

# Vulcan Energy Resources

July-August 2022



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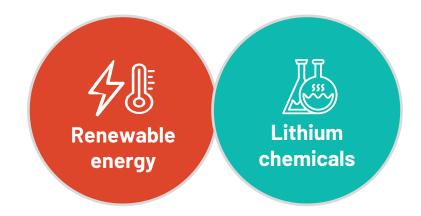
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# Vulcan Energy Resources

is aiming to become the world's first integrated lithium chemicals and renewable energy producer with net zero greenhouse gas emissions.

Vulcan's unique Zero Carbon Lithium™ Project aims to produce both renewable geothermal energy and lithium hydroxide for electric vehicle batteries from the same deep brine source in the Upper Rhine Valley, Germany.



Right time, right place for fully integrated renewable energy and sustainable lithium chemicals business in Europe





Rapidly advancing the Zero Carbon Lithium™ Project to ensure timely market entry

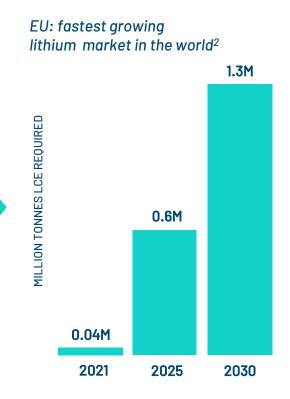
# How to support 30 million EVs by 2030 in Europe?



1,000GWh lithium-ion battery capacity by 2030<sup>1</sup>



Source: Public announcements



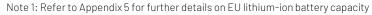
Source: Based on LiB capacity, S&P Global<sup>3</sup>





CHINA. 60 - 90

Source: Bloomberg



Note 2: Based on electric vehicle sales and lithium-ion battery production growth; https://www.reuters.com/article/us-climate-change-eu-transport-idUSKBN28E2KM) Bloomberg - https://www.bloomberg.com/news/articles/2020-12-03/eu-aims-to-have-30-million-electric-cars-on-the-road-by-2030

Note 3: https://www.spglobal.com/marketintelligence/en/news-insights/research/investment-in-lithium-ion-batteries-could-deliver-5-point-9-twh-capacity-by-2030

# Auto battery and cathode-makers committing to carbon neutrality

#### RENAULT GROUP

'Reducing carbon footprint is not just reducing vehicle emissions while they are being operated, but also [...] from the company's resource extraction and production processes through to the end of the vehicle's life cycle'.



'We work in partnership to implement responsible procurement practices, to ensure sustainable progress throughout the entire supply chain, with specific emphasis on the wise use of natural resources.

#### **VOLKSWAGEN**

GROUP

'By 2025, the company aims to reduce the carbon footprint of cars and light-commercial vehicles across the entire value chain by 30 percent compared to 2015 – and by 2050 to make the entire Group's balance sheet CO₂ neutral'.



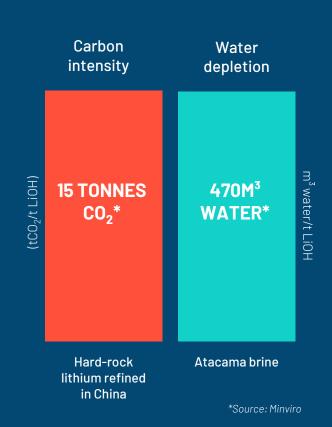
'Umicore commits to carbon neutrality for its Scope 1 and Scope 2 GHG emissions by 2035 ... Umicore pledges that its future growth, whether organic or through M&A, will be entirely carbon neutral'.

#### LG Energy Solution

'LG Energy Solution commits to be 100 percent carbon neutral by 2030. LG will set an example in cutting carbon emissions through battery production and promote the expansion of EVs'.

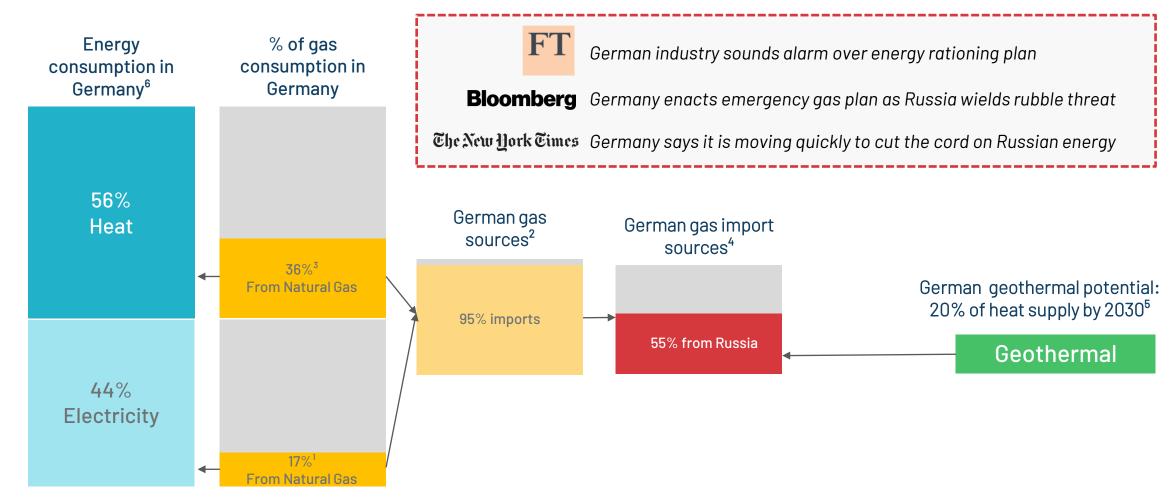


Current lithium production has a significant environmental footprint:



### How to support the German energy crisis?





Note 1: https://www.iea.org/countries/germany

Note 2: https://www.cleanenergywire.org/factsheets/germanys-dependence-imported-fossil-fuels#:~:text=Germany%20%2D%20GAS,imports%2C%20according%20to%20the%20BGR.

Note 3: https://iea.blob.core.windows.net/assets/60434f12-7891-4469-b3e4-1e82ff898212/Germany\_2020\_Energy\_Policy\_Review.pdf

Note 4: https://www.economist.com/europe/2022/01/29/how-will-europe-cope-if-russia-cuts-off-its-gas?gclid=Cj0KC0iAmpyRBhC-ARlsABs2EArS9KC3GxzZtyldz0trn0VJ0S6W2LviP1EVXk6lrunwxM040avYzHoaAl6MEALw\_wcB&gclsrc=aw.ds

Note 5: Klimaneutrale Wärme aus Geothermie 2030 / 2050 - Mai 2021 - Bundesverband Geothermie e. V. I www.geothermie.de,

Note 6: https://heatroadmap.eu/wp-content/uploads/2018/09/HRE4-Country\_presentation-Germany-1.pdf

### EU and Germany prioritising rapid growth of renewable energy

sources



#### Geothermal energy



Geothermal roadmap<sup>3</sup>

- Installation of 70GWh of capacity, deep geothermal energy could cover more than a quarter of Germany's annual heat requirements
- Mobilisation of government assistance and the national economy, to enable the drilling of deep 2,000 geothermal wells by 2030, and at least 7,000 to 10,000 more by 2050
- Billion-Euro federal level funding to support the development

#### Climate targets

German coalition agreement<sup>1</sup> includes:

# Order to secure the goal of climate neutrality

Generate almost all the country's electricity from renewable sources by 2035
Generate 50% of heat in a climate-neutral way by 2030
All new cars sold to be electric by 2035

#### Lithium production for EVs



- New EU Battery Regulation
- Carbon Border Adjustment Mechanism
- Battery Passport
- ISO/TC 333 Lithium
- European Battery Alliance
- Critical Raw Materials List
- EIB new energy lending policy
- European Raw Materials Alliance



#### EU Commissioner Thierry Breton

It is therefore high time to act. It is time to enshrine in legislation which raw materials are critical or strategic for Europe. This list will be our compass and will provide a stable, agile and predictable legal framework in order - for example - to identify projects, facilitate investments, guide our international partnerships and direct the innovation agenda.

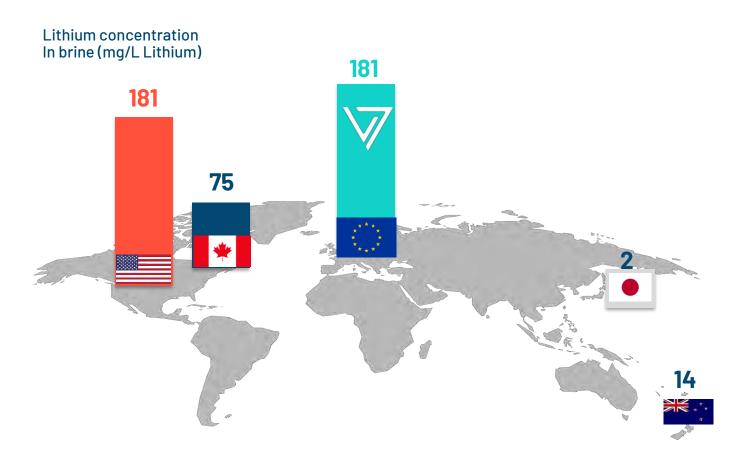
This includes mining in Europe.

Refer to Appendix 8: The new EU Battery Regulation



Strategically placed in the heart of the European EV market to decarbonise the supply chain

### We scoured the globe to find the right conditions for our Zero Carbon Lithium<sup>™</sup> development





We had the lithium and geothermal expertise to know that a Zero Carbon Lithium™ Project was possible using modern extraction methods, provided a geothermal brine reservoir could be found that had the following conditions:

- 1 Renewable heat
- 2 High lithium grades
- 3 High brine flow rate potential

Our initial research showed that this could be done in just two places:

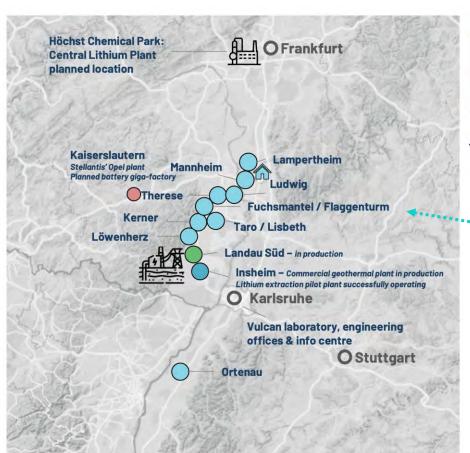
- The Upper Rhine Valley in Germany
- 2 The Salton Sea in California

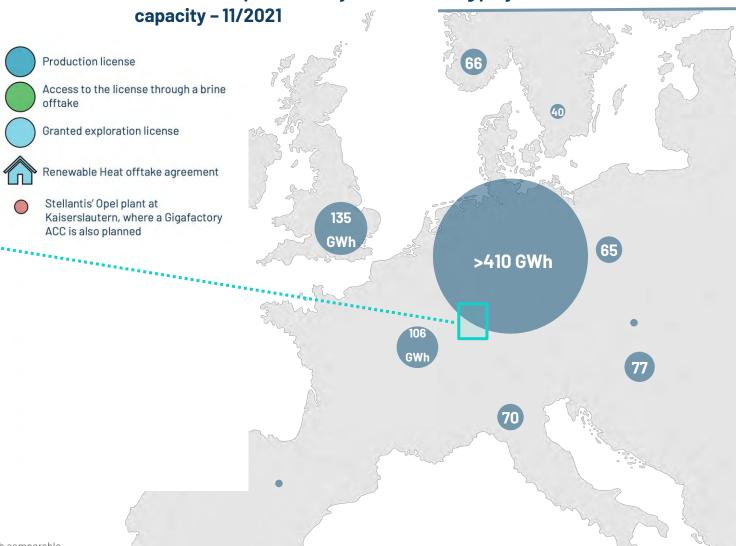
We chose Germany and Europe.

