

Green aluminium in cars

17/11/2025



Contents

1 The aluminium sector: a carbon problem?

How and where is aluminium produced, and how carbon intensive is the process?

2 How to reduce emissions from aluminium?

The pathway to achieving green aluminium

3 How fast can aluminium decarbonise?

How to decarbonise aluminium in the European automotive industry

4 Green aluminium: at what cost?

The cost impact of switching to green aluminium in cars

5 Policy recommendations

Ensuring timely uptake of clean aluminium in cars

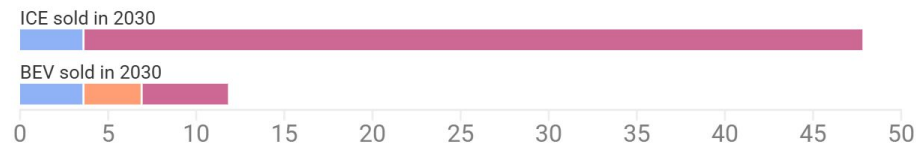
With the reduction of tailpipe emissions, the emissions burden shifts to production

By 2030, an average battery electric vehicle (BEV) will have one quarter of the lifetime emissions of an internal combustion engine vehicle (ICEV)

A BEV provides significant emissions savings over an ICEV

Lifecycle emissions for a medium passenger car in 2030

■ Vehicle production ■ Battery production ■ Use phase



Source: T&E own analysis



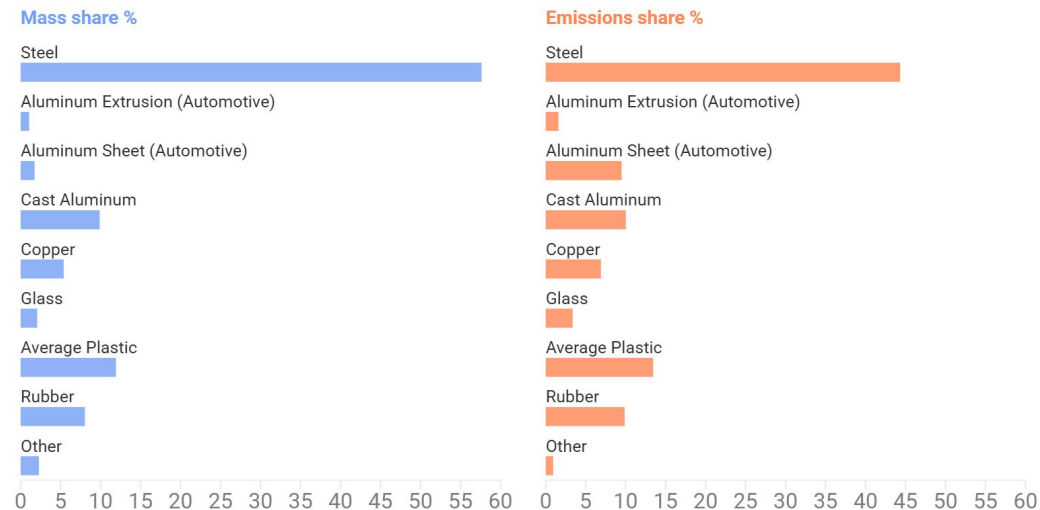
Aluminium - a growing climate problem in cars?

