Closed-Loop as a risk mitigation and scalability strategy for geothermal energy development

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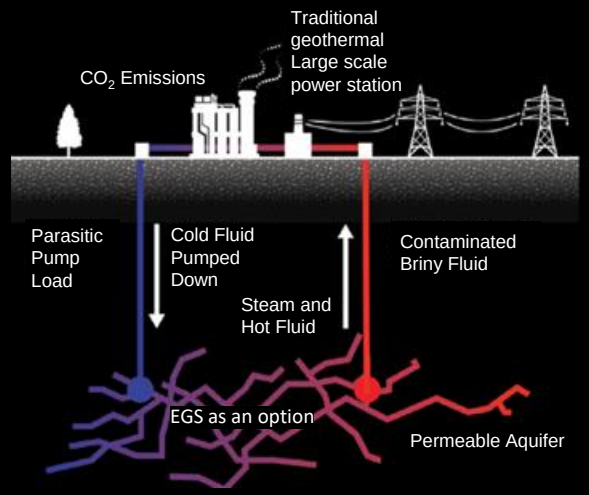
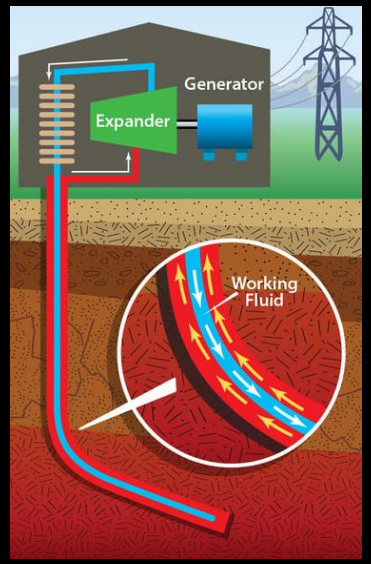
Hydrothermal vs Closed-Loop



Traditional Geothermal	Closed-Loop
Open System: water flows through reservoir, fluid exchange between system & reservoir	Closed System: Working fluid circulates in isolation from reservoir, no fluid exchange
Requires a permeable aquifer & hot convective zone	No need for permeable aquifer
Requires an electric pump to circulate brine; parasitic load	Large scale systems driven by natural thermosiphon, no pumping required
EGS provides an option to increase flow, but also increases risk of induced seismicity	No fracking required, no induced seismicity
Can produce GHG & CO_2 with produced brine	No GHG or CO_2
Continuous water use & ongoing treatment required	No water use, no production brine requiring treatment
Baseload, not Dispatchable	Baseload and Dispatchable (if driven by thermosiphon)



