

German Lithium Chemistry & Geothermal Lithium Expert Joins Vulcan Board

Highlights

- Dr. Katharina Gerber joins Vulcan Zero Carbon Lithium™ team as a Non-Executive Director.
- Dr. Gerber was awarded her chemistry PhD on cathode materials for lithium-ion batteries *magna cum laude* (with great distinction) at the University of Bonn, Germany.
- Currently a Project Leader at the California Energy Commission (CEC) focussed on lithium extraction from geothermal brines, life-cycle assessments of energy storage technologies, California State energy and environmental policies and management of grant funding opportunities.
- Dr. Gerber participates in multiple interagency working groups, including the “California Lithium Valley” initiative.
- Unique combination of expertise in lithium-ion battery chemistry and lithium extraction from geothermal brines.

Vulcan Chair, Gavin Rezos commented:

“We are delighted to welcome Dr. Gerber to the Vulcan Board as we continue to build the Vulcan team with leading lights in the fields of lithium extraction, processing and geothermal energy. Dr. Gerber’s unique combination of skills, in both lithium-ion battery chemistry and direct lithium extraction from geothermal brines, makes her a rare and valuable asset to Vulcan. We look forward to working with Dr. Gerber as we work towards achieving our goal of supplying the European electric vehicle battery market, the fastest growing in the world, with Zero Carbon Lithium™.”

This appointment follows on from recent announcements:

- Commencement of lithium extraction test work;
- The appointment of Ranya Alkadamani, who is highly regarded in the ethical and sustainable investment sector, as a Non-Executive Director; and
- Positive Scoping Study.

Highlights

Large, lithium-rich geothermal brine project, in the Upper Rhine Valley of Germany.

Europe’s **largest** JORC-compliant lithium resource.

Aiming to be the world’s first **Zero Carbon Lithium™** producer.

Fast-track development of project under way towards production.

Corporate Directory

Managing Director
Dr Francis Wedin

Chairman
Gavin Rezos

Executive Director
Dr Horst Kreuter

Non-Executive Director
Ranya Alkadamani

Non-Executive Director
Dr Katharina Gerber

CFO-Company Secretary
Robert Ierace

Fast Facts

Issued Capital: 53,670,002
Market Cap (@20c): \$10.7m

Contact

Level 11, Brookfield Place
125 St Georges Terrace
Perth WA 6000 Australia
08 6189 8767

Vulcan Energie Ressourcen
GmbH
Baischstr. 8, 76133 Karlsruhe

www.v-er.com
info@v-er.com

 @VulcanEnergyRes



Dr. Katharina Gerber

Katharina holds a Ph.D., M.S., and B.S. degrees in chemistry from University of Bonn. She is fluent in German, English and Russian.

Katharina is a Project Manager at the California Energy Commission (CEC) where she provides scientific & technical leadership in determining research priorities for R&D programs with focus on emerging energy storage technologies and lithium extraction from geothermal brine. In her role at the CEC Katharina directs and executes requests for proposals (RFPs) and leads evaluation of project applications & contract bids. In addition, Katharina participates in multiple interagency working groups, such as the “California Lithium Valley” initiative, conducting complex technological and market assessments on future availability of critical minerals used in lithium-ion battery technology, and develops recommendations for policymakers and stakeholders.

Prior to joining the CEC, Katharina conducted research developing and characterizing new electrode materials for lithium-ion battery as a part of her postdoctoral studies at the University of California, Davis, as well as a part of her doctoral thesis at the University of Bonn.

Who Are We?

We're a mixture of Australian entrepreneurial spirit, German engineering excellence and a dash of North American tech brains. We have a strong background in the lithium space.

We're aiming to decarbonize the currently high carbon production footprint of lithium-ion batteries used in electric vehicles.

We plan to produce a world-first **Zero Carbon Lithium™** hydroxide product from our Vulcan geothermal lithium brine project.

It is the largest lithium resourceⁱ in Europe and located in the heart of the EU.

We will use our proprietary **Zero Carbon Lithium™** process, married with our unique and very large lithium resource, to pump up hot lithium-rich brine to the surface, then use the renewable heat to drive lithium extraction, with renewable energy as a saleable by-product.

We will **disrupt and lead** the resources industry towards a Zero Carbon future.

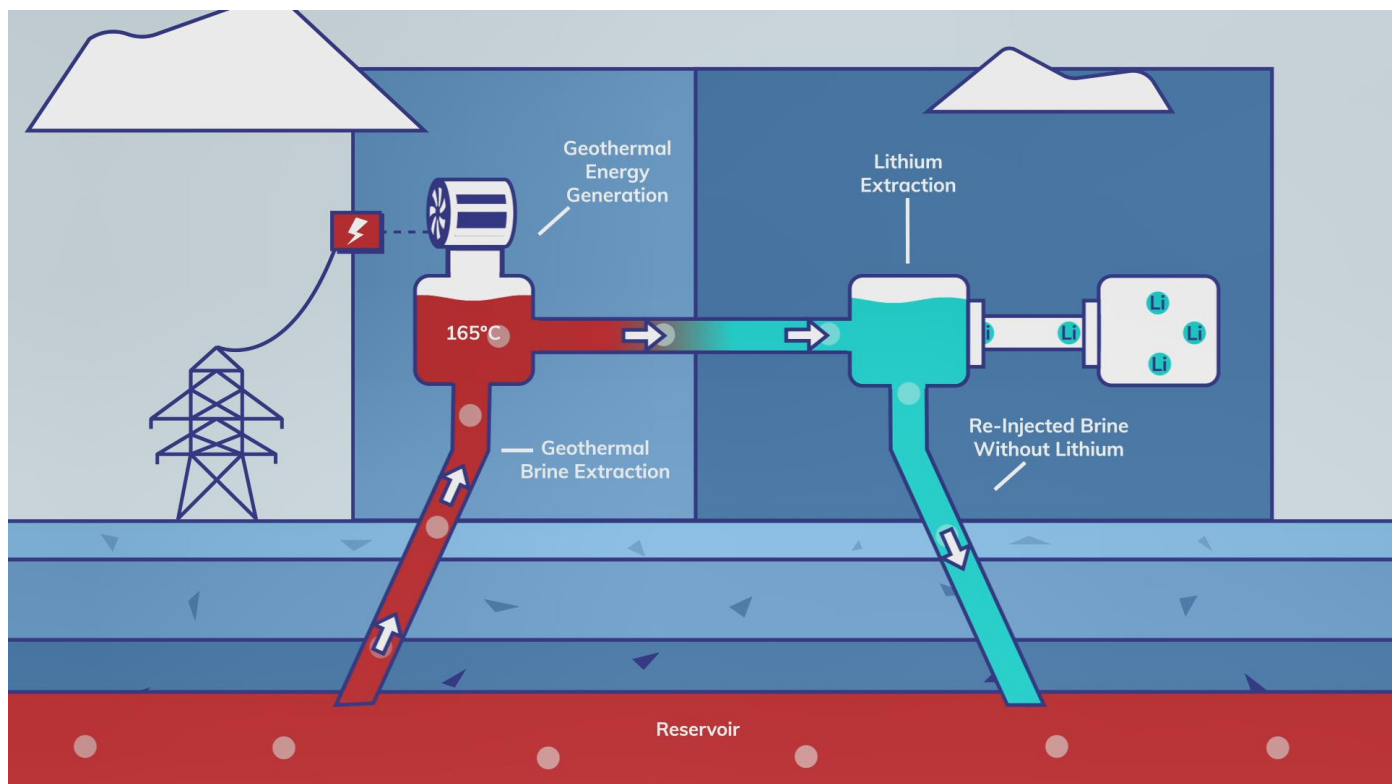


Figure 1: Schematic of the Zero Carbon Lithium™ process.

