CRU Consulting

Opportunities for aluminium in a post-Covid economy

Prepared for the International Aluminium Institute

28/01/2022

CRU Reference: ST2342-21

CRU Consulting, 1st Floor, MidCity Place, 71 High Holborn, London, WC1V 6EA, UK

Tel: +44 (0)20 7903 2000, Website: www.crugroup.com

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Executive Summary

The following report was prepared by CRU to deliver an overview of the aluminium demand growth for different sectors and regions, as well as future trends, policies and developments that will drive this growth in the coming decades. Based on these trends and policies, CRU proposes possible routes for the International Aluminium Institute (IAI) to influence and further promote the consumption of aluminium in selected sectors and regions.

Aluminium demand is forecast to grow by 33.3 Mt in the following decade, going from 86.2 Mt in 2020 to 119.5 Mt in 2030. Around 37% of this growth is expected to come from China, followed by 26% from Asia ex. China, 15% from North America and 14% from Europe.

The highest growth in terms of absolute demand will come from the **Transportation** sector which, driven by decarbonization policies and the shift from vehicles powered by traditional fossil fuels to electric vehicles (EVs), will go from consuming 19.9 Mt of aluminium in 2020 to consuming 31.7 Mt in 2030. Most of this growth will come from China (33%), North America (22%) and Europe (19%). In the second part of the following decade, CRU expects governments to start gradually phasing out subsidies that currently support growth in EV sales, which will lead to the cost of EVs vs ICEs to become a key factor for the industry. Due to this, it is imperative for the aluminium industry to reduce production costs to compete with steel, which represents a cheaper and potentially greener alternative. Working on integrating the whole value chain to study possible synergies between manufacturers and producers to reduce costs and approaching big OEMs to educate and promote the use of aluminium as a viable or better option for new and lighter vehicle designs will be crucial to secure and enhance the intensity of use of aluminium within this sector.

In the **Electrical** sector, the transition towards green energy sources will strengthen the sector's demand for aluminium, which will reach 15.6 Mt in 2030 starting from 10.4 in 2020. China is expected to account for 47% of this growth. The Electrical sector represents one of the most substantial opportunities for the aluminium industry in coming years: as countries transition to renewable energies – which are more intensive in the use of aluminium than traditional energy sources – and expand their power grids. Supporting solar power projects through alliances with designers and manufacturers can be key to increase aluminium demand coming from this sector, as solar power requires over four times more aluminium per installed megawatt than wind power, and around 25 times more than coal. In addition to this increase in consumption from renewables, the need for conductor cables for power distribution will also increase. Although these conductors have been traditionally made from copper, transitioning to aluminium represents a viable alternative and can be beneficial from a cost perspective, especially when physical space is not a constraint. For this to happen at a large scale, CRU believes working with specifiers and policy makers to update current standards which have been traditionally made with copper cable in mind, will be key.

Construction is expected to show relatively low growth in the next decade as consumption increases from 21.2 Mt in 2020 to 25.8 Mt in 2030. Following a slightly different path than other sectors, growth will come mainly from Asia ex. China as demand remains linked to infrastructure spending and urbanization rather than green trends. Although is not yet clear if the implementation of green codes and rating systems will boost the demand of aluminium coming from the Construction sector, CRU believes that working with policy makers on making these initiatives mandatory and assuring the inclusion of aluminium as a low carbon material in relevant building codes is a positive first step. In addition to this, due to the increase on residential construction's share of the market since the instauration of measures against the spread of Covid-19 and the rise of the "Work-From-Home" economy, it is essential for these mandatory policies to be adopted in both commercial and residential construction in order to take full advantage of future Construction trends.

Finally, aluminium consumption from the **Packaging** sector will increase from 7.2 Mt in 2020 to 10.5 Mt in 2030, driven mainly by the rise in popularity of canned drinks in North America, Europe, and China. The surge of demand for canned drinks in recent years, and the subsequent demand of aluminium from the Packaging sector, has been fuelled by the emergence of new products as well as a strong consumer preference for packaging options that are environmentally friendly. This is strongly linked to the negative perception that consumers in Western economies have of PET and other plastics that normally compete with aluminium in this space. Due to this dynamic, it is especially relevant for the aluminium industry to focus on looking after aluminium's public perception as a green, recyclable material with a low carbon footprint.

Introduction

Aluminium demand is set to increase at a substantial rate going forward, driven largely by a growing appetite for environmentally friendly solutions in transport, infrastructure, energy and food security.

With the intention of providing guidance to its membership and the wider industry at large regarding future aluminium market developments, the International Aluminium Institute (IAI) has commissioned this study to better understand and quantify the demand potential for the long-term future. The main focus of the study is on identifying key regions and sectors that will drive demand growth going forward, guiding the industry's response on key issues and opportunities.

With this objective in mind, this study has the following sections:

1. **Opportunities for the aluminium industry**

   This chapter lays out a variety of actions the aluminium industry must take to grasp different opportunities that CRU and other players in the industry expect will arise in the future. These actions are focused on the Transportation, Electrical, Construction and Packaging sector.

2. **Quantification of demand changes**

   This chapter provides and overview of demand for aluminium semi-finished products by region and by sector, with a focus on demand growth going forward. The regions covered include China, Asia ex. China, Europe, North America, and Rest of the World, while the sectors include Construction, Transportation, Electrical, Packaging, Machinery and Equipment, Foil Stock and Consumer Durables.

3. **Policy drivers & societal changes driving demand growth**

   This chapter provides a sector-level analysis of aluminium demand with a strong focus on describing which trends and policies will drive consumption in the most relevant sectors and regions. The sectors included include Transportation, Electrical, Construction and Packaging.

4. **Risks to demand changes**

   This chapter summarises the key risks to CRU's forecast for additional demand, taking into consideration the drivers behind them.

Note on methodology and definition of demand sectors

In order to capture the dynamics driving aluminium demand growth going forward, as well as understanding the areas where the IAI and its members could potentially influence outcomes in a way that benefits the industry, this report has been built using a combination of CRU's forecast and base assumptions, and the views provided by a number of people in direct contact with different sectors of the aluminium industry. For this, the steps followed were:

1. Identification of areas where demand changes are more likely going forward, including which regions and sectors will be the most relevant in defining the expected demand growth ahead. This initial information gathering process was conducted using CRU data and forecasts.

2. Primary research in the form of direct interviews with people across the aluminium industry, in order to complement CRU's initial views and collect additional relevant information. These interviews were processed, summarized and added to the study.

In terms of the end-use sectors analysed in this report, they consider the following:

1. Construction: this category includes all construction buildings, including commercial and residential infrastructure.
2. Transportation: this category includes sea, air and land transportation methods such as ships, aircrafts, rail transport and different types of light & heavy-duty vehicles.
3. Electrical: all infrastructure linked to power production, including non-conventional renewable energies, including transmission & distribution infrastructure.
4. Machinery & Equipment, used for industrial production and construction.
5. Foil Stock: precursor of the use of foil in different sectors. This sector is counted as a separate end-use to avoid double counting.
6. Packaging: includes beverage and food cans, foil packaging (including pharmaceutical packaging) and containers, among others. Anything that can be regarded as packaging is included in this sector regardless of the industry it is linked to.
7. Consumer durables: durable goods such as appliances, air conditioners, cell phones and computers, among other products.
8. Others: anything else that does not fall into any of the categories described above.

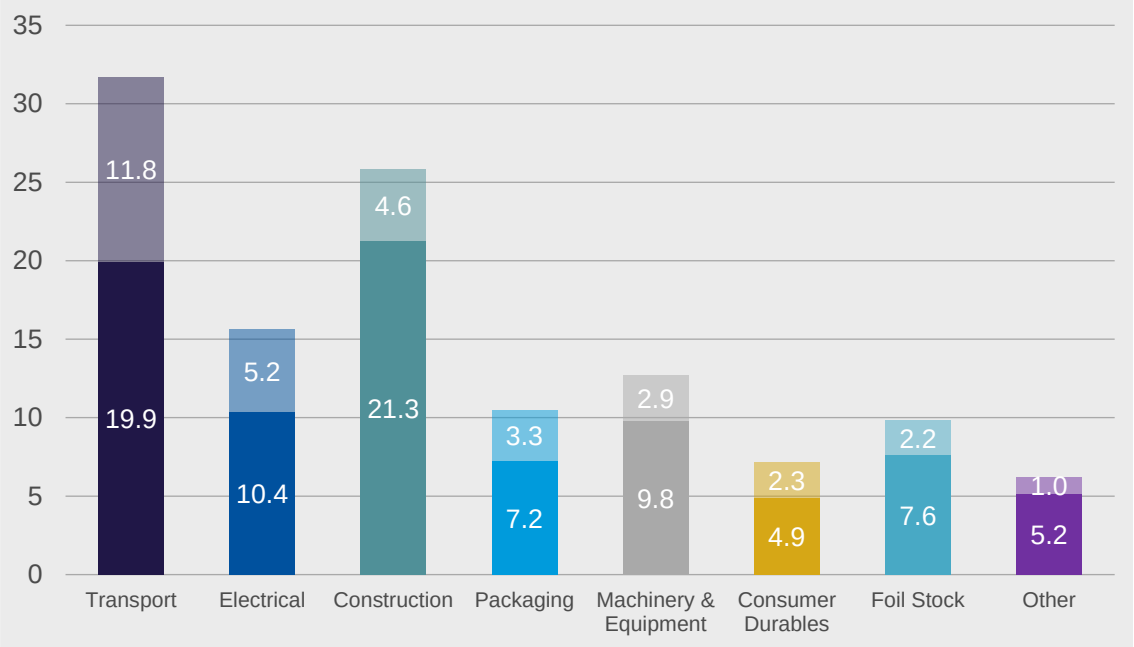
Note on regional coverage of the report

This report focuses on the analysis of regions which have been identified as the ones with the largest demand growth in terms of absolute volume going forward. However, the sectors analysed and the strategies presented for them are not exclusive to these regions. These strategies can be taken into consideration and applied at a local level in regions that might not be the largest consumers of aluminium today, but which have the potential for high relative consumption increases which will continue to complement the sustained growth of aluminium demand at a global level.

1. Opportunities for the aluminium industry

Decarbonization policies and the shift towards a more sustainable world are expected to have a substantial impact on aluminium demand. The adoption of renewable energies and electric vehicles (EVs), as well as the implementation of sustainable solutions in the Packaging and Construction sectors will represent major opportunities for the aluminium industry. Total aluminium consumption is expected to grow by 33.3 Mt in the following decade, going from 86.2 Mt in 2020 to 119.5 Mt in 2030. Around 75% of this demand growth is forecast to come from the Transportation (35%), Electrical (16%), Construction (14%) and Packaging (10%) sectors combined.

Figure 1 Aluminium semi-finished products consumption, 2020 vs 2030, Mt



Source: CRU

This chapter proposes several actions that the aluminium industry can take in order to secure and enhance aluminium consumption coming from the sectors mentioned above. These actions are a compilation of views from different players within the aluminium industry and CRU's own insights.

1.1. Transportation

The Transportation sector is likely to experience a generalized shift towards EVs in coming years, which will drive aluminium demand in various regions. In order to ensure and possibly enhance this expected growth in aluminium consumption, CRU suggests the following steps:

1. Working directly with auto makers such as Tesla, Ford, and GM to understand how the adoption of aluminium can be beneficial to new designs. The focus should be on promoting aluminium as a viable – and sometimes better – material for big auto parts such as the vehicle's body, chassis, wheels and doors, as well as any other parts that might benefit from a lighter design. Understanding the advantages that aluminium poses when compared to other materials is especially relevant in places like the US, where engineers in small and medium-sized OEMs tend to lean towards known and proven solutions. This results in a general preference for steel over aluminium, and a general reluctance to consider change.

Finding a way to collaborate with influential people such as Elon Musk and other players that can help shape industry frameworks around the use of aluminium is a good approach and could potentially result in a boost in demand from big manufacturers.

2. As different countries move away from subsidising EVs, the subsequent increase in EV prices is a potential threat to EV demand. Because of this, the EV industry will have to find new ways to remain competitive against ICEs.

   One alternative to reduce EV's manufacturing costs is to favour the use of steel over aluminium, as steel is cheaper and shares the same green credentials as aluminium due to its recyclability.

   In order to defend its position, the aluminium industry needs to focus on the following key aspects:

   - Encouraging real collaboration between players in different stages of the value chain, creating an ecosystem to develop R&D, work on common goals and increase coordination. This can lead to the reduction of costs for the production of key products, which can then be passed on to final costumers.

     A good example of an area of interest for following this approach would be battery casings. Due to their technical complexity, very few companies manufacture aluminium battery casings, and these are usually not standardized. Funding research to enhance the supply chain of this product with private companies could lead to cost reduction for manufacturers and an increase in standardization.

   - Promote aluminium as a green and low carbon footprint material for auto makers. Putting emphasis on the advantages of the use of aluminium while highlighting its potential for recyclability and reuse in closed loops.

3. Funding research to promote the viability of the use of aluminium cable in the EV industry. As of today, copper remains the predominant material of choice for wiring conductor in automotive harnesses, accounting for 94% of low voltage cabling in the vehicle sector. This can be done in coordination with automakers and aluminium cable suppliers and can be beneficial for both, as substitution of copper for aluminium can help reduce the cost of manufacturing EVs.

