



# INVESTMENT OPPORTUNITIES GEOTHERMAL

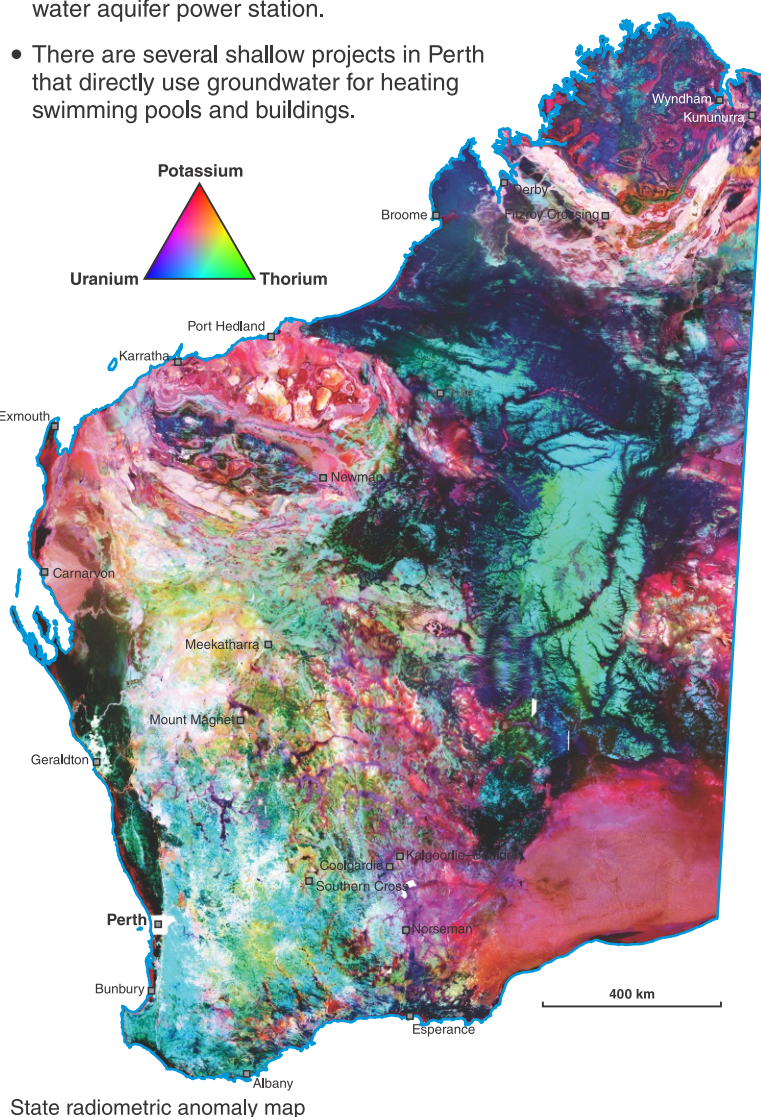
## Geothermal energy overview

Geothermal energy is considered to be a renewable and clean energy source, and is already being harnessed in many places throughout the world. Sources of geothermal energy are heated groundwater, or hot aquifers, which can be used directly, and hot dry rocks where water injected into the ground will produce steam which can be converted to electricity.

Heat is derived from radiogenic elements in the rocks (particularly granite) or from the earth's core and trapped by layers of sediment that act as thermal blankets.

To find Australia's hot rocks, researchers at the Australian National University (ANU) have compiled well-temperature data into a database called Austherm. Other studies are specific to Western Australia. The Canning, Carnarvon and Perth Basins have suitable potential targets for geothermal energy from both hot rocks and hot aquifers.

- Australia's only hot dry project was a test in the Cooper Basin. It was expected to derive energy from granite at a cost that is cheaper than other green energy sources. The test project has since closed due to costs of implementing the technology from the remote site.
- The Birdsville power station in Queensland is Australia's only hot water aquifer power station.
- There are several shallow projects in Perth that directly use groundwater for heating swimming pools and buildings.



