



THE UNIVERSITY
of EDINBURGH



Galleries2Calories

Using abandoned flooded mines to store and transport waste heat – a Scottish feasibility study

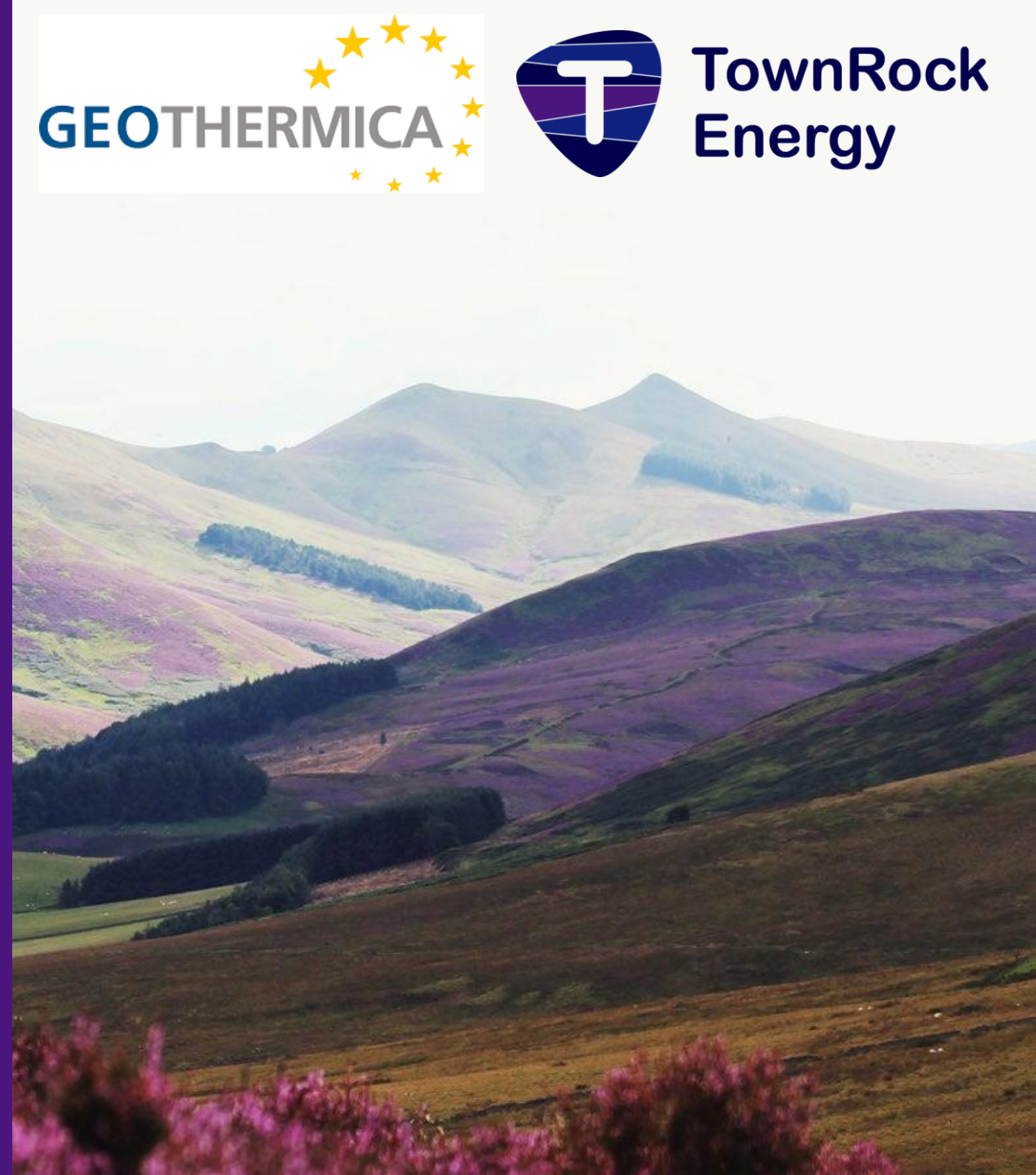
Presented by David Townsend – Founder & CEO

21st February 2024

Co-PI Professor Chris McDermott, University of Edinburgh



TownRock
Energy



G2C – Heat GeoBattery



Using abandoned flooded coal mines to store and transport waste heat



Co-funded by:

- Scottish Enterprise, Scotland
- Geological Survey Ireland (GSI)
- Department of Energy (DoE) USA
- European Union

Plus, significant own contributions from project partners.

Cooperation partners

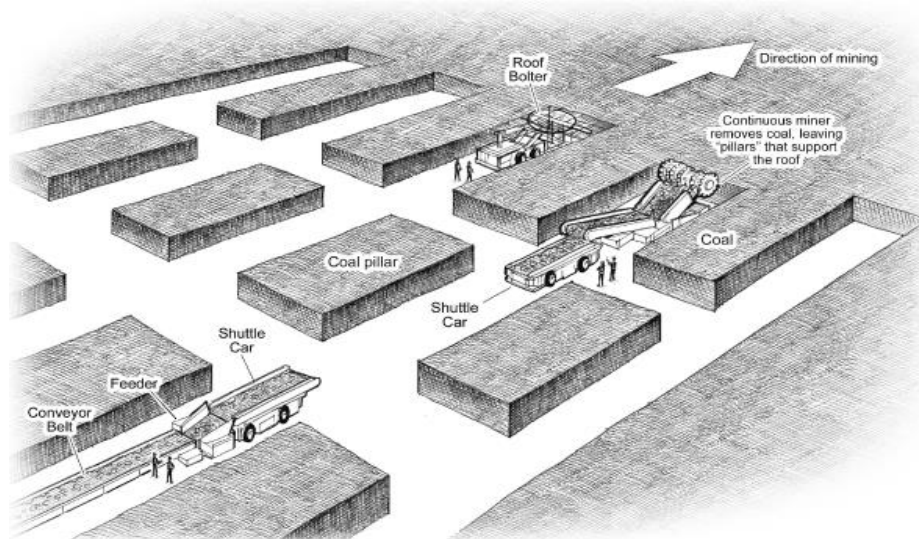


£2.6 million

3-year project

Initiation in September 2022, End date September 2025

Historic mine workings = geothermal resource?



