Perspective on a Dual Resource Play: Geothermal Energy with Lithium Extraction

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Agenda

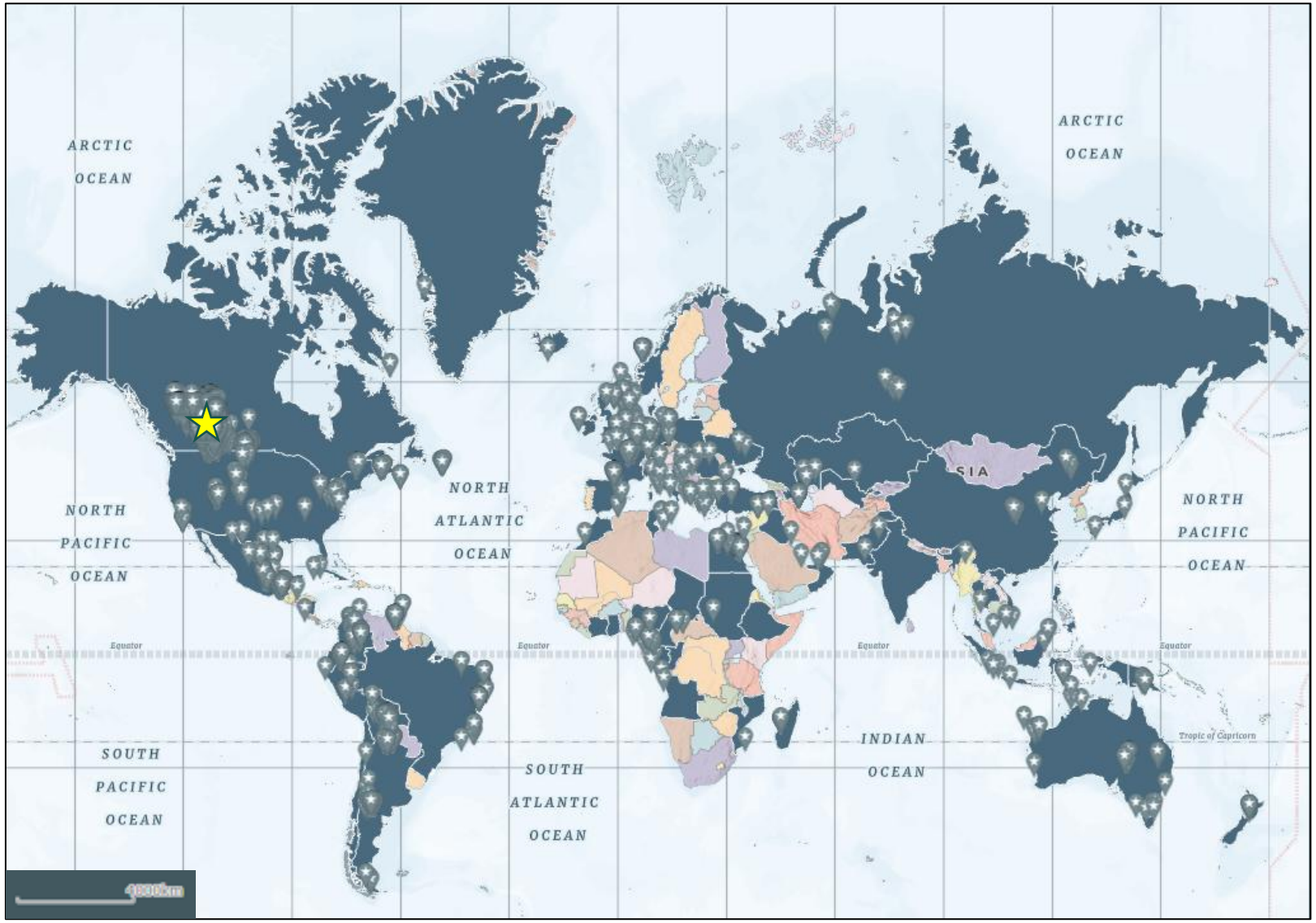
- GLJ Introduction
- Dual Resource Geothermal and Lithium Overview
- Example Project Overview – Vulcan Energy in Germany
- Final Perspective - Takeaways

GLJ Intro

Who Are We? *A leading consulting and advisory firm*

- **Headquartered in Calgary, Canada**
  - **50+** years of success in business
  - **70+** countries & **5** continents
  - **100+** expert professionals:
    - ✓ Engineers
    - ✓ Geoscientists
    - ✓ Business
    - ✓ Sustainability
  - **200+** clients annually

- **Broad Global Client Base**
  - International clients on markets in US, UK, Europe, and Hong Kong
  - IOCs, NOCs, private equity, midstream, pipelines
  - Evaluator market share leader for Toronto Stock Exchange



What Do We Do? *Independent Evaluations, Certifications & Audits.*

- **Services for Oil & Gas Industry Partners**
  - Strategy, Advisory & Training
  - Reserves & Resources Evaluations
  - Technical & Integrated Studies
  - New Ventures & Emissions Management
  - Acquisition & Divestitures
  - Sustainability & ESG

Conventional Resources

Unconventional Resources

Offshore Oil & Gas

Enhanced Oil/Gas Recovery

Reserves & Resources

Field Development Plans

Integrated Studies

Modeling & Simulation

Acquisition & Divestitures

Sustainability & ESG

What Else Do We Do? *Energy Transition & Decarbonization Services.*

Services for Other Energy Clients

Carbon Capture, Utilization & Storage

- ✓ CCUS Roadmap & Strategy
- ✓ Site Screening & Characterization
- ✓ Project Planning & Risking
- ✓ Applications & Compliance

Lithium

- ✓ Lithium Brine Extraction
- ✓ Geothermal Lithium Development
- ✓ Techno-Economic Feasibility
- ✓ NI43-101 & JORC Compliance

Geothermal

- ✓ Technology Assessment
- ✓ Development Plans
- ✓ Risks & Uncertainties
- ✓ Investment Advisory

Helium

- ✓ Geological & Reservoir Studies
- ✓ Development Planning
- ✓ Economic & Market Analysis
- ✓ Resource & Compliance

Hydrogen

- ✓ Strategy & Value Chain
- ✓ Development Plans
- ✓ Surface & Underground Storage
- ✓ Distribution to End Users

