PVSYST TRAINING

Using PVSYST for Grid-Connected Systems

OBJECTIVES

- Understand the effect of solar irradiation on PV production.
- Understand the PV module modelling (one diode model) for any technology.
- Characterize the components of a PV system, and their modelling implementation in PVsyst.
- Use the program PVsyst for the design and optimization of grid connected PV systems.
- Analyze system layout and shading issues.
- Design Building Integrated PV systems (BIPV).
- Design utility scale ground mount PV systems with fixed and tracking planes.
- Establish economic balances.

TARGET AUDIENCE

- PV design engineers, PV installers (with experience), PV project managers and teachers.

PREREQUISITES

- Good knowledge in electricity,
- Basic knowledge of PV system design and available technology,
- Knowledge of the PV market and industry,
- Basic knowledge of PV module and array electrical behavior,
- Basic knowledge of inverters and their operation,
- Previous experience in designing or installing one or several PV systems.

MATERIALS PROVIDED

- A hard copy of the presentation,
- A USB key with a copy of the materials that are presented in class and additional documentation,
- The PVsyst software for the duration of the training.

REQUIRED HARDWARE

Participants should bring a laptop that runs under Windows and with the latest version of PVsyst installed (available from www.pvsyst.com).

INSTRUCTORS

- **André Mermoud** is a PhD physicist and the author of the PVsyst software. He studied Energy and PV systems at the University of Geneva (CUEPE, Energy Group).
- **Michel Villoz** is an electrical engineer from the EPFL with more than 30 years of experience in PV component fabrication and PV systems design.
- **Bruno Wittmer** is a PhD physicist and worked for more than 15 years on semiconductor detectors for particle physic. He joined the PVsyst team in 2013.

INFORMATION

The PVsyst software uses extensive knowledge of PV technology, meteorological irradiation resources and PV components. However, it cannot replace the user's expertise. It is a tool that facilitates the acquisition of a deeper understanding PV systems and the optimization of their design. This training therefore includes an important section about theoretical concepts.

This course does not provide information about the PV industry, its standards and regulations, nor does it cover such topics as administrative or bureaucratic constraints, the commercial, economic or legal aspect of a project’s design.

PROGRAM

1st day:	PV modules, photovoltaic technology bases, theory about meteorological
2nd day:	Resources, PV modules and inverters modelling
3rd day:	Implementation in PVsyst using the software,
4th day:	Applications on PV system designs.

1st day: PV bases theory

Bruno Wittmer

9:00 am – 13:00 am

Welcome and presentation of participants

PV Cells and Modules

- Semiconductors
  - ✓ Semiconductor basics
  - ✓ The pn-junction and its characteristics
- PV Cells
  - ✓ Photovoltaic Effect, Working Principle of PV Cells
  - ✓ IV and PV Curves, Dependence on Irradiation and Temperature
  - ✓ PV Cell Manufacturing Technologies: Crystalline Silicon, Thin Films, New Developments
- PV Modules
  - ✓ Basic Structure of a PV Module
  - ✓ Encapsulation, Bypass Diodes, Backsheets, Glass Covers
  - ✓ Characterization of PV Modules, Measuring Standards, Data Sheets, PAN Files
- Exercises
  - ✓ Crystalline Si Modules
  - ✓ Thin Film Modules
  - ✓ First Sizing Exercise

Coffee Break

10:30 – 10:45

LUNCH BREAK 1:00 pm - 2:30 pm

Adrien Villoz and André Mermoud

2:30 pm - 6:00 pm

Solar irradiation

- Solar geometry, sun energy,
- Irradiance on an horizontal plane, available meteorological data,
- Exercises (meteo management import)

Coffee Break

4:00 – 4:15

Solar irradiation

- Irradiance on a tilted plane, sheds mounting, trackers,
- Far and near shadings,
- Calculation with PVsyst.

2nd day: PV bases theory

André Mermoud

9:00 am – 13:00 pm

PV Generator

- Actual technologies,
- Modeling – Standard model used in PVsyst ,
- Model validation (any technology),
- Incidence angle modifier,
- Module temperature,
- "Hot-Spot" – by-pass diodes,
- Electrical effect of shadings for a PV field,
- Exercises with PVsyst

Coffee Break

10:30 – 10:45

Inverters and systems

- Inverters technology,
- Features, description,
- Input and output range, security,
- Working principle,
- Grid connection, limitations,
- PV design architecture,
- Inverter and PV field sizing.

LUNCH BREAK 1:00 pm - 2:30 pm

2:30 pm - 6:00 pm

Using PVsyst

- Complete project design,
- Analysis of the simulation's report,
- Economic evaluation tool,
- Losses.

Coffee Break

4:00 – 4:15

3rd day: Applications and use of PVsyst

Michel Villoz

9:00 am - 12:30 am

Mounting and cabling of PV systems

- Roof, terrace, ground mounting.
- Shed systems and cabling.
- Mechanical design, supports, constraints.
- System design: cabling, earthing, voltage protections.
- Safety issues, high voltage, lightning protection, conductor loops.

Coffee Break

10:00 – 10:15

PVsyst simulation steps

- Minimal steps for a pre sizing.

LUNCH BREAK 12:30 pm - 2:00 pm

2:00 pm – 5:30 pm

Module performance

- Hot spot examples.
- LID, PID, TCO corrosion, other degradations...
- Module glass.
- Life time of the modules.

Coffee Break

4:00 – 4:15

PV on buildings, architectural constraints

- Sources of data.
- Architect plans: usable data for the drawing in PVsyst.
- Shading modeling.
- Simulation and choice of strings (layout).

PV on buildings, exercise

- Villa PV system.
- Simulation with roof drawing.
- Optimization of the strings cabling vs shadowings.

4th day: Applications and use of PVsyst

Michel Villoz

9:00 am - 12:30 pm

PVsyst precision

- Validation of the simulation
- Discrepancies between production and simulation

Coffee Break

10:00 – 10:15

PV in the field pre study

- Site choice constraints

LUNCH BREAK 12:30 pm - 2:00 pm

2:00 pm – 5:30 pm

PV in the fields

- Optimized pre-sizing, electrical model
- Influence of the panel mounting on the shading losses, detailed drawing
- Support choice, influence of the ground Inverter choice: criteria

Coffee Break

Flexible

PV trackers

- Example of trackers: optimization of the design on a closed surface

The end

Satisfaction survey