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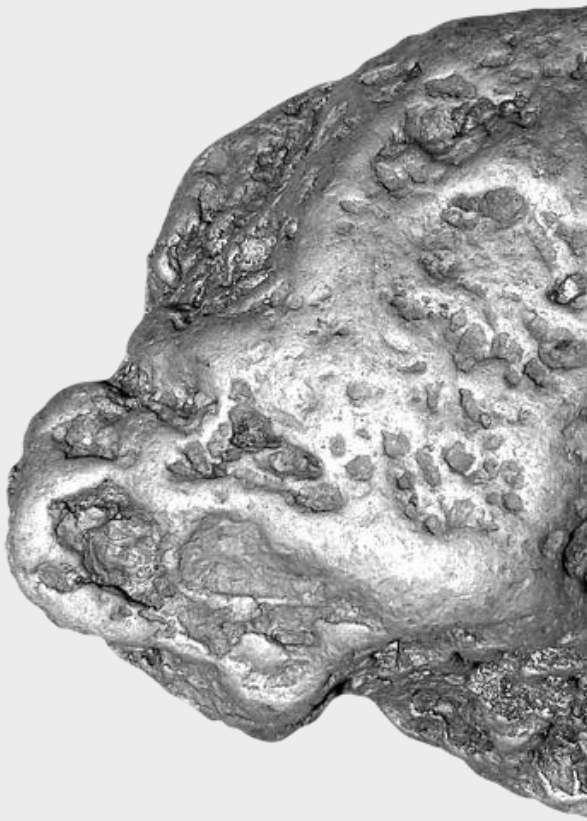

Fastmarkets

Exploring the future of global low-carbon aluminium pricing

Fastmarkets

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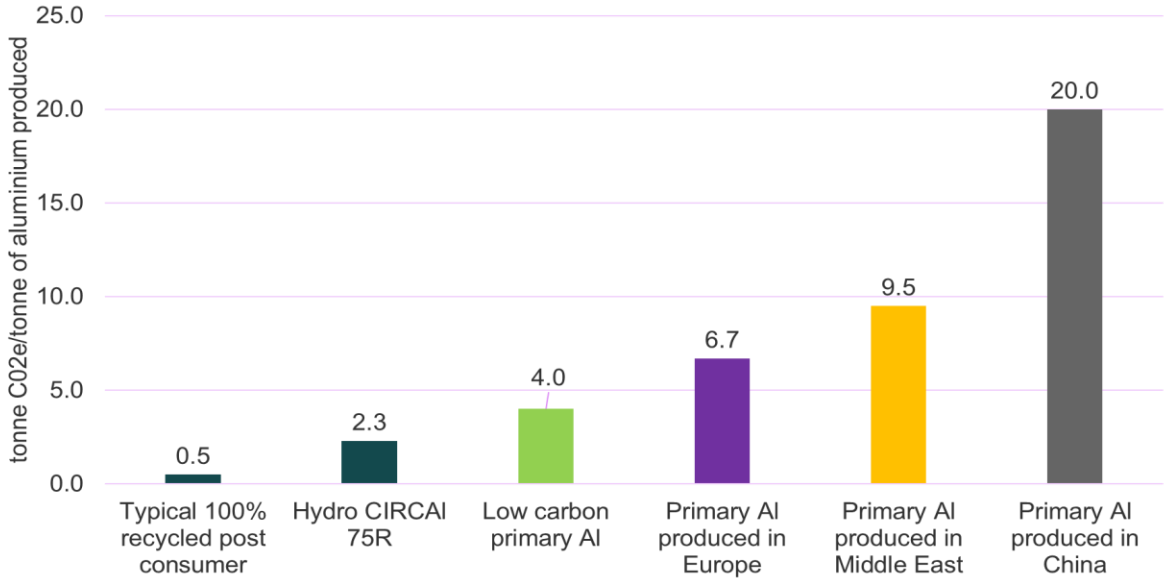
LOW-CARBON ALUMINIUM INTRO

COMPETITVE PLAYING FIELD

- Several years ago, low-cost power was considered the key for aluminium expansions, but increasingly the carbon footprint of the operation is becoming a key factor.
- Aluminium smelters manufacturing primary metal using hydropower-generated electricity tend to have a CO_2 footprint of under 4.5t per tonne of aluminium produced. Many of the smelters producing primary metal using hydropower have gone through external audits to have their output certified as low-carbon or “green”.
- The current definition of low carbon tends to have a cut-off point of 4-4.6t CO_2 emissions per tonne of aluminium produced,
- This differentiates their material from primary aluminium manufactured in the Middle East using gas sources, and from those in China, using highly polluting coal, as shown in the chart opposite.
- Production of aluminium using a share of post-consumer scrap inputs has an even lower carbon footprint, which typically falls below 3t CO_2 emissions per tonne of aluminium produced, assuming that any primary metal input is itself low carbon.
- Material produced using 100% post-consumer scrap tends to have a carbon footprint of under 1t CO_2 emissions per tonne of aluminium produced.

CO_2 EMISSIONS IN ALUMINIUM PRODUCTION



- Although recycled, and to a lesser extent, remelt aluminium, has a much lower carbon footprint than primary, key certification processes increasingly required by consumers are running at a much slower rate.
- But for companies such as Hydro and Alcoa, that have so much experience in this sector having been through the process for their primary operations, the route to certification is more straightforward.

LOW-CARBON ALUMINIUM – PUSH AND PULL

STARTED WITH A PUSH FROM PRODUCERS

- The major hydro-powered aluminium smelter groups started to certify and brand their low-carbon primary material in the mid-late 2010s
- Prior to this certification and branding process the same group of companies had been producing low-carbon metal for decades in some cases
- The sale of this branded material slowly gained traction ahead of the pandemic

2016 **Rio Tinto** launched its "**RenewAl**" range in 2016, which was the world's first certified low CO^2 aluminium.