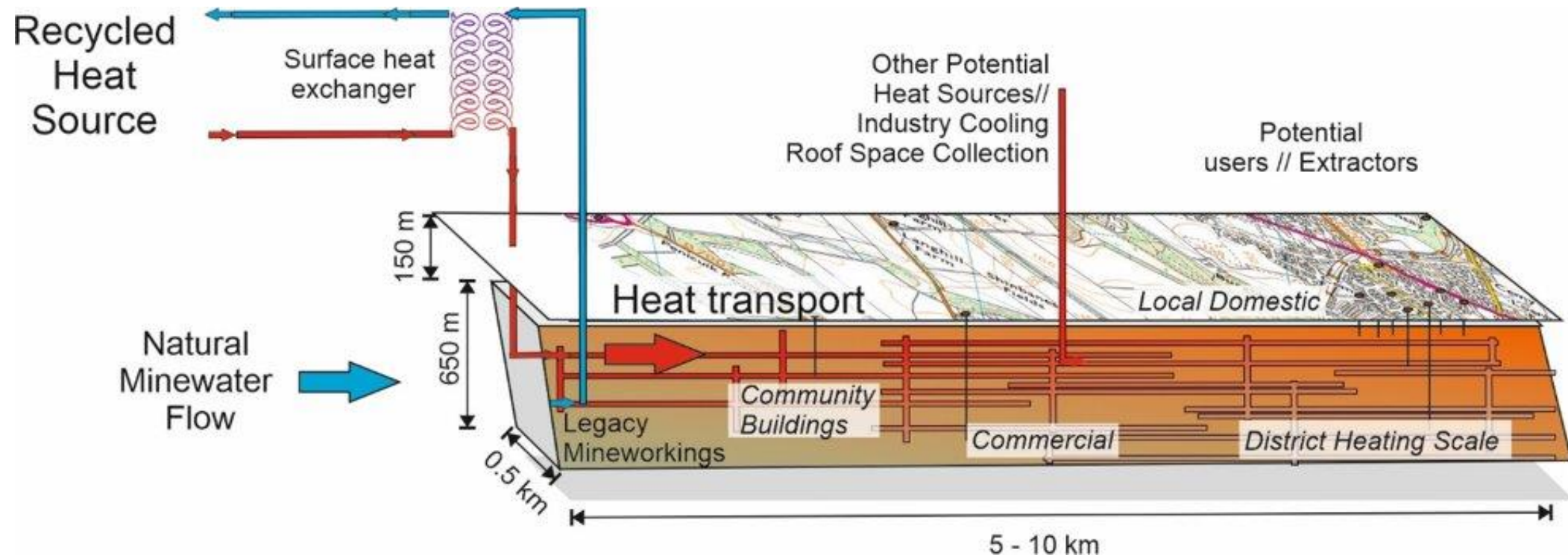
- About **600,000** households are facing fuel poverty, up to **1 in 4 households in the central belt of Scotland**
- **1,677 GWh** of waste heat across ~1000 sites in Scotland
- Mine workings proven to be a viable source of net-zero heat, but can they also form a free heat network?

<https://www.climateexchange.org.uk/media/4481/waste-heat-sources-for-heat-networks-scotland-final-nov-20.pdf>

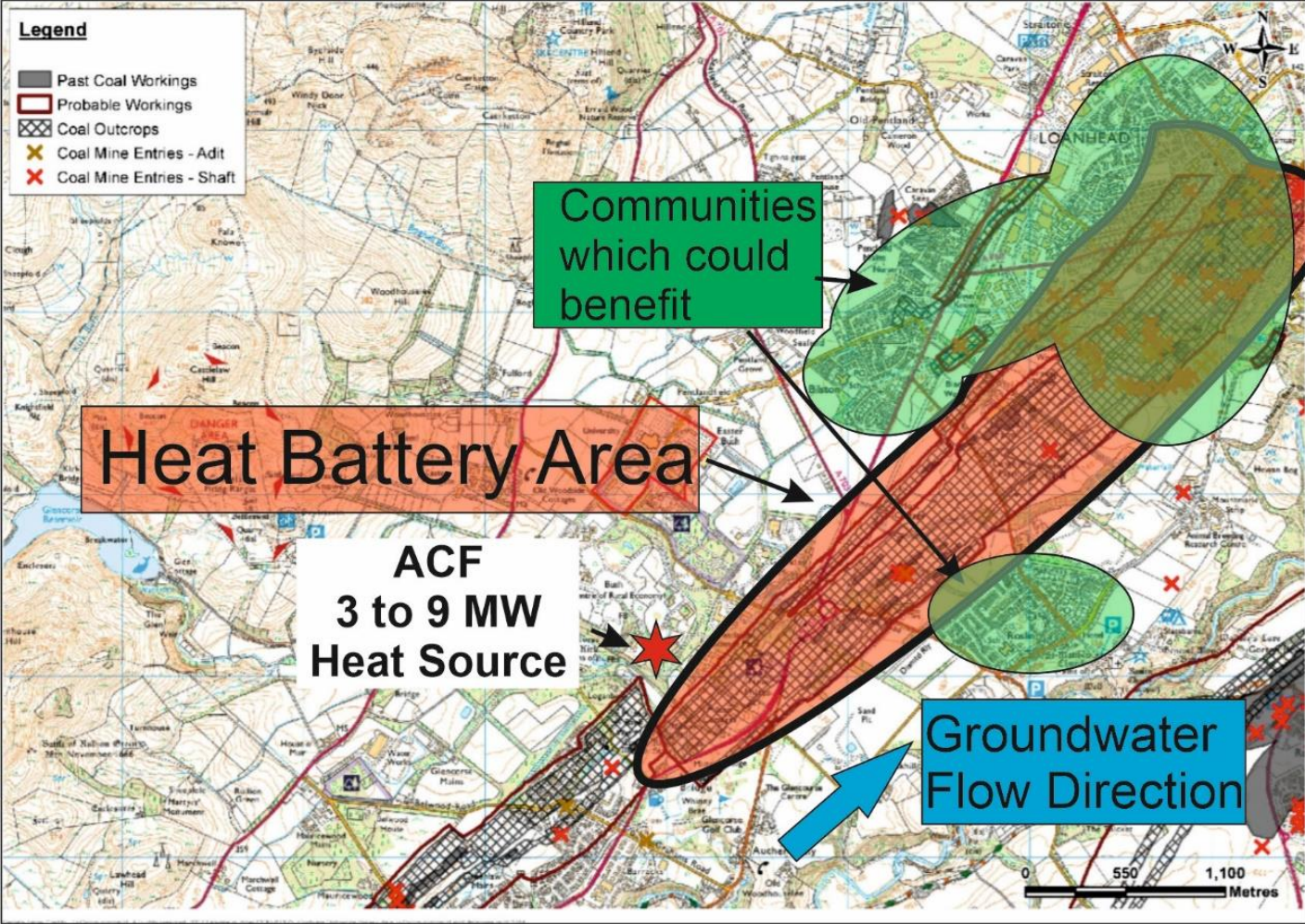
<https://mapapps2.bgs.ac.uk/coalauthority/home.html>

