TownRock Energy

Reservoir Independent Deep Geothermal Technology for Heating

(not just electricity)

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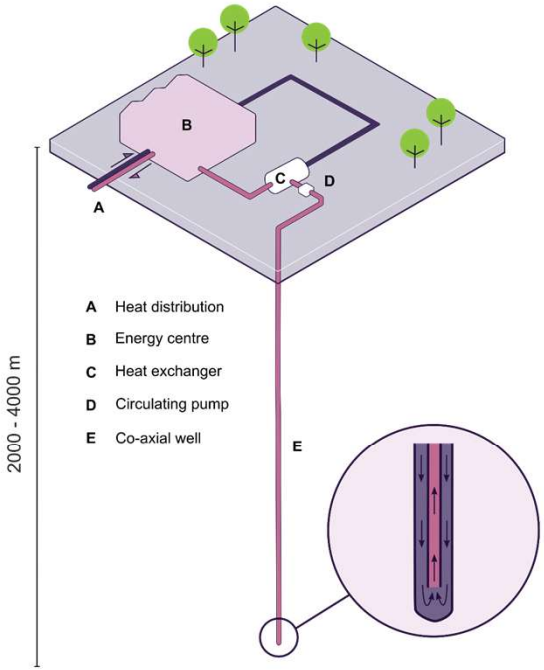
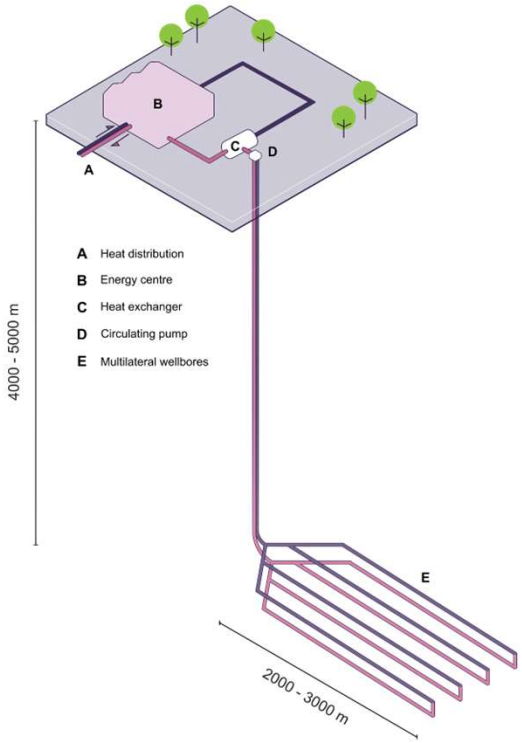
Contents

The technologies



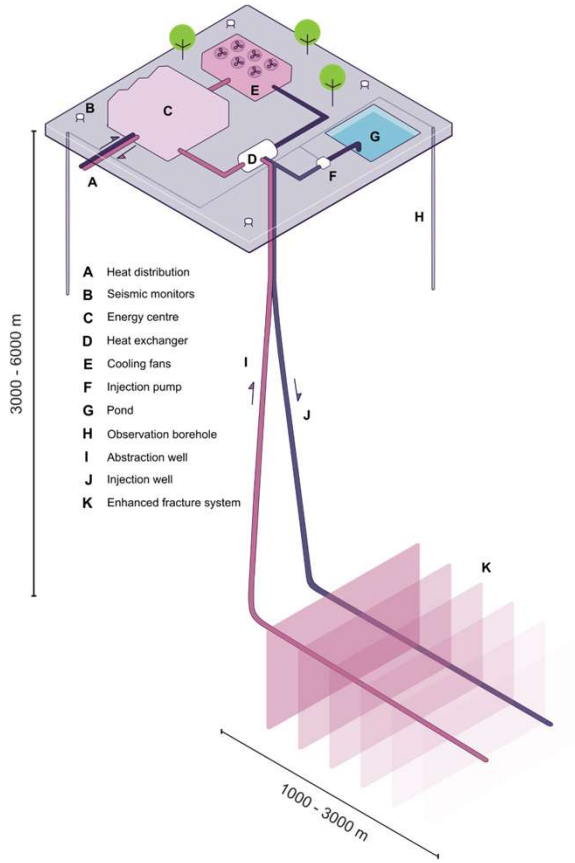
Coaxial System

High readiness



Advanced Geothermal System (AGS)

