

Proceedings World Geothermal Congress 2026, Calgary, Canada, June 8—11, 2026

DeepHeat: Enabling Next-Generation Geothermal Energy for New Zealand

Jalilinasrabady Saeid*, Chambefort Isabelle
Earth Sciences New Zealand
saeid.jalilinasrabady@earthsciences.nz

INTRODUCTION

DeepHeat is a five-year, $10.7 million research programme funded by the Ministry of Business, Innovation and Employment (MBIE)[1] and led by Earth Sciences New Zealand.

DeepHeat will address this challenge by investigating how superhot fluids move at depth at the interface between magma and rocks, developing AI-driven reservoir models, conducting fracture network experiments, and assessing wellbore performance. We will also advance stimulation and well -integration technologies, evaluate energy and economic scenarios, establish environmental monitoring frameworks, and co-design Māori-led business models to ensure long-term sustainable benefits.

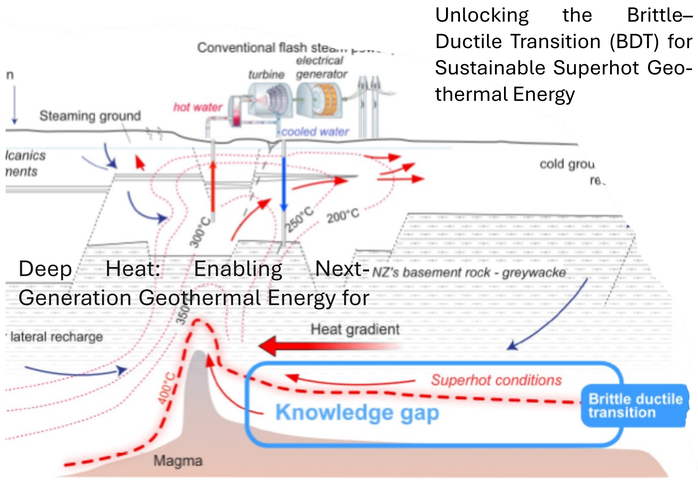


Figure 1. DeepHeat: Unlocking Superhot Geothermal and National Energy Security Through Advanced Permeability Modelling .

METHODS

- Permeability, stress, and thermal transport.
- Poorly constrained globally due to limited deep-well data.
- DeepHeat will quantify fluid–rock interactions and permeability evolution.