<https://www.gov.scot/publications/scottish-house-condition-survey-2018-key-findings/pages/6/>

GeoBattery Concept



Heat Battery Location





Research Questions

1. Feasibility Study for ACF Cooling Using Mine Water

- Quantification of Waste Heat Available
- Abstraction & Discharge Locations Identified
- Cost Engineering
- Environmental & Social
- Risk Assessment

2. Development of the Experimental Field Site

- Baseline Monitoring
- Borehole drilling:
 - 1 x abstraction borehole
 - 1 x discharge borehole
 - 1 x monitoring borehole
- Hydraulic and Tracer Tests
- Local Monitoring

3. Modelling, Monitoring and Making It Happen

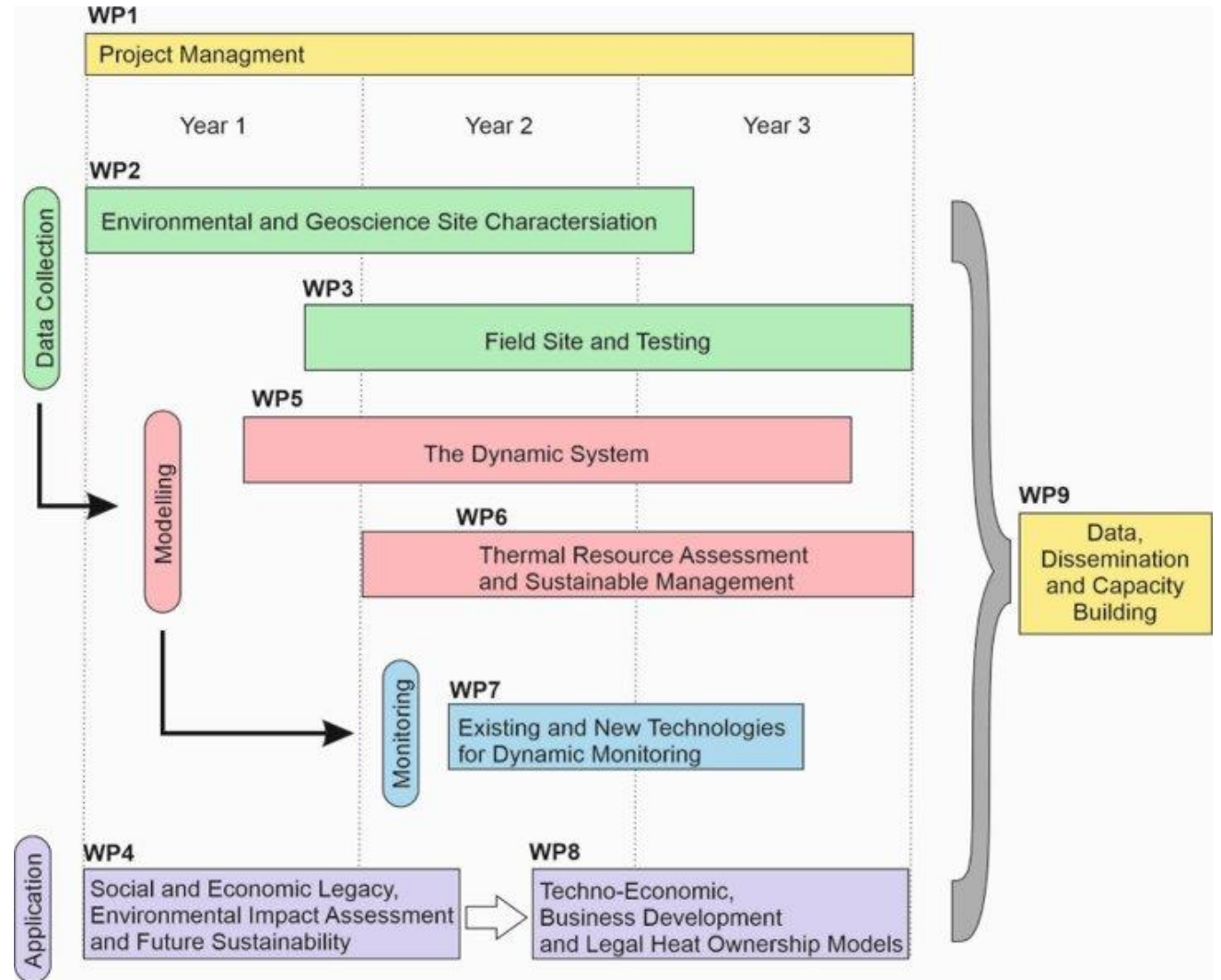
- Heat Discharge
- Heat Storage
- Heat Transport
- Heat Recovery
- Heat Ownership
- Regulation & Policy
- Techno-economic Case

Project Timeline



Year 1 Activities

- Conceptual Model Developed
- Hydraulic Model Developed
- Baseline Monitoring Programme
- Stakeholder & Risk Mapping
- Spring Meeting in Edinburgh with All Partners
- Transnational Collaboration Agreement Signed

