Strategy for a sustainable industry

In a carbon-conscious world, every industry needs to demonstrate it is conducting sustainable practices to secure future business. This article describes five strategies for building a more sustainable aluminium industry. **By Dr Subodh K Das***

The global aluminium industry stands on the cusp of a shift in terms of how we think about manufacturing and design.

The movement towards more sustainable practices challenges consumers, policymakers, designers and manufacturers to develop new standards and strategies that enhance product quality, promote economic growth and enhance production efficiency, while reducing our carbon footprint.

In this carbon-conscious world, every industry needs to demonstrate to the public's satisfaction that it is conducting sustainable practices to secure future business.

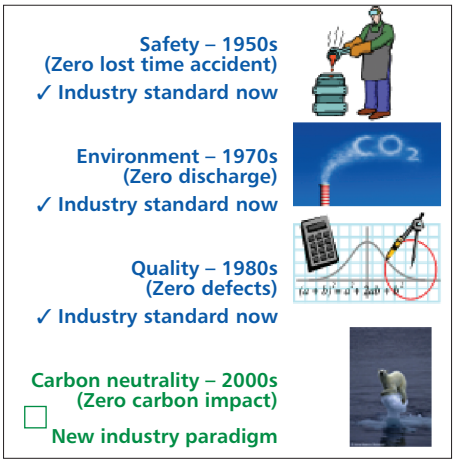

Fig 1 Trends in the aluminium industry

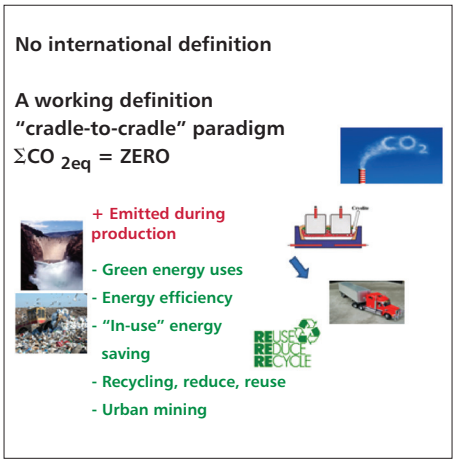

Fig 2 Defining Carbon Neutrality

Achieving carbon neutrality

In the past 60 years, the industry has experienced a series of phases towards better practices, higher quality and improved standards, (**Fig 1**).

The 1950s witnessed industry-wide efforts to improve safety standards. The environmental movements of the 60s and 70s spearheaded campaigns to eliminate harmful pollutants.

In the 80s and 90s, manufacturers sought to elevate the quality of their products to the highest level, practically reducing product defects to zero.

Today, the aluminium industry teeters on the threshold of another change: the quest for total carbon neutrality.

For the global aluminium industry, carbon neutrality should be defined as a state where the total 'in-use' CO_2eq saved from all the products in current use, including incremental process efficiency improvements, recycling and urban mining activities, exceeds the CO_2eq expended to produce the global output of aluminium (**Fig 2**).

In other words, the industry must seek to effectively eliminate the carbon emissions generated during extraction, refining, manufacturing and recycling processes, countering these emissions with energy-saving strategies.

"So what?" you might ask, "Why should carbon neutrality become the new industry paradigm?" The answer is this: carbon neutrality could be an economic boon to the global aluminium industry.

Often, the ability to deliver green, carbon neutral or sustainable products and services can impact long-term economic success in an environmentally conscious global marketplace.

Thus, the industry, by achieving carbon neutrality, can remain competitive with other material alternatives. Striving for carbon neutrality now can help prepare the aluminium industry for the stricter government policies and social expectations on the horizon.

Reducing emissions saves money and makes aluminium a more marketable material. Emission reduction can cut costs by enhancing process efficiency, lowering energy usage and reducing consumption of scarce (and expensive) raw materials.

This principle has already been thoroughly illustrated by the significant production and economic gains recently achieved by the strategy adopted by DuPont: "In 1994, DuPont committed to cutting its gas emissions by 40% by 2000 from its 1990 levels. By 2000, the company had met its original target and set an even more ambitious one – a 65% reduction by 2010. But the gains have been so dramatic that DuPont has already hit that goal, too. It also uses 7% less energy than it did in 1990, despite producing 30% more goods. This action has saved DuPont over $2bn."[1]

The quest for carbon neutrality represents the next frontier for our industry. By working to reduce carbon emissions today, the aluminium industry will secure a positive position in the material marketplace in the 21st century and beyond.

