AUSTRALIAN
ALUMINIUM
COUNCIL LTD

info@aluminium.org.au

Department of Climate Change, Energy, the Environment and Water (DCCEEW)
https://consult.dcceew.gov.au/electricity-and-energy-sector-plan-discussion-paper

26 April 2024

Dear Minister

Re: Electricity and Energy Sector Plan Discussion Paper

The Australian Aluminium Council (the Council) represents Australia's bauxite mining, alumina refining, aluminium smelting and downstream processing industries. The aluminium industry has been operating in Australia since 1955, and over the decades has been a significant contributor to the nation's economy. Department of Industry, Science and Resources has recently forecast[1] that earnings for Australian exports of aluminium, alumina and bauxite are expected to rise from $16 billion in 2023–24 to $18 billion in 2024–25. More than $14B of this comes from the alumina and aluminium industries, as value adding mineral processing sectors. The industry includes six large bauxite mines plus several smaller mines which collectively produce over 100 Mt per annum making Australia one of the world's largest producers of bauxite. Australia is the world's largest exporter of alumina with six alumina refineries producing around 21 Mt per annum of alumina. Australia is the seventh largest producer of aluminium, with four aluminium smelters and additional downstream processing industries including more than 20 extrusion presses. Aluminium[2] is one of the commodities most widely used in the global transition to a clean energy future. It is also recognised for its importance to both economic development and low emissions transition. Aluminium is Australia's top manufacturing export. The industry directly employs more than 19,000 people, including 6,600 full time equivalent contractors. It also indirectly supports around 60,000 families predominantly in regional Australia.

Yet, as the Council has maintained throughout our dialogue with Government, the future of the industry in Australia cannot be taken for granted[3]. Key risks include high energy costs combined with a high cost to decarbonise industrial processes, proactive industry policy among competitor nations, as well as regulatory complexity and uncertainty.

Aluminium is one of the commodities most widely used in the global transition to a clean energy future[4]. It is also recognised for its importance to both economic development and low emissions transition. Aluminium use is highly correlated with GDP, so as countries urbanise, per capita use of aluminium increases. It is expected that by 2050, global demand for aluminium will nearly double[5]. While an increasing proportion will be met through recycled aluminium, there will still be a need for increased production of primary aluminium requiring a comparable increase in global bauxite mining and alumina refining rates.

The Council welcomes the opportunity to respond to the Electricity and Energy Sector Plan Discussion Paper (the Paper), as one part of the Government's consultation on the overall Net Zero Plan. The aluminium industry has a strong overlap with the industry and resources sectoral decarbonisation plans, as well as some with the built environment and transport for aluminium in use. The Council looks forward to the integration of these sectoral plans to effectively bring together the necessary steps to allow Australia's industry to first

survive the transition and then thrive in a net zero economy. The Council notes there is an intention to consult on the overall plan later in 2024. In its response to the Paper the Council will focus on responses to key questions.

In addition to this covering letter, this submission includes three parts:

A. Aluminium Industry Decarbonisation Pathways.
B. Feedback on the Electricity and Energy Sector Discussion Paper.
C. References

Australia has a large resource and industrial base and has great potential for conversion to zero- and low-emissions industrial production including for export, with economic benefits to match. While industrial production is a major contributor to Australia's overall emissions, both directly and via consumed electricity, Australia's green industry ambition is linked to opportunities created by the global transition to net zero.

Australia is one of the very few countries which has bauxite mining, alumina refining, aluminium smelting and aluminium extrusion all within its borders, making aluminium one of only two commodities in which the raw materials are mined and processed all the way to a consumer product right here in Australia. The single biggest opportunity to decarbonise the energy intensive, vertically integrated Australian aluminium industry is through the combination of electrification or conversion to low emissions fuels for existing industrial processes and decarbonisation of the national electricity supply.

However, to support this industrial decarbonisation, Australia must be sufficiently competitive to be able to attract global decarbonisation investment. Recent analysis by the Council compared industry policy measures in Australia with other key aluminium and alumina producing jurisdictions[6] and found more is required to ensure appropriate policy settings are in place to support a positive future for this strategically important industry. The Council supports the use of targeted public investment in both decarbonisation and ensuring delivered energy costs are internationally competitive, as an important step in reducing long-term carbon exposure de-risking investment decisions and accelerating technology cost reductions through deployment and learning. This should be combined with Production Tax Credits and a Transformational Infrastructure and Technology Fund to enable Australia to be competitive and attract global decarbonisation investment.

The Council notes that a critical aspect of the transition will be to find a pathway for Australia's world class energy resources to be translated into internationally competitive, low emissions, reliable energy to ensure industrial production, emissions and jobs are not exported to other countries. Australia has the opportunity to shape its future, including its energy transition and industrial transformation, in a manner which is consistent with not only its net zero ambitions, but which maximises the social and economic potential of its resources. The Council looks forward to continuing constructive dialogue during the development of the Government's Net Zero Plan. The Council is happy to provide further information on any of the issues raised in this submission.

Kind regards,

Marghanita Johnson
Chief Executive Officer
Australian Aluminium Council
M +61 (0)466 224 636
marghanita.johnson@aluminium.org.au

A. **Aluminium Industry Decarbonisation Pathways**

The Mission Possible Partnership, in collaboration with the International Aluminium Institute, recently released Making Net Zero Aluminium Possible: A Transition Strategy for a 1.5°C-compliant Aluminium Sector[7] (the Strategy). The release of the Strategy was supported by the Council and its members. This work brought together companies across the global industry, including those operating across the value chain in Australia. The Strategy recognised that it is possible to meet rising aluminium demand, reduce emissions from the sector to net zero by 2050, and align with a 1.5°C target. The Strategy also highlighted that a global investment of approximately US$1 trillion will be required for the aluminium sector transition, including significant investment to supply the required zero-emissions electricity. Considering the size of the Australian aluminium industry (~3% of the global industry), this equates to an investment of US$30bn to deliver the same outcome. The Strategy outlines not only actions the industry needs to take, but also actions required by Governments to support this. In particular, developing policy that is predictable, stable and transparent to enable businesses to confidently plan for the substantial investment that comes with a commitment to decarbonisation. Governments also have a vital role to play designing markets to support the transition, particularly for the energy and electricity sectors.