# Largest lithium resource at the centre of the fastest growing market in the world



Largest lithium resource in Europe: 15.85Mt LCE<sup>1</sup>





Planned European battery manufacturing projects in GWh

# Potential European expansion in Italy





Vulcan and Enel Green Power have signed a binding collaboration agreement

- Vulcan and Enel Green Power have signed a binding collaboration agreement to explore and develop its Cesano license in Italy on a 50:50 basis
- ▶ The Parties aim to enter a Joint Venture agreement on completion of a joint positive Scoping Study
- Both companies also agreed to evaluate the opportunity to cooperate on other geothermal lithium projects in Italy
- ► Enel Green Power is part of the Enel Group and the largest geothermal energy producer in Italy
- ► Enel Green Power has already previously explored and drilled a number of wells in the Cesano area and gathered relevant data direct from local reservoirs



Figure 1: Location of A) Vulcan's Zero Carbon Lithium Project in the Upper Rhine Valley Brine Field, Germany, in relation to B) the Cesano license in Italy.



# Zero Carbon Lithium™ Project

### Vulcan's renewable energy and lithium chemicals project





Lithium hydroxide distributed to the EU market





Central Lithium Plant



Lithium chloride transported to the central lithium plant



LITHIUM BUSINESS

Renewable electricity and/or heat sold to the grid



Renewable heat, electricity and brine transferred to the sorption plant









**ENERGY BUSINESS** 

Wells are drilled into the deep, hot, lithium-rich brine resource, which is pumped to the surface







Re-injection of brine. A closed loop, circular system

Reservoir

# Commercially available technologies combined and adapted to be fossil-free



Our process incorporates technologies with commercial analogues across the world.

What is unique about us is the proposed combination of these different steps, and our **strict exclusion of fossil fuels to power our process.** 

Binary cycle



2. Sorption plant



Central lithium plant



4. End product



**Hundreds** of geothermal energy plants running **globally** 

geothermal plant

**37** deep geothermal energy plants in operation in **Germany**\*

**Upper Rhine Valley** well-known area for geothermal operations

Team of **leading in-house experts** in developing and permitting geothermal plants

Natür<sup>3</sup>Lich Insheim **geothermal plant acquired** 





Sorption commercially **used for decades & Vulcan has unique expertise** 

Sorption technologies **commercially available** from several suppliers

Lithium recoveries averaging 94-95%

Ongoing **piloting on live brine**, operating 24/7 for the last 15 months

**Demo plant** planned for Q4 2022



Conversion of lithium chloride to lithium hydroxide using an **electrolysis process** 

Electrolysis has been used by the **chlor-alkali industry** in a similar process for more than 100 years

**Joint project** for the development, construction and operation of the CLP



Site selected near Frankfurt<sup>2</sup>



In-house team of experts

First **samples** of battery quality lithium hydroxide produced **Binding offtake contracts** signed<sup>1</sup>:

**VOLKSWAGEN** 

GROUP

STELLANTIS

**RENAULT GROUP** 



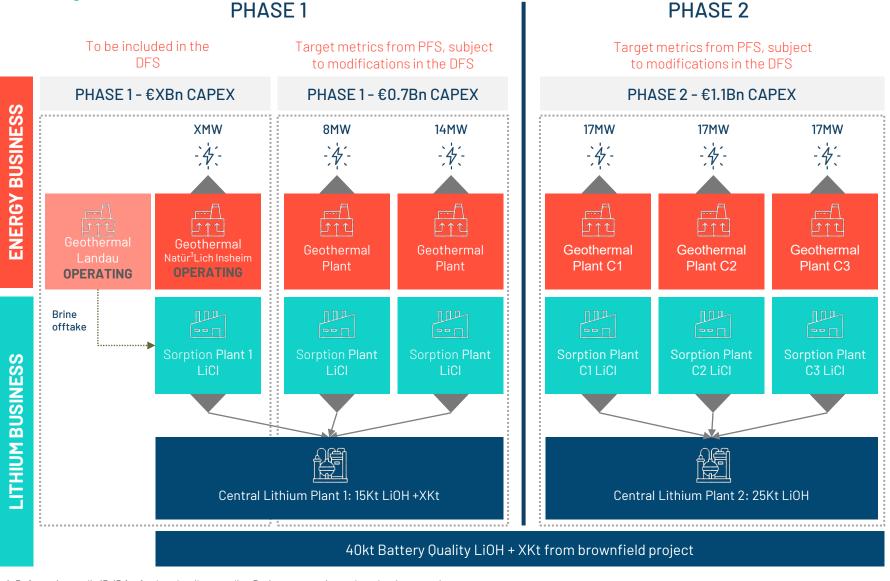




In-house team of experts

\*Source: Clean Energy Wire

# Our proposed expansion plan across the Upper Rhine Valley field





### ADDITIONAL LICENCES Available to add capacity

>1,000km² of licenses in the Upper Rhine Valley presenting opportunities to develop additional assets



# Taking advantage of and expanding from existing infrastructure

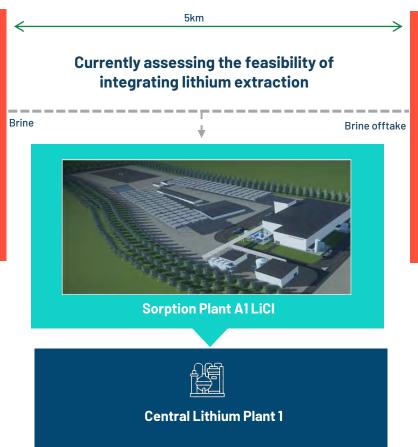


To be included in the DFS

#### PHASE 1 - €XBn CAPEX



- Vulcan acquired Natür<sup>3</sup>Lich Insheim in Dec 2021
- Current technical ability to produce up to 4.8MW power or 28.5MW thermal energy
- Aiming to upgrade capacity and increase brine flow rate
- Indicated Mineral Resource of 0.7Mt Lithium Carbonate Equivalent @181 mg/l Li
- Generated €1.7 million in revenue in March Ouarter 2022
- Feed-in Tariff in place





- Vulcan executed a 20-year brine offtake agreement with geox GmbH
- Expected additional brine volume to complement Vulcan's planned expanded developments at Insheim
- Existing production well at Landau has the tested ability to produce at a rate of over 100 l/s, but an additional re-injection well is planned to help accommodate this flow



# Geothermal division update

#### Sub-surface development





- Vulcan Energy Sub-Surface (VESS) team is continuing to gather data, including seismic and drilling data, to incorporate in a planned resource update in H2 2022
- Vulcan's current resource covers 3 of its 11 licenses, and it is aiming to incorporate more of its license areas into the updated resource for the Upper Rhine Valley Brine Field (URVBF) that forms the basis of its Zero Carbon Lithium™ Project

#### Above surface development





- Works at Vulcan's Sorption Demo Plant are continuing, led by the Vulcan Energy Engineering (VEE) team
- The VEE team is also working on the DFS for the surface piping and geothermal plant design
- Permitting works ongoing, with first preliminary EIA granted for development drilling, negating the need for a full EIA

#### Geothermal drilling



### VERCΛΝΛ

- Vulcan acquired two electric drill rigs in November 2021
- Specialised rigs can drill to the target depth required for deep geothermal energy wells in the Upper Rhine Valley, Germany
- Experienced in-house drilling established
- Refurbishment of the drill rigs is ongoing to ensure optimal safety and efficiency during operation
- The rigs will be operationready in early 2023

#### Renewable energy operations

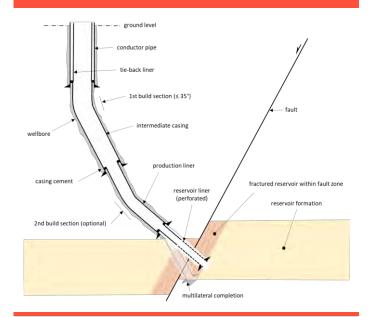


#### Natür Lich Insheim

- Vulcan acquired the Insheim geothermal power plant in January 2022
- Natür³Lich Insheim generated €1.7m in revenue in the March 2022 Quarter
- The plant currently has the technical ability to produce a maximum of 4.8MW renewable power, equivalent to the power usage of approximately 8,000 households, with an additional ability to produce heating

# Geothermal division update

#### Development drilling preparation



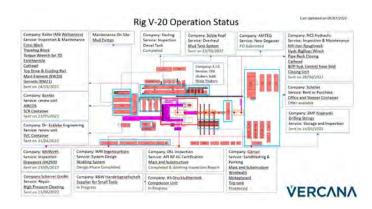
- First positive community decisions in Lionheart area (Landau and Offenbach)
- Political and community work ongoing in Taro and Ortenau areas
- Land acquisition for drilling and geothermal plant site started in Taro
- Pre-design ongoing for 3D-seismic in Kerner area
- First preliminary EIA granted for development drilling in Taro area

#### Geothermal plant design



- Pre-design of DLE and plant in Landau completed
- Joint development with municipality of Landau about land area
- Land acquisition activities started in Taro area
- 3D- seismic campaign in Mannheim being prepared

#### Drilling equipment



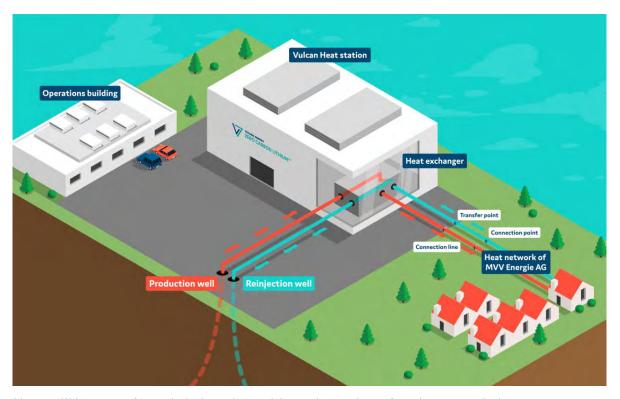
- Acquisition of two electric rigs in 2021
- Refurbishment of electric rigs ongoing
- Building up administration ongoing:
  - Odoo ERP implementation
  - SAM Training platform introduction
  - IT being merged into Vulcan system

# Vulcan to supply German energy company with renewable, zero carbon heat



First of a number of planned district heating arrangements from geothermal energy to help combat Germany's energy crisis.

