection*

Through the special menu shown in Fig. 38 - "**Inverter**" menu, you can select the individual Inverter whose efficiency you wish to analyse.

2. *Selection of date/month/year of display*

To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press "Refresh chart" key.

Buttons to select the display interval are shown in Section B top side:

- Daily: it shows the daily trend of chosen inverter efficiency on the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the efficiency of the selected inverter, for each day of the selected month. (To choose the month and year use the special selection menus next to the field)
- Yearly: it shows the efficiency of the chosen inverter, for every month of the selected year. (To choose the year use the special selection menu next to the field)

Note: if the "Inverter name" list is empty that means no inverter is configured in the VMU-C PV module.

3. Select the desired graphic mode among the available ones: "Line, Area".

Note: The chart is displayed automatically without having to click on the "Refresh Chart" button.

If you wish to display an other Inverter among the available ones, click again on the "Inverter Name" menu and select the desired item from the list.

Note: The chart sampling frequency depends on the storage interval set on VMU-C PV . It can be: 5,10,15,30,60 minutes.

3.5.11 EFFICIENCY – BOS

BOS (Balance of System) efficiency is calculated as the ratio between: the AC energy measured by the reference energy meter and the total DC energy produced by the photovoltaic field measured by the VMU-S string controls; obviously the two energies are measured in the same time interval.

BOS efficiency cannot be calculated without a reference energy meter.

Select BOS from the Efficiency menu.

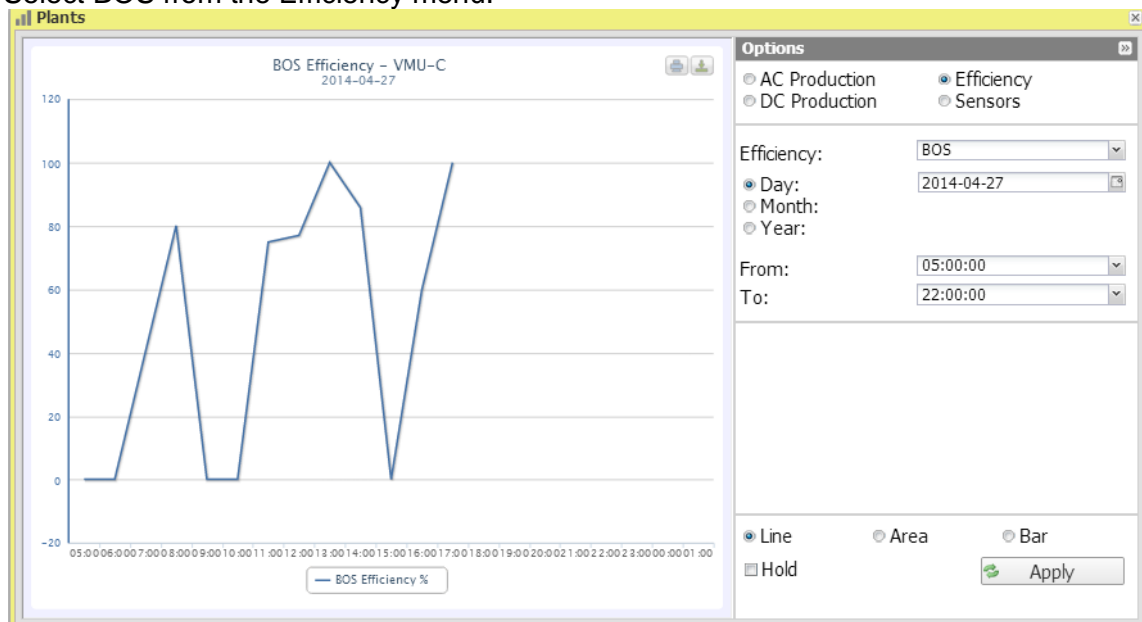


Figure 37: Plant Window; Efficiency Chart "BOSs".

As soon as you access this page, the chart shows the BOS efficiency curve for the current day. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press the "Apply" key.

In the top left of the chart there is a menu allowing to select the graphic display mode.

Note: Interval between samples in "daily" view is 60 minutes.

3.5.12 SENSORS – IRRADIANCE

The curve is only available if at least one solar irradiation sensor exists.

As soon as you access this page, the chart shows the solar irradiation in W/m^2 as measured by reference sensor, for the current day. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press the “Apply” key.

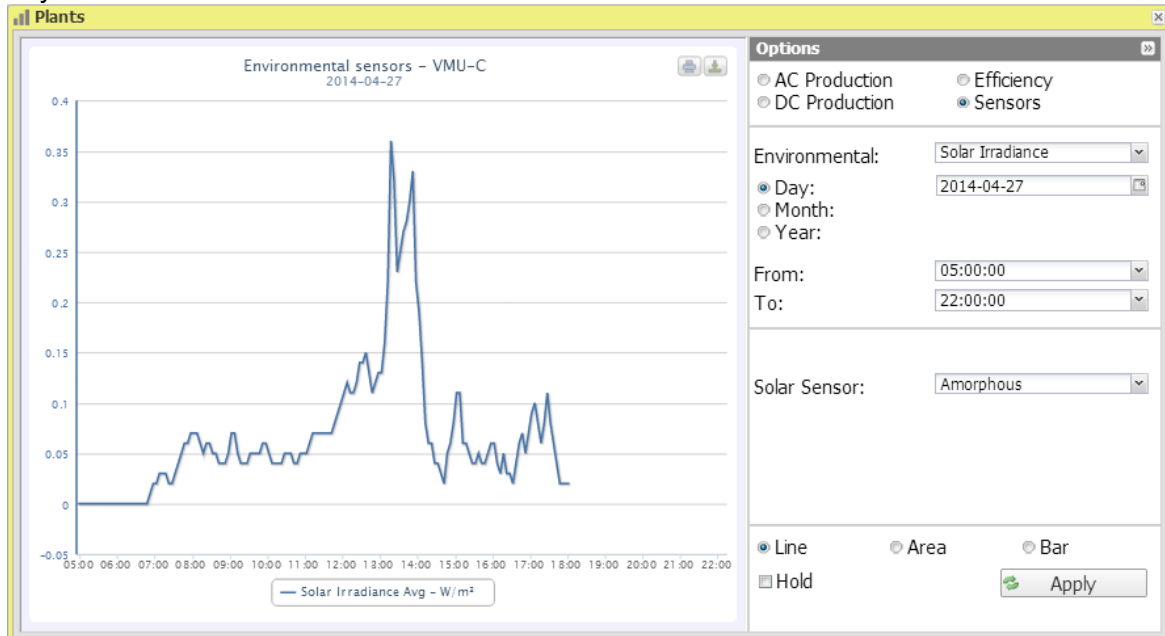


Figure 38: Plant Window; Sensors – Radiance, Options Panel.

Note: The time interval between a chart sample and the other one in "daily" display mode depends on storing time interval set up on VMU-C PV. It can be: 5,10,15,30,60 minutes.

Fig. 40 shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

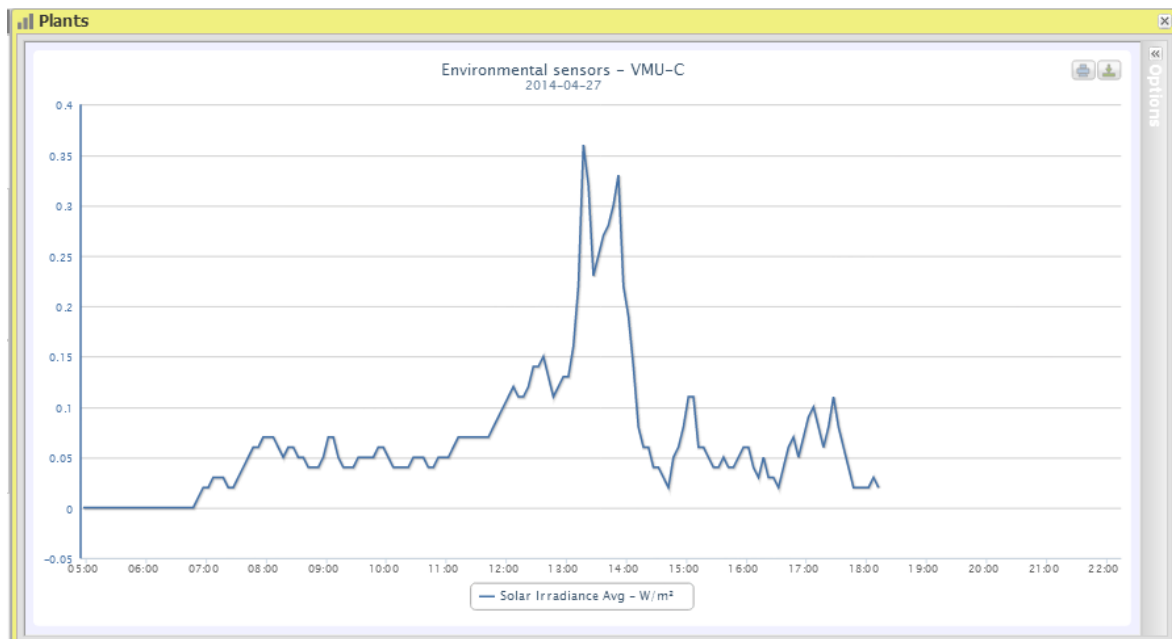


Figure 39: Plant Window; Sensor Chart "Irradiance".

Fig. 40 shows that you can change the VMU-C PV module area using the special “Solar Sensor” menu.

Note: Using this menu only makes sense when the data of a VMUC device are displayed; For plants, this menu will be blank, as data are aggregated.

3.5.13 SENSORS – TEMPERATURE

The curve is only available if at least one temperature sensor exists.

From the “SENSORS” menu click on the “TEMPERATURE” item.

As soon as you access this page, the chart shows the temperature in °C as measured by reference sensor, for the current day. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press “Refresh chart” key. On left-hand top side of the chart, a selection menu exists for graphic display mode (Line or Area).

Note: The time interval between a chart sample and the other one in "daily" display mode depends on storing time interval set up on VMU-C PV. It can be: 5,10,15,30,60 minutes.

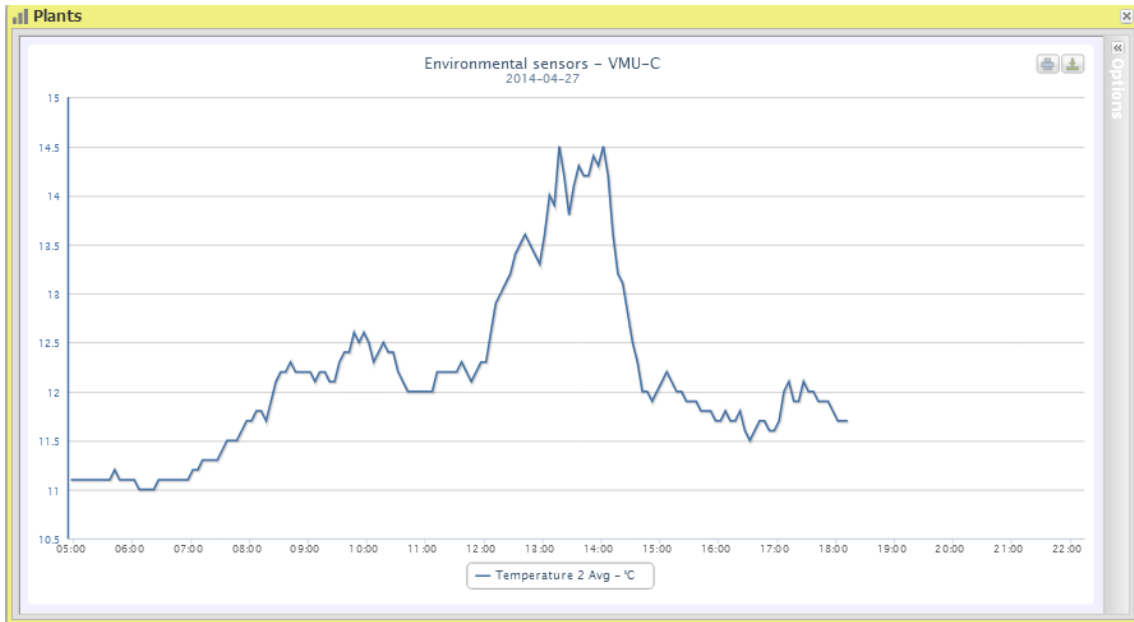


Figure 40: Plant Window; Sensor Chart "Temperature".

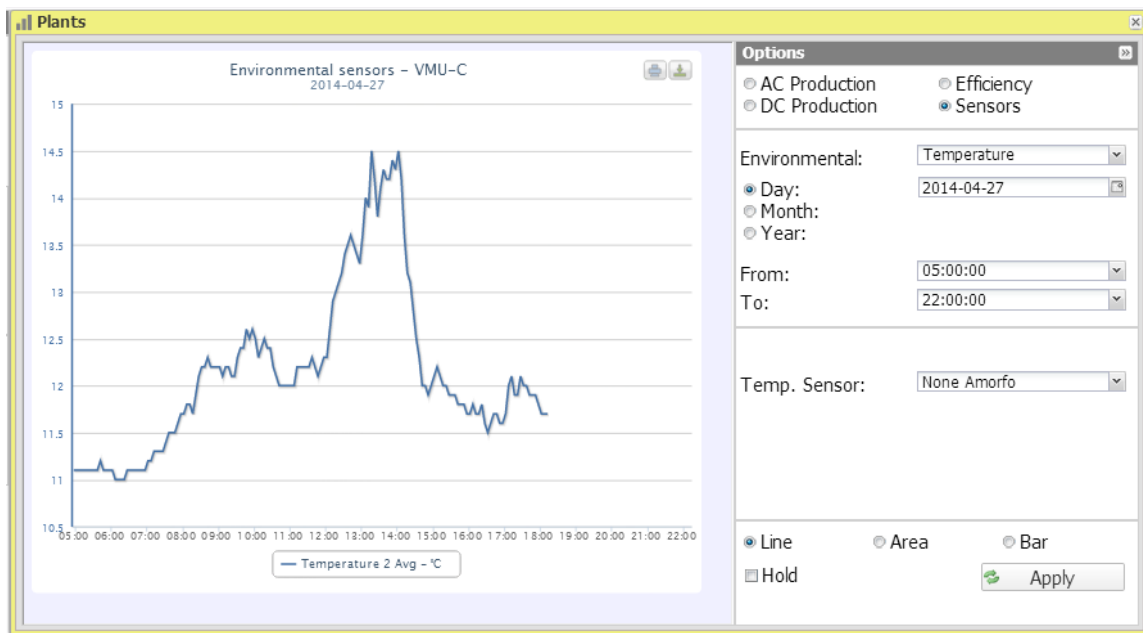


Figure 41: Plant Window; Sensor Chart "Temperature" - Options.