The Australian Renewable Energy Agency (ARENA), in consultation with Alcoa, Rio Tinto and South32 has published a Roadmap for Decarbonising Australian Alumina[8]. The Roadmap identifies four key themes for decarbonisation that could transform the way alumina refineries consume and use energy by enabling the uptake of renewables and removing the use of fossil fuels. It also provides a framework for future policy and investment decisions and serves as a call to action to collaboratively transition the sector into an industry at the forefront of the transition to net zero.

In 2022, Scope 1 and 2 emissions from Australia's integrated aluminium industry (bauxite, alumina, aluminium) were about 33.7Mt CO2-e, which was 7% of Australia's national emissions (Figure 1). Energy typically accounts for 30-40% of the industries cost base, and therefore energy efficiency is a key focus of for these processes.

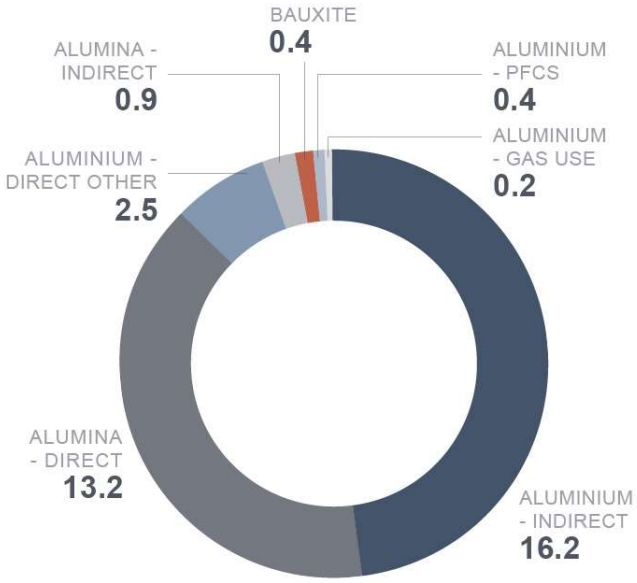

Figure 1. 2022 Industry Emissions (Mt CO_2-e)

Globally, there is a focus across industry to find solutions for the technology challenges required to decarbonise, including the use of hydrogen based technologies. There is an opportunity for Australia to lead the world in development and implementation of these technologies, capitalising on Australia's national

advantages, providing jobs and value to the economy. The Council has produced a series of five detailed factsheets to help articulate the technology pathways:

1. Australia's role in a global aluminium decarbonisation pathway;
2. How Australian bauxite will help meet global demand for aluminium;
3. Australia's role in developing low carbon alumina refining technologies for the world;
4. The role of Australia's aluminium smelters in providing baseload stability in a decarbonising grid; and
5. Decarbonisation of Australia's electricity supply, which the Council sees as the single biggest opportunity to decarbonise the vertically integrated domestic aluminium industry.

The Council updates these factsheets annually; reflecting not only progress in decarbonisation in the industry; but also updating the industry's views of the evolution of decarbonisation technologies, based on research undertaken in Australia and through global partnerships. A summary of key Australian Aluminium industry initiatives is provided in Table 1.

Table 1 Key Australian Aluminium Industry Initiatives

Activity	Link
Affreightment Carbon Reduction	https://www.combinationcarriers.com/insights-and-news/2022/1/4/kcc-and-south32-conclude-first-sustainability-linked-contract-of-affreightment
ARENA Roadmap for Alumina	https://arena.gov.au/knowledge-bank/a-roadmap-for-decarbonising-australian-alumina-refining/
Electric Calcination Study	https://arena.gov.au/projects/alcoa-renewable-powered-electric-calcination-pilot/
Gladstone Renewable Request for Proposals / PPAs	https://www.riotinto.com/news/releases/2022/Rio-Tinto-calls-for-proposals-for-large-scale-wind-and-solar-power-in-Queensland https://www.riotinto.com/en/news/releases/2024/rio-tinto-to-drive-development-of-australias-largest-solar-farm-at-gladstone https://www.riotinto.com/en/news/releases/2024/rio-tinto-signs-australias-biggest-renewable-power-deal-as-it-works-to-repower-its-gladstone-operations
HILT CRC	Heavy Industry Low-carbon Transition Cooperative Research Centre https://hiltcrc.com.au/
Hydrogen Calcination Study	https://arena.gov.au/projects/rio-tinto-pacific-operations-hydrogen-program/
Hydrogen Pilot Plant	https://www.riotinto.com/news/releases/2021/Rio-Tinto-and-Sumitomo-to-assess-hydrogen-pilot-plant-at-Gladstones-Yarwun-alumina-refinery
Mechanical Vapour Recompression Study	https://arena.gov.au/projects/mechanical-vapour-recompression-for-low-carbon-alumina-refining/
Memorandum of Understanding between Tasmania and Rio Tinto	https://www.stategrowth.tas.gov.au/__data/assets/pdf_file/0010/334558/TAS-RIO_TINTO_MOU_Feb_2022.pdf
Mission Possible Partnership	https://missionpossiblepartnership.org/wp-content/uploads/2022/10/Making-1.5-Aligned-Aluminium-possible.pdf
Refinery of the Future	https://www.alcoa.com/global/en/stories/releases?id=2021/11/alcoa-to-design-an-alumina-refinery-of-the-future
Rio Tinto and GMG	https://graphenemg.com/gmg-riotinto-energysavings-battery/
Spinifex Wind Farm (Portland)	https://arena.gov.au/news/offshore-wind-could-power-portland-aluminium-smelter/ https://www.spinifexoffshore.com.au/#/
Tomago Aluminium Renewable Future	https://www.tomago.com.au/tomago-aluminium-future-renewable-energy-needs/
Weipa Solar and Battery Capacity	https://www.riotinto.com/news/releases/2021/Rio-Tinto-to-triple-Weipa-solar-capacity-and-add-battery-storage-to-help-power-operations https://www.riotinto.com/en/news/releases/2023/rio-tinto-approves-new-solar-farm-and-battery-storage-to-power-its-amrun-bauxite-operations-on-cape-york

