

## Industry-leading Life Cycle Assessment results

### Summary:

- Having originally commissioned the world's first Life Cycle Assessment (LCA) and global study on the environmental footprint of lithium hydroxide (LHM) production, Vulcan recently again commissioned Minviro Ltd., to update its independent LCA based on more recent data from Vulcan's Pre-Feasibility Study (PFS).
- Results of the updated LCA estimate negative 2.9t of CO<sub>2</sub> emitted per tonne of LHM to be produced from Vulcan's Zero Carbon Lithium™ Project, including Scope 1, 2 and 3 emissions.
- Vulcan's negative CO<sub>2</sub> emission intensity is a product of the significant impact offset generated by renewable geothermal energy production as well as use of geothermal heat to drive lithium processing, and Vulcan's industry-leading move to strictly exclude fossil fuels as an energy source from its planned operations.
- According to public data, this result confirms that Vulcan's Zero Carbon Lithium™ Project has the lowest planned carbon footprint in the world compared to any LCA results previously published in the lithium industry.
- The LCA was conducted according to ISO-14040:2006 and ISO-14044:2006 standards and included a third-party expert review.
- The LCA also confirms a low water usage and water scarcity factor, compared to traditional forms of lithium production.
- The Zero Carbon Lithium™ Project has been designed from its inception to help decarbonise the German electrical grid and lithium supply chain simultaneously.

Managing Director, Dr. Francis Wedin, commented: *"This LCA update is part of our commitment to continuously scrutinise our environmental footprint as we develop our project and scale up with the highest standards of integrity. At Vulcan, our mission is to produce lithium for batteries with the highest environmental performance of any lithium chemical produced anywhere in the world. We are doing the hard scientific work of decarbonisation by intentionally deploying technologies with lower environmental impacts. European consumers and regulators expect to see actual measured carbon footprint reduction from industry, not just aspirations or untested claims. Vulcan intends to produce the lithium products that the electrification revolution deserves."*

### Highlights

Globally unique **Zero Carbon Lithium™** Project.

**Combined lithium chemicals & renewable energy project** in the Upper Rhine Valley of Germany.

EU's **largest** lithium resource.

Located at the heart of the EU Li-ion battery industry.

Fast-track development towards supplying the EU's battery & electric vehicle industry.

