VULCAN ENERGY RESOURCES
Zero Carbon Lithium™

# Lithium-Brine Grades Above Expectation: Vulcan Zero Carbon Lithium™ Project

## Highlights

- Assay results received from 2019 geothermal well brine sampling program in Upper Rhine Valley
- Lithium grades above expectation, including a **maximum of 215 mg/l Li**
- Insheim Geothermal Plant, the subject of Vulcan's recent MoU with Pfalzwerke geofuture GmbH, **recorded highest average Li-brine grades** of all sampled wells
- Results represent same order of magnitude lithium grades as typical South American brines, but with **processing advantage** as geothermal brines of **readily available heat & power**
- The brine sampling program is part of Vulcan's strategy toward production of **battery-quality lithium hydroxide**, with **net zero carbon footprint**, for the rapidly growing European market
- The analytical results will be used in Vulcan's maiden mineral resource estimate, **expected imminently.**

Vulcan Energy Resources Ltd. ("Vulcan", "VUL", "the Company") is pleased to announce the results from its October 2019 regional geothermal well brine sampling and analysis campaign in the Upper Rhine Valley, Germany. Results were generally above expectation, ranging from 104 mg/l Li to a maximum recorded value of 215 mg/l Li (average of 181 mg/L Li) as analyzed by total metal Inductively coupled plasma - optical emission spectrometry analysis (ICP-OES). The highest average lithium grade was recorded from the Insheim plant where Vulcan has an MoU with the owner Pfalzwerke geofuture to earn in to 80% of the lithium rights. The Li-brine analytical results will be used in Vulcan's maiden mineral resource estimate for the project, which is expected to be completed imminently.

Managing Director, Dr. Francis Wedin commented: *"These geochemical results, which confirm the high lithium grades within the heated, high-flow rate geothermal brines of the Upper Rhine Graben, are an important step of our strategy to fast-track the development of the Vulcan project, to achieve our goal of producing a **Zero Carbon Lithium™** hydroxide product in Germany. The next step will be to incorporate the results into our maiden mineral resource estimate, which we expect to update our shareholders on imminently."*

ASX Release
2 December 2019
ASX: VUL

## Highlights

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

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

Strategically located at the heart of the EU auto & Li-ion battery industry.

Access agreement in place with German geothermal operator at producing plant

Fast-track development of project under way, targeting production of lithium hydroxide by 2023.

## Corporate Directory

Managing Director
Dr Francis Wedin

Chairman
Gavin Rezos

In-Country Principal
Dr Horst Kreuter

Non-Executive Director
Patrick Burke

## Fast Facts

Issued Capital: 48,500,002
Market Cap (@15.0c): $7.3m

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## Vulcan 2019 Geochemical Brine Sampling Programme

To verify the historical lithium concentrations in deep-seated brine from the Upper Rhine Graben (URG), Vulcan conducted a 2019 brine sampling program to analyse brine from the Landau and Insheim geothermal wells. Approvals to analyse the brine were acquired by Vulcan from the respective geothermal operators. Retained samples from the Brühl geothermal well were also analysed. The spatial location of the wells is presented in Figure 1. A description of the sample numbers, well locations, and sample points is presented in Tables 1-4.

At surface, the sampled Insheim well is situated within Vulcan's project area of interest, as per the Memorandum of Understanding recently signed with Pfalzwerke geofuture GmbH[1]. The other wells are situated in the Upper Rhine Valley outside the Vulcan project area. In this instance, the wells were sampled because of the lack of accessible wells that penetrate deep-seated brine-saturated sandstone aquifers underlying Vulcan's licenses. Based on the knowledge that: 1) deep-basin URG brine is lithium-enriched as per historical documentation; and 2) confined aquifers in a graben system can have massive spatial extent with homogeneous to semi-homogeneous lithium-in-brine concentrations, it is assumed that the Li-brine content of neighbouring wells are a good proxy of the lithium content in Triassic aquifers underlying the URG and the Vulcan project licenses. Vulcan's project licenses were also applied for on the basis that indicative fault zones from historical seismic data indicate areas of potential high brine flow rate, which combined with high lithium grades are the ingredients Vulcan believes are necessary for a commercial geothermal plus lithium extraction project. Two separate geothermal wells were analysed as part of Vulcan's 2019 sampling program: Landau and Insheim. Retained samples from Brühl geothermal well were also analysed for verification purposes. Samples at the Landau and Insheim geothermal operations were collected at two different sample points within the geothermal facility: the hot and cold circuits located on either side of the heat exchanger. Hence a total of five brine samples were collected by Vulcan. Brine samples were taken directly from the geothermal brine circuit at Landau and Insheim, whereas archivally collected brine samples obtained by Vulcan from GeoThermal Engineering GmbH, Vulcan's local consultant, were analysed from the Brühl well. In addition to the brine samples, a sample blank (composed of deionized water with no lithium) and a standard sample (a laboratory created Li-brine standard) were inserted into the sample stream at each sample site. Lastly, three aliquots of brine were collected at each sample point for various analytical work (i.e., anion chemistry and trace elements by total metal and dissolved metal analysis). Consequently, a total of 26 brine samples (and/or aliquots) were collected by Vulcan during their 2019 brine sampling program in the URG. The brine samples were analyzed at 3 separate laboratories: University of Karlsruhe and University of Heidelberg in Germany, and AGAT Laboratories in Edmonton, AB Canada.

Total metal and dissolved metal ICP-OES results are presented in the Table 3, observations of which are presented as follows:

- The total average lithium content of the brine analyzed by total metal ICP-OES is 181 mg/L Li. The total average lithium content of the brine analyzed by dissolved metal ICP-OES is 173 mg/L Li.
- The highest average inter-lab lithium content of the geothermal wells sampled is sample MK-3 (Insheim geothermal well) with an average of 194 mg/L Li followed by: sample MK-1 (Landau; 187 mg/L Li) and sample MK-5 (Brühl; 104 mg/L Li).
- The fact that brine collected from sample sites at the hot and cold circuit sites of the Landau and Insheim geothermal plants returned similar lithium values is encouraging because the test suggests that almost no lithium is lost during the geothermal processing.

[1] VUL ASX announcement 26/11/2019

- The Brühl well sample site contained the lowest lithium value; this could relate to the fact that Brühl represents a production test sample, hence may include some amount of contamination with non-lithium-bearing fluids. All other wells sampled by Vulcan are from geothermal operations, which would have a comparatively purified production circuit. Further testing is required.
- An assessment of the analytical results from the three laboratories used to analyse the Vulcan brine samples showed that there is very good data quality for Landau and Insheim (i.e., low coefficient of variation, or RSD%). Unfortunately, Vulcan was unable to analyse archived brine from the Brühl well at all three labs, due to the limited volume of brine available. However, reliable literature data exist for the production wells and is comparable to Vulcan Li-brine analytical results. For example,
    - Samples MK-1 and MK-2 from Landau well Gt La1 yielded an average of 187 mg/L Li. In comparison, brine from the same well yielded historical values[2] of 179 and 182 mg/L Li.
    - Samples MK-5 from the Brühl GT1 well had 104 mg/L Li; in comparison historical sampling contained 118 mg/L Li.
    - Sample MK-2 and MK-4 from the Insheim production well contained 183 and 194 mg/L Li; in comparison, historical sampling yielded 168 mg/L Li.