- ▶ Vulcan and MVV Energie AG (MVV) have executed a binding purchase agreement for 240 gigawatt hours per year of renewable heat, a first for Germany
- ▶ 20-year, long-term agreement commences in 2025
- ► Includes the supply of a minimum of 240,000MWh per year to a maximum of 350,000MWh per year
- ► The heat will be supplied from Vulcan's planned geothermal wells in the area surrounding the City of Mannheim
- Vulcan is developing its Mannheim licence as part of a planned larger Phase 2 of the Zero Carbon Lithium™ Project



Heat will be transferred via heating grids and a series of underground pipes that deliver hot water or steam to buildings in the local community

# Lithium division update

#### Laboratory work



- Lab and pilot studies active since April 2021, generating data for DFS
- Expanded laboratory opened Feb 2022, extending the company's analytical capability and expertise
- Acquisition of new instruments including an ICP-OES and an IC, enhance the team's efficiency and reduces analysis waiting time

#### Pilot plant



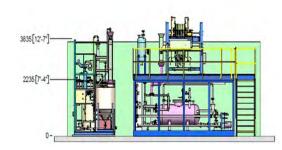
- Pilot Plant 1, located at an operational geothermal plant, with "live" geothermal brine
- Consistent lithium concentration and low level of impurities
- Lithium recovery rates are averaging 94-95%
- Multiple sorbents from commercial providers have been successfully tested, including from DuPont and others, providing optionality
- Scale-up of piloting continuing during 2021-22

#### Sorption-Demo plant



- Demo Plant fully integrated with all process steps including electrolysis
- Sorption at site with "live" geothermal brine
- All recycles to be included
- 80% of the equipment has been ordered and design-work has been finalised
- Start of commissioning expected late Q4 2022
- Approximately 1:200 scale of the first commercial plant
- Commercial scale-up factor of 1:50 in terms of column size

#### CLP-Demo plant



- Experts from Nobian, Vulcan and external engineering teams have been assembled to adapt Vulcan's CLP – Demo Plant design to Nobian's site at the Höchst Chemical Park
- The CLP-Demo Plant will represent an approximately 1:200 scale of the first commercial plant
- Commercial CLP electrolysis cells won't have a scale up factor (i.e., 1:1) but a multiplication factor, as electrolysis cells are not scaled up further but multiplied

# DLE offers "significant promise of increasing supply, reducing the industry's environmental, social, and governance (ESG) footprint, and lowering costs"

-McKinsey, April 2022



# Sorption-type DLE: a commercial technology adapted to our local resource



- Direct lithium extraction (DLE) using sorption has a fifty-year development and implementation history
- ▶ Sorption-type DLE practiced commercially in South America for 26 years by Livent. More recently sorption-type has been commercially deployed in China
- ► Large investment into DLE projects have recently been made in Argentina by Rio Tinto (Rincon project¹) and Eramet (Eramine project²)





#### **RioTinto**

Sorption-type DLE includes several key advantages compared to traditional brine evaporation:

- Higher lithium recovery
- Lower water and chemicals consumption
- Shorter lead time to production
- Minimal footprint

Sorption-type DLE associated with geothermal brine adds:

- No need to heat the brine with natural gas
- Potential for no carbon emissions
- Additional revenue stream from energy

For more information, see our DLE presentation here: <a href="https://bit.ly/3x0eWp2">https://bit.ly/3x0eWp2</a>

# Zero Carbon Lithium™ Project



### Securing long term lithium supply contracts



- Binding lithium hydroxide offtake agreement
- Initial 5-year term, starting in 2025, which can be extended by further 5 years
- Minimum of 28,000t and a maximum of 42,000t of battery grade lithium hydroxide

Lithium-ion batteries

**Electric vehicles** 

**LG** Energy Solution

- Binding lithium hydroxide offtake agreement
- Initial **5-year term**, starting in **2025**, which can be extended by further 5 years
- Minimum of 41,000t -50,000t of battery grade lithium hydroxide

#### RENAULT GROUP

- Binding lithium hydroxide offtake agreement
- Initial 6-year term, starting in 2025, which can be extended by further 5 years
- Minimum of 29,000t and a maximum of 49,000t of battery grade lithium hydroxide

#### STELLANTIS

- Binding lithium hydroxide offtake agreement
- 10-year term, starting in 2026
- Min. of 81,000t and a max. of 99,000t of battery grade lithium hydroxide for the first 5 years

#### VOLKSWAGEN

GROUP

- Binding lithium hydroxide offtake agreement
- Initial 5-year term, starting in 2026
- Between 34,000t and 42,000t of battery grade lithium hydroxide

# Strategic partnership with Stellantis

This represents the world's first upstream investment in a listed lithium company by a top tier automaker.

- Vulcan has agreed a A\$76M (€50M) equity investment from Stellantis
- Proceeds will go towards Vulcan's planned production expansion drilling
- ▶ Binding lithium hydroxide offtake agreement extended by five years, to 2035.
- ► Stellantis is now Vulcan's second largest shareholder with 8% shareholding
- Stellantis is one of the world's leading automakers and mobility providers
- ▶ Stellantis targeting 100% of passenger car battery electric vehicle sales mix in Europe by 2030





Stellantis also increased planned battery capacity by 140 GWh to approximately 400 GWh, to be supported by five battery manufacturing plants in Europe and North America, together with additional supply contracts.

### Dual revenues: energy and lithium



#### **ENERGY BUSINESS**



Grid #





Bans for fossil heating systems

**Industries** 



**Cities** 



#### Renewable Electricity:

Geothermal energy in the form of electricity is sold to the grid

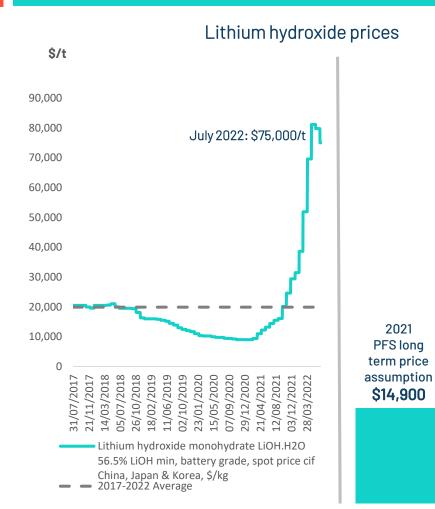
Feed-in Tariff: €0.252 /KWh Guaranteed for 20 years for new projects Renewable Heat: Energy in the form of heat can be sold to several public and private customers via pipes, proximity is a requirement

One heat offtake has been concluded and negotiations for additional offtakes with local stakeholders are under way



Vulcan Energy's 100% owned NatürLich Insheim, an operational geothermal renewable energy power plant in the Upper Rhine Valley, Germany.

#### **LITHIUM BUSINESS**



July 2022 Fastmarkets Contract price \$75,000

+400%

2022
Banks long
term price
assumptions\*
>\$20,000

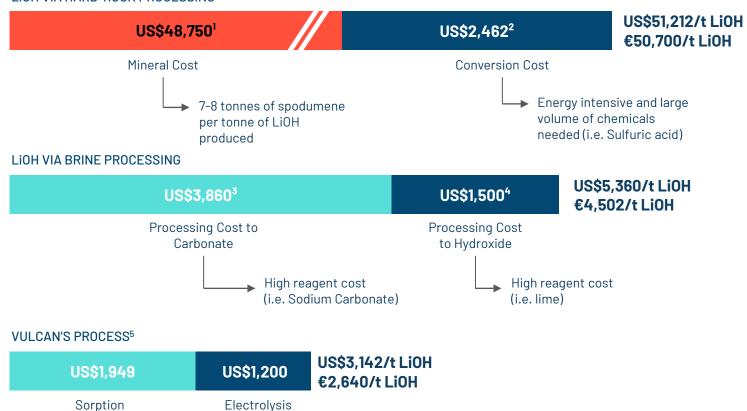
>+34%

Source: Fastmarkets

### Potential for very low OPEX operation

Select South American brine and Australian/Chinese mineral conversion vs Vulcan's process

#### LIOH VIA HARD-ROCK PROCESSING





#### **Feedstock**

Vulcan's "feedstock" is expected to be low cost and have a dual purpose: lithium extraction and energy production in the form of renewable electricity.

#### Processing

Vulcan plans to use sorption to isolate lithium as opposed to using large volumes of chemicals such as sulfuric acid to dissolve a rock feedstock or soda ash for brine. Vulcan intends to use low-cost energy coming from its geothermal operation.

#### Upgrading

Vulcan plans to use electrolysis to upgrade chloride into a high purity hydroxide using renewable energy. No heavy reagent usage such as sodium hydroxide or lime.



Note 1: Fastmarkets Spodumene min 6% Li20, spot price, cif China, \$/tonne 11 July 2022

Note 2: Kidman Resources PFS announcement, October 2018, contingency on Refinery OPEX of 15%. Cash operating cost including royalties.

Note 3: Cash operating costs lithium carbonate, Orocobre 2021 Annual report

Note 4: Orocobre 2020 Corporate Presentation - Naraha Lithium Hydroxide plant, Japan

Note 5: Refer to Appendix 13-15 for further details regarding Project economics and production capacity

Note 6: Figures in this slide assume an exchange rate of €0.84/US\$1.00

Note 7: Vulcan notes that the comparison operating cost figures above are actual results from lithium hydroxide projects that are currently in production, whereas the above data for Vulcan's process is based on estimates in the PFS. As the Project is still at an early exploration and development stage, there is a high level of inherent uncertainty associated with the Project. A comprehensive list of risks is flagged in the PFS under "Project Risks and Opportunities"

# Robust target project financials and production metrics from PFS



#### **ENERGY BUSINESS**



#### 74MW Power\*

\* Renewable heat sales to also be examined in DFS

#### **LITHIUM BUSINESS**



**40,000**tpy Li0H

€0.7Bn NPV Pre-tax

€0.5Bn NPV Post-tax

€2.8Bn NPV Pre-tax

€1.9Bn NPV Post-tax

16% IRR Pre-tax

13% IRR Post-tax

31% IRR Pre-tax

26% IRR Post-tax

€226M CAPEX Phase I

**€0.066/**KWh OPEX

**€2,681/t** LiOH OPEX

€474M CAPEX Phase I

Payback: 6 years

Payback: 4 years

Numbers are based on the PFS published in 2021 and are subject to change



**BNP PARIBAS** appointed as Financial Advisor toward financing the Zero Carbon Lithium™ Project

# Working hard to de-risk the project further and address all identified risks



#### Risk

#### Availability of key equipment

Drill rigs that can reach the deep geothermal reservoirs are in short supply in Germany. With Germany phasing out fossil fuels, rigs will likely be in short supply as there is a sharp increase in geothermal project development for heating.

#### Mitigation

Vulcan has agreed to acquire two electric drill rigs, re-purposed from the oil and gas industry, which can reach the target depths required to reach the deep geothermal reservoir in the Upper Rhine Valley. Vulcan is developing its own in-house drilling unit, VERCANA, which will provide approximately 30 jobs locally. This will be a strategic asset, as decarbonisation efforts in Germany and Europe continue to accelerate, and demand for renewable heat increases.

#### **Brine flow rates**

The amount of renewable energy and lithium that can be extracted will depend on the brine flow rate achieved at each site. The flow rate from each well will be verified once the well has been drilled.

Vulcan uses modern geothermal industry best practice by incorporating 3D seismic data and analysis into its geological modelling to target high-flow fault zones, and factors in state-of-theart techniques to increase flow, such as double completion of wells and multi-reservoir completion, using the experience of its technical team.