4. Both lithium and cobalt play a key role in the manufacturing of batteries used on EVs and are essential to the industry's future growth. Supply shortages and the associated high prices of these elements might pose a substantial threat to the widespread adoption of EVs in the future. Associating and working with other entities and industries that are interested in the development of EVs going forward in order to support these industries might be a good approach to secure battery supply and to avoid a potential increase in EV prices.

1.2. Electrical

The Electrical sector, driven by the rise of renewable energies and the expansion of the power grid, will be one of the main drivers for aluminium demand in the coming decades. Although aluminium already has an important role in this revolution, there is still room for growth going forward. In order to make the most out of the opportunities presented and to take full advantage of potential additional growth, the aluminium industry should focus on the following:

1. Although both wind and solar power are substantially more aluminium intensive than traditional energy sources, solar power uses, on average, more than four times the amount of aluminium per megawatt than wind technologies (see Figure 19). Supporting solar power projects through alliances with designers and manufacturers, working closely to ensure supply chains are streamlined and solar power remains competitive, is a good starting point to making the most of aluminium's exposure to the non-conventional renewable energies sector.

2. The potential of aluminium to substitute copper in electrical applications such as power distribution is a recurrent point of discussion within the industry. Although most players agree that aluminium has become a viable alternative – especially as copper prices remain high –, CRU believes that the Aluminium industry needs to focus its efforts towards modifying and updating codes and standards in order to enable and intensify this transition.

   To guide the transition towards a more intensive use of aluminium in power distribution, changes to current standards will have to be addressed regionally, since the demand for increased electrification is likely to be managed via procurement processes lead by governments and standards are usually applied at a national level.

   Since current standards are largely written based on existing technologies, changes will need to be focused on electric conductivity efficiency rather than size, as the use of aluminium implies the use of a larger cable diameter when compared to copper.

   Aluminium conductor manufacturers must work in association with standard setting organizations in places where the use of aluminium has already proven to be a success in power distribution. This will be crucial to understand and overcome possible technical hurdles that might pose a concern for policy makers in other regions.

3. The Aluminium industry would benefit greatly from a coordinated effort towards the generation of technical research focused specifically on applications where the use of aluminium as an electrical conductor represents a technical or economical gain. Success at a global level in this area, followed by information sharing between members within the aluminium industry, can support conversations in individual regions.

4. Actively promoting the communication between designers of renewables installations and cable suppliers, putting a special focus on increasing the understanding of the long-term costs of using aluminium, is key. Since aluminium is cheaper and lighter than copper but requires more material to be used to achieve the same electrical conductivity, aluminium represents a viable option when physical space is not a constrain. This will be especially relevant in solar and onshore wind, as offshore installations prefer copper for submarine and underground transmission cables where minimizing maintenance requirements is imperative.

1.3. Construction

The Construction sector has moved towards having a more sustainable and environment-friendly approach with relatively low success in later years, and with no clear impact on aluminium demand. CRU has discussed with players in the industry and has found the following possible actions to promote the use of aluminium in this sector:

1. The aluminium industry will have to work closely with certifiers and standard setting organizations to make sure that green policies include aluminium, as these initiatives are usually thought out with other materials such as steel and concrete in mind.

In addition to this, advocating for the inclusion of sustainable solutions such as solar shading technologies and solar power for energy efficiency purposes in building codes, would be a positive driver for aluminium demand as both solutions are usually intensive in the use of this metal.

2. Green initiatives such as building codes and rating systems do not currently apply for residential construction. Therefore, this sector is not seen as an immediate area of growth for aluminium, but it could represent a big opportunity in case green practices are adopted. Conceptually speaking, there is no reason why residential construction should not be subject to the same building codes and incentives as commercial properties, and growth in this sector will be of special interest in a post-Covid world where residential construction will increase its share of the construction market.

   Given the above, CRU believes that sustainable materials related industries need to engage with policy makers with the intention of expanding the scope of green policies to include the residential construction sector. This transition would normally be led by entities such as the Department of Energy in the US, and other similar institutions elsewhere.

3. Although rating systems such as LEEDs have been the “backbone” of the push for increased use of sustainable materials in Construction and have brought the construction industry’s carbon footprint into the public eye, CRU believes that guiding policy makers towards a shift from third party certifications towards mandatory policies is required to see a widespread shift towards the use of sustainable solutions and materials in the Construction sector.

4. Reaching policy makers and educating them regarding the benefits of aluminium can be of especial importance. A tangible opportunity in that area in the US is to coordinate efforts with the Aluminium Association, which has formed the Congressional Aluminium Caucus in the House of Representatives and needs support in reaching out to various agencies – such as the Departments of Energy, Defence and Transportation – to effect change.

5. CRU encourages the aluminium industry to seek alliances with the glass industry, as aluminium is a promoter of bigger windows and vice versa. An alliance of this type – between aluminium extruders and glass companies for example – could result beneficial for both industries within the Construction sector.

6. Collaborating with architects to include carbon footprint in engineering specifications and provide them with the right data. This can be done by approaching construction software designers and helping them add the right metrics to software that estimates material use rates-based CAD designs, for example. They could measure/calculate environmental impact in real time, so that building designers can use more or less of a certain material in order to meet a carbon footprint target. This practice could be advantageous for secondary or low-carbon aluminium in particular.

7. Reaching out to the academic world to teach engineers, specifiers and architects how to make use of aluminium and its properties for energy efficiency and ornamental solutions is an initiative that could have considerable impact in the long-term. Because of this, CRU recommends connecting with universities in order to understand where the incorporation of knowledge about the benefits of aluminium could fit in their broader curriculums, and work in partnerships with them to facilitate knowledge transfer.

1.4. Packaging

As of today, aluminium holds a special place in the Packaging sector due to its high recyclability, which support the perception of aluminium as a highly environmentally friendly material. CRU believes this perception needs to be protected in order to ensure future demand as circular economy policies gain popularity across the world and the general public becomes even more aware of the virtues of certain materials over others.

In order to continue to benefit from increases in packaging demand growth, the aluminium industry should focus on the following:

1. To protect aluminium's green image, the industry needs to collaborate with big brands that are vocal about sustainability issues and have a direct link to final consumers, such as Walmart and Nespresso. Despite brands like these not being big consumers of aluminium, they are somehow relevant in shaping consumer behaviour. These collaborations can be done through the implementation and marketing of closed loops and other types of circular economy projects that emphasize aluminium's recyclability and therefor, it's potential for low carbon footprint.

2. On a similar note, it is crucial to work with municipalities to secure the supply of secondary aluminium by improving collection networks, as the use of recycled material is essential to reduce the carbon footprint of aluminium packaging.

   Improving recycling and collection networks can be particularly beneficial to aluminium over other types of materials as it is one of the few materials where the use of secondary sources makes sense from an economic standpoint, as aluminium production from these sources generates higher margins due to lower energy consumption.

3. One of the key aspects of environmental regulation nowadays is that it focuses primarily on CO_2 emissions. This causes big brands to commit to reducing their emissions, putting pressure on the packaging industry. CRU believes that working on guiding regulators and policy makers to focus on more than just CO_2 and take into account the life-cycle impact of different materials as a whole would benefit the aluminium industry. Some of the additional criteria that could be taken into consideration include:

   - Endless recycling: a focus on this aspect would be beneficial for aluminium and glass, likely at the expense of plastics. This is also linked with the decreased waste levels associated to aluminium when compared to plastics.

   - Shelf life: focusing on reducing organic waste from expired products could lead to a higher adoption of aluminium foil packaging.

   When competing against the plastics industry, considering an alliance with the glass industry to redirect the sustainability discussion at issues where both materials have a proven advantage over the plastics and petrochemical industries could yield positive results for both industries. This is particularly true given the size and influence of the plastics industry in general.

4. Forming an alliance in specific areas with the glass industry does not mean that the aluminium industry should not compete with glass in other spaces. When competing directly with the glass industry in the packaging sector, a key theme to focus the message around is aluminium's light weight when compared to glass and the benefits

that this has in terms of logistics and CO_2 emissions linked to the transportation of good.

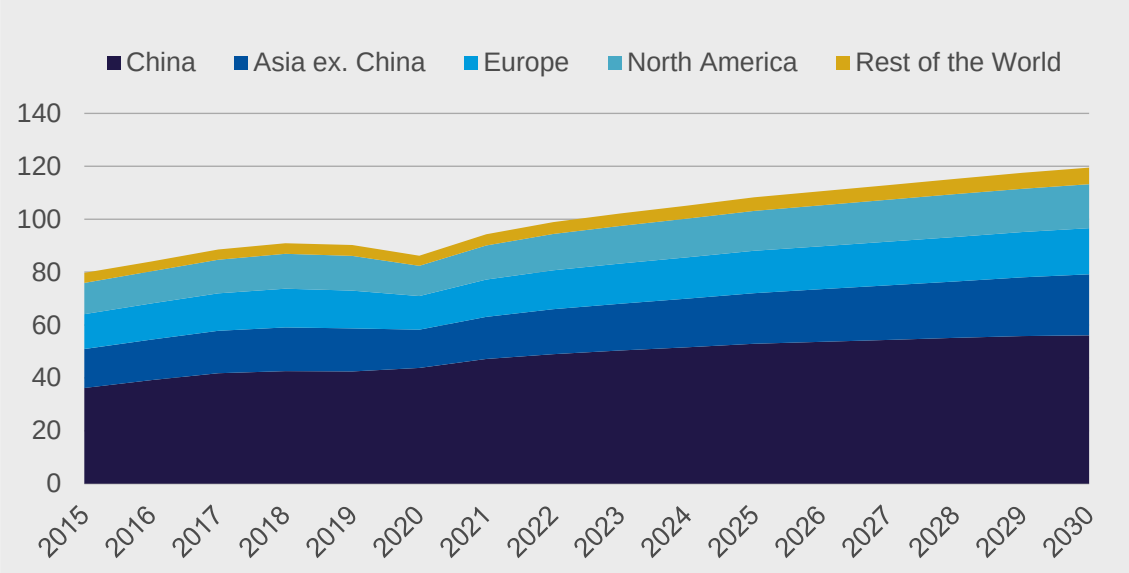
2. Quantification of demand changes

2.1. Global aluminium consumption

2.1.1. Aluminium consumption by region

The aluminium industry is the world's second largest metals industry after the steel industry. Global consumption of aluminium semi-finished products in 2020 reached 86.1 Mt, 6.4 Mt more than the 79.7 Mt consumed in 2015.

Figure 2 Aluminium semi-finished products consumption by region, 2015 – 2030, Mt

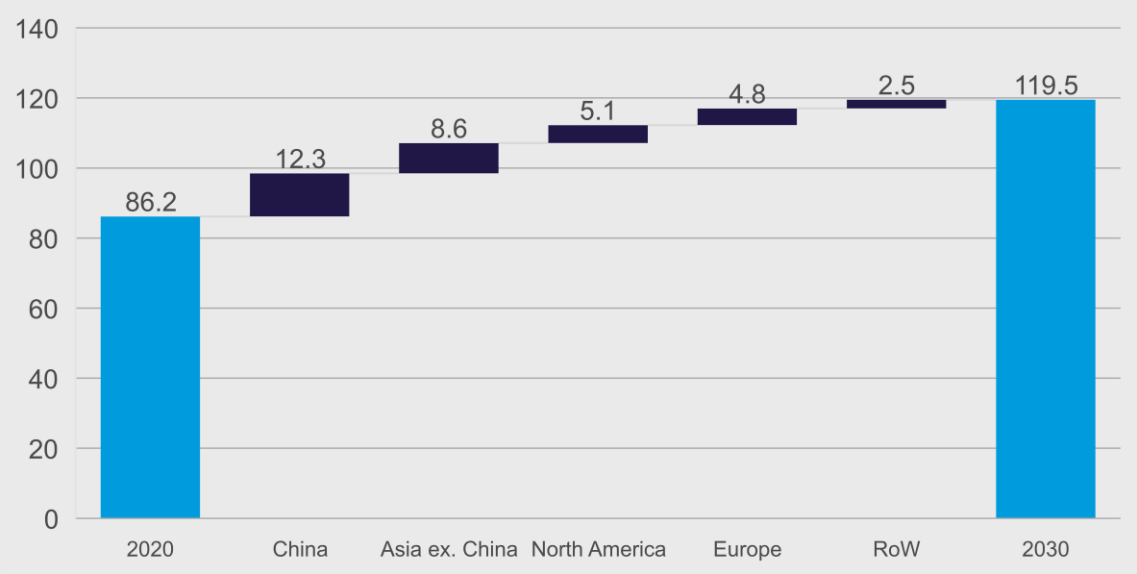


Source: CRU

China has historically been the World's biggest consumer of semi-finished aluminium products by a large margin, making up for more than 45% of the market since 2015. In 2020, the country accounted for more than 50% of the World's demand for the first time, reaching a total consumption of 43.8 Mt and experiencing growth from 2019 despite the Covid-19 pandemic. Other key regions include Asia ex. China, Europe, and North America. Europe and North America accounted for 15 and 13% of global consumption in 2020 at 12.7 and 11.5 Mt respectively, with consumption decreasing by 11 and 13% each due to the pandemic.

In the longer term, China is expected to remain the biggest semis-consuming country by a large margin. The country will continue to account for close to 50% of global demand. The Chinese semis fabricated industry will have to prepare itself for a slowing in the rate of demand increases, moving from a 3.9% CAGR in the 2015-2020 period to a 1.9% CAGR from 2021 to 2030. With China set to adopt a more sustainable growth path, the country will move from a state-led economy to a more consumer-led one.