Fig.43 shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)

3.5.14 SENSORS – RADIANCE/TEMPERATURE/WIND

The curve is only available if at least one temperature sensor exists.

From the “SENSORS” menu click on the “RADIANCE/TEMPERATURE/WIND” item.

As soon as you access this page, the chart shows the curve representing the data as measured by reference sensor, for the current day. To select another date or a time interval such as monthly or yearly, use the dark grey section on top and press “Refresh chart” key.

In the top left of the chart there is a menu allowing to select the graphic display mode.

Note: The time interval between a chart sample and the other one in "daily" display mode depends on storing time interval set up on VMU-C PV. It can be: 5,10,15,30,60 minutes.

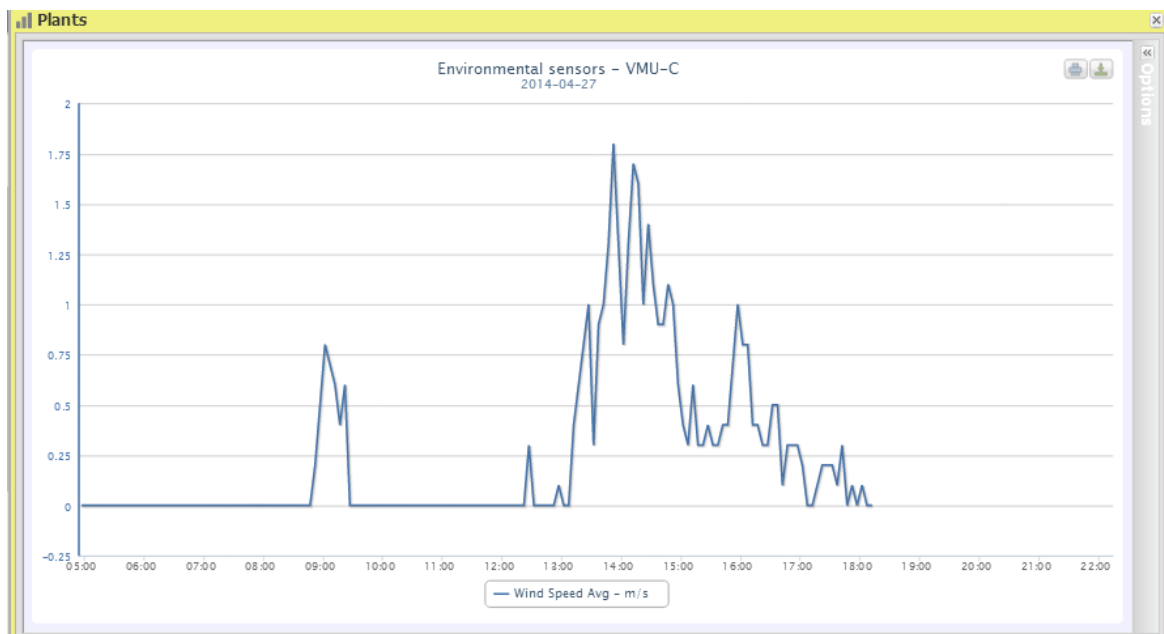


Figure 42: Plant Window; Sensor Chart "Wind".

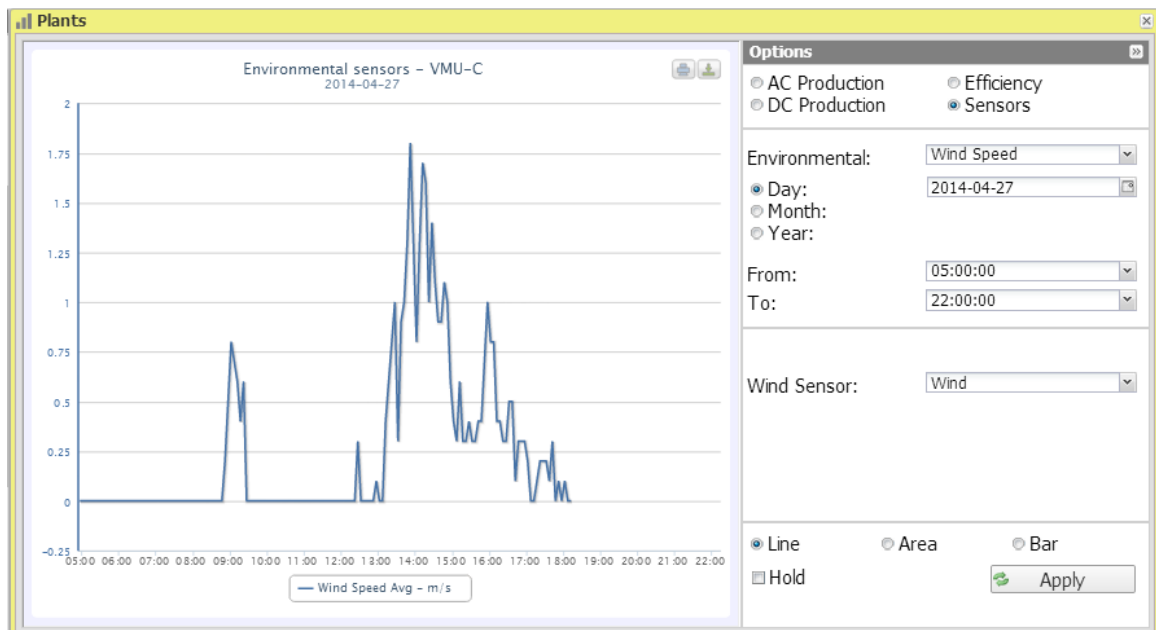


Figure 43: Plant Window; Sensor Chart "Wind" - Options.

The figure shows the buttons allowing to select the display range:

- Daily: it shows the daily trend of the selected electrical dimension, in the selected day. (To choose the day use the special calendar which can be accessed through the button next to the date field)
- Monthly: it shows the monthly data. (To choose the month and year use the special selection menus)
- Yearly: it shows the yearly data. (To choose the year use the special selection menu)


Note: the user shall be responsible for ensuring that the engineering units defined during configuration in the VMU-C PV match the ones defined at user level in Eos-Server. Eos-Server doesn't perform any automatic conversion and any inconsistencies might result in errors in calculations or in data interpretation

3.5.15 ZOOM FUNCTION

The Zoom function is available in any chart display page; it allows to magnify a given area of the chart, to analyse in greater detail the displayed data.

The ZOOM function is fast and instantaneous. The following is the sequence of the operations to be performed:

The following is a sample chart, which the user wishes to analyse in greater detail. The user, in particular, wishes to analyse the area framed in orange:

Move the pointer “” to point “A”, then using the mouse (holding the left button pressed) drag the pointer to point “B” (Fig. 46).

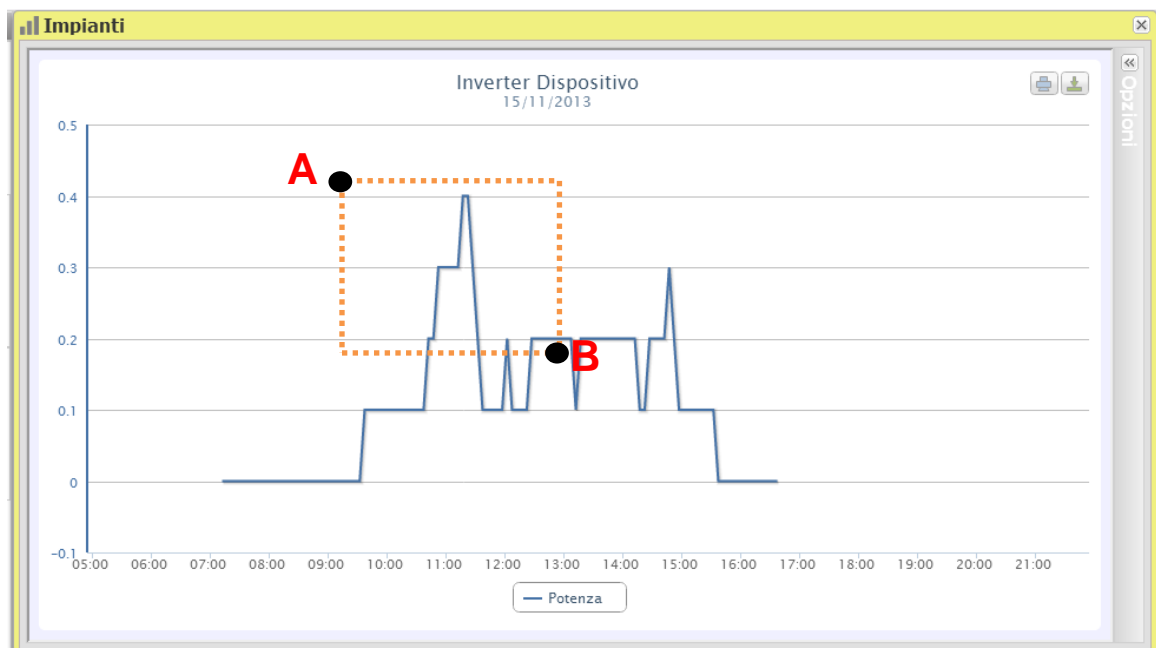


Figure 44: Zoom function

As soon as the left mouse button is released, the zoomed area will be immediately highlighted (Fig. 47) and you'll be able to analyse in greater detail the chart trend in the highlighted section

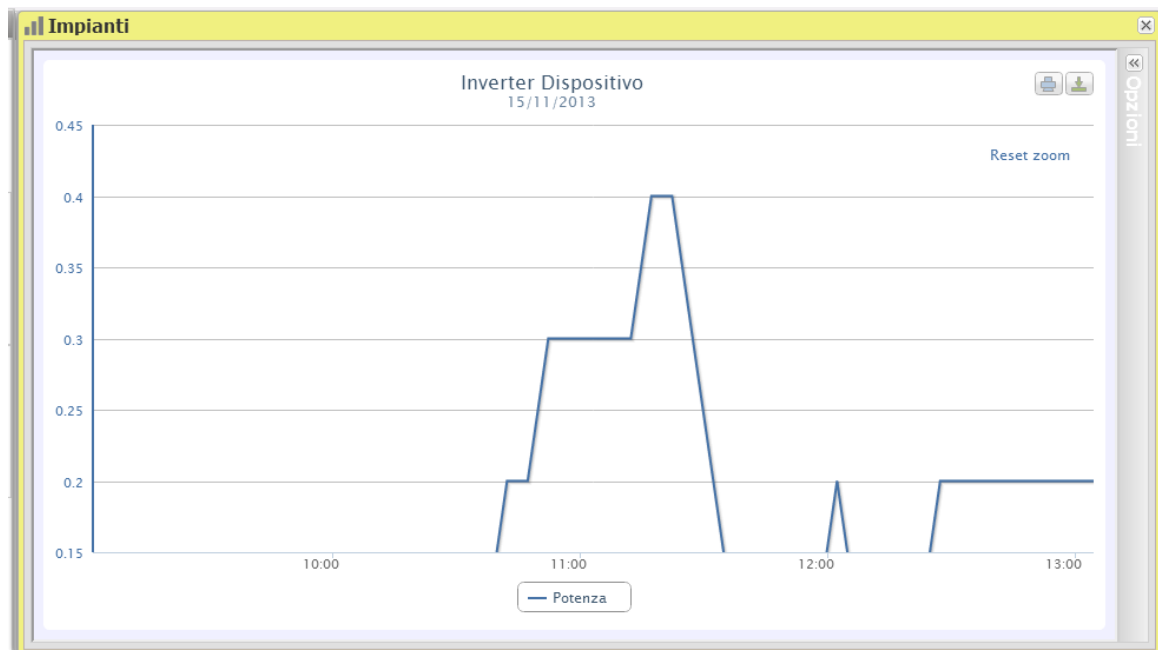


Figure 45: Zoomed area

The zoom function is available for all chart formats, whether histograms or areas.

3.6 STRINGBOX

The String-Box function must be used to monitor the behaviour of the Eos-Arrays. Each frame of this view represents an 'Eos-Array'. Typically Eos-Arrays and String-boxes are in a 1/1 ratio; should that not be the case, and should the same string-box contain multiple Eos-Arrays, this view will still be intrinsically linked to the individual Eos-Arrays. In the text below, will assume that Eos-Arrays and string-boxes are in a 1/1 ratio and we'll use either term interchangeably to indicate the minimum monitored unit.

This section allows to simultaneously monitor all the string boxes, while providing a global overview of the plant's instant production, of environmental conditions and of any active alarms.

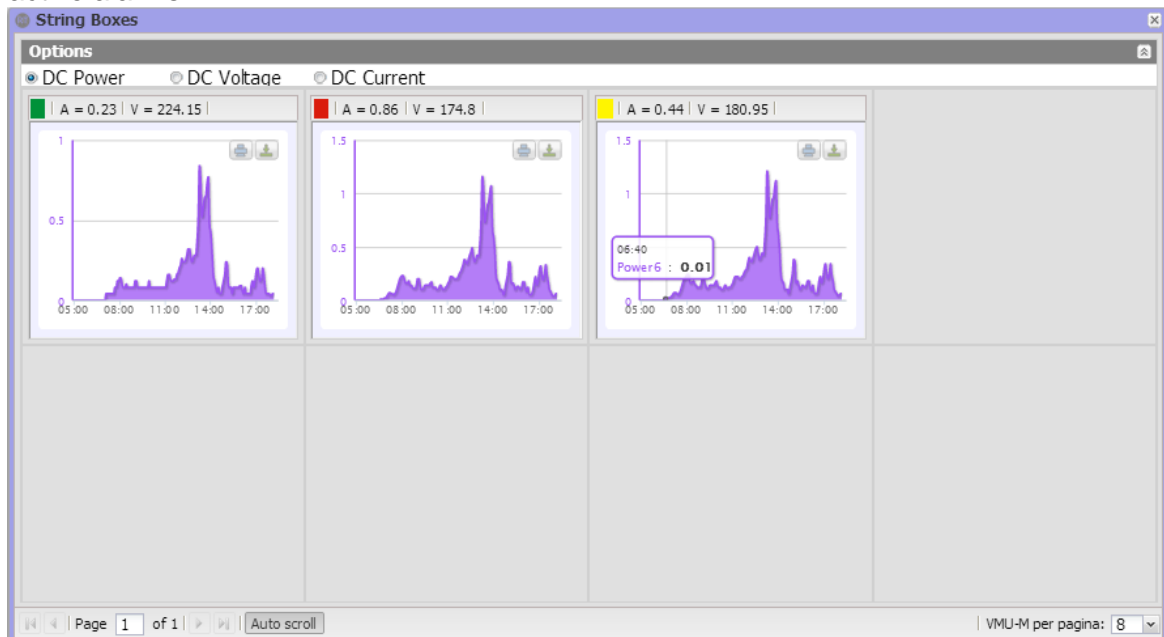


Figure 46: Real Time StringBox.