Aluminium represents around 20% of the embedded emissions of a BEV today

This share of emissions is expected to increase due to lightweighting

Breakdown of emissions and mass share of a BEV

Aluminium represents over 20% of a vehicle's total embedded emissions



Source: T&E internal modelling & Greet 2

Europe is heavily dependent on primary aluminium imports

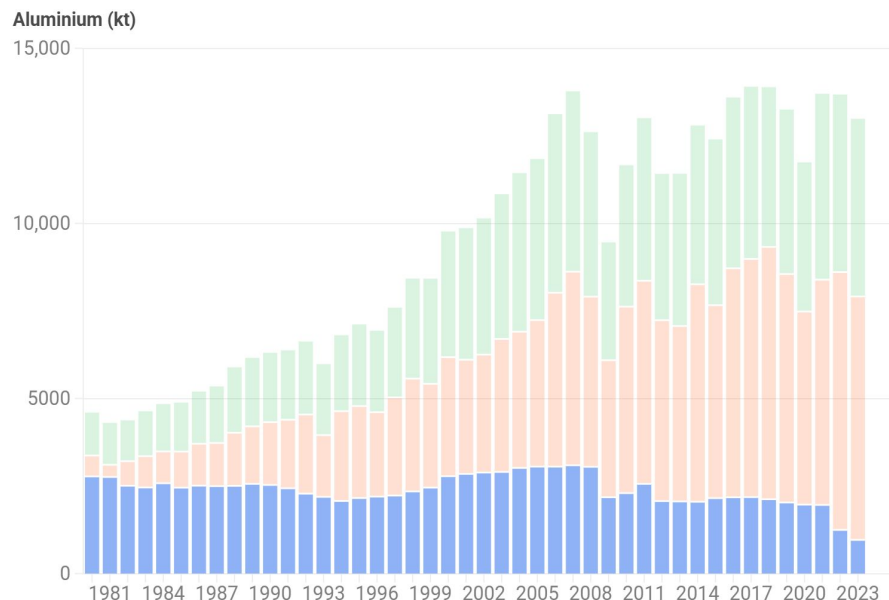
Total European aluminium consumption has increased by 300% since 1980.

European primary production has decreased to now represent just 7% of total consumption.