2016 **Alcoa** launches its "**SUSTANA**" range of low carbon aluminium, which includes "**ECOLUM**", its low carbon primary aluminium brand.

2017 **Rusal** launches its **"ALLOW"** brand of low carbon primary aluminium.

2017 **Hydro Aluminium** launches its Hydro 4.0: hydropower-based aluminium with a maximum content of 4.0 kg CO^2 per kg aluminium in November 2017.

2019 **Hydro Aluminium** rebranded and relaunched its low carbon primary metal as "**REDUXA**" in August 2019.

2020 **Century Aluminum** launches its "**Natur-Al"** brand in February 2020. The brand is exclusive to output from the company's Grundartangi smelter in Iceland, which is powered using geothermal power.

Company	Brand	Carbon Footprint Threshold	Boundary
Alcoa	ECOLUM	2.5tCO_2 /t Al at smelter 4tCO_2 /t Al cradle to gate	Separately defined for both boundaries. Scope and methodology not fully disclosed
Century Aluminum	NaturAl	4tCO_2 /t Al	Unclear - appears to be smelter only
Hydro Aluminium	REDUXA	4tCO_2 /t Al	Cradle-to-gate (up to and including ingot casting). Scope and methodology not fully disclosed
Rio Tinto	RenewAl	4tCO_2 /t Al	Unclear - appears to be smelter only
Rusal	ALLOW	4tCO_2 /t Al	Scope 1 & 2 emissions of smelter (level 1 of IAI guidelines)

LOW-CARBON ALUMINIUM – PUSH AND PULL

SHIFTED TO A PULL FROM CONSUMERS OVER PAST THREE YEARS

- After the initial push from producers, consumers have taken up the reins
- In the past 3-4 years a growing number of aluminium consumers have been specifying low-carbon material in their supply contracts
- Transportation consumers, particularly automotive OEMs, have been some of the most active in this trend, followed by the packaging sector
- Many European consumers of PFA will only purchase low-carbon material in their 2024 contracts
- Multiple local manufacturers of consumer goods and suppliers to the B&C sector are also requesting greener aluminium solutions

TRANSPORTATION

OEMS

- BMW Group
- VW Group (Audi, Porsche)
- Chrysler
- Ford
- Honda

Component suppliers

- Ronal
- Kosei Aluminium
- Taiwan Hokada

New Energy

- Chargenode
- Vita Power

PACKAGING

- Nestlé (Nespresso)
- Coca Cola
- Anheuser-Busch
- Corona
- Ball Packaging
- Amcor Capsules

WIRE AND CABLE

- Nexans
- Prysmian

CONSUMER PRODUCTS

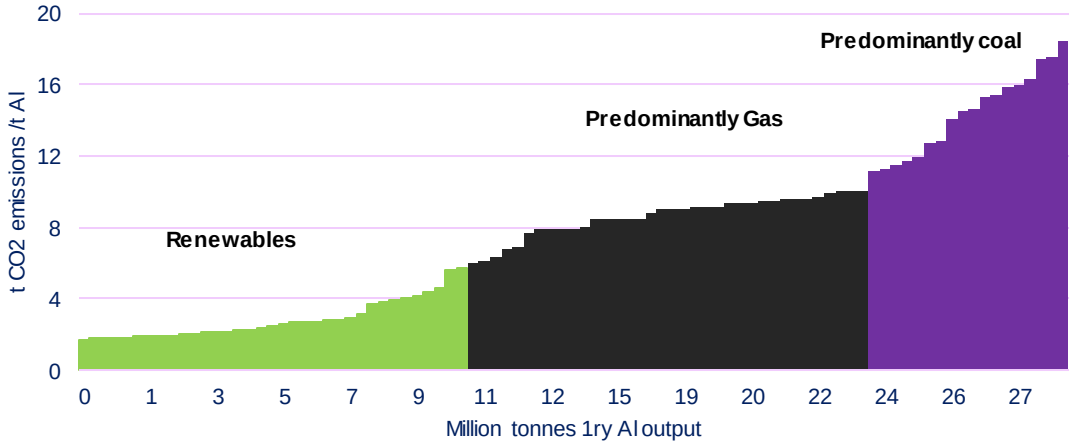
- Apple
- Velux

NON-GREEN SUPPLIES

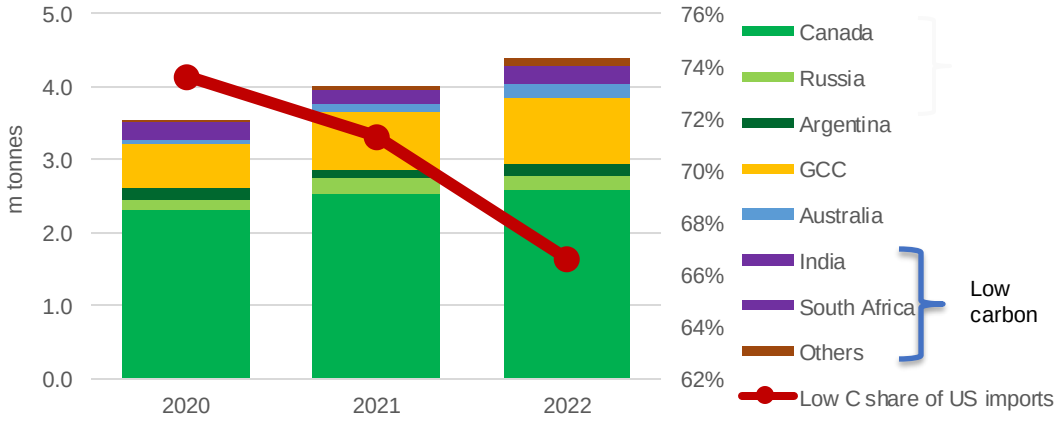
OPPORTUNITIES & CHALLENGES

- Gas-powered Middle Eastern smelters sit in the “grey zone” of carbon emissions
- Higher CO2 footprint than “green” renewable-based output, but notably lower than coal-based output.
- Yet material with a CO2 footprint of over 4t CO2e/t Al is all lumped together in the “non-green” category
- In the near-term primary aluminium produced using gas-derived power will remain a vital component of the supply chain, which will permit the status quo to persist, albeit with the possibility of slight shifts in sales geography