Low readiness

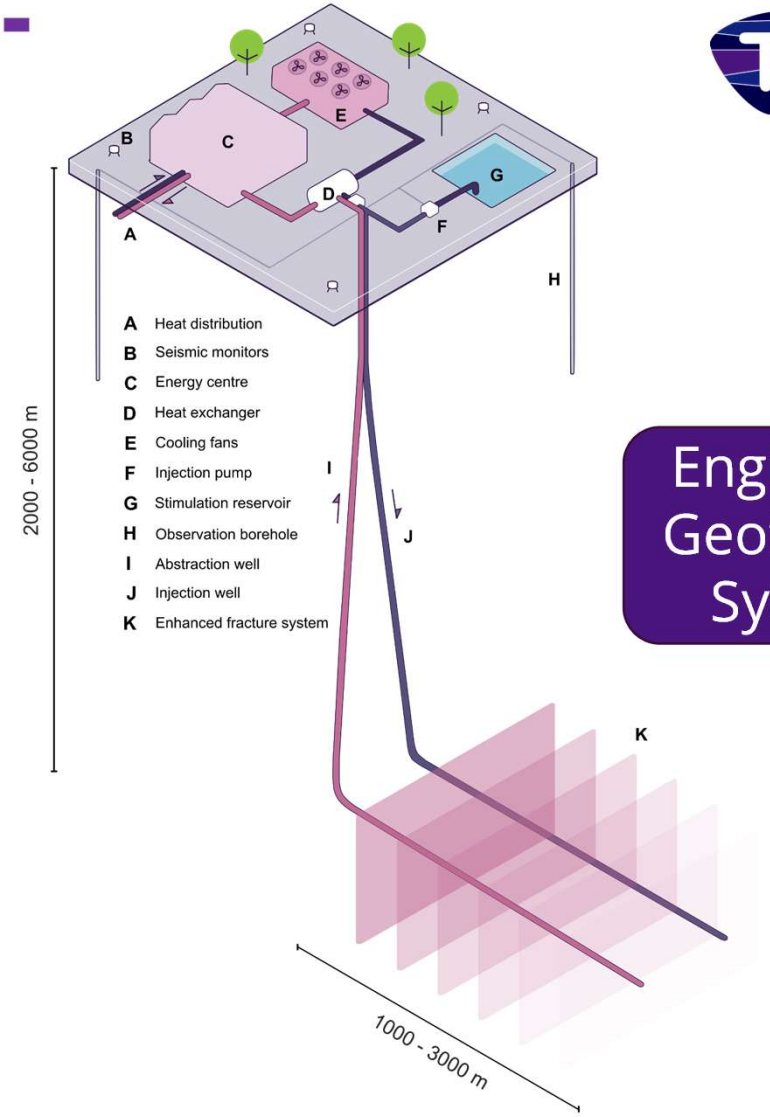


Engineered Geothermal System (EGS)

Medium readiness

City Scale Heating - EGS

Set up of drilling rig on site in Espoo, Finland. (EGS research project)
(Source: St1)



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Engineered Geothermal Systems

Why bother? It sounds expensive!

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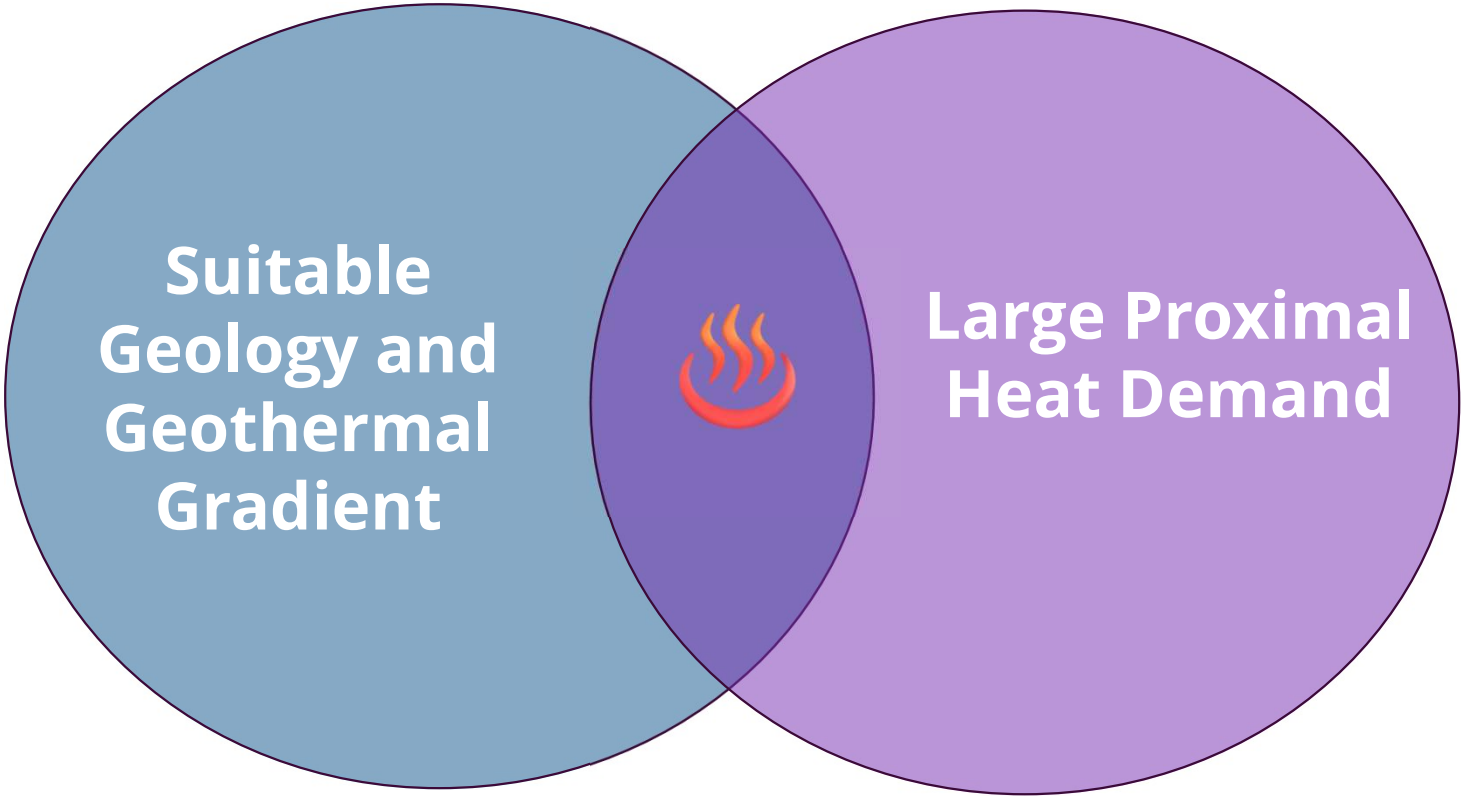
When is it appropriate?

- Large heating demands
- Electrical grid constraints
- High demand temperature

- ✓ **Scalable in many areas** as not reliant on natural groundwater reservoir
- ✓ **Increasing the application/locations** of deep geothermal energy
- ✓ **Lower temperature** compared to electricity (100 – 150 °C sufficient)
- ✓ **Very high COP** – no electricity required for heat pump

Suitable locations



→ **Hospitals** → **University Campuses** → **Heat Networks**

What are the risks?

