MTM CRITICAL METALS

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ASX RELEASE

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FLASH JOULE HEATING (FJH) TESTING ACHIEVES COMMERCIAL LITHIUM CALCINATION YIELD

Highlights:

- **Flash Joule Heating (FJH) testing achieves over 90% lithium conversion in spodumene calcination, a yield deemed commercially viable by industry leaders.**
- **Over 80% reduction is calcination time versus conventional kiln processing**
- **FJH technology offers a faster & more efficient alternative to traditional calcination methods.**
- **MTM is continuing discussions with top-tier industrial firms in both the US and Australia.**
- **FJH technology holds the potential to dramatically lower energy consumption and CO_2 emissions in lithium production, addressing key sustainability challenges faced by the industry.**

MTM Critical Metals Limited (ASX: MTM) ("MTM" or "the Company") is pleased to announce recent Flash Joule Heating (FJH) tests have achieved over 90% conversion yield in the calcination of lithium mineral spodumene (conversion of α to β form), and a significant reduction in processing time, marking a significant step in advancing the use of FJH technology for lithium recovery.

Importantly, based on MTM's discussions with leading industrial firms, **above 75%** yield is considered as sufficient for commercial application by end-users which highlights the significant potential for FJH to revolutionise lithium extraction. These results build on earlier tests[1] demonstrating FJH's capability to significantly improve the energy efficiency of calcination; the most energy-intensive stage in lithium refining, thereby providing a potential solution to the high energy demands of traditional industrial processes.

This α to β testing, utilising the Company's FJH prototype unit in Houston, Texas, has been running alongside the previously reported testing which has achieved **conversion of spodumene concentrate directly into lithium chloride**[2]. Both applications hold the potential to revolutionise lithium processing flowsheets, with strong interest from major players in the lithium industry.

Due to the refractory nature of spodumene, conventional recovery processes are very energy-intensive and involve the use of rotary kilns operating at high temperatures for extended periods. Calcination, which is essential for rendering spodumene amenable to acid leaching, is the most energy and CO_2-intensive step in producing battery-grade lithium, accounting for over 50% of the energy consumption and emissions[3] (see *Fig. 1*).

MTM Chief Executive Officer, Michael Walshe, said: *"Achieving a commercial yield of over 90% for the calcination of spodumene is a significant breakthrough for the FJH process revolutionising how lithium is extracted in the future. The search for more sustainable, lower-energy calcination alternatives has long been a priority for the lithium industry, given the sheer energy and CO_2 intensity of traditional methods. While further testing is required, these results give us increased confidence in the FJH process. MTM continues to engage in*

[1] Ref: ASX: MTM announcement dated 09 July 2024 *'Positive Lithium Extraction Results from Flash Joule Heating'*
[2] Ref: ASX: MTM announcement dated 21 August 2024 *'Flash Joule Heating converts Spodumene to Lithium Chloride'*
[3] Fosu et.al 2020

commercial discussions with several leading industrial firms, and we look forward to providing further updates soon".