Europe now imports more than half of its primary aluminum needs

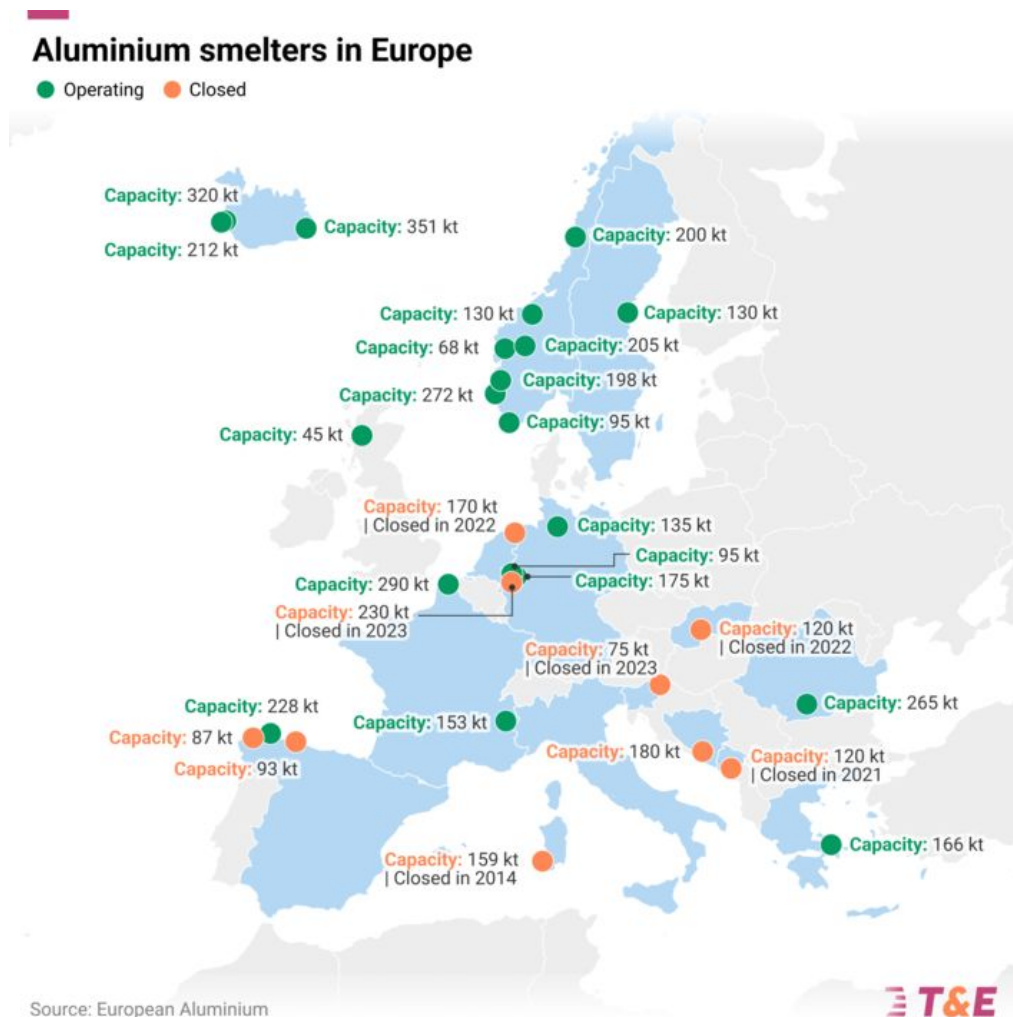
European Aluminium consumption by type

European Primary Production (kt) Net Primary Production Imports (kt) Recycling (kt)



Closure of aluminium smelters in Europe

The EU has seen its number of operational primary aluminium smelters halved in a decade, driven by surging energy costs, regulatory pressures, and global competition.



The EU exports large amounts of its scrap aluminium

The value of EU aluminium scrap exports has increased from \$400 million in 2000 to over \$2.4 billion in 2024.

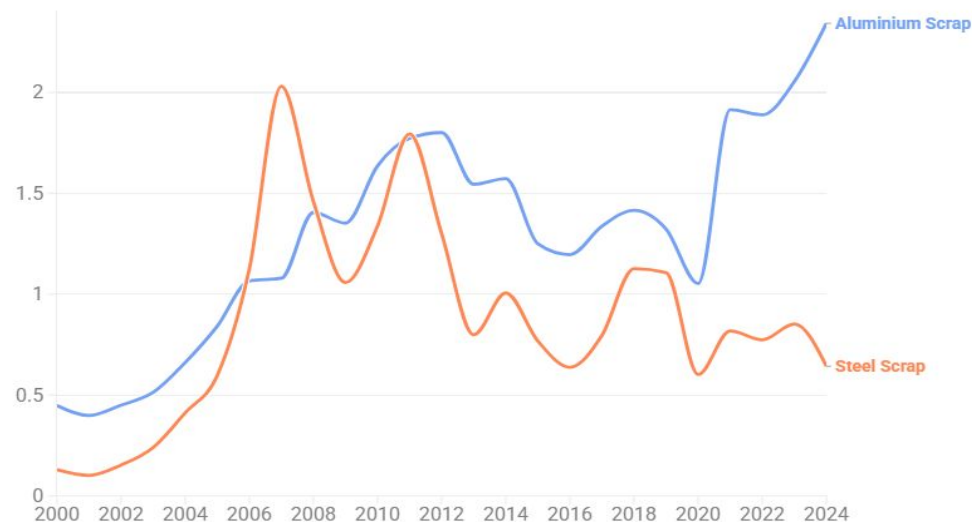
The majority of the scrap is sent to India and China.

The EU exported over two billion euros of scrap aluminium in 2024, with over 80% sent to Asia