CO_2 EMISSIONS IN EX-CHINESE 1RY ALUMINIUM PRODUCTION



US IMPORTS OF UNWROUGHT ALUMINIUM BY ORIGIN



SECONDARY: THE FASTEST ROUTE TO LOW CARBON ALUMINIUM?

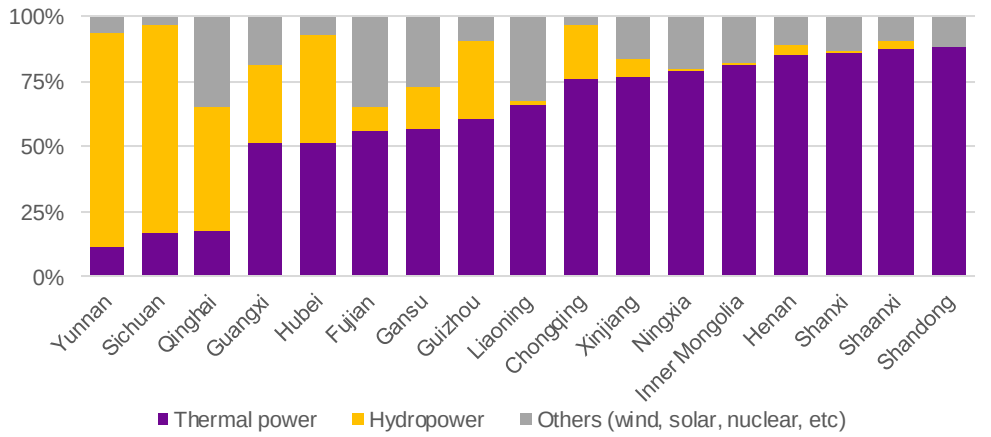
- The growth in secondary metal units in wrought alloy output is advancing at a rapid pace. Improvements in scrap sorting and upgrading technologies are increasing the possibility of using End-of-life scrap in the manufacture of billet, slab, and even PFA equivalents.
- In addition to launching low carbon brands of primary metal, both Alcoa and Hydro Aluminium have launched low carbon brands of remelt products manufactured with a high scrap content, with a particular focus on old, post-consumer scrap.
- Multiple other suppliers of remelt slab/billet, but certification is slower

WHAT INFLUENCE WILL CHINA HAVE?

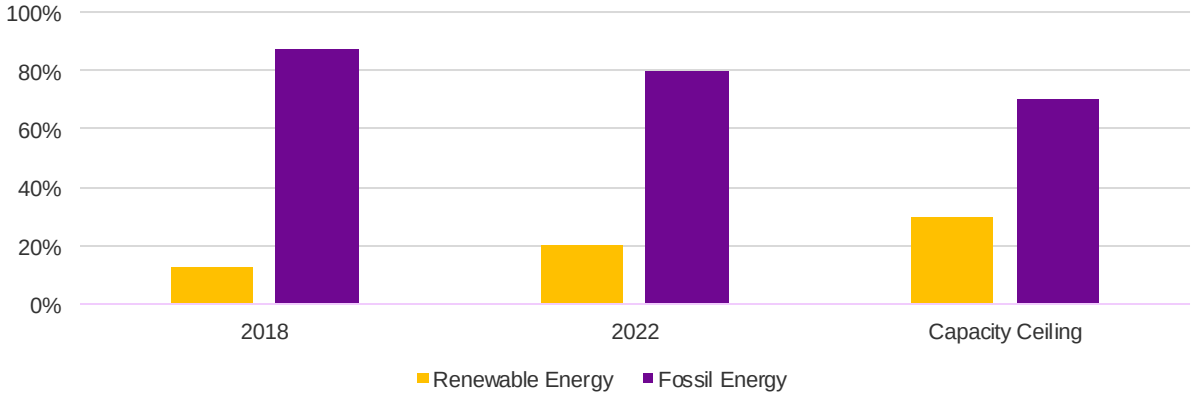
UNTAPPED LOW CARBON SUPPLY POTENTIAL?

- Overall thermal-power-produced primary metal dominates China's +40mtpy output.
- The greatest growth in output is coming from hydro-powered smelters.
- Reports that low carbon certification is gaining momentum in the country
- Initially this appears to "pull" rather than "push" related
  - i.e. being driven by consumer demand/requirements
  - Initially related to export customers rather than domestic customers
- In the order of 2.7m tonnes of low-carbon aluminium could be certified in China this year, equivalent to around 7% of the country's production.
- Will Chinese certification meet international standards? Buyers in export markets are pushing for this change

