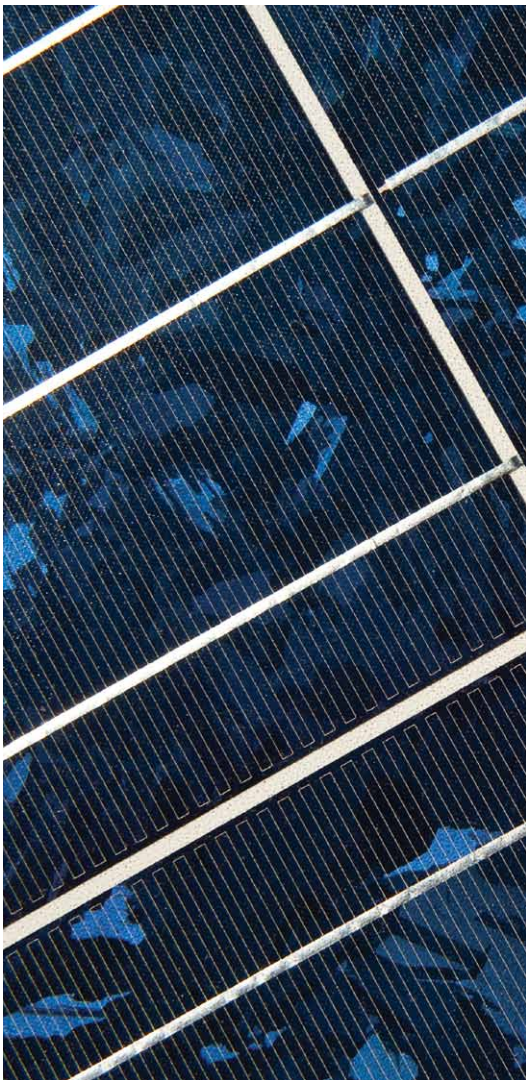
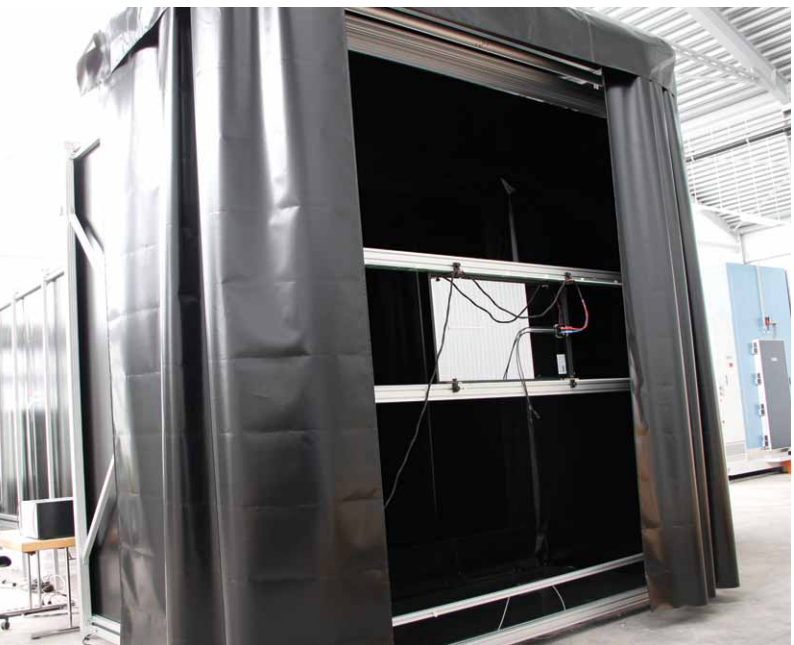
EURAC research

SoLaRE-PV

South Tyrol Laboratory for Renewable Energy – Photovoltaics

Indoor test facility for PV module characterisation according to IEC standards





Description of SoLaRE-PV laboratory

SoLaRE-PV is a laboratory of EURAC Institute for Renewable Energy for the assessment of the characteristics and performance of photovoltaic modules based on different technologies: monocrystalline silicon (m-Si), polycrystalline silicon (p-Si), amorphous silicon (a-Si), multi-junction technologies, CIGS, CIS, and other emerging technologies.

The laboratory is comprised of:

- one solar simulator (classified as "AAA" class according to international standard IEC 60904-9) which reproduces the solar spectrum with a high level of accuracy;
- one climatic chamber for the execution of thermal and humidity accelerated cycles;
- a detailed monitoring system comprised of sensors and acquisition tools to measure the physical parameters that characterise the tested module.

The PASAN SunSim 3b solar simulator is equipped with 4 Xenon flash tubes that generate a pulsed, calibrated and time-steady light.
The light travels through a black tunnel and illuminates the module, which is positioned 8 meters away on an uniformly illuminated 3x3 meters surface.
Different irradiance levels can be reproduced by attenuating the light with special masks (100, 200, 400, 700 W/m^2) placed in front of the lamps.
A tracer records the electrical response of the module measuring up to 4000 points of the I-V curve, along with other electrical parameters.

Attaching a PV module to the panel mount at the front of the solar simulator

The Angelantoni PV4500 climatic chamber is equipped with a heating, cooling, humidification and dehumidification system for the complete control of temperature and humidity conditions.
The tests are performed according to international standards IEC 61215 (crystalline silicon modules) and IEC 61646 (thin film modules), and simulate the environmental conditions under which a module is normally exposed to during its life cycle, accelerating the process of natural degradation.
By integrating climatic chamber and solar simulator testing it is possible to assess the performance degradation process of photovoltaic modules.

