

<<https://doi.org/10.1595/205651321X16165776867357>>

SUPPLEMENTARY INFORMATION FOR:

**Comparative life cycle assessment of lithium-ion capacitors
production from primary ore and recycled minerals**

By Peter I. Chigada*, Olivia Wale, Charlotte Hancox, Koen Vandaele and Barbara
Breeze

Johnson Matthey, Blount's Court, Sonning Common, Reading, RG4 9NH, UK

Andrew Mottram and Alexander J. Roberts

Warwick Manufacturing Group (WMG), University of Warwick, Coventry, CV4 7AL, UK

*Email: <Peter.Chigada@matthey.com>

<Summary>

The supplementary information contains:

S1 Flowcharts and inventory to produce a lithium ion capacitor module and

S2 A list of assumptions applied in the study.

S1.1 LTO Powder synthesis

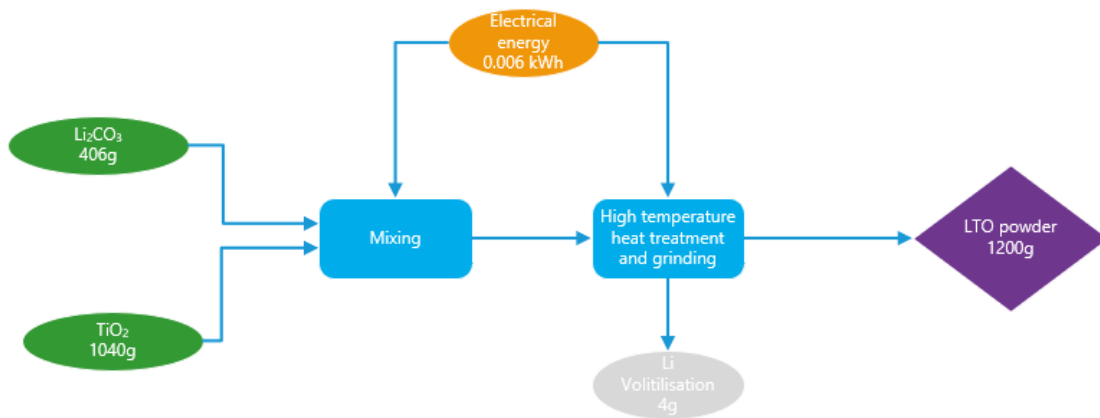


Figure S1. Anode powder material synthesis flowsheet and inventory

S1.2 Anode preparation

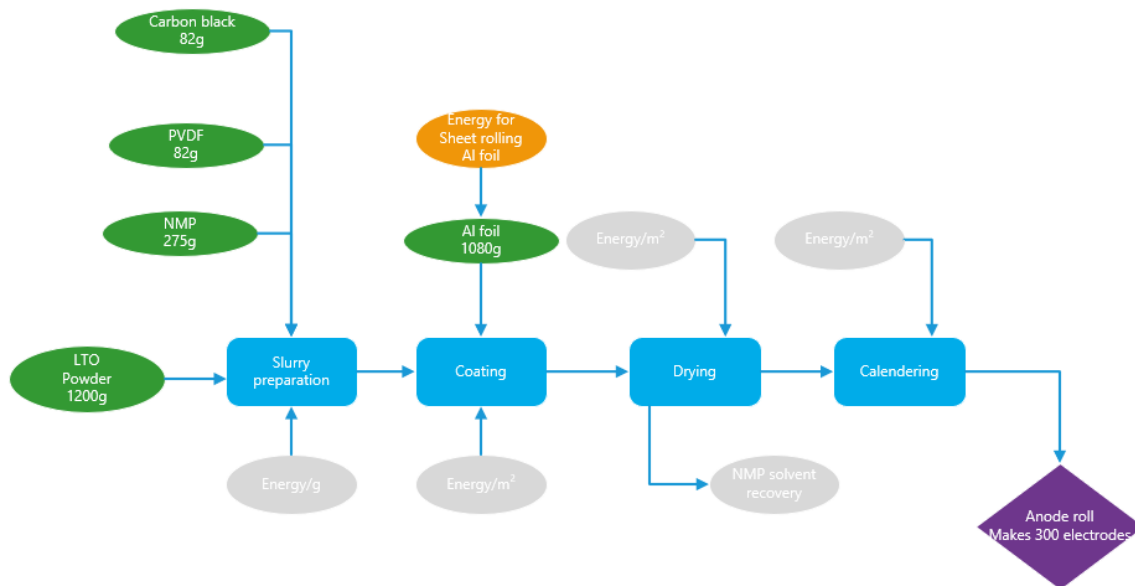


Figure S2. Anode preparation assemblies and product stages

S1.3 Cathode preparation

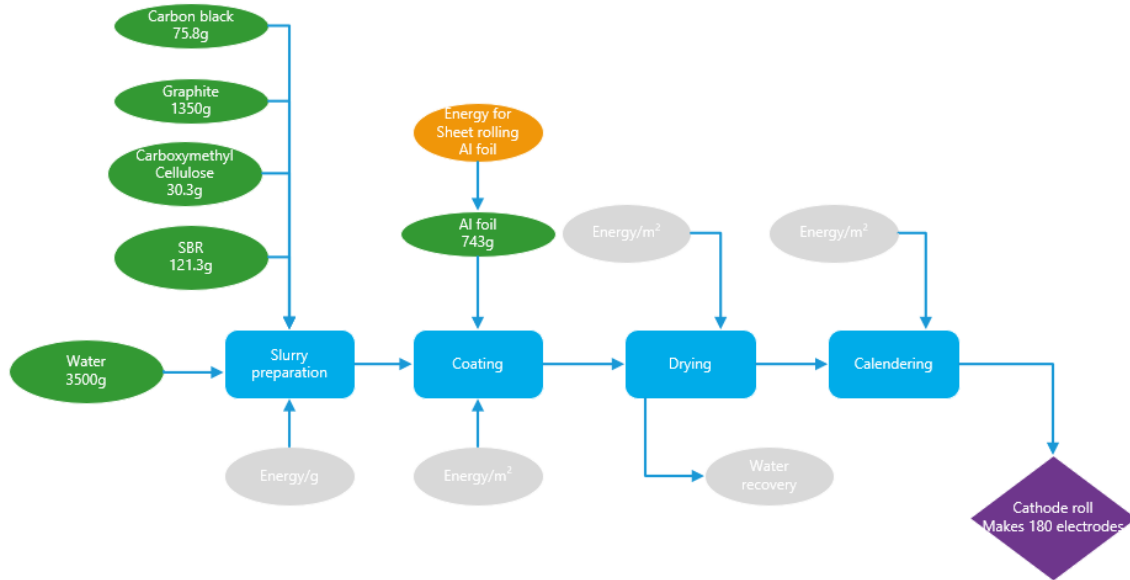


Figure S3. Cathode preparation assemblies and product stages

S1.4 Cell build

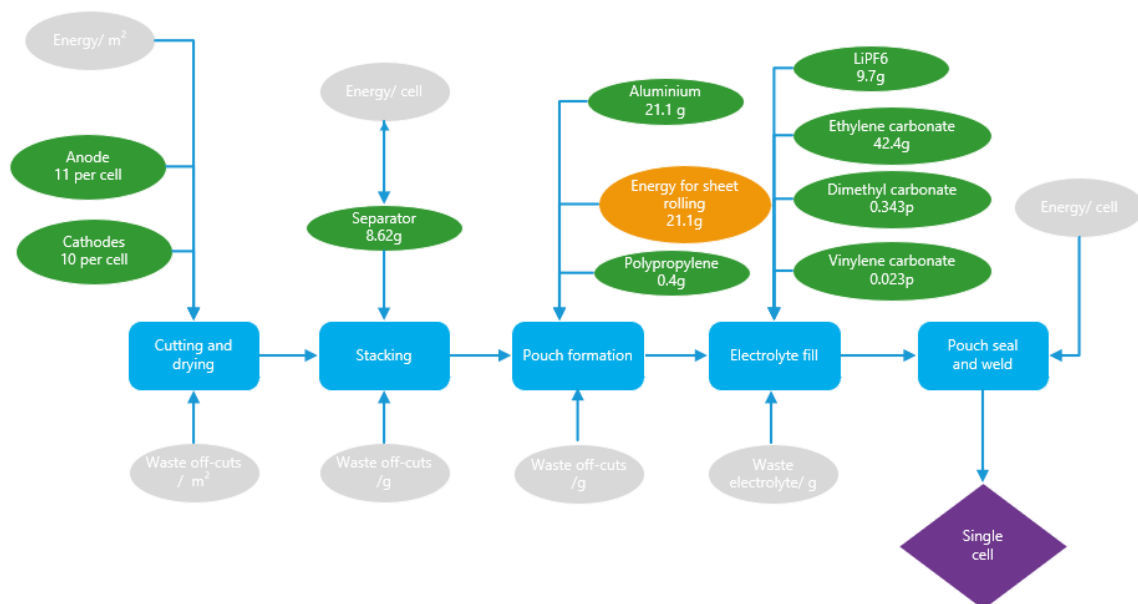


Figure S4. Flowsheet for a single cell formation

S2.0 LCA assumptions for the 48V LIC module**Table S1**

Process stage	Data source	Assumption