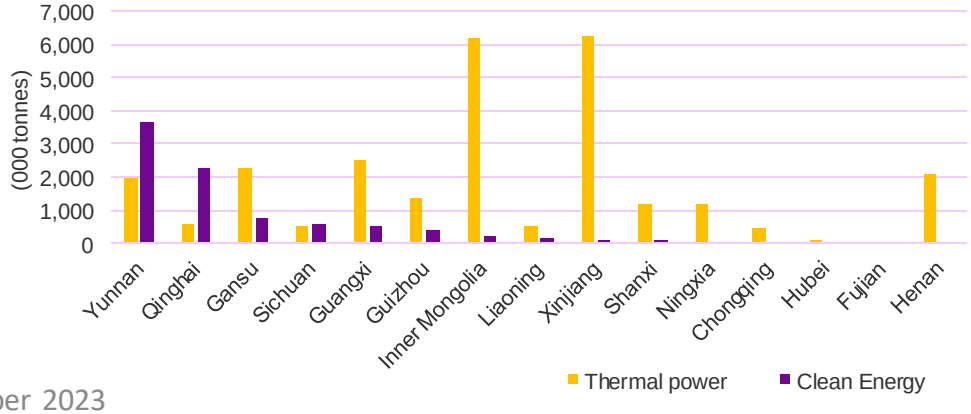
POWER GENERATION BY DIFFERENT SOURCES IN CHINA



RISING SHARE OF RENEWABLES-BASED SMELTING CAPACITY IN CHINA



SMELTERS POWERED BY DIFFERENT SOURCES BY PROVINCE



The industry submits transaction and contract prices

Price reporters gather price information

Price reporters enter source data

Price reporter considers appropriate price and rationale

Supervisors validate or return to price reporter

IOSCO compliant methodology and systems

Trained price reporters

Market data is collected

Data analysis

Pricing data into MInD

Our integrated peer-review system

Data published

Robust

Transaction Based

Auditable

Transparent

Controlled

Low-carbon aluminium price offering in Europe

Fastmarkets' current aluminium offering includes 65 prices and premiums, including the daily duty-unpaid Rotterdam premium and FOB Australia alumina index which are both IOSCO accredited.

Rotterdam aluminium premiums are the underlying for CME and LME contracts

Fastmarkets' current low-carbon assessments:

- Aluminium P1020 low-carbon differential, Europe
- Aluminium value-added product low-carbon differential, Europe

Defining low-carbon aluminium

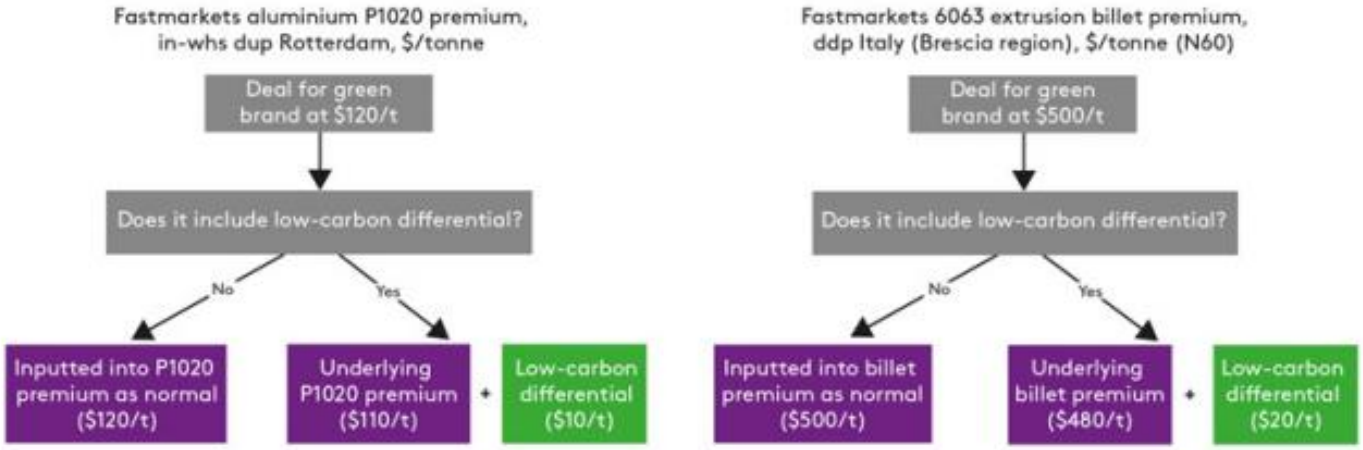
For data to be accepted, it must meet and reflect the standards set in the specifications: a maximum of 4 tonnes of CO_2 equivalent ($4tCO_2e$) per tonne of aluminium produced, outlined in the Green House Gas Protocol Scope 1 and 2 emissions.

MB-AL-0381	**Aluminium low-carbon differential P1020A, Europe, $/tonne**
Carbon limit:	4tCO2e per tonne of aluminium produced, Scope 1 and 2 emissions
Quality:	P1020A or 99.7% minimum Al purity (Si 0.10% max, Fe 0.20% max). Ingot
Quantity:	Min 100 tonnes
Location:	Europe
Unit:	USD/tonne
Timing:	Within three months
Publication:	Monthly, first Friday of the month, 4pm London

MB-AL-0382	**Aluminium low-carbon differential value added product, Europe, $/tonne**
Carbon limit:	4tCO2e per tonne of aluminium produced, Scope 1 and 2 emissions.
Type:	Extrusion billet, primary foundry alloy, wire rod, slab
Quantity:	Min 100 tonnes
Location:	Europe
Unit:	USD/tonne
Timing:	Within three months
Publication:	Monthly, first Friday of the month, 4pm London

European differentials pricing process

Examples:



What is a differential?

A differential means the market can be at a premium, a discount or at parity (0).

These can be used on top of Fastmarkets' underlying European P1020 and VAP premiums.