This area displays the information read from the string boxes, divided into individual frames, in both chart and table form, as shown in the figure.

When opening the control panel, the system automatically loads up to 8 string boxes, which are displayed on a single page. If the total number of boxes existing in the plant exceeds 8, the system creates multiple pages (each containing at most 8 frames), in which it automatically loads the data of the remaining string boxes, until completing the display of each installed box. This number can be increased to 12 using the selection menu in the bottom right (Fig. 48).

To browse the different pages you can use the selection bar located to the bottom left of the String Boxes area, shown in figure 48.

Page scrolling can be:

- *Manual*: each page is selected by just clicking on the right and left arrows or entering the page number in the corresponding box (you need to deselect the “Scroll automatically” button).

- *Automatic*: pages are scrolled automatically after pressing the “Scroll automatically” button located to the right of the page numbers.

The individual area of each string box provides the following information:

Eos-Server

- A coloured square showing any alarm existing on the string box
- DC parallel voltage (V)
- Total generated DC current (A)
- Total generated DC power (kW)
- String box name

Note: while charts are being loaded, no other operation can be executed. Wait until chart loading is complete before issuing a new selection command.

In the top section of the page you can choose whether you wish to display:

- DC parallel voltage (V)
- Total generated DC current (A)
- Total generated DC power (kW)

Hovering the mouse inside the chart will display a window, allowing to read the value of the variable associated with a specific point of the chart. If you left-click inside the chart area, then drag the mouse while holding the left button pressed to select a part of the chart, it will be automatically zoomed. You can cancel zooming by clicking on the “reset zoom” caption, which will be displayed along with the zoom.

3.7 INVERTERS

This section allows to simultaneously monitor all the inverters, while providing a global overview of the plant's instant production and of any active alarms.

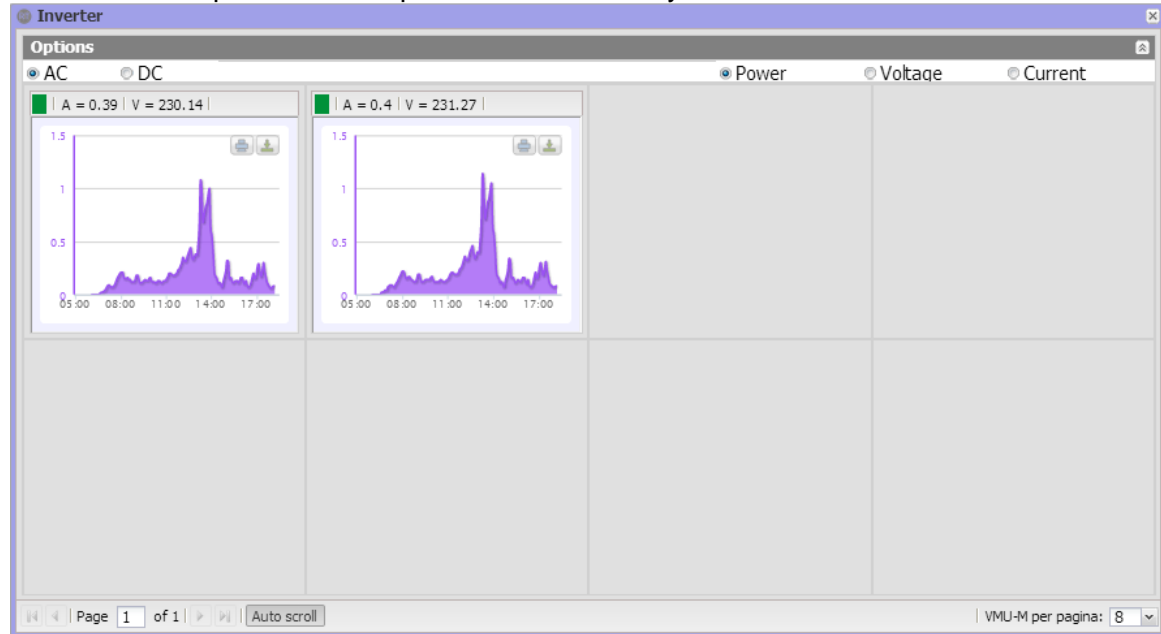


Figure 47: Real Time Inverter.

This area displays the information read from the inverters, divided into individual frames, in both chart and table form, as shown in figure 49.

When opening the control panel, the system automatically loads up to 8 inverters, which are displayed on a single page. If the total number of inverters existing in the plant exceeds 8, the system creates multiple pages (each containing at most 8 frames), in which it automatically loads the data of the remaining inverters, until completing the display of each installed inverter. This number can be increased to 12 using the selection menu in the bottom right.

To browse the different pages you can use the selection bar located to the bottom left of the Inverters area, shown in figure .

Page scrolling can be:

– *Manual*: each page is selected by just clicking on the right and left arrows or entering the page number in the corresponding box (you need to deselect the “Scroll automatically” button).

Automatic: pages are scrolled automatically after pressing the “Scroll automatically” button located to the right of the page numbers.

The individual area of each string box provides the following information:

- A coloured square showing any alarm existing on the inverter
- DC parallel voltage (V)
- Total generated DC current (A)
- Total generated DC power (kW)
- String box name

Note: while charts are being loaded, no other operation can be executed. Wait until chart loading is complete before issuing a new selection command.

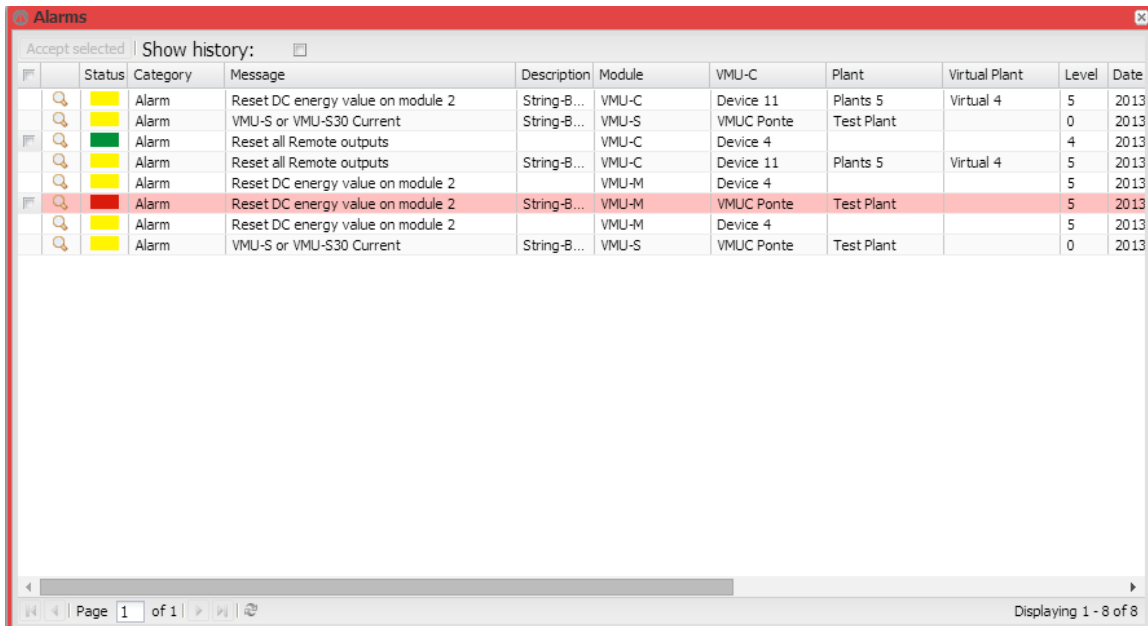
In the top section of the page you can choose whether you wish to display:

- DC parallel voltage (V)
- Total generated DC current (A)
- Total generated DC power (kW)

Hovering the mouse inside the chart will display a window, allowing to read the value of the variable associated with a specific point of the chart. If you left-click inside the chart area, then drag the mouse while holding the left button pressed to select a part of the chart, it will be automatically zoomed. You can cancel zooming by clicking on the “reset zoom” caption, which will be displayed along with the zoom.

3.8 ALARMS

This section is dedicated to alarm management and display occurred on a system.



	Status	Category	Message	Description	Module	VMU-C	Plant	Virtual Plant	Level	Date
	Yellow	Alarm	Reset DC energy value on module 2	String-B...	VMU-C	Device 11	Plants 5	Virtual 4	5	2013
	Yellow	Alarm	VMU-S or VMU-S30 Current	String-B...	VMU-S	VMUC Ponte	Test Plant		0	2013
	Green	Alarm	Reset all Remote outputs		VMU-C	Device 4			4	2013
	Yellow	Alarm	Reset all Remote outputs	String-B...	VMU-C	Device 11	Plants 5	Virtual 4	5	2013
	Yellow	Alarm	Reset DC energy value on module 2		VMU-M	Device 4			5	2013
	Red	Alarm	Reset DC energy value on module 2	String-B...	VMU-M	VMUC Ponte	Test Plant		5	2013
	Yellow	Alarm	Reset DC energy value on module 2		VMU-M	Device 4			5	2013
	Yellow	Alarm	VMU-S or VMU-S30 Current	String-B...	VMU-S	VMUC Ponte	Test Plant		0	2013

Figure 48: Alarm page.

Note: alarm classification cannot be changed by user.

This table shows the list of alarms stored in VMU-C PV in chronological order from the most recent.

- Fields of Alarms table

The Alarms table shows the following fields:

1. Magnifying glass icon: If clicked, this icon allows to put into context all the displays on the device associated with the alarm in question.
2. "Message": Alarm description.
3. "Description": Name/Label assigned to the device during configuration.
4. "Module": Address of the primary device (VMU-C PV or relevant VMU-M) and position of the secondary device (VMU-S or VMU-P or VMU-O) which raised the alarm in the Eos-Array chain.
5. Device: Name of the alarm source device
6. Plant: Name of the alarm source plant
7. Virtual Plant: Name of the alarm source virtual plan
8. Level: A value indicating the alarm level
9. "Date": Date on which the alarm occurred.
10. "Resolved on": Date on which the alarm finished. If alarm still exists, the field is blank.

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11. "Area": Indication of the alarm source area (if specified).
12. Acknowledged on: Date on which the alarm was acknowledged by the user.
13. Acknowledged by: User who acknowledged the alarm.

Note: this view is not linked to the context defined by the navigator and shows all the managed alarms existing in the overall plant portfolio.

3.9 ECONOMIC ANALYSIS

This section is dedicated to the economic analysis of photovoltaic system. Economic countervales of sold and saved energy are calculated, together with any incentives. Using a simple three-value classification you can easily manage many different business models, as far as their base definition is concerned; more complex analyses involving tax-related issues which are specific to the business model or to the country must be managed using dedicated systems and are outside the Eos-Server scope.

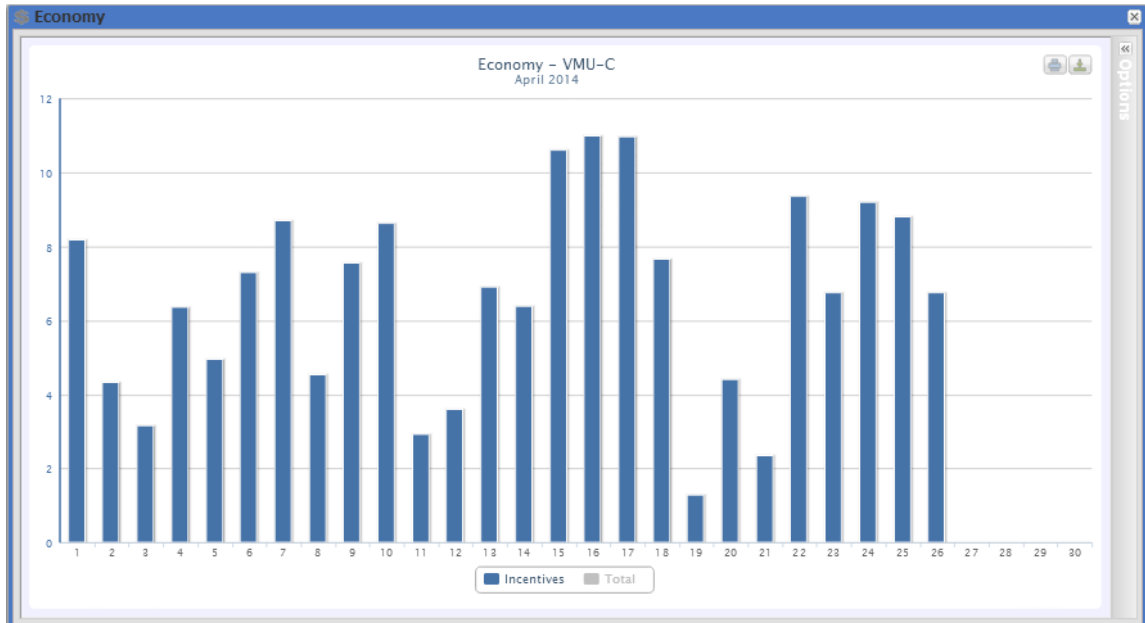


Figure 49: Economy Page – Sample Incentives.

