

The Cyprus Institute (CyI) has been developed as an international science and technology organization, to strengthen the research community of Cyprus, help transform its economy to a knowledge-based economy and to create a research hub for the Eastern Mediterranean region. For realizing its vision the Institute is developing pioneering research infrastructures and programmes involving cutting-edge, high throughput technologies, in order to address problems of local and regional significance and of international interest and providing high quality graduate education and training in related areas. The research conducted at the institute will continue to be relevant to many important scientific and technological areas and challenges relevant to Cyprus, as well as to regional and international society. The research thrusts of CyI include:

- Solar energy research and solar desalination
- Renewable energy sources and synergies with natural gas exploitation
- Environment and environmental monitoring
- Climate change and climate impact assessments
- Energy conservation with a focus on the built environment
- Natural Resources and water management
- High performance computing and its applications
- Visualization technologies
- Digital cultural heritage and digital libraries for use in Culture and Education.
- Cross-disciplinary approaches and technologies to archaeological sciences, bioarchaeology and cultural landscapes.
- Enabling technologies for Culture and Tourism.

CyI offers two (2) infrastructures for the TA in this project:

- The **LiFE FRESNEL facility** is a Fresnel solar collector with a light structure integrated onto a building to support air-conditioning with the help of an absorption chiller and thermal storage. The facility is operational since July 2016. The facility provides a test-bench for conducting under realistic conditions, experiments geared at the development improvement and utilizations of Solar Energy in the built environment sector. The facility offers meteorological data in parallel to experiments. It consists of a The primary reflector is constituted by 288 mirrors, arranged in 18 rows, driven thanks to 72 DC motors controlled by 18 PLCs (SIEMENS 1214C). Dimension of each mirror is 0.32m x 2m. The mirrors are parabolic with a focal distance varying from 3.8m to 5.9m, according to the distance to the absorber. The global reflective area is 184.32 m². Reflectivity of the mirrors is superior to 92%. The field is oriented North-South with a 32 m long receiver including 8 absorbers in series under vacuum. The receiver is located at 3.7m above the roof level. A parabolic secondary reflector (90% reflective) is located on top of the receiver. The heat transfer fluid is oil (Durathem 450S) working at up to 180°C. A master PLC controls the PLCs for the motors and the pump of the oil. A weather station records data on the nearby building (Temperatures, wind speed, wind direction and DNI) and the DNI every second.
- The **Athlassa's Heliostat Testing Laboratory (AHTLab)** was established in 2013 in CyI's Headquarters in Nicosia with objective to experimentally test heliostat performance and novel technologies relating to heliostat tracking. The facility consists of two heliostats, each with a single facet of 4.5 m² reflective area and a focusing distance of 35 m, along with a 12m high tower with a 2x2 m lambertian target. The laboratory has access to local meteorological data, including DNI. Additional instrumentation consists of an industrial camera with neutral density filters used to observe the heliostat image on the target to determine tracking errors. This laboratory is currently used for quantification of tracking errors, determination of heliostat shape through photogrammetry, and validation of ray-tracing codes. New areas of investigation include development of new tracking mechanisms and electronics for heliostat control.

Services currently offered by the infrastructure:

The services offered at the **LiFE facility** are:

- **Outdoor optical and thermal performance of Linear Fresnel receiver.** CyI can offer an access to the facility including reflectometry measurements as well as thermo-sensors for the identification of heat transfer model (ISO 9806, quasi-dynamic). This facility hosts visitors for onsite experimentation to work on the reflectivity assessment of the primary reflector and asset the effect

of the dust on the efficiency. The users also worked on the identification of the steady-state model of the absorber. A thermal camera, a weather station and a pyrliometer are also available.

- **Linear Fresnel control algorithms.** The Fresnel collector hosted visitors for the tuning of the control of the motors to enhance the tracking strategy of the primary reflector. The facility is unique in the sense that it is an easily accessible facility and fully monitored. Also the facility offers a unique configuration with 72 DC motors that allows flexible control strategies for tracking unlike Fresnel collectors on which several rows are mechanically connected to the same gear.

The services offered at the **Athalassa Heliostat Testing Laboratory** are:

- The Athalassa Heliostat Testing Laboratory provides users with access to heliostat hardware to test their own **control algorithms for heliostats.**
- The facility includes an instrumented lambertian target and video monitoring that can be used to **determine the effectiveness of the tracking algorithms or feedback methods developed.**

Several groups on the European level are working on developing both heliostat tracking algorithms and closed-loop feedback systems for heliostats, which need to be tested on a laboratory scale to verify their performance.

Name of the infrastructure: PROTEAS – 4 installations : Exposure, Msloop, receiver, MED

Location (town, country) of the infrastructure: Pentakomo, Cyprus

The **PROTEAS Facility** is one of the most complete research and development facilities in Cyprus devoted to concentrating solar thermal energy systems. The facility uniquely combines ideal environmental conditions with a seaside environment for research, development and testing of technologies related to Concentrated Solar Power (CST), Solar Thermal Energy (STE) and thermal Desalination of Sea Water (DSW). It consists of a field of 50 heliostats with a total reflective area of 250 m², concentrating the sun's light more than 800 times on a point and delivering a peak power of 150 kW of thermal energy. The field layout efficiently utilizes the hilly terrain with a high-density placement of heliostats. An 18-meter tall tower with multiple experimental stations is available for the central receiver placement and experimental work as well as distribution network for sea water intake and discharge for desalination experiments. Continuous monitoring of environmental conditions is available through a fully automated weather station.

The true strength of the PROTEAS Facility is the versatility it provides for the researchers and experiments hosted there via:

- Solar Receiver – iSTORE: A novel solar energy receiver that converts solar radiation into heat and simultaneously store it is being developed. The Integrated Storage and Receiver device is a proprietary development pioneered at the Cyprus Institute.
- Energy Storage: Experimentation in thermal energy storage is pursued in order to maintain continuous supply of electricity throughout periods of cloudiness and during night-time. The energy is stored in a molten mixture of salts that can reach temperatures of 560 °C and acts as a battery releasing thermal energy per the operational strategy of the plant.
- Solar Desalination: A steam engine produces electricity and a thermal desalination unit (Multi Effect Distillation) is used for seawater desalination. Both devices work continuously to supply the end customer with two essential products: electricity and water directly from the sun. This versatile facility complements the research carried out at CyI's Athalassa campus, providing a test-bed for testing under realistic conditions experiments developed through The Cyprus Institute's various research activities. Additionally, in the spirit of collaboration the facility is open to the international scientific community on a merit based priority scheme.

Services currently offered by the infrastructure:

The **PROTEAS facility** is located in challenging conditions close to the sea in a semi-arid island environment. The infrastructure is supported by qualified scientists, engineers and technicians, who operate a fully tooled machine shop. The facility is regularly hosting visitors for onsite experiments (3-4 visitors per year).

The visitors for instance tested sensors prior to their installation into an experimental facility, both hardware and software. Support in terms of machining implementation and electronic developments were also provided.

