Resource Efficiency of Aluminium

GESAMTVERBAND DER
ALUMINIUMINDUSTRIE e.V.

Great commitment in matters relating to sustainability

Michael Kuhndt

Sustainable value creation is becoming increasingly more important: the world population is continuing to grow strongly, the global economy is tending to grow dynamically, strategically important resources are becoming scarcer, and at the same time the world is facing serious ecological challenges. Conservation of resources and energy efficiency are key aspects of a socially acceptable and an eco-friendly development of production and consumption. They are the responsibility of companies and their decision-makers as well as of each individual consumer of products and services.

The German aluminium industry is playing a leading role in the debate concerning the direction of sustainable development and for years has been involved in progressively introducing sustainable practices, both at its production plants and outside the workplace. In this connection it has had an important influence on the direction of the sustainability debate at corporate level, as well as via the work of its trade association: for example by commissioning life-cycle analyses for the broadest possible range of aluminium products. These studies contribute to a better appreciation of the use of resources in the supply chain and demonstrate the influence of consumer behaviour on the consumption of resources. One should also emphasise the dialogue being conducted between GDA and its member companies, the IG Metall trade union and the Federal Environment Ministry (BMU) in the form of a social partnership. The aluminium industry is thus an important source of inspiration for other industries.

Michael Kuhndt
Managing Director of the Centre on Sustainable Consumption and Production (CSCP)

Aluminium – resource-conserving and energy efficient

Lightweight aluminium can point to an excellent performance record when it comes to sustainability, climate change prevention and ecological 'footprints'. Aluminium products come out particularly well in the two key categories: conservation of resources and energy efficiency. The same is true for the aluminium producing and processing companies in the sector.

The resource efficiency of products first becomes really apparent when one takes their complete life cycle into consideration – from the extraction of the metal via its processing into semi-finished and finished products through to its utilisation and finally to its recycling and its life as a new product. With aluminium, such a life cycle does not come to an end after just a few cycles: it can be repeated indefinitely. Not only theoretically but also in practice: more than three-quarters of all the aluminium ever produced is still in use today and has already been recycled many times over.

The key aspects of the "resource efficiency" of aluminium products and the processes used to make them are summarised below. ■

Energy efficiency at product and process level

Aluminium is synonymous with energy efficiency – at both product and process level. Compared to conventional metallic materials, lightweight parts made from aluminium reduce weight and hence fuel-consumption, emissions and the release of carbon dioxide. Energy consumption during production has been significantly reduced by means of manifold technical innovations.

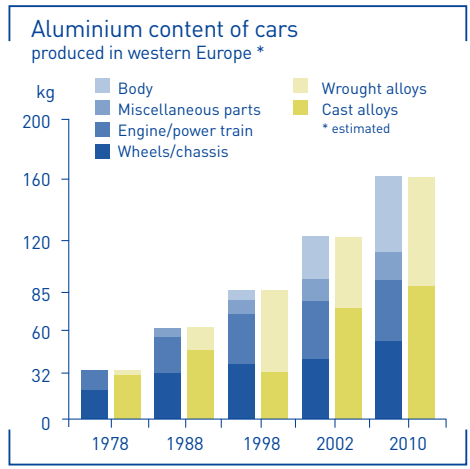
The trend to lightweight aluminium construction for road vehicles is apparent both in commercial vehicles and passenger cars. More and more aluminium components are being used, increasingly in the body as well: for example, the body of the Audi TT coupé only weighs 206 kilograms thanks to an aluminium content of 140 kilograms. If an all-steel construction were to be used, the body would be 48 per cent or almost 100 kilograms heavier.

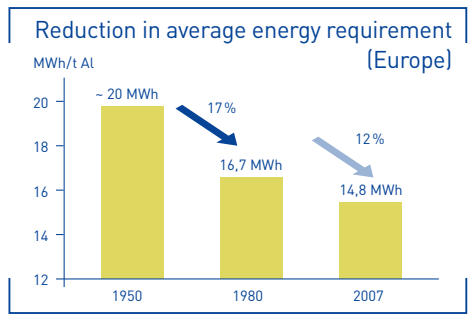
According to widely accepted studies, a weight saving of 100 kilograms in a car due to the use of lightweight constructional materials leads to an average fuel saving of 3.5 litres of petrol per 1,000 kilometres. Worldwide, seven million tonnes of aluminium were used in car components in 2006. The resultant weight saving will thus enable 55 billon litres of crude oil to be saved during the life of these vehicles. In addition, the commercial-vehicle sector also offers great potential for energy savings via the use of aluminium components. For example, reducing the weight of a bus by one tonne leads to a saving of between 1,700 and 1,900 litres of fuel per 100,000 kilometres.