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Eavor-Loop™

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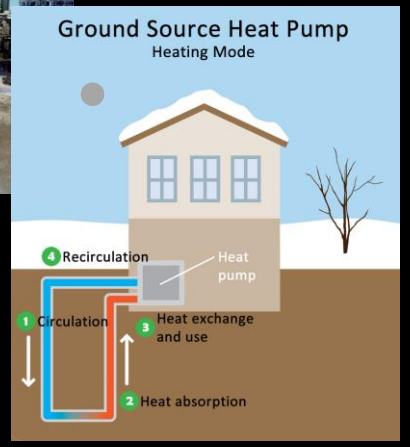
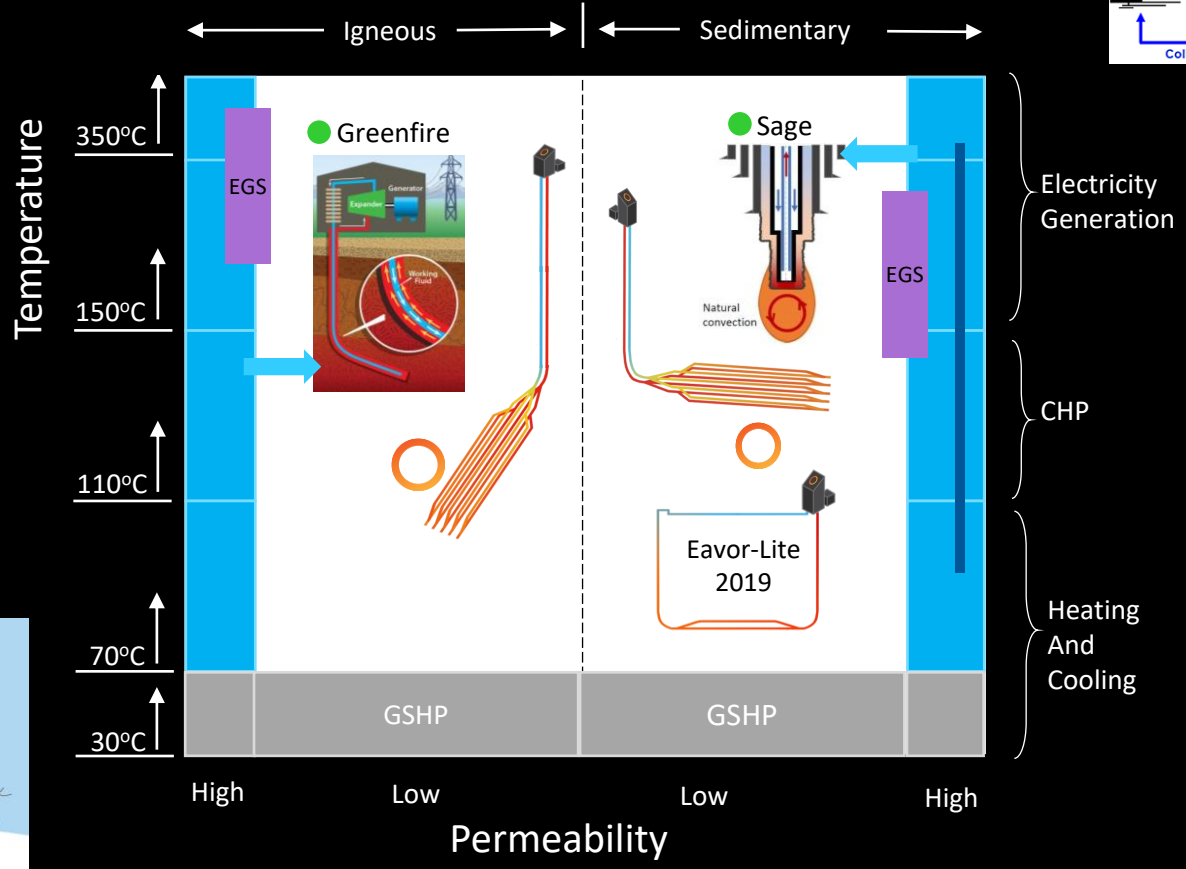
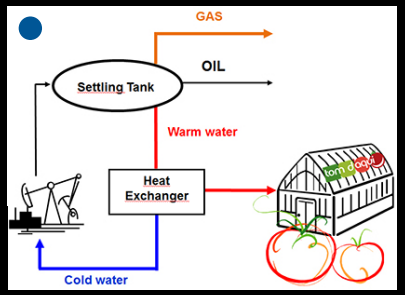
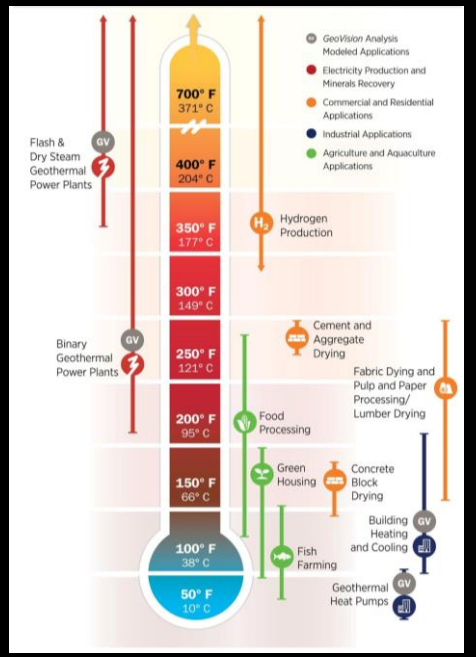
Geothermal Development Options

Project	# boreholes	Office space (sq m)	Office space per borehole (sq m)	# People
Celsius - Clamart	10	3,000	300	200
Microsoft - Redmond	875	230,000	263	8,000









● = Hydro-geothermal ● = GSHP ● = Enhanced Geothermal ● = Pipe-in-pipe
● = co-produced water from oil and gas ○ = Eavor-Loop

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Overcoming the conduction limitations

	Convection Zone	Large Surface Area
Igneous	GreenFire Energy	Eavor™
Sedimentary	SAGE GEOSYSTEMS™	Eavor™

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For campus scale heating/cooling projects

