SNAPSHOT

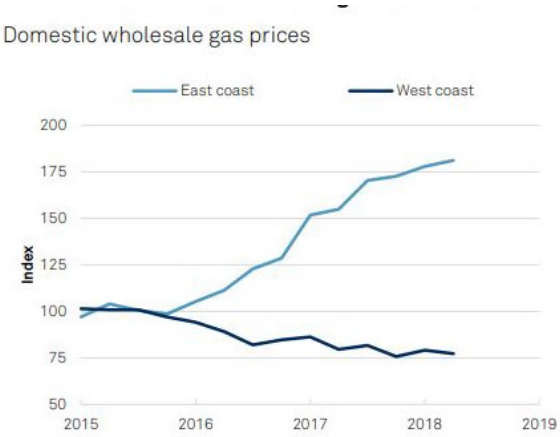
CONCENTRATED SOLAR THERMAL & GEOTHERMAL STEAM AND POWER ASSESSMENT

Project Report Reference: 2019-1043 **Date: 26 November 2019**

Project Description

This study was commissioned to review, assess and determine the national application of modular Concentrated Solar Thermal (CST) and Shallow Geothermal (SG) technologies for the industry, aimed at improving energy security, lowering energy costs and reducing reliance on gas network supplies.

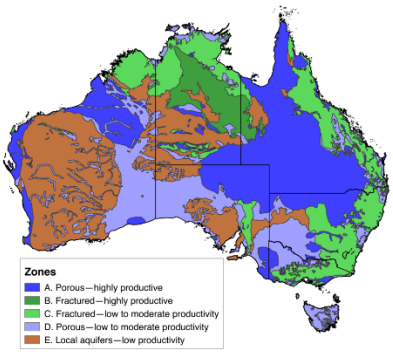
The study focused on assessing the viability of modular CST and SG technologies across different climatic/geographic zones to provide the industry with clarity as to the business case for these technologies throughout Australia. Operational data from reference abattoir sites across these zones, specifically relating to the steam production hours and costs, was applied to test the application of these technologies and establish the feasibility of the required system size and gas offset available within each zone. The intent was to define the economic feasibility and identify high priority regions where the technologies could be applied to deliver measurable benefits to the industry.



Source: Australian Bureau of Statistics, S&P Global Ratings.

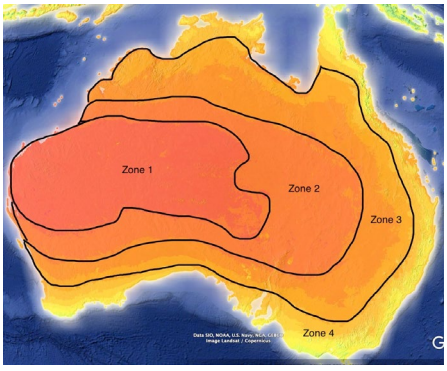
Project Content

Geothermal zones were created based on national hydrogeological data to assess whether AMPC member sites were within moderate to high productivity SG zones. This included large aquifers of the Great Artesian Basin (QLD & NSW), the Perth Basin (WA) and the Otway Basin (VIC).



The zones were broken down into aquifer identification and water temperatures available at 1 km and 1.5 km depths. Based on an average operating model for steam temperature, steam volume and corresponding water use of 365M litres a year, the SG design model was established to test the viability of this technology. The final aspect of the assessment included a review of the ambient surface temperature and geothermal temperature in each zone to define the difference in temperature and allow a calculation of the average savings in gas usage over the year in each zone.

The modular CST assessment involved the modelling of Direct Normal Irradiance (DNI), the solar radiation measure for determining solar generation potential, and separating Australia into 4 zones to assess modular CST performance within these zones. In a similar approach to the SG assessment, the average operating model was used to define the potential steam generating capacity in each zone and the potential average savings in gas usage over the year.



Both assessments established the capital and operating costs for the technology and compared this against the average gas usage savings to determine the viability of the SG and modular CST technologies.

Project Outcome
A detailed financial model was created to show the economic viability of the modular CST and SG technologies in the different solar and aquifer regions when compared to the traditional and existing steam generation methods. Operational data received to assess the economic viability of the chosen technologies included:

- Gas Usage (GJ)
- Gas Price ($/GJ)
- Steam Requirement (Cubic meters)
- Steam Temperature (Degrees Celsius)
- Water usage (ML)
- Operation profile (Hours & days/week)

The key focus of the model was to analyse the amount of gas in gigajoules (GJ) that would be offset by the inclusion of either modular CST or SG solution and compare this to the cost data for the technologies. The financial model consists of the selected "fit for purpose" CST and SG designs and the subsequent capital costs (CAPEX), operational costs (OPEX), Net Present Value (NPV) and Internal Rate of Return (IRR) to define the viability of the technologies.

The financial modelling utilised ambient surface water temperatures in each zone to define the energy requirements to increase ambient surface water temperatures to create steam. This delivered a model that measures the relative energy inputs, energy generation potential of the technologies, costs and offset potential set against the economics of current base-case operations.

Benefit for Industry
Evidence provided in this study suggests whilst modular CST technologies offer the potential for district level outcomes, the current capital costs are still prohibitive without significant Government assistance. In contrast, there is a wide-ranging application and potential for the use of SG technology to support the industry and provide a significant proportion of water heating requirements. The potential is regionally specific and aligned to known SG potential, however, numerous operations fall within these zones presenting a basis for more detailed geographical and commercial assessments from an investment perspective.

Geothermal is a well understood, proven and technically robust source of renewable energy already used in industries and local communities throughout regional communities with a small site footprint and low O&M costs. It has the distinct advantage for a processing business in its continuous availability unlike solar technologies.

SG technology presents a significant added potential for being capable of providing both heating and water supply benefits. The potential to extract and utilise the water in some locations for combined heat and water sourcing offers a significant advantage for the industry.