How Did We Get Here?

We started with a mission to create a Zero Carbon Lithium company.

We'd noticed European car manufacturers wanted to produce electric vehicles (EVs), with a zero-carbon production footprint:

"(Battery raw materials) sustainability as selection criteria on par with quality and price"

"Volkswagen's delivery promise: CO₂-neutral (EV) production including supply chain"

go TO zero



EVs are a great idea. They have no tailpipe emissions, are quicker, quieter, more efficient and over their lifetime much greener than fossil fuel cars.

The transition to EVs is happening quickly.



But because of all the metals that go into the lithium-ion battery, they currently take a lot of carbon to produce.

As much carbon by 2030 as the Netherlands emits, if we don't do something.

Successful companies are already trying to decarbonise:

6 DECEMBER 2019 **NEWS**

Alcoa-Rio Tinto JV sells first carbon-free aluminium to Apple

But there is no zero carbon or low carbon lithium, cobalt, nickel or graphite available for lithium-ion batteries^{ii iii iv}. **We can help fix that.**

We Searched for the Right Project

Lithium is mostly sourced from salty fluids on the surface called “continental brines”, but this takes a lot of energy and water to produce as they are not heated.

Hot, salty fluids deep in the sub-surface, called “geothermal brines”, produce renewable power and heat, and sometimes contain lithium.

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

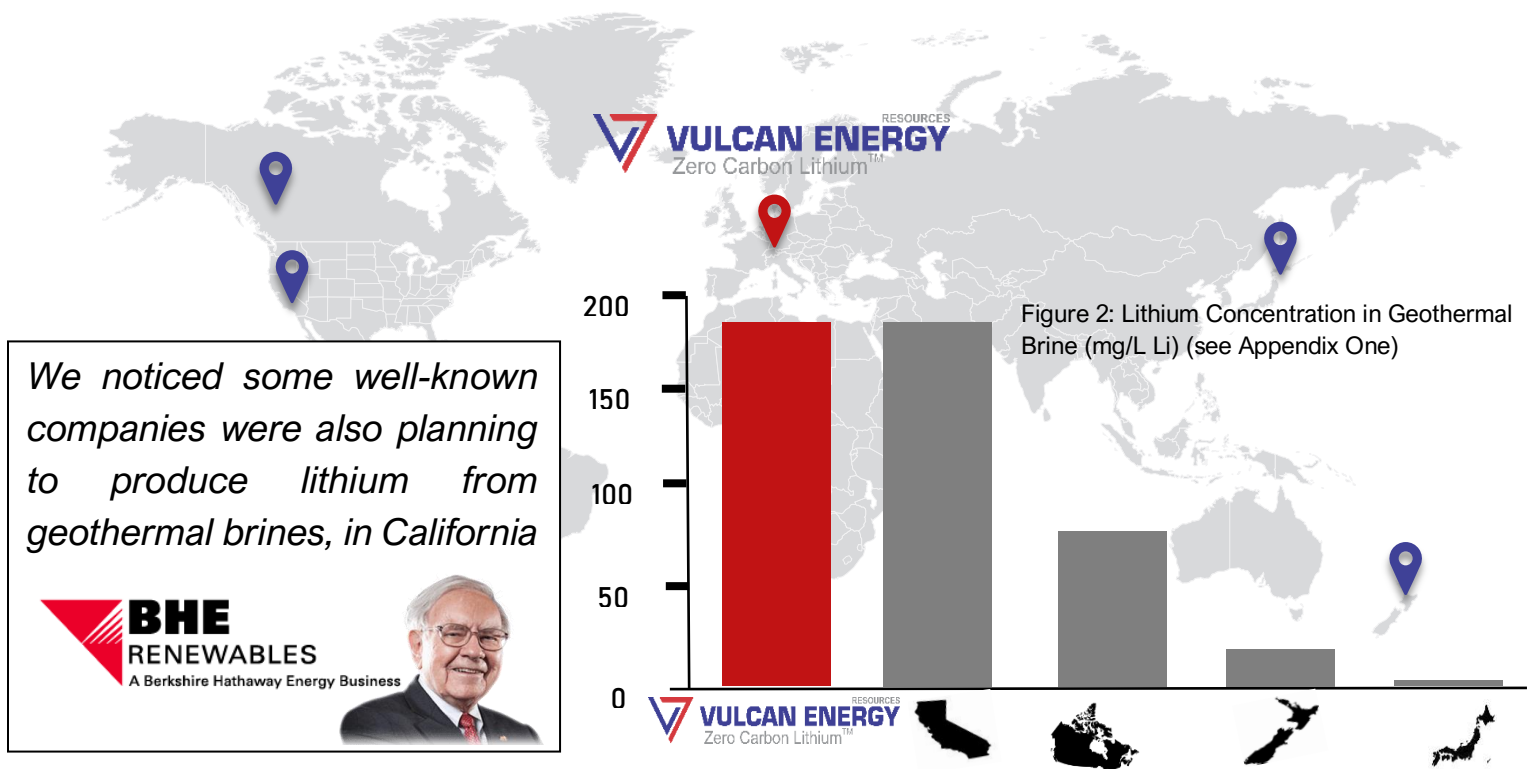
1. Renewable heat;
2. High lithium grades;
3. High brine flow rate.

*We **scoured the globe** to find these conditions. Most geothermal brines don't have the required flow rate or lithium grade.*



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

1. The Upper Rhine Valley in Germany, and 2. The Salton Sea in California^v.



We chose Germany and Europe, because we know it will be the fastest growing lithium market in the world in the 2020s, driven by EVs, and currently has zero domestic production of lithium hydroxide.

