

Control PV Plant with a PLC

(Energy gateway for renewables)

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Product Features

- Unified PLC interface
- Power efficient
- Modular solution
- Embedded experience since 1997

Monitoring of

- | | |
|---|--|
|  Inverters |  Safety Relays |
|  String Boxes |  Door Contact (Theft Protection) |
|  Electricity Meters (AC, DC) |  Overvoltage (Lightning Protection) |
|  Sensors (Irradiation, Temperature, Wind) | |



Why this gateway is useful?

- Technological criteria
- Fast implementation
- Costs reduction
- Postpone energy consumption
- Weather forecast
- Systems interaction
- Dependancy on price levels, stock market prices
- Conditions for connection a PV plant to the grid

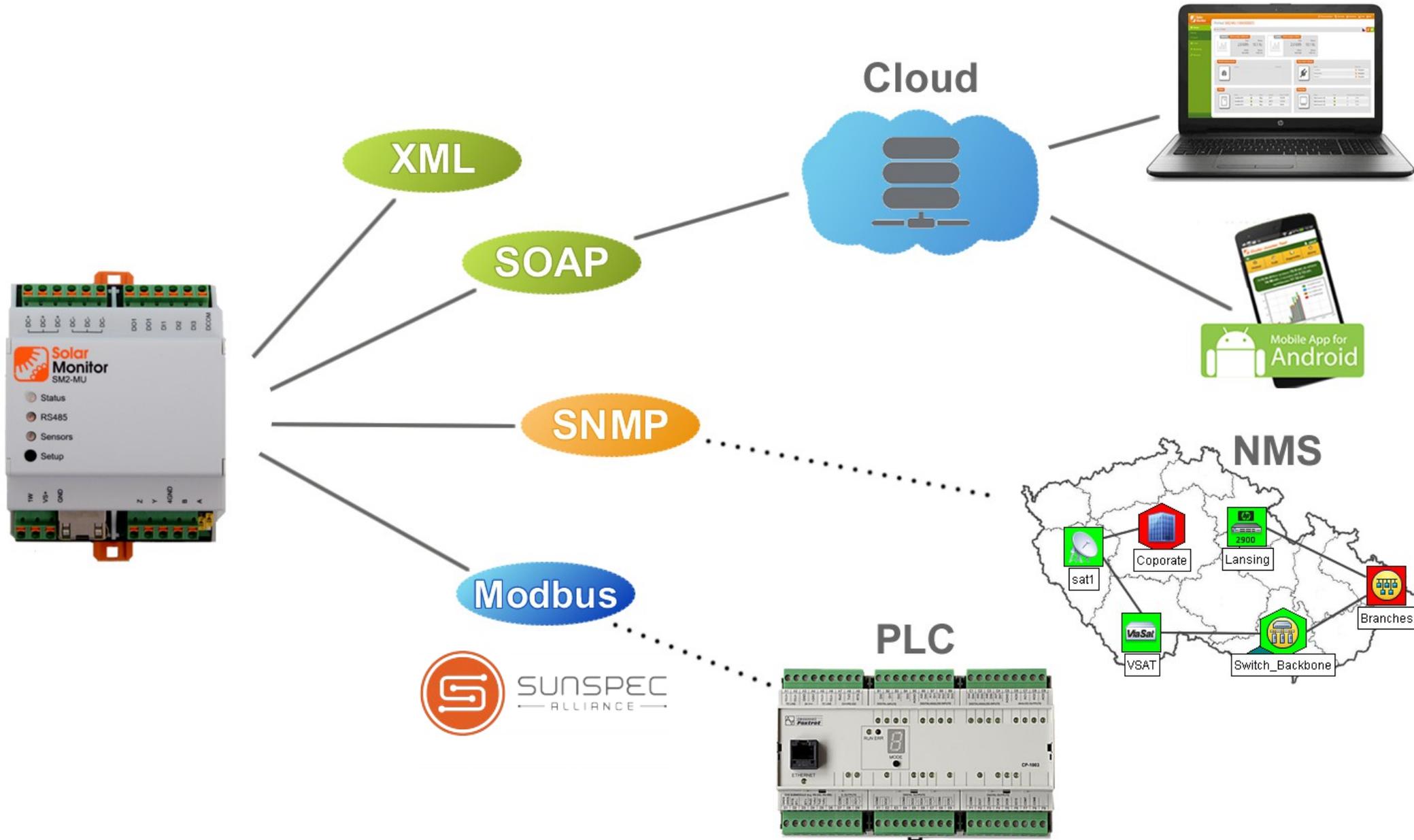
Which manufacturers are supported?



What Are the Solar Monitor Solution Areas?



Software Interface Overview



Webserver of the SM2-MU: Responsive Design



Overview SolarMonitor - Studer Test

Overview

Peaks

LCD Panel

Charts

Alerts

Home > Overview



Inverter(s) Total Produced Energy from inverters

Today	Earnings
0.0 kWh	0.0
Total	Earnings

Tracker(s) Total Produced Energy from trackers

Today	Earnings
0.0 kWh	0.0
Total	Earnings

Inverters (Hybrid)



Name	State	Mode	Temperature	Grid power (0.2kW)	Power (0.2kW)	Updated
XTH 8000-48V (L1)	✓	Charger	- °C	104.98 W	141.96 W	0s
XTH 8000-48V (L2)	✓	Charger	- °C	151 W	42.99 W	0s
XTH 8000-48V (L3)	✓	Charger	- °C	-20 W	42.99 W	0s

MPP Trackers



Name	State	Mode	Temperature	Arr Power (0kW)	Power (0.1kW)	Updated
VT 80-48V	✓	Night	22 °C	0 W	52 W	0s
VS 70-48V	✓	Night	22 °C	0 W	0 W	0s
VS 120-48V	✓	Night	22 °C	0 W	0 W	0s

