

## Maiden Indicated Lithium-Brine Resource at the Insheim Licence, Vulcan Zero Carbon Lithium™ Project

### Highlights

- **Maiden Indicated Lithium-Brine Mineral Resource Estimation** completed at the Insheim Licence, subject to Vulcan's recent agreement with the Insheim Geothermal Plant owner-operator Pfalzwerke geofuture GmbH.
- **Indicated Mineral Resource of 722,000 t of contained Lithium Carbonate Equivalent (LCE)**, at the Insheim Licence with a lithium brine grade of 181 mg/l Li.
- Vulcan's combined global Resource now estimated at **13.95 Mt LCE (Indicated & Inferred) at 2 of 6 licences, the largest JORC-compliant Lithium Resource in Europe.**
- Scoping Study completion **on track for completion in Q1 2020.**
- Vulcan is the fastest growing lithium project in the world and is **leading the industry with its Zero Carbon Lithium™ Project.**

Managing Director, Dr. Francis Wedin commented: *"With Vulcan's Maiden Indicated Mineral Resource Estimate at Insheim, we are continuing to advance our Zero Carbon Lithium™ project at a rapid rate. The use of data from producing wells at Insheim allows for increased confidence in the resource category used. It increases the size of the JORC lithium resource at the Vulcan Project, already easily the largest in Europe, and increasingly highlights the potential for it to be the primary source for the European battery industry's lithium hydroxide needs, via a low-impact, Zero Carbon Lithium™ process powered by and sourced from geothermal wells. The supply-demand dynamic is compelling: European lithium-ion battery production is the fastest growing in the world, with new capacity plans announced regularly, but this market has zero local supply of battery-quality lithium hydroxide. We next look forward to updating our shareholders on our Scoping Study, the results of which are on track to be reported this quarter."*

### Highlights

**Large, lithium-rich** geothermal brine field, 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.

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

Access agreement in place with German geothermal operator at a **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

Executive Director  
Dr Horst Kreuter

### Fast Facts

Issued Capital: 48,500,002  
Market Cap (@16.5c): ~\$8m

### Contact

Suite 2, 1 Altona St,  
West Perth  
WA 6005 Australia  
08 6559 1792

Vulcan Energie Ressourcen GmbH  
Baischstr. 8, 76133 Karlsruhe

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

 @VulcanEnergyRes

### **Maiden Indicated Resource Estimate at the Insheim Licence**

Vulcan Energy Resources Ltd. (“Vulcan”, “VUL”, “the Company”) is pleased to announce the completion of the maiden Indicated Lithium-Brine Mineral Resource Estimate at the Insheim Licence, in the Upper Rhine Valley (or Upper Rhine Graben) of South-West Germany (Figure 1 & 2). The resource estimation (and previous Vulcan resource estimations) were completed by APEX Geoscience Ltd. and were conducted in consideration of, and in accordance with JORC (2012).

Vulcan has acquired direct access to lithium-enriched brine at the operating Insheim Geothermal Plant and Insheim Exploitation Licence via a binding Memorandum of Understanding with German utility Pfalzwerke geofuture GmbH (announced November 26, 2019; Vulcan Energy Resources Ltd., 2019). The Insheim Geothermal Plant is currently pumping hot (approximately 165° C), high-flow, lithium-enriched brine from aquifer depths of >2,980 m to the surface for power generation. Pfalzwerke geofuture GmbH is not processing or extracting lithium as part of the power generation circuit before the reinjecting the brine back down into the reservoir and the Memorandum of Understanding grants Vulcan an initial collaboration period that allows access to the Insheim Licence brine and data, with a pathway to construct a lithium extraction demonstration plant at Insheim in the future. The agreement marks a material milestone for Vulcan as the Company has obtained access (and a pathway to co-production lithium rights) to lithium-enriched brine from within the deep aquifer underlying the Insheim Exploitation Licence.

The Insheim Licence is 19 square kilometres and brings Vulcan’s total land position in the Upper Rhine Graben to 807.19 square kilometres (80,719 hectares; Figure 2). A total of 7 cross-sectional slices of interpreted geology from surface to basement spaced approximately 1 km apart were used to create the 3-D subsurface stratigraphic model (Figure 3). The original cross-sections were derived from GeORG, a publicly-available digital geological atlas of geothermal information. The subsurface model for the Insheim Licence was validated against 2-D seismic profiles and geothermal well data provided by Pfalzwerke geofuture GmbH.



*Figure 1: Aerial view of Insheim operational geothermal plant*

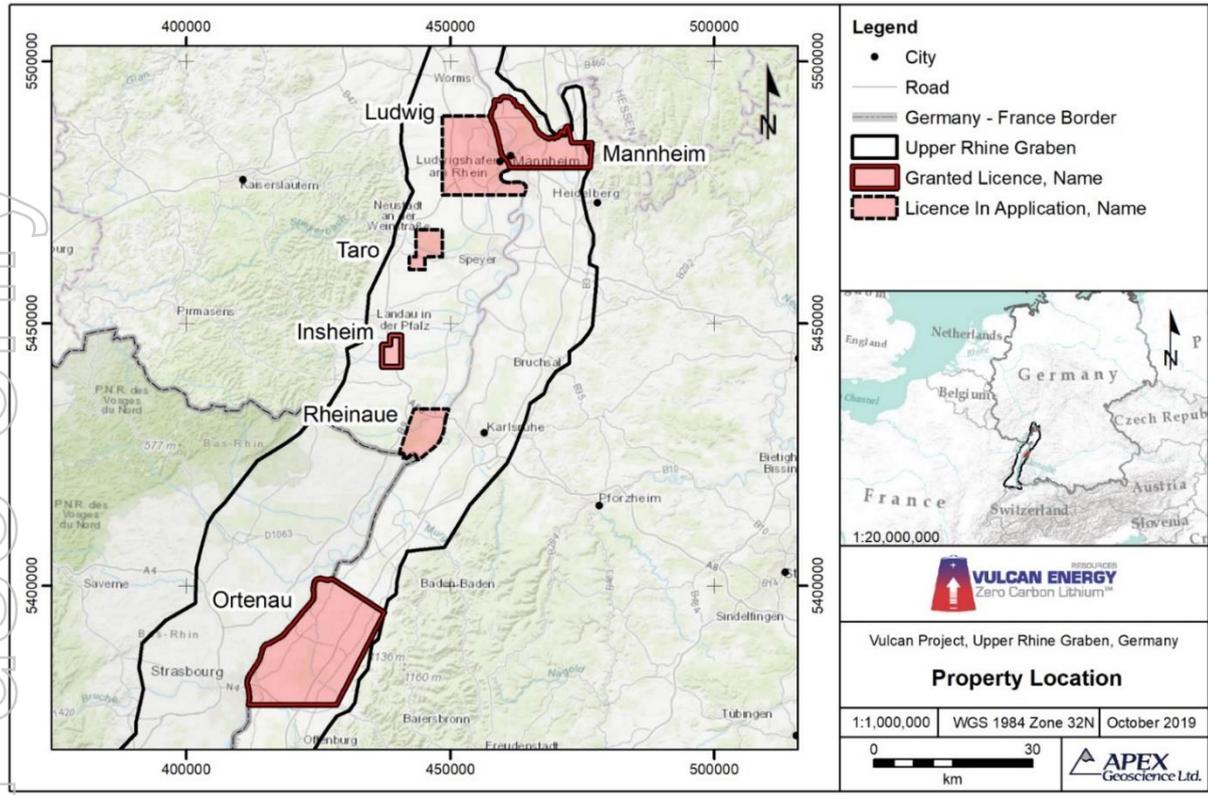


Figure 2: Location of Vulcan’s licences in the Upper Rhine Graben. Insheim is an Exploitation Licence and the remaining sub-properties are Exploration Licences.

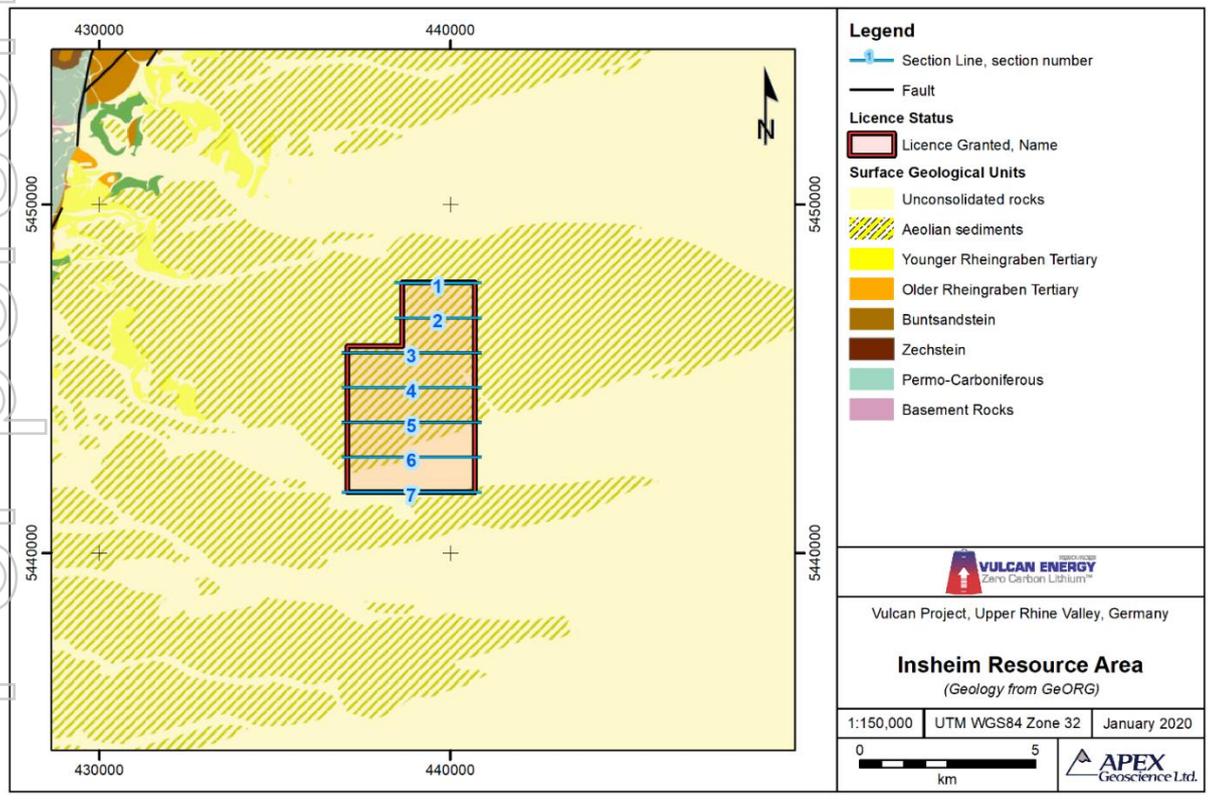


Figure 3: Detailed overview of the GeORG interpreted geological cross-sections used to create a 3-D geological model for use in the Insheim Licence resource estimation process.

Using the commercial mine planning software MicroMine (v 18.0), a resource domain area consisting of the Lower Triassic Buntsandstein and Permocarboniferous Rotliegend groups (Permo-Triassic strata) were wireframed as the main aquifer domain for the Insheim resource. The Permo-Triassic strata, which has an average thickness of 438 m, corresponds with Insheim production well perforation windows in which the well currently derives brine for geothermal power production (Figure 4). The Insheim Licence Permo-Triassic aquifer domain, or resource area, was clipped to the boundaries of the Insheim Licence. The Insheim Permo-Triassic aquifer domain was used to define the Insheim Licence aquifer volume.

Based on a review of over 1,800 publicly-available effective porosity measurements of the Permo-Triassic strata in the Upper Rhine Graben (and general region) a conservative average porosity of 9.0% was used in the Insheim resource calculation. Geothermal projects in the URG have documented sufficiently high flow rates and the Insheim Geothermal Plant is operated with a flow rate of 70 liters/second. It is assumed that brine accounts for 100% of the pore space within Permo-Triassic strata; hydrocarbons are situated within younger Tertiary stratums and at in-situ reservoir pressures, there is no gas phase present as the dissolved carbon species has not transformed to CO<sub>2</sub>. Resources have been estimated using a cutoff grade of 100 mg/L lithium. The average porosity and pore space percentage, together with the aquifer volume, was used to define the Insheim Licence brine volume.

The study of the Insheim Licence lithium-brine concentration was aided by the inclusion of 24 Insheim-specific brine analyses that included brine measured by Pfalzwerke geofuture GmbH (2015-2018), Vulcan (2019), the Competent Person (2019) and historical data (2016). A summary of the lithium assay data is presented in Table 1 and a mean Insheim Permo-Triassic aquifer brine lithium concentration of 181 mg/L Li was used in the Insheim Resource calculation.

*Table 1: Analytical summary of Insheim Geothermal Plant brine sampling analytical results. The grey shaded average lithium concentrations were used in the Insheim Resource calculation.*

	<b>Li (mg/L)</b>	<b>Count</b>	<b>%RSD</b>
<i>Average (all data)</i>	180.3	24	6.3
<i>Average (Pfalzwerke geofuture data)</i>	178.6	5	7.5
<i>Average (Vulcan data)</i>	181.6	16	6.2
<i>Average (Pfalzwerke geofuture &amp; Vulcan data)</i>	180.9	21	6.4
<i>Average (Pfalzwerke, Vulcan &amp; CP data)</i>	180.8	23	6.3
<i>CP Average</i>	180.0	2	7.1

The Insheim Exploitation Licence has been classified as an Indicated Resource because of the binding Memorandum of Understanding between Vulcan and Pfalzwerke geofuture GmbH, which permits access to the Permo-Triassic aquifer brine, and the enhanced understanding of the Insheim subsurface geology via seismic and well log data. The maiden Indicated Vulcan Li-Brine Resource estimation for the Insheim Licence is estimated at 136,000 tonnes of elemental lithium (Table 2). In order to describe the resource in terms of industry standard, a conversion factor of 5.323 is used to convert elemental Li to Li<sub>2</sub>CO<sub>3</sub>, or Lithium Carbonate Equivalent (LCE); the total LCE for the main Indicated Resource is 722,000 tonnes LCE. Mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no guarantee that all or any part of the mineral resource will be converted into a mineral reserve.

Table 2: Indicated Vulcan Li-Brine Resource Estimate of lithium-bearing brine within the Permo-Triassic strata aquifer domain at the Insheim Licence.