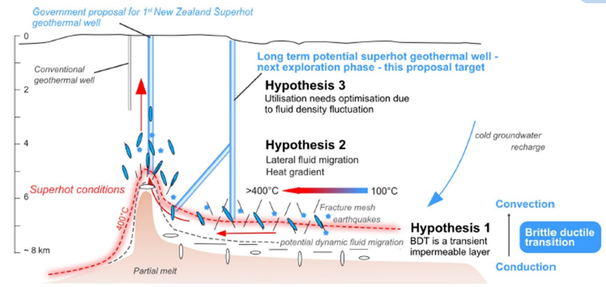


Figure 2. Scientific Gap at the BDT

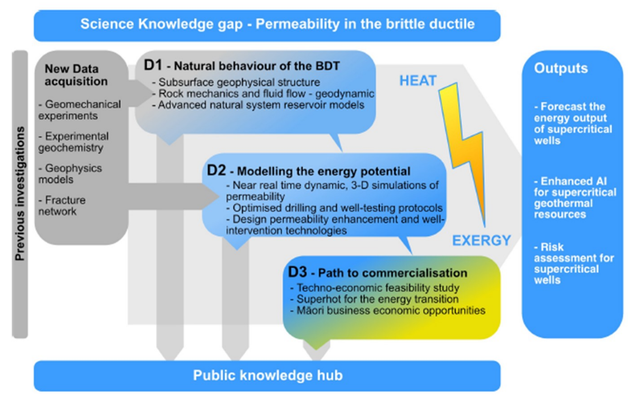


Figure 3. From Conventional to Superhot Geothermal

RESULTS

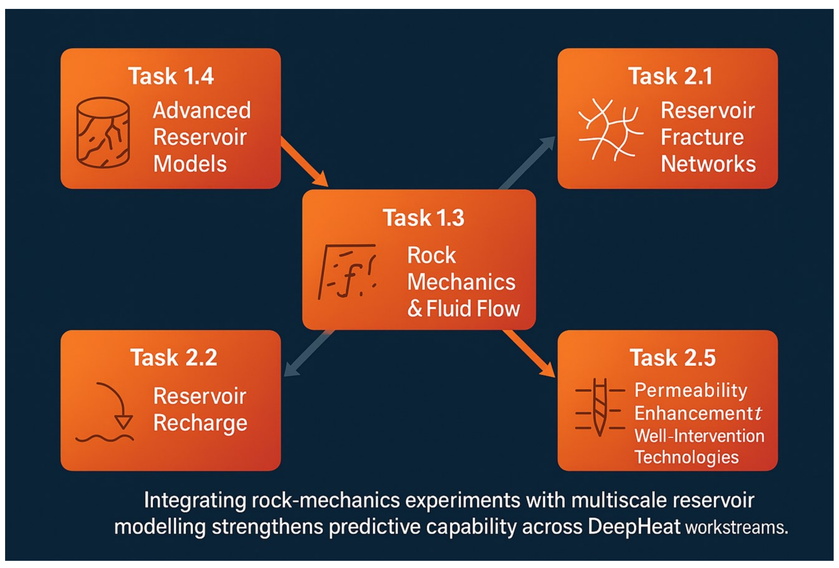


Figure 4. Linking rock mechanics and reservoir dynamics

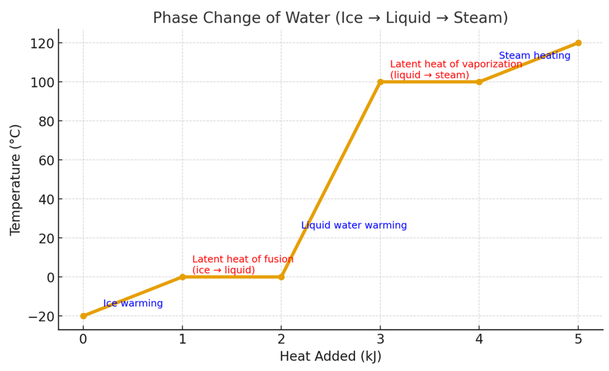


Figure 5. Water : The Messenger of Heat

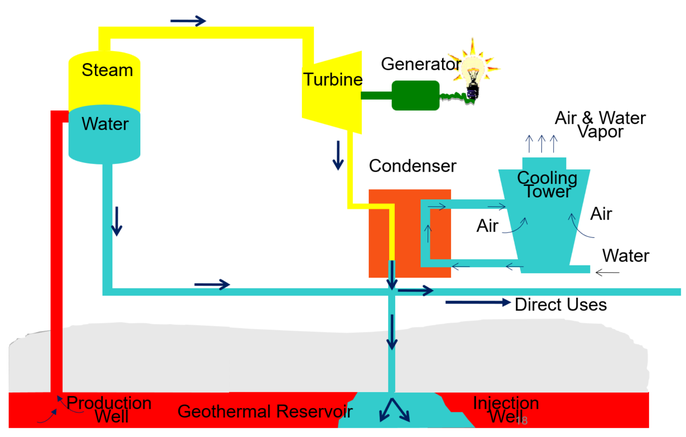


Figure 6. Single-flash power plant layout

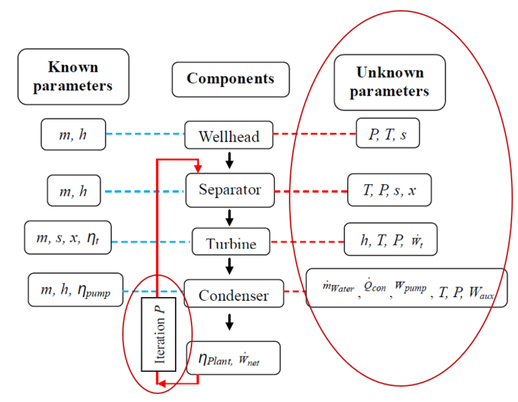
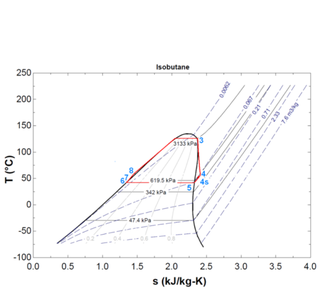


Figure 7. Flash cycle optimisation process



Temperature-entropy diagram of the ORC cycle

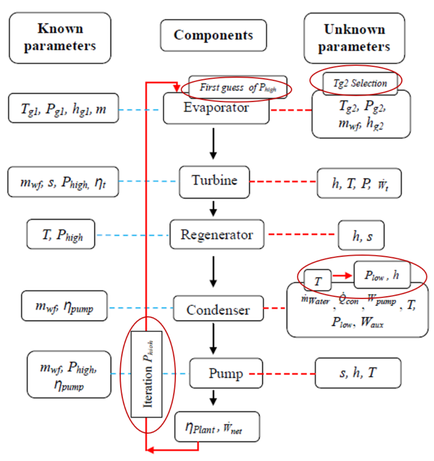


Figure 8. Binary cycle optimisation process [2]

