CREATING
THE FUTURE
TOGETHER

DECARBONIZATION ROADMAP 2050

Kibar

Assan Alüminyum

Overview

Aluminium is essential for decarbonization. It is necessary for e-mobility, net zero buildings, reducing food waste and more. In principle, it can be 100% recycled and without losing quality, thus enabling the transition to circular economy.

However, the production of primary aluminium is energy intensive. The aluminium sector is actively working on decarbonizing every stage of the product life cycle.

This roadmap outlines how the sectoral decarbonization pathways can be adapted to Assan Alüminyum.

Current carbon footprint of the aluminium sector

The aluminium sector emits currently about 1 gigatonne of carbon dioxide equivalent (1 Gt CO_2e) or approximately 2% of global emissions. Unless actions are taken to limit them, emissions can be expected to grow by up to as much as 90% as a result of population growth and economic development by 2050.

Pathways to decarbonization for the aluminium sector

One of the recent global roadmaps was published by MPP[1]. In the MPP roadmap, the major levers for decarbonization are given as:

- **Transition to Low-Carbon Power** (651 million tonnes [Mt] CO_2e savings by 2050): The aluminium industry, which demands nearly 1,000 terawatt-hours (TWh) of electricity, is highly energy-intensive. Switching to low-carbon electricity is the most significant action the industry can take to align with net-zero goals.
- **Maximize Secondary Aluminium Production** (456 Mt CO_2e savings by 2050): Recycling aluminium, or secondary production, has a much lower carbon footprint compared to producing new (primary) aluminium—0.5 t CO_2e/t Al versus up to 16 t CO_2e/t Al.
- **Enhance Resource Efficiency** (321 Mt CO_2e savings by 2050): The industry should focus on efficient aluminium usage in product design. This includes extending the lifespan of buildings, automobiles or other products, as well as replacing vehicle ownership with mobility-as-a-service.
- **Deploy New Technologies** for Near-Zero-Emissions Refineries and Smelters (232 Mt CO_2e savings by 2050): To decarbonize thermal energy in refineries and achieve low-carbon anodes in smelters, new technologies such as heat recovery and fuel switching must be developed and commercialized by 2030.

Naturally, these are also the main levers for Assan Alüminyum but they need to be adapted to our circumstances and expressed in company specific terms.

[1]MPP: Mission Possible Partnership (https://www.missionpossiblepartnership.org/action-sectors/aluminium/). The European industry associations are also working on decarbonization roadmaps for the European aluminium sector, however they are not expected to be published until 2024.

Current carbon footprint of Assan Alüminyum

In 2023, our Scope 1 + 2 emission intensity was 0.649 tCO_2e/t as given in our Sustainability Report[2]. After the offset of Scope 2 using I-RECs, it reduces to 0,352 tCO_2e/t. Scope 3 emission is estimated to be 12.85 tCO_2e/t, over 95% coming from the embedded emissions of purchased aluminium.

Twin roll casting production technology

The twin roll continuous casting technology (TRC or more generally, CC) used by the company has inherently lower energy intensity (Scope 1 + 2) than the alternative of direct chill (DC) casting since, by casting coils thin enough to be cold rolled to final thickness, it obviates the need to hot roll thick slabs cast using DC.

On the other hand, CC product mix naturally tends towards alloys with higher Al content, which reduces the availability of suitable secondary aluminium (or scrap).

Assan Alüminyum has the largest CC capacity in Europe and North America, and consequently, has the best know-how to expand the envelope of the CC technology, including developing alloys that can use more scrap/secondary aluminium.

The effect of the product mix on the emission intensity

Assan Alüminyum produces a wide variety of aluminium flat rolled products with different product characteristics. The most important attributes affecting the emission intensity of the products are:

- Alloy (or chemical composition): limits (along with other factors) the share of scrap/secondary aluminium that can be used as input. Alloys with high aluminium content (e.g. 1000 series alloys with more than 99% aluminium content) cannot use much scrap/secondary aluminium since these are rarely pure enough.
- Thickness: thinner products need to be rolled more and have higher energy intensity.
- Coating: pre-painted products have higher energy intensity compared to mill finish products. Of course, most aluminium products are coated before use, and pre-painting is more efficient than post-painting.

Currently, the alloy of a product is more important than thickness or other characteristics as Scope 3 emission coming from the primary aluminium dominate other sources of emission.

Scope 1

The majority of Scope 1 emission relate to the natural gas used for melting aluminium prior to casting and for annealing. Both melting and annealing are essential parts of the production process and cannot be removed.