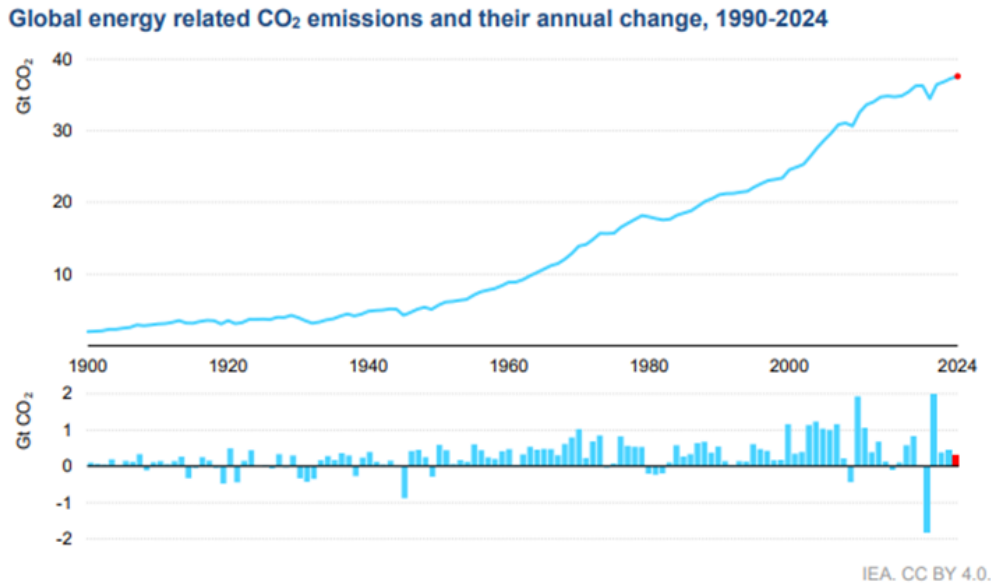
Decarbonization

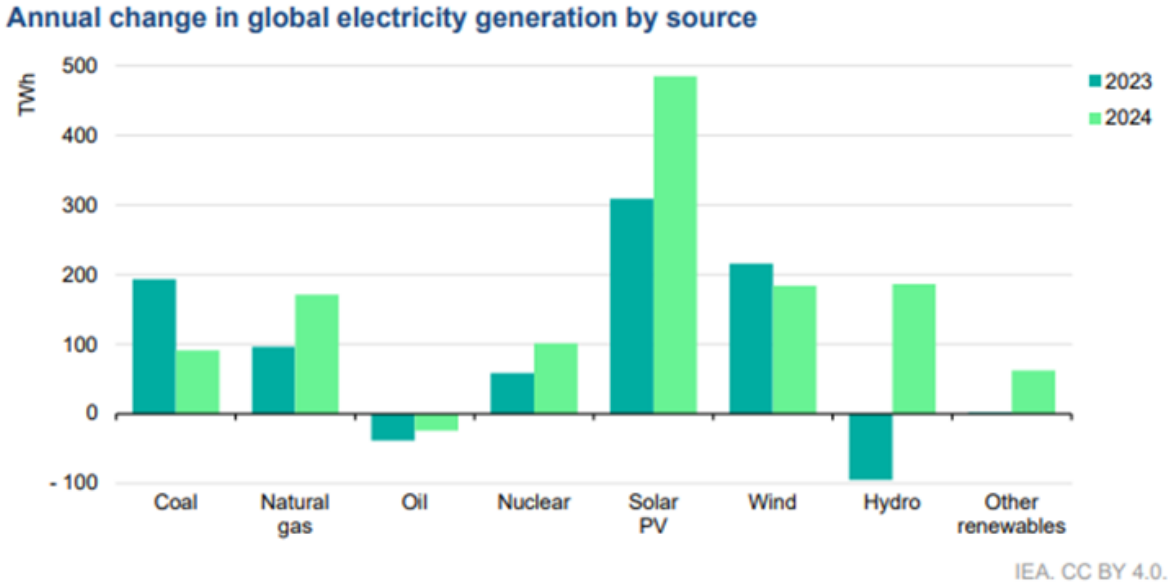
- ✓ Decarbonization Roadmap & Strategy
- ✓ Emission Reduction Targets
- ✓ Feasibility & Profitability Studies
- ✓ Scenario Assessment

Dual Resource Geothermal and Lithium

Energy Transition

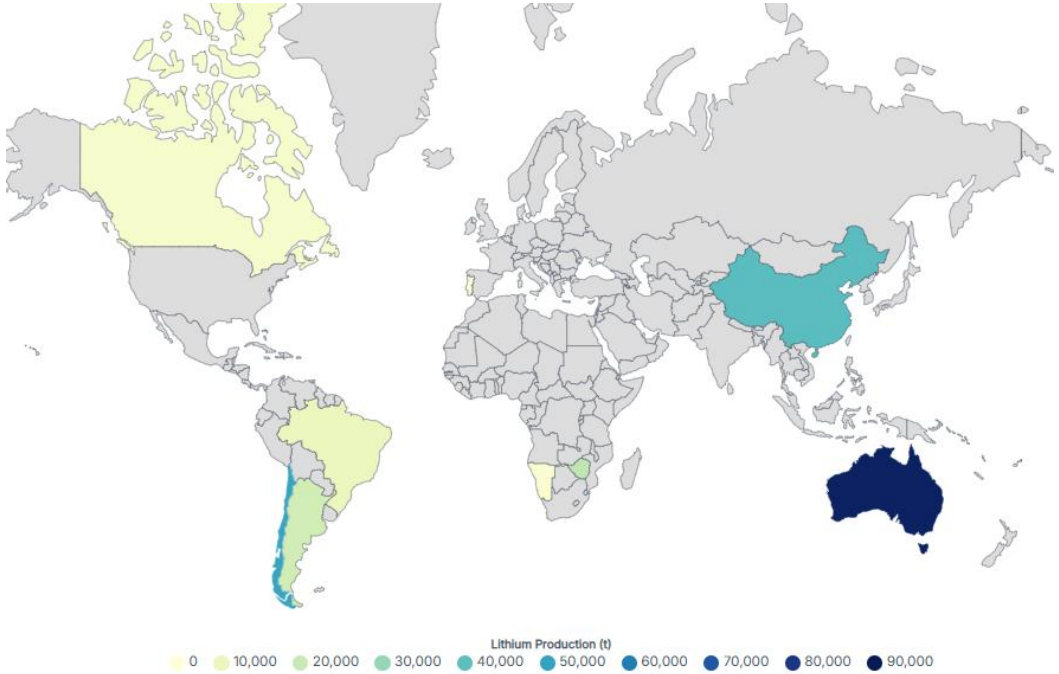
- Renewable energy demand is driven by Greenhouse Gas (GHG) emissions reduction
  - Wind and solar lead market share at 30% (2025 IEA)
  - Geothermal electricity capacity globally at less than 1%
- Shift to Electric Vehicles (EV) has driven growth of critical mineral exploration and development
  - Critical minerals required with lithium as a key component in EV batteries
  - Many countries defining incentives for sector growth – driven by self sufficiency targets