To select another month or a yearly time interval, use the dark grey section on top and press on the “Apply” key.

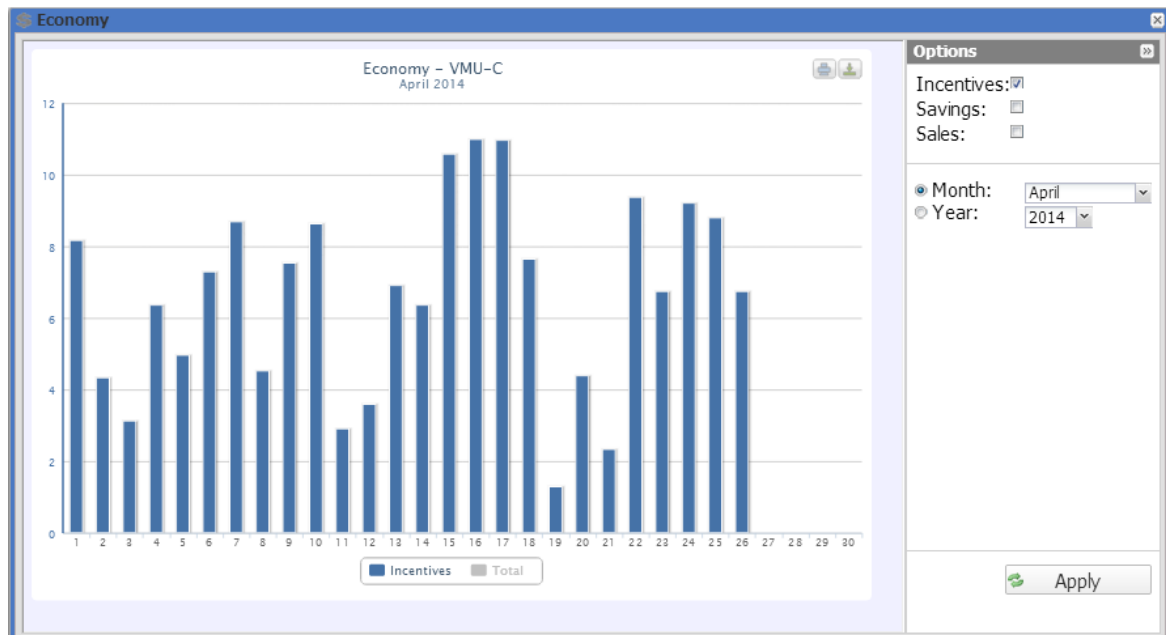


Figure 50: Economy Page –Options Panel.

You can choose between:

1. “*Incentive (...€)*”: Click on “*Incentive*” to automatically view the chart with economic countervalues obtained from incentives. Values specified are calculated and stored by the system every day at 11:59 p.m., considering the amount paid for each kWh (set up in “Economic data” section in system data configuration and total value of energy produced during the day in kWh).
2. “*Savings on bill (... €)*”: Click to automatically view the chart with economic countervalues obtained from energy not purchased but self-produced. Values specified are calculated and stored by the system every day at 11:59 p.m., considering the "Price per kWh of energy purchased", set up in “Economic data” and total value of energy produced during the day in kWh.
3. “*Sales (...€)*”: Click to automatically view the chart with economic countervalues obtained from energy sales. Values specified are calculated and stored by the system every day at 11:59 p.m., considering the "AMOUNT paid for each kWh sold", set up in “Economic data” and total value of energy produced during the day in kWh.
4. The system will automatically display in the chart the “Total” series, representing the total of the three values. The series is initially disabled; you can enable it by just clicking on the series name.

The following is a sample economic chart with all three series enabled.

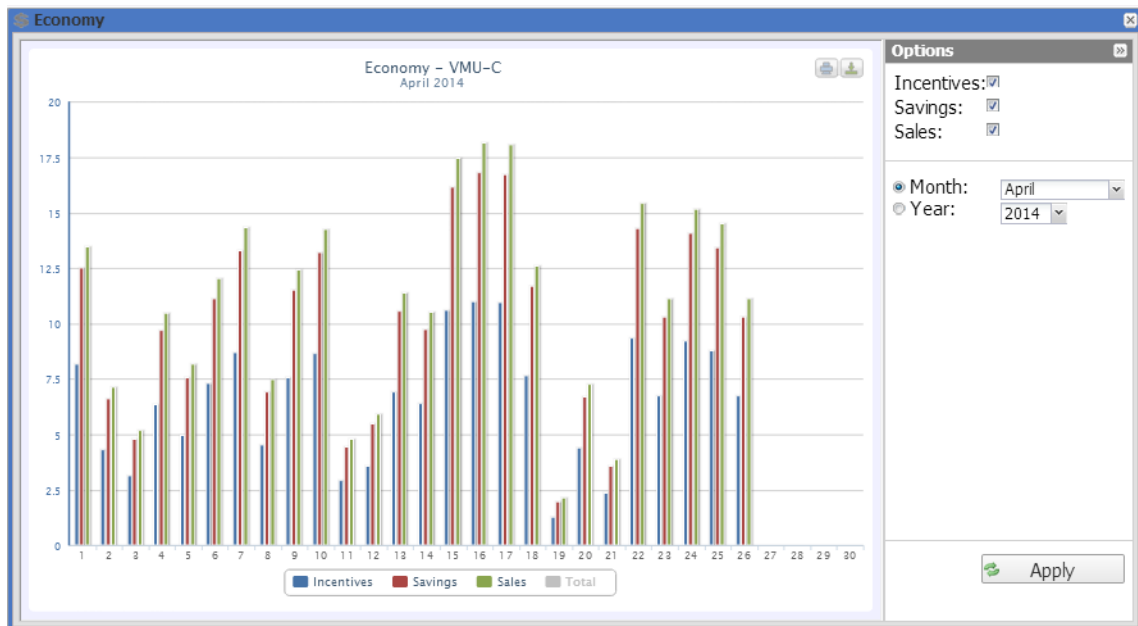


Figure 51: Economy Page – All three series enabled except for the total.

If the time interval selected is "Yearly" type, values shown are calculated at the end of each month like the addition of all relevant daily values.

Note: Total daily energy produced (kWh) is considered in calculations. Data can come from the reference external energy meter or from the Inverters, if no energy meter exists.

3.10 INFORMATION

This section shows the data and characteristics of the monitored photovoltaic system, whether it is a physical plant, a virtual plant or a VMUC.

Description		Monthly Planned Yield index (kWh/kWp)	
Plant Name	VMU-C 115	January	45
Plant Location	Ponte nelle Alpi (BL) ITALIA	February	60
Plant Property	Carlo Gavazzi S.p.A.	March	70
Installer	Carlo Gavazzi S.p.A.	April	80
PV Modules Installation Date	2011-01-01 01:00:00	May	90
VMU-C Installation Date	2011-01-01 01:00:00	June	100
Technical Data		July	110
Plant Type	Fixed	August	120
PV Modules Total Area	70.8 m ²	September	110
Number of Inverters	2	October	100
Number of Strings	8	November	80
Peak power of Plant	8.88 kW	December	40
Financial Highlights		Annual Yield Corrective Factor	5%
Feed-in Tariff	Own	Yearly Expected Yield	854.25 kWh/kWp
Incentives	0.228 €/kWh		
Costs	0.15 €/kWh		
% Sold Energy	0%		
Sale	0 €/kWh		

Figure 52: Information Page.

This page consists of four sections:

1. *“Description”*: Plant characteristics are specified here.
2. *“Technical data”*: Technical data of photovoltaic plant is specified here.
3. *“Financial highlights”*: Economic values are specified here.
4. *“Monthly energy production index estimated during the design stage (kWh/kWp)”*: It indicates the expected monthly production index for the current year. This calculation takes into account the *“decay”* index set in the configuration page. The *“Expected energy for the year”* line also includes the value resulting from the sum of the production index of each individual month.

3.11 EXPORT

This section allows exporting data stored in the Eos-Server database in XLS format or through a chart.

Data mining can be configured in detail, down to the individual database field; for this reason the appendix to this manual includes a section showing the full database structure, for user reference.

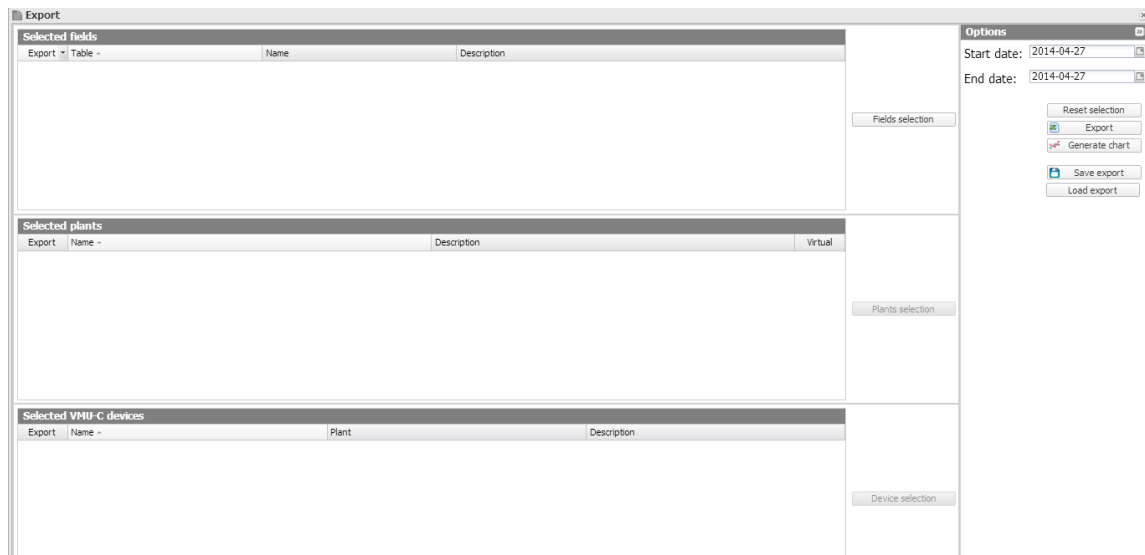


Figure 53: Export Page.

The main page of the “Export” menu includes 4 main frames:

- Field Selection: This frame allows to quickly see the fields selected for export; the “Select fields” button on the right allows to select them.
- Plant Selection: This frame allows to quickly see the selected plants; the “Select plants” button on the right allows to select them. Only if a field of a “Plant” or “Virtual plant” table is selected shall the selection of one or more reference plants be enabled.
- Device Selection: This frame allows to quickly see the selected VMU-C PV devices. The “Select Devices” button on the right allows to select them. Only if a field of a “Devices” table is selected shall the selection of one or more reference plants be enabled.
- Options: In this frame you can select the starting date and the end date for export, restore the default value for all the selections, export data in Excel format and generate the corresponding chart.

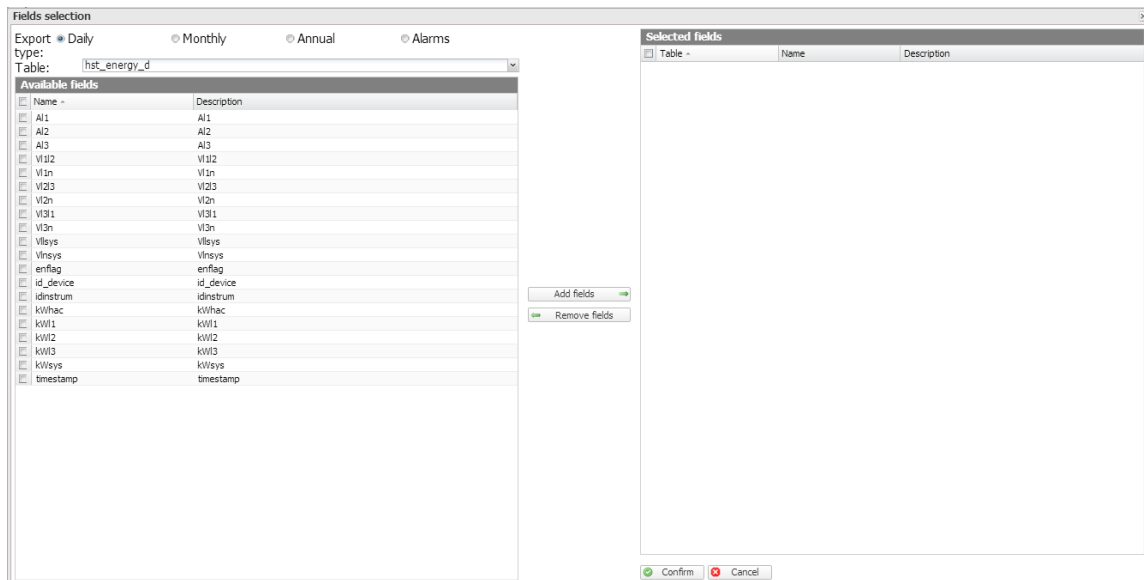


Figure 54: Export Page – Select Fields to be exported.

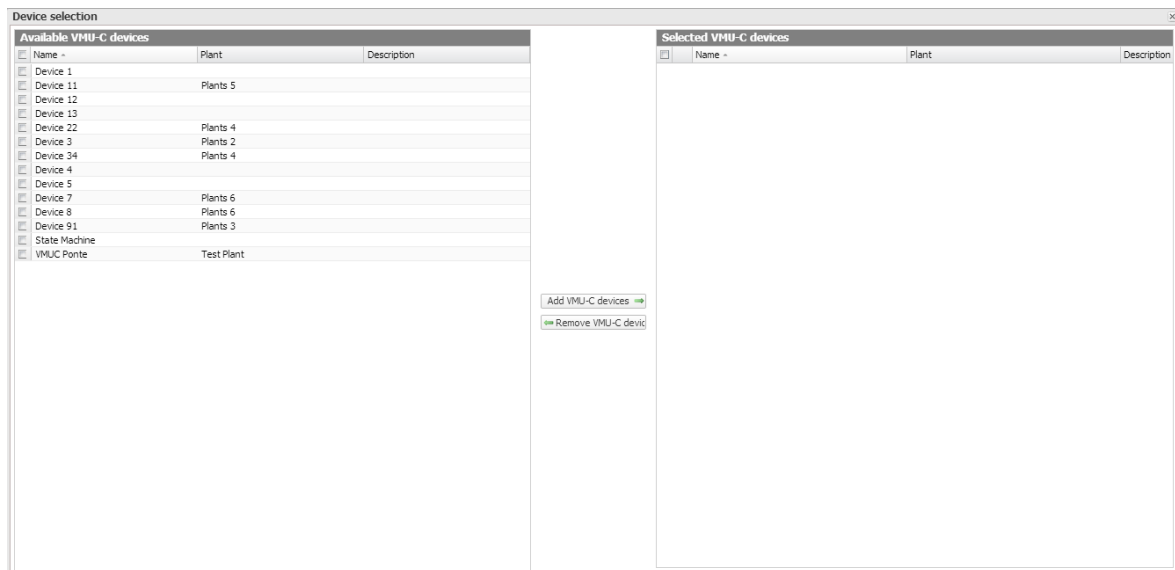


Figure 55: Export Page – Select Devices.