Inferred premiums include:

- Aluminium P1020A premium, in-whs dup Rotterdam, inferred low-carbon mid-point, $/tonne
- Aluminium 6063 extrusion billet premium, ddp North Germany (Ruhr region), inferred low-carbon midpoint, $/tonne

The differentials can also be used as an upcharge for other aluminium products such as slab and wire rod, which Fastmarkets does not currently price.

Demand sectors for low carbon aluminium

End user sectors

- Automotive/Evs - The automotive sector was one of the early drivers of the green market, many aluminium producers now exploring offtakes or partnerships -

- Examples include Hydro-Porsche, EGA-Nissan, Rio Tinto-BMW

- Building & Construction – producers reporting demand from B&C sector for low carbon extrusion profiles for use in buildings, LCAs –

- Hydro now offering profiles from 100% scrap

- Cable industry now entering into the low carbon space –

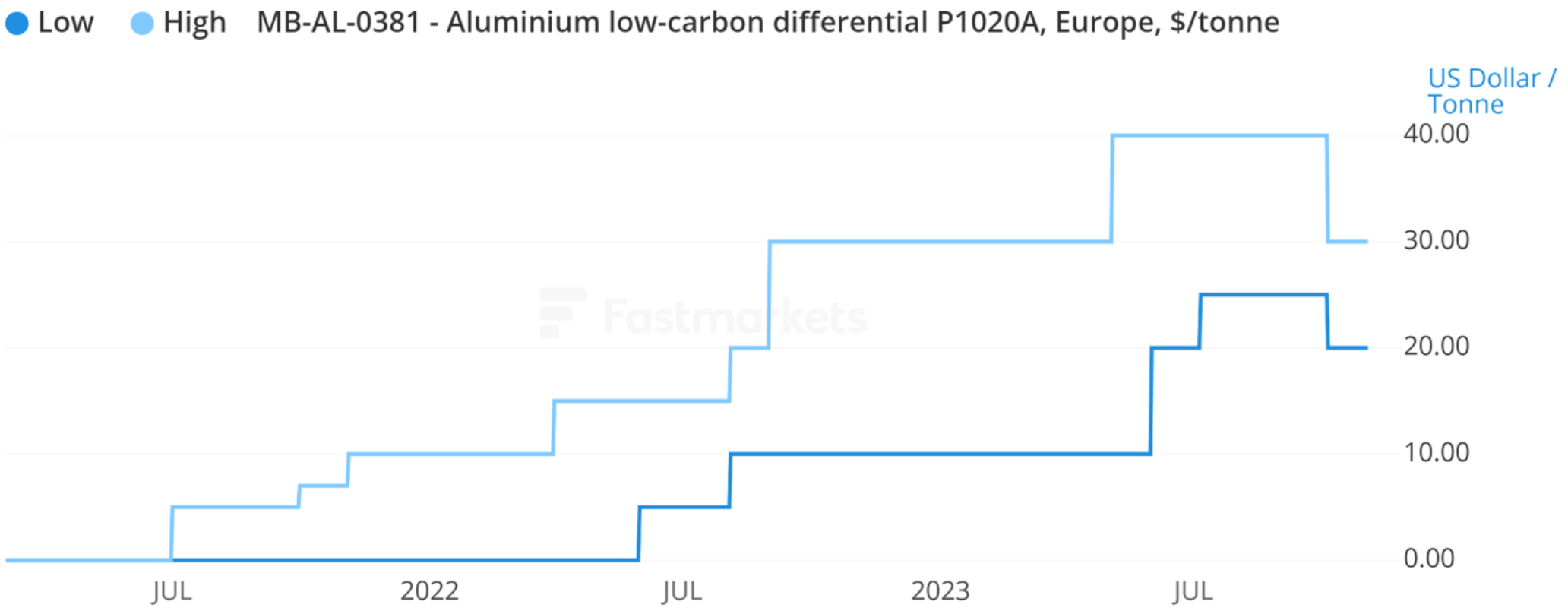
- Recent power grid agreements NKT-Ellevio, Rio Tinto-Prysmian

- Solar power industry continuing to report growth amid the ongoing switch to renewable power solutions

Other supportive factors

- Rise in consumer requirements
- Growing supply chain traceability
- Emergence brand preference
- Introduction of CBAM in Europe

