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Decarbonisation

A potential opportunity for aluminium producers

Edison themes

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Aluminium production is one of the most carbon-intensive industries, due to the high levels of electricity required for aluminium smelting. It emits nearly 1.1bn tonnes of carbon dioxide equivalent (t CO_2e) globally and is not helped by China accounting for c 55% of global production. 80% of electricity consumed in Chinese aluminium production comes from coal-fired plants, and a majority of these are subcritical (low efficiency).

The aluminium industry must reduce its emissions by 77% by 2050 to meet global climate targets. This will largely be achieved through shifting to green electricity and assisted by increasing recycling capacity and efficiency (recycled aluminium uses c 5% of the electricity required for primary aluminium production). The International Energy Agency has called for all subcritical coal plants to be shut by 2030; this equates to the removal of c 60% of China's aluminium production (c 30% of global supply) in less than 10 years. In the meantime, customers of aluminium are seeking to decarbonise their supply chains on a shorter time frame, due to investor and other stakeholder pressures, and therefore may be willing to pay a premium for low carbon aluminium. This creates an opportunity for aluminium producers that are early movers in decarbonisation.

S&P Global Platts has launched low-carbon aluminium price (LCAP) and zero-carbon aluminium price (ZCAP) assessments, starting with the European market. It defines low-carbon aluminium as applying to primary aluminium with a maximum emissions intensity of 4t CO_2 per tonne of aluminium at the smelter. On a smelter-level basis, this corresponds to less than a quarter of global supply. We assess latest reported carbon emissions data and emissions reduction targets for listed aluminium producers to ascertain leaders and laggards, which are:

Leaders: Rusal and Norsk Hydro (hereafter referred to as Hydro)

Transitioning: Rio Tinto, Alcoa and Mytilineos

Laggards: Hindalco, Century Aluminum and all other listed and non-listed aluminium producers (which do not provide emission data and emissions reduction targets), equating to c 80% of global supply.

From the street

'Aluminium smelting might often be thought of as an old-world industry, but usage is increasingly new world, given its light-weighting and recyclable properties. Producing aluminium is incredibly energy intensive, which has typically meant a reliance on cheap coal. However, Norsk Hydro produces its aluminium from predominantly hydropower, resulting in an approximately 80% lower carbon footprint than coal-based producers.

Demand for lower-carbon aluminium will have a profound effect on the supply side too, and autos are a great example. The average car today uses around 180kg of aluminium per vehicle. Larger EVs [electric vehicles], in a bid to offset battery weight, are increasingly replacing steel with aluminium. For example, the Tesla Model S and the Audi 8 Tron use 700800kg of aluminium per vehicle.'

Graham Hay, Antipodes Global Fund

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Companied mentioned in this report

Alcoa Corporation
Century Aluminum
Hindalco Industries
Mytilineos*
Norsk Hydro
Rio Tinto Group
United Company RUSAL

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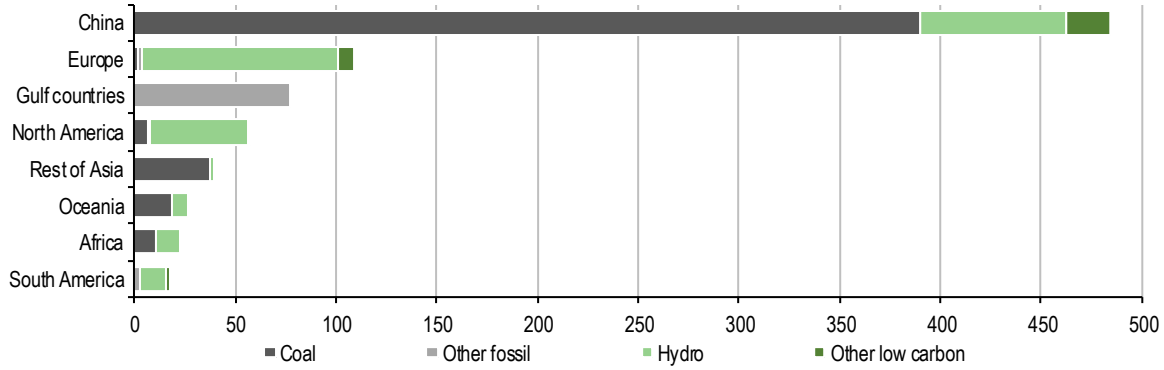
An enormous challenge for global aluminium supply

