

To: All members and other interested parties

Ref: 23/091

Classification: Trading Consultation

Date: 31 May 2023

Subject: **UPDATE ON, AND BENCHMARK REGULATION CONSULTATION RELATING TO, THE CLOSING PRICE METHODOLOGY**

Summary

1. This Notice provides an update on the methodology used to establish Closing Prices and proposes that the LME adopt the VWAP Methodology (as defined in this Notice) to determine Closing Prices for Cash, 3-month and the first four third-Wednesday monthly contracts in aluminium, copper, lead, nickel and zinc¹. It also proposes certain amendments to the “Last Price” methodology (as defined in this Notice), where it continues to be used to price other contracts.
2. As outlined in the Action Plan to Strengthen the LME Group’s Markets (the “**Action Plan**”), the LME’s view is that it is preferable to further evolve the Closing Price methodology to a more deterministic industry standard methodology. An updated Pricing Blueprint detailing the proposed methodology can be found in Appendix 2.
3. This Notice takes into account feedback from the User Committee as well as input from the Closing Price Working Group (“**CPWG**”), which was established in light of the Outcomes of the January 2021 Discussion Paper on Market Structure (“**2021 Discussion Paper**”), Notice 21/111 (the “**Outcomes Notice**”). The LME notes that the feedback received to date has included a range of views in respect of further evolving the Closing Price methodology. However, the LME believes the proposed Pricing Blueprint represents an appropriate balance in introducing a more deterministic methodology for the most liquid instruments at the front of the curve.

Background

4. As outlined in the Action Plan, and in response to the Independent Review recommendation (item 7.4) to “*provide a clear vision of the future of market structure at the LME and LME Clear*” and “*commit to measures that would standardise the market structure with global peers to enable participation and consequent growth in liquidity*”, the LME Group has returned to the 2021 Discussion Paper, which prompted significant market engagement and a set of outcomes which the LME believes it remains appropriate to implement.
5. In particular, the 2021 Discussion Paper proposed a number of structural changes designed to allow the LME Group to modernise, enabling the LME to adapt and service the market as effectively as possible, while remaining guided by its strategic principles to serve the physical market, ensure fairness, increase user choice, and maximise trading efficiency. The Outcomes Notice was published in June 2021 and among other things, confirmed the LME’s decision to permanently move the determination of Closing Prices to electronic determination, using data from the electronic trading venue, LMEselect.
6. Within the Outcomes Notice the LME expressed its confidence that electronic pricing processes are more transparent, promote broader participation in the market, reduce barriers to entry, strengthen market

¹ For all other base metals the existing Closing Price methodology (known as “Last Price”) would continue to apply notwithstanding any changes that might be adopted as a result of consultation feedback.



liquidity and provide the most reliable pricing outcomes. The LME also believes that electronic pricing methodologies represent the long-term direction of travel for the market, while accepting that Ring-determined Official prices continue to be best suited to the specific requirements of physical market participants.

7. The 2021 Discussion Paper's consideration of possible Closing Price methodology changes (and thus the outcome) was based on the utilisation of the LME's previous business continuity pricing methodology, which was adopted as the primary methodology via LME Notice 22/147 to reflect the decisions made in the Outcomes Notice. This methodology uses a volume-weighted-average-price ("**VWAP**") to determine the 3-month Closing Prices. Other contracts are determined using the last price, applying the pricing waterfall and using expert judgement where necessary ("**Last Price**"), to trades done on the LME's electronic venue.
8. The Outcomes Notice also set out the LME's view that it is possible to further evolve the electronic Closing Price methodology in order to incorporate more determinism, ensure Closing Prices most accurately reflect prevailing prices at the end of the trading day, and ensure that the Closing Price methodology encourages trading practices that will improve liquidity for participants. The LME established the CPWG in order to consider a potential evolution to the Closing Price methodology. The LME also published a Pricing Blueprint based on expanding the use of deterministic calculations of VWAPs as a starting point for consideration.

Closing Price Working Group

9. The CPWG comprised participants who volunteered in response to the Outcomes Notice to take part. Participants included a broad group of Category 1 and 2 Members, financial participants and physical participants. The CPWG met five times between July and October 2021, with all participants giving the LME significant feedback in respect of the various topics discussed. The LME would like to thank all of the participants of the CPWG for their valuable input into this process. The sessions allowed productive debate, which highlighted key considerations, risks and benefits around any potential change to the Closing Price methodology. A summary of the CPWG discussions can be found in Appendix 1. On the basis of the CPWG's feedback, a working hypothesis for an evolved VWAP model for front-of-curve Closing Prices ("**VWAP Methodology**") was developed. Further details of this methodology can be found in the updated Pricing Blueprint in Appendix 2.

