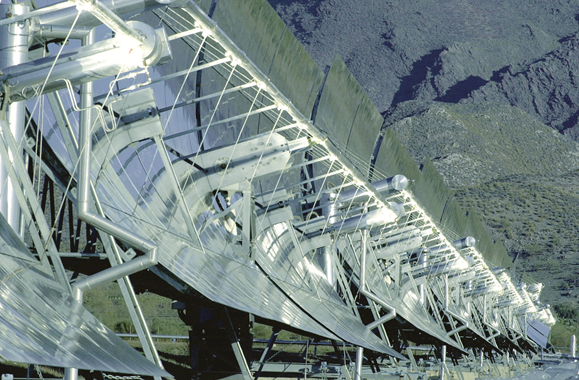
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| Didactic Guide  Solar thermal Systems and Applications for water heating and industrial process heat |

*SIDS DOCK in cooperation with PCREEE, CCREEE and ECREEE.*

*Developed with key technical support of UNIDO and CIEMAT.*

*With the financial support of AECID and ADA.*

# Didactic Guide

## Solar thermal Systems and Applications for water heating and industrial process heat

## OBJECTIVES

### General Objective

* The purpose of the Solar Thermal Energy Module is to provide a general overview of the potential applications that solar thermal technologies have. Starting from physics fundaments on which these technologies base up to offering an outline for developing new approaches, the students will acquire the capability to define and design, at an elementary level, some solar thermal systems for a specific location.

### Specific Objectives

* Understanding the availability of solar resources for solar thermal technologies in a specific location, in order to define, briefly, the potential these technologies have
* Defining the type of solar thermal systems that can be implemented for a specific application and location, identifying the main components these systems have
* Understanding the way solar thermal systems work and their potential integration with other conventional thermal systems
* Defining and elementary designing solar thermal systems

## MODULE STRUCTURE

1. **Introduction**

Solar radiation

The solar spectrum. Components of solar radiation

1. **Solar Radiation Databases**
2. **Energy Balance in a Solar Thermal Collector**

Thermal functioning of a solar thermal collector

Energy transfer mechanisms

Radiation

Conduction

Convection

1. **Solar Thermal Systems: from the Flat Collector to Concentrating Dishes**

Low-temperature collectors (below 125ºC)

