Consulting

Industry Report for Project 618

Prepared for Chuangxin Industries Holdings Limited

11/11/2025

Final Report

CRU Reference: ST2765-24

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Global alumina and electrolytic aluminum alumina overview

1.1. Global aluminum industry overview

1.1.1. Introduction to aluminum industry

Aluminum is the second-largest consumed metal in the world economy after steel. By property, aluminum is interchangeable between product forms and its ingot form is standardised and exchanged globally. Aluminum price is determined by supply and demand dynamics in the global market, as such, individual stakeholders in the aluminum industry (consumers, producers, traders, etc) are price takers with limited pricing power.

Benefiting from its properties such as light weight, strength, malleability, and conductivity, aluminum is widely used in various sectors, including electricals, automotive, transportation, construction, etc. Transport and construction are traditionally the two largest aluminum end-use sectors domestically and globally, representing roughly half of the total aluminum demand. In China, construction is the largest end-use sector, however, its share has and continues to decline sharply, from 31% in 2021 to approximately 19% in 2028. Driven by the robust growth in lightweight automotive and EVs (electric vehicles), transport is expected to take over construction as the largest end-use sector in 2027. With the ongoing energy transition, electrical sector is another fast-growing end-use sector in China, expecting to reach a market share of 19% in 2028. In conclusion, both the transport and electrical sectors are forecast to lead China's aluminum demand growth over the medium term by 2028. A more detailed analysis of aluminum consumption by end-use sector is covered in section

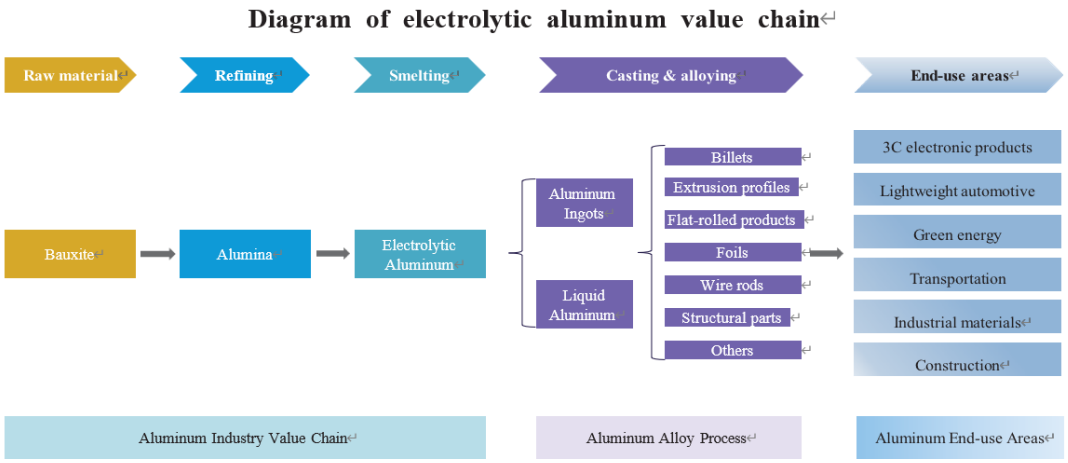
1.1.3.

By source of production, aluminum can be divided into electrolytic aluminum (also called primary aluminum) and secondary aluminum (also called recycled aluminum):

- **Electrolytic aluminum** represents most of the aluminum production and consumption, with a share of 78% in China and 70% globally in 2024. The starting form of electrolytic aluminum is bauxite, which is refined into alumina and then electrolysed into aluminum. These three steps are explained in the following figure.
- **Secondary aluminum** is extracted from the used aluminum. To produce recycled aluminum, the used aluminum is sent directly to the furnace to be melted down. Compared with electrolytic aluminum, secondary aluminum saves 90%-95% of the energy required. However, secondary aluminum's purity and quality are normally inferior to electrolytic aluminum, and it cannot be used in applications requiring high-grade aluminum. In 2024, secondary aluminum represents 22% of China's total aluminum consumption, which is lower than the global average of 30%.

The raw material to produce electrolytic aluminum mainly include bauxite, which is refined into alumina and then electrolyzed into electrolytic aluminum. Based on the market prices of bauxite, alumina and electrolytic aluminum in 2024 and the conversion rate of each (roughly 2.5 tons of bauxite is required for each ton of alumina, and roughly 1.9 tons of alumina is required per ton of aluminum), the value is spread along the aluminum industry value chain, with 13% in bauxite, 25% in refining and 62% in smelting. The refining and smelting stages together account for approximately 87% of the whole value chain. The following diagram sets forth the key stages in the value chain:

Figure 1: Detailed electrolytic aluminum value chain



SOURCE: CRU

1. **Bauxite mining**:

Bauxite ore is the main aluminum-containing ore with abundant reserve. Globally, the proven bauxite reserves of roughly 30 billion tonnes are sufficient for over 90 years at the current rate of extraction. 90% of the world's bauxite production is open cast, making mining relatively low-cost and straightforward. Bauxite ore typically contains 30-60% alumina.

2. **Alumina refining:**

Bauxite ores are processed into alumina at an alumina refinery predominantly using the Bayer process. The Bayer process consists of four stages: dissolution, separation, decomposition and calcination. This process results in alumina, also known as aluminum oxide, in the form of white powder. Alumina could be used as the feedstock for electrolytic aluminum smelting and in various chemical applications. Most alumina is consumed for electrolytic smelting.

In this industry overview, alumina refers to alumina used in electrolytic aluminum smelting process only.

3. **Electrolytic aluminum smelting:**

Alumina is processed into electrolytic aluminum through an electrolytic process. In this process, the electric current passes through the carbon anode to the cathode, and alumina is fed into a bath of molten cryolite and dissolved. Therefore, aluminum smelting requires high temperatures and is energy intensive. Upon completion of the smelting process, electrolytic aluminum could be in the form of ingots or liquid aluminum and then transferred to the aluminum alloy processing plants.

4. **Aluminum casting and processing:**

Electrolytic aluminum is taken to the aluminum alloy processing plants either in liquid or ingot form. In this stage, impurities are removed from the electrolytic aluminum and sometimes alloying metals (e.g. Manganese, Magnesium, Copper, Silicon) are added to produce a range of aluminum alloys (e.g. billets, extrusion profiles, flat rolled products, structural parts, foils, wire rods). In cases where an aluminum alloy processing plant is near a smelter, electrolytic aluminum could get transferred in liquid form from the smelter to aluminum processing plants directly.

5. **Aluminum end-use:**

After being processed into aluminum alloys, aluminum could be widely applied in various end-use areas, such as lightweight automotive, renewable energy installation and transmission, 3C electronics products, construction materials and packaging.

- **Lightweight automotive:** aluminum has been widely used in the transport industry, notably lightweight automotive manufacturing given its property of high strength and lightweight. Automotive manufacturers can reduce vehicle weight using aluminum for components such as the body, chassis and battery houses. In recent years, the popularity of electrical vehicles (EVs) has boosted the trend of lightweight vehicles. Besides, aluminum is also applied in aerospace and rail transport as a key structural material in aircraft and train bodies.
- **Renewable energy installation and transmission:** aluminum's high thermal conductivity, durability, and corrosion resistance allows it to transmit power over long distances with little energy loss and high reliability. Hence, aluminum is widely applied in electrical transmission components, such as cables, connectors, and wiring harnesses. In recent years, aluminum demand has risen with the increasing need for renewable energy (notably solar PV and wind power), which poses an increasing demand for electrical transmission. Besides, aluminum is also used as a core structural material in wind turbines and solar power frames.
- **3C electronics products:** aluminum is extensively used in 3C electronics products, namely computer, communication and consumer electronics products, for its lightweight, durability and heat conductivity. Aluminum's high conductivity makes it ideal for heat sinks, ensuring colling in electronic devices. Meanwhile, it serves as the casings and frames for laptops, smartphones and tablets, offering structural protection.
- **Construction materials:** aluminum has been traditionally used in the construction sector due to its high malleability, durability and lightweight. It is used in structural elements such as roofs, bridges and modular construction. Its lightweight nature reduces the load on the foundation, especially for high-rise buildings and long-span structures. It is also used in curtain walls, window frames and doors given its high strength and corrosion resistance.
- **Packaging materials:** aluminum is widely used for flexible and rigid packaging products in industries such as food, beverage and pharmaceuticals. These markets are not cyclical, so they are attractive to aluminum companies.
- **Aluminum applied in other sectors:** aluminum could also be widely applied in other sectors, including foil stock for food, beverage and pharmaceutical packaging; consumer durables, household appliances and kitchenware; and machinery and equipment, where it is incorporated into components such as frames, housings and heat sinks.

Aluminum production summary (Global and China)

Global aluminum production is highly consolidated. In 2024, the world's top five producers supplied approximately 22 mt, which was equivalent to approximately 30% of global electrolytic aluminum production. The top 25 producers supplied approximately 51 mt, which was equivalent to approximately 71% of global electrolytic aluminum production.

Table 1: Production and share of top global electrolytic aluminum producers globally, 2024

	2024 Cumulative production (mt)	Share of world's total supply (%)
Top 5 producers	22	30
Top 10 producers	34	47
Top 25 producers	51	71
Top 50 producers	64	88
World total	**73**	**100**

SOURCE: CRU, Industry sources

China currently dominates the world's electrolytic aluminum production. It has 14 out of the world's top 25 electrolytic aluminum producers in 2024. These 14 aluminum producers in

total contributed approximately 30 mt in 2024. It is important to note that China's MIIT introduced the Scheme of Aluminum Capacity Swap ("《关于电解铝企业通过兼并重组等方式实施产能置换有关事项的通知》(工信部原[2018]12 号)") as part of the supply-side reform in aluminum in 2018, stating that any new capacity must be a swap of existing capacity. Hence,

China's total electrolytic aluminum capacity has been strictly kept at the 2017 level of roughly 45 mt per year. As such, China's electrolytic aluminum capacity is expected to converge to the 45 mt of annual electrolytic aluminum production capacity cap over the forecast period. With the cap, China is expected to produce approximately 57% of global electrolytic aluminum in 2028, compared with that of 59% in 2024.

Outside of China, major producers are mainly in India, Russia, the United Arab Emirates (UAE), Australia, Norway and Canada. India is home to two of the world's top 25 largest producers. Russia owns one of the top 5 largest producers, which largely adopts hydropower as the source of power. UAE has one aluminum producer which ranks ninth globally in terms of production. Four Western producers are listed among the world's top 25 largest producers, contributing 12% of the global production. Under both environmental and cost pressures, western producers focus more on the development of decarbonization technologies in the smelting process, with less emphasis on expanding their existing capacity.

Benefiting from rapid economic development and sufficient raw materials, Middle East has the potential to become the next capacity-growing spots. The smelters in the Middle East are among the most competitive in terms of cost, primarily due to the region's low electricity prices. In 2024, four (out of six) operating electrolytic aluminum smelters in the Middle East had cash costs among the lowest 25% globally. Besides the advantage in electricity prices, Saudi Arabia's production is backed by the robust aluminum demand. Under the state-led Vision 2030 initiatives, Saudi Arabia has announced its ambitious infrastructure investment pipeline and is projected to spend over USD1 trillion by 2030. This comprehensive investment will cover a wide range of infrastructure construction, from mining hubs, financial centers, economic development zones to green energies and public transportation, which all involve massive aluminum demand in Saudi Arabia.

Aluminum consumption summary (Global and China)

Global electrolytic aluminum consumption was 73 mt in 2024, and consumption is highly associated with the economic scale. In 2024, the largest five economies in total consumed 56 mt of electrolytic aluminum (equivalently 77%), and the largest ten economies in total consumed 59 mt (equivalently 81%) of electrolytic aluminum. Under the vast economic development, the Middle East and Southeast Asia are regions with substantial growth potential in aluminum consumption. Between 2025 and 2028, their electrolytic aluminum demands are forecast to grow at a CAGR of 4.6% and 3.0%, respectively. Saudi Arabia's electrolytic aluminum demand is forecast to grow at a CAGR of 5.9% during the same period of time.

Table 2: Consumption and share of top producers globally, 2024

	2024 cumulative consumption (mt)	Share of world's total consumption (%)
Top 5 economies*	56	77
Top 10 economies*	59	81
World total	**73**	**100**

SOURCE: CRU

Note: The top 5 and 10 largest economies are calculated based on 2024 GDP: US, China, Germany, Japan, India, UK, France, Italy, Brazil, and Canada.

1.1.2. Global bauxite and other raw material market analysis

Bauxite reserves landscape

Bauxite reserves are abundant, and exhaustion is rarely a concern for the foreseeable future. Globally, current proven reserves of roughly 30 billion tonnes are adequate for over 90 years at the current extraction rate, and unproven resources are many times greater. Bauxite generally contains 30-60% alumina content and is divided into two main types, Trihydrate bauxites and Monohydrate bauxites.

Trihydrate bauxites are usually found in tropical regions, specifically Brazil, West Africa and Australia. They are generally large deposits, close to the surface and mined by the open-cast method. Given its lower silica content and high alumina content, trihydrate bauxite typically uses the lower temperature approach to digest (140℃). With lower digestion temperature requirements, refineries using trihydrate bauxites require less heating, which lowers its heating costs. With lower silica contents, refineries using trihydrate bauxites typically require less caustic soda to remove the silica contents, which lowers the caustic soda cost.

Monohydrate bauxites are usually found in Europe, China and the Caribbean, and are mined by open-cast and underground methods. Monohydrate bauxites have high silica content, usually over 5-6%, requiring higher temperatures (230-270℃) for digestion than monohydrate bauxites (140℃).

In the international third-party market, trihydrate bauxites are more traded given their high alumina but low silica content, which lowers the fuel costs as well as the caustic soda costs. Besides, a high alumina content in trihydrate bauxite also increases freight efficiency.

Table 3: Global bauxite reserves and supply, by major country and region, mt, 2023

Country	Type of bauxite (by supply)	Reserve	Supply	% of supply
Africa	**25% Monohydrate; 75% Trihydrate**	**9,940**	**120**	**31%**
- Guinea	-	7,400	117	31%
- Others	-	2,540	3	1%
Asia*	**70% Monohydrate; 30% Trihydrate**	**9,010**	**108**	**28%**
- Vietnam	-	5,800	3	1%
- Indonesia	-	1,000	13	3%
- China	100% Monohydrate	710	74	19%
- Others	-	1,500	18	5%
Australasia	**39% Monohydrate; 61% Trihydrate**	**3,825**	**98**	**26%**
- Australia	-	3,500	98	26%
- Others	-	325	0.01	0%
C&S America	**7% Monohydrate; 93% Trihydrate**	**6,230**	**36**	**9%**
- Brazil	-	2,700	28	7%
- Jamaica	-	2,000	7	2%
- Others	-	1,530	1	0%
Europe	**100% Monohydrate**	**995**	**12**	**3%**
- Russia	-	480	6	2%
- Others	-	515	6	2%
Middle East	**100% Monohydrate**	**283**	**7**	**2%**
- Saudi Arabia	-	180	4	1%
- Iran	-	40	1	0%
- Turkey	-	63	2	0%
North America	**100% Monohydrate**	**20**	**-**	**0%**
- USA	-	20	-	0%
Total World	**43% Monohydrate; 57% Trihydrate**	**30,303**	**381**	**100%**

SOURCE: CRU, General Administration of Customs of the People's Republic of China (GACC), "Asia" here excludes the Middle East, "C&S America" refers to Central and South America

Bauxite Pricing

Given bauxite is not a commodity with a standard quality specification, there is no consensus on a pricing mechanism like LME and SHFE price. Hence, most bauxite is traded based on long-term, fixed-price contracts, which are priced individually in accordance with its quality and some benchmark FOB (Free on Board) bauxite prices.

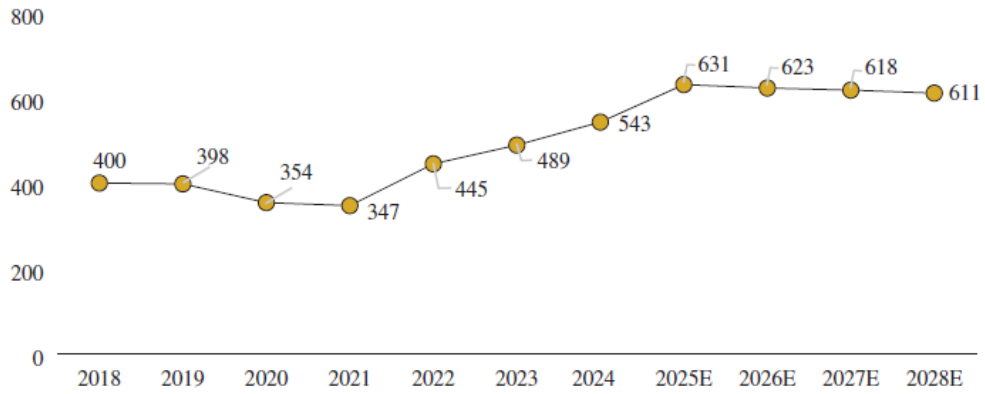
Trihydrate bauxite is traded more on the international market as it has relatively high alumina contents. Given the third-party trihydrate bauxites were dominated by Guinea, Brazil, and Australia, the main benchmark prices for the bauxite contract have traditionally been based on key production regions, namely the FOB (Free on Board) bauxite prices in Guinea's Boke, Brazil's Trombetas, and Australia's Weipa. With strong growth in bauxite shipments to China, CIF (Cost, Insurance and Freight) China, which includes the bauxite cost, insurance, and freight fee, has become another important benchmark, particularly in the third-party market. CRU's China Bauxite price is collected and forecasted based on the weighted average price of imported bauxite reported by China Custom. The refinery's actual bauxite purchasing price varies according to the specific importing country, grade, transporting cost, and other fees.

Bauxite prices are mostly influenced by market demand and supply dynamics. However, bauxite resources are unevenly spread geographically. Main bauxite consumers such as China heavily rely on imported bauxite. Imported bauxite constituted approximately 77% of China's total bauxite demand in 2024. As such, any production or transportation disruption led by geopolitical events or supply chain disruption might lead to fluctuations in bauxite prices.

Bauxite demand is primarily driven by alumina production volume, which ultimately depends on China's aluminum market demand. Affected by the public health incident and the introduction of the 45 mt of annual electrolytic aluminum production capacity cap, China's alumina production shrank from approximately 72 mt in 2018 to approximately 69 mt in 2020, leading to a weak demand for bauxite during this period. As such, CRU China bauxite price declined from RMB400 per ton in 2018 to RMB354 per ton in 2020. Backed by the recovery of China's alumina market, CRU China bauxite price has rebounded since 2021 and reached RMB489 per ton in 2023. In June 2023, Indonesia imposed the bauxite export ban. As such, Guinea and Australia became China's main bauxite importer, representing approximately 70% and approximately 25% of China's total imports in 2024. In addition, the soaring alumina prices in 2024 were driven by issues of raw material supply, including a damage to Jamaica's port conveyor system in the third quarter of 2024 disrupting bauxite exports, customs' suspending shipments from Guinea Alumina Corporation and a force majeure on bauxite shipments from Juruti Port both in the fourth quarter of 2024. The impact of these disruptions on the supply of bauxite were gradually lifted towards the end of 2024 and early 2025. Meanwhile in 2024, the bauxite import demand in China reached over 150 mt, pushing the CRU China bauxite price to RMB543 per ton.

Despite the impact of disruptions bauxite supplies was gradually resolved, CRU China bauxite price is forecast to remain strong, backed by China's burgeoning import demand. China's bauxite demand is forecast to stabilize at approximately 227 mt under the 45 mt of annual electrolytic aluminum production capacity cap, and the supply is forecast to rely more heavily on imports. As most of the new alumina refineries in China are using imported bauxite, China's total bauxite import is expected to increase from approximately 159 mt in 2024 to approximately 192 mt in 2028, and over 76% of the imports is expected to come from Guinea. As a result of the increasing use of bauxite imported from the overseas, CRU China bauxite price is forecast to rise significantly to approximately RMB611 per ton in 2028.

Figure 2: CRU China Bauxite Price 2018-28E, RMB/t



SOURCE: CRU, General Administration of Customs of People's Republic of China (GACC)
Note: CRU China bauxite price is based on the CIF China bauxite price plus the 13% VAT

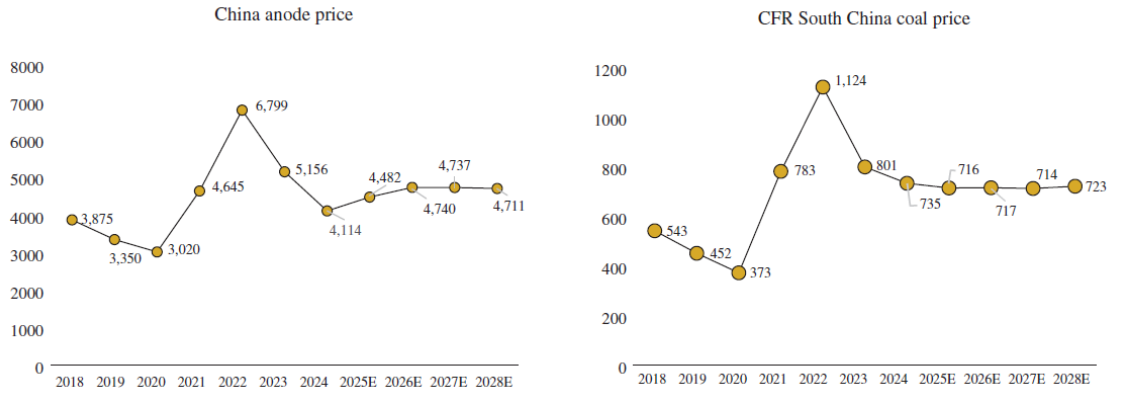
Apart from bauxite, carbon anode and thermal coal are two key raw materials used during the smelting process.

Carbon anodes are primarily composed of calcined petroleum coke and coal tar pitch. Calcined petroleum coke, the key feedstock, is a byproduct of crude oil refining, making its price highly dependent on crude oil fluctuations. Coal tar pitch, used as a binder in anode production, is influenced by coal availability.

The prices of carbon anodes are largely driven by raw material costs — especially calcined petroleum coke and coal tar pitch — as well as demand from aluminum smelting. In 2022, soaring energy prices led to the increased costs of these raw materials, pushing CRU China's carbon anode price to a peak of RMB6,799 per ton. Subsequently, as new carbon anode production capacity came online and energy price declined, prices of carbon anodes dropped to RMB4,114 per ton in 2024. Looking ahead, prices of carbon anodes are forecast to remain above RMB4,000 per ton, supported by strong aluminum smelting demand in China as the industry approaches its 45 mt of annual electrolytic aluminum production capacity cap.

Coal is burned to generate steam for electricity power generation. Electricity costs constitute approximately 36% of the electrolytic aluminum production cost in 2024. The industry average electricity self-sufficiency rate was 59.0%, 57.2% and 54.5% in 2022, 2023 and 2024, respectively. In 2024, approximately 57% of electricity in China was generated by coal. The actual purchase prices of coal vary based on the coal grade and the distance to the coal resources. Power plants with access to local resources will likely benefit from a lower coal price. In this report, CRU CFR (Cost and Freight) South China coal price is used to track China's coal price. The coal price is predominantly influenced by the supply-demand dynamic. The CFR South China coal price plunged from RMB543 per ton in 2018 to RMB373 per ton in 2020 due decreasing in demand during the public health incident. However, a rebound occurred in 2021, with prices surging to RMB783 per ton amid China's economic resurgence and constrained coal supplies. In 2022, there was further upward pressure as the demand for coal-fired power intensified. Globally, the Russia-Ukraine conflict escalated natural gas prices, prompting a shift toward coal-based electricity generation. Domestically, a summer drought in 2022 curtailed hydro-power output, further amplifying reliance on coal. Under the ongoing energy transition, CRU estimates China's thermal coal demand to peak in 2025. China's coal-fired power generation is forecast to decrease from 5,464 terawatt-hour in 2024 to 5,115 terawatt-hour in 2028, with its share of power generation declining from approximately 57% to 44% over the same period. Consequently, CRU forecasts the CFR South China coal price to decrease from RMB735 per ton in 2024 to RMB723 per ton in 2028.

Figure 3: CRU China carbon anode and thermal coal price, 2018-28E, RMB/t



SOURCE: CRU, General Administration of Customs of People's Republic of China (GACC), Industry sources

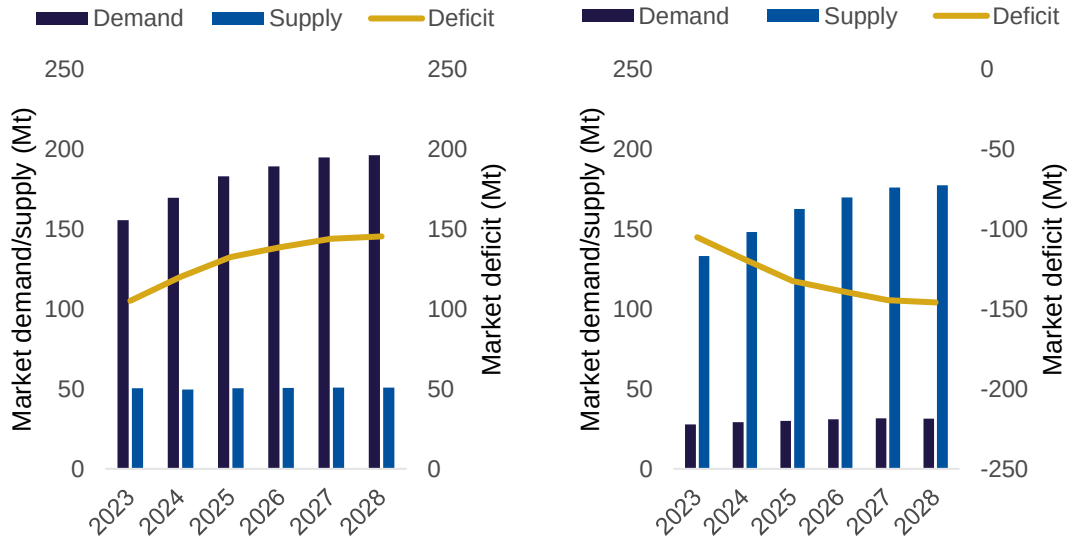
Note: CRU uses the CFR (Cost and Freight) South China 5,500 kcal/kg NAR coal as the benchmark to forecast China's coal price trend.

Third-party bauxite trade

Global bauxite market can be split into two broad regions: Pacific and Atlantic markets, with India forming the dividing line. The two markets also have almost opposite characteristics when it comes to the supply and demand gap for bauxite.

- **Pacific market:** China is the largest bauxite consumer in the Pacific market. In 2023, China consumed 197 mt and produced 74 mt of bauxite. All Chinese bauxites are consumed domestically to satisfy the downstream demand. For the supply gap, most are fulfilled by the imported third-party trihydrate bauxites. Due to China's large demand and low domestic supply, the Pacific market for 3rd party bauxite will be in a deficit throughout 2023-2028. As China increases its bauxite import needs, the Pacific market deficit will widen from 123 mt in 2023 to 145 mt by 2028. This deficit will likely be fulfilled by imports from the Atlantic market, notably from Guinea (West Africa).
- **Atlantic market:** The Atlantic market is well served by abundant reserves and productions in Brazil (South America) and Guinea (West Africa). In this market, the demand for third-party bauxite will be stable over 2023-2028 as we don't see significant expansion of non-integrated refineries in Europe and America. The excess bauxite supply in the Atlantic market is expected to sell to the Pacific market, notably China.

Figure 4: Third-party bauxite market balance, Pacific (LHS) & Atlantic (RHS), 2023-28E, mt



SOURCE: CRU. Please note that CRU views bauxite demand as third party when a refinery purchases either a proportion or its entire bauxite needs from a mine that is not owned by the refinery.

Bauxite availability

Bauxite reserve is abundant but highly concentrated. In 2024, about 74% of the world's proven reserves are concentrated in six countries, namely Guinea, Australia, Vietnam, Brazil, Jamaica and Indonesia, among which Guinea and Australia are the world's two largest bauxite producers.

China's bauxite reserve was around 680 mt and produced 61 mt in 2024. At the current ratio of supply, China's domestic bauxite reserve could only sustain around 11 years of bauxite production. Hence China is the world's largest bauxite importer. In 2024, China imported 159 mt of bauxite and the import volume is forecast to rise to 192 mt in 2028. West Africa, notably Guinea, is China's largest bauxite importing source. Bauxite import from West Africa is forecast to increase from 112 mt in 2024 to 147 mt in 2028.

Table 4: China's bauxite import source, mt

	2024	2028E
West Africa	112	147
Australia	40	36
Indonesia	0	0
Rest of world	7	9
Total	**159**	**192**

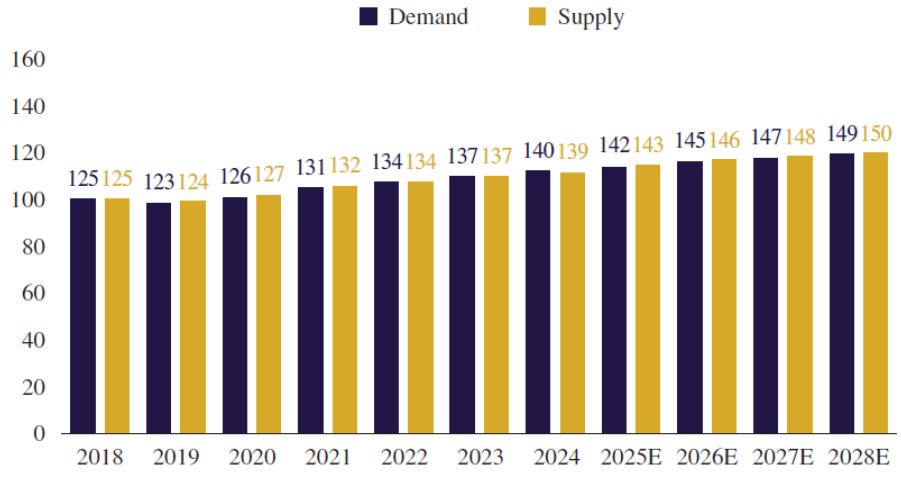
SOURCE: CRU, General Administration of Customs of People's Republic of China (GACC)

1.1.3. Global and China alumina and electrolytic aluminum market outlook

Alumina is used as the feedstock for electrolytic aluminum smelting. In an aluminum smelter, alumina is converted into electrolytic aluminum through the electrolytic process. Meanwhile, it could also be applied in various chemical applications, including refractories, abrasives, and polishing materials. CRU forecasts around 94% of alumina is used in aluminum smelting.

Global alumina market outlook:

Figure 5: Global alumina market demand and supply, 2018-28E, mt



Alumina demand and supply CAGR (%)	CAGR (2018-2024)	CAGR (2025E-2028E)
Global demand	2.0	1.6
Global supply	1.9	1.5

SOURCE: CRU

Alumina demand is directly driven by growing downstream electrolytic aluminum production. Backed by a robust global electrolytic aluminum market, CRU expects global alumina demand to rise from 142 mt in 2025 to 149 mt in 2028, representing a CAGR of 1.6%. China is the world's largest alumina consumer, in 2024, China's alumina demand took up 59% of the global demand. From the supply side, global production is forecast to increase from 143 mt in 2025 to 150 mt in 2028, representing a CAGR of 1.5%. China is also the world's largest alumina producer, taking up 60% of the global supply share in 2024. China, India and Indonesia are the three largest alumina production drivers, collectively forecast to account for 95% of the production growth between 2024 and 2028.

Between 2018 and 2023, the global alumina market stayed balanced with the supply slightly higher than the demand. Given the global alumina production disruption in 2024, a market deficit of over 1 mt occurred in 2024 globally. In the future, the ramp-up of alumina production will fulfil the current alumina market deficit. Therefore, the global alumina market is forecast to recover from the current deficit position and stay at a one mt surplus by 2028.

The table below lists upcoming refinery projects outside China identified by CRU. Most new refinery projects will be constructed in India and Indonesia.

Table 5: Key upcoming alumina refinery projects outside China, Ktpa

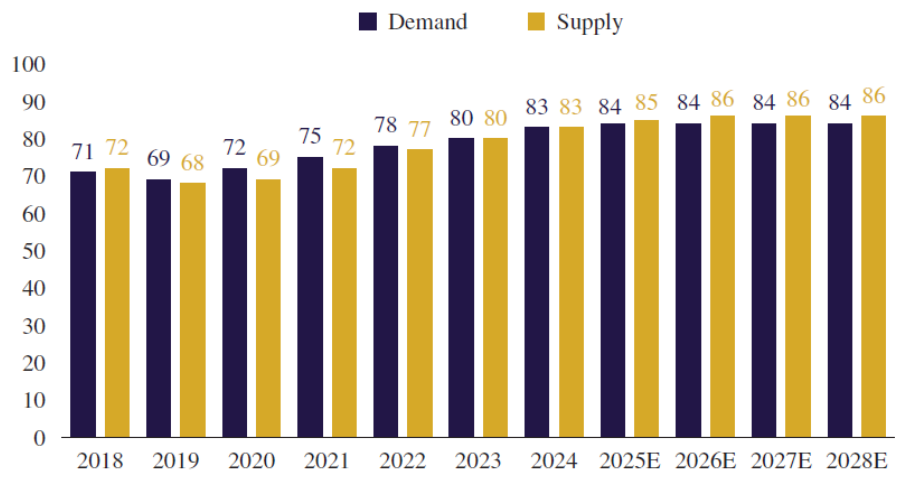
Project	Country	Type	Expected start date	Expected capacity (Ktpa)	Likelihood
Project A	Guinea	Greenfield	Post-2028	1,000	N/A
Project B	India	Brownfield	2024	3,000	Committed
Project C	India	Greenfield	2029	4,000	N/A
Project D	India	Brownfield	2026	1,000	Probable
Project E	India	Greenfield	2029	2,000	N/A
Project F	Indonesia	Greenfield	2026	1,000	Probable
Project G	Indonesia	Greenfield	2025	1,000	Committed
Project H	Indonesia	Greenfield	2025	1,000	Committed
Project I	Indonesia	Brownfield	2025	2,000	Committed
World Total				**16,000**	

SOURCE: CRU, "Ktpa" refers to "kilotons per annum"

China alumina market outlook:

Under the aluminum capacity cap, China's alumina demand is forecast to converge mildly to 83 Mt, the input equivalent to meet the 45 Mt aluminum production and then plateau over the long term. Despite little change in the absolute term, the geographic allocation of alumina demand will shift over the next 3 years along with the downstream aluminum production. Inner Mongolia's alumina demand share is forecast to rise from 15% in 2024 to 17% in 2028. Meanwhile, Shandong's alumina demand share is forecast to decline from 17% in 2024 to 11% in 2028. Yunnan, Inner Mongolia, and Xinjiang will be the top three alumina consumers, accounting for over 50% of the country's demand by 2028.

Figure 6: China alumina market demand and supply, 2018-28E, Mt



Alumina demand share by province (%)	2023	2024	2025E	2026E	2027E	2028E
Yunnan	11%	12%	14%	16%	17%	18%
Inner Mongolia	15%	15%	16%	17%	17%	17%
Xinjiang	15%	14%	14%	14%	14%	14%
Shandong	18%	17%	16%	14%	12%	11%
Rest of China	42%	41%	40%	39%	39%	40%

SOURCE: CRU

While demand will increase over the short term and stabilise over the medium term, China's alumina production is expected to rise mildly in correspondence. CRU forecasts China's alumina production will increase by one mt from 2025 to 2028.

Table 6: Key upcoming alumina refinery projects in China, Ktpa

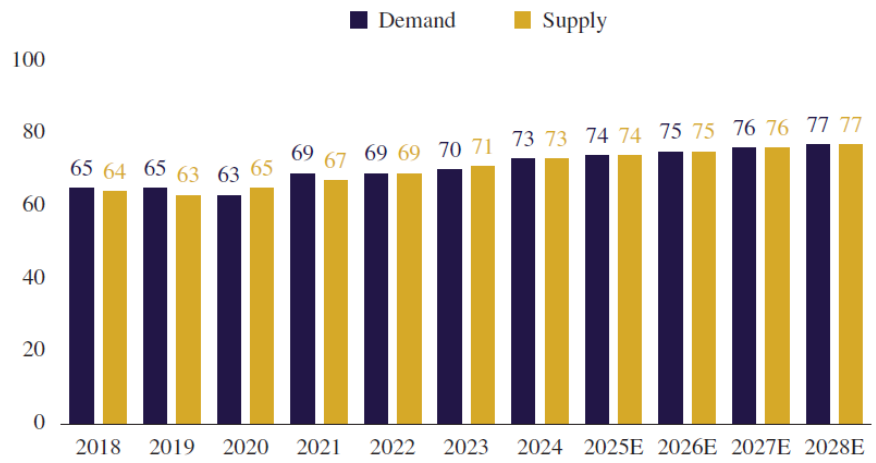
Project	Province	Type	Expected start date	Expected capacity (Ktpa)	Likelihood
Project A	Guangxi	Greenfield	2026	2,000	probable
Project B	Guangxi	Brownfield	2025	2,000	probable
Project C	Guangxi	Greenfield	2027	1,600	possible
Project D	Inner Mongolia	Greenfield	2028	3,900	probable
Project E	Hebei	Brownfield	2025	1,600	probable
China Total				**11,100**	

SOURCE: CRU, "Ktpa" refers to "kilotons per annum"

Global electrolytic aluminum market outlook:

Global electrolytic aluminum demand has grown at a 3.4% CAGR during 2013-2024, primarily driven by demand from Asia, notably China (20 mt growth from China, out of 22 mt globally). Going forwards, CRU expects global aluminum demand to grow from 74 mt in 2025 to 77 mt in 2028, representing a slower CAGR of 1.6%. China, India, the US and Europe are expected to be the four largest growing forces, contributing a total of two (out of three) mt growth in electrolytic aluminum consumption.

Figure 7: Global electrolytic aluminum market demand and supply, 2018-28E, Mt



Share of electrolytic aluminum demand by country (%)	2024	2028E
China	62	59
US	7	7
India	4	4
Germany	2	2
Rest of world	26	27
World Total	100	100

SOURCE: CRU

Together with demand, CRU forecasts the global aluminum production to grow from 74 mt in 2025 to 77 mt in 2028 (1.6% CAGR), with China contributing less than one mt. Outside China, the production growth is expected to be 3 mt over 2024-2028 and most of this increase will be from India, Indonesia and the Middle East.

Table 7: Key brownfield and greenfield smelter projects outside China, Kt

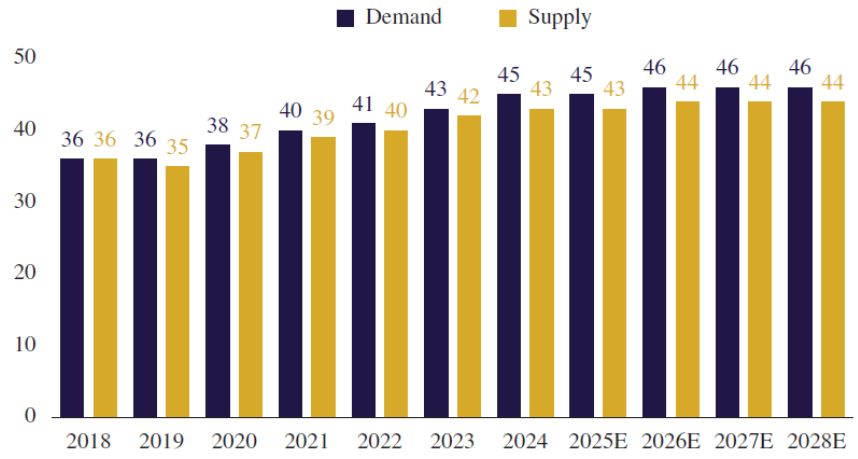
Smelter	Country	Type	Power source	Change 2023-2028
Project A	Angola	Greenfield	Mix	120
Project B	Azerbaijan	Brownfield	Gas	46
Project C	Canada	Brownfield	Hydro	164
Project D	Colombia	Greenfield	Hydro	N/A
Project E	India	Brownfield	Coal	38
Project F	India	Brownfield	Coal	421
Project G	Indonesia	Brownfield	Mix	150
Project H	Indonesia	Greenfield	Hydro	500
Project I	Indonesia	Greenfield	Coal	657
Project J	Indonesia	Brownfield	Hydro	61
Project K	Iran	Greenfield	Gas	220
Project L	Russia	Greenfield	Hydro	317
Project M	Saudi Arabia	Brownfield	Gas	152
Project N	Tajikistan	Brownfield	Hydro	227
Project O	Vietnam	Greenfield	Mix	N/A
World Total				**3,074**

SOURCE: CRU, Industry sources

China electrolytic aluminum market outlook

Backed by its robust industrialization and modernization process, China experienced significant electrolytic aluminum consumption growth for the first two decades of this century. Its consumption rose from 3 mt in 2000 to 45 mt in 2024 at 12% CAGR. CRU forecasts China's electrolytic aluminum demand to rise mildly from 45 mt in 2024 to close to 46 mt in 2028.

Figure 8: China electrolytic aluminum market demand and supply, 2018-28E, mt



Share of electrolytic aluminum production by province (%)	2024	2028E
Yunnan	12	18
Inner Mongolia	15	17
Xinjiang	14	14
Shandong	17	11
Rest of China	42	40
China Total	100	100

SOURCE: CRU

With rising demand, China's production also increased from 2 mt in 2000 to 43 mt in 2024 at 13.6% CAGR. Under the 45 mt of annual electrolytic aluminum production capacity cap, China's supply growth slowed and has become a net importer in recent years. Meanwhile, Inner Mongolia, Yunnan and Xinjiang are overtaking Shandong as China's largest electrolytic aluminum production bases, benefiting from their abundant green and affordable power resources. In the future, the 45 mt to 46 mt consumption compared with the 43 mt to 44 mt production forecast will mean a sustained deficit of over one to two mt each year.

CRU lists the identified upcoming smelter projects in China. Most of the greenfield projects are in Inner Mongolia and Yunnan.

Table 8: Key brownfield and greenfield smelter projects in China, Kt

Smelter	Province	Type	Power source	Change 2023-2028
Project A	Guangxi	Brownfield	Coal & Hydro	45
Project B	Guizhou	Brownfield	Grid	142
Project C	Guizhou	Greenfield	Coal	15
Project D	Guizhou	Brownfield	Grid	131
Project E	Inner Mongolia	Greenfield	Coal	202
Project F	Inner Mongolia	Brownfield	Grid & Renewables	350
Project G	Inner Mongolia	Greenfield	Mix	330
Project H	Inner Mongolia	Brownfield	Coal	420
Project I	Qinghai	Brownfield	Hydro	110

Project J	Sichuan	Greenfield	Hydro	11
Project K	Yunnan	Greenfield	Hydro	81
Project L	Yunnan	Greenfield	Hydro	942
Project M	Yunnan	Greenfield	Hydro	1,499
Project N	Yunnan	Greenfield	Hydro	117
Project O	Yunnan	Greenfield	Hydro	195
Project P	Yunnan	Greenfield	Hydro	96
Project Q	Yunnan	Greenfield	Hydro	142
China Total				**4,827**

SOURCE: CRU, Industry sources

1.1.4. Green aluminum

The topic of green aluminum has been drawing attention both globally and in China. From October 2023, Europe CBAM (Carbon Border Adjustment Mechanism) requires emission data reports for all aluminum imports into the Europe region. Under the same scheme, aluminum imports into Europe will be charged based on its emission level from 2026. Other countries such as the US and Japan are also in the path of regulations, despite that a scheduled regime for import is not yet seen.

China also announced in 2020 its goal of achieving carbon neutrality by 2030 and carbon zero by 2060. In 2024, the Chinese authorities also released a work plan for the 15th Five-Year Plan covering the 2026-2030 period, which shifts the focus from controlling energy consumption to controlling carbon consumption. To lower the carbon consumption in the aluminum sector, China's state council further issued the Action Plan for Energy Saving and Decarbonization (2024-25). The plan explicitly sets the objective to apply 25% of renewable energy in the electrolytic aluminum industry by 2025. In the same year, the authorities officially introduced the Green Electricity Certifications (GECs). Despite the GECs are now non-binding for aluminum producers, it is possible that in the future aluminum producers who fail to meet the renewable energy requirement will need to purchase GECs to validate renewable energy generation. In 2025, the MIIT issued the Aluminum Industry High Quality Development Initiative 2025-2027. For electrolytic aluminum, the initiative confirms that the renewable energy target for electrolytic aluminum smelting has been raised from 25% by 2025 to 30% by 2027.

1.1.5. Aluminum ingot and liquid analysis

Upon completion of the smelting process, electrolytic aluminum could be in the form of ingots or liquid aluminum.

Ingot is the standard solid form of electrolytic aluminum. It is cast from liquid aluminum for the purpose of long-distance transportation. The downstream buyers then remelt them into liquid form, before forming into various aluminum products.

Liquid aluminum is the liquid form of electrolytic aluminum. It is common for smelters to sell liquid aluminum to downstream alloy processors for economic efficiency. Liquid aluminum is most commonly transported within a 10-kilometre radius and can be technically transported up to a 50-kilometre radius.

From the economic efficiency perspective, short-distance transportation of liquid aluminum benefits both upstream electrolytic aluminum manufacturers and downstream alloy processors. This is because, as compared to long-distance ingot transportation, use of short distance transported liquid aluminum (i) saves costs on transportation fees; (ii) reduces loss of liquid aluminum during transportation; and (iii) saves energy for heating or remelting by downstream aluminum alloy processors. Therefore, the price of liquid aluminum is usually lower than aluminum ingots.

In 2024, approximately 72% of electrolytic aluminum in China was sold in liquid form. Under the Action Plan for Energy Saving and Decarbonization (2024-2025), the Chinese authority encourages that at least 90% of electrolytic aluminum shall be converted into liquid aluminum for downstream aluminum alloy. This policy is viewed as non-coercive, and CRU has not observed any substantial incentives or penalties regarding the policy. Furthermore, The Aluminium Industry High-Quality Development Initiative 2025-2027 again encourages the direct use of liquid aluminum in downstream aluminum alloying.

1.1.6. Aluminum end-use analysis

After the casting stage aluminum is turned into aluminum products, these aluminum products have a wide range of end uses, namely in transport, electrical, construction, foil stock, consumer durables, machinery & equipment, etc. In recent years, energy transition, lightweight automotive and electrification have supported the growth of electrolytic aluminum demand in China. CRU forecasts the transport sector and electrical sector to replace the construction sector as the two largest end-use sectors for aluminum products by 2028, driven by the following factors:

Figure 9: China aluminum product demand by end-use proportion (%) and CAGR (%)

	2018	2024	2028E	CAGR (2018-2024)	CAGR (2025E-2028E)
Transport	17	19	20	5	3
Electrical	12	18	19	13	2
Construction	31	23	19	(2)	(1)
Others	40	40	42	4	2
China Total	**100**	**100**	**100**	**4**	**2**

SOURCE: CRU

Note: others primarily include foil stock for food, beverage and pharmaceutical packaging; consumer durables such as 3C electronics, household appliances and kitchenware; and machinery and equipment, where it is incorporated into components such as frames, housings and heat sinks.

Lightweight automotive manufacturing is one of the main areas for aluminum used in the **transport sector**. Recent developments in EVs support the demand for lightweight automotive. On average, each EV consumes 0.28 ton of aluminum, 47% more than that of an ICE (Internal Combustion Engine). China is the world's largest consumer and producer of EVs. Its EV production rose from 1.1 million in 2018 to 12.6 million in 2024 and is forecast further grow to 19.5 million in 2028. China's expanding EV production is expected to add about 1.9 mt of new aluminum demand, supporting growth in the transport sector. CRU forecasts that the transport sector will consume approximately 11.4 mt of aluminum products in 2028, making it the largest aluminum end-use sector in China.

Electrification facilitates aluminum use in the **electrical sector**. Aluminum is used in power cables, solar PVs and wind power equipment. The growing green energy sector is supporting aluminum growth. Aluminum is used in power cables, solar PVs and wind power equipment. With the global development of green energy, notably solar and wind power, aluminum demand in the electrical sector is forecast to grow at a CAGR of approximately 2% from 2025 to 2028 globally. Much of the growth will be in Asia as around 85% of green energy equipment is manufactured in Asia, including China, and then exported. In addition, aluminum is forecast to partially substitute copper in power cable production. Both copper and aluminum are good conductors of electricity, but copper is nearly four times more expensive than aluminum. With the copper/aluminum pricing ratio continuing to rise, aluminum is gradually replacing some copper in cables for cost advantage, adding aluminum's usage in electrical transition. CRU forecasts that the electrical sector will consume approximately 10.4 mt of aluminum products in China in 2028.

Construction sector is the conventional largest end use sector of aluminum in China but the share will gradually lower. With the slowdown of China's real estate and infrastructure development, construction sector demand is forecast to decline from 31% in 2018 to less than 19% in 2028.

1.2. Global and China electrolytic aluminum and alumina industry market size (2018 – 2028E)

1.2.1. Methodology

CRU collects the historical and forecast demand, supply and price for global and China to estimate their industry size. The industry size is the multiplication of demand and price:

- Global alumina industry size = Global alumina demand * CRU alumina price
- China alumina industry size = China alumina demand * CRU China alumina price
- Global electrolytic aluminum industry size = Global electrolytic aluminum demand * LME cash price
- China electrolytic aluminum industry size = China electrolytic aluminum demand * SHFE cash price

1.2.2. Alumina industry market size

By industry size, China dominates the global alumina market with a share of 66% in 2024. From 2018 to 2024, its industry size rose from USD32 billion to USD46 billion, driven by soaring alumina prices in 2024. In the future, China's alumina industry size is forecast to decline to USD39 billion in 2028 with the retreat of alumina prices. China's share of alumina industry size is expected to decline from 66% in 2024 to 64% in 2028, led by the plateauing of China's alumina demand under the 45 mt of annual electrolytic aluminum production capacity cap.

Driven by both rises in alumina prices and demand, the global alumina industry size excluding China is expected to expand from USD20 billion in 2025 to USD22 billion in 2028. Southeast Asia and India are the two regions leading the global alumina industry growth as a list of new alumina projects is expected to be commissioned there.

Table 9: Global alumina industry size, 2018-2028E

Category	Unit	2018	2019	2020	2021	2022	2023
Supply	Mt	125	124	127	132	134	137
Demand	Mt	125	123	126	131	134	137
Price*	USD/t	473	332	271	330	364	345
Industry size	**USD bn**	**59**	**41**	**34**	**43**	**49**	**47**

Category	Unit	2024	2025E	2026E	2027E	2028E
Supply	Mt	139	143	146	148	150
Demand	Mt	140	142	145	147	149
Price	USD/t	503	390	370	390	410
Industry size	**USD bn**	**71**	**56**	**54**	**58**	**61**

SOURCE: CRU, * "Price" stands for CRU global alumina price

Table 10: China alumina industry size, 2018-2028E

Category	Unit	2018	2019	2020	2021	2022	2023
Supply	Mt	72	68	69	72	77	80
Demand	Mt	71	69	72	75	78	80
China price	RMB/t	2,936	2,676	2,323	2,776	2,936	2,906
Industry size	**USD bn**	**32**	**27**	**24**	**32**	**34**	**33**

Category	Unit	2024	2025E	2026E	2027E	2028E
Supply	Mt	83	85	86	86	86
Demand	Mt	83	84	84	84	84
China price	RMB/t	4,030	3,127	2,963	3,123	3,283
Industry size	**USD bn**	**46**	**36**	**34**	**36**	**39**

SOURCE: CRU, * "China price" stands for CRU China alumina basket price

1.2.3. Electrolytic aluminum industry market size

China is currently dominant in the electrolytic aluminum industry and is expected to maintain this leadership position. China's industry size is expected to grow from USD125 billion in 2024 to USD148 billion in 2028, representing 71% and 69% of the global industry size respectively. The decline in China's share is mainly due to the slow peaking of China's electrolytic aluminum supply over the forecast period.

Table 11: Global electrolytic aluminum industry size, 2018-2028E

Category	Unit	2018	2019	2020	2021	2022	2023
Supply	Mt	64	63	65	67	69	71
Demand	Mt	65	65	63	69	69	70
LME Cash	USD/t	2,110	1,791	1,704	2,480	2,703	2,249
Industry size	**USD bn**	138	116	107	171	187	158

Category	Unit	2024	2025E	2026E	2027E	2028E
Supply	Mt	73	74	75	76	77
Demand	Mt	73	74	75	76	77
LME Cash	USD/t	2,419	2,418	2,441	2,605	2,755
Industry size	**USD bn**	176	178	183	199	213

SOURCE: CRU, "LME Cash" stands for LME Aluminum cash price

Table 12: China electrolytic aluminum industry size, 2018-2028E

Category	Unit	2018	2019	2020	2021	2022	2023
Supply	Mt	36	35	37	39	40	42
Demand	Mt	36	36	38	40	41	43
SHFE Cash	RMB/t	14,197	13,902	14,119	18,936	19,945	18,678
Industry size	**USD bn**	77	73	77	118	121	113

Category	Unit	2024	2025E	2026E	2027E	2028E
Supply	Mt	43	43	44	44	44
Demand	Mt	45	45	46	46	46
SHFE Cash	RMB/t	19,949	20,107	20,050	21,550	22,913
Industry size	**USD bn**	125	124	124	136	148

SOURCE: CRU, "SHFE Cash" stands for SHFE Aluminum cash price

1.3. Electrolytic aluminum and alumina pricing mechanism and forecast (2010-2028E)

1.3.1. Methodology

CRU's price forecast is envisaged on future market balances. In the short to medium run, bulk commodity markets can frequently slip into disequilibrium, as supply is usually sluggish to self-adjust within a short timeframe and demand can easily exceed or fall behind the capacity. Therefore, commodity prices are volatile. Short-to-medium term (ST/MT) price forecasts seek to understand and predict price cycles by monitoring and modelling market fundamentals such as demand, supply, costs, and inventories. In addition to that, there is usually more observable real-time information for the ST/MT than long terms which allows more accuracy in price forecast. The medium-term trend is usually affected by the smelter's capacity shutdowns, volatility of feedstock supply and geopolitical risks.

The section below provides the historical (2010-2023) and forecast prices (2024E-2028E) for (1) CRU's alumina price; (2) CRU's China alumina basket price; (3) LME cash price; (4) SHFE cash price.

1.3.2. Alumina Price

Like bauxite, there is not a consensus on alumina pricing mechanisms like SHFE or LME aluminum price. Alumina trade is based on fixed contracts, either long-term or short-term. Historically, the contract price is agreed as a percentage of the LME aluminum price. In recent years, the benchmark for the contract price has instead transformed to third-party references or indices, including CRU's alumina price index. In the international market, third-party references like CRU alumina price are widely adopted as the alumina benchmark price. In China, alumina buyer refers more to the average price from authoritative third parties, such as Aladdiny, Baiinfo, and Antaike.

CRU's alumina price is also referred to as the Australia FOB price. It monitors transactions in the most liquid third-party alumina market. Transactions are normalized to the Port of Bunbury in Western Australia. While most transactions reported to CRU derive from Australia, CRU alumina price also considers transactions elsewhere for alumina which flows within the Pacific region.

CRU's China alumina price is collected based on alumina transaction prices in key provinces, including Shandong, Henan, Shanxi, Guangxi, Guizhou and Inner Mongolia.

Table 13: Alumina price forecast, 2010-2028E, nominal price

	Unit	2010	2011	2012	2013	2014	2015	2016
China alumina	**RMB/t**	2,767	2,763	2,612	2,452	2,497	2,335	2,037
Global alumina	**USD/t**	339	376	319	326	329	301	253

	Unit	2017	2018	2019	2020	2021	2022	2023
China alumina	**RMB/t**	2,868	2,936	2,676	2,323	2,776	2,936	2,906
Global alumina	**USD/t**	354	473	332	271	330	364	345

	Unit	2024E	2025E	2026E	2027E	2028E	-	-
China alumina	**RMB/t**	4,030	3,127	2,963	3,123	3,283	-	-

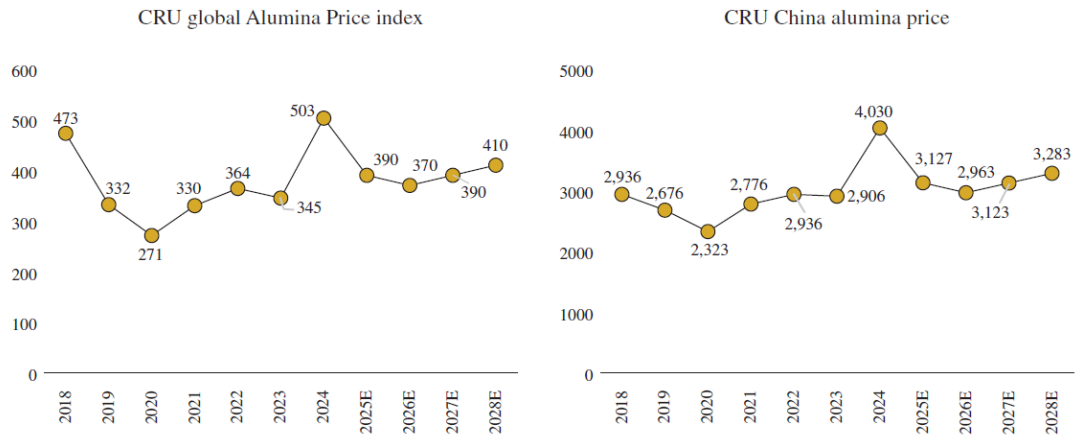
Global alumina	**USD/t**	503	390	370	390	410	-	-

SOURCE: CRU,

Note. “China alumina” refers to CRU’s China alumina price, “Global alumina” refers to CRU’s alumina price

Alumina historical and forecast price review

Figure 10: CRU Global and China alumina price, 2018-28E, USD/t & RMB/t



SOURCE: CRU, Industry sources

2010-2015: Falling prices under new capacity in China and weak demand in the West

The alumina price declined sharply between 2011 and 2016, with CRU China alumina price dropping from an average of RMB2,763 per ton in 2011 to RMB2,037 per ton in 2016. This drop was driven by almost doubled alumina capacity, from 44 Mtpa in 2011 to 73 Mtpa in 2016.

2015-2020: Volatile price due to supply disruption and limited storage capacity

The alumina price was relatively volatile between 2015 and 2020 under exceptional circumstances: US’s sanctions on Rusal, Alcoa’s strike, and the 50% shutdown at Alunorte (Brazil). CRU China alumina price reached an average of RMB2,936 per ton in 2018.

In addition to short-term events, features of the alumina market naturally added to price volatility in general. One feature is the limited amount of storage capacity, which means there is little buffer to absorb shocks in supply or demand. Additionally, as the market is highly consolidated and refineries are of large scale, any supply disruption by a single refinery could pose a significant supply-side shock, which translates into short-term price volatility.

2020-2024: Volatile price due to public health incidents and global inflation

Volatile market prices continued between 2020 and 2024, influenced by various factors. In 2020, CRU China alumina price dropped to RMB2,323 per ton as the public health incidents dampened the global demand. The price quickly recovered and surged to RMB2,776 per ton in 2021 due to the rising energy cost led by global inflation and increasing demand from the recovering aluminum sector.

In 2024, alumina prices soared due to a global supply deficit. This was attributable to (i) several alumina production disruption incidents as several refineries in Australia, India and Brazil faced bauxite and energy supply constraints. Specifically, an alumina refinery in Kwinana of Australia closed down in August 2024; an alumina refinery in India experienced shipment delays in the second quarter of 2024 due to logistical disruptions in India; there was a force majeure on bauxite shipments from Brazil’s Juruti Port due to a stranded vessel in November 2024; and there was a force majeure on alumina refineries in Yarwun and Queensland of Australia in May 2024 due to restricted local gas supply; (ii) temporary disruption to Guinea bauxite shipments as discussed above; and (iii) China’s persistent high

demand for alumina as its electrolytic aluminum production reached new high in 2024. By the end of 2024, the CRU Global Alumina Price Index had reached a record high of USD720 per ton, the highest nominal level in over 35 years of CRU's price reporting. Simultaneously, CRU China's alumina price rose to RMB5,763 per ton. As a result, there was a global alumina deficit of one mt in 2024, with average alumina prices reaching USD503 per ton globally and RMB4,030 per ton in China.

2024-2028E: Sizeble alumina capacity expansion stabilizes the price over the medium term

After 2024, CRU Global and China alumina prices have declined sharply, averaging USD475 per ton and RMB3,635 per ton for the first four months of 2025, respectively. The price plunge is due to a shift in market balance from a deficit in 2024 to a surplus in 2025. On the supply side:

(i) Most of the temporary alumina production disruptions seen in 2024 have been resolved in 2025, the temporary disruption in bauxite shipment have been gradually resolved and global alumina supply was sufficient to cover the resilient demand in 2025;

(ii) New refinery capacity is expected to come online, in 2025 and 2026, partially because many market players were drawn to the rising alumina market prices since the end of 2024, promoting them to establish new alumina refining production lines or expand existing ones in China and Indonesia.

CRU forecasts global alumina supply to increase by approximately 4 mt in 2025, versus demand growth of approximately 2 mt. Consequently, the global alumina market is forecast to enter in a modest surplus in 2025, and alumina prices are forecast to retreat from 2024 highs, averaging USD390 per ton globally and RMB3,127 per ton in China by 2025. Alumina prices are primarily determined by market demand and supply, and only limitedly by the cost of its raw material, such as bauxite. Therefore, while bauxite prices rised in 2025, it did not translate into higher alumina prices in China and globally.

Over the forecast period, alumina prices are expected to remain strong, staying above the levels in 2020 due to rising bauxite prices and increasing global demand for electrolytic aluminum. CRU alumina price is forecast to average USD410 per ton globally and RMB3,283 per ton in China by 2028. However, any further production disruptions could trigger another price surge, as seen in 2024.

1.3.3. Aluminum price

The London Metal Exchange ("LME") aluminum cash price refers to the price per tonne of electrolytic aluminum on LME deliverable in two days, stated in USD.

The Shanghai Future Exchange ("SHFE") aluminum cash price refers to the price per tonne of electrolytic aluminum on SHFE deliverable immediately, stated in RMB. In China, the average price of electrolytic aluminum quoted on the website of Shanghai Metal Markets indicates the market-assessed price of electrolytic aluminum trade in China and is the market price indicator typically used by Chinese market players.

Given aluminum's commodity nature, the LME cash price and the SHFE cash price are highly correlated, except for some deviations led by hedging, logistics, and geopolitical events.

Table 14: Electrolytic aluminum price forecast, 2010-2028E, nominal price

	Unit	2010	2011	2012	2013	2014	2015	2016
SHFE Cash	**RMB/t**	15,782	16,817	15,655	14,501	13,541	12,169	12,383
LME Cash	**USD/t**	2,173	2,395	2,018	1,845	1,867	1,661	1,605

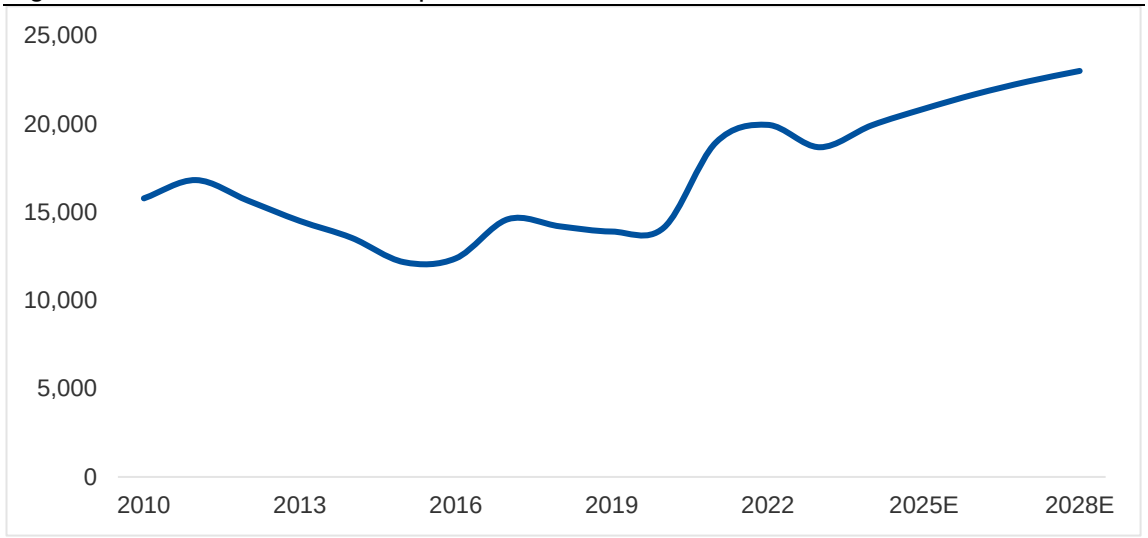
	Unit	2017	2018	2019	2020	2021	2022	2023
SHFE Cash	**RMB/t**	14,598	14,197	13,902	14,119	18,936	19,945	18,678
LME Cash	**USD/t**	1,969	2,110	1,791	1,704	2,480	2,703	2,249

	Unit	2024	2025E	2026E	2027E	2028E	-	-
SHFE Cash	**RMB/t**	19,949	20,107	20,050	21,550	22,913	-	-
LME Cash	**USD/t**	2,419	2,418	2,441	2,605	2,755	-	-

SOURCE: CRU

SHFE aluminum historical and forecast price review

Figure 11: SHFE aluminum cash price, 2010-28E, RMB/t



SOURCE: CRU

2010-2015: Price declines under weak global demand and strong China supply

The global aluminum market remained bearish between 2013-2015, with the nominal LME 3M price declining from USD1,887 per ton to USD1,680 per ton. The dampening price was superseded by a persistently weak global demand since 2011 due to the European debt crisis and inflation in China.

As the new capacity kept ramping up and marginal producers showed no sign of curtailment, Chinese domestic market production was ramping up during this period. As a result, China's supply increased from 17 Mt in 2010 to 31 Mt in 2015. Chinese exports remained strong over the period, bringing less support for both domestic and global aluminum prices.

2015-2020: Price recovered under China's supply-side reform and aluminum supply disruption outside China

Following the trough around 2015, SHFE aluminum price entered a relative recovery period. The nominal SHFE price rose by 17% from RMB12,169 per ton in 2015 to RMB14,197 per ton in 2018.

The trend had been mostly driven by China's supply-side reforms since its 13th Five-Year-Plan (FYP), which started a shutdown of "backward capacity" in the aluminum industry in the next few years. On the other hand, the SHFE price is also envisaged by the supply disruption outside China. Smelter disruptions and lower electrolytic output in the US and Europe further suppressed world stocks except China. The negative global between 2017-2018 caused significant upward pressures on LME aluminum prices, which further pushed up SHFE aluminum prices.

2020-2023: public health incidents, global inflation, Russia-Ukraine War push up the price

The public health incidents during 2020-21 profoundly affected the Chinese aluminum market. The rise of SHFE price was triggered by global inflation given public health incident related friction on supply chains and ultra-expansionary monetary policies across the globe. LME cash price boosted from USD1,704 per ton to USD2,480 per ton through 2020-2021, which supports the SHFE price.

The trend remained volatile in 2022 with the SHFE price ranging between RMB18,000 per ton and RMB21,000 per ton over 2022-2024. This is mostly due to disruption arising from the Russia-Ukraine War, with Europe experiencing significant economic headwinds and the global aluminum market shrinking as a response. The demand weakness has persisted in 2023, leading to the SHFE price staying subdued compared to the 2022 level.

2024-2028E: key growth drives paint a positive picture for aluminum in the medium run.

Over the forecast period, CRU expects the electrolytic aluminum prices to rise mildly under a tighter demand-supply balance. From the demand side, the key growth drivers including energy transition, electrification and lightweight automotive are forecast to paint a positive outlook, especially for China. From the supply side, China's 45 mt of annual electrolytic aluminum production capacity cap and Western producers' hesitancy to invest in the new aluminum smelting capacity indicate a relatively slow growth in aluminum supply, which pushes up the electrolytic aluminum prices. Hence, CRU forecasts the SHFE and LME prices to rise from RMB20,107 per ton and USD2,418 per ton in 2025 to RMB22,913 per ton and USD2,755 per ton respectively in 2028, at a CAGR of 4.5% and 4.4%.

2. China aluminum industry competitive landscape

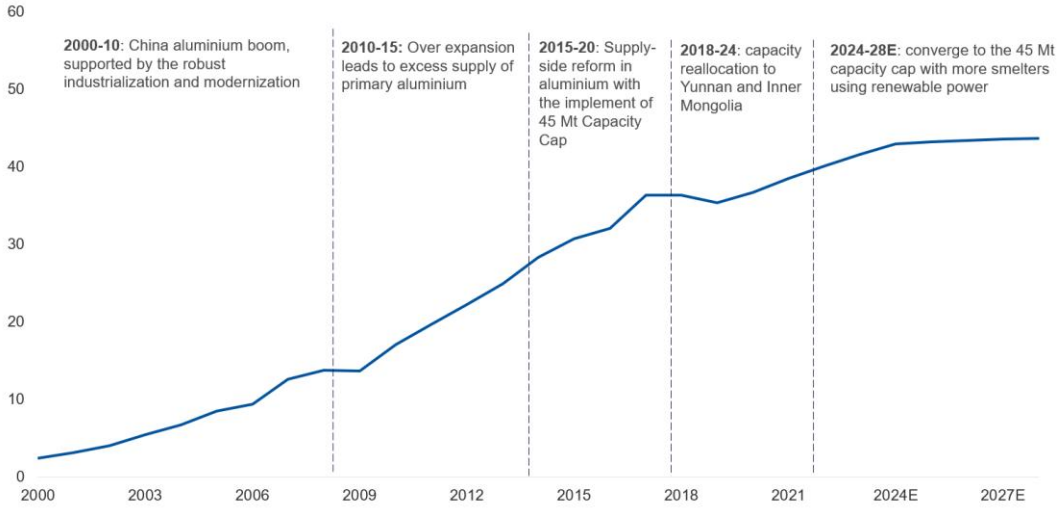
2.1. China aluminum industry analysis

2.1.1. China's electrolytic aluminum landscape

China has led the global aluminum growth in the past two decades. It experienced a significant increase in electrolytic aluminum consumption from approximately 3 mt in 2000 to approximately 45 mt in 2024 at 12% CAGR. In 2024, China accounted for over 62% of the global electrolytic consumption and 59% of the global production.

Despite dominating the world's electrolytic aluminum market, China is barely an electrolytic aluminum exporter. In 2024, China reported an ingot export of 0.36 mt in total, and most of them were sold to Asian countries. In comparison, China is a large exporter of aluminum products. According to the General Administration of Customs of the People's Republic of China (GACC) data, China exported approximately 6.3 mt of aluminum products in 2024.

Figure 12: China electrolytic aluminum production, 2000-28E, mt



SOURCE: CRU

China's electrolytic aluminum production experienced a vast expansion over 2000-2010 and the country quickly became the world's largest producer. A continuing expansion of electrolytic aluminum capacity in the first half of the 2010s led to an electrolytic aluminum surplus. In 2015, China saw a historically high surplus of approximately 1.5 Mt.

The turning point of surplus to deficit started in January 2018, when China's Ministry of Industry and Information Technology officially introduced the Scheme of Aluminum Capacity Swap"《关于电解铝企业通过兼并重组等方式实施产能置换有关事项的通知》(工信部原〔2018〕12 号)" as part of the supply-side reform in the aluminum industry. This policy sets the rule that any new capacity must be a swap of a closed capacity. Hence, China's total aluminum capacity has been strictly kept at the 2017 level, which is roughly 45 Mt/y. In 2024, China's state council issued the *Action Plan for Energy Saving and Decarbonization (2024-25)* "《2024–2025 年节能降碳行动方案》国发〔2024〕12 号". The plan explicitly sets the goal to achieve 25% renewable energy in the electrolytic aluminum industry by 2025 and sets the vision that 90% of aluminum casting material needs to be liquid aluminum by 2025. The two agendas have and will pose the following effects:

1. **Undersupply of Chinese aluminum will be sustained throughout 2028:** Under the current capacity cap, China's aluminum surplus is quickly narrowed before moving into a

deficit. Based on CRU estimation, China's electrolytic aluminum balance first time shifted from a surplus of 0.4 Mt in 2018 to a deficit of 0.9 Mt in 2019. CRU estimates the market deficit will be sustained throughout 2028.

2. **Increasing investment into renewable power-sourced aluminum capacity:** Under the capacity cap, smelters with high costs and high pollution will be replaced by those with lower costs or cleaner power. It is observed that Chinese aluminum producers have started to relocate from coal-sourced regions such as Henan and Shandong to Northwest and Southwest China for cost and decarbonization goals since 2018. The northwest regions including Inner Mongolia, Xinjiang, and Qinghai are attractive for aluminum smelting projects due to the relatively low power tariffs and sufficient renewable power including hydro, solar power, and wind power, which significantly lowers the cost of newly built capacities. With the ongoing state-set aluminum decarbonization goal, more smelters in Northwest China are forecast to adopt more renewable power, either from grid power or invest in renewables by themselves.

On March 28, 2025, the MIIT issued the Aluminum Industry High Quality Development Initiative 2025-2027 (《铝产业高质量发展实施方案（2025-2026 年）》). In this initiative, the government outlines key regulatory requirements aimed at promoting high-quality development in the aluminum industry.

For electrolytic aluminum, the initiative confirms that the current annual electrolytic aluminum production capacity cap of approximately 45 mt will remain in effect. The renewable energy target for electrolytic aluminum smelting has been raised from 25% by 2025 to 30% by 2027. New aluminum smelting projects are encouraged to use electrolysis cell technology with a capacity of 500 kiloamperes and above. According to CRU, stricter renewable energy requirements will help aluminum smelters move away from traditional coal-fired areas to regions with green energy sources, such as Inner Mongolia, Yunnan and Xinjiang. Aluminum smelters that do not meet these renewable energy standards or fail to adopt the 500 kiloamperes technology may be phased out.

For alumina, China's electrolytic aluminum production cap of 45 Mt is binding, whereas there is no binding national production quota for alumina. This is because alumina is a midstream intermediate product with demand directly tied to electrolytic aluminum supply, and its refining process is less value-added than smelting. Instead of a quota, China is optimizing the alumina industry through strict regulations. Under the Aluminum Industry High-Quality Development Initiative 2025-2027, new alumina projects must be prudentially constructed, meeting rigorous standards for raw materials, environmental protection, and red mud utilization rate. For example, new alumina refining capacity will not be allowed in key areas of air pollution control and the utilization rate of red mud needs to be over 15% or above.

The initiative also promotes the expansion of downstream applications for electrolytic aluminum, encouraging its use as an alternative to copper, steel and wood in certain applications. This shift is expected to strengthen China's overall electrolytic aluminum consumption. Additionally, China encourages aluminum companies to enhance cooperation with resource-rich countries and increase participation in the global supply chain.

2.2. China electrolytic aluminum smelter ranking

2.2.1. Production ranking

Our aluminum smelter in Huolinguole, Inner Mongolia, was the fourth-largest production base of electrolytic aluminum in terms of production output in 2024 in North China. It was also the twelfth-largest electrolytic aluminum producer in terms of production output in 2024 in China.

Table 15: Top 5 China electrolytic aluminum producers, by production, 2024

Top 5 producers in China*	Smelter	Production (Kt)	Market share (%)
1	Smelter A	5,892	13.7
2	Smelter B	5,134	11.9
3	Smelter C	3,700	8.6
4	Smelter D	2,987	6.9
5	Smelter E	2,150	5.0

SOURCE: CRU

Notes:

(1) In the CRU database, the electrolytic aluminum producer refers to the electrolytic aluminum production company.

(2) Producer A is a private vertically integrated aluminum producer established in China. The company mainly operates in the production of bauxite, alumina, electrolytic aluminum and fabricated products. The company is publicly listed on the Hong Kong Stock Exchange.

(3) Producer B is a Chinese state-owned vertically integrated aluminum producer established in China. The company mainly operates in the production of bauxite, alumina, electrolytic aluminum, carbon anode and coal. The company is publicly listed on the Hong Kong Stock Exchange.

(4) Producer C is a private vertically integrated aluminum producer established in China. The company mainly operates in the production of alumina, electrolytic aluminum and aluminum products. The company is not publicly traded on any stock exchange.

(5) Producer D is a Chinese state-owned enterprise specializing in energy. The company mainly operates in hydropower, thermal power, nuclear power, new energy and aluminum production. Its aluminum segment is listed on the Shenzhen Stock Exchange.

(6) Producer E is a private diversified company established in China. The company mainly operates in the agricultural and chemical sectors. The company is not publicly traded on any stock exchange.

2.2.2. Cash cost ranking

CRU models the cash costs of global electrolytic aluminum smelters, including smelters in China. The average cash cost for an electrolytic smelter to be approximately USD2,275 per ton globally and approximately USD2,460 per ton for China in 2024. According to CRU, our ability to manage the cash costs of aluminum per ton was among the top 5% of all aluminum smelting companies in China.

The cash cost is the direct costs involved in the smelting process. CRU cash cost of producing electrolytic aluminum includes alumina costs, power process cost, labor costs, fuel process costs, carbon cash costs, maintenance process and other supply costs, bath material costs, pot relining costs, casthouse cash costs, and carbon emission costs.

Electricity costs and costs of alumina are the two largest cost items for electrolytic aluminum production cost, accounting for approximately 36% and 46% of total electrolytic aluminum production costs in China in 2024. Costs of alumina usually do not vary significantly due to its nature of commodity, leaving electricity costs the biggest differentiating factor in cost efficiency. Electricity costs depend on both the electricity consumption of aluminum per ton and the electricity price where the smelter is located. In 2024, our Group reported an electricity consumption of 13,366 kWh per ton of electrolytic aluminum produced, which was lower than the industry average of 13,670 kWh per ton. In the five months ended May 31, 2025, our Group reported an electricity consumption of 13,314 kWh per ton of electrolytic aluminum produced. In addition, our Group has benefitted from the low electricity prices enabled by its electricity generation capability and Inner Mongolia's abundant power resources. In 2024, our Group reported a cost of electricity consumption of current coal-fired thermal power generation of RMB0.37/kWh, which is lower than the national average of RMB0.43/kWh. In the five months ended May 31, 2025, our Group reported a cost of electricity consumption of current coal-fired thermal power generation of RMB0.33 per kWh. Benefiting from the advantages in the efficiency of electricity consumption and the electricity price, our Group has an average electricity cost of aluminum smelting, namely the power process cost under CRU cash cost, of approximately RMB5,439 per ton, RMB5,266 per ton and RMB4,786 per ton of electrolytic aluminum produced in 2022, 2023 and 2024. This is significantly lower than China's industry average of approximately RMB6,153 per ton, RMB6,039 per ton and RMB5,878 per ton during the same periods, respectively. Other minor factors contributing to our cash cost control ability include lower labor costs due to our high labor production efficiency. During the Track Record Period, our Group's electrolytic

aluminum production per capita was approximately between 590 tons and 670 tons, which was over two times higher than that of the industry average during the same period. Our Group's cash cost in 2024 was approximately RMB15,112 per ton, significantly lower than China's average of approximately RMB17,700 per ton. Our group's rate of electricity self-sufficiency was approximately 88% in 2024, significantly higher than the industry average of approximately 57% in the same period.

2.3. Key success factors in the electrolytic aluminum industry

Stable access to bauxite raw material

Access to stable bauxite resources is not easy especially for new Chinese refineries as China has been relying on imports and global markets for bauxite are currently tight. Indonesia has banned bauxite exports from 2023, which means China's bauxite imports will rely more on Guinea and Australia. As Guinea faces political instability and infrastructure backwardness, the bauxite industry in the country has contended with several challenges in the past. In September 2021, the military coup led to some initial disruptions in mining operations and export logistics as many large bauxite companies were concerned about the safety of their operations. In December 2023, the oil terminal explosion in Guinea's capital Conakry damaged the transportation networks, which caused delays in shipping bauxite to the international market. In October 2024, the bauxite export from Global Alumina Corporation was suspended due to a combination of political and logistical challenges. However, Guinea remains the world's largest bauxite producer. In 2024, around 71% of Chinese imported bauxite was from West Africa, notably Guinea, and this trend is forecast to continue in the future. Australia is China's second-largest bauxite importer, accounting for 25% of China's bauxite import in 2024.

Australia-China bauxite trade might face geopolitical risks such as tense diplomatic relations between the two countries. These tensions might lead to trade disputes and higher tariffs on Australian exports to China, including bauxite.

Stable downstream offtake near the smelter

Electrolytic aluminum is produced and sold for downstream alloy uses. Having a stable off-taker near the smelter side means the aluminum liquid is produced and then transferred directly to the alloy processers for downstream processing. It is crucial for aluminum producers for both operational and economic reasons.

From the operation side, a stable off-taker provides guaranteed demand. It helps mitigate short-term market fluctuations, making it easier for producers to manage their operations. Besides, a reliable off-taker also helps stabilize revenue and reduce financial risks.

From an economic consideration, having a downstream off-taker built next to the smelter reduces the cost for both sides, including the cost of casting, remelting as well as transportation. Besides, it also reduces the loss of aluminum liquid during the transportation process.

A stable relationship with the off-taker also leads to collaboration on product development, logistics, and sustainability initiatives. The off-takers could tailor the upstream aluminum products with its supplier, according to their seller's needs.

Access to stable, affordable, and green power

In 2024, power cost takes up to an average of 36% of the electrolytic aluminum cash cost in China. Having a stable and reliable power cost is therefore the key to keeping the cost competitive for electrolytic aluminum. In recent years, decarbonisation trend has pushed the

need for green aluminum. As such, access to renewable is becoming more important to aluminum smelters. In China, Inner Mongolia, Xinjiang, and Yunnan are attractive locations for their affordable green energy.

Inner Mongolia and Xinjiang historically relied on cheap thermal coal but have the potential for vast wind and solar capacities. A combination of power sources provides smelters in the two regions both stable and green power supplies. In recent years, both smelters and the local grid companies have increased their investment in wind/solar power in Inner Mongolia and Xinjiang. Compared with Xinjiang, Inner Mongolia is geographically proximate to the downstream alumina production and aluminum consumption base in East China, which results in relatively lower transpiration costs for raw materials and final products. Inner Mongolia's strategic location has contributed to a substantial increase in its electrolytic aluminum production, growing from 4.5 mt in 2018 to 6.6 mt in 2024, at a GAGR of 7.0%,

Yunnan benefits from the hydropower resources. However, the hydropower supply has seasonal variability. Water flow can vary seasonally, leading to inconsistent power generation during dry periods, and affecting the power supply's stability. In 2022, smelters in China are forced to cut their output amid the drought.

2.4. Key trends in the electrolytic aluminum industry

Shift to green aluminum from both production and consumption

As decarbonization becomes a universal consensus, smelter worldwide faces the challenge of shifting from traditional power to green power. In 2024, the Chinese authorities issued the Action Plan for Energy Saving and Decarbonization (2024-2025). The plan explicitly sets the objective to achieve 25% renewable energy in the electrolytic aluminum industry by 2050. In the same year, the authorities officially introduced the Green Electricity Certifications (GECs). Despite the GECs are now non-binding for aluminum producers, it is possible that in the future aluminum producers who fail to meet the renewable energy requirement will need to purchase GECs to validate renewable energy generation.

Trade-wise, aluminum exports might face trade barriers if they fail to meet the green-carbon standard imposed by the importing country. Europe's CBAM (Carbon Border Adjustment Mechanism) introduces a charge on aluminum imports based on emission level. The official charging will come into effect in 2026. Other countries such as the US and Japan are also on the path to similar policies and the world might see more regulations on carbon-related tariffs.

At the end-use consumption level, consumers' preferences have also been shifting. Global brands especially in the automotive, electronics, and consumer goods sectors, are increasing their demand for green aluminum in their products, which triggers premium for green aluminum products.

Overseas expansion of the aluminum industry

In recent years, it has become more popular for Chinese aluminum companies to expand overseas, this is partially driven by China's 45 mt capacity cap, deficit in bauxite resources, and cost advantages in some regions. Investing in aluminum value chain overseas allows Chinese companies to increase competitiveness by accessing stable raw material supply, lowering the production cost, or increasing the proximity to the overseas buyer market. CRU has observed several overseas projects invested by Chinese companies along the aluminum value chain.

Vertical integration of the aluminum industry

It is common for smelters to integrate upwardly with refineries worldwide. Many large aluminum producers own both smelters and refineries. For smelters, integration with a

refinery helps guarantees a reliable supply of alumina and minimizes exposure to external supply disruptions or price volatility. Additionally, it enables more efficient production coordination between refining and smelting units, improving the producers' reaction to market changes. Meanwhile upstream electrolytic aluminum smelters and downstream aluminum processing manufacturers within the same group are located in proximity to each other for liquid utilization.

Larger use of liquid aluminum for aluminum alloy

Electrolytic aluminum is produced and sold for downstream alloy uses in either ingot or liquid forms. Liquid aluminum can be safely transported up to a 50 km radius. In recent years, it has become more common for smelters to sell liquid aluminum to downstream alloy processors for economic efficiency.

From the economic efficiency perspective, short-distance transportation of liquid aluminum benefits both upstream electrolytic aluminum manufacturers and downstream alloy processors. This is because, as compared to long-distance ingot transportation, use of short distance transported liquid aluminum (i) saves costs on transportation fees; (ii) reduces loss of liquid aluminum during transportation; and (iii) saves energy for heating or remelting by downstream aluminum alloy processors. Therefore, upstream electrolytic aluminum smelters are often located in proximity to downstream aluminum processing plants for liquid aluminum utilization.

In 2024, approximately 72% of electrolytic aluminum in China was sold in liquid form. Under the Action Plan for Energy Saving and Decarbonization (2024-2025), the Chinese authority encourages that at least 90% of electrolytic aluminum shall be converted into liquid aluminum for downstream aluminum alloy. This policy is viewed as non-coercive, and CRU has not observed any substantial incentives or penalties regarding the policy.

2.5. Key risk factors in the electrolytic aluminum industry

Regulatory risk on aluminum industry development

As decarbonization becomes a universal consensus, smelter worldwide faces the challenge of shifting from traditional fossil-fuelled power to green power.

From the policy and regulation side, China has committed to achieving a carbon peak by 2030 and carbon neutrality by 2060. These targets impose significant pressures on energy-intensive industries like aluminum smelting. In 2018, the Chinese authority officially implemented the 45 mt capacity cap. Further in 2024, China set the goal to enforce 25% use of renewable energy in aluminum smelters by 2025. CRU forecasts more stringent regulations are expected to be made at both national and provincial levels to reach China's carbon peaking and carbon neutrality goal. Smelters who fail to satisfy the requirement are likely to cut their production or even face the risk of shutdown. Globally, aluminum exports might face trade barriers if failed to meet the green-carbon standard imposed by the importing country. For example, the EU's Carbon Border Adjustment Mechanism (CBAM) will officially pose tariffs on carbon-intensive imports, including aluminum, from 2026.

Raw material risk

Raw material risk in aluminum refining and smelting is influenced by factors such as resource availability, energy costs, geopolitical issues, and regulatory changes. CRU identified the following risk factors in each section of the aluminum value chain:

- *Supply risk on bauxite*: bauxite is geographically concentrated, with a few countries holding most global reserves. China's bauxite import reached 159 mt in 2024 and will

further rise to 192 mmt in 2028. Bauxite supply chain disruption in any of the importing countries is likely to affect China's bauxite import and consequently affect the Chinese refinery production.

- *Supply risk on affordable and stable power:* In China, power cost represents approximately 36% of aluminum cash cost in 2024. Therefore, fluctuation in power prices due to supply chain disruption not only disrupts the stable production of aluminum products but also affects the overall profitability.

Uncertainty on the US tariff

In August 2018, the U.S. imposed 25% tariffs on Chinese aluminum products. On March 12, 2025, the U.S. imposed an additional 25% tariffs on aluminum products from all countries, which was subsequently doubled to 50%, effective from June 4, 2025. This series of tariff increases on aluminum products is expected to have a limited direct impact on China's electrolytic aluminum industry because China has a relatively small export of electrolytic aluminum and aluminum products to the U.S. According to the statistics of the General Administration of Customs of the People's Republic of China, China only exported 1.7 kt of aluminum ingots to the U.S. in 2024, which accounted for less than 0.01% of China's total electrolytic aluminum production in the same year. In terms of downstream products, China exported 260 kt of aluminum products to the U.S. in 2024, accounting for approximately 4% of China's total aluminum product export during the same year.

On February 4, 2025, the U.S. imposed 10% tariffs on all Chinese imports. On March 4, 2025, the U.S. further imposed an additional 10% tariffs on all Chinese imports. On April 2, 2025, the U.S. further announced the reciprocal tariffs on all its trade partners, including an additional 34% tariffs on imports from China. According to the latest announcement, and as confirmed by CRU, certain imports, including aluminum products, will be excluded from the reciprocal tariffs scheme. In 2024, China exported 6.3 mt of aluminum products overseas. For aluminum-made components contained in various downstream end-uses, China's export values are difficult to measure. In this case, tariff policies imposed by the U.S. to imports may indirectly affect the global consumption of all goods made in China, which includes the Chinese aluminum products as well as products containing aluminum-made components. The decreased demand for any such products containing aluminum-made components may indirectly reduce the demand for China's upstream electrolytic aluminum products, the extent of which remains uncertain.

Nonetheless, any further aggressive tariff policies imposed by the U.S., as well as unofficial announcements on social media or during public speeches by President Trump and other government officials, on foreign imports can influence the growth of the global economy and the level of consumption, thereby indirectly impacting the overall pricing in the global aluminum industry. This may create a challenging environment for all the players in the industry.

ESG risk

The aluminum industry faces several ESG (Environmental, Social, and Governance) challenges. Environmental risks include the industry's intensive power consumption and carbon emissions. Social risks involve the impact on local communities, particularly in the mining, refining and smelting regions. Companies are expected to engage in fair labour practices, ensure worker safety, and facilitate local economic development. Governance risks centre around regulatory compliance, ethical business practices, and transparent reporting. Companies must navigate complex global regulations on emissions, labour and trade.

A failure to meet ESG standards can result in legal in reputational damages and reduced access to capital, as investors and consumers increasingly favour companies that practice sustainability and responsible practices.