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SUSTAINABLE RESOURCE OF RAW MATERIALS: NON–FERROUS METALS TURNED BACK INTO THE ECONOMY AS SECONDARY RAW MATERIALS

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Abstract: Non–ferrous metals such as aluminum, copper, magnesium or zinc are important for all manufacturing industries, sustainability, and economic growth. They are irreplaceable for many products in the automotive, aerospace, mechanical engineering, and construction sectors. Therefore, non–ferrous metals are very important to the economy, competitiveness, and industrial development. The targets in waste legislation have been a key driver to improve waste management practices, stimulate innovation in recycling, limit the use of landfilling, and create incentives to change consumer behavior. The circular economy calls for a coordinated redesign of production and consumption patterns, ensuring that cascading material and product resource use continues for as long as possible. Moving away from the "take, make, use and dispose" paradigm, the circular economy aims to extract the maximum value and utility from resources and products, encouraging principles such as zero–waste design, product–life extension and resource recovery.
Keywords: raw materials, non–ferrous metals, resource efficiency, waste hierarchy

INTRODUCTION

Raw materials are particularly crucial for the development of modern technologies and a strong industrial base. Raw materials, such as metals and minerals, have become increasingly important. It can be said that raw materials, from primary and secondary sources, are the backbone of the economy. Even if we recycle better and more, primary raw materials will continue to play an important role in the economy. But, in the same time, securing a sustainable supply of raw materials must be a key priority to the global economy, growth and competitiveness. In a circular economy, waste that can be recycled is turned back into the economy, as secondary raw materials. These materials can be traded and shipped just like primary raw materials but, at present, they still account for only a small proportion of the materials used in new productions.

Non–ferrous metals such as aluminum, copper, magnesium or zinc are important for all manufacturing industries, sustainability, and economic growth. They are irreplaceable for many products in the automotive, aerospace, mechanical engineering, and construction sectors. Their unique thermal, electrical, and isolating characteristics coupled with endless recyclability and low weight make them indispensable. Therefore, non–ferrous metals are very important to the economy, competitiveness, and industrial development.

Industrial, certain parts of commercial waste and extractive waste are extremely diversified in terms of composition and volume, and very different depending on the structure of the industry or commerce sector that generates the waste and the industrial or commercial density in a given geographical area. As a result, its management involves a need for a highly complex waste management system including an efficient collection scheme, a need to actively engage citizens and businesses, a need for infrastructure adjusted to the specific waste composition, and an elaborate financing system.

The targets in waste legislation have been a key driver to improve waste management practices, stimulate innovation in recycling, limit the use of landfilling, and create incentives to change consumer behavior. Taking waste policy further can bring significant benefits: direct savings linked with better waste management practices and a better environment. The main elements are:

- increase of the preparing for re–use and recycling practices;
- gradual limitation of the landfilling of the potential secondary raw materials;
- new measures to promote prevention and re–use;

Waste management should be improved, with a view to protecting, preserving and improving the quality of the environment, ensuring prudent and rational use of natural resources and promoting a more circular economy. Also, waste prevention, according to the waste hierarchy, is the most efficient way to improve resource efficiency and to reduce the environmental impact of waste. Therefore, resources – including the non–ferrous metals and their wastes – should be used in the most efficient way and without depleting the planet's resources. Recycled waste can be turned back into the economy as secondary raw materials.

MANAGEMENT OF RAW MATERIALS & RESOURCE EFFICIENCY

The economy currently loses a significant amount of potential secondary raw materials which are found in waste streams. Only a limited value of the waste generated was recycled, with the rest being landfilled. Therefore, we need to have significant opportunities to improve resource efficiency and create a more circular economy, extracting the maximum value and use from all raw materials, products and waste. Recent trends suggest that further progress on resource efficiency is possible and that it can bring major economic, environmental and social benefits, covering the full lifecycle: from production and consumption to waste management and the market for secondary raw materials. In fact, turning waste into a resource is an essential part of increasing resource efficiency and closing the loop in a circular economy. It should put in place adequate incentives for the application of the waste hierarchy, in particular, by means of financial incentives aimed at achieving the waste prevention and recycling objectives, such as landfill charges.

