The Aluminum Association

Aluminum in Green Buildings

A Guide to Environmental Declarations

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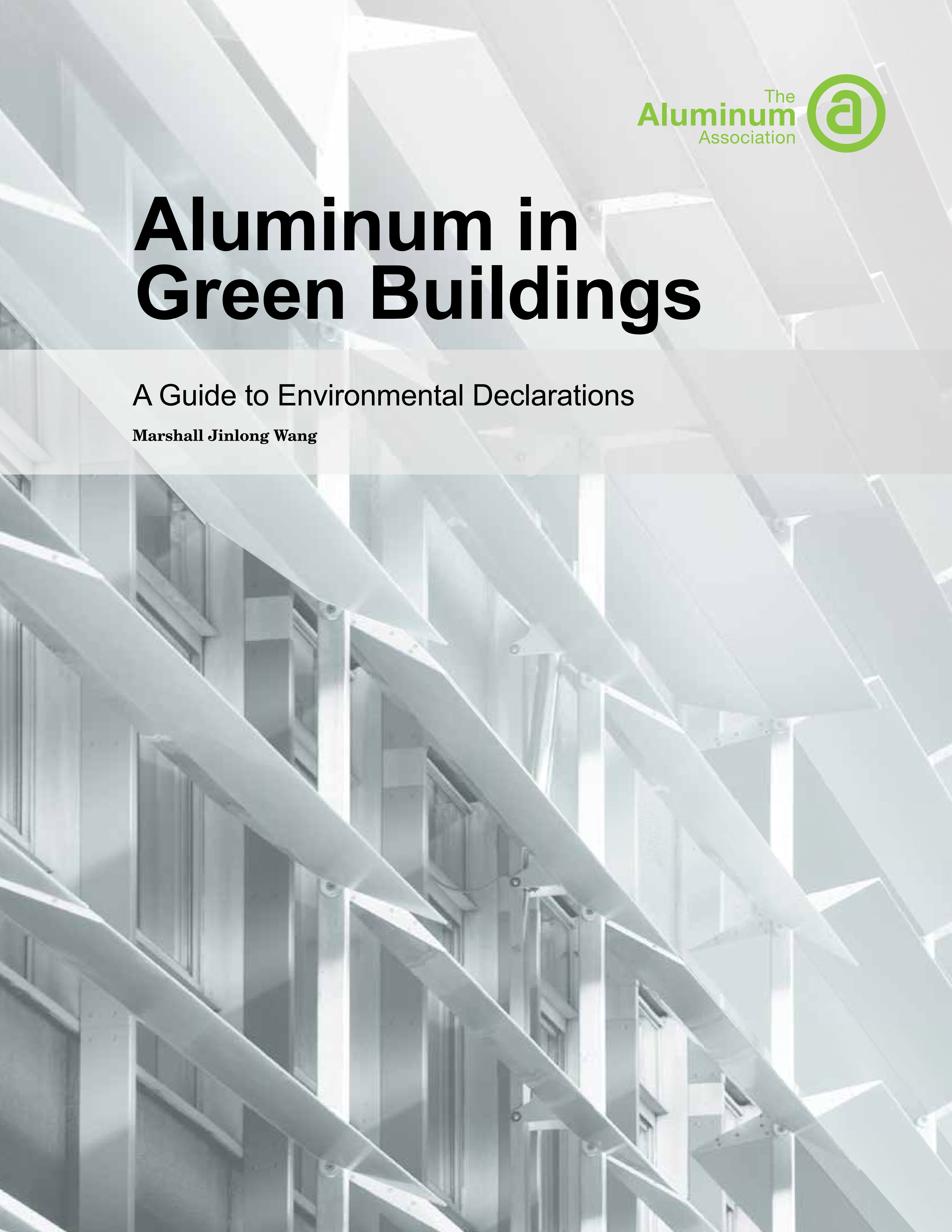

About The Aluminum Association

The Aluminum Association represents U.S. and foreign-based companies and their suppliers throughout the value chain, from primary production to value added products to recycling. The Association is the industry's leading voice, providing global standards, business intelligence, sustainability research and industry expertise to member companies, policymakers and the general public. The aluminum industry helps manufacturers produce sustainable and innovative products, including more fuel efficient vehicles, recyclable packaging, greener buildings and modern electronics. In the U.S., the aluminum industry creates $186 billion in annual economic activity. For more information, please visit www.Aluminum.org, follow us on Twitter @AluminumNews, or connect with us on Facebook.com/AluminumAssociation.

Disclaimer

The material presented in this publication has been prepared for the general information of the reader and should not be used or relied on for specific applications without first securing competent advice. The Aluminum Association can help refer users to appropriate experts. Contact information is enclosed in the final section of this guide.

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What Are Environmental Declarations?

