# Coastal Geothermal Energy Initiative

## Shallow drilling as a means of assessing geothermal potential

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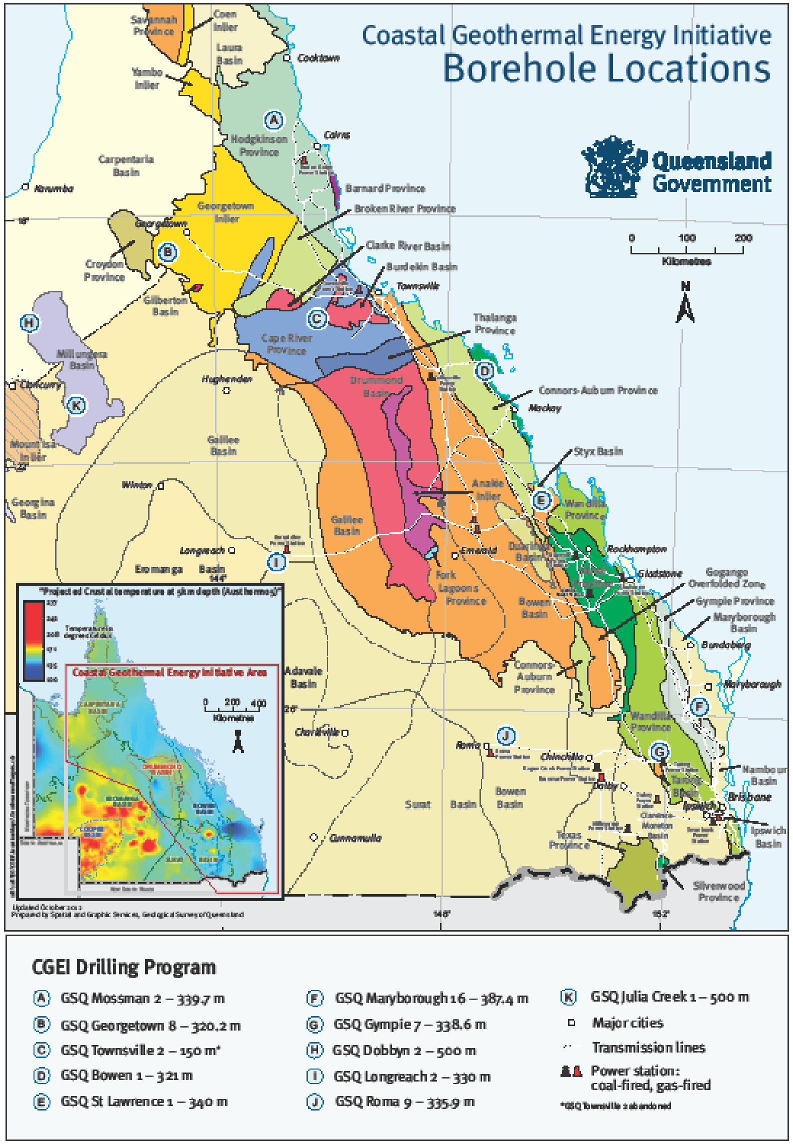
# Coastal Geothermal Energy Initiative