### Corporate Directory

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### Contact

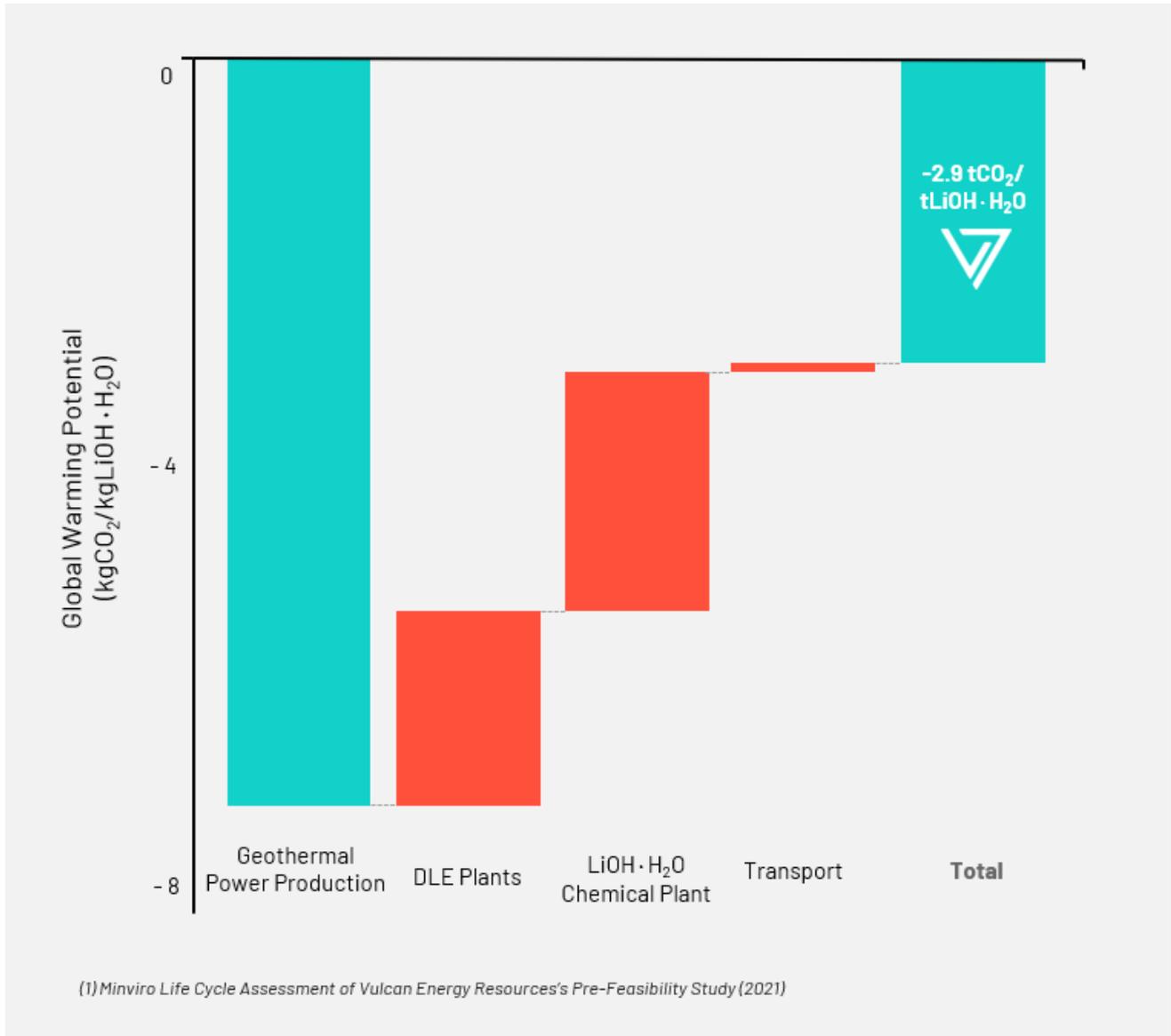
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## Lithium product Global Warming Potential (GWP)

Vulcan will burn zero fossil fuels in its process, instead leveraging geothermal energy and decarbonised electricity