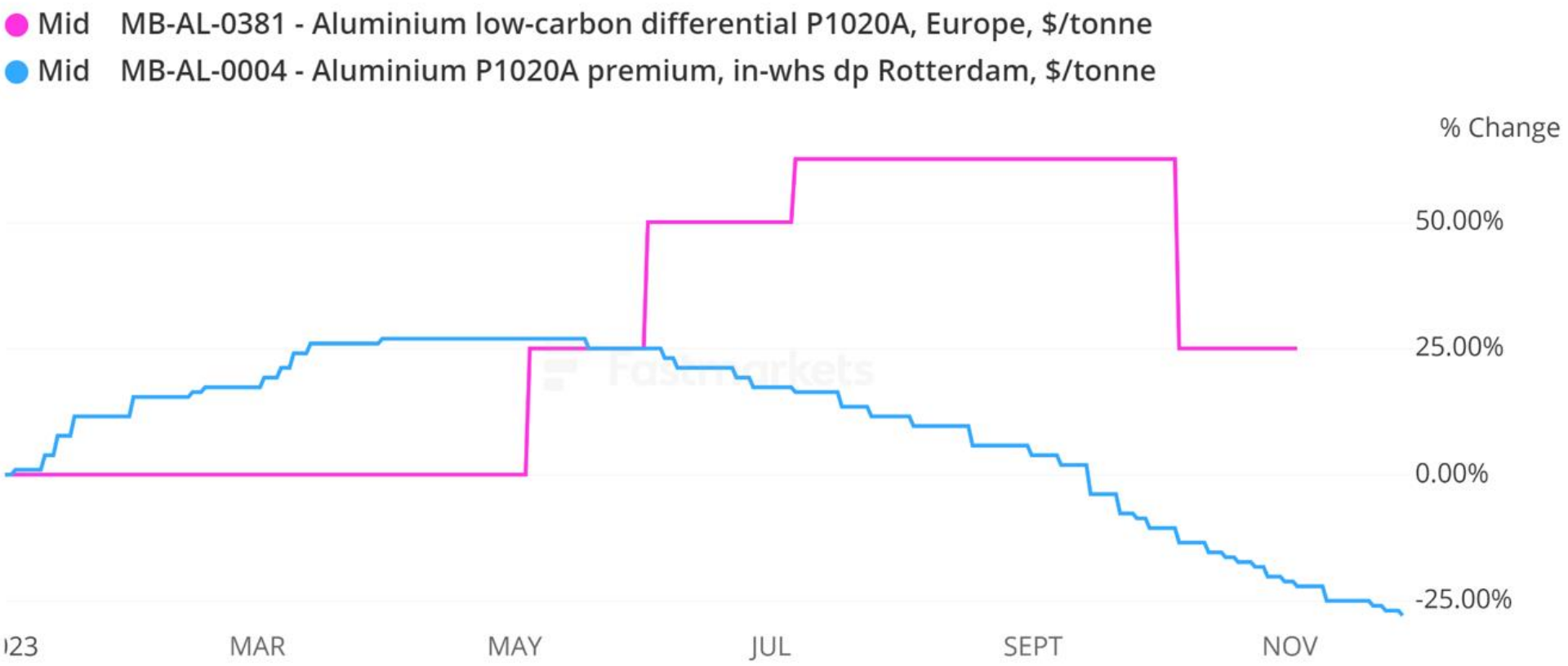
European P1020 differential stumbles



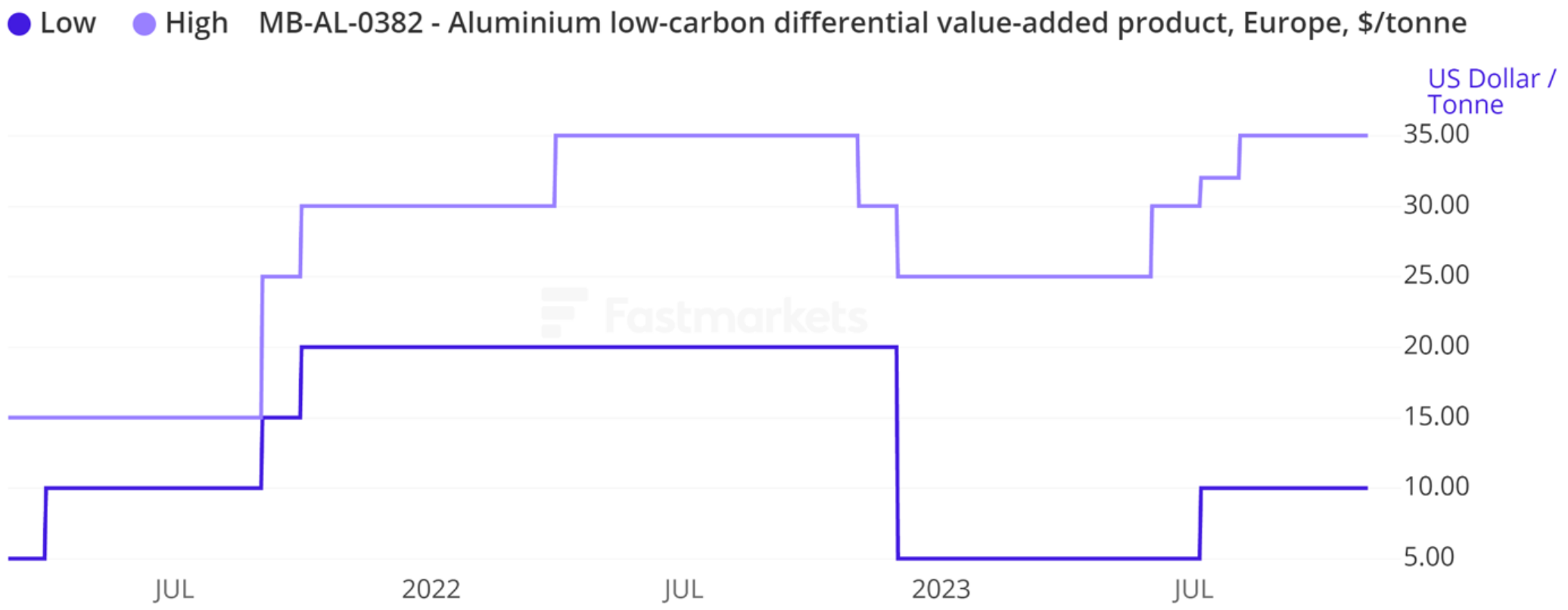
Fastmarkets data March 2021 - present

- Differential for P1020 was $0/t when first launched in 2021, growing until October 2023 as the market continued to develop.
- First decline recorded in October on challenging market and weak underlying premium.
- Demand for green P1020 remains robust into 2024, with offers heard close to $50/t in 2024

Rotterdam P1020 v low carbon upcharge



VAP differential diverges on lower billet upcharge



Fastmarkets data March 2021- present

- VAP differential more volatile based on broader market fundamentals.
- Diverging product markets see range widen, with higher upcharges achievable for PFA vs billet (automotive v construction)
- Fastmarkets recently concluded its consultation on amending the VAP differential – is set to launch two separate differentials as a result of the developing market dynamics.