SNMP – Castlerock SNMPc: Geographical Maps

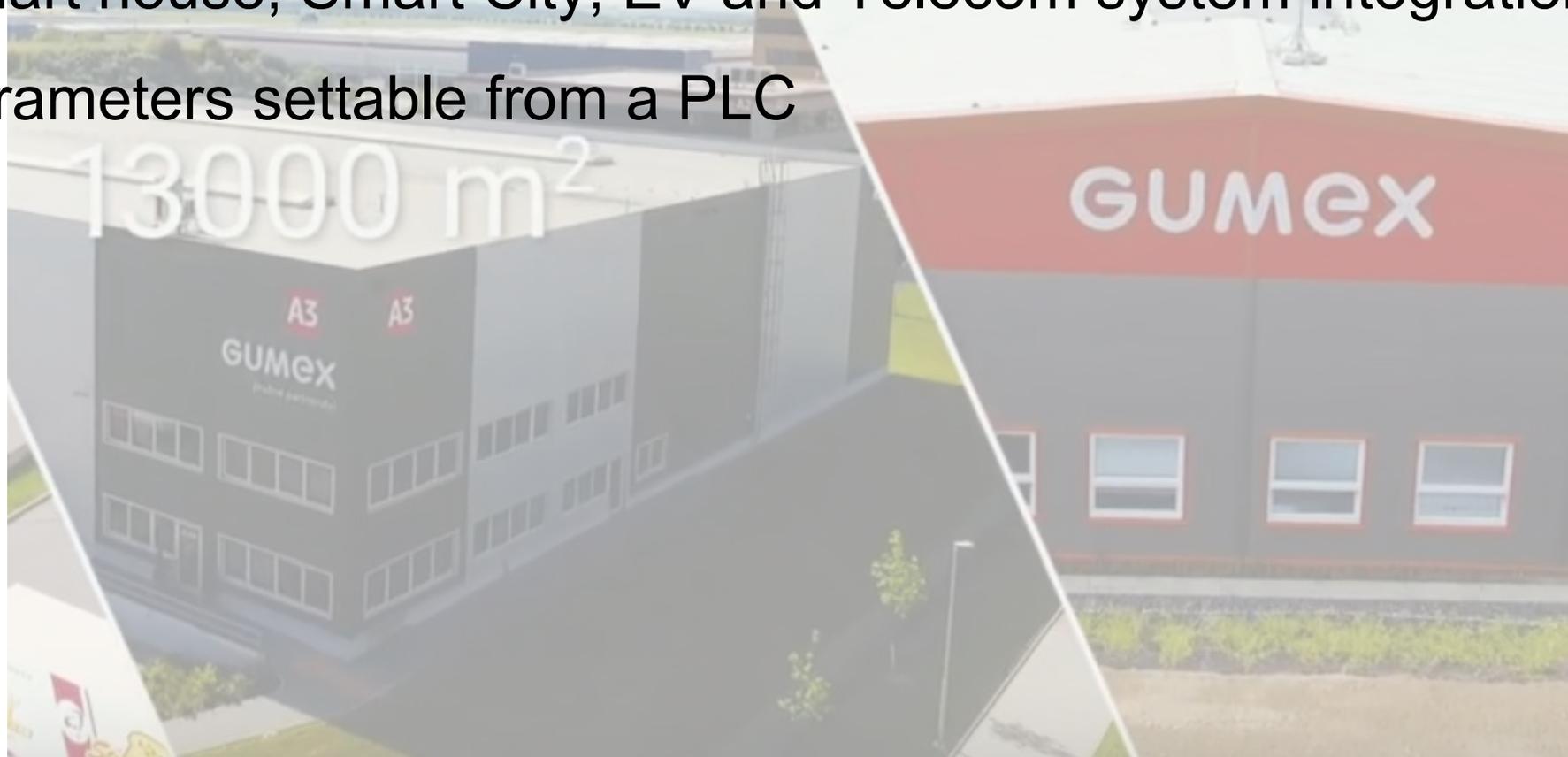
The screenshot displays the SNMPc Management Console interface. The main window is titled "SNMPc Management Console" and features a menu bar (File, Edit, View, Insert, Manage, Tools, Config, Window, Help) and a toolbar with various icons. The interface is divided into several sections:

- Left Panel (Tree View):** Shows a hierarchical structure of network objects under "Root Subnet". The "Intl" folder is expanded, listing nodes: CRC_HQ, Dallas, Denver, Lansing, Miami, and NY. Other folders include R&D, Sales, and Switch_Backbone, which contains various Cisco and server models.
- Center Panel (Map):** A geographical map of the United States with network nodes placed at various locations: CRC_HQ (California), Denver (Colorado), Lansing (Michigan), Dallas (Texas), and Miami (Florida). A "Branches" window is overlaid on the map, showing a network topology diagram with nodes like App_Server, Servers_1, Cisco_7200, WAP_1, VoIP_CM, Backup, Exchange, and UNIX.
- Right Panel (Network Diagram):** A detailed network topology diagram showing a central "Company_WAN" node connected to various devices: HP_8200, WAP_1, Cisco_7200, VoIP_CM, Backup, and NDRETEL.
- Bottom Panel (Log):** A log window displaying system events. The log entries are as follows:

Severity	Date	Time	Source	Message
Normal	09/10/2009	14:15:28	User-PC	Sntp Service Up
Normal	09/10/2009	14:41:16	DNA	Device Responding to Poll
Normal	09/10/2009	15:03:58	San_Jose	Trend Report Agent Connected to Server
Normal	09/10/2009	15:09:51	Florida	Device Responding to Poll
Normal	09/10/2009	15:10:38	Dallas	Device Responding to Poll

What we automate at a power plant?

- Power control – active & reactive, fluent regulation
- Obtaining data from devices with proprietary protocols
- Smart house, Smart City, EV and Telecom system integration
- Parameters settable from a PLC

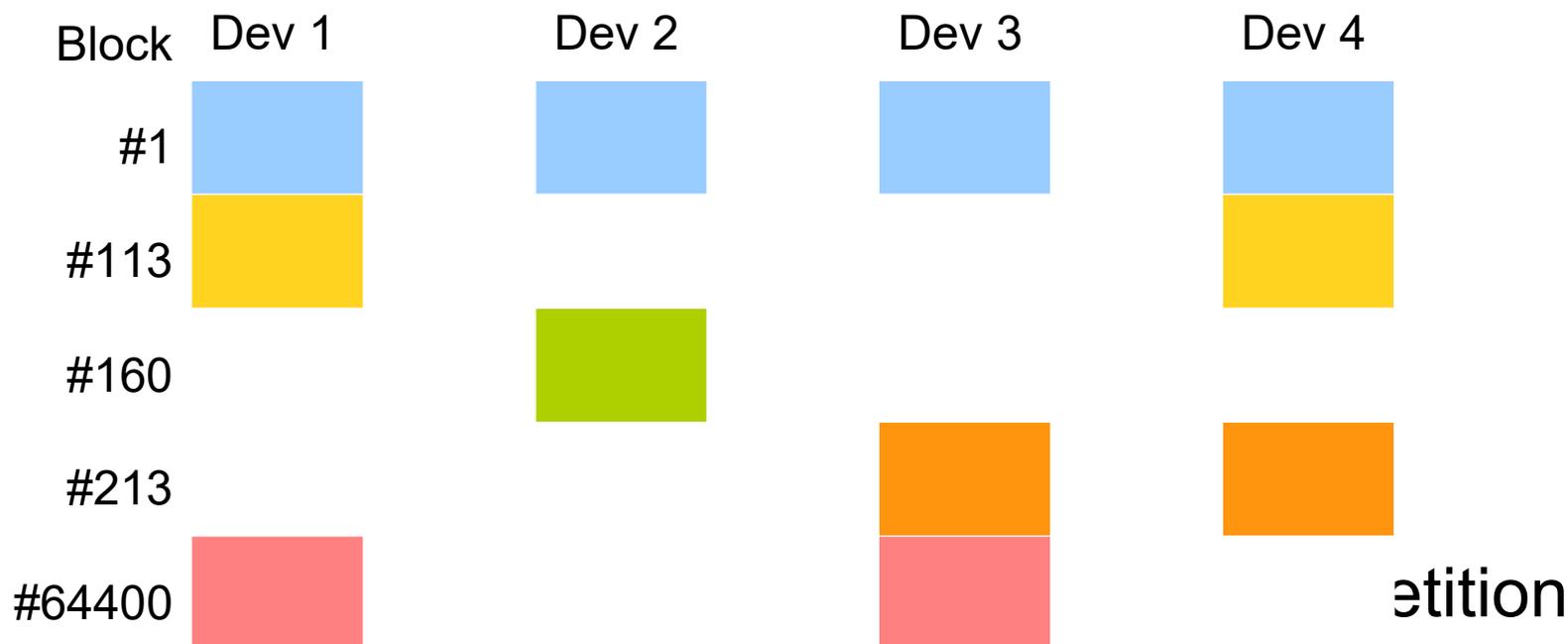


What you can control at a PV Power Plant?