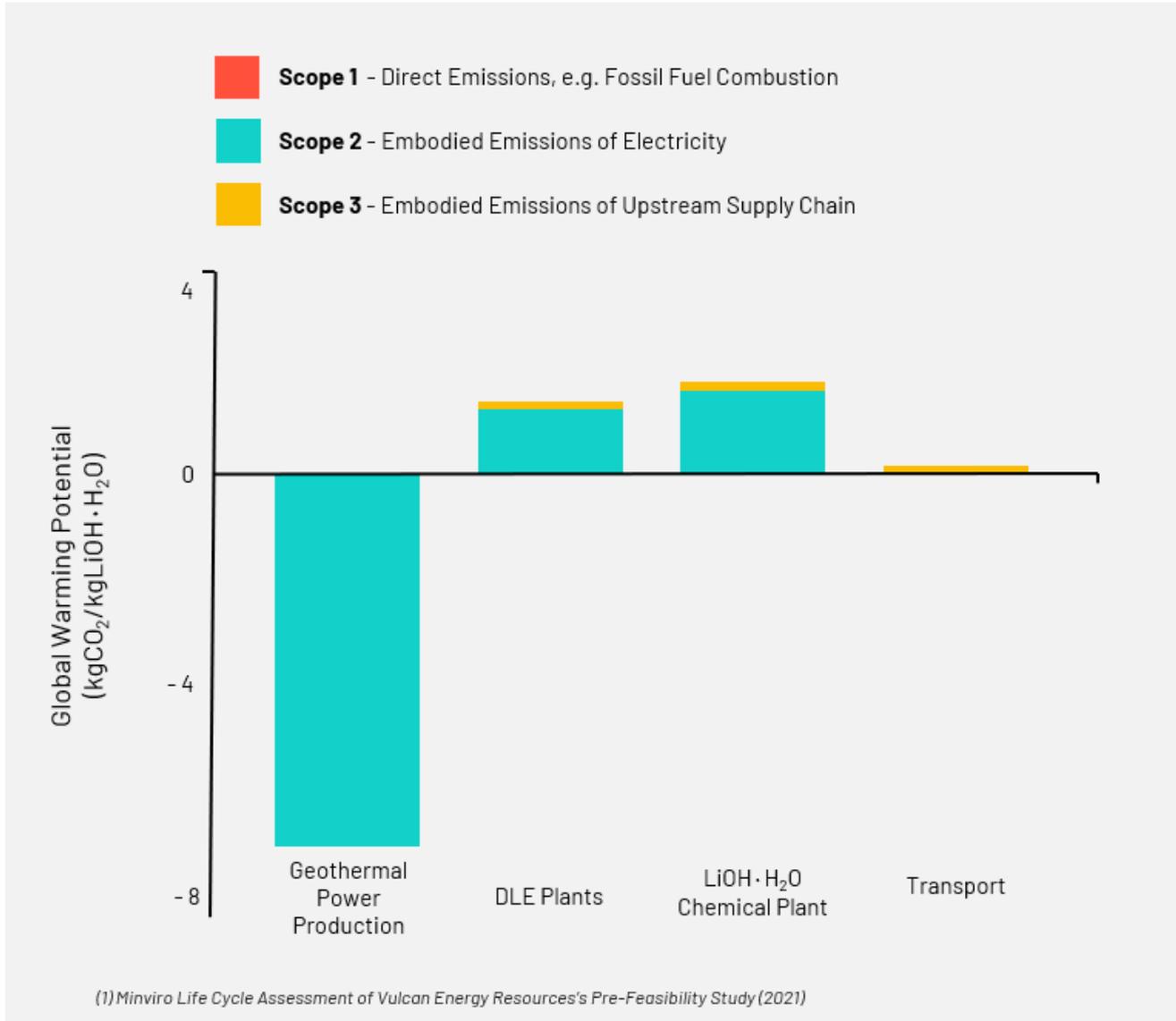
The LCA conducted on our PFS-level extraction and chemical process study shows that Vulcan is expected to have the lowest global warming potential of any other lithium product in the world. This is because:

1. **Vulcan will burn zero fossil fuels** while producing lithium chemicals and electricity.
2. We will co-produce low-carbon electricity for the high CO<sub>2</sub>-intensity German grid which is struggling to decarbonise. We will produce much more power than we will use, decarbonising the German grid.
3. Vulcan is making deliberate technology decisions to reduce CO<sub>2</sub> emissions, notably the choice of electrochemical LiCl to LHM conversion instead of reagent-intense processing through Li<sub>2</sub>CO<sub>3</sub>.



## Carbon footprint by “Scope” of emissions

Scopes of emissions are helpful for understanding the drivers of CO<sub>2</sub> emissions in manufacturing a product



Vulcan’s CO<sub>2</sub> emissions can be broken down into “scopes” of emissions according to the Greenhouse Gas Protocol. In alignment with future European regulations and best practice CO<sub>2</sub> emission reporting, we disclose our Scopes 1, 2, and 3 emissions up to the “gate” of LHM product delivery:

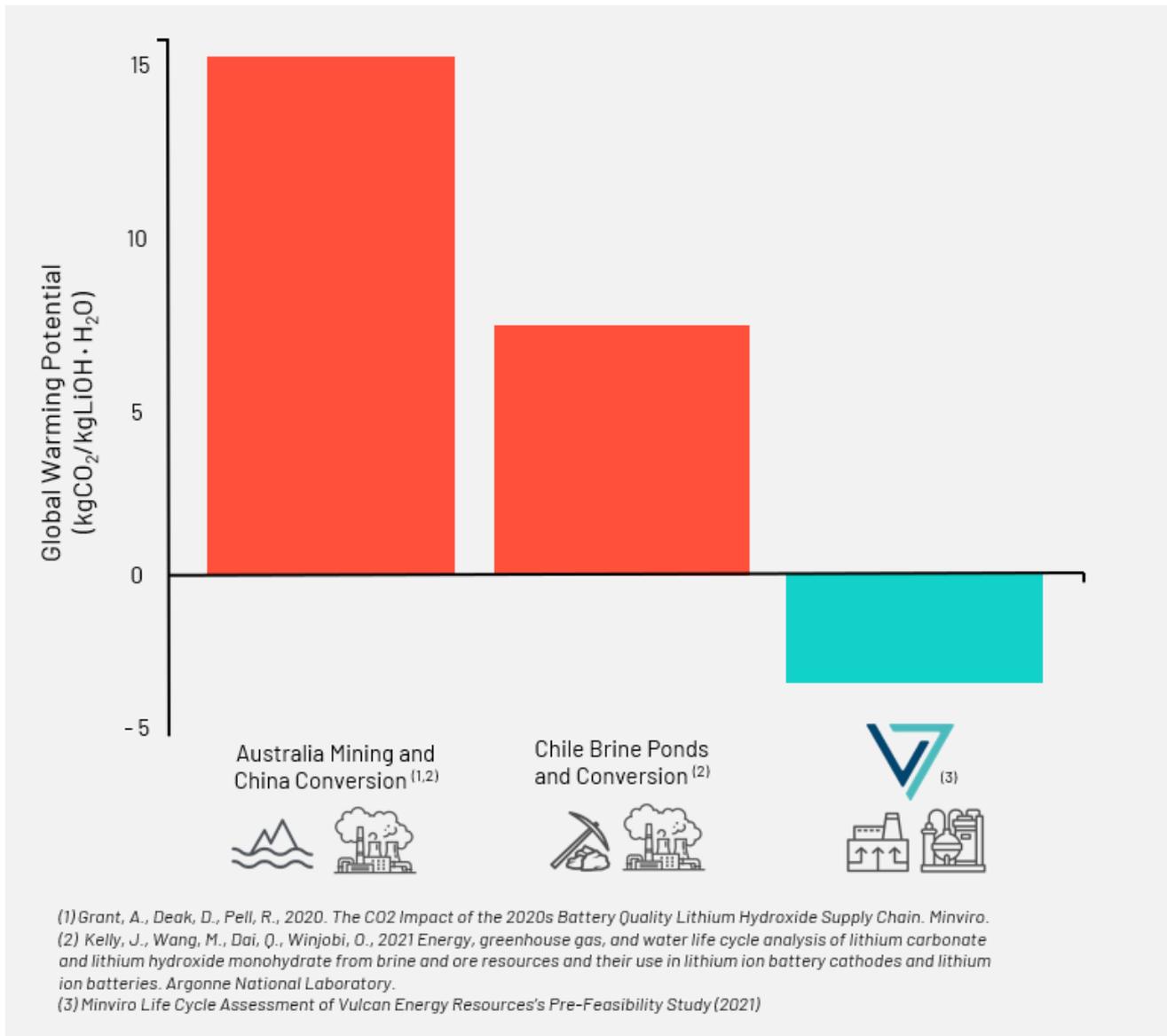
**0 kg CO<sub>2</sub>/kg LHM Scope 1 emissions** because Vulcan will not burn any fossil fuels, and will not release CO<sub>2</sub> in the brine to the atmosphere.