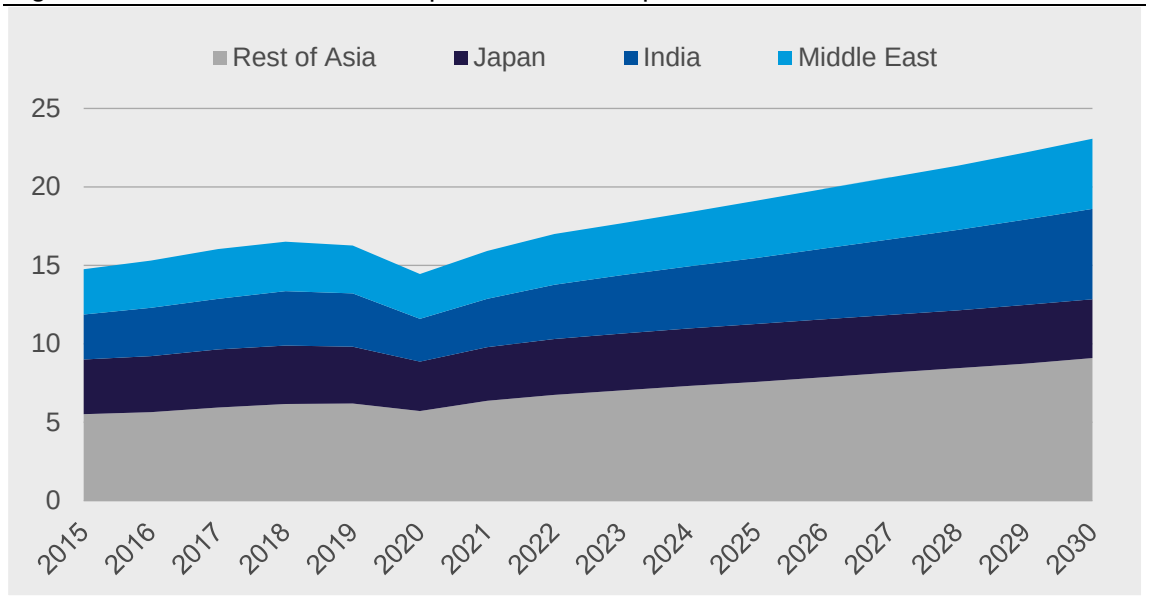
Figure 3 Aluminium semi-finished products consumption growth by region, 2020 vs 2030, Mt



Source: CRU

In terms of absolute consumption growth, China will see an increase of 12.3 Mt between 2020 and 2030, while the US and Europe will grow by 5.1 and 4.8 Mt, respectively. Around 61% of the 8.6 Mt growth expected to come from Asia ex. China will be distributed among India (35%), the Middle East (19%) and Japan (7%).

Figure 4 Aluminium semi-finished products consumption in Asia. Ex China, 2015 – 2030, Mt

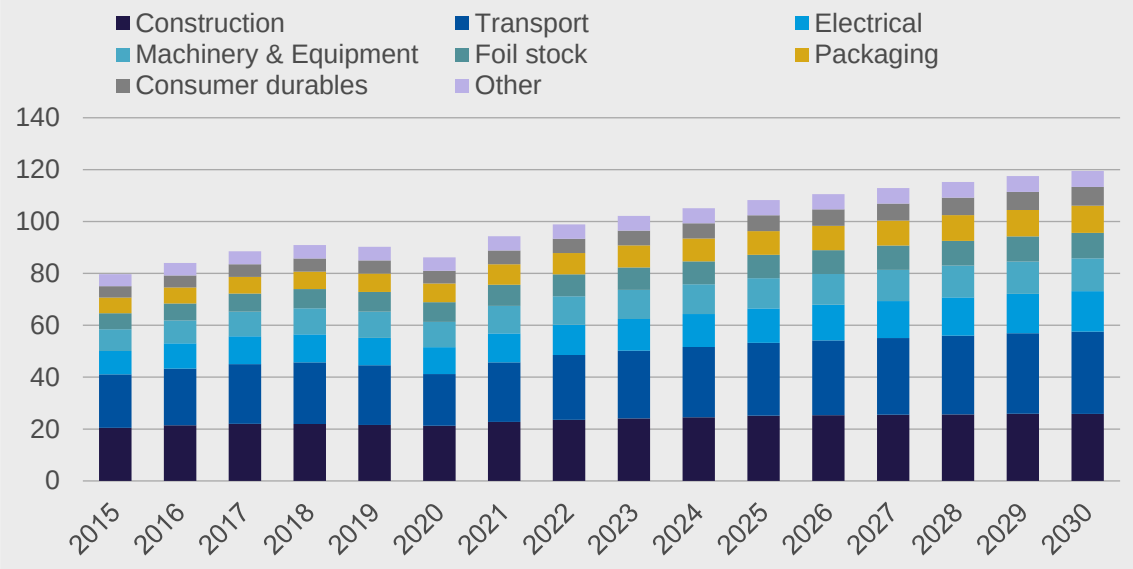


Source: CRU

2.1.2. Aluminium consumption by sector

More than half of aluminium consumption came from the Transportation and Construction sectors, which together accounted for half of total consumption. These sectors were followed by the Electrical and Machinery & Equipment sectors with 11 and 12% of global demand each. Packaging and Foil Stock accounted for 7 and 9% of total consumption each.

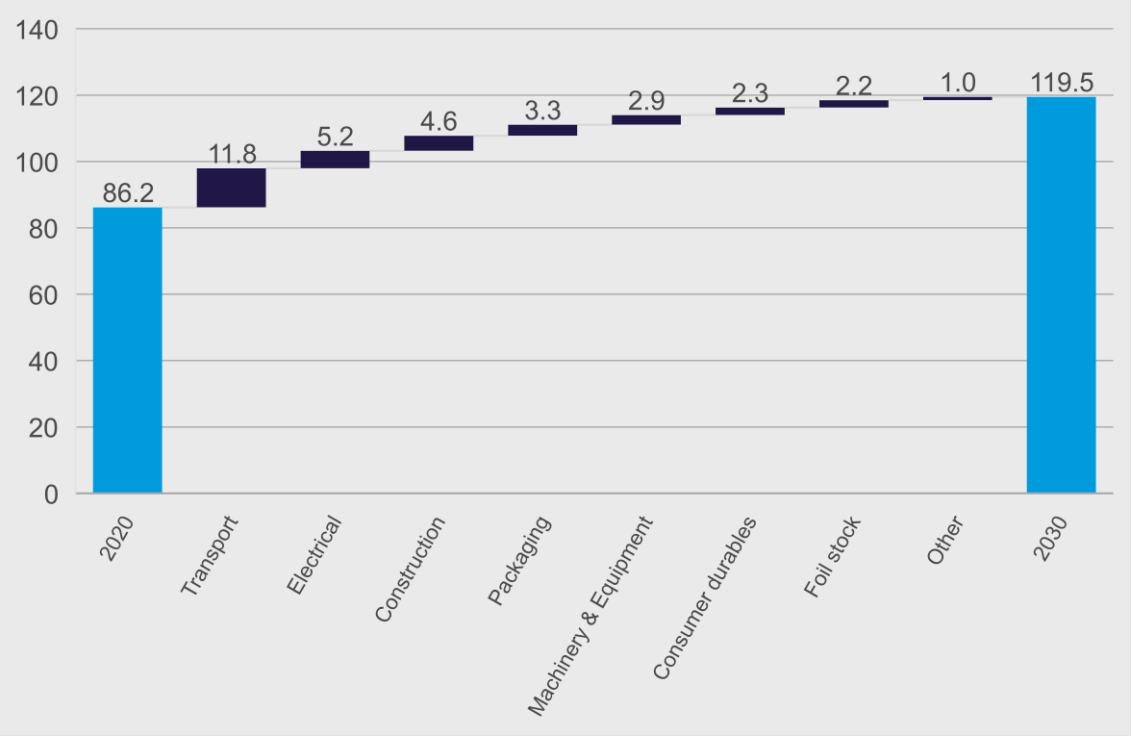
Figure 5 Aluminium semi-finished products consumption by sector, 2015 – 2030, Mt



Source: CRU

CRU expects that this distribution will change slightly in the upcoming decade, mainly due to Construction showing the slowest growth across all sectors with a 1.4% CAGR, going from 22.7 Mt in 2021 to 25.2 Mt in 2030. The Transportation sector will remain the main consumer of aluminium going forward, reaching a global demand of 31.7 Mt in 2030 – around 8.7 Mt more than its 2021 consumption of 23.0 Mt. Other sectors such as Electrical and Packaging will also show substantial growth during this period, increasing their respective consumptions by 5.2 Mt and 3.3 Mt.

Figure 6 Aluminium semi-finished products consumption growth by sector, 2020 vs 2030, Mt



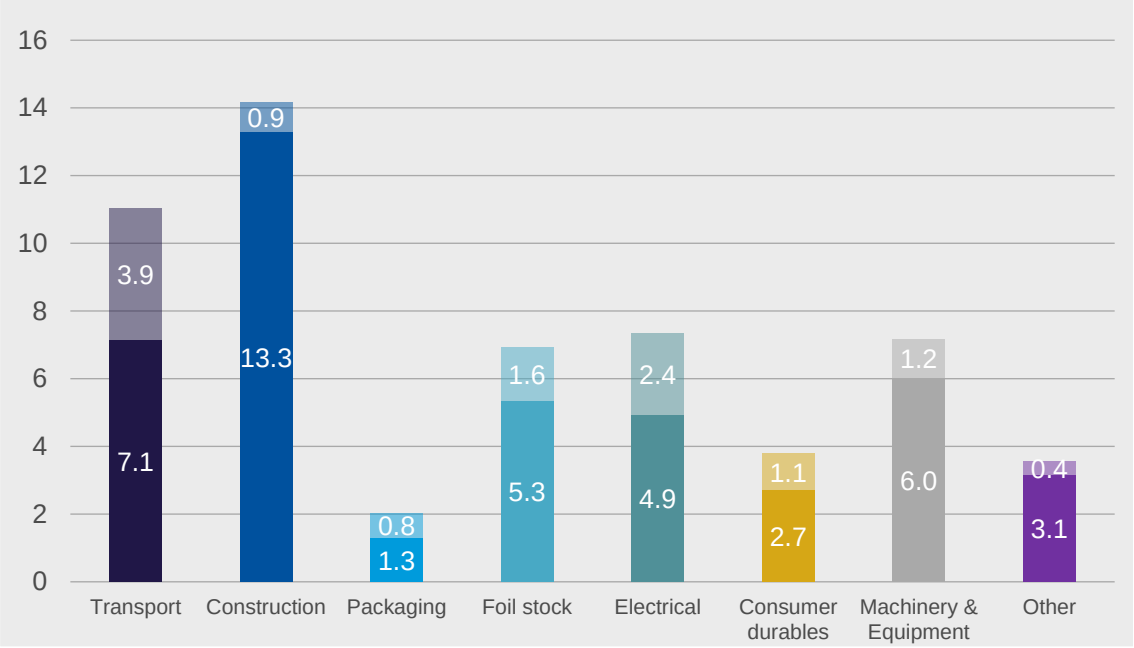
Source: CRU

2.2. Aluminium consumption in China

Aluminium will remain a compelling metal of choice for consumers in China. A combination of price, supply and attractive material properties compared with copper and steel will

maintain its competitive position. The wide diversity of end-use applications, including consumer applications, also means that aluminium demand is well positioned for future growth.

Figure 7 Aluminium semi-finished products consumption by sector in China, 2020 vs 2030, Mt



Source: CRU

Approximately a 30% of China's total consumption of aluminium in 2020 came from the construction sector with ~13.3 Mt, followed by Transportation with 7.1 Mt (16%) and the Machinery & Equipment sector with 6.0 Mt (14%).

Going forward, China's aluminium consumption is expected to grow by 12.3 Mt, reaching a total of 56.1 Mt in 2030:

- A third of this growth is expected to come from Transportation, which, driven by a fast adoption of electric vehicles, will grow by 55% in the following decade. Demand from this sector is expected to reach 11.0 Mt or 20% of the country's total in 2030.
- Although Packaging will remain the smallest end-use sector in China, it is expected to experience the fastest relative growth of all sectors, primarily due to the shift to canned beers away from glass. Consumption in Packaging will reach 2.0 Mt in 2030, growing by 60% between 2020 and 2030.
- The implementation of renewable energy installations in distant areas and subsequent power transmission projects will increase the demand of aluminium coming from the Electrical sector, which will growth by 2.4 Mt.
- A shift from physical infrastructure and heavy industry towards services will halt growth coming from the Construction and Machinery & Equipment sectors, which will show the lowest relative growth with 7% (0.9 Mt) and 19% (1.2 Mt), respectively.