- Residential
 - Energy overflows
- Companies
 - dtto
 - ¼ hour production and consumption maximums, batteries
 - Electricity flow (charging, discharging)
- Solar parks, institutions
 - Distributor control, Reactive power control (correction)

What makes our solution unique?

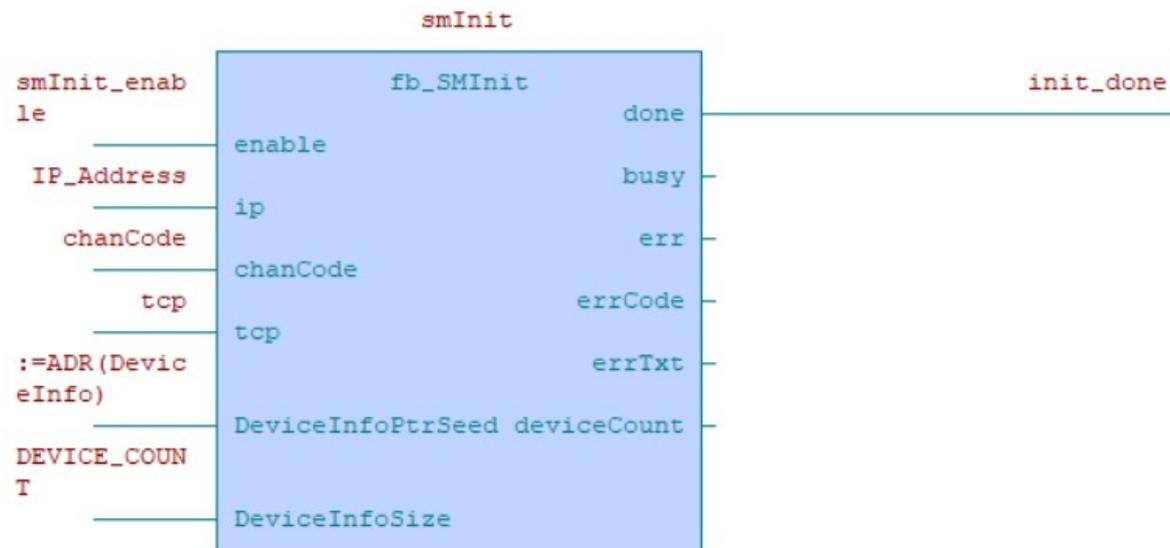
- Universal and custom blocks in the SM2-MU



- Forward and backward both device and SW compatibility
- Communication with "not yet existing devices"

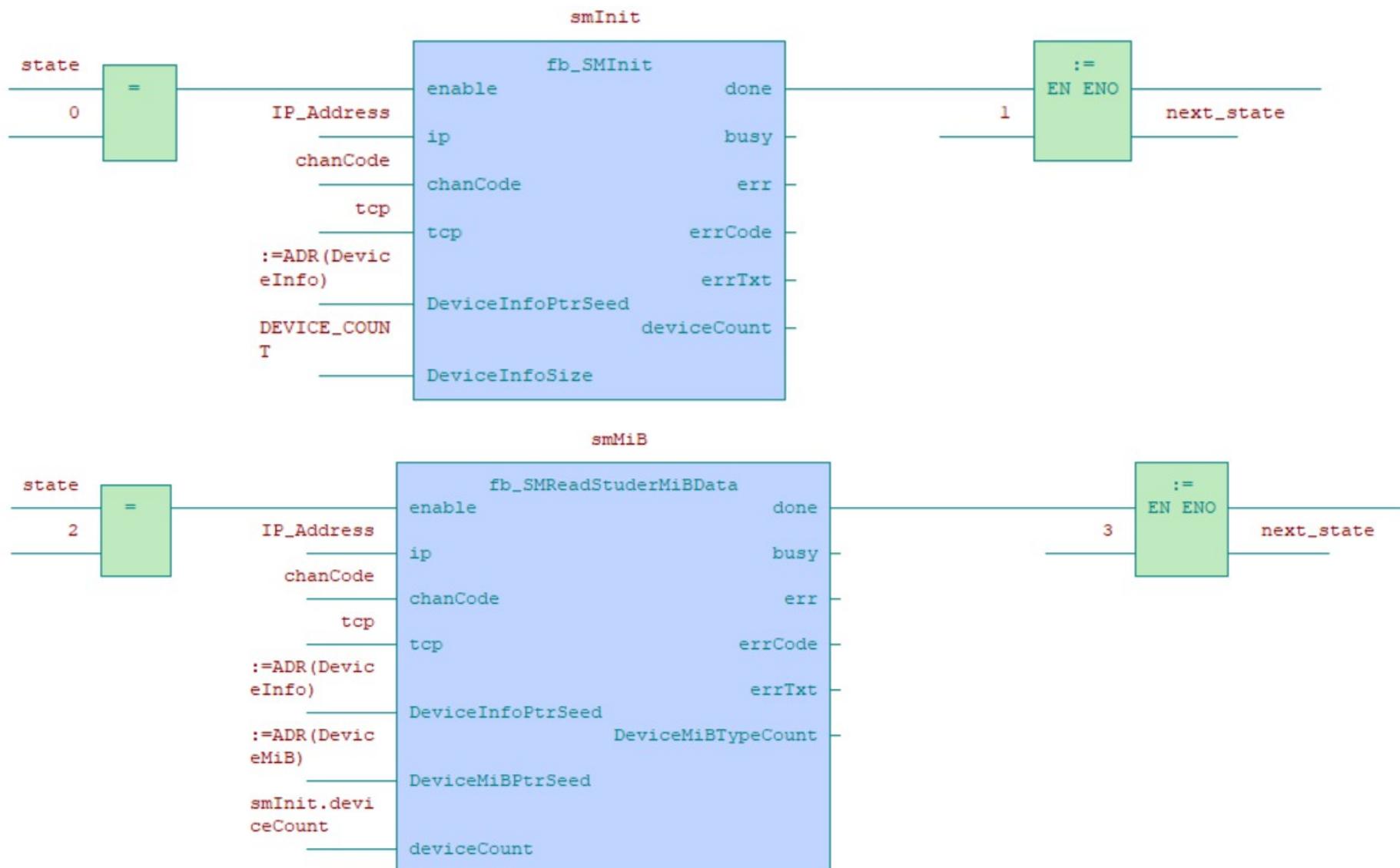
How do we achieve easy and fast implementation?

