



# FOSS Research Centre for Sustainable Energy University of Cyprus

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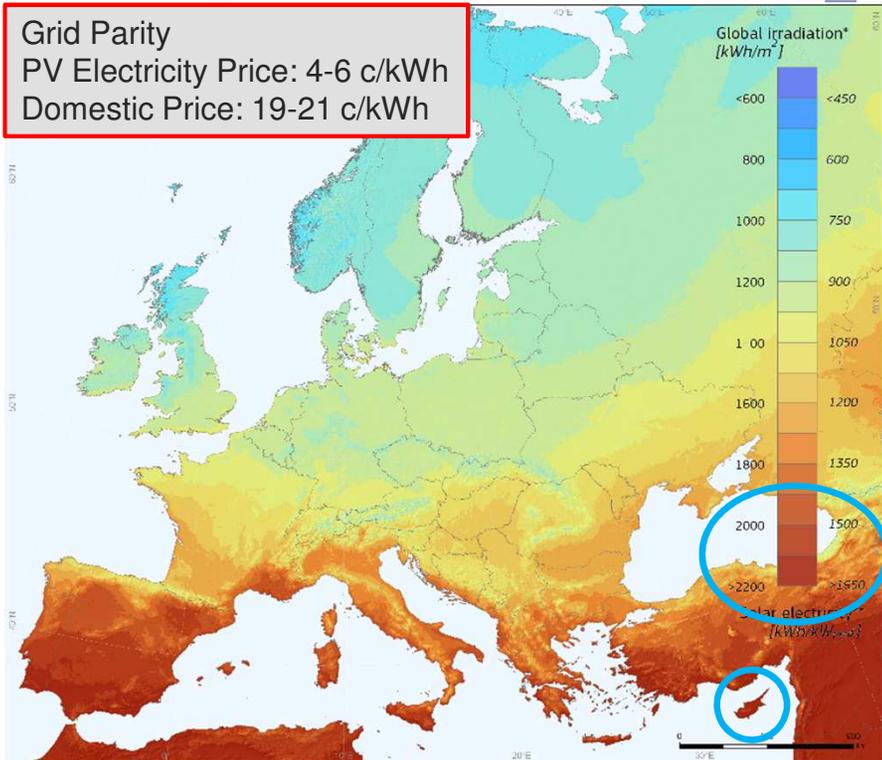


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# Cyprus



# Solar Potential in Cyprus



Urban area Yearly sum of solar electricity generated by 1kW system with performance ratio 0.75 [kWh/kW<sub>p</sub>·year]

1350 1425 >1500

1800 1900 >2000 Yearly sum of global irradiation [kWh/m<sup>2</sup>]

Solar resource of Cyprus

$$2000 \frac{\text{kWh}/\text{m}^2}{\text{year}}$$

Annual PV energy yield of Cyprus :