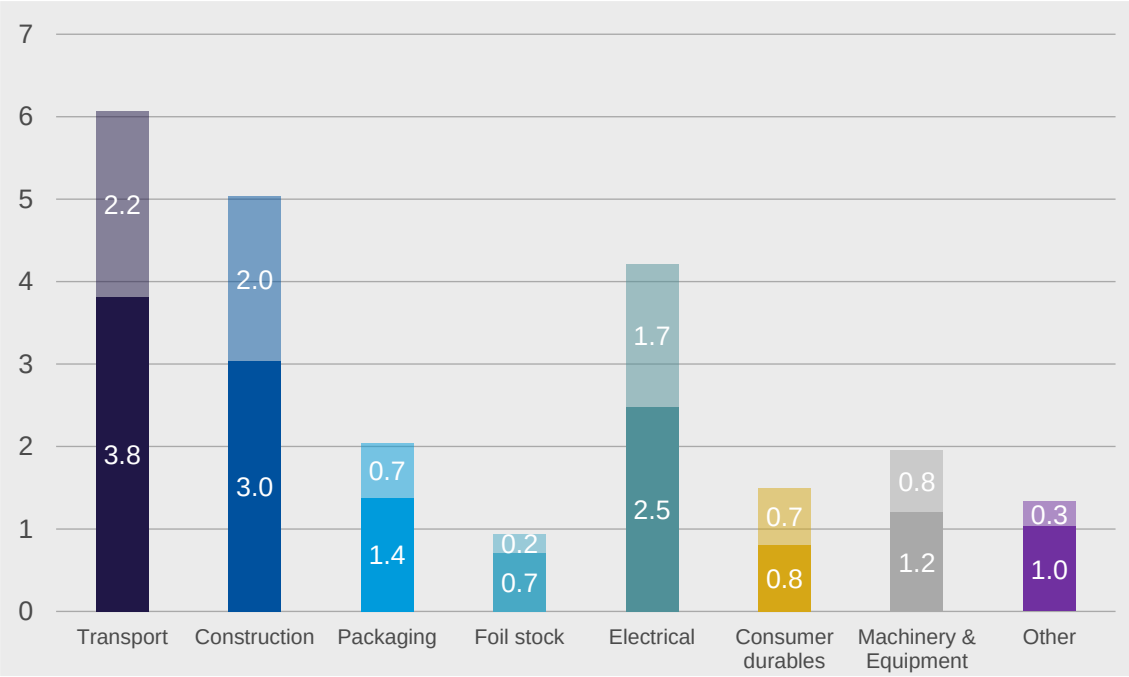
2.3. Aluminium consumption in Asia ex. China

As mentioned earlier in this report, around 61% of the region's demand growth is forecast to come from India, the Middle East and Japan. Additional consumption from India will be heavily driven by population growth and urbanization trends. In the Middle East, a growing working age population will support GDP growth in Turkey while government spending

supports the forecast for the Gulf countries. Japan, on the other hand, is relevant due to the increase in aluminium consumption expected to come from the country's auto manufacturing industry, which will be the second largest in Asia after China.

From an end-use perspective, growth in aluminium demand coming from Asia ex. China will be mainly driven by the growth of the Transportation, Construction, and Electrical sectors, which combined, are expected to represent close to 70% of the region's consumption growth in the coming decade.

Figure 8 Aluminium semi-finished products consumption by sector in Asia ex. China, 2020 vs 2030, Mt



Source: CRU

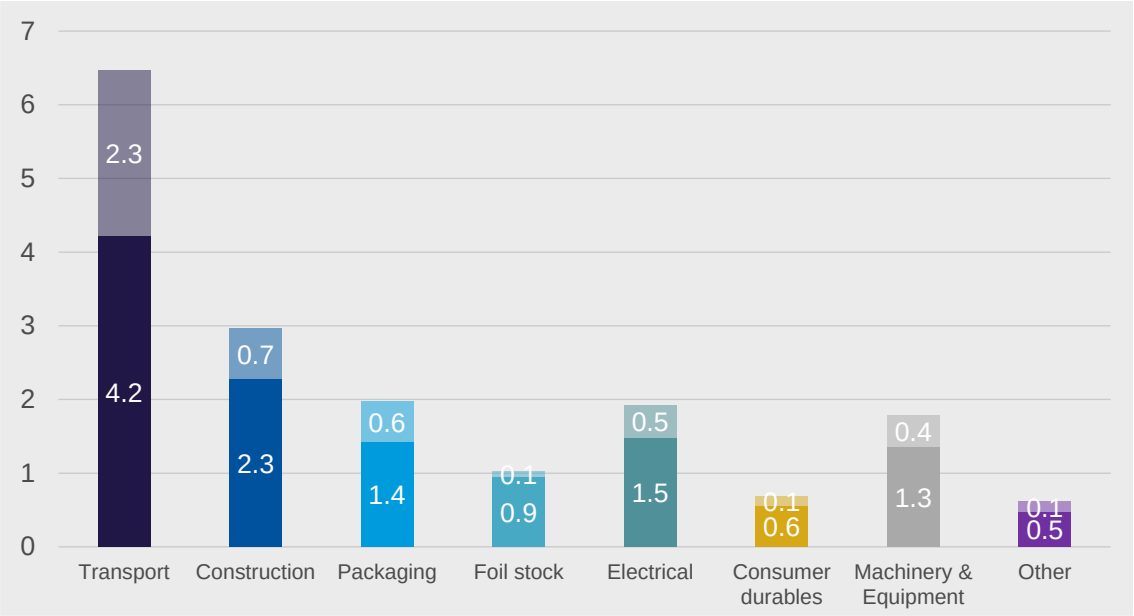
- More than half of the aluminium consumption growth coming from the Transportation sector in Asia ex. China is expected to come from India (27%), Japan (17%) and the Middle East[1] (12%).
- The Construction sector will be marked by a strong demand growth coming from the Middle East, which will represent around 34% of the sector's growth, followed by India with 22%.
- Demand of aluminium coming from the Electrical sector in in the region will be driven by the rapid adoption of renewable energies in India. The country's electrical market growth will represent 62% of the total region's demand growth in this sector.

2.4. Aluminium consumption in Europe

Europe's aluminium consumption comes mainly from its developed Transportation sector with 4.2 Mt in 2020, representing a 33% of the Region's total demand, followed by construction with 2.3 Mt (18%) and Electrical with 1.5 Mt (12%). Looking forward, Europe is expected to have the world's third smallest growth in aluminium consumption after China and Australasia, going from 12.7 Mt in 2020 to 17.5 Mt in 2030, although almost half of this growth will come from the Transport sector, a 15% from construction and a 12% from Packaging

[1] Including Turkey

Figure 9 Aluminium semi-finished products consumption by sector in Europe, 2020 vs 2030, Mt



Source: CRU

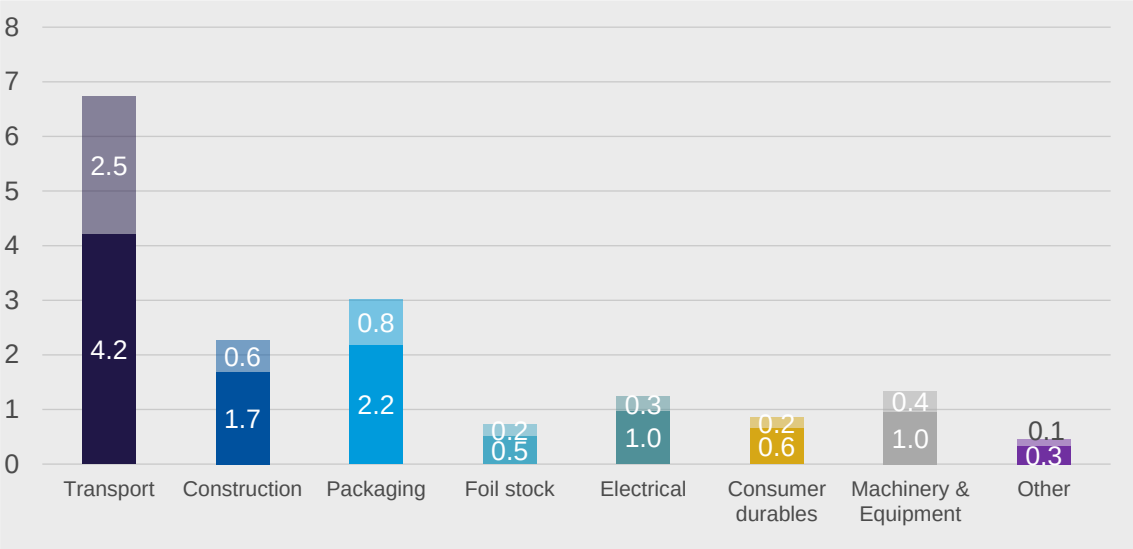
Economic growth drivers for Europe are almost universally negative. Working age population has already peaked, while labour market rigidities and limited movement of workers will continue to be reflected in low productivity rates. Consequently, European GDP growth is expected to drop below 1% p.a. by the early 2030s. Aluminium demand coming from the Transportation and Electrical sectors will be enhanced by the EU's climate strategy, which aims to have a near one third share for renewables by 2030 and net-zero greenhouse emissions by 2050.

When it comes to specific policies such as the European Green Deal, CRU's view is that it could encourage a shift in consumption from high-carbon to low-carbon aluminium but, overall, will not have a considerable impact in aluminium demand coming from the construction sector.

2.5. Aluminium consumption in North America

North America's biggest share of aluminium semi-finished products consumption comes from the Transportation sector, which represented 37% of the regions demand in 2020 with 4.2 Mt. Due to its strongly consumer-driven economy, North America is the only developed region where the Packaging sector consumes more aluminium than the Construction sector with 2.2 Mt (19%) and 1.7 Mt (15%), respectively in 2020. Looking ahead, North America is expected to reach a demand of 16.6 Mt in 2030, which represents a 45% increase from the 11.5 Mt consumed in 2020. Similarly to Europe, 49% of this growth is expected to come from the Transportation sector alone – as the region becomes one of the key EV producing markets in the world –, combined with a 16% from Packaging and an 11% from Construction.

Figure 10 Aluminium semi-finished products consumption by sector in North America, 2020 vs 2030, Mt

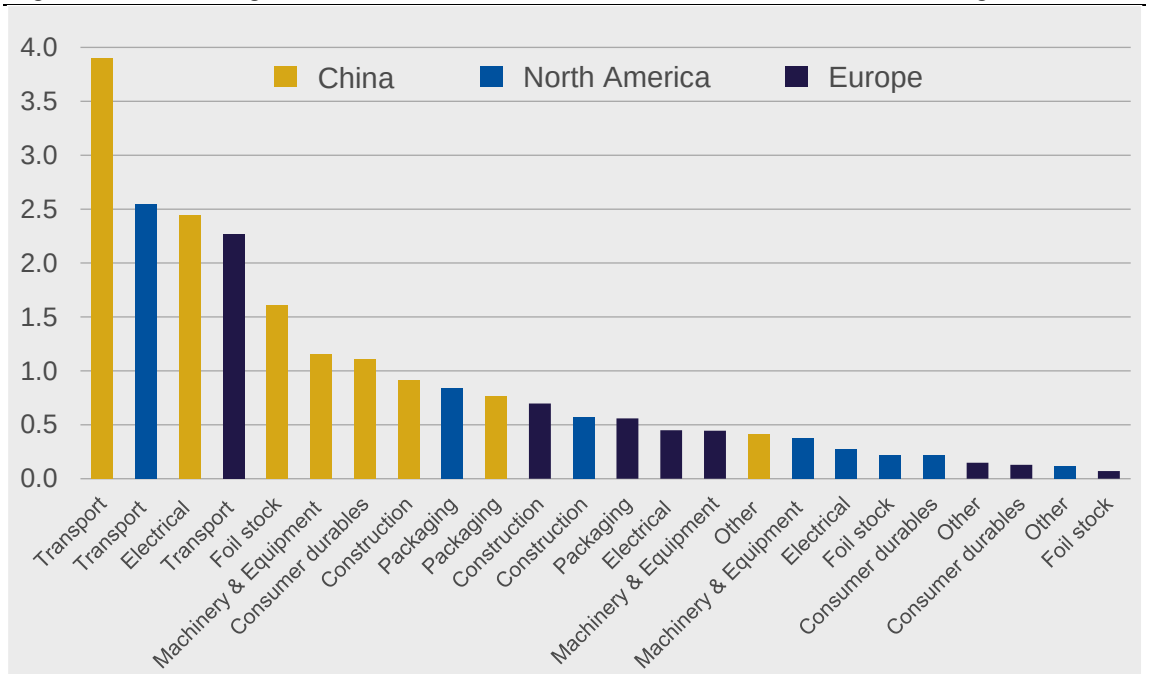


Source: CRU

2.6. Selection of key sectors

The selection of sectors targeted on this report is largely based on the total aluminium demand growth that CRU forecasts will come from those sectors in the coming decade.

Figure 11 Demand growth between 2020 and 2030 for different sectors and regions, Mt



Source: CRU

Based on this, the sectors analysed on this study are Transportation, Electrical, Construction and Packaging. Although Machinery & Equipment and Consumer durables are similar to Packaging in terms of total aluminium demand, these first two sectors are mostly driven by industrial activity and residential construction respectively, while Packaging is particularly susceptible to consumer preference and public policy.

3. Policy drivers & societal changes driving demand growth

3.1. Transportation

3.1.1. Key takeaways

- Transportation will be the fastest growing sector in terms of absolute aluminium demand in the next decade. Consumption from this sector will grow by 11.8 Mt, going from 19.9 Mt in 2020 to 31.7 Mt in 2030, with a 33% of this growth coming from China, 22% from North America and 19% from Europe.
- Aluminium demand coming from the Transportation sector will by driven by the shift towards electric vehicles which, on average, contain 60-80 kg more aluminium per vehicle than those powered by internal combustion.
- CRU estimates that total EVs sales will grow from 6.7 million-vehicles in 2020 to 40.9 million in 2030, going from representing 9% of total vehicle sales to representing 40%.
- The rate of adoption of EVs depends largely on carbon emissions reduction goals set by individual countries and regions, and the actions implemented towards reaching those goals. These actions can go from direct subsidies to EV purchases and traffic benefits, to quotas on EVs sales imposed to OEMs by governments or manufacturers themselves.