Lithium Supply Chain

- Lithium supply - hard rock mining and brine salars
  - Large footprint and environmental impact
- Direct Lithium Extraction (DLE) technologies enabling advancements
  - Adsorption based DLE makes up 10% of global lithium production



Lithium annual production 2024 by country (World Population Review, 2025)

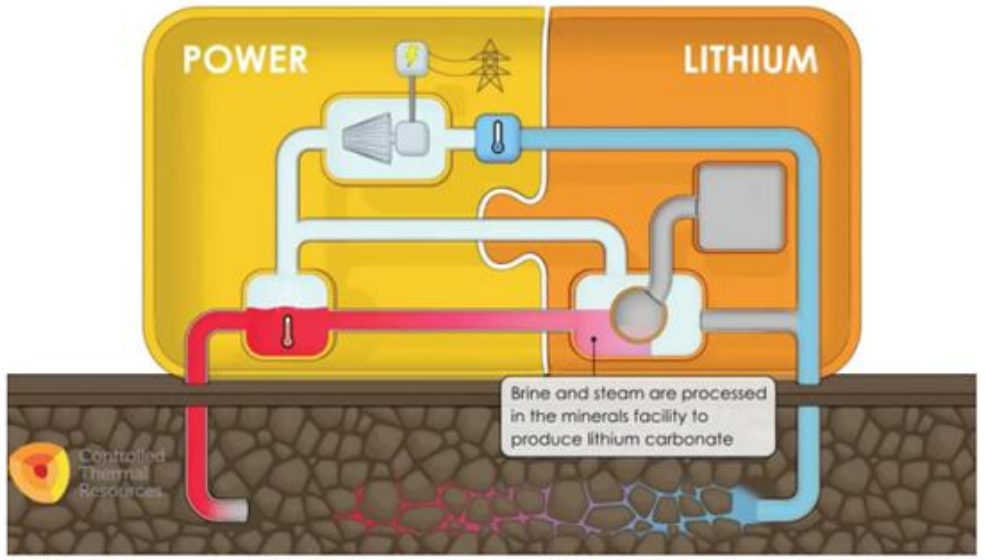
Greenbushes spodumene mine, Australia (businessnews.com.au, 2025)

Evaporation ponds in Atacama's Salt Flat, Chile. (*Image by Zeta Fernández | Stocksy.*)

Dual Resource: Synergy of Geothermal with Lithium

- Deep subsurface brines can be the source of:
  - Geothermal power and heating
  - Lithium extraction
  - Other critical mineral extraction
- Derisking through leveraging existing geothermal or oil & gas plays
- “Green” power can be harnessed from the brine before lithium is extracted
  - ORC (Organic Rankine Cycle) binary power plant
  - Geothermal power reduces operating costs of DLE
- Lithium production is energy intensive
  - Parasitic load for pumps
  - DLE and Refining/Polishing
- Geothermal lithium co-production is a more economic option

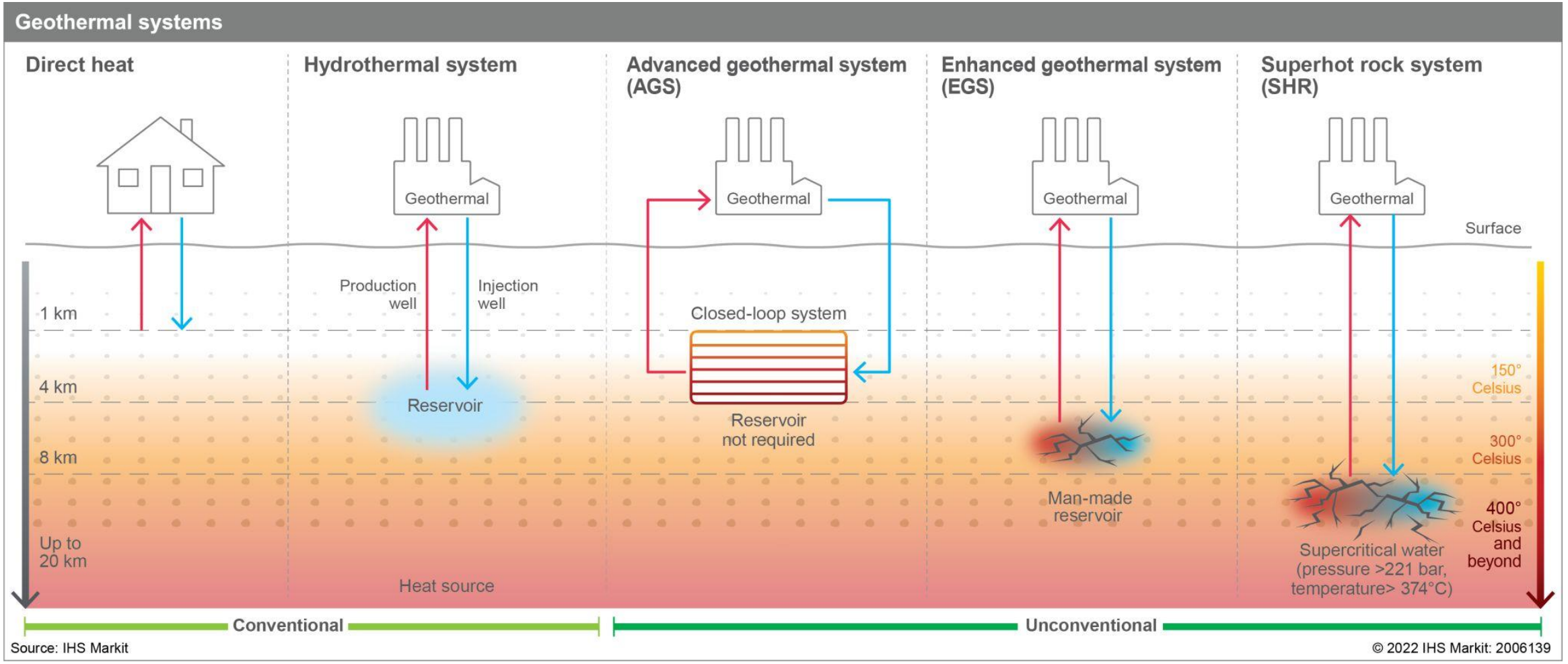
Simplified overview of Geothermal Lithium operation