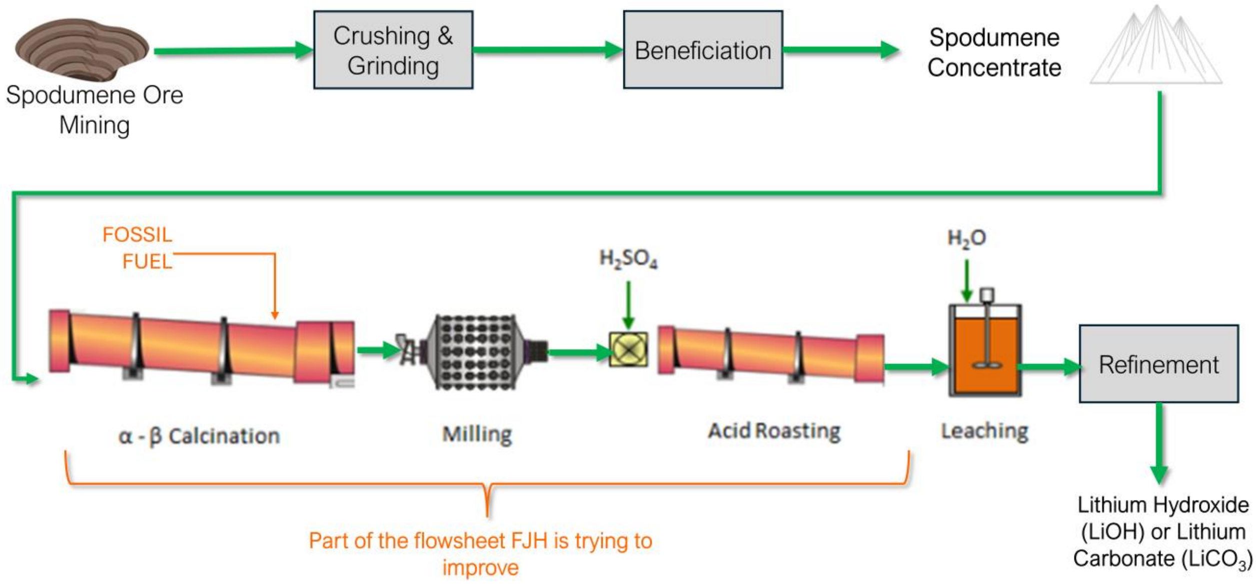

Figure 1: Simplified flowsheet for Lithium production from hardrock spodumene ore source showing the phases that the FJH process will target for improvements.

Table 1: *Test results showing the positive effect on spodumene mineral conversion using FJH technology.*

Sample ID	"Conventional" Kiln Process used in industry [4]	FJH Test 24-608-2	FJH Test 24-608-1
α-β spodumene conversion (%)	75 - 90%	**92.9%**	**85.2%**
Reaction time (minutes)	180	35	35
Time saving vs Industry Standard (%)	N/A	**81%**	**81%**

Notes to Table 1:

- Results are **preliminary only**. There remains significant scope for further optimisation and refinement.
- The concentrate contains approximately 5.5 - 6% Li_2O by mass, typical of spodumene mines.
- Test samples were 'flashed' and assessed pre- and post-flashing using semi-quantitative XRD to determine the extent of conversion of refractory α-spodumene to β.
- The conversion yield relates to the non-amorphous portion of lithium present in the feedstock material.
- See also Figure 3 in the Appendix.

[4] Salakjani et al. 2016 and Liontown Resources Ltd 2020.

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Lithium Recovery from Spodumene:

Spodumene, the world's largest source of lithium, is highly refractory in its natural α-monoclinic form, resisting acid leaching. The conventional method to make it leachable involves calcination at over 1000°C for up to three hours in a rotary kiln, converting it to the more acid-soluble β-tetragonal form. This industry-standard process, developed over 70 years ago, consumes large amounts of fossil fuels and results in significant CO_2 emissions, as current kiln technology relies on natural gas or diesel and is thermally inefficient.

These and the previously announced results[1] indicated FJH can transform α-spodumene to β-spodumene in a much shorter timeframe compared to conventional calcination kilns (Salakjani et al. 2016). Applying energy directly to the material with FJH is conceptually more thermodynamically efficient than conventional kiln calcination, which requires heating not only the spodumene concentrate but also the kiln internals and surrounding air. The prolonged heating process of rotary kilns further increases heat dissipation and thermal losses (Boateng 2015, pp. 243-244).

Strategic Collaborations & Partnerships:

MTM is continuing discussions with top-tier industrial firms in both the US and Australia.

Next Steps:

- **Prototype Testing:** Continue optimisation of the FJH prototype reactor to scale up the recovery process.
- **Commercial-Scale Facility:** Finalise the design and operational plans for the 1-ton per day facility, targeting full-scale production in the next year.
- **Strategic Partnerships:** Continue discussions with international partners and pursue funding opportunities to support the development and commercialisation of this technology.

The Company will continue its test work to demonstrate the scalability and effectiveness of the FJH & chlorination-enhanced FJH technology with a focus on maximising lithium & other critical metal recovery. Discussions with industry partners, academia and government agencies are ongoing to support the development and commercial deployment of this revolutionary technology.

Additionally, test work is completed, underway or planned on a range of additional sample streams including **refractory minerals** such as monazite (rare earths), & pyrochlore (niobium); **precious metal recovery** from e-waste; and **critical metal (Li, Co etc) recovery** from spent lithium-ion batteries ('black mass').

This announcement has been authorised for release by the Board of Directors.