Environmental declarations are governed by the voluntary international standards ISO 14021, 14024 and 14025. They often distinguish by three types: ***environmental labels (Type I), self-declared environmental claims (Type II), and environmental product declarations (Type III)*** - which are referred to as EPDs for brevity[1]. Since only the EPDs are based on ***life cycle assessment (LCA)*** following ***product category rules (PCR)*** to quantify environmental burdens (Figure 1) and require ***verification*** by a ***third party*** within a ***Type III environmental declaration programme***, they are the most credible and comprehensive of the three environmental declarations. In recent years, the use of EPDs has grown significantly in the building & construction sector, with the U.S. Green Building Council's LEED® program (Leadership in Energy and Environmental Design) driving the demand in North America. Similar programs exist or are under development in many other regions of the world. Based on the experiences gained over the last couple of years, it has become obvious that EPDs are here to stay. They are becoming an integral part of product communication for the building & construction industry. This guide will help you better understand available environmental product declarations while at the same time provide information that is crucial to producing meaningful declarations on aluminum building products.

PCR	Product Category Rules - Set of specific rules, requirements, and guidelines for developing Type III environmental product declarations for one or more product categories (ISO 14025)
LCA	Life Cycle Assessment - Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle (ISO 14044)
EPD	Environmental Product Declaration - Providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information (ISO 14025)

Figure 1: Decoding the acronyms of environmental declarations

A GLOBAL COMMODITY

Aluminum is a global commodity. It is centrally traded in the forms of futures or spots on large international commodity exchanges. As such, aluminum metals from different producers will change hands multiple times and become commingled before being turned into usable products. While companies that are more vertically integrated may be better equipped to track the movements of metals from mining or recycling to product manufacturing, the nature of global aluminum trading poses a challenge in terms of traceability. In addition, the North-American aluminum industry—including the United States and Canada—is highly integrated. Raw materials and intermediate products can cross borders multiple times before the final products reach the consumer. In recent years, more than 60% of primary ingot consumed in North America was produced in Canada, while the majority of aluminum recycling, semi-fabrication, and finishing was performed in the United States.

A number of companies along with others in the aluminum value chain are currently engaged in the Aluminium Stewardship Initiative (ASI) to foster responsible production and resource management of aluminum. As part of this initiative, ASI is developing standards and chain-of-custody requirements to allow coherent reporting of information across the value chain. Please refer to Aluminum Stewardship Initiative for more information (http://aluminium-stewardship.org/).

[1] Terms in italics are further detailed in the section 'Speaking Environmental Declarations' of this Guide.

Typical Steps of EPD Creation

A typical process of developing an EPD is depicted in Figure 2. The process usually takes many months to complete and significant technical and financial support is necessary from "declarers." Familiarity with the process and its technical perspectives are therefore very important. In most cases, multiple stakeholders and third parties will be involved including consultants, program operators, LCA modelers, critical reviewers, EPD verifiers and registrars, etc.

Among the major steps, the most fundamental one is the life cycle assessment step. A high quality LCA not only determines the creditability of the EPD itself, but also determines the consequences of decision makings, e.g., environmentally beneficial or counterproductive. For this reason, this Guide focuses the majority of its content on explaining the life cycle of aluminum and helps users better understand aluminum and LCA issues. In addition, finding or creating an appropriate product category rule is a critical first step. The Aluminum Association believes that not all PCRs are created equal and that misrepresentation and misleading happen very often for a variety of reasons. It is therefore recommended that appropriate guidelines be followed to make a PCR environmentally sound. One of such guidance documents was developed by multi-stakeholders in 2013 and the document

PCR	Find or develop an appropriate product category rule.
LCA	Conduct and verify the product lifecycle assessment (LCA)
EPD	Compile the EPD
Verify	Verify the EPD
Register	Register the EPD

Figure 2: steps of creating an EPD

is available online at https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=518083.

The current LEED program accepts EPDs from both the product manufacturers and trade associations in which the product manufacturer participated in the creation of the EPDs.
On behalf of 15 participating companies, the Aluminum Association released EPDs of five categories of generic aluminum products in 2014 (Figure 3). These EPDs will be valid for use until October 2019. The EPDs are available online as free downloads.

Figure 3: Aluminum Association EPDs.

The Life Cycle of Aluminum

The archetypical ***life cycle*** of aluminum products is depicted in Figure 4. The 'aluminum industry' encompasses all of the shown activities except for 'Product Markets'. In North America, the industry is mainly involved in primary and secondary metal production, processing (semi-fabrication), and recycling.

There are two distinctive routes of aluminum production: from bauxite and from recycled resources, i.e., from aluminum scraps. Metals made from these two different resources can share the same properties and perform the same functions. From an environmental footprint point of view, however, there are significant differences. The smelting of aluminum from bauxite ore is done via the ***electrolysis process***. This is a highly energy-intensive process whose environmental footprint is largely dominated by the emissions associated with electricity generation[2]. On the other hand, the production of aluminum with scrap as a raw material can use natural gas or electricity as an energy source, and the total amount of energy needed is only a small fraction of that of primary aluminum production[3] (Figure 5).

After the aluminum metal has been produced, which usually requires ***alloying*** with small percentages of other elements such as copper or magnesium to meet mechanical performance requirements, it goes through semi-fabrication (such as rolling into sheet or extruding into unique shapes) and finishing processes to be turned into usable products. The product's use phase can be as short as a couple of weeks (e.g. aluminum packaging products), or it can exceed a century (such as in buildings and infrastructure applications). At the end of the product's service life, it is usually recycled into new metals.