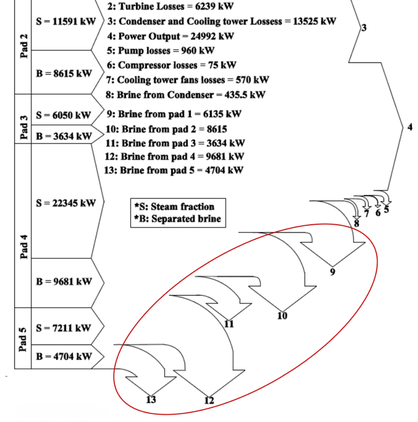


Figure 9. Grassmann presentation of a single-flash power plant

DISCUSSION

Superhot geothermal energy is essential for providing reliable, low-carbon, weather-independent 24/7 electricity. It enhances climate resilience, reduces dependence on global energy storage markets, and strengthens national energy independence-addressing all aspects of the energy trilemma: security, equity, and sustainability[3].

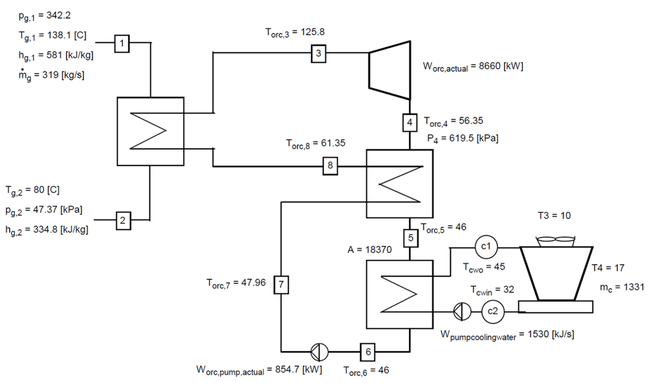


Figure 10. Schematic diagram of the optimised organic Rankine cycle (ORC) model

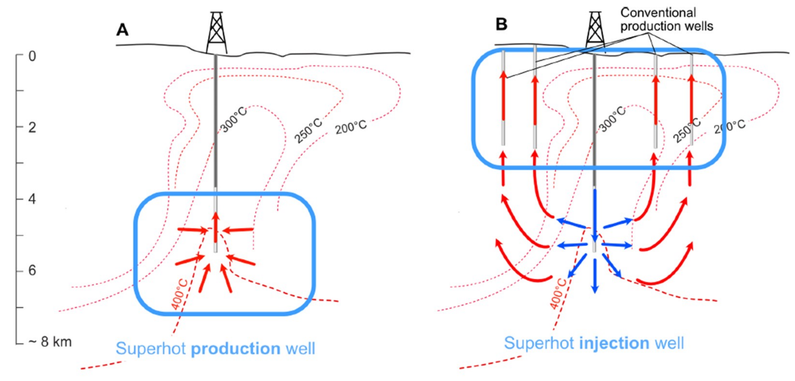


Figure 11. Production and well stimulation scenarios from superhot reservoir. A. Direct production from the superhot reservoir using natural permeability. B. Deep reinjection into the superhot reservoir, stimulating the conventional high enthalpy geothermal reservoir above. The blue box denotes the depth of production.

CONCLUSION

- Continuous chain from rock mechanics to societal integration.
- Multiscale coupling and uncertainty qualifications for supercritical geothermal systems.
- Engineering innovation integrates field-scale validation.
- Building strong foundation for sustainable, high-enthalpy production in New Zealand.
- Māori engagement included throughout
- Coupling rock mechanics, reservoir modelling, and DFN simulation and into one coherent framework.
- Integrating Māori values, engineering innovation, and AI-driven modelling to ensure outcomes are technically sound and socially responsible.
- Contributing to secure, sustainable, and superhot geothermal energy for Aotearoa New Zealand.

Acknowledgements

This work is funded by the Ministry of Business, Innovation and Employment (MBIE) through the DeepHeat programme, led by Earth Sciences New Zealand.

REFERENCES

1. Ministry of Business, Innovation & Employment (MBIE) - New Zealand, 2025, Research Programmes successful proposals
2. Jalilinasrabady, Saeid, Itoi, R., Valdimarsson, P., Saevarsdottir, G., Fujii, H.: Flash cycle optimization of Sabalan geothermal power plant employing exergy concept, *Geothermcis*, **43**, (2012), 75-82.
3. World Energy Council. WORLD ENERGY TRILEMMA 2024: EVOLVING WITH RESILIENCE AND JUSTICE. (2024).