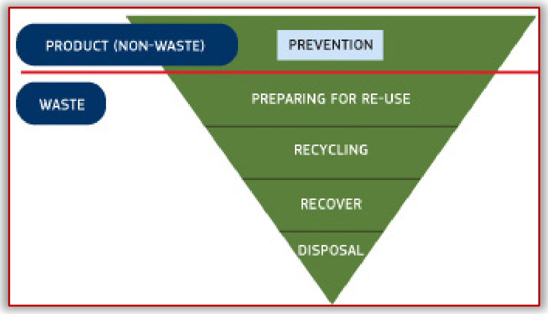


Figure 1: The waste hierarchy

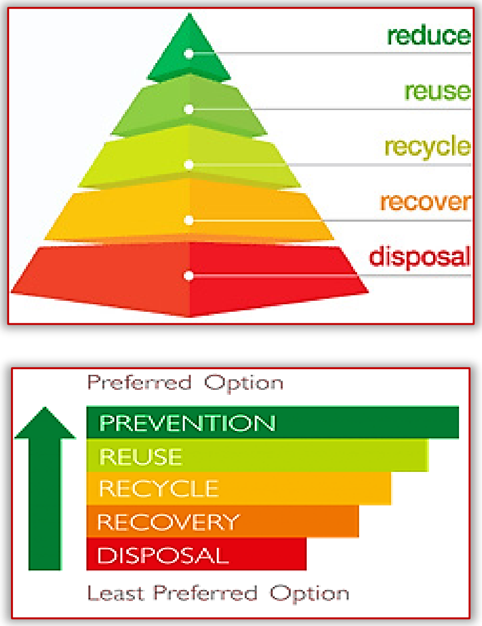


Figure 2: Preferred options in the waste hierarchy

The traditional model of economic growth – a linear economy (resource extraction – product making – waste disposal) – must therefore be replaced with a circular economy model aiming at closing the loop of resources and reducing the environmental impact of the product life cycle at all stages of the process (production, distribution, consumption).

In the linear model, mining companies extract virgin raw materials, which are subsequently processed into products by other companies. The products are sold to customers, who use them for a given time depending on the type of product. Ultimately, the products are disposed of. The disposed products are landfilled, mostly with little or no attempt to recover the products or the embedded materials.

In the linear model, mining companies extract virgin raw materials, which are subsequently processed into products by other companies. The products are sold to customers, who use them for a given time depending on the type of product. Ultimately, the products are disposed of. The disposed products are landfilled or incinerated, mostly with little or no attempt to recover the products or the embedded materials.

A radical shift is required from linear to circular thinking. End–of–life products must be considered as a resource for another cycle, while losses and stocks of unused materials must be minimized and valorized along the value chain. In addition, the interactions between materials must be considered to define the best circular solution from a systemic standpoint. The successful transition of a society to the circular economy at the global scale depends on the reliable and sustainable supply and management of raw materials. Therefore, preventing products and materials from becoming waste for as long as possible and turning wastes that cannot be avoided into a resource are key steps to achieve a circular economy. The world has streamlined its linear production systems for decades. These processes rely on virgin raw materials. This is why it is important to intensively develop technologies to utilize recycled materials. Resource efficiency has been of interest to the manufacturing industry for years, most recently expressed in several management strategies, which need to lead to minimize resource use by identifying and eliminating wasteful procedures.

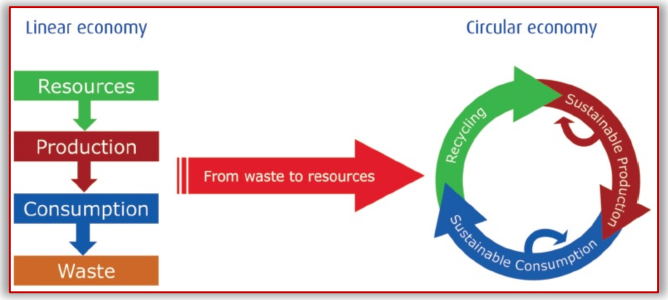


Figure 3: From waste to resources

The circular economy has the potential to preserve precious and increase scarce resources, reduce environmental impacts of resource use and inject new value into waste products, making the transition to a stronger and more circular economy where resources are used in a more sustainable way. The proposed actions will contribute to "closing the loop" of product lifecycles through greater recycling and re–use, and bring benefits for both the environment and the economy. The measures for changing the full product lifecycle go beyond a narrow focus on the end–of–life stage, by innovative and more efficient ways of producing.