http://www.thinkgeoenergy.com/simplified-overview-on-planned-lithium-production-from-geothermal-operations/

Geothermal Extraction Technologies

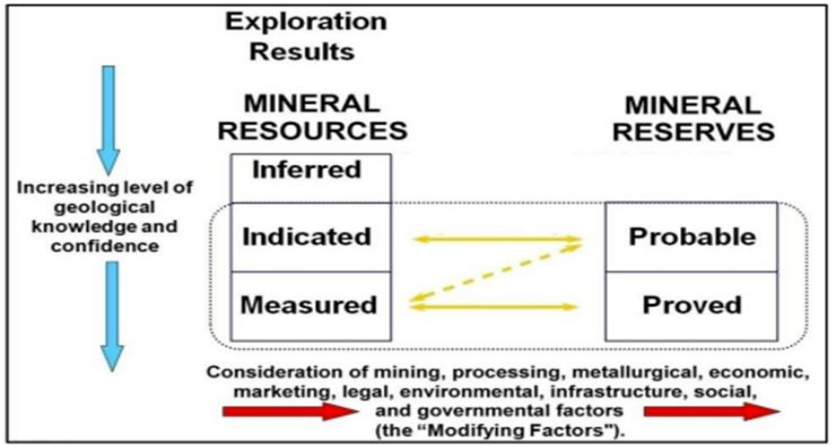
- Geothermal compatible with lithium co-production is hydrothermal, EGS or SHR



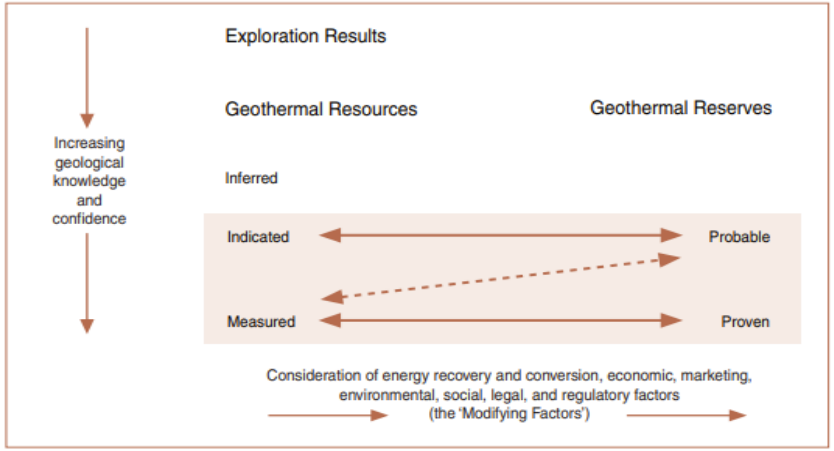
Reporting for Dual Resource Projects

Lithium from deep subsurface brines is treated as a mineral

- Regulated under mining authorities as hard rock mining
  - CRIRSCO (Committee for Mineral Reserves International Reporting Standards)
  - Canada NI43-101 (National Instrument)
  - Australia JORC Code 2012 (Joint Ore Reserves Committee)
  - USA SK-1300
- Geothermal resource and reserve reporting not as well established
  - Australia Geothermal Code
  - UNFC (United Nations Framework Classification)
- Modifying Factors are similar to determine technical and economic viability
  - Mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and government



General relationship between exploration results, mineral resources and mineral reserves (CRIRSCO 2019)

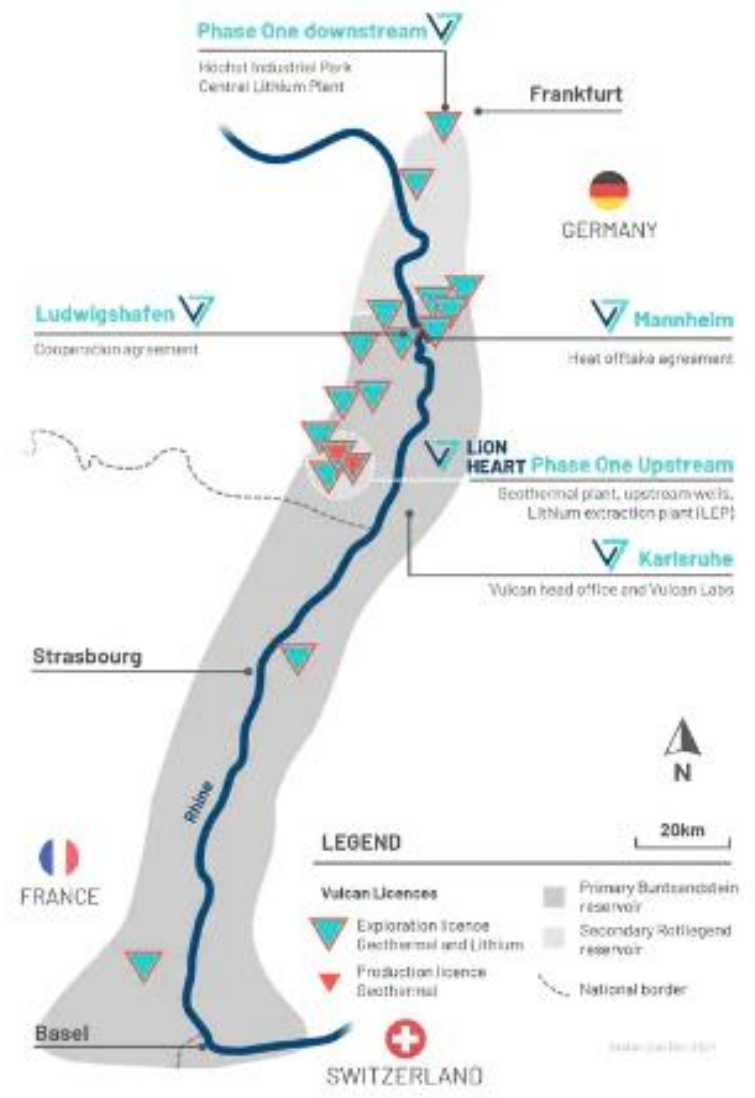


Geothermal reporting relationship between exploration results, geothermal resources and geothermal reserves (AGEA 2010)

