



A Verisk Business

# **Greener aluminium When possibility meets reality**

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# Contents

Emissions by the aluminium industry and where they occur

Challenges that the industry faces in its journey to decarbonisation

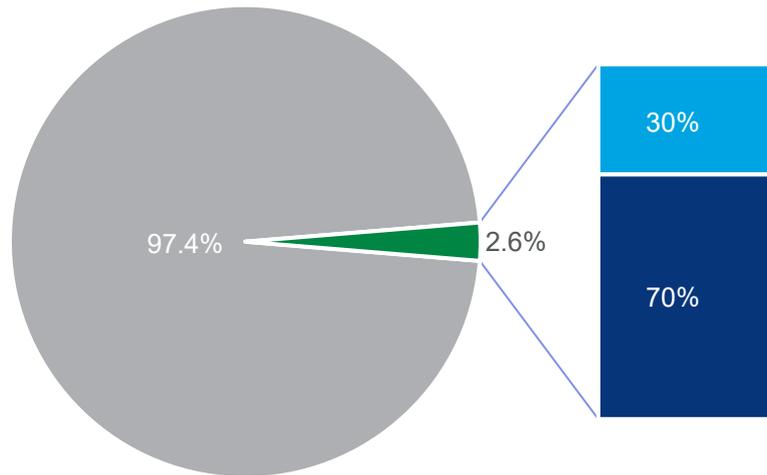
The most effective and realistic steps to decarbonisation



# Primary aluminium is responsible for 2.6% of global emissions ...

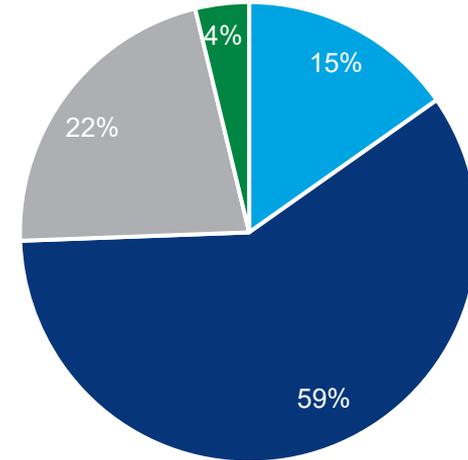
... and Chinese producers generate 70% of the industry's total

### Aluminium emissions vs. total, 2020



- ROW aluminium industry
- Chinese aluminium industry
- Rest of global emissions

### Emissions through the value chain, 2020



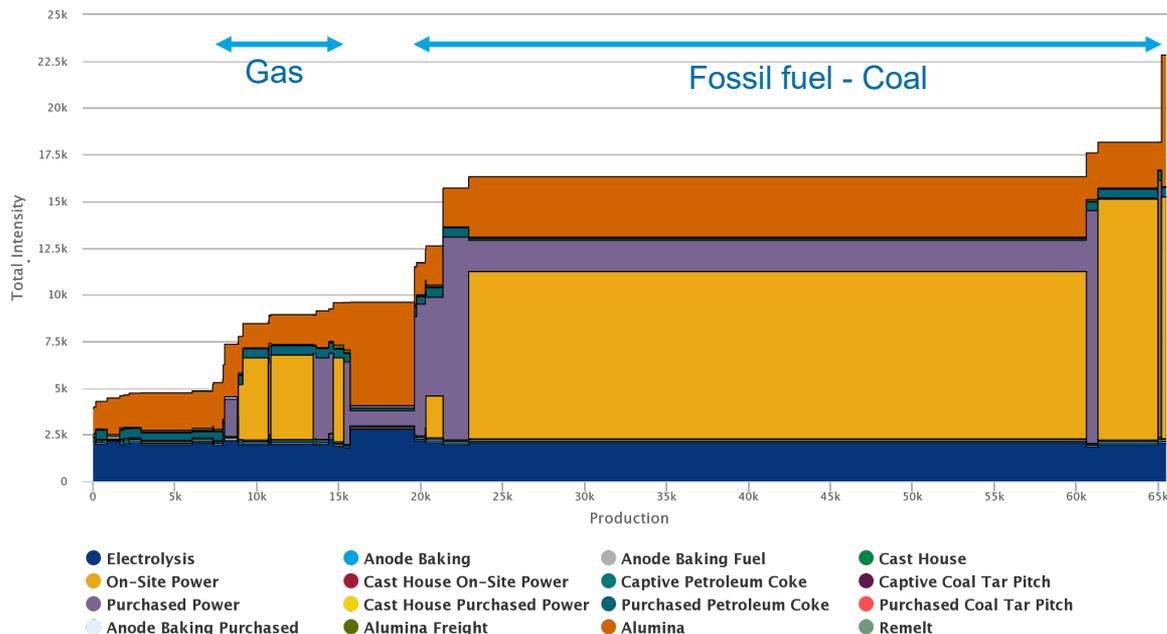
- Electrolysis
- Power
- Cradle-to-gate
- Anode and cast house



