



## PV-Hybrid System data visualisation

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# What is IEA PVPS?



- The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD).
- The Technology Collaboration Programme was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of thousands of experts across government, academia, and industry dedicated to advancing common research and the application of specific energy technologies.



# What is IEA PVPS?



- The IEA Photovoltaic Power Systems Programme (PVPS) is one of the Technology Collaboration Programme established within the International Energy Agency in 1993
- 32 members - 27 countries, European Commission, 4 associations
- *“To enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems”*



# The idea and the concept

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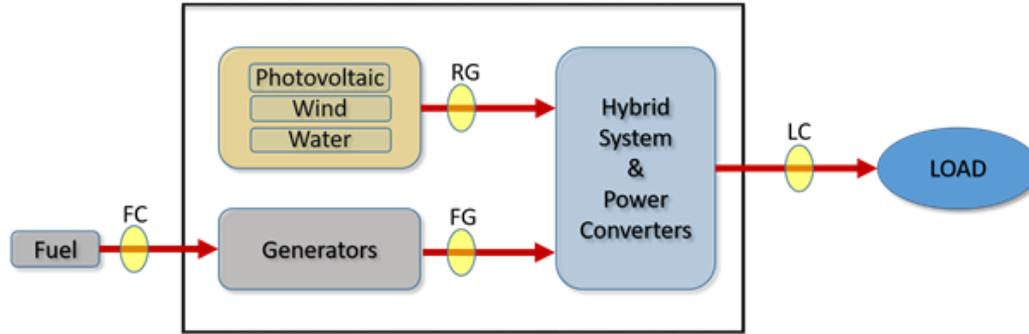


- Many PV-Hybrid systems are installed and operate without control of the performance even though datalogging is often available
- This report defines standardised easy to use data visualisation proposal
- Advantages:
  - Standardised data format and graphs
  - Easy to calculate key figures to analyse the performance
  - Easy to compare different systems
  - Easy to monitor the change of performance by the time



- Three different aspects for data visualisation
  1. Energy analyses to identify the system performance
  2. Single parameter analyses of
    - Battery voltage
    - Battery current
    - Temperature
    - State of Charge (SOC)
  3. Overall energy analyses

# 1 Energy and Performance analyses



**Genset fuel consumption**

$$\text{GFC}[\text{l/kWh}] = \text{FC}[\text{l}] / \text{FG}[\text{kWh}]$$

**Renewable Energy Contribution**

$$\text{RG}[\text{kWh}] / (\text{RG}[\text{kWh}] + \text{FG}[\text{kWh}])$$

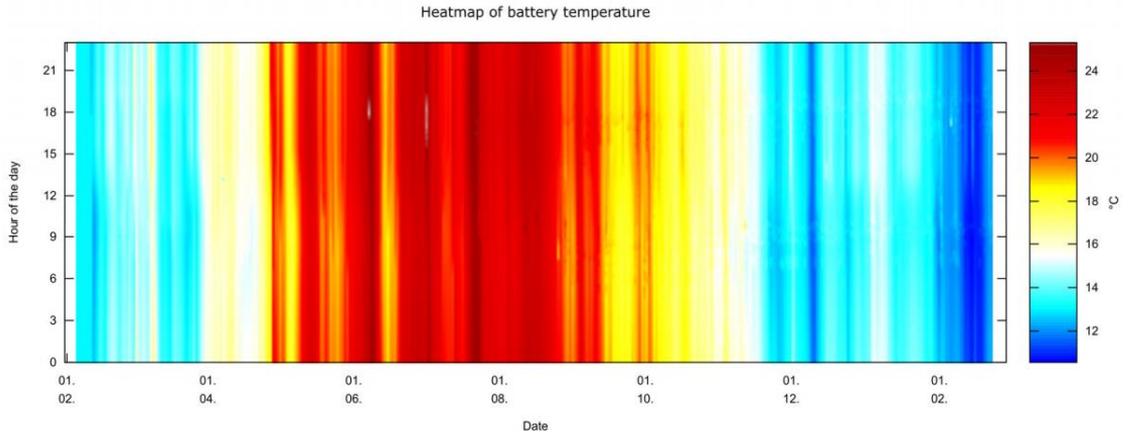
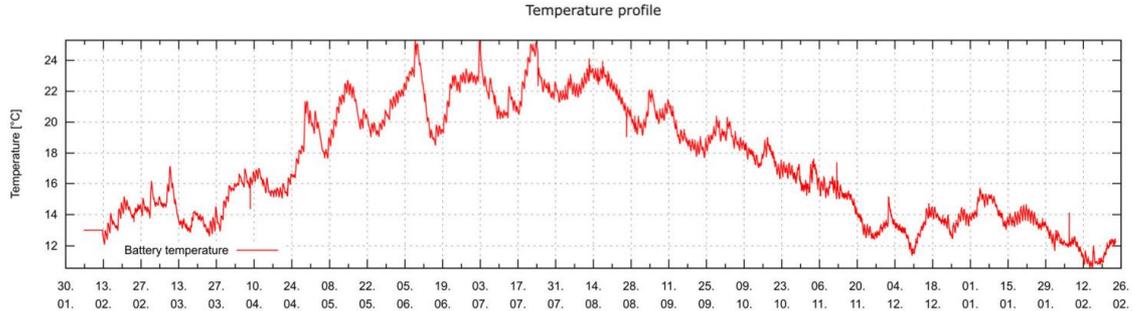
**Hybrid System Efficiency Performance**

$$\text{HSEP}[\%] = \text{LC}[\text{kWh}] / (\text{RG}[\text{kWh}] + \text{FG}[\text{kWh}])$$

