Partners

ENEA / Italy
Italian National agency for new technologies,
Energy and sustainable economic development

ASRT / Egypt
Academy of Scientific Research and Technology

KT / Italy
KT Kinetics Technology S.p.A.

ORASCOM / Egypt
Orascom Construction Industries

Archimede Solar Energy / Italy

Delft Environment / Egypt

Cranfield University / UK

Fraunhofer ISE / Germany
Fraunhofer- Gesellschaft zur Förderung
der Angewandten Forschung E.V.

NREA / Egypt
New & Renewable Energy Authority

CEA / France
Commissariat a l'Energie Atomique
et aux Energies Alternatives

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MATS

Multipurpose Applications by Thermodynamic Solar

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In cooperation with the City of Scientific Research and Technology Applications (SRTA-City)

www.mats.enea.it

Project summary

Solar energy is a reliable and proven renewable source for generating electrical power and water with improved environmental and socio-economic factors, compared to other resources. However, solar energy is a fluctuating and fairly unpredictable source, unable itself to fully satisfy end-users' needs. Its availability depends on night and day cycles and weather conditions, determining over-production during solar radiation peaks and shortages during unfavorable conditions or high-energy demand peaks.

Therefore, the challenge is to identify and exploit appropriate technologies that can conveniently integrate solar energy in the current energy system and secure a stable supply to final users. Suitable energy storage systems can stabilize and smooth out solar energy fluctuations, while the integration with a back-up fuel makes the system more flexible and enables stable "ON DEMAND" supply.

The project MATS "Multipurpose Applications by Thermodynamic Solar", co-funded by the European Union under the 7th Framework Programme, is designed to achieve these goals. Thanks to the development of an innovative solar technology, the project aims to demonstrate secure production of electrical power and water supply for a community of at least 1,000 people in a desert area, through the following main steps:

- solar energy is captured and stored as high temperature heat, to generate superheated steam to drive a thermo-electrical steam cycle
- solar energy is also supplemented with a gas fuel to demonstrate the best integration between solar (renewable) and conventional heat sources for a stable heat and power supply
- electrical power production is combined with a desalination unit using residual heat to produce demineralized water from salty water.

In this way, it will be possible to generate electricity and co-generate fresh water in a desert region, supporting social and economic growth of the area.

The MATS Consortium includes partners from Italy, Egypt, France, Germany and UK. The lead partner of the Project is the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA). The lead Egyptian research partner is the Academy of Scientific Research and Technology (ASRT) in Egypt.

The total budget of the project is 22.0 Million Euros. The project received 12.5 Million Euros funding from the European Union and 2.4 Million Euros from ASRT.

Thanks to the successful cooperation between Egyptian and European research organizations and companies, MATS' Concentrating Solar Power plant has been built inside the City for Science and Technology (SRTA-City) in Borg El-Arab. The plant is the first of its kind in the world with its unique features of environmental friendly fluids, easy management and flexibility of operation.

The diffusion of the promoted technology by the project will create new job opportunities in the field of plant design, construction, operation and maintenance. The MATS plant and partnership now represent a platform for capacity building and training of Egyptian personnel. It is also a vehicle to attract investments and promote diffusion of solar technologies.

Concepts & Objectives

MATS technology is based on linear parabolic mirrors that concentrate the solar radiation to generate heat at high temperatures. Solar receiver tubes absorb the concentrated solar radiation and the heat is transferred to a heat transfer fluid.

The innovative solar technology proposed in MATS makes use of molten salts (sodium and potassium nitrates) as the heat transfer fluid. This fluid has several positive environmental, safety and technical features, including the possibility to operate at low pressures and reach temperatures as high as 550°C.

An innovative heat storage system integrated with a steam generator detaches the fluctuating solar radiation from the power cycle. A gas heater further guarantees stable heat supply, using natural gas or a biomass-derived gas for a fully renewable energy conversion.

The solar collectors, back-up heater and the heat storage system were individually developed with prototypes tested at ENEA (Italy). Then, the three basic components were combined in such a way as to facilitate plant operation and flexibility, especially for distributed generation.

This combined system allows controlled production of super-heated steam, which drives a steam cycle for electrical power generation. Moreover, a co-generative power cycle is designed with a Multi-Effect water Desalinator (MED) applied as the steam condenser unit, to recover the residual heat from the exhaust steam. Fresh desalinated water represents a high value by-product, especially in CSP plants built in desert areas with water shortage. Heating and cooling of buildings represent another co-generation option.

In conclusion, the MATS plant demonstrates the high flexibility of the technology to integrate solar energy in energy networks and to satisfy different users' demand. Solar energy can be supplied "on demand" (24 h/24 h, combined with gas fuel back-up) and co-generative power cycles can be applied.

MATS Concentrating Solar Power plant in SRTA-City (Egypt)

The MATS demo plant includes 18 solar collectors, each 100 m long, with total 10,000 m² area of reflective panels. During normal operation, molten salts enter in the solar field at 290°C, to be heated up to 550°C. In the event of a lack of solar radiation, the natural gas back-up unit heats the salts to 550°C. Molten salts are collected in a heat storage tank integrated with a steam generator. Produced steam (460°C, 55 bar) feeds a co-generative cycle to produce 1 MWe power with 250 m³/day of desalinated water from the desalination (MED) unit.