3.1.2. Introduction

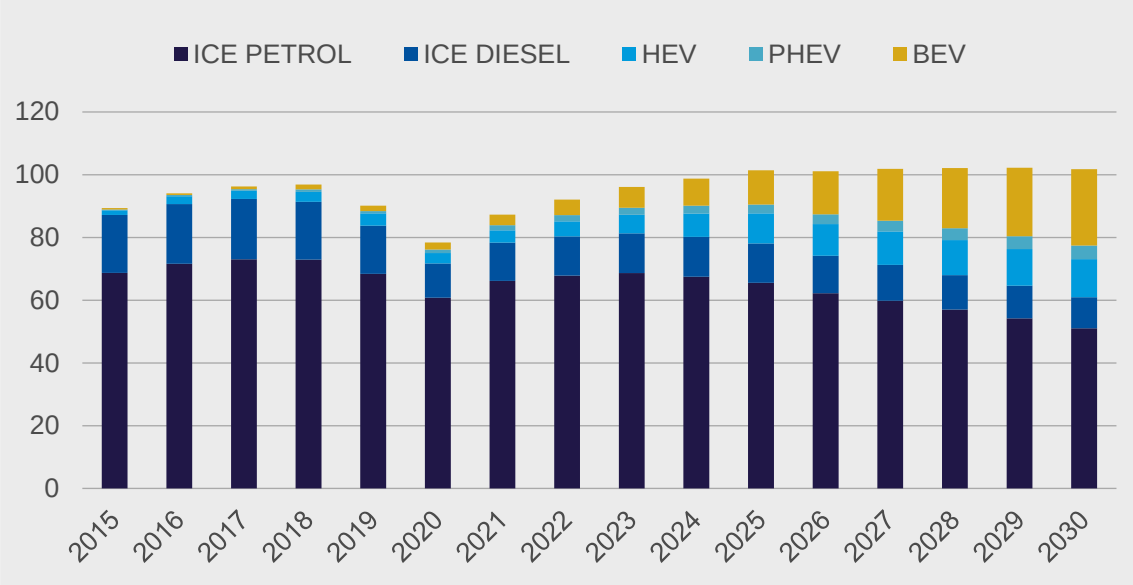
The Transportation sector is expected to grow by 11.8 Mt in the following decade, going from 19.9 Mt in 2020 to 31.7 Mt in 2030. This growth will be primarily driven by the decarbonization of the sector and the consequential shift towards the production of electric light-duty vehicles, which is forecasted by CRU to represent around 63% (7.4 Mt) of the total consumption growth coming from this sector. Because of this, this section is focused on describing the different drivers behind the surge of EVs and possible routes for the IAI to promote the use of aluminium by this particular industry.

3.1.3. Electric vehicles (EVs)

Environmental concerns have led many countries to introduce policies to curb their carbon emissions. In 2020, the UK announced that it will ban the sale of new petrol and diesel cars from 2030. Several countries – including the US, Canada, EU, Germany, Norway, China, and India – have adopted similar plans to ban non-EV sales by 2035 or earlier. These environmental policies will help accelerate the already prevalent transition to EVs. Furthermore, major car companies like Honda, Mercedes, and GM have announced plans to become close to fully electric by 2035.

CRU expects EVs to account for over 30% of total sales by 2027, and over 50% by 2034. Hybrid electric vehicles (HEV) and Plug-in hybrid electric vehicles (PHEV) will play an important role in the transition to EVs, but as consumers become more environmentally conscious, CRU expects battery electric vehicles (BEV) to become the popular choice.

Figure 12 Global automotive forecast, 2015 – 2030, million-unit



Source: CRU

Table 1: Definition of different powertrains and aluminium intensity of use

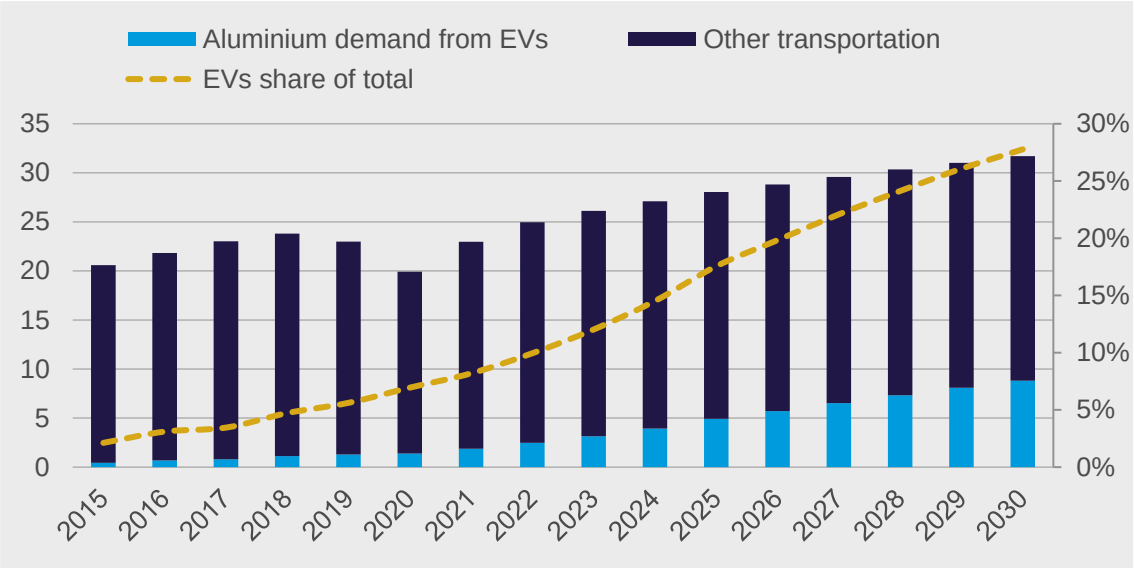
	Power train categorization for each vehicle type	Al Intensity of use (Al kg/vehicle)
ICE	Internal combustion engine	164
HEV	HEX (Mild hybrid electric vehicle + Full hybrid electric vehicle). Split w/ diesel	184
PHEV	Plug in hybrid electric vehicle (including extended range EV (REEV))	244
BEV	Battery electric vehicle	227

DATA: CRU

The many unique properties of aluminium make it indispensable in the auto industry. Crash boxes rely on its high energy absorption, heat transfers rely on its conductivity and its lightweight properties make it vital for many body-in-white parts. However, aluminium faces competition from other materials in some automotive components, such as steel in battery casing and copper in cabling. Battery housing in particular is an area where there is tough competition between steel and aluminium, as both materials make good housing. The light-weighting potential of aluminium makes it desirable, but it is the more expensive choice, which is why it is often found only in premium EVs. Additionally, a new emerging area for aluminium demand in EVs is wire and cable: with more on-board chargers, batteries, and connectors, aluminium has become popular choice, especially for HV cable. Wire and cable in traditional ICEs formed just 1% of the total aluminium content, but for BEVs, this increases to 7%.

Due to electric vehicles having a higher intensity of aluminium use than traditional internal combustion engine vehicles (mostly from battery casings), EVs market penetration will bring a surge in aluminium demand from the Transportation sector, specially from BEVs, which are expected go from representing a 3% of the total light duty vehicles sold in 2020 and 24% by the end of the decade, with 24 million units to be sold in 2030, translating into a demand of 5.5 Mt of aluminium coming from BEVs alone in that year.

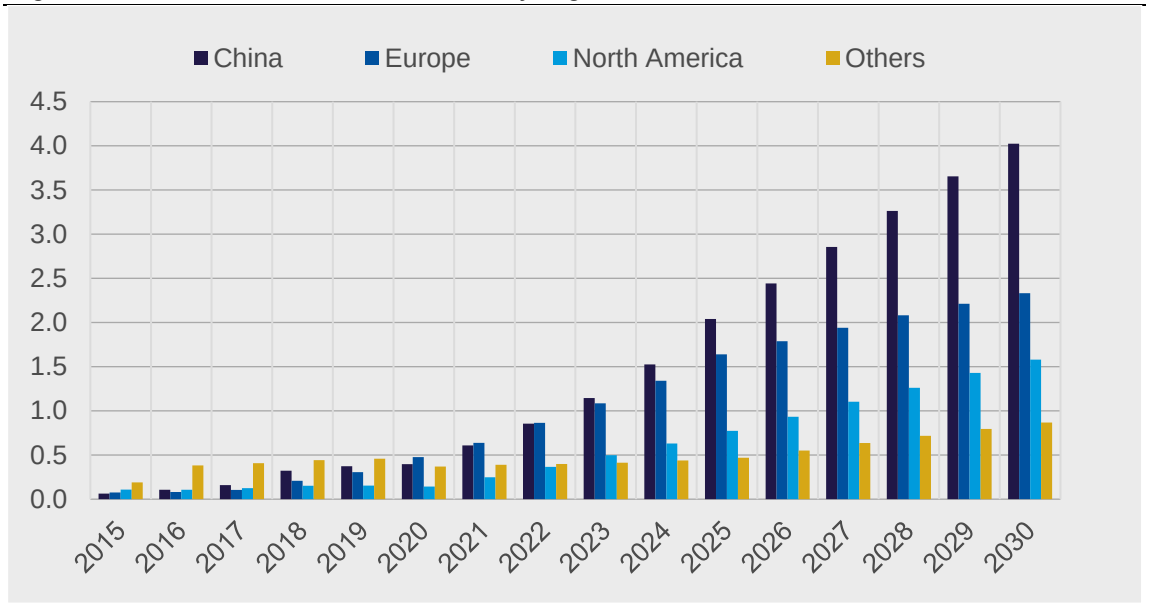
Figure 13 Aluminium demand from EVs as a share of total Transportation demand, 2015 – 2030, Mt



Source: CRU

At a global level, aluminium demand from EVs is expected to go from 1.4 Mt in 2020 to 8.8 Mt in 2030, representing a 7.4 Mt growth in just ten years with a 20% compound annual growth rate, with ~93% of this growth expected to come from China, Europe and North America combined.

Figure 14 Aluminium demand from EVs by region 2015 – 2030, Mt



Source: CRU

In general terms, during the second part of this decade, cost competitiveness of EVs will play a key role as countries start phasing out subsidies which are currently directly correlated to EVs sales. Related to this, the rise of the price of battery metals such as lithium and cobalt represent a potential downside risk for CRU's forecast, as batteries encompass around 40% of the total EV costs.

Beyond 2030, CRU expects a slight decline in the overall number of vehicles sold at a global level, although this should not have a noticeable impact on aluminium demand coming from the automotive sector as the metal's consumption will continue to grow along with the share

of EV sales. However, this demand is expected to shift towards developing regions as Europe and China reach a widespread adoption of EVs in the coming decades.

China

China is the biggest EV consumer in the world with around 1.8 million units sold in 2020, which translates to ~400 kt of aluminium, around 6 times what the country's EV industry consumed just 5 years prior.

New electric vehicle (NEV) monetary subsidies started in China more than a decade ago although, in recent years, the country has been focusing on moving away from direct subsidies paid to producers. This has partially been due to frauds committed by manufacturing companies who, in some cases, over-reported their EVs production to obtain more financial support. Due to this, China has been focusing on incentivising the EV market through different policies that facilitate and promote market growth and competition:

- Performance and production requirements: China introduced the New Electric Vehicle (NEV) mandate policy, aimed at assigning a number of credits to each NEV depending on different metrics such as mileage per charge and energy efficiency. This mandate established annual credits goals required for manufacturers to be achieved via NEVs production or imports.
- Zero emissions vehicle mandate: Vehicles manufacturers and importers are required to produce or import at least 10% of their units as EVs, and this percentage is expected to reach 20% in 2025.
- EV licence plates: Chinese cities are offering cost-free license plates and/or destinating a fixed portion of license plates to EVs exclusively.
- Traffic restriction exemptions: These exemptions include, in some cases, dedicated parking spots and lifting restrictions for driving during days intended to combat air pollution.
- Infrastructure: China's EV Charging Infrastructure Development Guidelines (2015 – 2020) set the target of having 120,000 EV charging stations and 4.8 million EV charging posts by 2020. China's charging infrastructure is expected to keep growing, keeping up with the country's EV sales goals.
- Global competition: China abolished foreign ownership restrictions in 2018, which allows foreign companies to produce EVs in China without having to form a joint venture with a local counterpart.

These policies, along with a shift towards global competition openness, are expected increase the pace of adoption of EVs in China: according to CRU's current forecast, China is set to reach total production of 18.5 million units in 2030. This will translate to over 4.0 Mt of aluminium demand in that year, around 21% of the entire Transportation sector demand. As a possible downside, China's attempt to make EVs as low cost and as competitive as possible in order to comply with stronger adoption goals could lead to a more intensive use of steel as a cheaper substitute for aluminium, although this trend is not expected to slow down aluminium demand from the sector.