Reporting parameter	Insheim
Aquifer volume (km <sup>3</sup> )	8.322
Brine volume (km <sup>3</sup> )	0.749
Average lithium concentration (mg/L)	181
Average effective porosity	9.000
Total elemental Li resource (tonnes)	136,000
Total LCE (tonnes)	722,000

Note 1: Mineral resources are not mineral reserves and do not have demonstrated economic viability. Note 2: The weights are reported in metric tonnes (1,000 kg or 2,204.6 lbs). Numbers may not add up due to rounding of the resource values percentages (rounded to the nearest 1,000 unit). Note 3: The volume and weights are estimated at an average porosity of 9.0% and assumes brine occupies 100% of the pore space. Note 4: The Vulcan Li-brine Project estimation was completed and reported using a lower cut off of 100 mg/L Li. Note 5: In order to describe the resource in terms of industry standard, a conversion factor of 5.323 is used to convert elemental Li to Li<sub>2</sub>CO<sub>3</sub>, or Lithium Carbonate Equivalent (LCE). Note 6: The Indicated Resources at Insheim are subject to the terms of the MoU between Vulcan and Pfalzwerke geofuture as announced 26 November 2019. Vulcan has a pathway to earn up to 80% lithium rights at the project, after an initial collaboration period during a Pre-Feasibility Study, the subsequent formation of a legal Joint Venture, then by funding a Definitive Feasibility Study at the project.

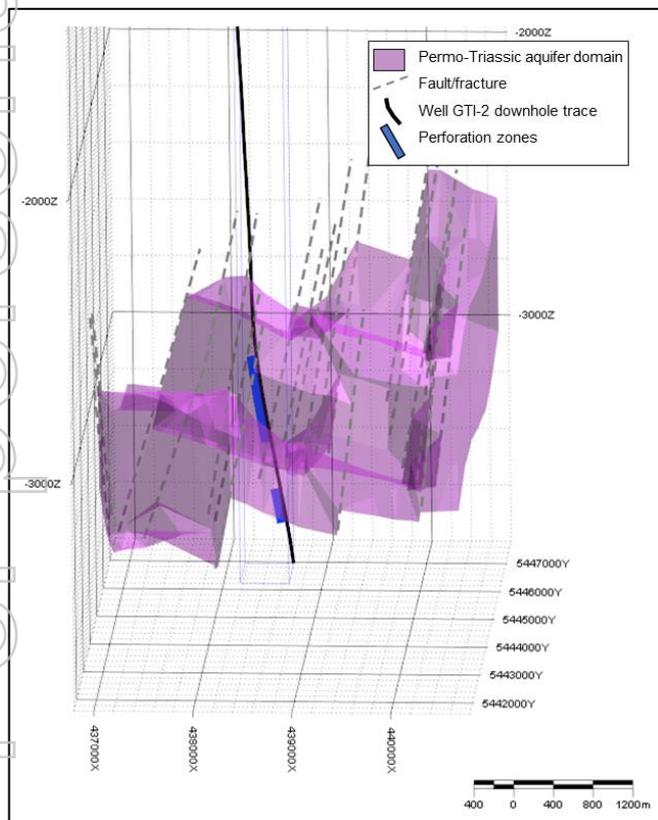


Figure 4: Rotated (facing north) 3-D model illustrating the Permo-Triassic aquifer domain at the Insheim Licence. Production well GTI-2 (black solid line) includes the perforation windows (shown in blue) that sample brine from the Permo-Triassic aquifer domain.

### Reiterated Inferred Mineral Resource Estimate at the Ortenau Licence

An Inferred Resource estimation at the Ortenau Exploration Licence was presented in a Vulcan News Release dated December 4, 2019 and remains unchanged. The Ortenau License was assessed using the resource modelling and estimation processes outlined above (for the Insheim Licence) with the following exceptions:

- Conservatively, only the Lower Triassic Buntsandstein Group aquifer was wireframed and modelled for the Ortenau Licence, because the resource area is not as well defined and Insheim has an abundance of subsurface information.
- The Ortenau resource estimation used an average porosity of 9.5% (with respect to Insheim, an average porosity of 9.0% was used because the underlying Rotliegend Group porosity was determined to have a slightly lower than porosity than the Buntsandstein Group and therefore the Permo-Triassic porosity is lower).

As outlined in Vulcan News Release dated December 4, 2019, the Inferred lithium-brine resource estimate at the Ortenau Licence was 2.48 million tonnes of elemental lithium, or 13.225 M tonnes of LCE.

Mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no guarantee that all or any part of the mineral resource will be converted into a mineral reserve. While it would be reasonable to expect that the majority of Inferred Mineral Resources would upgrade to Indicated Mineral Resources with continued exploration, due to the uncertainty of Inferred Mineral Resources it should not be assumed that such upgrading will always occur. There is no direct link from an Inferred Mineral Resource to any category of Ore Reserves.

*Table 3: Inferred Vulcan Li-Brine Resource Estimate of lithium-bearing brine within the Buntsandstein Group aquifer domain at the Ortenau Licence (see Vulcan's December 4, 2019 News Release for more information). The table also includes the Indicated Vulcan Li-Brine Resource Estimate at the Insheim Licence (see previous text) to provide a combined global Resource now estimated at 13.95 Mt LCE (Indicated & Inferred).*

Category	Aquifer Volume (km <sup>3</sup> )	Brine Volume (km <sup>3</sup> )	Average Lithium Concentration (mg/l Li)	Average Effective Porosity	Total Contained Elemental Li Resource Tonnes	Total Contained Lithium Carbonate Equivalent (LCE) Million Tonnes
Indicated (Insheim License)	8.322	0.749	181	9.00	136,000	0.722
Inferred (Ortenau License)	144.489	13.726	181	9.50	2,484,000	13.225
<b>Total</b>	<b>152.811</b>	<b>14.475</b>	<b>181</b>	<b>9.47</b>	<b>2,620,000</b>	<b>13.95</b>

Note 1: Mineral resources are not mineral reserves and do not have demonstrated economic viability. Note 2: The weights are reported in metric tonnes (1,000 kg or 2,204.6 lbs). Numbers may not add up due to rounding of the resource values percentages (rounded to the nearest 1,000 unit). Note 3: The volume and weights are estimated at average porosities of 9.0% and 9.5% for the Insheim and Ortenau resources, respectively. Note 4: The Vulcan Li-brine Project estimation was completed and reported using a lower cut off of 100 mg/L Li. Note 5: In order to describe the resource in terms of industry standard, a conversion factor of 5.323 is used to convert elemental Li to Li<sub>2</sub>CO<sub>3</sub>, or Lithium Carbonate Equivalent (LCE). Note 6: The Indicated Resources at Insheim are subject to the terms of the MoU between Vulcan and Pfalzwerke geofuture as announced 26 November 2019.

## Reiteration of Exploration Targets for Remaining License Areas

Exploration Target estimations for the Mannheim, Taro, Ludwig and Rheinaue Exploration Licences were presented in a Vulcan News Release dated August 20, 2019 and remain unchanged. The total Exploration Target (i.e., the sum of Exploration Targets from all four licences) was calculated using a range of potential volume, porosity and lithium concentration and estimated between 889,000 tonnes to 3.00 million tonnes of elemental lithium, or 4.73 to 15.98 million tonnes of LCE.

The Exploration Target's potential quantity and grade is conceptual in nature, there has been insufficient exploration to estimate a Mineral Resource, and it is uncertain if further exploration will result in the estimation of a Mineral Resource. The Exploration Targets should not be misrepresented or misconstrued as an estimate of a Mineral Resource or Ore Reserve.

*Table 4: Summary of the lithium-brine Exploration Targets at the Vulcan Lithium Project (see Vulcan's August 20, 2019 News Release for more information).*

Licence name	Buntsandstein volume (m <sup>3</sup> )		Porosity (%)		Lithium (mg/L)		Elemental lithium (tonnes)		Lithium carbonate equivalent (tonnes)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Mannheim	26,330,185,372	39,495,278,058	7.6	11.4	126	190	253,000	855,000	1,349,000	4,552,000
Taro	12,242,856,163	18,364,284,244	7.6	11.4	126	190	118,000	398,000	627,000	2,116,000
Ludwig	34,796,431,605	52,194,647,408	7.6	11.4	126	190	335,000	1,130,000	1,782,000	6,015,000
Rheinaue	19,052,986,884	28,579,480,326	7.6	11.4	126	190	183,000	619,000	976,000	3,294,000
<b>Total</b>	<b>92,422,460,024</b>	<b>138,633,690,036</b>	<b>7.6</b>	<b>11.4</b>	<b>126</b>	<b>190</b>	<b>889,000</b>	<b>3,002,000</b>	<b>4,734,000</b>	<b>15,977,000</b>

Note 1: The Exploration Target's potential quantity and grade is conceptual in nature, there has been insufficient exploration to estimate a Mineral Resource, and it is uncertain if further exploration will result in the estimation of a Mineral Resource. Note 2: Buntsandstein volume ranges have been taken from the three-dimensional wireframed model created by APEX. The weights are reported in metric tonnes (1,000 kg or 2,204.6 lbs). Note 3: Porosity is based on historical studies and information from GeORG, including measurements on core plugs (effective porosity); the porosity is intended to reflect the combined lithostratigraphic porosities of the entire Buntsandstein Formation section. In a 'confined' aquifer (as reported), porosity is a proxy for specific yield. Note 4: The lithium concentration is based on 6 publicly available Buntsandstein Formation lithium analyses from throughout the Upper Rhine Graben. Note 5: Numbers may not add up due to rounding of the resource values percentages (rounded to the nearest 1,000 unit). Note 6: The Exploration Targets are reported using a cut-off of 100 mg/L Li. Note 7: A conversion factor of 5.323 is used to convert elemental Li to Li<sub>2</sub>CO<sub>3</sub>, or Lithium Carbonate Equivalent (LCE).

### Next Steps

Exploration works will continue targeting resource definition in areas with Exploration Targets, and to upgrade confidence category in areas with Inferred or Indicated Resources. These works are likely to include the collection of bulk brine sample(s) for lithium processing and recovery testwork, seismic data acquisition and processing, and further geochemical sampling from wells in the region.

## **Appendix One: Summary of the Insheim Maiden Resource Estimate and Reporting Criteria**

*As per ASX Listing Rule 5.8 and the JORC 2012 reporting guidelines, a summary of the material information used to estimate the Mineral Resource is detailed in the following pages (for more detail please refer to JORC Table 1, Sections 1 to 3 presented in Appendix 3).*

*The Technical Report was prepared by a multi-disciplinary team of geologists, geothermal specialists and chemical engineers with relevant experience in brine geology, brine resource modelling and estimation, and lithium-brine processing. The author and Competent Person, Mr. Roy Eccles M.Sc. P. Geol. of APEX Geoscience Ltd. (APEX) in Edmonton, Alberta Canada, takes overall responsibility for the Technical Report, including report collaborator contributions, and the maiden mineral resource estimate.*

### **Property Location and Description**

The Vulcan Property is comprised of five separate and non-contiguous Exploration Licences within the Upper Rhine Valley of southwest Germany that include: Mannheim; Ludwig; Taro; Rheinaue and Ortenau. In addition, Vulcan has formed a binding Memorandum of Understanding with Pfalzwerke geofuture GmbH that establishes an initial collaboration period to test lithium from brine extraction feasibility at the Insheim Exploitation Licence, which represents an established and operating geothermal Exploitation Licence.

The Vulcan Lithium Project is strategically located at the heart of the European auto and lithium-ion battery manufacturing industry. Collectively, the five Exploration Licences encompass a land position of 788.19 square kilometres (78,819 hectares) with the Insheim Exploitation Licence adding another 19.00 square kilometres (1,900 hectares). Collectively, the total size of the Vulcan Property land position is 807.19 km<sup>2</sup> (80,719 hectares). All licences occur within the German states of Baden-Württemberg and Rheinland-Pfalz near the cities of Mannheim and Karlsruhe, Germany and the France-Germany border city of Strasbourg. With respect to the Insheim Exploitation Licence, the binding Memorandum of Understanding was announced on November 26, 2019 (see Vulcan News Release dated November 26, 2019). The agreement has an initial collaboration period in which Pfalzwerke geofuture GmbH will supply brine and well data from its operational Insheim Geothermal Power Plant for Vulcan to conduct geological, lab-scale pilot test work and engineering, and financial studies toward a Pre-Feasibility Study. Upon successful completion, a legal Joint Venture may be formed with Vulcan earning up to 80% Joint Venture interest in the lithium-brine project and lithium rights at the Insheim Geothermal Plant by successfully completing a Definitive Feasibility Study.

### **Geology and Geological Interpretation**

The Property is located within the Upper Rhine Graben of south western Germany. The Upper Rhine Graben is characterized as a roughly Azimuth 020° orientated Cenozoic graben that is composed of Permian to Tertiary sedimentary rocks and Quaternary surficial deposits with minor Tertiary volcanism. The basement is unconformably overlain by Permocarboniferous Rotliegend and Zechstein groups that are dominated by fluvial and aeolian depositional environments. A pervasive Lower Triassic succession of continental sandstone defines the Buntsandstein Group. The Permo-Triassic aquifer domain modelled in the Insheim Resource is defined by the combined Permocarboniferous and Lower Triassic Buntsandstein Group sedimentary, sandstone-dominated, rock units.

Recent German Government policy emphasizes conservation and promotes the development of renewable sources. Consequently, emphasis on stratigraphically deep geothermal wells in the Upper Rhine Graben has created access points to acquire deep, geothermally heated, lithium-enriched brine associated with the Buntsandstein Group sandstone aquifer and Permo-Triassic strata sitting on top of the crystalline basement. The geothermal well at the Insheim Exploitation Licence targets a hydrogeological- connected fracture network that encompasses the Buntsandstein Group sandstone, its underlying Permocarboneous Rotliegend Group sandstone, and the uppermost portion of a highly faulted, fractured and altered granitic basement. Production well perforation windows target this Permo-Triassic stratigraphic succession and further define the Insheim Permo-Triassic aquifer domain for resource modelling. The Permo-Triassic strata at the Insheim Licence, which include sandstone-dominated aquifers of the Lower Triassic Buntsandstein and Permian Rotliegend groups, have a mean thickness of 438 m.

### **2019 Vulcan Exploration Program**

Vulcan conducted a 2019 data compilation and brine sampling program that consisted of:

1. A geological compilation and subsurface review of the Buntsandstein Group and Permo-Triassic stratigraphy toward development of 3-D geological models at each of the Vulcan Property Licences. The modelling at the Insheim Licence benefited from access to 2-D seismic profiles and detailed well data that included lithologs and downhole geophysical surveys;
2. An assessment of the hydrogeological conditions underlying the Vulcan Project in the Upper Rhine Graben; and
3. Collection and analysing Buntsandstein Group brine samples from Property-neighbouring geothermal wells and Permo-Triassic brine samples at the Insheim Licence to verify historical Li-brine geochemical results and formulate mean lithium concentration values for resource calculations.

The 3-D geological modelling was completed by APEX who conducted due diligence reviews to validate GeORG (a public geodatabase in Germany) cross-sections, which were created using historical seismic data. The hydrogeological assessment was conducted by Dr. Michael Kraml of GeoThermal Engineering GmbH using publicly available information. The geochemical analytical work was completed by independent university laboratories (University of Heidelberg and University of Karlsruhe), and accredited commercial laboratories (AGAT Laboratory and Bureau Veritas Laboratories in Edmonton, AB). A total of 3 wells were drilled by Pfalzwerke geofuture GmbH at the Insheim Licence (Figure 6). Their drill date, locations, orientations, dips and true vertical and measured depths are described in Table 5. The production well, GTI-2, has two perforation zones at depths of 2,981 to 3,337 m (356 m total depth window) and 3,537 to 3,684 m (147 m total depth window). The GTI-2 well perforation windows access aquifer brine from the Buntsandstein Group and Rotliegend Group sandstone aquifers, and the fractured uppermost granitic basement surface.