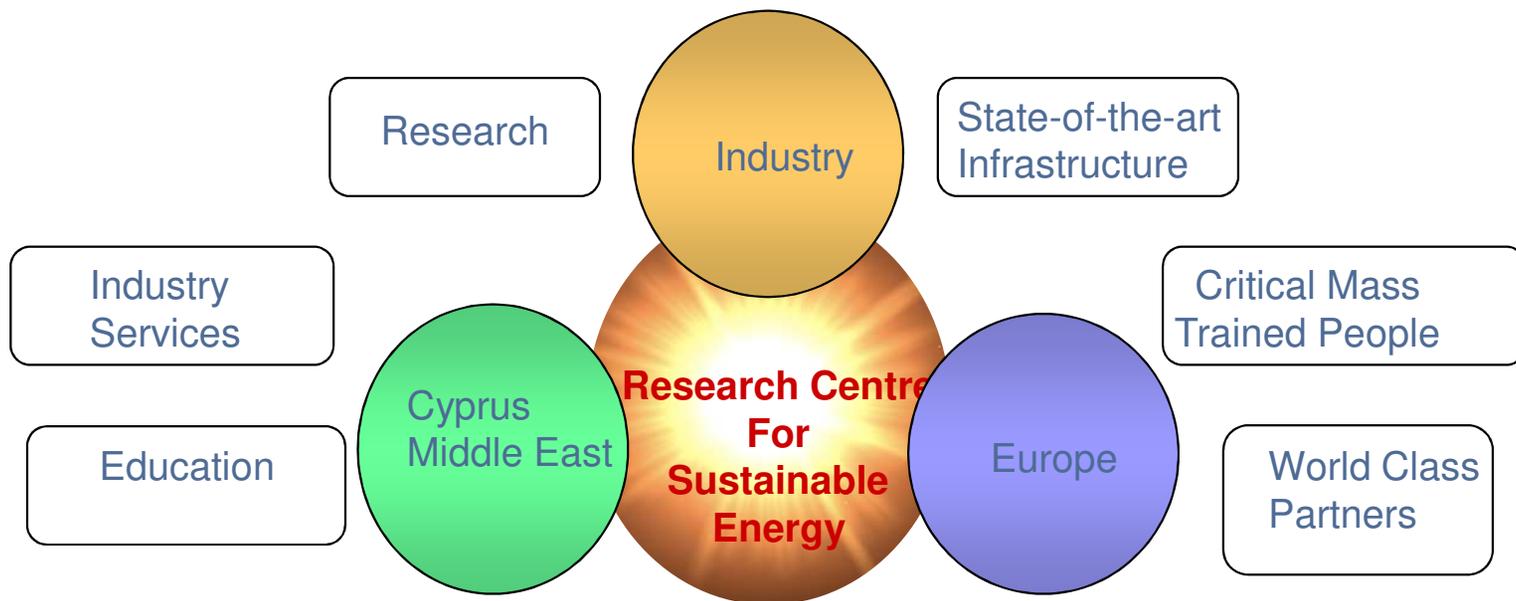
$$1600 - 1700 \frac{\text{kWh}}{\text{kW}_p}$$

# Potential of Roof-Top Systems

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## FOSS in a nutshell



**Core Research Themes:** Renewables (solar energy), smart grids, storage, grid integration, integrated solutions, societal impact