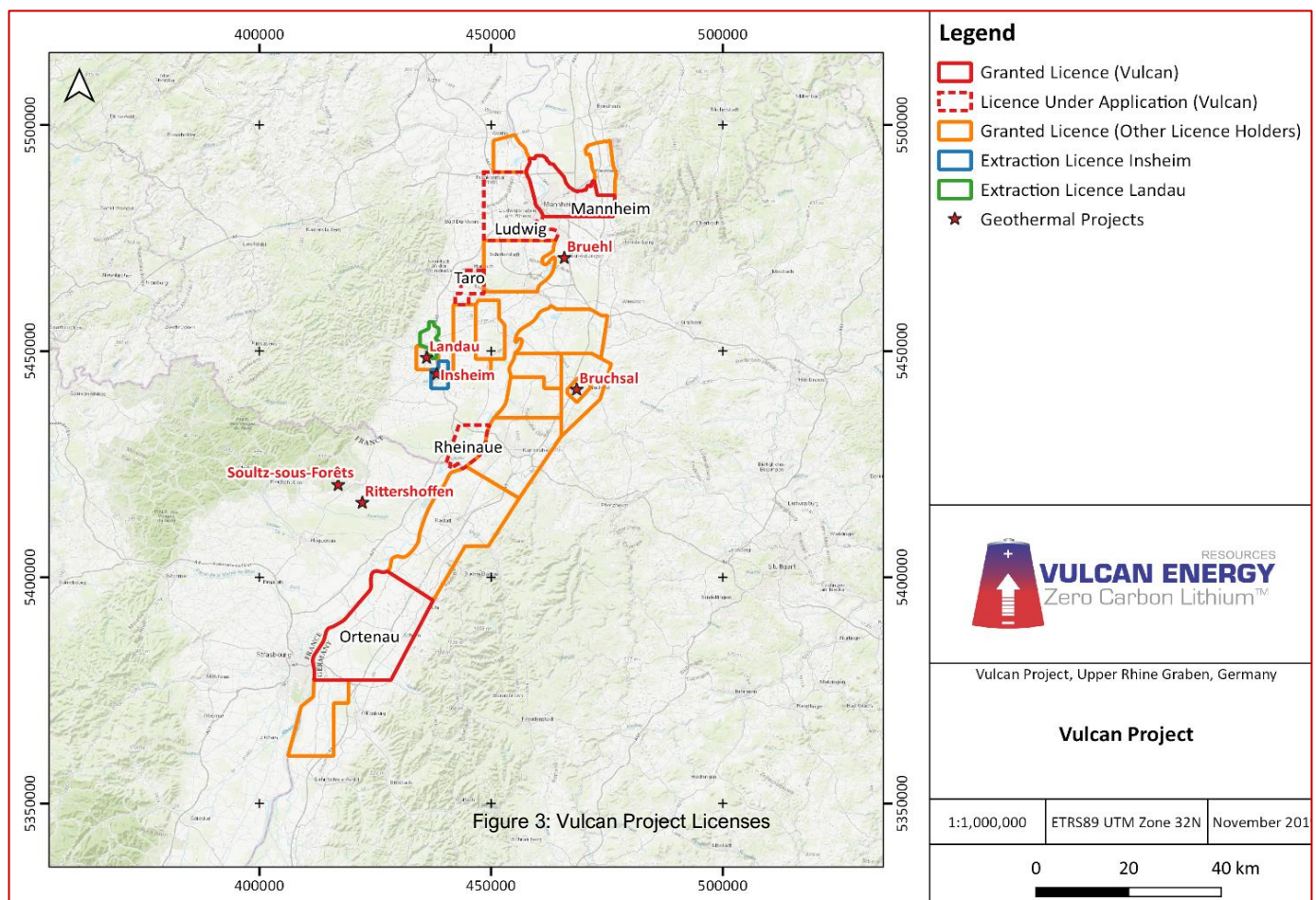
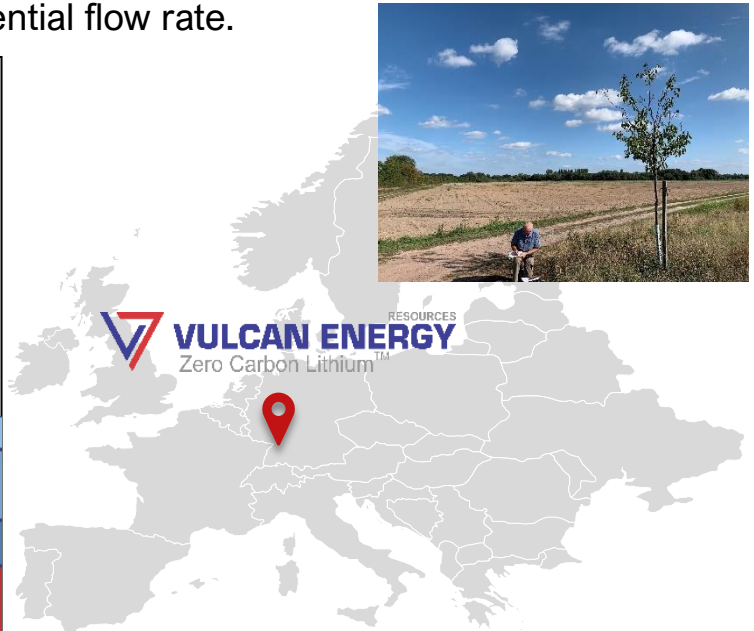
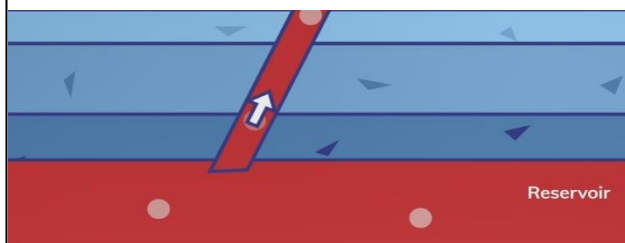


Birth of the Vulcan Project...

We used our geological expertise to pick out the best areas in the Upper Rhine Valley for sub-surface lithium grade and potential flow rate.

We secured exclusive rights to these areas: a very large license package hundreds of square kilometres in size.