Europe

Europe has taken significant steps toward electric mobility in the last decade, going from 0.4 million units sold in 2015 to 2.2 million in 2020. Some of these policies that have supported this growth are listed below:

- EV Purchase benefits: These benefits go from direct subsidies and ownership tax breaks to scrapping schemes to promote aluminium recycling and can range from hundreds to several thousand euros. For instance, France offers a €7,000 "ecological bonus" for vehicles emitting less than 20 g of CO_2/km and up to €5,000 for purchasing BEVs and PHEVs while disposing of a diesel or gasoline car.

- EV charging incentives and infrastructure: Charging incentives are offered to individuals, condominiums and private companies for the purchase and installation of EVs chargers. Some countries such as Norway have opted for investing in public infrastructure, with more than 10,000 charging spots publicly available.

- EVs sales and emissions goals: The European Union has set a new policy package called "Fit for 55" with the goal of cutting carbon emissions by at least 55% by 2030, with the long-term goal of reaching net-zero emissions by 2050. For the automotive industry, this would mean a complete transition from internal combustion engines and hybrids to EVs by 2035.

Most recently, the European Union announced a 750-billion-euro economic stimulus that includes 20 billion destined to boosting EVs sales and charging stations. This is in addition to individual country-level initiatives such as Germany's 2.5-billion-euro stimulus package to push the production of battery cells and enlarge its existing charging infrastructure.

CRU expects European aluminium demand from EVs to go from ~0.5 Mt in 2020, to more than 2.3 Mt by 2030, with 10.9 million units sold that year. Around 94% of this demand is expected to come from Western European countries.

Looking further into the future, Europe's generational change and its shift towards smart cities could represent a downside risk to light vehicles consumption as consumers opt to use lighter and less carbon intensive methods of Transportation, such as bikes and electric scooters which, in some cases, also benefit from monetary subsidies.

North America

Although North America shows promising growth for the EV market in upcoming years, the region's demand has lagged behind China and Europe. Demand for EVs in North America has increased by ~0.2 million units in the last 5 years, which translated into a consumption of 142 kt of aluminium from the EVs industry in 2020. This is equivalent to 30% and 36% of European and Chinese demand, respectively. Although North America as a whole has established goals towards electric mobility, the goals of individual countries of the region seem to vary significantly:

- **Canada** has already invested over 1 billion USD towards zero-emission vehicle adoption and plans to keep moving in this direction:

    - Zero-Emission Vehicles program: $587 million have been invested in helping ~92,000 Canadian citizens and businesses to transition to zero-emissions vehicles since 2019. This program includes monetary incentives of up to $5,000 for EV purchases.

    - Charging Infrastructure: Over $460 million have been destinated to building a network of EV chargers from coast to coast, which has resulted in the implementation of more than 16,500 new electric vehicle chargers to this date.

    - EVs sales goals: The Government of Canada has recently announced a mandatory target for light duty vehicles and passenger trucks sales to be 100% zero-emission by 2035 instead of by 2040.

Canada has set up the goal to be a net-zero economy by 2050 and, to support this, has implemented a 5-year Net Zero Accelerator Initiative that includes $8 billion for supporting projects to reduce greenhouse emissions. This includes the auto manufacturing sector.

- The **US**, despite not setting clear-cut goals in the past, has been implementing tax credits and exemptions to motivate EV purchases at federal & state level for years, although these might vary substantially from state to state:
    - Tax credits: The United States has been implementing tax credits since 2009, ranging from $2,500 to $7,500 to boost EV sales.
    - Charging Infrastructure: Several states such as Los Angeles and Arizona offer tax credits to commercial (up to $4,000) and residential (up to $75) costumers to install charging stations.
    - EVs sales goals: In August of this year, President Joe Biden announced that 50% of new vehicles sold will be electric powered by 2030. If achieved, this measure could represent an upside risk to CRU's forecast which currently estimates North American EV sales to represent 36% of total sales by 2030.

In the shorter term, the country expects an important growth with around half a million units in EV pick-up trucks sold preproduction from Ford and GM alone for 2022. This trend suggests another upside risk in terms of aluminium demand, as the American costumer seeks for bigger automobiles with towing capacity, capable of traveling long distances from state to state. Lighter aluminium components such as wheels, doors and cable could be a requirement for this market as the technology becomes available, although medium and small-sized OEMs have shown some resistance to including aluminium in their engineering designs (partly due to risk aversion and steel still being the most commonly used material).

Overall, CRU expects the North American EVs industry to reach a consumption of ~1.6 Mt of aluminium by 2030, representing a 1.4 Mt increase from demand in 2020.

3.2. Packaging

3.2.1. Key takeaways

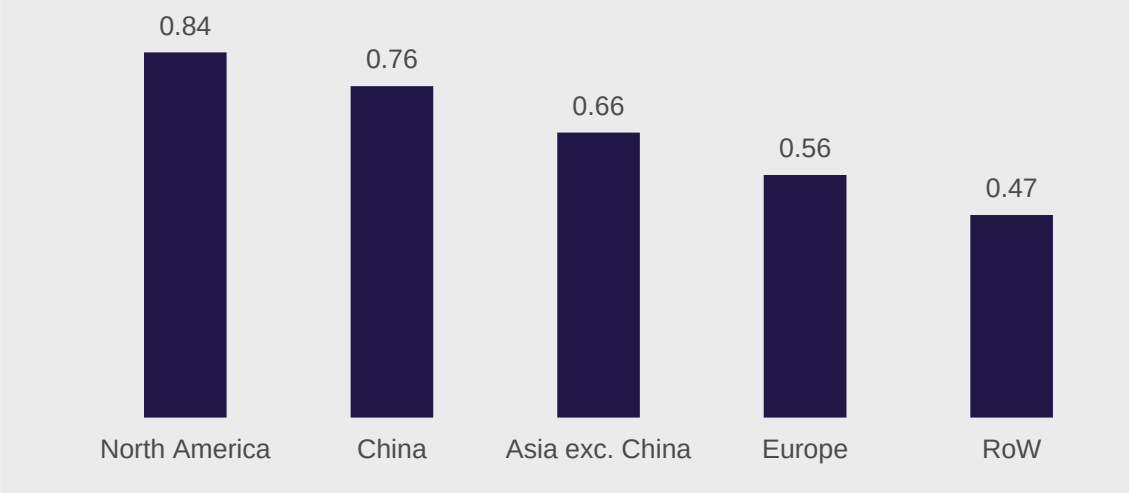
- The Packaging sector is expected to grow by 3.3 Mt in the following decade, going from 7.2 Mt in 2020 to 10.5 Mt in 2030, with 26% of this growth expected to come from North America, 23% from China and 17% from Europe.
- Growth from this sector will be primarily driven by the increasing popularity of canned drinks in North America, a shift from glass to aluminium in the Chinese beer market, the strong backlash against PET in Europe and other western countries, and the implementation of recycling and EPR policies.
- Aluminium's carbon footprint will be especially important for the Packaging sector going forward, as this is a client-facing industry that is more exposed to the public eye and therefore, influences public perception.

3.2.2. Introduction

After remaining strong during the pandemic, the Packaging sector is expected to experience the fourth biggest growth across all sectors in terms of yearly aluminium demand, increasing by 3.3 Mt from 7.2 Mt in 2020 to 10.5 Mt in 2030.

As mentioned earlier in this report, the Packaging sector currently has the highest share of scrap consumption across all sectors with around 53% of its consumption coming from primary sources.

Figure 15 Additional aluminium demand between 2020-2030 in the Packaging sector by region, Mt



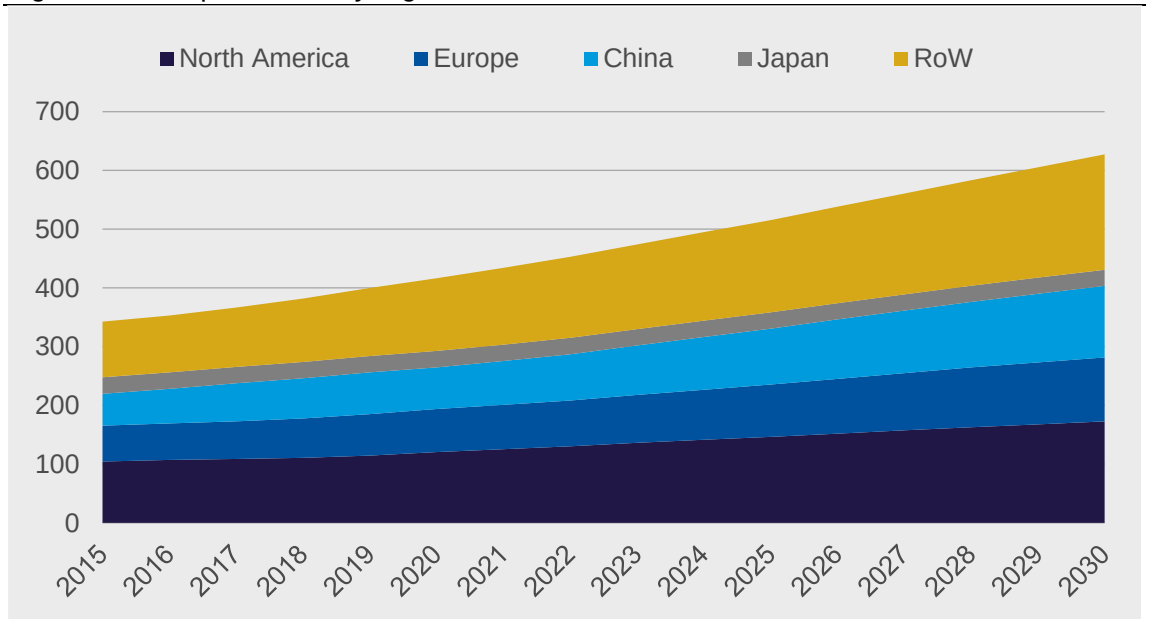
Source: CRU

Differing from other sectors where the Chinese market is the primary driver of growth, the Packaging sector will be characterized by a strong increase in demand coming from North America. This growth is mostly due to the environmental impact and reduced recyclability of PETs and other plastics when compared to aluminium, which is starting to gain recognition as a viable substitute to these products. This becomes increasingly important when EPR policies are implemented.

3.2.3. Aluminium Cans

The surge of younger consumers, new products and environmental awareness has positively impacted the demand for canned products, which has grown by 21% from 343 billion units in 2015 to 416 billion units in 2020, despite of the effects of the pandemic.

Figure 16: Can production by region, billion*



Source: CRU, *Including tinplate cans

Can production is expected to grow by 211 billion units in the following decade, reaching 627 billion in 2030. Around 66% of this growth will be coming from North America, China, and Europe combined.

The rise of new beverages like hard seltzers in the US, a higher demand for canned water in both the US and Canada and an increasing demand for canned beer in the region will drive demand growth in North America, which is expected to go from 120 billion cans produced in 2020 to 173 billion in 2030, accounting for ~25% of the world's demand growth.

China's growth in aluminium packaging consumption will be mostly driven by the shift to canned beers away from glass as the proportion of beer consumed in aluminium cans gets closer to the levels seen in developed countries, coupled with a moderate growth coming from soft drinks. PET substitution will not be as strong as in Western regions.

Tinplate cans represent around 30% of the total can production in China and, unlike Europe, there is no policies in place to increase the share of aluminium cans. Being the second biggest can market in the world, a transition to aluminium in this sector could represent an important opportunity in the future.

Chinese can production is expected to go from 71 billion units produced in 2020 to 122 billion units in 2030.

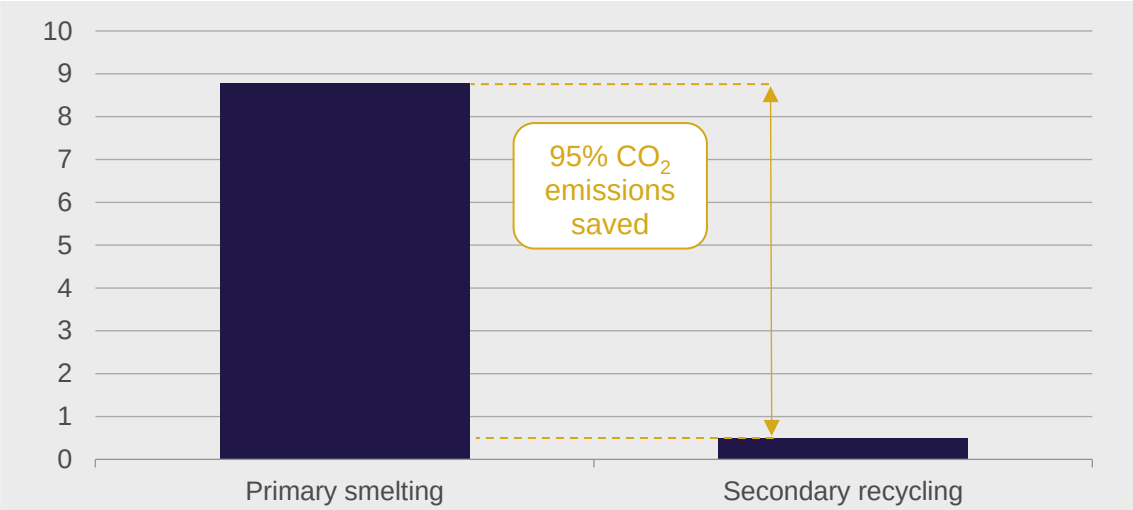
In Europe, cans have increased its market share compared to PET in both canned soft drinks and water, and canned beer continues to rise against glass while seltzers also increase their popularity. CRU forecasts an almost complete shift from tinplate to aluminium cans in the next 10 years, with producers such as Ball and Crown already completing this shift in France and Spain. European cans production is expected to grow by 17% in the next decade, going from 73 billion units produced in 2020 to 109 billion units in 2030.