Activity	Link
Worsley Boiler Conversion	https://www.south32.net/news-media/latest-news/worsley-alumina-converts-first-boiler-from-coal-to-natural-gas
Yarwun Hydrogen Calcination Pilot Demonstration Program	https://www.riotinto.com/en/news/releases/2023/rio-tinto-and-sumitomo-to-build-gladstone-hydrogen-pilot-plant-to-trial-lower-carbon-alumina-refining https://arena.gov.au/projects/yarwun-hydrogen-calcination-pilot-demonstration-program/

Corporate Ambitions

The major operators and joint venture participants in Australia's aluminium industry have the common ambition of net zero by 2050, supported by interim goals (Table 2). However, when comparing these targets with performance within Australia or at a facility level, it is worth noting that corporate ambitions are set at levels that are in line with their policies and subject to their accounting and transparency rules. All the Council's members' interim ambitions are for *both* Scope 1 and Scope 2, and the application of known technologies such as increasing renewable energy supply will be the major pathways for these to be achieved.

Table 2 Summary of Corporate Ambitions[9]

Company	Interim Goal (s)	Net Zero Ambition
Alcoa	30% reduction in scope 1 & 2 emission intensity by 2025 50% reduction in scope 1 & 2 emissions emission intensity by 2030 from 2015 baseline	Net zero by 2050
Rio Tinto	15% reduction in scope 1 & 2 emissions by 2025 50% reduction in scope 1 & 2 emissions by 2030 From a 2018 baseline (equity basis)	Net zero by 2050
South32	50% reduction in operational carbon emissions (Scope 1 & 2) by 2035 from FY21 baseline	Net zero by 2050
Alumina Ltd[10]	45% reduction in scope 1 and 2 emissions by 2030 (from a 2010 baseline)	Net zero by 2050
Hydro[11]	Reduction of 30% by 2030	Net zero by 2050

International Comparisons

As articulated in Figure 1, the main emitting processes in the mine to market production of aluminium are the emissions associated with the consumption of electricity in aluminium smelting (Scope 2), secondly the emissions associated the production of alumina (largely Scope 1), and thirdly the emissions associated with the consumption of carbon anodes in aluminium smelting (Scope 1, this is the predominate source associated with the category Aluminium – direct other). In considering this in the context of the Net Zero Plan it is worth noting that:

1. The two largest producing aluminium regions globally, China and Gulf Cooperation Council[12], use primarily thermal power sources for their aluminium smelting production (Figure 2). While data for Oceania does include New Zealand, this comprises only around 17% of the energy use.
2. Australia's alumina already has some of the lowest emissions in the world, with an average scope 1 and 2 emissions intensity for alumina of <0.7 t CO_2-e/t compared to the global industry average of 1.2 t CO_2-e/t. For the most efficient alumina refineries abatement opportunities are also limited by the development of step change technology and/or the availability of low emissions, competitively priced, firmed electricity. Key decarbonisation technologies for refining are not expected to be available for commercial roll out until around 2030 or later[21].
3. For all smelters globally, more than 95% of Scope 1 emissions could be eliminated with conversion to inert anodes and the industry has been working on inert anode technology development for many decades at a research scale. Elysis[13], a joint venture between Alcoa, Rio Tinto, Apple and the Quebec Government has been developing this technology. The technology has the potential to be used at both new and existing smelters, including those in Australia. However, as articulated in the September 2022 Mission Possible Partnership report, the global rollout of inert anode technology is not anticipated to be

widescale until post 2030[21]. There are, therefore, limited process emission abatement opportunities (<5%) for smelters until this technology is deployed.