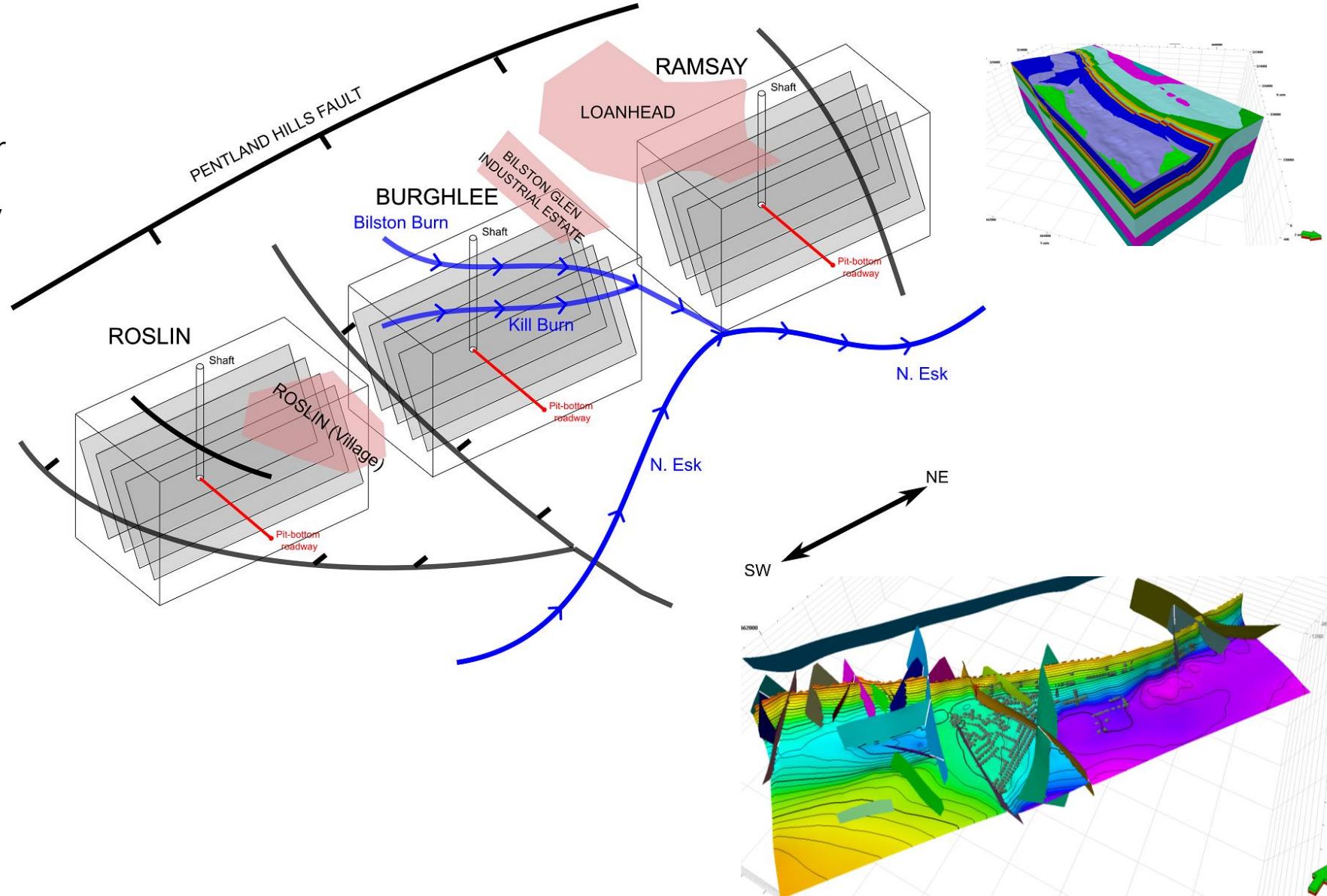


Collieries in Series

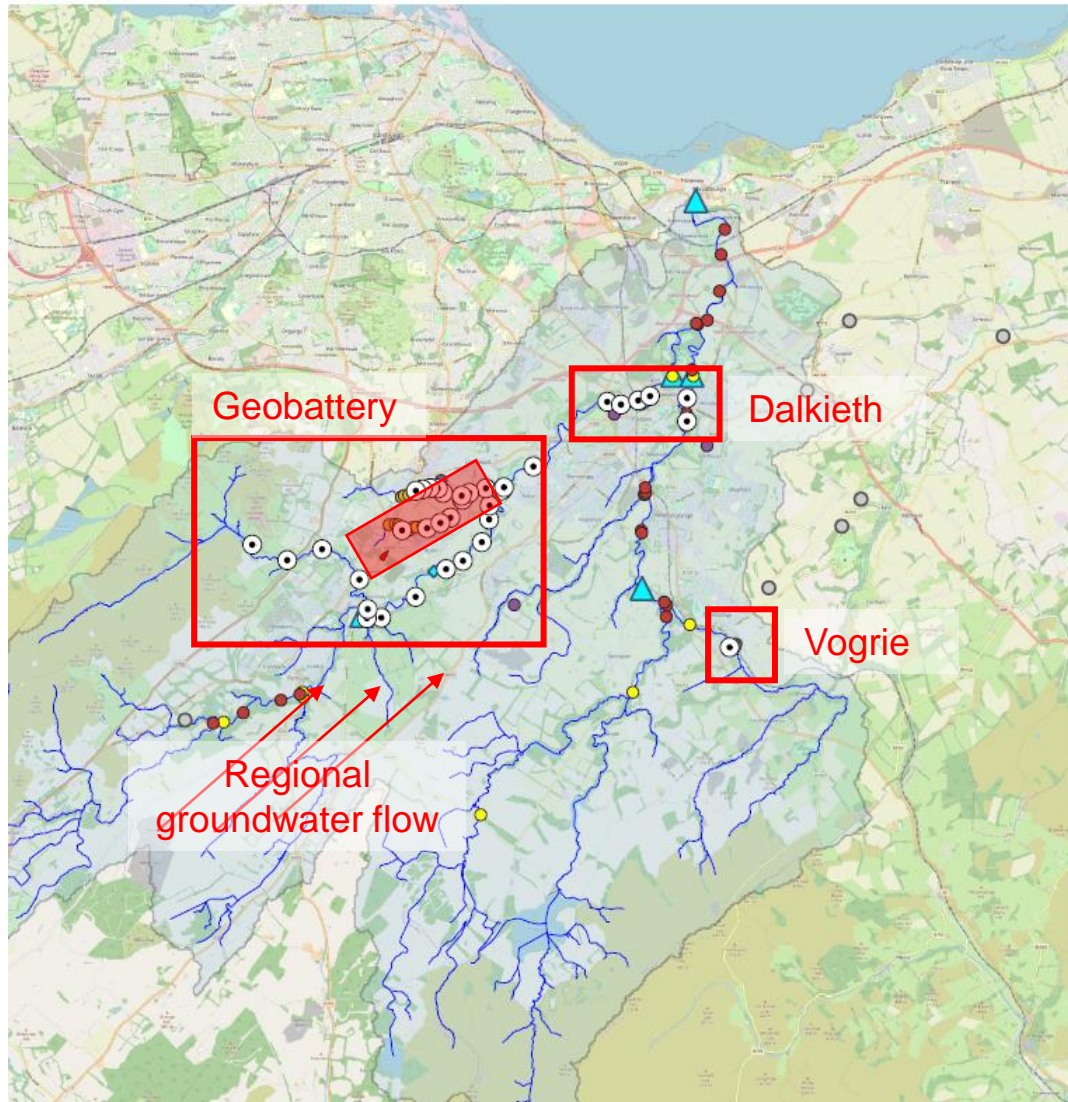
Sam Graham, Sean Watson, Pablo Rodriguez