Value of scrap material exported from the European Union annually

Aluminium Scrap Steel Scrap

USD billion



Source: UN Comtrade

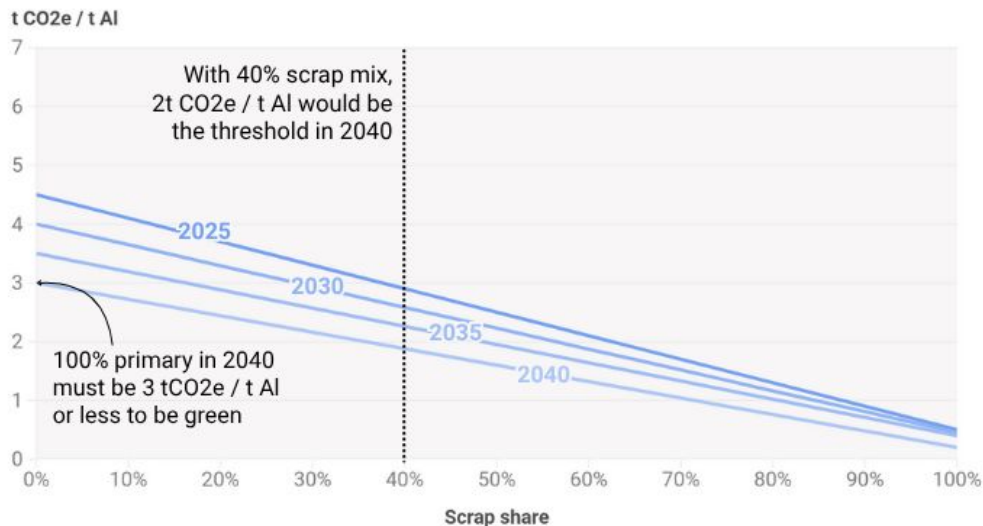
How to reduce emissions from aluminium?

Defining green aluminium

Green aluminium can be reached through primary, scrap or a combination of both.

The thresholds will decrease over time to account for expected decreases in carbon intensity of the grid.

Green aluminium can be achieved through primary, recycled or a mix of both according to the sliding scale



Which technologies can get us there?

Overview and assessment of aluminium decarbonisation technologies today

Low ●○○○ ●●○○ ●●●● High

Possible pathways	 CO ₂ reduction potential	 Affordability	 Technology maturity
Direct process emission reduction technology*	●●●●	●●○○	●○○○
Shift to higher recycling	●●●●	●●●●	●●●●
Electric boilers	●○○○	●●○○	●●●●
Electric furnaces	●●○○	●●○○	●●○○
Hydrogen boilers	●○○○	●○○○	●○○○
Hydrogen furnaces	●●○○	●○○○	●○○○

Source: T&E . *This technology could be either Inert anodes or a carbochlorination process



How fast can aluminium decarbonise?

How EU automotive emissions from aluminium will develop

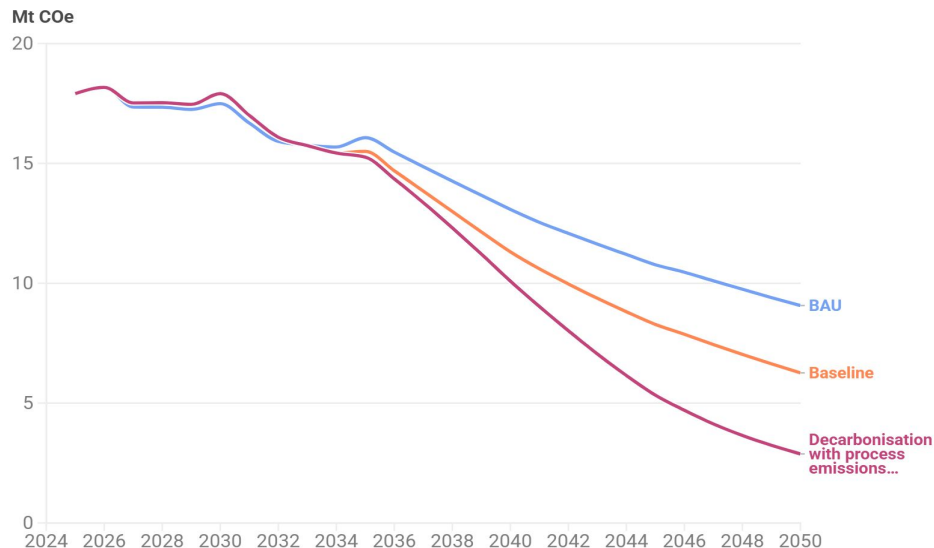
We modelled scenarios utilising different decarbonisation technologies applied to both primary and secondary aluminium

The results depict substantial cumulative emissions savings from the baseline decarbonisation scenario relative to the BAU scenario. These savings increase further if technology to reduce emissions from smelting are implemented.