Reservoir Risk – achieving sufficient communication between wells

- Design based on well characterised reservoir and stress field
- Stranded wells can be converted to coaxial offering fallback, reduced heat output

Seismic Risk – seismic events at surface unacceptable to local stakeholders

- Thorough stakeholder engagement
- Comprehensive monitoring
- Traffic Light system (stimulation paused at PGAs well below what is detectable at surface)

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NHS Grampian Foresterhill Case Study

The big questions

Heat Demand

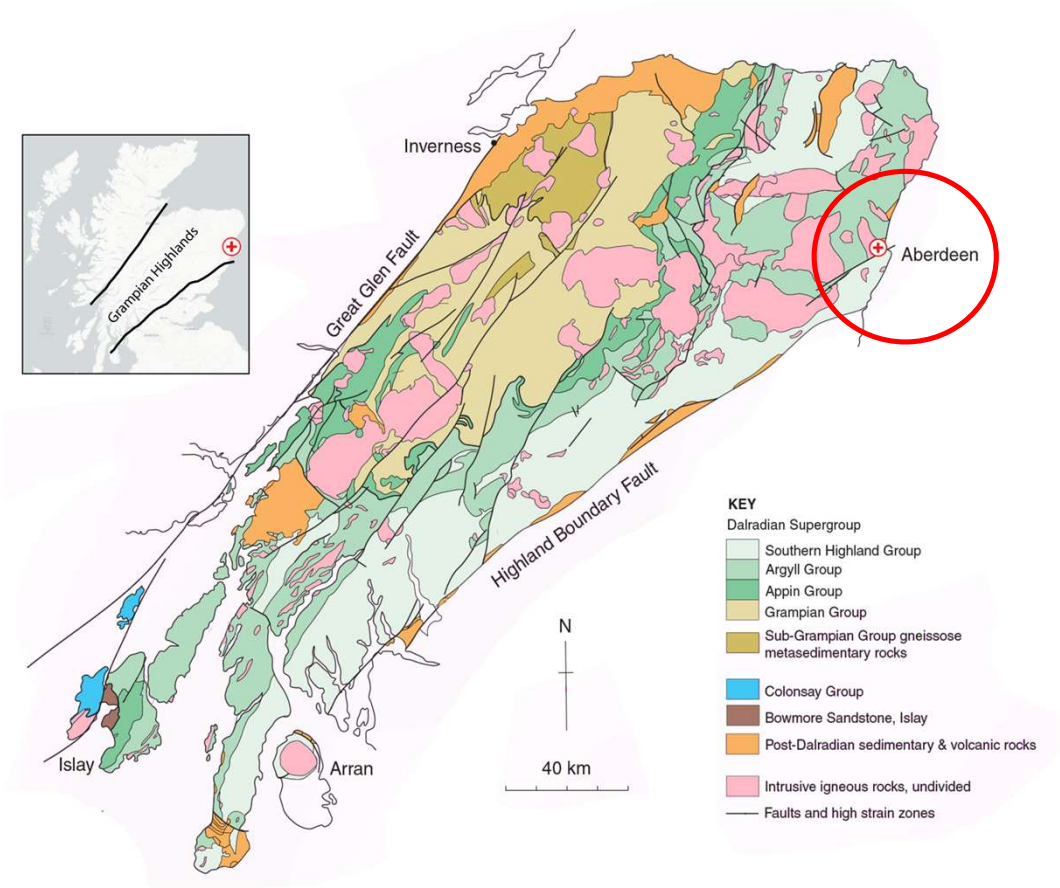
- What are the target temperatures?
- What is the peak heat demand?
- What is the baseload demand?

Geology

- What are the properties of the Aberdeen Granite?
- How deep does it extend?
- What is the geothermal gradient?
- Are there natural connections?
- Palaeoclimatic effect?

Modelling performed using CMG Stars

Scottish Grampian granites



(modified from Thomas et al., 2004)

Other granites in the Grampians offer higher estimated heat flow values and geothermal gradients.

But they lack a large nearby heat demand.

Foresterhill Hospital - Aberdeen

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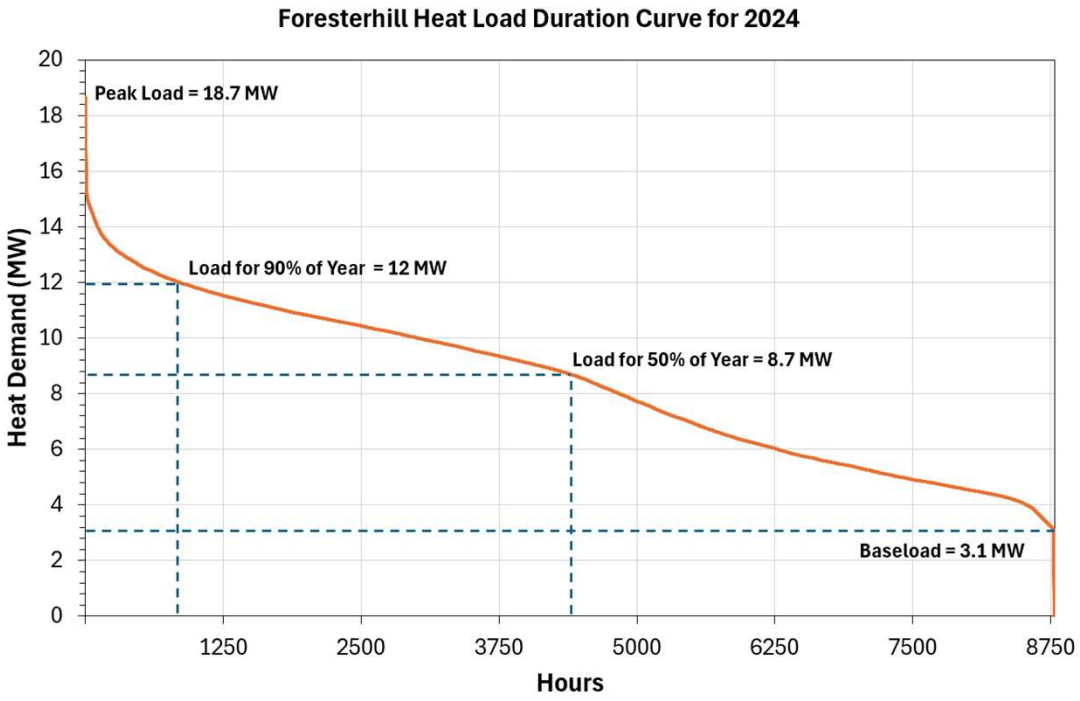
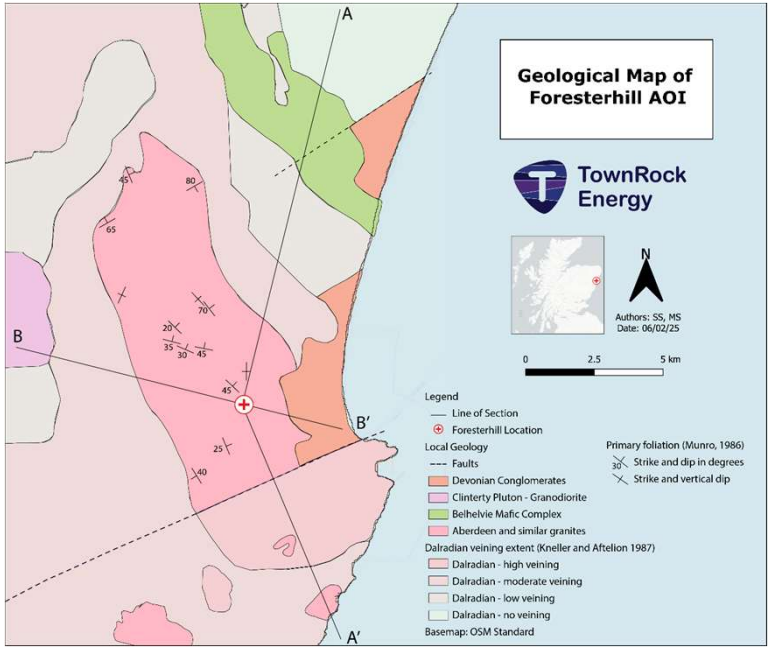
Conservative geothermal gradient of **30 °C/km**
- **100 °C at 3.5 km depth**
- **150 °C at 5 km depth**