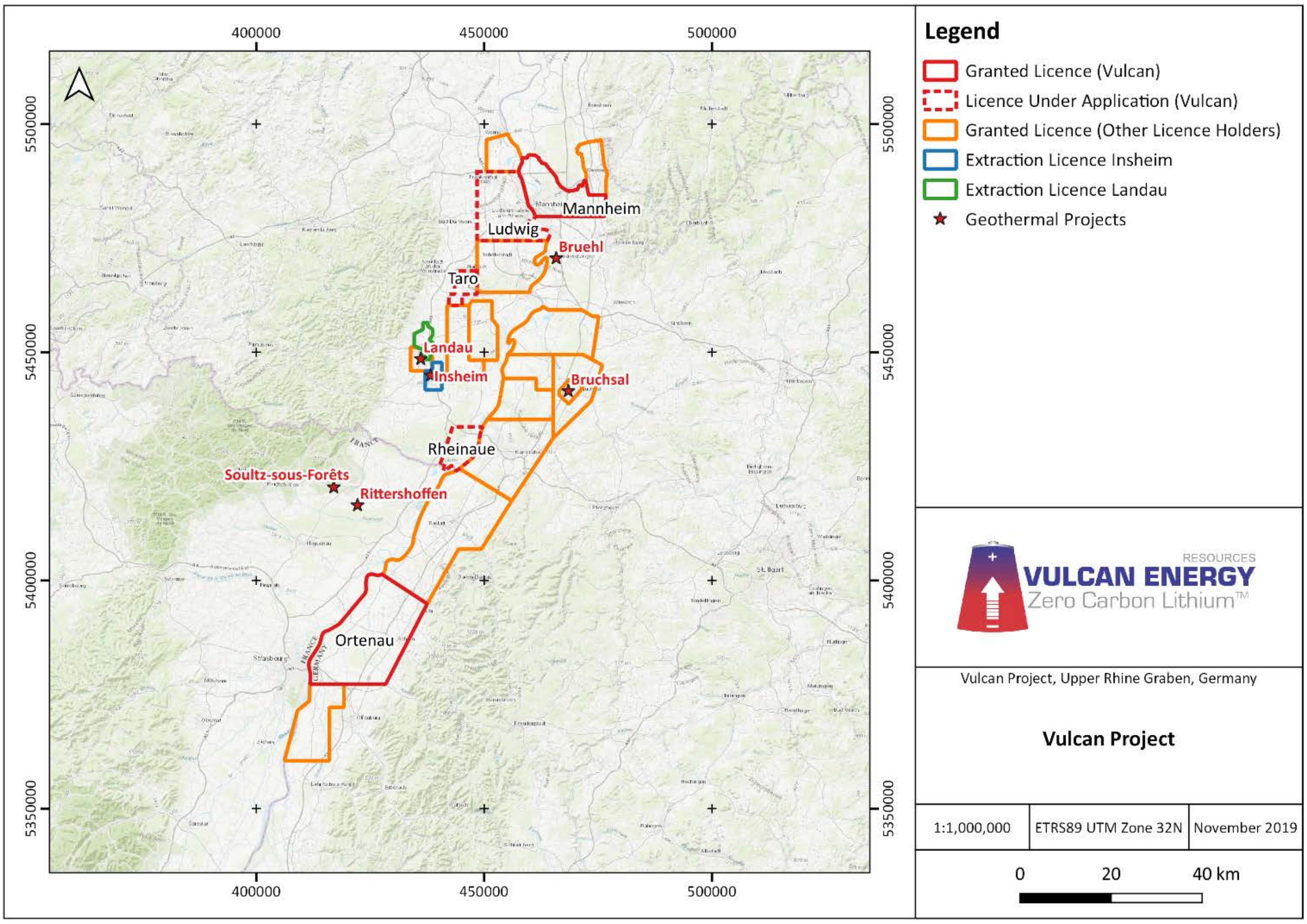


*Figure 1: Vulcan Project licenses, showing location of geothermal wells (Insheim, Brühl, Landau) that were sampled by Vulcan as part of the Company's 2019 brine sampling program.*

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[2] See VUL announcement 20/08/2019

*Table 1: Geothermal Well and Brine Sample Location Descriptions.*

| Sample ID | Sample type/media | Sample location (easting) | Sample location (northing) | Sample location name | Sample location well id | Sample point (hot or cold side of circuit) | Sample date | Formation aquifer sampled (fault/fractures) |
|---|---|---|---|---|---|---|---|---|
| MK 1-001-a | Brine | 3436152 | 5450302 | Landau | Gt La1 | Hot side | 8/10/2019 | Buntsandstein & Granite |
| MK 1-001-b | Brine | 3436152 | 5450302 | Landau | Gt La1 | Hot side | 8/10/2019 | Buntsandstein & Granite |
| MK 1-002 | Brine | 3436152 | 5450302 | Landau | Gt La1 | Hot side | 8/10/2019 | Buntsandstein & Granite |
| MK 2-001-a | Brine | 3436152 | 5450302 | Landau | Gt La1 | Cold side | 8/10/2019 | Buntsandstein & Granite |
| MK 2-001-b | Brine | 3436152 | 5450302 | Landau | Gt La1 | Cold side | 8/10/2019 | Buntsandstein & Granite |
| MK 2-002 | Brine | 3436152 | 5450302 | Landau | Gt La1 | Cold side | 8/10/2019 | Buntsandstein & Granite |
| MK 3-001-a | Brine | 3438343 | 5446624 | Insheim | GTI2 | Cold side | 8/10/2019 | Muschelkalk & Buntsandstein |
| MK 3-001-b | Brine | 3438343 | 5446624 | Insheim | GTI2 | Cold side | 8/10/2019 | Muschelkalk & Buntsandstein |
| MK 3-002 | Brine | 3438343 | 5446624 | Insheim | GTI2 | Cold side | 8/10/2019 | Muschelkalk & Buntsandstein |
| MK 4-001-a | Brine (archived sample) | 3438343 | 5446624 | Insheim | GTI2 | Hot side | 10/05/2017 | Muschelkalk & Buntsandstein |
| MK 4-001-b | Brine (archived sample) | 3438343 | 5446624 | Insheim | GTI2 | Hot side | 10/05/2017 | Muschelkalk & Buntsandstein |
| MK 4-002 | Brine (archived sample) | 3438343 | 5446624 | Insheim | GTI2 | Hot side | 10/05/2017 | Muschelkalk & Buntsandstein |
| MK 5-001-a | Brine (archived sample) | 3465862 | 5472347 | Brühl | GT1 | Production test | 30/03/2013 | Muschelkalk & Buntsandstein |
| MK 5-001-b | Brine (archived sample) | 3465862 | 5472347 | Brühl | GT1 | Production test | 30/03/2013 | Muschelkalk & Buntsandstein |
| MK 5-002 | Brine (archived sample) | 3465862 | 5472347 | Brühl | GT1 | Production test | 30/03/2013 | Muschelkalk & Buntsandstein |

*Table 2: Well details. The geothermal wells are typically collared with zero orientation and vertical dip (-90 degrees); however, due to the well length (often >2,200 m), switches to smaller diameter drill rods at depth, and drill methodologies to angle into near vertical fault zones, the wells commonly end up being deviated at depth. Of known well survey examples, the wells can deviate horizontally up to approximately 950 m. The total vertical depth of the wells sampled varies between 3,000 and 5,000 m depth.*

| | | | | | Surface orientation [1] | | |
|---|---|---|---|---|---|---|---|
| **Sample location Geothermal Plant name** | **Sample location well id** | **Sample location (easting, WGS84, Z32)** | **Sample location (northing, WGS84, Z32)** | **Collar elevation (m asl)** | **Well orien-tation (degrees)** | **Well dip (degrees)** | **Total vertical depth (m)** |
| Landau | Gt La1 | 436152 | 5450302 | 149.0 | 0 | -90 | 3,045 |
| Insheim | GTI2 | 438343 | 5446624 | 138.4 | 0 | -90 | 3,686 |
| Brühl | GT1 | 465862 | 5472347 | 98.3 | 0 | -90 | 3,285 |

[1] The wells are deviated at depth and the well deviation surveys/profiles is not known.

