Global Perspectives on Geothermal Drilling

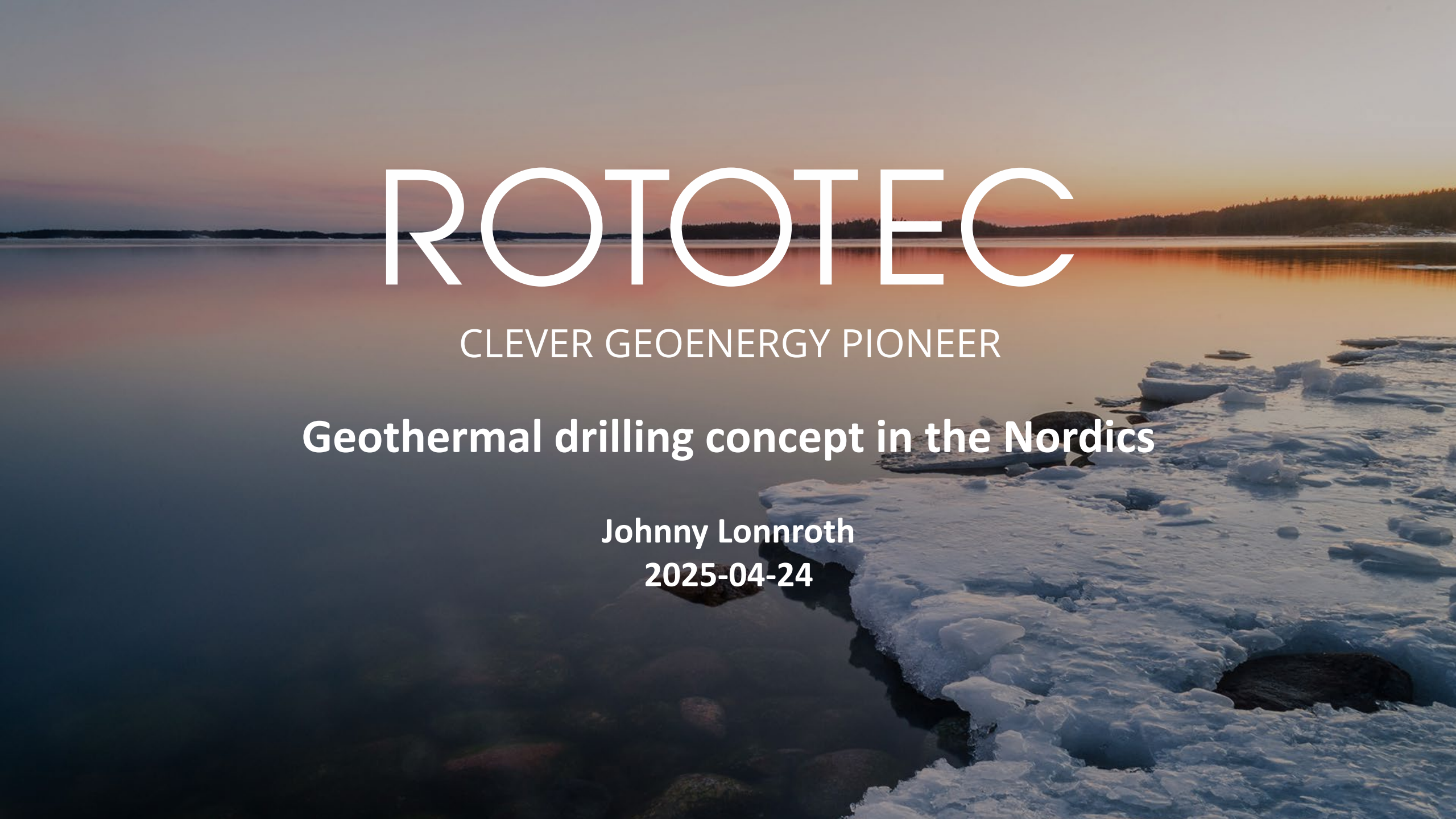
Moderator: Brock Yordy / *Geothermal Drillers Association*

Panel: Johnny Lönnroth / *Rototec Europe (SW)*

Geoff Ellison / *Dragon Drilling (UK)*

Soren Soe / *Coil Drilling (AU)*

Tunca Alikaya / *Celsius Energy (FR)*



Geothermal drilling concept in the Nordics

Johnny Lonnroth

2025-04-24

Rototec Group in a nutshell

About us

We deliver geoenergy (shallow geothermal) fields for ground source **heating and cooling** especially for large properties and industries and provide consulting services for geoenergy projects.

Locations worldwide

Nordics

USA

Germany

In numbers

6.5
Million feet of energy wells drilled per year

140
Employees

66
Modern drilling units

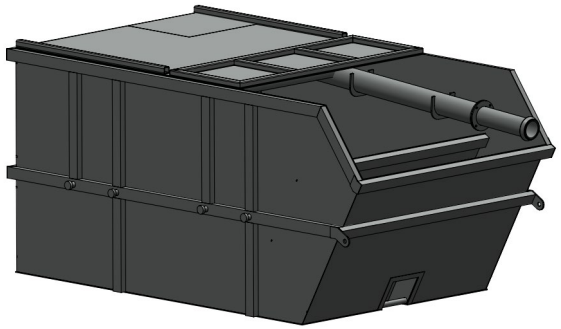
310 000
Tonnes/year reduction in CO_2 emissions thanks to Rototec's energy wells

Drilling the Rototec way – typical for the Nordics

Main features of drilling concept

- A small single-head easily manoeuvrable drilling rig on track belts
- 508 psi (35 bar) compressor
- Compressor and rig transported on the same truck
- Down-the-hole hammer drilling method
- 4.5 in diameter boreholes in bedrock, 5.5 in casing in overburden
- Casing is drilled 6.5 ft into solid bedrock and left in the ground
- One drilling unit (with one driller) typically drills 1 000 ft in one day