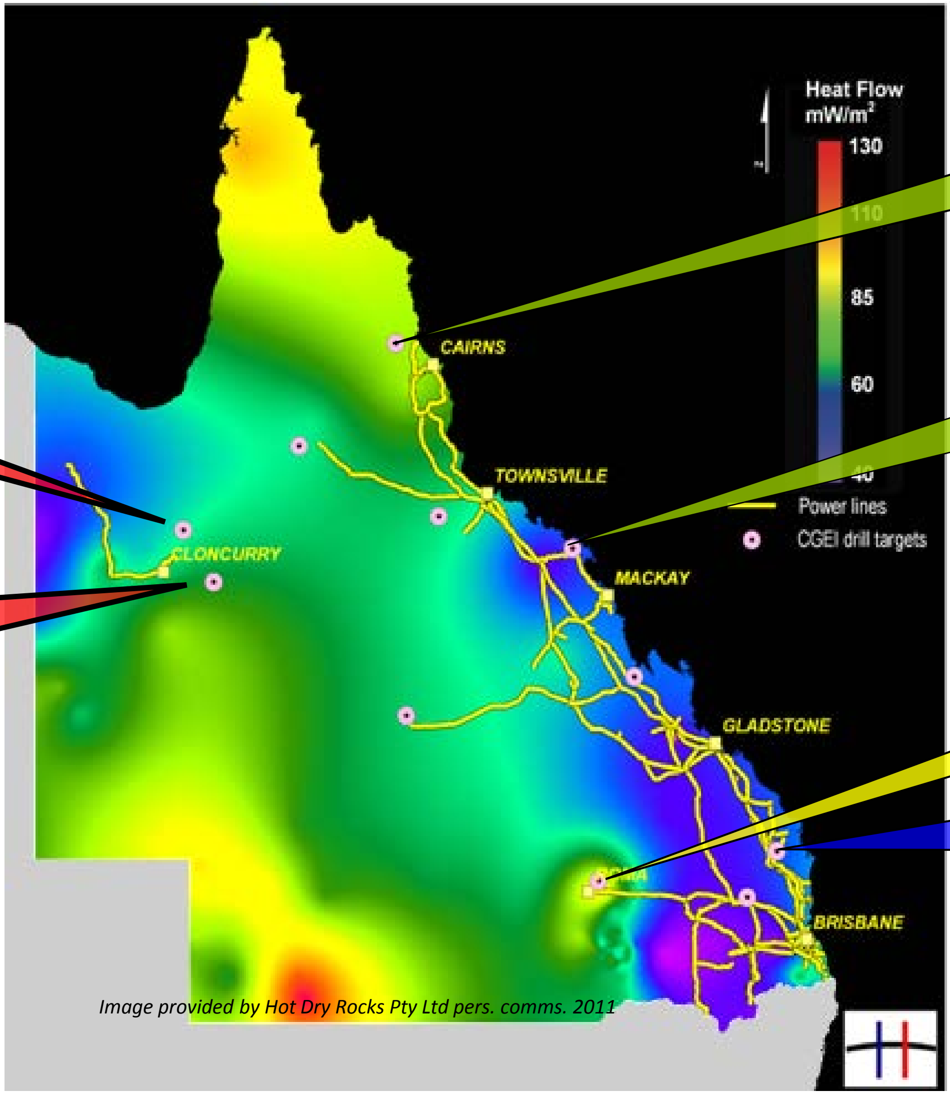
- Targets selected close to population centres and power transmission lines
- Drilling commenced November 2010, with 10 fully cored drill holes to TD between 320 and 500 m
- Collected thermal conductivity and precision temperature data
- Modelled heat flow and temperature to 5 km depth
- Models used to evaluate resource potential