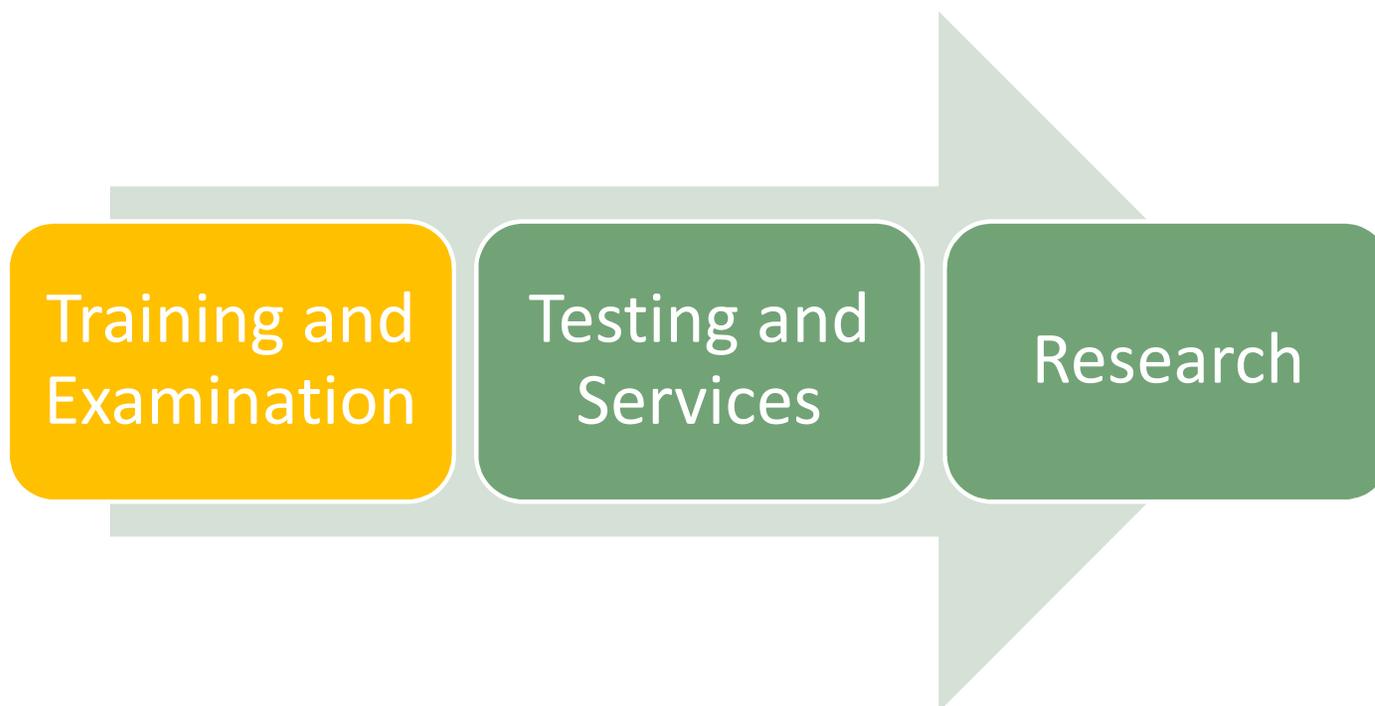
## Highlights of FOSS

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## FOSS Activities

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## Academic courses

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### **ECE447: Renewable Energy Sources: Photovoltaics**

This course covers theoretical and practical aspects of photovoltaic technology and in particular introduces students to aspects of solar generation, technology characteristics, design principles and system types.



### **ECE687: BIPV - Towards nearly zero energy buildings (NZEB)**

This course covers theoretical and practical aspects of building integrated photovoltaics (BIPV) in the domain of nearly zero energy buildings (NZEB).

# Vocational Training - Photovoltaics

The courses cover theoretical and practical aspects for trainees to develop skills and understanding on the design and installation of both grid-connected and stand-alone photovoltaic (PV) systems alongside with new and innovative topics such as self-consumption, smart meters, storage and PV applications such as pumping, solar desalination, PV system performance assessment etc.



**University of Cyprus PV Technology**

### PV System Inspection and Performance Testing according to EN 62446

**Objectives**

Ensuring the long-term quality and safety of a PV system is an essential requirement in order to achieve the best performance and to minimize risk of failure. In addition, the electric installation of various components is of utmost importance, as it affects whether the system complies with current and equipment manufacturers' provisions in the local installation rules.

This course covers theoretical and practical aspects for trainees to develop skills and understanding on the minimum requirements for documentation, commissioning and operation of grid-connected PV systems, according to IEC 62446.

Candidates will have the opportunity to operate professional status of the art equipment (thermal imager in a few meters distance) and to be trained by worldwide recognized personnel.

**Outcomes**

Upon completion trainees will be expected to be able to:

- Identify the main types of PV system inspection and testing
- Understand the specific requirements for inspection and documentation in accordance to EN 62446
- Demonstrate ability to perform PV system inspections and conduct performance assessments for grid-connected PV systems.

**Practical Competency**

On-site training: 2 days (14 hours)  
 Practical work: Experimental work: 2 day (14 hours)

Required for:

- PV installers and designers
- Technical technicians and engineers
- Quality of engineering

**Prerequisites**

- 1 Year (12 units)
- Electrical apprenticeship
- Practical work comprised of the following departments:

Experiment 1: Minimum testing in compliance to EN 62446  
 - Commissioning and operation of the string inverters, junction and performance  
 - Commissioning and operation of the solar meters, smart meters, energy storage  
 - Commissioning and operation of the solar pumps  
 - Experiment 2: Insulation and documentation in compliance to EN 62446

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**University of Cyprus PV Technology**

### PV System Designer and Installer

**Objectives**

This course covers theoretical and practical aspects for trainees to develop skills and understanding on the design and installation of both grid-connected and stand-alone photovoltaic (PV) systems alongside with new and innovative topics such as self-consumption, smart meters, storage and PV applications such as pumping, solar desalination, PV system performance assessment etc.

The course covers theoretical and practical aspects for trainees to develop skills and understanding on the minimum requirements for documentation, commissioning and operation of grid-connected PV systems, according to IEC 62446.

Candidates will have the opportunity to operate professional status of the art equipment (thermal imager in a few meters distance) and to be trained by worldwide recognized personnel.