The average lithium content from brine collected by Vulcan from six geothermal wells located throughout the Upper Rhine Graben and proximal to the Vulcan Project licences was 181 mg/L Li (n=13 total metal analyses by ICP-OES). In addition, a detailed assessment of the lithium-in-brine content at the Insheim geothermal production well GTI-2 includes 2015-2018 geochemical analysis as conducted by Pfalzwerke geofuture GmbH (n=5 analyses) together with

2019 analytical work as completed by Vulcan (n=16 analyses), the Competent/Qualified Person (n=2 analyses) and historical analysis by Sanjuan et al. (2016; n=1). Collectively, the average lithium content in Permo-Triassic aquifer brine at the Insheim Geothermal Plant also yields 181 mg/L Li (n=23 analyses), which is identical to the regional Li-brine value.

The Vulcan analytical work includes multiple laboratories (universities of Karlsruhe and Heidelberg, and AGAT Laboratories) and multiple analytical techniques (total metal ICP-OES, dissolved metal ICP-OES and dissolved metal ICP-MS). The CP analytical work includes analysis at two Canadian laboratories: Bureau Veritas and AGAT Laboratories. In total, there are 24 separate analytical results on Permo-Triassic brine at the Insheim Geothermal Plant. A summary of the analytical lithium results of all Insheim Geothermal Plant brine samples is presented in Figure 5. The Competent Person considered various combinations of analytical mean results. The mean value of the combined Pfalzwerke geofuture - Vulcan (n=21) and Pfalzwerke geofuture -Vulcan-CP (n=23) data are 180.9 mg/L Li and 180.8 mg/L Li, respectively best summarize the mean lithium concentration of the Insheim Geothermal Plant Permo-Triassic brine (181 mg/L Li).

Table 5: Description of the Insheim Geothermal Plant production and reinjection wells.

Well name	Well type	Drill year	Easting (m, WGS84, Z32)	Northing (m, WGS84, Z32)	Elevation (m asl)	Orientation (Azimuth °)	Dip (depth interval)	Casing diameters (cm)	True vertical depth (m)	Measured depth (m)
GTI-1	Reinjection	2008	438343 (collar) 438753 (EOH)	5446624 (collar) 5446035 (EOH)	139.78	145.67	-89° E (0 to 1,200 m) -72° E (1,200 to EOH)	76, 34, 18	3,548	3,654
GTI-1b	Reinjection	2009	438343 (collar) 438802 (EOH)	5446624 (collar) 5446098 (EOH)	139.78	146.31	-90° E (0 to 750 m) -75° E (750 to EOH)	76, 34, 18	3,750	3,848
GTI-2	Production	2009	438343 (collar) 438809 (EOH)	5446624 (collar) 5447291 (EOH)	139.78	34.06	-89° E (0 to 1,425 m) -64° E (1,425 to EOH)	76, 34, 18	3,672	3,848

<sup>1</sup> The wells are deviated at depth and the well deviation surveys/profiles is not known.

A) Analyzed by Pfalzwerke Geofuture GmbH (2015-2018).

Sample ID	Sampling date	Lithium (Li) mg/L
GTI-2	01-Jun-16	197
GTI-2	01-Feb-17	174
GTI-2	29-May-17	188
GTI-2	26-Feb-18	165
GTI-2	19-Sep-18	169
<b>Average</b>		178.6
<b>RSD%</b>		7.5

B) Analyzed in 2019 by Vulcan Energy Resources Ltd. (by total metal ICP-OES).

Sample ID	Sample point	University of Karlsruhe	University of Heidelberg	AGAT Laboratories	Average	RSD%
MK 3	Cold side	181	185	215	193.7	9.6
MK 4	Hot side	181	175	194	183.3	5.3

C) Analyzed in 2019 by Vulcan Energy Resources Ltd. (by dissolved metal ICP-OES).

Sample ID	Sample point	University of Karlsruhe	University of Heidelberg	AGAT Laboratories	Average	RSD%
MK 3	Cold side	180	180	176	178.7	1.3
MK 4	Hot side	175	176	161	170.7	4.9

D) Analyzed in 2019 by Vulcan Energy Resources Ltd. (by ICP-MS).

Sample ID	Sample point	Lithium (mg/L) analyzed by total metals	Lithium (mg/L) analyzed by dissolved metals
MK 3	Cold side	184	179
MK 4	Hot side	179	185
<b>Average</b>		181.5	182.0
<b>RSD%</b>		1.9	2.3

E) Analyzed in 2019 by the Competent/Qualified Person

Sample ID	Sample point	Laboratory	Li total metals (mg/L)
RE19-INS-001	Cold side	AGAT Laboratories	189
RE19-INS-002	Cold side	Bureau Veritas	171
<b>Average</b>			180.0

F) Historical analysis. Source: Sanjuan et al. (2016)

Sample ID	Sample date	Li (mg/L)
INSH	10-Jun-13	168.0

G) Mean summary of various analysis

	Li (mg/L)	Count	%RSD
Average (all data)	180.3	24	6.3
Average (Pfalzwerke data)	178.6	5	7.5
Average (Vulcan data)	181.6	16	6.2
Average (Pfalzwerke and Vulcan data)	180.9	21	6.4
Average (Pfalzwerke, Vulcan and CP/QP data)	180.8	23	6.3
CP/QP average	180.0	2	7.1

Figure 5: Summary of all lithium geochemical analysis conducted on Insheim Geothermal Plant brine.

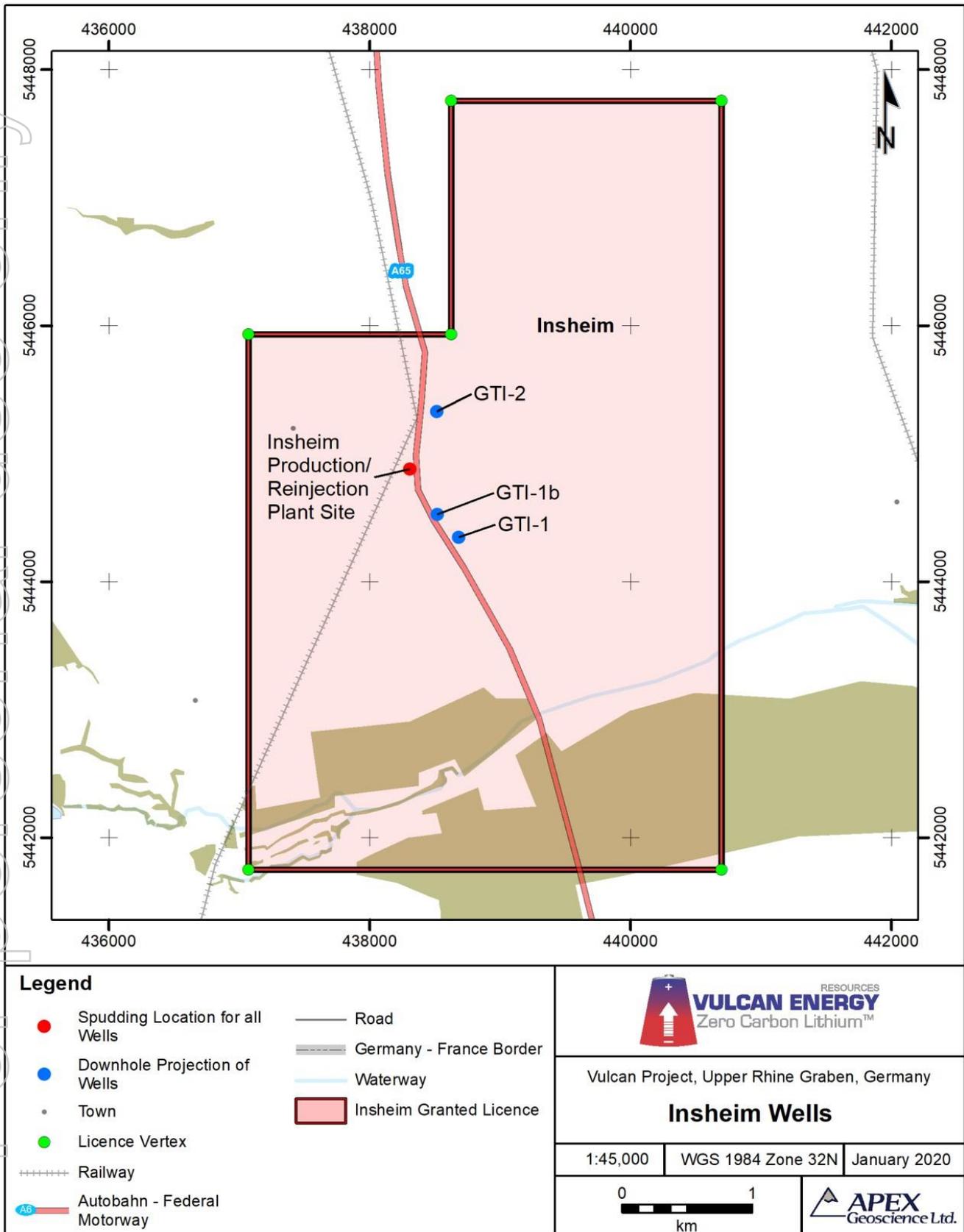


Figure 6: Location of the Insheim production and reinjection wells (red circle) and their planimetric downhole end of hole positions (blue circles).

## Estimation Methodology, Cut-off Grades & Classification Criteria

Statistical analysis, three-dimensional (3-D) modelling and resource estimation was prepared by APEX. The workflow implemented for the calculation of the Insheim lithium-brine resource estimation was completed using the commercial mine planning software MicroMine (v 18.0).

Critical steps in the determination of this Vulcan Li-Brine Resource Estimate include:

- 1) definition of the geometry and volume of the Permo-Triassic aquifer domain; 2) hydrogeological characterization of the specific yield, or in the case of the confined aquifer, the average effective porosity; 3) calculating the total volume of in situ brine; and 4) determination of the concentration of lithium within the brine and at the Property.

The Permo-Triassic aquifer at the Insheim Licence, represent a large-scale aquifer(s). The Insheim Geothermal Plant production well includes perforation points that occur within the Buntsandstein and Rotliegend groups providing brine access points in both Permocarboniferous and Lower Triassic sandstone aquifers (i.e., the Permo-Triassic domain). The average effective porosity of the Buntsandstein Group within the Upper Rhine Graben and the Property is 9.5%, which was applied to the previous Ortenau resource calculation. With respect to Insheim, an average porosity of 9.0% was used because the underlying Rotliegend Group porosity was determined to be slightly lower than porosity associated with the Buntsandstein Group. Geothermal projects in the Upper Rhine Graben have documented sufficiently high flow rates within fault zones associated with the Buntsandstein Group and Permo-Triassic strata. These structural sub-domains represent key determinants for locating zones of high fluid flow. The review of 2-D seismic and well log information at Insheim shows the Insheim Licence was targeted due to its structural association with a fragmented basement and highly faulted/fractured Permo-Triassic strata.

Subsurface interpreted geological cross-sections were used to model the Permo-Triassic aquifer domain, or resource area at the Insheim Licence. The cross-sections were originally created within the GeORG project, a collaboration between Switzerland, Germany, France and Interreg IV Upper Rhine program to better understand the Upper Rhine Graben and its geological potential. The Insheim resource area utilized a set of seven east-west cross-sections from GeORG that were spaced approximately 1 km part to create the 3-D subsurface model of the Buntsandstein and Rotliegend groups (Permo-Triassic) aquifer for the Insheim resource. Each cross-section was stratigraphically 'hung' using 0 m above sea level as a datum to accurately reflect spatial relationships between sections. The digital elevation model for the Vulcan Property surface area was derived from publicly available Shuttle Radar Topography Mission (SRTM) 1-Arc Second data. With respect to wireframing, individual 2-D strings of the Permo-Triassic strata were created by tracing the top of the Buntsandstein Group and the Permian-basement contact. The 2-D strings were then connected to create a solid 3-D wireframe of the Permo-Triassic aquifer. The wireframe of the resource area was clipped to the extents of the Insheim licence for the resource estimation. The Insheim Permo-Triassic strata wireframe was further evaluated using information as provided by Pfalzwerke geofuture GmbH. Two-dimensional seismic profiles and well log data were used to elevate the confidence level of the 3-D geological model. In addition, the Insheim production well GTI-2 perforation windows plot within the Permo-Triassic wireframe, and therefore, the geological model is representative of the brine being pumped at the Insheim Geothermal Plant.

Permo-Triassic porosity values were derived by reviewing published manuscripts that document over 1,800 effective porosity measurements on Buntsandstein and Rotliegend rock exposures and drill core/plug from wells located throughout the Upper Rhine Graben. The porosity varies widely in the Upper Rhine Graben, from 1.4% to 24.2%, and

mean porosity values were selected for the resource calculations. Because geothermal companies target structural deformed zones, which elevate porosity, permeability and fluid flow rate, the mean porosity value chosen is a conservative estimation of mean Permo-Triassic porosity at the Insheim Licence.

Lastly, the Insheim resource estimation benefited from a variety of lithium analytical assays (n=24 analyses) that were conducted on brine from the Insheim production well GTI-2. The lithium analytical results represent: 1) a temporal assessment as conducted by Pfalzwerke geofuture GmbH between 2015-2018; 2) verification of lithium concentrations via Vulcan's 2019 exploration program; and 3) independent evaluation and confirmation of Li-brine by the Competent Person.

Critical matters likely to influence the prospect of economic extraction of Li-brine from the Permo-Triassic aquifers include aquifer dimensions, brine composition, fluid flow, brine access and mining methods, recovery extraction technology and environmental factors. The Competent Person has used due diligence practices to derive reasonable estimates of the aquifer dimensions, hydrogeological characteristics and brine composition. Vulcan has constant and reliable access to Permo-Triassic brine at the Insheim Licence via the Memorandum of Understanding with Pfalzwerke geofuture GmbH. It is the author's opinion that geothermal facilities and Li-brine extraction operations are a good fit. The Li-brine extraction pilot plant (or commercial operation) could be situated after the heat exchanger, and therefore would not influence the main purpose of the geothermal plant. Assuming the lithium extraction process causes minimal compositional change to the brine, the lithium-removed brine could return to the subsurface aquifer via the reinjection well. Hence it is assumed both companies (geothermal and lithium) are extracting their own commodity of interest with virtually no interference between the two processes. There is collective agreement among the authorship group that the Vulcan lithium-brine project has reasonable prospects for eventual economic extraction, and the Competent Person takes responsibility for this statement.

