TRADE & INDUSTRIAL POLICY STRATEGIES

POLICY BRIEF: 12/2022

# Hillside Aluminium: Low-carbon energy options and the implications

## OVERVIEW

Aluminium is lightweight, recyclable, non-corrosive, has high thermal and electrical conductivity, is low density, non-toxic, and non-magnetic, making it the most versatile multiuse metal. It is predominantly used in the transport, construction, consumer goods, packaging, and machinery and equipment industries (Plunkert et al., 1991). Due to its unique properties, aluminium can contribute towards the decarbonisation efforts of a variety of industries, although its production is also a major source of greenhouse gas (GHG) emissions. In 2019, aluminium production accounted for 2% of global GHG emissions (IEA, 2020).

South Africa has no known bauxite deposits, the primary material in aluminium production, and as such has no mining and refining facilities. South Africa's aluminium value chain begins with primary aluminium production, at the South32 (previously BHP Billiton) Hillside Aluminium smelter. Hillside Aluminium is the only primary aluminium producer in South Africa and the largest in the Southern Hemisphere. This Policy Brief draws on a study on the climate compatibility of the South African aluminium value chain in South Africa by Lerato Monaisa and Gaylor Montmasson-Clair: *South Africa's Aluminium Value Chain and Climate Change Compatibility*. It presents the argument for Hillside sourcing low-carbon energy and outlines the options for Hillside as well as the implications of a low-carbon transition.

## INTRODUCTION

Hillside Aluminium, based in Richards Bay, is a key industrial employer and has played a role in developing the industrial base in the KwaZulu-Natal region. Hillside supplies both domestic and export markets and has linkages with domestic downstream industries (South32, 2021a). The value chain also consists of secondary aluminium production by Zimco Metals and Insimbi (Metlite Alloys), semi-fabrication and fabrication by Hulamin and Wispeco, aluminium scrap recovery and recycling by Hulamin and Zimco Metals.

Reliance on fossil fuels as energy inputs makes the South African aluminium value chain highly carbon intensive. Across the value chain, indirect emissions[1] account for most GHG emissions. The Hillside smelter is completely dependent on coal-powered electricity from national utility, Eskom. In 2021, electricity accounted for 88% of the smelter's combined Scope 1 and Scope 2[2] emissions (South32, 2021).

In the long run, Hillside would need to produce aluminium from low-carbon energy sources to remain internationally competitive (Creamer, 2022a). The world is shifting towards a low-carbon economy. As climate change action intensifies, carbon-intensive industries like aluminium will need to rethink their operations and business models and align them with a low-carbon future.

In addition to ensuring Hillside remains competitive, shifting towards a low-carbon energy supply could be an opportunity not only for the smelter but for the South African aluminium industry as a whole. The market for "green aluminium"[3] is growing, with green aluminium producers increasingly receiving a premium price for their products (Creamer, 2022a). Hillside producing green aluminium could offer some domestic downstream industries protection from climate change policies, by supplying low-carbon inputs.

[1] *Indirect emissions (also known as Scope 2) occur through the use of purchased electricity, steam, heat, or cooling. They result from an organisation's activities, but are actually emitted from sources owned by other entities.*

[2] *Scope 1 covers emissions from owned or controlled sources. Scope 2 covers indirect emissions generally from generation of purchased electricity, stream, heat or cooling.*