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PREVIOUS DISCLOSURE

The information in this announcement is based on the following MTM Critical Metals Limited ASX announcements, which are all available from the MTM Critical Metals Limited website www.mtmcriticalmetals.com.au and the ASX website www.asx.com.au.

Previous **lithium-related announcements** highlighted

Date	Description
03/04/2024	Flash Joule Heating Prototype Complete, Testing Commenced
06/05/2024	Flash Joule Heating Prototype Test Increases REE Recovery
31/05/2024	Global Licence Agreement Secured for Flash Joule Heating Technology with Rice University
24/06/2024	Positive Advances with Metal Recovery Test Work
09/07/2024	Positive Lithium Extraction Results from Flash Joule Heating
13/08/2024	Addition of Chlorination enhancement to FJH Licence
21/08/2024	Flash Joule Heating converts Spodumene to Lithium Chloride
27/08/2024	Gallium Recovered from Semiconductor Waste Using FJH Tech
06/09/2024	MTM Advances FJH Commercialisation with 1 TPD Demo Plant
12/09/2024	High Gold Recovery from E-Waste using FJH Technology

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original ASX announcements and that all material assumptions and technical parameters underpinning the relevant ASX 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 represented have not been materially modified from the original ASX announcements.

REFERENCES

Boateng, A 2015, *'Rotary Kilns: Transport Phenomena and Transport Processes'*, Second Edition, Butterworth-Heinemann.

Fosu, A, Kanari, N, Vaughan, J, Chagnes A, 2020, 'Literature Review and Thermodynamic Modelling of Roasting Processes for Lithium Extraction from Spodumene', *Metals*, MDPI, vol. 10, Issue 10, pp.1312-1338

Habashi, F 1997, 'Handbook of Extractive Metallurgy', Wiley Germany, vol. 2.

Liontown Resources Ltd, *Downstream Scoping Study Kathleen Valley Lithium-Tantalum Project*, p. 9, https://www.ltresources.com.au/wp-content/uploads/2023/06/61002415.pdf

Nazir M, Dyer L, Tadesse B, Albijanic B, & Kashif N 2023, '*Influence of calcination temperatures on lithium deportment by screening hard rock lithium'*, Heliyon, vol. 9, Issue 3, https://doi.org/10.1016/j.heliyon.2023.e13712.

Salakjani N, Singh P, & Nikoloski N 2016, *'Mineralogical transformations of spodumene concentrate from Greenbushes, Western Australia. Part 1: Conventional heating'*, Minerals Engineering, vol. 98, pp. 71-79, https://doi.org/10.1016/j.mineng.2016.07.018.

Sichuan Calciner Technology Pty Ltd 2024, http://www.calciner.cn/en/.

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ABOUT MTM CRITICAL METALS LIMITED

MTM Critical Metals Limited is a dynamic company with a dual focus on mineral exploration and metal recovery technology development. We hold exploration assets prospective for niobium (Nb), rare earth elements (REE), and gold, strategically located in Western Australia and Québec. Additionally, we possess exclusive licensing rights to the innovative Flash Joule Heating technology, a cutting-edge metal recovery and mineral processing method developed by esteemed researchers at Rice University, USA.

Flash Joule Heating (FJH) is an advanced electrothermal process that enhances metal recovery and mineral processing compared to traditional methods. By rapidly heating materials in a controlled atmosphere, FJH efficiently extracts metals like lithium from spodumene, gallium from scrap, and gold from e-waste, among others. This technology has the potential to revolutionise metal recovery by reducing energy consumption, reagent use, and waste, offering a more economical and environmentally friendly alternative.

MTM's West Arunta Nb-REE exploration assets are situated in one of Australia's premier exploration hotspots, where over $60 million has been invested by ASX-listed companies such as WA1 Resources, Encounter Resources, Rio Tinto (in JV with Tali Resources), and IGO Limited. MTM also holds tenements in other key mineral regions across Western Australia, including the Mukinbudin Nb-REE Project, East Laverton Gold & Base Metals Project, and Mt Monger Gold Project. In Québec, the Pomme Project is a highly promising carbonatite intrusion rich in REE and niobium, located near the world-class Montviel deposit.

ABOUT KNIGHTHAWK ENGINEERING

KnightHawk was founded in 1991 and specializes in identifying high technology solutions in a short timeframe. They have executed projects throughout the United States, Europe, and Asia. Their clients range from individual entrepreneurs to the large industrial organisations such as Shell, Exxon Mobil, Chevron and NASA. They have a depth of experience and expertise and are leaders in design, failure analysis and troubleshooting across a range of engineering disciplines. KnightHawk was selected for its expertise across a wide range of disciplines and their focus on ensuring outcomes in a timely manner.