In addition, the Insheim Exploitation Licence has been classified as a maiden Indicated Resource because of the binding Memorandum of Understanding, which permits continued access to the Permo-Triassic aquifer brine, and the enhanced understanding of the Insheim subsurface geology via seismic and well log data.

A lower cut off of 100 mg/L Li is used in this Li-brine resource estimation. It is the opinion of the author that this cut off is acceptable because: 1) confined aquifer deposits traditionally have lower concentrations of lithium (in comparison to unconfined lithium- brine salar and hard rock lithium deposits), and 2) numerous commercial, academia and independent laboratories are now developing rapid lithium extraction techniques using low lithium concentration source brine.

The resource estimation presented was estimated using the following relation in consideration of the Permo-Triassic aquifer domain at the Insheim Licence:

Lithium Resource = Total Volume of the Brine-Bearing Aquifer X Average Porosity X Average Concentration of Lithium in the Brine.

The maiden Indicated Vulcan Li-Brine Resource estimation for the Insheim Licence is estimated at 136,000 tonnes of elemental lithium (Table 6). The total lithium carbonate equivalent (LCE) for the main Indicated Resource is 722,000 tonnes LCE. Mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no guarantee that all or any part of the mineral resource will be converted into a mineral reserve.

Table 6: Maiden Inferred Vulcan Li-Brine Resource Estimate of lithium-bearing brine within Insheim license.

Reporting Parameter	Value
Aquifer Volume (km <sup>3</sup> )	<b>8,322</b>
Brine Volume (km <sup>3</sup> )	<b>0.749</b>
Average Lithium Concentration (mg/L)	<b>181</b>
Average Effective Porosity	<b>9.00</b>
Total Contained Elemental Li Resource (Tonnes)	<b>136,000</b>
Total Contained LCE Tonnes	<b>722,000</b>

Note 1: Mineral resources are not mineral reserves and do not have demonstrated economic viability. Note 2: The weights are reported in metric tonnes (1,000 kg or 2,204.6 lbs). Numbers may not add up due to rounding of the resource values percentages (rounded to the nearest 1,000 unit). Note 3: The volume and weights are estimated at an average porosity of 9.0%. Note 4: The Vulcan Li-brine Project estimation was completed and reported using a lower cut off of 100 mg/L Li. Note 5: In order to describe the resource in terms of industry standard, a conversion factor of 5.323 is used to convert elemental Li to Li<sub>2</sub>CO<sub>3</sub>, or Lithium Carbonate Equivalent (LCE).

### Extraction and Metallurgical Methods and Parameters

Vulcan’s Lithium-Brine Project is an early stage project. The Company has yet to conduct bench-scale test work but has contracted Hatch and Jade Cove Partners to consult on engineering work that includes:

1. Lithium plant design; 2. An economic scoping study; and 3. Directing lithium extraction process test work that involves a combination of the selective absorption and lithium hydroxide production techniques.

Hatch is a global multidisciplinary management, engineering and development consultancy principal with experience in the mining and metals, energy, and infrastructure sectors, and unique experience in lithium and geothermal plant engineering design.

A generalized process flowsheet of Vulcan’s model to derive zero-carbon lithium (LiOH•H<sub>2</sub>O) from the Vulcan Property and the Buntsandstein Formation aquifer is presented in this News Release. The process flowsheet has three main components: 1. A brine conditioning process to remove deleterious metals/elements is implemented to raise the pH and oxidation-reduction potential (ORP) of the brine as it enters the Direct Lithium Extraction (DLE) Plant. 2. The DLE plant removes >85% of the lithium from the brine in less than an hour while leaving >99.9% of all other impurities. The brine is sent back to the geothermal plant and after conditioning re-injected into the geothermal reservoir. A new beneficiated lithium stream with significantly higher Li concentration is formed for further processing. 3. A series of chemical operations convert the lithium stream into battery quality lithium hydroxide using conventional processes that have been previously demonstrated at commercial scale. An estimated 98% of water is recycled with no toxic waste produced and no gases are emitted. Heat and power from the geothermal plant circuit are not affected. No fossil fuels are burned during lithium hydroxide processing, thereby eliminating direct carbon emissions.

## Risks and Uncertainties

This section pertains to risks and uncertainties as they pertain to the Li-brine resource estimations presented in this Technical Report.

At Insheim, initial risks and uncertainties identified are largely related to lithium processing, which has not yet been proven to work with Vulcan's planned flowsheet. Lithium processing and recovery risks will be progressively de-risked in a staged manner through bench-scale and demonstration plant test work campaigns, in consultation with Hatch and Vulcan's in-house lithium recovery expertise.

Due to the unique nature of the deep geothermal brine-hosted lithium resource, there is generally limited sub-surface geological and geochemical data available from drilling in the Upper Rhine Valley. At the Insheim Licence, the Competent Person gained confidence in the GeORG-dependent 3-D geological models by comparing GeORG cross-sections (and the APEX 3-D geological model) against Pfalzwerke geofuture GmbH 2-D seismic profiles and well log data. While this is an isolated test of the GeORG 3-D geological model at the Insheim Licence, the Competent Person concludes that the GeORG data are generally representative of the Buntsandstein Group and Permo-Triassic strata in the Upper Rhine Graben (strata thicknesses and structural control). Importantly, the GeORG model does not over-estimate the thickness of the Permo-Triassic strata, and in this instance, the 3-D geological model used in the resource estimation process provides a conservative estimation of the Permo-Triassic aquifer domain volume. With respect to hydrogeological characteristics, however, there is generally very little hydrogeological information available at the Insheim Licence. While there was a significant amount of effective porosity measurements on Buntsandstein Group and Rotliegend Group sandstone from outcrop samples and drill core plugs throughout the Upper Rhine Graben, none of the data are from Permo-Triassic subsurface rock units within the boundaries of the Insheim Licence. Consequently, the Competent Person used a conservative mean value for porosity in the resource calculation. The reader should be aware future detailed porosity and permeability studies at Insheim may either reduce or expand the maiden Insheim Indicated Li-Brine Resource estimate as presented.

## Appendix 2

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

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-served 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. JORC

The Company is concluding a Scoping Study at the project, on track for completion Q1 2020, and is targeting initial commercial production by 2023.

#### **World's First & Only Zero-Carbon Lithium™ Process**

Co-generation of geothermal energy from production wells will power lithium extraction. Unique process will satisfy OEMs' stated desire for ISO-compliant, zero carbon Electric Vehicle (EV) raw materials supply.

#### **Europe's Largest JORC Lithium Resource**

Recent JORC Mineral Resources contain a total combined Indicated and Inferred estimates of 13.95 million tonnes of Lithium Carbonate Equivalent (LCE). Large enough to be Europe's primary source of battery-quality lithium hydroxide.

#### **Most Optimally Positioned for Supply Chain Security & Footprint Reduction**

Located in Germany, in the centre of the European lithium-ion battery industry. Removes dependence on South America/China for this designated Critical Raw Material. Removes carbon footprint of supply chain.

#### **Europe's Lowest Impact Lithium Project**

No hard-rock mining, no evaporation ponds required in Vulcan's Zero Carbon Lithium™ process. Instead lithium extraction the European way, from renewable energy-producing geothermal brine wells rich in Li.

#### **World's Most Rapidly Advancing Lithium Project**

Recent agreement with major German utility provides access to existing wells and potentially a fast-track to production. Targeting production in 2023.

#### **Unprecedented Demand Forecast for Lithium Hydroxide in Europe**

Ramp-up of lithium-ion battery manufacturing for auto industry in Europe in 2020s forecast to dwarf China expansion of 2016-18. Zero local supply of battery quality lithium hydroxide.

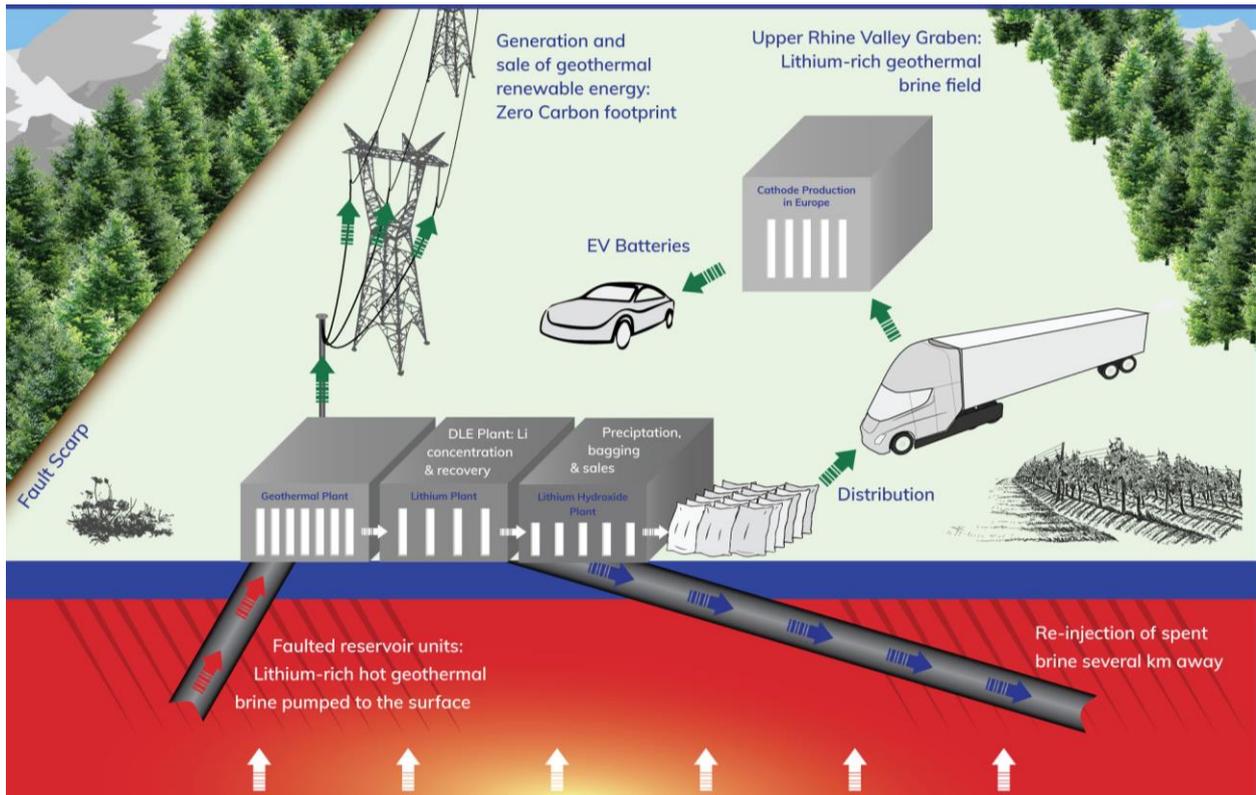


Figure 7: Schematic of the Zero Carbon Lithium project

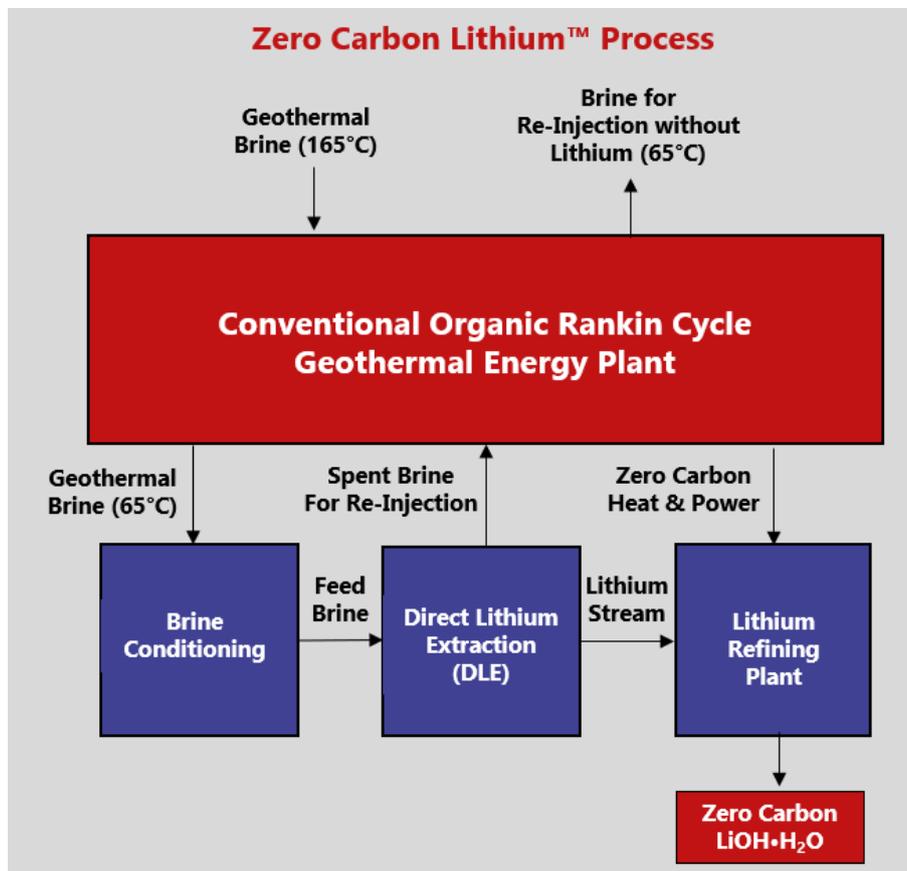


Figure 8: Vulcan's Zero Carbon Lithium™ process

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## Unprecedented Demand for Lithium in Europe - The Next China?

- In the 2010s, China experienced the world’s highest growth in lithium-ion battery production for electric vehicles. **It caused a lithium supply shortage & 300% lithium price spike.**
- In the 2020s, the **same is forecast to happen in Europe, on a larger scale.**
- “European battery cell production capacity is set to increase rapidly in the coming decade. Europe currently has no commercial lithium production or refining capacity of its own to meet this demand, but plans are afoot to change this” (Benchmark Mineral Intelligence, 2019).

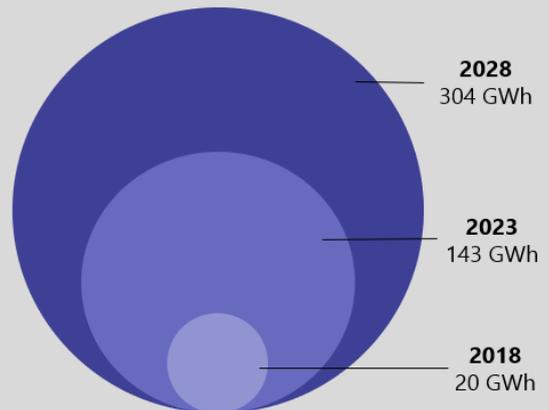
There is an unprecedented ramping up of lithium-ion and associated cathode production in Europe. Forecasts show that the European Union (EU) is set to require the equivalent of the entire current global battery quality lithium demand by the mid-2020s, with 2023 being the main inflection point. There is currently zero EU production of battery-quality lithium hydroxide, let alone a CO<sub>2</sub>-neutral product. A severe battery-quality lithium chemical supply shortfall is thus developing in the EU.