- Conceptually similar characteristics (they mine the same strata in a similar way) but some distinctions:
 - **Roslin** – Mines up to, and locally through, Regional fault
 - **Burghlee** – Crosses local water course
 - **Ramsay** – Mines through local fault
- There are local through-connections between all three collieries
- The coalfield underlies the catchment of the River Esk, its North and South branches, and their associated tributaries.



Sampling & Baseline Monitoring



Legend

Hydrochemistry

- Baseline chemistry points (quarterly)
- Baseline hand-probe points (monthly)
- BSc project sample points
- Discharges
- Coal Authority monitoring points
- SEPA monitoring points

Hydrology

- ▲ Gauging station (National River Flow Archive)
- Catchment of Musselburgh gauge (19007)
- Water courses above Musselburgh gauge

- GeoBattery 'footprint'

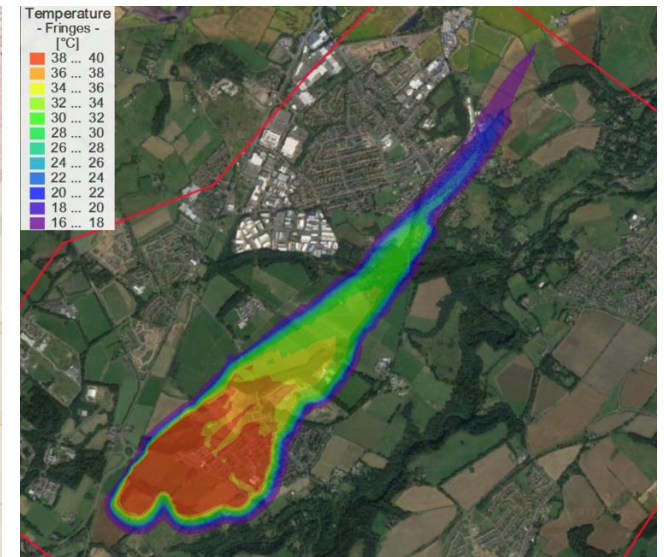
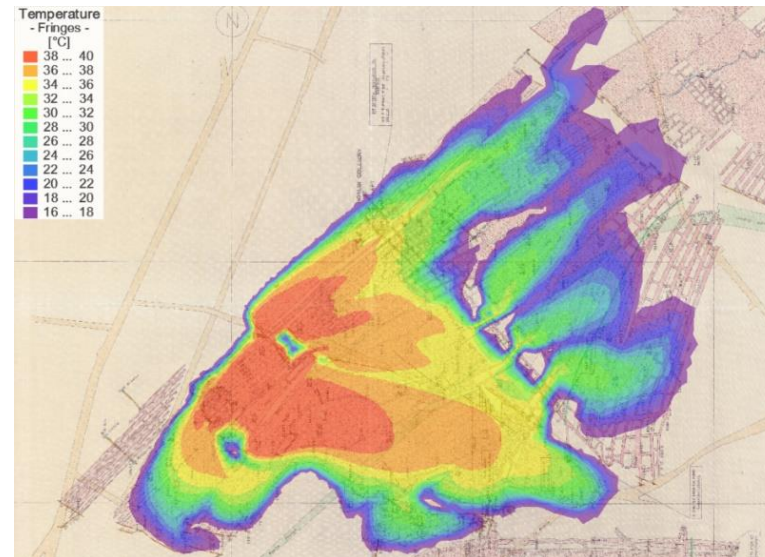
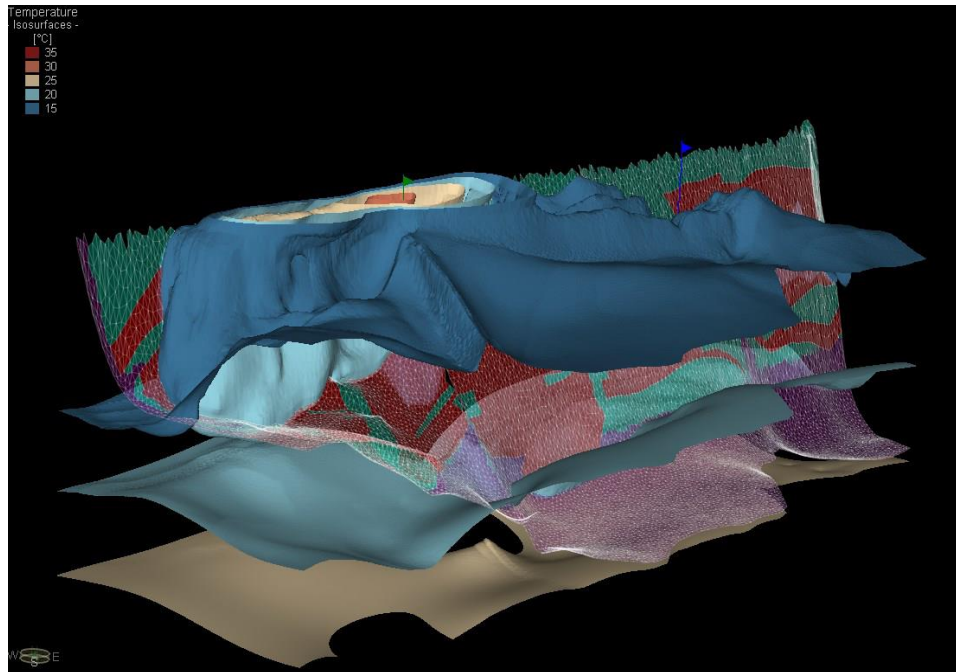
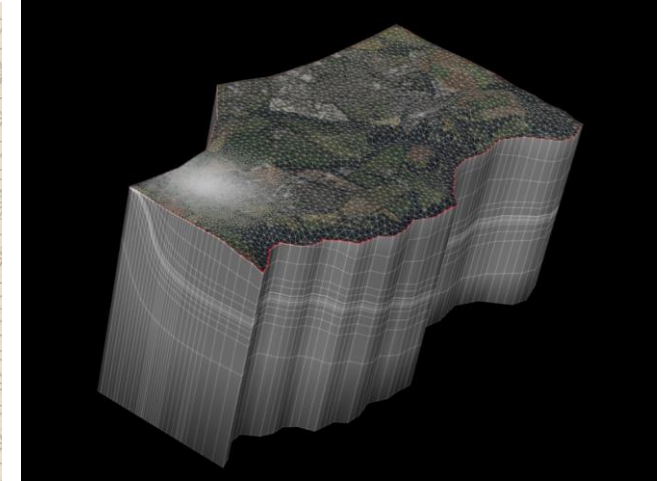
- Geobattery footprint covers ~5km²
- Interacts locally with a number of watercourses
- Historic, shafts/adits near watercourses could be activated
- Potential interactions minewater discharges in Dalkeith and Vogrie

