Underground Thermal Energy Storage

Lessons learnt from the IEA Geothermal co-sponsored events

- Aquifer Thermal Energy Storage Workshop, Netherlands 2023;
- Underground Thermal Energy Storage Symposiums, Germany 2024;
- Mine Water Geothermal Energy Symposium, Scotland 2024.

https://iea-gia.org/workshop-presentations/

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Some Context

To achieve the Energy Transition, globally we need to decarbonize the Heating & Cooling Sector

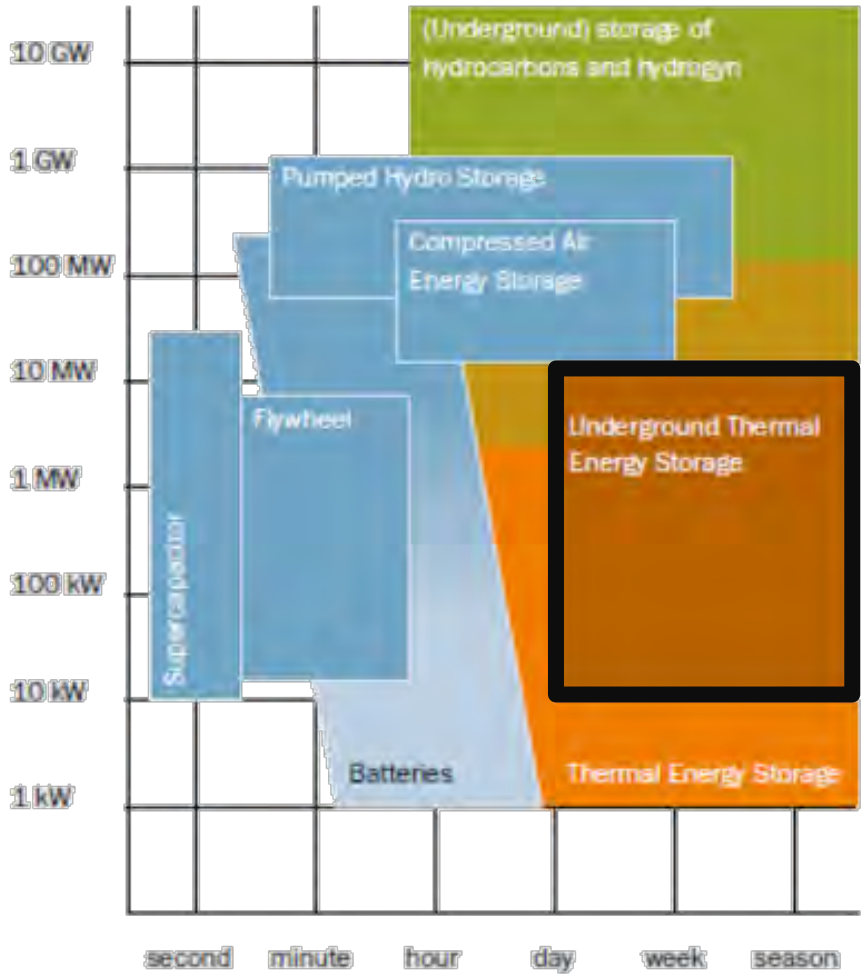
EU countries are active in Underground Thermal Energy Storage