Recent changes to Fastmarkets' low-carbon offering

Upcoming launch of two new low carbon differentials, discontinuation of existing differential

- Following an extended consultation period, Fastmarkets is launching two new European low-carbon VAP differentials:

  - **MB-AL-0391 Aluminium low-carbon differential billet, Europe, $/tonne (3-month delivery window)**
  - **MB-AL-0392 Aluminium low-carbon differential value-added product ex-billet, Europe, $/tonne (12-month delivery window)**

- The new launch will complement the existing offering and adapt to better suit the developing low carbon market. The existing differential will be gradually phased out.

Secondary billet launch - January 2023

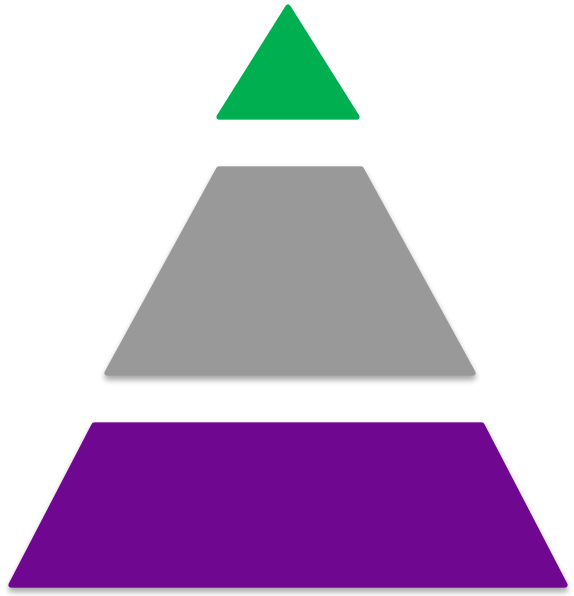
- Fastmarkets also launched European secondary aluminium billet premiums in January 2023, aligned with growing focus on sustainability.

Further market developments

- Fastmarkets undertaking feasibility studies into launching low-carbon differentials in Asia, with Japan showing increasing demand for transparency in low-carbon P1020.
- Industry move towards including scope 3 GHG in specifications but limitations with auditing on certificates vs EPDs
- Changing ASI specifications to include scope 3 and expanded ESG
- Supply chain traceability of increasing importance following US tariffs
- Start of CBAM reporting period now underway ahead of full implantation in 2026, creating an additional duty
- Growth in green financing & bonds with stricter lending requirements by banks

US differentials pricing process

Fastmarkets launched US low-carbon differentials on November 3, 2023.



Fastmarkets low-carbon differential

+

Fastmarkets premium

+

Exchange-based aluminium price

Specifications for US low-carbon aluminium differentials

Aluminum low-carbon differential P1020, US Midwest, c/lb

Carbon limit: 4tCO2e per tonne of aluminum produced, Scope 1 and 2 emissions.
Quality: P1020A or 99.7% minimum Al purity (silicon 0.10% max, iron 0.20% max, zinc 0.03%, gallium 0.04%, vanadium 0.03%). Ingot, T-bar, Sow
Quantity: Min 100 tonnes
Location: Delivered consumer works Midwest, differential on top of P1020A premium and exchange-listed aluminum price.
Unit: US cents per pound
Timing: Delivery starting within three months
Type: Assessed range
Publication: Monthly, first Friday of the month. 4pm London

Aluminum low-carbon differential value-added product, US Midwest, c/lb

Carbon limit: 4tCO2e per tonne of aluminum produced, Scope 1 and 2 emissions.
Products: Extrusion billet, primary foundry alloy, wire rod, slab
Quantity: Min 100 tonnes
Location: Delivered into US Midwest region, differential on top of value-added product premium and exchange-listed aluminum price
Unit: US cents per pound
Timing: Delivery starting within three months
Type: Assessed range
Publication: Monthly, first Friday of the month. 4pm London

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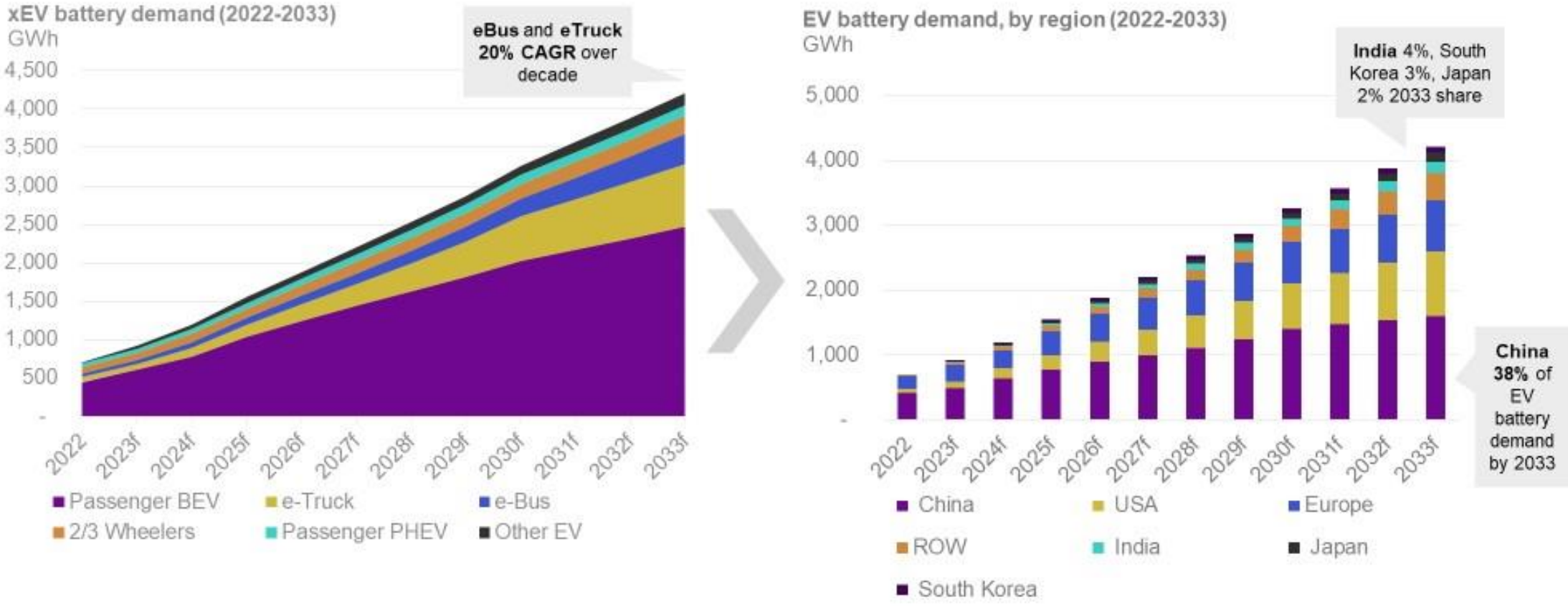
Turbulent 2024