Downgauging represents a possible risk to aluminium demand growth coming from canned beverages and, although this effect is expected to vary from region to region, it will decrease the intensity of aluminium used per can in the future.

3.2.4. Recycling policies and aluminium packaging sustainability

Aluminium consumption in the Packaging sector is driven by consumer preference and the implementation of EPR & recycling policies. Although the implementation of these policies generally favours the demand for all metallic elements used for packaging, aluminium holds a special place in the public eye, as it is generally perceived as a "green" material due to its high recyclability and therefore, its high potential for carbon footprint reduction.

Figure 17: Direct emissions from aluminium production – Primary vs Secondary, t CO_2-e/t liquid aluminium



Source: CRU

This perception is key for the future of aluminium in packaging and most other client-facing aluminium products although it only holds true for secondary sources, as emissions coming from primary smelting are considerably higher. In order to protect aluminium's public perception, working on improving secondary aluminium availability via enhancing collection networks is important. Additionally, aluminium is one of the few materials used in packaging that generate larger economic margins when reprocessed, which makes it particularly appealing to recyclers.

Europe

Europe is the world's most advanced region in terms of waste recycling and, as a part of the European Green Deal, the EU has put forward plans in both Circular Economy and Waste Recycling. When it comes to waste recycling, Europe has introduced specific targets for packaging waste:

Table 2: European commission packaging recycling targets.

	Current targets (%)	By 2025 (%)	By 2030 (%)
All packaging	55	65	70
Plastic	25	50	55
Wood	15	25	30
Ferrous metals	50	70	80
Aluminium	**50**	**50**	**60**
Glass	60	70	75
Paper and cardboard	60	75	85

Data: European Commission

Although recycling goals for aluminium are lower than the ones for glass and ferrous metals, the EU has already reached an average recycling rate of over 75% for aluminium cans and over 95% for countries like Germany, Belgium and Lithuania. Going forward, the EU, with a joint venture between EU Aluminium and Metal Packaging Europe, aims to achieve a 100% recycling rate for the beverage can industry by 2030, focusing on:

- Improving collection systems for aluminium cans.
- Enhancing sorting infrastructure.
- Addressing informal recyclers.

- Informing and educating consumers.

At the same time, the European Soft Drinks Industry pledges that the EUs beverage packaging industry will be completely circular by the same year, which could put more pressure on PET bottles and potentially boost the preference for aluminium packaging.

China

Being the World's second largest municipal solid waste (MSW) producer after the US, China set to fight waste pollution in 2017 by aiming to reach a MSW recycling rate of 35% on its 46 major cities by 2020. In 2019, Shanghai passed a law to adopt mandatory waste classification. Most recently, China included circular economy policies within its 5-year plan, which aims to implement circular production, promote green manufacturing, and enhance resource utilization by 2025. These policies include:

- Producing 20 Mt of recycled non-ferrous metals.
- Banning the production of ultra-thin plastic bags in the country.
- Increase resource productivity by 20%.
- Reduce water and energy consumption per unit of GDP by 16 and 13.5%, respectively.
- Reach a utilization rate of 60% for both bulk solid waste and construction waste.
- Increasing the output value of the recycling industry to 5 trillion RMB or ~US$773 billion.

To achieve these goals, China also plans on enhancing recycling infrastructure, boost innovation, improve recycling networks and standardizing recycling processes, among others.

North America

Last year in the US, the Environmental Protection Agency (EPA) established a new country-level target of a 50% recycling rate by 2030. This target represents a substantial increase from the country's current recycling rates of ~30%, which has remained relatively stable during the last two decades. To accomplish this, the EPA is currently working on the National Recycling Strategy, which focuses on the following main points:

- Reduce contamination in recycling by increasing public awareness and education.
- Make the recycling processing more efficient by improving equipment and curb-side recycling.
- Strengthen the economic markets for recycled materials. This means helping manufacturers to make products using recycled materials and boost consumer demand for these products.

On the other side of the border, Canada has had recycling policies in place for years. In 2014, the country established a goal of reducing all types of waste from 706 kg per person by 30% (490 kg per person) by 2030 and 50% (350 kg per person) by 2040. This propelled the adoption of various strategies to reduce waste and increase recycling, such as:

- Canada-wide Action Plan for Extended Producer Responsibility (2014)
- Canada-wide Action Plan on Zero Plastic Waste Phases 1 (2019) and 2 (2020).

3.3. Construction

3.3.1. Key takeaways

- Aluminium demand from construction is expected to grow by 4.6 Mt in the coming decade, going from 21.2 Mt in 2020 to 25.8 Mt in 2030, with 20% of this growth coming from China, 15% from Europe and 12% from North America.
- Around 44% of the growth from the Construction sector will come from Asia ex. China. This is equivalent to 2.0 Mt of additional aluminium consumption, out of which 1.1 Mt will come from the Middle East and India combined.
- Although the construction sector has begun implementing building codes and rating systems promoting the use of low carbon footprint materials to certify green construction in the last few years, these are yet to have a measurable impact on aluminium consumption.

3.3.2. Introduction

The construction sector is forecast to be the third fastest growing sector in the coming decade in terms of absolute aluminium consumption after Transportation and Electrical, growing by 4.6 Mt in the 2020-2030 period. Although this growth is expected to be mainly driven by economic and population growth, this section focuses on analysing how aluminium demand can be enhanced through the implementation of green policies and standards, and the decarbonization of the Construction sector.

3.3.3. Green Buildings

The push for the reduction of carbon footprint in recent years has pressured governments to adopt strategies to ensure the use of low-carbon materials across industries and the construction sector is no exception. These strategies include new standards and tools, such as the implementation of Green Public Procurement (GPP), which gives governments the ability to set higher procurement standards for goods and services with a diminished or positive environmental impact. This becomes particularly relevant in the case of non-residential construction, energy consuming products, vehicle manufacturing and others.

GPP adoption can become relevant as Public Procurement accounts for 12% of GDP in OECD countries on average, and up to 30% in developing countries. At this moment, almost all OECD countries have GPP strategies developed while 69% of them are currently measuring the success of these policies.

In some countries, GPP policies are mandatory and have proven successful in the Construction sector. Such has been the case in the Netherlands, where the effects of these policies have been permeating into the private sector. Another example is the implementation of “Buy Clean California” (2017) in the US, where state-funded building projects must consider the environmental impact potential of a list of construction materials during procurement. Aluminium has not yet been added in this list of materials, but there is the expectation that it will be added at some point by industry players.

Initiatives such as standards, building codes and rating systems also have the goal to reduce the impact of building construction on the environment, promoting the inclusion of sustainable practices at a design level. Voluntary standards and rating systems have been important contributors to the recent shift towards “green” construction practices, although the implementation of *mandatory* codes and standards appears to be imperative for an extensive adoption of these practices.

Table 3: Description and examples of standards, building codes and rating systems for green buildings.

	Standards	Building Codes	Rating Systems
Definition	A standard is a set of guidelines against which a product can be judged. The ISO defines a standard as a "document, established by consensus, approved by a recognized body that provides for common and repeated use as rules, guidelines, or characteristics for activities or their results."	Green building codes offer comprehensive pathways for green construction from cradle to grave. They can either be **prescriptive** – where materials, equipment and design must meet certain criteria or **performance based** – where buildings are designed to achieve specific results	Rating systems are a type of building certification system that rates or rewards relative levels of compliance or performance with specific environmental goals and requirements. They can either be single attribute (e.g., only focused on water management) or multi attribute across ESG
Status	Not mandatory	Mandatory if adopted.	Not mandatory
Green examples	• ANSI/ASHRAE/IES Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings • NSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings except Low- Rise Residential Buildings	• International Green Construction Code (IgCC) • ICC 700 National Green Building Standard (NGBS) • California Green Building Standards Code (CALGreen Code)	• Building Research Establishment Environmental Assessment Method (BREEAM) • Leadership in Energy and Environmental Design (LEED) • Green Globes

Source: CRU

Some of the results of these initiatives and their possible impact on aluminium demand are listed below:

- **Building codes:**
    - Originally released in 2010, the IgCC building code was intended to replace traditional building codes. The uptake of the IgCC failed in the US, as it was adopted by only 5 states as mandatory policy.
    - Concerns over the content of the regulations being too stringent and lacking in variation for different purposes are the key to lack of uptake.
    - A respected mandatory green building code, if fit for purpose, could increase the uptake of green building practices significantly.
    - Unlike steel, concrete and lumber, aluminium is not typically used as a structural material in building construction, and it is not usually seen as user-friendly as other more standard building materials by architects and engineers. Most building codes default to the use of non-aluminium building materials, even for architectural and ornamental applications where aluminium has distinct advantages, unless an aluminium component is specified in the construction drawings.
    - There is a risk that even if industry-wide sustainability efforts in construction are realised, they might not be designed with aluminium in mind. Aluminium-related trade associations will need to collaborate effectively with building code standard setting organizations (SSOs) and other relevant stakeholders to ensure aluminium benefits from any future developments in building codes or design best practices.

- **Rating systems:**
    - LEED is a voluntary rating system and despite apparent successes, it is not going to singlehandedly transform the Construction sector.
    - The weight of material choice in the LEED system is quite small. Considering a total score of 100 and taking into consideration that relatively small measures such as adding a bike rack to a building translates into 1 point:
        - ‘Sourcing of raw materials’ including recycled content, recyclability and whether suppliers participate in an EPR program only contributes 1-2 points to the total LEED score.
        - ‘Environmental Product Declarations’ i.e., verification of positive life cycle impacts (including embodied carbon) of raw materials selected, also only receives 2 points.
        - ‘Material ingredients’ also only receives 2 points. In context, building a bike rack receives 1 point.
    - Increasing the weight given to material choice could benefit the uptake of low carbon aluminium. Alternatively, setting stricter LCA limits on embodied carbon, recycled content and overall recyclability of raw materials selected (currently only 50% of non-structural materials are needed to be recyclable, for example) would also benefit the use of low-carbon aluminium.
    - However, such changes may not necessarily be favourable for aluminium building material suppliers, as contractors can easily choose steel – a competing material that also has high recycled content – in an effort to reduce higher project costs associated with meeting these new standards.

Notably, the clauses described above only apply to commercial interiors, hospitality, and retail buildings. There are no similar standards for residential constructions.

3.4. Electrical

3.4.1. Key takeaways

- The Electrical sector will be the second fastest growing sector after Transportation in terms of absolute aluminium demand. It is expected to grow by 5.2 Mt in the following decade, going from 10.4 Mt in 2020 to 15.6 Mt in 2030.
- Around 47% of this growth will come from China, 9% from Europe and 5% from North America. Asia ex. China will play a significant role in this sector’s growth, with a growth of around 1.1 Mt of aluminium consumption coming exclusively from India.
- In 2020, ~90% of aluminium demand from the Electrical sector was satisfied with material from primary sources.
- Aluminium demand coming from the Electrical sector will be mainly driven by the implementation of CO_2 emissions reduction policies and therefore, the widespread adoption of renewable energies which, being substantially more aluminium intensive than traditional sources, will directly increase aluminium consumption in this sector. The adoption of renewable energies brings with it a need for an expansion of the power grid for both transmission and distribution projects.

3.4.2. Introduction

Aluminium consumption from the Electrical sector will reach 15.6 Mt in 2030, growing by 5.2 Mt from the 10.4 Mt consumed in 2020. As of 2020, more than 90% of the demand from this sector corresponds to primary aluminium.

According to CRU's forecast, around 70% of the sector's growth in the coming decade is expected to come from the implementation of renewable energies and the resulting expansion of the power transmission and distribution capacity. As such, this section focuses on describing the different drivers for the growth of the renewables market and the possible routes to increase the use of aluminium in this industry.

3.4.3. Renewable energies and power grid

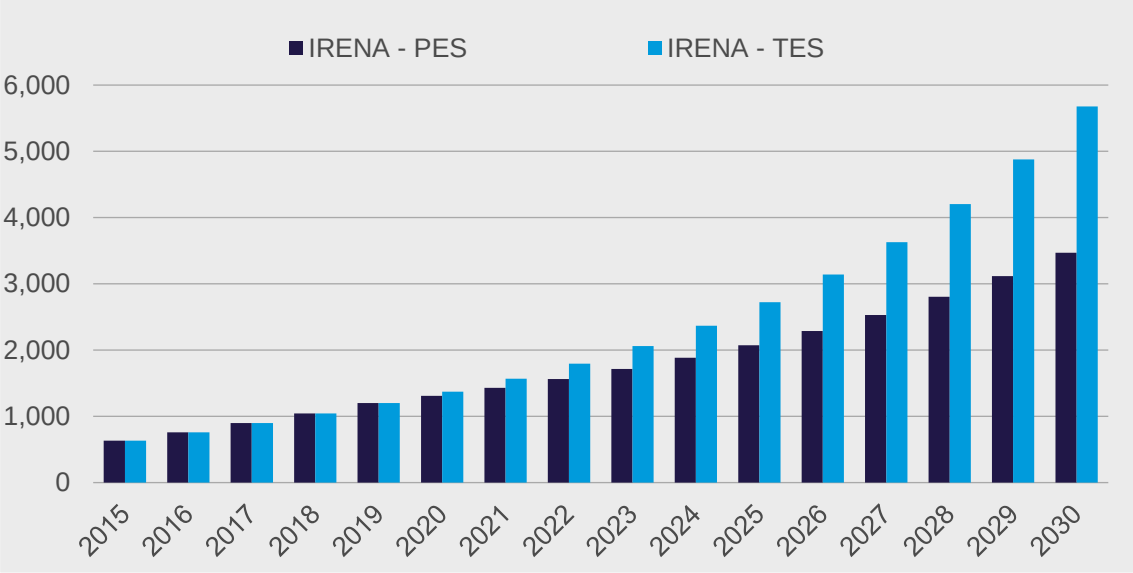
The adoption of renewable energies is deeply intertwined with GHG emissions and global temperature reduction goals. Although the general consensus is that these goals should aim towards limiting global warming to below 2°C, commitments in individual regions can differ significantly:

Table 4: Emission reduction targets by region

Country/Region	2030 unconditional emissions reduction targets
Canada	**40 – 45% below 2005 by 2030.** (July 2021)
United States	**50 – 52% below 2005 by 2030.** (Apr. 2021)
European Union	**At least 55% below 1990 in 2030.** (As of 2021, previously 40%).
China	**Peak CO_2 emissions latest 2030** Non-fossil share: 25% by 2030 Carbon intensity of GDP: -60% to -65% vs 2005.