Conduction mitigation strategy

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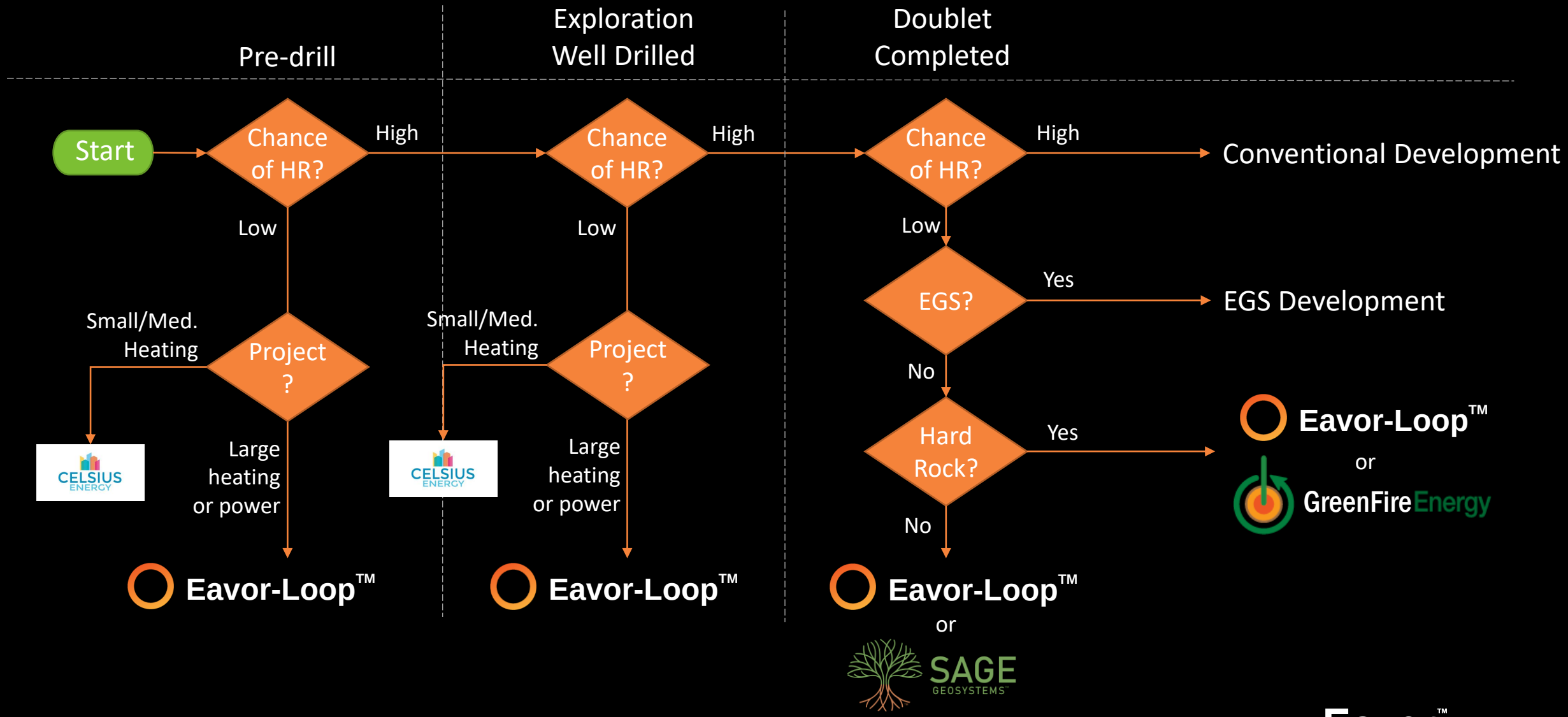
Risk mitigation decision tree



HR = Hydrothermal Resource

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Eavor – Risk Mitigation Examples

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Eavor-Loop™ overview

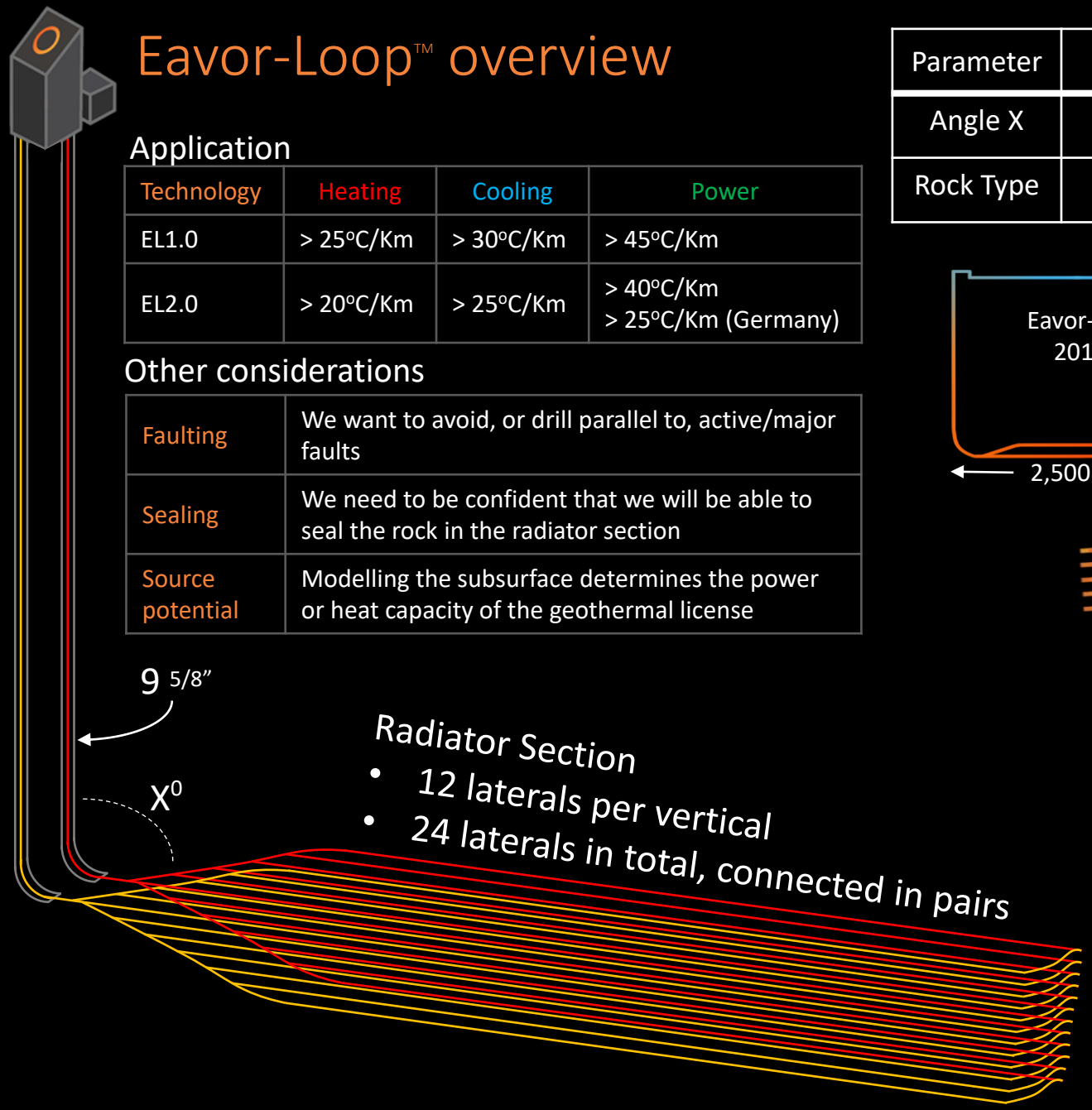
Parameter	Eavor-Lite	Eavor-Loop 1.0	Eavor-Loop 2.0
Angle X	90^0	90^0	20^0
Rock Type	Sedimentary	Sedimentary	Igneous