**Outcomes**

Upon completion trainees will be expected to be able to:

- Design, install and commission both grid-connected and stand-alone PV systems
- Commissioning and operation of the PV systems
- Understand the specific requirements for inspection and documentation in accordance to EN 62446
- Demonstrate ability to perform PV system inspections and conduct performance assessments for grid-connected PV systems.

**Practical Competency**

On-site training: 2 days (14 hours)  
 Practical work: Experimental work: 2 day (14 hours)

Required for:

- PV installers and designers
- Technical technicians and engineers
- Quality of engineering

**Prerequisites**

- 1 Year (12 units)
- Electrical apprenticeship
- Practical work comprised of the following departments:

Experiment 1: Design of Maximum Power Point Controller and PV systems using the solar inverter  
 - Experiment 2: Self-consumption and commissioning of grid-connected and stand-alone PV systems  
 - Experiment 3: PV system performance assessment and commissioning

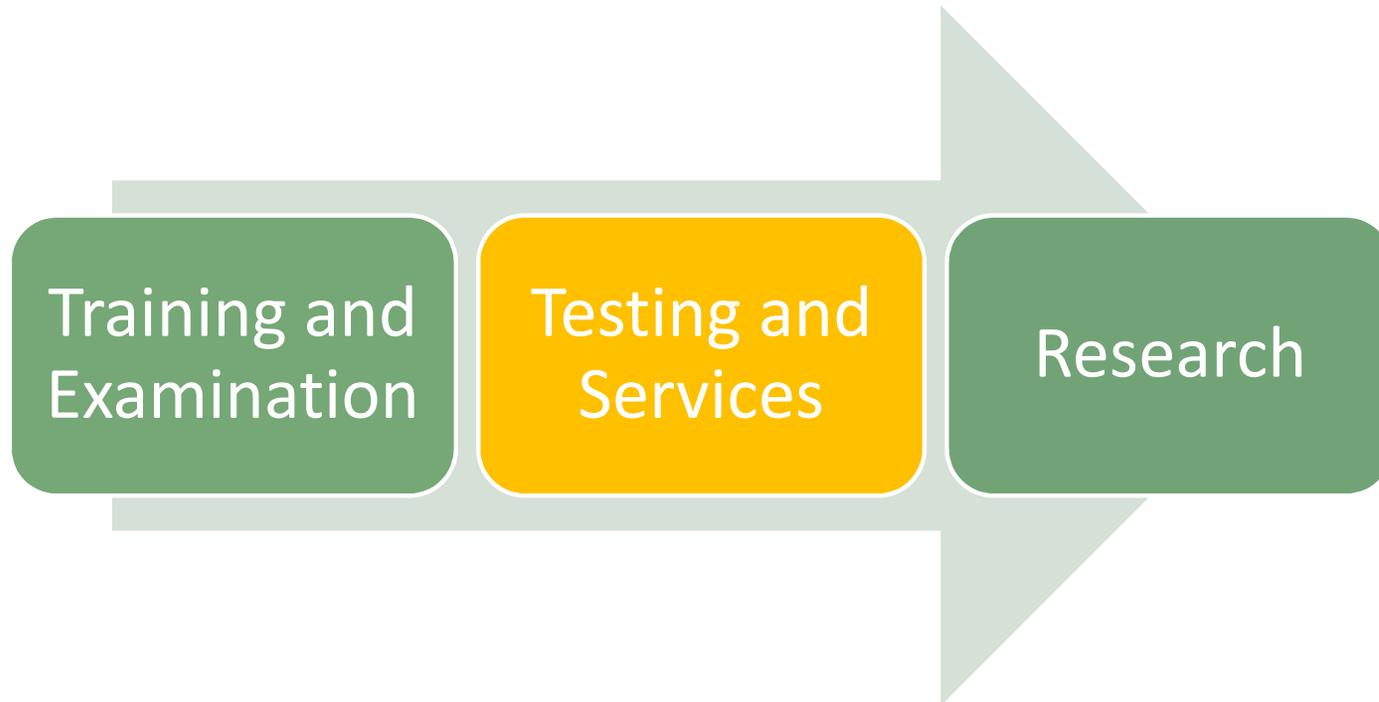
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## FOSS Activities