50% **Total Energy demand in EU**

Cooling demand

Grid Congestion Issues

Variable Demand/Supply



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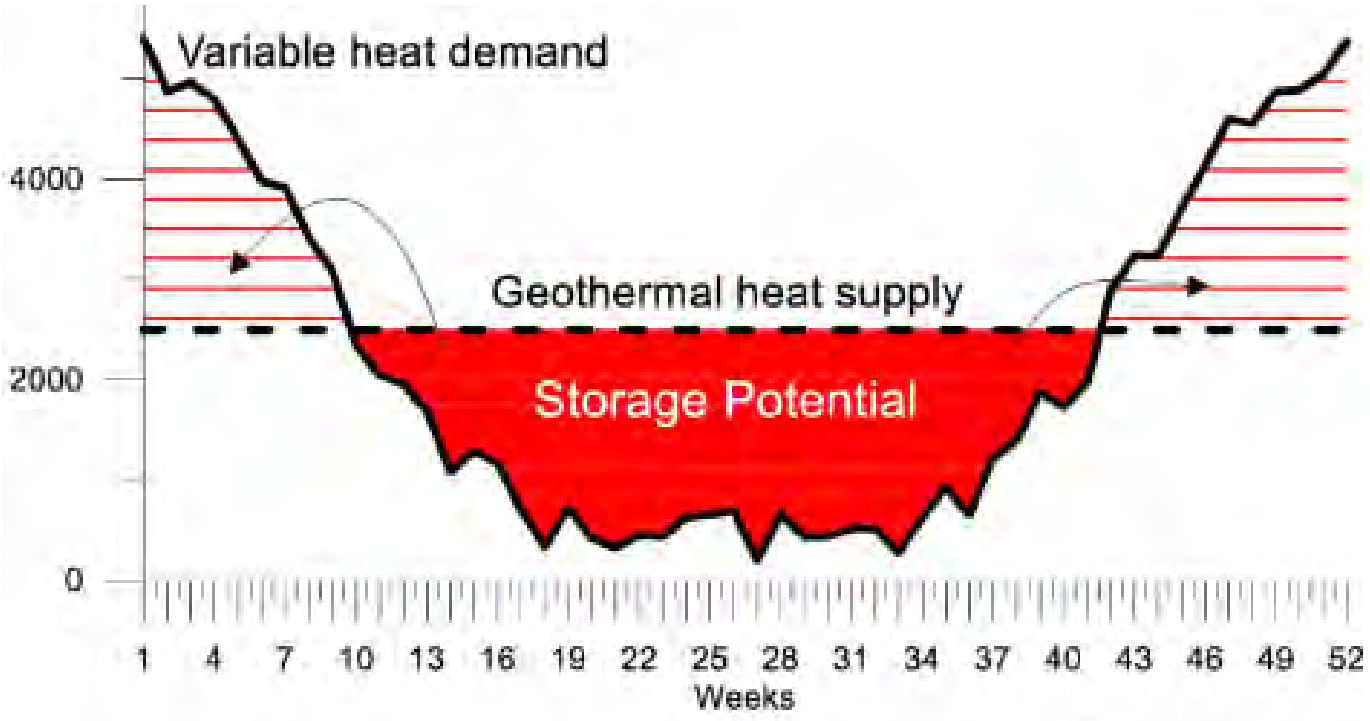
Underground Thermal Energy Storage (UTES) has a role to play

Heat Storage

- **The Underground as a Thermal Battery**
- **Balancing the Heat Demand/Supply over time**
- **Add in Heat:**
  - Waste Heat
  - Excess Power
    - Renewable electricity to heat
  - Storing collected solar thermal



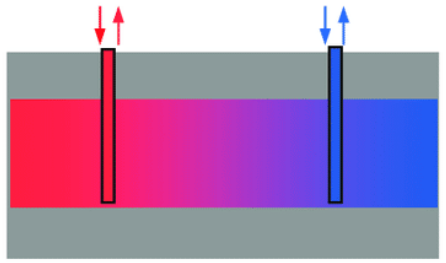
Types of UTES

- **Different systems for different needs:**
  - Daily, Weekly, Seasonal storage
  - Small to Large Scale depending on application
  - Low to Medium temperature
  - Open or closed systems
  - Shallow / Deep
- **Proven technology**
  - Known R&D and operations in Europe, USA, and Asia

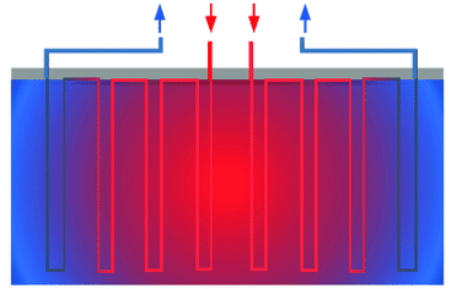
    3000 ATES systems in the Netherlands