*Table 3: Summary of the lithium ICP-OES analytical results from Vulcan's 2019 brine sampling program. A) Lithium analyzed by total metals ICP-OES; and B) Lithium analyzed by dissolved metals ICP-OES. RSD% is standard deviation/mean x 100.*

| **A) Sample ID** | **Sample location** | **Sample point (hot or cold side of circuit)** | **Karlsruhe University (mg/l Li)** | **Heidelberg University (mg/l Li)** | **AGAT Laboratories (mg/l Li)** | **Average (mg/l Li)** | **RSD%** |
|---|---|---|---|---|---|---|---|
| MK 1 | Landau | Hot side | 181 | 182 | 198 | 187 | 5.1 |
| MK 2 | Landau | Cold side | 178 | 179 | 205 | 187 | 8.2 |
| MK 3 | Insheim | Cold side | 181 | 185 | 215 | 194 | 9.6 |
| MK 4 | Insheim | Hot side | 181 | 175 | 194 | 183 | 5.3 |
| MK 5 | Brühl | Production Test | 104 | / | / | / | / |

| **B) Sample ID** | **Sample location** | **Sample point (hot or cold side of circuit)** | **Karlsruhe University (mg/l Li)** | **Heidelberg University (mg/l Li)** | **AGAT Laboratories (mg/l Li)** | **Average (mg/l Li)** | **RSD%** |
|---|---|---|---|---|---|---|---|
| MK 1 | Landau | Hot side | 175 | 179 | 197 | 184 | 6.4 |
| MK 2 | Landau | Cold side | 183 | 184 | 173 | 180 | 3.4 |
| MK 3 | Insheim | Cold side | 180 | 180 | 176 | 179 | 1.3 |
| MK 4 | Insheim | Hot side | 175 | 176 | 161 | 171 | 4.9 |
| MK 5 | Brühl | Production Test | 107 | / | / | / | / |

*Table 4: Summary of the lithium ICP-MS analytical results from Vulcan's 2019 brine sampling program. These analyses were conducted at the University of Karlsruhe.*

| Sample ID | Location | Sample Point | Lithium (mg/l) analysed by total metals | Lithium (mg/l) analysed by dissolved metals |
|---|---|---|---|---|
| MK 1 | Landau | Hot side | 189 | 184 |
| MK 2 | Landau | Cold side | 182 | 180 |
| MK 3 | Insheim | Cold side | 184 | 179 |
| MK 4 | Insheim | Hot side | 179 | 185 |
| MK 5 | Brühl | Production Test | 114 | 114 |

*Figure 2: Sampling in progress*

## Vulcan Project Summary: Unique Zero-Carbon Lithium™ Production

World-first unique process to satisfy car manufacturers' stated desire for zero carbon Battery Electric Vehicle (BEV) raw materials supply chain.

### Potentially the Largest Lithium-Brine Project in EU & Globally Significant

Recent JORC Exploration Target[3] 10.73-36.20 Million Tonnes Contained Lithium Carbonate Equivalent (LCE)

### Secure Domestic Lithium Supply for EU

Auto industry and governments determined to reduce key threat of security of supply and reliance on China

### Lithium Brine: Ultra-Low Impact Project for EU

Ultra-low impact relative to hard-rock, recent permitting precedent in region; widespread social acceptance in EU

### Accelerated Path to Production

Agreement with Pfalzwerke geofuture GmbH allows access to operational geothermal brine plant

The **Vulcan Zero Carbon Lithium™ Project** is aiming to be Europe's and the **world's first Zero Carbon Lithium™ project**. It aims to do achieve this by producing **battery-quality lithium hydroxide** from hot, sub-surface geothermal brines pumped from wells, with a renewable energy by-product fulfilling all processing energy needs. The Vulcan Zero Carbon Lithium™ Project is strategically located, within a region well-serviced by local industrial activity, at the heart of the European auto and lithium-ion battery manufacturing industry, just 60km from Stuttgart. The burgeoning European battery manufacturing industry is forecast to be the world's second largest, with currently zero domestic supply of battery grade lithium products. The Company is concluding a Scoping Study at the project and is targeting a maiden JORC resource during Q4 2019.

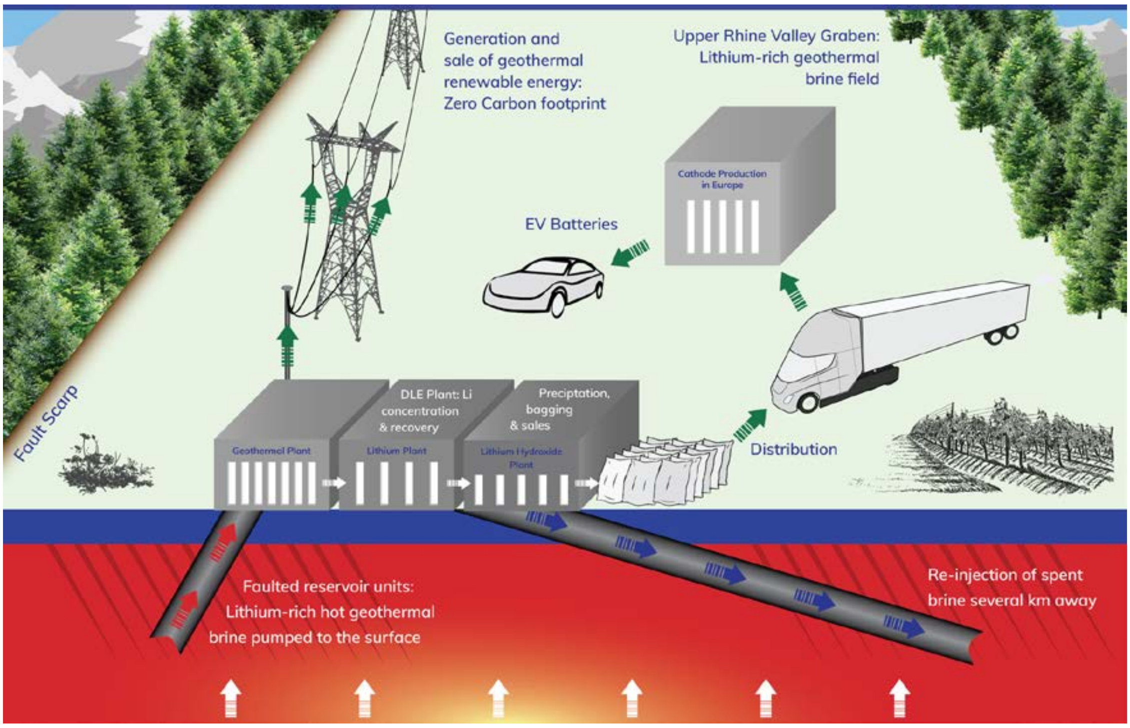


*Figure 3: Schematic of the Zero Carbon Lithium project*

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[3] VUL ASX release 20/08/2019

## Why Vulcan? Zero Carbon Supply Chains Required

BEV raw material supply chains have a carbon footprint problem, producing more $CO_2$ during production than Internal Combustion Engines (ICE). Car manufacturers are actively trying to reduce the carbon footprint of their battery supply chains to bolster the credibility of their BEV offerings. This will enable them to avoid financial emissions penalties and obtain premium pricing for lowest carbon footprint in production. Volkswagen, among others, is placing great importance on having a $CO_2$-neutral production supply chain for its very extensive new EV line-up, with a raw materials purchasing metric for sustainability put on par with price[4], and the goal of producing net zero carbon BEVs as delivered to the customer.