Evolving the Closing Price methodology

10. The LME has considered its own views on the matter of evolving the Closing Price methodology, having been informed by and taken into consideration the views of both CPWG and the User Committee. As noted in paragraph 3, the feedback received to date has included a range of views in respect of further evolving the Closing Price methodology. However, the LME believes the proposed Pricing Blueprint represents an appropriate balance in introducing a more deterministic methodology for the most liquid instruments at the front of the curve.
11. As such, the LME believes it is in the interests of the market as a whole to adopt the VWAP Methodology for establishing Closing Prices (which will apply to the six liquid contracts at the front of the curve).

Closing Price methodology proposal

12. This Notice proposes that the LME adopt the VWAP Methodology to determine Closing Prices for Cash, 3-month and the first four third-Wednesday monthly contracts in aluminium, copper, lead, nickel and zinc. While back-testing suggests that this methodology change will not materially change the published Closing Prices on most days the LME is cognisant that the change may impact some Members' ability to offer guaranteed Closing Price orders and in light of such potentially material impact, the LME consulting on the proposed change under its Benchmark Changes and Cessation Procedure.
13. As part of the VWAP Methodology, the LME proposes to change the timings of when each metal closes (and the resulting VWAP time windows). This is in order to meet the requests by CPWG participants to: (1) move the zinc close to later in the day; and (2) enable the LME to publish Closing Prices more efficiently, by moving the lead close to the end of the process. The full proposed schedule can be found in the updated Pricing Blueprint in Appendix 2.



14. The LME has also made available nine months' worth of back-testing data that is available for download from its website ([click here to access](#)²) to allow any stakeholder to easily make a comparison of the changes that the VWAP Methodology is likely to have for the six prompt dates. This back-testing data is based on aligning the VWAP windows with the existing closes, in order to capture the appropriate data. It should be noted that the valuation of other prompts may have been impacted had such a VWAP methodology been in place.
15. The LME also proposes to amend the Last Price methodology, such that, where an instrument does not have any orders in LMEselect, in the window 5 minutes prior to the start of the Pricing Period any subsequent orders during the Pricing Period in that instrument which create pricing conflicts may have a lower priority for consideration³. While the LME does not consider this change to be material from the perspective of the LME Benchmark Changes and Cessation Procedure, questions on it are included here for completeness.
16. Any potential futures changes to the calculation methodology would themselves be subject to a materiality test in order to determine whether the LME would again consult.

Anticipated timeline for implementation of the proposals

17. The LME will fully consider all responses to this consultation before making its decision on whether to move forwards with the proposals, which may be implemented in full, in part, or not at all. The LME will communicate its decision in due course, but currently anticipates this to be in Q3 2023.
18. Subject to the outcome of this consultation, if the LME was to adopt the VWAP Methodology as proposed, it intends to give market adequate notice prior to implementation. If the decision is made to proceed with the VWAP methodology, then when the consultation response Notice is published the LME will make available VWAP model prices for the six prompt dates that would be determined using the VWAP Methodology, on a daily basis on the LME website for a period of two months prior to implementing the VWAP methodology.. Taking these plans into account, but without prejudicing the outcome of the consultation, the LME thinks any implementation (subject to consultation) is likely to happen in early Q4 of 2023.

The consultation process and timelines

19. This consultation is open to all interested parties including, but not limited to, Members, Clients and other users of the LME's reference prices. Formal responses should be submitted in writing. This consultation will remain open until 6pm (London time) on 30 June 2023. The LME shall not be under any obligation to consider responses submitted after this time.
20. Any questions regarding this consultation and any formal written responses should be submitted by email to consultation@lme.com.
21. The LME may need to share responses received with regulatory authorities, members of its group, and its legal or other professional advisors, or as required by law. Anonymised responses (verbatim or paraphrased) may be included in any Notice(s). Apart from this, all responses will be treated in confidence.
22. Prior to becoming effective, any regulatory approvals that are required in respect of the proposals will be sought, and the implementation of any changes is subject to any relevant regulatory approvals. Following consideration of any responses and following the close of this consultation, the LME may implement:
 - (a) in respect of any or all of the consultation proposals, that proposal, a modified version of that proposal, an alternative to that proposal, or no measure in respect of that proposal;
 - (b) any other measures; or
 - (c) no measures.