A body made completely of aluminium, such as the Jaguar XJ shown here, contributes to the good eco-balance of the end-product.

Traditionally, there has been widespread use of the light metal in aircraft construction. Even though there is much talk nowadays about carbon fibre reinforced plastics and composites, aluminium is, and remains, the material of choice. The aluminium industry has worked intensively in the past to further reduce the gauge of aluminium sheet used in aircraft components, thereby saving more weight. In addition, the sector is pushing forward with the development of new, even lighter aluminium alloys. The 7000 Series alloys used in aircraft construction make weight savings of up to 15 per cent possible. Novel new aluminium alloys containing additions of scandium or lithium can even achieve weight savings in excess of 25 per cent.

Aluminium companies have also optimised their extrusion and rolling processes over the years in order to make them more energy efficient. Some examples: the specific energy consumption for electricity and gas in a rolling mill in Hamburg was reduced by a third between 1998 and 2006, and the specific CO_2 emissions by a quarter. The world's largest rolling mill in Norf improved the energy efficiency of its use of compressed air by 43 per cent between 2003 and 2008. The use of innovative superconductivity-based induction heaters for billet heating in extrusion plants can reduce electricity consumption by about a half compared with conventional systems. And the electricity consumption in the fused-salt electrolysis process used to extract aluminium metal has been reduced by almost a third over the past 60 years as a result of technical improvements. From a technical and ecological point of view, the few remaining primary aluminium smelters in Germany are among the most modern in the world. ■





Recycling is gaining ground

Aluminium has recycling properties that are unmatched by any other metal. Only five per cent of the energy required to extract aluminium initially is required to melt down aluminium scrap. State-of-the-art recycling furnaces in which the hot pyrolysis gases are extracted from the scrap chamber and subjected to direct combustion in the heating chamber achieve even better energy figures. Aluminium is thus an excellent energy store.

Aluminium – a "renewable raw material".

In contrast to other materials, aluminium scrap can be melted down and repeatedly turned into new high-grade products without any loss in quality. There is no difference in quality to that of primary aluminium produced from bauxite ore: casting is used to convert old gearbox casings into new gearbox casings of the same quality, ingots made from used beverage cans are rolled into canstock for making new cans, and billets made from old window profiles are extruded into new profiles – or different high-grade products in each case. This conserves primary raw materials to meet the needs of future generations.

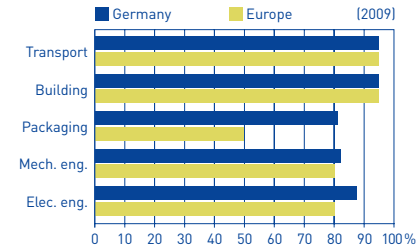
Today, three-quarters of all of the aluminium ever produced can still be found somewhere within the material loop. This shows that used aluminium is a valuable raw-material source for metal-processing plants, particularly in a country like Germany that has few natural resources but a logistics system that has functioned well for decades. Aluminium is thus a "renewable raw material".

Nowadays, the material loops comprising extraction, processing and use of the metal through to its recycling are closed as far as possible. This has been the case for a long time with long-life aluminium applications in cars or buildings – with recycling rates of about 95 per cent – and is now also the case for product applications with relatively short service lives in the packaging sector. Here, recycling rates of over 80 per cent have been reached in Germany. With the deposit scheme now in force, the recycling rate for aluminium beverage cans is now over 95 per cent. This is the highest recycling rate in the whole of Europe, if not in the world!

The aluminium industry is in no way sitting back and resting on these successes. It is continuing to look for and close any gaps that exist in material loops. In order to recycle the raw material more intensively in Germany, the country's aluminium companies are investing in expanding recycling capacity and in doing so are resorting to the use of the latest plant technology. For example, new recycling furnaces with regenerative burner technology, each with a capacity of 50,000 tonnes, have recently been installed in Norf and Hamburg.