Assan Alüminyum has an ISO 50001 certified energy management system and each year completes many energy efficiency projects to lower energy consumption and Scope 1 + 2 emission. Over the last 10 years, these projects have reduced Scope 1+2 emissions by 6.4% per product.

[2]https://www.assanaluminyum.com/en/sustainability/sustainability-reports

Scope 2

Electric power is mostly used by the mills and other production equipment and currently account for about 27% of total energy use.

Assan Alüminyum owns and operates a renewable energy plant in Manavgat, Türkiye. The hydroelectric plant has a capacity of 48 MW, with plans for adding solar power capacity in the near future. The current capacity is sufficient to cover the majority of the electricity used in Tuzla and DilovasÞ plants.

We use I-REC certificates issued for the production of electricity at the Manavgat HEPP and additional purchased certificates to offset our entire Scope 2 emissions.

Scope 3

Over 95% of Assan Alüminyum carbon footprint comes from purchased primary aluminium (main portion of Scope 3).

We are actively working with our suppliers and customers to create low-carbon supply chains using low-carbon primary, and to increase scrap collection from customers.

Using our expertise in CC technology, we have developed products with high recycled content compared to more typical CC products and correspondingly lower emissions.

Pathways to decarbonization for Assan Alüminyum

For the aluminium sector the four main levers are low-carbon power, scrap/secondary aluminium, resource efficiency and near-zero-emissions refineries and smelters. For Assan Alüminyum, these can be expressed as:

- **Low-carbon energy** can lower the footprint of purchased primary aluminium (Scope 3) and enable transitioning from fossil fuels to electricity in production (Scope 1).
- Using more scrap/secondary aluminium as input instead of primary aluminium lowers the Scope 3 emissions.
- **Resource efficiency** at company level means producing the same or greater output using more efficient resources (Scope 1 + 2). The advantages of longer-life products or products using less aluminium are also important, but use-phase advantages are hard to measure and include in company footprint.
- **Near-zero-emissions refineries and smelters** can lower the footprint of purchased primary aluminium (Scope 3).

In general, the company roadmap assumptions are compatible with industry models from IAI[3] and MPP.

Scope 1

There is limited scope for improvement in the short-term because of the low share of the Scope 1 emissions in the total. However, these will become more important once Scope 3 emissions are lowered.

[3]https://international-aluminium.org/resource/aluminium-sector-greenhouse-gas-pathways-to-2050-2021

In the near- to mid-term, energy intensity can be reduced by improving energy efficiency of the melting and annealing operations (e.g., by transferring liquid metal directly from the recycling facility to the melting furnace of the cast shop), redesigning production parameters to reduce energy use, and reducing process scrap.

The impact of these improvements can be expected to be fairly modest. These in general require no or low investment, and no new technologies.

In the mid- to long-term, more efficient burning technologies can be used, but the benefit will be also fairly modest. These require investment to replace existing furnaces but the technologies are fairly mature.

In the long-term, electrification of the furnaces could allow zero emission melting and treatment operations. These would also require investment. The technology of the electric furnaces exists (Assan Alüminyum already operates induction furnaces for recycling process scrap) but may need to be scaled up.

A relatively minor component of the current Scope 1 emissions relates to the coil coating line. New paint and coating technologies (such as electron beam curing) that are necessary for net zero pre-painted products are being developed and should be available in the mid- to long-term.

Scope 2

We are already offsetting Scope 2 emissions fully and will continue to do so in the future.

Turkish Energy Plan[4] foresees the share of the renewables in the grid to go up to 61% by 2053. In any case, we will continue to invest in renewables to cover our power needs, using I-RECs or equivalents to cover any shortfalls.

For the purposes of modelling, gate-to-gate Scope 1+2 emissions and emission reductions are assumed to be parallel to IAI model.

Scope 3

To lower Scope 3 emissions, we need to use more scrap/secondary aluminium and more low-carbon primary.

The main impediment to increasing the use of the scrap/secondary aluminium is the limited availability of scrap. Aluminium use is increasing and most of the aluminium products have long lives, e.g. around 10 years for cars or consumer durables, up to 50 years for buildings. As a result, even with 100% collection efficiency, the available scrap is never enough for the current demand. The availability is further restricted by less-than-perfect collection and sorting of post-consumer scrap.

We are working to increase the use of our customers' process scrap to increase circularity by setting up closed loops.

[4]https://enerji.gov.tr/Media/Dizin/EIGM/tr/Raporlar/TUEP/T%C3%BCrkiye_National_Energy_Plan.pdf

Using our CC expertise, we are developing products with chemical compositions that allow increased scrap/secondary aluminium usage. These can be rarely direct replacements of existing products, nevertheless, we need to work with our customers to use them to replace existing alloys and even develops suitable applications for them.