**-3.1 kg CO<sub>2</sub>/kg LHM Scope 2 emissions** because Vulcan will produce excess zero-carbon power which will decarbonise the German power grid.

**0.2 kg CO<sub>2</sub>/kg LHM Scope 3 emissions** (upstream and downstream to gate of delivery to customer) due to Vulcan’s decision to use ultra-low reagent consumption electrochemical lithium chloride to lithium hydroxide chemical processing.

## Global Warming Potential (GWP)

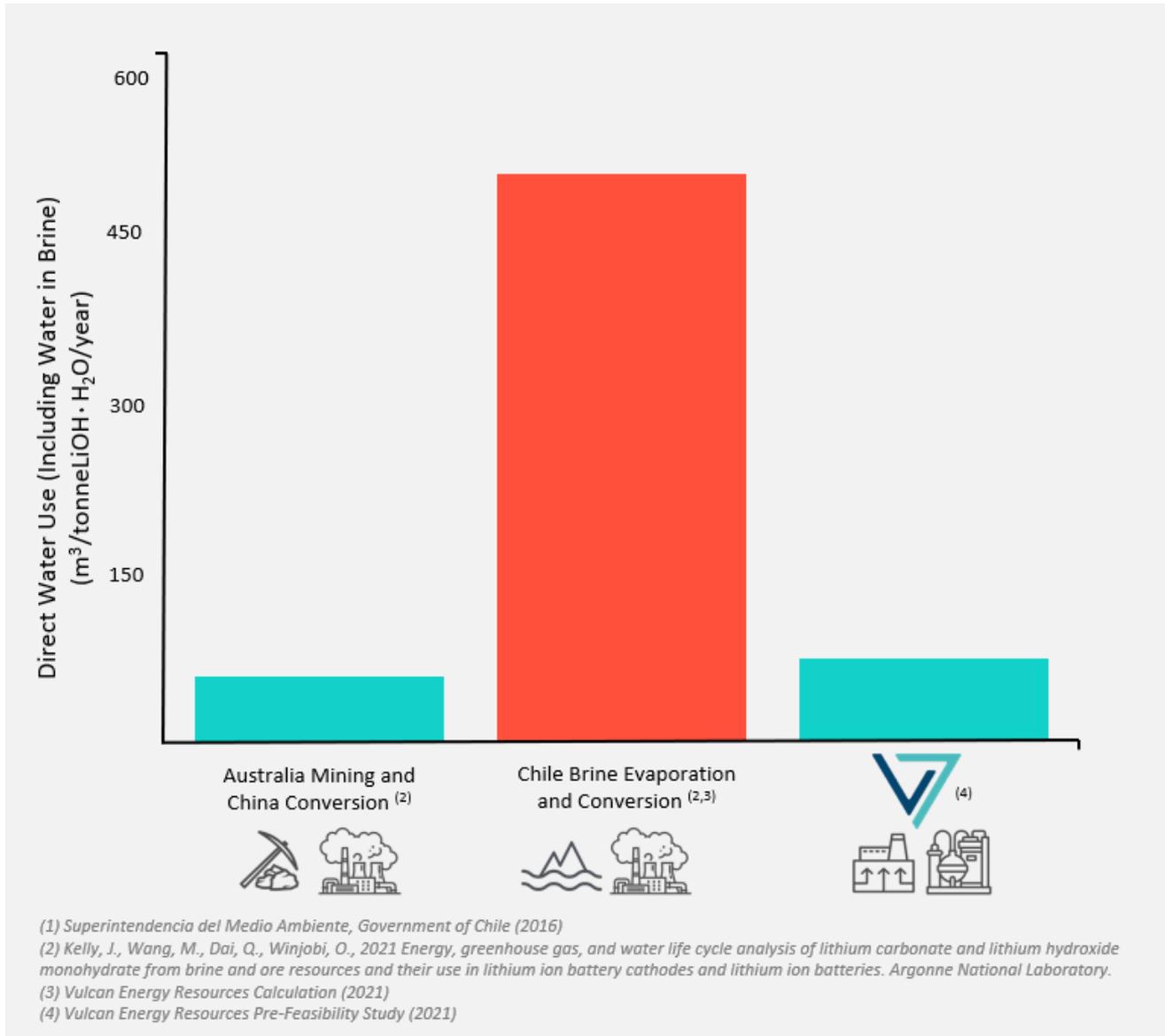
kg CO<sub>2</sub> equivalent per kg of battery-quality LHM



