CALL FOR POST-DOCTORATE PROJECTS

The PV-STAR Key Challenge awards post-doctoral grants for research in the field of "Photovoltaic in non-standard conditions" (refer to the appendix for the scientific themes covered by PV-STAR).

1. Call for post-doctorate projects:

Applications to be submitted by 31 March 2026. The Executive Committee will select candidates.

Duration: 12 months. Renewable once, after the examination of results and perspectives.

Application file:

- Topic proposal and its significance to the PV-STAR Key Challenge aims (2 or 3 pages).
- Detailed CV.
- Funding plan (including co-financing and additional sources of funding).

Selection criterions:

- The topic is relevant to the themes and objectives of PV-STAR (refer to appendix).
- The project must involve at least two partner laboratories out of IES Montpellier, PROMES (Font Romeu-Perpignan), LAAS-CNRS Toulouse, RAPSODEE IMT Mines Albi, ONERA Toulouse, ICGM Montpellier.
- Particular attention will be paid to the quality of the candidate’s CV. After the post-doctoral training, the candidate must be able to continue his/her career as a researcher or as a university lecturer and researcher.

2. Post-doctoral allocation

PV-STAR can support a postdoctoral allocation of 5,000 up to 10,000 euros (depending on the topic and with appropriate justification).

Applications should be sent to contact@pvstar.cnrs.fr and also to the directors of the targeted laboratories or to their representatives on the Executive Committee.

NB: The PV-STAR Key Challenge and the Occitanie Region must be mentioned in the acknowledgements of any written or oral communication of the funded research.

The Executive Committee

Appendix: Objectives and scientific themes of PV-STAR Key Challenge.

The Key Challenge aims to address the current technological gaps identified in the field of photovoltaics in non-standard conditions. There are many and varied solutions in this area, which may result from physical concepts that are not yet employed, the adaptation of existing principles, or the implementation of materials not yet used in the PV field. From these observation, five scientific areas have been defined:

1. Physics of photovoltaic energy conversion in non-standard conditions.

Geographical location, time of day, and season can cause significant variations in the lighting and environmental conditions of solar cells. As a result, the nature of the solar spectrum under standard conditions (AM1.5) can change significantly. These specific operating conditions may require new concepts for converting light into electricity, as the physical principles involved may differ from those under standard conditions for PV. Some of the concepts that are being explored are already being used in applications such as photodetection, lasers, and sensors. These new concepts require further study, both from a fundamental point of view and from an experimental point of view, to demonstrate their relevance to targeted applications. There are still many scientific and technological barriers to overcome in this field. This requires a broad knowledge of physics, ranging from quantum physics to optics, and including electrical transport in complex materials and heterostructures.

2. Overview of innovative materials

New concepts may be addressed in response to this key challenge. Technological solutions can be developed using materials that are suitable for standard condition tests or extreme conditions. These materials can be associated with both first or second-generation technology and third or fourth-generation technology. The primary challenge in this field is identifying material families that possess optical and electrical properties suitable for the targeted spectral conditions. The resources to be deployed concern the overview and characterisation of these materials, including their structural, electrical, optical, and thermal properties. Modelling resources will also be necessary to determine the impact of these properties on the materials' effectiveness for the targeted applications. The consortium's laboratories cover a wide range of families of inorganic II-VI and III-V semiconductor materials, as well as organic materials in this field.

3. New concepts for the hybridisation of solar energy conversion

To overcome the fundamental issue of solar resource intermittence, there has been significant interest in developing electrical storage systems in recent years. However, the cost and materials associated with massive electrochemical storage (i.e. batteries) have proven to be limiting factors. Among the targeted solutions, PV-CSP hybridisation seems promising because it offers low-cost electricity production during the day through PV and the capacity to store solar energy as heat through CSP, which is a less expensive technical storage method than electrochemical storage. In this context, the high-temperature hybrid systems involve an integrated PV-CSP receiver that operates at temperatures several hundred degrees above ambient temperature. However, the practical realization of such systems requires solutions to several major scientific and technological challenges. For instance, how will the extreme conditions of temperature and solar concentration affect the performance of high-temperature cells? How can the architecture of these cells be optimised to maximise their conversion efficiency? How can hundreds or thousands of PV cells be connected in a single module while minimising the impact of temperature and illumination gradients to which these modules will be subjected? This Key Challenge encompasses a wide range of scientific issues, from theoretical understanding of physical phenomena to prototype manufacturing technology, all of which may be addressed by the candidate.

4. Exploring the limits: high solar concentrations and extreme conditions

The conversion efficiency of PV cells is fundamentally related to the solar power density absorbed by them. Concentrating solar power significantly increases the voltage of PV cells, improves their temperature resistance and enhances their conversion efficiency. It is also a prerequisite for the operation of several cell technologies (multi-junction cells, hot-carrier cells, intermediate-band cells) which are not suitable for standard solar conditions (STC) due to technical or economic reasons. One part of this Key Challenge is dedicated to developing, manufacturing and characterising high-efficiency solar cells that work under high solar concentrations. The spatial environment is another application field. The PV cells used in space differ from those used on Earth due to the unique stress they encounter. In space, it is crucial to maximize energy density, which refers to the ability to produce maximum electrical power for minimum cell weight.
Innovative technological solutions are required to address the additional constraints of dissipating residual heat and resisting space radiation in the absence of an atmosphere. Therefore, it is logical to focus on developing PV cell technologies that are adapted to the extreme conditions prevailing in space as a key challenge.

5. The role of digital technology in collecting and analysing data in non-standard conditions.

Solar PV plant performance is typically evaluated under conditions that differ from their actual operating conditions. Therefore, it is necessary to establish and interpret deviations from theory based on operator-measured data. Exploratory data analysis methods, such as multidimensional and descriptive statistical methods, can be used to analyse the operating data. This can help to identify systematic structures and trends, understand the links between variables, detect abnormal data, and eliminate biases. Exploratory data analysis methods can aid in formulating hypotheses and diagnosing solar power plants. This is particularly useful for accurately assessing the impact of non-standard operating conditions on both the conversion efficiency and output of these plants. Exploratory data analysis and machine learning can be combined to merge, model and even forecast data, in order to choose the best solution based on exploratory conditions.

The issues for each of these fields are as follows:

1. Remove technological obstacles that have already been identified in existing technologies by combining skills and resources.

2. Develop innovative concepts for energy production in extreme conditions. Develop the skills required to achieve this objective using new scientific approaches.

3. Develop leadership in Occitanie Research about photovoltaic systems under extreme conditions. The goal is to enhance collaboration among academic institutions in Occitanie.

4. Enhance the visibility of the Region nationally and internationally in the targeted field to increase our participation in national and international projects such as European Project, ERC, ANR, etc.

5. Improve the appeal of research for future generations, both nationally and internationally.

6. Make companies aware of emerging concepts early to prepare for future technology transfers. Similarly, inform academic players about the importance of filing patents and supporting technology transfer projects.