# CGEI heat flow modelling results

**Average =**

**60-65 mW/m²**




***Millungera North***
GSQ Dobbyn 2
107.5 ± 1.7mW/m²

***Millungera South***
GSQ Julia Creek 1
113.0 ± 2.3mW/m²

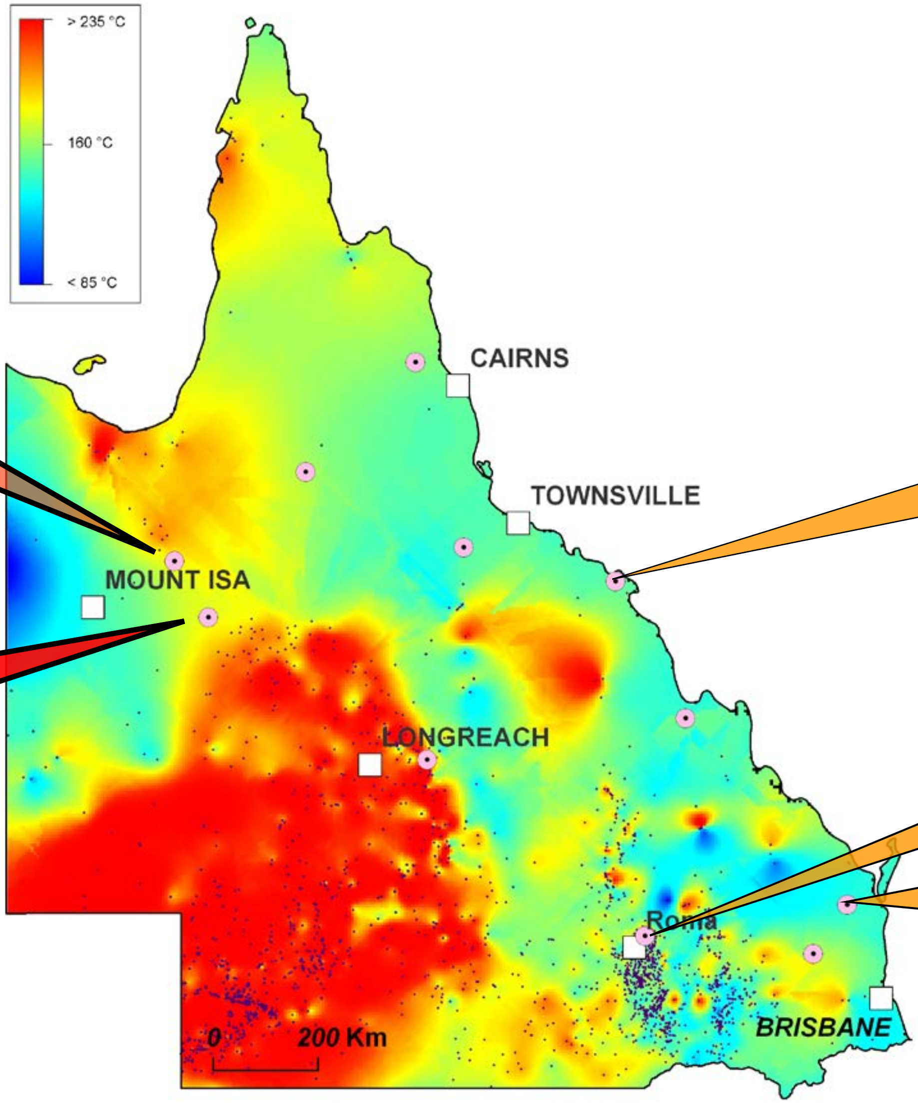
***Hodgkinson Province***
GSQ Mossman 2
77.0 ± 0.9mW/m²

***Hillsborough Basin***
GSQ Bowen 1
71.0 ± 2.3 mW/m²

***Surat Basin (Roma Shelf)***
GSQ Roma 9
82.5 ± 2.5mW/m²

***Nambour Basin***
GSQ Maryborough 16
67.5 ± 2.9mW/m²

# Temperature projections to 5km




**Above 200 °C is ideal**

***Millungera North***
GSQ Dobbyn 2
212 ± 15 °C

***Millungera South***
GSQ Julia Creek 1
239 ± 18 °C

***Hillsborough Basin***
GSQ Bowen 1
204 ± 16 °C

***Surat Basin (Roma Shelf)***
GSQ Roma 9
204 ± 14 °C

***Nambour Basin***
GSQ Maryborough 16
206 ± 14 °C

# Thermal Conductivity

Two methods of analysis:

1. preserved *in situ* moisture content
2. saturated conditions

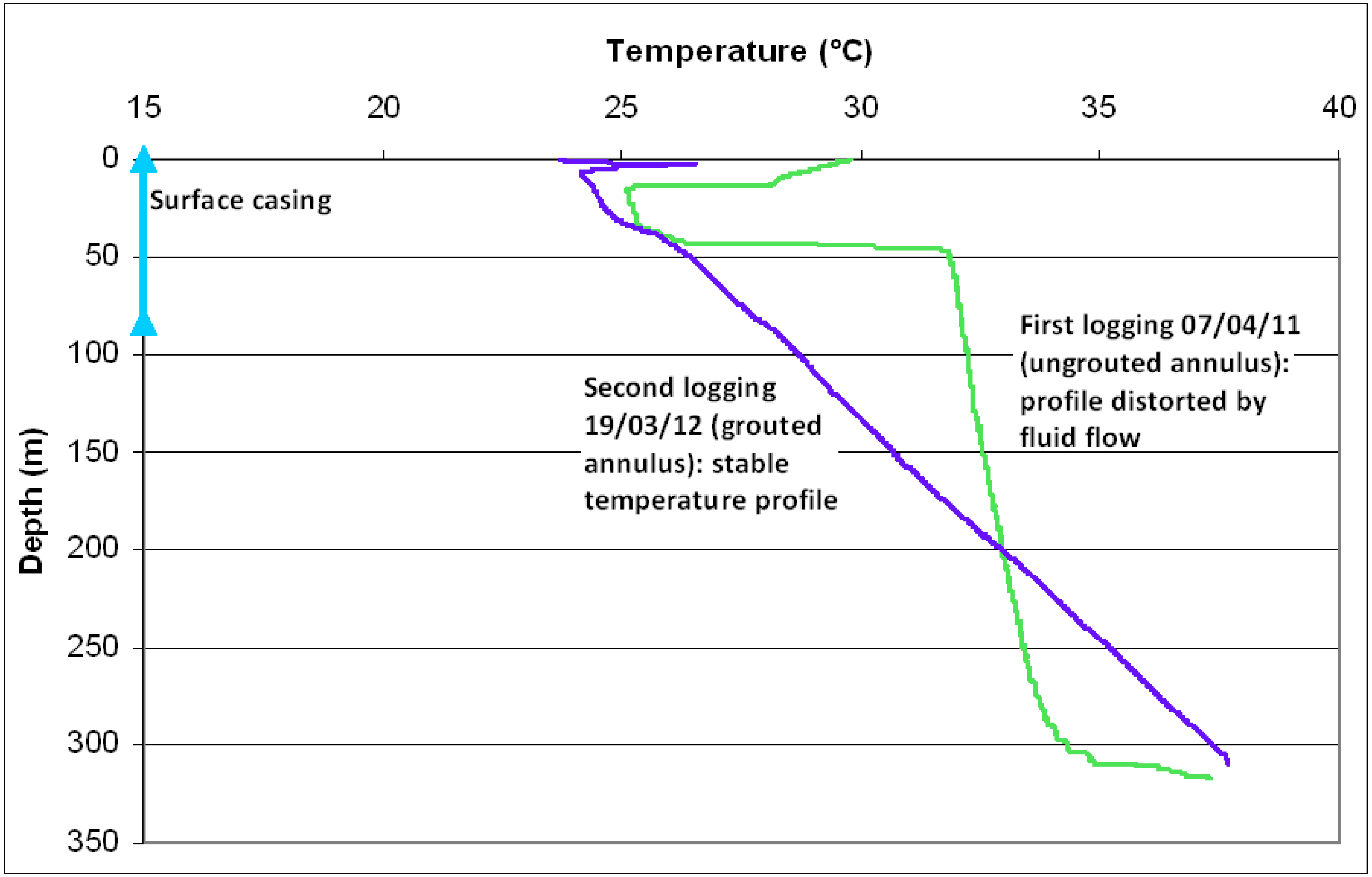
- Samples with *in situ* moisture better represent formation conditions
- TC for CGEI sedimentary strata lower than published values
- Published values closer to CGEI metasedimentary terranes

| | Thermal conductivity range (W/mK) | | |
|---|---|---|---|
| **Lithology** | **Published** | **CGEI Sedimentary Basins** | **CGEI Metasedimentary Terranes** |
| Sandstone | 2.8 – 7.1 | 1.47 – 3.52 | 2.50 – 7.69 |
| Siltstone | 2.67 – 3.2 | 1.88 – 2.43 | 4.12 – 5.06 |
| Mudstone | 1.9 – 2.9 | 0.47 – 2.70 | - |