### China Lithium-Ion Battery Cell Production to 2018



Source: Adapted from Ministry of Industry & Information Technology of China

### European Lithium-Ion Cell Production Capacity Forecast to 2028



Source: Adapted from Benchmark Mineral Intelligence Q2 2019 Review

Figure 9: Forecast battery production in EU and associated lithium demand<sup>1</sup>

## Why Vulcan? Zero Carbon Supply Chains Required

BEV raw material supply chains have a carbon footprint problem, producing more CO<sub>2</sub> 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<sub>2</sub>-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<sup>2</sup>, and the goal of producing net zero carbon BEVs as delivered to the customer.

<sup>1</sup> See VUL Presentation 4/12/19

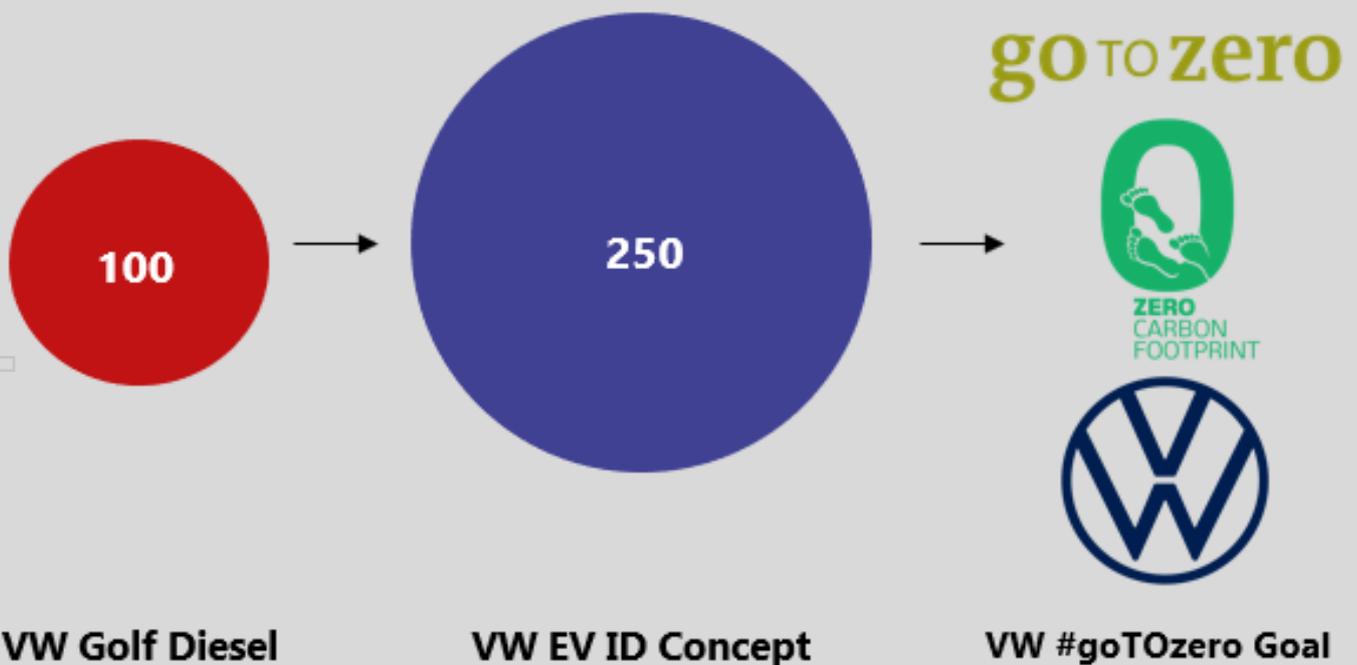
<sup>2</sup> Volkswagen ID presentation, 2019

The European Commission is following suit, recently flagging that “CO<sub>2</sub> Passports” will be issued to BEVs detailing the full CO<sub>2</sub> footprint of each battery. The aim is to differentiate EU lithium-ion battery and BEV production, by producing uniquely low CO<sub>2</sub> products. The EU has declared a climate emergency and aims to cut 55% of emissions by 2030, net zero by 2050. Currently, there is no “zero carbon” lithium chemical product in the world, since all current extraction, processing and transport routes are very carbon intensive. Spodumene converted by fossil fuel-fired processes and lithium products transported from South America will always emit significant quantities of CO<sub>2</sub> to sell their lithium products in Europe.

Hard-rock lithium production has a high OPEX and high CO<sub>2</sub> 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<sub>2</sub> 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.

The world’s conventional lithium supply chains are not geared towards low carbon intensity production, so Europe will need to build its own.

**Embodied Manufacturing tCO<sub>2</sub> Emissions (Normalized)**



Source: Adapted from Volkswagen Presentation, ID. Insights, Sustainable Mobility, 2019

Figure 10: EVs’ carbon problem, and the industry goal to fix the problem

## The Solution: Vulcan's Zero Carbon Lithium™ Project

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.

### Summary

- Unique flowsheet developed by Vulcan, making use of **binary cycle geothermal electricity & heat** to create a **Zero Carbon Lithium™ product**.
- Direct Lithium Extraction (DLE) process to produce  $\text{LiOH}\cdot\text{H}_2\text{O}$  from the brine,
- Zero carbon electricity generated and used to produce premium, Zero Carbon Lithium™ with no gas input.
- Spent brine re-injected into reservoir with no evaporation losses.
- Processing time **hours instead of months**, not dependent on weather like South American brines.
- Creates high purity, high concentration solution that is easily converted on site into **battery quality  $\text{LiOH}\cdot\text{H}_2\text{O}$** .
- Excess **power will be sold** at a Feed-in-Tariff of €0.252/kWh, displacing coal and decarbonizing the German electric grid.
- No need for high energy mining, crushing, grinding and conversion processes used in hard-rock lithium deposits.

Vulcan intends to test and de-risk this flowsheet in 2020, during its feasibility studies.

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  $\text{CO}_2$ .
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  $\text{LiOH}\cdot\text{H}_2\text{O}$  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  $\text{LiOH}\cdot\text{H}_2\text{O}$  operation.

## Vulcan Project, Germany: Strategic Location, Large License-Holding

### Summary

- Most well-explored graben system in the world: large quantities of existing 2D and 3D seismic data to shortcut development timeline.
- Dominant license landholding in lithium-rich brine field - ~800 km<sup>2</sup> of license area.
- Thousands of historical wells and multiple operating geothermal wells in the region provide a wealth of data and readily accessible brine.
- Geothermal brine production socially & environmentally accepted in region with vineyards and communities next to existing operations.
- Lithium hydroxide is a “semi-bulk” commodity. Vulcan’s short distance to markets is a major cost advantage as well as carbon advantage.
- Strategic, secure domestic supply for EU OEMs at a time of global trade insecurity.
- Located in Germany just 60km from Stuttgart; the centre of the burgeoning European lithium-ion supply chain.

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. This 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 licence 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.



Project Location:  
Upper Rhine Valley  
In the Heart of the EU  
Auto & EV Battery  
Industry

Figure 11: Vulcan Zero Carbon Lithium™ Project Location

## German Utility Partnership: Shortcut to Development

### Summary

- MoU agreement signed in November 2019 with subsidiary of German utility Pfalzwerke Group – Pfalzwerke geofuture, for JV at operational Insheim geothermal plant to produce lithium hydroxide.
- Transformational agreement for Vulcan, gives access to lithium-rich, producing brine operations neighbouring Vulcan's existing project area.
- Potential to significantly short-cut timescale to production of Zero Carbon Lithium™ hydroxide.
- Vulcan to earn up to 80% of lithium rights at Insheim by completing Pre-Feasibility (PFS) and Definitive Feasibility (DFS) studies.
- Pfalzwerke Gruppe is a German and international energy provider with annual revenue in excess of €1.5 billion.
- Insheim geothermal plant (shown) a shining example of geothermal best-practice, operating in harmony with local community and environment for more than 7 years.



Figure 12: Insheim plant, showing harmony with local surroundings

**For and on behalf of the Board**

Mauro Piccini

Company Secretary

For further information visit [www.v-er.com](http://www.v-er.com)

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**Competent Person Statement:**

The technical information relating to exploration results and Mineral Resource Estimates that forms the basis for this News Release (main body, Appendix 1 and JORC Table) 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 the technical information in this News Release in the form and context in which it appears.

**Appendix Three: JORC Table One**

**JORC CODE 2012 TABLE 1. SECTION 1: SAMPLING TECHNIQUES AND DATA.**

**Author note: The JORC Table 1 presented in this Technical report focuses only on the maiden Insheim Indicated Resource estimation. To review JORC Table 1's associated with the Inferred Resource estimation for Ortenau the reader is directed to Vulcan's News Releases (Vulcan Energy Resources Ltd., 2019a,b).**

Criteria	JORC Code Explanation	Commentary
<p><b>Sampling techniques</b></p>	<ul style="list-style-type: none"> <li>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.</li> <li>Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.</li> <li>Aspects of the determination of mineralisation that are Material to the Public Report.</li> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>Permo-Triassic aquifer brine was sampled at the Insheim Geothermal Plant production well GTI-2, which produces brine at a flowrate of approximately 70 litres/second (L/s).</li> <li>Brine can be sampled at the well head, (the hot side of the production circuit) or after the heat exchanger (the cold side of the production circuit prior to reinjection of the brine back down into the aquifer). Brine samples take at the well head require a cooling mechanism (e.g., brine flows through a tube immersed in ice) and a mobile degasser unit to reduce CO<sub>2</sub>. No special equipment is required on the cold side of the production circuit.</li> <li>Brine from the Insheim Geothermal Plant has been sampled by 4 different parties including: 1) Pfalzwerke geofuture GmbH sampling between 2015 and 2018; 2) Vulcan 2019 sampling program; 3) 2 samples collected by the CP, Roy Eccles, during a 2019 site inspection; and 4) historical analysis by Sanjuan et al. (2016). Collectively, a total of 24 Insheim brine samples were collected and analyzed for their lithium content.</li> <li>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.</li> <li>In 2019, Vulcan collected Buntsandstein Group aquifer brine samples to verify historically reported lithium concentrations of the Permo-Triassic brine at Insheim. Brine samples were taken from the hot and cold production circuits as the brine circulates through the production circuit. QA-QC work as part of the sampling program included Sample Blanks (deionized water with no lithium) and Sample</li> </ul>

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		<p>Standards (laboratory prepared brine standard) that were inserted into the sample stream. 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 CP in Edmonton, Alberta Canada for analysis at a commercial Canadian Laboratory (AGAT Laboratories).</p> <ul style="list-style-type: none"> <li>• The Vulcan- and CP site inspection-collected samples verified the Pfalzwerke geofuture GmbH and historical lithium analytical results and confirmed the Permo-Triassic brine at Insheim is enriched in lithium.</li> </ul>
<p><b>Drilling techniques</b></p>	<ul style="list-style-type: none"> <li>• 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).</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan has yet to conduct any drilling at the project and is reliant on existing geothermal wells to access brine.</li> <li>• The following points provide drilling information for the Insheim Geothermal Plant as conducted by Pfalzwerke geofuture GmbH: <ul style="list-style-type: none"> <li>• In 2008 and 2009, two wells were drilled at the Insheim Geothermal Plant: one injector well (GTI-1) and one producer well (GTI-2). The wells were successfully drilled to true vertical depths of between 3,409 m and 3,532 m. The wells were orientated at - 0.63° and were highly deviated to the southeast and northeast, respectively. In 2010, a lateral injector draining well (GTI-1b) was drilled out of the original injection well (GTI-1) starting at a depth of approximately 2,500 m to better distribute the reinjected brine flow.</li> <li>• At Insheim, the geothermal target was a normal fault-oriented north-south that dips westward in a horst/graben system. Subsequently, the wells intersected the fault zone with deviated trajectories to maximize penetration in the targeted fracture zone.</li> <li>• The casing diameters decrease downhole from 76 cm to 34 cm to 18 cm. Perforation zones are penetrated by 18 cm liner, which with the aid of thermal water pumps can produce up to a maximum of 80 L/s.</li> <li>• The perforation windows in the production well, GTI-2, occur at depths</li> </ul> </li> </ul>

		<p>of 2,981 to 3,337 m (356 m total depth window) and 3,537 to 3,684 m (147 m total depth window). The perforation windows access aquifer brine from the Buntsandstein Group and Rotliegend Group sandstone aquifers, and the fractured uppermost granitic basement surface, respectively.</p>
<p><b>Drill sample recovery</b></p>	<ul style="list-style-type: none"> <li>• Method of recording and assessing core and chip sample recoveries and results assessed.</li> <li>• Measures taken to maximise sample recovery and ensure representative nature of the samples.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan has yet to conduct any drilling and/or drill core sampling at the project and is reliant on existing geothermal wells to access brine.</li> <li>• Brine samples were recovered directly from the flowing brine stream within the geothermal facility brine circuit. The sample method and sampling documentation are in accordance with reasonable sampling expectations and Li-brine industry standards.</li> <li>• No relationship is expected or known between sample recovery and grade of the Li brine.</li> </ul>
<p><b>Logging</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.</li> <li>• The total length and percentage of the relevant intersections logged.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan has yet to conduct any drilling at the project and is reliant on existing geothermal wells to access brine.</li> <li>• Geothermal well logs of wells GTI-1, GTI-1b and GTI-2 were provided to Vulcan by Pfalzwerke geofuture GmbH. Detailed, complete litho-logs and wireline geophysical logs (Spectroscopy Gamma Ray, Caliper logs, Correlation Resistance logs) were provided from the well collar to the end-of-hole (total vertical depths of 3,409 m, 3,610 m and 3,632 m, respectively).</li> <li>• Core from wells GTI-1, GTI-1b and GTI-2 were not available.</li> <li>• In addition, the project benefited from oil and gas, and geothermal, log data and seismic profile data that has been compiled into 3-D 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 geophysical seismic sections and 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. The Vulcan Project particularly benefitted from a 3-D model of the Upper Rhine Graben in which the user can select interpreted cross-sectional slices anywhere within the graben basin.</li> </ul>