    Mine Water Energy growing rapidly in the UK
- **Applications:** Utility (Office buildings), Hospitals, University campuses, Greenhouses, Airports, Datacentres, Shopping Malls, Residential areas

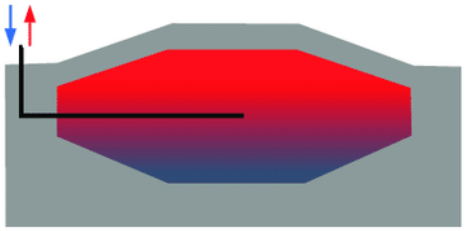
ATES: Aquifer Thermal Energy Storage



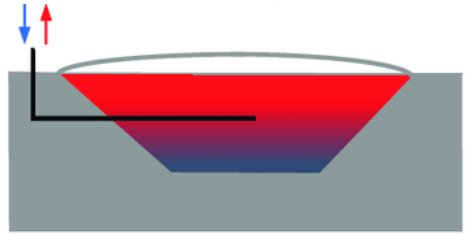
BTES: Borehole Thermal Energy Storage



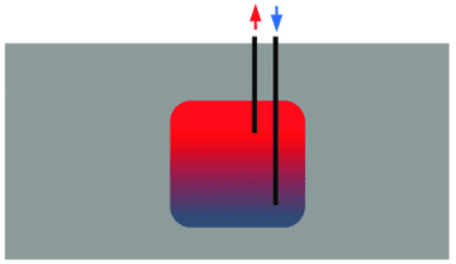
TTES: Tank Thermal Energy Storage



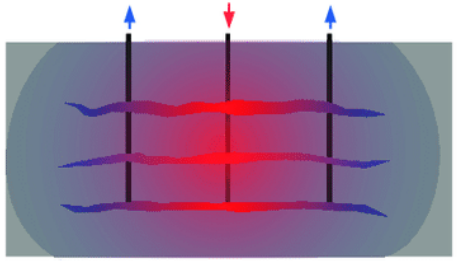
PTES: Pit Thermal Energy Storage