Foresterhill Hospital - Aberdeen

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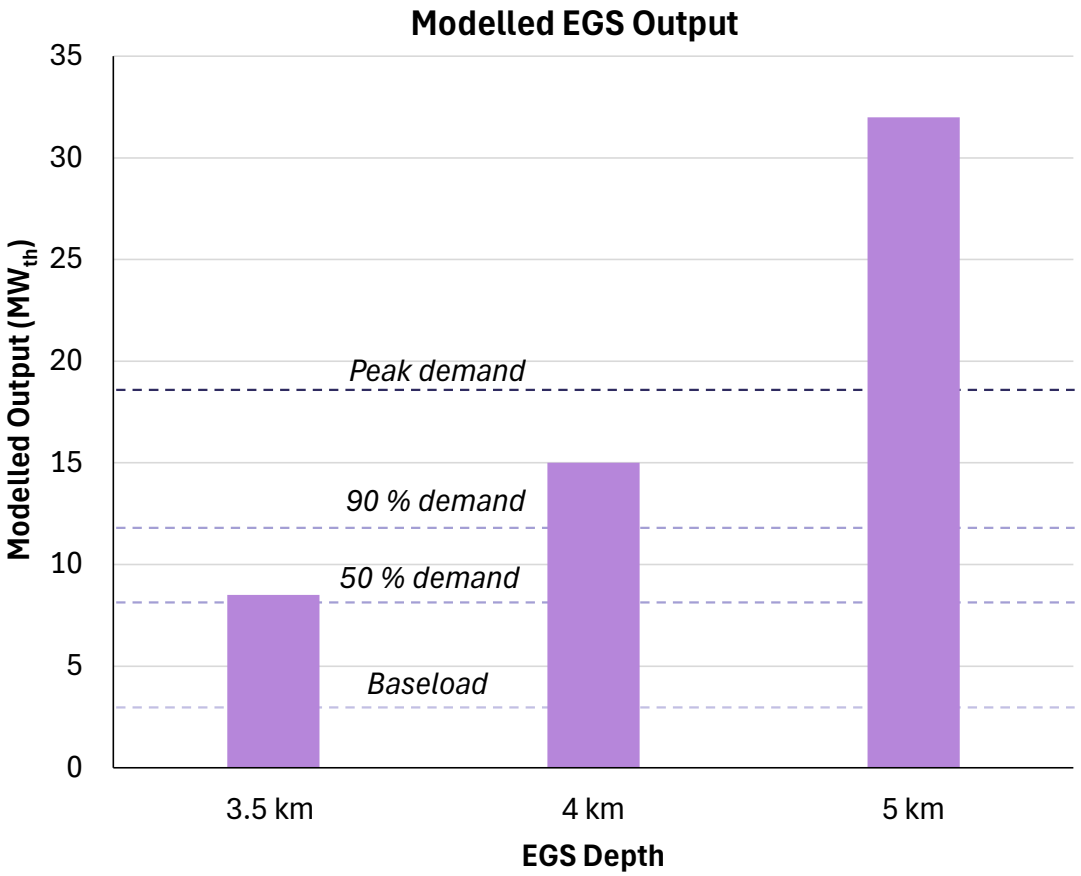

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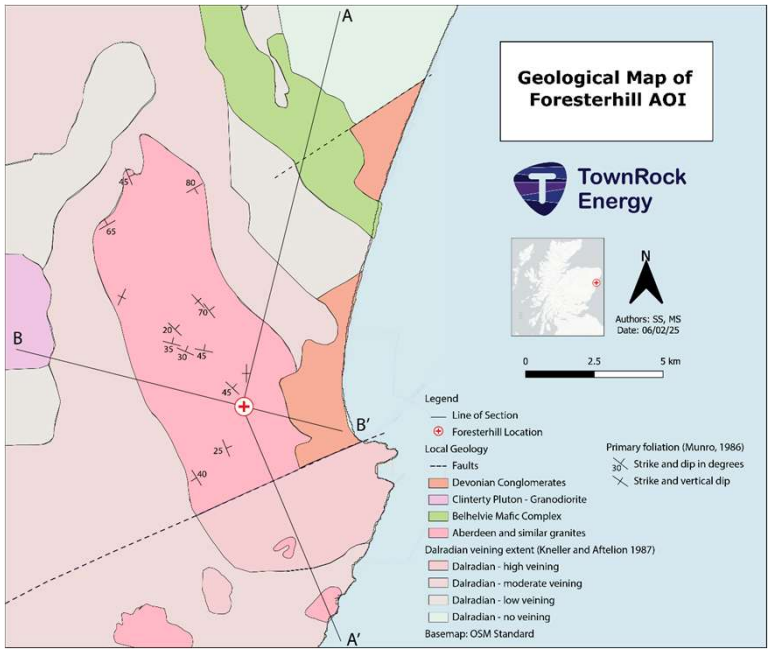
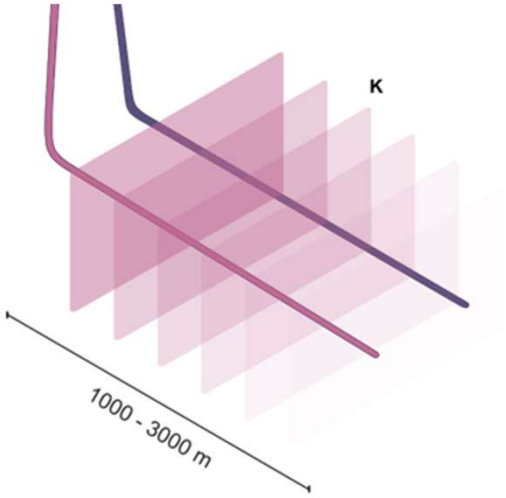