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<p><b>Sub-sampling techniques and sample preparation</b></p>	<ul style="list-style-type: none"> <li>• If core, whether cut or sawn and whether quarter, half or all core taken.</li> <li>• If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.</li> <li>• For all sample types, the nature, quality and appropriateness of the sample preparation technique.</li> <li>• Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.</li> <li>• 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.</li> <li>• Whether sample sizes are appropriate to the grain size of the material being sampled.</li> </ul>	<ul style="list-style-type: none"> <li>• With respect to the Vulcan 2019 sampling program, 3 aliquots of brine were collected at each sample point for various analytical work including: anion chemistry; trace metal ICP-OES; and dissolved metal ICP-OES.</li> <li>• 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.</li> <li>• 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.</li> <li>• The sample sizes were appropriate for industry standard brine assay testing. As the brine was collected from the geothermal production brine stream, the brine sample is representative of the brine being drawn from depths associated with the Permo-Triassic aquifer.</li> </ul>
<p><b>Quality of assay data and laboratory tests</b></p>	<ul style="list-style-type: none"> <li>• The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.</li> <li>• 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.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Data verification procedures applied by the CP were performed to confirm the Li-brine mineralization at the Insheim Geothermal Plant. A Permo-Triassic Insheim brine sample collected by the CP during the site inspection was split and analyzed at 2 separate commercial labs in Edmonton, Alberta Canada (AGAT Laboratory and Bureau Veritas Laboratory). The analytical result of the CP collected samples contained a mean value of 181 mg/L Li substantiating lithium-enriched brine in deep URG aquifer.</li> <li>• 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.</li> <li>• 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.</li> <li>• The resulting data – as they pertain to the Sample Blank and Standard Sample 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.</li> </ul>

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		<ul style="list-style-type: none"> <li>• 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.</li> <li>• A split of Vulcan’s 2019 samples was sent by courier to APEX and analyzed at AGAT Laboratories in Edmonton, AB Canada. A comparison of the analytical results between the 3 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 3 independent labs.</li> </ul>
<p><b>Verification of sampling and assaying</b></p>	<ul style="list-style-type: none"> <li>• The verification of significant intersections by either independent or alternative company personnel.</li> <li>• The use of twinned holes.</li> <li>• Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.</li> <li>• Discuss any adjustment to assay data.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan has yet to conduct any drilling or core sampling at the project.</li> <li>• Data verification procedures applied by the CP were performed on key data components as they pertain to the mineral resource estimation.</li> <li>• Analytical brine data were prepared by independent and third-party universities and or accredited commercial laboratories.</li> <li>• Data verification procedures applied by the CP were performed to confirm the Li-brine mineralization at the Insheim Geothermal Plant. A Permo-Triassic brine sample collected by the CP/QP during the site inspection was split and analyzed at 2 separate commercial labs in Edmonton, Alberta Canada (AGAT Laboratory and Bureau Veritas Laboratory). The analytical result contained a mean value of 180 mg/L Li substantiating lithium-enriched brine in deep URG aquifer.</li> <li>• No adjustments were made, or necessary, to the original laboratory data.</li> <li>• 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 Permo-Triassic aquifer is consistently enriched in lithium in the deep-seated strata and aquifer underlying the URG and Vulcan’s Insheim Licence.</li> </ul>
<p><b>Location of data points</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Specification of the grid system used.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan has yet to conduct any drilling or core sampling at the project.</li> <li>• Brine samples were collected from established geothermal wells (owned by geothermal companies other than Vulcan).</li> <li>• The collar location of the Insheim</li> </ul>

	<ul style="list-style-type: none"> <li>Quality and adequacy of topographic control.</li> </ul>	<p>Geothermal Plant and production well GTI-2 is well documented in published literature.</p> <ul style="list-style-type: none"> <li>The grid system used is UTM WGS84 zone 32N.</li> <li>The surface Digital Elevation Model used in the three-dimensional model 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.</li> </ul>
<p><b>Data spacing and distribution</b></p>	<ul style="list-style-type: none"> <li>Data spacing for reporting of Exploration Results.</li> <li>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.</li> <li>Whether sample compositing has been applied.</li> </ul>	<ul style="list-style-type: none"> <li>Vulcan has yet to conduct any drilling and/or core sampling at the project.</li> <li>With respect to the subsurface data, subsurface interpreted geological cross-sections were used to model the Buntsandstein Group and Permo-Triassic aquifer domains for the Vulcan resource, areas (Insheim, Ortenau).</li> <li>Each resource area utilized a separate set of east-west cross-section from GeORG that were spaced approximately 1 km part to create the 3-D subsurface geological model.</li> <li>The orientation of the Permo-Triassic strata is generally flat-lying and continuous in the Licence concessions. As the strata are situated within the Upper Rhine Graben, high-angle faults have created a complex horst and graben structural environment; having said this, the Permo-Triassic strata maintain their lateral continuity despite being juxtapositioned by rift events.</li> <li>I.e., While locally there are minor faulting and slight offsets, the horizontal continuity of the sandstone unit is tremendous with the thickness isopach thickening in the vicinity of the Vulcan licences. This statement is supported by knowledge that the Permo-Triassic strata has been mapped for approximately 250 km along the north-northeast strike length along the entire Upper Rhine Graben.</li> <li>To help with due diligence, a comparison by the CP between the GeORG cross-sections (and hence the 3D geological model created by APEX) against Insheim-specific 2-D seismic sections and the GTI-1, GTI-1b and GTI-2 well logs. It is notable that a random slice of subsurface information from GeORG generally assimilated not only the thickness of the Permo-Triassic strata at the Insheim Licence (within 8%), but also accurately represented the high-angle normal fault structure. The CP concludes that the GeORG data are generally</li> </ul>

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		<p>representative of the Buntsandstein Group and Permo-Triassic strata in the URG (strata thicknesses and structural control). Importantly, the GeORG model does not over-estimate the thickness of the Permo-Triassic strata, and in this instance, the 3-D geological model used in the resource estimation process provides a conservative estimation of the Permo-Triassic aquifer domain volume.</p> <ul style="list-style-type: none"> <li>• With respect to brine sampling, the Insheim samples were collected from a single well, GTI-2. Two separate perforation windows collect the brine, which is then pumped to the surface for geothermal power processing. The perforation windows are 356 m and 147 m thick. Because the sampled product is a brine in liquid-form, a drawdown affect would mean the brine is sampled from a relatively large Permo-Triassic aquifer domain underlying the Insheim Licence.</li> <li>• With respect to Li-brine concentration, the Insheim Li-brine analytical results are comparable to historical and proprietary lithium concentrations that were compiled from throughout the Upper Rhine Graben in wells with highly variable spatial locations. Spacing between wells varied from proximal locations (&lt;1 km) to up to 32 km apart.</li> </ul>
<p><b>Orientation of data in relation to geological structure</b></p>	<ul style="list-style-type: none"> <li>• Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan has yet to conduct any drilling and/or core sampling at the project.</li> <li>• The Insheim geothermal wells investigated are highly deviated wells intended to angle into fault zones that enable zones of high fluid flow. As the perforation windows (356 m and 147 m thick) indiscriminately sample Permo-Triassic brine in the liquid form within a large-scale aquifer, no sample bias is expected.</li> <li>• The 3D geological model created by APEX was created using GeORG cross-sections; a cross-sectional slice for approximately every 1 km was used to create the geological model. The sectional slices include local and regional faulting. The 3-D geological models were manually adjusted to honor the faulting that was interpreted at each section. This was completed by manually creating triangles that connect the fault on one section to the same location of the fault in a different section (and so on). Care was taken to ensure each model accurately reflected the interpreted</li> </ul>

		<p>cross-sections provided by the GeORG project.</p> <ul style="list-style-type: none"> <li>It is well documented that areas of faulting within the Permo-Triassic to basement deep-strata of the Upper Rhine 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.</li> </ul>
<p><b>Sample security</b></p>	<ul style="list-style-type: none"> <li>The measures taken to ensure sample security.</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> <li>The CP collected 2 Insheim 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.</li> </ul>
<p><b>Audits reviews</b></p>	<p>or</p> <ul style="list-style-type: none"> <li>The results of any audits or reviews of sampling techniques and data.</li> </ul>	<ul style="list-style-type: none"> <li>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 Property.</li> <li>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 Permo-Triassic aquifer that form the basis of the resource model.</li> <li>The CP participated in a meeting with the CEO of the Insheim Geothermal Plant, Mr. Jörg Uhde that included a presentation overview of the Insheim facility, geology, infrastructure, production, risks and uncertainties, and lithium potential.</li> </ul>

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

Criteria	JORC Code Explanation	Commentary
<b>Mineral tenement and land tenure status</b>	<ul style="list-style-type: none"> <li>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.</li> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>The Vulcan Property is comprised of 6 separate and non-contiguous Exploration and Exploitation Licences within the URG of southwest Germany that include: Insheim, Mannheim; Ludwig; Taro; Rheinaue and Ortenau.</li> <li>The licencing conditions can be separated into 3 groups based on licence type, agreement and approval as follows:             <ul style="list-style-type: none"> <li>Insheim Exploitation Licence: Vulcan has acquired direct access to lithium-enriched brine at an operating geothermal brine producing facility via a binding Memorandum of Understanding with German utility Pfalzwerke geofuture GmbH (announced November 26, 2019; Vulcan Energy Resources Ltd., 2019c).</li> <li>Mannheim and Ortenau Exploration Licences: Vulcan has been granted Exploration Licences pursuant to the Germany <i>Federal Mining Act</i> for the purpose of commercial exploration of mining-free mineral resources: geothermal, brine and lithium.</li> <li>Ludwig, Taro and Rheinaue Exploration Licences: These licences are in application as of the Effective Date of this Technical Report.</li> </ul> </li> <li>With respect to interest ownership as they relate to licencing conditions:             <ul style="list-style-type: none"> <li>The Exploitation Licence (Insheim) is held by Pfalzwerke geofuture GmbH and Vulcan can earn up to 80% of the lithium rights by completing Pre-Feasibility or Feasibility studies (Vulcan Energy Resources Ltd., 2019c). The Memorandum of Understanding constitutes an initial collaboration period, during which time, Pfalzwerke geofuture GmbH will supply Vulcan with Insheim brine and well data from its operation geothermal power plant for mineral processing test work required to advance the Property.</li> <li>The granted Exploration Licences (Mannheim and Ortenau) are held 100% by Vulcan.</li> <li>The in-application Exploration Licences (Taro, Ludwig and Rheinaue) have an</li> </ul> </li> </ul>

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		<p>agreement in place with Global Geothermal Holding (GGH) in which Vulcan can earn a joint venture (JV) interest of 80%.</p> <ul style="list-style-type: none"> <li>• Collectively, the licences encompass 807.19 km<sup>2</sup> (80,519 hectares). The Insheim Exploitation Licence is 19.00 km<sup>2</sup> and the Insheim Geothermal Power Plant is located at: 438300 E, 5444500 N.</li> <li>• The Insheim Exploitation Licence grants Pflanzwerke geofuture GmbH the exclusive right to geothermal energy from brine. The Insheim Licence is in the area of the federal state of Rhineland-Palatinate. The mining authority of Rheinland-Pfalz has decided, based on their interpretation of the mining law, that lithium in geothermal brine constitutes a by-product of geothermal and falls under the same license (Vulcan Energy Resources Ltd., personal communication, 2019). It should be noted that production of lithium without a geothermal licencing stipulation is likely not possible as it would conflict with the production of geothermal power.</li> <li>• The Memorandum of Understanding grants Vulcan an initial collaboration period that allows full access to the Insheim Licence brine, data and the ability to construct a lithium extraction demonstration plant at Insheim. Following completion of advanced geological and technological work by Vulcan, Pflanzwerke geofuture GmbH can then choose to co-contribute to the construction of a commercial-scale lithium plant on site, or dilute interest to a royalty on lithium production.</li> <li>• The holder of an Exploitation 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 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.</li> <li>• In the Upper Rhine Graben, increased anthropogenic activity such as hydraulic</li> </ul>
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		<p>fracking, gas extraction and enhanced geothermal systems can potentially lead to induced seismicity. Seismic risk can be mitigated by:</p> <ul style="list-style-type: none"> <li>• Performing regularly actual seismic monitoring, particularly before the implementation of stimulation works;</li> <li>• Ceasing to stimulate the reservoir, or</li> <li>• By reducing production flow rates when seismicity occurs during the operational phase.</li> </ul>
<p><b>Exploration done by other parties</b></p>	<ul style="list-style-type: none"> <li>• Acknowledgment and appraisal of exploration by other parties.</li> </ul>	<ul style="list-style-type: none"> <li>• The Upper Rhine Graben is being actively investigated for its geothermal potential by multiple companies (other than Vulcan).</li> <li>• A summary of historical brine geochemical analytical results (n=43 analyses) was evaluated. In historical brine analysis records, six historical analysis are from the Buntsandstein Group aquifer and yield a mine brine composition of 158.1 mg/L Li. The mean lithium value of 11 ‘basement’ brine samples – or Permian and fractured uppermost granite basement -- is 157.7 mg/L Li. The historical data are 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. The historical geochemical information was used as background information and were not used as part of the resource estimation process.</li> <li>• GeotIS and GeORG are essentially digital geological atlases with emphasis on geothermal energy, and offer extensive compilations of well data, seismic profiles, information and 3D stratigraphic content with emphasis on deep stratigraphy and aquifers in Germany. The raw data – such as seismic data – are not available (as they are owned by the respective energy companies), and hence the data/profiles have been collated and interpreted into the representative geo-dataset information systems. These data were evaluated and used to construct the 3-D geological model used in the resource evaluations.</li> <li>• The evaluation of the Insheim Licence benefited from the addition of data as contributed by Pfalzwerke geofuture GmbH as part of the Memorandum of Understanding with Vulcan. For example, data specific to the Insheim Licence included: <ul style="list-style-type: none"> <li>• Insheim Licence boundary shapefile;</li> </ul> </li> </ul>

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		<ul style="list-style-type: none"> <li>Well data for wells GTI-1, GTI-1b (re injection wells) and well GTI-2 (production well) with technological logs, lithological logs, downhole geophysical logs, well schematics and well trajectories;</li> <li>Two-Dimensional (2-D) seismic profiles and interpretations; and</li> <li>A geochemical survey and interpretation report of the deep brine obtained from the Insheim production well GTI-2.</li> <li>The Pfalzwerke geofuture GmbH data were collectively summarized by the CP to enhance the resource estimations presented in this Technical Report. The Pfalzwerke geofuture GmbH data and reports were prepared by persons and interdisciplinary teams consisting of geotechnical engineers, geologists and geophysicists with comprehensive expertise (e.g., GEO Service GmbH of Georgsdorf, Germany; Schlumberger GmbH Data Services of Bucharest, Romania; Pfalzwerke geofuture GmbH of Ludwigshafen, Germany; Bißmann/ DMT GmbH (DMT-Group) of Essen, Germany; and BWG Geochemische Beratung GmbH of Neubrandenburg, Germany.</li> </ul>
<p><b>Geology</b></p>	<ul style="list-style-type: none"> <li>Deposit type, geological setting and style of mineralisation.</li> </ul>	<ul style="list-style-type: none"> <li>The potential lithium mineralization is situated within confined, subsurface aquifers associated with the Lower Triassic Buntsandstein Group and Permocarbiniferous Rotliegend Group (the Permo-Triassic strata) sandstone aquifers situated within the Upper Rhein Graben at depths of between 2,165 and 4,004 m below surface.</li> <li>The Permo-Triassic strata are comprised predominantly of terrigenous sand facies deposited in arid to semi-arid conditions in fluvial, sandflat, lacustrine and eolian sedimentary environments.</li> <li>The various facies exert controls on the porosity (1% to 27%) and permeability (&lt;1 to &gt;100 mD) of the sandstone sub-units. Within the Permo-Triassic strata, porosity, permeability and fluid flow rates are dependent on the fault, fracture and micro-fracture zones that are targeted by geothermal companies in the Upper Rhine Graben.</li> <li>Lithium mineralization occurs in the brine that is occupying the Permo-Triassic aquifer pore space.</li> </ul>