- Modbus variables organized in blocks (Sunspec)
- PLC library



- E.g.: Existing installation with 3 inverters from one manufacturer, 1 device breaks down, replaced with another one, no change in communication, neither in management

PLC Example in IEC 61131-3 FBD: Data Reading



PLC Example in IEC 61131-3 ST: Data Reading

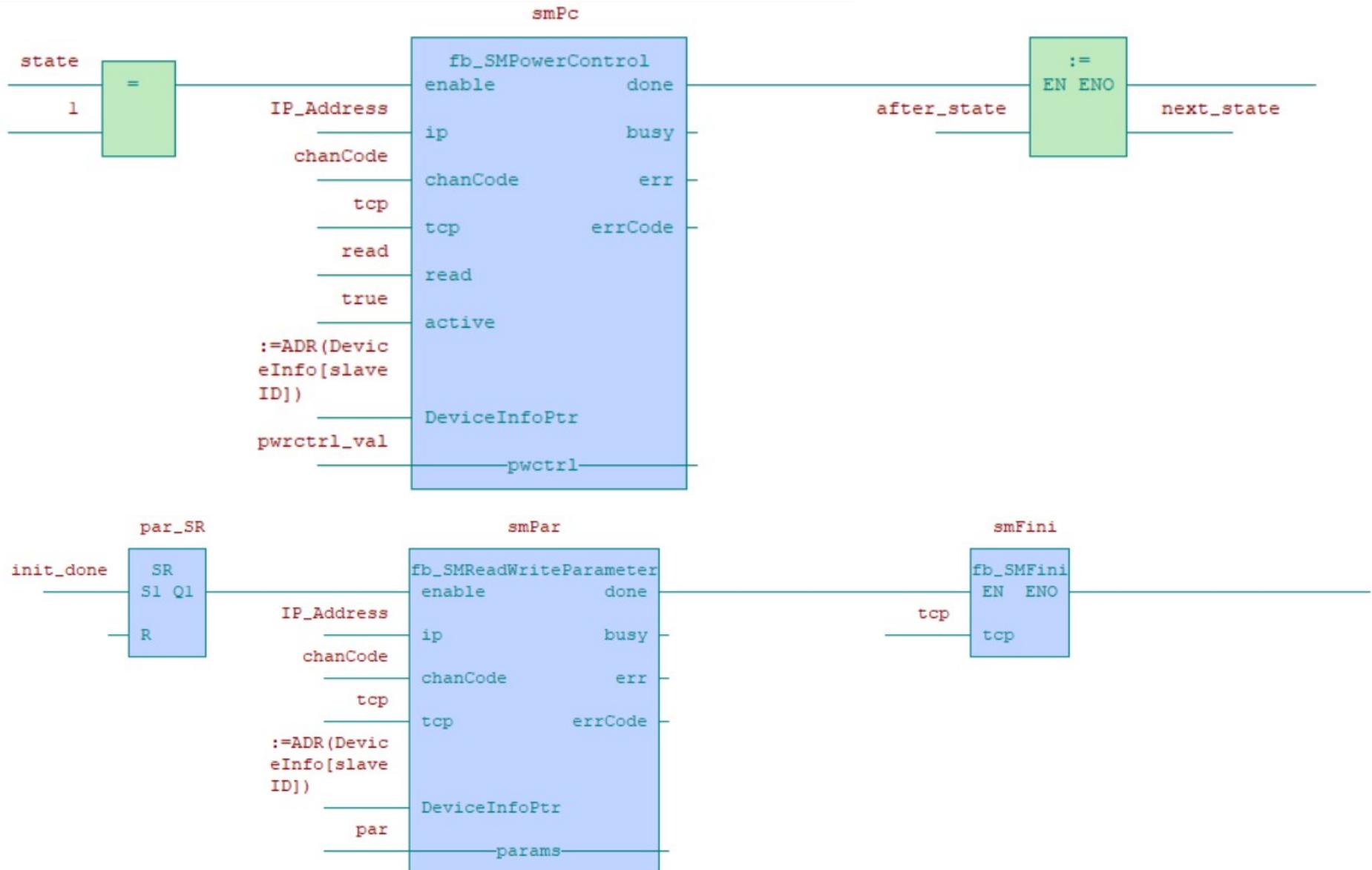
```
PROGRAM prgMain
  VAR_INPUT
  END_VAR
  VAR_OUTPUT
  END_VAR
  VAR
    enable : BOOL := 1;
    ip : STRING := '192.168.1.221:502';
    chanCode : UINT := ETH1_uni0;
    tcp : BOOL := TRUE;
    sm : fb_Solarmonitor10;

  END_VAR
  VAR_TEMP
  END_VAR

  sm(enable := enable, ip := ip, chanCode := chanCode, tcp := tcp);

END_PROGRAM
```

PLC Example in IEC 61131-3 FBD: Power Control



PLC Example in IEC 61131-3 ST: Power Control

```
PROGRAM prgMain
  VAR_INPUT
  END_VAR
  VAR_OUTPUT
  END_VAR
  VAR
    enable : BOOL := 1;
    unitID : USINT := 5;
    sm_pc : fb_PowerControl30;
    ip : STRING := '192.168.1.221:502';
    chanCode : UINT := ETH1_uni0;
    tcp : BOOL := TRUE;
    val : UINT := 60;
    active : BOOL := TRUE;

  END_VAR
  VAR_TEMP
  END_VAR

  sm_pc(enable := enable, ip := ip, unitID := unitID, chanCode :=
chanCode, tcp := tcp, pwctrl := val, active := active);

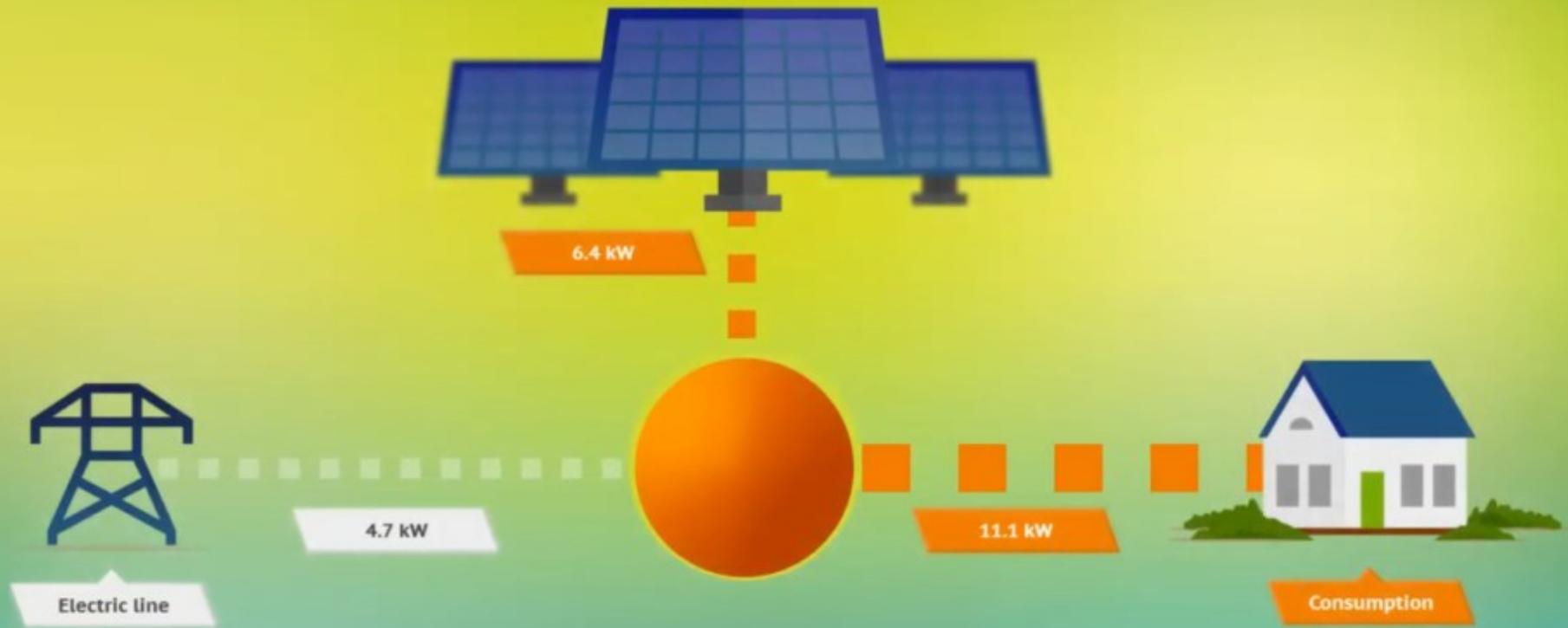
END_PROGRAM
```