All	–	Emissions and energy associated with transport has not been considered in this LCA. But the Ecoinvent database does include transport associated with primary ore mining of minerals.
Anode Material: LTO synthesis	Zhang <i>et al.</i> 2013	Energy requirements for LTO synthesis are similar to LMO with data obtained from Greet model
Anode preparation: anode slurry coating	Pilot plant	90 % recovery and reuse of NMP assumed at plant production scale. Polyvinylidene fluoride (PVDF) absent in Ecoinvent database and polyvinyl fluoride (PVF) used as surrogate.
Cell formation: electrolyte & housing	–	Diethyl carbonate absent in Ecoinvent database, stoichiometric consideration applied to make diethyl carbonate from ethylene carbonate and methanol
Cell formation: electrolyte & housing	–	Vinylene carbonate absent in Ecoinvent database, stoichiometric consideration applied to make vinylene carbonate from ethylene carbonate and chlorine
Cell build	Pilot plant	Cell build yield of 89%
48 V LIC module	Pilot plant	2% failure rate of cells
Recycling end-of-life LIC	Laboratory flowsheet	Estimate of energy for LTO decoating, leaching and precipitation based on scale-up values using process model

Reference

Q. Zhang, C. Zhang, B. Li, S. Kang, X. Li and Y. Wang, *Electrochim. Acta*, 2013, **98**, 146. doi: 10.1016/j.electacta.2013.03.006