## State geothermal acreage

Acreage for geothermal exploration may be obtained through a Geothermal Special Prospecting Authority (GSPA) with Acreage Option (AO) until further notice.

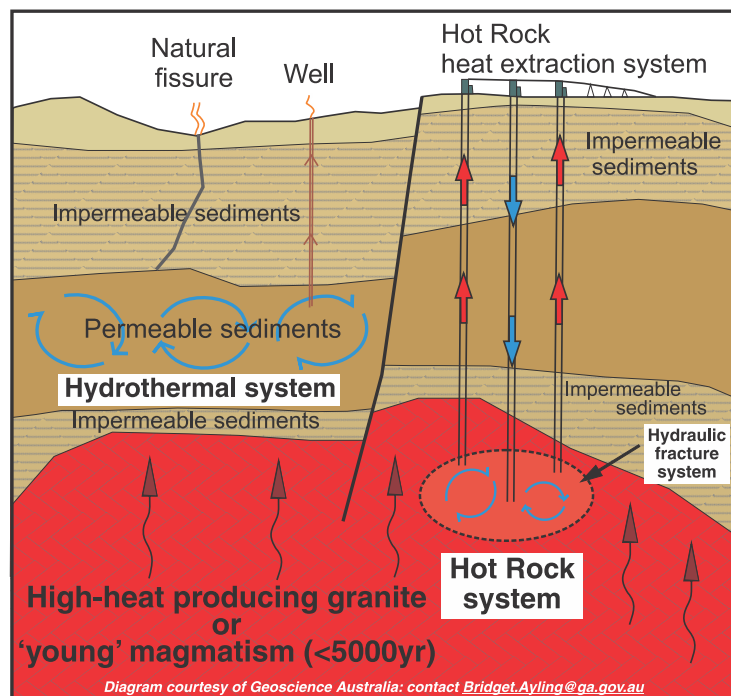
The GSPA is an up to six month, non-renewable title granted for the purpose of conducting a geothermal energy resource exploration survey. A geothermal well is not permitted under a GSPA. On expiry of the GSPA term, the title holder has a further six months in which to take up the Acreage Option and apply for either a Geothermal Exploration Permit (GEP) or Geothermal Drilling Reservation (GDR). It is important to note that the Acreage Option must form part of the GSPA application and cannot be applied for retrospectively. The AO generally covers only a portion of the GSPA area.

All areas in the State are available except those currently encumbered under title or applications under assessment. No areas are under title as of the release of this document.

The minimum number of contiguous graticular blocks deemed acceptable for a Geothermal Special Prospecting Authority is 4 blocks and the maximum number is 160 blocks. It should be noted that a graticular block is a 5' x 5' surface area referenced to the 1: 1 000 000 Map Sheet Series of Australia (AGD66 projection).

Applications must be made online at [www.dmp.wa.gov.au/PGR](http://www.dmp.wa.gov.au/PGR). A fee is applicable.

For further information search the Department's website. [www.dmp.wa.gov.au](http://www.dmp.wa.gov.au)



Conceptual model of a geothermal system.