What are your advantages?

- Easy and fast implementation
- Technology independence
- Seamless hardware replacement in case of a failure of an original inverter
- Readiness for future systems
- Electronic parts that lasts (without "electrolytes" like Aurora)
- Graphic presentation (locally and in the cloud)
- Visualization on a large LCD display

LCD Visualization Example (see our Youtube channel)

Ibn Hayan Kindergarten



Designed & Implemented by:



Dashboard Example: normal, no consumption during day



Od 04.07.2018

Do 04.07.2018

dnes

listopad

2018

Dashboard

Solar Production

Max: 2.94 [kW]
Energy: 23.69 [kWh]

Consumption

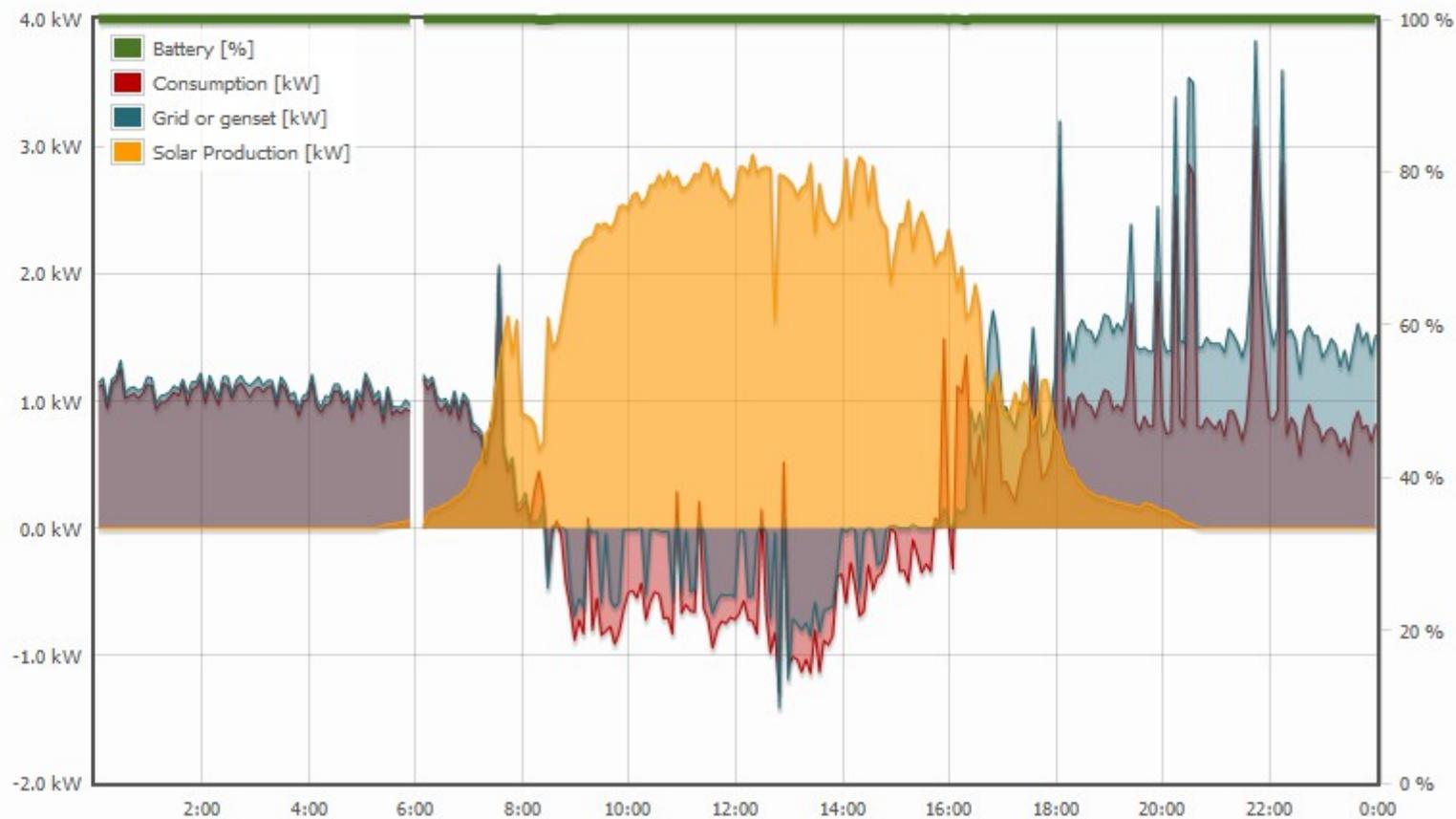
Max: 3.16 [kW]
Energy: 11.33 [kWh]

Grid or genset

Max: 3.83 [kW]
Energy: 18.13 [kWh]

Battery SOC

Max: 100.00 [%]
Min: 99.81 [%]



Graph Example: normal, consumption during day



Od 30.07.2018

Do 30.07.2018

dnes

listopad

2018

Dashboard

Solar Production

Max: 3.00 [kW]
Energy: 25.23 [kWh]