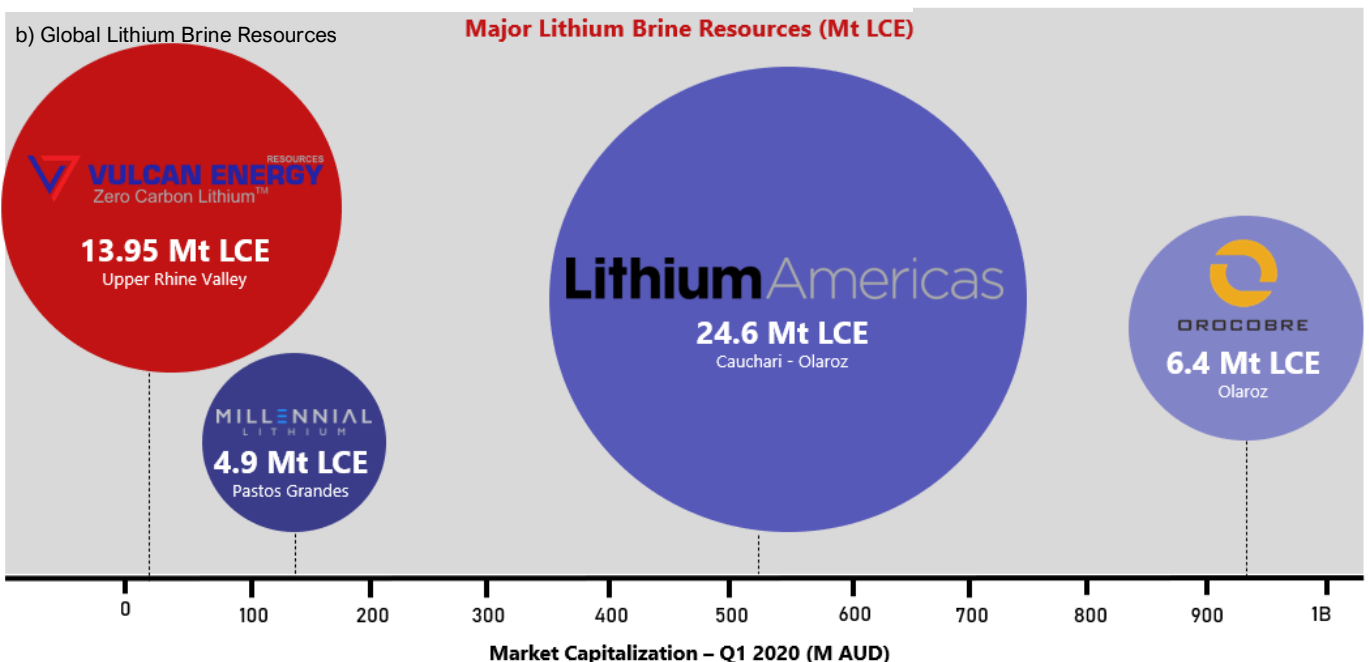
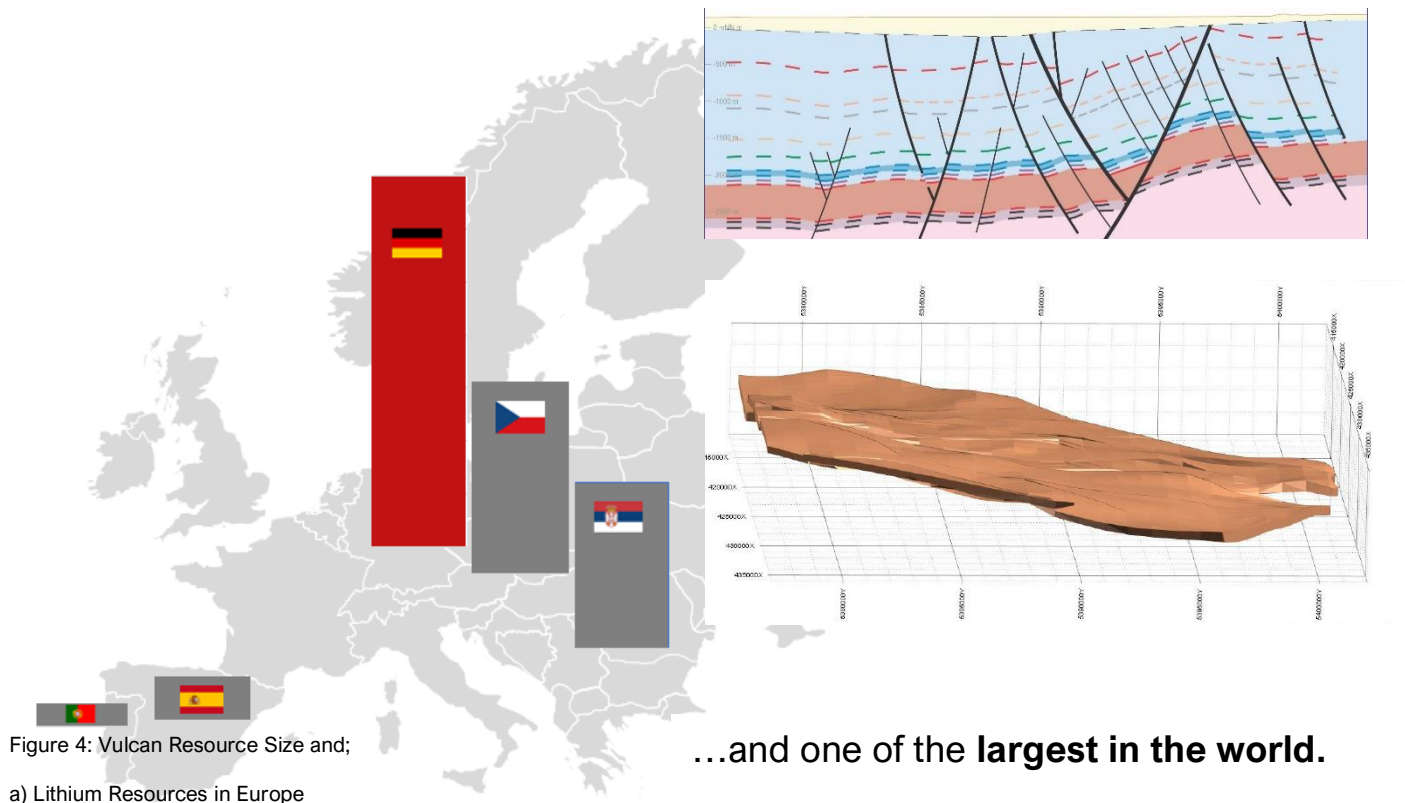
Underneath is the lithium, stored in the hot geothermal reservoir.



...and Growth to the Largest Resource in Europe

There's a treasure-trove of sub-surface data in the Upper Rhine Valley, including seismic and drilling data. Companies have been exploring for oil here for decades.

We gathered this data, generated our own data, analysed both, and defined the **largest lithium resource in Europe^{vi}** by far...



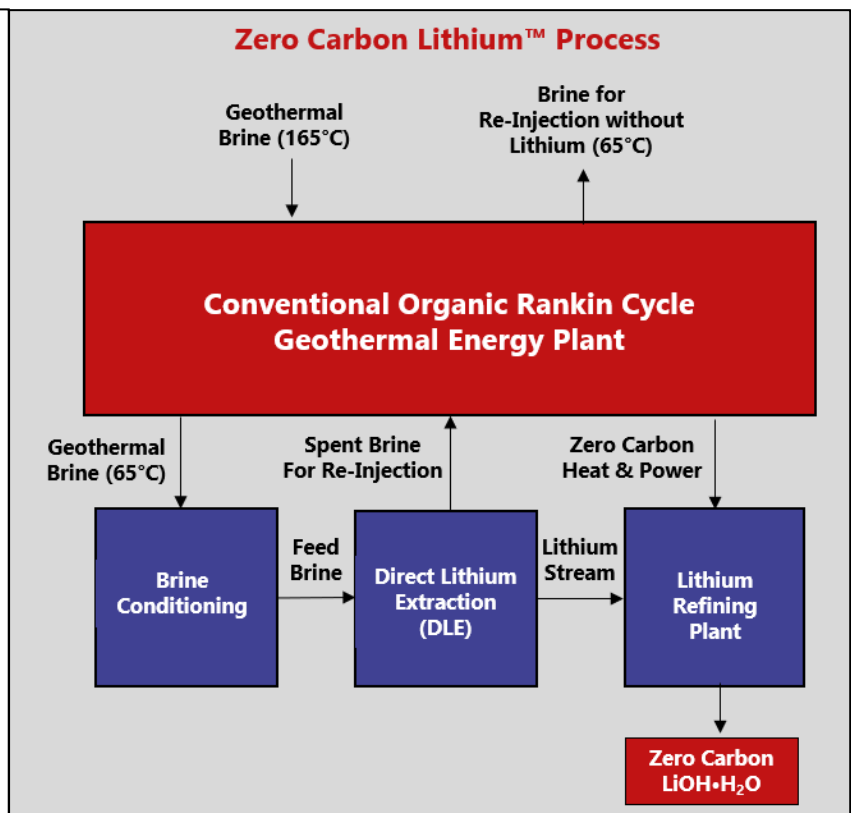
We Designed our Zero Carbon Lithium™ Process^{vii}