Medium and high-temperature collectors

1. **Solar Domestic Hot Water and Heating**

Possible configurations

Direct Systems

Indirect systems

Thermosyphon or natural circulation systems

Compact systems

Orientation and inclination of the collectors

Solar heating

1. **Solar Cooling and Air Conditioning**

Closed-cycle thermal cooling equipment

Open loop solar cooling

Development in Latin American and Caribbean countries

1. **Solar Industrial Process Heat**

Keys to Integrating Solar Plants

Process temperature

Energy flux transfer medium

Consumption profile

1. **Linear Focus Technology: Parabolic Troughs and Fresnel**

Parabolictrough collector components

Fresnel-type linear concentrators

Applications

Linear focus collector plants

Predesign of the solar field

1. **Focal Point Technology: Central Receiver Power Plants and Parabolic Dish**

Central receiver or power tower systems

The solar field

The receiver

The thermal energy system

Parabolic dish systems

1. **Thermal Storage**

Sensible heat storage

Sensible heat storage materials

Sensible heat storage configurations

Latent heat storage

Latent storage materials

Latent heat storage configurations

Thermochemical storage

Applications

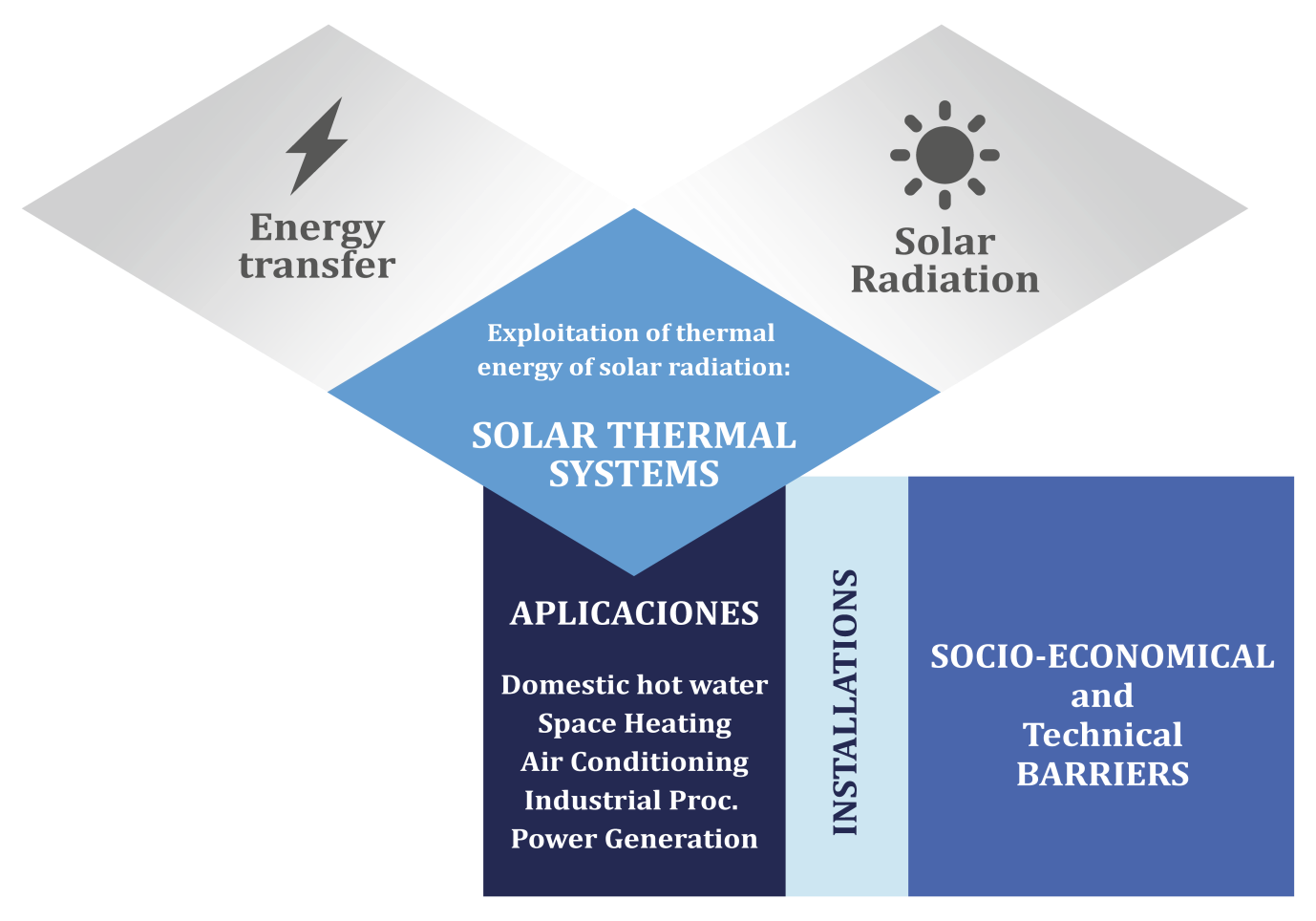
1. **Worldwide Status**

Low-temperature solar systems

Medium and High-Temperature Solar Systems

Barriers to real deployment of solar thermal energy

## CONCEPTUAL MAP



## PLAN OF ACTIVITIES

The study of this course requires reading and understanding of the theoretical concepts, which you will find in the documentation of the module. The content of this study covers the areas of the course activities which will be evaluated at the end of this module. These activities are the following:

* Displaying the multimedia content and conduct of the assessment test type associated with it. This test will consist of 5 multiple choice questions. There are 2 attempts to do so.

To pass this activity the participant must achieve 80% correct answers (4 correct answers).

* Read the documentation. In the first place, the main text of the module has to be read. Later on, the student should check the bibliography to get a further understanding of the different concepts and in order to have an overview of all the data and information that is being addressed in each chapter.

### Case study: “Elemental predesign of a parabolic trough solar field for a power plant of 11 MWe”. The case study should be performed whenever the student is sure of having understood and consolidated the concepts and information given in the Extensive documentation. It is suggested to re-read in advance the 1, 3, 8 and 10 chapters. It is not critical if the student is able to solve this practical case the first time, but it is necessary that, after its study, the student is able to solve it by his/her own.

### A short test will assess the comprehension of the fundamental concepts of this practical case. It has 5 attempts to perform it. To pass this activity the participant should have 100% of the correct answers.

### Final self-assessment test, through which it can be checked the level of conceptual understanding of the module, and it can be used as a reference of these aspects that deserved a further analysis by the student

### This test will present 20 questions with several possible answers and only one correct. You have 1 hour and 2 attempts to perform it. To pass this activity the participant should reach 80% of correct answers (16 correct answers).

### To properly complete the course, the estimated time commitment is **20 hours** distributed as is most convenient for each participant. Being a self-training mode is allowed flexibility in the implementation of activities, although we recommend regularly in the course, spending one to two hours daily, to the best use.

All those activities with more than one attempt for implementation, will consider the highest score to reach the final result.

## DIPLOMA

Upon graduation UNIDO, CIEMAT and ECREEE will issue a certificate of achievement for participants who exceed the following requirements:

* View 100% of the content and achieve 80% of the assessment test associated with it.
* Perform the case study and correctly answer to 100% of the questions associated with it
* Overcoming 80% of the final self-assessment test.

Once achieved these requirements, the participant may access the appropriate section in the virtual classroom and download the diploma in electronic format.