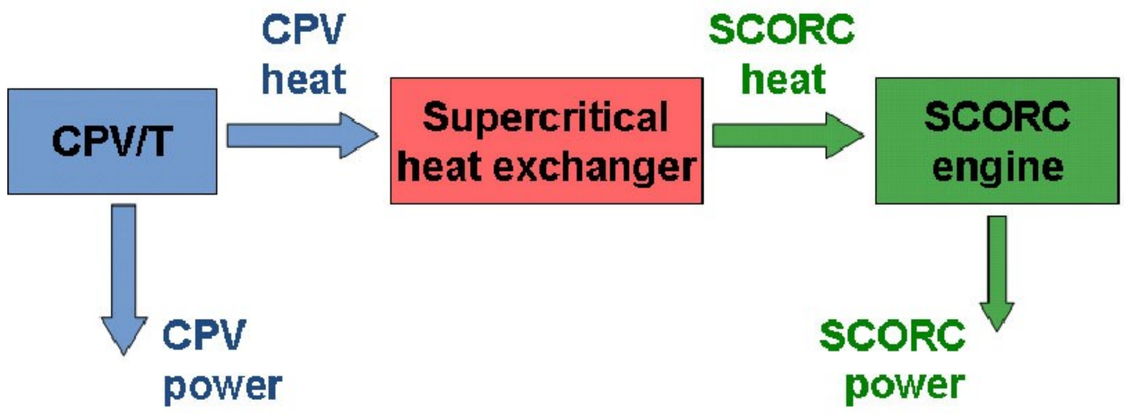
Improving the Performance of Concentrating PV by Exploiting the Excess Heat through a Low Temperature Supercritical Organic Rankine Cycle

Concept

The proposed innovative concept deals with the conversion of the CPV/T low-temperature heat to additional electricity through the Supercritical Organic Rankine Cycle (SCORC) process, with final aim to manufacture a prototype system and test it under real conditions.



Integrated system concept

This integrated CPV/T-SCORC system minimizes the temperature effect on the PV cells performance and improves the annual energy productivity (in kWh/kWp). In comparison to a flat PV system a performance improvement between 15-40% is anticipated.

CPV/T: The CPV/T used is a solar collector that simultaneously generates heat and electricity as it combines a photovoltaic panel and a solar thermal collector in the same module. The solar cells are optimized for concentrated solar radiation and each cell has 10 times more electric production than the same surface of solar cells.

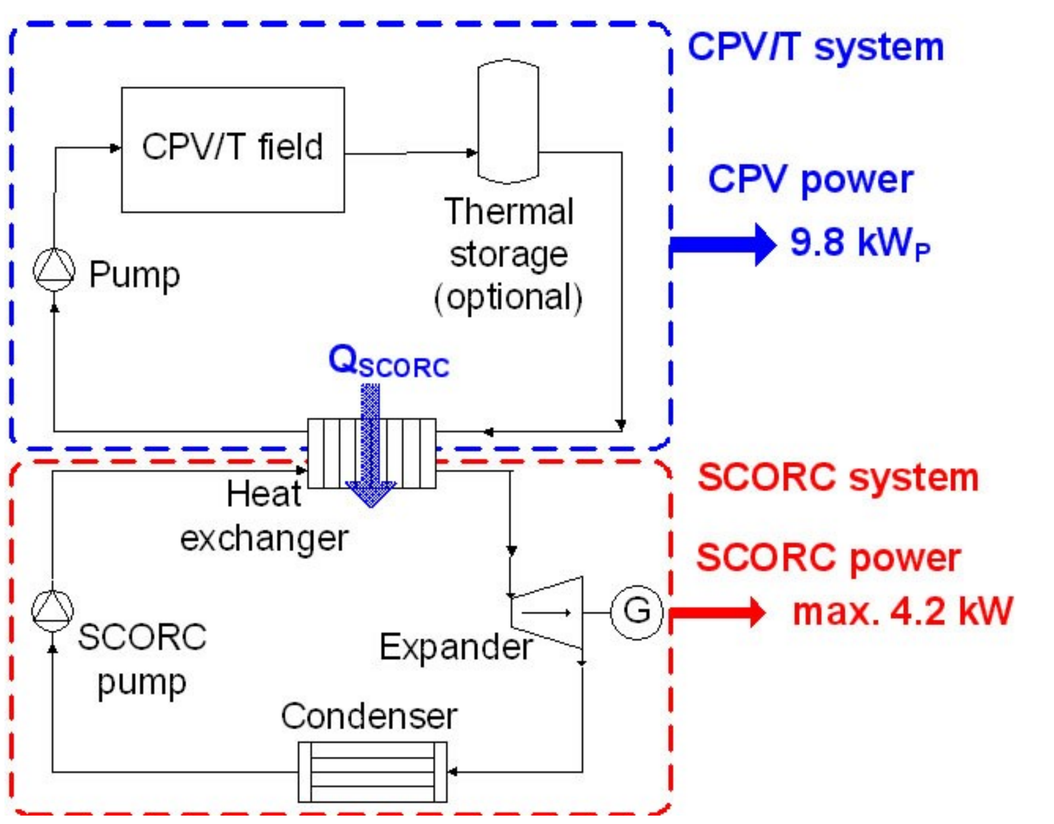
SCORC: A Supercritical Organic Rankine Cycle technology is used for the recovery of low-grade heat. The working fluid is a refrigerant, which can boil at temperature as low as 60 °C, while the scale of such engines can be of few kW. The available heat is of low-temperature (80-90 °C) and partially converted to electricity. The capacity of the SCORC engine is around 4 kW.

Objective

The objective of the project is to develop, construct and test a small-scale hybrid system with a capacity of 14 kWp, where CPV/T heat is effectively recovered by the SCORC process for electricity generation. A significant reduction of specific electricity cost is anticipated, making the current technology competitive in the PV market.

The participating SMEs are coming from Greece, Spain and Belgium. The integrated concept is observed in the Figure below. There are two separate fluid circuits, which are coupled through a heat exchanger:

- The CPV/T circuit, where the heat transfer fluid (HTF) is circulated with a pump and serves as a heat sink for the PV cells.
- The SCORC circuit, where the circulated high-pressure organic fluid is heated by the HTF and then expands in an expansion machine for electricity production.



Simplified integrated system design

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Duration and Funding

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