Optimised Microturbine Solar Power (OMSoP)
EU FP7 cooperation project
Contract No. 308592
24 June 2015

Summary

The EU RTD-MOST (Ministry of Science and Technology of China) second workshop on concentrated solar power (CSP) (solar dish systems) was held at City University London on 3-4 June 2015 and was attended by delegates from academia and industry from Europe and China and from representatives of EU RTD and MOST. The proceeding of the workshop underlined the importance of this technology in the energy mix required to achieve the future low carbon economy. This document outlines the state of development of CSP-solar dish systems with particular emphasis on those driving a micro gas turbine (MGT) and identified future directions for research and development to move the Technology Readiness Level (TRL) to a stage closer to the market. It also emphasises China as a key partner in terms of development and manufacturing and as a significant market for such systems. Finally the opportunity, the importance and the joint benefits of establishing cofounded research and development programmes between consortia from the EU and China is highlighted.

Description of the technology and background

Parabolic solar dish systems concentrate solar radiation at a small area in the focal point achieving temperatures that could approach about 1000^{o}C. This can then be used to drive a prime mover using a suitable thermodynamic cycle to produce mechanical power to drive an electricity generator. Units up to about 25kWe could be produced using a single dish providing systems that can be deployed in stand-alone applications or forming modular units for solar parks. Solar dish systems can cover a market sector which is not suitable for solar tower power plants that are only economic in the 100's of MW scale. They can also be used for distribute poly-generation (electricity, heating and cooling) reducing infrastructure costs and transmission losses. They can also provide advantages over photovoltaic systems such as the inherent ability to hybridise the systems with hydrocarbon fuels to produce electricity around the clock, and the ability to operate more effectively in very hot climates where photovoltaic performance and life degradation.

Most of the previous development projects utilised Stirling engines as the prime mover. However commercial ventures of such systems in the past few years were not successful. This can be attributed to the fact that the Stirling technology has not reached sufficient maturity to enable it to compete with the more established solar systems and further research and development were required.

The EURTD programme has identified CSP solar dish systems as a key area for research and development and the FP7 programme funded two consortia in 2013: one on the development of Solar dish – Stirling systems and the other on Solar dish – MGT systems (OMSoP). This document focuses on the current state of the latter and requirements for future research and development.

Solar dish – Micro gas turbine systems

MGTs offer a strong alternative for use in Solar dish systems. They are, in contrast to Stirling engines, a well-established technology in the market, particularly for powers above 30kWe

and have demonstrated, among other things, long life and low maintenance cost in different power generation applications. The main aim of the OMSoP project is to develop and demonstrate a solar dish system based on an MGT in the range of 3-10kWe. This requires the development and realisation of a suitable solar dish, receiver, MGT, system integration and testing. In addition, the project aims at performing techno-economic optimisation for future systems together with market and cost analyses.

The project has achieved its mid-term milestone review in April 2015 and is on track for demonstrating a prototype of 5kWe system during 2016. This is anticipated to take solar dish – MGT systems to TRL 5.

Future Research and development requirements

Due to the advantages of the systems, there was significant interest during the EU RTD-MOST workshop in the technology from the Chinese delegates, in particular in partnering with future projects and demonstrations in China. To take the technology further in a timely manner, a framework of funding should be set-up so that a follow-up on project starts immediately at the conclusion of the current project. The following areas have been identified as key for future development to take the technology to the market:

- Increasing the overall efficiency of the system through improvements of the efficiency of key system components, concentrator, receiver and MGT. This points out to the need to higher turbine inlet temperatures requiring improvements to the receiver, the micro-turbine, mirror reflectivity, dish tracking system and focussing.
- Testing and demonstration of optimised cycles that are being proposed by the OMSoP project. These include advanced cycles, poly-generation.
- Providing power round the clock through the integration of suitable storage systems or hybridisation with other fuels, particularly renewables.
- Cost reduction of the system production. This requires identification of suitable supply and manufacturing chains and identification of suitable installation and operation and maintenance processes.

These are research and development areas that would fit very well in joint projects between EU and China. The European OMSoP industrial partners have a very strong technical competence in many of the above areas but there are areas where Chinese industries and institutes could give valuable contribution both on basic technologies and also in manufacturing technologies.

Impacts

- Move the TRL of Solar dish with MGT systems to a stage closer to the market.
- Open up the market for sustainable Solar dish MGT systems for implementation in both China and in the EU that will enable a growth of sustainable and reliable distributed generation.
- Strengthen European MGT industry and opening the Chinese markets for export both for solar dish system applications and other areas of application of MGTs such as combined heat and power, electric vehicle range extenders and those utilising biofuels. This also apply to complementing components such as high temperature receivers and heat exchangers.