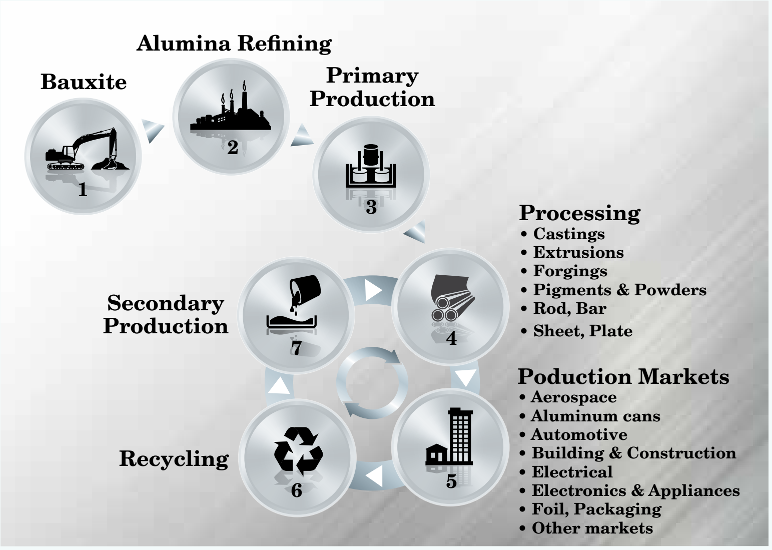

Figure 4: The life cycle of aluminum

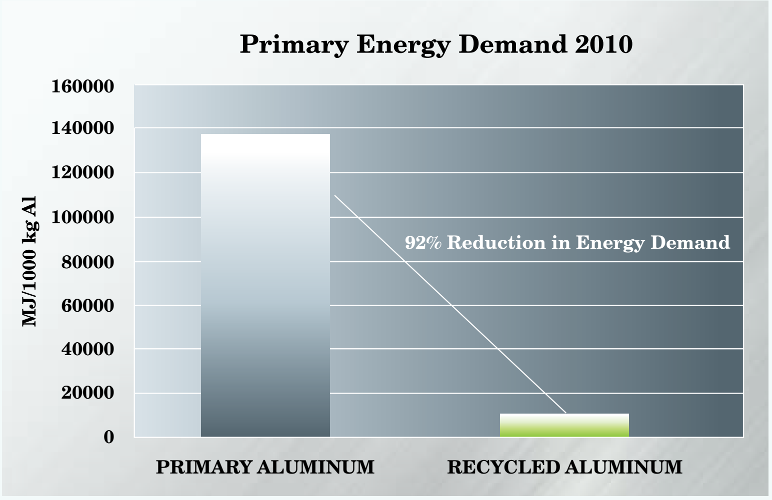

Figure 5: recycling saves significant amount of energy

[2,3] The Aluminum Association, The Environmental Footprint of Semi-Finished Aluminum Products in North America, 2013

Aluminum and Circular Economy

The ***circular economy*** concept is currently gaining a lot of momentum with researchers, policy makers, and industry alike[4]. Looking at the life cycle of aluminum, the following features support the goals and objectives of a Circular Economy:

- Of all the aluminum metals ever produced in the world throughout its 125-year history of commercial production, about 75% is still in productive use[5].
- In North America, it is estimated that at least 85% of aluminum shipped to the building and construction sector is still in productive use today and 12% has been recovered and recycled in the form of ***end-of-life (EoL)*** scrap. Only 3% has been estimated to be permanently lost and goes back to the natural environment[6].
- This significant level of material conservation has been achieved on one hand through the long service lives that most aluminum products have, particularly in the building and construction sector, and on the other hand through the extremely high ***recyclability*** of the metal and continuous reuse and recycling as a raw material. The aluminum industry was a pioneer on implementing recycling on a commercial scale and continuously increases the amount of recycled contents in its products.
- The durability, recyclability, and recycling of aluminum in the building and infrastructure sector are elaborated in two reports published by IAI titled Towards Sustainable Cities[7]. For details, please visit www.world-aluminium.org.
- Recycling of aluminum not only saves about 92% of the energy and natural resources, it also reduces the same level of the environmental impacts compared to producing the metal from virgin bauxite ore.

Things to Consider in Aluminum LCAs

The aluminum industry embraces ***life cycle thinking*** as the fundamental strategy to address ***sustainability*** issues. A significant component of this strategy is to adopt life cycle assessment (LCA) as a holistic tool to measure the environmental performance of its products in order to avoid burden shifting from one activity or phase in the life cycle to another.

According to ISO 14040, LCA is the “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle” from initial extraction of raw materials from the earth up until the point at which any residuals are returned to the earth, also referred to as a ***“cradle-to-grave”*** assessment. It generally follows the four-step procedure depicted in Figure 6.

The following sections will help you understand some of the key issues around LCA studies of aluminum products in order to assist you in interpreting and evaluating EPDs and other claims of aluminum products. The information may also be used to inform the development of product category rules for aluminum products.