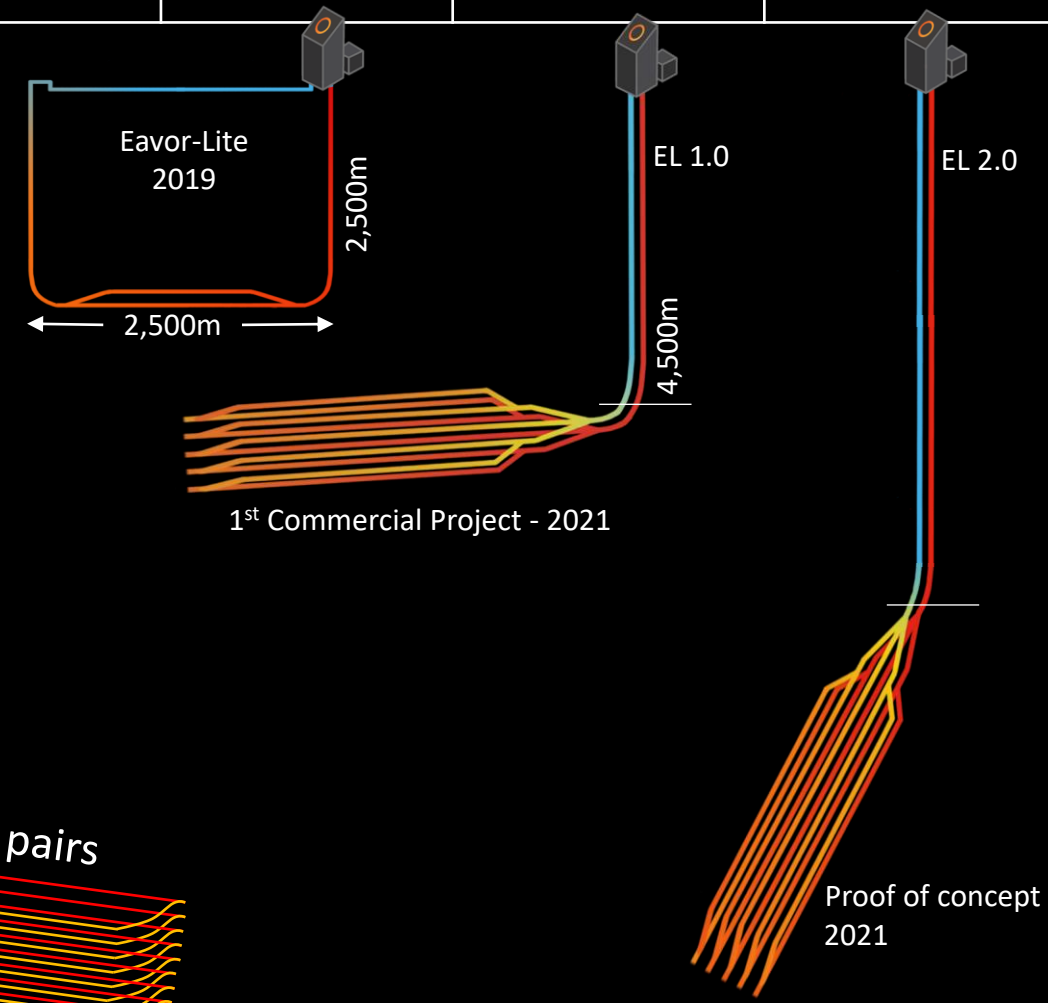
Application

Technology	Heating	Cooling	Power
EL1.0	> 25°C/Km	> 30°C/Km	> 45°C/Km
EL2.0	> 20°C/Km	> 25°C/Km	> 40°C/Km > 25°C/Km (Germany)

