A Cost Effective And Efficient Approach For A New Generation of Solar Dish-Stirling Plants Based on Storage And Hybridization

The Biostirling project will build, deploy and test a new type of solar dish-Stirling plant to power Square Kilometer Array (SKA) antennas in Moura, Alentejo. This Renewable energies project has been supported by the synergies found with the large-scale international project SKA. B4SKA is implementing a cost effective and efficient new generation of solar dish-Stirling plant based on hybridization and efficient storage at the industrial scale.

PROJECT WEBPAGE URL
https://www.it.pt/Projects/Index/1728

Main Project Team

Luis Saturnino Gonzalez Gonvarri	**(SP)**
Domingos Barbosa	IC-Av
Arnold van Ardenne	ASTRON (NL)
Norbert Pffannig	Frauenhoffer
Francisco Caballero	Alener (SP)
Paulo André	OCP-Lx
Paulo Antunes	OCP-Av
Lars Gustavsson	Cleanergy (SE)
Carlos Marques	OCP-Av

Funding Agencies

European Commission - FP7	**140,000€**
Start Date	01/03/2013
Ending Date	30/11/2016

Indicators

Journal papers	3
Conference papers	4
Patents	2
Concluded PhD	1
Concluded MSc	1

Two Main Publications

D. Barbosa, J. P. B. Barraca, A. B. Boonstra, R. Aguiar, A. A. van Ardenne, J. S. Santader-Vela, L. V. Verdes-Montenegro, **A Sustainable approach to large ICT Science based infrastructures; the case for Radio Astronomy**, IEEE International Energy Conf. - ENERGYCON, Dubrovnik, Croatia, May, 2014.

A Cost Effective And Efficient Approach For A New Generation Of Solar Dish-Stirling Plants Based On Storage And Hybridization, T0000-0000-MP-001, 2015

Fig. 1 A Biostirling parabolic concentrator with its Stirling engine at its focus.

Fig. 2 The SKA antennas : from paraboloids to Aperture Arrays (left)

GENERAL MOTIVATION AND OBJECTIVES

Renewable energies represent a wide field upon which international research needs to be focused. The necessity has been envisaged by the BIOSTIRLING consortium and it has been supported by the synergies found with the large-scale international project SKA. The SKA antennas and reception centres, constitute a continental scale sensor network. Aligned with the trend of renewable resources, the overall objective of the project is to implement a cost effective and efficient new generation of solar dish-Stirling plant (15 meter dishes) based on hybridization and efficient storage at the industrial scale.

CHALLENGE

The Dish Stirling systems have demonstrated the highest efficiency of any solar power generation system by converting nearly 31.25% of direct normal incident solar radiation into electricity after accounting for parasitic power losses. The Dish Stirling systems are modular, each system is a self-contained power generator, which can be assembled into plants ranging in size from kilowatts to MWs. However, the aforementioned technology is not commercially exploitable to date as other CSP technologies, such as tower and Parabolic solutions. This is because the current solar dish technology still presents several limitations: high costs, limited life time, low system stability and reliability. On the other hand, the SKA will be installed in Southern Africa and Australia, where solar irradiance is very high and power grid connectivity is scarce, thus making solar energy an option for its energy provision.

WORK DESCRIPTION AND ACHIEVEMENTS

The Square Kilometre array (SKA) is the only global Landmark Project of the EU Strategic Forum on Research Infrastructures (ESFRI). As one of the major scientific Infrastructure of the XXI century, it will operate over a wide range of frequencies and its size will make it 50 times more sensitive than any other radio instrument. The expected average power usage of the whole SKA will be between 50-100 MW, but over an extended location (up to 3000 Km diameter), with many different nodes, and sparse occupation of that terrain beyond the central core. It will require very high performance central computing engines and long-haul links with a capacity greater than the current global internet traffic. B4SKA will test in Moura a prototype project providing around 10kW with a 15-meter paraboloid focusing heat on a Stirling engine. This engine transforms the received solar thermal power into electrical power than can feed power hungry antenna prototypes based on Synthetic Aperture Radar technologies like SKA Aperture Antennas. To research, develop and implement a new technology capable to allow the commercial establishment of the solar dish technology at large-scale, an interdisciplinary approach is necessary. The BIOSTIRLING Consortium is constituted by two industrial companies (GESTAMP TOUGHTROUGH), three technological SME's (ALENER, MACHTTECHNIK and CLEANERGY) and an important group of research centres and Universities (JYI, CTAER, US, CSIC, ASTRON, IT, MPG and FRAUNHOFER). This multidisciplinary team covers all the main aspects of the technology: structure, glass, engine, hybridisation, storage and also experts in demo-projects, in particular associated to Fundamental Science like the SKA. The BIOSTIRLING Project is based on the achievement of four targets simultaneously: reduce costs, increase efficiency, optimize the dispatchability and life-time, in order to validate a new commercial solar dish technology at demonstration scale. Furthermore, compatibility with the SKA antennas will be tested in Moura. IT will deploy a Monitoring system based on optical sensors that will measure deformation of the paraboloid and the structure supporting the Stirling engine, and will lead the Assembly, Integration and Testing of the SKA antenna prototypes with the power concentrator.