Consumption

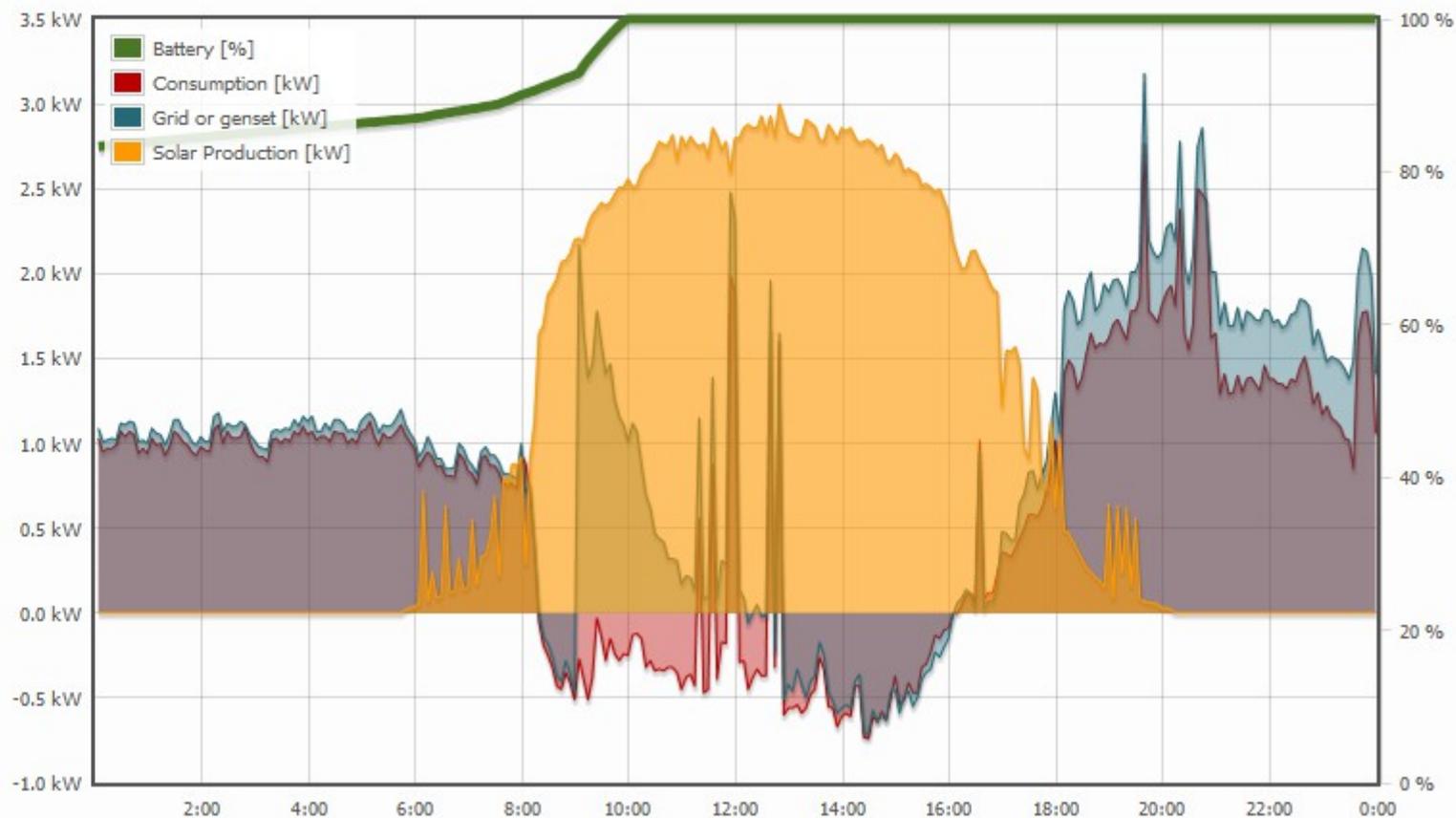
Max: 2.77 [kW]
Energy: 16.04 [kWh]

Grid or genset

Max: 3.18 [kW]
Energy: 22.24 [kWh]

Battery SOC

Max: 100.00 [%]
Min: 83.31 [%]



Graph Example: increasing consumption = ?

← ↑ → Od 27.08.2018 Do 27.08.2018 **dnes** listopad 2018

Dashboard

Solar Production

Max: 5.86 [kW]
Energy: 33.14 [kWh]

Consumption

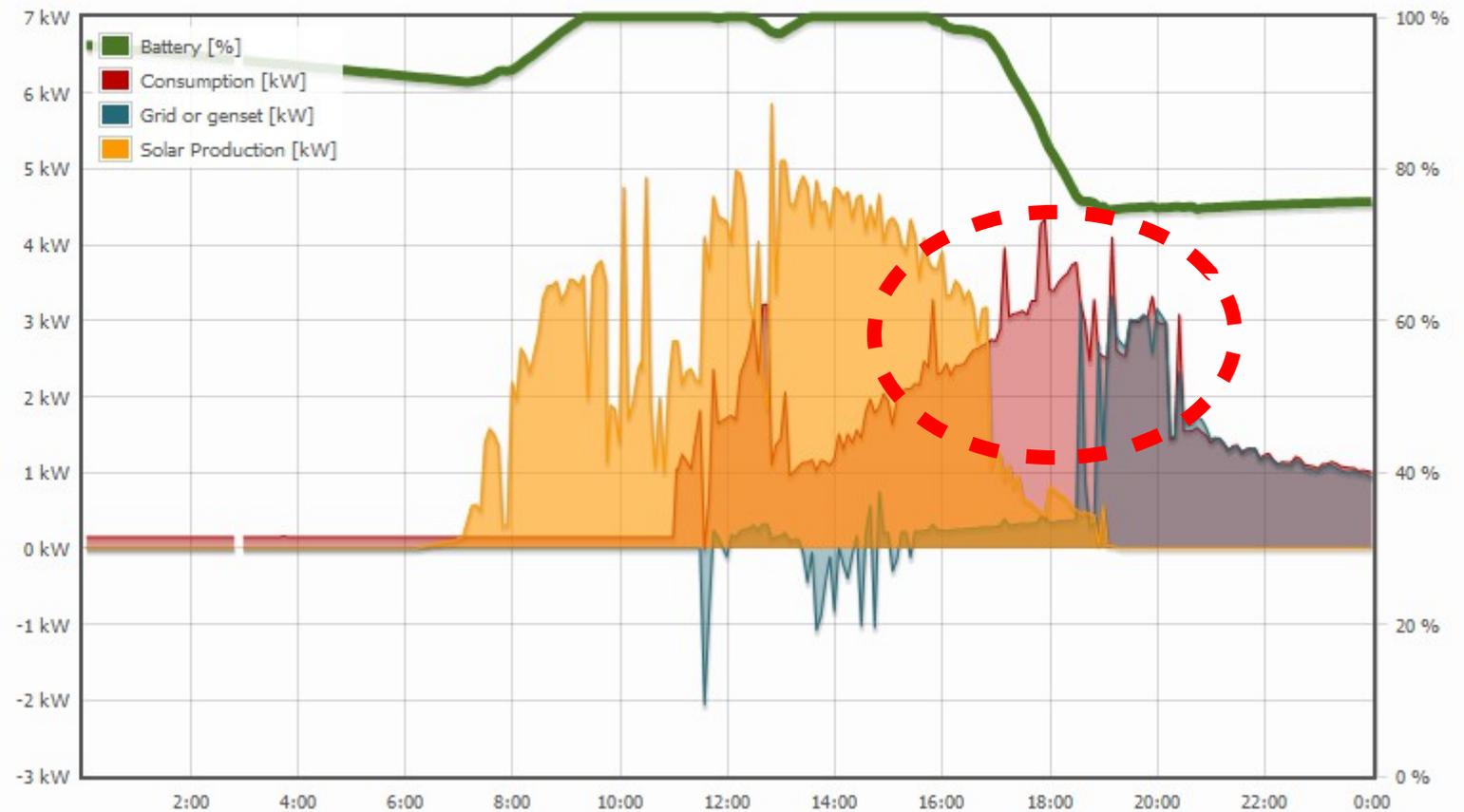
Max: 4.35 [kW]
Energy: 28.23 [kWh]