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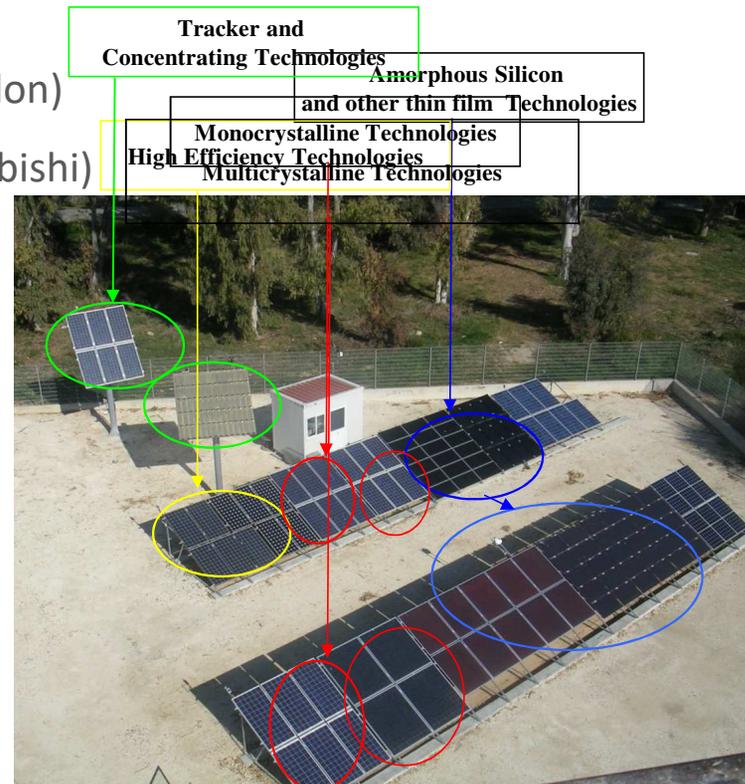
## Reliability Outdoor Facilities



Project Funded by the German Federal Ministry for the Energy, Environment and Nature Conservation (BMU).

## PV System Technologies

- Monocrystalline Silicon (Atersa)
- Multicrystalline Silicon (SolarWorld, Solon)
- Amorphous Silicon (Schott Solar, Mitsubishi)
- EFG and Main (Schott Solar)
- Saturn Cell (BP)
- Back Contact Cell (Sunpower)
- HIT (Sanyo)
- Cadmium Telluride (First Solar)
- Copper Indium Diselenide, CIS (Wurth)
- Tracked System
- Concentrator System (Concentrix Solar) Funded by the German BMU



# UCY Outdoor Infrastructure



## Other Infrastructure



## Indoor Characterisation (Module)



UV  
Simulator



Climatic Chamber



Solar Simulator

Infrastructure suitable for IEC 61215, 61646 and 62108 testing

## Indoor Characterisation (Cell)

### Spectral response setup

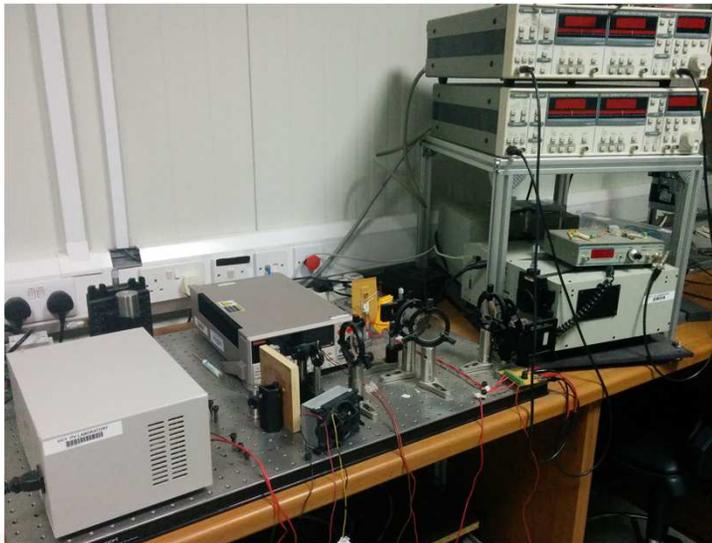
- Single – triple junction PV cells
- Spectral response (359nm – 1800nm)
- Quantum efficiency of PV cells