The European Commission is following suit, recently flagging that "$CO_2$ Passports" will be issued to BEVs detailing the full $CO_2$ footprint of each battery. The aim is to differentiate EU lithium-ion battery and BEV production, by producing uniquely low $CO_2$ products. High cost to offset $CO_2$ footprint of current lithium supply chain

Currently, there is no "zero carbon" lithium chemical product in the world, since all current extraction, processing and transport routes are very carbon intensive.

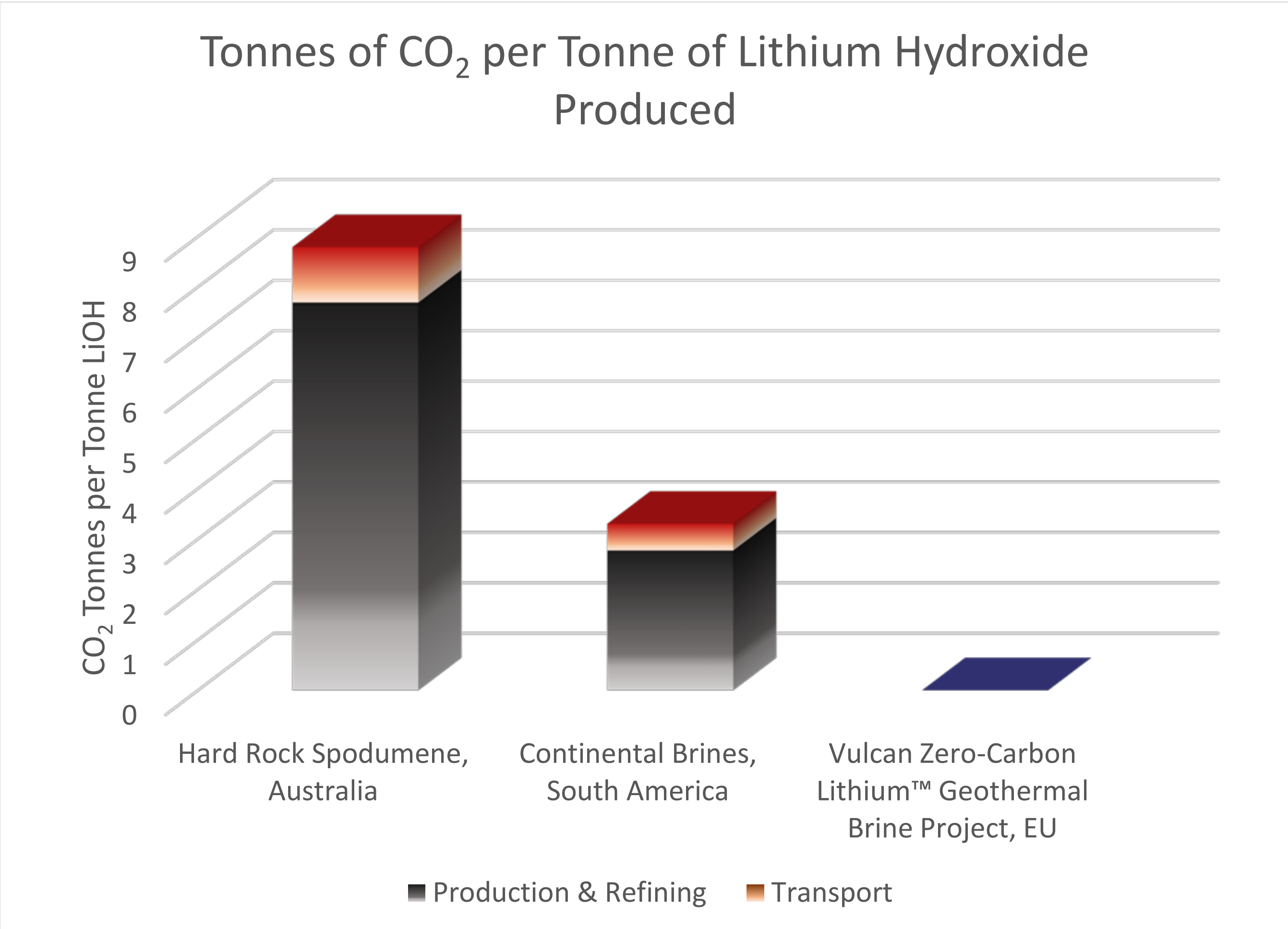


*Figure 4: $CO_2$ footprint of lithium sources relative to Vulcan Zero Carbon Lithium™ Project[5]*

[4] Volkswagen ID presentation, 2019
[5] See VUL Presentation 16/10/19

## Why Vulcan? Lithium Supply Chain Problematic

Hard-rock lithium production has a high OPEX and high $CO_2$ footprint due to its inherent energy requirement for mining, crushing and processing to producing battery quality lithium chemicals, as well its transport distance to major global markets. A processing bottleneck has also developed for spodumene concentrate going through lithium refinery plants in China, creating downward pressure on concentrate prices.

South American lithium brine operations make up the balance of current production. Because of their distance to market, remoteness and substantial use of reagents from North America, there is a substantial $CO_2$ footprint inherent in these operations also. These operations can also be very slow and unreliable in terms of producing battery quality lithium chemicals, as the evaporation process makes them vulnerable to weather events. The evaporation can also cause stresses on local environment and communities.

In parallel with this, there is an unprecedented ramping up of lithium-ion and associated cathode production in Europe. Forecasts show that the European Union (EU) is set to require the equivalent of the entire current global battery quality lithium demand by the mid-2020s, with 2023 being the main inflection point. There is currently zero EU production of battery-quality lithium hydroxide, let alone a $CO_2$-neutral product. A severe battery-quality lithium chemical supply shortfall is thus developing in the EU.