[3] *Aluminium produced from renewable energy sources.*

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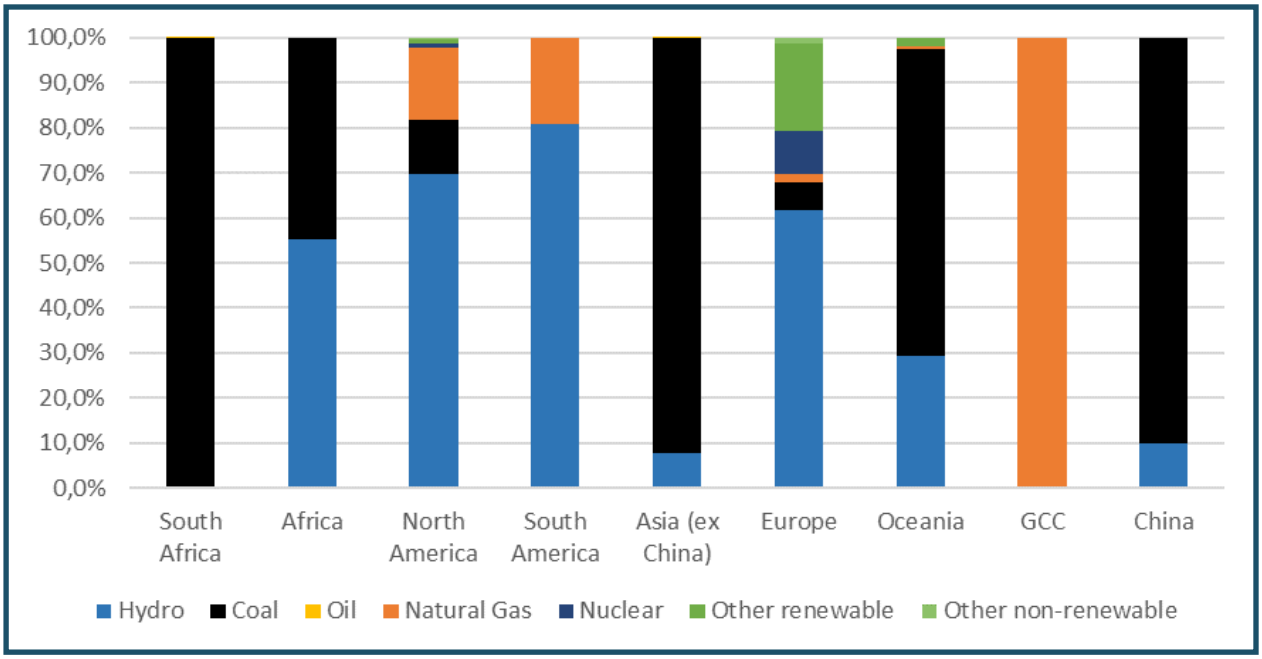
**Figure 1. Power mix of primary aluminium production in 2017**




*Source:* Authors, based on data from the International Aluminium data base on Primary Aluminium Smelting Power Consumption primary aluminium smelting power consumption in September 2022. *Note:* GCC = Gulf Cooperation Council.

## SOUTH AFRICA'S PRIMARY ALUMINIUM: A BRIEF HISTORY

In the 1980s and 1990s, Eskom had excess generation capacity, with about a 40% reserve margin. Two BHP Billiton (now South32) aluminium smelters, Bayside and Hillside, were established to promote industrial development, support the growth of Richards Bay, and to absorb the excess power generation capacity. Industrial policy at the time advocated investment in large, energy-intensive sectors and was seen effectively as a coal-beneficiation strategy (Montmasson-Clair et al., 2014).

Given the cost of storing surplus electricity, Eskom entered into 25-year Special/Negotiated Pricing Agreements (SPAs/NPAs) with BHP Billiton. The SPAs provided the smelters with an electricity tariff fluctuating with the performance of aluminium prices and the South African rand to United States dollar exchange, rather than the cost for Eskom to supply power (Montmasson-Clair et al., 2014).

As electricity supply constraints led to loadshedding in the late 2000s, the government requested that the industry reduces electricity demand by 10%, meaning BHP Billiton had to reduce 120 000 tonnes of production to cut its electricity consumption. In 2014, the Bayside smelter was decommissioned due to "significant and ongoing financial pressure" (De Klerk, 2019). Hillside remained the only primary aluminium smelter in the country.

When the old NPAs expired in 2020, Eskom entered into a new 10-year NPA with South32 for the remaining smelter. The original NPAs were criticised for the length and embedded derivative risk[4] which favoured BHP Billiton. Over time (as aluminium pricing dropped), the NPAs resulted in the heaviest user of electricity paying some of the lowest prices for it (Moorcroft, 2014).