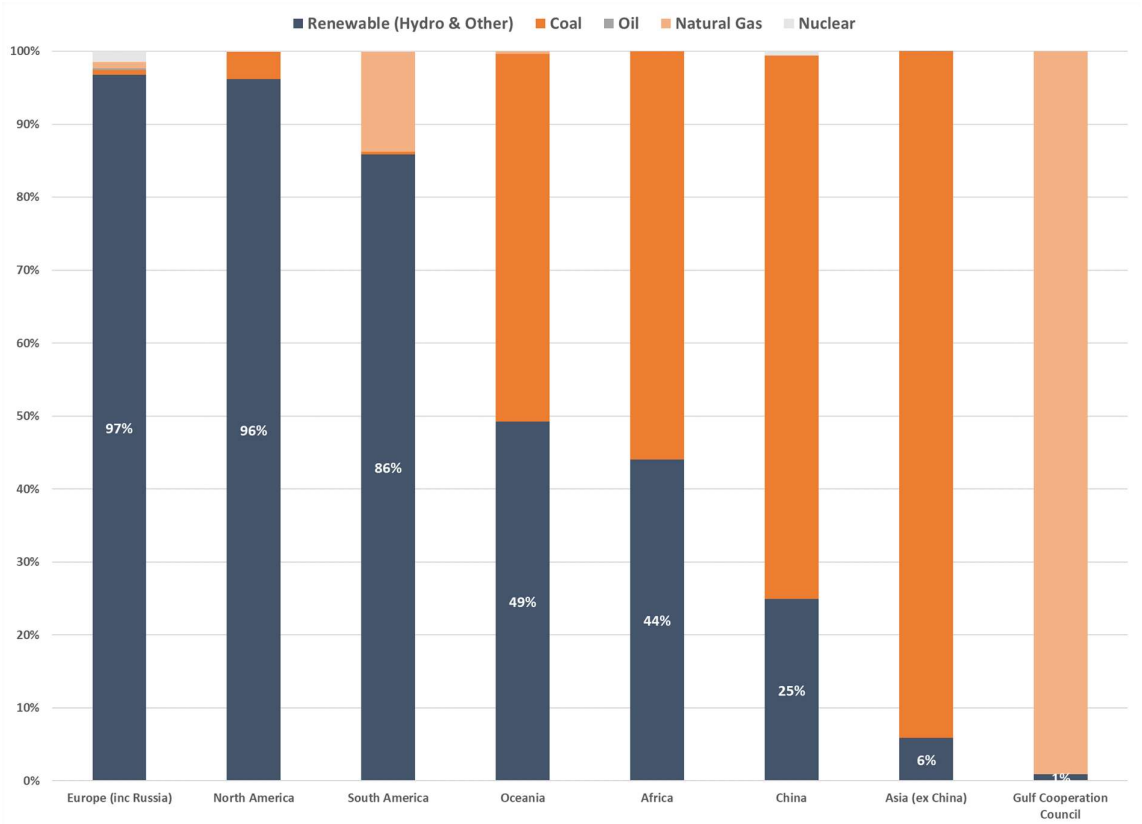

Figure 2. Primary Aluminium Smelting Power Consumption by Source 2022[14]

B. Feedback on the Electricity and Energy Sector Plan Discussion Paper

Mobilising investment to transform energy

The energy transformation will require large amounts of investment

The Paper recognises that decarbonising the Australian economy will require substantial capital investment. The Mission Possible Partnership[15] highlighted that a global investment of approximately US$1 trillion will be required for the aluminium sector transition. Considering the size of the Australian aluminium industry (~3% of the global industry), an investment of US$30bn would be necessary to deliver the same outcome.

Yet, Australia is in a global clean energy race, competing for both capital and skilled workers, while other nations undertake their own transition. As noted in the Paper, compared to international competitors, Australia has low rates of investment in relative to the size of its economy. Capital follows the strongest investment signals and Australia's energy and industry policy signals are currently too weak to attract globally relevant industrial abatement and investment capital.

While the Australian Government has committed to projects to unlock these opportunities for investors, they are not currently at the required scale. For example, while the Council appreciates the creation of a dedicated Powering the Regions Fund (PRF) Critical Inputs to Clean Energy Industries (CICEI) stream the program, at $400m, is currently two orders of magnitude smaller (relative to GDP) than similar programs in other jurisdictions like Canada, Europe and Japan. By comparison, with the PRF, under the Inflation Reduction Act the United States Department of Energy has recently announced[16] a US$500 M (AUD ~$760M) grant to a single facility - Century Aluminum to build the first greenfield domestic primary aluminium smelter in 45 years. This new facility will rely on carbon-free electricity and will more than double primary aluminium production in the U.S. This is seen as increasing the strategic ability of the U.S. to not only compete on a global scale, but to increase capacity to meet growing demand and be a source of the security and diversity of strategic material supply chains in the U.S.

The Council notes the recent increase in the Capacity Investment Scheme (CIS). The Council had been concerned that the 6GW initially proposed was insufficient and supports the revised CIS in its intent to deliver an additional 32GW of capacity and clean dispatchable capacity projects by 2030 to help fill the expected generation and reliability gaps. The Council believes that other Government incentives should similarly be reviewed to ensure they are fit for purpose to meet the challenges of the transition.

Wholesale electricity market design will change to drive efficient investment in a renewable future

Both the National Electricity Market (NEM) and Wholesale Electricity Market (WEM) are going through a once in a century transformation and as Australia moves towards net zero emissions by 2050, this transition will need to be carefully managed to ensure that all consumers are provided with internationally competitively priced, reliable, low emissions energy. The NEM and WEM are currently heading towards systems which lacks the inertia and demand response requirements needed to address the risk of instability, which is becoming increasingly problematic for industries which rely on firm, uninterrupted power supplies.

The biggest single opportunity to decarbonise the vertically integrated domestic aluminium industry is via decarbonisation of the electricity supply, which assists with both direct electrification and other potential pathways, such as hydrogen. Decarbonising the electricity supply needs to be combined with technology availability for the facilities to enable transformation. Both are long-term, complex endeavours, which need to move together. However, in some cases it is the supply and availability of competitively priced zero emissions electricity which may be the rate limiting step.

While the cost of variable renewable energy generation has fallen dramatically, the delivered cost (including transmission and distribution) of firmed electricity has not. The cost of firming renewable energy supply is likely to be one of the largest differentiators of Australia's future competitiveness for electricity-intensive industries. There is no transition without transmission and in both the NEM and the South West Interconnected System (SWIS) effort is needed to continue to progress future state transmissions networks,

to support the large volume of renewable energy required to offset not only existing coal fired generation but also increased demand for facilities to electrify once this technology becomes viable. For example, the SWIS does not have the generation nor transmission capacity to electrify one alumina refinery, let alone three. The fundamental pillar of global competitiveness is low-cost renewable energy, firming and transmission. Despite recent announcements, such as the expansion of the CIS[17], the scale of the investment at this stage does not match the scale of investment of Australia's competitors.

Australia as a renewable energy exporter: opportunities and challenges

The Paper highlights the opportunities for Australia to become a renewable energy superpower – and to develop new opportunities such as export of green metals. However, this ignores the history of Australia's metal production - aluminium is Australia's original critical mineral and clean energy export.

The construction of the Bell Bay aluminium smelter in Tasmania was catalysed by the Australian Aluminium Industry Act (1944), which established a joint venture between the Federal and Tasmanian governments to ensure domestic aluminium supply during World War II. Construction at Bell Bay commenced in 1950, with first production in 1955, becoming the first smelter in the southern hemisphere. Bell Bay is also Australia's original clean energy super power export, exporting around 170 kt of lower carbon aluminium to the world. Transitioning all of Australia's aluminium smelters would be the equivalent of Australia exporting an additional 18 TWh of clean energy every year. This is bigger than the proposed SunCable energy export.