30% of emissions could be reduced by 2050, increasing to 68% with technology to reduce direct emissions from smelting*

Projected emissions from the European aluminium car industry

BAU Baseline Decarbonisation with process emissions reduction technology



Source: T&E analysis • *This could be achieved with inert anodes or carbochlorination technology

Emissions savings from decarbonisation scenarios

Emissions savings by 2040 are estimated to be the equivalent of removing 900,000 combustion engine cars off the road, or avoiding 335 Mt CO₂e.

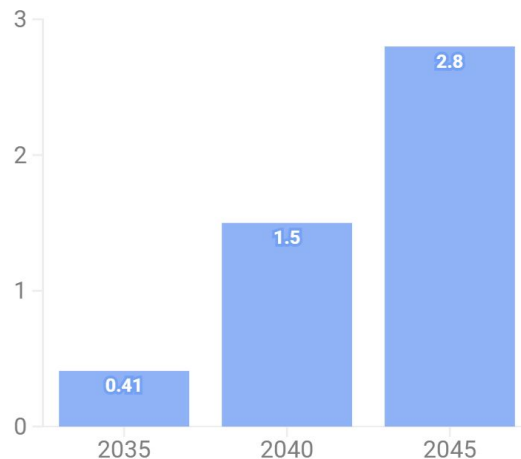
This increases to one and a half million ICE car equivalents off the road if technologies to reduce direct emissions in smelting are adopted for the same year.

Decarbonising aluminium in cars can lead to the equivalent of taking 3 million ICE's off the road in 2050

■ With process emissions reduction technology ■ No process emissions reduction technology

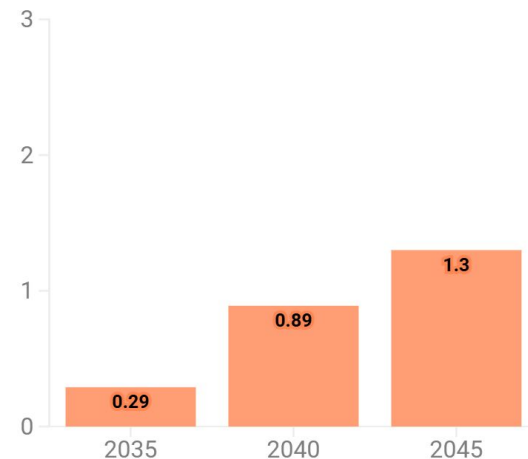
With process emissions reduction technology

Number of cars taken off the road (millions)*



No process emissions reduction technology

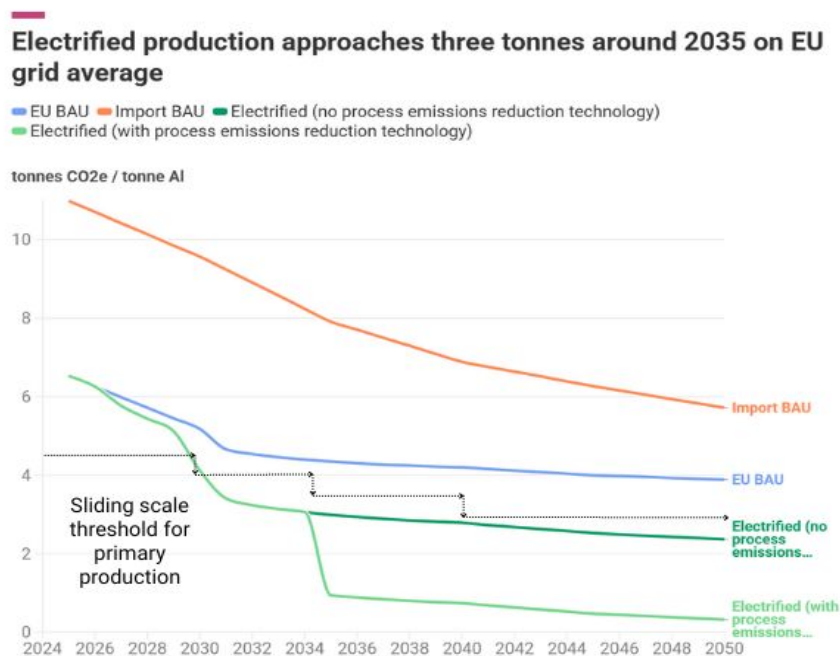
Number of cars taken off the road (millions)*



Amounts are relative to our BAU scenario

When can primary aluminium achieve 'green' status?