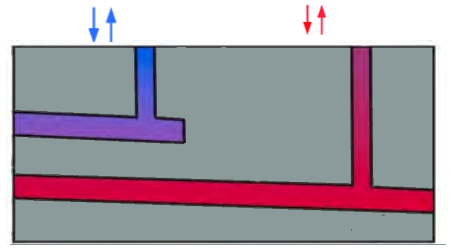


CTES: Caver Thermal Energy Storage



FTES: Fractured Thermal Energy Storage

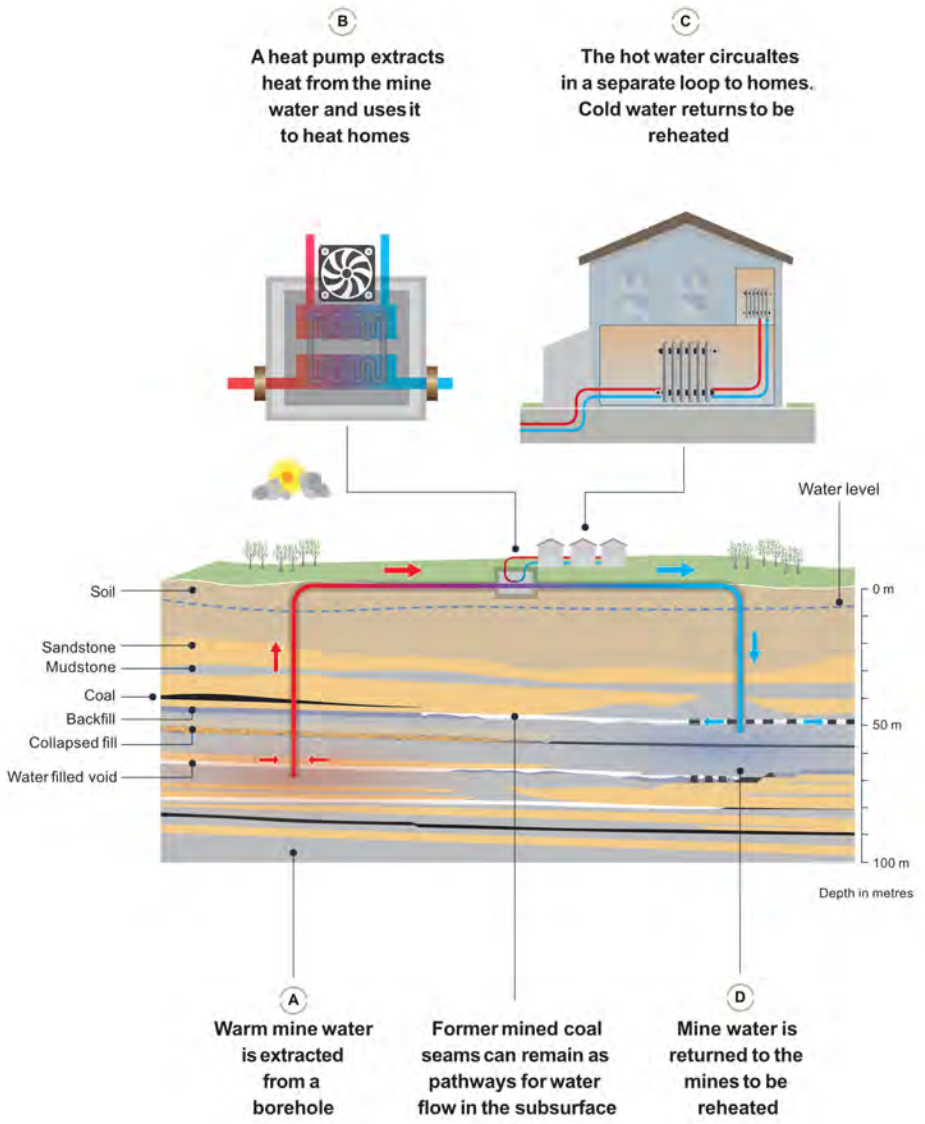




MTES: Mine Thermal Energy Storage

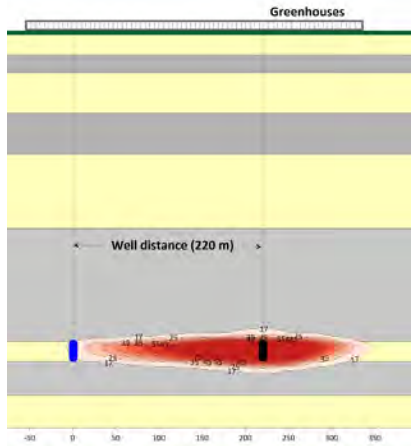
Examples

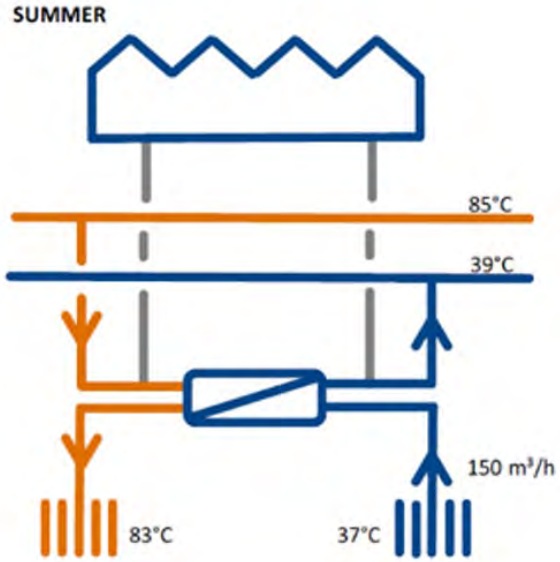
MTES – Glasgow Observatory

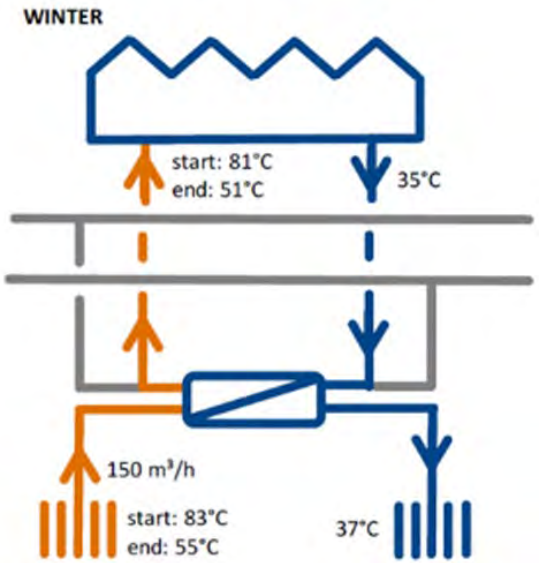


https://www.ukgeos.ac.uk/glasgow/mine-water-thermal-energy

HT-ATES, ECW Middenmeer, the Netherlands