² <https://www.lme.com/Trading/Initiatives/Strengthening-the-market>

³ If the LME makes this change, the considerations taken into account by the Quotations Committee when adjusting the price curve shall be updated within the Last Price methodology



23. Following this consultation and once any required regulatory approvals are obtained, the LME will advise the market via one or more Notices when any relevant changes will take effect.

Questions

- Q1 Do you agree with the LME's identified key factors related to the Closing Price methodology?
- Q2 In light of those factors, do you agree with the LME's proposed path of travel to evolve the Closing Price methodology to expand the use of deterministic calculation methodologies based on VWAPs?
- Q3 Irrespective of your answer to Q1 or Q2, if the LME does move towards a more deterministic methodology based on VWAPs, do you agree that the proposed VWAP Methodology described in this document is the most appropriate one? If you believe there is a more appropriate model, please give full details.
- Q4 Do you agree with the new timings proposed by the LME for determining each metal's Closing Price?
- Q5 Do you agree that the LME should make the change to the Last Price methodology described in paragraph 15?
- Q6 When pricing additional prompts using the proposed VWAP methodology, do you think the LME should apply rounding? If you believe the LME should apply rounding, please detail what rounding should be applied.
- Q7 For the 3-month prompt VWAP there are currently Minimum Volume Requirements ("**MVRs**") in place for all base metals (set out on the LME website), the LME is minded to reduce the MVRs to 1 for non the VWAP methodology metals⁴ ?
- Q8 Are there any potential wider market impacts of moving to the proposed Closing Price methodology that the LME should be aware of, for example on the pricing of related OTC contracts?

Jamie Turner
Interim Chief Operating Officer, LME

cc: Board directors
All committees

⁴ The LME will retain the right to change the MVRs from time to time following ongoing review of market activity and approval by the Pricing and Valuations Committee



Appendix 1 – Feedback from the CPWG

Closing Price Working Group

As laid out in LME Notice 21/135, at inception, the remit of the CPWG was to inform the LME's thinking in relation to the Closing Prices methodology, and in particular to:

- (a) advise the LME on the need (or otherwise) for changes to the current electronic Closing Prices methodology,
- (b) as appropriate, support the development of an enhanced Closing Price methodology (based on the Pricing Blueprint or otherwise) and
- (c) advise on an appropriate timeframe for consultation on any enhanced Closing Price methodology

Evolution of the Pricing Blueprint

When considering the Pricing Blueprint, there were some areas where the CPWG participants showed a clear majority (though not necessarily unanimous) preference on changing aspects of the methodology including:

- (a) focusing a VWAP methodology only on the more liquid prompts at the front of the curve, and excluding LME Tin (due to its lower levels of liquidity);
- (b) reordering the pricing schedule of metals such that the more liquid contracts, such as LME Zinc, are priced later within the ordering (eg after LME Tin); and
- (c) reducing the previously proposed 30-minute pricing window for carries, to a 5 minute carry pricing window followed by a 5 minute 3-month pricing window per metal.

In other areas there was no clear majority and valid arguments were raised for and against various approaches. Key aspects of the feedback included (but was not limited to):

- (a) When pricing any given prompt, whether to include all relevant carry data between the relevant prompt and previously priced prompts in order to capture as much data as possible and maximise the carries that contribute to pricing, versus using a limited number of carries that, in some participants' views, may be easier to monitor and may simplify the calculation methodology making it easier for the market to understand; and
- (b) whether, under a VWAP based pricing model, additional TAS order books would be beneficial in certain key carries in order to help participants transfer Closing Price risk.
- (c) whether to include the Cash prompt in the front of curve methodology

The CPWG also gave feedback on other areas of Closing Price methodology (aside from the conversations around VWAPs). In particular, some participants felt that when operating the Last Price methodology, the LME should take some steps to ensure trading behaviours were as orderly as possible. It was suggested that, where an instrument did not have orders prior to a cut-off (eg 5 minutes), the subsequent orders in such an instrument should either not feed in to Closing Price calculations, or should receive a lower priority where it is not possible to reflect all orders in the valuation (referred to as a "pricing conflict" by the market).