Vulcan Energy Project Overview

Example: Geothermal Lithium Project

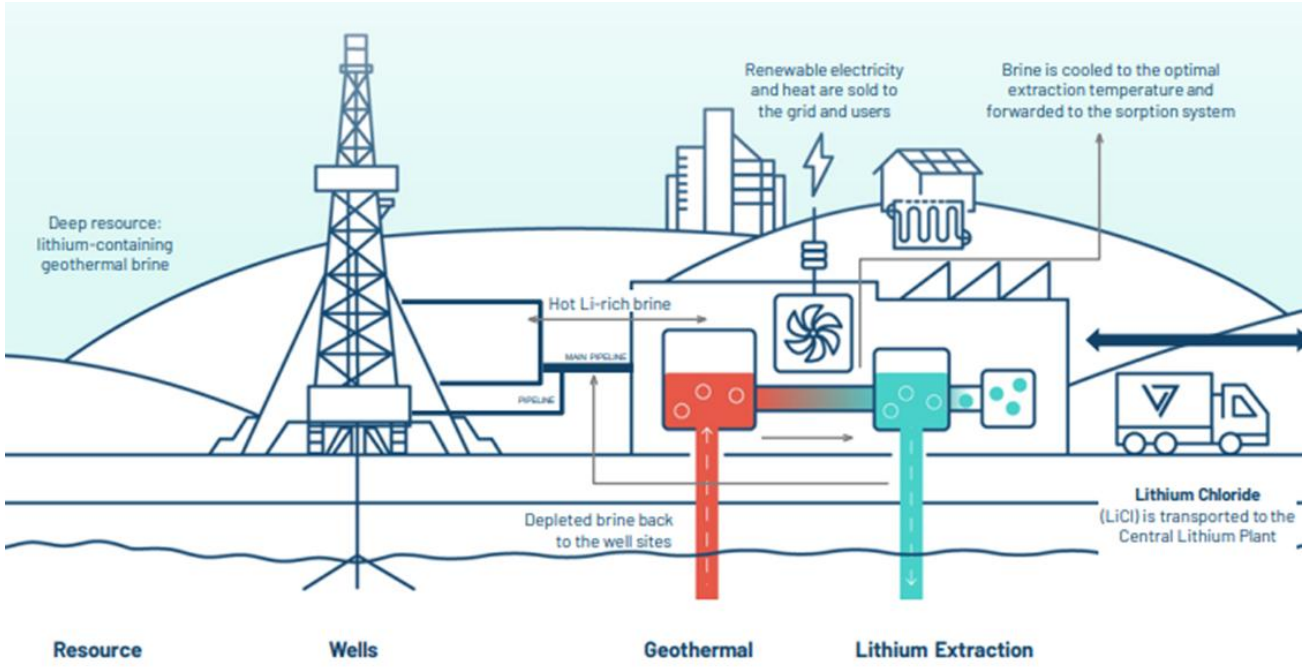
- Several projects are in early development, pilot and demo stages in Canada, USA, France, and Germany
- Vulcan Energy Resources Ltd.
  - Australian company traded on ASX and FSE
  - Key projects located in Upper Rhine Valley, Germany
  - Leverage existing owned Geothermal Power plants at Insheim and Landau
  - 29.1 Mt LCE Lithium Mineral Resource reported for majority of Vulcan's licenses in region
- GLJ has supported Vulcan projects since 2020 as Competent Persons (JORC)



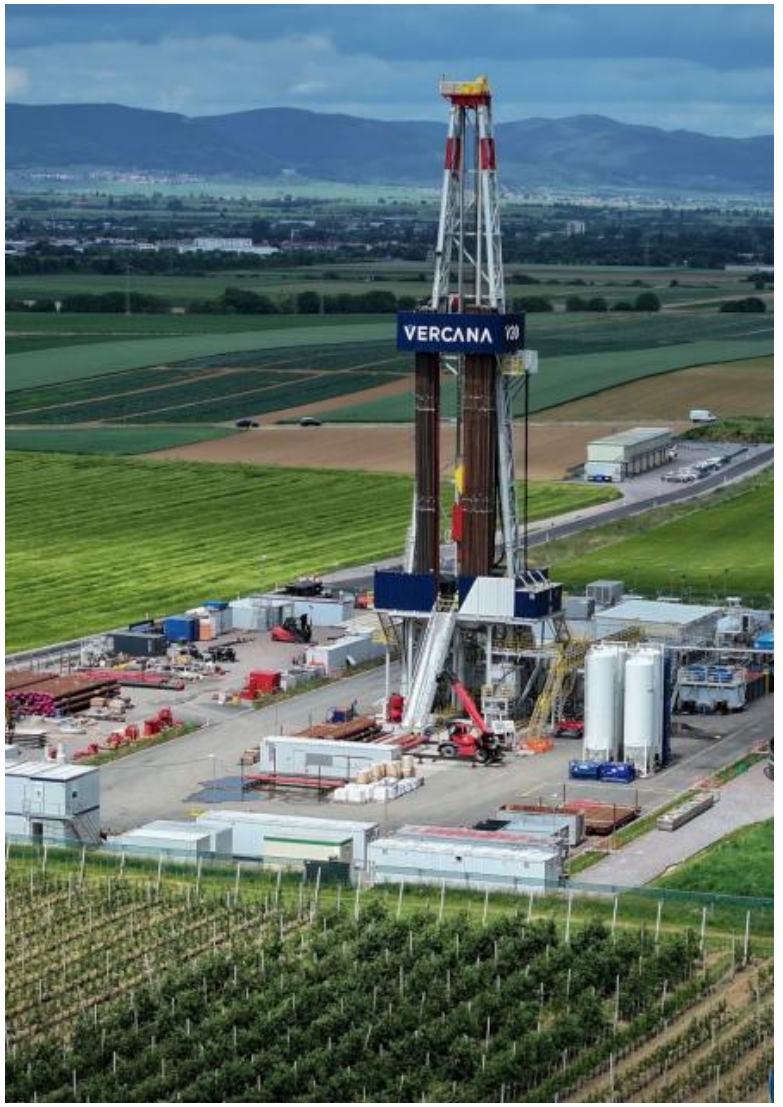
Vulcan Phase One project location and other licenses, Upper Rhine Valley, Germany (Vulcan, 2025)