We will use **renewable heat** derived from the geothermal brine to drive the lithium extraction process, with **no fossil fuel consumption**.

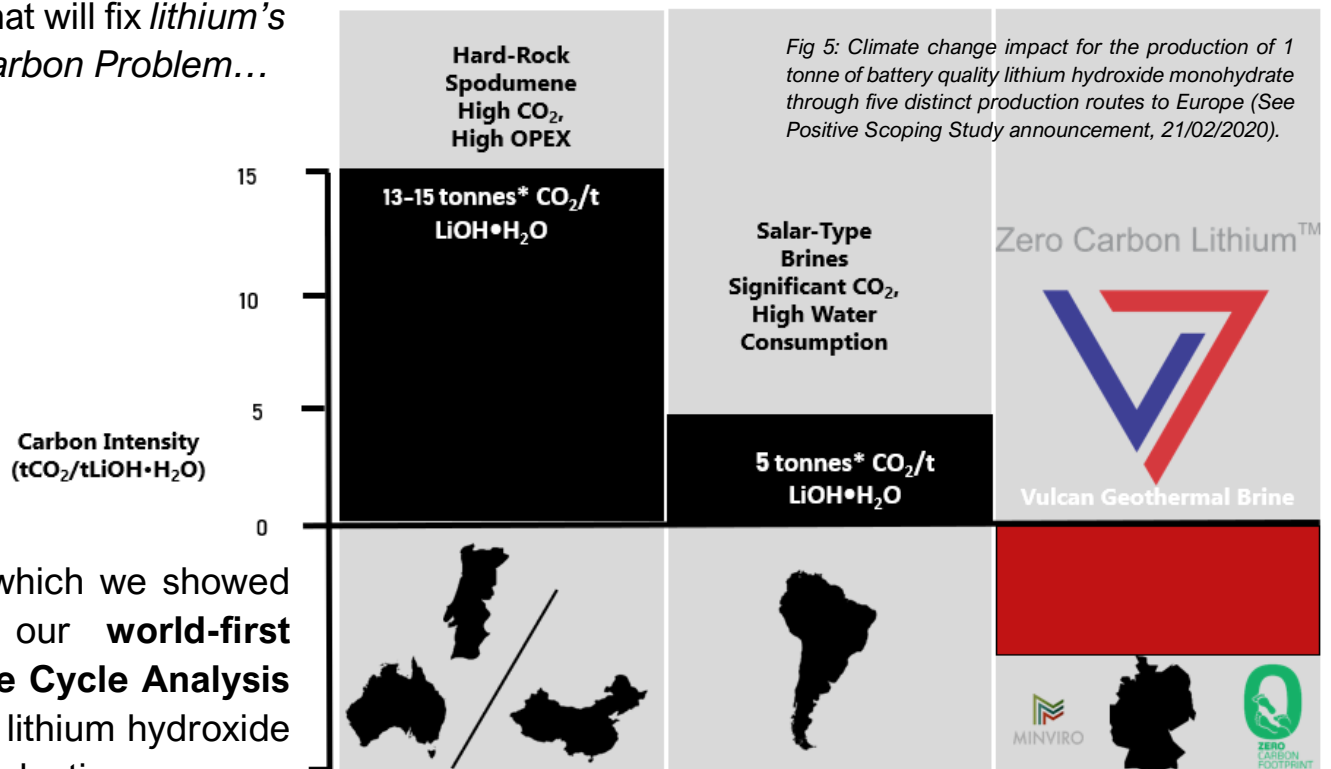
We will produce a surplus of renewable electricity, actually **decarbonising** the grid.

We will produce a unique, premium, battery-quality **Zero Carbon Lithium™** hydroxide product for EVs.

The spent brine then gets re-injected.



That will fix *lithium's Carbon Problem...*



...which we showed in our **world-first Life Cycle Analysis** for lithium hydroxide production:

No Evaporation, Mining or Fossil Fuels Required

Lithium extraction in South America evaporates large quantities of water in the second driest place on earth. This stresses the environment and local communities.



Europe doesn't want hard rock mines for lithium. Once you mine it, the rock has to be roasted with fossil fuels to produce lithium hydroxide. This is very CO₂-intensive.



And this is our solution: lithium from geothermal plants in the Upper Rhine Valley.

In harmony with the environment.

Lithium production from, and powered by, a renewable energy source: the **Zero Carbon Lithium™** process.

No evaporation, mining or fossil fuels required.

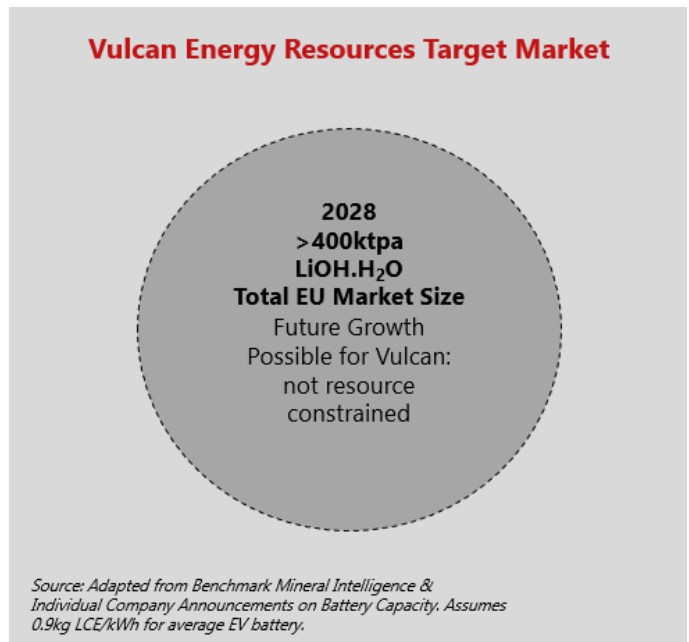
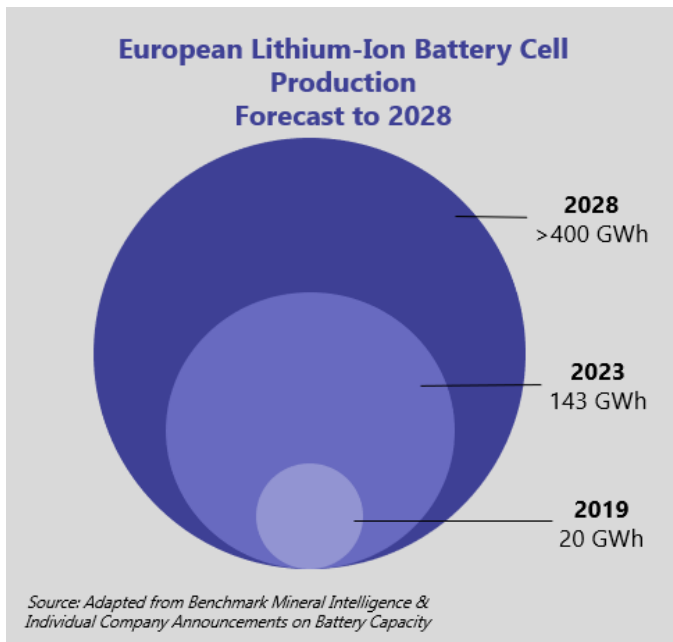