CPWG participants also raised that it would be beneficial if the LME were able to make changes in order to bring the Closing Price publication sooner. This topic covered both minor operational changes that the LME may be able to make, and the larger operational challenges of pricing using the Last Price methodology with expert judgement, the potential pricing conflicts, and the resulting time it can take the LME to calculate and publish Closing Prices.

Key factors related to the Closing Price methodology

It should be noted that there was no consensus from the CPWG as to whether the LME should evolve the Closing Price process to a more deterministic methodology expanding the use of VWAPs. Some CPWG



participants were strongly opposed to an expanded use of VWAPs, while other CPWG participants were strongly in favour of such a methodology.

However, a number of key factors were identified by CPWG members for the LME to assess when determining the most appropriate path forwards for Closing Price methodology, considering the interests of the market as a whole. These factors included:

- (a) **The provision of guaranteed Closing Price orders** – There was significant debate among CPWG participants on the potential impact that an expansion of VWAP pricing may have on the provision of guaranteed Closing Price orders. Some CPWG participants felt that a greater use of VWAPs in the Closing Price methodology would make it difficult for them to target the Closing Price, and thus would mean they would no longer offer guaranteed Closing Price orders or this service would become more expensive for clients. These participants also felt that there would be a consequential negative impact to the wider market, as a reduction in guaranteed Closing Price orders would reduce Client interest in trading LME contracts. Other CPWG participants felt that by employing appropriate technology (such as VWAP execution algorithms) they (and other participants) would be able to continue to offer guaranteed Closing Prices. There was also some discussion about whether further trade-at-settlement (TAS) contracts could help participants who want to trade at Closing Prices, again with a range of views for-and-against.
- (b) **The representativeness of Closing Prices** – The CPWG discussed the impact that a greater use of VWAPs in the Closing Price methodology would have on the representativeness, fairness and reliability of pricing. In general CPWG participants felt that VWAP based prices were particularly fair and representative by their nature of being volume-weighted over a time period meaning that smaller trades were less likely to have an influence on pricing. Some participants did see some challenges with a VWAP methodology as it can result in “unsatisfied volume” for an order. For example, this can be the result of a large buying order at the end of a pricing window which may remain unfilled, while the VWAP then establishes at a lower price level (if earlier trades in the window happened at a lower price). In general, where instruments have sufficient liquidity, these potential challenges to a VWAP methodology were reduced, which supported the case to focus on liquid prompts at the front of curve. It was generally accepted that the existing use of VWAPs for the 3-month contracts has consistently produced highly credible and representative prices.
- (c) **Trading behaviours driven by the Closing Price methodology, and their impact on volatility and liquidity** – The CPWG discussed both direct consequences of an expanded use of VWAPs within the Closing Price methodology, and indirect consequences (such as potential impacts of a reduction in guaranteed Closing Price orders). Some participants felt that VWAPs encourage greater liquidity, because traders are incentivised to trade throughout the pricing window, whereas a Last Price methodology can encourage traders to hold their orders away from the market until the last moment in order to best target the Closing Price. It was suggested that a VWAP methodology thus might create a virtuous circle, where pricing windows attract more liquidity and trading. It was also suggested that an expanded use of VWAPs may reduce volatility around the close, as it spreads the activity over a pricing window, rather than concentrating it all into the final few seconds. Conversely, other CPWG participants felt that a knock-on impact of any reduction in guaranteed Closing Price orders would have an overall impact on LME trading volumes and liquidity, as they felt that some Clients would be disincentivised to trade on the LME.

Overall, each CPWG participant’s view on whether the LME should adopt the VWAP Methodology was largely driven by their views on the above factors, and how they balanced the relative importance of these factors.

While the matter of the operational challenges of the Last Price methodology, and the potential to publish Closing Prices earlier did factor in to the discussion, it was generally a secondary factor for CPWG participants. Most participants acknowledged the operational benefits of a VWAP methodology in terms of avoiding conflicts and making the pricing process more efficient, however this was generally not considered a key factor when determining whether the LME should expand the use of VWAPs.

It should be noted that the summary of CPWG participants’ opinions and inputs within this document is a non-exhaustive list. Over the five CPWG meetings (and in 1:1 meetings) participants gave significant detail on a large number of detailed topics related to Closing Prices. While not all this detail is contained within the document, it was all considered by the LME in shaping its views on the most appropriate path forwards.