Cuttings and water treatment



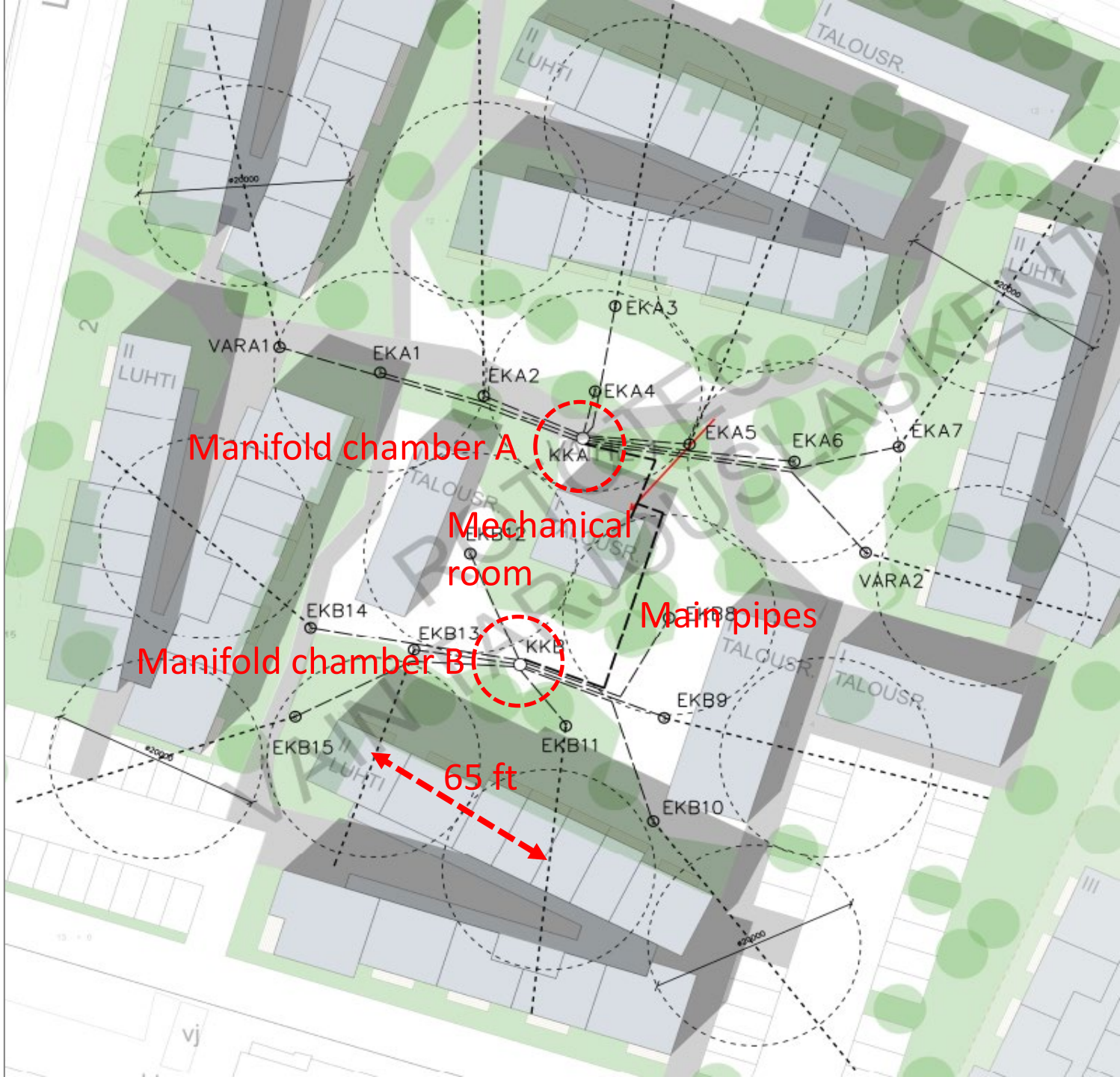
Cuttings (stone dust) collected in a skip (dumpster) and transported to an appropriate dump site. Sediments are allowed to settle in the skip before water is pumped out e.g. to a storm drain.

Water treatment dumpster (Rotocont or Rotocont+): An addition to the standard process. Water is filtered through several compartments to achieve a higher level of purity. Developed by Rototec. Patent pending.

Design principles in the Nordics – borehole configuration

Main design principles

- Typical borehole depth in large projects 1000 – 1300 ft
- Boreholes are almost always angled in large projects, typically up to 15°
- Boreholes are typically spaced 65 ft apart in heating-only applications (in order not to cannibalise each other significantly)
- With balanced heating and cooling loads, borehole spacing can be smaller, even as small as 20 ft



Design principles in the Nordics – grouting only in very rare instances

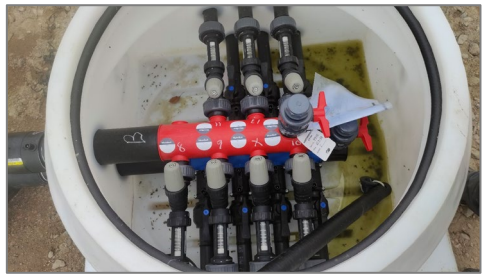
Ungrouted boreholes deemed safe in the Fennoscandian geology by the authorities

- **No grouting** apart from in special circumstances (such as when drilling in water protection areas). The boreholes fill up with groundwater
- **Rationale:** Crystalline bedrock with typically only isolated fractures. Biodegradable bioethanol is used as heat carrying fluid
- In the rare instances when the boreholes are grouted, **premixed cement-based grout with quarts sand** is used, ensuring good pumpability in different temperatures