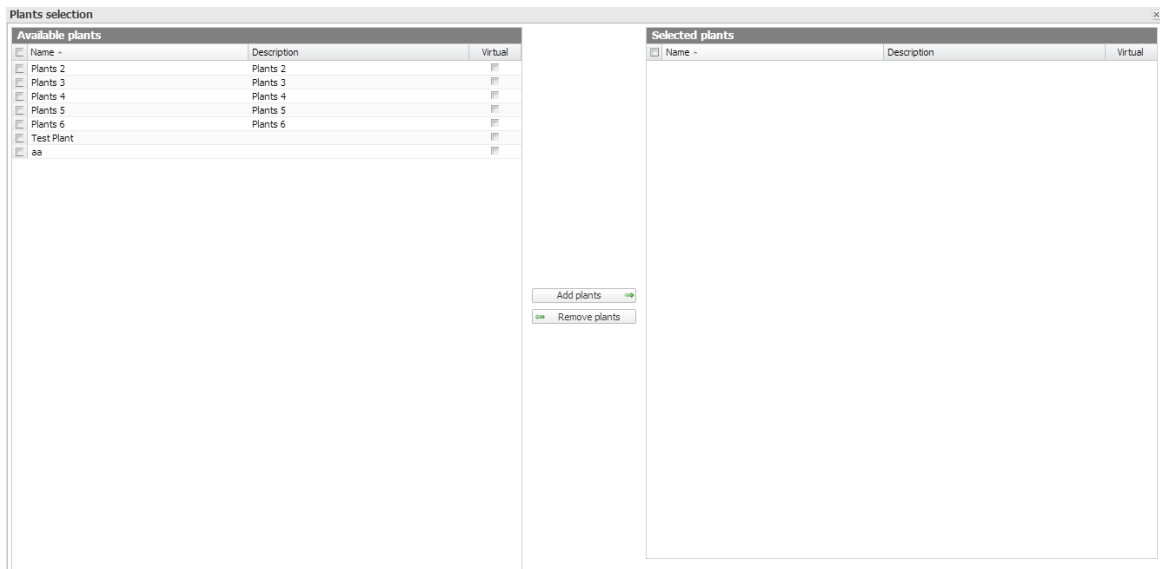


Figure 56: Export Page – Select Plants.

4 CONFIGURATION

4.1 OBJECT HIERARCHY IN EOS-SERVER

Eos-Server manages 3 hierarchy levels (which can be displayed in the navigator):

1. VMU-C PV
2. Physical plant (an aggregate of one or more VMU-C PV)
3. Virtual plant (an aggregate of one or more physical plants)

While the VMU-C PV elements are generated automatically during the activation of the link between VMU-C PV and Eos-Server, and thus depend on the field configuration of each individual VMU-C PV, the “Plant” type aggregations are to be defined inside Eos-Server; once they are defined, the system will univocally and automatically define the lower level element data aggregation rules followed to build the aggregate data.

Some restrictions to the deletion and modification of the plants once they have been created are defined in the paragraphs below, to preserve the database consistency.

4.2 PHYSICAL PLANT

4.2.1 CREATE PLANT

Figure 57: New Physical Plant Page.

The “**Create plant**” section (see the dotted area “A”) allows to enter the general plant data, for easier plant management.

The “**Technical data**” section (see the dotted area “B”) displays the most technical data (surface, amount of inverters and strings, plant rated power). These data cannot be edited;

the relevant fields are populated by the software referring to the system configuration data (see chapters "Area configuration" and "VMU-S module configuration"). "Total area of PV modules" indicates the product between the surface of each photovoltaic module and the total number of modules installed in the system.

In the "**Economic Data**" section (see dotted area "C") you can define the "*Self-consumption*" or "*Sale*" management mode, appropriately selecting the 4 existing parameters "Incentive", "Costs", "% of sold energy", "*Sale In particular: % of sold energy*" (in case of partial sale) ranges between 0 and 100%, and shall be used to correct the economic countervalue obtained from Energy Sale. The above parameters may be defined by date, to manage periodically changing business models (e.g.: incentive tariffs depending on the year). By default production data are acquired from the energy meters and displayed as the sum of the individual values. The selection affects the subsequent calculation of economic counter-values, the data shown in "LH frame" and "RH frame" and the total efficiency calculated.

Press "Save setting" to store data.

Note: All decimal numbers must be separated by a point.

4.2.2 EDIT PLANT

All the fields are identical to those described for the "Create Plant" menu. In the top right section of the page the "Plant" drop-down menu allows to select the plant to be edited.

Clicking on the "Save Settings" button allows to save the edited settings.

4.2.3 DEVICES

This page allows to associate a VMUC device with a physical plant. The list of the available devices is displayed in the left section of the page, while the list of the associated devices is displayed in the right section.

To preserve the database consistency, once any devices have been added to a plant the plant association can no longer be altered.

Once the plant setting is completed click on the Save button to save the changes.

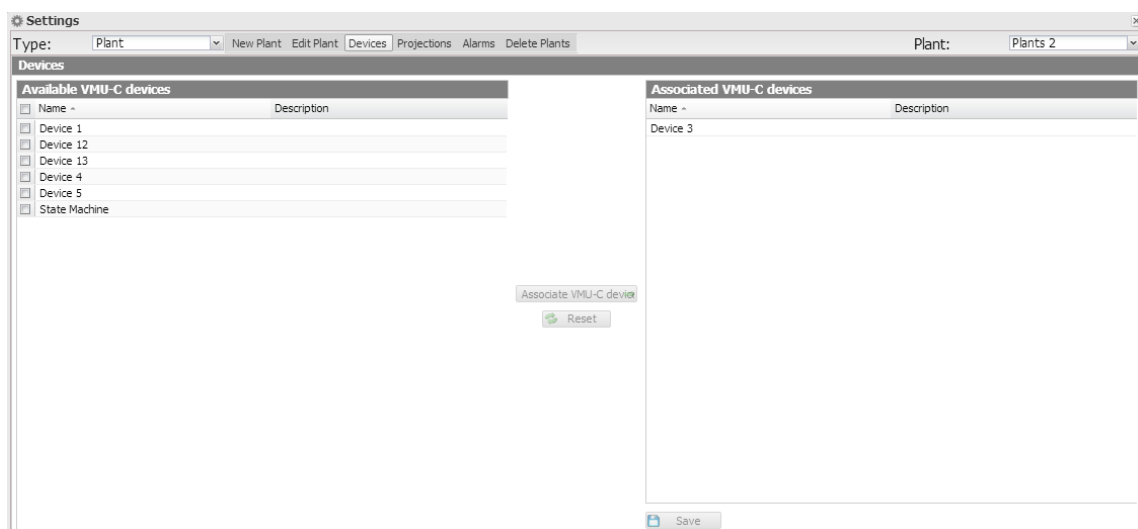


Figure 58: Devices Page.

Note A VMUC module can be associated with ONE and only ONE physical plant.

4.2.4 PROJECTIONS

In this configuration page the user shall specify the “YIELD” (kWh/kWp) data expected of the plant in question for each month. He shall also indicate the “Annual Decay Factor” of installed panel performance. VMU-C PV will automatically calculate the “Correct Annual Value”, which will take into account the installed value and the decay due to panel ageing, for each month. VMU-C PV will also automatically provide the “Expected Energy for the current year”.

The screenshot shows a web interface titled 'Settings' with a navigation menu including 'Plant', 'New Plant', 'Edit Plant', 'Devices', 'Projections', 'Alarms', and 'Delete Plants'. The current page is 'Projections' for a plant named 'Test Plant'. The main section is titled 'Monthly Planned Yield index (kWh/kWp)' and includes a 'PV Modules Installation Date' field set to '2013-01-01'. Below this is a table with the following data:

	First Installation Value	Annual Corrected Value		First Installation Value	Annual Corrected Value
January (kWh/kWp)	45	42.75	July (kWh/kWp)	110	104.5
February (kWh/kWp)	60	57	August (kWh/kWp)	120	114
March (kWh/kWp)	70	66.5	September (kWh/kWp)	110	104.5
April (kWh/kWp)	80	76	October (kWh/kWp)	100	95
May (kWh/kWp)	90	85.5	November (kWh/kWp)	80	76
June (kWh/kWp)	100	95	December (kWh/kWp)	40	38

Below the table, there are two summary rows:

Annual Yield Corrective Factor (undefined)	5	Expected Energy on Current Year (kWh/kWp)	1005
--	---	---	------

At the bottom of the form, there are two buttons: 'Update Projections' and 'Save Settings'.

Figure 59: Projections Page.

Parameters may be edited; if you wish to return to the pre-calculated values just click on “Refresh forecasts”: data shall be recalculated by summing the values of the forecasts for the devices associated with the plant.

4.2.5 ALARMS

Figure 60: Alarms Page.

Eos-Server can send alarm email-s or SMS to multiple receivers at the same time and according to pre-set rules. This page contains two separate configuration screens, in order to create two separate users groups to send communications to. The “Send for” selection field allows to filter the type of alarm messages to be sent to the relevant receivers.

Fill in the fields in both screens according to the following specifications:

“*Receivers' addresses*”: E-mail addresses of receivers the alarm messages are sent to.

Note: You may specify multiple addresses; in that case addresses must be separated by a semicolon (;) without any space.

“*Re*”: Subject of email to be sent. (Ex. *Alarm from FV Plant*).

“*Action*”:

- “*Send email*”: Check to enable email sending.

Note: To be able to send any mails, the outgoing mail server must be appropriately configured in the system.

- “*Test Mail*”: Press this key to receive a test email at the email addresses specified in “*Receivers' addresses*” field.

Note: If the e-mail is not received, check outgoing mail server settings, receiver's address, VMU-C PV reachability from Internet.

“*Send for*”: Selections allow to select and filter the alarm type the e-mail and/or the SMS is to be sent for. If not sent, the event is anyway stored and visible on monitor from Alarms list. Details of alarm types:

Eos-Server

- “Alarms”: High-priority alarms.
- “Warning”: Low-Medium priority alarms.
- “Events”: Opening/Closing of digital inputs and outputs
- “Commands”: Variation of parameters on Eos-Array

For further details on alarm types, refer to “Alarm display” paragraph.
Press “Save setting” key to store settings.

*You can configure both the individual VMU-C PV , both the Eos-Servers for alarm sending by e-mail. The choice depends on the constraints and structure of the application.
To send the alarms by SMS you will have to specifically configure the VMU-C PV along with the VMU-W modem*

4.2.6 DELETE PLANTS

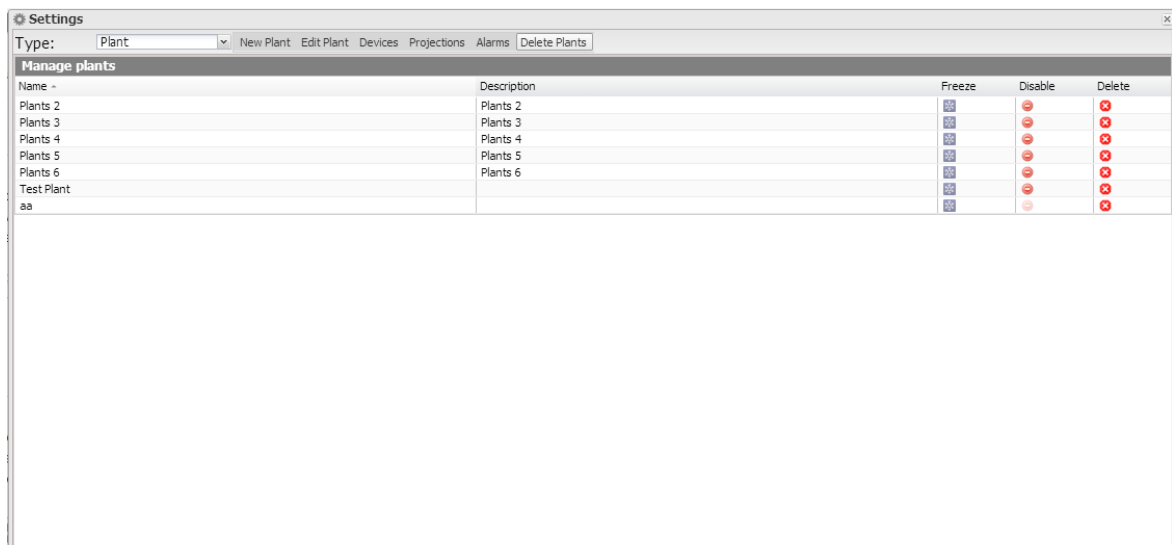


Figure 61: Delete Plants Page.

This page allows to perform some operations on the plants, like:

- Freezing a plant
- Disabling a plant
- Deleting a plant

Freezing a plant just means switching the selected plant to stand-by mode. Plant data will be displayed until the freezing date. The operation is reversible. The association with the VMU-C PV devices belonging to the plant is not removed.

Disabling a plant means deleting the plant structure, freeing all the VMU-C PV associated with it. Once the operation is completed, aggregated plant data will be

Eos-Server

available; the data of the individual VMU-C PV initially belonging to the plant, instead, will no longer be available. The operation is not reversible.

Deleting a plant results in the full deletion of the plant and of all associated data. The operation is not reversible.

Note: all the operations available in this menu restrict or remove the possibility to access historic installation data; as a consequence, they must be performed with great care and only after verifying the final impact

4.3 VIRTUAL PLANT

4.3.1 CREATE PLANT

Figure 62: New Virtual Plant Page.

