De-Risking the Geothermal Resource of Malawi

Scottish and UK Governments' Global Challenges Research Fund and RCUK Impact Acceleration

The ubiquitous provision of clean, reliable energy is a key challenge for Malawi that has both economic and well-being impacts. The current status where both heat and electrical power are supplied via erratic systems severely impacts economic growth. In addition, the use of carbon-based (often charcoal) cooking systems has crippling health impacts, with associated deforestation causing further compounding of local environmental damage.

Over the last 10 years many developing nations have leap-frogged the Western world in telecom technology with a step change in thinking that is revolutionising daily lives (GSMA – The Mobile Economy, Africa, 2016). In a similar mode, energy provision could also make a step change by not following a typical delivery system for energy through grid supply. Rather, an off-grid model of energy provision (supply and storage) based on a scalable solution for small homesteads, through villages to townships could offer not only vital power to stimulate local industrial growth but could do so with major health benefits for the local populations. Malawi is ideally positioned for this step-change in energy where de-risking the geothermal resources provides part of the solution.

Chiweta Hot Springs: Hot Sedimentary Aquifer
- >75°C
- ~0.5 L/s per spring (x3+),
- 150 L/s overall @ ~50°C

Mwankenja Hot Springs:
Basement-bounding fault and dyke
- ~50°C +
- ~1 L/s per spring (x3+)

Nkhotakota Hot Springs:
Fractured basement
- ~60°C
- ~0.5 L/s per spring (x13)

Heat flow map of Malawi with major hot springs indicating geothermal potential

The **University of St Andrews** and private sector geothermal specialist **TownRock Energy**, were funded in 2017 to undertake an evaluation of Malawi's geothermal resource potential. The ***Stage 1*** evaluation consisted of three parts:
- Background desk-top review of geothermal potential
- Reconnaissance survey of known hot-spring sites
- Delivery of preliminary results plus geothermal methodologies and economics at a workshop to local stakeholders

Ministry of Mining
Republic of Malawi

Addis Ababa University
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SEEK WISDOM, ELEVATE YOUR INTELLECT AND SERVE HUMANITY !