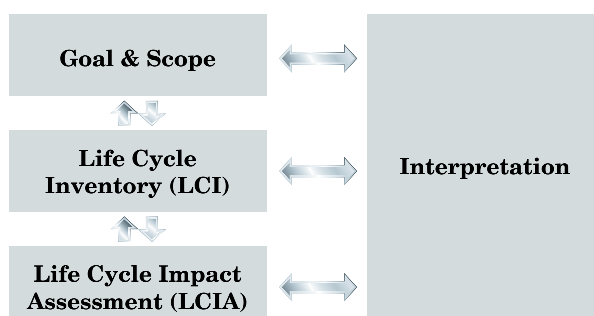

Figure 6: General structure of LCA studies (ISO 14040)

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4 https://www.ellenmacarthurfoundation.org/
5 IAI, GARC model, available online at www.world-aluminium.org
6 IAI, regional GARC model, available online at www.world-aluminium.org
7 IAI, Towards Sustainable Cities. Report I: Aluminum and Durability, Report II: Aluminum Recycling and Recyclability.

General limitations

There are a few general limitations that apply to any LCA study. By becoming aware of these, misinterpretation and misuse of LCA results may be identified or reduced.

Potential vs. actual impacts – LCA does not predict actual environmental impacts. ISO 14040/44 consistently speak of ***potential*** environmental impacts due to the following reasons: the relative approach of LCA based on a functional unit; the integration of ***life cycle inventory (LCI)*** data over space and time, especially with regard to activities that may happen decades into the future; and the inherent uncertainty in any form of environmental impact modeling. While there have been advancements made recently to provide geographically specific impact factors[8], available ***background data*** sources usually do not yet provide the necessary spatial resolution to match these.

Uncertainty – Besides the general uncertainty of environmental impact modeling during ***life cycle impact assessment (LCIA)***, there are thousands of data points and a multitude of assumptions involved in creating the ***life cycle inventory (LCI)***. Many of these introduce additional uncertainties, especially when the use phase of a product is to be included which may vary with user behavior and location, amongst others. LCA results without any information about uncertainty should be used with caution for decision making.

Individual choices - The choice of different data sources, assumptions, and methodological options can lead to very different LCA results. While product category rules (PCR) aim at increasing consistency across EPDs for the same ***product category*** by prescribing many of these choices, they usually do not suffice to establish full comparability between results of different EPDs based on those same PCR[9].

LCA & sustainability - LCA only covers one aspect of product sustainability needed for a comprehensive decision making process: the environmental dimension. Its comprehensiveness is further limited by the availability of data and methodologies to assess any and all environmental aspects of relevance. LCA results should therefore not be used as the sole basis for decision making. EPDs in particular usually contain a section on additional environmental information that covers anything not appropriately captured by the LCA results. ISO 14044 also requires that any additional information of relevance, be it quantitative or qualitative, be considered when drawing conclusions.

NOT ALL DATA ARE CREATED EQUAL

Due to the known limitations of LCA, it is strongly suggested that LCA practitioners use the most up-to-date industry-average aluminum LCI data provided by the Aluminum Association to conduct their LCAs wherever aluminum components are involved and whenever one cannot track the products back to a particular producer which has its own company or facility-specific LCI data available. The current LCA report is available for free download on the Association's website and the aggregated inventories are available in the US LCI Database, thinkstep's GaBi databases, the KeiranTimberlake Tally™ tool, and the EcoCalculator and ImpactEstimator of the Athena Sustainable Materials Institute.

Given the potential misuse of LCA data and the data quality concerns for green building rating systems which may grant credits for providing life cycle information, it is also strongly suggested that LCA studies be done by professionals and strictly comply with relevant standards and rules. Questions regarding to how the aluminum LCI data can be accurately interpreted and used shall be directed to the Senior Sustainability Specialist of the Aluminum Association, Marshall Wang, at jwang@aluminum.org.

8 Reference to IMPACT World+ homepage: http://www.impactworldplus.org/en
9 Reference to BIFMA Chair LCA Study: https://www.bifma.org/?LCAStudy.

System boundary

By definition, life cycle assessment covers the entire life cycle of a product (cradle-to-grave). Nevertheless, ***cradle-to-gate*** or ***cradle-to-gate plus EoL*** (end-of-life) system boundaries are frequently used for building products in practice, especially when the declaring organization is located relatively far upstream in the value chain and the declared product is a raw material or a semi-finished good with a multitude of possible use and end-of-life scenarios.

While reducing the ***system boundary*** to cover only parts of the full life cycle is sometimes a practical necessity, the following two shortcomings need to be taken into account when interpreting these results:

- First, omitting the use phase disregards any environmental burdens caused by the product's direct or indirect energy and material consumptions in order to use and maintain it over its service life.
- Second, excluding the EoL phase neglects any benefits associated with the recycling of the product to provide raw materials to the same or other product systems as well as excluding any burdens associated with the disposal of material that either cannot or simply is not recycled.

Environmental claims of overall environmental superiority (i.e., ***comparative assertions***) that are not based on a cradle-to-grave system boundary have to be viewed as incomplete and cannot be accepted as the sole basis for decision making.

Electricity Modeling for Smelting

The environmental footprint of primary aluminum is largely driven by the environmental characteristics of the energy sources – particularly that of electric power – used to produce the metal during the smelting process. The modeled fuel mix of the consumed electricity is therefore the most important contributor to the environmental footprint of aluminum products.

WOULD YOU HAVE KNOWN IT?

