



Friend-Shoring LFP Batteries Under MACR Rules: Exploring Feasible Scenarios

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LFP Batteries:

A Strategic Technology for the U.S.

4.7 TWh

Global LFP Demand by 2030

Why LFP?

\$ LOW COST
Lowest \$/kWh at Scale



Cobalt and Nickel Free



Cycle Life
Fast Charge
Safety



AI & Grid Storage

Dominant chemistry for utility-scale storage
Growing role in data-center backup systems
Enables AI infrastructure growth



Electric Vehicles

Vehicle electrification is a cornerstone of U.S. efforts to strengthen domestic manufacturing. LFP's cost advantages have made it the fastest-growing battery chemistry for many EV segments, increasing its strategic importance.



Energy & National Security

LFP is central to the U.S.–China contest over advanced manufacturing. Both the Biden IRA and Trump's critical minerals agenda reflect bipartisan urgency.

Challenge

Given rising geopolitical tensions and growing LFP demand through 2030, can the United States diversify battery supply chains quickly enough to reduce dependence on Chinese-controlled production networks?

The MACR Framework:

How the U.S. Defines and Enforces Supply Chain Compliance for Battery Technologies



What is the MACR?

Material Assistance Cost Ratio: the mathematical test that determines whether a project or component receives too much input from a Prohibited Foreign Entity (PFE) to qualify for U.S. tax credits.



How it Works

$$\text{MACR} = \frac{\text{Non-PFE Direct Costs}}{\text{Total Direct Costs}}$$

If the ratio falls below the threshold, the project loses eligibility for §45X production tax credits.

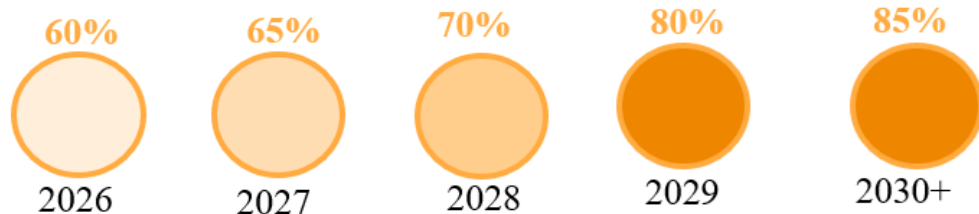


Who is a PFE?

China is the primary Prohibited Foreign Entity. This covers not just geographical manufacturing but also IP licensing, royalty structures, and supply agreements that give Chinese entities effective control or ownership.

RISING THRESHOLDS

Minimum non-PFE share required to qualify for credits



Thresholds step up annually under OBBBA schedule

Cell Sourcing is now a Critical compliance variable

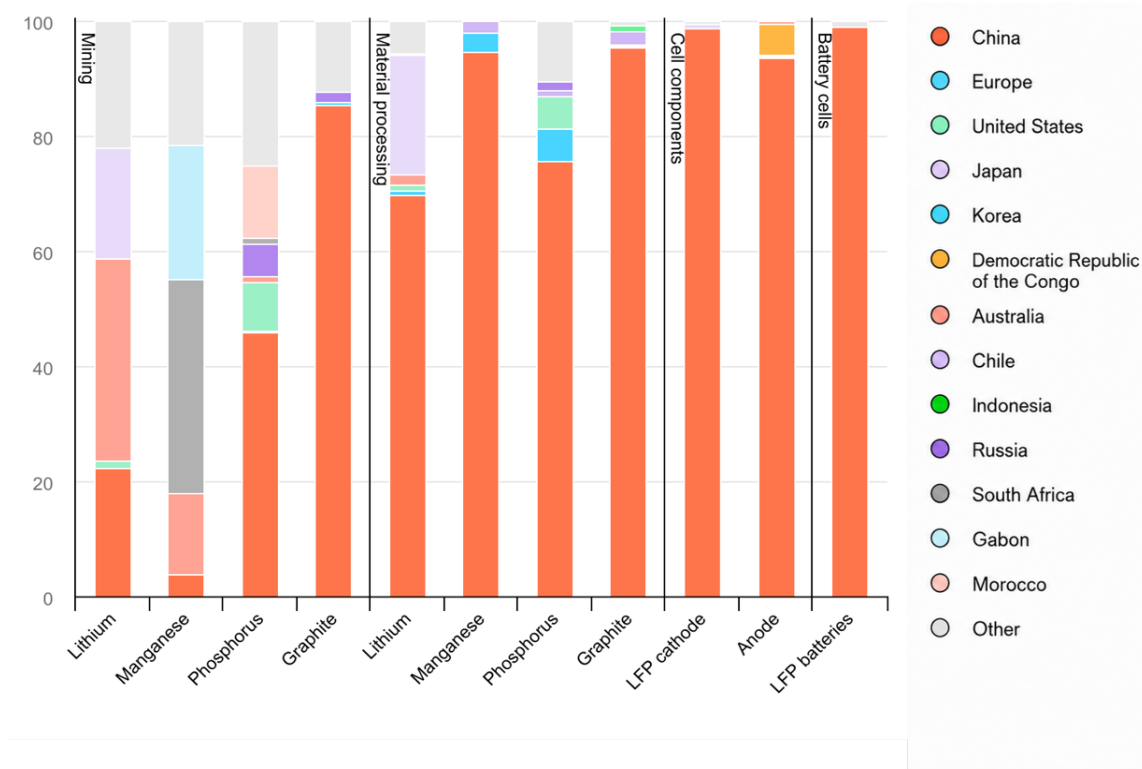
Cathode and anode account for the majority of the cost of a cell