3D T-H Numerical Model

Alejandro Perez Silva



- A 3D model of the G2C area has been built in *FEFLOW* with the mesh structure created in the *Leapfrog* Geological Model
- 40-year heat plume migration simulated - preliminary results only

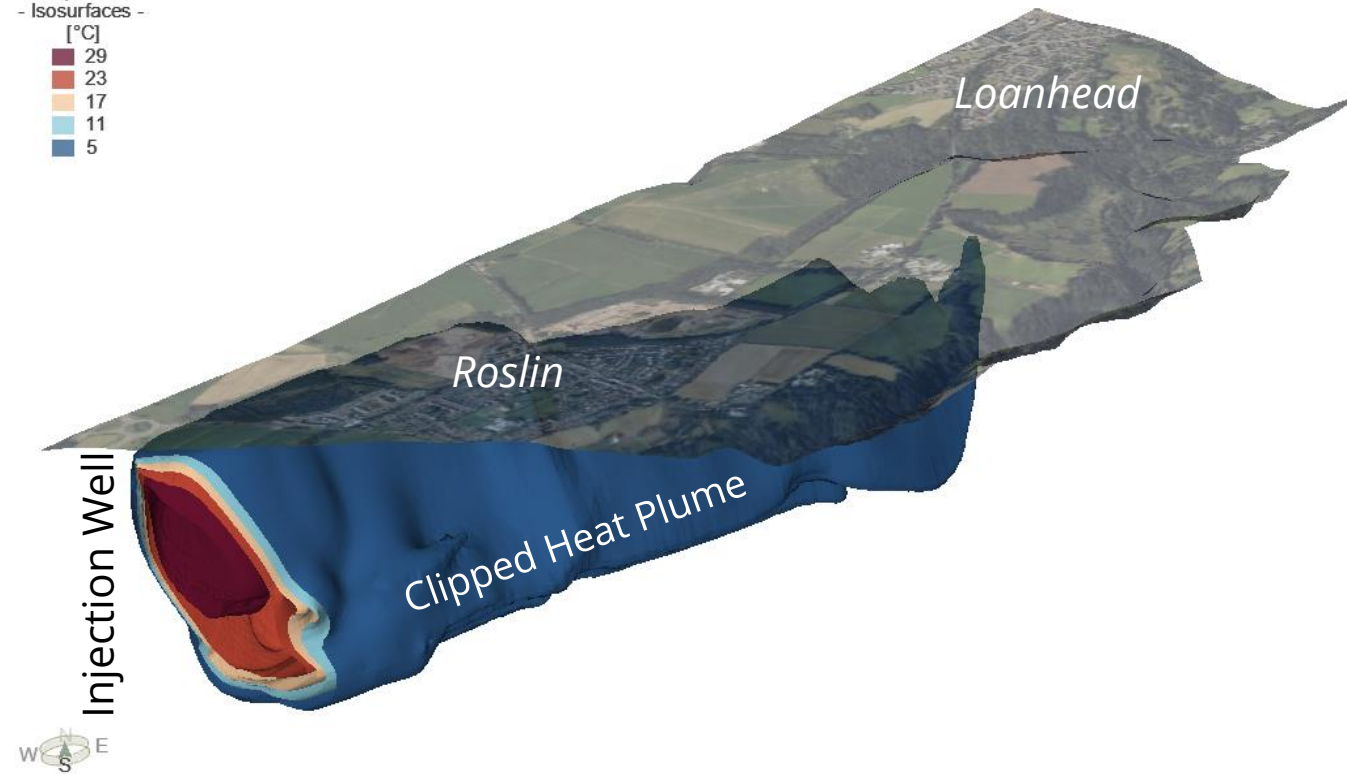
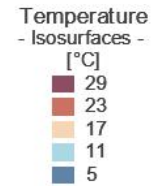
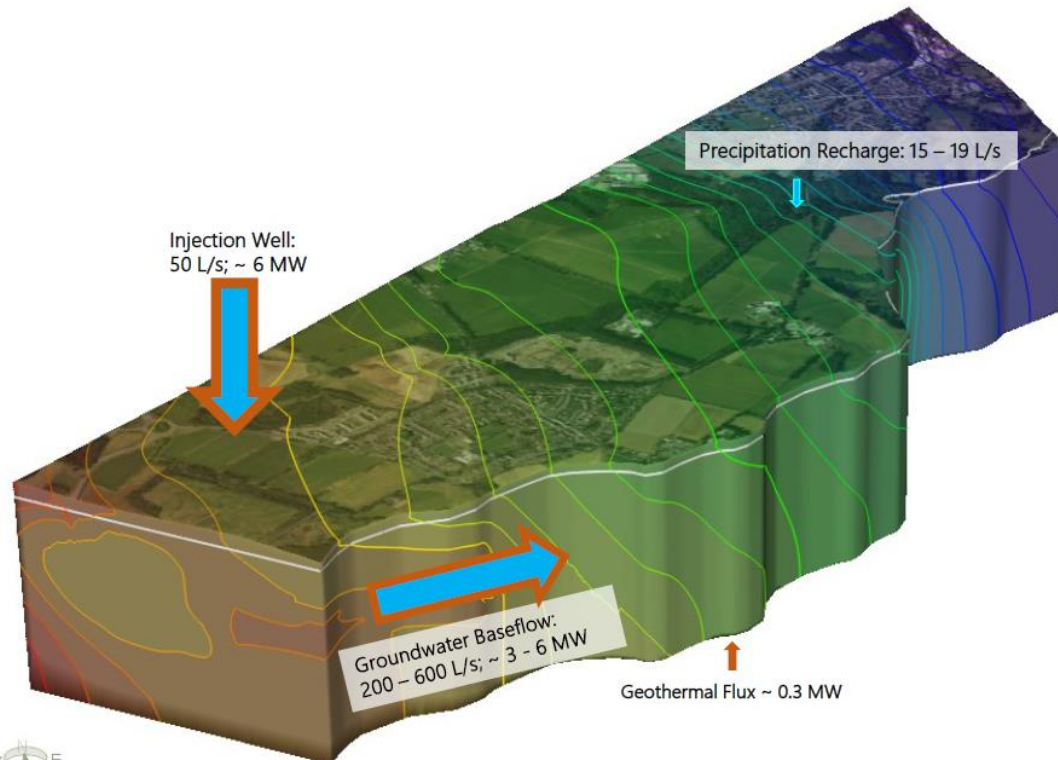