Grid or genset

Max: 3.33 [kW]
Energy: 9.62 [kWh]

Battery SOC

Max: 100.00 [%]
Min: 74.56 [%]



Graph Example: afternoon consumption discharges battery



Od 28.07.2018

Do 28.07.2018

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listopad

2018

Dashboard

Solar Production

Max: 3.34 [kW]
Energy: 13.23 [kWh]

Consumption

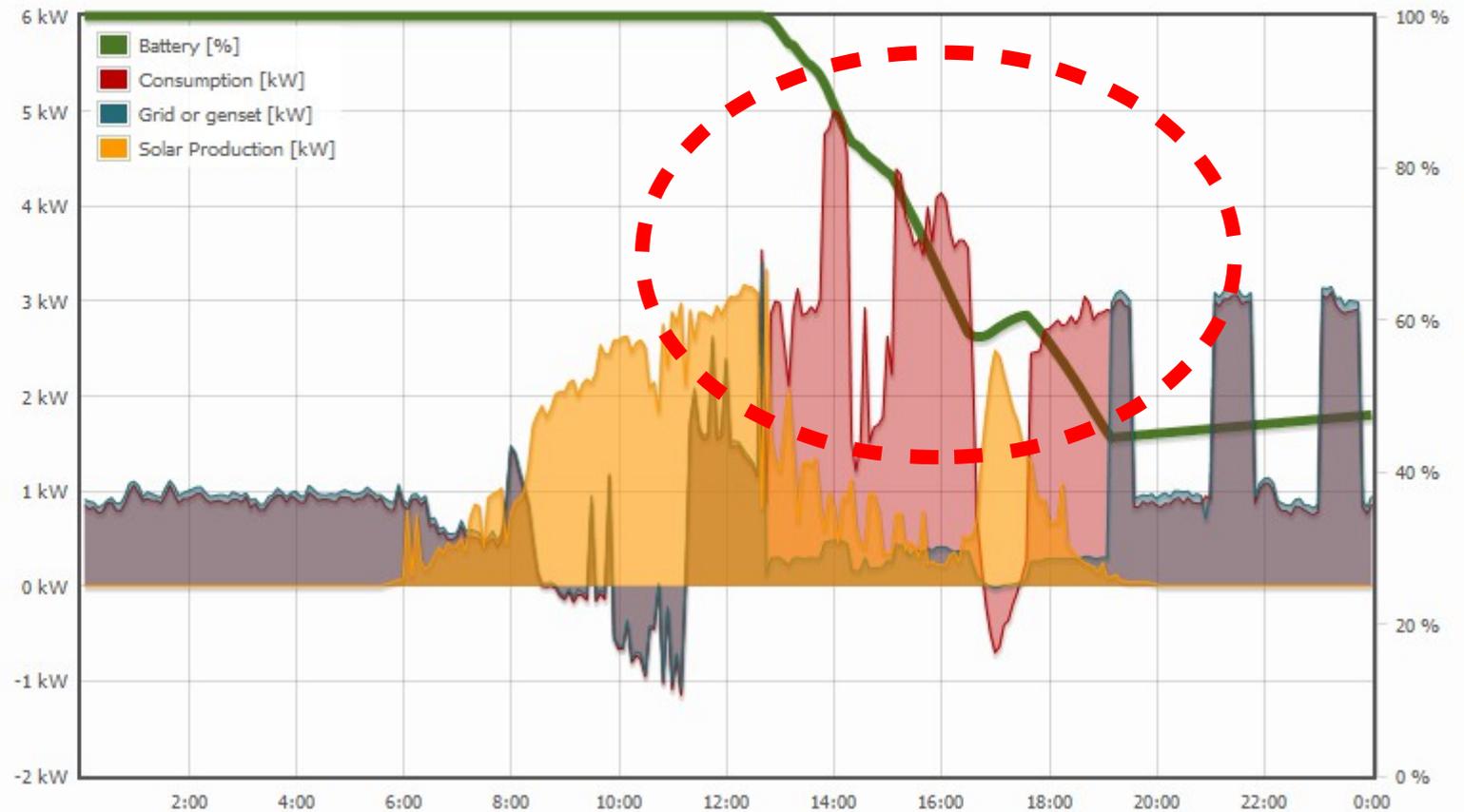
Max: 5.00 [kW]
Energy: 25.97 [kWh]

Grid or genset

Max: 3.42 [kW]
Energy: 11.88 [kWh]

Battery SOC

Max: 100.00 [%]
Min: 44.50 [%]



Graph Example: evening consumption, night peaks



Od 30.08.2018

Do 30.08.2018

dnes

listopad

2018

Dashboard

Solar Production

Max: 4.40 [kW]
Energy: 25.54 [kWh]