What's Our Target Market Like?

Europe is the world's fastest growing market^{viii} for lithium hydroxide, driven by a massive growth in production of lithium-ion batteries for EVs.

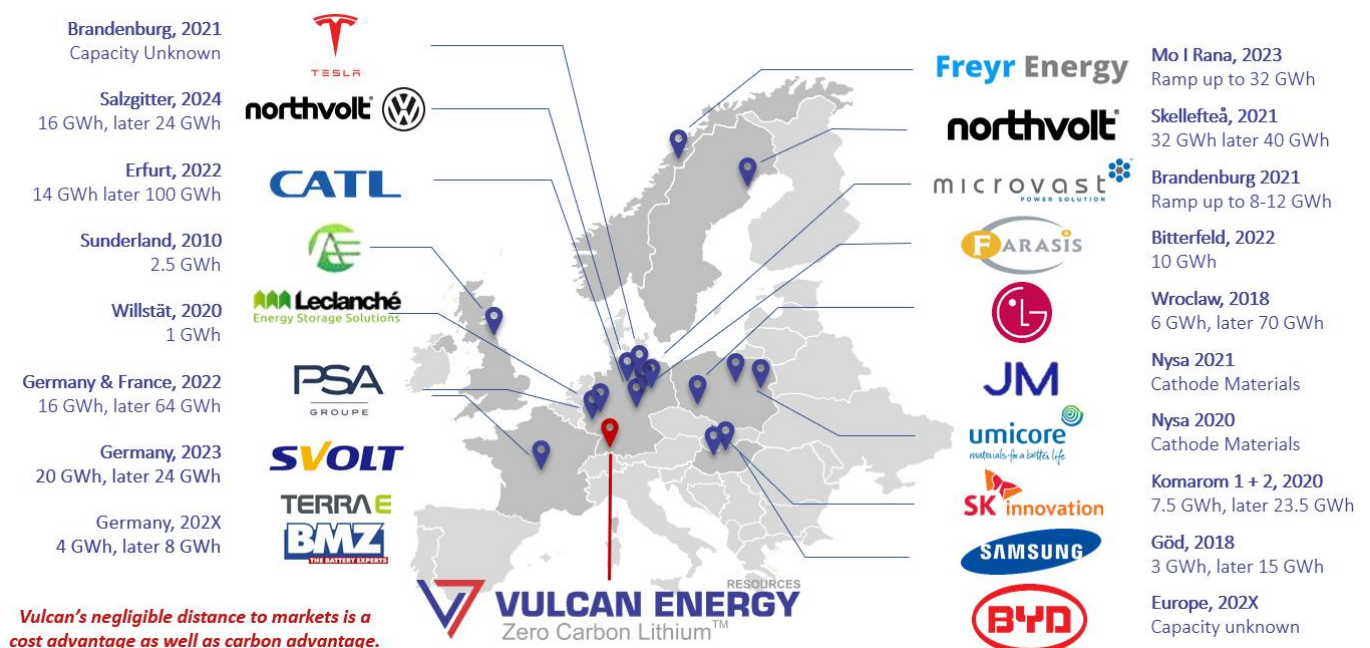
It needs more lithium hydroxide by 2028 than **the entire world consumes today**.

It has **zero local supply** of lithium hydroxide. 80% of global supply is from China.



Here's where we sit in relation to that market: at the very centre.

No high-carbon, high-cost transport from thousands of km away. Security of supply.



Cost: Advantage Geothermal Lithium Brine

If you're producing battery-quality lithium hydroxide chemicals, the price environment is strong. Lithium hydroxide is currently selling for around US\$13,000/t. It is widely tipped to rise even from here due to looming deficits.

LiOH Asia Weighted Average Price

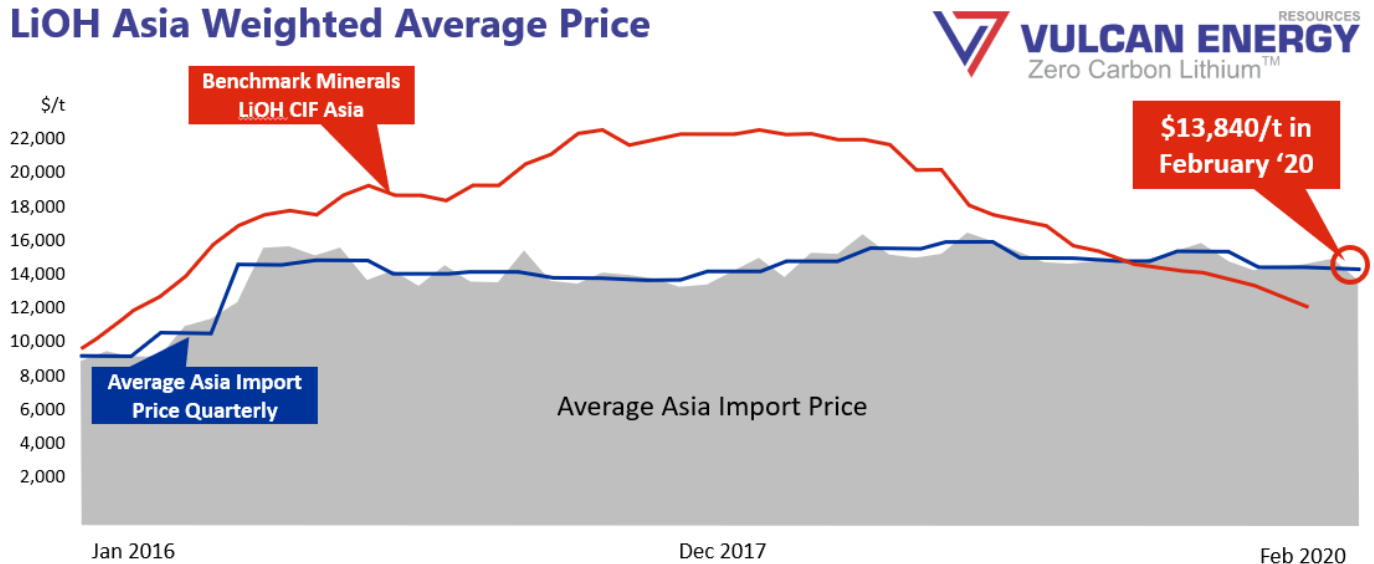


Fig 7: Weighted prices average from lithium hydroxide imports into Japan and South Korea from Chile, China, and the US. This represents 75% of the global LiOH trade and is mostly used in cathodes. Source: Infinity Lithium.