- In 2015, 74% of the electricity used for aluminum smelting in North America was from hydropower.
- Due to ongoing changes in the industry and closures of smelters, the share of hydropower is expected to be increased to 82% from 2016 and onward.
- More than 38% of North America's aluminum supply is from recycled metal.
- For North America, the average recycled content is 60% for cold rolled coil, 51% for extruded profile, and 85% for cast shapes.
- About 2 million metric tons of scrap is net exported from North America each year, representing 1/3 of the international scrap trade market.
- A three-year study sponsored by the Aluminum Association and carried out by the Delft University measured a collection rate of 98% and an overall EoL recycling rate of over 90% for aluminum products in the building sector.
- Including the net exported scrap, North America recovers nearly 6 million tons of aluminum scrap each year. From a life cycle point of view, this level of recycling helps avoid greenhouse gas emissions for about 48 million tons CO_2 equivalent.

In order to properly account for the emissions of electricity, the source(s) of primary metal in the products need(s) to be tracked. As stated previously, a product containing primary aluminum in North America is very likely containing metals made in both Canada and the United States by multiple producers. Annual surveys performed by the International Aluminium Institute (IAI) track both consumption of the electric power and the fuel mix of power generation. The tracking of the fuel mix of power generation follows the guidance in the GHG Protocol[10] by using supplier-specific or self-generated electricity emissions profiles when available and defaulting to regional grid mixes when not. ***Offsetting*** and ***renewable energy certificates (REC)*** are not accounted for by the IAI. The 2015 power mix for smelting in North America is shown in Figure 7.

[10] World Resources Institute, The Green House Gas Protocol, ***A Corporate Accounting and Reporting Standard (revised edition 2011)***

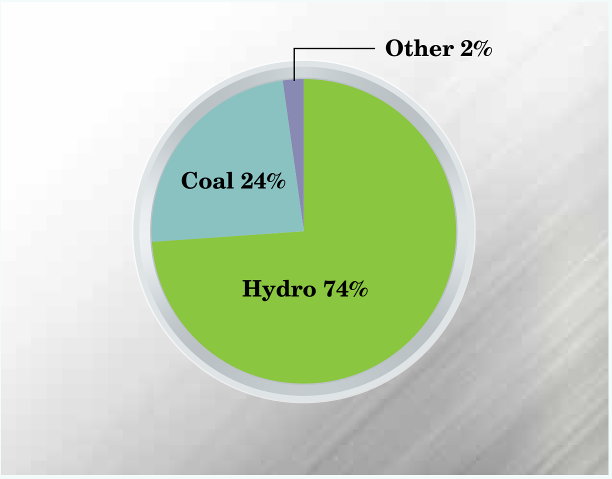

Figure 7: Fuel mix of electricity consumed in aluminum electrolysis in North America for the year 2015

Aluminum Recycling in LCA

One classic example of a subjective methodological choice and its consequences is the choice of ***end-of-life (EoL) allocation approach***. Many different methods exist to account for the footprint of a product at its end-of-life stage. The most relevant ones in LCA practice today are the following:

- the ***cut-off approach***, also known as the recycled content approach
- the ***avoided burden approach***, also known as the EOL recycling approach
- ***hybrid approaches*** which constitute a combination of the above two

The ***cut-off approach*** draws the system boundary at any incoming and outgoing scrap. No primary production environmental burdens are assigned to the incoming scrap. Meanwhile, recycling the product at its end-of-life is not considered part of the system boundary and the product system providing the scrap input to manufacturing can likewise not claim any credits for providing a valuable secondary material.

The cut-off approach thus puts a higher emphasis on the use of ***recycled content*** in manufacturing today over the recycling during the product's end-of-life. It deemphasizes the responsibility of the product manufacturer to ensure high-quality and high-level recycling of their products.

The ***avoided burden approach***, on the other hand, either assigns a primary burden to any scrap inputs into the system (***value-of-scrap variant***) or calculates the net scrap amount to send to recycling and crediting it (***net scrap variant***). 'Net scrap' is defined as the sum of all relevant scrap inputs minus the scrap recovered at the end of a product's lifetime. If more scrap is required during manufacturing than collected at EoL, a primary burden is assigned to the net scrap. If more scrap is recovered at end of life than is used as an input, a primary credit is assigned to net scrap. Also note that the 'net scrap variant' provides the same incentive to maximize the recycled content of one's product design as the cut-off approach.

Finally, a ***hybrid approach*** between the cut-off approach and the avoided burden approach is currently being promoted in the building & construction sector based on the European Norm EN 15804, which will likely be adopted during the ongoing revision of ISO 21930:2007. Here, the potential burdens and benefits of EoL recycling are considered to be outside of the system boundary (i.e., following the ***cut-off approach***) while at the same time allowing for the optional reporting of them under ***Module D*** (i.e., following the ***avoided burden*** approach). In order to ensure that all other results remain constant regardless whether Module D is reported or not, the norm adopted the 'net scrap variant' described above which will only affect the values reported under Module D, but not the values reported for any other modules.

Regardless which of the above variants one follows, the avoided burden approach will always put a much stronger emphasis on the producers' responsibility to ensure high-quality and high-level recycling of their products than the cut-off approach. The aluminum industry has embraced and adopted the avoided burden approach from the very beginning of its LCA practice. In 2007, the industry joined a group of global metal industry associations to release a methodology declaration to advocate the use of the avoided burden method for the metals industry[11].