LCAs have been conducted by Minviro and Argonne National Laboratory on lithium chemicals produced from the Salar de Atacama in Chile and lithium chemicals produced by Chinese converters using Australian spodumene concentrate as feedstock. Based on this publicly available data on existing modes of production, Vulcan's lithium product from its planned operations is expected to have a far lower CO<sub>2</sub> emissions intensity than existing modes of production.

## Direct Water Use

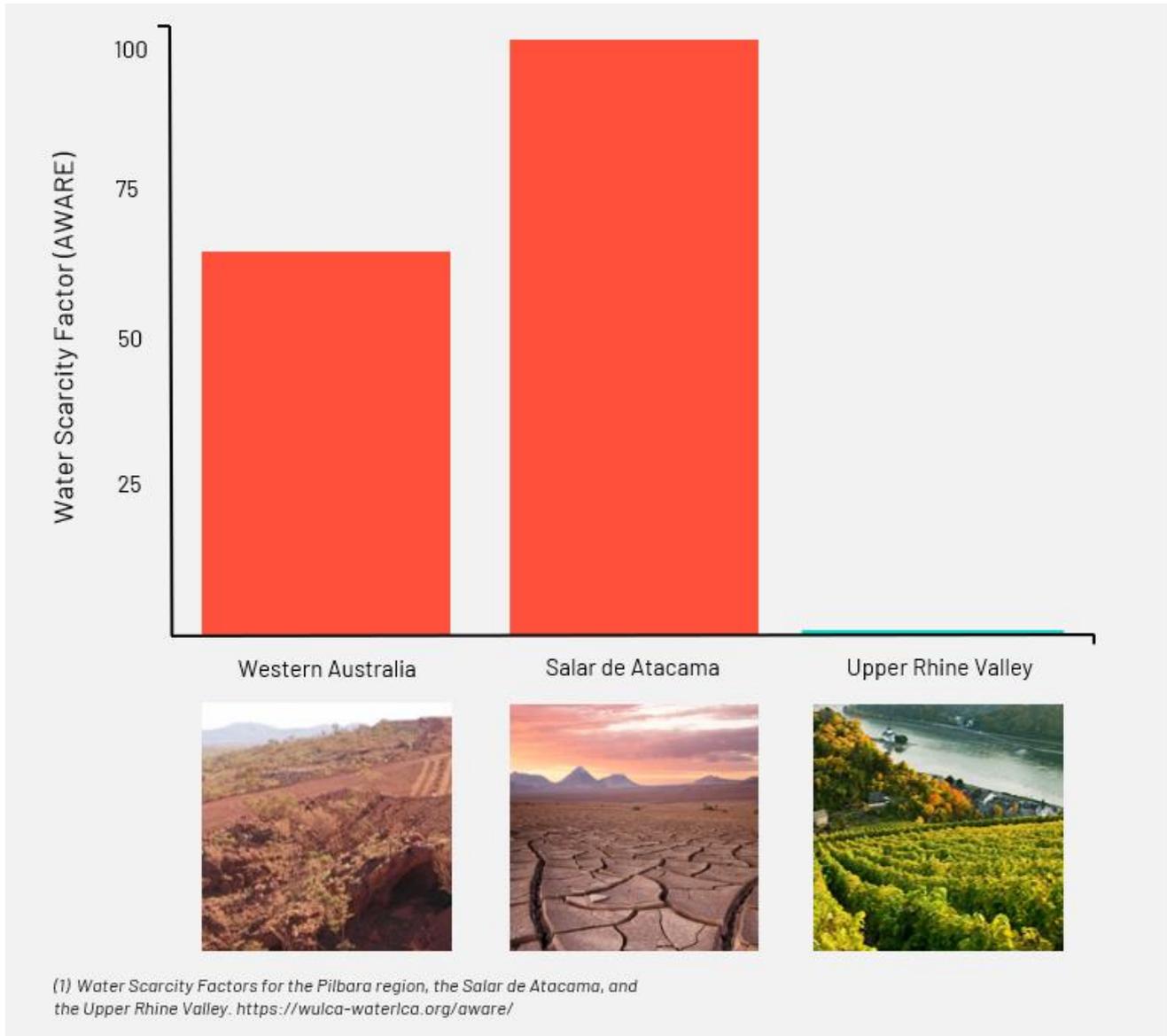
Water consumption for lithium extraction in arid locations is scrutinised by European buyers