Consumption

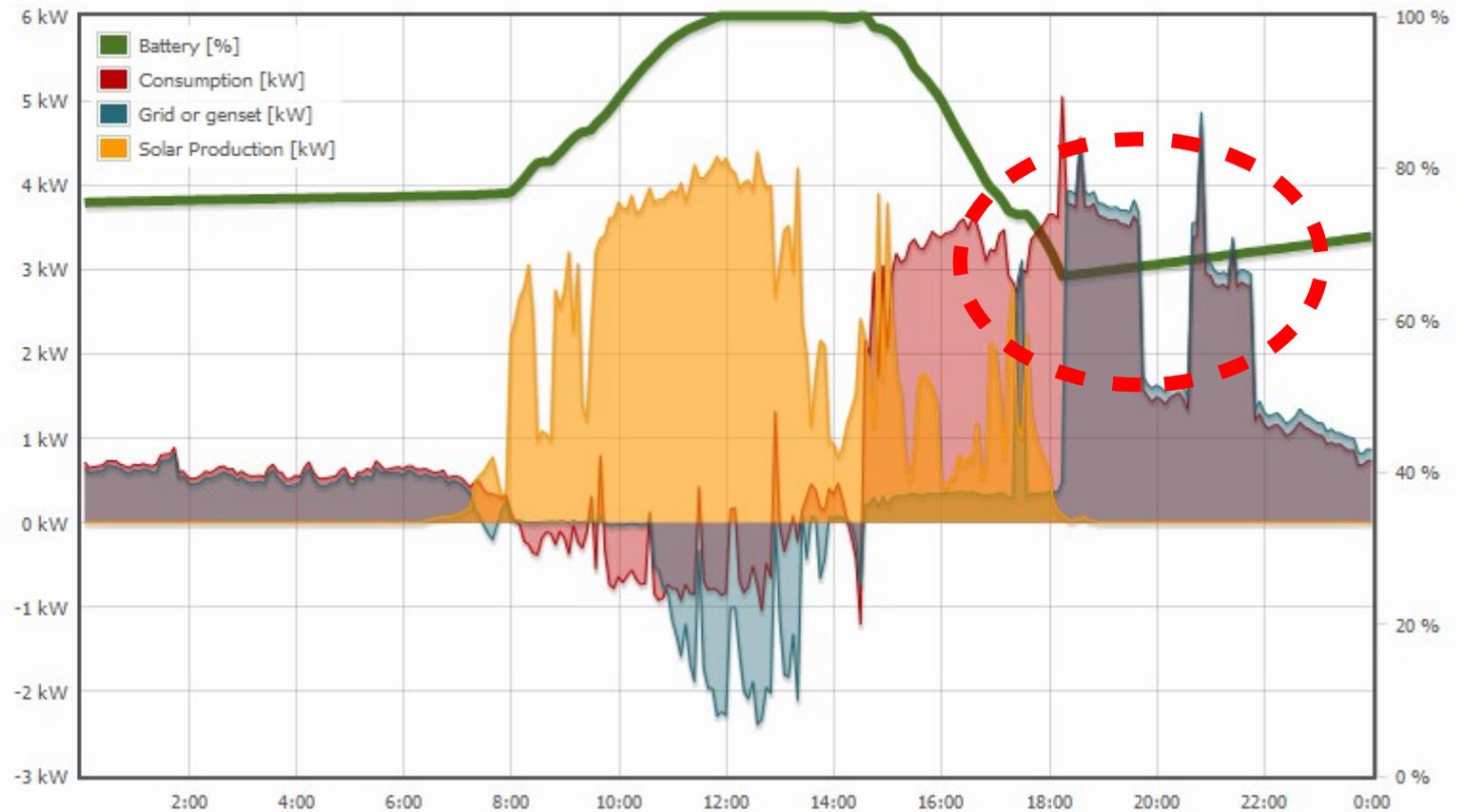
Max: 5.05 [kW]
Energy: 27.15 [kWh]

Grid or genset

Max: 4.86 [kW]
Energy: 14.68 [kWh]

Battery SOC

Max: 100.00 [%]
Min: 65.75 [%]



Graph Example: same situation + next day (charging)

← ↑ → Od 30.08.2018 Do 31.08.2018 **dnes** listopad 2018

Dashboard

Solar Production

Max: 4.40 [kW]
Energy: 45.60 [kWh]

Consumption

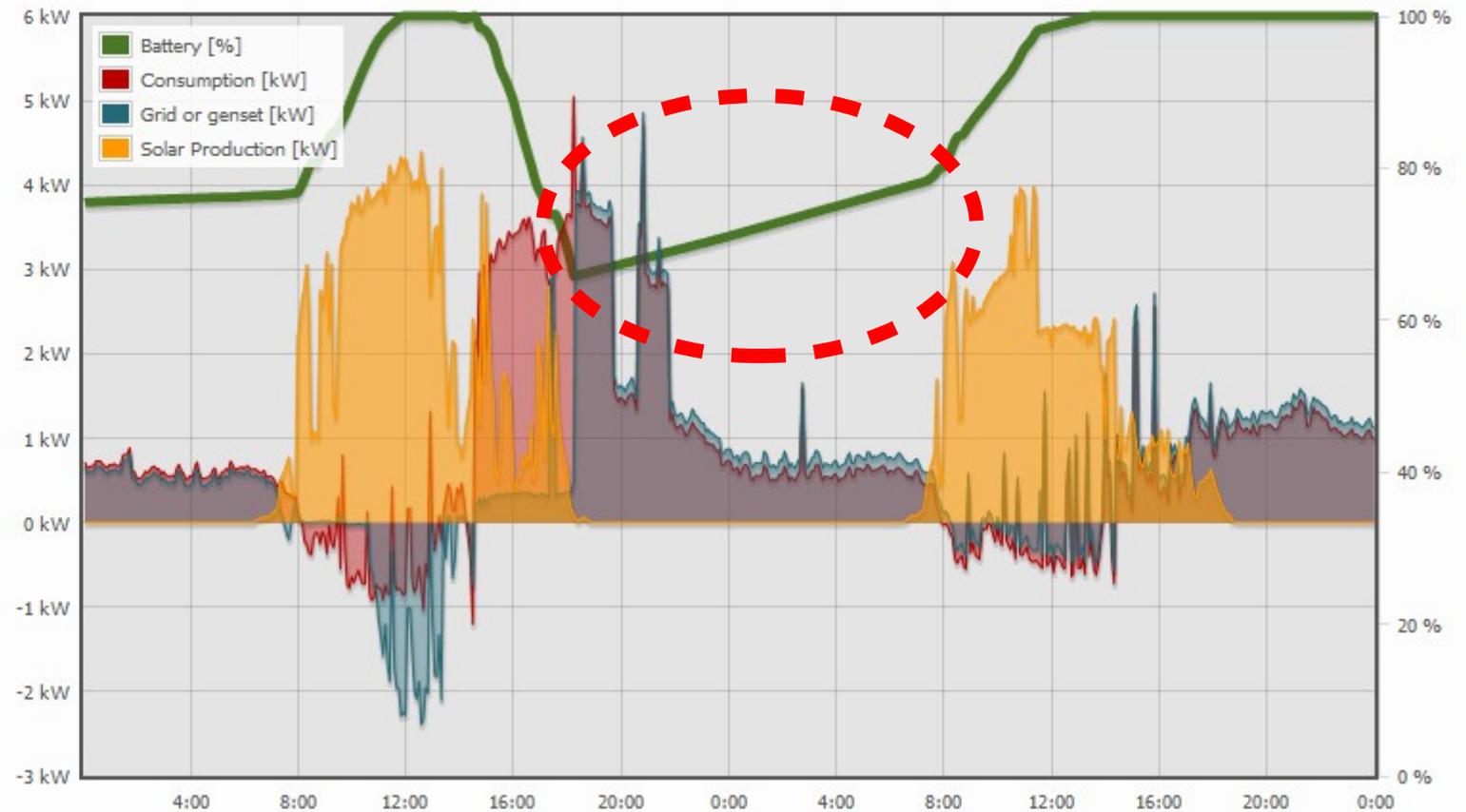
Max: 5.05 [kW]
Energy: 40.26 [kWh]

Grid or genset

Max: 4.86 [kW]
Energy: 31.26 [kWh]

Battery SOC

Max: 100.00 [%]
Min: 65.75 [%]



Any questions are welcome!

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