[11] Atherton, et al, 2007, ***Declaration by the Metals Industry on Recycling Principles***

In 2013, the industry again joined major global metal industry associations and other third-party organizations to develop a guidance document on LCA methodology harmonization. The guide was released in February 2014[12].

Aluminum scraps are a valuable global commodity, and competition sets the market price as well as the final destination of usage. Building aluminum scraps can be reused in an airplane, a train, a car, or a computer and, vice versa, aluminum scraps sourced from recycled computer cases, bicycle frames, aluminum cooking pots, aluminum automotive parts, or aluminum beverage cans can be used to produce aluminum building products.

The Bottom Line

In recent years, the use of EPDs has grown significantly in the building & construction sector, with the U.S. Green Building Council's LEED® program (Leadership in Energy and Environmental Design) driving the demand in North America. To develop credible environmental declarations related to aluminum products made in North America,

- use the most up-to-date industry-average aluminum LCI data readily available through the Aluminum Association to conduct your supporting life cycle assessments whenever you cannot track the products back to a particular producer or facility-specific LCI data,
- be sure to use appropriate emissions factors for electricity supply related to the smelting of primary aluminum,
- utilize the "avoided burden" approach to model recycling. This methodology has been endorsed by the global metals community and will always put a much stronger emphasis on the producers' responsibility to ensure high-quality and high-level recycling of their products than the cut-off approach.

CLOSING MATERIAL LOOPS

It is the aluminum industry's position that ***closed-loop recycling*** should focus on the inherent material properties. Semi-closed-loop recycling should be deemed equivalent to closed-loop recycling in this regard. In addition, the evaluation of recycling loops should be performed at an industry-wide level rather than on the level of individual producers unless the producers have dedicated take-back programs in place.

Selecting an allocation method could end up affecting the recycling of aluminum in a significant way. For this reason, the aluminum industry recommends the use of the avoided burden approach. In particular, the aluminum industry recommends the ***net scrap variant*** of the ***avoided burden approach*** since such method provide incentives for both maximizing the recycled content and increasing the level and quality of recycling at the end of product's lifetime.

The aluminum industry hopes to deliver a clear message about its position to the LCA community in this regard so that metals will be treated fairly and that the value of closing material loops at end-of-life is appropriately addressed.

Alma smelter, Quebec, Canada

[12] PE International, 2014, ***Harmonization of LCA Methodologies for Metals***

Want to Know Even More?

If this brochure got you interested to know more about all things aluminum, the Association recommends that you check out the following websites.

- For detailed information on aluminum and sustainable cities, visit **http://www.world-aluminium.org/publications**.
- For detailed information on responsible bauxite mining, visit **http://bauxite.world-aluminium.org**.
- For current information on LCI data and other sustainability-related topics for North-American aluminum products, visit **http://www.aluminum.org/sustainability/sustainability-reports**.
- To download the current environmental product declarations (EPD) of The Aluminum Association, please visit **http://aluminum.org/sustainability/environmental-product-declarations**.
- For detailed information regarding to aluminum recycling, visit **http://aluminum.org/industries/production/recycling**; **http://aluminum.org/sustainability/aluminum-recycling**; and **http://recycling.world-aluminium.org/home.html**.
- For more information on the Aluminum Stewardship Initiative, visit **http://aluminium-stewardship.org**.

Do You Speak 'Environmental Declaration'?

The terminology used in and around Environmental Declarations can be confusing to non-experts. To that end, it's imperative to have the basics in order to and excel in discussions about environmental declarations and life cycle assessments with peers, customers, policy makers, and LCA experts. Below you will find descriptions of common terms that are provided by third parties along with a few the industry has provided itself. Ensuring everyone is using the same terminology and definitions correctly is essential to having meaningful discussions about environmental declarations.

Alloying	… refers to the addition of certain elements to the pure primary aluminum in order to achieve desired mechanical properties in the aluminum alloy. Common alloying elements include copper, magnesium, manganese, silicon, tin and zinc.
Avoided burden approach	… is an EoL modeling approach where the recycling of materials is rewarded by assigning a credit of primary burden based on the mass of recovered secondary material.
Background data	… denotes average or generic LCI data that are taken from commercial or public data sources to model those processes which occur up- and downstream of the processes under the operational control of the organization(s) that produce(s) the product being studied in a life cycle assessment. This includes, amongst others, data on material production, electricity generation, transportation, and waste management.