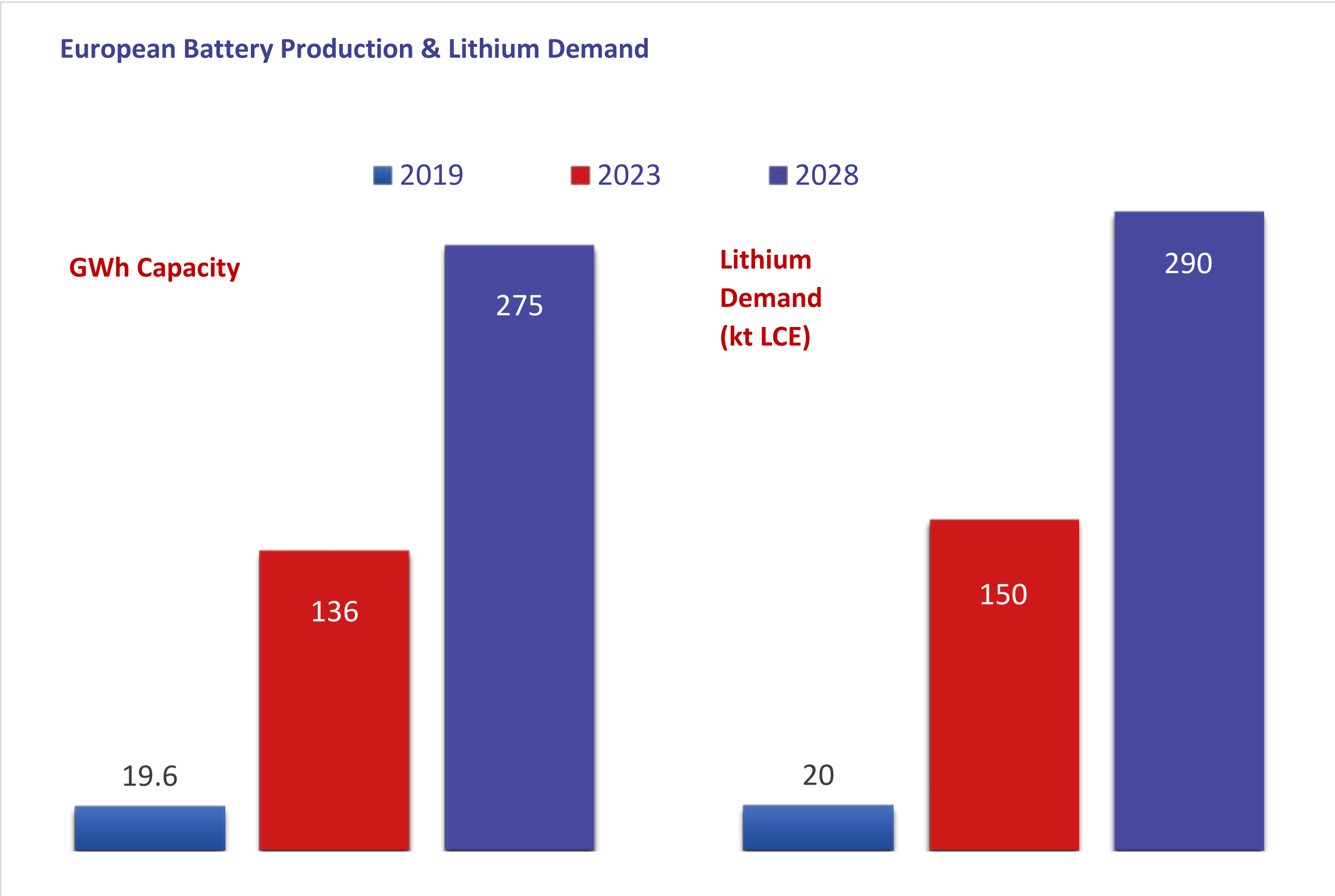


*Figure 5: Forecast battery production in EU and associated lithium demand*[6]

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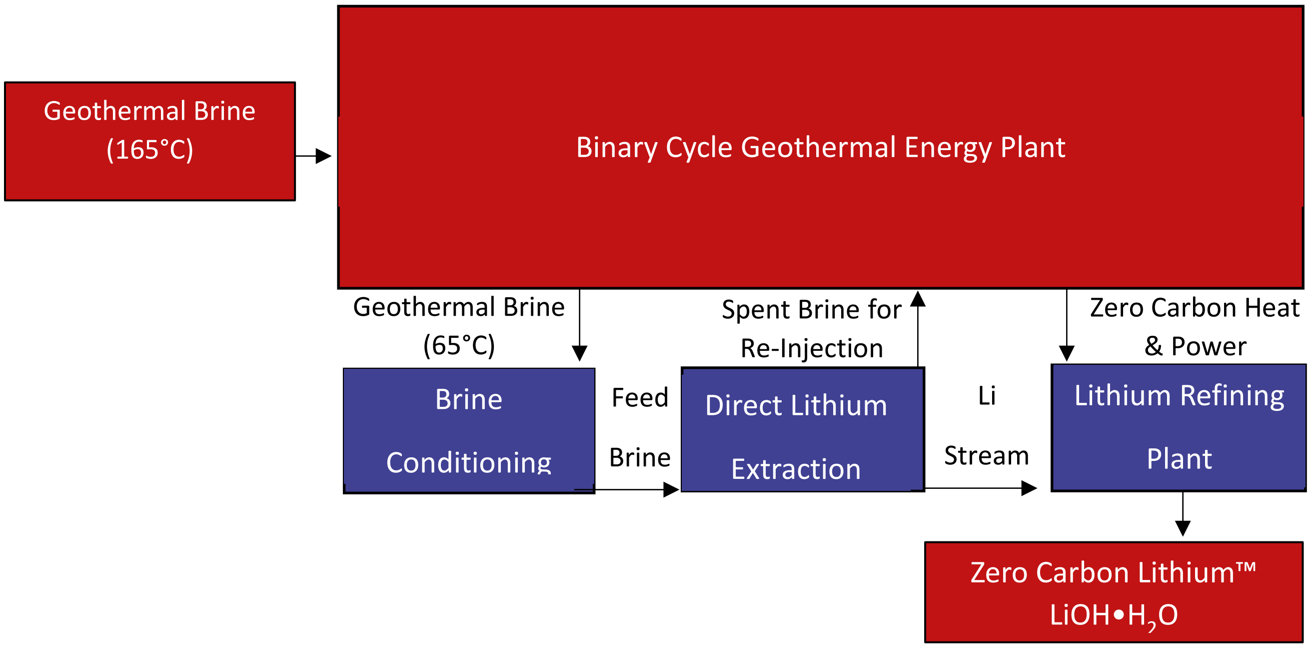
[6] See VUL Presentation 16/10/19

## Premium, Peerless & Disruptive Solution: Zero-Carbon Lithium™: Vulcan Project, Germany

The Company believes that the solution lies in the **Vulcan Zero Carbon Lithium™ Project.** This comprises a very large, lithium-rich geothermal brine field in the Upper Rhine Valley of South-West Germany, in the heart of the EU's battery "giga-factory" production.

The Zero Carbon Lithium™ production stems from a clever, unique process:

1. Standard geothermal production wells will be drilled into high flow rate, lithium-rich brine reservoir units, including the Buntsandstein unit. Geothermal energy wells have been successfully doing this for decades in the Upper Rhine Valley, so there is strong precedent. The heated brine is pumped up and produces geothermal energy via a binary cycle plant, which emits no $CO_2$.
2. Usually the spent brine would then be re-injected into the reservoir. In the Vulcan process, the spent brine gets diverted through a Direct Lithium Extraction (DLE) plant, where the vast majority of the lithium is extracted in less than an hour, while leaving other impurities. The brine is then re-injected into the reservoir minus the lithium. A new lithium stream of much higher concentration is formed for further processing and nothing is added to the brine. Livent has used a similar process to produce LiOH•H2O from Argentine brine for over 30 years. Importantly, such technologies have been successfully tested in California for the Salton Sea geothermal lithium field, which has similar brine characteristics to the Upper Rhine Valley brine, meaning a similar process can be used. Vulcan will fast-track project development through its relationships with the most successful groups in the DLE industry who have already de-risked the methods used.
3. A series of chemical operations convert the lithium stream into battery quality lithium hydroxide using conventional processes all previously demonstrated at commercial scale. Water is recycled, no toxic wastes are produced, and no gases are emitted. Heat and power from the geothermal plant are used, meaning no fossil fuels are burned, eliminating carbon emissions from lithium hydroxide processing. On top of being a zero-carbon product, it is expected that the Vulcan flowsheet will be a very low cost LiOH•H2O operation.