## Geothermal royalties

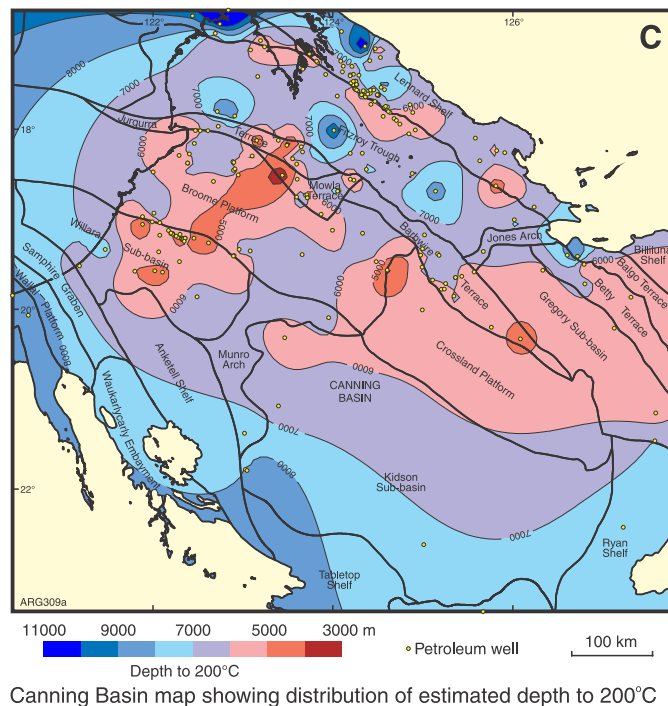
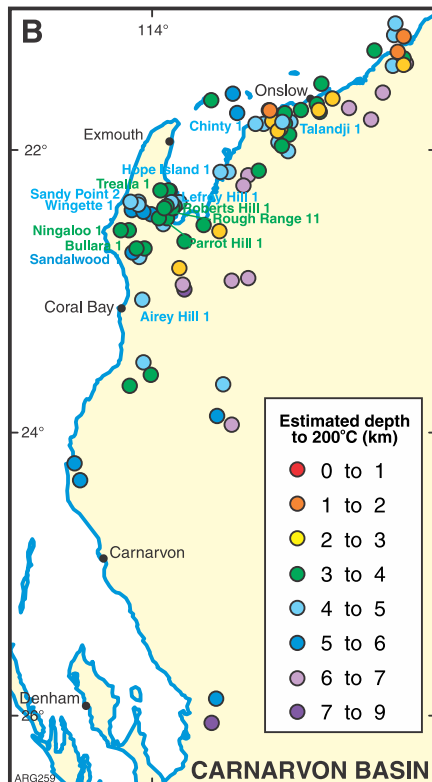
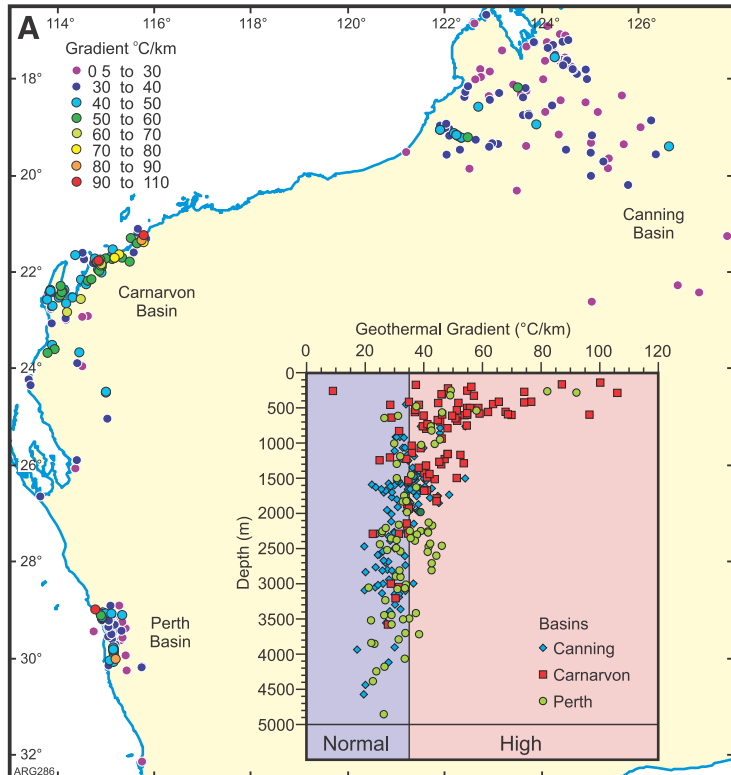
A royalty, calculated at 2.5% of the value of the geothermal energy, is payable under the legislation. It is worth noting that the rate for petroleum royalties is 10 to 12.5%. The royalty value is generally the wellhead value, which is defined as the value of the geothermal energy at the valve station as agreed.