Circular economy	… is a concept defined as "an industrial economy that is restorative by intention; aims to rely on renewable energy; minimizes, tracks, and hopefully eliminates the use of toxic chemicals; and eradicates waste through careful design" (www.ellenmacarthurfoundation.org). The closing of material loops is at the core of the circular concept.
Closed-loop recycling	… refers to a situation where EoL scrap is recycled back into the product system that generated it (e.g., aluminum can recycling). Such cycles in most cases save significantly on energy consumption, resource use, and environmental releases without sacrificing the performance of the product. The product system can be narrowly defined or broadly defined, depending on individual perspectives. A broader product system sometimes is also referred to as a semi-closed-loop recycling.
Collection rate	… refers to the fraction of product scrap in EoL that can be collected for material recycling.
Cradle-to-gate	… a form of system boundary that includes the entire value chain of a product up to the point of it being ready for shipment.
Cradle-to-grave	… a form of system boundary that covers the entire life cycle of a product up until recycling and disposal.
Cradle-to-gate plus EoL	… a form of system boundary that covers the full life cycle of the product with the exception of the use and maintenance phase because it is either irrelevant or it is difficult to predict with any certainty.
Cut-off approach	… is an EoL modeling approach where the EoL recycling of materials is considered to be outside of the system boundary. No credits are awarded for EoL recycling and scrap inputs are free of any primary burden.
Electrolysis process	… refers to aluminum smelting and is also called Hall-Heroult electrolytic process. This involves two steps: dissolving the aluminum oxide (alumina) in a molten cryolitic bath, and passing electric current through the solution to decompose the alumina into aluminum and oxygen. Aluminum is tapped out of the reduction cell (pot) at daily intervals and the oxygen bonds with the anode carbon to form carbon dioxide and carbon monoxide.
End-of-life (EoL)	… constitutes the last phase in a product's life cycle and typically begins when the product is turned into waste. Any collection, distribution, treatment, processing, and recycling as well as any other forms of waste management are part of the EoL phase.
Environmental labels (Type I)	… are "environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations" based on a "voluntary, multi-criteria-based third-party program" (ISO 14024:1999, section 3.1.).

Environmental product declarations (Type III) (EPD)	… provide “quantified environmental data using predetermined parameters and, where relevant, additional environmental information. The predetermined parameters are based on the ISO 14040 series of standards, which is made up of ISO 14040 and ISO 14044. The additional environmental information may be quantitative or qualitative” (ISO 14025:2006).
Life cycle	… refers to “consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal” (ISO 14044:2006, section 3.1).
Life cycle assessment (LCA)	… is the “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle” (ISO 14044:2006, section 3.2).
Life cycle inventory (LCI) analysis	… refers to the “phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle” (ISO 14044:2006, section 3.3)
Life cycle impact assessment (LCIA)	… denotes the “phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product” (ISO 14044:2006, section 3.4).
Life cycle thinking	… is about “going beyond the traditional focus on production site and manufacturing processes to include environmental, social and economic impacts of a product over its entire life cycle” (http://www.lifecycleinitiative.org/starting-life-cycle-thinking/what-is-life-cycle-thinking/)
Module D	… includes “reuse, recovery and/or recycling potentials, expressed as net impacts and benefits” (EN 15804:2012, section 6.2.7).
Net export	… refers to the gross exports minus the gross imports of a certain scrap material over a defined time period.
Net scrap variant	… is a form of the avoided burden approach where the gross scrap collected for recycling at EoL is reduced by any scrap inputs into manufacturing before being sent to recycling and crediting.
New scrap	… is generated from aluminum wrought and cast products as the metal is processed by fabricators into consumer or industrial products. Also see ***post-industrial material***.
Old scrap	… is retrieved from discarded products of all types. Common sources for old scrap include automobile parts, beverage cans, aluminum siding, door and window frames, cables and wires, and consumer durable goods or parts. Also see ***post-consumer material***.

Open-loop recycling	… occurs when a scrap material is recycled into a different product system than the one it was generated by (e.g., recycling a plastic bottle into a textile).
Post-consumer material	… refers to material generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain (ISO 14021: 1999).
Post-industrial material	… refers to material diverted from the waste stream of a manufacturing process for reuse or recycling. Does not include ***runaround material***.
Product category	… refers to a "group of products that can fulfil equivalent functions" (ISO 14025:2006).
Product category rules (PCR)	… are a "set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories" (ISO 14025:2006)
Recovery rate	… is the ratio of the amount of material or product recovered and the amount of the material or product collected.
Recyclability	Recyclability… is defined as the characteristic of materials that still have useful physical or chemical properties after serving their original purpose and that can, therefore, be reused or remanufactured into additional products[13]. In theory, aluminum and other metals can be indefinitely recycled. In practice, aluminum is one of the most recycled materials in the world. Other 'recyclable' materials like plastics or wood pulp products are 'recyclable', but are much less frequently recycled in practice or can only be recycled so often due to material deterioration.
Recycled content	… is "the proportion, by mass, of recycled material in a product or packaging" (ISO 14021:1999). Consistent with both this ISO definitions and USGBC requirements, The Aluminum Association only considers ***post-industrial (pre-consumer) materials*** and ***post-consumer materials as recycled content***.
Recycling rate	… is the product of the ***collection rate*** and the ***recovery rate***. The involvement of time as a factor could complicate the definition and causes the term to be misused. The aluminum industry defines recycling rate, in particular ***end-of-life recycling rate***, as the ratio of the amount of material recovered at the end-of-life of a product to the amount of material that was originally used in the product.