Figure 2: Knighthawk Engineering, FJH Team, Houston Texas

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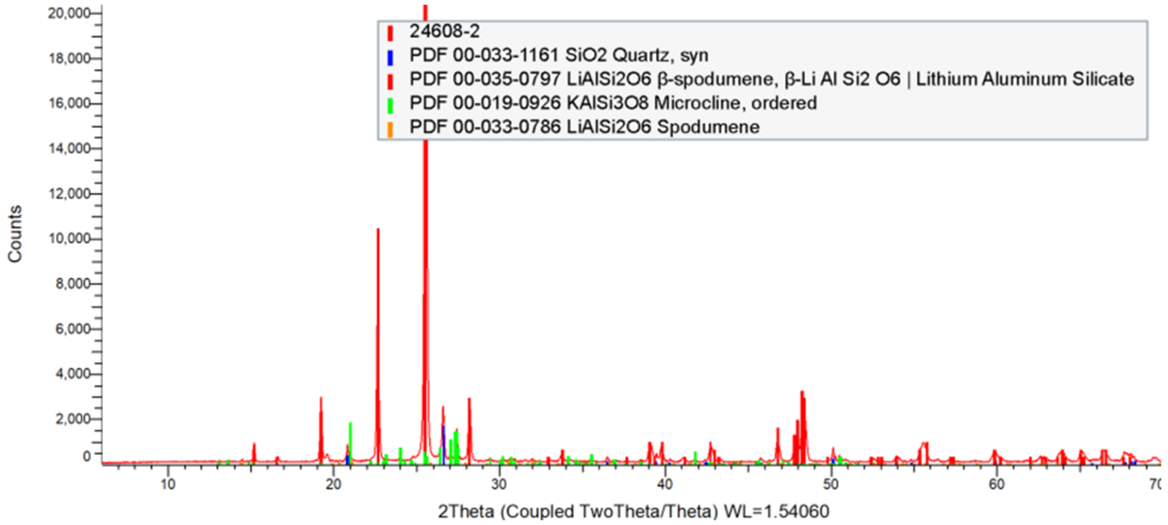
Appendix 1 XRD Results from FJH Testing