The good news is that carbon neutrality is an attainable goal. By executing the five 'cradle-to-cradle' strategies outlined in **Fig 3**, the industry will eliminate emissions.

Eliminating unnecessary alloys

In an age when production and demand

*CEO Phinix

WORLD CARBON FOOTPRINT (2008)	+29,888
Aluminium carbon footprint (~1.7% of global)	+500
Increase use of "greener" sources of electrical energy by 8%	(27)
Reduce process energy requirements by 16%	(79)
Eliminate anode effects/process improvements/new technologies	
Deploy 35% of products in "in-use" energy savings	(266)
Applications	
Transportation & renewal energy sectors	
Divert 6.1MMt per year form incinerators/landfills	(74)
Recover 4.5MMT per year from "urban mining"	(54)
Global carbon impact	ZERO

Fig 3 Achieving carbon neutrality (CO2eq Mt)

Industry/Field	Recycle-friendly alloy
Electrical	1350
Can sheet	One "uni-alloy" 3104 (for body, lids, tabs)
Building and construction	3105 (painted sheet); 606x (extrusion)
Automotive	5754, 6111-0 (interior);6111-T4 (exterior); 6061-T6 (bumpers/structural); A356, 380, 319
Aerospace	2x24, one 7x50 (place, extrusion)
Marine	5052 (plate); 6063 (extrusion)
Guidelines for Material/metallurgical Engineers & alloys Designers	Mininise use of Li, Ag, Be, Bi, Pb, Ti, Cr, Zr, V ("Entropy enhancers/recyclability reducers") Only need: Cu, Zn, Mg, Mn, Fe and Si

Table 1 Suggested Recycle-Friendly Alloys

Table 2 Al recycling rate by market sector

Sector	Market Share	Use life Cycle (y)	Recycling Rate (%)	Recyclability	Opportunities
Transportation ground	30	8-12	~90	High	Multi-metal components
Marine	5	10-15	~70	Medium	low Mg
Aerospace	10	20-25	~50	Low	Avoid Li 2xxx/7xxxMix
Building & construction	20	25-40	~80	Medium	Extrusion/ rolled separation
Packaging LG	10	1-3(m)	~20	Low	Avoid Zn
Packaging cans	10	1-2 (m)	~50	Low	Uni alloy
Electrical/machinery	10	20-30	~40	Medium	Oxidation
Electronics	5	1-3	~20	Low	Recycling

continue to increase, it is not unusual to spot superfluous elements in the manufacturing cycle. Unnecessary components and materials increase production costs, while spawning products that are difficult (if not impossible) to recycle.

In the aluminium industry, this often occurs in the form of excessive alloy differentiation.

The speed, efficiency and cost savings of recycling can be improved with materials and products engineered from the start to facilitate the process.

Most of the alloying elements used to produce aluminium alloys – including Mg, Cu, Si, Mn, and Zn – have even higher carbon footprints than aluminium, complicating subsequent recovery and recycling at the end of the product life.

Excessive product differentiation to promote perceived competitive advantages also leads to more waste, higher costs and larger carbon footprints.

It is estimated that more than 110 varieties of aluminium alloys are in commercial use today.

Table 1 shows that the industry could serve the spectrum of applications with only 15 alloys, using alloying elements Cu, Zn, Mg, Mn, Fe, and Si. This minimises the use of entropy-enhancing and recycle-limiting elements such as Li, Ag, Be, Bi, Pb, Ti, Cr, Zr, and V.

Focusing on the development and production of a small collection of multi-use, recycle-friendly alloys promotes recycling and reduces the industry's carbon footprint.

Urban mining

Urban mining represents the new frontier in aluminium recovery and recycling, and may hold the key to promoting secondary production. The author estimates US landfills alone contain more than 20-30Mt (~240-360Mt of CO_2eq) of used beverage cans (UBC), valued at ~US$50-75bn at current prices.