Thermal Plume Migration Simulated

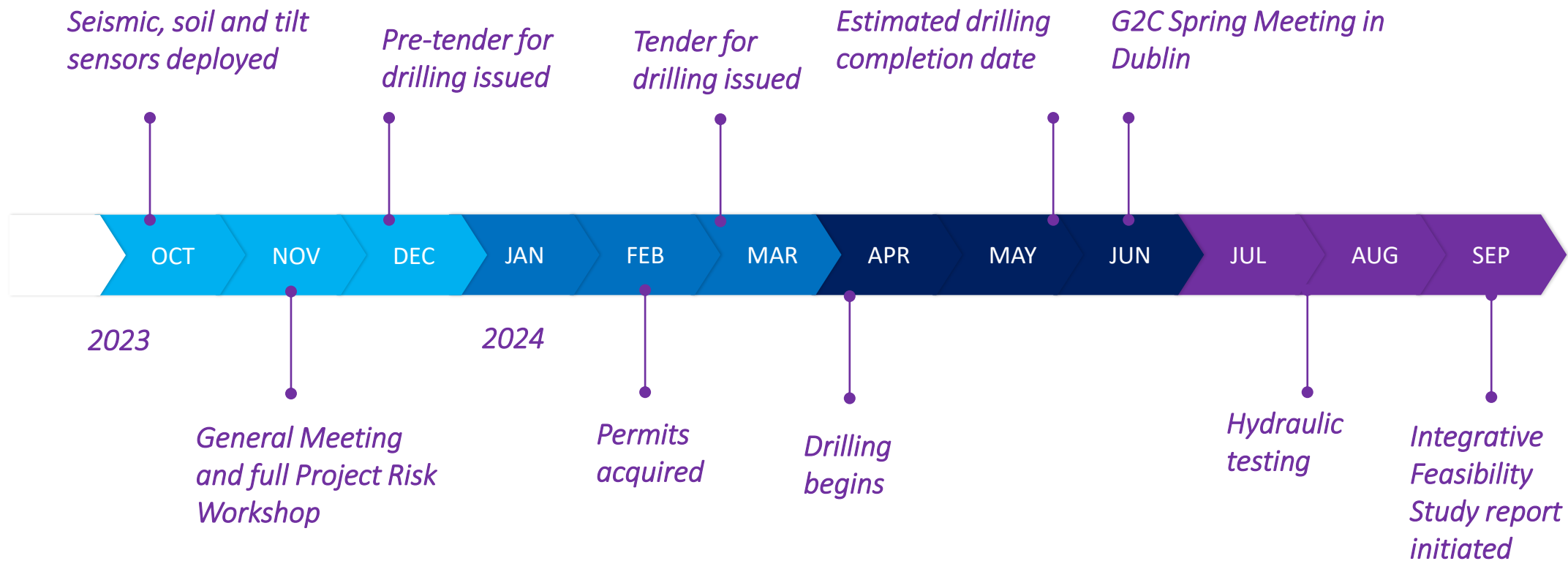


Alejandro Perez Silva

- Initial operational scenario simulated including open-loop systems (i.e. extraction wells in Roslin and Loanhead).