Customers' support of the transition to new alloys and low-carbon primary is essential for meeting decarbonization targets.

Risks and financial considerations

The most important risks relating to decarbonization are

- On the supply side, the availability and price of scrap/secondary aluminium and low-carbon primary
- On the sales side, customer requirements and price sensitivity

In general, carbon costs are expected to increase during the transition to circular economy and net zero. Therefore, businesses will face increased costs both from existing carbon emissions (mostly OPEX), and from investments and operational changes required for the transitioning (CAPEX and OPEX). While some of the transition costs will be offset by reductions of the existing emissions, the total costs in a circular economy are likely to be higher than current costs.

Relative prices of scrap, secondary aluminium, low-carbon primary and high-carbon primary will shift to reflect relative availability, carbon costs and customer preferences. Low-carbon rolled products will be more expensive compared to high-carbon rolled products because the relative prices of low-carbon primary and scrap/secondary will be higher.

It is assumed that the businesses will be able to pass on these cost increases down the value chain to the consumers, but even if they are able to do so, it may decrease the demand for their goods.

The necessary CAPEX financing will be at least partially provided by direct and indirect public support. The European Green Deal and US Inflation Reduction Act of 2022 promise tax credits and financing support in various forms and similar support will need to be provided in other countries including Türkiye.

One reflection of the state support is increasing appetite of the financial institutions for financing green projects. In 2023, Assan Alüminyum obtained its first green loan from the IFC under the Assan Alüminyum Green Financing Framework.

For Assan Alüminyum, the largest CAPEX requirements for decarbonization should be:

- The electrification of the furnaces
- Secondary aluminium plants
- Renewable power plants
- Net zero technologies for the coil coating line
- Interim efficiency and emissions upgrades to existing furnaces and other equipment
  It is assumed that green financing will be available for these projects.

Roadmap

By 2025
- Refine roadmap to align with sectoral roadmaps
- Measurement and reporting infrastructure (ISO 14064/GHG Protocol, CBAM reporting, EPDs)
- Develop products with high scrap/secondary aluminium content
- Increase secondary aluminium capacity and share of scrap/secondary aluminium
- Develop low-carbon primary supply chain
- Increase renewable power capacity
- Incremental energy efficiency projects

By 2030
- Continue to increasing secondary aluminium capacity and share of scrap/secondary aluminium
- Increase share of low-carbon primary
- Increase renewable power capacity
- Incremental energy efficiency projects
- Pilot electrification projects

By 2035
- Continue increasing share of scrap/secondary aluminium in parallel to the aluminium sector
- Continue lowering carbon footprint of primary aluminium in parallel to the aluminium sector
- Continue increasing secondary aluminium capacity
- Start the electrification of melting and annealing furnaces
- Pilot net zero pre-painting technologies

By 2050
- Complete the switch to scrap/secondary aluminium and near-zero primary
- Complete electrification
- Identify and offset remaining emissions to reach net zero for Scope 1 + 2 + 3

Model assumptions

Scope 2 will continue to be offset with own renewable power generation + IRECs/PPAs.

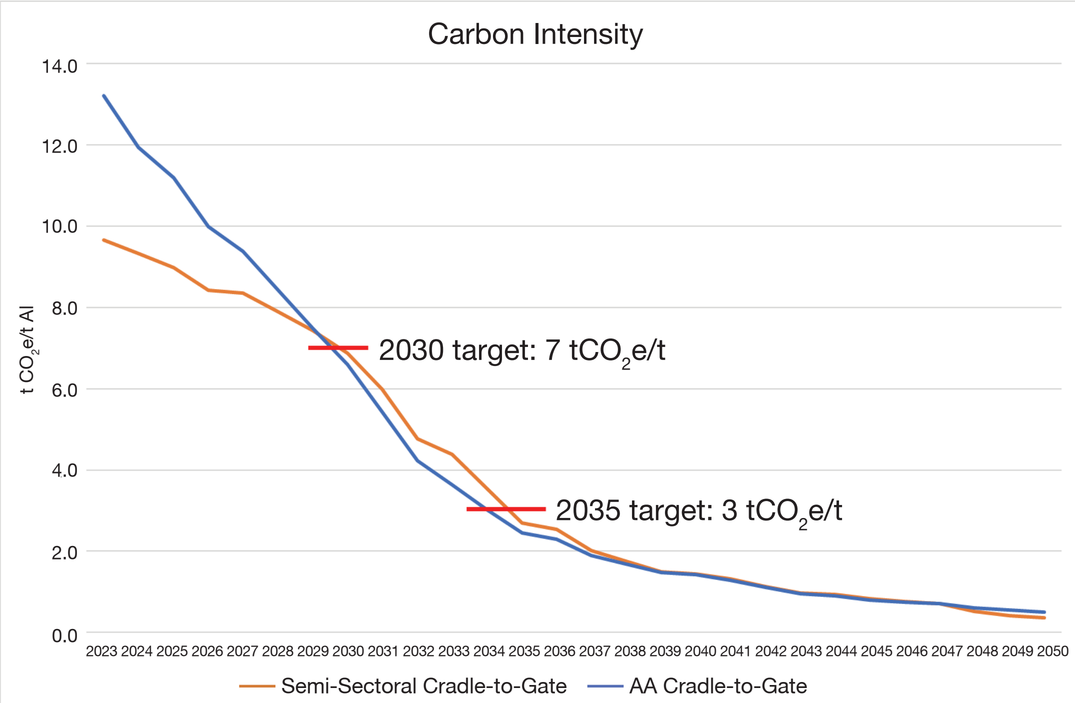
Scope 1 + 2 emission intensity (including Scope 2 offset) will decrease to 0,22 tCO_2e/t by 2030, after that it will remain constant until the electrification of furnaces between 2030-2040.