Other considerations

Faulting	We want to avoid, or drill parallel to, active/major faults
Sealing	We need to be confident that we will be able to seal the rock in the radiator section
Source potential	Modelling the subsurface determines the power or heat capacity of the geothermal license





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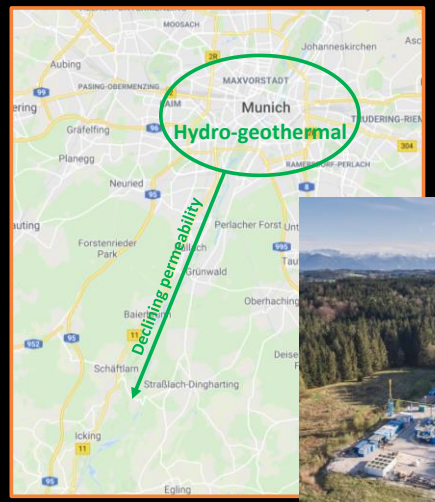
Eavor-Loop™ – Geretsried Germany

Background

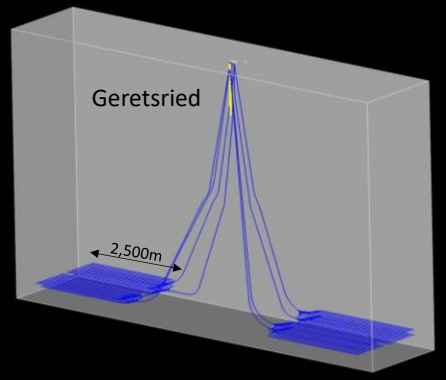
- 2009-2012: Enex acquired lease and approvals
  - Combined Heat and Power
  - District Heating to town of Geretsried

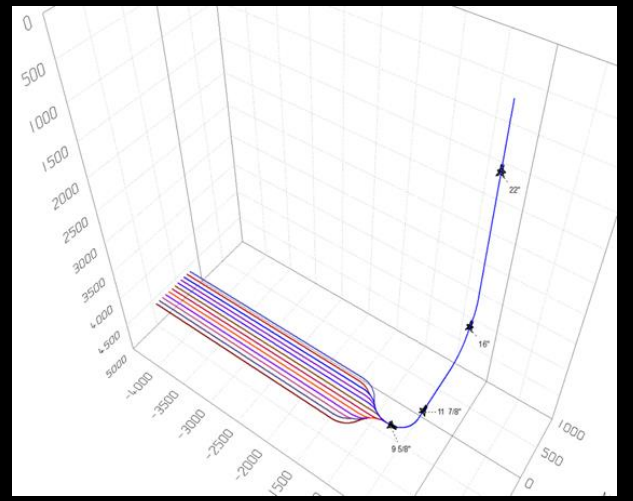


- Key environmental approvals, stakeholder relationships, infrastructure, offtake in place.

Opportunity Overview

- Manufacturing-style development
- Modular facilities, economies of scale
- Deployment of Eavor-Loop™ technology in manufacturing style approach for infrastructure scale heat and power generation





Current Plan

(2020 – 2024)

- ~9 MW_e / 65 MW_{th}
- Initial four (4) Eavor-Loop™ 1.0 implementations built from single surface location.
- Provision for direct power generation and heat sales to district