Modelling vs reality

Risk	Mitigation
Thermal feedback	Repeatable fractures from multistage stimulation Correctly spaced laterals
Creating and maintaining open fractures	Correct choice and placement of proppant



Model

Axial planar fractures perpendicular to wellbore

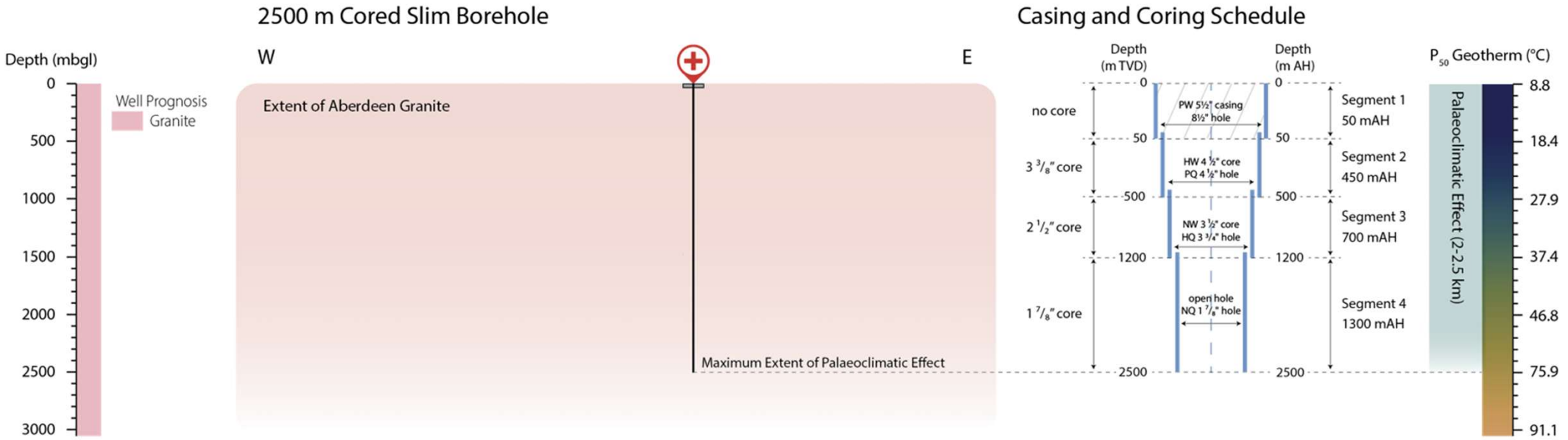
All fractures high permeability and contribute to flow equally

Reality

Fracture cloud radially propagating radially from wellbore

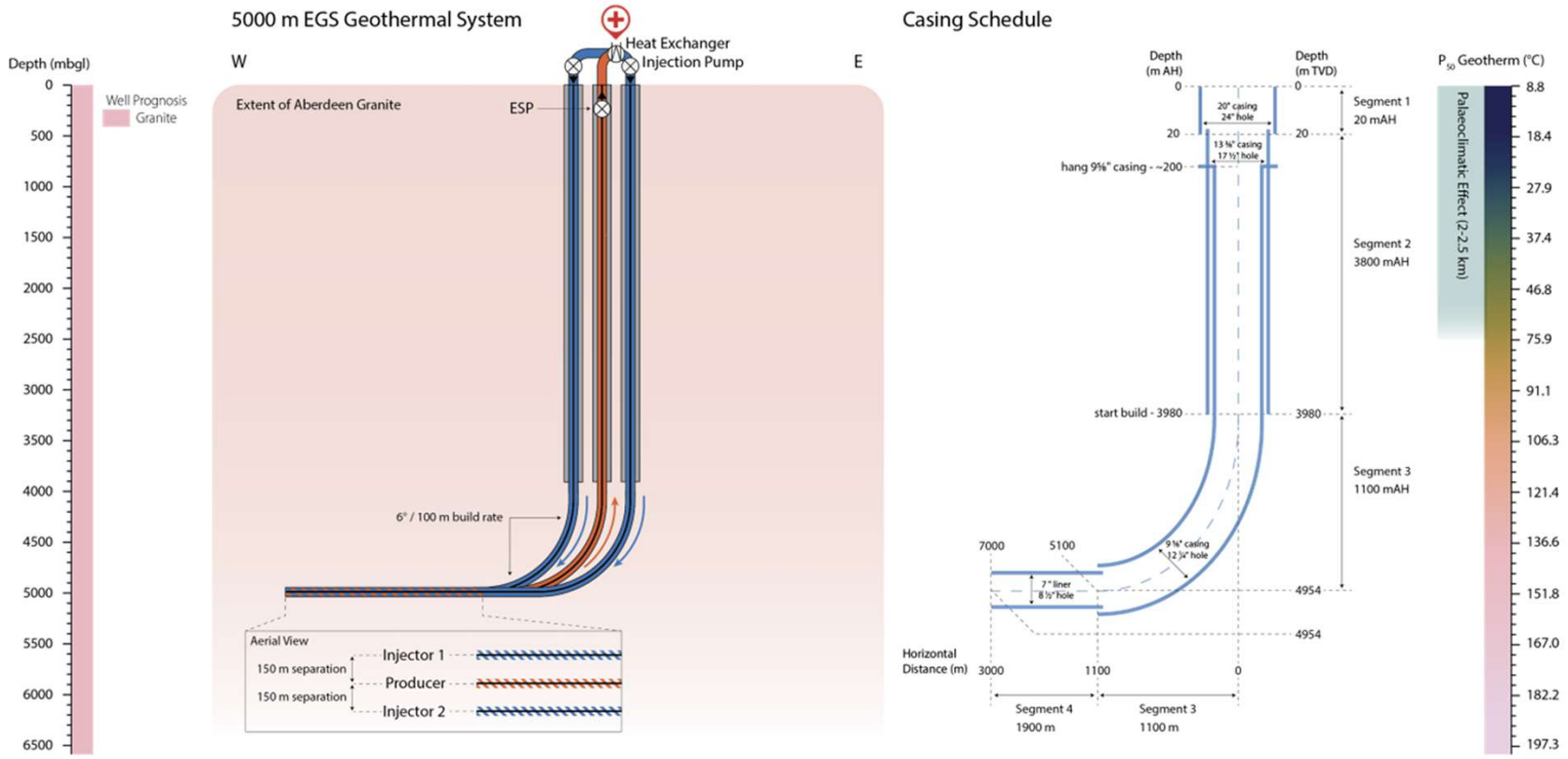
Some fractures contribute more than others