		<ul style="list-style-type: none"> <li>With respect to deposit model, the lithium chemical signature of the brine is believed to be 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.</li> </ul>
<b>Drill hole Information</b>	<ul style="list-style-type: none"> <li>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: <ul style="list-style-type: none"> <li>easting and northing of the drill hole collar</li> <li>elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar</li> <li>dip and azimuth of the hole</li> <li>down hole length and interception depth</li> <li>hole length.</li> </ul> </li> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>Vulcan has yet to conduct any drilling and/or core sampling at the project</li> <li>With respect to Pflazwerke geofuture GmbH Insheim geothermal wells, the production (GTI-2) and reinjection (GTI=1 and GTI-1b) well descriptions are provided in the Table 1 below.</li> <li>The geothermal wells were drilled as highly deviated wells that are purposely orientated to angle into Permo-Triassic strata fault zones that comprise elevated fluid flowrates.</li> <li>The wells are perforated at depths of between 2,961 m and 3,337 m, and 3,537 m and 3,684 m (Table 2), and via geothermal pumping, draw brine from deep-seated Permo-Triassic aquifers upward to the earth’s surface for geothermal power production.</li> <li>The brine is sequestered from two perforation windows measuring 356 m and 147 m in thickness. As the brine is in liquid form, an absolute sample width is not applicable because of the draw-down influence of the liquid brine being sampled.</li> </ul>

**Table 1. Summary of technical drill information relating to wells drilled at the Insheim Geothermal Plant. Source: Pflazwerke geofuture GmbH (2019).**

Well name	Well type	Drill year	Easting (m, WGS84, Z32)	Northing (m, WGS84, Z32)	Elevation (m asl)	Orientation (Azimuth °)	Dip (depth interval)	Casing diameters (cm)	True vertical depth (m)	Measured depth (m)
GTI-1	Reinjection	2008	438343 (collar) 438753 (EOH)	5446624 (collar) 5446035 (EOH)	139.78	145.67	-89° E (0 to 1,200 m) -72° E (1,200 to EOH)	76, 34, 18	3,548	3,654
GTI-1b	Reinjection	2009	438343 (collar) 438802 (EOH)	5446624 (collar) 5446098 (EOH)	139.78	146.31	-90° E (0 to 750 m) -75° E (750 to EOH)	76, 34, 18	3,750	3,848
GTI-2	Production	2009	438343 (collar) 438809 (EOH)	5446624 (collar) 5447291 (EOH)	139.78	34.06	-89° E (0 to 1,425 m) -64° E (1,425 to EOH)	76, 34, 18	3,672	3,848

<p><b>Data aggregation methods</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• The assumptions used for any reporting of metal equivalent values should be clearly stated.</li> </ul>	<ul style="list-style-type: none"> <li>• 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. A Memorandum of Understanding between Vulcan and Pfalzwerke geofuture GmbH is material to Vulcan as it permits the Company to continual access to evaluate and test Permo-Triassic brine underlying the Insheim Licence.</li> <li>• The brine geochemical data presented represent raw laboratory values; i.e., no weighting average or truncation techniques were applied to the data.</li> <li>• Elemental lithium within the maiden Indicated Insheim Licence Li-Brine Resource Estimate were converted to Lithium Carbonate Equivalent (“LCE” using a conversion factor of 5.323 to convert Li to Li<sub>2</sub>CO<sub>3</sub>); reporting lithium values in LCE units is a standard industry practice.</li> </ul>
<p><b>Relationship between mineralisation widths and intercept lengths</b></p>	<ul style="list-style-type: none"> <li>• These relationships are particularly important in the reporting of Exploration Results.</li> <li>• If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.</li> <li>• 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’).</li> </ul>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• With respect to the Pfalzwerke geofuture GmbH geothermal wells at Insheim, all engineering aspects of the wells are documented. Hence, the CP has a good indication of the true vertical depths of the perforation windows used to sample and pump liquid brine from Permo-Triassic aquifers to the Earth’s surface for geothermal power generation.</li> <li>• As mineralization being sought is related to liquid brine within a confined aquifer, 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.</li> </ul>
<p><b>Diagrams</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Appropriate map images including scale and direction information such that the reader can properly orientate the information being portrayed are included in the body of this news release.</li> </ul>

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<p><b>Balanced reporting</b></p>	<ul style="list-style-type: none"> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive reporting of all Exploration Results is presented in full in this report.</li> <li>There are no outlier analytical results in Insheim geochemical dataset used to evaluate the lithium concentration of Permo-Triassic aquifer brine.</li> </ul>
<p><b>Other substantive exploration data</b></p>	<ul style="list-style-type: none"> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>A substantive amount of historical data was used and includes information in relation to the: spatial dimensions, hydrogeological characterization and historical lithium composition of the Buntsandstein Group and Permo-Triassic aquifers. These include:             <ul style="list-style-type: none"> <li>Spatial dimensions of the aquifer: Each Vulcan Property Licence, or resource area, utilized a separate set of east-west cross-section from the GeORG geothermal information, the creators of which utilized an extensive set of oil and gas, and geothermal, well logs and seismic data. Seven GeORG cross-sections lines were used to model the Insheim Licence subsurface geology.</li> <li>Hydrogeological information: Over 1,800 and 1,000 Buntsandstein Group and Rotliegend Group measurements were used to discuss and define porosity and permeability.</li> <li>Historical assessment of Li-brine: A total of 43 historical brine analysis records were compiled.</li> </ul> </li> <li>With respect to the CP’s assessment of the lithium concentration of the Permo-Triassic aquifer domain at the Insheim Licence, a total of 23 of the 24 Insheim geochemical analyses were used to define the average Li content and used to calculate the maiden Insheim resource estimation. These data came from multiple sources including: Brine from the Insheim Geothermal Plant has been sampled by 4 different parties including: 1) Pfalzwerke geofuture GmbH sampling between 2015 and 2018; 2) Vulcan 2019 sampling program; 3) 2 samples collected by the CP, Roy Eccles, during a 2019 site inspection; and 4) historical analysis by Sanjuan et al. (2016). Of these data, the only analysis not used in the resource estimation related to the historical sample.</li> <li>The CP reviewed the Pfalzwerke geofuture GmbH sample and analytical techniques and found the work was conducted using reasonable techniques in the field of brine</li> </ul>

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		<p>assaying and there are no significant issues or inconsistencies that would cause one to question the validity of the sampling technique used by Pfalzwerke geofuture GmbH's consultant.</p>
<p><b>Further work</b></p>	<ul style="list-style-type: none"> <li>• The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or large-scale step-out drilling).</li> <li>• Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.</li> </ul>	<ul style="list-style-type: none"> <li>• At the Insheim Exploitation Licence, a two-phase recommendation approach is recommended</li> <li>• Phase 1 work includes the collection of a bulk sample of Permo-Triassic brine from the Insheim production well GTI-2 for mineral processing test work. In concert with the bulk sample, Vulcan should continue with its project management level workplan report to advance the Vulcan Lithium-Brine Project engineering to a scoping level of detail.</li> <li>• Based on the positive results of the Phase 1 work, it is recommended that Vulcan conduct: technological test work; address modifying factors toward the completion of a scoping study and/or a Pre-Feasibility Study.</li> <li>• The total cost of the Insheim Exploitation Licence Phase 1 and 2 recommendations – with a 10% contingency – is CDN\$1,446,500 (EUR\$998,085).</li> </ul>

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### JORC Code 2012 Table 1. Section 3: Estimation and Reporting of Mineral Resources

Criteria	JORC Code Explanation	Commentary
<p><b>Database integrity</b></p>	<ul style="list-style-type: none"> <li>Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.</li> <li>Data validation procedures used.</li> </ul>	<ul style="list-style-type: none"> <li>The review of third-party, government and/or compiled data was conducted by the CP who – to the best of his knowledge – can confirm the data was generated with proper procedures, has been accurately transcribed from the original source and is suitable for use in the maiden Insheim resource estimation and Technical Report.</li> <li>The CP was able to verify ‘lithium-enriched brine’ from Insheim Geothermal Plant Permo-Triassic brine that was collected via a geothermal well GTI-2 during a Sep 2019 site visit.</li> <li>To validate the GeORG information system and cross-sections used to develop the APEX 3-D geological model, the CP made comparisons between a GeORG cross-section at Insheim against Pfalzwerke geofuture GmbH contributed data that consisted of 2-D seismic sections and Insheim well log data. In the opinion of the CP, it is notable that a random slice of subsurface information from GeORG generally assimilated not only the thickness of the Permo-Triassic strata at the Insheim Licence (within 8%), but also accurately represented the high-angle normal fault structure. The CP concludes that the GeORG data are generally representative of the Buntsandstein Group and Permo-Triassic strata in the URG. Importantly, the GeORG model does not over-estimate the thickness of the Permo-Triassic strata, and in this instance, provides a conservative estimation of volume used in the resource estimation process.</li> <li>The Insheim geochemical brine data, which was collected and analyzed by multiple parties, yielded similar lithium concentration results with a high precision of reproducibility (see Table 3).</li> <li>Lastly, based on the CP’s previous experience and research of confined lithium-brine deposits, and sampling and analytical protocols, the CP is satisfied to include these data in resource modelling, evaluation and estimations as part of Vulcan’s Insheim Licence lithium-brine</li> </ul>

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resource estimate.

**Table 3. Analytical summary of Insheim Geothermal Plant brine sampling.**

	Li (mg/L)	Count	%RSD
<i>Average (all data)</i>	180.3	24	6.3
<i>Average (Pfalzwerke geofuture data)</i>	178.6	5	7.5
<i>Average (Vulcan data)</i>	181.6	16	6.2
<i>Average (Pfalzwerke geofuture &amp; Vulcan data)</i>	180.9	21	6.4
<i>Average (Pfalzwerke, Vulcan &amp; CP data)</i>	180.8	23	6.3
<i>CP Average</i>	180.0	2	7.1

<b>Site visits</b>	<ul style="list-style-type: none"> <li>• Comment on any site visits undertaken by the Competent Person and the outcome of those visits.</li> <li>• If no site visits have been undertaken indicate why this is the case.</li> </ul>	<ul style="list-style-type: none"> <li>• The CP conducted a site inspection of the Vulcan Property on September 17, 2019. The site visit included a meeting and tour of the Insheim Geothermal Power Plant and Insheim Licence.</li> <li>• The site inspection of the Vulcan Property observed the existing infrastructure at/near the Property licences, including primary and secondary road networks that make the licences accessible and with ease of access to the electrical power grid.</li> <li>• At the Insheim Licence, the CP collected two brine samples and delivered them to the independent and accredited laboratories in Edmonton, Alberta. Both labs routinely process high TDS brine and perform trace element analysis for lithium. The results (mean of 180 mg/L Li) validated lithium-enrichment of the Permo-Triassic aquifer brine at the Insheim Licence.</li> </ul>
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<b>Geological interpretation</b>	<ul style="list-style-type: none"> <li>• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.</li> <li>• Nature of the data used and of any assumptions made.</li> <li>• The effect, if any, of alternative interpretations on Mineral Resource estimation.</li> <li>• The use of geology in guiding and controlling Mineral Resource estimation.</li> <li>• The factors affecting continuity both of grade and geology.</li> </ul>	<ul style="list-style-type: none"> <li>• An uncertainty in the evaluation of Permo-Triassic brine related to Vulcan's Property in the Upper Rhine Graben relates to the overall lack of subsurface data and current access to brine within the boundaries of the Vulcan Property Exploration Licences. However, the Vulcan – Pfalzwerke geofuture GmbH Memorandum of Understanding is materially important to Vulcan because:             <ol style="list-style-type: none"> <li>1. The MoU guarantees that Vulcan has continued access to a constant source of Permo-Triassic brine at the Insheim Geothermal Plant;</li> <li>2. The MoU permits access to geological and geotechnical information related to the</li> </ol> </li> </ul>
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		<p>production and reinjection wells, and assessment of the subsurface stratigraphy underlying the Insheim Licence.</p> <ol style="list-style-type: none"> <li>3. The Insheim licence is an Exploitation Licence with Li-brine rights.</li> </ol> <ul style="list-style-type: none"> <li>• Access to Pfalzwerke geofuture GmbH data provided confidence in:             <ol style="list-style-type: none"> <li>1. The subsurface stratigraphy via well logs and seismic profiles.</li> <li>2. The GeORG information system that was used to generate cross-sectional slices of the Upper Rhine Graben subsurface – and these cross-sections were used to design the APEX 3-D geological model used in the resource estimations.</li> <li>3. Additional geochemical brine evaluations that included a temporal (2015-2018) assessment of the lithium content of the Permo-Triassic brine being pumped to the Earth’s surface at the Insheim Geothermal Plant.</li> </ol> </li> <li>• Increased confidence in the subsurface 3-D modelling and Li-brine concentration at Insheim were important criteria for elevating the Insheim Resource estimate to an Indicated Resource classification.</li> <li>• Average porosity of the Permo-Triassic strata remains an uncertainty: While there is a significant amount of effective porosity measurements on Permo-Triassic sandstone from outcrops and drill cores, none of the outcrops or wells occur (or were collared) within the boundaries of the Insheim Licence. Accordingly, the CP used the regional porosity information to develop a conservative average porosity that was used in the resource calculation.</li> </ul>
<p><b>Dimensions</b></p>	<ul style="list-style-type: none"> <li>• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.</li> </ul>	<ul style="list-style-type: none"> <li>• The Permo-Triassic strata at the Insheim Licence occur at depths of between 2,759 m and 3,207 m below sea level. The average thickness of the Permo-Triassic strata at the Insheim Licence is 438 m. The thickness of the strata is in-line with Vulcan’s other licences and the author advocates that – with the exception of the northernmost part of the Upper Rhine Graben, the Permo-Triassic strata are laterally extensive over almost the entire length of the Upper Rhine Graben.</li> </ul>