## Vulcan Project, Germany: Location, Location, Location

The **Vulcan Zero Carbon Lithium™ Project** is situated within one of the most well-studied and well-explored graben systems in the world. This means that the lithium-rich brine in the field is very well understood, and large amounts of seismic and geochemical data are readily available, reducing the need for exploration time and spend. Drilling data and existing wells are also available and can be used to shortcut project development. Based on historical data, the Upper Rhine Valley brines have been shown to have grades in the same order of magnitude as typical South American salars, in the hundreds of ppm Li, but with the advantage of readily available heat and power. Commonly, grades are >150mg/l Li in the Upper Rhine Valley at the depths targeted, with grades sometimes up to 210mg/l Li. The means that the Upper Rhine Valley brine field is one of the only geothermal brines in the world, the Salton Sea in California being the other main example, with both high flow rates and lithium grades within the brine reservoir. The Vulcan project represents a dominant license landholding within this brine field.

Importantly, as well as being European, the project is just 60km away from Stuttgart, the home of the German auto-industry. It is perfectly placed to reduce the transport footprint of lithium chemicals down to almost negligible amounts, both from a carbon cost and direct financial cost perspective. In addition, existing and recently permitted geothermal operations within the area are testament to the social and environmental acceptance of drilling geothermal wells within the region, in contrast with hard rock mining projects elsewhere in Europe. Indeed, the Insheim geothermal operation, which is the subject of Vulcan's MoU with Pfalzwerke geofuture, is surrounded by vineyards, showing the harmony of such operations with local communities.

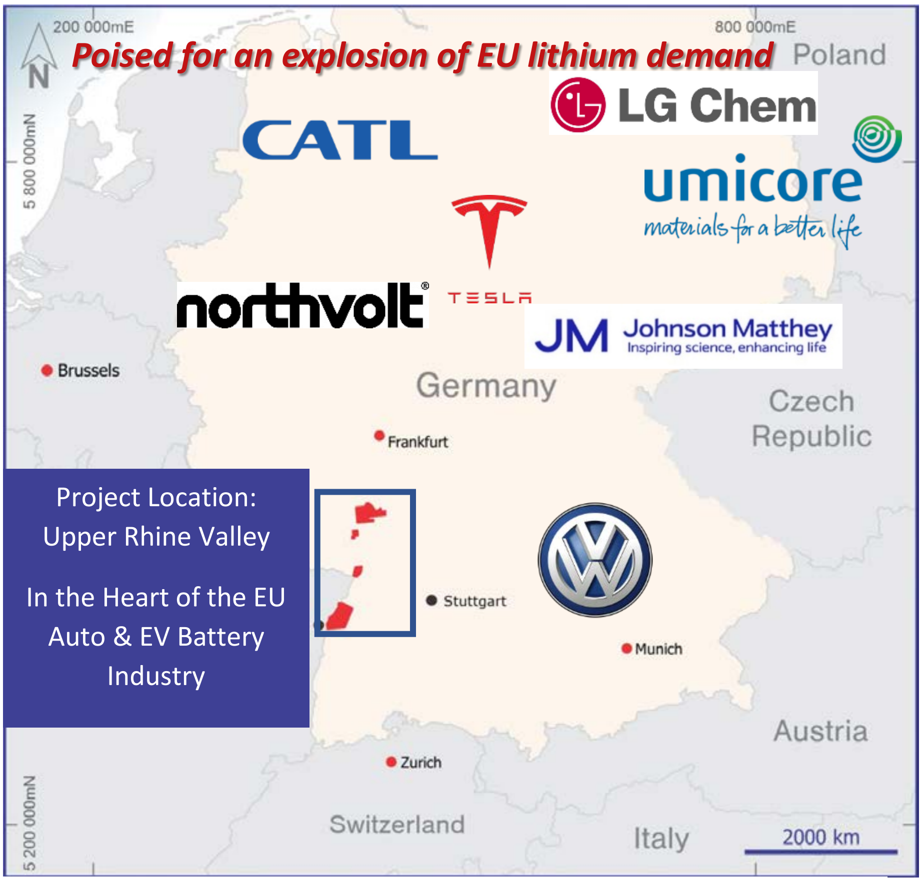



*Figure 6: Vulcan Zero Carbon Lithium™ Project Location*

**For and on behalf of the Board**

Mauro Piccini

Company Secretary

For further information visit www.v-er.com

**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.

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**Competent Person Statement:**

The technical information that forms the basis for this News Release has been prepared and reviewed by Mr. Roy Eccles P. Geol. and Mr. Steven Nicholls MAIG, who are both full time employees of APEX Geoscience Ltd. and deemed to be both a 'Competent Person'. Both Mr. Eccles and Mr. Nicholls have sufficient experience relevant to the style of mineralization and type of deposit under consideration and to the activity which they are undertaking to qualify as Competent Person as defined in the 2012 Edition of the Australian Code for the Reporting of Exploration Results, Mineral Resources, and Ore Reserves (JORC Code). Mr. Eccles and Mr. Nicholls consent to the disclosure of information in this News Release in the form and context in which it appears.

JORC Code 2012 Table 1. Section 1: Sampling Techniques and Data.

| Criteria | JORC Code Explanation | Commentary |
|---|---|---|
| **Sampling techniques** | • Nature and quality of sampling (eg cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.<br>• Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.<br>• Aspects of the determination of mineralisation that are Material to the Public Report.<br>• In cases where 'industry standard' work has been done this would be relatively simple (eg 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (eg submarine nodules) may warrant disclosure of detailed information. | • In 2019, Vulcan collected Buntsandstein Formation aquifer brine samples from 3 different geothermal wells in the Upper Rhine Graben area to verify historically reported lithium concentrations of the Buntsandstein Formation aquifer.<br>• Brine samples were taken from the brine circulating through the production circuit at 3 of the geothermal wells.<br>• The sample method and sampling documentation are in accordance with reasonable sampling expectations and Li-brine industry standards.<br>• Archival bine samples were stored at GeoThermal Engineering GmbH in air-tight containers and at approximately 20 °C<br>• Sample Blanks (deionized water with no lithium) and Sample Standards (laboratory prepared brine standard) were inserted into the sample stream.<br>• Collectively, a total of 26 brine samples (and/or aliquots) were collected by Vulcan during their 2019 brine sampling program.<br>• Vulcan maintained chain of custody of the brine samples from the geothermal well sample point to the respective laboratories in Germany (University of Karlsruhe and University of Heidelberg). Four brine samples were couriered to the Competent Person, Roy Eccles in Edmonton, Alberta Canada for analysis at a commercial Canadian Laboratory (AGAT Laboratories).<br>• The CP has reviewed the techniques and found the sampling was conducted using reasonable techniques in the field of brine assaying and there are no significant issues or inconsistencies that would cause one to question the validity of the sampling technique used by Vulcan. |
| **Drilling techniques** | • Drill type (eg core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (eg core diameter, triple or standard tube, depth of diamond tails, face- sampling bit or other type, whether core is oriented and if so, by what method, etc). | • Vulcan has used existing geothermal wells to access brine and has yet to conduct any drilling itself. |

| | | |
|---|---|---|
| **Drill sample recovery** | • Method of recording and assessing core and chip sample recoveries and results assessed.<br>• Measures taken to maximise sample recovery and ensure representative nature of the samples.<br>• Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material. | • Vulcan has used existing geothermal wells to access brine and has yet to conduct any drilling itself. |
| **Logging** | • Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.<br>• Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.<br>• The total length and percentage of the relevant intersections logged. | • No drilling conducted by Vulcan. Vulcan has used existing geothermal wells to access brine. Hence, no logging was conducted.<br>• Geothermal (and oil and gas) well logs are proprietary company-owned information in Germany; however, the CP compiled well information from publicly available manuscripts and reports to ascertain and validate subsurface stratigraphy.<br>• In addition, the project benefits from the data compiled in national geothermal information systems. This work was conducted by state geological surveys and coalitions of German Government and academic working groups, and include data and interpretations from more than 30,000 oil and gas wells, geothermal, thermal, mineral water and mining well boreholes in the Vulcan Project area and Upper Rhine Graben. |
| **Sub-sampling techniques and sample preparation** | • If core, whether cut or sawn and whether quarter, half or all core taken.<br>• If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.<br>• For all sample types, the nature, quality and appropriateness of the | • In 2019, Vulcan staff collected Buntsandstein Formation aquifer brine samples from 3 different geothermal wells in the Upper Rhine Graben area. Sample Blanks (deionized water with no lithium) and Sample Standards |