# 2 Single parameter analyses



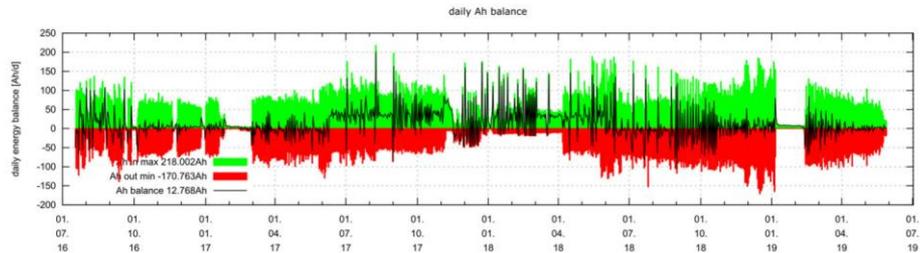
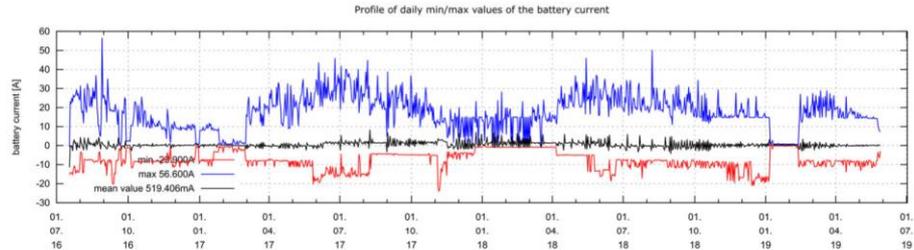
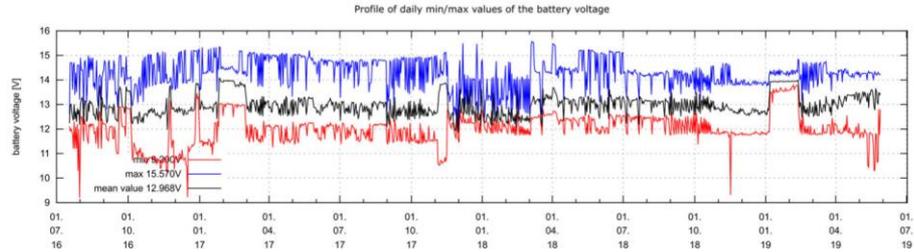
- To display the profile
- To generate a heat map
- To show the frequency distribution



# 3 Energy analyses



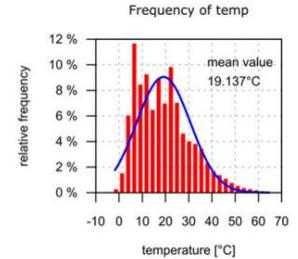
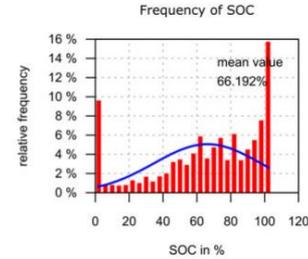
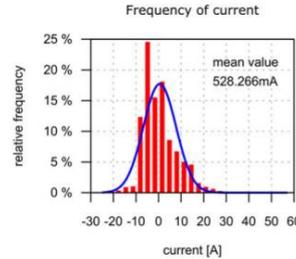
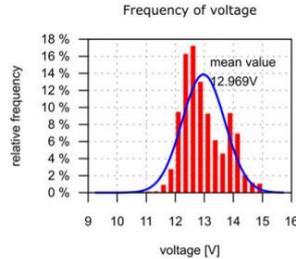
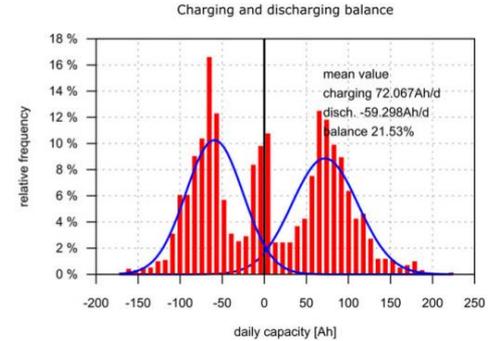
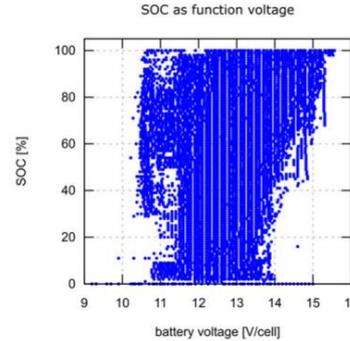
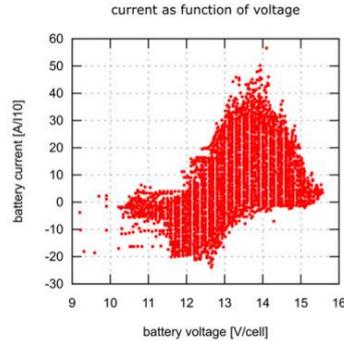
- To display the profile of battery voltage
- To display the profile of battery current
- To display the daily energy balance