The new 10-year contract excludes the embedded derivative by excluding the rand dollar exchange link and includes real yearly price increases linked to South African producer price inflation (Eskom, 2021a). While the tariff rate under the new agreement is publicly unknown, according to Eskom, the new agreement aims to sustain the production of aluminium at Hillside and to maintain its largest industrial customer. Hillside also plays an important role in stabilising Eskom's grid. The smelter provides flexible interruptible loads, which is used by the National System Operator during peak and low demand. Hillside offers 2 000 MW of instantaneous reserve and supplemental reserve to supply the demand during national power supply constraints (Monaisa and Montmasson-Clair, 2022).

## WHY HILLSIDE NEEDS TO PRODUCE ALUMINIUM FROM LOW-CARBON ENERGY

Hillside is heavily reliant on Eskom's grid. Coal-powered electricity accounts for 100% of the energy requirement at a base load of 99.9%. As shown in Figure 1, coal accounts for 44% of the energy for primary aluminium production in Africa. This is largely attributed to the Hillside and Mozal smelters. Mozal in Mozambique sources about 47% of its electricity from Eskom. Mozambique exports hydropower generated from the Cahora Bassa

[4] *A risk component that includes a non-derivative host with the effect that some of the cash flows of the combined instrument vary in a way similar to a stand-alone derivative.*

*In the long run, Hillside will not survive without securing low-carbon electricity. Hillside shutting down would have adverse implications for the local aluminium industry, the Richards Bay region, and the broader South African economy.*

hydropower to South Africa, which is then bought back from Eskom by Mozal (Manuel, 2013). Ghana and Cameroon primarily produce their primary aluminium using hydroelectric power from the Akosombo and Edea hydroelectric dam respectively. Egypt primarily sources it energy from natural gas and oil (Africa Intelligence, 2003; EJAtlas, n.d.; Moamar, 2022).

Asia's and China's primary production are also largely coal-driven, with 92% and 90% of energy requirement respectively. In Europe, North America and South America smelters predominantly use hydropower with the largest hydropower use being in South America where it contributes 81% to the energy requirements. Countries of the Gulf Cooperation Council use oil as their primary energy input for aluminium smelting.

The premise under which primary aluminium was established in South Africa, i.e. access to excess, cheap, reliable electricity, no longer holds. Electricity generation supply constrains have worsened over the past 15 years and electricity tariff increases have far outpaced inflation (Moolman, 2015). In addition to these factors, Hillside is also facing internal and external pressures to reduce its carbon footprint.

South32 targets a 50% reduction in operational GHG emissions (Scope 1 and Scope 2) by 2035 compared to the 2021 baseline. Hillside contributes to 58% of the South32 group's operational GHG emissions. South32 has announced that it is looking to secure options to procure low-carbon electricity for Hillside. The initial outcome of its scoping exercise suggests that renewable energy would be technically feasible. The group is engaging with the South African government, Eskom and other potential partners to identify options for renewable energy infrastructure. If South32 were unable to secure affordable low-carbon electricity, Hillside would over time become uncompetitive. Accordingly, South32 has started planning to support a just transition through the closure of the smelter if the energy transition is not commercially viable (South32, 2021).

Countries are progressively implementing climate change mitigation measures, such as carbon pricing and carbon border taxes to curb GHG emissions. South Africa is no exception, as exemplified by the implementation of a carbon tax and carbon budgets. The European Union (EU), South Africa's largest aluminium export destination (34% of aluminium exports in 2021 in value), is implementing the Carbon Boarder Adjustment Mechanism (CBAM) (Monaisa, 2021), which will impose a tax on direct and indirect embedded emissions in aluminium products imported into the EU. It will impact the value chain's competitiveness and erode profit margins (European Commission, 2021; Trade Map, 2022). Other jurisdictions, such as the United Kingdom, the United States and Canada, are also planning to implement their own carbon border taxes. (Brauch et al., 2021).