#### Resources/ Reserves

Lithium resources and reserves indicated must be considered as estimates only until such reserves are actually extracted and processed. Vulcan's resources are based on limited data points because the reservoir is deep.

Vulcan utilises the considerable local geological expertise of its team, as well as state-of-the-art 3D seismic data, to construct the most accurate models it can. Vulcan reports on its estimates of Mineral Resources and Ore Reserves in compliance with the JORC Code, the ASX Listing Rules and applicable regulation. Vulcan's resource estimates and reserves are signed off by independent external consultants APEX Geoscience Ltd. and GLJ Ltd. respectively.

#### Sorption

Lithium extraction from brine using sorption is used commercially, but each brine chemistry is different, and risks remain when adapting to each brine.

We are testing multiple alumina-based sorbents at our pilot plant to find the best fit. Similar approaches are used at multiple locations around the world with existing lithium production. This and other types of similar DLE techniques are being used in numerous new lithium developments worldwide. We are adapting this technology to fit with our geothermal brine, in collaboration with companies such as Dupont, and with the experience of our team. Critically, we are testing on "live" geothermal brine, which so far has produced encouraging results.

#### Permitting

The project may be affected by delays in receiving the necessary approvals from all relevant authorities and parties.

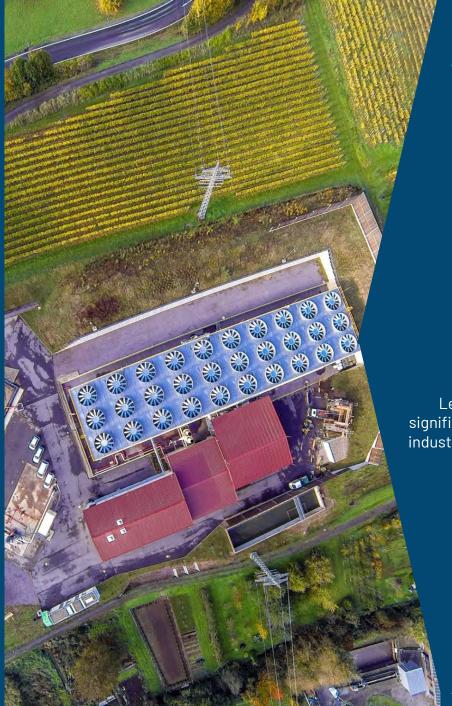
We will continue to keep our stakeholders updated on the timetable, and if anything changes, we will inform the market. We have a team of experts in geothermal development who have developed numerous projects in the past. We have received encouragement from state and federal governments that renewable energy project permitting times will be reduced as a priority, and domestic production of strategic raw materials will also be prioritised.

## Social acceptance

As with virtually any sort of new development especially for infrastructure projects, we expect some opposition - as has and has been seen with wind and solar in Germany.

This is normal and we will work to address these concerns. Vulcan has an experienced public relations team. We use geothermal industry best practice, and we are commencing community engagement in the various areas where we intend to develop projects. We think that by clearly and transparently explaining our process to develop renewable heat and power, combined with sustainable lithium extraction, we will achieve stakeholder acceptance.





# Sustainability Highlights



Employ ~130 people up from 70 in 2021



Carbon neutral certified (Australia)



35% female employment Gender balanced board



Leveraging the skillsets of significant numbers of ex-Oil & Gas industry experts employed towards decarbonisation



~20ktCO<sub>2</sub> annual avoidance renewable electricity<sup>1</sup> from existing operations & ~3.6MtCO<sub>2</sub> to be avoided for LiOH material allocated to current offtakers<sup>2</sup>



Renewable Heat offtake agreement signed with MVV to supply 25,000 – 35,000 households from 2025



ESG linked KPI's for Executive Team



UN Global Compact Member since 2022



Budget allocated for biodiversity project support

<sup>1</sup>Comparative to coal fueled electricity, based on Natür<sup>3</sup>Lich Insheim annual production of ~20,000MWh <sup>2</sup>Minviro Report – comparison to LiOH battery grade currently from China estimated at 15tCO<sub>2</sub> p/ton processed

## Sustainability framework

The **Vulcan Compass** guides our sustainable decision making - binding our purpose, mission, strategy and values together.

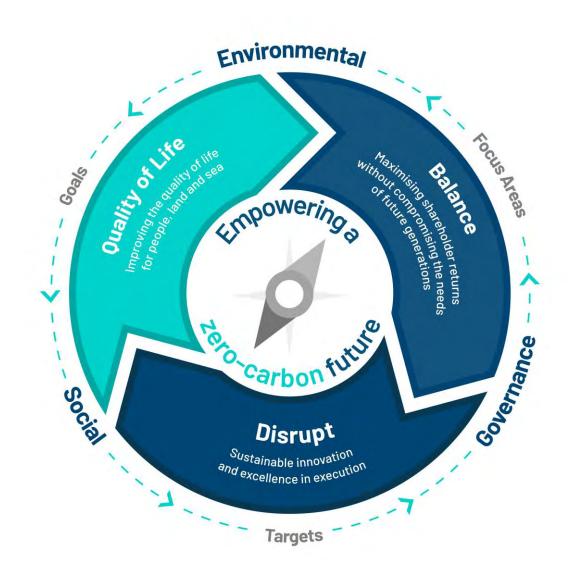
The **Vulcan Compass** incorporates our 3 sustainability themes:

**Quality of Life -** improving the quality of life for people, land and sea

**Balance -** maximising shareholder returns without compromising the needs of future generations

**Positive disruption -** sustainable innovation and excellence in execution

The **Vulcan Compass** is underpinned by 29 key ESG initiatives, summarised on the next page.

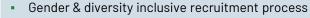


### **Key ESG Initiatives**



- Certified carbon neutral organisation across the Vulcan Group
- Ensure 100% renewable energy is used to power operations
- Increase renewable energy use by 50% for all office buildings
- Set GHG reductions target to SBTi's
- Update LCA with live data at both DFS and production
- Successfully implement Circulor CO<sub>2</sub> traceability at production for lithium product
- Peer benchmarking
- Climate risk analysis linked to TCFD and TNFD frameworks





- External validation of gender pay parity
- Constantly improving employee satisfaction rating
- Mental wellbeing training for executive team
- Fully integrated internal training and development program



- Positive climate impact on surrounding environment at all Vulcan operational sites
- Partner with local biodiversity projects















- Supply renewable heating to MVV
- Extend geothermal capacity with additional plants
- Certification to ISO 14001:2015 & 9001



- Water stewardship assessment pre-production
- Waste management assessment

- Carbon credit verification for DLE
- Support university research & development programs
- Robust sustainable procurement system
- Undertake supply chain risk analysis including environmental and modern slavery audit
- Local info centres near exploration licenses to increase local support
- Increased educational programs for the benefits of geothermal heat and energy
- Support 'girls in science' school scholarship
- Targeting zero environmental negative impacts
- Targeting zero health and safety incidents

# Materially improving the global battery chemicals supply chain





**INNOVATION** 

R&D Fuelling

Zero Carbon

Energising the Green Future of Extraction





Process development and R&D development of world's first lithium and renewable energy coproduction process in Pre-Feasibility Study: Zero Carbon Lithium™.

Life cycle assessment shows leading environmental credentials including negative carbon footprint (Scope 1, 2, 3) for planned lithium production, a world first.

Working with Circulor to achieve world's first lithium traceability and dynamic  $\mathrm{CO}_2$  measurement across supply chain.

Admission to Global Battery
Alliance toward advancing battery
materials traceability and
transparency.

CARBON NEUTRAL NOW, AND IN THE FUTURE.

Refer to Appendix 18: Vulcan & Circulor to establish world-first full lithium traceability & transparency across the EU supply chain



#### Transport Distances for Different Lithium Chemicals

Transport Distances for Different Lithium Chemicals



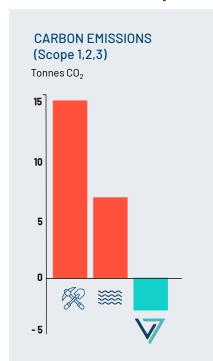


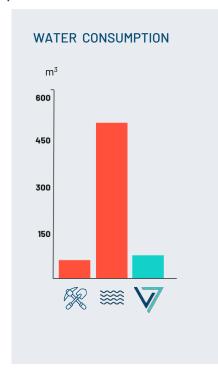
As well as having a carbon neutral process, the Vulcan Zero Carbon Lithium™ Project also intends to reduce the transport distance of lithium chemicals into Europe

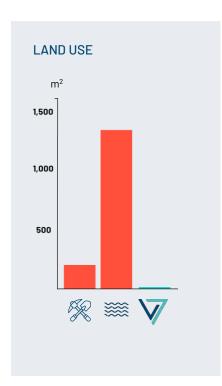
### Leading environmental credentials

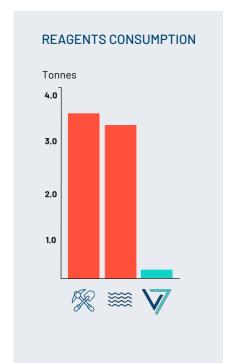


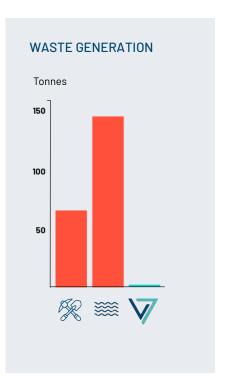
#### Per tonne of lithium hydroxide produced

















### Four pillars of community engagement



#### Public affairs



- Discuss and exchange ideas regularly with political representatives
- Recent meetings with CDU and the Greens
- Presentations for members of the state parliaments
- Introduction of Vulcan and questions and answers in the municipal councils

#### Media engagement



- Raise awareness through in-depth reporting
- Interviews with national and international magazines, tv stations, radio broadcasts
- Background-stories in the Laboratory/ Pilot Plant

#### Community outreach



- Community roadshows, school presentations, discussion forums
- 'Show truck', targeting local events and markets
- Info-Community Hotline
- Website with milestones and updates
- Sponsoring of environmental events

#### Partnerships/ cooperation



- Conduct research projects with universities and colleges, as well as renowned research institutions
- Cooperate with renewable energy networks/ battery and raw material alliances
- Engagement in regional technology networks



# Informing the community

# V

## Building trust and understanding

- Hosted eight roadshow events in the South Palatine Region, Germany with information stalls in six municipalities
- Hosted three roadshow events in the Ortenau Region, Germany with information stalls in city of Bühl
- Two information events with around 130 citizens highly appreciated by participants
- Maimarkt consumer fair in Mannheim, reached over 3,000 community members over ten days



#### **Board of Directors**





Dr. Francis Wedin
Managing Director &
Founder-CEO

Founder of Vulcan Zero Carbon Lithium™ Project. Lithium industry executive since 2014. Previously Executive Director of ASX-listed Exore Resources Ltd. Track record of success in lithium industry as an executive since 2014, including the discovery of three resources on two continents. PhD in Geology, MBA in Renewable Energy, global experience in battery metals sector.



Annie Liu
Non-Executive Director

Former Tesla Head of Battery and Energy Supply Chain. Led and managed Tesla's multi-billion-dollar strategic partnerships and sourcing portfolios that support Tesla's Energy and Battery business units including Battery, Battery Raw Material, Energy Storage, Solar and Solar Glass, including raw materials sourcing efforts such as lithium for battery cells. 20 years' experience with Tesla and Microsoft.