Brine projects are the lowest cost method of lithium hydroxide production, typically around US\$5-7,000/t (Source: Canaccord).

We have the added advantages of free heat to drive our process, short distance to market, a premium product, and most importantly, we also sell energy.

Germany has a fixed price of €0.25c/kWh for the renewable electricity we can produce. We plan to have **two revenue streams**: lithium and electricity.

They de-risk and complement each other.



Lithium Revenue

Energy Revenue

Where to From Here?

We just completed our **Scoping Study** in just six months, using our in-house team and world-renowned consultants. It was **highly positive**^{ix}.

Next, we'll be commencing our Pre-Feasibility Study (**PFS**).

We've just started bench-scale processing test work as part of this.

We'll then be constructing our own pilot plant to demonstrate and de-risk.

We expect to maintain our rapid momentum and get this done this year.

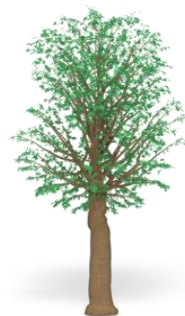
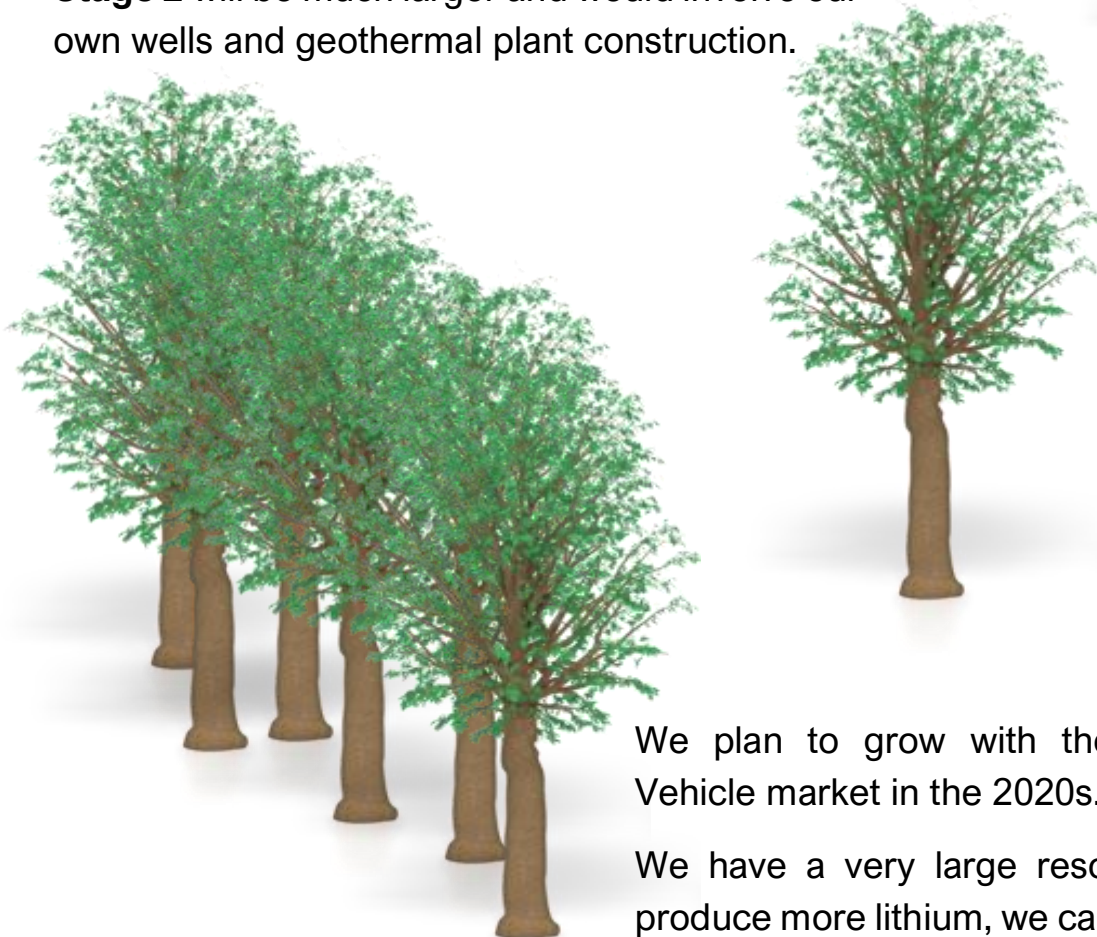
In 2021 we want to complete our Definitive Feasibility Study (**DFS**). We can take that to the bank.

We then plan a sensible scale-up, with our first, small commercial plant to be built at an existing geothermal operation, saving CAPEX: **Stage 1**.

Stage 2 will be much larger and would involve our own wells and geothermal plant construction.

We plan to grow with the European Electric Vehicle market in the 2020s.

We have a very large resource. If we want to produce more lithium, we can just drill more wells.



Local Partnerships^x

We have a Memorandum of Understanding (MoU) with a highly respected local geothermal plant operator.

This gives us access to live brine for processing test work.

It also contemplates us processing the plant's waste brine to product our first commercial Zero Carbon Lithium™ hydroxide, in a “win-win”.



This could potentially be a shortcut to commercial development.



A Note on Geothermal Lithium

Geothermal brines contain natural CO₂ in solution.

In Germany, this stays in solution and is re-injected. In some other parts of the world, this is de-pressurised and released to the atmosphere.

Not all geothermal lithium projects are the same.

Choose a Zero Carbon Lithium™ product.

A Note on our Process

We use Direct Lithium Extraction (DLE) as part of our overall flowsheet. It involves lithium extraction from brine without evaporation ponds.

The lithium industry is shifting to DLE processes, because:

1. Lithium extraction in hours instead of months.
2. Not weather-dependent like evaporation, in increasingly unstable climate.
3. Ability to produce consistent product for battery industry.
4. Spent brine water re-injected into reservoir with no evaporation losses.



This term has been used to describe a number of very different methods, at very different stages of development.

