# **Comply or Collapse**

THE DILEMMA FACING THE LITHIUM-ION BATTERY INDUSTRY

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# Future drivers of the battery industry

- The drive towards net zero has produced a plethora of policy and legislation.
- Although reporting of sustainability is now a requirement in the EU, somewhat ironically "sustainability" is not defined in the legislation.
- Interaction of various Acts and policies points to a common sustainability factor: carbon footprint.
- Progressive introduction of compliance will probably result in a practical definition of "sustainability" by 2026.

# Warning

Low recovery of spodumene form Australian pegmatite operations poses a real sustainability compliance risk for marketing concentrates, lithium chemicals, or downstream products, manufactured from Australian spodumene.



#### **Europe spearheads the move to lithium sustainability**

Let's take a look as the major policies



### **Rate of policy introduction**



## **EU Battery Regulations, May 2023**





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## EU Sustainability Reporting (ESG regulations)

- Corporate sustainability directives (CSRD) require large EU companies and publicinterest entities to disclose information on their annual ESG performance.
- Reporting requires upstream and downstream supply chain impacts to be assessed.
- Sustainable Finance Disclosure Regulation (SFDR) and the Taxonomy Regulation, require disclosure of the sustainability characteristics of investment products, to assist end investors in making more informed investment decisions.
- EU Carbon Border Adjustment Mechanism (Oct 2023) will attempt to level the impacts of environmental supply chain sensitivity.
- Suppliers into the EU to comply as though they were EU companies.
- 4000 Australian companies require compliance.
- Spodumene producers and subsequent products to be affected.



#### **EU Carbon Border Adjustment Mechanism Oct 2023**



of certificates each year.

weekly ETS allowances.

#### #EUGreenDeal



can be deducted



#### **Global Carbon Pricing**



Australian climate policies will be dictated by foreign powers. Revenue from taxes to go offshore.



## **EU Battery Regulations, May 2023**



- All batteries collected must be recycled.
- Today 30% of battery mass and 40% of EVs must be sourced from within EU/UK; rising to 45/60% by January 2024.
- Likely 80,000tpa recycled lithium carbonate equivalent required to meet EU mandatory requirements by 2030.
- Globally, recycled lithium is set to make up around 10% of the lithium supply in 2031, rising to over 20% in 2036 (Benchmark).



# **EU Battery Passport May 2026**

#### Passport to carry digitally recorded battery data and history

- Battery type & unique identification (manufacturer, serial number etc).
- Date of manufacture and sale.
- Chemical composition including list of toxic substances.
- Recycled raw materials contained in the battery.
- Information and activities related to repair, reuse and dismantling.
- End-of-life treatment, recycling and recovery methods.

EU Regulations 2028 full LCA CO<sub>2</sub> reporting





#### How is the battery industry being managed in the USA?

Policies are clearly focused on securing supply, developing domestic battery production capability, reducing emissions and getting on top of inflation.



# **USA – reinforcing the National Battery Blueprint**

#### **The Biden Battery Blueprint**



**1** Secure access to raw and refined materials and discover alternates for critical minerals for commercial and defense applications



2 Support the growth of a U.S. materials-processing base able to meet domestic battery manufacturing demand



**3** Stimulate the U.S. electrode, cell, and pack manufacturing sectors



4 Enable U.S. end-of-life reuse and critical materials recycling at scale and a full competitive value chain in the U.S.



5 Maintain and advance U.S. battery technology leadership by strongly supporting scientific R&D, STEM education, and workforce development



Source:https://www.energy.gov/eere/vehicle s/articles/national-blueprint-lithium-batteries

- The USA National Blueprint for Lithium Batteries is strongly supported by the Inflation Reduction Act, 2022.
- The IRA provides a framework of subsidies, grants and tax breaks to stimulate the clean energy industry.
- The IRA is heavily oriented towards developing domestic supply chains, stimulating the battery industry and providing tax incentives
- The IRA requires that EV manufacturers source 40% of critical battery minerals domestically or with free trade partners by 2024 increasing to 80% in 2026. This strongly favours the use of Australian sourced lithium.

#### **Process problems and potential solutions**

If we don't act, Australia will squander a once in a century opportunity



# A move towards lithium sustainability

- Sustainability evaluations must cover the entire supply chain including mining, concentration, transport, conversion etc. BUT there is no substitute for maximizing the recovery of contained lithium units within an orebody.
- Downstream improvements include:
  - Minimising transport impact,
  - Using renewable energy,
  - Recycling product.
- We must strive towards maximising the value of our resources and to do this we need to maximise recovery.
- The lithium industry has arisen by amalgamation of legacy technologies, but the time has come to design production systems fit for purpose.