Chinese-sourced cathodes and anodes can fail the test even before any other inputs are counted



How feasible is it for the United States to achieve 85% non-PFE content in LFP supply chains by 2030, and what are the constraining factors?

The LFP Supply Chain: Implications for MACR Feasibility



Origins of Material across LFP Battery Supply Chain (IEA (2024))

The LFP Supply Chain: Implications for MACR Feasibility

Near-term substitution feasibility			
	Alternative non-PFE supply?	Hidden PFE exposure?	Near-term MACR feasibility
Raw lithium	 Yes, several sources	 Low at mine level	 Relatively favorable
Processed lithium (LOH)	 Very limited alternatives	 Refining reintroduces China exposure	 Difficult
Graphite anodes	 Very limited alternatives	 High hidden / explicit PFE exposure	 Difficult
LFP cathode material	 Very limited alternatives	 High hidden / explicit PFE exposure	 Difficult
Cell assembly	 Yes, outside China	 Depends on upstream and midstream inputs	 Mixed

Where the Constraints Bind

Evidence from Current Supply Chains

MACR compliance is usually framed as a **sourcing problem**. The evidence shows this understates the difficulty, i.e. the binding constraints run deeper than geography.

- **Regulatory & Traceability** cost attribution, opaque chains, contractual / IP lock-in
- **Trade Exposure** substitution is uneven; the key inputs lack alternatives
- **Capital & Scale** investment is rising but the midstream stays underfunded
- **Technological Dependence** embedded know-how & equipment keep China in the chain

Regulatory & Traceability / Trade Exposure

- **Cost attribution.** integrated Chinese suppliers make an input's PFE share $\approx 100\%$.
- **Traceability.** graphite crosses 4 processing stages, rarely transparent.
- **Contractual lock-in.** IP & “effective control” count (Ford–CATL license).
- **Unresolved rules.** ownership / royalty thresholds still undefined.
- **Uneven substitution.** raw lithium re-sourceable; graphite & cathode are not.
- **Hidden exposure.** China refines $\sim 60\%$ of lithium $\rightarrow$ PFE attribution returns.
- **Entity-based.** BTR is a PFE $\rightarrow$ its non-China plants give no benefit.
- **Trade policy gap.** $\sim 160\%$ duties raise cost but create no qualifying supply.

Technological Dependence/ Capital & Scale

- **Graphite.** >90% of 2030 battery-grade graphite still from China.
- **Cathode (CAM).** China >98% of LFP CAM; Korea sub-scale.
- **Electrolyte (LiPF₆).** 70–95% China; no U.S.-scale producer.
- **Equipment.** Chinese vendors = 68% of top-25 supplier sales.
- **Upstream mobilizing.** Thacker Pass, EXIM >\$2.2B, Syrah Louisiana.
- **Midstream bottleneck.** U.S. <1% of global lithium processing capacity, while China has >65%.
- **Downstream scaling.** 12 plants operating, 23 in development.
- **Structural mismatch.** investment pace lags the MACR schedule.