While the Australian aluminium industry has been highly successful since its establishment nearly 70 years ago and remains a major source of employment and export income yet still has strong growth potential under the right policy settings. The bauxite mined in Australia each year could produce up to 40 Mt of alumina, which is nearly double our existing production, which in turn could support aluminium output of 20 Mt – more than 13 times current levels. Australia is well placed to build on its aluminium supply chain to meet growing international demand. To do so, however, requires specific government policies:

1. Deliver internationally competitive supplies of clean energy;
2. Use of Production Tax Credits and a Transformational Infrastructure and Technology Fund to enable Australia to be sufficiently competitive to be able to attract global decarbonisation investment;
3. Prioritise the Australian aluminium value chain, as a strategic material, within industry development policies;
4. Environmental approval processes across the supply chain that appropriately balance the environmental rigour and protection with timelines that reflect commercial needs; and
5. Development of long-term strategic partnerships with likeminded countries.

These policies are outlined in greater detail in recent analysis undertaken by the Council[18].

1. What actions are needed to attract the required large scale private capital and household investment in the energy transformation, with or without government intervention?

As previously articulated, Australia must be sufficiently competitive to be able to attract global decarbonisation investment. Recent analysis by the Council compared industry policy measures in Australia with other key aluminium and alumina producing jurisdictions[18] and found that there is still a way to go to ensure that the appropriate policy settings are in place. The Council supports the use of targeted public investment in decarbonisation as an important step in reducing the long-term carbon exposure, de-risk investment decisions and accelerate technology cost reductions through deployment and learning. The Council's Members have considerable experience with funding through ARENA and are currently exploring opportunities within the PRF. However, capital follows the strongest investment signals and Australia's signals are currently too weak to attract globally relevant industrial and manufacturing investment.

Industry needs two key policies in to be an attractive destination for industrial abatement to take place:

1. **Production Credits.** This policy pathway is being used effectively in a range of jurisdictions, including the US, China, India and Europe, to incentivise production of low carbon products and inputs into the clean energy supply chain. The credits are typically priced in a manner that bridges the relevant regional or global green production premium, through an implied cost of carbon required to support investment. The policy should be specifically relevant to aluminium metal production and could be doubly incentivised into domestic downstream manufacturing, such as extrusion; solar panel production etc.
2. **Transformational Infrastructure and Technology Funding**. The Government's existing grant funding through the PRF is currently two orders of magnitude smaller (relative to GDP) than similar programs in other jurisdictions like Canada, Europe and Japan. The scale being offered must be significantly increased with a fixed commitment to co-fund 50% of all green industrial capital investment across existing and new assets for both on and off-site investment. This will allow industry to then cost efficiently and competitively demonstrate technological innovation and deliver regional infrastructure upgrades, such as transmission. This would be particularly relevant for the alumina industry, where the principal barriers to decarbonisation are:
    - the capital cost of on-site transformation to low carbon production methods; and
    - the need to upgrade regional electricity infrastructure to deliver the requisite energy to the sites in a low margin mid-stream industry.

Non-financial means of support – particularly the streamlining of regulatory approvals – are also critical to lowering investment barriers.

Enabling electrification for a smooth transition

The biggest single opportunity to decarbonise the vertically integrated domestic aluminium industry is via decarbonisation of the electricity supply, which assists with both direct electrification and other potential pathways, such as hydrogen. In 2022 the industry's indirect emissions associated with the consumption of grid purchased electricity are around 17.1 Mt CO_2-e, of which 95% is from the production of primary aluminium (Figure 1). However, technologies which electrify the digestion process in alumina refineries could offset an additional ~11 Mt CO_2-e of the 13.2 Mt alumina Scope 1 emissions.

Australia's aluminium smelters are already a large electricity consumer, with the four smelters already using around 2600 MW or ~ 10% of the electricity consumed in the NEM. Providing electricity is supplied consistently, with firm power, and at internationally competitive prices, aluminium smelting can be run on renewable electricity. As smelters are already electrified, no technological conversion is required. The carbon intensity of the Australian grid is declining rapidly, with this increased penetration of variable renewables. The owners of Australia's four smelters have signalled their intent (Table 1) to recontract renewable electricity at the end of their current terms (2025-2029).

The alumina industry also consumes around 220 PJ of energy, currently as gas and coal in the refineries. This energy use may convert to electricity requirements of 3-5GW[19] firm in the NEM and the SWIS depending on the technology applied in digestion and calcination[20]. Alumina refineries will require technology changes for both digestion and calcination processes to meet zero-emissions goals; either in the form of electrification or adaptation to use hydrogen for process heating. Development of this technology and its application will be stepwise as new technologies to reduce overall emissions become viable. The required thresholds for implementation will be differentiated by refinery (and processes within a refinery); locational access to energy, including supporting transmission infrastructure; the local emissions intensity of electricity supply and bauxite type. The investment required to implement these changes will be substantial.

Energy Efficiency

The Council recognises the Government's desire to set energy efficiency targets for Australia. While this may be useful at a national level or for improvements in household and commercial energy efficiency, the Council

does not believe this is the most effective driver for energy efficiency and emissions reductions in large industry.

2. What actions are required to ensure Australia's energy systems can enable increased electrification, while maintaining equity, reliability and security?

The single biggest factor in determining the location of future refining, smelting and manufacturing locations is reliable, internationally competitive, low emissions energy. New large scale renewable energy, firming and transmission assets to meet the needs of a decarbonising aluminium industry must be developed in a timely fashion to enable emissions associated with the industry to be reduced at scale. The Council believes that while the long term solution is renewable electricity, gas will have a necessary bridging role in lowering carbon emissions from refineries in the medium term, while low emissions alternatives are further developed and rolled out in the future.

As there is increased penetration of variable renewable technologies, there will be increased demand by the grid for smelters to be able to offer power flexibility and interruptibility. Interruptibility is the loss of power to either a whole potline or whole smelter. Flexibility is the ability to use more or less power than normal, for short term periods (seconds to minutes through to hours) without too much instability. Aluminium smelters already 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 helps 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 grid increase. For example, during May and June 2022 Tomago Aluminium provided 32 hours of modulation across 18 events which were a mixture of RERT and responding to high market price. This response by Tomago supported the Australian Energy Market Operator (AEMO_ to manage a complex and challenging system and maintain supply to domestic customers. Additionally, smelters are increasingly offering rights in in relation to the short-term reduction of volume at times of peak demand via contractual arrangements[21].