Notional Well Design | Exploration hole



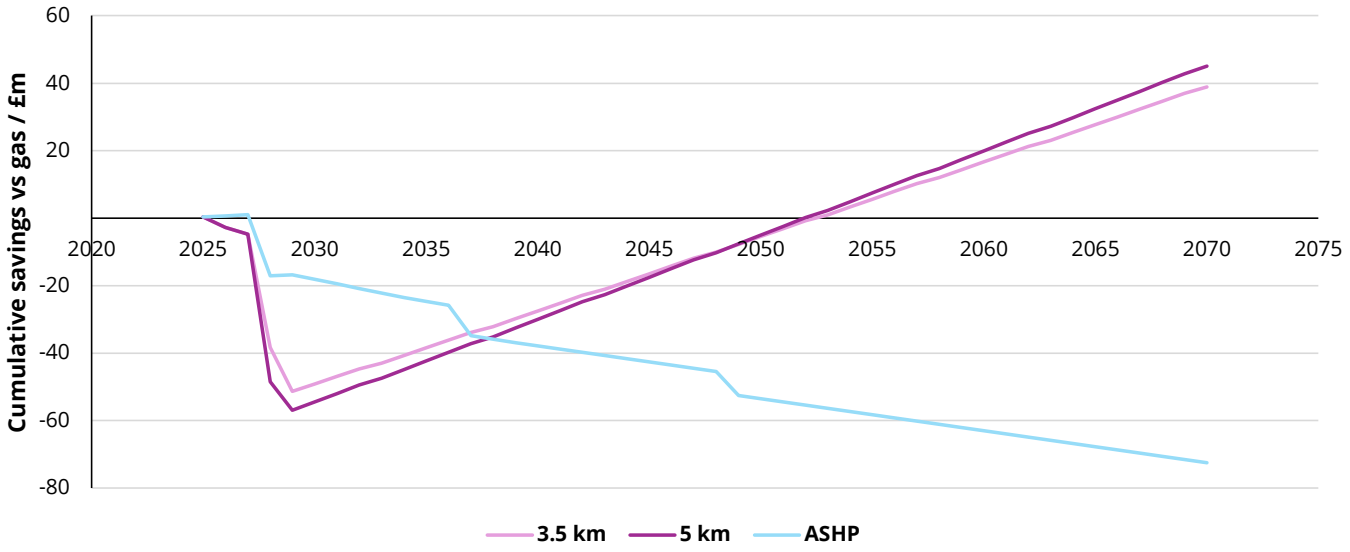
- Prove extent of the Aberdeen Granite to TD
- Establish extent of palaeoclimatic effects and confirm geothermal gradient
- Establish properties of the granite and regional stress regime
- Improved cost estimates for EGS phase
- Stakeholder engagement/community buy-in

Notional Well Design | 5 km EGS triplet



- Perforation of 7” casing horizontal leg
- Stimulation – 25 stages spaced at 75-100 m
- Isolation – of each stage with packer prior to next stage