This ranges from bench-scale R&D, to full-scale commercial plants in South American and China.

We selected our preferred method using very strict criteria:

1. It must be commercially proven and already used on brines.
2. It must have a low CAPEX and OPEX.
3. It must be suitable for hot geothermal brines.
4. It must not involve solvents or reagents that could harm the environment.

Just like any resources project, we need to do processing test work to de-risk our geochemistry as we scale up.

We have strictly adhered to our policy of choosing process methods that are already commercially used on brines, which gives us confidence in our Zero Carbon Lithium™ flow sheet.

A Reminder of What Makes Us Special

World's 1st & Only Zero-Carbon Lithium™ Process.

A premium product and unique IP.

Zero Carbon Lithium™

Positive Scoping Study.

Global Experts. Robust basis for further work.



Dual Revenue Potential.

Lithium and geothermal energy revenue de-risks project.



Size & Quality: Europe's Largest Lithium Resource.

Not constrained by size, can grow with the market.



Location, Location, Location.

Centre of Europe, the world's fastest growing lithium market.



Local Partners & Infrastructure Access

Potential for fast track to production.



The Right Team for the Job

Lithium, geothermal and finance expertise.



Rapidly Advancing Lithium Project

With sensible path to growth.



For and on behalf of the Board

Robert Ierace

Chief Financial Officer - Company Secretary For further information visit www.v-er.com

Zero Carbon Lithium™

Disclaimer

Some of the statements appearing in this announcement may be in the nature of forward-looking statements. You should be aware that such statements are only predictions and are subject to inherent risks and uncertainties. Those risks and uncertainties include factors and risks specific to the industries in which Vulcan operates and proposes to operate as well as general economic conditions, prevailing exchange rates and interest rates and conditions in the financial markets, among other things. Actual events or results may differ materially from the events or results expressed or implied in any forward-looking statement. No forward-looking statement is a guarantee or representation as to future performance or any other future matters, which will be influenced by a number of factors and subject to various uncertainties and contingencies, many of which will be outside Vulcan's control.

Vulcan does not undertake any obligation to update publicly or release any revisions to these forward-looking statements to reflect events or circumstances after today's date or to reflect the occurrence of unanticipated events. No representation or warranty, express or implied, is made as to the fairness, accuracy, completeness or correctness of the information, opinions or conclusions contained in this announcement. To the maximum extent permitted by law, none of Vulcan, its Directors, employees, advisors or agents, nor any other person, accepts any liability for any loss arising from the use of the information contained in this announcement. You are cautioned not to place undue reliance on any forward-looking statement. The forward-looking statements in this announcement reflect views held only as at the date of this announcement. This announcement is not an offer, invitation or recommendation to subscribe for, or purchase securities by Vulcan. Nor does this announcement constitute investment or financial product advice (nor tax, accounting or legal advice) and is not intended to be used for the basis of making an investment decision. Investors should obtain their own advice before making any investment decision.

Competent Person Statement:

The information in this report that relates to Mineral Resources for the Vulcan Geothermal-Lithium Project is extracted from the ASX announcements "maiden JORC (2012) Mineral Resource Estimate for its Ortenau licence" and "Maiden Indicated Resource Insheim Vulcan Zero Carbon Lithium" released on the 4th of December 2019 and 20th of January 2020, and the information in this report that relates to Vulcan's Scoping Study is extracted from the ASX announcement "Positive Scoping Study" released on the 21st of February 2020, which are available on www.v-er.com. The Company confirms that it is not aware of any new information or data that materially affects the information included in the previous market announcement and that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement 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 have not been materially modified from the original market announcements.

Appendix One: References and Footnotes

ⁱ See ASX releases 4th of December 2019 and 20th of January 2020. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcements.

ⁱⁱ Volkswagen ID presentation, 2019

ⁱⁱⁱ http://www3.weforum.org/docs/WEF_A_Vision_for_a_Sustainable_Battery_Value_Chain_in_2030_Report.pdf

^{iv} <https://www.mining-technology.com/news/alcoa-rio-tinto-carbon-free-aluminium/>

^v 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 Acta 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

The Company is not aware of any new information or data that materially affects the information contained in the above sources or the data contained in this announcement

^{vi} European Peer Comparison Data

Company	Code	Project	Stage	Resource Category	Resource Tonnes	Resource Grade (Li2O)	Contained LCE Tonnes	Information Source
European Metals	ASX: EMH	Cinovec	PFS Complete	Indicated & Inferred	695.9	0.42	7.17	Corporate Presentation Released 20 November 2018
Rio Tinto	ASX: RIO	Jadar	PFS Underway	Indicated & Inferred	135.7	1.86	6.24	Corporate Presentation Released 21 March 2018
Infinity Lithium	ASX: INF	San Jose	PFS Complete	Indicated & Inferred	111.3	0.61	1.68	ASX Announcement Released 22 August 2019
Savannah Resources	AIM: SAV	Barroso	DFS Underway	Measured, Indicated & Inferred	27.0	1.00	0.71	Corporate Presentation Released May 2019
European Lithium	ASX: EUR	Wolfsburg	PFS Complete	Measured, Indicated & Inferred	10.98	1.00%	0.27	Corporate Presentation Released 22 March 2019

Global Peer Comparison Data

Company	Code	Project	Stage	Resource Category	Brine M ³	Resource Grade (mg/l Li)	Contained LCE Tonnes	Information Source
Orocobre	ASX:ORE	Salar de Olaroz	Production	Measured & Indicated	1.8 x 10 ⁹	690	6.4	Company Presentation 5 May 2014
Lithium Americas	NYSE:LAC	Cauchari-Olaroz, Chile (50% ownership. Thacker Pass not Included)	DFS Complete, Construction Underway	Measured, Indicated & Inferred	7.8 x 10 ⁹	592	24.6	Resource Statement 7 May 2019
Millennial Lithium	CVE:ML	Pastos Grandes, Argentina	FS Complete	Measured, Indicated & Inferred	2.2 x 10 ⁹	428	4.9	Resource Statement 31 May 2019

The Company is not aware of any new information or data that materially affects the information contained in the above sources or the data contained in this announcement

^{vii} Minviro Independent ISO 14044 Study. Figures for peer data are quoted in: <https://static1.squarespace.com/static/5c9aa323c46f6d499a2ac1c5/t/5e1cf0d3a12a6a33c900c8ea/1578954965079/The+CO2+Impact+of+the+2020s+Battery+Quality+Lithium+Hydroxide+Supply+Chain.pdf>

^{viii} Adapted from Benchmark Mineral Intelligence and Individual Lithium-Ion Battery Manufacturing Company Announcements from Tesla, Northvolt, CATL, Leclanche, PSA, SVolt, TerraE, BMZ, Freyr Energy, Microvast, Farasis, LG Chem, Johnson Matthey, Umicore, SK Innovation, Samsung, BYD.

^{ix} See Scoping Study ASX announcement, 21/02/2020

^x See ASX announcement, 26/11/2020