Vulcan Phase One Subsurface

- Target formation - Buntsandstein Group
  - Typical well depth is 3,000+ m with bottomhole temperatures of 165 ºC
- Phase One Mineral Resource and Ore Reserves (JORC) at Li concentration of 181 mg/L
  - Measured and Indicated Mineral Resources of 4.16 Mt LCE
  - Proved and Probable Ore Reserves 0.57 Mt LCE



Vulcan Energy, 2024

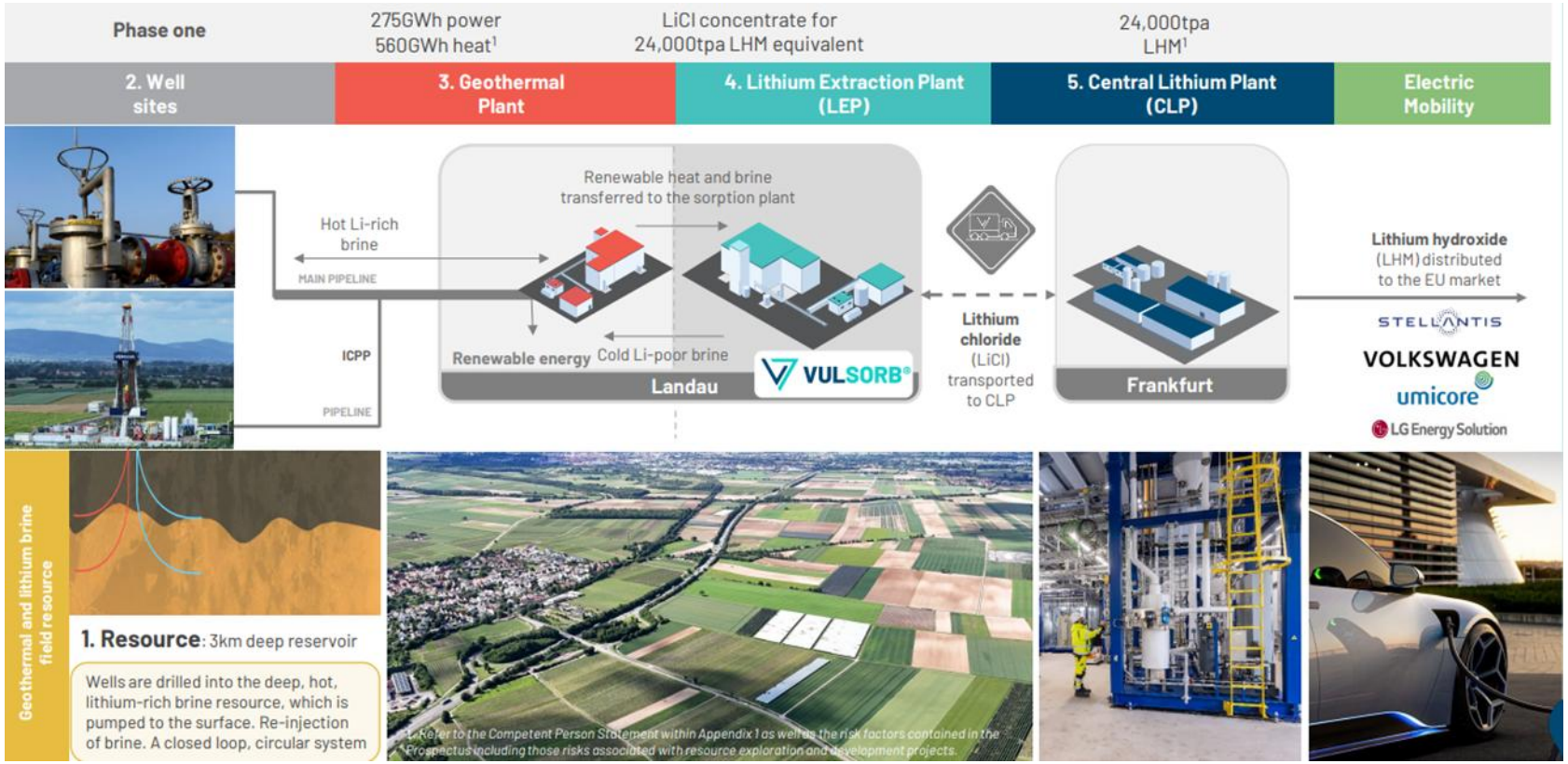


Vulcan Phase One Drilling Rig 2025

Vulcan Phase One Project Overview

- 24 new directional plus 4 existing wells
- Plan to produce 950 l/s brine
- New ORC Geothermal Power Plant
  - 27.5 MWp and 79.5 MWh capacity
  - Heat offtake to local communities

- Adsorption-type DLE - proprietary alumina-based sorbent (VULSORB)
- Processed to LHM at Central Lithium Plant
- Capacity of 24,000 tpa LHM



Representation of Vulcan's Phase One development plan (Vulcan, 2025)