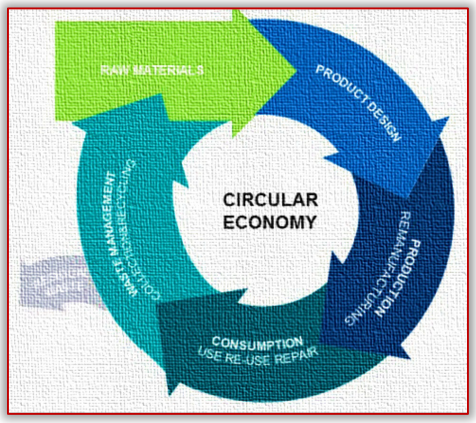
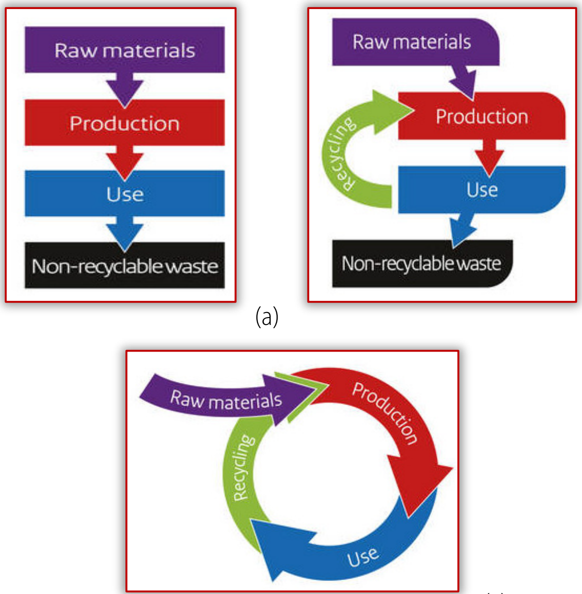


Figure 4: Conceptual diagram illustrating the "Circular Economy" in a simplified way

Resource efficiency has been of interest to the manufacturing industry for years, most recently expressed in several management strategies, which need to lead to minimize resource use by identifying and eliminating wasteful procedures. In this sense, the circular economy suggests a setup for the production and use of goods in which resources are conserved for as long as possible. Thus, in a circular economy, resources are circulated again and again through closed loops. The useful life of products, components and materials is prolonged through repair, reuse, remanufacturing and recycling, whereby the resource efficiency is increased and the need for new products and virgin raw material is reduced or ideally eliminated.

The circular economy calls for a coordinated redesign of production and consumption patterns, ensuring that cascading material and product resource use continues for as long as possible. Moving away from the "take, make, use and dispose" paradigm, the circular economy aims to extract the maximum value and utility from resources and products, encouraging principles such as zero–waste design, product–life extension and resource recovery.



(a) (b) (c)

Figure 5: The resource efficiency in: (a) linear economy; (b) reuse economy; (c) circular economy

Beyond waste reduction and recycling, a more circular raw material sectors needs to search for new forms of collaborations between and across traditionally linear value chains. Circular economy strategies can offer multiple environmental benefits by keeping resources in productive use for as long as possible. Large scale system and process change, involving the entire non–ferrous industries and their supply chains, will need to be coupled with recovery and recycling on local and regional levels, working close to source, close to consumers and together with local stakeholders. Compliance with the obligation to set up separate collection systems for all wastes is essential in order to increase preparing for re–use and recycling rates. In addition non–ferrous waste should be collected separately to contribute to an increase in preparing for re–use and recycling rates of these recyclable materials.

— "preparing for re–use" means checking, cleaning or repairing recovery operations, by which waste, products or components of products that have been collected by a recognised preparation for re–use operator or deposit–refund scheme are prepared so that they can be re–used without any other pre–processing.
— "recycling process" means the recycling process which begins when no further mechanical sorting operation is needed and waste materials enter a production process and are effectively reprocessed into new products.

In a circular economy resources are kept in a circulatory system over the longest possible use phase. The materials are often used for several purposes and returned again and again in the recycling cycle. The ecological advantage of the circular economy is that it produces less waste and minimizes the extraction of resources. In fact, the aim of a circular economy is the resource–efficient and sustainable use of natural resources, their reuse and recycling within a circulatory system and the prevention of waste. The implementation of a circular economy should not be in conflict with economic interests which are served by the fact that in the system of circular economy companies generate an additional value from the materials.