Appendix 2 – Closing Price methodology blueprint

1 Detailed explanation of the LME’s proposed Closing Price pricing methodology

This document provides a detailed explanation of the proposed pricing methodology for Closing Prices, including detailed examples for the front-of-curve (“FC”) methodology.

1.1 FC methodology

The FC methodology is a deterministic approach for pricing the liquid contracts at the front of LME forward curves. It is based on a volume-weighted-average-price (“VWAP”) calculation of trades during defined pricing windows. The FC framework below has been written in a flexible manner, with the intention that it is scalable and could be applied to additional prompt dates in future if deemed appropriate. Initially it will apply to Cash, M1, M2, M3, M4 in addition to the existing 3-month VWAP for Copper, Aluminium, Nickel, Zinc and Lead.

The approach to price the front of the curve is to:

1. Establish the 3-month price (anchor contract) using a VWAP calculation
2. Then, in a defined order, price each third Wednesday monthly contract using the carries between that month and all other contracts that have already been priced. For example, 3m outright first, then establish M3 on the basis of the M3-3m carry, then establish M2 on the basis of both M2-3m and M2-M3 carries etc
3. Then price the Cash contract on the basis of the carry between Cash and the nearest monthly contract, eg Cash-M1

The 3-month and carry prices will be established over separate pricing windows for each metal (with the respective carry window immediately preceding the 3-month window) to allow for traders to separately focus on outright trading and carry trading. No outright trades for prompts other than 3-month will be included in the calculation as otherwise the outright prices for the monthly contracts may not align to the 3-month outright price (as they were taken from different pricing windows).

If the volume of the contract being priced does not meet the minimum-volume-requirement (aggregating the input instruments) during the relevant pricing window, then a time-weighted-average-price (“TWAP”) of a defined “indicator reference price” (“IRP”) is used. This IRP reflects the last trade (or previous day’s Closing Price if there are no trades), dragged higher or lower by a respective better bid or better offer (during the carry pricing window). The IRP will use only one carry which will be the 3m-M3 carry when pricing M3, then for all other instruments it will be the carry from the instrument to the nearest already priced monthly instrument (e.g. for M4 the IRP will use M3-M4, for M2 the IRP will use M2-M3).

The key parameters, and the detail of the calculation of the FC methodology is explained below. For detailed pricing examples please see section 2 of this document.

1.1.1 Parameters (FC methodology)

Anchor contracts:

Anchor point	Month
Primary:	3-month (3m)
Other:	None



Carry VWAP Contract order:

Ordering	Contract	VWAP Instruments	TWAP Instrument
1	3rd 3rd Wednesday (M3)	M3-3m	M3-3m
2	2nd 3rd Wednesday (M2)	M2-3m M2-M3	M2-M3
3	4th 3rd Wednesday (M4)	M2-M4 M3-M4 3m-M4	M3-M4
4	1st 3rd Wednesday (M1)	M1-M2 M1-M3 M1-3m M1-M4	M1-M2
5	Cash	Cash-M1	Cash-M1

The above table assumes that the 3m prompt date falls between M3 and M4 (which is the most common occurrence). Where this is not the case, the same instrument is used, but in its reversed form eg 3m-M3 and M4-3m.

Where the Cash contract is a 3rd Wednesday, then for the purpose of this calculation it will be priced as the Cash contract (with the next contract being M1).

Where the 3-month contract is a 3rd Wednesday, the ordering stays the same but the related “M” contract is already known at the relevant step in the pricing methodology.

Pricing windows:

VWAP Methodology Prompts

Metal	Anchor Pricing Window	Carry Pricing Window
Nickel	16:15:00:000 – 16:19:59:999	16:10:00:000 – 16:14:59:999
Aluminium	16:25:00:000 – 16:29:59:999	16:20:00:000 – 16:24:59:999
Zinc	16:35:00:000 – 16:39:59:999	16:30:00:000 – 16:34:59:999
Copper	16:45:00:000 – 16:49:59:999	16:40:00:000 – 16:44:59:999
Lead	16:55:00:000 – 16:59:59:999	16:50:00:000 – 16:54:59:999

Other non VWAP Methodology prompts⁵

Metal(s)	Pricing window
Cobalt and Molybdenum	15:50:00:000 – 15:54:59:999
Aluminium premiums, aluminium alloy and NASAAC	15:55:00:000 – 15:59:59:999
Tin	16:00:00:000 – 16:09:59:999

Rounding:

	Anchor Contract	Carry VWAP Contract
Aluminium	\$0.5/mt	\$0.25/mt
Copper	\$0.5/mt	\$0.25/mt

⁵ 3-month established by VWAP, all other prompts valued using existing last price methodology



Lead	\$0.5/mt	\$0.25/mt
Nickel	\$1/mt	\$0.50/mt
Zinc	\$0.5/mt	\$0.25/mt

Rounding will be done within each contract’s price calculation, such that the onwards use of that contract’s price will use the rounded form. Halfway values are rounded toward positive infinity.

Minimum volume requirements:

VWAP Methodology Prompts

	3m MVR	Carry MVR
Aluminium	1	1
Copper	1	1
Lead	1	1
Nickel	1	1
Zinc	1	1

Other non VWAP Methodology prompts⁶

	3m MVR
Cobalt and Molybdenum	1
Aluminium premiums (M1), aluminium alloy and NASAAC	1
Tin	1

These minimum volume requirements have been included to allow the methodology to be flexible. The LME believes there is an advantage to having all MVRs set as 1, such that any trades during the respective pricing window will always take precedence.

1.1.2 Calculation (FC methodology)

Anchor Contracts

Each Anchor Contract is priced based on the following waterfall:

1. If the total volume of trades during the Anchor Pricing Window is above the Outright MVR, the Closing Price will be the VWAP of outright trades in the Anchor Contract during the Anchor Pricing Window
2. If the total volume of trades during the Anchor Pricing Window is below the Outright MVR, the Closing Price will be the TWAP of the Indicator Reference Price for the Anchor during the Anchor Contract Pricing Window

⁶ 3-month established by VWAP, all other prompts valued using existing last price methodology



Carry VWAP Contracts

In order as listed, each Carry VWAP Contract is priced using the following waterfall:

1. The Closing Price will be the VWAP of the VWAP Instruments for the respective Carry VWAP Contract during the Carry Pricing Window, where the price used in the VWAP will be the traded carry price, applied to the already established price for the other contract
2. If the total volume of all trades considered in this calculation is below the respective Carry MVR, the Closing Price will be the TWAP of Indicator Reference Price of the TWAP Instrument during the Carry Pricing Window, applied to the already established price for the other contract

Indicator Reference Price (“IRP”)

If trades have occurred during current day:

If [Current Bid⁷ > Last Trade] Then [IRP = Current Bid]

If [Current Offer < Last Trade] Then [IRP = Current Offer]

Otherwise [IRP = Last Trade]

If no trades during current day:

If [Current Bid > Previous Close] Then [IRP = Current Bid]

If [Current Offer < Previous Close] Then [IRP = Current Offer]

Otherwise [IRP = Previous Close]

In the event that a Previous Close value is not available, which can occur if the 3M date was not tradable on the previous day, a linear interpolation is performed between the nearest available priced dates either side of the required date.

Calendar days are used as the basis of interpolation if the two points are in Contango, otherwise Business days are used.

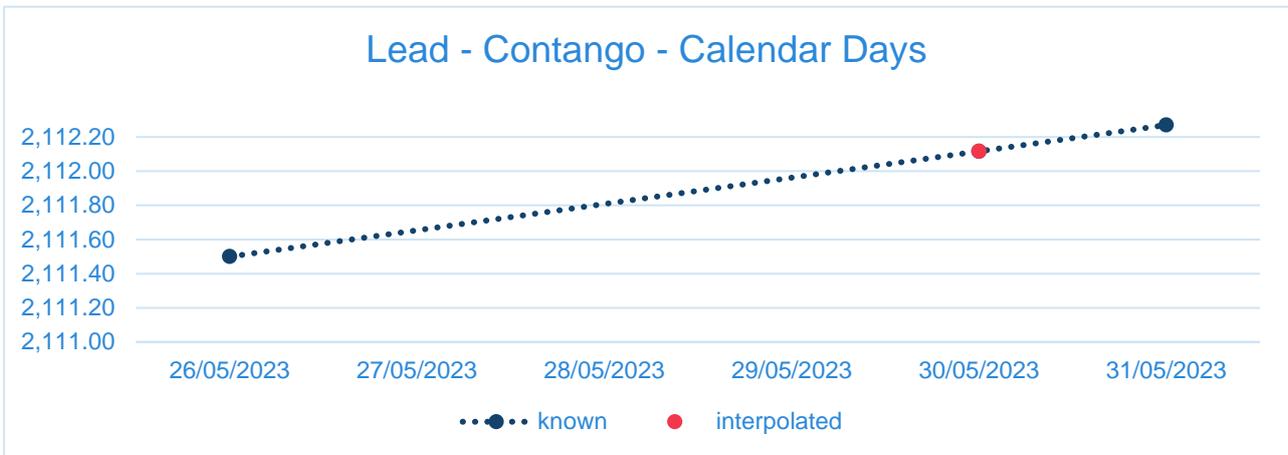
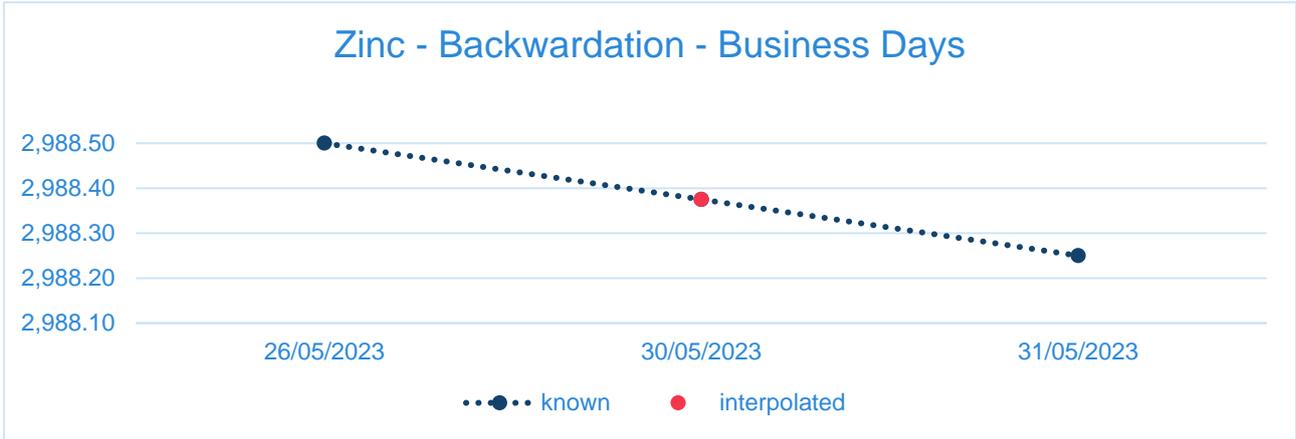
Interpolation Examples

Business Date: 28-Feb-2023

3M Prompt: 30-May-2023

Date	Date Type	Previous Close	
		Zinc	Lead
		Backwardation	Contango
26/05/2023		2,988.50	2,111.50
27/05/2023	Weekend	NA	2,111.65
28/05/2023	Weekend	NA	2,111.81
29/05/2023	Bank Holiday	NA	2,111.96
30/05/2023		2,988.38	2,112.12
31/05/2023		2,988.25	2,112.27

⁷ Bids and offers during the relevant TWAP period



1.2 Rest-of-curve (RC) methodology

When pricing the rest of the forward curve, including both the daily prompt dates and the longer dated monthly contracts, the LME's existing last price with expert judgement methodology will be used. It should be noted that the RC methodology will always follow after the completion of the FC methodology. As such prices established during the FC methodology will not be changed on the basis of data considered within the RC methodology.



2 Pricing examples for the front-of-curve methodology

The below example prices copper on 15 April 2021 (such that M1 is the April 3rd Wednesday contract, and 3m is 15 July 2021). The prices used are for example only, and are not the prices which traded on 15 April 2021.

3-month Closing Price calculated by a VWAP of all 3-month trades between 16:45-16:50 eg \$9,201
 Jun (M3), May (M2), Jul (M4) and Apr (M1) are then all calculated in this order using trades between 16:40 and 16:45:

Jun21 (M3) price is calculated as VWAP of all Jun21-3m (M3-3m) carry trades, applied to 3m:

Instrument	Volume (lots)	Carry price	Known basis price	Price used in VWAP i.e. the 3m price +/- the carry price	VWAP price * volume
Jun21-3m	100	\$5	\$9,201	\$9,206	\$920,600
Jun21-3m	50	\$4		\$9,205	\$460,250
Jun21-3m	200	\$4.5		\$9,205.5	\$1,841,100
Jun21-3m	25	\$5		\$9,206	\$230,150
TOTAL	375				\$3,452,100

Established Jun21 price: \$9,205.50 (rounded from $\$3,452,100 / 375 = \$9,205.60$)

May21 (M2) price is then calculated as VWAP of all May21-Jun21 (M2-M3) trades, and May21-3m (M2-3m) trades:

Instrument	Volume (lots)	Carry price	Known basis price	Price used in VWAP	VWAP price * volume
May21-Jun21	50	\$2.25	\$9,205.50	\$9,207.75	\$460,387.5
May21-Jun21	250	\$2.5	\$9,205.50	\$9,208	\$2,302,000
May21-3m	5	\$7.5	\$9,201	\$9,208.5	\$46,042.5
May21-3m	15	\$7	\$9,201	\$9,208	\$138,120
Total	320				\$2,946,550

Established May21 price: \$9,208 (rounded from \$9,207.97)



Jul21 (M4) price is then calculated as VWAP of all May21-Jul21 (M2-M4), Jun21-Jul21 (M3-M4) and 3m-Jul21 (3m-M4) trades:

Instrument	Volume	Carry price	Known basis price	Price used in VWAP	VWAP price * volume
May21-Jul21	5	\$6	\$9,208	\$9,202	\$46,010
May21-Jul21	1	\$4	\$9,208	\$9,204	\$9,204
Jun21-Jul21	500	\$3	\$9,205.5	\$9,202.5	\$4,601,250
3m-Jul21	100	\$0	\$9,201	\$9,201	\$920,100
3m-Jul21	70	-\$0.5	\$9,201	\$9,201.5	\$644,105
Total	676				\$6,220,669

Established Jul21 price: \$9,202.25 (rounded from \$9,202.17)

Apr21 (M1) price is then calculated as VWAP of all Apr21-May21 (M1-M2), Apr21-Jun21 (M1-M3), Apr21-3m (M1-3m) and Apr-Jul21 (M1-M4) trades. If we assume there were no trades in any of those carries (during the Carry Pricing Window), then Apr21 (M1) is priced as the TWAP of the Indicator Reference Price of Apr21-May21 (M1-M2), applied to the already established May21 (M2) price.

So given the following activity on Apr21-May21:

Previous day's Closing Price \$3

Last trade prior to the Carry Pricing Window was \$3.75

16:46 - 10 lot Bid at \$4 entered (no orders in the book prior to this)

16:47 - 100 lot Offer at \$4.5 entered

16:48 - 10 lot Bid at \$4 removed

16:49 – 50 lot Offer at \$3.5 entered

Then the IRP for the following periods is:



Time Period	Duration of period	IRP of carry	Duration * IRP used in TWAP
16:45 – 16:46	1 minute	\$3.75 (no current orders, so use Last Trade)	\$3.75
16:46 – 16:48	2 minutes	\$4 (bid is higher than Last Trade. The higher \$4.5 offer at 16:47 does not change the IRP)	\$8
16:48 – 16:49	1 minutes	\$3.75 (no better bid or offer than Last Trade)	\$3.75
16:49 – 16:50	1 minutes	\$3.5 (current offer is below Last Trade)	\$3.5
Total	5 minutes		\$19

The TWAP of Apr21-May21 (M1-M2) is \$3.8 (\$19 / 5 minutes)

Established Apr21 price: \$9,211.75 (rounded from \$9208 + \$3.8)

Whole minutes are used in this example for simplicity. The calculation will actually be done at a millisecond level as per market data timestamping.

Cash price is then calculated as the VWAP of Cash-Apr21 (Cash-M1). If we assume that there were no trades (during the Carry Pricing Window), then Cash is priced on the basis of the TWAP of the IRP of Cash-Apr21. If there have been no trades in Cash-Apr21 during the current trading day, then the IRP uses the previous day's Closing Price as reference (which will use today's Cash prompt date 19 Apr 21, rather than the previous day's Cash prompt date).

If we assume the previous day's Closing Price for (today's) Cash-Apr21 was \$0.5 and the bid/offer in Cash-Apr21 during the Carry Pricing Window was constant at \$0 / \$1, then the TWAP will only use the \$0.5 from the previous day (as there is no better bid or offer).

Established Cash price: \$9,212.25