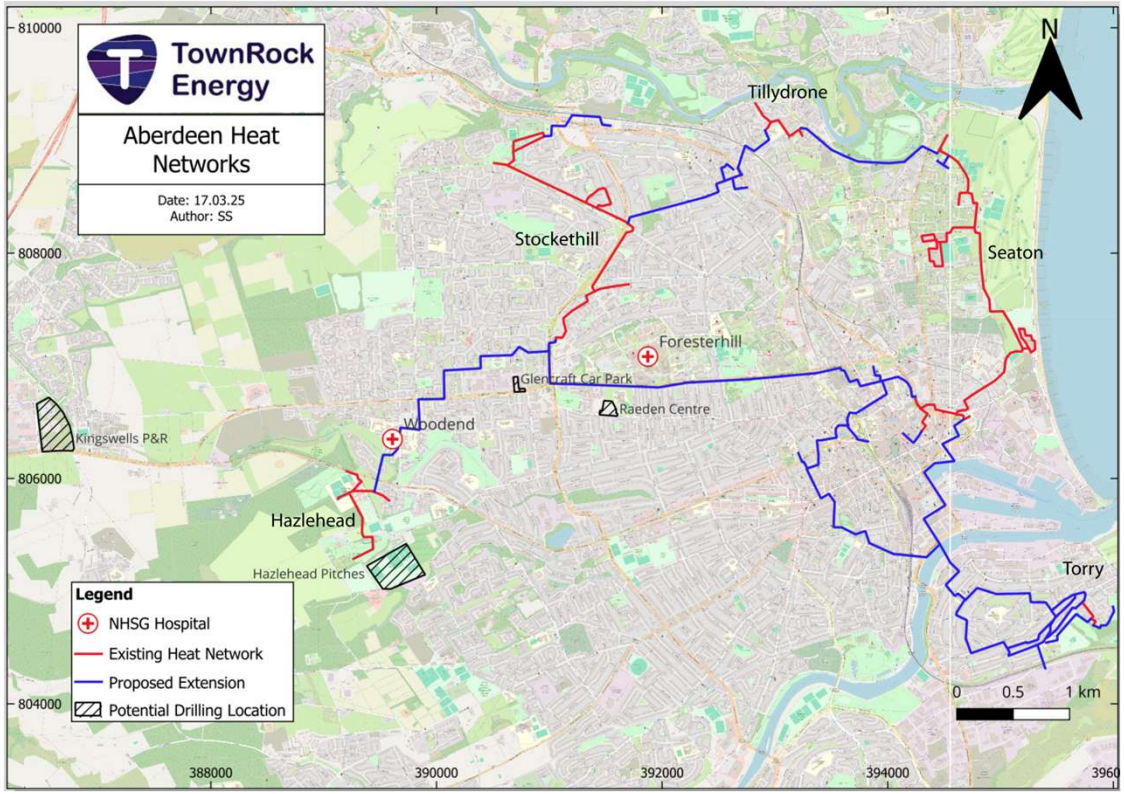
Cumulative savings and LCOH

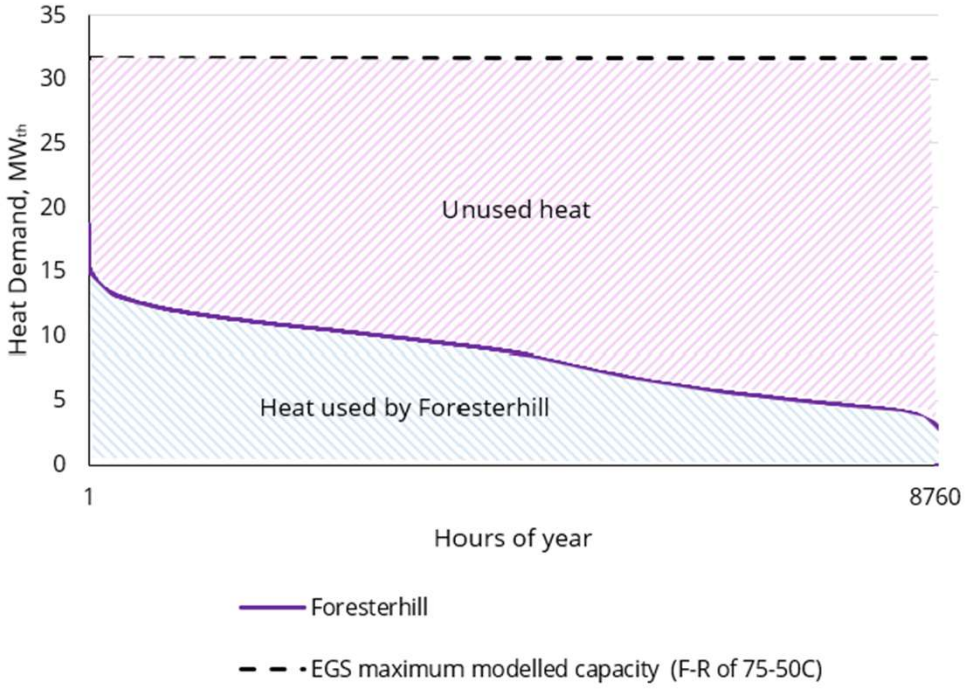


$$\text{LCOH} = \frac{\text{total lifetime cost}}{\text{total lifetime energy produced}}$$

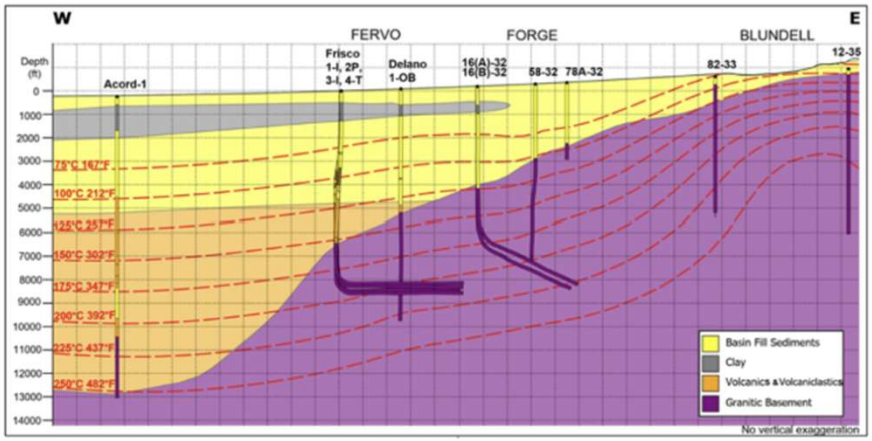
Levelised Cost Of Heat (p/kWh)			
3.5 km	5 km	ASHP	Gas + biomass
4.7	4.5	7.8	5.5