[13] PE International, 2014, ***Harmonization of LCA Methodologies for Metals***

Runaround material	… also called internal material, refers to materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it (ISO 14021:1999). The Aluminum Association's interpretation is that if a facility where the material is generated is not capable of reclaiming it, or if the generated material requires significant manufacturing (chemical) processes to reclaim and reutilize, it can be counted as pre-consumer material.
Self-declared environmental claims (Type II)	are "made, without independent ***third-party verification***, by manufacturers, importers, distributers, retailers or anyone else likely to benefit from such a claim" (ISO 14021:1999, section 3.1.13).
System boundary	… denotes a "set of criteria specifying which unit processes are part of a product system" (ISO 14044:2006, section 3.32).
Third-party	… refers to a "person or body that is recognized as being independent of the parties involved, as concerns the issue in question" (ISO 14024:1999, section 3.7).
Type III environmental declaration programme	… refers to a "voluntary programme for the development and use of → Type III environmental declarations, based on a set of operating rules" (ISO 14025:2016).
Value-of-scrap variant	… is a form of the avoided burden approach where the 100% of the gross scrap collected for recycling at EoL is sent to recycling and crediting and any scrap inputs into manufacturing are assigned an upstream burden that equals the difference between primary and secondary material. Over the entire life cycle, the results will be the same as with the ***net scrap variant***, but it provides little incentive to maximize the recycled content in one's product to lower manufacturing burden today.
Verification	… denotes the "confirmation, through the provision of objective evidence, that specified requirements have been fulfilled" (ISO 14025:2006, section 3.9).

National Museum of African American History and Culture designed by David Adjaye

The Aluminum Association

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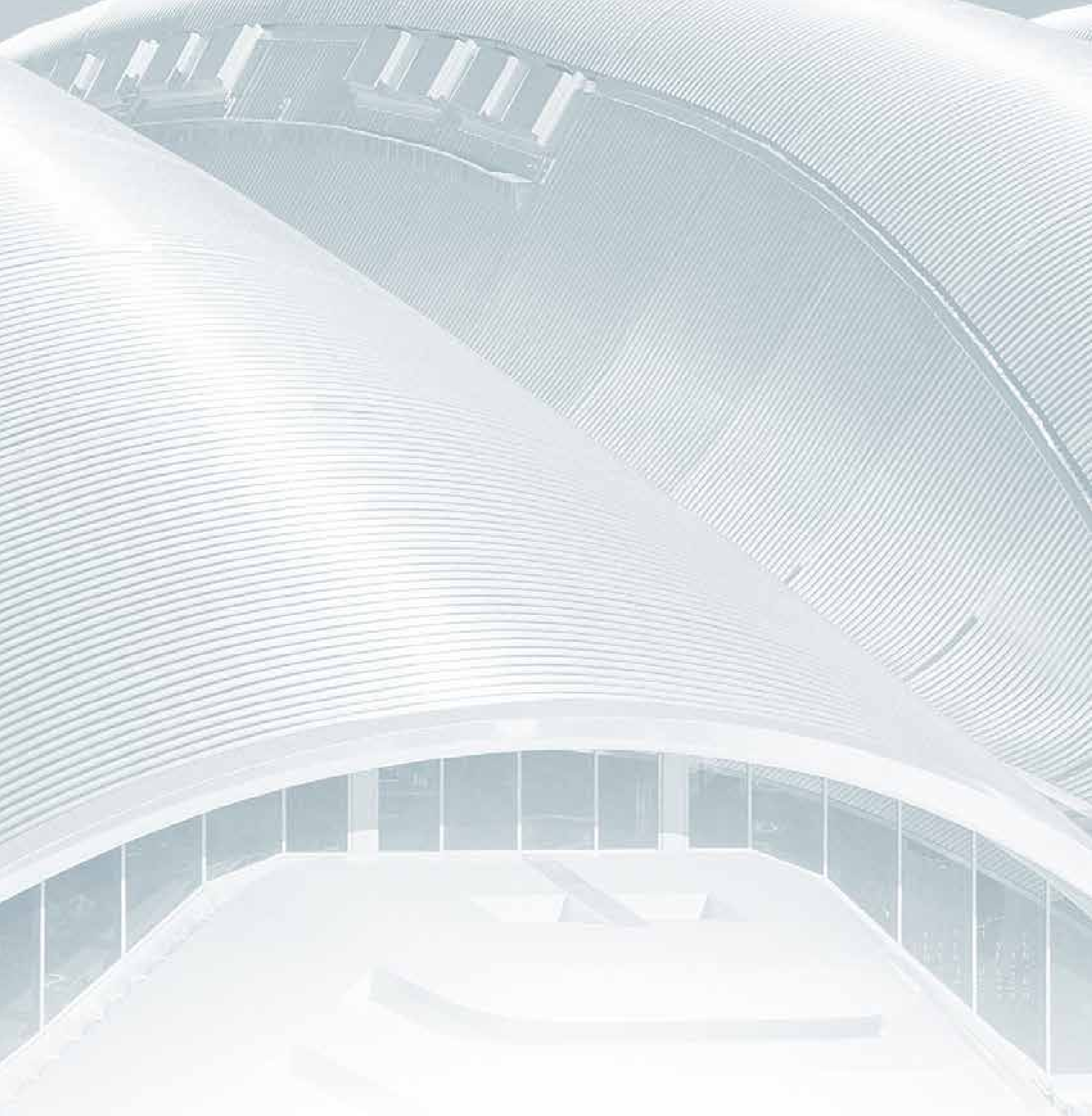

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