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		<ul style="list-style-type: none"> <li>• The extent of the Insheim resource area wireframe was clipped to the boundary of the Insheim Licence, which has an area of 19.00 km<sup>2</sup>, is centered at approximately 438910 E, 5444210 N (Zone 32N WGS84), and has vertical and lateral licence measurements of approximately 4.18 km to 6.00 km (north-south) and 2.08 km to 3.64 km (east-west).</li> <li>• The volume of the Permo-Triassic aquifer domain underlying the Insheim Licence was calculated using the 3-D wireframes created in Micromine.</li> <li>• As the 3-D wireframes are closed solids, the author calculated the volume of rock they enclose. The 'aquifer volume' at the Insheim Licence was 8.3 km<sup>3</sup></li> <li>• A mean Permo-Triassic porosity value of 9.0% was used to define the Insheim Licence 'aquifer brine volume' of 0.80 km<sup>3</sup>, which was calculated by multiplying the aquifer volume (in m<sup>3</sup>) times the average porosity (9.0%) times the percentage of brine assumed within the pore space (100% as there is no oil within the Permo-Triassic samples collected by Vulcan and CO<sub>2</sub> gas is in its dissolved state at reservoir pressures).</li> <li>•</li> </ul>
<p><b>Estimation and modelling techniques</b></p>	<ul style="list-style-type: none"> <li>• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.</li> <li>• The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.</li> <li>• The assumptions made regarding recovery of by-products.</li> <li>• Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).</li> <li>• In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.</li> </ul>	<ul style="list-style-type: none"> <li>• This is a maiden Li-brine resource estimate for the Insheim Licence.</li> <li>• Previously, Eccles et al. (2019) defined Inferred Resource estimations for the Ortenau Exploration Licence. The Inferred resources and Exploration Targets range of values are reported in Vulcan Energy Resources Ltd. News Releases.</li> <li>• The Insheim Licence resource estimation is classified as an Indicated Resource. Pertinent points to support an Indicated Resource classification at the Insheim Licence include:             <ul style="list-style-type: none"> <li>• Vulcan has acquired direct access to lithium-enriched brine at the operating Insheim Geothermal Power Plant via a binding Memorandum of Understanding with German utility Pflazwerke geofuture GmbH.</li> <li>• The Exploitation Licence, which is held by Pflazwerke geofuture GmbH and Vulcan can earn up to 80% of the lithium rights by completing Pre-Feasibility and Definitive Feasibility studies, grants the user permission to</li> </ul> </li> </ul>

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| <ul style="list-style-type: none"> <li>• Any assumptions behind modelling of selective mining units.</li> <li>• Any assumptions about correlation between variables.</li> <li>• Description of how the geological interpretation was used to control the resource estimates.</li> <li>• Discussion of basis for using or not using grade cutting or capping.</li> <li>• The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.</li> </ul> | <p>co-produce lithium from the brine in the region of the mining authority of Rheinland-Pfalz.</p> <ul style="list-style-type: none"> <li>• The Insheim Geothermal Plant has been operational since its start-up in November 2012, and the geothermal production utilizes a brine flowrate at an operating capacity of 70 L/s (maximum output of 80 L/s).</li> <li>• The CP was able to evaluate 24 individual brine samples and assay analytical work from brine collected directly from the Insheim Geothermal Plant production well and brine circuit.</li> <li>• The only element being estimated is lithium, and consideration of deleterious elements is beyond the scope of this early stage project and resource estimate (i.e., is dependent on mineral processing and lithium recovery flowsheets).</li> <li>• With respect to lithium recovery, Vulcan hopes to develop a rapid extraction technology to extract lithium from the geothermal brine cycle. Vulcan has yet to conduct bench-scale test work but has contracted HATCH and Jade Cove Partners to consult on future engineering work that includes: 1) lithium plant design; 2) an economic scoping study; and 3) directing lithium extraction process test work that involves a combination of the selective absorption and lithium hydroxide production techniques. A generalized process flowsheet of Vulcan’s model to derive zero-carbon lithium hydroxide from the Vulcan Property and the Buntsandstein Group aquifer is presented along with risks, uncertainties and mitigation strategies, as they pertain to process operations associated with extracting lithium-from-brine in conjunction with geothermal production.</li> <li>• The workflow implemented for the calculation of the Vulcan lithium-brine resource estimations was completed using: the commercial mine planning software MICROMINE (v 18.0).</li> <li>• The resource is calculated using a volumetric approach. Critical steps in the determination of the inferred Vulcan lithium-brine resources include:             <ul style="list-style-type: none"> <li>• Definition of the geometry and volume of the Permo-Triassic domain aquifers;</li> </ul> </li> </ul> |
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- Hydrogeological characterization and an historical compilation and assessment of mean porosity within the Permo-Triassic strata;
- Determination of the concentration of lithium in the Permo-Triassic brine;
- Demonstration of reasonable prospects of eventual economic extraction are justified; and
- Estimate the in-situ lithium resources of Permo-Triassic brine underlying the Insheim Licence using the relation:
 

Lithium Resource = Total Volume of the Brine-Bearing Aquifer X Average Effective Porosity X Average Concentration of Lithium in the Brine.
- The geometry and volume of the aquifers were calculated by designing 3-D model that wireframed the outline of the Permo-Triassic aquifer at the Insheim Licence (i.e., the resource area). A total of 7 cross-sections were used to formulate the Insheim Licence 3-D geological model. Individual 2-D strings of the Permo-Triassic strata were created by tracing the top and bottom of the Permo-Triassic stratigraphy using each cross-section. The 2-D strings were then connected together to create a solid 3-D wireframe of the Permo-Triassic aquifer. The 3-D geological models were manually adjusted to honor the faulting that was interpreted at each section.
- Permo-Triassic sandstone porosity varies widely in the URG, from 1.4% to 24.2%. Hence, the CP uses a mean porosity value of 9.0% (mean of over 1,800 effective porosity measurements from publicly available reports). This value is considered to represent a conservative, limit of Permo-Triassic porosity for use in the resource estimation presented.
- The average lithium-in-brine concentration used in the resource estimations presented in this Report is 181 mg/L Li and is based on the average of 23 samples collected by Vulcan, Pfalzwerke geothermal GmbH and the CP, and analyzed by trace metal ICP-OES analysis at 3 independent laboratories.
- No top cuts or capping upper limits have been applied, or are deemed to be

		necessary, as confined Li-brine deposits typically do not exhibit the same extreme values as precious metal deposits (and this statement is applicable to the Permo-Triassic aquifer Li-brine data in this study).
<b>Moisture</b>	<ul style="list-style-type: none"> <li>Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.</li> </ul>	<ul style="list-style-type: none"> <li>Not applicable. The resource is a Li-brine resource.</li> </ul>
<b>Cut-off parameters</b>	<ul style="list-style-type: none"> <li>The basis of the adopted cut-off grade(s) or quality parameters applied.</li> </ul>	<ul style="list-style-type: none"> <li>A lower cut off of 100 mg/L Li is used in this Li-brine resource estimation. It is the opinion of the author that this cut off is acceptable because: 1) confined aquifer deposits traditionally have lower concentrations of lithium (in comparison to unconfined lithium-brine salar and hard rock lithium deposits), and 2) numerous commercial, academia and independent laboratories are now experimenting with rapid lithium extraction techniques using low lithium concentration source brine.</li> </ul>
<b>Mining factors or assumptions</b>	<ul style="list-style-type: none"> <li>Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.</li> </ul>	<ul style="list-style-type: none"> <li>It is the CP's opinion that geothermal facilities and Li-brine extraction operations are a good fit co-production opportunity.</li> <li>The Li-brine extraction pilot plant (or commercial operation) could be situated after the heat exchanger, and therefore would not influence the main purpose of the geothermal plant.</li> <li>Assuming the lithium extraction process causes minimal compositional change to the brine (which has been preliminary shown in the geochemical data assessed in this Technical Report), the lithium-removed brine could return to the subsurface aquifer via the reinjection well. Hence it is assumed both companies (geothermal and lithium) are extracting their own commodity of interest with virtually no interference between the two processes.</li> <li>It is also assumed that Vulcan could drill their own wells at the Vulcan Property's 6 licences. The 3-D geological models completed for each licence shows there is a high degree of faulting with potential for high fluid flow in the Permo-Triassic strata underlying all of the Vulcan Property licences.</li> </ul>
<b>Metallurgical factors or assumptions</b>	<ul style="list-style-type: none"> <li>The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the</li> </ul>	<ul style="list-style-type: none"> <li>To the best of the authors knowledge, brine from confined subsurface aquifers has yet to be commercially mined for lithium. This because a rapid extraction technology – that will replace more traditional beneficiation processes by solar</li> </ul>

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	<p>assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.</p>	<p>evaporation – is still in development.</p> <ul style="list-style-type: none"> <li>• Confined aquifer Li-brine deposits traditionally have lower concentrations of lithium in comparison to unconfined Li-brine salars and hard rock lithium deposits. In addition, the aquifer deposits typically occur in areas where solar evaporation is not an option. Consequently, a number of laboratories (commercial, academia, independent) are attempting to develop modern technology that will beneficiate and recover the Li-brine from these types of deposits in real time. The developers are aware that the technology must incorporate lower source concentrations of lithium and are therefore testing Li-brine at low lithium concentrations. Accordingly, there are several laboratories that are experimenting with rapid lithium extraction techniques and/or conduct test work on low lithium source brine, including starting source levels of approximately 50 mg/L Li.</li> <li>• It is the opinion of the author that it is only a matter of time, funding and test work until the rapid extraction technology becomes commercially viable. For example, European Geothermal Brines Lithium (EuGeLi) is developing the ERAMET and IFPEN direct adsorption lithium extraction processes at the Soultz-sous-Forêts Geothermal Facility, in the URG near the Town of Soultz-sous-Forêts and has reportedly extracted 85-90% lithium from brine. In addition, EnergySource Minerals Ltd. has reportedly extracted lithium from geothermal brine projects at the Salton Sea geothermal resource.</li> </ul>
<p><b>Environmental factors or assumptions</b></p>	<ul style="list-style-type: none"> <li>• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfield project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be</li> </ul>	<ul style="list-style-type: none"> <li>• Recent Government policy emphasizes conservation and hence promotes development of renewable sources, such as solar, wind, biomass, water and geothermal power. It is the supposition of the CP that green energy opportunities such as Li-brine projects will be viewed favourably by the German Government.</li> <li>• The CP relies completely on statements provided by Vulcan CEO Dr. F. Wedin (on December 17, 2019) that a geothermal Exploitation Licence in the region of the mining authority of Rheinland-Pfalz grants the user permission to co-produce lithium from the brine (see Section 4.4, Vulcan's</li> </ul>

	<p>reported with an explanation of the environmental assumptions made.</p>	<p>Licensing Conditions). This statement is reportedly reiterated from discussion between Vulcan and the mining authorities.</p> <ul style="list-style-type: none"> <li>• In the Upper Rhine Graben, increased anthropogenic activity such as hydraulic fracking, gas extraction and enhanced geothermal systems can potentially lead to induced seismicity. Seismic risk can be mitigated by: <ul style="list-style-type: none"> <li>• Performing regularly actual seismic monitoring, particularly before the implementation of stimulation works;</li> <li>• Ceasing to stimulate the reservoir, or</li> <li>• By reducing production flow rates when seismicity occurs during the operational phase.</li> </ul> </li> <li>• Through personal communication, the CP has confirmed that Pflanzwerke geothermal GmbH has the necessary seismic monitoring network and reaction scheme and can produce and maintain a continued brine flow rate at the Insheim Geothermal Plant.</li> </ul>
<p><b>Bulk density</b></p>	<ul style="list-style-type: none"> <li>• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.</li> <li>• The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.</li> </ul>	<ul style="list-style-type: none"> <li>• Bulk density is not applicable, or necessary to be applied, to the liquid, brine-hosted resource.</li> <li>• The lithium resource was calculated using the volume of the brine bearing aquifer, the average effective porosity, the percentage of brine in the pore space and the average concentration of lithium in the brine.</li> </ul>
<p><b>Audits or reviews.</b></p>	<ul style="list-style-type: none"> <li>• The results of any audits or reviews of Mineral Resource estimates.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulcan's Li-Brine Project is an early stage exploration project. No audits have been conducted on the resource estimations calculated at the Vulcan Li-Brine Project.</li> </ul>
<p><b>Classification</b></p>	<ul style="list-style-type: none"> <li>• The basis for the classification of the Mineral Resources into varying confidence categories.</li> <li>• Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).</li> </ul>	<ul style="list-style-type: none"> <li>• The Vulcan Lithium-Brine Project has reasonable prospects for eventual economic extraction based on aquifer geometry, brine volume, brine composition, hydrogeological characterization, porosity, fluid flow, and potential for brine access and mining methods.</li> <li>• Vulcan's recent Memorandum of Understanding with Pflanzwerke geofuture GmbH and ability to gain access to Permo-Triassic brine and brine/lithium rights at the Insheim</li> </ul>

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	<ul style="list-style-type: none"> <li>• Whether the result appropriately reflects the Competent Person's view of the deposit.</li> </ul>	<p>Geothermal Plant supports this statement as the Company now has unlimited access to brine to advance their Direct Lithium Extraction technology.</p> <ul style="list-style-type: none"> <li>• The Insheim Licence resource estimation is classified as an Indicated Resource. Pertinent points to support an Indicated Resource classification at the Insheim Licence include: <ul style="list-style-type: none"> <li>• Vulcan has acquired direct access to lithium-enriched brine at the operating Insheim Geothermal Power Plant via a binding Memorandum of Understanding with German utility Pflzwerke geofuture GmbH.</li> <li>• The Exploitation Licence, which is held by Pflzwerke geofuture GmbH and Vulcan can earn up to 80% of the lithium rights by completing Pre-Feasibility or Feasibility studies, grants the user permission to co-produce lithium from the brine in the region of the mining authority of Rhineland-Pfalz.</li> <li>• The Insheim Geothermal Plant has been operational since its start-up in November 2012, and the geothermal production utilizes a brine flowrate at an operating capacity of 70 L/s (maximum output of 80 L/s).</li> <li>• The CP was able to evaluate 24 individual brine samples and assay analytical work from brine collected directly from the Insheim Geothermal Plant production well and brine circuit.</li> </ul> </li> <li>• Consequently, the CP has an increased level of confidence in the subsurface 3-D modelling and Li-brine concentration at Insheim; an important criterion for elevating the Insheim Resource estimate to an Indicated Resource classification.</li> </ul>
<p><b>Discussion of relative accuracy/confidence</b></p>	<ul style="list-style-type: none"> <li>• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the</li> </ul>	<ul style="list-style-type: none"> <li>• In the opinion of the CP, the maiden Insheim Indicated Resource estimation reasonably reflects the Li-brine resource of the modelled Permo-Triassic aquifer at the Insheim Licence. The CP is adequately confident in the continuity of geology, volume of the Permo-Triassic aquifer domain, lithium concentration and reliability of quality, quantity and distribution of the input data.</li> <li>• As the resource is calculated using a volumetric approach, any changes to the</li> </ul>

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	<p>relative accuracy and confidence of the estimate.</p> <ul style="list-style-type: none"> <li>• The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.</li> <li>• These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.</li> </ul>	<p>3-D model, the Permo-Triassic wireframe, lithium concentration and/or the porosity will affect the calculated resource estimate. It is possible that future geological models to advance the deposit and resource classification, use a strategy in which portions or sub-domains of the Permo-Triassic aquifer, underlying any given licence, are wireframed to depict localized fracture zones with high fluid flow. This methodology would yield a smaller resource – and/or potentially convert a smaller portion of the resource to a higher level of classification.</p>
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