Water is consumed in all lithium extraction and processing. In evaporation ponds, large quantities of water are evaporated from brine to produce lithium chloride which are converted into lithium chemicals. Even though water in brine cannot be consumed or used for agriculture directly, withdrawal of water in brine from the ecosystem has been found to be causing dehydration of soil and death of flora in places like the Salar de Atacama<sup>1</sup>. There is also concern about the impact of depletive brine extraction on freshwater aquifers which sit on top of brine aquifers at the Atacama. Vulcan's geothermal lithium process will involve reinjection of all the water in the brine back to where it originally came from, leading to a very low water usage.

## Water scarcity factor: AWARE methodology

In life cycle assessment, water scarcity factors are used to compare direct water use in different places



The AWARE methodology in LCA involves the use of scarcity factors in order to make comparisons of water use in different locations globally. The scarcity factor corresponds to the likelihood that water use will impact the availability of water for human use or ecosystems in a specific watershed. Scarcity factors range from 0.1 (no water scarcity) to 100 (high water scarcity). Since there is significantly more water in Western Germany than is needed, the water scarcity factor there is 0.7. In the Atacama it is 100, the highest water scarcity factor on the planet. This means that Vulcan’s water use will have no local impact on water availability compared to water used in a place like the Atacama in Chile.



# VULCAN ENERGY ZERO CARBON LITHIUM™

## About Vulcan

*Vulcan is aiming to become the world's first lithium producer with net zero greenhouse gas emissions. Its ZERO CARBON LITHIUM™ Project intends to produce a battery-quality lithium hydroxide chemical product from its combined geothermal energy and lithium resource, which is Europe's largest lithium resource, in Germany. Vulcan's unique, ZERO CARBON LITHIUM™ Project aims to produce both renewable geothermal energy, and lithium hydroxide, from the same deep brine source. In doing so, Vulcan intends to address lithium's EU market requirements by reducing the high carbon and water footprint of production, and total reliance on imports. Vulcan aims to supply the lithium-ion battery and electric vehicle market in Europe, which is the fastest growing in the world. The Vulcan Zero Carbon Lithium™ project has a resource which can satisfy Europe's needs for the electric vehicle transition, from a source with net zero greenhouse gas emissions, for many years to come.*





## **For and on behalf of the Board**

Daniel Tydde

Company Secretary

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

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### Competent Person Statement:

The information in this report that relates to Mineral Resources is extracted from the ASX announcement made by Vulcan on the 15 December 2020, which is available on [www.v-er.eu](http://www.v-er.eu). The information in this presentation that relates to the Pre-Feasibility Study for the Vulcan Lithium Project is extracted from the ASX announcement "Positive Pre-Feasibility Study", released on the 15<sup>th</sup> of January 2021 which is available on [www.v-er.eu](http://www.v-er.eu). The Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcements and that all material assumptions and technical parameters underpinning the estimates in the relevant market announcements continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcements.