

1 INTRODUCTION

The CBIX Value-in-Use (ViU) adjusted bauxite price index, the world's first and most widely quoted bauxite index, is an initiative which has evolved over many years of detailed bauxite industry experience, analysis and price assessments by the CM Group.

In 2020, we take our bauxite reference pricing to the next level by rolling out five new global indexes, namely,

- CBIX HT,
- CBIX LT,
- Guinea LT,
- Indonesia LT and
- Australia HT.

These indexes are all China-centric, as China alone accounts for more than 90% of the global third-party traded bauxite market.

China Front and Centre

We estimate China's end-2019 total alumina refining capacity at almost 90 mtpy, with around 50% processing imported bauxite. These refineries, principally located in Shandong Province, but increasingly common in other parts of China, consumed around 85 mln t of imported bauxite in 2019 and are forecast to double this consumption rate over the years ahead, as depletion of economic domestic reserves worsens.

A growing trend to modify inland plants to process imported bauxite will continue, as domestic depletion forces more alumina refineries to switch to processing imported bauxite over the next decade.

The major source countries for China's imported bauxite are Indonesia, Australia and, more recently, Guinea, which has established itself over the past five years as the dominant supplier. Despite the rise of Guinea, new mines in other countries such as Ghana, Cameroon and Tanzania continue to be assessed.

China's dominance of world bauxite trade is forecast to increase as its refineries continue to migrate to processing imported bauxite. China will therefore remain the largest and most important traded bauxite market in the world for the foreseeable future.

About CM Group

CM is an independent, privately owned, commodity advisory group, specialising across a range of non-ferrous industries,

particularly the global bauxite, alumina and primary aluminium sectors. Our core capability is to conduct detailed, bottom-up, single-scope industry and project assessments, aimed at generating informed, insightful market views and industry outlooks.

CM sets the benchmark in global bauxite industry analysis. Our databases, analytical frameworks and market outlook capabilities have been refined over decades of intense industry analysis. Our hypotheses and our insights are used, and tested, regularly by the world's leading mining, project management and investment companies. CM has a strong capability, and presence, in China, employing 10 FTEs who collect and analyse bauxite and alumina industry data every day. Our local knowledge and strong 'guanxi' (network) across the entire global AI community position us as a world authority on the AI supply chain.

If you have any questions, please contact our specialist bauxite team at info@thebauxiteindex.com.

2 METHODOLOGY

2.1 Overview

The primary objective of our bauxite indices is to provide market participants an independent and impartial assessment of China's imported bauxite market. They are a set of 'Value-in-Use' (ViU) reference price indices which reflect current market prices for bauxites of different grades and origins into the Chinese market.

This document describes the methodology used to

- Collect market data
- Gauge and use market intelligence
- Calculate the five indices
- Interpret each index, and
- Understand the output from the CBIX CALCULATOR

2.2 Data Collection

Our specialist bauxite team collects data from various sources and talks to industry participants usually on a daily, but at least a weekly, basis as well as conducts detailed field studies wherever and whenever we consider it necessary. This approach forms the basis of our proprietary market databases, which supports the index calculations.

Every week a representative sample of bauxite shipments into China from various regions is collected from sources including

but not limited to alumina refineries, bauxite miners, traders, industry technologists, freight companies, mining contractors, government bodies and other relevant parties with market knowledge. Our specialist bauxite teams from China, Australia and Singapore use multiple means to gather such data, including phone surveys, emails and other media.

The data collection time period is one week in the lead up to each Monday, the day of index publication. The cut-off time for data submission each week is 3:00pm Sydney time on the day of publication. Data received after this time will be included in the following week's calculation.

Given the complexity of bauxite specifications and its key role in bauxite pricing, it is essential to define what is considered a valid data sample that can be used in the calculation model of our journalistic-style indices.

- Trades concluded during the data collection period that include minimum price, quantity and quality data.
- Trades concluded during the data collection period that include price and quantity data, exclude plausible grade data, but the source region is known. CM will substitute a 'standard' specification from its proprietary database matching the source and include the trade in its calculation.
- Valid bids and offers submitted for a bauxite with specified grade or for a known source of bauxite whose quality can be inferred using available market intelligence and existing databases.
- Price assessment from market participants that passes CM's internal review and cross-examination procedures. In the absence of quantity data required for calculating weighted averages, CM assumes a typical vessel type for the region, with a designated standard grade, depending on its source.

The reference units, such as currencies and volumes, are in line with prevailing bauxite market practices. The specifications also define a minimum-acceptable volume for any trade.

All primary market data collected is kept strictly confidential.

2.3 Index Calculation Methodology

Bauxite traded into China comes from many different mines and countries. Over the past decade, however, supply has gravitated to three key regions

- Guinea - currently the dominant supplier of Low Temperature (LT) bauxite; low cost, high grade but high freight costs to China
- Indonesia - previously the dominant supplier of LT bauxite to China but restricted by current government policy; variable grades and low freight costs to China, and
- Australia - long-term stable and reliable supplier; low freight costs to China, the dominant supplier of High Temperature (HT) bauxite

Together, these three regions currently account for around 95% of bauxite imports to China.

To reflect these three different sources, CM has established three region-specific indices:

- Guinea LT
- Indonesia LT and
- Australia HT

To cover other suppliers and to provide a general overview of market trends, CM also publishes two general market indices:

- CBIX LT - a trade weighed agglomerate of all imported LT bauxite, and
- CBIX HT - a trade weighed agglomerate of all imported HT bauxite.

This suite of five indices provides the market with a broad sense of pricing as well as a country-specific sense of pricing.

Value-in-Use (ViU) Quality Adjustment

Each bauxite deposit is unique in terms of location, grade and impurity levels. As such, its value to a refinery must be considered in the context of refinery processing costs relative to other bauxites.

CM Group has developed a Value-in-Use (ViU) quality adjustment procedure whereby the price of each bauxite landed into China is adjusted to that of a standard bauxite grade for each of the three key regions, as well as a 'standard grade' bauxite, called CBIX, which is used for the traded weighted indexes.

To properly reflect the value proposition for the Chinese refiner, the Value-in-Use quality adjustment is performed by an equivalent alumina production cost method: the theoretical landed price of the standard bauxite for each index is calculated so that its processing cost to alumina would be the same as that

of the actual trade. The calculated landed cost of the standard bauxite is then taken as the ViU quality-adjusted price for the trade. In this way the price for each bauxite can be compared on an equal 'value' basis from the perspective of the refiner.

Further details are presented in the "Bauxite Indices - Definitions & Specifications" section of this document.

Normalisation & Penalties

Before ViU quality adjustment, prices are normalised to a US\$/dmt CIF Qingdao basis using up-to-date freight, port and other inputs using CM's industry leading modelling and analysis. Penalties are also applied for specific impurities including Total Organic Carbon (TOC), goethite and phosphorous. Further details are presented in the "Bauxite Indices - Definitions & Specifications" section of this document.

Tonnage weighting calculations

For CBIXLT and CBIXHT calculations, inputs from the sub-indices (Guinea LT, Indonesia LT and Australia HT) as well as trade data gathered from other regions is agglomerated into single weekly values to represent overall LT and HT markets into China. This is done by weighting the various input data according to the most recent monthly trade tonnages into China. Where CM acquires trade data for a supplier that is not represented in the previous months' data, it is excluded from the indices, as no accurate weighting can be applied.

Data Review and Exclusions

CM uses its expertise to review every data point submitted. Sometimes this results in trades being excluded.

As examples, trades which are considered not 'arms-length' commercial trades, or trades considered as 'distressed' cargoes i.e. sold under unusual circumstances such as bankruptcy, are not included in calculations, as they are deemed unrepresentative of the mainstream market.

Lack of Market Liquidity

Should a market become illiquid for less than four weeks, CM will initially roll forward the price, although CM can, at its discretion, include market intelligence it believes reflects the general sentiment of the market at the time. If the period of illiquidity is greater than four weeks, CM Group may suspend the relevant index until such time as trades resume.

Verification & Market balance

Every week CM seeks to find a balanced view of trade prices between buyers and sellers so as to maintain an independent view of the overall market and each regional market segment.

Record Keeping

CM retains full records of the trades and adjustments in relation to each the indices it publishes.

2.4 Publication

Indices are published on a weekly basis, on or before 6pm Sydney time every Monday. In the case of major public holidays in China and Australia, we may postpone the publishing time or skip the publication depending on the length of holiday. If public holidays occur on a Monday, the indices will be published the following working day. For extended holidays such as Chinese New Year Holiday and Christmas, no update will be available for the holiday period and our indices will be rolled over.

Our publishing schedule is constantly kept up-to-date on our website. Please click [here](#) to get the latest publishing schedule.

In a rare case whereby an index is published incorrectly, immediate action will be taken to rectify and republish the index and a correction notice sent to all subscribers.

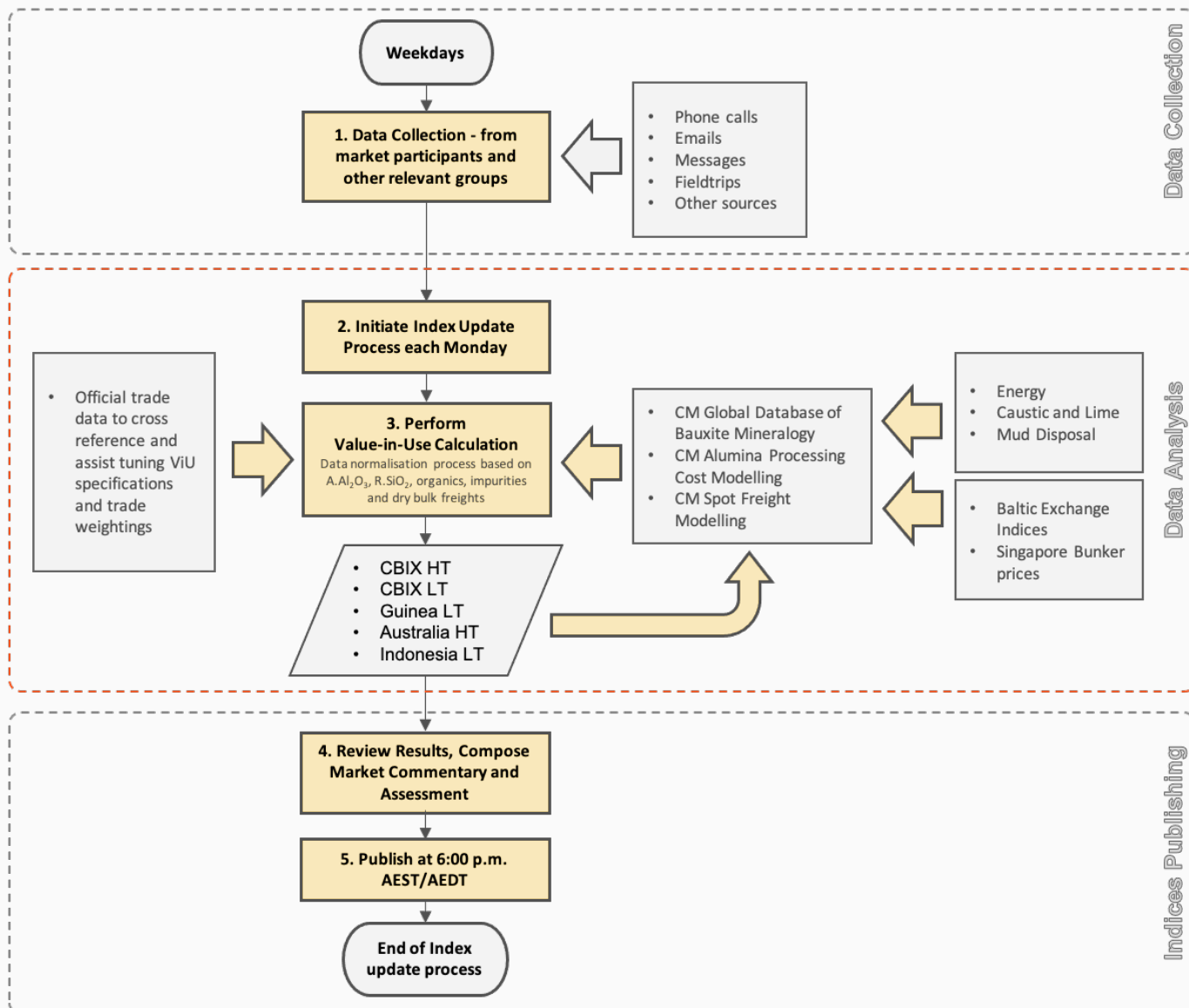
All endeavours will be taken to avoid delays in the index publication. However, should such a delay occur, our team will inform subscribers as soon as possible.

In the event of a delayed publication, the index calculation will only include data received within the designated standard timeframe. No amendments will be made due to the emergence of new data or market intelligence after the publication date. Retrospective changes to published values will only be made in cases of administrative or calculation error.

2.5 Methodology and Specifications Review

CM reserves the right to review index specifications and methodology at its absolute discretion. Subscribers will be notified three months in advance of any forthcoming changes to the methodology and specifications.

Bauxite Indices - Calculation Flowchart



Bauxite Indices - Definitions & Specifications

Overview

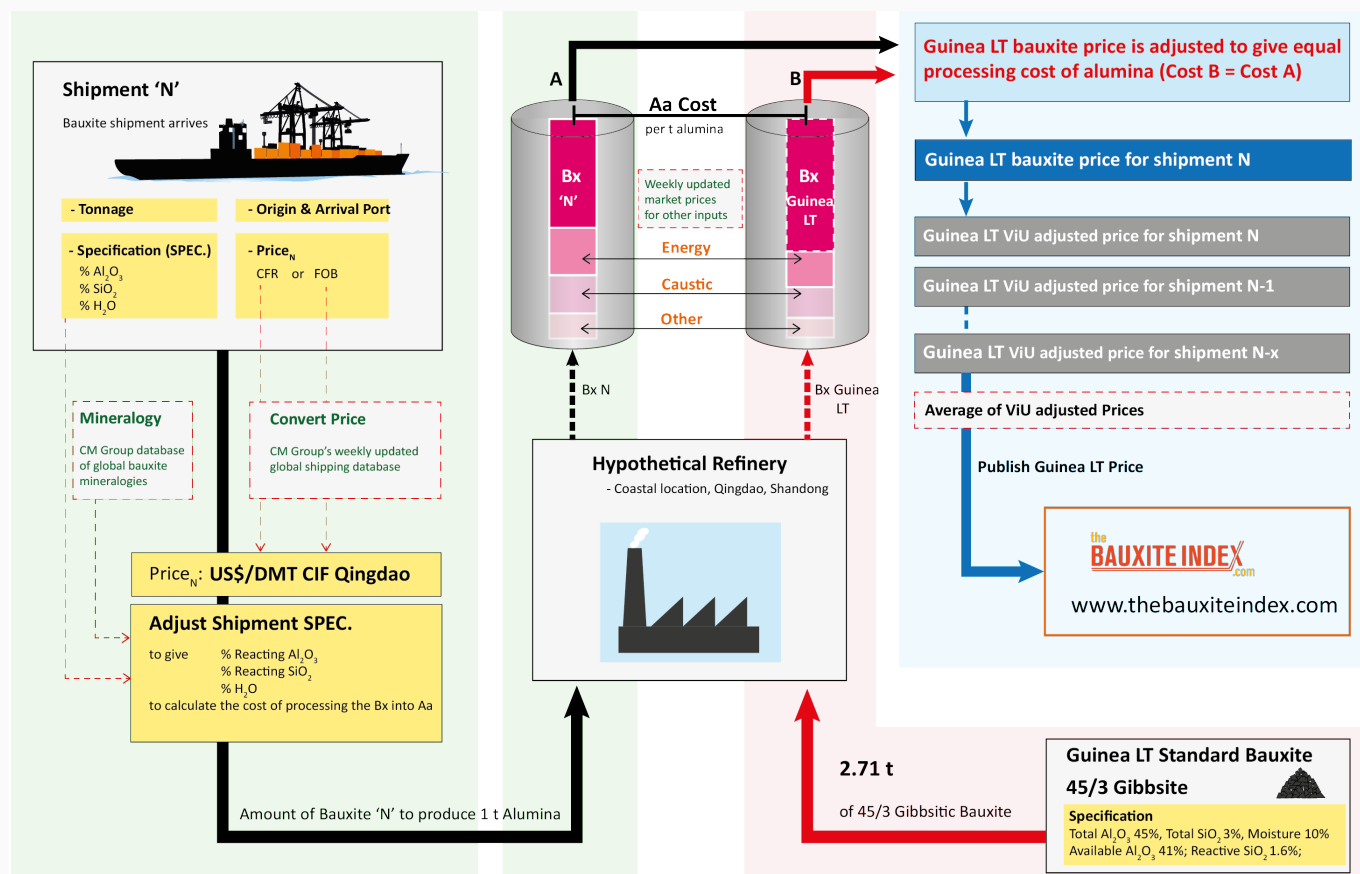
Thebauxiteindex.com publishes five bauxite price indices to reflect current traded prices of key segments of China's imported bauxite market, namely

- "Guinea LT" - standard Guinea ore CIF Qingdao, low temperature refining
- "Indonesia LT" - standard Indonesian ore CIF Qingdao, low temperature refining
- "Australia HT" - standard Australian ore CIF Qingdao, high temperature refining
- "CBIX LT" - trade weighted aggregate of all low temperature refining ores CIF Qingdao ViU adjusted to the standard CBIX grade reference ore
- "CBIX HT" - trade weighted aggregate of all high temperature refining ores CIF Qingdao ViU adjusted to the standard CBIX grade reference ore

Specifications

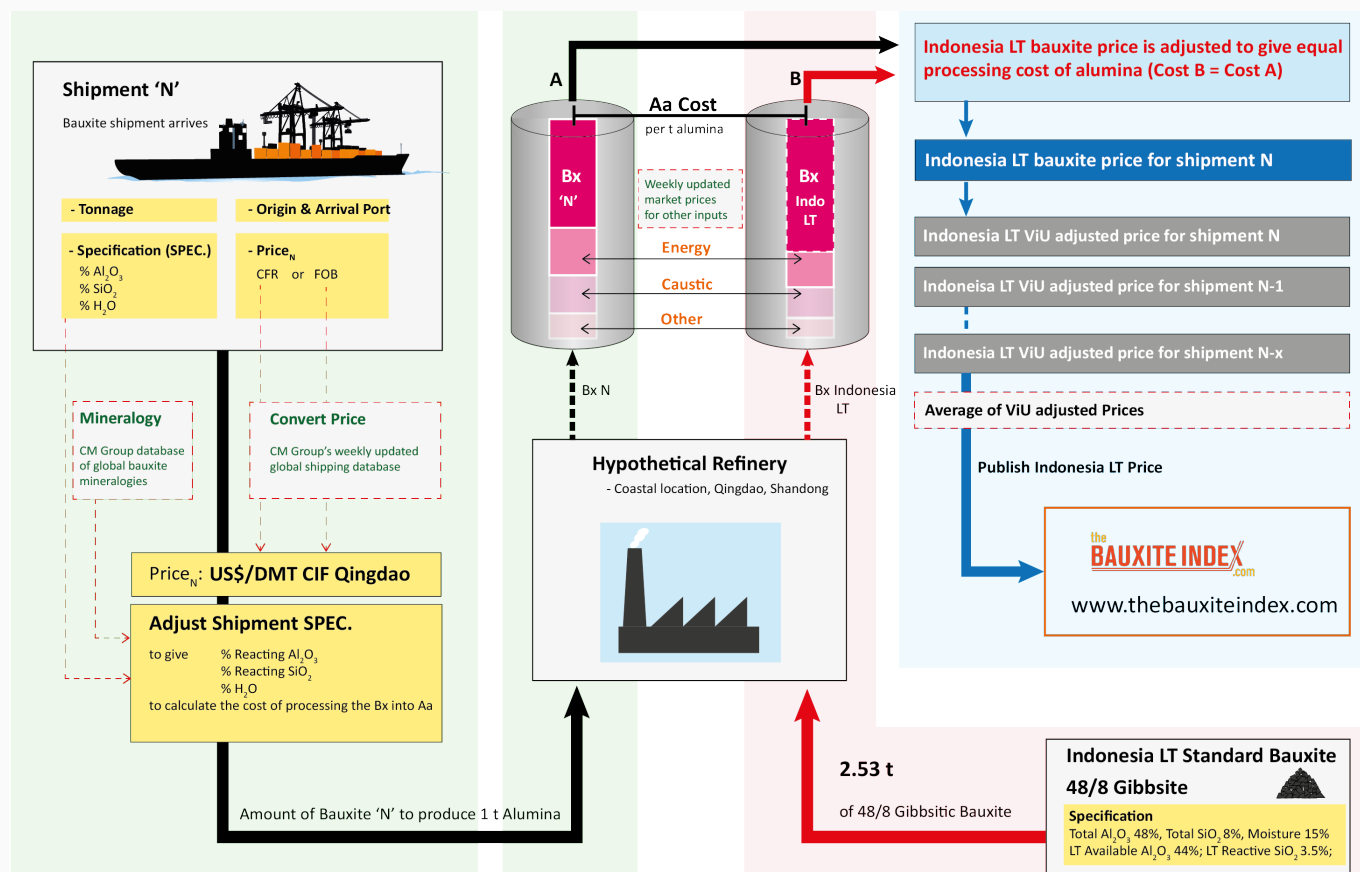
Guinea LT

Publication	Monday 6pm Sydney time
Unit	US\$/dry metric tonne (dmt)
Location	CIF Qingdao, China
Payment terms	LC on site
Delivery Window	Within 182 days of date of data collection
Minimum Quantity	20,000 dmt by sea
Form & Granularity	Less than 300mm lump
Quality	Total Alumina nominal 45.00%
	Total Silica nominal 3.00%,
	LT Available Alumina 41.0%
	LT Reactive Silica 1.6%
	Moisture: 10%
	Total Organic Carbon: 0.05% to less than 0.15%
	Other Impurities: Nil



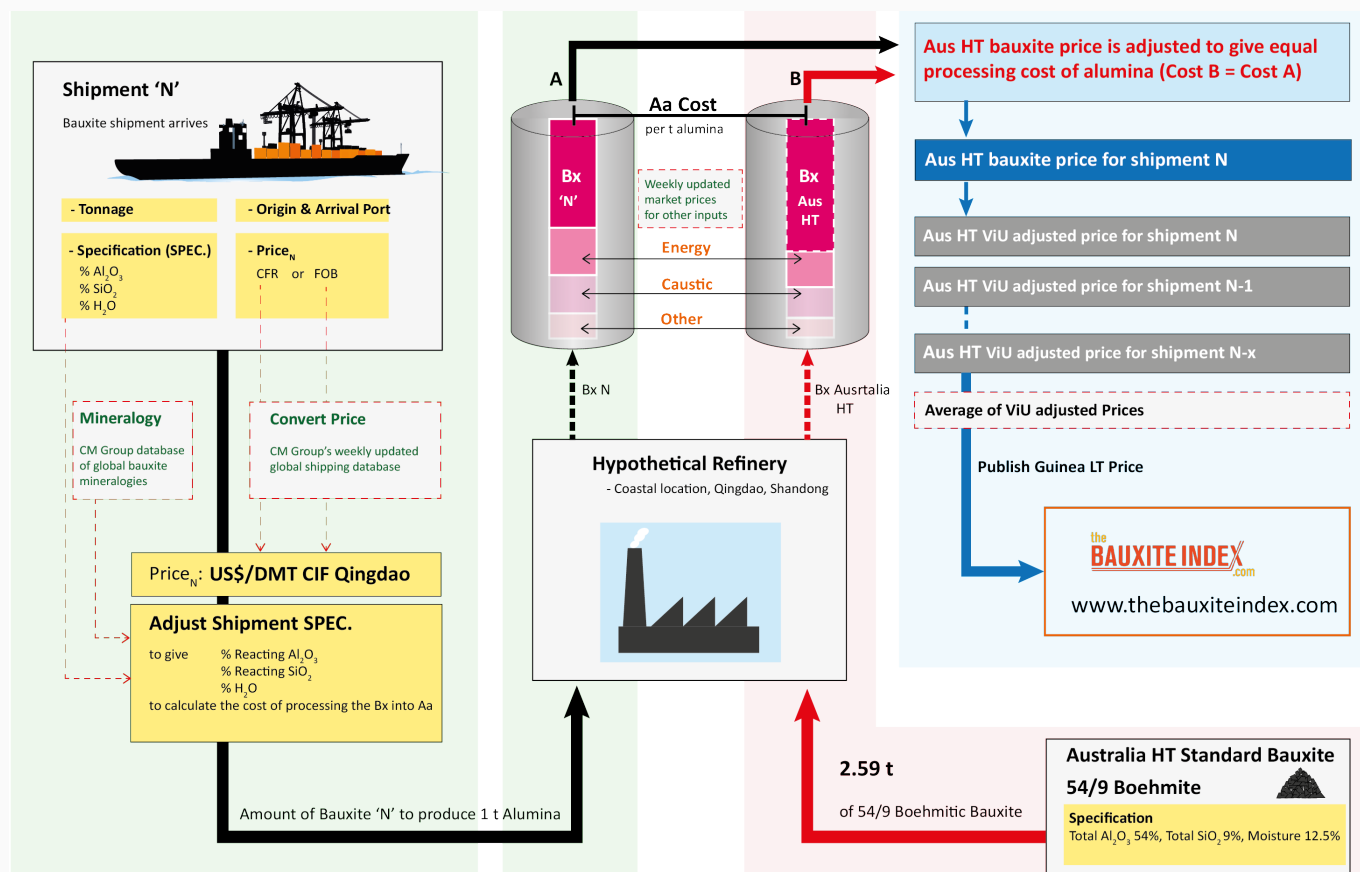
Indonesia LT

Publication	Monday 6pm Sydney time
Unit	US\$/dry metric tonne (dmt)
Location	CIF Qingdao, China
Payment terms	LC on site
Delivery Window	Within 91 days of date of data collection
Minimum Quantity	20,000 dmt by sea
Form & Granularity	Less than 100mm lump, washed
Quality	Total Alumina nominal 48.00%
	Total Silica nominal 8.00%, LT Available Alumina 44.0%
	LT Reactive Silica 3.5%
	Moisture: 15%
	Total Organic Carbon: 0.05% to less than 0.15%
	Other Impurities: Nil



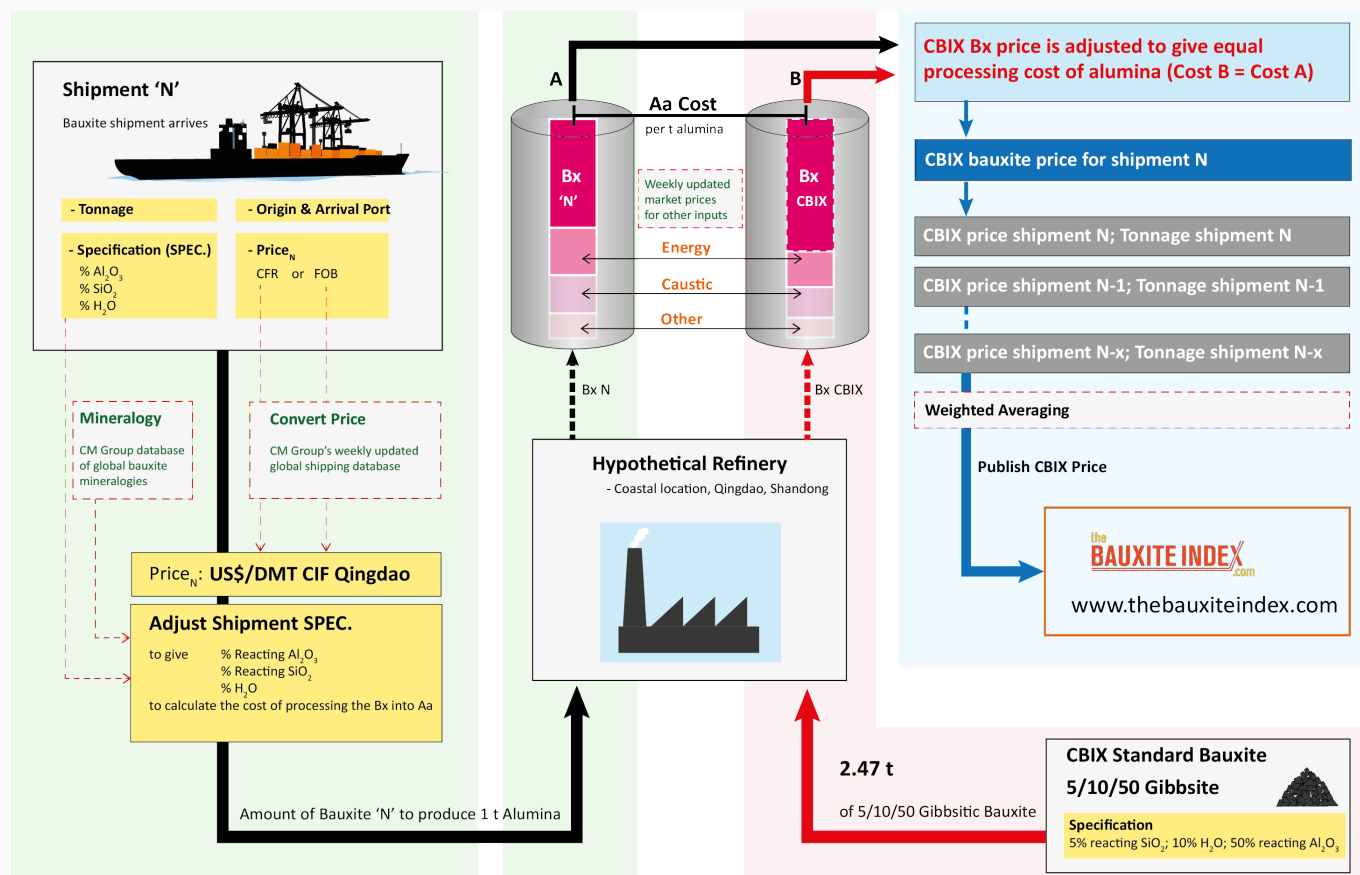
Australia HT

Publication	Monday 6pm Sydney time
Unit	US\$/dry metric tonne (dmt)
Location	CIF Qingdao, China
Payment terms	LC on site
Delivery Window	Within 91 days of date of data collection
Minimum Quantity	20,000 dmt by sea
Form & Granularity	Typical pisolitic, whether beneficiated or not
Quality	Total Alumina 54.00%
	Total Silica 9.00%
	Moisture: 12.5%
	Total Organic Carbon: 0.15% to less than 0.25%
	Other Impurities: Nil



CBIX LT & HT

Publication	Monday 6pm Sydney time
Unit	US\$/dry metric tonne (dmt)
Location	CIF Qingdao, China
Payment terms	LC on site
Delivery Window	As specified in relevant sub-indices
Minimum Quantity	20,000 dmt by sea
Form & Granularity	Per sub-indices
Quality	Total Alumina 50.00%
	Total Silica 5.00%,
	LT Available Alumina 45.00%
	LT Reactive Silica 5.00%
	Moisture 10%
	Total Organic Carbon: Nil
	Other Impurities: Nil



Notes on Value-in-Use (ViU) Quality Adjustment, Normalisations & Penalties

Freight Normalisation

Where data is not CIF Qingdao (e.g. FOB or CFR, and or delivered another Chinese port), prices are normalised to a CIF Qingdao value using CM's freight model, which calculates freight rates based up-to-date vessel fuel prices, spot time-charter rates and port data. Where cargo sizes are unknown, a vessel class typical for the origin mine / region is used.

Missing Mineralogical Information

Where data lacks detailed mineralogical information, CM draws on its extensive mineralogical database to estimate typical values for the origin mine / region.

Value-in-Use (ViU) Quality Adjustment

After normalisation and adjustment for other factors, prices are ViU-adjusted to the standard specification for the relevant index using an equivalent cost of alumina production approach.

Penalties for Impurities

Specific impurities can reduce the value of bauxite. To account for varying levels of impurities in different bauxites, CM applies penalties for

- Total Organic Carbon (TOC),
- Goethite, and
- Phosphorus

Penalties are applied according to the details in the tables below.

Penalties applied for Total Organic Carbon (TOC):

Total Organic Carbon Classification	Total Organic Carbon Content	Penalty (US\$/dmt) (added to CIF Qingdao price for input trade)
Low	less than 0.05%	0.00
Moderate	0.05% to less than 0.15%	0.33
High	0.15% to less than 0.25%	0.67
Very High	greater than 0.25%	1.00

Penalties applied for other impurities:

Impurity	Penalty (US\$/dmt) (added to CIF Qingdao price for input trade)
High Goethite (e.g. India, Malaysia, Jamaica, Dom. Rep.)	0.50
High Phosphorous (e.g. Sol. Is.)	1.00

USING THE CBIX CALCULATOR

About

The CBIX CALCULATOR is a simple tool that provides an indicative price for bauxite of different grades, CIF Shandong (US\$/dmt). The coefficients in the calculator are updated regularly so the results reflect the market at the time.

Note that calculated prices are indicative only and cannot be relied on as a price guarantee. For more accurate price estimates, please contact the thebauxiteindex.com via the link below.

info@thebauxiteindex.com

How to Use the Calculator

Al₂O₃ Input (%)

The alumina input should reflect total alumina (on a dry basis) expected to react in the digestion process during the bayer refining process. In standard industry jargon, this input would typically be referred to as Available Alumina plus the Reactive Silica.

For a gibbsitic bauxite undergoing low temperature (LT) refining, the alumina would include all gibbsitic alumina (i.e. the Available Alumina) plus any alumina contained in clays (e.g. kaolinite) (i.e. the Reactive Silica).

For a boehmitic or diasporic bauxite undergoing high temperature (HT) refining, the alumina input would be the total alumina present in the bauxite.

SiO₂ Input (%)

The silica input should be all silica (on a dry basis) expected to react during the bayer refining process. For a gibbsitic bauxite undergoing LT refining, this would typically be the Reactive Silica (i.e. the silica contained in the clays such as kaolinite).

For a boehmitic or diasporic bauxite undergoing HT refining, the silica input would typically be the total silica content of the bauxite.

H₂O Input (%)

The H₂O % input has little impact on the CFR price. The moisture content of the bauxite mostly affects freight rates, so its impact is greater on FOB prices. The Chinese market currently accepts a wide range of moisture contents, although typical moisture levels would not exceed 15%.

Organics Input

Total Organic Content (TOC), meaning organic matter, detracts from bauxite prices because of its cumulative and deleterious effect on process liquor during bayer processing.

Bauxites from South America typically contain low organics, Guinean bauxites contain moderate organics and others, such as those from Australia, can contain high or very high organics. Nominating the level of TOC in a bauxite assigns a price penalty in the Calculator consistent with current market penalties.

Other Impurities

Other impurities such as phosphorous, titanium, sulphur, and high levels of goethite can also influence the price a bauxite will fetch. While the market is sensitive these impurities their impact in any given refining process is less predictable and cannot at this stage be included in any generic indicative pricing calculation.