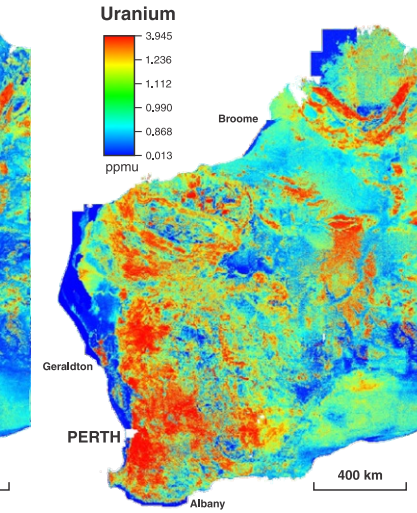


## Potential hot rock resources

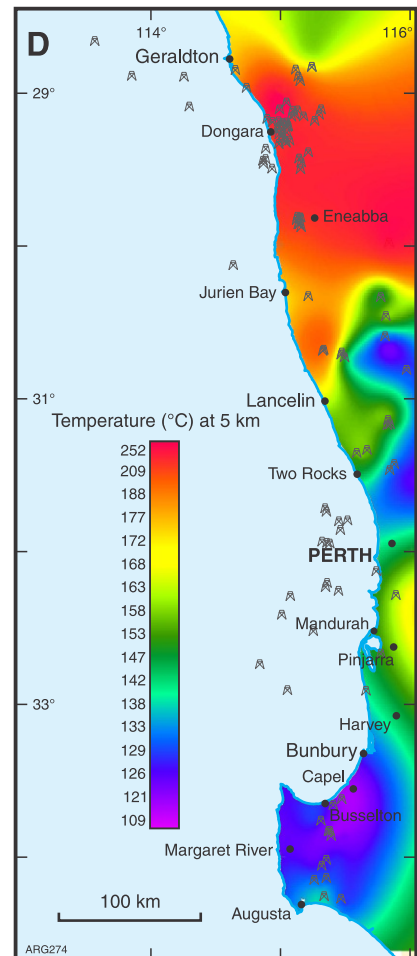
Maps showing distribution of present-day geothermal gradients of selected petroleum exploration wells of the Canning, Carnarvon, and Perth Basins. Map A shows that the Carnarvon Basin has the greater number of wells with higher gradients, followed by the Canning and Perth Basins, respectively.



Carnarvon Basin map showing distribution of depth to 200°C



The Geological Survey of Western Australia has also produced maps of the distribution of Thorium and Uranium in the state. These indicate where hot rocks that could be used as a basis for geothermal exploration are most likely to be located.



Perth Basin map showing estimated temperature at 5 km depth

The most prospective basin for geothermal energy is the Carnarvon Basin (B), followed by the northern Perth (D) and Canning Basins (C). This is based on the present-day geothermal gradient for wells where the estimated depth to 200°C is less than 5 km, and potential basement heat production.

The stress conditions are best known for the Perth Basin where the predominant orientation of the maximum horizontal stress is east–west, with similar conditions inferred for the Canning and Carnarvon Basins. The extent and economic feasibility of hot water and hot rock geothermal resources are presently unknown because studies were qualitative, rather than quantitative, and based on limited datasets.

The estimates of equilibrium geothermal gradient and depth to basement have been used to predict the temperature at the top of the basement and the depth at each well location required to reach the 200°C isotherm.

Publications on geothermal energy by the GSWA can be downloaded from [www.dmp.wa.gov.au/ebookshop](http://www.dmp.wa.gov.au/ebookshop) (keyword search 'geothermal').

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