For Scope 3

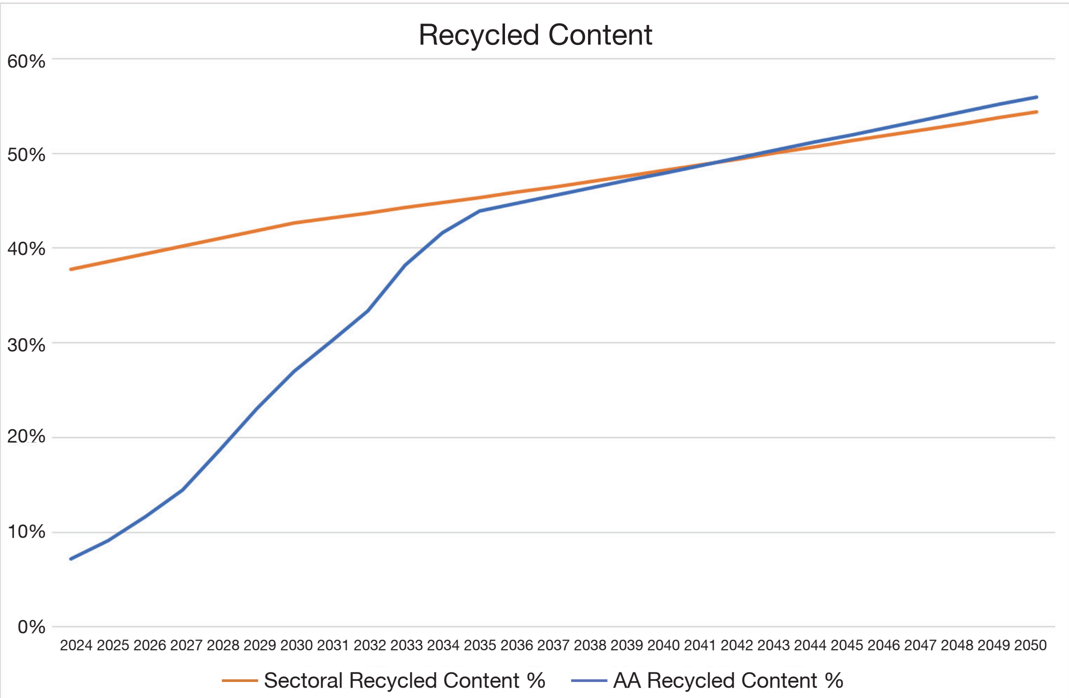
- Scrap/secondary aluminium share increases to 9% by 2025, 27% by 2030 and 56% by 2050, parallel to industry models.
- The carbon intensity of the primary will decline in line with the IAI projections.
- Low-carbon primary share increase until 2035 when the average primary emission intensity reach low-carbon levels and the distinction becomes moot.
  In general, we are following the MPP model pathway which is SBT 1.5 compatible.

Model outputs

The carbon intensity of our products will rapidly decrease until 2030 to catch up sectoral average and thereafter continue to decrease in parallel with it.



The main driver of the reduction in emission intensity is increasing share of the scrap/secondary aluminium.



Targets

We aim to reach 7 tCO_2e/t by 2030, 3 tCO_2e/t by 2035 and net zero by 2050.

Customers cooperation is crucial for the shift to new alloys and low-carbon primary aluminium to achieve decarbonization targets. Therefore, the company targets are applicable to products bought by individual customers only if they support the transition.

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