http://www.geothermica.eu/media/ates/8.2.12.-Fieldtrip-ECW-Middenmeer-HT-ATES-2023-04-20.pdf

Critical Success Factors

1- Demand:

- Climate requiring Heating and Cooling over time
- End Users

2- Supply: Excess Heat available

- Cheap source of energy locally

3- Suitable subsurface

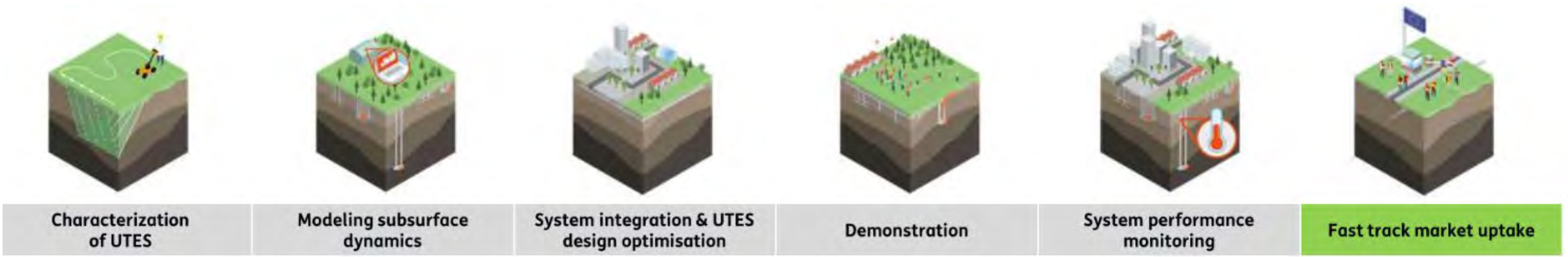
- Data availability
- Good confined aquifers or reservoirs
- Minimal heat loss and useable temperature

4- Regulations

- Clear regulations for the various technologies, depth, T°
- Treat heat as a commodity