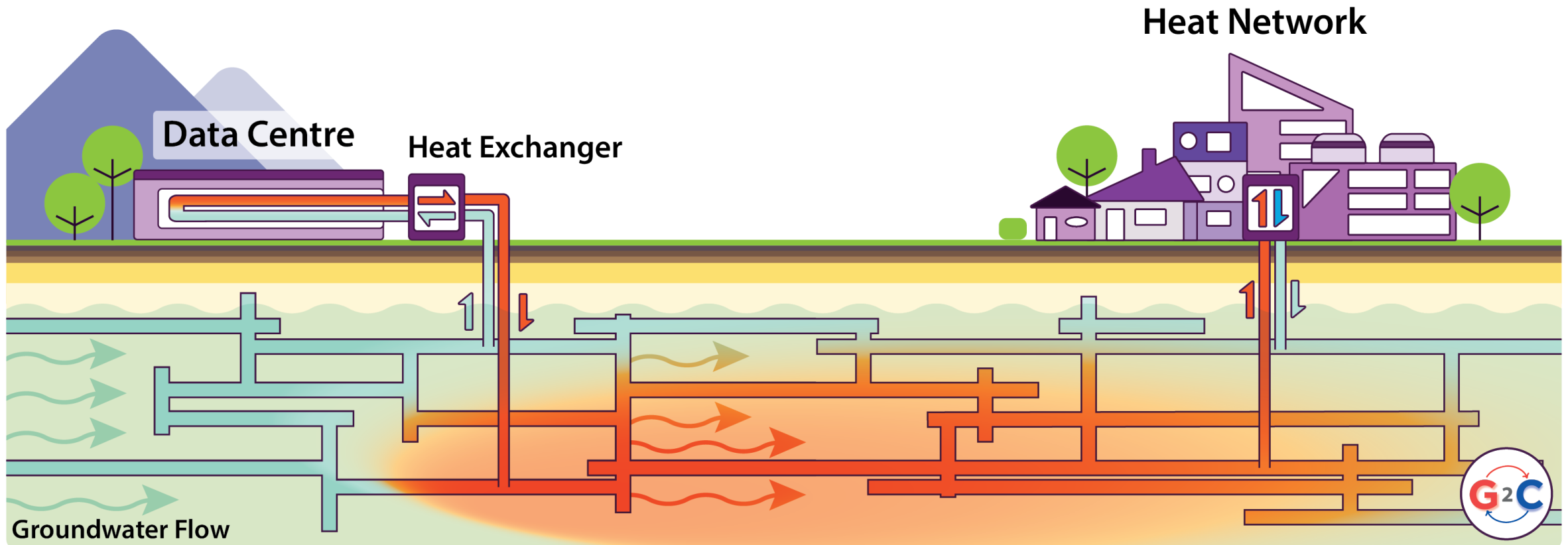
Year 2 - Timeline



Year 3 - Techno-economic Model



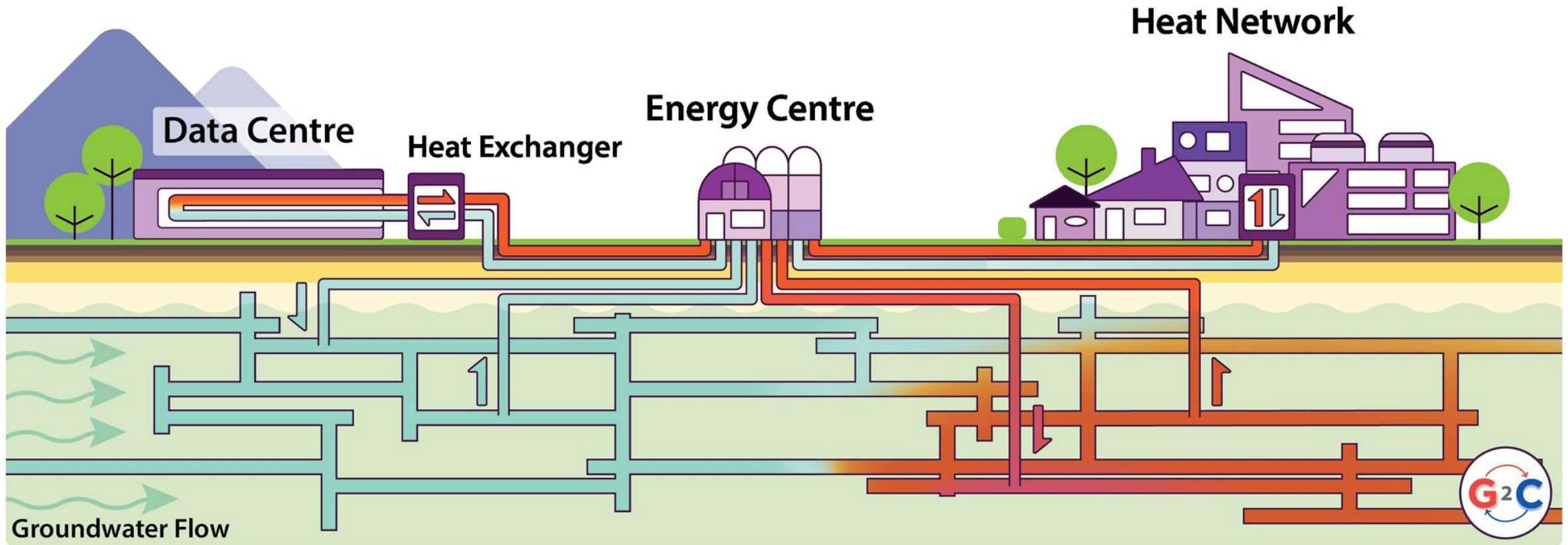
Using the mines as a heat storage and transportation system



Year 3 - Techno-economic Model



Using the mines as a heat storage system



Project Outcomes



- Outline techno-economic modelling tool for the Heat GeoBattery concept
- UK and Scottish Governments policy and regulatory recommendations for the use of mine workings as thermal stores
- Guidance on potential application of Heat GeoBattery concept to European & United States of America flooded mineral mines
- Best Practice Guidelines from G2C project for future projects



Part of a Wider Vision

- Heating accounts for 45% of the UK's energy use: market value of £45bn pa
- 66% of the mine water sites in the Central Belt of Scotland: £550m pa by 2031
- 81% of the most deprived communities live above coalfields.
- Conversion of the UK's £2.4b pa ex-coal mine liability to a £10bn asset
- Enhanced sense of place and pride for local ex-mining communities



Thank you for listening

david.townsend@townrock.com

Presented by:
David Townsend

Date:
21.02.2024



**TownRock
Energy**