The ability to offer these services varies as each smelter has a unique aluminium reduction cell (also called a pot) design which impacts its ability to offer any demand response into the system. After around 75 minutes without electricity, aluminium begins to "freeze" in the pots, which can force plant/line interruption and potentially freezing of the cells with a restart which can take months to complete.

3. What insights do you have on the pace, scale and location of electrification, and how to embed this in system planning?

When considering the gas needs of the aluminium industry it is important to consider the time scale for change. The Australian aluminium and alumina industries are investing significant resources to identify, develop and commercialise complex new technologies that will enable fossil fuels, to be phased out of operations as soon as commercially possible. The timeline for reduction in fossil fuel consumption depends on time taken to successfully identify, develop and commercialise these processes, and to integrate into existing facilities accordingly as well as the availability of competitively priced electricity and associated infrastructure. The right government incentive structure and well-resourced partnering models can provide an additional push for industry to move faster. While it is difficult to project the timescale for this change even the Innovator Abatement Pathway of the ARENA Roadmap for Decarbonising Australian Alumina[22], does not show substantial abatement potential until close to 2030 (Figure 3).

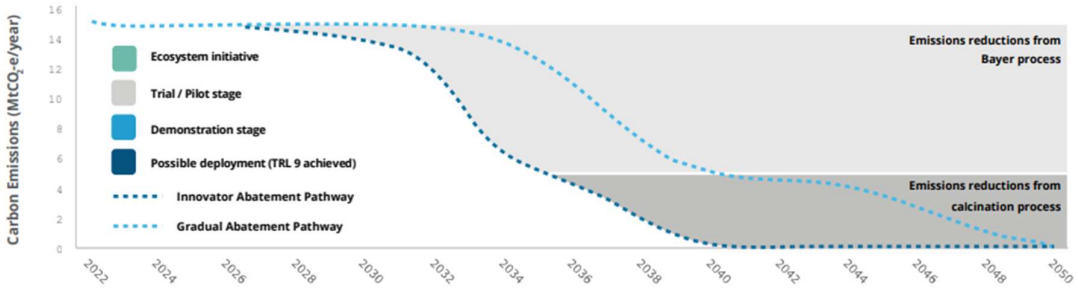

Figure 3. Alumina decarbonisation roadmap until 2050 with staging for key on-site and off-site ecosystem initiatives to achieve an 'Innovator Abatement Pathway (ARENA Roadmap)

Growing alternative low carbon fuels

Alumina refining is an energy intensive process, using about 10.5 GJ per tonne produced. Digestion and calcination are the two most energy intensive steps, with digestion consuming around two thirds of this energy. Currently, this energy is largely derived from gas and coal, as well as electricity. All of Australia's alumina refineries have some combined heat and power generation (cogeneration) facilities which use coal, gas, or biomass fuels. Cogeneration is an efficient way to produce process heat from the waste steam from electricity generation, resulting in the refineries using, and in some circumstances, also exporting low emissions electricity.

The six alumina refineries currently use around 150 PJ of energy, derived from gas or coal, in the digestion phase to generate steam and electricity. This has the potential to be replaced by internationally competitive renewable electricity, subject to the successful development and commercialisation of refinery side technology (including Mechanical Vapour Recompression, thermal storage and Electric Boilers). This has the potential to require 3-4 GW of electricity at a national level to replace the existing energy supply, on a like for like basis. This would transform both the NEM and SWIS electricity markets.

However, this relies on not only the development of commercial and technological solutions for electrification of alumina refineries but also the development of sufficient competitively priced low emissions generation and storage, and transmission capacity at scale to match. The electrification of existing industry, combined with the development of new electricity intensive industries, such as hydrogen, will require substantial volumes of electricity delivered reliably, affordably and at scale. The Council is concerned that if technology development lags, or energy transmission and supporting infrastructure is delivered in the manner and at the pace it has historically, this will become the rate limiting step in the transition[23]. For example, Worsley Alumina[24] have confirmed that a substantial expansion and modification of the energy grid would be required to deliver renewable power at the necessary scale for industrial users in the region (SWIS). Therefore, decarbonisation of Worsley Alumina may be in two stages, firstly conversion of the onsite boilers to natural gas and only in the longer-term application of new technologies to support increased electrification and renewable energy for the refinery, which would require broader investment in shared energy infrastructure in the region.

It is the internationally competitive cost of zero carbon electricity at industrial scale to facilities, which will enable the greatest transformation of the sector. It is hoped that some technologies for refinery digestion may be able to be deployed prior to 2030. However, access to the required generation, storage and infrastructure outside the facility could be the rate limiting step in the electrification process. To assist with this, one solution is that Government could accelerate significant private investment in renewable generation, low-carbon industries and industrial decarbonisation projects by committing to upfront funding of transmission upgrades, that could be recovered from users (as needed) once operating.

5. What policy settings and certainty are required to support a fair, equitable and orderly transition for the decarbonisation of both natural gas and liquid fuels?

For many industrial users of natural gas, in particular, there currently is no economic, technically available, low carbon alternative. To maximise the climate benefits of policies related to decarbonising energy sources such as natural gas, policy settings should encourage energy users who do have technical and largely economically neutral to electrify wherever possible. These examples include a range of domestic, small and medium applications such as low-grade heat for space heating and cooking. This would reduce the pressure on gas markets, allowing demand to drop to meet available supply and ensuring this increasingly scarce energy source is used in those industries which have little viable alternative. Consumers who have no alternative to conventional energy sources are also likely to be the long-term consumers of biofuels and renewable gases.

6. What actions are required to establish low carbon fuel industries in Australia, including enabling supply and demand, and what are the most prospective production pathways?

7. Are the proposed policy focus areas for managing the liquid fuels transition (outlined in Section 4 of the discussion paper) the correct areas to focus on, and what is missing?

The Council believes that these questions are largely addressed in the Council's response to the Future Gas Strategy Consultation Paper[25].

