

ECOSun

Economic COgeneration by Efficiently COncentrated SUNlight

Project duration: 02.2020 to 01.2023

Report submitted: 07.2020

Publishable Summary

ECOSun targets a radical cost reduction of electricity and heat co-generation via a CPV-T system, by applying low-cost materials and advanced industrial manufacturing methods. Solar radiation is captured in a parabolic through concentrator based on a novel support structure fabricated by injection molding and focused on a Co-Generation Absorber Module (CAM), where special c-Si-PV-cells are operated under concentration. The heat dissipated through the cells is transferred into a heat transfer fluid (HTF) and - in combination with the generated electricity - can be used for various applications, such as solar cooling or heating, significantly increasing system efficiency.

A significant cost reduction is achieved by designing and optimizing the economically most relevant elements of the ECOSun system:

1. CPV-Cell

As a novelty, a low-cost solar cell based on crystalline silicon will be designed, which can reach high efficiencies under 60 x concentration and perform well under elevated operating temperatures. Due to the concentration, much less active cell area is required, which reduces specific cost (€/Wp). (At high production volumes, mirrors can be acquired for 2~5 €/m², while flat-plate PV panels range from 70~100 €/m².)

2. Heat Sink and Thermal Management

The heat rejection strategy and hardware for optimal cell cooling (i.e. a sweet spot between cell service life, efficiency and temperature level for heat use) will be optimized with respect to low-cost industrial manufacturing, maximum service life and highest system performance. Integration of the cell with the heat sink will be studied for sake of robustness, ease of application and industrial feasibility of the system.

3. Mirror and Support Structure

Since mirror, support structure and related assembly represent the biggest cost share in most concentrating solar power systems, a novel approach using industrially manufacturable support elements (e.g. injection molding) is proposed. This will not only allow to reach independency from metal price fluctuations on the global market, but also enable easy assembly by untrained personnel, as well as a significant CO₂ reduction of the transportation process due to light-weight design.

All strategic goals of the ECOSun project are in accordance with the TWP SET-Plans by the European Union:

Europe is a high wage region and the only chance to regain leadership as CSP/CPV supplier is to substitute labor-intensive manual tasks with high-tech manufacturing know-how. This ambitious

goal can be achieved by introducing automated manufacturing methods, like injection molding, instead of conventional welded/riveted support structures for through concentrators made of aluminum or steel. Austria has a long history in industrial manufacturing due to the strong relation to the automotive industry (MAGNA, BMW, etc.), where low-cost, large-scale serial production plays an important role. Many of Austria's companies are well known for innovation in the field of automated manufacturing and material science. From the steel industry (Böhler, VOEST, etc.) to high-tech fiber composite (Carbotech, SECAR) Austria's companies and related know-how must be considered a catalyst and ideal breeding ground for low-cost solar power components. Despite all the potential for design and engineering innovation, Austria needs research and business partners in southern Europe to realize its new ideas in the CSP and CPV market. The ECOSun project will be a door-opener for the desired international cooperation by integrating partners from Turkey and Spain.

Project consortium

Coordinator and all contact details:

| | |
|---------------------------------------|--|
| Full name of organisation | Graz University of Technology |
| First and family name of coordinator: | Armin Buchroithner |
| Full address: | Inffeldgasse 23/II, 8010 Graz, Austria |
| E-mail: | armin.buchroithner@tugraz.at |

Participating countries and financing:

| Country | Number of organisations involved | Project costs in EUR | Public funding in EUR |
|--------------|----------------------------------|----------------------|-----------------------|
| Austria | 2 | 687'183 | 571'899 |
| Turkey | 2 | 357'010 | 357'010 |
| Spain | 1 | 191'000 | 145'500 |
| <i>Total</i> | 5 | 1'235'193 | 1'074'409 |

Funding agencies involved and contracts

| Funding Agency | Contract N° and Title |
|--|---|
| Austrian Research Promotion Agency (FFG) | 873785 eCall-number: 21722556 ; 25112870 |
| Türkiye Bilimsel ve Teknik Araştırma Kurumu (TÜBİTAK) | 219M027 219M028 |
| Agencia Española de Investigación (AEI) Ministerio de Ciencia e Innovación (MINECO) | PCI2019-111922-2 |