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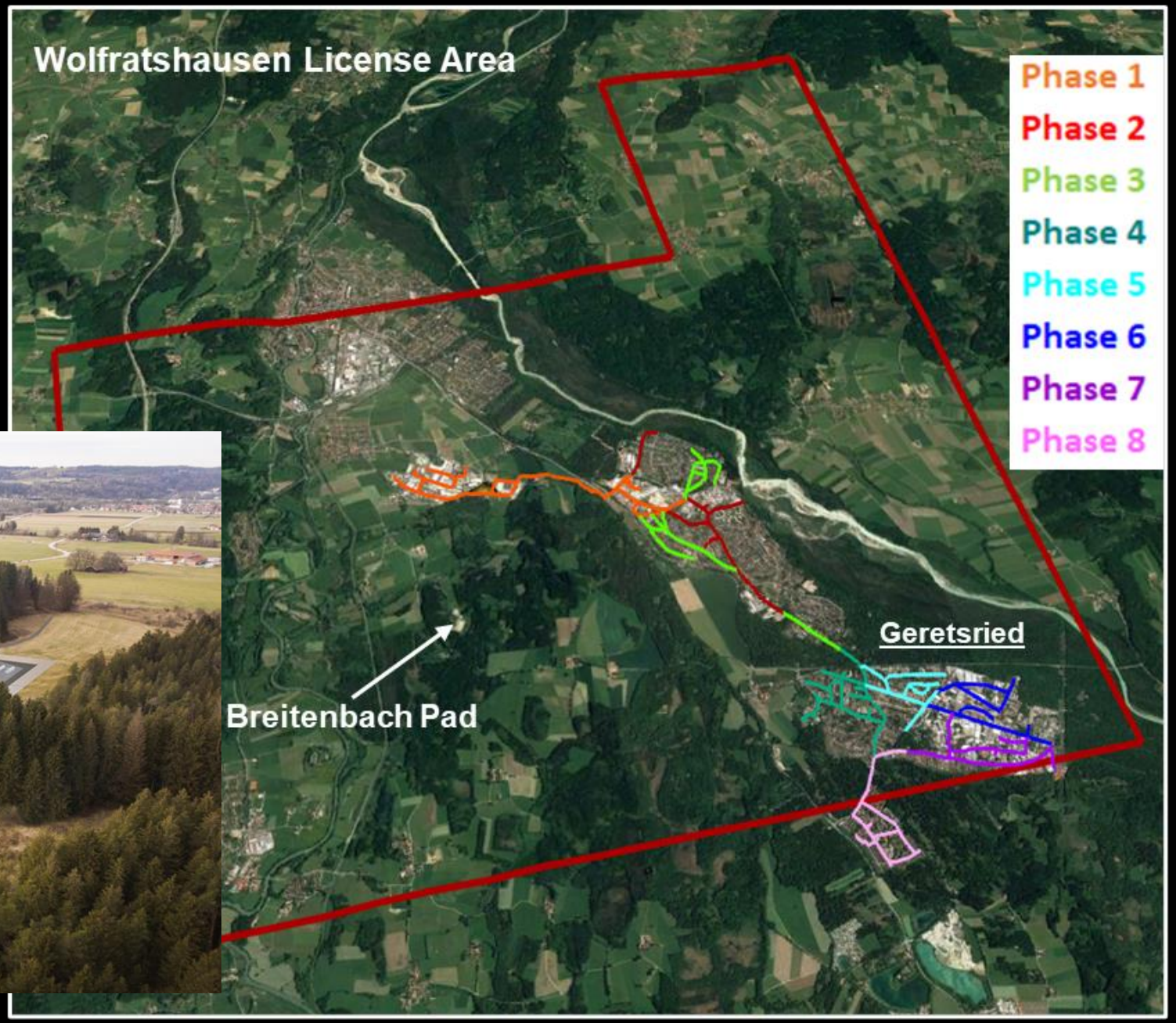
Eavor-Loop™ – Geretsried

The heat network