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| | sample preparation technique.<br>• Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.<br>• Measures taken to ensure that the sampling is representative of the in-situ material collected, including for instance results for field duplicate/second-half sampling.<br>• Whether sample sizes are appropriate to the grain size of the material being sampled. | (laboratory prepared brine standard) were inserted into the sample stream. In addition, three aliquots of brine were collected at each sample point for various analytical work (anion chemistry; trace metal ICP-OES; and dissolved metal ICP-OES). Collectively, a total of 26 brine samples (and/or aliquots) were collected by Vulcan during its 2019 brine sampling program.<br>• At two geothermal plants, brine was collected from the hot and cold circuit sample points to gain an understanding of whether the geothermal plant cycle has any influence on the lithium concentration as the brine cycles through the plant.<br>• Vulcan maintained chain of custody of the brine samples from the geothermal well sample point to the respective laboratories in Germany (University of Karlsruhe and University of Heidelberg). Four brine samples were couriered to the Competent Person, Roy Eccles in Edmonton, Alberta Canada for analysis at a commercial Canadian Laboratory (AGAT Laboratories). |
| **Quality of assay data and laboratory tests** | • The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.<br>• For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.<br>• Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established. | • Data verification procedures applied by the CP were performed to confirm the Li-brine mineralization. A brine sample collected by the CP during the site inspection was split and analyzed at two separate commercial labs in Edmonton, Alberta Canada (AGAT Laboratory and Bureau Veritas Laboratory). The analytical result of the CP/QP collected samples contained a mean value of 181 mg/L Li substantiating lithium-enriched brine in the deep Upper Rhine Graben aquifer.<br>• As per Vulcan's QA/QC, the Company commissioned the University of Alberta to prepare a laboratory prepared Sample Standard by adding a measured amount of elemental lithium to a saline brine concoction.<br>• A sample blank (composed of ionized water with no lithium) and a standard sample (a laboratory created Li-brine standard) were inserted into the sample stream at each sample site.<br>• The resulting data – as they pertain to the Sample Blank and Standard Sample |

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| | | samples – were excellent and show the analytical data were performed with high precision. The results helped the CP deem the data acceptable for the purpose of estimating a mineral resource.<br>• The lithium content (and trace elements) of the brine samples were analyzed by inductively coupled plasma optical emission spectrometry (ICP-OES), which is a standard analytical technique and industry standard for the measurement of lithium-in-brine.<br>• A split of Vulcan's 2019 samples from MK-1, MK-2, MK-3 and MK-4 was sent by courier to APEX and analyzed at AGAT Laboratories in Edmonton, AB Canada. A comparison of the analytical results between the three laboratories yields RSD% values of between 1.3% and 9.6%. It is concluded that there is very good data quality of Vulcan 2019 Li- brine analytical results between the three independent labs. |
| **Verification of sampling and assaying** | • The verification of significant intersections by either independent or alternative company personnel.<br>• The use of twinned holes.<br>• Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.<br>• Discuss any adjustment to assay data. | • Vulcan has yet to conduct any drilling or core sampling at the project.<br>• Data verification procedures applied by the CP were performed on key data components as they pertain to the mineral resource estimation presented in this Technical Report.<br>• Analytical brine data were prepared by independent and third-party universities and or accredited commercial laboratories.<br>• No adjustments were made, or necessary, to the original laboratory data.<br>• The CP has reviewed all geotechnical and geochemical data and found no significant issues or inconsistencies that would cause one to question the validity of the historical Li- brine geochemical data – and Vulcan's 2019 brine geochemical results – to verify that the Buntsandstein Formation aquifer is consistently enriched in lithium in the deep-seated strata and aquifer underlying the URG and the Vulcan licences. |

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| **Location of data points** | • Accuracy and quality of surveys used to locate drill holes (collar and down- hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.<br>• Specification of the grid system used.<br>• Quality and adequacy of topographic control. | • Vulcan has yet to conduct any drilling or core sampling at the project. Brine samples were collected from established geothermal wells (owned by geothermal companies other than Vulcan). One of the wells, Insheim, is the subject of an agreement between Vulcan and the operator (see announcement 26/11/2019). The collar locations of the geothermal wells are meticulously documented in the literature.<br>• The grid system used is UTM WGS84 zone 32N.<br>• The surface Digital Elevation Model used was acquired from JPL's Shuttle Radar Topography Mission (SRTM) dataset; the 1 arc-second gridded topography product provides a nominal 30 m ground coverage. |
| **Data spacing and distribution** | • Data spacing for reporting of Exploration Results.<br>• Whether the data spacing, and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.<br>• Whether sample compositing has been applied. | • Vulcan has yet to conduct any drilling and/or core sampling at the project.<br>• To help with due diligence, Vulcan acquired proprietary well log data for the a geothermal well located near the Taro and Rheinaue Licences. A comparison by the CP between the proprietary well log and GeORG cross-sections illustrated a very good correlation for the general stratigraphy and specific vertical characteristics of the Buntsandstein Formation sandstone unit.<br>• Historical and proprietary lithium concentrations have been compiled from throughout the Upper Rhine Valley in wells with highly variable spatial locations. Spacing between wells varied from proximal locations (<1 km) to up to 32 km apart.<br>• At surface, some of the geothermal wells sampled are situated outside Vulcan's individual Property licences. In this instance, the wells were sampled because there currently are no wells that penetrate deep-seated brine-saturated sandstone aquifers underlying the Property, except for Vulcan's agreement with the owner of the Insheim well. Based on the knowledge that: 1) deep-basin URG brine is lithium-enriched as per historical documentation; and 2) confined aquifers in graben systems can have massive spatial extent with homogeneous to semi-homogeneous lithium-in-brine concentrations, it is assumed that the Li-brine content of neighbouring wells are a good proxy of the lithium content in Triassic aquifers |

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| | | underlying the URG and the Vulcan Property. |
| **Orientation of data in relation to geological structure** | • Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.<br>• If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material. | • Vulcan has yet to conduct any drilling and/or core sampling at the project.<br>• The geothermal wells investigated as part of data compilation and Vulcan's brine sampling program include vertical wells (zero orientation with a dip of -90) which are deviated at depth to best intersect areas faulting and high fluid flow.<br>It is well documented that areas of faulting within the Permo-Triassic to basement deep-strata of the Upper Rhein Graben will have some influence on local fluid flow and are therefore targeted by geothermal companies. Zones of high fluid flow would also be targeted for Li-brine exploration. |
| **Sample security** | • The measures taken to ensure sample security. | • Vulcan's 2019 brine sampling program was conducted by Dr. Kraml of GeoThermal Engineering GmbH. Dr. Kraml collected the samples and maintained their chain of custody from sample site to delivery of the samples to the University of Karlsruhe and University of Heidelberg for analytical work. In addition, Dr. Kraml couriered brine samples to APEX for analytical work at the Canadian Laboratories; during transport, chain of custody was maintained from Dr. Kraml to the courier to the CP and to the laboratory.<br>• The CP collected two brine samples. The only time the samples were out of the possession of the CP is during the flight from Frankfurt to Edmonton (in a locked travel bag). The samples were delivered to laboratories by the CP. |
| **Audits or reviews** | • The results of any audits or reviews of sampling techniques and data. | • The CP assisted with, and reviewed, the adequacy of Vulcan's sample collection, sample preparation, security, analytical procedures, QA-QC protocol, and conducted a site inspection of the Vulcan License Area.<br>• In addition, the CP coordinated discussion and meetings involving methodologies and interpretation resulting from the exploration work to define the geometry and hydrogeological characterization of the Buntsandstein Formation aquifer that form the basis of the resource model. |

