Site Price Tag Graphic: How It Was Calculated

Disclaimer: The projections shown are illustrative estimates intended to help visualize potential future scenarios and trends. They are based on assumptions and publicly available information but should not be interpreted as predictions, financial advice, investment guidance, or guarantees of future market performance. Actual prices may differ materially due to market, economic, technological, regulatory, and other factors. This content is provided for informational and educational purposes only and should not be relied upon for investment or business decisions.

The cost of LFP estimation:

* LFP Equivalent (LFPE) normalizes lithium-bearing commodities to the lithium content of finished $LiFePO_4$ (4.4% Li), analogous to the industry-standard LCE basis (Li_2CO_3, 18.8% Li). The LFPE factor for any commodity is its lithium weight fraction divided by that of LFP, giving the tonnes of LFP that contain equivalent lithium. Cost per tonne LFPE expresses the lithium's cost on that same basis, enabling like-for-like comparison of brine, carbonate, and cathode prices along the supply chain. The full market price represents the value of the contained lithium; LFPE redistributes that value onto a common reference unit rather than discounting it.

* 2025 basis. $/ton of lithium calculated using i) the LCE lithium carbonate cost equivalent) , ii) the fact that 18.8% of lithium carbonate by weight is the lithium element.

Note – Numbers here are in are actually $/ton on LCE basis (not $/$LFP_{EQ}$)

Synthesis route weighted avg (solid-state ~80%, hydrothermal ~20%) · Transport: sea freight @ 0.010–0.016 kg CO_2e/tonne-km · Li_2CO_3:LFP mass ratio = 0.27 · 2 kg LFP/kWh

LFP Battery Embodied Carbon

Cathode powder only · kg CO_2e/kWh · Averages across synthesis routes

Hard Rock Spodumene

Australia → China → USA

Li_2CO_3 production
11.50 kg CO_2e/kg Li_2CO_3

+ Shipping to China
0.09 kg CO_2e/kg Li_2CO_3

Cathode synthesis
4.50 kg CO_2e/kg LFP

+ LFP shipping to USA
0.15 kg CO_2e/kg LFP

TOTAL kg CO_2e / kWh
16.55

Atacama Evaporation Ponds

Chile → China → USA

Li_2CO_3 production
4.00 kg CO_2e/kg Li_2CO_3

+ Shipping to China
0.26 kg CO_2e/kg Li_2CO_3

Cathode synthesis
4.50 kg CO_2e/kg LFP

+ LFP shipping to USA
0.15 kg CO_2e/kg LFP

TOTAL kg CO_2e / kWh
12.59

Direct Lithium Extraction

Smackover, USA → China → USA

Li_2CO_3 production
7.00 kg CO_2e/kg Li_2CO_3

+ Shipping to China
0.18 kg CO_2e/kg Li_2CO_3

Cathode synthesis
4.50 kg CO_2e/kg LFP

+ LFP shipping to USA
0.15 kg CO_2e/kg LFP

TOTAL kg CO_2e / kWh
14.17

Synthesis route weighted avg (solid-state ~80%, hydrothermal ~20%) · Transport: sea freight @ 0.010–0.016 kg CO_2e/tonne-km · Li_2CO_3:LFP mass ratio = 0.27 · 2 kg LFP/kWh

Assumptions & Sources

Basis for embodied carbon estimates · Cathode powder stack

Step 1 · Li_2CO_3 Production

Hard Rock Spodumene (Australia)

Range (kg CO_2e/kg Li_2CO_3)	**8–15**	*avg 11.5*

Mine → concentrator → rotary kiln conversion (~1,000°C). Energy-intensive; fossil fuels dominate Australian grid. Diesel equipment, HCl/H_2SO_4 reagents in LiOH conversion step.

Dai et al. 2019; Wentker et al. 2019; ecoinvent 3.x spodumene dataset; Minviro spodumene LCA 2021

Atacama Evaporation Ponds (Chile)

Range (kg CO_2e/kg Li_2CO_3)	**2–6**	*avg 4.0*

Solar evaporation (18–24 months). Low direct energy; emissions from diesel pumping, lime/soda ash reagents, on-site calcination. High-grade Atacama brine at lower end.

SQM/Albemarle disclosures; Stamp et al. 2012 brine LCA; Argonne GREET 2022 Li_2CO_3 pathway

Direct Lithium Extraction (Smackover, USA)

Range (kg CO_2e/kg Li_2CO_3)	**2–12**	*avg 7.0*

Electricity-dominated process. Wide range reflects clean vs. coal-grid power. DLE literature sparse and often vendor-funded; treat low-end claims cautiously.

Step 1b · Transport Li_2CO_3 to China

Australia (~6,500 km)	**0.05–0.13**	*avg 0.09 kg CO_2e/kg*
Chile (~20,000 km)	**0.20–0.32**	*avg 0.26 kg CO_2e/kg*
Smackover (~14,000 km)	**0.14–0.22**	*avg 0.18 kg CO_2e/kg*

Emission factor: 0.010–0.016 kg CO_2e/tonne-km (deep-sea bulk/container). Li_2CO_3 bulk density ~1,000 kg/m^3. Transport is 1–6% of Step 1 total.

GLEC Framework v3; IMO Fourth GHG Study 2020; Clean Cargo Working Group vessel EFs

Step 2 · Li_2CO_3 → LFP Cathode Powder

Solid-state synthesis	**3–8 kg CO_2e/kg LFP**	*avg 5.5*
Hydrothermal synthesis	**3–6 kg CO_2e/kg LFP**	*avg 4.5*
Weighted avg (~80% SS)	**~5.3 kg CO_2e/kg LFP**	*used in model*
Li_2CO_3 : LFP mass ratio	**0.27**	*kg/kg*

Solid-state: calcination 600–750°C. Hydrothermal: autoclave 150–200°C + filtration/drying. Carbon coating via sucrose/citric acid pyrolysis. ~90% commercial production is solid-state. Key driver: Chinese grid carbon intensity (~550–600 g CO_2e/kWh).

Peters et al. 2017 LFP LCA; Degen & Schütte 2021 cathode review; ecoinvent LFP cathode dataset

Note: Step 2 unit is kg CO_2e per kg LFP powder (not per kg Li_2CO_3).

Step 3 · LFP Powder → kWh Conversion

LFP practical capacity	**140–160 mAh/g**	
Nominal cell voltage	**3.2–3.3 V**	
LFP powder per kWh (cell)	**~2.0 kg/kWh**	*used in model*
Cathode as % of cell mass	**35–45%**	
Full cell mass per kWh	**4.5–5.5 kg/kWh**	
Li_2CO_3 per kWh (cell)	**~0.5–0.6 kg/kWh**	

CATL/BYD blade cell datasheets; Zubi et al. 2018 LFP review; NREL BatPaC model v5

Scope & Caveats

- Cathode powder only — excludes graphite anode (~2–4 kg CO_2e/kWh), electrolyte, separator, cell manufacturing, and pack assembly. Full cell/system is typically 4–6× higher.
- Chinese grid intensity (~550–600 g CO_2e/kWh) dominates Step 2. Renewable-powered cathode plants could halve synthesis emissions.
- DLE LCA literature is sparse and often vendor-funded; treat optimistic low-end values with caution.
- Synthesis route 80/20 SS/HT weighting reflects current commercial practice; emerging wet-process routes may shift this.
- Yield losses, solvent recovery, and wastewater treatment can add 10–20% to Step 2 and are typically excluded from published LCAs.

Model: bottom-up LCA stack from published literature ranges and operator disclosures. Values kg CO_2e unless noted. Ranges reflect low/high scenario inputs in accompanying Excel model.