Demand for low-carbon aluminium is increasing, driven largely by shifting consumer preferences and companies which want low-carbon supply chains. Automotive OEMs like Audi and BMW are sourcing low-carbon aluminium, at a premium, from producers such as Natur-AL, Hydro and Emirates Global Aluminium. Electronic and tech companies such as Apple, Teslar and LG are also increasing low-carbon aluminium content in their product ranges (Adriaan Kruger, 2022). As the market for low-carbon aluminium grows many low-carbon aluminium producers have begun rebranding their products to differentiate them from carbon-intensive products (Creamer, 2020).

In the long run, Hillside will not survive without securing low-carbon electricity. Hillside shutting down would have adverse implications for the local aluminium industry, the Richards Bay region, and the broader South African economy.

## AVENUES FOR HILLSIDE TO SOURCE LOW-CARBON ENERGY

Hillside urgently needs to secure low-carbon energy sources. The internal and external pressures mentioned in the previous section show that Hillside needs to have significantly reduced its indirect emissions by 2035. The smelter's Scope 2 intensity, at 14.9 tCO2e/t aluminium, far exceeds the global average Scope 2 intensity of 1.6 tCO2e/t aluminium (South32, 2021). In the absence of hydropower solutions, Hillside will need to rapidly deploy renewable energy and battery storage. From the research in Monaisa and Montmasson-Clair (2022), Hillside has three main options to secure renewable energy: the decarbonisation of the national grid, Hillside procuring renewable energy independently, and a partnership between Eskom and Hillside.

### Decarbonisation of the national grid

This option would require accelerating new renewable energy generation and storage capacity builds at the national system level. The Integrated Resource Plan (IRP) 2019 aims to increase renewable energy generation from 6% in 2019/20 to 41% in 2030. Eskom aspires to build large-scale renewable energy power generation aligned with the IRP.

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In addition to building renewable energy and battery storage capacity, Eskom would also need to upgrade its transmission and distribution network (Department of Mineral Resources and Energy, 2020; Eskom, 2021b). Energy experts recommend that renewable energy and battery storage build needs to be undertaken at a pace four times faster than is currently being built. South Africa would need about 4GW of renewable energy per year over the next 30 years to reach net-zero by 2050 (NBI, BUSA and BCG, 2021).

While the decarbonisation of the national grid is under way, this avenue may not be fast enough for Hillside. Another concern is that the renewable energy which goes online cannot be earmarked for Hillside. Hillside currently pays a special NPA tariff rate for electricity,[5] the price of which is not publicly known. The concern is that any negotiated renewable energy tariff rate would need to be higher than the NPA tariff rate. This might not be financially feasible for Hillside (Monaisa and Montmasson-Clair, 2022).

## Hillside procuring electricity independently

Hillside's power demand is 1 205MW of electricity at a baseload factor of 99.9%, meaning it requires a constant supply of electricity. Operating the smelter on renewable energy alone would require about 5 000MW of solar and wind energy supplemented by a large battery storage capacity (Monaisa and Montmasson-Clair, 2022).

According to energy expert Clyde Mallison, Hillside could secure solar and wind energy at a factory gate price of R0.03/kWh by 2030. This would enable a zero Scope 2 smelter by 2030. Hillside could procure the renewable energy and storage from Independent Power Producers (IPPs) (Creamer, 2022a; Mallinson, 2020). As Hillside would be unable to build the required renewable energy generation capacity on or near its smelter, it would be required to wheel it through Eskom's and municipalities' distribution and transmission networks. This approach, recently enabled by policy and regulatory changes which have eased licensing requirements for private-to-private power generation transactions, would require significant investment in renewable energy generation and storage capacity. The capital required could be raised by issuing a dollar-denominated power purchase agreement, thereby attracting dollar-based financing and more attractive interest rates.