Building Australia's clean energy workforce

Australia's existing aluminium industry is already predominantly located in regional Australia (Figure 4). The majority of the more than 19,000 employees live in the regions in which they work and there is often intergenerational employment at sites. In regions like Cape York, bauxite mines can have indigenous participation rates of 30%[26]. In the regions in which the Council's members operate the intent is to provide financial benefits but also education, training, cultural heritage protection and employment.

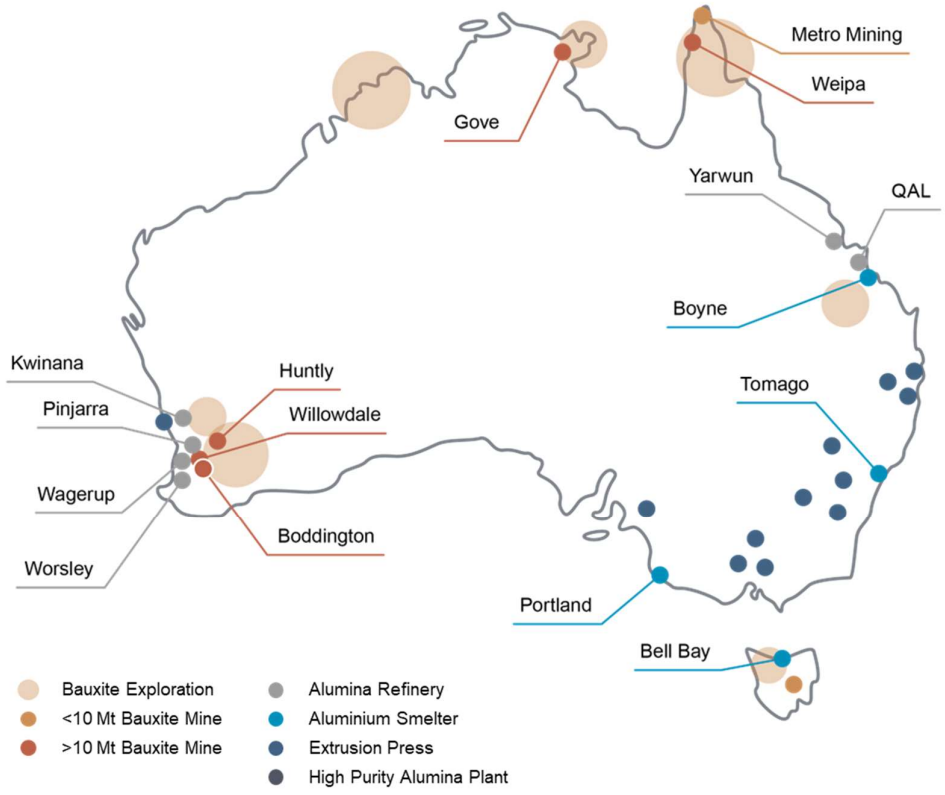

Figure 4. Aluminium Operations in Regional Australia

The Council agrees that there are already workforce and skills shortages across many industries and regions that will impact on industry growth and the further development of advanced manufacturing. The scale of the workforce and skills required for transformational abatement projects and new industries should not be underestimated, nor should the impacts of this on the pace of abatement. These challenges are, however, not unique to the aluminium sector and maintaining the existing assets in these regions will in fact help maintain a trained and agile workforce which can adapt to future opportunities.

8. What actions are required to ensure workforce requirements for the energy transformation are met, while supporting equitable outcomes?

Decarbonisation is an electrification story: large scale wind and solar, distributed solar, household and grid scale energy storage, increased electricity transmission and distribution, electric vehicles and the electrification of industry, in particular, mining and alumina refining. As a result, there will be significant demand for those with electrical skills including electrical discipline engineers, electricians, process control engineers and analyser technicians, electric vehicle mechanics. This demand will occur across all sectors in the economy. These skills are strongly linked to STEM subjects at high school and historically male dominated industries. These professions are likely to attract high salaries, good conditions and offer long term career prospects that are suitable for a range of employment arrangements including “fly-in fly-out", regional and metro-based roles, full and part time, site, office and home based locations.

Ensuring there are enough suitably qualified workers will require the largest, and therefore most diverse, pool of talent. The promotion of STEM and the encouragement of both male and females into these careers is paramount to achieving decarbonisation. This should include re-training mature employees into these roles.

Maximising outcomes for people and businesses

9. What actions are required to ensure better energy outcomes for people and businesses, and maximise their benefit from the energy transformation?

Decarbonisation is a highly capital-intensive process requiring significant new capital inflows but generally benefits users from lower ongoing operating costs (such as fuel costs). However, this generalisation does not always hold true. Energy users who are capital constrained (whether that is a low-income household, or a capital constrained industrial facility) are likely to rely more on the electricity markets and so may be exposed to market volatility, especially during the transition phase with little ability to alter their demand – other than shutting down.

Incentives and government support should be focussed on those industries and customers who have less capacity to fund the capital to enable them to transition at a pragmatic rate. This may include mechanisms to limit exposure to very high electricity spot prices, subsidies and grants to deploy new appliances and technologies that provide greater electricity demand flexibility or to move off fossil fuel consuming appliances.

Government support should not be directed to entities who have the financial capacity to move quickly on decarbonisation, it should be directed to those who cannot feasibly afford to decarbonise in a time consistent with our climate goals.

10. What social licence and circular economy aspects should be considered as part of the pathway for the energy transformation?

The Council notes the inclusion of circular economy considerations in the development of this plan. Aluminium can be recycled again and again, almost infinitely, making it an incredibly sustainable material. Around 75% of the almost 1.5 billion tonnes of aluminium ever produced is still in productive use today as it can be recycled endlessly. Aluminium’s life cycle provides significant benefits through recycling, saving 95% of the energy it would take to make primary aluminium metal.

However, despite having an integrated primary aluminium sector, the closure of Australia's car industry a decade ago was accompanied by a closure in the two aluminium rolling mills[27] which also provided aluminium remelt capabilities. Australia has lost this manufacturing capability. As aluminium smelters generally cannot safely accept post consume scrap, specialist metal recyclers currently collect and export both pre and post-consumer scrap for recycling. However, within the existing industry, pre consumer scrap may offer an-efficient feedstock for recycled billet product and an initial entry point into increased recycled content for Australian supply chains. The industry is exploring this further in 2024.