# The source of energy is the main driver of aluminium carbon emissions

Emissions from electricity range from zero to around 15 tonnes of CO<sub>2</sub>e/t of aluminium

## Carbon intensities across the aluminium value chain by country, 2020



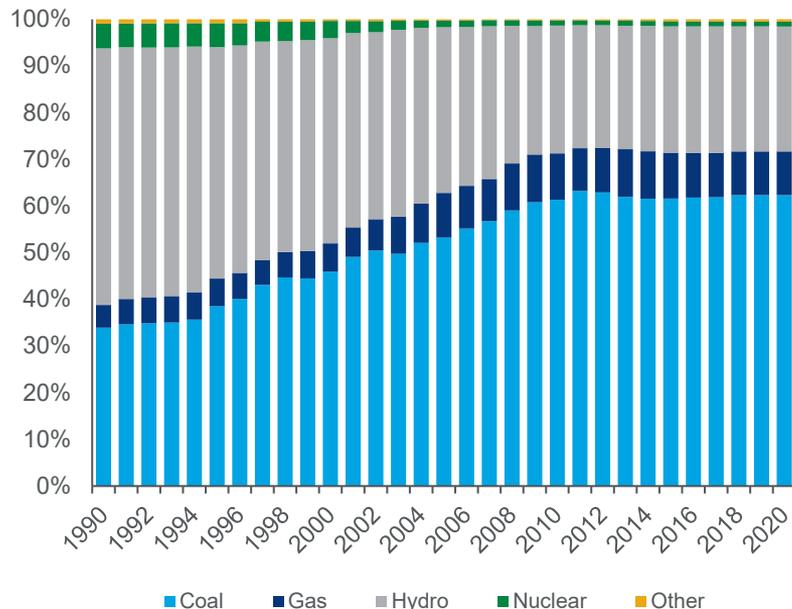
- The aluminium industry needs to move away from fossil fuels to make a meaningful reduction in carbon emissions (yellow and purple blocks)
- With current technology there is little scope to reduce CO<sub>2</sub> emissions from electrolysis (blue)
- There is scope to reduce emissions from the production and transportation of raw materials (primarily orange and green)



# Removing fossil fuel from power generation will be the main challenge

Smelters powered by fossil fuels are relatively new and have little choice of power sources

## Global smelting power mix, 1990-2020



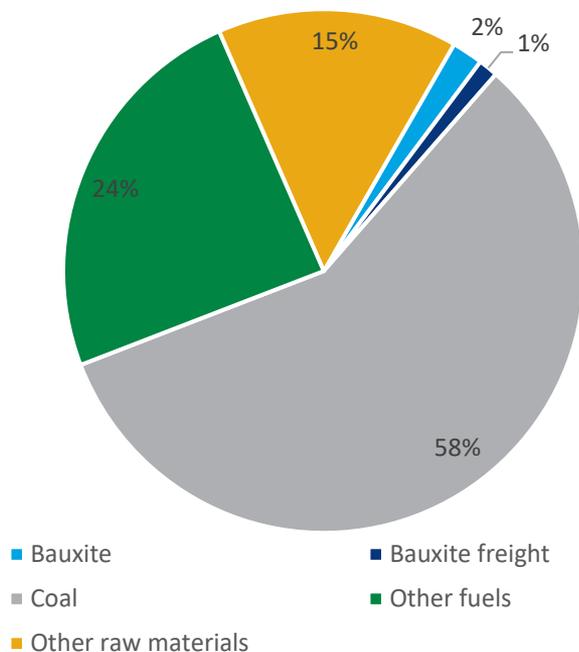
- More than two third of smelter production currently rely on fossil fuels for electricity.
- Reliance on fossil fuels increased in the nineties and noughties with the surge of the Chinese aluminium industry.
- Most of the smelter capacity running on coal power is relatively new
- Smelters running on coal mostly operate dedicated power plants and have little choice for alternative power sources
- Smelters relying on coal power are still being built in China and India
- Smelters relying on gas –primarily in the Middle East – are relatively new and have little opportunity to diversify