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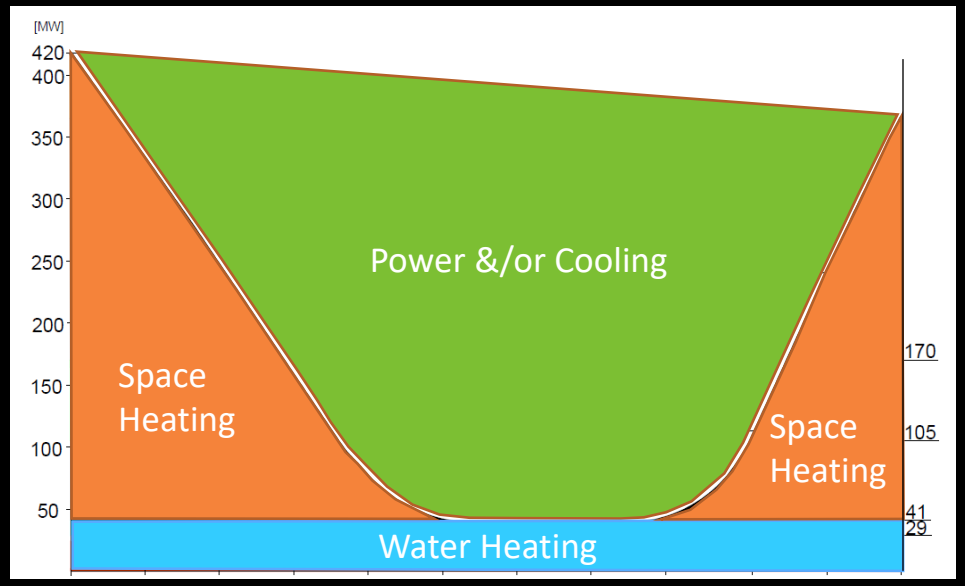
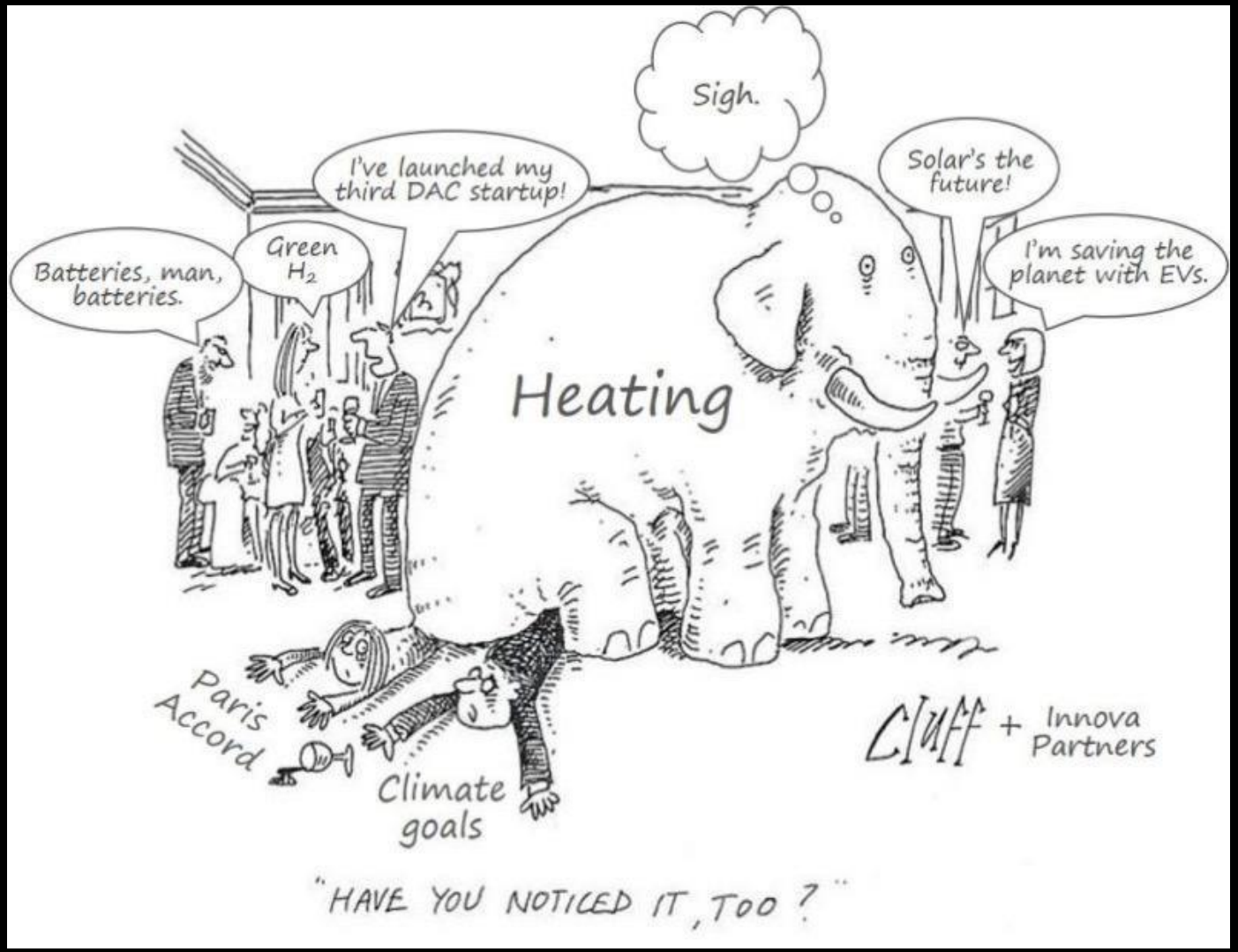
Heating, CHP & CCHP

