AUSTRALIAN ALUMINIUM COUNCIL LTD

# Electricity

## Decarbonisation of the Australian Electricity Supply

The single biggest opportunity to decarbonise the Australian vertically integrated aluminium industry is through decarbonisation of their electricity supply.

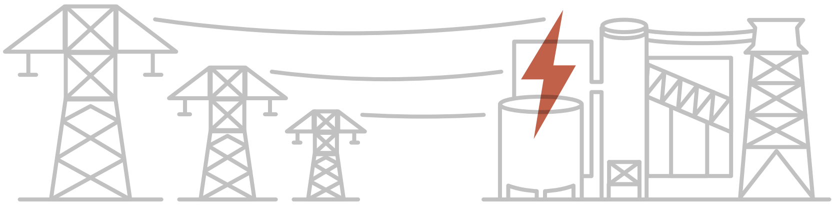
Australia's grid connected mines, refineries and particularly smelters perform an enabling function in grid stabilisation which helps with increased penetration of variable renewable electricity. The carbon intensity of the Australian grid is declining, with this increased penetration of variable renewables. Industry also has the opportunity, as part of contract renewal, to source firmed renewable electricity from on grid sources or behind the meter sources.

Currently, the industry's indirect emissions associated with the consumption of grid purchase electricity are around **17 Mt CO2-e**, of which **95% is from the production of primary aluminium**. However, technologies which to electrify alumina refineries could offset an additional **14 Mt CO2-e**, largely associated with replacement of fuel combustion in digestion.

Growth in the penetration of renewable energy has, in recent years, outstripped previous forecasts. Nationally, the electricity sector is forecast to have a total penetration of more than **82% renewables by 2030**, almost quadrupling the 23% in 2019[1]. In the National Electricity Market (NEM), where **all four smelters** are located, the penetration is forecast to be similar at **83% of electricity in 2030**[2].

**As smelters already use an electrolytic process, this change alone could reduce emissions associated with aluminium smelting by around 13Mt CO2-e by 2030. As the four smelters recontract over the period 2025-2029, there are further opportunities for decarbonisation**[3].

## Smelters have an increasing role to play in grid stability



The high penetration of intermittent renewable generation will require more firming capacity and support for system strength to maintain the reliability required by smelters. In an aluminium smelter, electricity both enables the alumina to split into aluminium and oxygen and to maintain the temperature of the process at about 950°C. After around 75 minutes without electricity, liquid aluminium cools and starts to solidify or "freeze" in the smelter, which can lead to loss of a potline requiring months to rebuild and restart. Each smelter has a unique design which impacts its ability operate flexibly.

Aluminium smelters can offer a range of services and functions which support the network over varying weather, network demand and operating conditions, including Reliability and Emergency Reserve Trader (RERT) and Frequency Control Ancillary Services (FCAS). Smelters' large and fast-acting interruptibility help secure and restore stability to the network before and after contingencies occur. The industry has increasingly been called upon to support grid stability and reliability, as the challenges in managing the increased penetration of variable renewables in the grid increases.

The range of services varies by smelter technology and a number of other external factors[4]. For example, a one-hour notice period can allow a smelter to prepare for an event and take precautions, such as applying additional power in the pots, to minimise the recovery time should an interruption be called. However, in an emergency situation, it is possible to shed large amounts of load in less than a minute. The ability of smelters to provide a response is also influenced by the recency, duration and frequency of interruptions, where consecutive interruptions within a short time frame are considered more challenging. This applies to both interruptibility and flexibility.

Very large electricity users play a number of roles in the market including:

- Buffering the erosion of minimum scheduled demand;
- Support for the continued economic commitment and operation of large-scale synchronous generation (noting that de-commitment of synchronous units due to inadequate base demand levels can regularly remove large blocks of inertia and system strength from the system);
- Supply of certain essential system services, such as contingency FCAS;
- Potential participation in "backstop" reliability schemes such as RERT or Interim Reliability Reserve (IRR); and
- Enhancing system resilience through rapid unscheduled interruptibility in the case of extreme high impact events, which like more extreme weather conditions are occurring increasingly frequently in the NEM and are increasingly complex to match with dispatch in real time.