- Automotive sector set to slow
- Other sectors has to pick up the slack
- Construction growth remain questionable amid China beleaguered property sector and Europe timid infrastructure spending

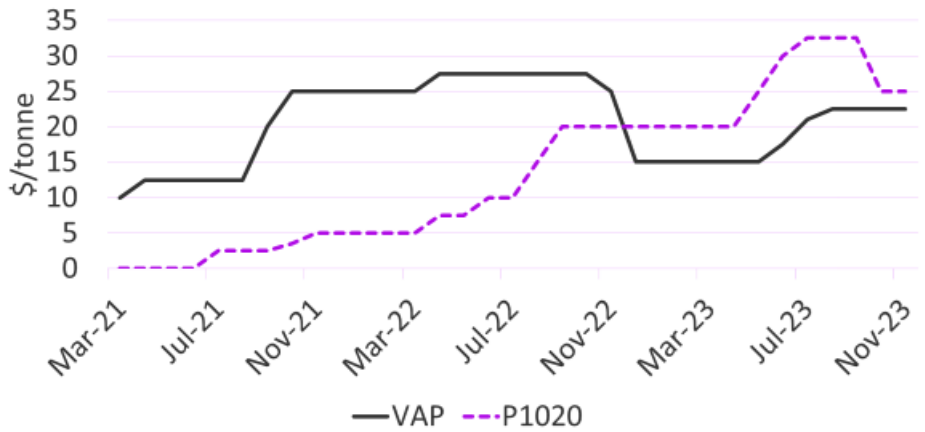
EV battery demand to quadruple by 2033 as EV adoption surges



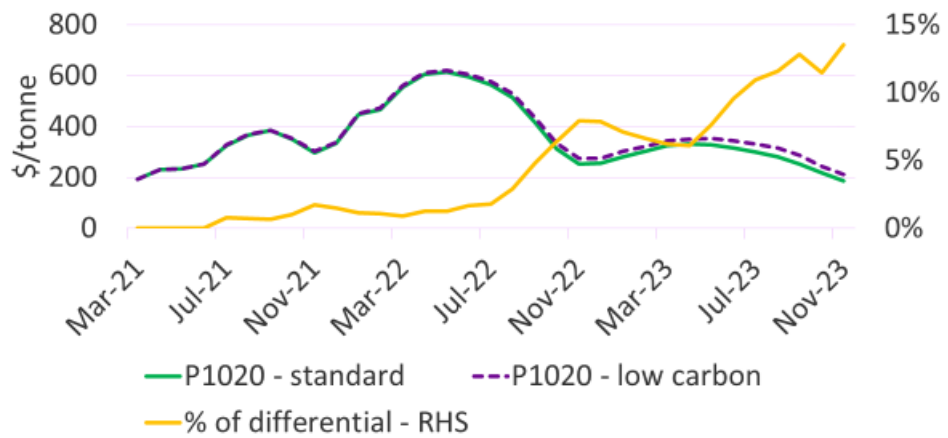
Source: Fastmarkets Long Term Forecasts

LOW-CARBON ALUMINIUM PRICING

EUROPEAN LOW-CARBON AL DIFFERENTIAL*



EUROPEAN LOW CARBON VS STANDARD DP PREMIUMS



OBSERVATIONS

- The increased value of low-carbon aluminium versus standard aluminium is part of the attraction for the production and certification of material that meets current specifications.
- Premiums on low carbon material have become a reality on many sales in the European region over the past two years
- Even in the face of a sharp deterioration of standard p1020 premiums in Europe, the low-carbon premiums being achieved have held relatively steady
- Premiums on unalloyed material have been more resistant to the downturn than premiums on VAPs, where quotations have been impacted by the sharp downturn in billet demand
- When comparing standard duty-paid European p1020 premiums with low carbon duty-paid premiums (DP p1020 + low carbon differential), the relative value of low carbon material continues to rise (lower chart)
- The fact that the differential has risen over the past year, while overall premiums have fallen, is supportive of our view that some customers will remain fully committed to purchasing material with a maximum carbon footprint of 4tCOe per tonne of aluminium, irrespective of demand conditions.

* Fastmarkets proprietary low carbon differential, which was launched in March 2021. Low carbon is defined as max 4 tonnes of CO_2 equivalent ($4tCO_2e$) per tonne of aluminium produced, outlined in the Green House Gas Protocol Scope 1 and 2 emissions.

Low carbon outlook

Thank you

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