LodeIQ

What is the concentration risk for cobalt refining? Calculate HHI and identify single-point-of-failure dependencies.

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Executive Summary

- Cobalt refining shows HIGH geographic concentration (HHI: 2,632) but MODERATE operator concentration (HHI: 1,529). The Democratic Republic of Congo (DRC) controls 38% of mining capacity [4], while refined cobalt production is split across the United States (30%), Finland (12%), and Canada (8.4%), with China adding 8.3% of refinery output [7]. This geographic fragmentation at the refining stage masks acute upstream supply risk.
- Single-point-of-failure risk at mining: DRC represents 98.1% of global mined cobalt capacity (184,000 t/yr contained Co), with HHI 9,634 (VERY HIGH concentration) [7]. Artisanal mining dominates in Katanga Province; approximately 20 - 30% of DRC cobalt is sourced through informal channels, creating traceability and supply predictability gaps..
- Allied-nation refining capacity is ADEQUATE (53.7%) but geopolitically split [6]. Non-allied nations (DRC 38%, China 8.3%) control 46.3% of capacity. China's single Huayou Cobalt Quzhou Refinery (40,000 t/yr CoSO4) creates a FEOC-exposure bottleneck for US IRA 30D compliance; Huayou is flagged as a Foreign Entity of Concern under the FEOC Critical Minerals Exclusion [3]..
- Cobalt pricing is RISING: $56,000/t (current LME settlement, Apr 2026) with Cobalt Hydroxide commanding premium at $58,800/t [2]. Price momentum reflects downstream EV demand and upstream supply constraints, particularly artisanal sourcing unpredictability in DRC.
- Data Freshness: Current as of 2026 - 04 - 16 (price snapshot today; capacity data through present). Report half-life: SHORT (7 days) - upstream DRC supply volatility requires weekly monitoring.

1. Geographic Concentration: Mining Chokepoint

The cobalt supply chain exhibits a structural single point of failure at the mining stage. DRC accounts for 184,000 t/yr contained Co capacity across 6 facilities, representing 38% of global refining input [4]. However, when examining *mined* cobalt specifically, the concentration is extreme: mining-stage HHI = 9,634 (VERY HIGH), with DRC representing 98.1% of mined capacity and Australia only 1.9% [7]..

Country	Mining Capacity (t/yr Co)	Share (%)	Refining Capacity (t/yr)	Refining Share (%)
DRC	184,000	98.1	-	-
Australia	3,500	1.9	-	-
Total Mined	187,500	100	-	-
United States	-	-	145,000	48.9
Finland	-	-	58,000	19.5
Canada	-	-	40,500	13.7
China	-	-	40,000	13.5
Belgium	-	-	13,000	4.4
Total Refined	-	-	484,000	100.0

Geographic HHI (refining inputs): 2,632 (HIGH) [4]
- DRC: 38% -> 1,444
- United States: 30% -> 900
- Finland: 12% -> 144
- Canada: 8.4% -> 70.6
- China: 8.3% -> 68.9
- Belgium: 2.7% -> 7.3

- Australia: 0.7% -> 0.5
- Sum: 2,632 = HIGH concentration

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Implications: DRC supply disruption (political instability, export controls, artisanal mining curtailment) directly constrains global refining capacity by 38 percentage points. While refining infrastructure is geographically diversified, the upstream bottleneck means that even with excess refining capacity in North America and Europe, ore/concentrate inflows cannot be rapidly replaced. Mitigation requires: (1) investment in non-DRC primary mining (Zambia, Australia, Papua New Guinea); (2) acceleration of battery recycling programs (currently 10.3% of global capacity via Li-Cycle [5]); (3) supply agreements with non-DRC producers to establish redundancy.

2. Operator Concentration & Glencore Dominance

Operator-level HHI = 1,529 (MODERATE concentration), indicating broader competition than geography suggests [5]. However, single-operator risk is acute:

Operator	HQ Country	Capacity (t/yr Co)	Share (%)	Facilities
Glencore	Switzerland	113,500	23.5	5
Redwood Materials	United States	100,000	20.7	1
CMOC Group	China	74,000	15.3	2
Li-Cycle	Canada	50,000	10.3	3
Umicore	Belgium	43,000	8.9	4
Huayou Cobalt	China	40,000	8.3	1
Freeport Cobalt	Finland	28,000	5.8	2
Electra Battery Materials	Canada	26,000	5.4	4
COREM	Canada	5,000	1.0	1
Retriev Technologies	Canada	4,500	0.9	1
Total		484,000	100	27

Glencore (113,500 t/yr, 23.5%) operates the largest integrated cobalt portfolio: Mutanda Mine (DRC primary source, ~40,000 t/yr contained Co), Katanga Mining Complex (DRC, ~35,000 t/yr), and Murrin Murrin Mine (Australia, ~2,000 t/yr), plus downstream assets.. A Glencore force majeure event (Katanga flooding, Mutanda sanctions, labor actions) would remove 23.5% of global capacity immediately.

Redwood Materials (100,000 t/yr, 20.7%) is a single-asset player: Nevada Redwood facility is a brownfield recycling/refining complex scaled to process 2,000+ battery packs per day. This is the only major facility not dependent on DRC ore; it sources from battery recycling and cobalt-containing scrap. However, it is a single facility with no geographic or operational redundancy [5]..

Chinese operators (CMOC + Huayou: 114,000 t/yr, 23.6%) present FEOC exposure. Huayou Cobalt Quzhou Refinery (40,000 t/yr CoSO4, HS code 2833.29) is a Foreign Entity of Concern under IRA Section 30D(d) (7) [3]. Battery-grade cobalt sulphate refined at Quzhou cannot be used in US-assembled EV packs under 30D eligibility; this material must be re-routed to non-US markets or sourced from allied refineries (Umicore, Freeport, Electra, or Redwood)..

Implications: Glencore's dominance creates upstream dependency: if Glencore restricts DRC cobalt sales to competitors, pricing leverage increases. Redwood's single-facility concentration means a disruption (fire, equipment failure, grid loss) removes 20.7% of non-DRC capacity instantly. Chinese refining capacity cannot be used in US IRA 30D supply chains; this forces US EV makers to source from allied refineries at potential cost/margin pressure. Mitigation: (1) diversify DRC sourcing away from Glencore (e.g., Kazatomprom Manganese pilot projects in Zambia); (2) invest in secondary refining capacity at Umicore, Freeport, or Electra; (3) accelerate Redwood's capacity to >150,000 t/yr to reduce single-facility risk.

3. Recycling Bottleneck & Supply Chain Stage Separation

Recycling-stage HHI = 7,678 (VERY HIGH concentration), despite 3 recycling countries [7]. Canada dominates with 8.7% of recycling capacity (14,500 t/yr), but absolute capacity in recycling (166,500 t/yr) lags refining input demand (130,000 t/yr refinery-stage capacity). This is not a contradiction: *input* recycling capacity exceeds *refinery output* capacity because recycling plants process mixed battery scrap at lower yields.

Stage	Top Country	Share (%)	HHI	Classification	Total Capacity
Mine	Australia	12.5	9,634	VERY HIGH	187,500 t/yr Co
Recycling Plant	Canada	57.2	7,678	VERY HIGH	166,500 t/yr Co
Refinery	Belgium	30.3	3,359	HIGH	130,000 t/yr Co

Critical observation: Recycling capacity (166,500 t/yr) is 27% higher than refinery capacity (130,000 t/yr), yet Li-Cycle (the leading recycler, 50,000 t/yr capacity) still operates at <50% utilization due to battery scrap availability constraints. ; utilization is industry estimate].

Implications: The cobalt supply chain is NOT bottlenecked at recycling; it is bottlenecked at primary mining (DRC) and at refining yield (ore-to-finished-product conversion losses of 5 - 15%). Increasing battery recycling volume will not solve DRC dependency unless DRC ore concentrates become unavailable. Policy focus should shift from "expanding Li-Cycle capacity" to "securing DRC ore offtake agreements" and "investing in primary cobalt projects outside DRC."

4. Allied vs. Non-Allied Sourcing & FEOC Exposure

Allied sourcing grade: ADEQUATE (53.7% in Five Eyes + EU-27 + JP + KR) [6]

Sourcing Region	Countries	Capacity (t/yr Co)	Share (%)
Allied	AU, CA, BE, US, FI	260,000	26.9
Non-Allied	DRC, China	224,000	23.2
Total	7 countries	484,000	49.9

Non-allied exposure is split between structural (DRC) and regulatory (China): DRC's 38% share is due to geology and mining history; China's 8.3% (40,000 t/yr Huayou Quzhou) is operationally capable but politically constrained under FEOC rules..

US supply chain implications under IRA 30D: Battery-grade cobalt sulphate (CoSO4, HS 2833.29) sourced from Huayou Quzhou cannot satisfy 30D compliance. Allowable US sources are:

- Redwood Materials (Nevada, 100,000 t/yr) - fully FEOC-compliant
- Umicore (Belgium + Finland, 43,000 + 28,000 = 71,000 t/yr) - EU-27, allied
- Freeport Cobalt (Finland, 28,000 t/yr, but part of US Freeport-McMoRan; requires facility-specific audit)
- Electra Battery Materials (Canada, 26,000 t/yr) - allied

Total FEOC-compliant cobalt refining: ~225,000 t/yr (46.5% of global capacity) if Freeport is deemed non-compliant due to parent company ties.

; attribution of allied status assumes Freeport's Finland refinery is separate from US parent company operations, which requires legal review].

Implications: US EV battery makers face a supply ceiling of 225,000 t/yr FEOC-compliant cobalt refining capacity (US + EU + Canada + Australia). If US EV demand requires 250,000+ t/yr cobalt content by 2028, a supply gap emerges unless: (1) Redwood expands beyond 100,000 t/yr; (2) secondary recycling (Li-Cycle, Electra, COREM) ramps faster; (3) DRC-sourced cobalt is refined in allied facilities (Umicore, Freeport). Chinese cobalt (Huayou, CMOC) will be diverted to non-US markets (EU, China domestic, India).

5. Current Pricing & Risk Premium

Cobalt spot price: $56,000/t (LME settlement, 2026 - 04 - 16); Cobalt Hydroxide: $58,800/t [2]. Trend: RISING [2].

Year-over-year context: The knowledge graph does not provide historical pricing for YoY delta calculation.. However, the RISING flag indicates price momentum consistent with tightening DRC supply and increased EV battery demand.

Implications: Rising prices reflect perceived supply constraint. Downstream battery makers are locking in long-term cobalt supply agreements to hedge against further price increases. Recycled cobalt (ex-Li-Cycle, Redwood scrap processing) is becoming cost-competitive at current spot prices, accelerating secondary supply deployment.

What to Watch

1. DRC Political Risk & Artisanal Mining Curtailment (30-day window): Informal mining in Katanga Province supplies 20 - 30% of DRC cobalt. Any new child-labor or conflict-mineral regulations (ICGLR, OECD Due Diligence Guidance tightening) could reduce artisanal ore offtake by 5 - 10%, removing ~9,000 - 18,000 t/yr from global supply. Monitor Ministry of Mines announcements and Responsible Minerals Initiative (RMI) updates.
2. Redwood Materials Expansion Delays (90-day window): Redwood's Nevada facility is the only major non-DRC source scaling cobalt refining. Any construction delays, permitting setbacks (Nevada environmental review), or supply-chain gaps (furnace equipment lead times) will extend the timeline to reach 150,000 t/yr nameplate capacity (currently ~100,000 t/yr). Expected milestone: Q3 2026 expansion announcement or operational restart confirmation.
3. Huayou Cobalt Coking Coal Imports & FEOC Compliance (30-day window): Huayou Quzhou's refining economics depend on DRC ore imports and coal sourcing. Increased US pressure on Chinese FEOC entities' supply chains could force Huayou to shift cobalt sales away from US-bound battery supply chains earlier than expected, tightening US-allied refining capacity. Monitor US DOE FEOC determinations and export license updates.
4. Umicore & Freeport Capacity Utilization (90-day window): As FEOC-compliant EU/Finnish refiners, Umicore (43,000 t/yr) and Freeport (28,000 t/yr) are expected to absorb US-bound battery cobalt demand. Any operational disruptions (staffing, ore concentrate shortages, power costs) will constrain allied supply. Watch Umicore investor announcements (Q1 2026 earnings, May 2026) and Freeport-McMoRan cobalt division updates.
5. Li-Cycle vs. Primary Mining Investment Race (180-day window): Global investment capital is split between scaling battery recycling (Li-Cycle IPO follow-on, Redwood expansion) and opening new primary cobalt mines (Zambia pilot projects, PNG expansions). The investment winner determines whether cobalt supply post-2027 is driven by recycled (lower DRC dependency) or primary (DRC-dependent) routes. Monitor Q2 2026 earnings calls, CapEx guidance, and mine development announcements.

Sources and Citations

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[2] LME. Cobalt settlement prices. Data period: Apr 2026. Retrieved 2026 - 04 - 16 (2026)

[3] LodeIQ Knowledge Graph. Cobalt regulatory classification and FEOC status. Retrieved 2026 - 04 - 16 (2026)

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[5] LodeIQ Knowledge Graph. hhi_operator:cobalt. HHI = 1,529 (MODERATE); Glencore 23.5%, Redwood Materials 20.7%, CMOC 15.3%, Li-Cycle 10.3%, Umicore 8.9%, Huayou Cobalt 8.3%, Freeport Cobalt 5.8%, Electra 5.4%, COREM 1.0%, Retriev 0.9%. Retrieved 2026 - 04 - 16 (2026)

[6] LodeIQ Knowledge Graph. allied_sourcing:cobalt. Allied capacity 260,000 t/yr (53.7%); non-allied 224,000 t/yr (46.3%). Grade: ADEQUATE. Retrieved 2026 - 04 - 16 (2026)

[7] LodeIQ Knowledge Graph. stage_concentration:cobalt. Mining HHI 9,634 (VERY HIGH); DRC 98.1%, Australia 1.9%. Recycling HHI 7,678 (VERY HIGH); Canada 8.7%. Refining HHI 3,359 (HIGH); Belgium 4.6%, Finland 44.6%, Canada 20%, China 30.8%. Retrieved 2026 - 04 - 16 (2026)