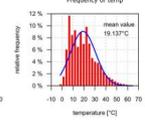
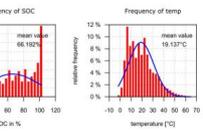
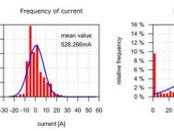
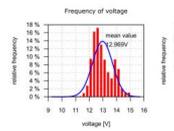
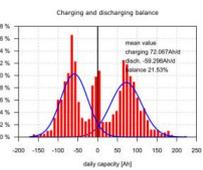
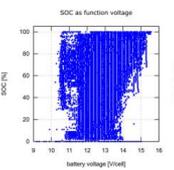
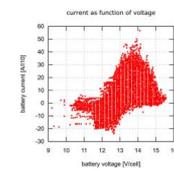
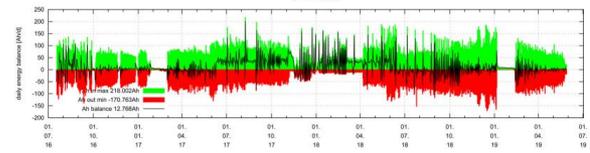
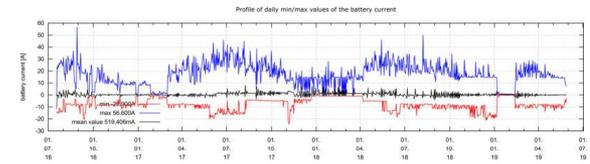
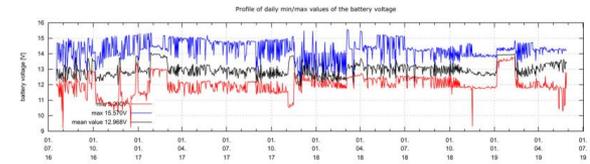
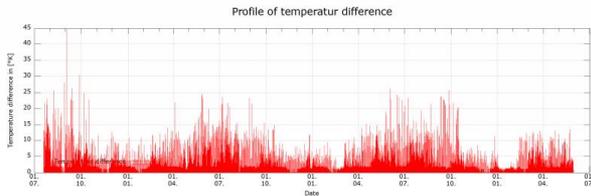
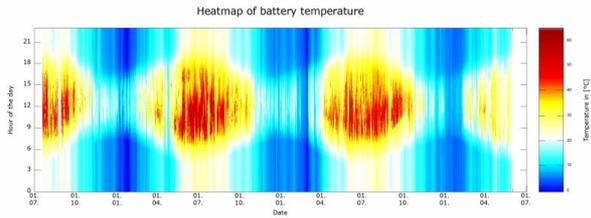
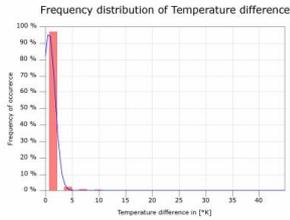
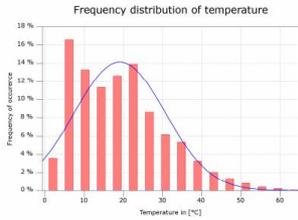
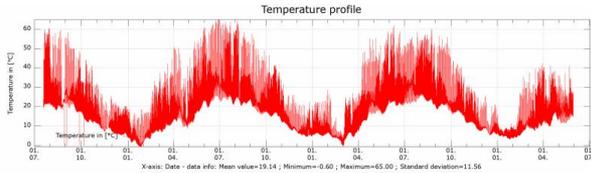
# 3 Energy analyses



- To display statistical information of
  - SOC
  - Charging behaviour
- Frequency distribution of all parameters



# Examples





- The proposed data visualisation allows a fast performance analyses
- The grafical analyses allow an easy comparison among
  - The performance during several years of operation of one system
  - The fast comparison of several systems
- The standardised data format allows fast calculations
- Within the IEA PVPS Task18 project a data analysing service is available free of costs. Please contact the author. Data conversion services can be offered accordingly.
- The work is available under ISBN



Thank you

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