**JORC Code 2012 Table 1. Section 2: Reporting of Exploration Results.**

| Criteria | JORC Code Explanation | Commentary |
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| **Mineral tenement and land tenure status** | • Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.<br>• The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area. | • The Vulcan Property consists of: 1) two granted Exploration Licences (approximately 51,000 hectares; Ortenau and Mannheim); and 2) three in-application Licence Fields (an additional 27,600 hectares; Tara, Ludwig and Rheinaue; see Figure 1).<br>• The granted Exploration Licences (Mannheim and Ortenau) are held 100% by Vulcan Energy. The in-application Exploration Licences (Tara, Ludwig and Rheinaue) have an agreement in place with Global Geothermal Holding (GGH) in which Vulcan can earn a joint venture (JV) interest of 80%.<br>• Licence's Ortenau and Mannheim were granted on 1st of April 2019 and 18th of June 2019 respectively for a period of two years. The licence applications for Taro (submitted 26th of November 2018), Rheinaue and Ludwig (both submitted 24th of April 2019) are expected to be approved later this year or in 2020.<br>• The Licences are defined as 'Exploration Licences' and include the exploration rights to brine, hydrothermal and lithium. If required, Exploitation Rights would need be acquired pending the results of Vulcan's future exploration work. The Exploitation Licence is typically smaller in spatial area in comparison to the Exploration Licence and require advanced modelling of the aquifer production and injection wells.<br>• The holder of an exploration licence for commercial purposes shall pay an annual field royalty. The field royalty for the first year the licence is granted shall be EUR$5 per square kilometre or part thereof and shall increase for each subsequent year by EUR$5 per year, not to exceed EUR$25 per square kilometre or part thereof. The expenses incurred for exploration in the exploration licence field during the year shall be deducted from the field royalty for that year.<br>• The holder of an Extraction Licence shall pay an annual royalty for the freely mineable resources extracted or incidentally extracted from the extraction licence field. A mining royalty must not be paid for resources that are extracted exclusively for technical reasons and are not commercially exploited. The mining royalty shall be calculated as ten percent of the average attainable market value of |

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| | | resources of this type extracted under this Act within the assessment period. For resources without any market value, the competent authority shall determine the price on which the mining royalty shall be based in consultation with experts.<br>• Protected areas exist in each of the Licence’s and include: water protection areas (Zones I and II), nature conservation areas and Natura 2000 areas. |

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| **Exploration done by other parties** | • Acknowledgment and appraisal of exploration by other parties. | • The Upper Rhine Graben is being actively investigated for its geothermal potential by multiple companies (other than Vulcan).<br>• Exploration and Extraction Licences associated with the geothermal work is regulated by the *Federal Mining Act*, which manages and promotes the exploration, extraction and processing of mineral resources in Germany.<br>• A summary of historical brine geochemical analytical results was presented in a Vulcan news release dated 20/08/2019. Of the 43 historical brine analysis records, 6 analyses are from the Buntsandstein Formation aquifer and yield a mine brine composition of 158.1 mg/L Li. The historical data were presented in referred journal manuscripts and the CP has verified that the analytical protocols were standard in the field of brine analysis and conducted at university-based and/or accredited laboratories. |
| **Geology** | • Deposit type, geological setting and style of mineralisation. | • The potential lithium mineralization is situated within confined, subsurface aquifers associated with the Lower Triassic Buntsandstein Formation sandstone situated within the Upper Rhein Graben at depths of greater than approximately 1,120 m below surface.<br>• The Buntsandstein Formation is comprised predominantly of terrigenous sand facies deposited in arid to semi- arid conditions in fluvial, sandflat, lacustrine and eolian sedimentary environments.<br>• The various facies exert controls on the porosity (1% to 27%) and permeability (<1 to >100 mD) of the sandstone sub- units.<br>• Lithium mineralisation occurs with brine |

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| | | occupying the Buntsandstein Formation aquifer pore space.<br>• The chemical signature of the brine is controlled by fluid-rock geochemical interactions. With increasing depth, total dissolved solids (TDS) increases in NaCl-dominated brine. Lithium enrichment associated with these deep brines is believed to related to interaction with crystalline basement fluids and/or dissolution of micaceous materials at higher temperatures. |
| **Drill hole Information** | • A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:<br>o easting and northing of the drill hole collar<br>o elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar<br>o dip and azimuth of the hole<br>o down hole length and interception depth<br>o hole length.<br>• If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case. | • Vulcan has yet to conduct any drilling and/or core sampling at the project<br>• All relevant information is presented in figures within the body of this announcement. |
| **Data aggregation methods** | • In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.<br>• Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low-grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.<br>• The assumptions used for any reporting of metal equivalent values should be clearly stated. | • Vulcan has yet to conduct any drilling and/or sampling and is reliant on existing geothermal wells operated by companies other than Vulcan to acquire brine samples for analysis.<br>• The brine geochemical data presented in this technical report represent raw laboratory values, and no weighting average or truncation techniques were applied to the data. |

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| **Relationship between mineralisation widths and intercept lengths** | • These relationships are particularly important in the reporting of Exploration Results.<br>• If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.<br>• If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known'). | • Vulcan has yet to conduct any drilling and/or sampling and is reliant on existing geothermal wells operated by companies other than Vulcan to acquire brine samples for analysis.<br>• These wells were drilled at zero orientation and -90 dip down to 1,500m and then deviated to intersect the reservoir at high flow-rate positions. While intersections within these wells would be considered true width, the mineralization being sought is related to liquid brine within a confined aquifer. Consequently, intercept widths is a moot point as the well perforation points would essentially gather mineralized brine from the aquifer at large assuming the pumping rate is sufficient enough to orchestrate drawdown of the brine being sampled. |
| **Diagrams** | • Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views. | • All map images, including scale and direction information such that the reader can properly orientate the information being portrayed, are presented within the body of this announcement. |
| **Balanced reporting** | • Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results. | • Comprehensive reporting of all Exploration Results is presented in full.<br>• The CP does discuss a single outlier analytical result that does contain lower lithium in comparison to all other samples. The CP discusses pragmatic causes for the low outlier value including contamination and the potential for a zone of low Li-brine mineralization occurring within the Upper Rhine Graben. |
| **Other substantive exploration data** | • Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances. | • The CP provides meaningful data, discussion and due diligence with respect to compilation and data assessment. |
| **Further work** | • The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or | |

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| | large-scale step-out drilling).<br>• Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive. | • Acquisition of existing or new seismic profiles for detailed geological interpretation, including fault zone delineation to depict zones of high fluid flow; mineral processing test work on brine from the Vulcan License Area; Technical Reporting including a potential economic scoping study. |