**Dr Günter Hilken Non-Executive Director** 

Dr Hilken has over 35 years' experience in and a deep understanding of the German chemicals, renewables and infrastructure investment sectors and, through leading industry advocacy associations, the German Government at the State and Federal level. Dr Hilken is a Senior Advisor to Macquarie Asset Management, Director of Currenta and President and Chairman of the Board of the German Federation of Industrial Energy Consumers (VIK).



**Gavin Rezos Chair** 

Executive Chair/CEO positions of three companies that grew from start-ups to the ASX 300. Extensive international investment banking experience. Investment banking Director of HSBC with senior multiregional roles in investment banking, legal and compliance functions. Currently Chair of Resource and Energy Group, principal of Viaticus Capital, Non-Executive Director of Kuniko Limited and Non-Executive Chair Resources & Energy Group Limited.



Dr. Heidi Grön Non-Executive Director

Dr. Grön is a chemical engineer by background with 20 years' experience in the chemicals industry. Since 2007, Dr. Grön has been a senior executive with Evonik, one of the largest specialty chemicals companies in the world, with a market capitalization of €14B and 32,000 employees.



Mark Skelton
Non-Executive Director

Mr Skelton has more than 35 years' experience including a 29-year tenure at BP and then at Fortescue Metals Group (Fortescue) as Project Director, and Director of Projects. A senior leader and advisor with a proven record in delivering major projects, business transformation and developing organisational capability within the mining, energy and oil and gas industries, Mr Skelton has extensive project experience in Australia and internationally.



Ranya Alkadamani Non-Executive Director

Founder of Impact Group International. A communications strategist, focused on amplifying the work of companies that have a positive social or environmental impact. Experience in working across media markets and for high profile people, including one of Australia's leading philanthropists, Andrew Forrest and Australia's former Foreign Minister and former Prime Minister, Kevin Rudd.



Josephine Bush
Non-Executive Director

Member of the EY Power and Utilities Board. Led and delivered the EY Global Renewables and Sustainable Business Plan and spearheaded a series of major Renewable Market Transactions. Successfully advised on the first environmental yieldco London Stock Exchange listing, Greencoat UK Wind PLC. Ms. Bush is a Chartered Tax Advisor, holds an MA Law degree from St Catharine's College, Cambridge, and brings a wealth of experience in ESG strategic advisory.



**Dr. Horst Kreuter Executive Director Germany** 

Ex-CEO of Geothermal Group Germany GmbH and GeoThermal Engineering GmbH (GeoT). Co- Founder of Vulcan Zero Carbon Lithium™ Project. Successful geothermal project development & permitting in Germany and worldwide. Widespread political, investor and industry network in Germany and Europe. Based in Karlsruhe, local to the project area in the Upper Rhine Valley.

## Leadership team



**Dr. Francis Wedin**Managing Director &
Founder-CEO



**Dr. Horst Kreuter**Executive Director
Germany



**Thorsten Weimann**Chief Operating Officer



Vincent Ledoux-Pedailles
Chief Commercial Officer



**Dr Stephen Harrison**Chief Technical Officer



Rob lerace Chief Financial Officer (Australia)



Markus Ritzauer Chief Financial Officer (Germany)



Daniel Tydde CoSec & In-House Legal Counsel (



**Dr Meinhard Grodde** In-House Legal Counsel (Germany)



**Beate Holzwarth**Chief Communication
Officer (Germany)



Jessica Bukowski
Public & Investor Relations
Manager (Australia)



#### Renewable Energy Business



Markus Ruff CEO Vulcan Energy Engineering



**Tobias Hochschild**CEO
Vulcan Energy Subsurface Solutions

#### **Lithium Chemicals Business**



**Dr Thomas Aicher** Lead Chemical Engineer



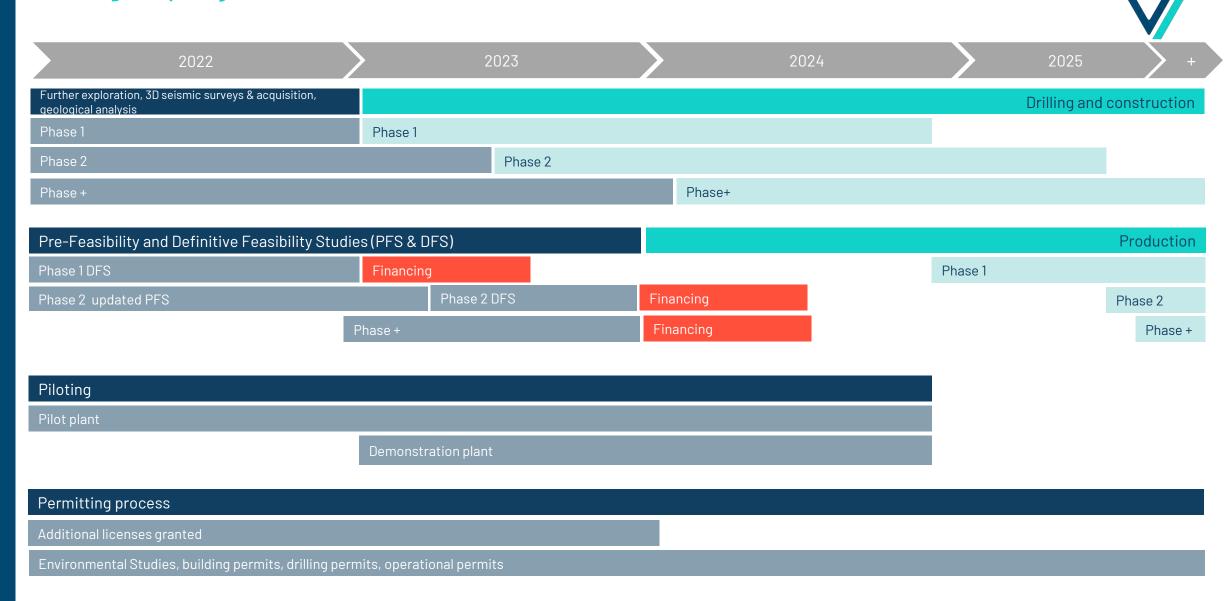
**Dr Angela Digennaro**Lab Manager



Benoit Girard Pilot Plant Manager

# Zero Carbon Lithium<sup>TM</sup> Project

# Target project timeline

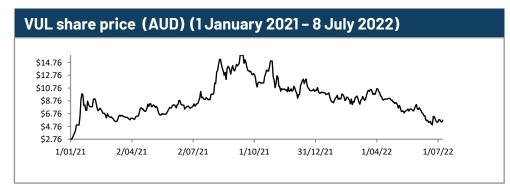


## Share price and capital structure

ASX: VUL	
Shares on Issue	143,335,301
Performance Shares*	91,174
Performance Rights	8,473,427
Market Capitalisation at \$5.39 (undiluted)	~\$773M
Cash Position (as at 30 June 2022 - unaudited)	€176M
Top 20 Stakeholders	~59.10%
Management (undiluted)	~17%

#### Frankfurt: VUL

Key Shareholders	
Dr. Francis Wedin	11.48%
Stellantis Group	8.00%
Gavin Rezos	5.30%
Hancock Prospecting Pty Ltd	5.64%