A steady ratcheting up of both the scale of ambition and the intensity of carbon policy is anticipated across all major regions. This is expected to speed up the pace for renewable energy adoption at an unprecedent pace.

Figure 18: World's installed renewables capacity by scenario 2015 – 2030, GW



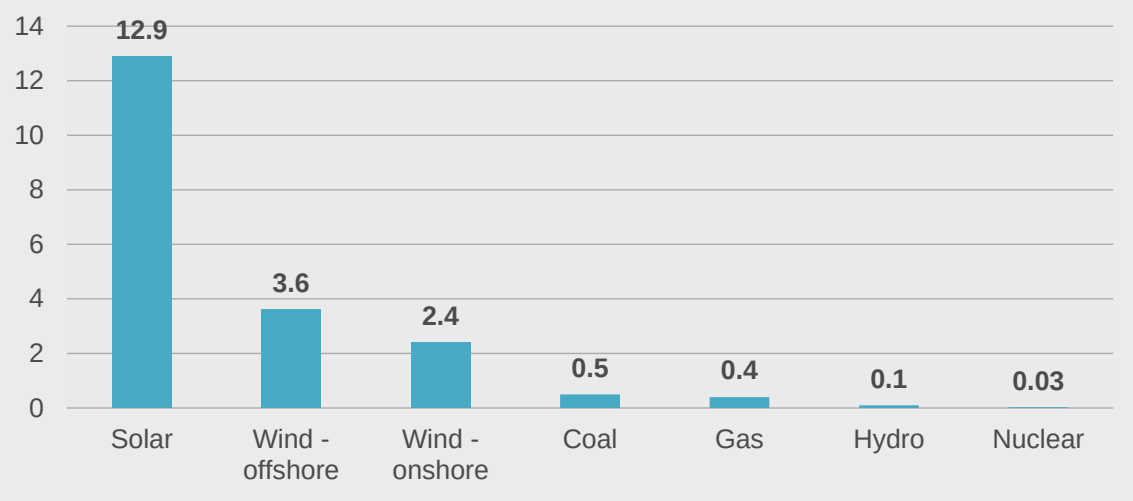
Source: IRENA

The International Renewable Energy Agency (IRENA) has created different renewable energy adoption scenarios:

- The Transforming Energy Scenario (TES): this scenario describes the required efforts that the energy sector needs to make regarding renewable energies installed capacity in order to cut carbon emissions by 70% in 2050 and keep the earth's temperature rise below 2°C, aiming at 1.5°C within this century. This scenario forecasts a renewable's installed capacity of ~5,700 GW by 2030, more than 3 times the ~1,500 GW installed by 2020.

- Planned Energy Scenario (PES): this scenario describes the planned targets as of 2019, which would likely result in a global temperature increase of 2.5°C during the second half of this century. The PES forecasts an increase of ~1,900 GW of renewables installed capacity in the next 10 years, with total installed capacity reaching ~3,400 GW in 2030. Although these numbers do not reflect updated GHG emissions targets presented in Table 4, this scenario is a good representation of the minimum renewables capacity to be installed in the following decade.

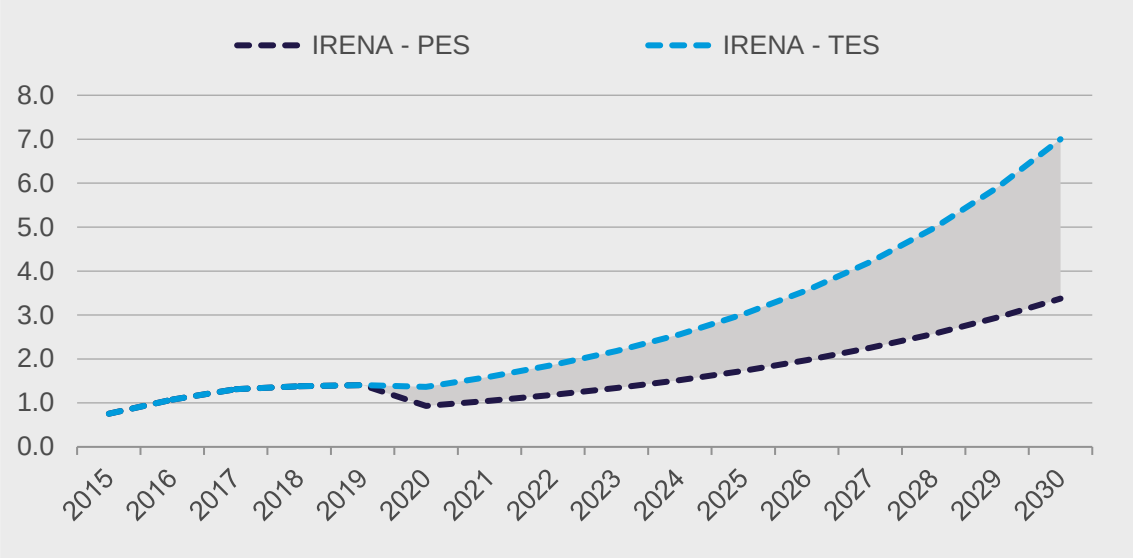
Figure 19: Aluminium intensity of different energy sources, t/MW



Source: CRU

Due to renewable energies – and solar in particular – being much less energy dense than traditional sources and aluminium being cheaper than copper, the widespread implementation of these technologies is expected to drive aluminium demand coming from the Electrical sector in the following decade. According to CRU's renewables model and IRENA's forecast, aluminium demand coming from renewable energies could reach between 3.4 Mt (PES) and 7.0 Mt (TES) by 2030.

Figure 20: Aluminium demand from renewable energies 2015 – 2030, Mt



Source: IRENA, CRU

Although this range is wide, CRU expects aluminium demand from the renewables sector to reach around 4.7 Mt by 2030, with the implication that new emissions targets and policies that set us closer to IRENA's TES scenario could represent a substantial upside from CRU's current forecast.

Under both scenarios it is expected that China, Europe and the US combined will represent over 70% of the World's total renewables installed capacity by 2030, with China alone being close to constituting half of it in the same year.

China

China's goals to reduce GHG emissions has led the country to become the World's leader in terms of total renewables installed capacity, surpassing Europe in the last decade. Looking ahead, the country's ambition to peak its emissions in 2030 by doubling its current wind and solar power capacity, combined with its target to be carbon neutral by 2060 and several other measures implemented by the government are expected to keep this trend going.

- The Chinese government, through the National Energy Administration, ordered the addition of 90 GW of wind and solar capacity to the grid during this year, as a way to ensure that wind and solar plants are able to sell all their electricity to the market.
- Chinese cities' (like Foshan, Wuxi and Rizhao, for example) local governments are, in some cases, integrated with local manufacturing solar photovoltaic panels. This integration is fuelled by policies that promote innovative solutions, shortening supply chains and lowering costs.
- China benefits from the collaboration of cities and provincial governments in the promotion of green policies. For example, the city of Suzhou has issued individual policies to ban heavy polluting fuels and setting renewable energy targets which can be highly replicable in other cities and towns.

For aluminium, the fast growth of the renewables industry in China presents a big opportunity in terms of power transmission, since installations in the country tend to be far away from populated areas and overhead lines are made of aluminium. At the same time, distribution lines need to be expanded for the rapid adoption of renewables and, although these are primarily made of copper – which is still preferred by the Chinese State Power Grid Corporation –, aluminium has proven to be a viable option for this application in places like the UAE and Saudi Arabia.

Europe

As of today, the European Union has set the World's most ambitious target for GHG emissions reduction, aiming at 55% below 1990 levels at a minimum by 2030, and to become carbon neutral by 2050. This is expected to be achieved implementing a set of policies called "Fit for 55" package, which include the following initiatives (among others):

- A 40% target for renewable energy production by 2030.
- Increasing the funding for the transition to a low-carbon economy. The EU plans to increase its budget share destined to fight climate change from 20% in the 2014 – 2020 period to 30% during the 2021 – 2027 period.
- Setting more ambitious energy efficiency targets for each member at EU level. This includes the renovation of 3% of the public sector's buildings each year in order to drive renovation and reduce energy use.
- A Carbon Border Adjustment Mechanism which will add a "carbon tax" on imports in order to prevent carbon leakage and encourage other countries to adopt similar emissions reduction policies.

Although Europe is not expected to experience an explosive growth of renewables capacity like China, the power grid's expansion also presents a relevant opportunity for aluminium as countries such as Switzerland have started replacing copper energy networks for aluminium due to the latter being considerably cheaper. However, in many cases, companies are reluctant to use aluminium, not because it is worst at energy transmission, but because most countries are accustomed to copper, and standards, which usually vary from country to country, are hard to change.

North America

North America is forecasted to be one of the fastest growing regions in relative terms from its comparatively low renewables installed capacity 2020 base. Recent announcements from the US and Canadian governments setting ambitious emissions reduction goals going to 2030 are expected to drive the growth of the industry in the region:

- In **The US**, President Joe Biden submitted the New Nationally Determined Contribution (NDC), where the US sets to reduce its GHG emissions by 50 – 52% below 2005 levels by 2030. To achieve this, the plan includes:
    - Reaching a share of electricity generated by non-carbon-emitting sources of 75% by 2030. This will rely on the expansion of wind and solar capacity, reduction of coal plants and preserving hydro and nuclear capacity.
    - Reducing emissions coming from the building sector and fossil fuels used directly for heating and cooking. The US aims to reduce total energy used by new buildings by 30% in 2030.
    - Expanding electric transmission infrastructure capacity by 40% by 2030. This, in order to achieve a better distribution of clean energy and enable charging infrastructure for EVs.
- This year, **Canada** confirmed its new GHG emissions reduction goals of 40 – 45% below 2005 levels by 2030. Canada presented "Canada's Strengthened Climate Plant" which describes the pathway to reach the countries goals:
    - Investment of $964 million in new renewable energy and power grid projects.

- Commitments to deliver clean energy to rural, remote, northern and Indigenous communities currently relying on diesel.
- Work with partners to build and efficient battery and critical mineral supply chain to reinforce the clean energy transition.

Similarly to China and Europe, the growth of renewable energy installations and the need for new charging stations for EVs in North America will bring an inevitable expansion of power transmission and distribution lines which, as mentioned before, represents an important opportunity for aluminium. This is especially true in the US, where new projects tend to be more cost sensitive.

4. Risks to demand changes

This section summarises the key risks to CRU's forecast for additional aluminum demand, taking into consideration the drivers behind them.

Table 5: Potential upside and downside demand risks by sector

Sector	Total demand 2020 (Mt)	Additional demand 2020-2030 (Mt)	Potential upside risk	Potential downside risk	Risk factors
Transportation	19.9	11.8	High	Medium	(+) CRU's forecasts of demand coming from this sector does not account for countries fully meeting their current targets of adoption of EVs. (+) CRU's numbers also consider a fixed aluminium intensity of use per type of powertrain going forward, which could be increased by the need to reduce vehicle weight to meet efficiency targets. (-) CRU considers that an increase in Cobalt and Lithium prices in the coming years might weaken EVs sales, as it would substantially increase the cost of this technology.
Electrical	10.4	5.2	High	Low	(+) CRU's forecast considers that the installation of renewables capacity required in order to meet IRENA's Transforming Energy Scenario will not be in place. Efforts put into achieving these goals would represent a substantial upside risk for aluminium demand. (+) Substitution from copper represents an opportunity, although considerable efforts have to be made in order to generate the required change to current standards and practices within the industry.
Construction	21.3	4.6	Low	Low	Although the implementation of green standards and rating systems is currently a reality, these have to be made mandatory in order to bring considerable change to the industry and, even if they are, it is not clear how big of an impact they will have on aluminium demand coming from the Construction sector.
Packaging	7.2	3.3	Medium	Low	(+) Substitution of plastic bottles for aluminium cans in the bottled water industry represents a considerable upside risk to CRU's current forecast, as well as the potential substitution of tinfoil cans for aluminium cans in China. However, some resistance might be encountered from big producers that want to have a balanced portfolio in this regard, and there is the possibility for considerable efforts to not bring considerable results.

Source: CRU