This rate is increasing at the annual rate of 1Mt (~12MtCO_2eq), valued at US$2.5bn. So, new landfilled aluminium UBC in the USA is equivalent to running three primary smelters (~330kt/y smelter) full time for the purpose of producing buried products, with each landfilled aluminium can equivalent to ~200 grams of CO_2eq.

The industry should actively investigate the feasibility of 'urban mining' to recover this large, untapped resource and prevent further unintended carbon sequestration.

Many are observing the opportunities presented by urban mining as it becomes a more standard process for the recovery of lost materials.

UrbanMining.org says, "up to 30 times as much gold can be found in cell phone circuitry as can be found in the gold ore processed in gold mines (some 150 grams, or 5.3 ounces/t, compared to 5 grams, or 0.18 ounces/t). The same quantity of cell phones contains 100kg (220lb) of copper and 3kg (6.6lb) of silver, as well as other materials." [3]

Manufacturing easily recyclable products

With a global population approaching 7bn, there is not enough primary aluminium available to indefinitely meet demand.

The industry must strive to produce alloys and products capable of meeting many demands, while also maintaining recyclability. This means manufacturers must design products that are easily disassembled and processed for recycling, using materials (such as the alloys suggested earlier) that are recycle-friendly (**Table 2**).

Today, as a result of the complicated processes associated with disassembling many products, most recycling plants have to manually disassemble products and devices by hand.

As Gary Legg observes, "the cost of disassembly and subsequent recycling becomes part of a product's cost and thus affects the bottom line. Manufacturers will be motivated to reduce this cost, just like any other, and speeding up disassembly in any way can help do that."

Legg recommends that designers should aim for a production strategy known as 'active disassembly':

"In the long term, automation and greater efficiencies will probably come about through what's called active disassembly, in which products partially disassemble themselves.

Products manufactured for eventual active disassembly contain fasteners, usually made from shape-memory alloys that release when exposed to an appropriate stimulus, such as heat.

Application of the stimulus is to an entire product or component, so one automated action can replace numerous manual steps. Nokia has built a prototype mobile phone using active-disassembly fasteners, and in one experiment disassembled the phone in two seconds, compared to 100 seconds manually.[4]

By aiming to design and manufacture more recycle-friendly products, the aluminium industry can improve its sustainability while reducing costs.

Some products can help the industry reduce its carbon footprint over time. These 'in-use' products, owing to their efficiency, generate fewer carbon emissions throughout their lifetime.

The industry should aim to produce more aluminium products that serve in these 'in-use' energy-saving applications. This is true for both transportation and renewable energy applications.

In-use products

Replacing steel components with aluminium prevents 20t of CO_2 emissions over 10 years of a vehicle's lifetime.

Randall Scheps, chairman of the Aluminum Association's Aluminium Transportation Group and marketing director at Alcoa observes: "We are fast-entering a transition stage to more holistic

vehicle design approaches premised on greater use of lighter, stronger and more crash-absorbent aluminium alloys replacing less efficient iron and steel. Vehicles with their size maintained but downweighted with aluminium are inherently more efficient than heavier ones." [2]

The integration of aluminium components in automobiles is on the rise. The Aluminium Association "estimates North American automakers will increase their use of aluminium from 327lbs/vehicle in 2009 to 550lbs/vehicle in 2025."

The Aluminium Association based its predictions on a survey conducted by Ducker Worldwide, which revealed "continued growth in overall use of aluminium reaching an all-time high of 343lbs/vehicle in 2012 – up 5% from 327lbs/vehicle in 2009.

The report predicts aluminium is expected to double its share of the average automotive materials mix to 16% by 2025, with future cars and light trucks reaching an expected average of 550lbs/vehicle of automotive aluminium." [2]

Adapting aluminium for renewable energy applications means the industry ideally placed to reduce carbon emissions.

Whatever emissions are generated during the manufacturing process can be off-set by aluminium-constructed clean energy generators. It is important that these products remain recycle-friendly to minimise the industry's carbon footprint. By deploying 35% of aluminium products in energy-saving applications, the industry can eliminate 270Mt/y of CO_2 emissions.

A positive market position

By implementing these five strategies, the industry can take a proactive role in the sustainability revolution, pioneering industrial innovation and ultimately, securing a positive market position for aluminium as a highly useful, sustainable material capable of fulfilling many applications.

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