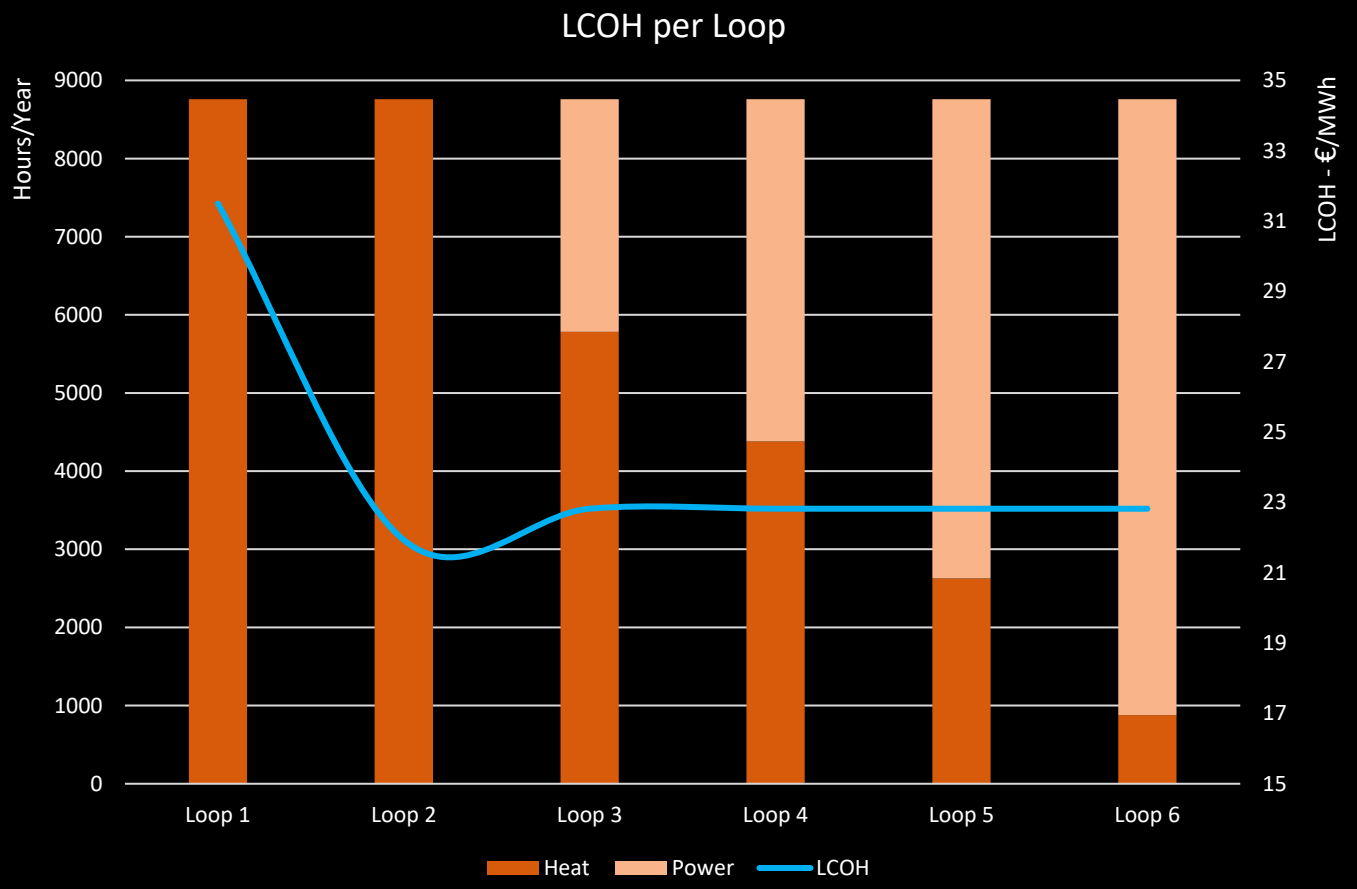


District Heating challenge

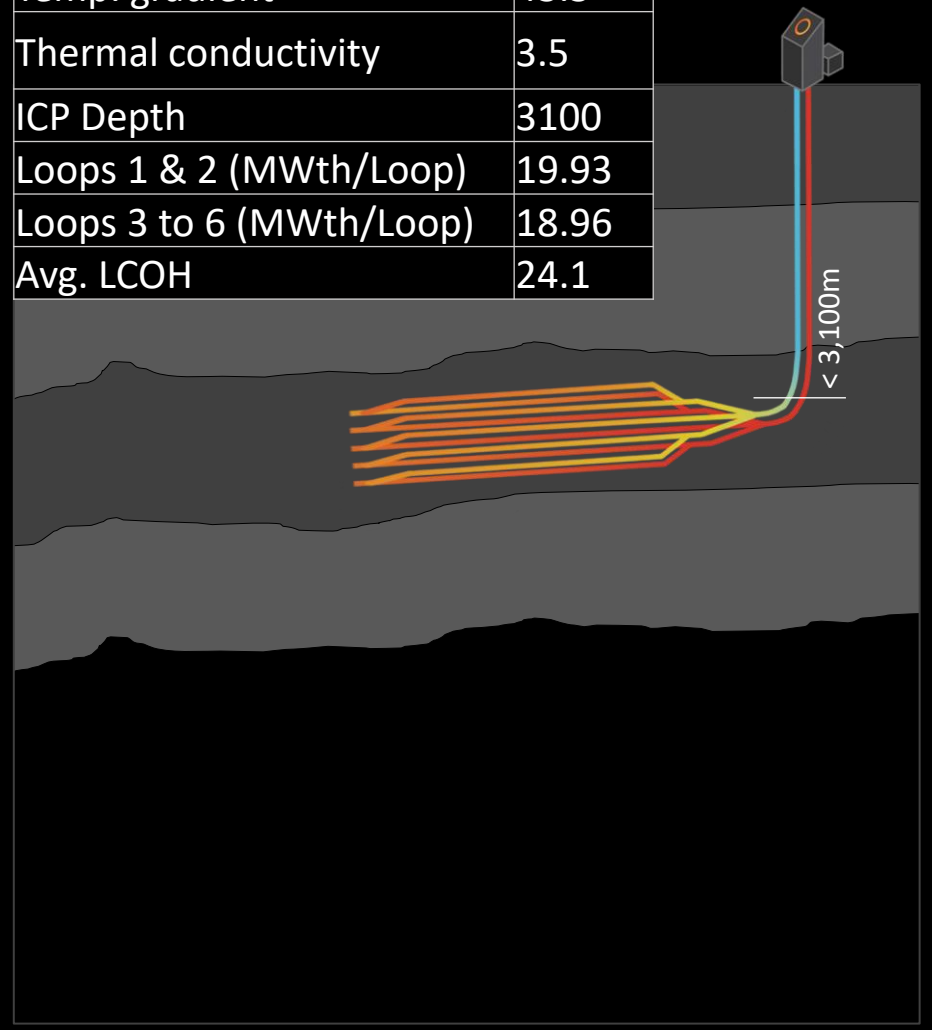
- 400,000 people, 180,000 homes
- Water heating – 50MW baseload (8760 hours/year)
- Space heating – seasonal demand
- Peak load only viable with CHP or CCHP



CHP EL1.0 Case Study - Germany



Location Overview	
Temp. gradient	43.5
Thermal conductivity	3.5
ICP Depth	3100
Loops 1 & 2 (MWth/Loop)	19.93
Loops 3 to 6 (MWth/Loop)	18.96
Avg. LCOH	24.1



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