Due to the high levels of electricity required for aluminium smelting, aluminium production is one of the most carbon-intensive industries. It emits nearly 1.1bn t CO_2e globally (with more than 75% of this from aluminium smelting), according to the International Aluminium Institute (IAI), and China accounts for c 55% of global production. To put it into context, China used 485TWh of electricity in aluminium production in 2020, of which 80% (c 390TWh) was from coal-fired plants, and a majority of these are subcritical (low efficiency). This resulted in 667Mt of CO_2e emissions from Chinese aluminium production, which is almost double the UK's entire CO_2e emissions (c 370Mt) and higher than all but the top seven CO_2-emitting countries globally.

Exhibit 1: Primary aluminium smelting power consumption by source in 2020 (GWh)



Source: Edison Investment Research analysis of latest available data from International Aluminium Institute (IAI), international-aluminium.org/statistics

The rest of Asia, which is mostly India, produces nearly all its aluminium using coal-fired power generation, and Oceania, which is mostly Australia, produces roughly two-thirds from coal-fired power. China, India and Australia were notably absent from the coal phase-out commitments made at the recent COP26 in Glasgow. On the other hand, Europe, North America and South America (which account for c 20% of global output) produce more than 80% of their primary aluminium using low-carbon (hydro, renewable energy or nuclear) power generation. We estimate that roughly a third of global primary aluminium production uses low-carbon power sources and could potentially be classified as 'low-carbon' aluminium according to S&P Global Platts' pricing classification. S&P Global Platts' 'low-carbon' aluminium classification applies to primary aluminium, with maximum emissions from smelting of 4t of CO_2e per tonne of aluminium. Excluding China, where supply chain verification is sometimes more challenging, potential 'green' aluminium accounts for a quarter of global production.

The aluminium industry must reduce its emissions by 77% by 2050 to meet global climate targets, according to the IAI. This will largely be met through shifting to green electricity and assisted by increasing recycling capacity and efficiency (recycled aluminium uses c 5% of the electricity required for primary aluminium production). The International Energy Agency has called for all subcritical coal plants to be shut by 2030; this equates to c 60% of China's aluminium production (c 30% of global supply) in less than 10 years. China has put caps on production but will need to take drastic measures to comply with global climate targets.

Increasing demand exacerbates the challenge

This enormous decarbonisation challenge for the supply side, which the IAI estimates could cost $0.5–1.5tn, is exacerbated by strong demand for aluminium due to the energy transition. Aluminium is a lightweight material used in electric vehicles, for 'green buildings' and power cabling. Based on the IAI's projections for a sub-two degrees global warming scenario, consistent with the Paris Agreement (Beyond 2°C Scenario or B2DS), demand (including recycled aluminium scrap) could increase by 80% to c 170Mt by 2050 (from 95Mt in 2018). The IAI suggests that secondary aluminium (including recycled scrap) production will increase its share from a third in 2018 (31Mt) to nearly 50% (c 80Mt) by 2050, and that up to a 40% increase in primary aluminium production is required (from 64Mt in 2018 to 90Mt in 2050), albeit produced using green electricity sources.

Carbon emissions analysis for aluminium companies

The challenge for the aluminium industry to decarbonise is exacerbated by only c 38% of global aluminium production residing with 10 pure-play listed aluminium producers, as well as Rio Tinto (a diversified miner), Hindalco (an aluminium and copper producer) and Mytilineos (diversified industrials). These are the companies most accountable to investors (and other stakeholders) for reducing their carbon emissions. Of the 13 companies, only seven provide emission-related data and six of these, accounting for c 19% of global production (13.6Mt in 2020), provide carbon emissions reduction targets.