## Conclusion



Commercial geothermal energy plant in operation



Site for Central Lithium Plant secured. Pilot plant in operation



LCA results with negative CO<sub>2</sub> emission intensity



In-house drilling for mass geothermal deployment



AUD\$400 million capital raised to date including from major corporates



Vulcan in-house team now >130 personnel and growing



Europe's largest lithium Resource, potential for stepwise production growth



Five binding lithium offtake agreements & one heat offtake



Dual listed on the regulated market (Prime Standard) of the FSE & ASX



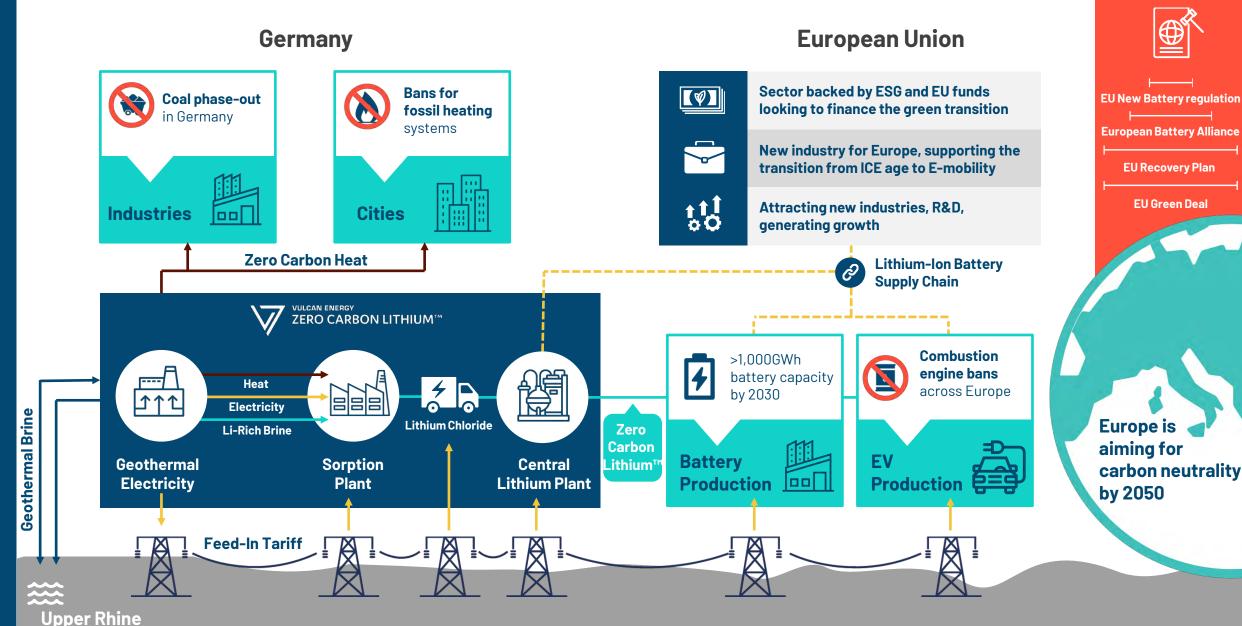
# Carbon I ithium<sup>TM</sup> Proie

# Appendices



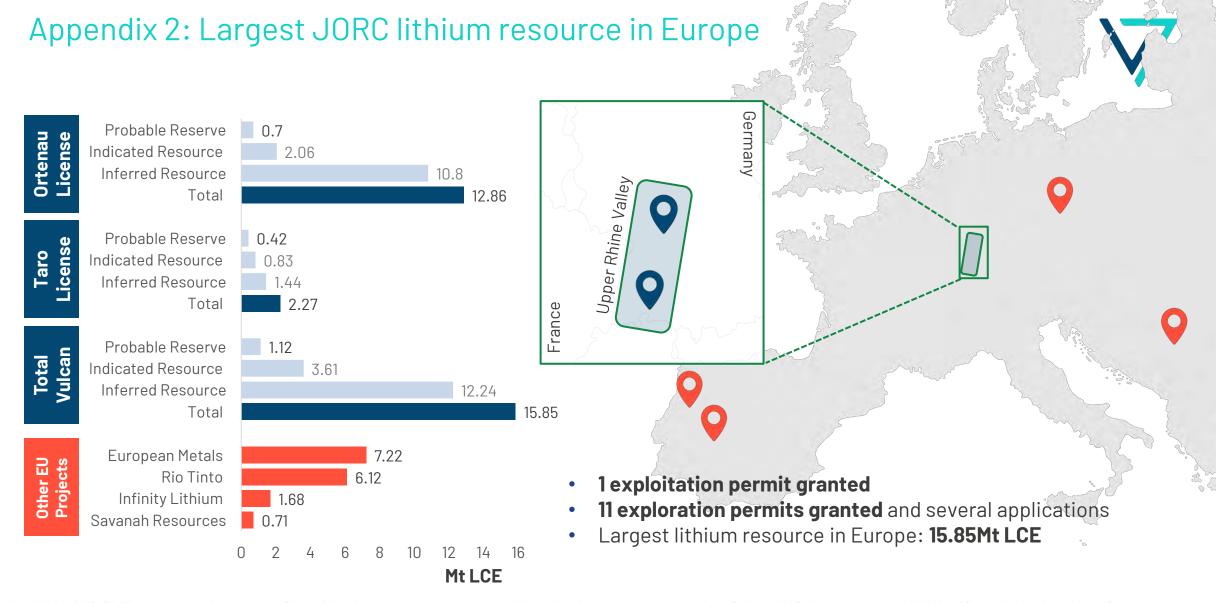
Valley Reservoir

#### Appendix 1: Vulcan's integrated renewable energy and lithium project description



Regulations &

**Initiatives** 



Note 1: Vulcan's URVP Li-Brine resource and reserve area in Europe. Mineral resources are not ore reserves and do not have demonstrated economic viability. Refer to the ASX Announcement entitled "Updated Ortenau Indicated and Inferred Resource" dated 15 December 2020 and the ASX Announcement entitled "Positive Pre-Feasibility Study" dated 15 January 2021, which refer to the Company's Mineral Resources and Ore Reserves (respectively) included in this Presentation, available on the Company's website and <a href="https://www.asx.com">www.asx.com</a>. The Company confirms that it is not aware of any new information or data that materially affects the information including in the original market announcements and that all material assumptions and technical parameters underpinning the estimates in the relevant market announcements continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented in this Presentation have not been materially modified from the original market announcements

# Appendix 3: Europe-focused and DLE lithium projects peer comparison references



Company <sup>1</sup>	Code	Project	Stage	Resource Category	Resources M tonnes	Resource Grade (Li20)	Contained Mt LCE Tonnes	Information Source
European Metals	ASX: EMH	Cinovec	PFS Complete	Indicated & Inferred	695.9	0.42	7.22	Corporate Presentation July 2021 – Company Website
Rio Tinto	ASX: RIO	Jadar	PFS Complete	Indicated & Inferred	139.3	1.78	6.12	ASX Announcement Released 10 December 2020
Infinity Lithium	ASX: INF	San Jose	PFS Complete	Indicated & Inferred	111.3	0.61	1.68	Company Presentation Released to ASX 16 February 2021
Savannah Resources	AIM: SAV	Barroso	DFS Underway	Measured, Indicated & Inferred	27.0	1.00	0.71	Corporate Presentation September 2021 – Company Website

Company	Project	Stage	Resource Category	Brine Volume	Resource Grade	Contained Mt LCE Tonnes	Information Source
Controlled Thermal Resources	Hell's Kitchen	PEA Completed	Inferred	Unknown	181mg/I Li	2.7	Company Website
E3 Metals	Clearwater, Rocky and Exshaw	PEA Completed	Inferred	5.5 billion m <sup>3</sup>	74.6mg/l Li	2.2	PEA released in December 2020

Elders, W., Cohen, L., (1983) The Salton Sea Geothermal Field, California, Technical Report. Institute of Geophysics and Planetary Physics, University of California
GeORG (2013) Projektteam Geopotenziale des tieferen Untergrundes im Oberrheingraben Fachlich-Technischer Abschlussbericht des INTERREG-Projekts GeORG. Teil 2: Geologische Ergebnisse und Nutzungsmöglichkeiten
Pauwels, H., Fouillac, C., Brach M. (1989) Secondary production from geothermal fluids processes for Lithium recovery 2nd progress report. Bureau de Recherches Geologiques et Minieres Service Geologique National
Pauwels, H. and Fouillac, C. (1993) Chemistry and isotopes of deep geothermal saline fluids in the Upper Rhine Graben: Origin of compounds and water-rock interactions. Geochimica et Cosmochimica Acro Vol. 51, pp. 2737-2749
Sanjuan, B., Millot, R., Innocent, C., Dezayes, C., Scheiber, J., Brach, M., (2016) Major geochemical characteristics of geothermal brines from the Upper Rhine Graben granitic basement with constraints on temperature and circulation. Chemical Geology 428
(2016) 27-47

# Appendix 4: Vulcan will supply leading actors across the lithium-ion battery supply chain

. . . . . . . . .







**Sumitomo Corporation** 







#### **Lithium-ion batteries**





#### CATL



**SAMSUNG SDI** 







#### **Electric vehicles**

















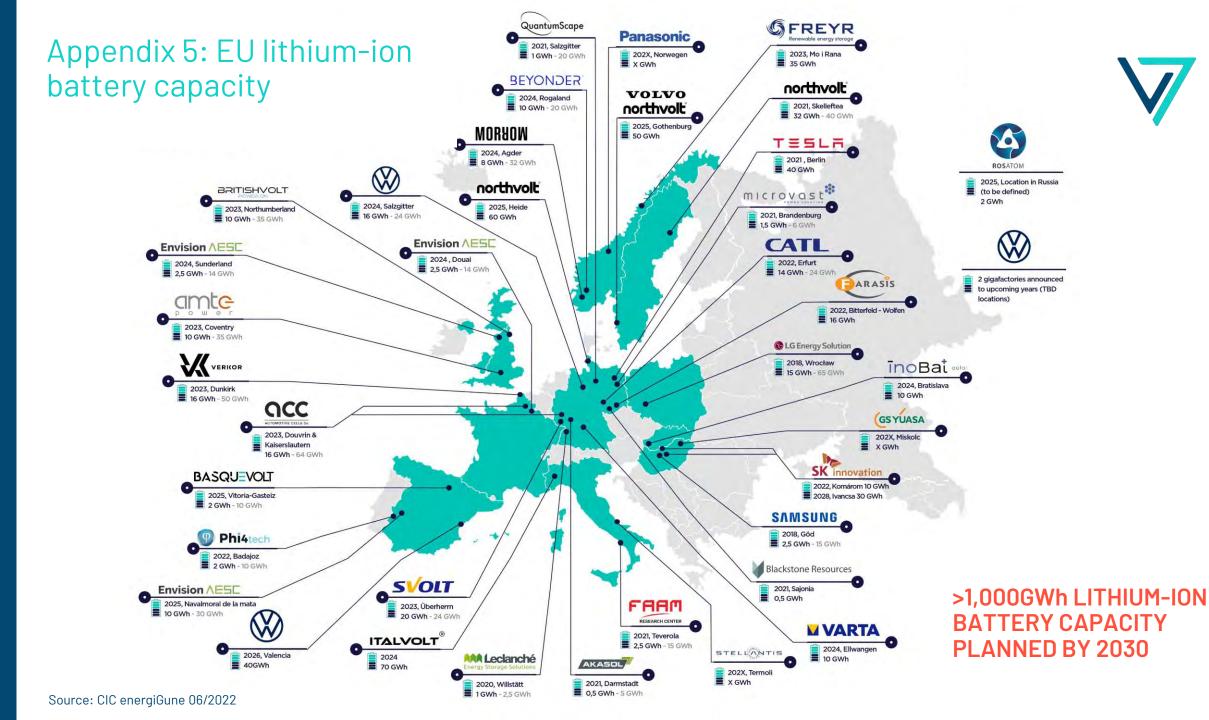












# Appendix 6: Global DLE assets and projects

Company	Livent	Lanke Lithium	Zangge Lithium	Jintai Lithium	Eramet/ Tsingshan	Standard Lithium	Vulcan Energy	Rio Tinto	CTR	Energy Source Minerals	Berkshire Hathaway	Lake Resources/ Lilac	Compass Minerals	E3 Metals
Asset name	Hombre Muerto	Qinghai	Qinghai	Qinghai	Centenario- Ratones	Smackover	Zero Carbon Lithium™	Rincon	Hell's Kitchen	ATLiS	Salton Sea	Kachi	Great Salt Lake	Clearwater Lithium
Country		*:	*;	*:										*
DLE technology	Sorption	Sorption	Sorption	Sorption	Sorption	IX	Sorption	Sorption	IX	Sorption	IX	IX	IX	lon Exchange
DLE provider	Proprietary	Undisclosed	Undisclosed	Undisclosed	, ,	Proprietary LiSTR	Undisclosed	Axion	Lilac	Proprietary ILiAD	Proprietary	Lilac	Undisclosed	Proprietary
Stage	Production	Production	Production	Production	Constructio n	Demo	Pilot	Pilot	Offsite pilot	Pilot	Pilot	Offsite pilot	Pilot	Pilot
Resource (Mt LCE)	Undisclosed	Undisclosed	Undisclosed	Undisclosed	10	3	16	12	3	Undisclosed	Undisclosed	4	2	7
Geothermal	×	×	×	×	×	×	<b>~</b>	×	<b>~</b>	<b>/</b>	<b>/</b>	×	×	X
Start date	1998	2017	2018	2019	2024	tbc	2024	2025	2024	2024	tbc	2024	tbc	2025
Capacity (ktpa LCE)	20	20	20	7	24	21	40	50	20	20	90	25	20-25	20
Ownership	Public	-	_	_	Public	Public	Public	Public	Private	Private	Public	Public	Public	Public
Significant Investments					Tsingshan \$375M 11/2021	Koch \$100M 11/2021	Institutional Investors \$320M 2021 Stellantis A\$76m	Rio Tinto \$825M 12/2021	GM \$?M 07/2021			Lilac Up to \$50M 09/2021		
Offtakes (announced publicly)	TESLA  Sare rounded to 0	<b>X</b>	×	×	×	×	STELLIANTIS  GROUPE RENAULT  Umicore	×	<u>gm</u>	×	×	×	×	×

Resources/Lilac

## Appendix 7: DLE Projects and Assets - References



Livent https://s22.g4cdn.com/453302215/files/doc\_presentations/2021/11/Livent-Investor-Presentation\_for-website.pdf

https://www.linkedin.com/pulse/from-catamarca-ginghai-commercial-scale-direct-lithium-alex-grant/

Lanke Lithium http://www.asianmetal.com/news/1665421/Lanke-lithium-plans-to-launch-commercial-production-of-battery-grade-lithium-

carbonate

Zangge Lithium https://www.linkedin.com/pulse/from-catamarca-qinghai-commercial-scale-direct-lithium-alex-grant/

Jintai Lithium https://www.linkedin.com/pulse/from-catamarca-qinghai-commercial-scale-direct-lithium-alex-grant/

Eramet/Tsingshan https://www.eramet.com/sites/default/files/2021-11/IR%20presentation\_Lithium\_VF.pdf