And one should not forget that closed material loops are not restricted to the aluminium products, they can also be found in the processes, such as for operating and auxiliary materials (e.g. lubricants for rolling or solvents in surface finishing operations). ■

Recycling rates in Germany and Europe



Aluminium helps protect the climate

Environmental policy in Germany has been characterised for many years by the attempt to drastically reduce emissions of carbon dioxide and other climate-relevant gases. The German primary aluminium smelters made a voluntary commitment as long ago as the 1990s to reduce significantly the formation of highly effective climate-change gases such as CF4 and C2F6 during metal extraction. The voluntary commitment

made to the Federal Government to reduce these emissions by half between 1990 and 2005 both in absolute terms and also specifically was more than fulfilled: reductions of 85 per cent were achieved. Here, German primary smelters are among the very best in the world.

It has also been possible to reduce significantly the specific emission of climate-change gases in processing plants. Wherever energy consumption is based on fossil fuels, a reduction always results in lower emissions of the greenhouse gas CO_2. There are numerous examples that can be cited for the optimisation of energy-consuming processes. A few are described below in the section on energy efficiency.

At product level, aluminium is also making a decisive contribution to preventing climate change. The use of aluminium components in cars and commercial vehicles leads to a sustainable reduction in the traffic-related environmental impact. This is because if one considers the complete life cycle of a car, more that 80 per cent of the total energy used is consumed during the utilisation phase. Material production, manufacturing and recycling/disposal account for 20 per cent.

The use of aluminium permits larger payloads to be transported and thus saves fuel.

If the whole fuel supply chain is taken into consideration, a reduction of 100 kilograms in the weight of a car and the resultant fuel saving reduces the CO_2 emission by about 10 grams per kilometre. Over the life of a normal passenger car (200,000 km) this results in a CO_2 saving of 2,000 kilograms. The seven million tonnes of aluminium mentioned in the section on energy efficiency that were used to make car components in 2006 will thus lead to a saving of 55 billion litres of crude oil and a reduction in CO_2 emission of 140 million tonnes. ■

LOWER EMISSIONS – STATE-OF-THE-ART THERMAL INSULATION

Aluminium products for sustainable consumption

With its specific material properties, aluminium is predestined to support ecologically sustainable consumption. Light, corrosion resistant, strong, a good conductor of electricity and heat, and no health risk – all of these make manifold resource-conserving applications with a high degree of product benefit possible.

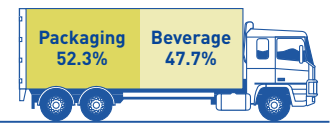
Aluminium foil's barrier to light, gases and vapours contributes to foodstuffs, beverages and pharmaceuticals having a significantly longer shelf life. As a "system partner" in composite packaging, a wafer-thin layer of aluminium 0.006 mm thick suffices to provide this barrier function and thus conserve valuable resources. According to the World Health Organisation, 30 per cent of the foodstuffs in developing countries perish through lack of suitable packaging. With this in mind, the fact that, for example, 1.5 grams of aluminium foil in a composite pack weighing 28 grams is enough to protect a litre of milk from deterioration for several months without the need for refrigeration cannot be rated highly enough.

When transporting goods by road, the use of aluminium components can reduce the dead weight of a truck and thus increase the possible payload without exceeding the permitted total weight of a vehicle. This allows more goods to be transported with less vehicles and this reduces the volume of traffic.

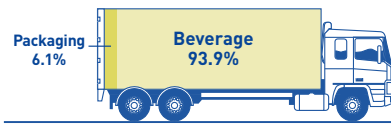
Aluminium and aluminium alloys have the dis-

Aluminium packaging compared with returnable glass bottles

→ Transporting drinks
in returnable glass bottles (0.2 litres in cartons of 12)



→ Transporting drinks
in stand-up pouches (0.2 litres in cartons of 10)



tinctive property that bare metal surfaces react spontaneously with the oxygen in air or water to form a compact, impermeable oxide layer. To a large extent, this makes the material corrosion resistant against the elements and contributes to a long product life, without the need for a protective coating and costly maintenance – a benefit that is widely used for windows, doors, roofing, façades and bridges. This also contributes to the conservation of resources.

Special aluminium façades meet the latest thermal insulation standards for the construction of passive energy houses, which achieve comfortable room temperatures both in winter and summer using extremely little energy. If solar collectors and solar power plants are used, the supporting structures of which are usually made of aluminium profiles, it is even possible to build zero-energy houses.