The “**Create plant**” section (see the dotted area “A”) allows to enter the general plant data, for easier plant management.

The “**Technical data**” section (see the dotted area “B”) displays the most technical data (surface, amount of inverters and strings, plant rated power). These data cannot be edited; the relevant fields are populated by the software referring to the system configuration data (see chapters “Area configuration” and “VMU-S module configuration”). “Total area of PV modules” indicates the product between the surface of each photovoltaic module and the total number of modules installed in the system.

In the “**Economic Data**” section (see dotted area “C”) you can define the “*Self-consumption*” or “*Sale*” management mode, appropriately selecting the 4 existing parameters “Incentive”, “Costs”, “% of sold energy”, “*Sale*”. In particular: “% of sold energy” (in case of partial sale) ranges between 0 and 100%, and shall be used to correct the economic countervalue obtained from Energy Sale. The above parameters may be defined by date, to manage periodically changing business models (e.g.: incentive tariffs depending on the year).

By default production data are acquired from the energy meters and displayed as the sum of the individual values. The selection affects the subsequent calculation of economic counter-values, the data shown in “LH frame” and “RH frame” and the total efficiency calculated.

Press “Save setting” to store data.

Note: The decimal separator is the dot

4.3.2 EDIT PLANT

All the fields are identical to those described for the “Create Plant” menu. In the top right section of the page the “Plant” drop-down menu allows to select the plant to be edited.

Clicking on the “Save Settings” button allows to save the edited settings.

4.3.3 PLANTS

This page allows to associate a physical plant with a virtual one. The list of the available devices is displayed in the left section of the page, while the list of the associated devices is displayed in the right section. Once any devices have been added to a plant the plant association can no longer be altered.

Once the plant setting is completed click on the Save button to save the changes.

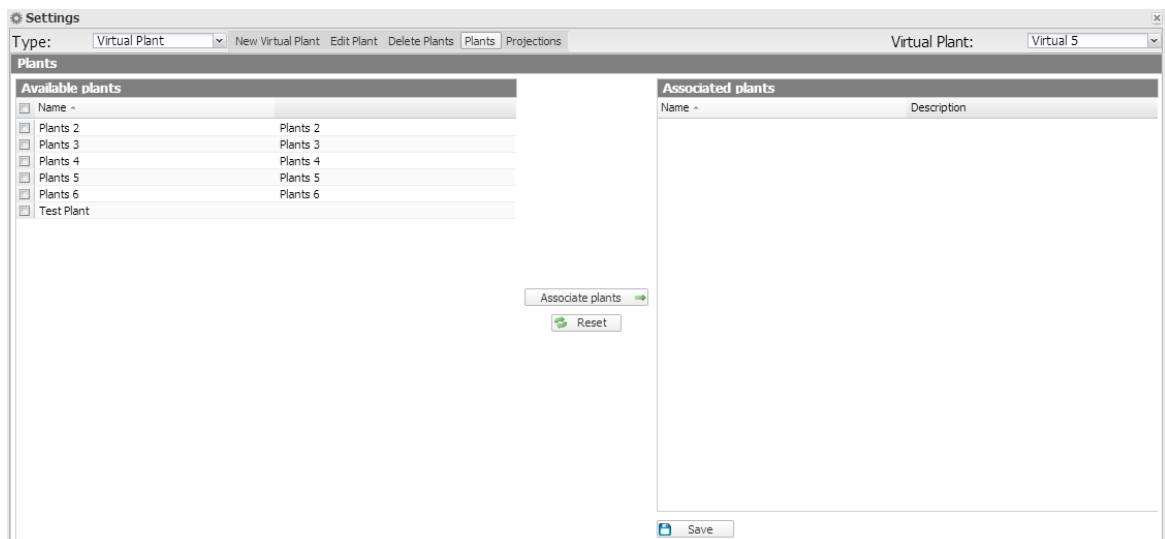


Figure 63: Plants Page.

Note: Contrary to the relation between VMU-C PV and physical plants, a physical plant can be aggregated to N virtual plant.

4.3.4 PROJECTIONS

In this configuration page the user shall specify the “YIELD” (kWh/kWp) data expected of the plant in question for each month. He shall also indicate the “Annual Decay Factor” of installed panel performance. The system will automatically calculate the “Correct Annual Value”, which will take into account the installed value and the decay due to panel ageing, for each month.

Monthly Planned Yield index (kWh/kWp)					
PV Modules Installation Date: <input type="text"/>					
	First Installation Value	Annual Corrected Value		First Installation Value	Annual Corrected Value
January (kWh/kWp)	<input type="text"/>	<input type="text"/>	July (kWh/kWp)	<input type="text"/>	<input type="text"/>
February (kWh/kWp)	<input type="text"/>	<input type="text"/>	August (kWh/kWp)	<input type="text"/>	<input type="text"/>
March (kWh/kWp)	<input type="text"/>	<input type="text"/>	September (kWh/kWp)	<input type="text"/>	<input type="text"/>
April (kWh/kWp)	<input type="text"/>	<input type="text"/>	October (kWh/kWp)	<input type="text"/>	<input type="text"/>
May (kWh/kWp)	<input type="text"/>	<input type="text"/>	November (kWh/kWp)	<input type="text"/>	<input type="text"/>
June (kWh/kWp)	<input type="text"/>	<input type="text"/>	December (kWh/kWp)	<input type="text"/>	<input type="text"/>

Annual Yield Corrective Factor (undefined):

Expected Energy on Current Year (kWh/kWp):

Figure 64: Projections Page.

Parameters may be edited; if you wish to return to the pre-calculated values just click on “Update projections”: data shall be recalculated by summing the values of the projections for the devices associated with the plant.

4.3.5 DELETE PLANTS

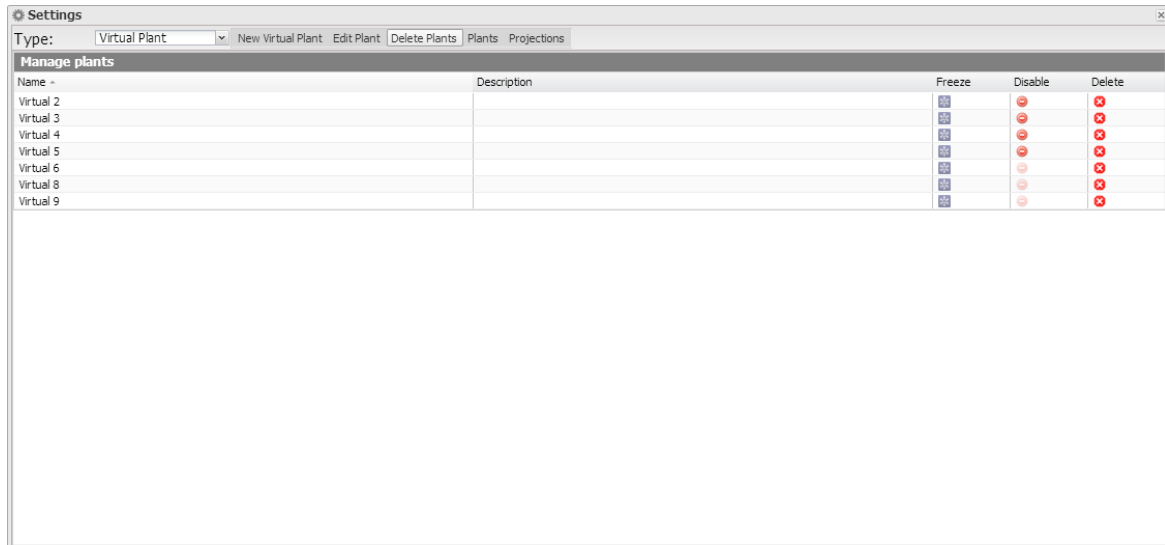


Figure 65: Delete Plants Page.

This page allows to perform some operations on the plants, like:

- Freezing a plant
- Disabling a plant
- Deleting a plant

Freezing a plant just means switching the selected plant to stand-by mode. Plant data will be displayed until the freezing date. The operation is reversible. Device association is not removed.

Disabling a plant means deleting the plant structure, freeing all the VMU-C PV associated with it. Once the operation is completed, aggregated plant data will be available; the data of the individual VMU-C PV initially belonging to the plant, instead, will no longer be available. The operation is not reversible.

Deleting a plant results in the full deletion of the plant and of all associated data. The operation is not reversible.

Note: all the operations available in this menu restrict or remove the possibility to access historic installation data; as a consequence, they must be performed with great care and only after verifying the final impact

4.4 SERVER

4.4.1 NEW COMMAND

To send a new command you need to click on “Commands – New Command”. The system will display a page with a command selection menu in the top section and the main command focus in the bottom section.

The top menu includes the following items:

User Management	Network	Configuration Management	Emergency
Add User	NTP Server	Update Firmware	Restart
Delete User	E-Mail Configuration	Reset Database	
		Scan Network Instruments	
		Sampling interval	
		Copy configuration	

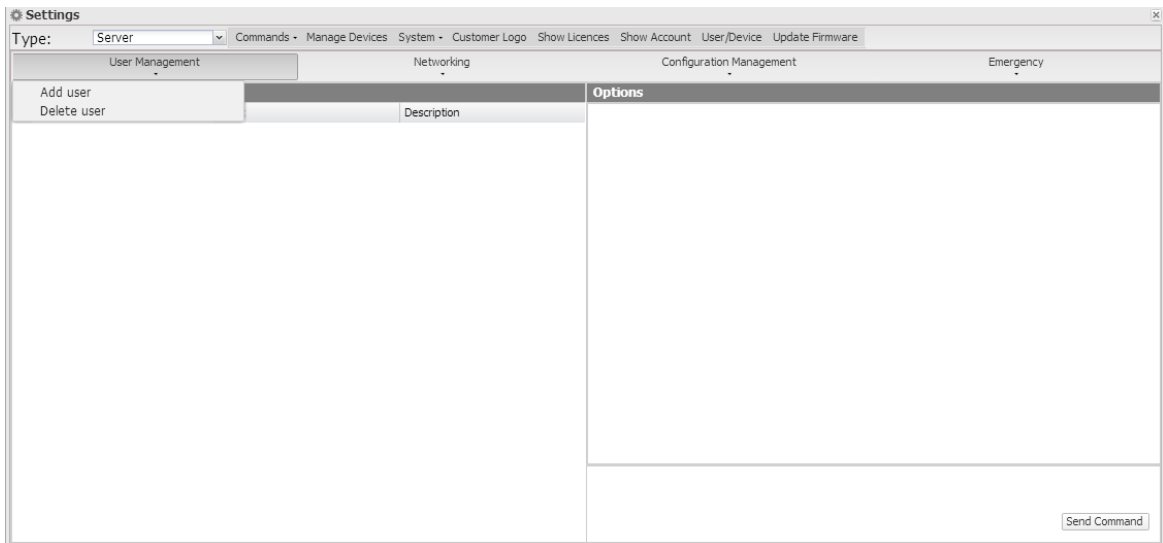


Figure 66: New Command Page.

The "Select Devices" panel display the list of the devices a command may be sent to; you can select both a single VMUC and a group of VMUC; you can also select all of them, by clicking on the box in the table header.

If there are any fields that need to be managed/filled in they are displayed in the “Options Panel”.

If a device is selected and the VMUC has properly replicated its configuration to the server, the VMU-C PV information is pre-loaded in the options panel.

Once you have filled in the fields to be edited click on the “Send Command” button.

4.4.1.1 USER MANAGEMENT – ADD USER

The system will display in the options panel the fields allowing to enter the Username and the Password to be added to the VMUC.

4.4.1.2 USER MANAGEMENT – DELETE USER

The system will display a drop-down list allowing to select the user to be deleted. If N devices are selected, only the users shared by the devices will be displayed.

4.4.1.3 NETWORK – NTP SERVER

The system will display a frame in the Options panel, allowing to enable clock synchronisation from the network and to specify two NTP servers for the synchronisation.

4.4.1.4 NETWORK – E-MAIL CONFIGURATION

VMU-C PV can send alarm emails or SMS to multiple receivers at the same time and according to preset rules. This page contains two separate configuration screens, in order to create two separate users groups to send communications to. The “Send for” selection field allows to filter the type of alarm messages to be sent to the relevant receivers.

Fill in the fields in both screens according to the following specifications:

“*Receivers' addresses*”: E-mail addresses of receivers the alarm messages are sent to.

Note: You may specify multiple addresses; in that case addresses must be separated by a semicolon (;) without any space.

“*Re*”: Subject of email to be sent. (Example: *Alarm from FV Plant*).

“*SMS addresses*”: Specify the phone number (complete with international prefix) to which the message shall be sent when an event occurs.

“*Action*”:

- “*Send email*”: Check to enable email sending.
- “*Send SMS*”: Check to enable SMS sending.

Note: To be able to send any mails, the outgoing mail server must be appropriately configured in the system. (See paragraph “*EMAIL*”)

Note: If the e-mail is not received, check outgoing mail server settings, receiver's address and the VMU-C PV reachability from Internet.

Note: Should the SMS fail to be received, check that the specified cell phone number is correct. Also check that the international prefix has been entered correctly.

“Send for”: Selections allow to select and filter the alarm type the e-mail and/or the SMS is to be sent for. If not sent, the event is anyway stored and visible on monitor from Alarms list.

Alarm type detail:

- “Alarms”: High-priority alarms.
- “Warning”: Low-Medium priority alarms.
- “Events”: Opening/Closing of digital inputs and outputs
- “Commands”: Variation of parameters on Eos-Array

For further details on alarm types, refer to “Alarm display” paragraph.
Press “Save setting” key to store settings.