# The spodumene carbon footprint problem

- Historically Australian spdoumene production has been geared towards the requirements of the Chinese spodumene converters.
- Stage 1 of conventioanl chemical conversion is counter-current roasting in rotary kilns.
- The critical particle size for kiln throughput is generally around 75μm.
- An enormous amount of the carbon footprint to produce spodumene concentrates is expended on the mining, comminution and rejection of material that cannot meet converter specifications.
- A disproportionate quantum of the carbon footprint must then be assigned to the commercial concentrate.
- Material reporting to tailings is notionally assigned a zero carbon footprint.



#### Solving the recovery problem – reducing CO<sub>2</sub> footprint



Recovery from ore to commercial concentrate (%)

Source: historic data c 2018



#### What needs to be improved?



Source: Fosu, A.Y. et al. Physico-Chemical Characteristics of Spodumene Concentrate and Its Thermal Transformations. Materials **2021**, **14**, **7423**. https://doi.org/10.3390/ma14237423

#### **ALTA** 2023®

#### What's in the sample?

- Sample from Pilbara region of WA.
- Mass yield from ore to concentrate 85%.
- Only about 40% of the concentrate exceeds a particle size of 75µm.

#### What's happening elsewhere?

- Recoveries to concentrate as low as 30%
- CO<sub>2</sub> footprint of resulting commercial concentrates very high.
- Discarded fines ultimately being exported carry a zero CO<sub>2</sub> production footprint.

Two promising solutions to the problem

#### Lithium Australia's caustic conversion – LieNA® and Calix & Pilabara Minerals' flash calcination



# Alternative #1 – Lithium Australia - LieNA® process



- LieNA<sup>®</sup> is a caustic conversion process.
- Requires no roasting.
- Ideally suited to fine and low-grade spodumene.
- Capable of recovering lithium from any form of spodumene but best for material not suited to conventional conversion.
- Developed in conjunction with ANSTO.
- Partially funded through Australian government grant (CRC-P).
- Pilot plant commissioning August 2023
- Choice of end product carbonate, hydroxide, phosphate etc. with potential to feed directly into LFP cathode production.
- Lithium phosphate output preferred to minimize carbon footprint (elimination of energy intensive evaporation).



# LieNA<sup>®</sup> comparison with conventional conversion





# Alternative #2 – Calix flash calcination

- Like LieNA<sup>®</sup>, the Calix' flash calcination process is focused on maximizing the commercial recovery of lithium from spodumene deposits.
- The process is being developed as a JV between Pilbara Minerals and Calix.
- Advantages:
  - As a process addition, it aids in optimizing the recovery of mined lithium units.
  - Electrically powered, it has potential to utilize renewable energy and reduce carbon footprint.
  - High conversion rates from  $\alpha$  to  $\beta$  spodumene.
  - Lithium recoveries > 90%
  - Can take advantage of the expanding market for lithium phosphate materials.
  - -8-10 fold reduction in shipping mass if the process is established next to the spodumene concentrator.
  - Production of high-value lithium salt, close to the spodumene source, will retain more value for local producers and reduce the carbon footprint of the final consumer product.



#### **Alternative #2 – Calix flash calcination**





Source: Calix

### **Conclusion – dodging the bullets**

# A wakeup call to the industry to improve sustainability and profitability



# Conclusion

- Australian lithium products are in danger of being alienated from EU markets on the basis of Australia having no domestic carbon tax and spodumene concentrate producers having a high carbon footprint.
- Foreign companies are seizing the opportunity and buying fine Australian spodumene which can be accounted for as having a zero production carbon footprint. It can also be marketed as a recycled product.
- Utilising the fine spodumene to fill surplus installed battery production capacity can open the EU markets to offshore entities and impede Australia's ability to capitalize on the current opportunity.
- Without addressing the sustainability issues in the lithium supply chain, Australia will be restricted to US and Chinese markets.
- Advanced technologies can alleviate the sustainability compliance issues faced by Australia and maintain competitive access to all markets – LieNA<sup>®</sup> and Calix.
- The Australian government needs to work with the lithium industry to implement policies addressing competitive pressures in international markets.