Exhibit 2: Listed aluminium producers that set a CO_2e emissions target

Company	Ticker	Headquarters	Primary aluminium production in 2021 (Mt)	% global production	% renewables in 2021	Provides emissions-related data?	CO_2e reduction target set?
Rusal	0486.HK	Russia	3.76	5.6%	98%	Yes	Yes
Rio Tinto	RIO.LN	London	3.20	4.8%	65%*	Yes	Yes
Hydro	NHY.OL	Norway	2.24	3.3%	70%	Yes	Yes
Alcoa	AA.N	United States	2.19	3.3%	81%	Yes	Yes
Hindalco	HALC.NS	India	1.23	1.8%	0%	Yes	Yes
Mytilineos	MYTIL.GA	Greece	0.18	0.3%	31%	Yes	Yes
Total - targets			**12.81**	**19.1%**			
Century Aluminum	CENX.OQ	United States	0.78	1.2%	>37%*	Yes	No**
Total – emissions data			**13.70**	**20.2%**			
Six remaining listed companies			12.24	18.2%		No	No
Total – listed			**25.83**	**38.4%**			

Source: Company data, Edison Investment Research. Note: *Edison rough estimate (as data not provided by company). **No group-level target; one of its four smelters provides its own targets.

Exhibit 3: CO_2 emissions intensity and targets analysis

Company	2020 CO_2 emissions intensity*	2025 emissions intensity reduction target**	Estimated 2025 CO_2 emissions intensity*	2030 emissions intensity reduction target**	Estimated 2030 CO_2 emissions intensity*
Rusal	<4	15%	<4	35%	<4
Rio Tinto***	>4	15% ****	>4	50%****	<4
Hydro	<4	10%	<4	30%	<4
Alcoa	>4	30%	>4	50%	<4
Hindalco	>>4	25%	>>4	No target	>>4
Mytilineos*****	>4	No target	<4	75%	<4
Century Aluminum	>4	No target	>4	No target	>4
Rio Tinto can be split as:					
– Atlantic aluminium	<4		<4		< 4
– Pacific aluminium	>4		>4		?
Total group aluminium	**>4**	No target	**>4**	**30%**	**<4**

Source: company data, Edison Investment Research. Note: *From aluminium smelting in t CO_2 per tonne of primary aluminium produced (see paragraph below for explanation on <4t, >4t and >>4t classifications and limitations). **From various baseline years. ***Equity basis. ****Rio Tinto's target is for absolute emissions not emissions intensity *****Mytilineos's target is per tonne of aluminium produced (primary & secondary).

Exhibit 3 is intended as a rough guide for assessing the ambitions of those listed companies that provide emission-related data. These include many of the best-in-class aluminium producers. The remaining listed companies and other non-listed companies, comprising almost 80% of global production, typically do not provide relevant emissions-related data and emissions reduction targets.

In addition, there are nuances relating to data consistency for the reported emissions intensities and corresponding emissions reduction targets. Thus, in Exhibit 3, we classify CO_2e emissions intensity from aluminium smelting (normalised by primary aluminium production) according to three buckets:

1. <4t CO_2e/t, which potentially equates to 'low-carbon' aluminium;
2. >4t CO_2e/t, which indicates average emissions intensity above that required for 'low-carbon' aluminium; and
3. >>4t CO_2e/t, which indicates average emissions intensity significantly above that required for 'low-carbon' aluminium and would apply to companies reliant mostly on coal-fired generation, which can equate to emissions intensities of above 15t CO_2e/t.

We note that even within these buckets, an averaging effect over the entire company can distort the fact that some production facilities are below 4t CO_2e/t and others are above 4t CO_2e/t. For example, Rio Tinto provides enough information for us to infer that its aluminium business is split between Atlantic, mostly Canada, where emission intensities at production plants are below 4t CO_2e/t, and Pacific, where emissions intensities are on average above 4t CO_2e/t. Other large aluminium producers, with production plants split across geographies, do not provide this level of detail. Alcoa's production facilities are based in areas including Canada, Iceland and Norway (as well as the United States and Australia), so we believe some of this production is likely to be below 4t CO_2e/t despite its average emissions intensity currently being above 4t CO_2e/t. Indeed, both Rio Tinto and Alcoa already have their own low-carbon branded aluminium, as do Hydro and Rusal.

