



### The summer school is organized in three phases:

- 1 week including Saturday (42 h), in the campus Pierre Laffitte (Sophia Antipolis) with courses, outdoor practical activity, a solar cooking workshop and a visit the Regional Natural Park of Préalpes-d'Azur with different photovoltaic systems;
- 8 h of autonomous work to prepare a short oral defense per group;
- 1 day of oral sessions and feedback (20 min + 10 min Q&A per group) with zoom. The date of the session shall be organized with the coordinator and will take place remotely.

	<b>Monday</b> August 26th	<b>Tuesday</b> August 27th	<b>Wednesday</b> August 28th	<b>Thursday</b> August 29th	<b>Friday</b> August 30th	<b>Saturday</b> August 31st
9:00-9:30 ----- 9:30-10:30	Welcome ----- Renewable overview	Basics of solar radiation	Introduction to LCA impact analysis	Workshop for solar cooking system	Workshop for solar cooking system	Visit of different photovoltaic systems in the landscape of the the Regional Natural Park of Préalpes-d'Azur + Solar picnic
10:30-11:00	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	
11:00-13:00	Renewable overview	Introduction to LCA impact analysis	Introduction to low-tech	Workshop for solar cooking system	Workshop for solar cooking system	
13:00-14:00	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	
14:00-15:30	Photovoltaic overview	Outdoor practical works	Introduction to low-tech	Workshop for solar cooking system	Outdoor test and performance assessment	
15:30-16:00	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	
16:00-18:00	Basics of solar radiation	Outdoor practical works	Introduction to the solar cooking project	Workshop for solar cooking system	Outdoor test and performance assessment	

## More about the courses and activities!

### **Renewable overview : Renewable energy in the European energy mix (Monday morning)**

*Robin Girard (prof. at MINES Paris – PSL)*

Overview of the penetration scenarios of Renewable Energy sources in the energy mix in Europe  
Objective: Understanding the stakes of the different plans and perspectives of the REN development in Europe.

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### **Photovoltaic overview: Introduction to photovoltaic systems (Monday afternoon)**

*Philippe Blanc (prof. at MINES Paris – PSL)*

Overview of photovoltaic systems: general principles, historical perspective, presentation of the different technologies (Silicium, thin-film, CDTE, bifacial-PV), different types of application (ground PV, PV rooftops and parking shades, Build-Integrated PV, Agri-PV, floating-PV, etc.) and different usages (feed-in tariff (FIT), individual and collective self-consumption, firm-PV)  
Objective: General culture on photovoltaic in the historical, technical and application perspectives.

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### **Basics of solar radiation (Monday afternoon, Tuesday morning)**

*Philippe Blanc (prof. at MINES Paris – PSL)*

Fundamentals of solar radiation: Sun-Earth geometry, solar position and collector orientation, top-of-atmosphere solar radiation, the solar constant, the different components of the solar radiation, clear-sky atmosphere and cloud effects, spatial and temporal variabilities, the dedicated in-situ sensors and alternative with numerical models and satellite imagery, the different ways to collect and convert the solar radiation (in addition to PV)  
Objective: gain knowledge of the terminology and the different orders of magnitudes about solar radiation; Understanding the different sources of spatio-temporal variabilities at different scales and the different ways to measure and collect and convert the solar radiation.

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### **Practical outdoor work on solar positions and the use of pyranometric sensors**

*Philippe Blanc (prof. at MINES Paris – PSL) and Susane Weyand (PhD student DLR/MINES Paris - PSL)*

Hands-on outdoor session to determine the True-North direction and to collect and comment in-situ measurements of the different components of the solar radiation with different specific pyranometric sensors (pyranometer, pyrhelimeter, reference cell)  
Objective: Better understanding and hands-on on solar position and on in-situ measurements of solar radiation.

## **Introduction to Life Cycle Analysis (LCA) for environmental impact analysis (Tuesday afternoon)**

*Mathilde Marchand-Lasserre (assistant prof. at MINES Paris – PSL)*

Introduction of the environmental analysis based on the methodology of the Life Cycle Analysis, description of the LCA approach (norm), the functional unit, the inventory, the different categories of environmental impacts and performance (CO<sub>2</sub>eq, DALI, etc.) and application to photovoltaic systems

Objective: Understanding the basics of LCA based environmental impacts and the key figures for photovoltaic applications. This learning will be applied to the project analysis.

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## **Introduction to low-tech (Wednesday)**

*Timothée Boisseau (independent engineer, consultant, alumnus MINES Paris – PSL)*

Introduction to low-tech: historical perspectives, definition(s) and concrete application (notably for solar applications) reviews, bibliographic reference list.

Objective: Acquire general culture on the low-tech approach and possibility to go beyond with the reference list. This learning will be applied to the project analysis.

### **The solar cooking project**

The objective of the project will be first to construct some solar cooking systems (of different kinds), to test their performance with the concomitant pyranometric and temperature measurements of reference and to use them for ... actual cooking. After the week in Sophia Antipolis, the participants will produce short group presentations, on the results of the workshop and test sessions. These presentations will include comparisons based on simple LCA analyses and low-tech perspectives to assess the relevance of the solar cooking systems.

### **What about the visit on Saturday ?**

The Regional Natural Park Préalpes-d'Azur is in the countryside of Sophia Antipolis, 20 km North. The park spans a diverse landscape from Mediterranean plains to alpine foothills. Covering over 88,000 hectares, it has a very rich biodiversity with a variety of flora and fauna, including many protected species. The park is also appealing to the development of photovoltaic power plants, raising the problem of local both positive and negative impacts. The visit will involve exploring various locations related to the development –positive or negative– of photovoltaic in the Park. The solar cooker will be also used for convivial “solar picnic”, provided the weather is favourable.