# Temperature

Two methods of hole completion:

1. cement aquifer upon penetrating and drill through (unsuccessful)
2. grout annulus after drilling (successful)



# Geology

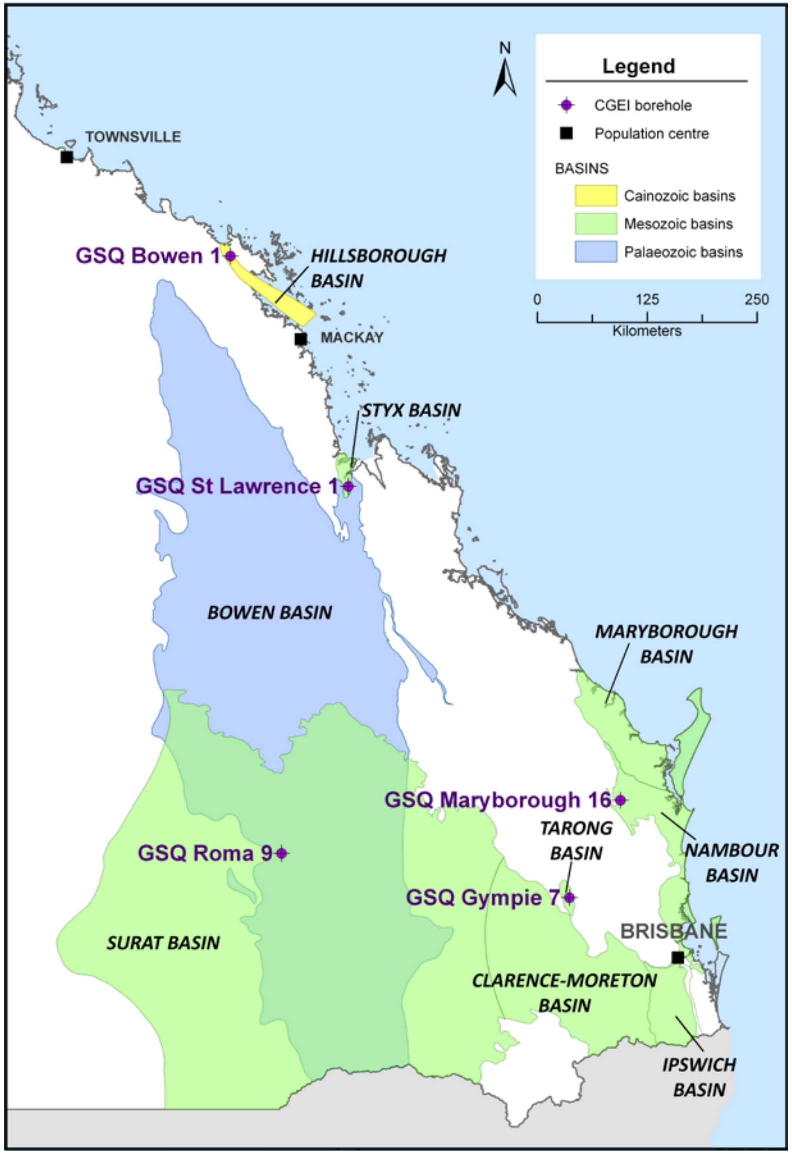
- High heat flow ≠ high temperatures at depth
- A variety of heat sources can generate high temperatures, but sedimentary cover is the key
- Metasedimentary terranes provide insufficient insulation to generate high temperatures