4.4.1.5 NETWORK – TUNNELLING

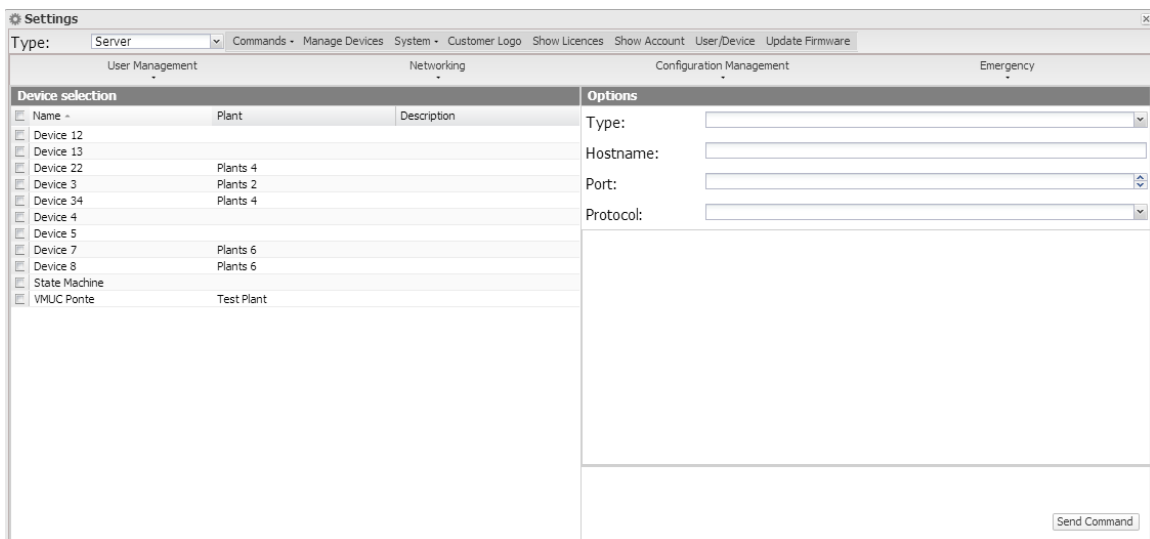


Figure 67: Tunnelling Commands Page.

Tunnelling is a process which allows to remedy any problems generated by restrictions in TCP/IP communications due to strict firewall policies on a device, allowing to channel a flow of HTTP or SSH data .

To issue a Tunnelling request you need to select a single Device and fill in all the fields displayed in the box on the right.

As a consequence, select:

- Requested tunnelling type:
 - o Local: This selection allows to request a tunnel to the local server in use.
 - o Remote: This selection allows to request a tunnel to a third-party server supporting the reverse tunnel.
- Hostname: Name of the host to connect to
- Port: Port number to be used for the tunnel on server
- Protocol:
 - o SSH: Request for SSH protocol tunnel, to be able to use a SSH connection through any SSH client (option available only to Carlo Gavazzi Support personnel)
 - o HTTP: Reverse tunnel of the HTTP protocol; this allows to display the Web site on the tunnelled module by accessing the server.

Usage sample.

For example you can reroute to a tunnel the web-server on the VMU-C PV on the EM2 server by proceeding as follows:

- Select the desired VMU-C PV from the device list;
- Select the "Local" type;
- Enter the name of the selected Eos-Server server;
- Select a server port; (NB: The port in question must be open on the VMU-C PV outbound firewall)
- Protocol: HTTP

5 after the request the tunnel will be active and you'll be able to manage it from the: System -> Tunnelling menu.

Note: the tunnelling requests are executed by the VMU-C PV during data synchronisation; as a consequence you need to wait until the next synchronisation before being able to access the tunnel.

4.4.1.6 CONFIGURATION MANAGEMENT – UPDATE FIRMWARE

There are no options to be managed in the relevant panel; the command is sent and the VMU-C PV is aware of the address of the server from which the updated firmware has to be downloaded.

4.4.1.7 CONFIGURATION MANAGEMENT – RESET DATABASE

This command allows to delete all the DB history data until a given date. In the Options panel you can choose the date in question.

4.4.1.8 CONFIGURATION MANAGEMENT – SCAN NETWORK INSTRUMENTS

This command requests that the VMU-C PV performs a new scanning of the instruments existing on its network.

4.4.1.9 CONFIGURATION MANAGEMENT – SAMPLING INTERVAL

Enter into the relevant field in the Options panel the value in seconds of the sampling interval for the devices connected to the VMU-C PV.

4.4.1.10 CONFIGURATION MANAGEMENT – COPY CONFIGURATION

The system will display a selection menu in the Options panel, allowing to choose the device from which the configuration shall be downloaded.

4.4.1.11 EMERGENCY – RESTART

This command requests that the VMU-C PV restarts the device.

4.4.2 COMMAND HISTORY

Clicking on “Command History” allows to display a page containing the list of all commands, sorted by last sent date.

The bottom section hosts the pagination bar, allowing to:

- Return to the first page
- Go back by one page
- Enter the number of the page you wish to display
- Go forward by one page
- Display the last page
- Refresh the displayed data.

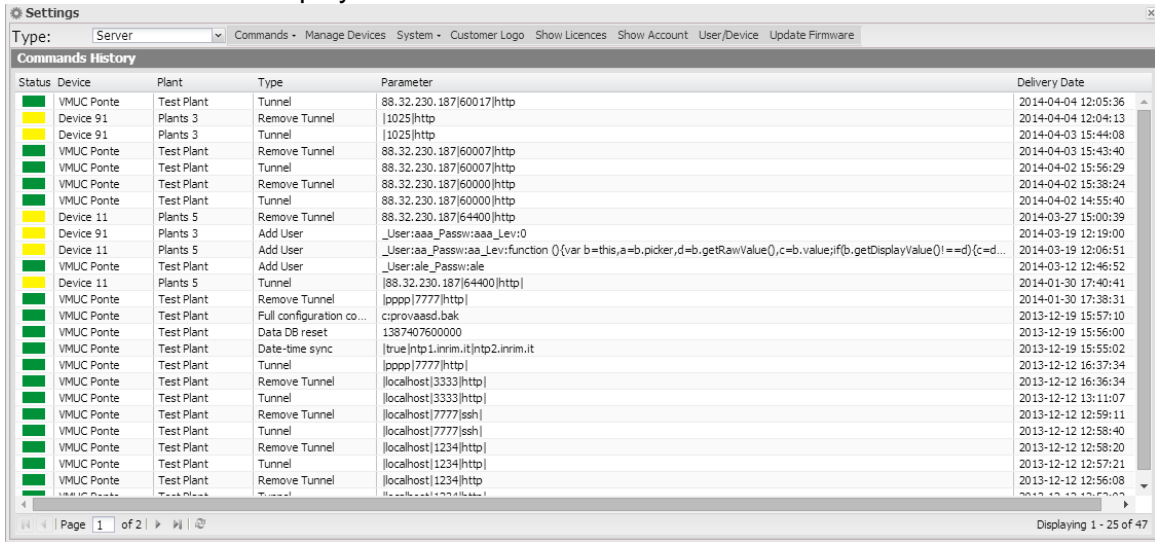


Figure 68: Command History Page.

4.4.3 DEVICE MANAGEMENT

This page allows to display the list of all the VMU-C PV devices which have connected to Eos-Server .

The devices are sorted alphabetically; the bottom section hosts the pagination bar, allowing to navigate the pages.

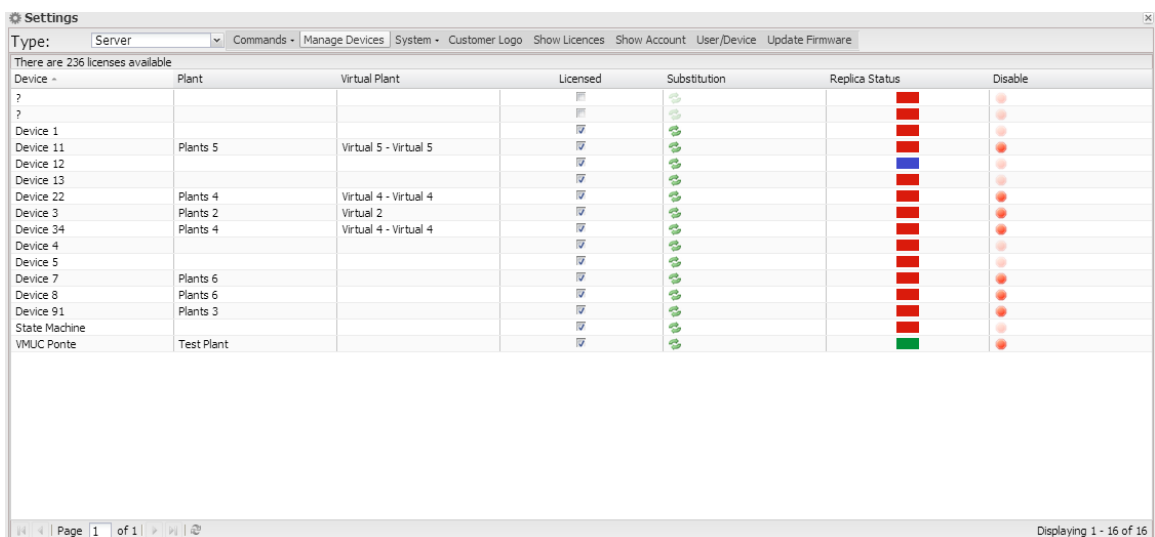


Figure 69: Device Management Page.

The table includes the following fields:

- Device: Name of the VMU-C PV device
- Plant: Name of the plant it is aggregated to
- Virtual Plant: Name of the virtual plant it is aggregated to
- Licensed: Whether the user has activated the licence on the device in question
- Replacement: You may click the icon to replace the piece (Fig. 71). When clicking the icon the system will display a window allowing to select the device replacing the device selected in the table. Check the send command box to automatically generate a configuration copy sending command.
- Replication Status: A coloured status icon indicating that data have been successfully replicated (green colour), or a replication error (red colour); the icon turns to red after 3 failed replications.
- Disable: Clicking the icon allows to disable the device. If it is red the device is disabled and CANNOT be activated; if it is green, instead, the device may be disabled by clicking on the icon and confirming the operation in the confirmation window. Disabling the device, therefore, is an IRREVERSIBLE operation.

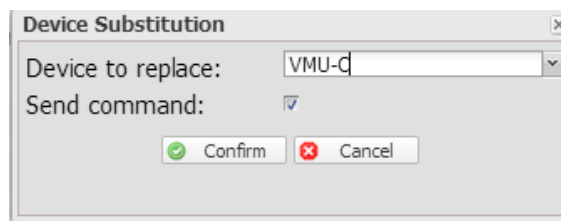


Figure 70: Device Management Page.

4.4.4 SYSTEM

4.4.4.1 LAN SETTINGS

The screenshot shows the 'Settings Network' page. It has two main sections: 'Use The Following IP Address:' and 'Use this following DNS server addresses:'. In the first section, 'Get an IP address Automatically (DHCP)' is selected, but the static IP fields are populated with values. In the second section, 'Get DNS Server address automatically' is selected, but the DNS server fields are also populated. A 'Save Settings' button is located at the bottom right of the form area.

Settings Network:	
<input checked="" type="radio"/> Use The Following IP Address: <input type="radio"/> Get an IP address Automatically (DHCP)	
IP Address:	10.0.1.82
Subnet Mask:	255.255.255.0
Default Gateway:	10.0.1.1
<input checked="" type="radio"/> Use this following DNS server addresses: <input type="radio"/> Get DNS Server address automatically	
Preferred DNS server:	10.0.1.7
Alternative DNS server:	10.0.1.6

Figure 71: LAN setting page.

To configure the LAN port, you can choose between two options:

- *Obtain an IP address automatically (DHCP):* the address is automatically acquired when switching on the Eos-Server from a DHCP server, which must exist inside the network the port is connected to. The IP address will be dynamic and not known in advance. In this case you can reach Eos-Server from within the same network by typing on the browser the Machine Name assigned to it.
- *Use the following IP address (Static routing):* you need to manually specify an IP address, along with a network mask and a default gateway.

In the absence of a network administrator who can provide the correct network parameters, assign an address belonging to the same class as those of the other existing devices (e.g.: ADSL router), and indicate "255.255.255.0" as the network mask. The default gateway is only mandatory if you plan to access Eos-Server through the Internet using the LAN connection; in this case, indicate in this field the IP address of the ADSL router

Finally, you can manually specify the addresses of the primary and secondary DNS servers to be used to access the Internet (*Use the following DNS server addresses*); as an alternative, if the LAN port is set to DHCP mode, you can allow Eos-Server to acquire the DNS servers from the DHCP server (*Obtain DNS server address Automatically*). Press the "Save configuration" button to store the network configuration. To apply the new settings, VMU-C PV needs to be automatically restarted; wait until the count-down is over; then you'll be routed back to the home page.

The system requires to have access to the Internet for the following outbound services:

- *To send e-mails to the configured SMTP server.*
- *To synchronise the date and time settings through the NTP service (if configured).*
- *To communicate through port 80 with the support server for Reverse Tunnelling.*
- *To communicate with the License Management System on port 443 (HTTPS)*

4.4.4.2 NTP SETTINGS

You can set up to two NTP servers. Enabling this server type allows to constantly synchronise the DATE and TIME data; this service also allows the Eos-Server to know in which geographic area it has been installed.

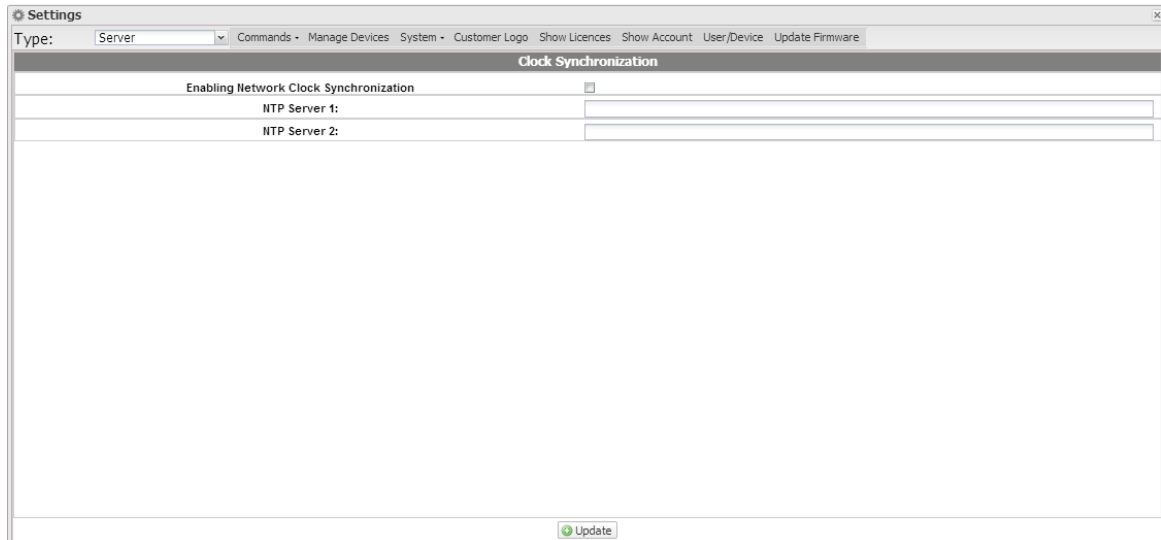


Figure 72: NTP setting page.