Hillside could take the following approach to securing renewable energy by 2030:[6]

- Block stages: Hillside could procure all the renewable energy and storage it requires in four block stages, procuring up to 1 000MW per stage. The smelter could also access up to 2GW of pumped storage over an eight-year period. This approach would be challenging, as raising investment funding and the procurement process would need to be done fairly rapidly for the first stages.
- Exponential stages: Hillside could procure its renewable electricity in an exponential manner, meaning procuring low amount of generation capacity at the beginning (2MW-10MW) and more towards the end. This approach would help the group capitalise on the falling prices of renewable energy and battery storage while easing its way off the national grid.

The scale of renewable energy required by Hillside would make this avenue challenging. In addition to financing the project, issues around wheeling and land use for construction of renewable energy and battery would need to be addressed. This approach would have serious implications for Eskom as it would mean losing its largest industrial customer and the revenues associated with it as well as losing Hillside as a grid stabiliser (Monaisa and Montmasson-Clair, 2022).

## Partnership between Hillside and Eskom

Hillside and Eskom could use their long-standing commercial relationship to establish a public-private partnership (PPP) to secure renewable energy and storage options for Hillside. This relationship would be mutually beneficial as Eskom would retain its largest industrial customer, while Hillside would secure its much-needed low-carbon power supply.

The partnership could entail repurposing old Eskom power stations to generate renewable energy for Hillside. Large short-duration energy storage facilities would need to be used to supplement the renewable energy. When extra capacity is available, it could charge the battery storage for use during low capacity periods.

The De Hoop dam Tubatse hydro-battery project, in Limpopo (about 650km away from Hillside), could enable Hillside's use of renewable energy sources from 2030 to beyond 2050. The project has been stalled for several years due to financial constraints. Tubatse's capacity and large capital requirements would make it ideal for Eskom and Hillside. The hydro-battery project has been suggested by energy experts as a PPP which could provide 12 000MWh of battery storage for Eskom and Hillside. The project would be

[5] *According to Eskom and Southh32, the Hillside smelter would not be viable or sustainable on the applicable Eskom standard tariff available (Megaflex).*
[6] *Interview with Clyde Mallison.*

**Table 1: Socio-economic implications of a Hillside-Eskom PPP**

| STAKEHOLDER | IMPLEMENTATION REQUIREMENTS | ESTIMATED COSTS | ESTIMATED BENEFITS |
|---|---|---|---|
| **Hillside** | Engage with Eskom and government to establish a PPP to secure low-carbon solutions.<br>Leverage the industrial relationship with Eskom to facilitate PPP.<br>Renegotiate a new contract with Eskom to accommodate PPP.<br>Invest in renewable energy generation capacity and battery storage through PPP with Eskom. | Investment and associated costs in renewable energy and energy storage. | Low-carbon electricity for production processes.<br>Reduction in indirect GHG emissions and lower carbon intensity of aluminium products.<br>Reduction in vulnerability to climate change and potential losses due to climate change policies.<br>Increased business resilience and improved competiveness. |
| **Eskom** | Engage with Hillside and government to establish a PPP to secure low-carbon solutions.<br>Leverage industrial relationship with Eskom to facilitate PPP.<br>Renegotiate a new contract with Eskom to accommodate PPP.<br>Secure funding and invest in renewable energy generation capacity and battery storage for PPP. | Investment and associated cost of renewable energy generation and storage for PPP.<br>Investment and associated costs of upgrading distribution and transmission network to facilitate PPP. | Reduction in Eskom's GHG emissions and lower power sector carbon intensity.<br>Retaining Hillside as largest industrial customer. |
| **Government** | Formulate and implement changes to regulatory and legislative framework to facilitate PPP with Eskom and Hillside. | Costs associated for support measures for decarbonising Eskom.<br>Associated costs and implication of changing the regulatory and legislative framework to facilitate PPP between Eskom and Hillside. | Reduction in national GHG emissions.<br>Reduced national vulnerability to climate change and climate change policies.<br>Retaining primary aluminium smelting as an economic activity. |
| **Workers and communities** | Participate in the establishment of a Hillside-Eskom PPP to secure low-carbon solutions. | Costs associated with participating in and implementing a Hillside- and Eskom PPP to secure low-carbon solutions. | Reduction in GHGs and vulnerability to climate change.<br>The employment and business opportunities from a sustainable aluminium smelter. |

accompanied by 1 000MW of solar PV and wind electricity generation which would be wheeled over Eskom's grid to power Hillside and an additional 1 000MW of solar PV and wind to recharge the battery. This project would need Eskom and South32 to leverage their long-term commercial relationship and mutual interest in the survival of the smelter (Creamer, 2022b). The hydro-battery project could also assist in stabilising the growing fleet of wind and solar energy. The Tubatse hydro-battery project should be accompanied by other options such as battery storage and other large short duration storage facilities.