Technical specifications of SoLaRE-PV laboratory

Solar simulator

Non-uniformity of irradiance	≤ 1% (class A IEC 60904-9)
Pulse instability	≤ 1% (class A IEC 60904-9)
Spectral irradiance distribution	≤ ±12.5% (class A IEC 60904-9)
Max usable duration of the pulse	10 ms
Min. light intensity	700 W/m^2
Max. light intensity	1200 W/m^2
Max. light incidence angle	< ± 15° on a 3x3 meters area

List of solar simulator sensors

Measured parameter	Type of sensor	Number of sensors	Unit of measurement
Irradiance	Reference cells in monocrystalline silicon	2	W/m^2
Ambient temperature	Pt1000	1	°C
Back of module temperature	Pt100	1	°C

Climatic chamber

Temperature range	-50 ÷ 90°C
Relative humidity range	20 ÷ 95%
Useful internal dimensions (L x D x H) in mm	1300 x 1520 x 2200
Maximum capacity	10 modules
Max. temperature variation speed (from -40°C to +85°C)	1.7 °C/min
Max. temperature variation speed (from +85°C to 0°C)	1.7 °C/min
Max. temperature variation speed (from 0°C to -40°C)	1.0 °C/min

List of sensors within the climatic chamber

Measured parameter	Type of sensor	Number of sensors	Unit of measurement
Ambient temperature	Pt100	2	°C
Back of module temperature	Pt100	5 (extendable up to 8)	°C
Relative humidity	relative humidity probe	1	%

Possible operations with SoLaRE-PV

Solar simulator:

- complete measurement of a module I-V characteristic curve, according to international standard IEC 60904-1;
- calculation of short-circuit current (Isc), open-circuit voltage (Voc), shunt resistance (Rsh), series resistance (Rs), max power (Pmax), voltage and current at max power, fill factor, efficiency, current and power at desired reference voltage.

Climatic chamber:

- Thermal cycling test (according to IEC 61215 and IEC 61646): execution of 50/200 thermal cycles, with a temperature variation from -40 °C to +85 °C and a max variation speed of 100 °C/h;
- Humidity-freeze test (according to IEC 61215 and IEC 61646): execution of 10 cycles under high temperature and humidity conditions, followed by module freezing at a temperature of -40°C;
- Damp-heat test (according to IEC 61215 and IEC 61646): the test module is kept for 1000 hours at 85°C temperature and 85% relative humidity.

Stakeholders

The services offered by SoLaRE-PV laboratory are addressed to:

- module manufacturers who want to assess and optimise the performance of their products;
- system designers, distributors, installers who are willing to assess the quality, performance and durability of different PV module technologies and brands, or to test their own inventory.

Related activities

The research group of Photovoltaic Systems of the EURAC Institute for Renewable Energy is active in applied research in the field of photovoltaics in collaboration with different national and international partners from the field of research, industry, and public decision makers.

The activities include:

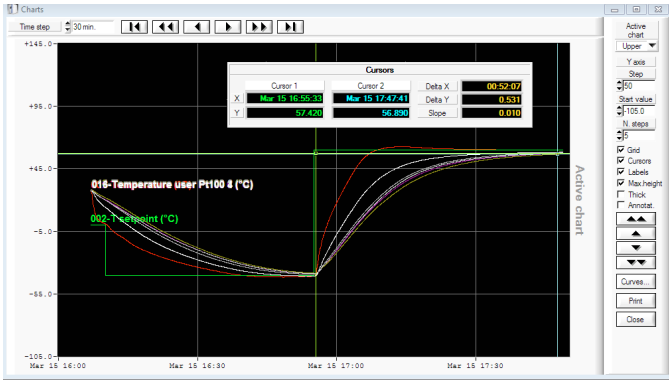
- feasibility studies of technical solutions with simulation tools;
- assessment of operational characteristic of innovative photovoltaic modules according to IEC 60904-1, IEC 61215 and IEC 61646 standards;
- development of photovoltaic products and setting of best practice, with reference to façade and roof integration sector;
- monitoring and assessment of the photovoltaic plant efficiency (ground mounted and BIPV);
- photovoltaic system performance simulation aimed at evaluating the investment;
- testing, analysis and monitoring of performance of different PV technologies at real outdoor conditions;
- indoor testing and analysis of performance of building-integrated PV systems (using a specific test facility developed at EURAC).

The research group can further profit from monitoring data of several multi technology installations set up with different partners, including over 20 photovoltaic technologies.

Changing the attenuation masks of the flash box at the rear of the solar simulator

Solar simulator software: visualisation of the I-V curves

Placing the PV test modules into the climatic chamber



Climatic chamber software: visualisation of temperature curves

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EURAC
Viale Druso/Drususallee 1
39100 Bolzano/Bozen – Italy
www.eurac.edu

EURAC Institute for Renewable Energy
Via Luis-Zuegg, 11 · 39100 Bolzano/Bozen – Italy
Tel. +39 0471 055 600 · Fax +39 0471 055 699
renewable.energy@eurac.edu

EURAC Institute for Renewable Energy is involved in several projects on a national and international level. Furthermore, it collaborates with industry partners in developing innovative products and assessing technological solutions. The Institute supports the development of complex energy systems, such as Net Zero Energy Buildings, promotes technologies related to renewable energy and provides bespoke scientific consultancy for policy makers.
Scientific results are obtained through testing carried out both in the laboratory and on-site (through monitoring campaigns of buildings and systems with solar energy). Dynamic simulation tools are widely used as well.