An electrified plant with an EU average grid intensity will reach the three tonnes CO₂e / tonne Al, below the threshold for “Green Aluminium”, by 2035.



Source: T&E analysis • Electrified scenarios assume electric boiler uptake in 2027 and electric furnace uptake by 2030. Electrification assumes EU grid average. Direct process emission technology could be inert anodes or carbochlorination processes such as Hydro's HALZERO

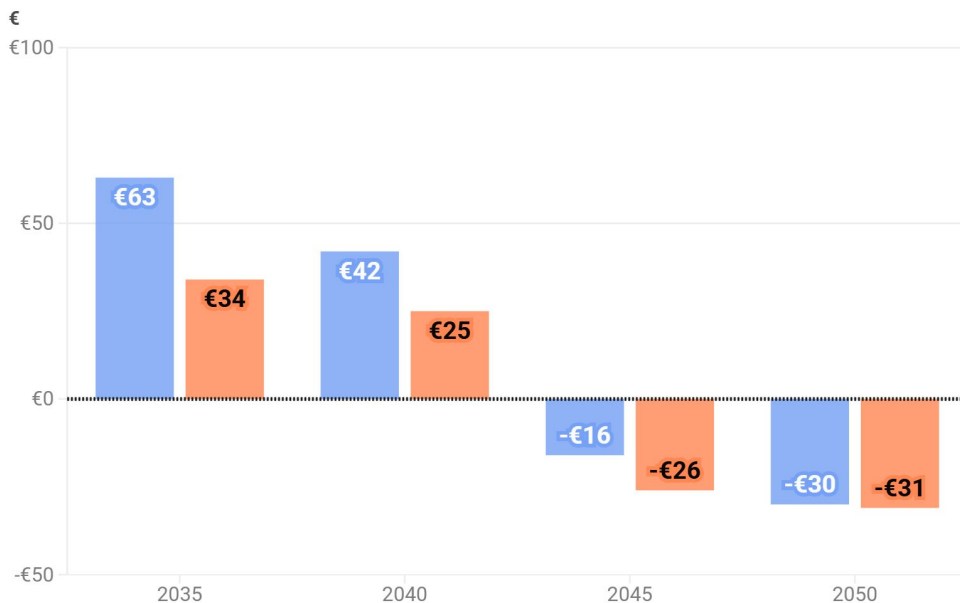
Green aluminium: at what cost?

Green aluminium: at what cost?

Green aluminium projected to become cost competitive by 2040

Differences between cost of Green vs Conventional Aluminium

■ With process emission reduction technology ■ No process emission reduction technology



Source: Opex and Capex estimates from Mission Possible Partnership. Carbon price projections from IEA



Policy recommendations

- 1** The EU should set minimum green aluminium quotas for new cars, via the upcoming Industrial Accelerator Act. Carmakers should be required to use a minimum of 60% green aluminium in new cars from 2035, increasing to 85% in 2040 and 95% in 2045, and 100% in 2050.
- 2** Recycled, local content targets should be introduced via a delegated act in the End-of-life Vehicles (ELV) regulation
- 3** The upcoming Circular Economy Act should include measures, including via improved waste codes, to significantly limit shipments of scrap aluminium outside of the EU.
- 4** The End-of-Life Vehicles Regulation (ELVR) should alleviate barriers to high quality recycling of aluminium, via dismantling and sorting requirements.
- 5** The Industrial Accelerator Act and Industrial Decarbonisation Bank should create strong conditions to invest into scaling green aluminium production in the EU, including via strengthened lead markets and the introduction of a carbon product label for aluminium used in vehicles.

Thank you

**Michael Carron, Battery and raw materials
researcher**

Michael.carron@transportenvironment.org