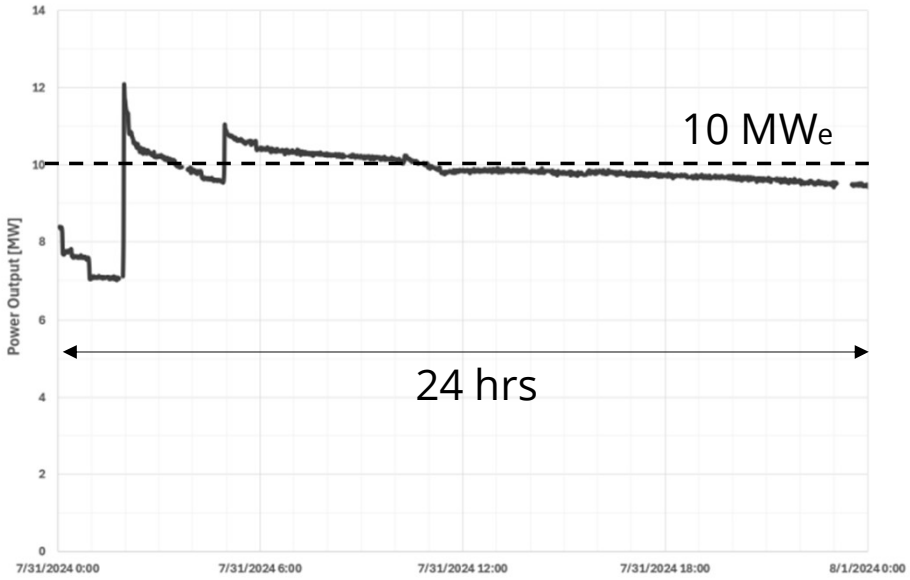
Expansion across Aberdeen





Case Study: Fervo Cape Station





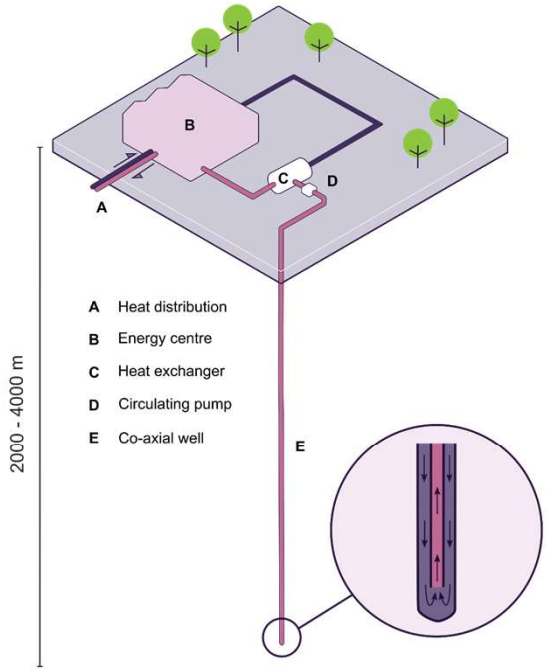
- 2025 data release indicating sustained 8 – 10 MW_e over 24hrs
- Scepticism over tail-off after 24hrs and parasitic pump power - 4.8MW_e a more realistic value?
- Optimistic generation efficiency of 25% - still equates to **~20MWth**
- Shallow reservoir in rural setting – need to transfer success to different geologies in more populated settings

Next steps

- EGS has the potential to provide city-scale geothermal heating at low LCOH
  - Characterising fractured EGS reservoirs is challenging
  - Reservoir, drilling and public acceptance risk need to be understood

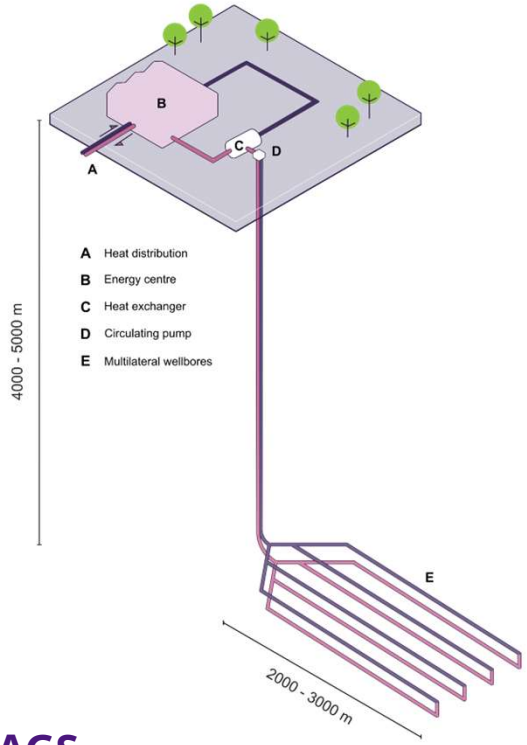
- Next Steps for NHS Foresterhill
  - Deep on-site exploration borehole
    - Constrain geothermal gradient and palaeoclimate effect
    - Establish stress fields and fracture orientations
    - Repurpose as seismic monitoring well
  - Opportunities for community engagement
    - Strong appetite for geothermal in Aberdeen

Concluding Remarks



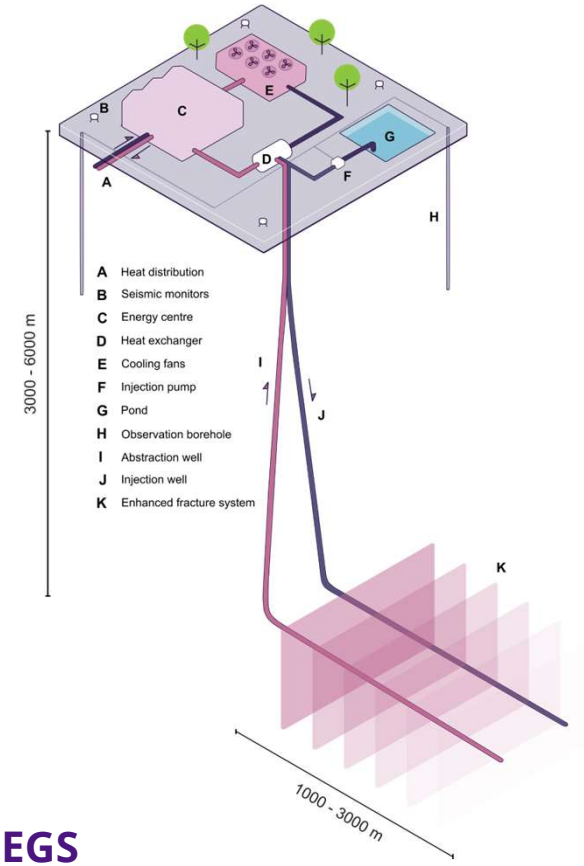
Coaxial

- Low risk
- Low heat outputs per well
- High LCOH



AGS

- Moderate risk
- Requires very high demand
- High LCOH



EGS

- Medium-to-High Risk
- Requires high demand
- Medium-to-Low LCOH

All merit consideration – geology, grid & heat demand matter!

Thank you

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