Standard Lithium https://www.standardlithium.com/projects/arkansas-smackover

Vulcan Energy https://v-er.eu/wp-content/uploads/2021/12/2021-AGM-MD-presentation.pdf

Rio Tinto https://www.rinconmining.com/wp-content/uploads/2021/10/Rincon-FINAL-E-210921-FINAL.pdf

CTR's NI 43 101 inferred mineral resource estimate contains ~2.7 million

Berkshire Hathaway https://www.ft.com/content/c9760a4e-1a76-11e9-9e64-d150b3105d21

https://lakeresources.com.au/wp-content/uploads/2021/11/lke\_noosa-presentation\_12-nov-21.pdf

http://lilacsolutions.com/2021/09/lake-resources-partners-with-lilac-solutions-for-technology-and-funding-to-develop-the-kachi-

lithium-brine-project-in-argentina/

Compass Minerals https://investors.compassminerals.com/investors-relations/investor-news/press-release-details/2021/Compass-Minerals-Identifies-

Approximately-2.4-Million-Metric-Ton-Sustainable-Lithium-Resource/default.aspx

E3 Metals https://www.e3metalscorp.com/\_resources/presentations/corporate-presentation.pdf?v=0.084

### Appendix 8: Vulcan supported by EU-backed group

EIT InnoEnergy will marshal its ecosystem and significant EUwide resources to launch the Zero Carbon Lithium Project forward:

- Securing project funding, including the use of applicable EU,
   national or regional grant schemes, and liaising with EU project finance and development banks.
- Driving relationships with European lithium offtakers, aimed at entering into of binding offtake agreements.
- Obtaining and fast-tracking necessary licenses.
- All services are entirely success-based, with no upfront cost to Vulcan.



# Appendix 9: Lithium market dynamics favour sustainable lithium production



#### **Technology & Costs**



#### Sustainability



#### **Market Balance**



**Prices** 

# FitchSolutions

We expect DLE technology to dominate the future lithium mining sector. Fitch posits geothermal lithium extraction techniques to rise in popularity among Western consumers<sup>a</sup>



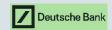
'We could have a European producer[Vulcan] producing at **one of the lowest costs globally**. These are the kind of initiatives we expect Europe to take in order to compete on raw material globally<sup>2</sup>



'DLE could offer many benefits including faster speed to market, as well as lower material costs and water usage. In Germany, Vulcan is pursuing this capability in the Upper Rhine Valley, Europe's largest lithium resource'<sup>3</sup>



"Geothermal lithium extraction has a much lower carbon footprint than both hard rock and brine extraction methods, as well as reduced water usage" 1



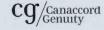
"The more sustainable lithium producers will become the suppliers of choice and be seen as less risky by customers and lenders. Country specific sustainability regulation is increasing and will likely lead to restrictions and higher production costs for producers that are less environmentally friendly" 3



"The drive for greener cars must be matched by cleaner lithium"<sup>5</sup>



"Incorporating the stronger demand outlook combined with limitations on the supply response due to rising product quality requirements is expected to see the lithium market shift from a small surplus in 2021 to a **deficit in 2022 and remain in tight** for 2023-2025, deficits widening each year"6



"Beyond 2025, we continue to forecast **significant** market deficits, noting a ~7x increase is required to meet our 2030 demand forecast"

"We continue to expect significant demand growth for LiOH as high-performance ternary cathodes move to market dominance in the EV battery sector. We estimate demand to increase by >850% by 2030 (from 2021) to 1.1Mt LiOH" g



"Lithium prices are likely to be impacted by **green premiums** due to heightened **priority of sustainable lithium** extraction techniques"



"Long term Lithium Hydroxide Prices are expected to be around \$16,000 per tonne"



"Our long-term assumptions for Li2CO3/Li0H remain at ~US\$15,000/t"9

## Appendix 10: The new EU Battery Regulation

New measures announced in December 2020 including:



**1. Responsible sourcing :** New mandatory procedures to ensure sustainable and ethical sourcing of raw materials such as lithium.



**2.** CO<sub>2</sub> footprint: All batteries sold in Europe must declare their carbon footprint. This will come in 3-step approach: 1/ Declaration (2024), 2/ Classification (2026), 3/ Threshold (2027). Batteries with the highest carbon footprint will be banned in Europe.



**3. Traceability:** All raw materials used in batteries to be procured according to OECD recognized guidelines for sustainable sourcing. Thanks to blockchain technology, each battery will have a digital passport tracking all components upstream.



**Maroš Šefčovič – European Commission VP :** "The new EU battery CO2 regulation will have an immediate impact on the market, which up until now has been driven only by price".

**Thierry Breton - EU commissioner:** "We are 100% dependent on lithium imports. The EU, if finding the right environmental approach, will be self-sufficient in a few years, using its resources".

# Other EU measures and initiatives supporting lithium:



EU list of Critical
Raw Materials & European Raw
Materials Alliance





## Appendix 11: Geothermal brine composition comparison

		Upper Rhine Valley Brine	Salton Sea Brine	URV vs SS
Salts (Cations)	Analyt e	Mg/kg <b>Value</b>	Mg/kg <b>Value</b>	%
Lithium: Source of revenue	Li	214	213	+1%
	Na	22,231	59,600	-63%
	К	4,878	18,126	-73%
	Rb	30.0	-	
	Cs	16.0	- 8	
	Mg	99	54	+83%
	Ca	5,195	31,714	-84%
	Sr	276	475	-42%
	Ва	14.4	139	-90%
Anions				
	CI	60,567	145,000	-58%
	504	172	127	+35%
	F	4.7	24	-81%
	Br	288		
Metals (Cations)				
Requires additional purification step if high	В	47	401	-88%
	Be	0.0207	0.2	-91%
Can negatively affect DLE if high	Si	67.2	550	-88%
Can negatively affect DLE if high	As	20.3	8.8	+131%
Can negatively affect DLE if high	Mn	24.5	1,563	-98%
Can negatively affect DLE if high	Fe	37.4	664	-94%
Can negatively affect DLE if high	Zn	5.2	492	-99%
	Pb	0.156	108	-100%
Can negatively affect DLE if high	Al	0.014	16	-100%
	Ni	0.188	0.5	-61%
Can negatively affect DLE if high	Co	0.015	8	-100%
	Sb	0.717	6.5	-89%
	Ti	<0.1		
	V	0.165	0.6	-71%
	Cr	0.181	2	-89%
	Cd	0.0205	3	-99%
	Mo	0.0124	8	-100%
	TI	0.328	2	-86%
pH		5.828	4.9	





Note: Refer to ASX announcement of 10 March 2021 "High grade lithium, low impurity results from Vulcan's 2021 Upper Rhine Valley bulk brine sampling". Comparison of Vulcan's January 2021 Upper Rhine Valley sample result analysed at KIT (n=1), compared to Salton Sea brine results (n=unknown) as recorded in publicly available literature (https://gdr.openei.org/submissions/499 for all multi-element results except silica; US Patent 4429535 for pre-flash silica values). Salton Sea values adjusted by the density 1.25 -> from mg/kg to mg/l.

# Appendix 12: Vulcan secured site for its planned commercial lithium hydroxide plant



- Vulcan signed an agreement with chemical park management company Infraserv, to secure a site for its planned Central Lithium Plant (CLP) at the Höchst Chemical Park, located just outside of Frankfurt
- Höchst is **one of Europe's largest chemical sites** and hosts more than 22,000 personnel and 90 companies including Nobian, Clariant, Sanofi and Celanese
- The CLP is intended as a **processing hub**, processing lithium chloride from multiple combined geothermal and lithium sorption plants into lithium hydroxide monohydrate
- From the CLP, the lithium hydroxide monohydrate is intended to be transported to Vulcan's European customers in the battery and electric vehicle industry, dramatically **lowering the transport footprint** of the current lithium supply chain
- The Höchst site features **key advantages** for the project including:
  - o proximity to Vulcan's project areas where the integrated geothermal and sorption operations are proposed to be built;
  - o multiple low carbon transport modes available (barge, train);
  - o availability of renewable power onsite; and
  - the required space and utilities for future phased expansion of the CLP



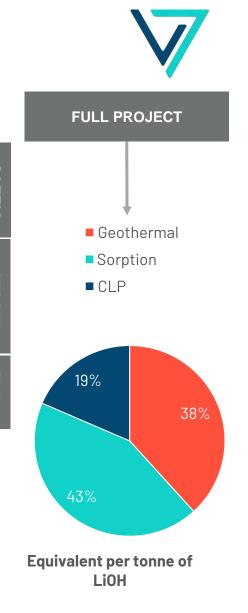


# Appendix 13: Target project economics from PFS - CAPEX

#### **ENERGY BUSINESS Geothermal Plant** 2 geothermal plants: PHASE 1 GB1 – 8MW GB2 - 14MW 2024 Start Capex: €226M 3 geothermal plants: GC1 – 17MW PHASE 2 GC2 - 17MW 2025 Start GC3 - 17MW Capex: €438M **FULL** 5 geothermal plants 74MW **PROJECT NO PHASING** Capex: €665M 2024 Start

# **Sorption Plant** 2 Sorption plants: SB1 - 8kt LiOH SB2 - 7kt LiOH Capex: €291M 3 Sorption plants: SC1 - 8kt LiOH SC2 - 8kt LiOH SC3 - 8kt LiOH Capex: €460M 5 Sorption Plants Capex: €751M





### Appendix 14: Target project economics - possible structures

#### Numbers are based on the PFS published in 2021 and are subject to change

Full project developed at the same time but separated in two different businesses: Energy and Lithium.

Phase 1 developed first, separated in two different businesses: Energy and Lithium.

Phase 2 developed second, separated in two different businesses: Energy and Lithium.