# Lowering greenhouse emissions of alumina refineries

22% of aluminium emissions are generated before raw materials reach the smelter

## Refinery cradle-to-gate emissions



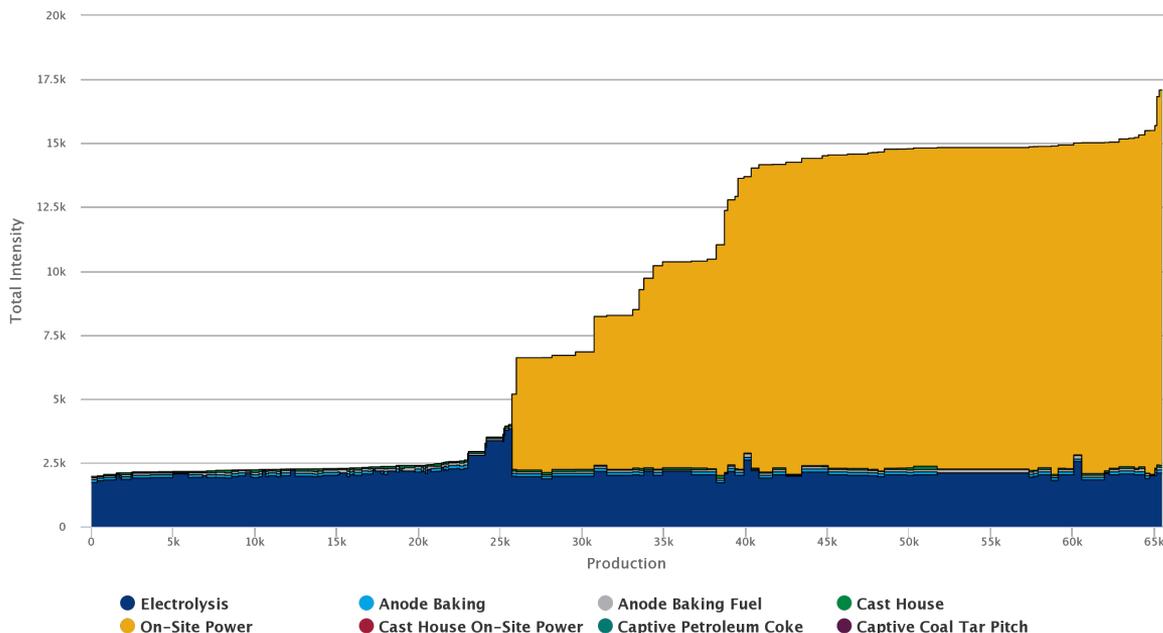
- Refineries use fossil fuels to generate heat for the boilers and calciners
- If all refineries switched from coal to gas as their main fuel, it would save 26% of cradle-to-gate emissions
- Bauxite transportation represents around 1% of cradle-to-gate emissions so offer little scope for reduction
- Emissions embedded in the production and transportation of caustic soda and lime (15%) are generally beyond the control of refineries



# Electrolysis is responsible for 15% of aluminium carbon emissions

There is limited scope to reduce emissions of electrolytic cells with the current technology