5- Managing Effects and impacts

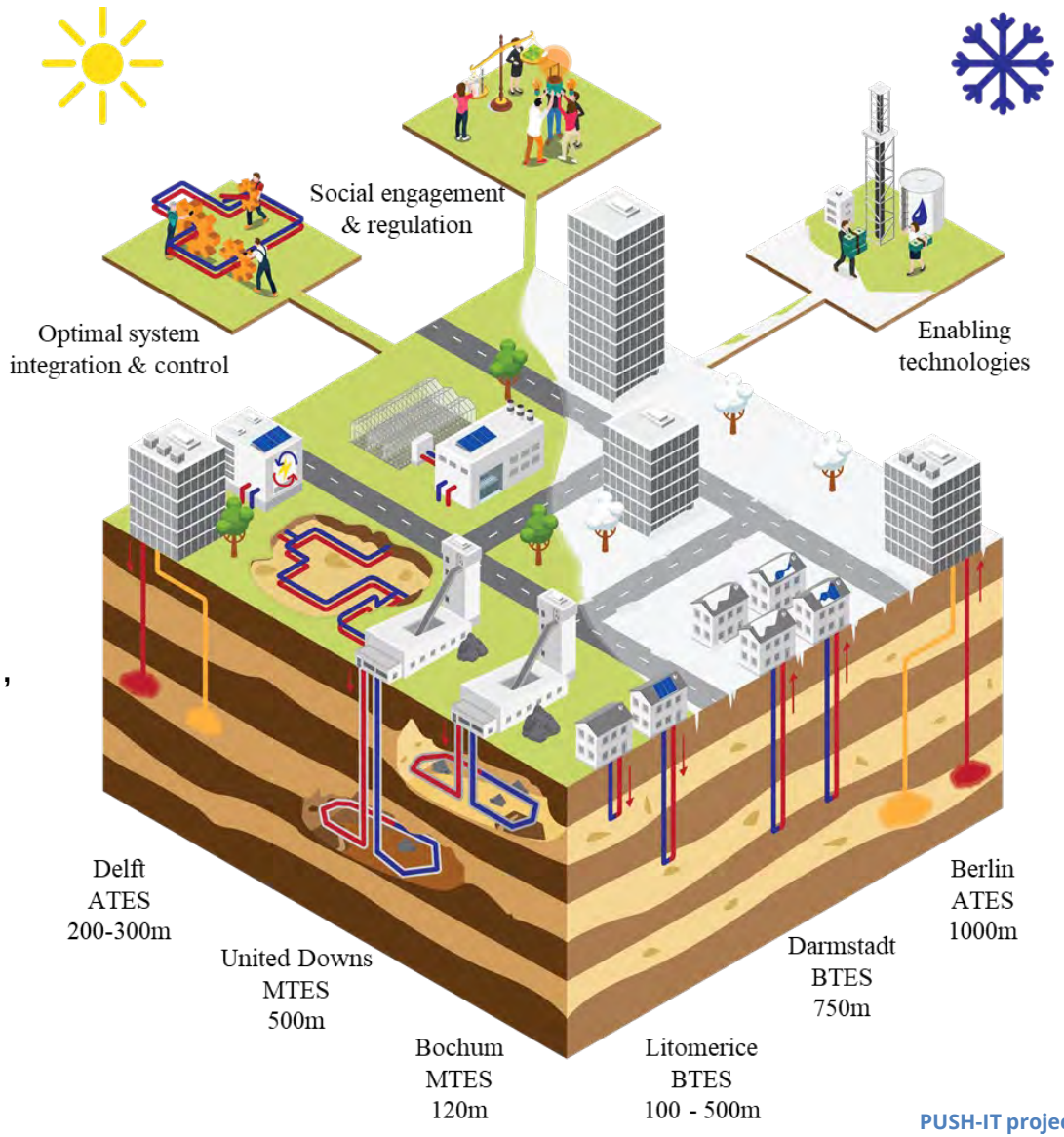
- Mitigations of risks (e.g. drilling, well performance)
- Acceptable surface and sub-surface effects
- Monitoring



https://www.heatstore.eu/

Opportunities for NZ

- **Security of supply of Heat**
  - Reduce electric load
  - Local baseload energy source
  - Large storage capacity
  - Diversification possible with hybrid systems
- **Affordable**
  - Efficient systems, Heating AND cooling
  - CO_2 emissions savings
  - Integrated system (District Heating and Cooling Networks),
  - Sharing infrastructure and capital cost
- **Sustainable**
  - Year-round solution
  - Small footprint, no smell, no noise
  - Resilient