GSQ Mossman 2


GSQ Gympie 7

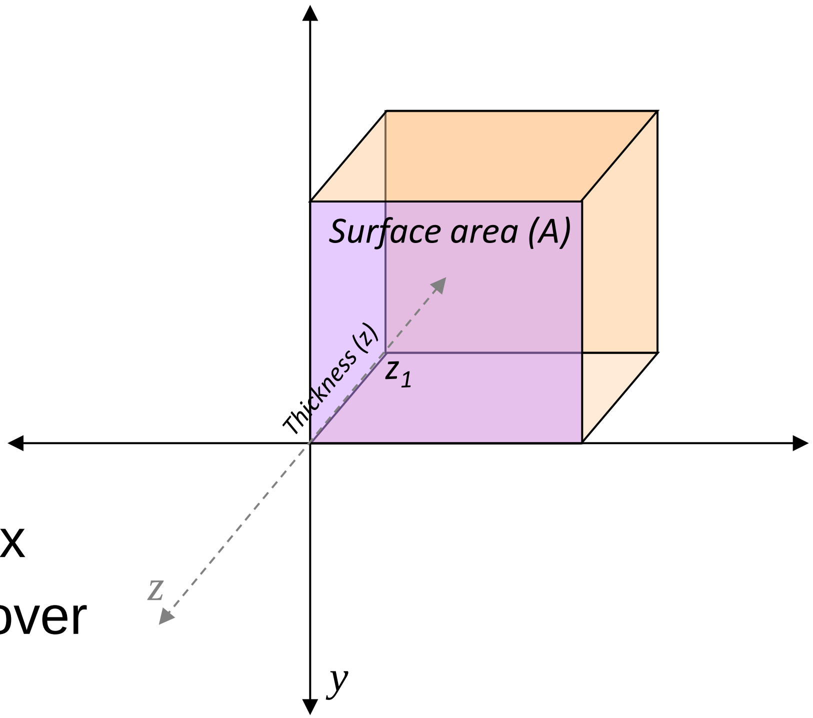
# Coal measures and shallow drilling

- Coal measures provide excellent insulation, but mask heat flow
- Low heat flow may be inferred as low geothermal potential
- Low to average heat flow for GSQ Gympie 7 and GSQ Maryborough 16 – coal seams not definitively penetrated
- Deeper drilling required to penetrate entire sequence