Figure 6: The maximum resource efficiency

By focusing on the waste hierarchy all key stakeholders can clearly define the difference between "Reuse", "Recycling" and "Recovery". This means that our account management and supply chain teams are able to focus on the upper tiers of the waste hierarchy which supports our customer's long term sustainability strategy.

By using the guiding principles of the circular economy we can recycles more than 80% of all waste material generated. Nearly half of all waste recycled has a commodity value for our customer. These materials are no longer looked upon as waste and they are a by–product of the production process.

Recycling is an important component when replacing raw materials for a number of metals, which are recyclable and which can always be recycled without losing any of their properties. In general, recycling prevents the loss of potentially useful materials and reduces the consumption of raw materials. Thus, recycling can make a significant contribution to sustain development; at the same time the introduction of secondary raw materials in a large proportion in the production process leads to a reduction in raw material consumption. Non–ferrous metals (including aluminum) can be recovered from their waste and can be reintroduced into the production cycle by recycling without losing their qualities.

Thus, producers are increasingly focusing on a particular segment: recycling and obtaining secondary metal. The collection, sorting and supplying of secondary raw materials to industry is based on the metal recycling industry which is very active in recovering metal from a variety of sources and consequently uses a wide range of secondary raw materials.

The most commonly used non–ferrous metals are aluminum, copper, lead, zinc, nickel, titanium, cobalt, chromium and precious metals. Millions of tons of non–ferrous scrap are recovered annually and used by smelters, refiners, ingot makers, foundries, and other manufacturers. Secondary materials are essential to the industry's survival because even new metals often require the combined use of recycled materials.

CONCLUSIONS

The rapidly growing consumption of the resources, including materials, need to find alternative solutions. Today, we extract and use around 50% more natural resources than we did just 30 years ago. Therefore, we need to become more sustainable. A significant portion of the material is recyclable and therefore, needs to be given a second life through the circular economy. In order to implement viable recycling options for non–ferrous metals, technologies with high investment and environmental risks as well as important volumes are required.

Resources like minerals are extracted from the environment and used to make a commodity, which is sold, used and then deposited as trash at the end of its life. A linear economy, more commonly referred to as "take, make, waste", cannot continue indefinitely – continuing resource constraints are putting business and humanity at risk. In the linear economy resources and raw materials are extracted, processed and usually used for a specific purpose. At the end of life the products are disposed of in the landfill or thermally recycled. Linear economy is therefore often referred to as a "disposable economy". The time is now to "close the loop" and create a more circular – and vibrant – economy that incorporates repurposing, redistributing, remanufacturing and reusing resources into our processes.

A circular economy is an alternative to a traditional linear economy in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each lifecycle. The circular economy is important because it creates sustainable opportunities for growth, helps to reduce waste, drive greater resource productivity and delivers a more competitive economy.

In a world which is increasingly demanding sustainability, non–ferrous metal recycling has become a very important practice. Millions of tons of non–ferrous scrap are recovered annually and used by smelters, refiners, ingot makers, foundries, and other manufacturers. Secondary materials are essential to the industry's survival because even new metals often require the combined use of recycled materials. The recovered materials are melted down in a furnace, poured into casters and shaped into ingots. These ingots are either used in the foundry industry or they can be transformed into flat sheets and other wrought products, which are then used to manufacture new products. Aluminum offers intelligent and practical solutions to recovering for recycling.

With the worldwide volume of wastes processed increasingly sourced from consumer and light industrial waste streams, the percentage of valuable non–ferrous metals has dramatically increased. This trend, coupled with ever increasing waste minimization and environment protection legislation, has driven the need for integrated non–ferrous recovery plants.

Non–ferrous metals, including aluminum do not degrade during the recycling process and thus can be recycled an infinite number of times. Thus, non–ferrous recovery and recycling has become increasingly important – both domestically and globally. The trends are continually increasing resource recovery rates with a particular focus on reduction of losses to and diversion from landfill. The general trend is for improvements to be sought in every area possible – new ways of applying existing technologies are sought to gain improvements along with the development of new technologies for solutions to existing and emerging applications.

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