#### **FULL PROJECT - NO PHASING** PHASE 1 PHASE 2 2024 Start 2024 Start 2025 Start **ENERGY BUSINESS ENERGY BUSINESS LITHIUM BUSINESS** LITHIUM BUSINESS **LITHIUM BUSINESS** GB1 GB2 GC1 GC2 GC3 GB1 GB2 GC1 GC2 GC3 GB1 | GB2 | GC1 | GC2 | GC3 SB1 SB2 SC1 SC2 SC3 SB1 SB2 SC1 SC2 SC3 SB1 | SB2 | SC1 | SC2 | SC3 CLP1 CLP2 CLP 22MW 15Ktpy LiOH 52MW 25Ktpy LiOH **74MW** 40Ktpy LiOH 187 111 312 46 Revenues €M/y 157 500 31 140 83 242 Net Op. Cash Fl. €M/v 394 114 **NPV Pre-tax €M** 155 971 530 1.647 685 2.802 **NPV Post-tax €M** 644 99 371 1,111 470 1.897 **IRR Pre-tax** 27% 18% **32**% 13% 16% 31% **IRR Post-tax** 11% 22% 15% 26% 13% 26% Payback (year) 4 4 6 4 **CAPEX €M** 226 474 438 700 665 1,073 CAPEX Geo 226 438 **CAPEX Sorption** 291 460 751 CAPEX CLP 182 0.066 240 322 OPEX €/KWh or 0.078 3,201 0.061 2,855 2,681 LiOH€/t

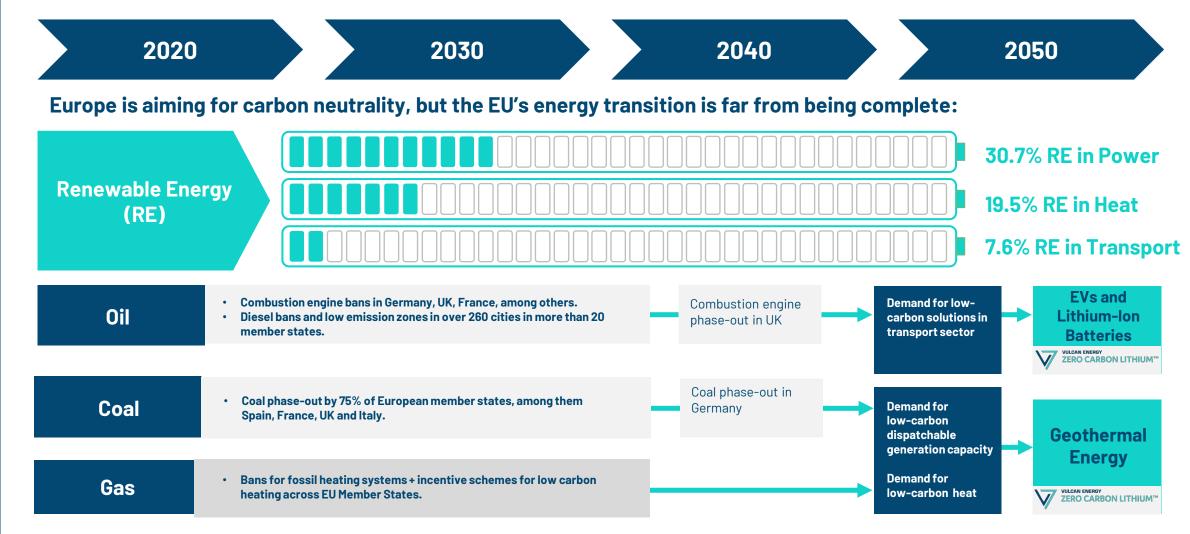
Note 1: Lithium Hydroxide Battery Quality at €12,542 or US\$14,925/t(assumes exchange rate of €0,84/US\$1,00)

Note 2: Phase 1 relates to Taro license, Phase 2 to Ortenau license

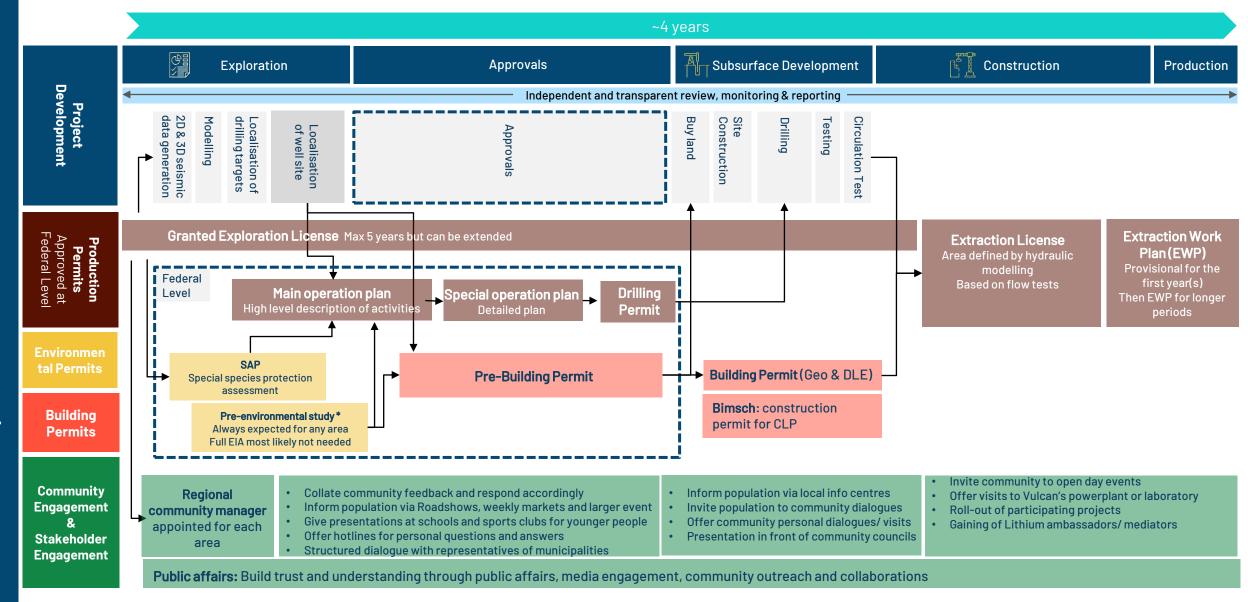
Note 3: Ortenau license is 100% owned by Vulcan. Vulcan has a 100% interest in Taro

## Appendix 15: The fossil fuel era in Europe is coming to an end





## Appendix 16: Project development timeline: example for one project area



### Appendix 17: Brine flow rates



Until we drill our first wells, risks around flow rate will remain. However, Vulcan believes it has an appropriate level of confidence around its flow rates assumptions, based on the experience of its team, and state-of-the-art scientific tools, data and studies

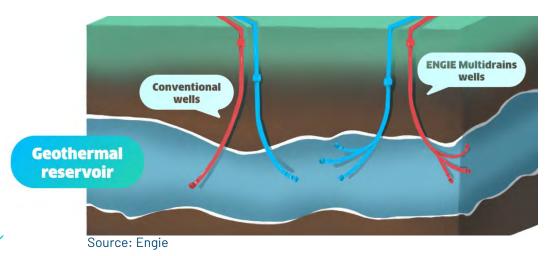
- 1. Vulcan is targeting high-flow fault zones within its sedimentary reservoir units, which are predominantly the Bunter Sandstone, using state-of-the-art seismic data. When exploration for geothermal brines first began in the Upper Rhine Valley, no seismic data was used, or the data was 2D seismic only, to get a picture of the sub-surface. The industry has seen a steady progression of understanding and improvements in exploration over time, including the **use of 3D seismic**, and a corresponding increase in flow rates, as would be expected. 3D seismic is now a standard for geothermal exploration in the Upper Rhine Valley and elsewhere
- 2. In our estimation of flow rates, we have conducted detailed studies using modelling information derived from seismic data in our areas. The Upper Rhine is a sedimentary graben system, geologically similar to hydrocarbon systems with **permeable formations confined by impermeable rock**. This differs to other types of geothermal plays, such as volcanic-hosted, where the systems are more complex, in general less permeable and seismic data is less useful
- 3. We also factor in techniques well known in the oil and gas industry to increase flow, such as **double completion of wells** and **multi-reservoir completion** as recently promoted by Schlumberger and Engie

Vulcan has, based on its detailed analysis and the various factors mentioned above, used between 100 and 120I/s as assumed flow rates for its projects in its PFS.

A **public list of flow rates** achieved at deep geothermal wells in and around Germany can be found in a 2014 report compiled for the German Federal Ministry of the Economy (BMWi) at the following link:

https://www.grs.de/sites/default/files/pdf/grs-316\_teilb.pdf.

Wells displaying flow rates at greater than 100l/s are common in the list, including at Brühl in the Upper Rhine Graben, with some projects reaching up to 150l/s.



# Appendix 18: Vulcan & Circulor to establish world-first full lithium traceability & transparency across the EU supply chain



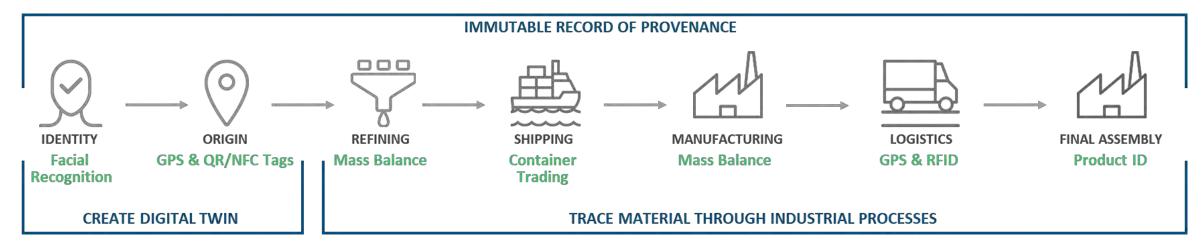
Circulor offers a software solution that enables customers to track raw materials and  $CO_2$  emissions through supply chains to demonstrate responsible sourcing and sustainability.

By applying blockchain, artificial intelligence, machine learning, facial recognition, mass balancing and other technologies Circulor makes sure that the digital twin is reliably linked to the physical resource throughout its entire journey. This enables:

1. Reputational Protection

- 2. Proof of compliance with guidelines and regulations
- 3. Dynamic carbon tracking

4. Reducing due diligence, audits and



Example applied to the cobalt supply chain



















# GLO

## Appendix 19: R&D projects







#### Effeo

Increasing efficiency of geothermal power plants via Project Management Jülich



#### GreGeo

Aims to develop a new well completion strategy that aims to establish a corrosion-resistant alternative to steel.



#### **GEORISK project**

Aims to develop financial schemes and mitigate the impact of the resource risk



#### **GeoThermScaling**

Development and evaluation of advanced iron boride-based anti-corrosion coating with high resistance to corrosion and scaling for deep geothermal applications.





#### **CROWDTHERMAL**

Empowering the European public to directly participate in the development of geothermal projects with the help of alternative financing schemes (crowdfunding) and social engagement tools.



#### **MEET**

Multidisciplinary and multi-context demonstration of EGS exploration and Exploitation Techniques and potentials



#### **DGE-Rollout**

Roll-out of Deep Geothermal Energy in Northwest Europe

## Vulcan Group: integrated, in-house capability to execute on our strategy

# Vulcan's expertise and assets

# Independent expertise

Industrial

# cosystem

# Bundesverband Geothermie

Renewable energy

**VES** Sub-surface

Natür<sup>3</sup>Lich Insheim

energy plant

**VERCANA** Deep

**Exploration data** packages acquired

multiple licences

geothermal renewable

geothermal rigs & team

Multiple geothermal-lithium brine licences

Multiple renewable energy projects in development across

team

geothermal & engineering

**VEE** Above-surface geothermal engineering





Lithium

Fully equipped

in-house lab with team

Operational pilot plant

Chemical engineering

**Demonstration plant** 

under construction



#### **Sustainability**



Carbon neutrality commitment during development and operations



Life Cycle Assessment and global study on the environmental footprint of lithium hydroxide production



Supply chain traceability and CO<sub>2</sub> measurement

#### **Finance**



Strong cash position



A\$320 million capital raising in 2021



Low cost and resilient financials

#### **Customers**



Five definitive lithium offtake agreements



One offtake agreement concluded and multiple additional heat offtakes in discussion





















BVMW



# Thank you

#### **Media and Investor Relations**

Germany

Beate Holzwarth
Chief Communication Officer
bholzwarth@v-er.eu

#### Australia

Jessica Bukowski PR & IR Manager jbukowski@v-er.eu

@VulcanEnergyRes|www.v-er.eu|info@v-er.eu ASX:VUL FSE:VUL