Vulcan Phase One Project Operations

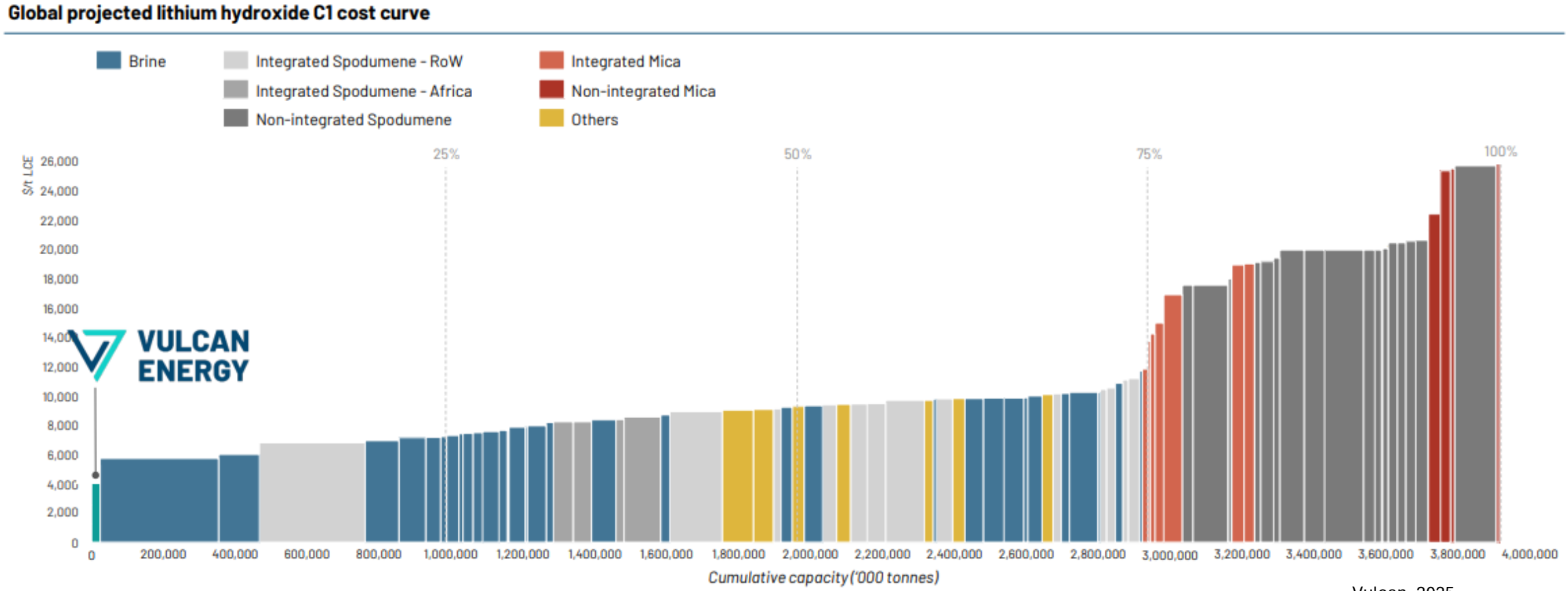
- Demonstration facilities in operation
  - Lithium Extraction Optimisation Plant (LEOP) since April 2024
    - Up to 95% extraction efficiency
  - Central Lithium Electrolysis Optimisation plant (CLEOP) started in November 2024
  - Concentrated LiCl sent from LEOP to CLEOP – manufacture LHM
    - Current production ~200kg LHM/mth
  - Qualification testing underway with offtake partners

Vulcan LEOP, Landau, Germany, 2025

Vulcan CLEOP, Frankfurt, Germany, 2025

Vulcan Phase One Project Considerations

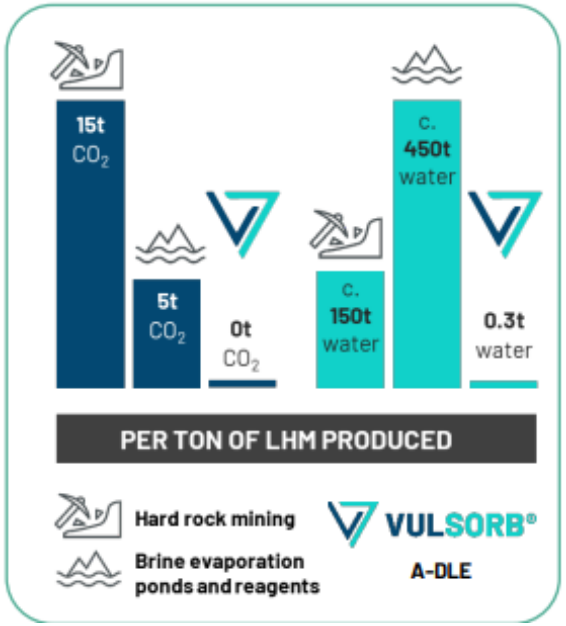
- Offtake contracts in place with large auto manufacturers
- Finished EPCM and preparing to award contracts upon secured funding
- Favorable production costs compared to hard rock and salar projects



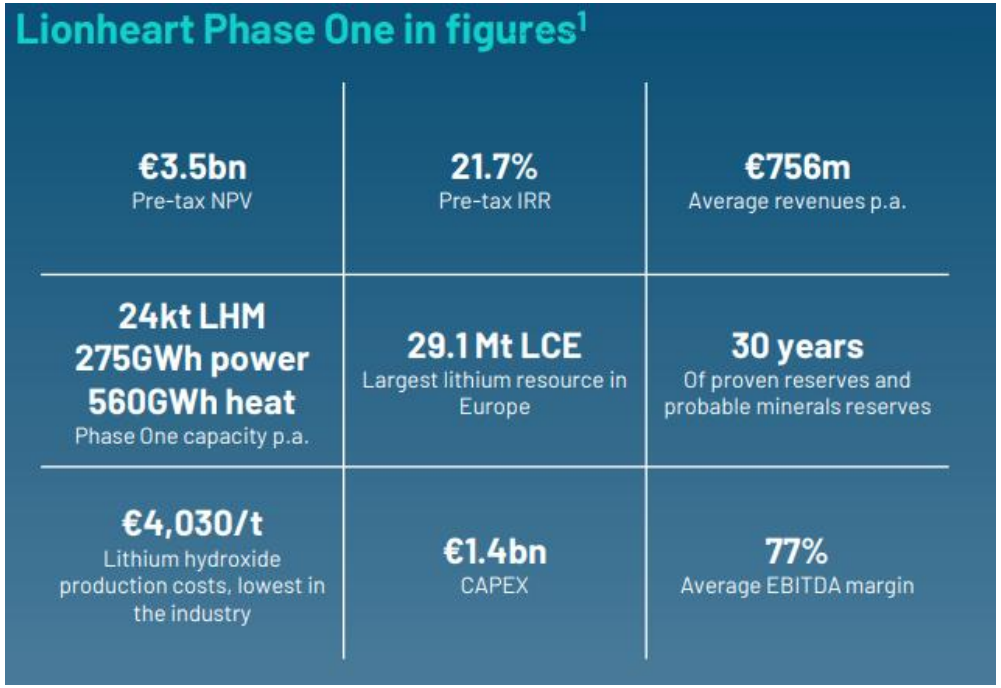
Vulcan, 2025

Vulcan Phase One Project Economics

- Economics are robust for over billion Euro project
- Produce enough lithium for ~ 500,000 EV's/yr
- Decarbonize lithium supply chain with avoidance of CO2
- Targeting renewable heat for ~ 90,000 people
- DLE consumes small amounts of water, due to recycling