4.4.4.3 E-MAIL

This page allow to edit the settings of the outgoing mail account.

The following fields may be edited:

- Sender's Address: Enter the address of the mail sender
- Sender's Name: Enter the alias of the e-mail address you wish to display when a mail is received from the server
- Sender's SMTP: SMTP server used to send the e-mails
- SMTP Server User Name: e-mail address user name
- SMTP Server Password: e-mail address password

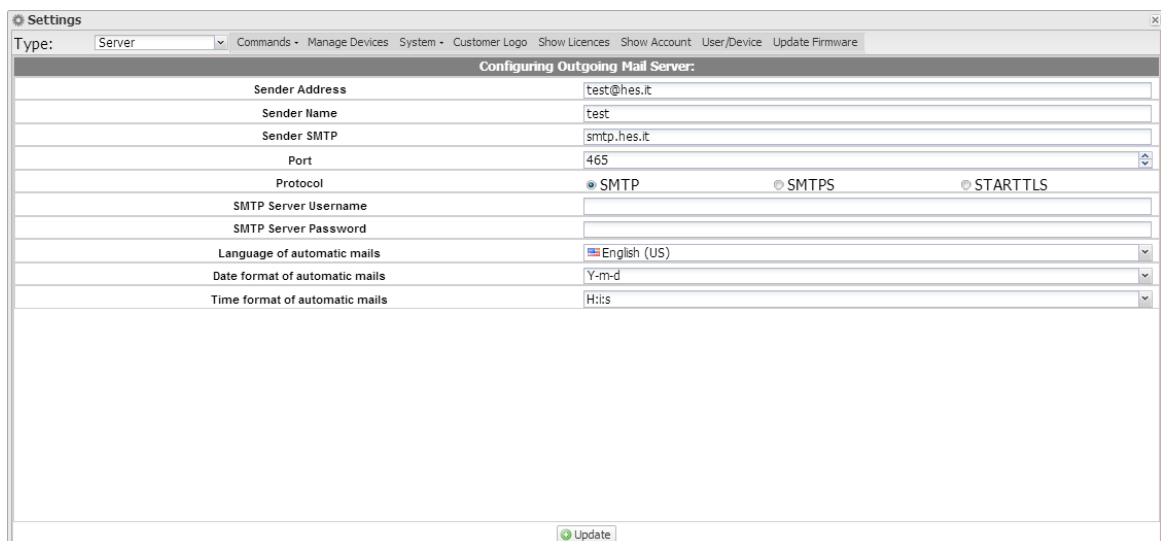


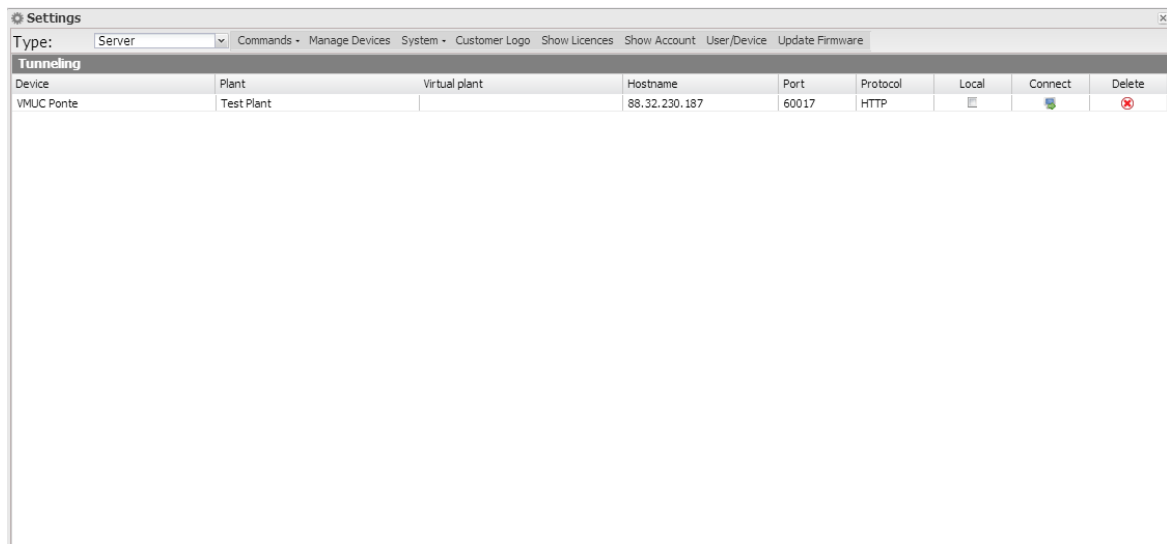
Figure 73: E-MAIL setting page.

4.4.4.4 TUNNELLING

This page allows to display all open tunnels, both pending and active.
The displayed information includes:

- Device: Name of the device the tunnel has been sent to;
- Plant: Name of the plant the device is aggregated to;
- Virtual Plant: Name of the virtual plant the plant is aggregated to;
- Hostname: Name of the server the tunnel has been sent to;
- Protocol: It specifies whether it is a HTTP or SSH tunnel;
- Local: If it is checked the tunnel has been created on the EOS server; if it is not checked the tunnel has been created on a third-party server;
- Go to: In case of http tunnel, clicking this icon allows to display the Web site of the tunnelled device;
- Delete: It generates a tunnel deletion command on the remote device.

If the tunnel is yet to be activated 20 minutes after the request, delete it and repeat the request





Device	Plant	Virtual plant	Hostname	Port	Protocol	Local	Connect	Delete
VMUC Ponte	Test Plant		88.32.230.187	60017	HTTP	<input type="checkbox"/>		

Figure 74: Tunnelling setting page.

4.4.5 CUSTOMER LOGO

Clicking on Load allows to load a customer logo which shall be displayed at the top right in the home page. The logo size is 280x73. If an image is larger it shall be automatically resized. We recommend that you create an image having the same proportions as the standard logo.

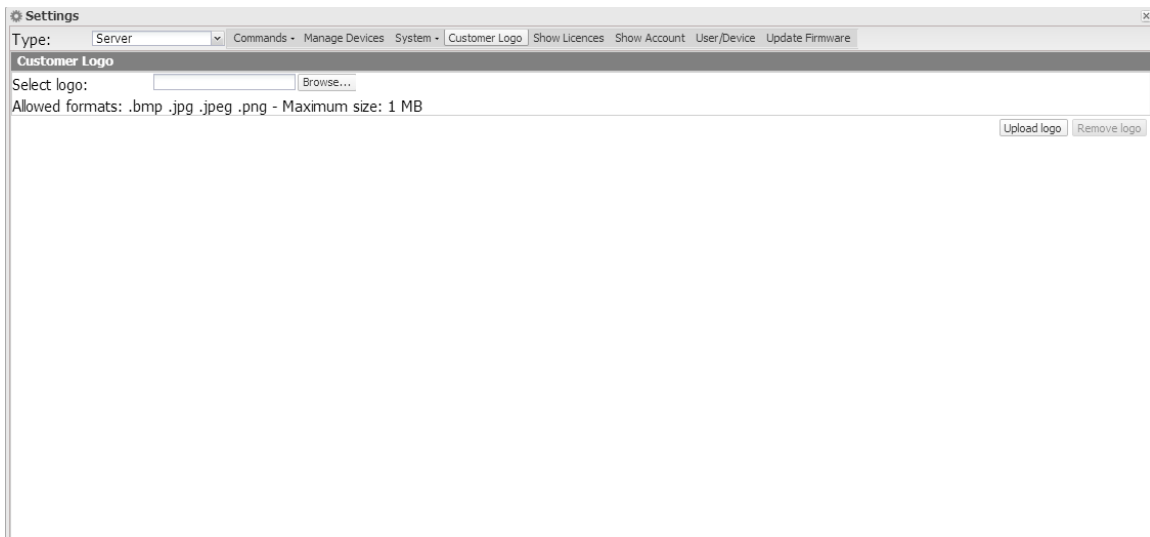


Figure 75: Logo setting page.

4.4.6 SHOW LICENCES

This page allows to enter a licence code. The entered licence code may be of two types:

- Standard Licence Code
- Premium Licence Code

The Licences table includes the following fields:

- Status: If the icon is green the licence is properly activated; if it is red, the licence is disabled
- Licence Code: Entered licence code
- Devices: Number of devices permitted by the entered licence
- Entering Date: Licence code entering date
- Delete: An icon allowing to delete a licence code

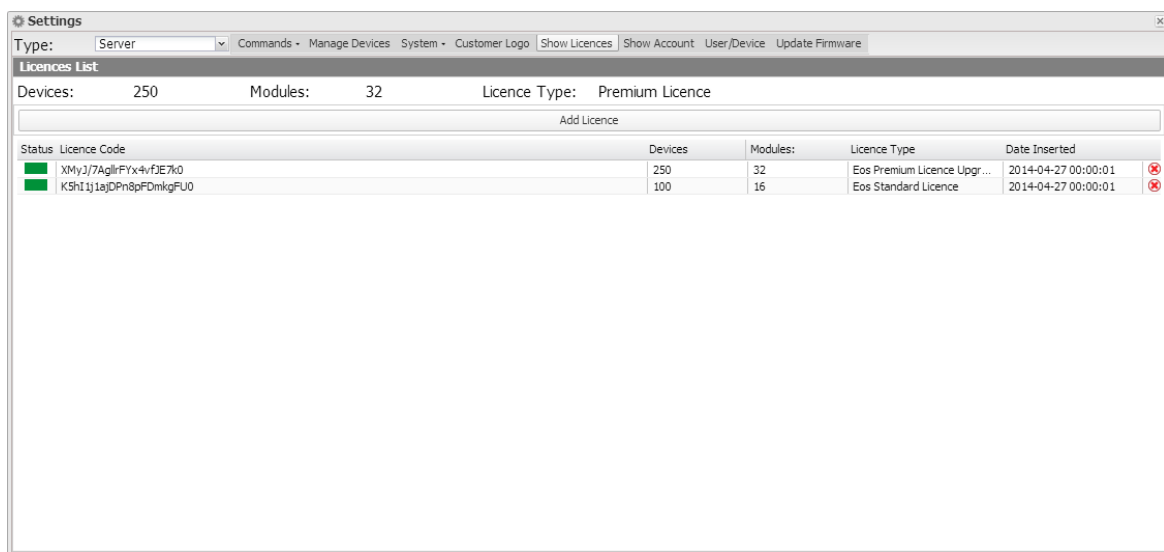


Figure 76: Licence setting page.

5 How-To

5.1 CONFIGURE A VMU-C PV DEVICE

The configuration of the individual VMU-C PV in their (data push) version must be performed using the relevant Web-server function built in the VMU-C PV itself before performing the link with Eos-Server. This will allow to configure all the parameters of the devices connected to VMU-C PV before sending the data, to avoid any inconsistencies. For information about the configuration procedure please refer to the user manual of the VMU-C PV product.

5.2 ENABLE A VMU-C PV DEVICE

Figure 76 shows the list of the entered licences or upgrades.

Figure 70 shows the list of all the VMUC which have actually communicated with Eos-Server

You can enable one of the listed devices by just clicking in the box and checking it, provided any licences are available.

5.3 CREATE AND CONFIGURE A PHYSICAL PLANT

It is possible to add a new plant by entering all the required data in the relevant fields.

Once all data have been entered, click on “Create plant” to register it.

The system will automatically display the VMU-C PV association page. This page only allows to associate the devices which are yet to be associated with any physical plant. Once the association is completed the system will automatically calculate the forecasts at plant level.

5.4 CREATE AND CONFIGURE A VIRTUAL PLANT

As for the physical plants, you can add a new virtual plant by entering all the required data in the relevant fields.

Once all data have been entered, click on “Create plant” to register it.

The system will automatically display the physical plant association page. This page allows to associate the physical plants the created virtual plan will consist of. Once the association is completed the system will automatically calculate the forecasts.

A physical plant may belong to one or more virtual plants.

5.5 SERVER SWITCHING

Eos-Server

To be able to install the virtual machine containing Eos-Server on a new physical server and in case of any copy or cloning of the virtual machine you need to follow an appropriate procedure to ensure that:

- a) There is one and only one instance of Eos-Server for a given licence ID
- b) If the virtual machine needs to be moved and 2 installations coexist for a certain time, licences must be disabled in one installation and enabled on the other.

As a consequence you need to:

- 1) create the new virtual machine and initialise it as you did for the one already running, without granting it access to the Internet.
- 2) In the original Virtual machine, delete the entries of the licences, to be able to use the codes in question in the new server.
- 3) Disconnect the first server from the Internet;
- 4) Connect the new server to the Internet;
- 5) Within 24 ours the server automatically performs a check with the central server and associates the new server;

NOTE: should it detect the coexistence of 2 or more installations with the same licence IDs, the Carlo Gavazzi remote licence management system will disable the licence, as it will be regarded as malicious.

You cannot keep an Eos-Server installation disconnected from the Internet, as this will result in the disabling of the Eos-Server itself after seven days.

5.6 EDIT THE USER CONFIGURATIONS

The special menu in the top left allows to edit the parameters of the user who has logged in

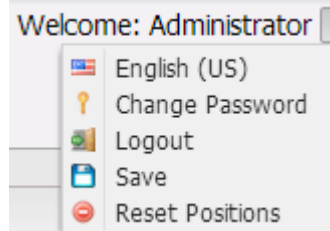


Figure 77

The following functions are available:

Menu item	Function
Language	It defines the interface language
Change password	It allows to re-define the user password
Logout	It disconnects the user from the current session
Save	It saves the configuration of the windows (size and location) as they are on the screen
Reset	It resets the standard location/size of the windows