Work[28] undertaken by the Council in 2022 in conjunction with Deloitte and Coreo found that significant opportunities in manufacturing and recycling can be unlocked by cross-value chain coordination, including with Government and its agencies. There are clear opportunities for value-added manufacturing enabled by the existing integrated aluminium industry. This includes an opportunity for Australia to redevelop its recycling capability as part of an integrated circular industry policy. This new manufacturing capability would fit with Australia's need to transition some regional economies, providing the potential for a new manufacturing base not linked to the location of a mineral deposit. This would cut across multiple commodities as well as a circular industry approach to the development of Australia's emerging clean energy industries, where these could be established with circularity in their design. The work identified three flagship projects which the Council believes would present a different approach to industry policy, two of which are relevant to Australia's future capability in a circular economy.

1. Increase recycling capacity - Global demand for recycled aluminium is growing rapidly, driven by emerging minimum content requirements from governments and corporate demand for low carbon products. A circular industry policy could lower cost and risk for domestic pre- and post-consumer scrap reprocessing.
2. A closed-loop mine-to-panel solar value chain - Aluminium is the second largest input by weight, and domestic extruders already have the capability to produce frame and rail for the sector. Solar panels, and other new renewable manufacturing should be designed with recyclability in their design.

For example, in the context of the energy sector, aluminium accounts for more than 88% of the metal in a solar panel. The aluminium frame and rail are examples of extrusions which can be made using existing manufacturing capability in Australia. For every GW of solar PV, 5.5 kt of aluminium extrusion is needed for frames and for every GW of rooftop solar, an additional 13 kt of aluminium extrusion is needed for rails and mountings. Aluminium frame and rail can be reused or recycled if circularity is considered in design. Installed solar in Australia will need more than 1.5 M tonnes of aluminium extrusion by 2050, creating a substantial increase in demand for both aluminium and extrusions. But today more than 70% all semi-finished aluminium used in Australia is imported and <3% of Australian extrusion capacity is supplied as solar rail and none as solar frame. Leveraging opportunities for Australian aluminium to be used in the development of a solar PV industry could see Australian bauxite become Australian made solar panels, which could be designed for end of life circularity. In addition, the upstream aluminium industry has a growing demand for renewables, which could further catalyse demand for solar PV manufacturing.

C. References

[1] https://www.industry.gov.au/publications/resources-and-energy-quarterly-december-2023
[2] https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action
[3] https://news.alcoa.com/press-releases/press-release-details/2024/Alcoa-announces-curtailment-of-Kwinana-Alumina-Refinery-in-Western-Australia/default.aspx
[4] https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action
[5] International Aluminium Institute High Substitution Scenario
[6] https://aluminium.org.au/wp-content/uploads/2023/11/Aluminium-Critical-Mineral-Report-Nov23.pdf
[7] https://missionpossiblepartnership.org/wp-content/uploads/2022/10/Making-1.5-Aligned-Aluminium-possible.pdf
[8] https://arena.gov.au/assets/2022/11/roadmap-for-decarbonising-australian-alumina-refining-report.pdf
[9]Sources: https://www.riotinto.com/en/sustainability/climate-change; https://www.alcoa.com/global/en/stories/releases?id=2021/10/advancing-sustainably-alcoas-2050-net-zero-ambition; https://www.south32.net/docs/default-source/exchange-releases/2021-south32-sustainability-briefing.pdf?sfvrsn=d8a76a71_2; https://www.hydro.com/en/media/news/2021/hydro-capital-markets-day-2021-sustainable-value-creation/
[10] Alumina Ltd are a JV participant in Alcoa World Alumina and Chemicals, which operate two mines and three refineries in Western Australia and has equity in the Portland Aluminium Smelter.
[11] Hydro is a JV participant in Tomago Aluminium Company.
[12] https://international-aluminium.org/statistics/primary-aluminium-production/
[13] https://www.elysis.com/
[14] https://international-aluminium.org/statistics/primary-aluminium-smelting-power-consumption/
[15] https://missionpossiblepartnership.org/wp-content/uploads/2022/10/Making-1.5-Aligned-Aluminium-possible.pdf
[16] https://www.energy.gov/oced/industrial-demonstrations-program-selections-award-negotiations
[17] https://minister.dcceew.gov.au/bowen/media-releases/delivering-more-reliable-energy-all-australians
[18] https://aluminium.org.au/wp-content/uploads/2023/11/Aluminium-Critical-Mineral-Report-Nov23.pdf
[19] The potential renewable capacity required to meet this demand is likely 3 to 5 times this amount. https://arena.gov.au/assets/2022/11/roadmap-for-decarbonising-australian-alumina-refining-report.pdf
[20] https://aluminium.org.au/wp-content/uploads/2022/07/FACT-SHEET-03-ALUMINA.pdf
[21] https://www.agl.com.au/about-agl/media-centre/asx-and-media-releases/2023/august/portland-smelter-contract-renewal-finalised
[22] https://arena.gov.au/assets/2022/11/roadmap-for-decarbonising-australian-alumina-refining-report.pdf
[23] https://www.worley.com/~/media/Files/W/Worley-V3/documents/our-thinking/from-ambition-to-reality/from-ambition-to-reality-report.pdf
[24] P73, https://www.south32.net/docs/default-source/all-financial-results/2022-annual-reporting-suite/sustainable-development-report-2022.pdf
[25] https://consult.industry.gov.au/future-gas-strategy/survey/view/63
[26] https://www.metromining.com.au/media/33566/metro-investor-presentation-noosa-conference-nov-2022.pdf
[27] https://news.alcoa.com/press-releases/press-release-details/2014/Alcoa-to-Close-Point-Henry-Aluminum-Smelter-and-Rolling-Mills-in-Australia/default.aspx
[28] https://aluminium.org.au/news/aac-deloitte-and-coreo-cast-anew-project/