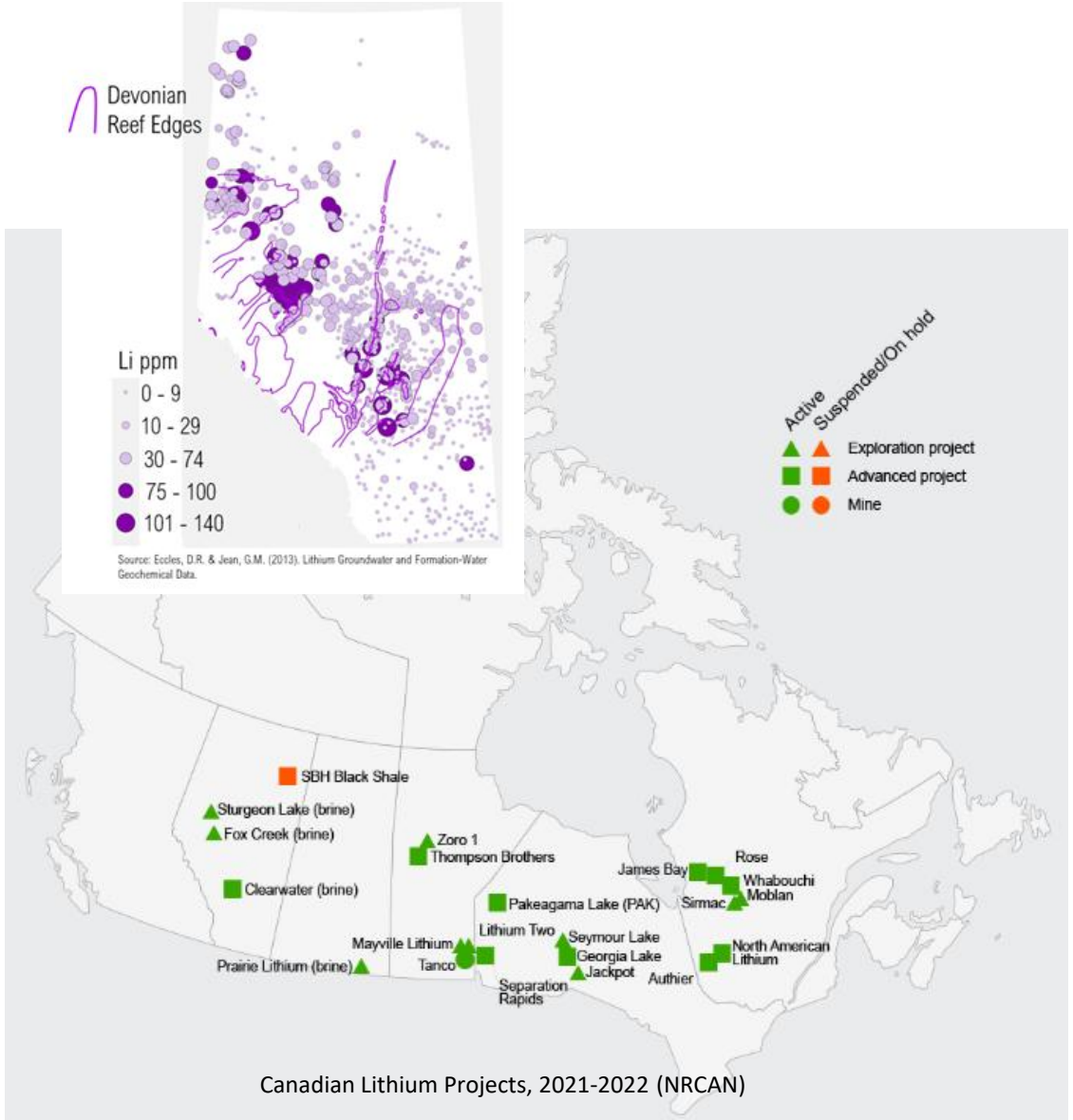
Vulcan, 2025



Final Insights

Canada Lithium Potential

- Canada currently has no commercial scale lithium production
  - Several spodumene deposits in Eastern Canada
  - Western Canada has lithium brine projects in Pilot or Demonstration stage
- Existing hydrocarbon plays may reduce derisking costs
  - Data and infrastructure
- Lithium concentrations in Western Canada brines range to 140 ppm
- Geothermal co-production in Canada is limited by deeper hot reservoirs



Canadian Lithium Projects, 2021-2022 (NRCAN)

Geothermal Lithium Challenges and Opportunities

- **Opportunities:**
  - Meet country specific critical mineral goals – potential incentives
  - Co-production of other critical minerals - if present in sufficient quantities to be economic
  - District heating may improve stakeholder support and improve economics
  - Leverage off oil and gas fields for subsurface data and existing infrastructure
- **Challenges:**
  - Exploration and new wells to verify Li concentrations and flow rates – High Cost
  - Brine chemistry may require pre-treatment and scaling mitigations
  - Lithium price volatility
  - EV Batteries may move away from lithium
  - Stakeholders may not support geothermal lithium – NIMBY
  - Pore space competition for other uses such as CCUS

Takeaways

- Geothermal co-production with lithium extraction – low GHG power and heat improves economics and sustainability
- Current lithium supply chain is complex and affected by geopolitics
- Lithium from deep brines have small footprint compared to hard rock or salars - drilling technologies enable long deep deviated wells
- DLE technologies are readily available - but must find right match as each brine is unique
- Derisking to scaled up commercial scale is a long road and not yet fully proven
- Project funding and the lender due diligence processes are challenging
- Transfer of skills and capabilities from oil and gas is valuable

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