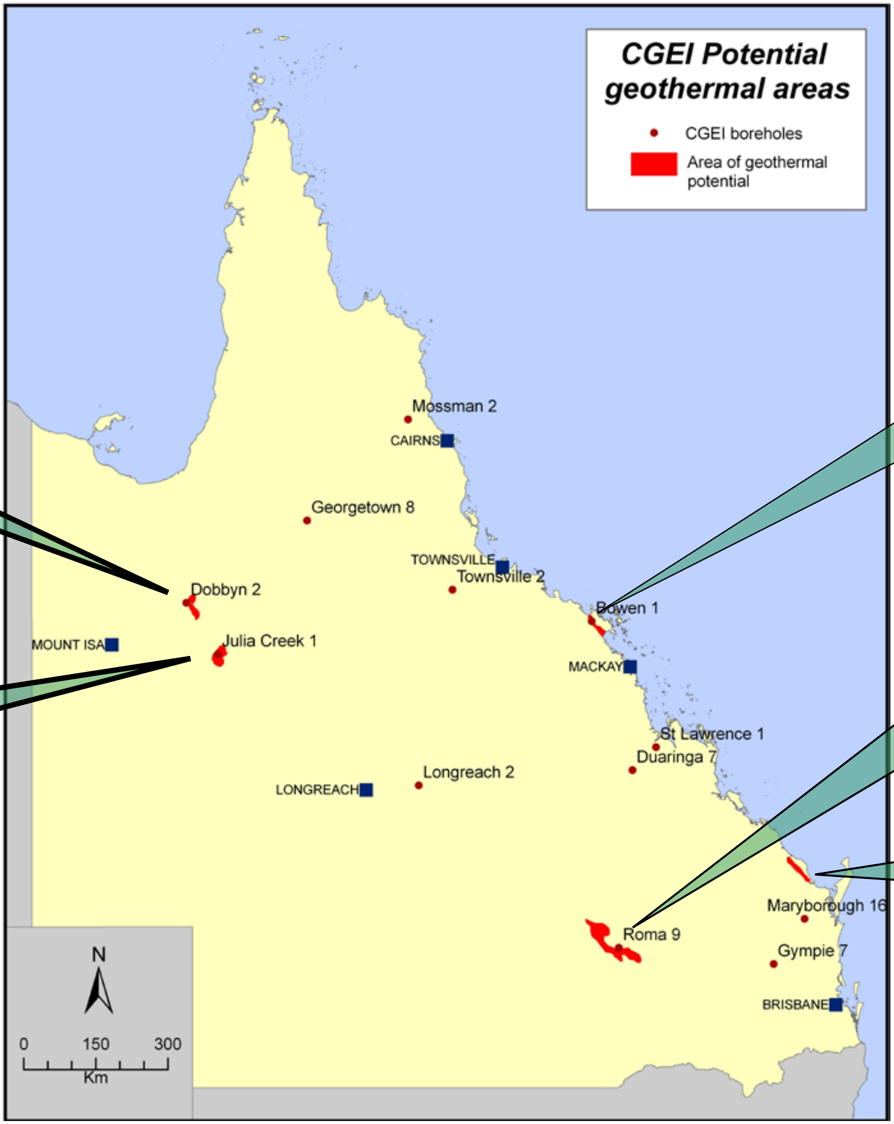
# Geothermal resource assessment

- Rock (resource) volume ($m^3$):
  - Surface area from geophysical data
  - Thickness = 150°C cut off to 5 km




- Assumptions:
  - Stored heat is contained within a box
  - Change in temperature is constant over the system
  - Porosity is negligible

# Estimated thermal energy in place




***Millungera North***
261,025 PJ

***Millungera South***
553,995 PJ

***Hillsborough Basin***
143,758 PJ

***Surat Basin (Roma Shelf)***
155,410 PJ

***Maryborough Basin***
145,644 PJ

*^Based on 70°C reference temperature ( $T_r$ )*

# Equivalent electric power generation potential

- Input parameters:

| Parameters | Estimate |
|---|---|
| Recovery factor | 5% |
| Thermal conversion efficiency | 7% |
| Plant capacity factor | 90% |
| Plant/project economic life | 25 years |

= [(stored heat x recovery factor x conversion factor) x plant capacity$^{-1}$] / plant life

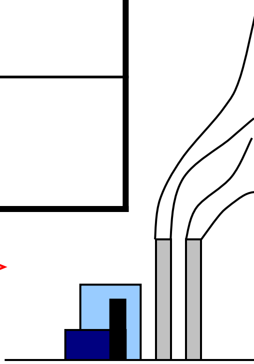
# Equivalent electric power generation potential

| Area | Thermal energy estimate (PJ) | Inferred resource recoverable heat estimate (PJ) | Equivalent gross electric power generation potential (MWe) |
|---|---|---|---|
| Millungera Basin (south) | 553995 | 27700 | 2730 |
| Millungera Basin (north) | 261025 | 13051 | 1290 |
| Surat Basin (Roma Shelf) | 155410 | 7770 | 760 |
| Maryborough Basin | 145644 | 7282 | 720 |
| Hillsborough Basin | 143758 | 7188 | 710 |

STORED HEAT IN PLACE

RECOVERABLE HEAT

GROSS POWER GENERATION



# Conclusions

- 5 areas have been identified with potential: Millungera, Surat (Roma Shelf), Hillsborough & Maryborough basins
- Fresh core with preserved *in situ* moisture content better represents formation conditions
- Less traditional heat source can be viable targets under sufficient insulating cover
- Grouting of annulus provides best means of aquifer control

Geothermal resource assessment:

- Limitations:
  - Does not address practicalities of development, resource-specific constraints such as poor permeability, scaling or corrosion problems
- Advantage:
  - provide an understandable, rational basis for comparing the size of different geothermal resources

# Future work

- Increasing spatial distribution of heat flow data
- Constrain the temperature field in 3D through modelling
- Extensive stress field study
- Exploratory drilling to validate temperatures and geology at depth
- An engineering feasibility study to evaluate the commercial viability of the prospective areas


Questions/comments?