

Solar Thermal – Fossil Energy Hybrid Technology for Advanced Power Generation

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CSIRO is investing \$7.5 million over three years to prove a concept for integrating solar thermal energy and fossil fuels in an advanced power generation technology which can be employed in both distributed and centralised systems and has minimal carbon dioxide emissions.

The concept involves the use of solar thermal energy to reform methane containing gas to generate a mixture of carbon dioxide and hydrogen. The carbon dioxide is recovered for disposal and the hydrogen used for power and heat generation.

A 10 – 30 kWe demonstration facility is under construction at CSIRO Energy Technology's site located at the ANSTO's Lucas Heights Science and Technology Centre south of Sydney. The demonstration facility incorporates all of the key steps in the concept, including electricity generation using a range of new high efficiency technologies.

A centrepiece of this facility is a 100 m² twin axis tracking solar thermal paraboloidal concentrating dish supplied by an Australian manufacturer Solar Systems Pty Ltd. A catalytic tubular reforming reactor is housed within a volumetric receiver mounted at the focal zone of the dish. Here steam and natural gas are reacted to produce synthesis gas (a mixture of carbon monoxide and hydrogen) which is then further converted via high and low temperature water gas shift reactors to a mixture of hydrogen and carbon dioxide. In doing so, approximately 20% of the energy in the reformed gas is embodied solar energy.

The gas is further treated to recover carbon dioxide in a concentrated form, the necessary first step in any subsequent sequestration or disposal operation. The hydrogen is then used in emerging advanced electricity generating technologies which include a polymer electrolyte membrane (PEM) fuel cell, a solid oxide fuel cell and a micro-scale gas turbine.

The paper will describe the rationale behind the concept and present a status report on the construction, commissioning and operation of the demonstration facility with emphasis on the performance of the solar dish and the catalytic steam-methane reformer.