Nearly all of Rusal's aluminium production likely qualifies as 'low-carbon' as it uses 98% renewable energy (mostly hydro). Rusal is seeking to demerge its few higher carbon aluminium smelters, along with alumina refineries and bauxite mines and rebrand the remaining low-carbon business as AL+. A significant portion of Hydro's and Alcoa's production also likely qualifies, as they use 70% and 81% renewable energy, respectively, although there might be potential to increase the portion as they deliver on their emission reduction targets. In particular, we note that Alcoa has production facilities in the United States and Australia that run on coal. Likewise, Rio Tinto has further scope to increase its portion of 'low-carbon' aluminium as it delivers on its emission reduction targets, potentially reducing the carbon exposure of its Pacific aluminium business. In addition, Rio Tino, in partnership with Alcoa, is working on an inert anode technology (branded ELYSIS) that eliminates all direct (Scope 1) emissions from the aluminium smelting process. We estimate that both Rio Tinto and Alcoa, on a group-wide basis, will be close to average emissions of 4t CO_2e/t by 2025 but not necessarily <4t CO_2e/t. Hydro is exploring three technology pathways towards almost 'near-zero' aluminium, including carbon capture and storage (CCS) for existing plants, its 'HalZero' technology, which reduces Scope 1 emissions, and a number of initiatives relating to aluminium recycling.

Hindalco has significant potential to decarbonise as it is currently fully exposed to coal. However, its 25% emissions reduction target is from a 2012 base year, and it has already achieved an 18% reduction since 2012 (without moving away from coal, through measures including efficiency saving). Century Aluminum does not provide a carbon emissions reduction target (at the group-level) or explicitly state the percentage of electricity consumed from renewables. However, the largest of its four smelters (Nordural, based in Iceland) sources its electricity from hydro and geothermal sources; based on this we estimate at least 37% of electricity, at the group-level, is from renewables. Furthermore, Nordural already produces low carbon-branded products as its carbon

intensity is <4t CO_2e/t and has its own smelter-level target to further reduce greenhouse gas emissions by 2030. Century Aluminum's other three smelters are based in the United States, with two of them in Kentucky, which generates c 70% of its electricity from coal. In the absence of a clear plan to decarbonise these three plants (ie through captive renewable plants) it does not seem likely that Century Aluminum will achieve group-wide carbon emissions <4t CO_2e/t by 2030 and thus we classify it as a laggard.

Mytilineos has set by far the most aggressive target of a 75% reduction in emissions intensity (normalised by primary and secondary aluminium production) by 2030. From 2025, we estimate that Mytilineos will qualify for S&P Global Platts' 'low-carbon' classification for its entire aluminium production, as it increases its share of electricity generation from renewables to 70% (mostly from low-cost solar photovoltaic (PV) in Greece). Furthermore, based on our review of sustainability reports for emissions reduction targets, Mytilineos appears to be the only company that is planning a material increase in secondary aluminium production. We estimate that its secondary aluminium production will increase from c 20% of total production in 2020 to 40% in 2030.

This report does not address the economics of renewable power generation and thus potential margins from low carbon aluminium. For instance, Mytilineos is securing low-cost solar energy due to very favourable conditions in Greece; in many markets the cost of solar is significantly higher. Low-cost energy combined with the CO_2 EU compensation scheme makes Mytilineos a beneficiary in the current higher energy and carbon price environment, maintaining its position at the low end of the cost curve.

In summary

A 'low-carbon' aluminium classification could potentially support above-average long-term pricing premiums as customers are increasingly willing to pay a premium for low-carbon products and services, which can in turn help them achieve their own emissions reduction targets and/or make their products more attractive to environmentally conscious consumers. Whether premium prices lead to premium profits depends on the potential to source renewable electricity from lower-cost projects/regions. Leaders and laggards are:

Leaders: Rusal and Hydro

Transitioning: Rio Tinto, Alcoa and Mytilineos

Laggards: Hindalco, Century Aluminum and all other listed and non-listed aluminium producers (which do not provide emission data and emissions reduction targets), equating to >50% of global supply.

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