

Low Enthalpy Geothermal Resources of Ireland Maps Encourage Geothermal Projects

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ABSTRACT

The Geothermal Resources of Ireland maps of 2005 (Goodman *et al.* 2004, Kelly *et al.* 2005) were published as a public resource to establish a modern baseline in geothermal energy resources and demonstrated the probable extent of geothermal resources across the island of Ireland to a depth of 5km. These maps for groundwater temperatures at 10m, 100m, 500m, 1,000m, 2,500m, 5,000m were reported at EGC 2007 in Unterhaching (Jones *et al.* 2007). They have allowed the development of a number of exploitation scenarios across the island and have initiated a number of investigative projects in identified target zones where further exploration is warranted.

1. INTRODUCTION

In the period since the publication of the maps the following developments have taken place.

2. SHALLOW RESOURCES

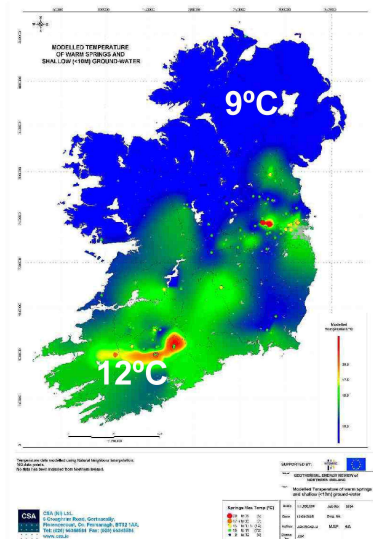


Figure 1: Surface / 10m depth temperatures.

Encouraged by government grants, recommended by Goodman *et al.* (2004) and a parallel 2004 Arsenal study (Boesworth, R. 2004), rapid development has taken place across the island (Allen *in press*). Warm moist ground conditions (Fig.1) have allowed the development of shallow resources. Horizontal loops are common for buildings with sufficient available ground area, whilst vertical closed loop borehole collectors are now common and multiple borehole fields recently starting to appear. Installed capacity has risen very rapidly from an estimated 0.5MW in 2000 to some 250MW in 2008 (Fig.2).

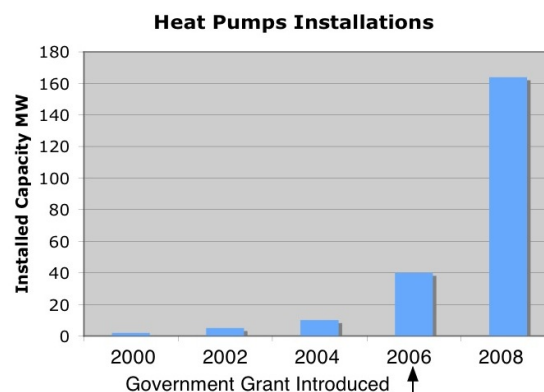


Figure 2: Recent steep rise in installed capacity..

In the region east of the warm spring at Mallow, Co. Cork an investigative study has been initiated (Allen & Mooney *in press*) to define the newly identified continuation of the warm spring zone to the Glanworth area (Fig. 3).

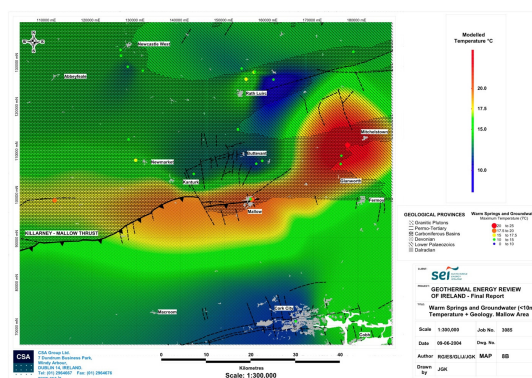


Figure 3: The geothermal anomaly in the Glanworth area.

Shallow aquifers with high yields have been successfully developed as seen in the very efficient open loop borehole systems of the Offaly County Council offices, Tullamore (Fig.4), the Cork City Council, the University College Cork schemes (Figs.5,6) and the 400kW system at Vista Medical Centre, Naas, Co. Kildare (Fig.7).

There are a number of moderate sized systems (up to 15kW) Open and Closed loop collectors from water bodies, used for both heating and cooling.

Medium sized projects with fields of multiple closed-loop boreholes are now being developed.

3. MEDIUM DEPTH RESOURCES

Ireland has no recognised deep aquifer systems, except in Mesozoic sediments in Northern Ireland (Figs.8, 9), where

there is good potential for district heating from doublet systems (Kelly *et al.* 2005).

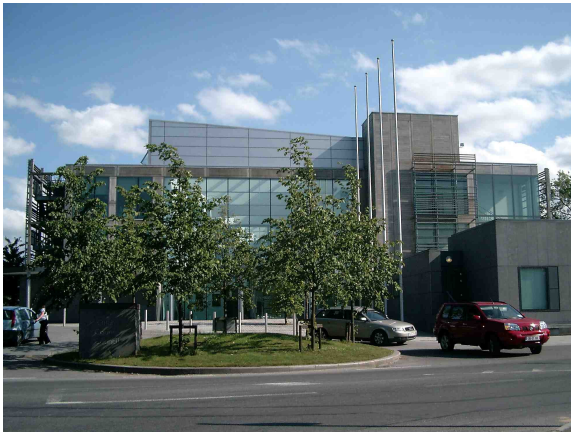


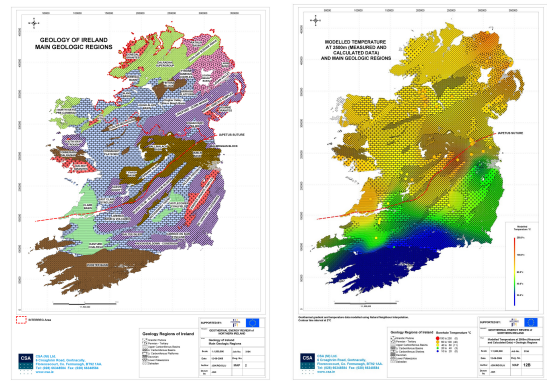
Figure 4: Offaly County Council offices, Tullamore



Figures 5, 6: UCC Cork IT building and plant room



Figure 7: Vista Medical Centre, Naas, Co. Kildare



Figures 8, 9: 8. Deep geology of Ireland. 9. Modelled temperatures at 2.5km depth.

The Geological Survey of Northern Ireland (GSNI) have drilled a 900m borehole at Kilroot in Co. Antrim (Fig.10), targeting the Sherwood Sandstone and Permian aquifers. This stratigraphic hole, together with magnetotellurics and infill gravity, will detail the geothermal potential of the area.



Figure 10: Drilling the GSNI Kilroot borehole. Picture T. Rosowski

Fracture ‘aquifers’ are common in the Carboniferous sequence which underlies over 50% of the country and are likely to provide numerous high flow low temperature geothermal resource sites as the market develops and their geometry and hydrodynamics are traced at depth.

More detailed investigations (O’Neill & Pasquali 2005, Jones *et al.* 2007) recommended specific sites for further study. Deeper resources are now being investigated and already two projects are proceeding to target geothermal resources associated with a major Palaeozoic fault at 2.5km in the Dublin area for potential district heating development.

Other resources, that include deep crystalline rock settings, have been identified for potential exploration activities but they will need further development of the market for deep drilling to begin.

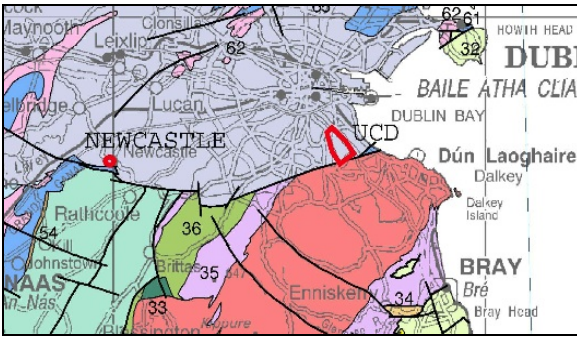


Figure 11: Geology of the Blackrock-Rathcoole Fault separating the Carboniferous Dublin Basin to the north from the older Leinster Massif to the south

The combination of deep faults and crystalline rocks have been identified in Germany and other countries as having the biggest geothermal resource. This combination exists south of Dublin where the Blackrock/Rathcoole Fault occurs adjacent to the Leinster granite and Lower Palaeozoic Massif (Fig.11). GT Energy Ltd. have already carried out deep exploratory drilling in the south-west (Fig.12), whilst University College Dublin are evaluating their location.



Figure 12: GT Energy's Marriott rig exploring a fracture aquifer south-west of Dublin.

4. DEEP RESOURCES AND ELECTRICITY POTENTIAL

The 5km depth resource map (Fig.13) indicates that there is significant potential for electricity generation in some areas, especially in the north-east. Development of this resource depends largely on additional drilling and on new data being collected. At 5,000m depth across Northern Ireland and a number of other locations, modelled temperatures show a number of potential 'hot-spots' with values of 115°C - 165°C in the Lough Allen Basin, 115°C - 150°C in the Larne - Lough Neagh Basins and a potential 180°C in the Rathlin Basin.

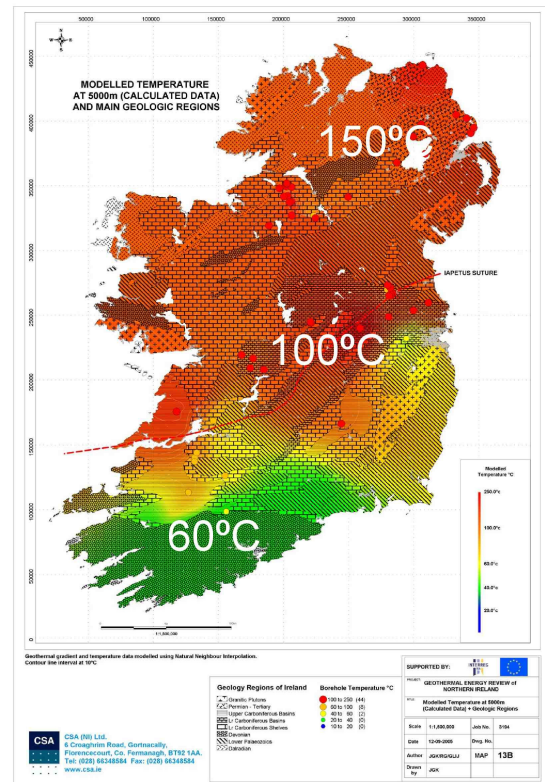


Figure 13: Modelled temperatures at 5km depth

The Geological Survey of Northern Ireland (GSNI) is investigating the geothermal potential in the Tertiary Mourne Granite with a 600m deep exploration borehole (Fig.14). They will geothermally log the borehole and carry out conductivity tests on the samples, which, with infill gravity to create a 3D model, will characterise the batholith.



Figure 14: Setting up the GSNI drill rig for the Mourne granite assessment borehole. Pic T. Rosowski

At present only binary or Organic Rankin Cycle (ORC) power plants can be considered for electricity generation production at temperatures down to 100 °C in Ireland from geothermal heat.

A perceived barrier to the investigation and development of medium-deep resources, is the lack of protective legislation. GTR-H, an EU funded research project, has looked at regulation across Europe and is developing a template (Pasquali & Goodman 2008). An Irish government geothermal working group is consequently drafting

legislation to cover this area and to provide security of tenure to geothermal companies (King & Dhonau 2008).

The successful development of Hot Dry Rock (HDR) technology and hydraulic stimulation techniques elsewhere in Europe will increase the perceived geothermal production capacity of Irish sites significantly and thereby accelerate the development in this area to look at electricity production from higher temperature resources.

5. CONCLUSION

A combination of resource assessment and government support has promoted the development of shallow resources and stimulated the investigation of specific geothermal locations for deeper projects.

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