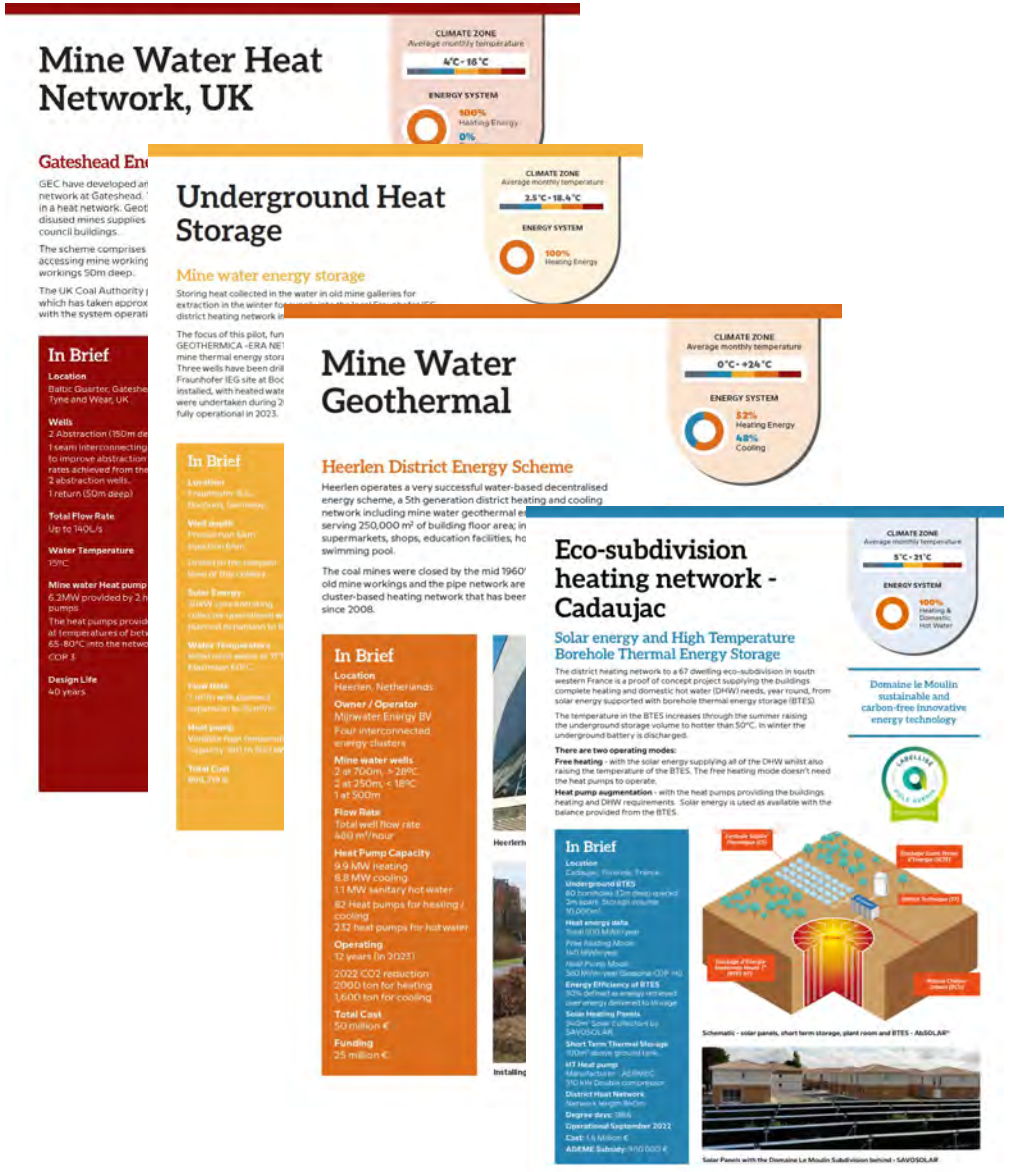


PUSH-IT project
https://www.kwrwater.nl/

Take Home messages

- Heat has a key role to play in the energy transition
- Various technologies to suit local needs
- Applies to all sectors from industrial to residential
- UTES will help reduce load on electrical grid
- **Energy Security, Energy Sustainability, Energy Affordability**
- Large investments and developments in the world, why not in New Zealand?

What are we waiting for?



https://iea-gia.org/publications-2/case-studies/

We know the potential is massive.

Working collectively on this journey is the key.

We do not know the outcome of today but let's work together on the future:

- **To find out if who would be interested in working on specific areas**
- **To be able to collate our collective learnings from today and share it with you all and your organisations**

This is time to generate some actions and progress.

2 + 2 → Infinity