### Cell Characterisation

- I-V curve acquisition
- Temperature coefficient measurements

### Lens Characterization

### Electroluminescence/Photoluminescence



## Before and after... First PV research infrastructure in Cyprus



### Then

Funds: 0

People: 0

Equipment: 0

### Now

Funds: 18 MEuros

People: 50

Equipment: Indoor and  
outdoor infrastructure



## Open Doors Event



## Testing site

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Official testing site for over 40 different manufacturers:

**Honeywell**

**Q CELLS**  
Engineered in Germany



**CONERCON**  
ENERGY SOLUTIONS

**tsmc solar**

**SunTechnics**

**oerlikon**



**REC**  
Solar

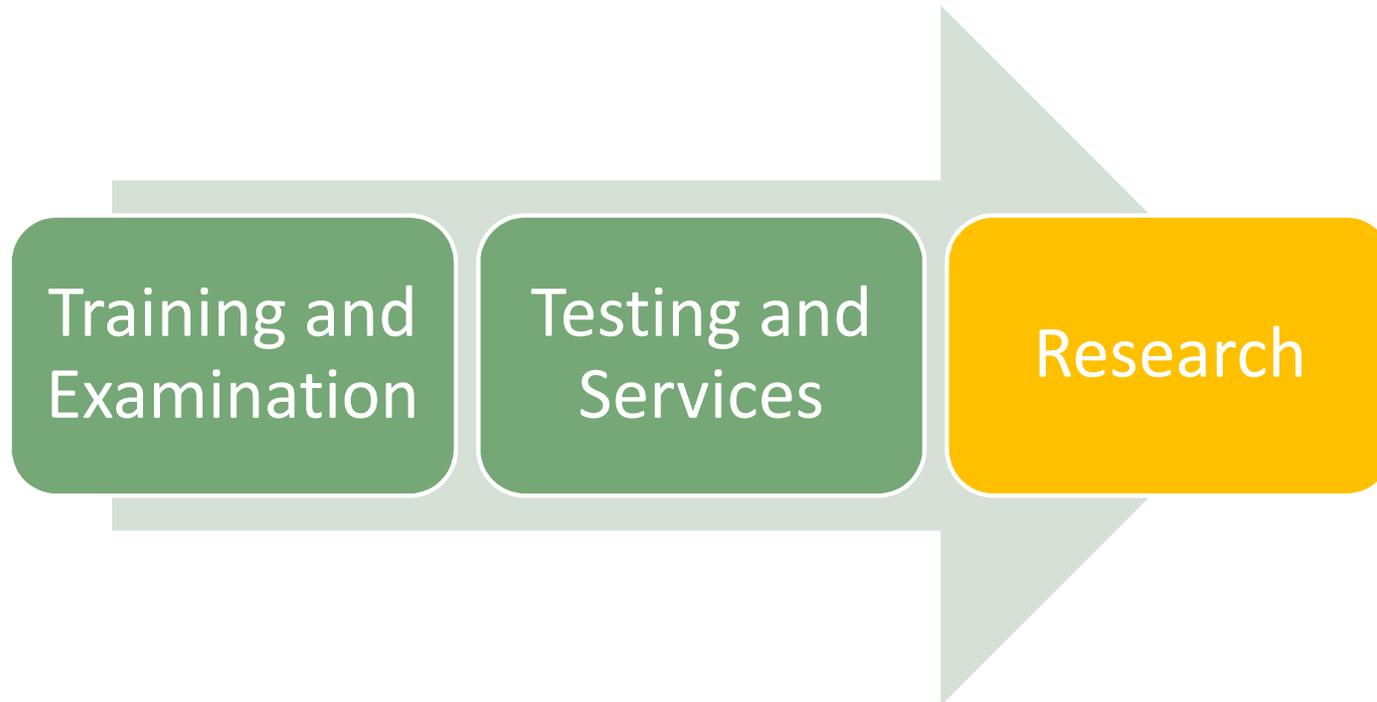
**SCHOTT**  
solar



**SOLARWORLD**

## FOSS Activities

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## Main Research Areas

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**PV performance and modelling: reliability, degradation, and performance of PV technologies, system issues as well as building integration.**

**Grid integration issues, control techniques, distributed generation and market tools.**

**Energy management systems, smart grids, storage, demand side management and energy forecasting.**