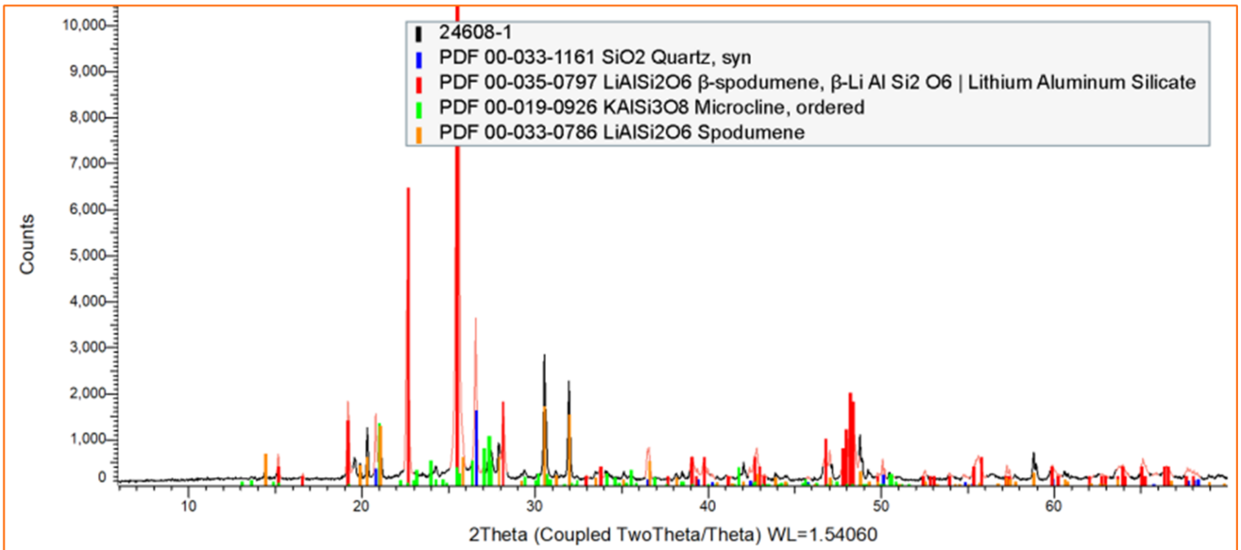
FJH Test 24-608-2



Pattern #	Compound Name	Formula	S-Q
PDF 00-035-0797	β-spodumene, β-Li Al Si2 O6 | Lithium Aluminum Silicate	$LiAlSi_2O_6$	92.9%
PDF 00-019-0926	Microcline, ordered	$KAlSi_3O_8$	5.2%
PDF 00-033-1161	Quartz, syn	SiO_2	1.4%
PDF 00-033-0786	Spodumene	$LiAlSi_2O_6$	0.5%

LAB: Houston Electron Microscopy, Inc.

FJH Test 24-608-1



Pattern #	Compound Name	Formula	S-Q
PDF 00-035-0797	β-spodumene, β-Li Al Si2 O6 | Lithium Aluminum Silicate	$LiAlSi_2O_6$	85.2%
PDF 00-033-0786	Spodumene	$LiAlSi_2O_6$	7.2%
PDF 00-019-0926	Microcline, ordered	$KAlSi_3O_8$	5.6%
PDF 00-033-1161	Quartz, syn	SiO_2	1.9%

LAB: Houston Electron Microscopy, Inc.

Figure 3: XRD Spectrum Results

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Appendix 2 Conversion of Alpha (α) to (β) spodumene via Calcination

The conventional processing of spodumene ore is highly energy intensive as it relies on calcination or 'decrepitation' to convert the monoclinic structure of the natural α-spodumene molecule to its tetragonal equivalent (β-spodumene) which is less dense. The resulting 'open' structure renders the mineral amenable to leaching. Naturally occurring α-spodumene is highly resistant to chemical leaching and until the calcination process was developed in the 1950s, no other means of lithium extraction from spodumene was economically feasible (Nazir et al. 2023).

Spodumene - Mineral and Properties

Spodumene, a lithium alumina silicate mineral, exists in two main crystal forms: alpha and beta. Alpha-spodumene is the low-temperature monoclinic phase stable below approximately 1100 – 1200°C, while beta-spodumene is the high-temperature tetragonal phase stable above this temperature threshold. The transformation from alpha to beta spodumene is driven by calcination, a controlled heating process that induces crystallographic changes in the mineral structure.

Calcination Process

Calcination involves heating crushed spodumene concentrate to temperatures typically ranging from 1100 – 1200°C in a controlled atmosphere. The process is conducted in kilns or rotary furnaces where precise temperature control and atmosphere conditions are maintained. The primary goal of calcination is to convert alpha-spodumene into the more desirable beta-spodumene phase which is amenable to chemical leaching.