Design principles in the Nordics – loops and pipes

Main features of loop and pipe design

- Typically pressure category **PN 10 SDR 17** for all loops and pipes
- Vertical loops typically 1.39 in, 1.56 in or 1.74 in **inner diameter**
- Boreholes are connected to the main pipes with manifold chambers or manifold cabinets
- Pipes are typically fused together using electrofusion



Advantages of using manifold chambers and manifold cabinets

Advantages of manifold chambers and manifold cabinets

- ✓ Possibility to control the flow through each borehole. Easy to maintain a stable flow through each borehole
- ✓ Possibility to shut off boreholes in case of leaks
- ✓ Easy to get rid of microbubbles by shutting off all but one borehole and then forcing a large flow through this borehole. Smaller pumping capacity thus needed to flush the boreholes
- ✓ Fewer total feet of piping compared to other solutions
- ✓ Less excavation compared to other solutions
- ✓ Better suited for dense urban areas than other solutions
- ✓ Easy expansion of the system possible
- ✓ Using motorised valves, it is possible to customise the flow through the boreholes e.g. for temperature gradients in borehole thermal energy storage (BTES) systems

Additional benefits of manifold cabinets

- ✓ Very easy access to the manifolds


ROTOTEC
CLEVER GEOENERGY PIONEER

NY-GEO 2025 – Saratoga Springs

Drilling Practices in the UK (Grouting & Testing)

22-24 April 2025

Presented by Geoff Ellison

ENVIROHIRE

DRAGON RENEWABLE ENERGY

DRAGON DRILLING

Typical Closed Loop Borehole

Borehole Diameter: 6 inches

Depth: 300 – 600 feet

Spacing: > 20 feet

Loop: Polyethylene SDR 11, 40mm O/D

UK Boreholes are grouted, except in Northern Scotland

Drilling Mud

Drilling mud is widely used in the industry.

Drillers are experienced in:

1. Preparing a product to a strict specification;
2. Testing product quality before use.

On site test is based on density.

Density test apparatus is already on site.

Grout

Grout is a mixture of powder and water.

Pre-mixed material. Consistent.

Add the correct amount of water and mix.

Test the density before use.

Grout type and density is specified by the Designer.

Accurate test method, suitable for use in field conditions.

Grout Installation

Sacrificial Tremi pipe.

Grout from the bottom to the top.

Displaces groundwater, prevents grout dilution.

Check density of grout that comes to the surface.

Make photographic record.

Grout Installation

Loop Testing

In English Law, heat became a ‘pollutant’ in October 2023.

Closed loop installations require an Environmental Permit.

Avoid permitting if working to named standards.

Three named standards produced by GSHPA:-

Vertical Borehole;
Horizontal;
Thermal Pile.

Water supply pressure test standard: BS EN 805:2000.

GSHPA Standards

Deals with Design, Materials, Installation & Testing.

Pressure test: BS EN 805.

Flow test: At the Design flow rate, in both directions.

Standards cross refer to UK Safety Regulations.

Now a legal requirement (in England) to comply with GSHPA standards for closed-loop installations.

Government Incentive

Payment of $9,000 for systems under 150K BTU.

Certified installer and certified equipment.

Extend UK certification procedure to include drilling.

External audit of the Driller, every 2 years.

Mandatory in 2025.

Extends certification to the whole project for payment.

NY-GEO 2025 – Saratoga Springs

Drilling Practices in the UK (Grouting & Testing)

Thank you and Questions

ENVIROHIRE

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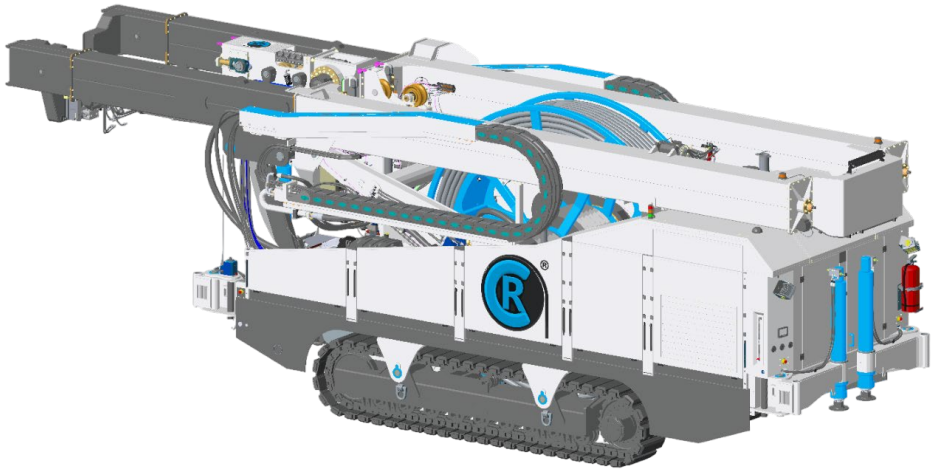
DRAGON DRILLING

CoilRig™ Australia

Continuous Coiled Tubing Drilling

CTEnergy500 & CTEnergy850 Geothermal Rigs
Drilling to 500ft / 850ft (150m / 260m)

Drilling for Geothermal "Ground Source Heat Pumps" Redefined



Patents Granted & Pending

Drilling for GSHP's Today

Conventional Drilling rigs using drill rods are used in +99% of the time for drilling in the GSHP market:

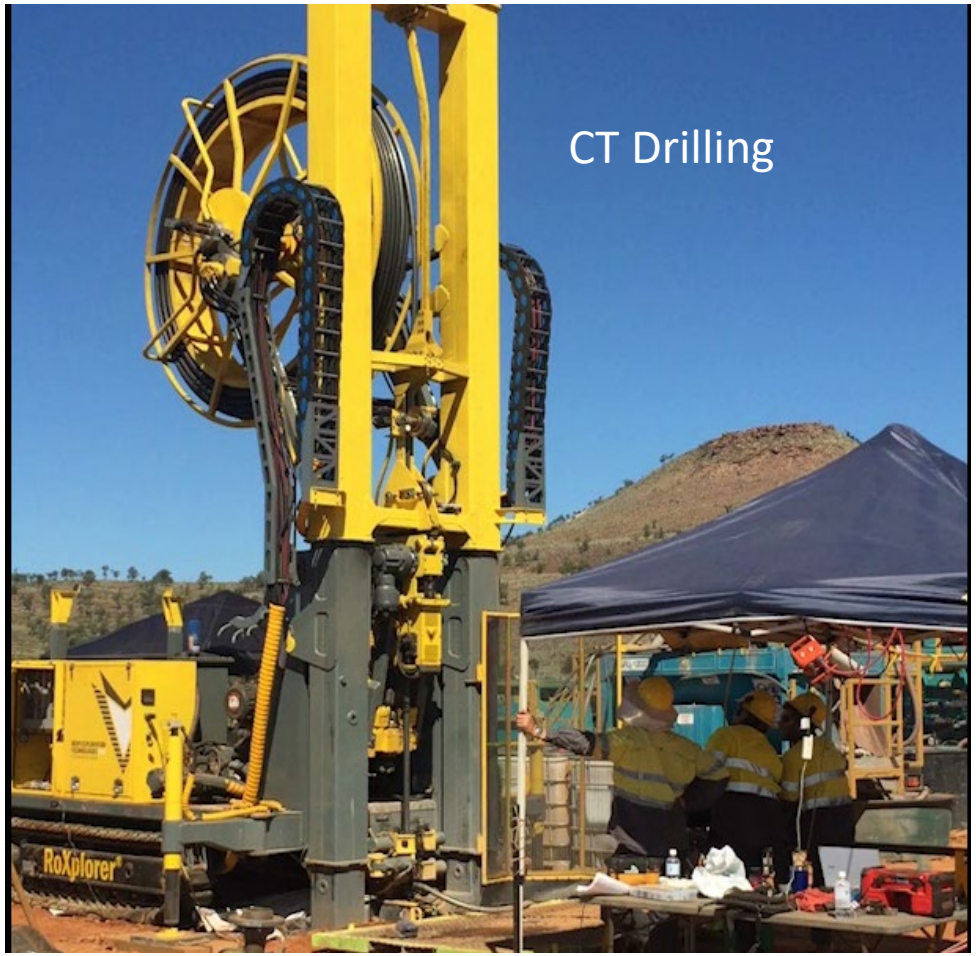
Drilling account for 25% to 50% of the installation costs for GSHP's.

No matter how fast you drill - Hours everyday are spent adding or removing drill rods instead of drilling the hole deeper.

A 175m (575ft) hole requires: 30 pc of 6m (20ft) or
59 pc of 3m (10ft) drill rods.

40 to 75 Seconds used to add or remove each drill rod.

CoilRig™ Australia



DET CRC

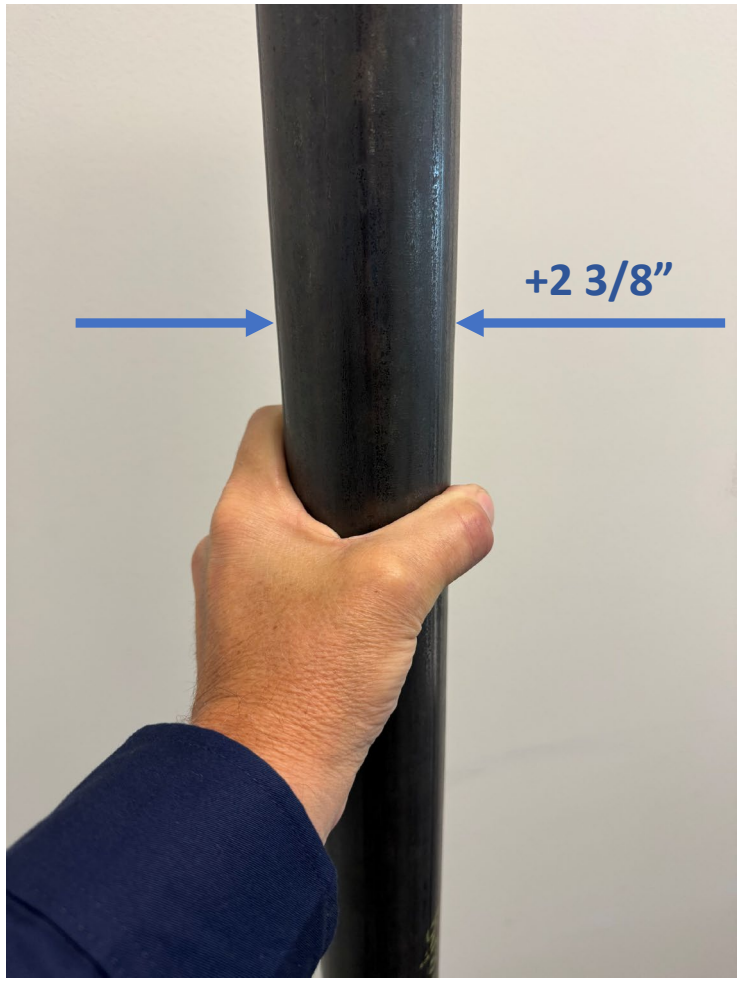
Reel with 1500 feet of Coiled Tubing

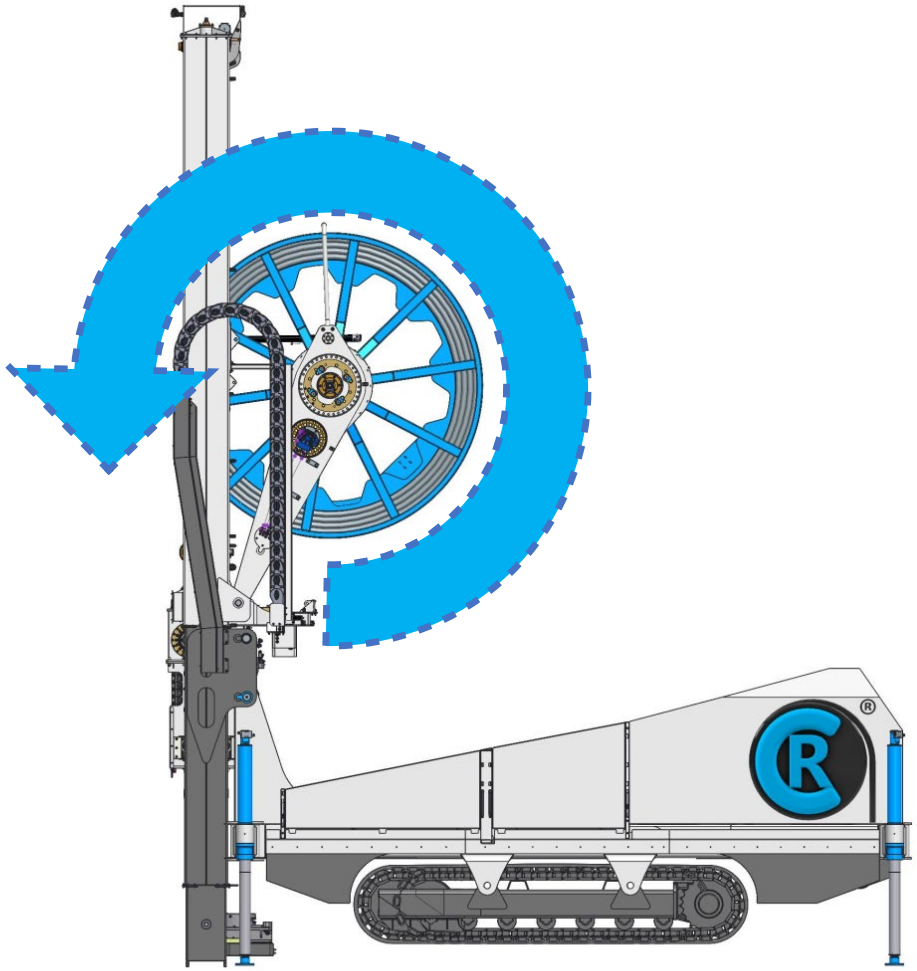
DIG-CT

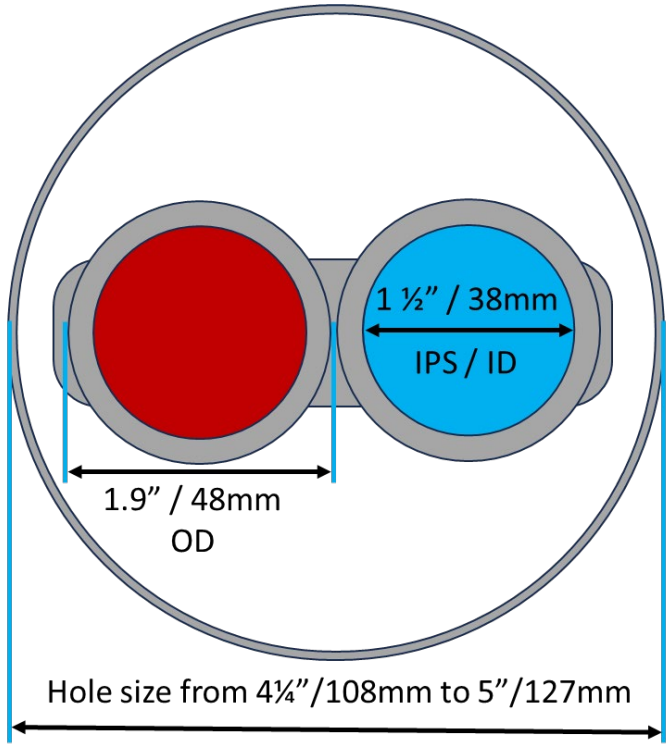
Reel with 3300 feet of Coiled Tubing

MinEx CRC

CoilRig™ Drilling Process

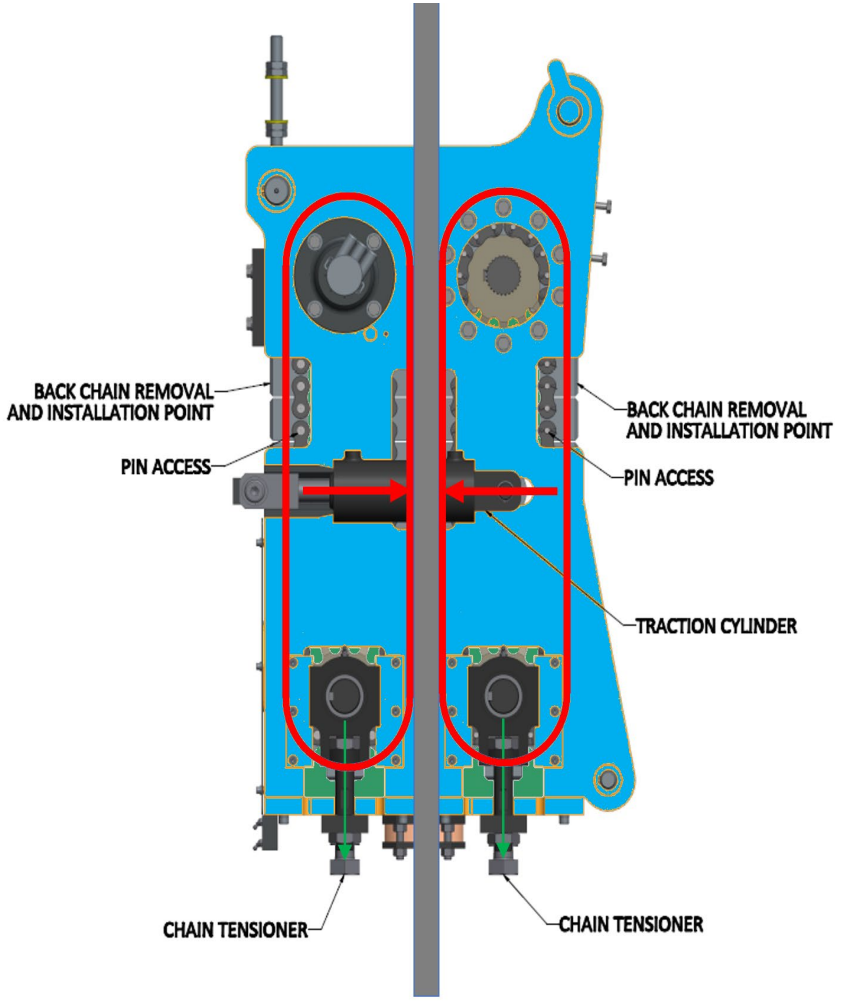






CoilRig™ Drilling Process

CoilRig™ coiled tubing injector

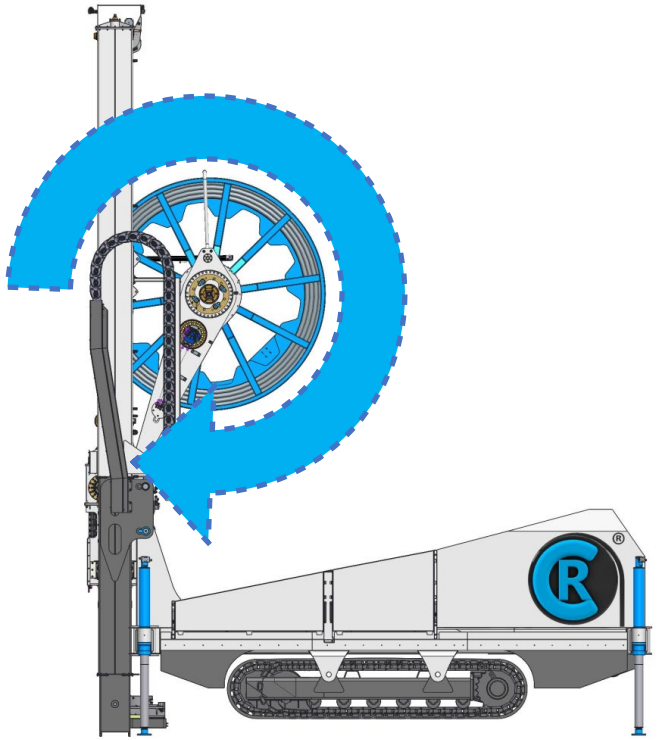


CoilRig™ Down Hole Motor and Fluid Hammer

CoilRig™ Drilling Process

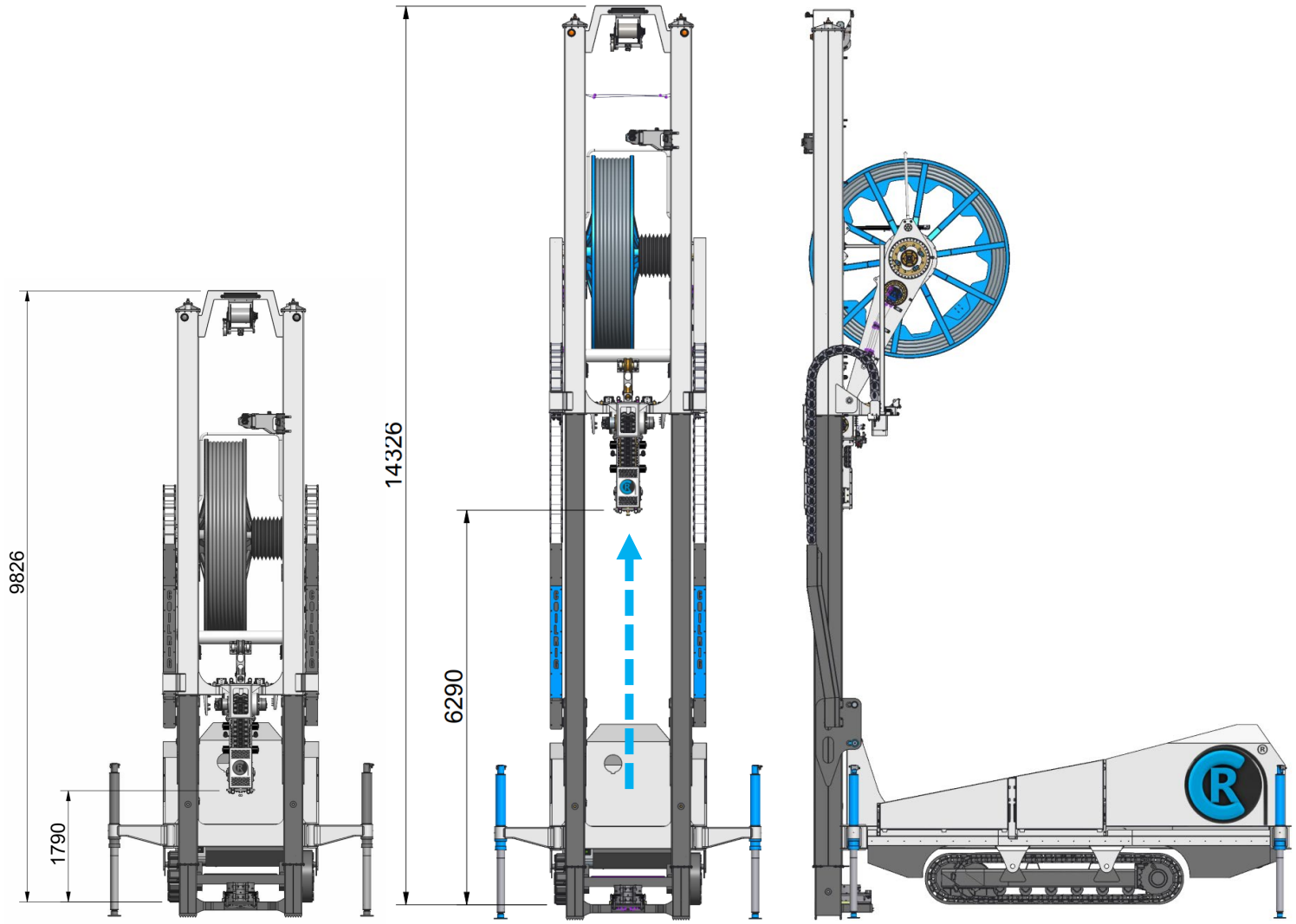
Once the borehole is completed the coiled tubing is pulled out and coiled back on the reel. The DHM stays on the rig, ready to move to the next hole and start drilling.

- Fast pullback speeds, 25m /80ft per min
- Fluid Circulation continues while pulling out
- Maintains static borehole pressures
- Borehole remains stable
- Clean job site (no mud spills from rods)



CoilRig™ Tool Loading Dimensions

Optional rotary head w/ rotation guard is available for Casing Installation.



CoilRig™ Control Panel

Get in Touch

Thanks for listening. If you have any further queries or would like more information, scan the code below:

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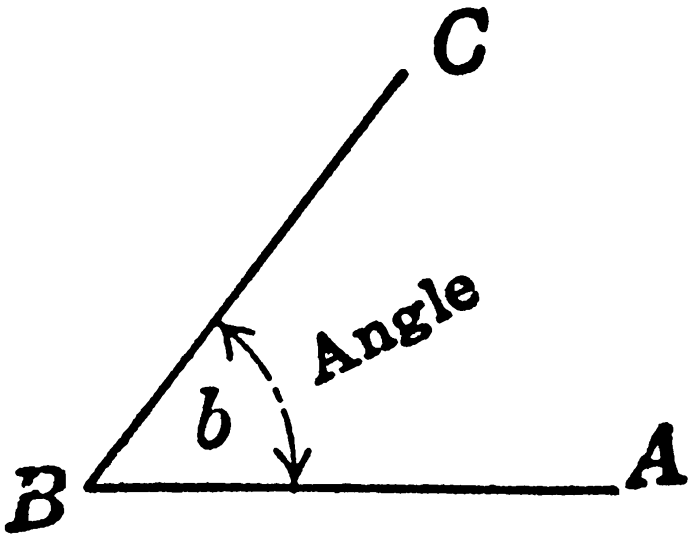
Simple. Renewable. Scalable.

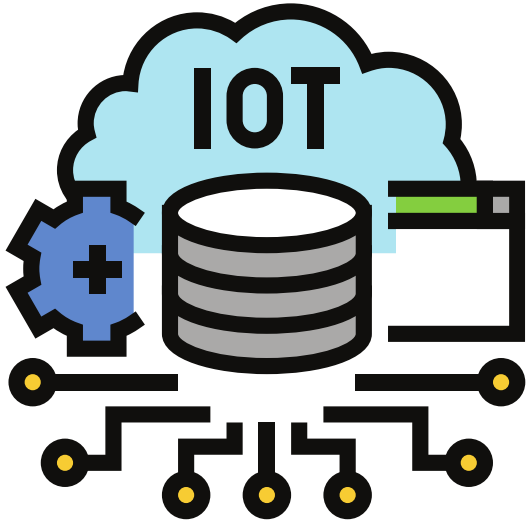
Global Geothermal Drilling:
FR & UK Perspective

Tunca Alikaya

CELSIUS ENERGY



Inclined design



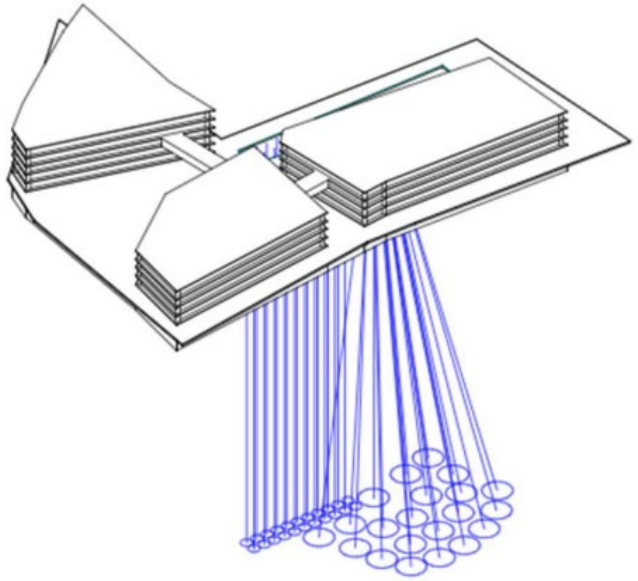
data analytics

pre-mix grout

Ferney-Geneva Innovation District:

Ferney-Voltaire, France

Ferney-Voltaire Networked Geothermal Project



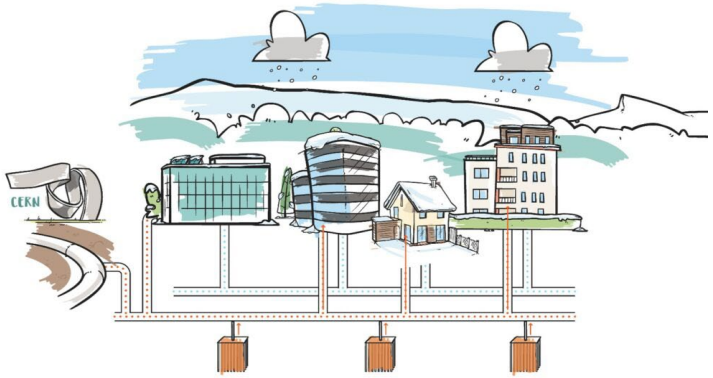
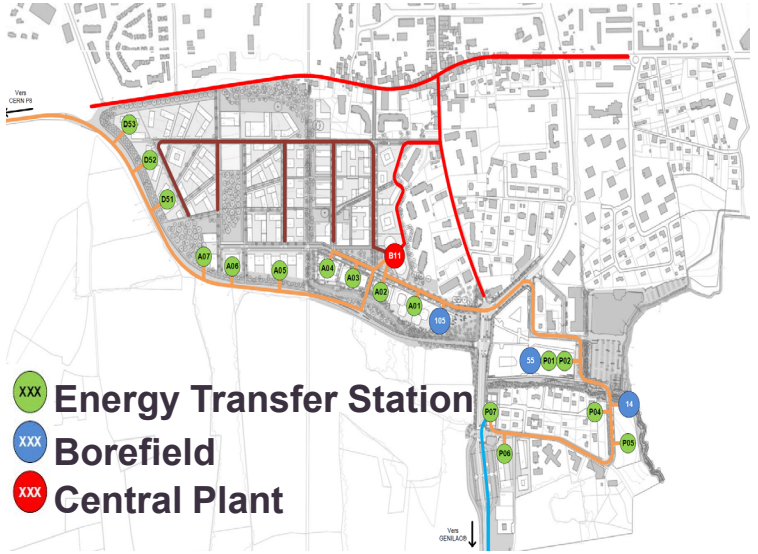


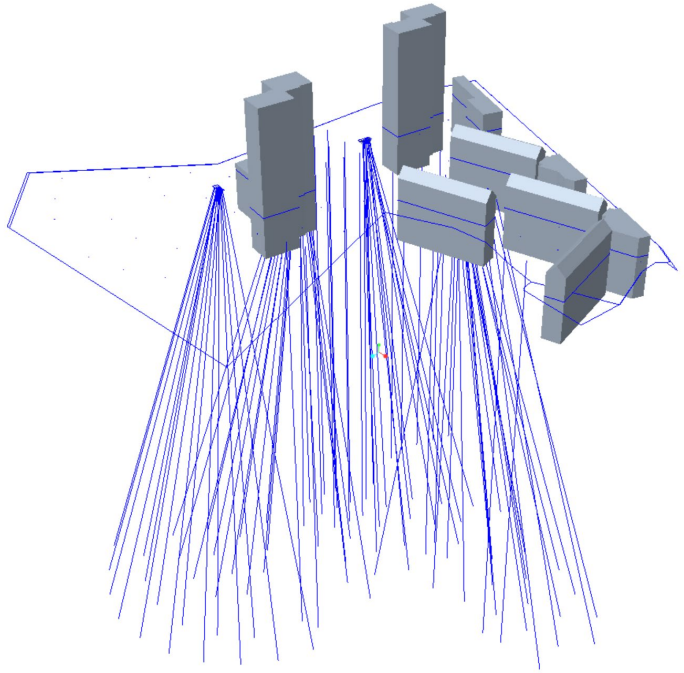
Illustration of the Ferney-Voltaire project in the Auvergne-Rhône-Alpes region of eastern France. (source: Celsius Energy)

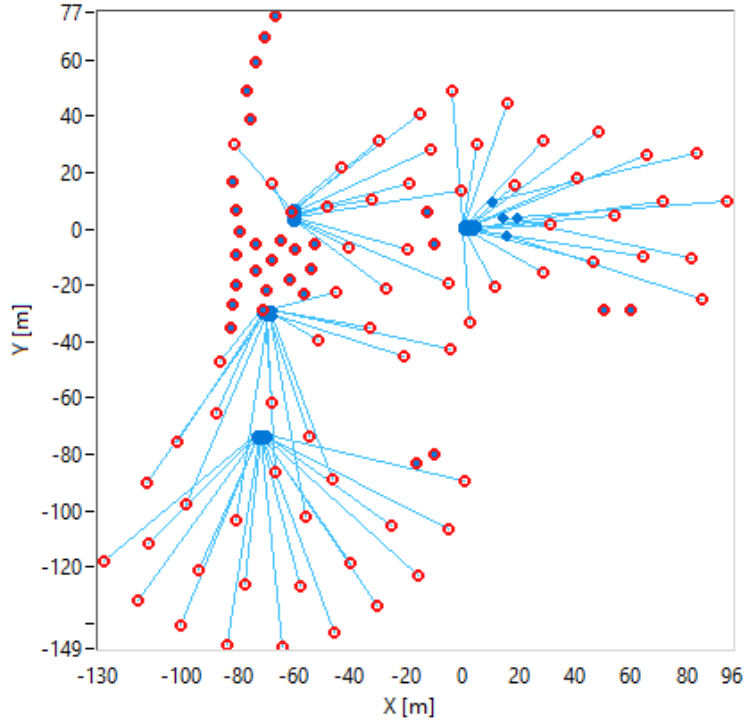


Social Housing Project

Greater London, UK

North London Social Housing Network Geothermal Project





Let's connect!

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