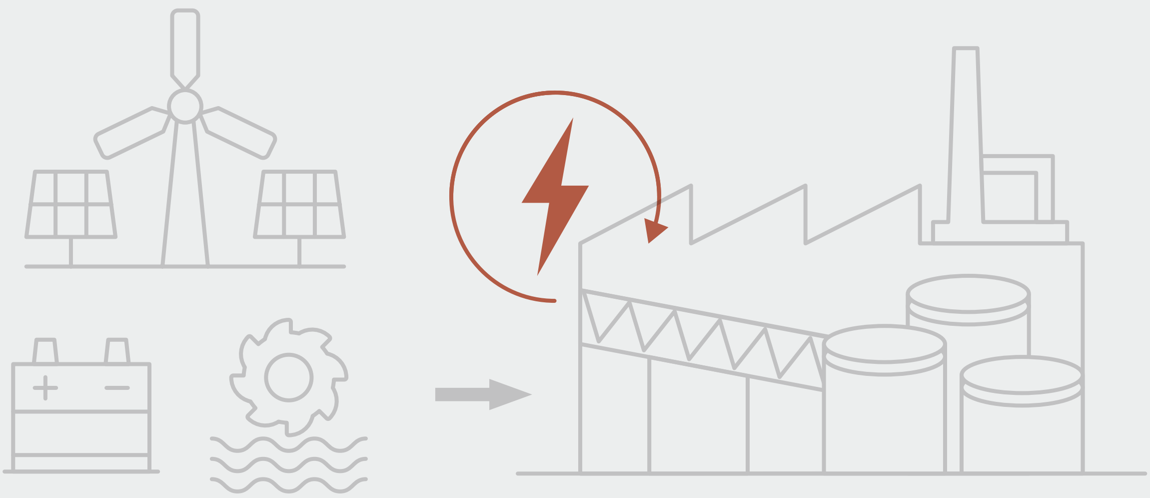
However, many of these services are currently unpriced, or where the mechanism to value them is poorly aligned with operational practices.

These are resources which already exist, although they could be further enhanced with improved investment signals.

## Alumina refineries could be significant in a future electricity market

Around 215 PJ of energy, derived from gas or coal, is currently used in the digestion and calcination phases in alumina refineries to generate steam and heat. This has the potential to be replaced by renewables, once they are internationally competitive and subject to commercialisation of technology development (including Mechanical Vapour Recompression, Electric or Hydrogen Calcination and Electric Boilers). This has the potential to require more than 3-5G GW[5] of electricity to replace the thermal generation, on a like for like basis. This would fundamentally transform both the NEM and South West Interconnected System (SWIS) electricity markets.

Alumina refineries already provide some demand response to the grid. However, if there was to be an increased supply of competitively priced zero emissions electricity and subject to technical developments, there is the potential to materially increase the electrification of alumina refineries combined with demand response, which could supplement electricity firming.



Sources:

[1]https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2022

[2]https://aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/2022-integrated-system-plan-isp.pdf?la=en

[3]https://www.afr.com/companies/energy/4b-offshore-wind-farm-proposedto-power-smelter-20211207-p59fe4, https://www.abc.net.au/news/2021-11-08/alocamelter-pot-restart-operations-at-portland/100602358, https://www.riotinto.com/news/releases/2022/Rio-Tinto-calls-forproposals-for-large-scale-wind-and-solar-power-in-Queensland, https://www.riotinto.com/news/releases/2022/Tasmania-and-Rio-Tinto-partner-fora-strong-and-sustainable-future-at-Bell-Bay

[4]https://esb-post2025-market-design.aemc.gov.au/32572/1608712640-energy-synapse-demand-response-in-the-nem-final-report-14-dec-2020.pdf, https://www.tomago.com.au/tomago-aluminium-future-renewable-energy-needs/

[5]https://arena.gov.au/knowledge-bank/a-roadmap-for-decarbonising-australian-alumina-refining/