South32 is investigating implementing the EnPot energy modulation technology. EnPot gives smelters the ability to turn their energy consumption up or down by as much as 30%. Smelters can then better match energy supply with demand, enabling them to more efficiently use renewable energy sources. It allows energy-intensive smelters to modulate energy use on demand at a much lower cost (Djukanovic, 2017; EnPot, 2019). EnPot could enable the PPP as Hillside's energy demand could be managed with greater margins.

South32 has stated that the most suitable approach is to partner with Eskom to secure green options for Hillside (Monaisa and Montmasson-Clair, 2022). This approach would require amendments to and/or a new NPA contract between Hillside and Eskom.

## THE WAY FORWARD AND POTENTIAL IMPLICATIONS

From the research, a partnership between Hillside and Eskom emerges as the most suited avenue for both. To secure renewable energy for Hillside by 2035, the partnership would require the following:

- The timely formulation and implementation of a PPP agreement between Eskom and Hillside, with the appropriate risk sharing between both parties;
- Since the PPP would be under duration of the current NPA, a new NPA would have to be negotiated and approved which incorporates the PPP;
- The relevant financial and support measures from both Hillside and Eskom; and
- The appropriate regulatory and legislate framework to enable such a PPP.

Table 1 shows the socio-economic implications of a Hillside-Eskom PPP.

*Decarbonising Hillside would ensure not only the survival of the smelter but could present an opportunity for downstream sectors to produce and export low-carbon aluminium products.*

While the financial implications of such a partnership are unknown, it will require significant investment financing. Given Eskom's financial health and debt crisis, it would be challenging for the utility to generate the funds to participate in the PPP. The financial implications of the PPP would also need to be financially feasible for South32. The time constraints required to secure low-carbon energy for Hillside mean that any delays in establishing the PPP and implementing the low-carbon energy options could delay the South32 group achieving its emissions reduction targets.

## CONCLUSION

The Hillside aluminium smelter is highly carbon intensive, primarily due to its reliance on coal-powered electricity from Eskom. Its Scope 2 carbon intensity far exceeds the global average Scope 2 emissions. In the long run, this will place the aluminium smelter at risk of losing international competitiveness and access to markets.

Decarbonising the energy input would be crucial for ensuring the survival of Hillside. From the research, three options emerge which can be pursued to secure low-carbon energy options for Hillside.

The first is decarbonising the national grid. This would require a rapid rollout of national renewable energy generation capacity. The key concerns with this option are that the renewable energy deployed cannot be earmarked for Hillside, the glide path may not be fast enough, and the current renewables tariff rate could not allow Hillside to remain competitive.

The second is that Hillside procures renewable energy independently through IPPs. This option would require Hillside to invest in utility-scale renewable energy and battery storage. While possible to some extent, it appears difficult to implement in practice. This would lead to Eskom losing its primary anchor customer.

A partnership between Hillside and Eskom would be a third avenue. This is the most suited option, as it is mutually beneficial for both parties. This option would ensure Eskom retains its largest industrial customer and it would secure low-carbon energy and battery storage for Hillside.

Decarbonising Hillside would ensure not only the survival of the smelter but could present an opportunity for downstream sectors to produce and export low-carbon aluminium products. Government, Eskom, South32 and other key stakeholders would need to collaborate on investment funding, unblocking constraints to expanding renewable energy and battery storage as well as new technologies which can further reduce the carbon footprint of the aluminium value chain.

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