Scenarios and Likelihood

**Scenario 1: Policy Works -
A Compliant Non-PFE
Supply Chain Emerges**

Likelihood: Low

**Scenario 2: Policy
Shortfalls - Capacity
Expands, but Not Fast
Enough**

Likelihood: High

**Scenario 3: Policy Fails -
Continued High
Dependence**

Likelihood: Moderate

Policy Recommendations



Midstream Capacity is the Critical Constraint



Policy Consistency and Capital Access Enable
Diversification



Compliance Timelines Should Reflect Industrial
Realities



Compliance Requires More Than Geographic
Diversification

Thank you

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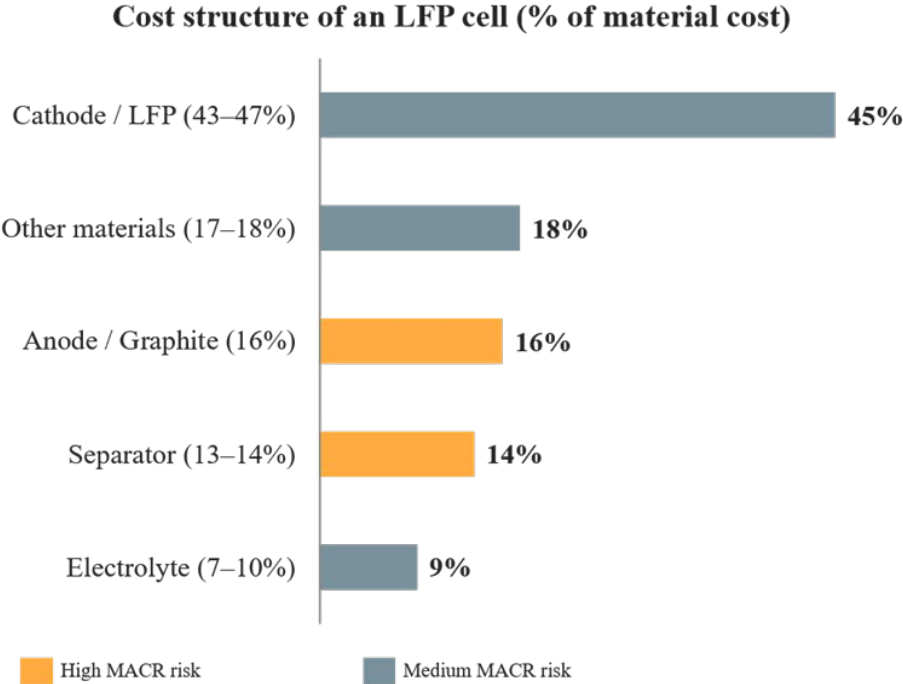
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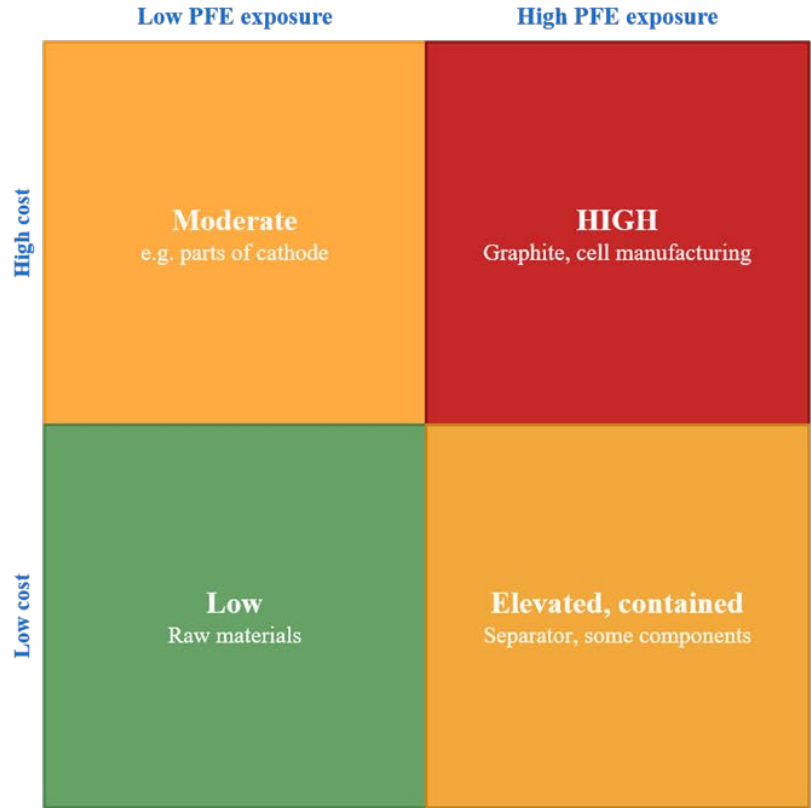
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Appendix

Compliance Risk Concentrates Where Cost Meets Exposure



Cost share × PFE exposure → MACR risk



	Scenario 1: Policy Works	Scenario 2: Policy Shortfalls	Scenario 3: Policy Fails
Regulation	Clear, timely, and effective regulations that provide incentives for governments to cooperate on a non-PFE, FTA-based supply chain.	Regulations remain inconsistent and evolve unevenly across jurisdictions. Firms face additional costs from cross-jurisdiction policy inconsistency .	Fragmented and unstable regulatory environment, with considerable policy uncertainty.
Trade Exposure	Coordinated 100% non-PFE supply chain	Upstream sourcing diversifies toward FTA partners, but key midstream segments such as graphite processing and battery chemicals remain heavily exposed to PFEs.	PFE dependence remains dominant across key stages in the LFP battery supply chain.
Capital	Policy consistency and incentives allow for major investment in FTA-based, non-PFE trade and supply across the supply chain.	Investment increases, but is inconsistent and does not address all supply chain infrastructure challenges.	Policy uncertainty, high costs, and weak coordination discourage investment in non-PFE supply chains.
Technological Dependence	No dependence on PFE technology, independent battery production	Some diversification in manufacturing equipment and technical partnerships occurs, but critical dependence on Chinese process know-how and industrial ecosystems persists.	Chinese dominance in battery manufacturing equipment, process chemistry, and industrial know-how remains largely intact.