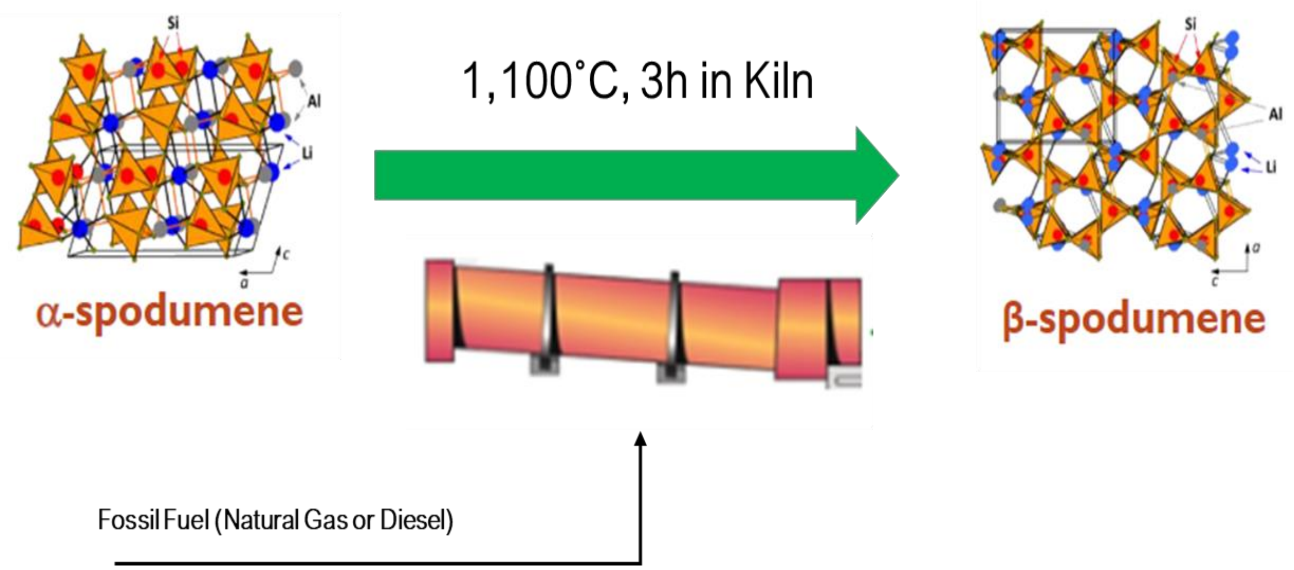

Figure 4: Simplified schematic of spodumene calcination transforming it from α to β polymorph via traditional processing

CONCLUSION

The calcination of spodumene from alpha to beta form is a fundamental process in lithium production for the current lithium-ion battery industry. This transformation alters the mineral's crystal structure, enhancing its chemical reactivity and suitability for subsequent lithium extraction processes. An improvement of the current process could potentially make lithium extraction from spodumene more efficient and environmentally friendly, addressing the significant energy and sustainability demands of current industrial processes.

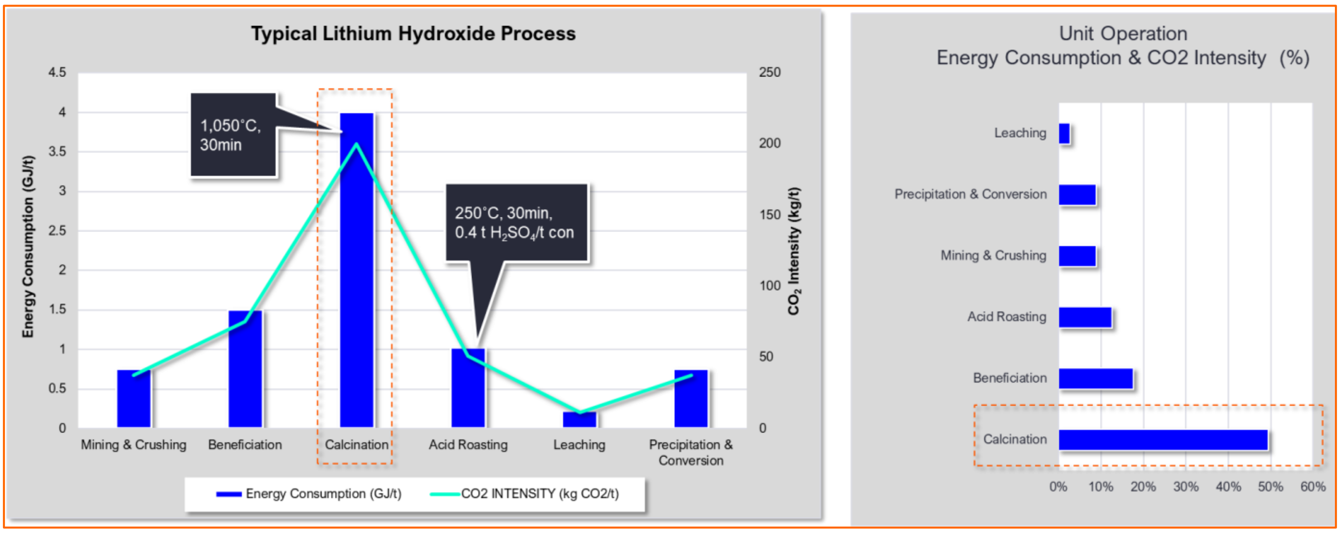

Figure 5: Estimated energy consumption & CO_2 intensity for each major unit operation of the conventional lithium hydroxide manufacturing process. As shown, Calcination is the largest energy consumer and CO_2 emitter (Habashi 1997, Fosu et. al 2020).

Figure 6: Typical natural-gas fired calcination kiln used in the lithium refinery process. Source: Sichuan Calciner Technology Pty Ltd