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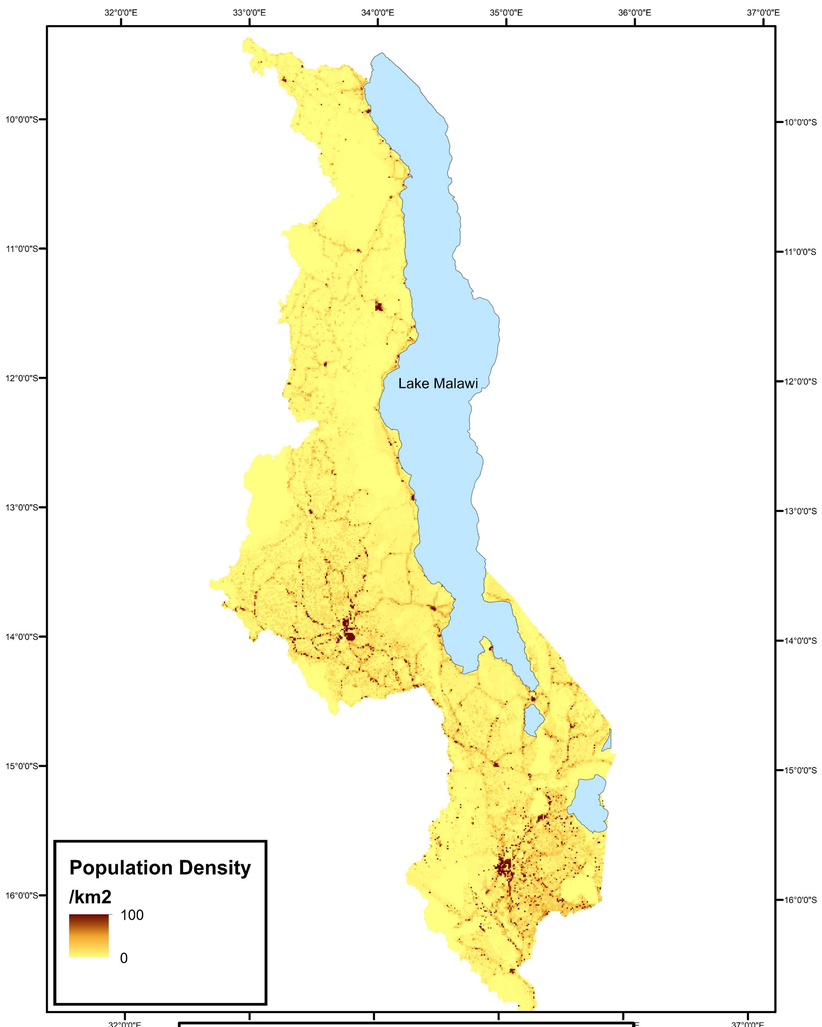
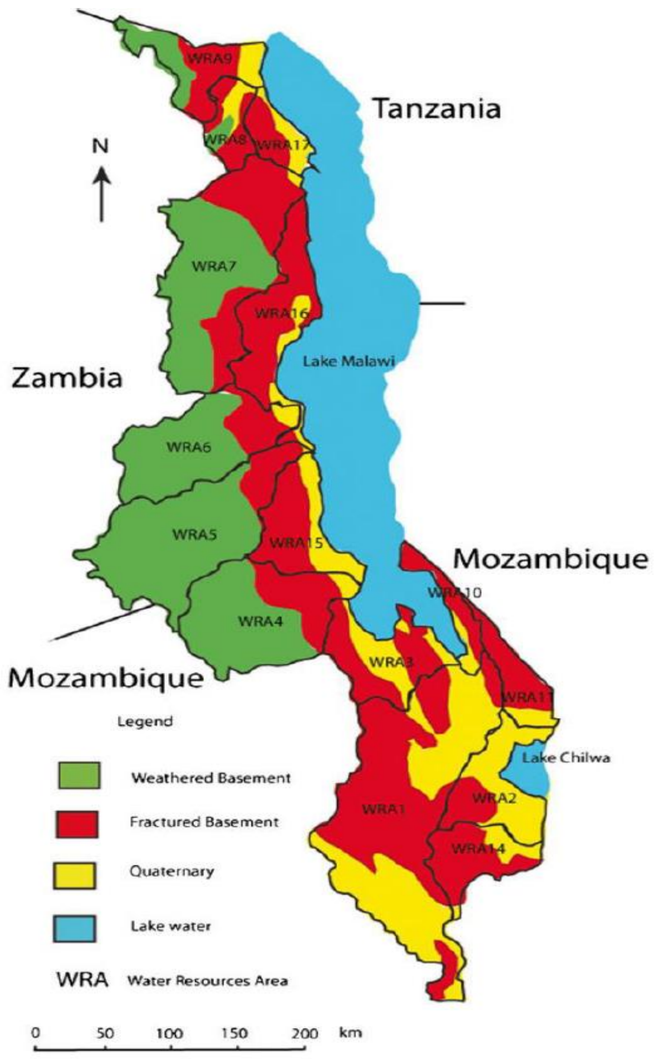
University of St Andrews

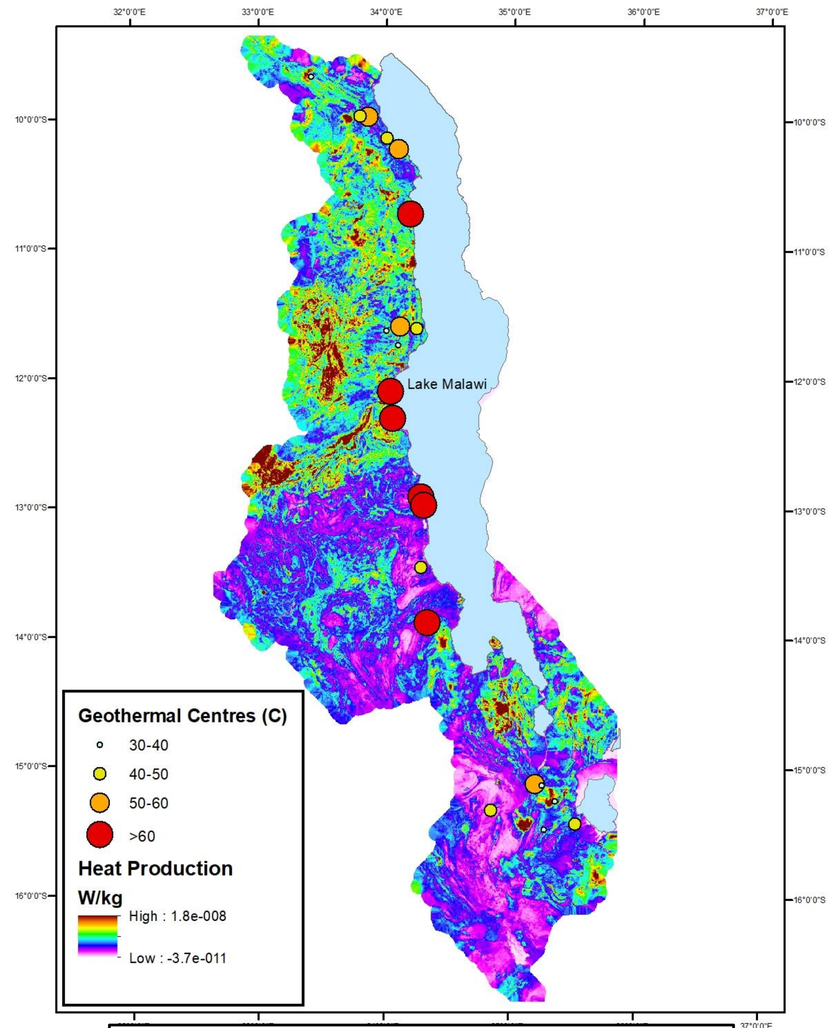
TOWN ROCK ENERGY

Addressing rural energy needs in the past have often failed as they have attempted to provide a singular energy solution to all settings. Rather, the diversity of rural settings necessitates a flexible approach that offers a varied range of scalable solutions working together in an integrated network. Different physical settings require different combinations of technology. Renewable systems such as biomass, geothermal, solar, wind and hydro could provide the required mix of both electrical and heat base load together with peak demand when properly managed and backed-up with appropriate storage solutions. The implementation of these solutions will require specialist teams of experts including resource scientist, engineers and social scientists.



Population Density map of Malawi





Heat flow map of Malawi with major hot springs

- Currently, Malawi produces 99.7% of electricity from hydro-power. Supply cannot meet demand, and blackouts are regular in urbanising areas and normal in rural regions. Most of the ~18 million population lives and works off-grid.
- Biomass burning is ubiquitous, and unique forest ecosystems have nearly been destroyed at a national level. This also contributes to soil erosion and hydro-power dam siltation, exacerbating Malawi's energy crisis.
- These power- and heat-generating challenges stunt development of industry, discourage tourism, frustrate personal ambition, and degrade Malawi's cultural heritage.

Recommendations - a collaborative approach

It has been clear from the activities during ***Stage 1*** of this project that there is not only a national geothermal resource for development in Malawi but that there is an appetite to do so at both Government level and most importantly at a local level. The latter is manifest by the high level of local interest especially from young entrepreneurs. These are clearly an important aspect of future developments as it is through the local development that communities will benefit most. A course of action for this project is outlined below.

Stage 2

- *Invitation to Malawian engineers to visit the EU to review geothermal projects. The visit will include meetings with Scotland-Malawi Partnership in Edinburgh; with collaborators at Strathclyde University in Glasgow; with industrial partners SASOL in St Andrews and ARUP in Edinburgh. Visit to Netherlands geothermal operational plant.* ***NOTE:*** *funding forthcoming from EPSRC Global Impacts*
- Identification of 6 test sites for further studies in Malawi – sites to cover range of temperature conditions and range of economic development/readiness. Work to be done in conjunction with the Ministry of Mines, Ministry of Energy, Malawian Geological Survey, Chancellor's College, University of Malawi and MUST
- Field survey at 2 test sites in Malawi to include further analysis of the geology (geophysical and geochemical surveys)
- Drill to test the geothermal potential with two, 100m boreholes (testing the geothermal gradient and flow rates)
- Assessment of the social infrastructure for development (work with socio-economic staff from University of Malawi)

Stage 3

- Build energy and resource development partnerships – these will include key players both in Scotland and Malawi at academic institutes, government bodies and private companies
- Delivery of integrated system to two test sites.

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