## Scope 1 emissions by smelter

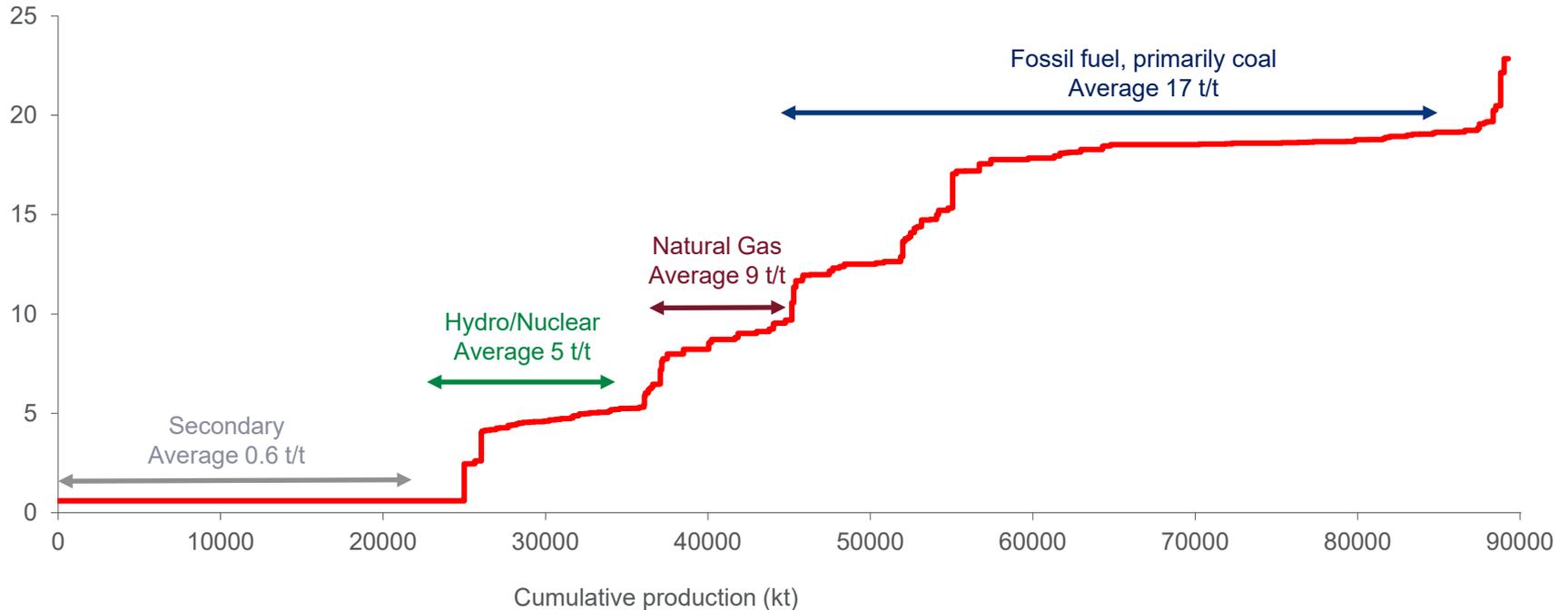


- Carbon anodes are consumed in the electrolytic process generating CO<sub>2</sub> emissions
- Emissions of this process vary between 1.8 and 3.8 tonnes of CO<sub>2</sub> per tonne of aluminium
- There is little scope to capture those emissions without a complete redesign of cells and pot rooms
- Non-carbon anode technologies have been tested in the past decades, but none have yet reached commercial scale.

# Recycled aluminium needs to be part of the solution

Secondary aluminium is the best and quickest short-term solution

## 2020 Aluminium cradle to gate CO2e emissions, tonnes per tonne aluminium





# How does the aluminium industry become greener?

**Maximum potential displacement of CO<sub>2</sub>e per tonne of metal**

15 t	Replacement of fossil fuels	<ul style="list-style-type: none"> <li>The aluminium industry needs to reduce its reliance on fossil fuels - policies that penalise aluminium produced from high carbon sources are necessary</li> <li>There is not enough low carbon energy to support aluminium demand - it will take time for this industry to decarbonise</li> </ul>
14 t	Increased recycling	<ul style="list-style-type: none"> <li>Use of scrap will be a key contributor to the decarbonisation story for the aluminium industry, but there are limits as not all end-use applications can use scrap as a feed</li> </ul>
1.8-3.8 t	Technological innovation	<ul style="list-style-type: none"> <li>Inert anode technologies will contribute to the reduction of carbon emissions from electrolytic cells</li> <li>Carbon capture</li> </ul>
0.2 t	Reduce process emissions	<ul style="list-style-type: none"> <li>Minimise emissions from transportation - distance</li> <li>Improve cell automation to predict process instability that can lead to abnormal emissions</li> </ul>

\* Replacing 1 tonne of aluminium from alumina with scrap aluminium at the highest emissions smelter

# Conclusions

- For aluminium to be a true enabler of a green economy, the industry needs to decarbonise its own value chain
- Decarbonising power for smelters will take time and will test the viability of a large portion of current aluminium supply
- There is scope to reduce emissions at alumina refineries, but the overall impact will be modest
- Eliminating emissions from electrolysis is not possible with the current technology
- A realistic pathway to the decarbonisation of the aluminium industry includes small gains in all the stages of the value chain and greater recycling, collection and use of scrap.