Aluminium plays an important though often mostly invisible role in air conditioning technology. Aluminium foil and strip is often used for thermal insulation, whereby the insulation is actually air or a vacuum. However, the bright aluminium surfaces have the task of reflecting thermal radiation. Aluminium is also used as a façade element if, for example, an additional layer of glass is placed in front of a thermally insulated inner façade. With underfloor and ceiling heating, aluminium sheet is used to distribute the heat from the heating coils to the brickwork or into the room. This minimises energy losses. ■

Sugar silos in Halfweg, Denmark; the former storage tanks comprising two concentric cylinders offer a perfect opportunity for reuse as office space.

LEAN IS IN

Use of material – as much as necessary, as little as possible

Aluminium beverage cans are easy to transport, unbreakable and can be cooled quickly.

As much material as necessary, as little material as possible. Manufacturers search for possible weight savings of the order of grams in the battle against excess weight in carmaking. The development of weight-optimised castings by use of improved alloys, new casting technologies and a casting-friendly design are part of the everyday life of R&D departments in aluminium foundries. Downsizing in engine technology in order to produce smaller, lighter but nevertheless highly efficient aluminium engines is a trend that will continue in the years to come.

This "slimming" process is also taking place in rolled products. Down-gauging, in other words reducing the thickness, of strip, sheet and foil has already led to considerable material savings in the past. It has led to today's beverage cans being 40 per cent slimmer than their predecessors were in 1980. Aluminium foil can be manufactured extremely thinly today: 0.006 mm, which is thinner than a human hair. The same volume of aluminium packaging can thus be transported using less fuel than previously. ■

Consumer behaviour influences consumption of resources

Life-cycle studies for foodstuffs show that if one considers the whole supply chain from the planting of the crops through to the consumption of the food product, only a small part of the energy required (often less than 10%) is attributable to packaging. Packaging thus protects far more resources than are required to produce it.

When discussing packaging one should not overlook the fact that packaging fulfils an essential function: protecting products against deterioration and ensuring that they reach the consumer in sound condition. This is the only way sustainable consumption is at all possible. If any of the items that the packaging is designed to protect cannot be used because the packaging has not fulfilled its intended function, it means automatically that all the resources that were consumed in their production and distribution have been wasted. Without packaging there would be considerably more waste.

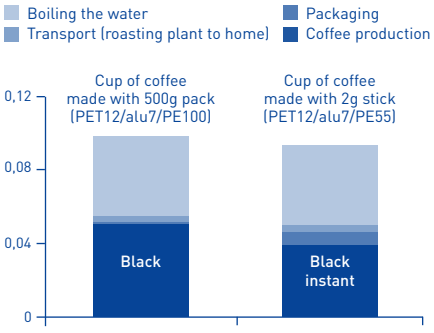
Aluminium packaging protects the contents and makes sustainable consumption possible.

Consumer behaviour often has a much stronger influence on the consumption of resources and other environmental parameters than the packaging itself. This can be the case, for example, when preparing a cup of coffee. When more water is boiled than is necessary, the excess amount can be of significantly greater relevance environmentally than the manufacture of a coffee stick pad. And the use of single single-portion packs can be more resource-conserving than large or family packs despite the higher fraction of packaging material if purchase of the latter is accompanied by deterioration of foodstuffs or disposal of unused products that have exceeded their use-by date.

In order to promote eco-friendly behaviour and a sustainable lifestyle, greater attention needs to drawn to the influence – which should not be underestimated – that individual consumer habits can have on the consumption of resources. ■

Coffee supply chain – CO_2 equivalents

kg CO_2eq per cup of coffee



Source: ESU Services

Use of dialogue to convey information

The aluminium industry makes a contribution to educating the public in many ways. For example, by means of the dialogue on the resource efficiency of aluminium products that GDA – Gesamtverband der Aluminiumindustrie is conducting jointly with the IG Metall (IGM) trade union and the Federal Environment Ministry (BMU) in the form of a social partnership. One aim of this dialogue is to promote the conscious handling of resources within companies and outside of them and to actively involve employees in the process: by using their experience and their expertise in day-to-day operations to take advantage of increased resource efficiency and to inform them of the potential for resource-efficient consumer behaviour in their private lives. ■

Poster series on the resource efficiency of aluminium.

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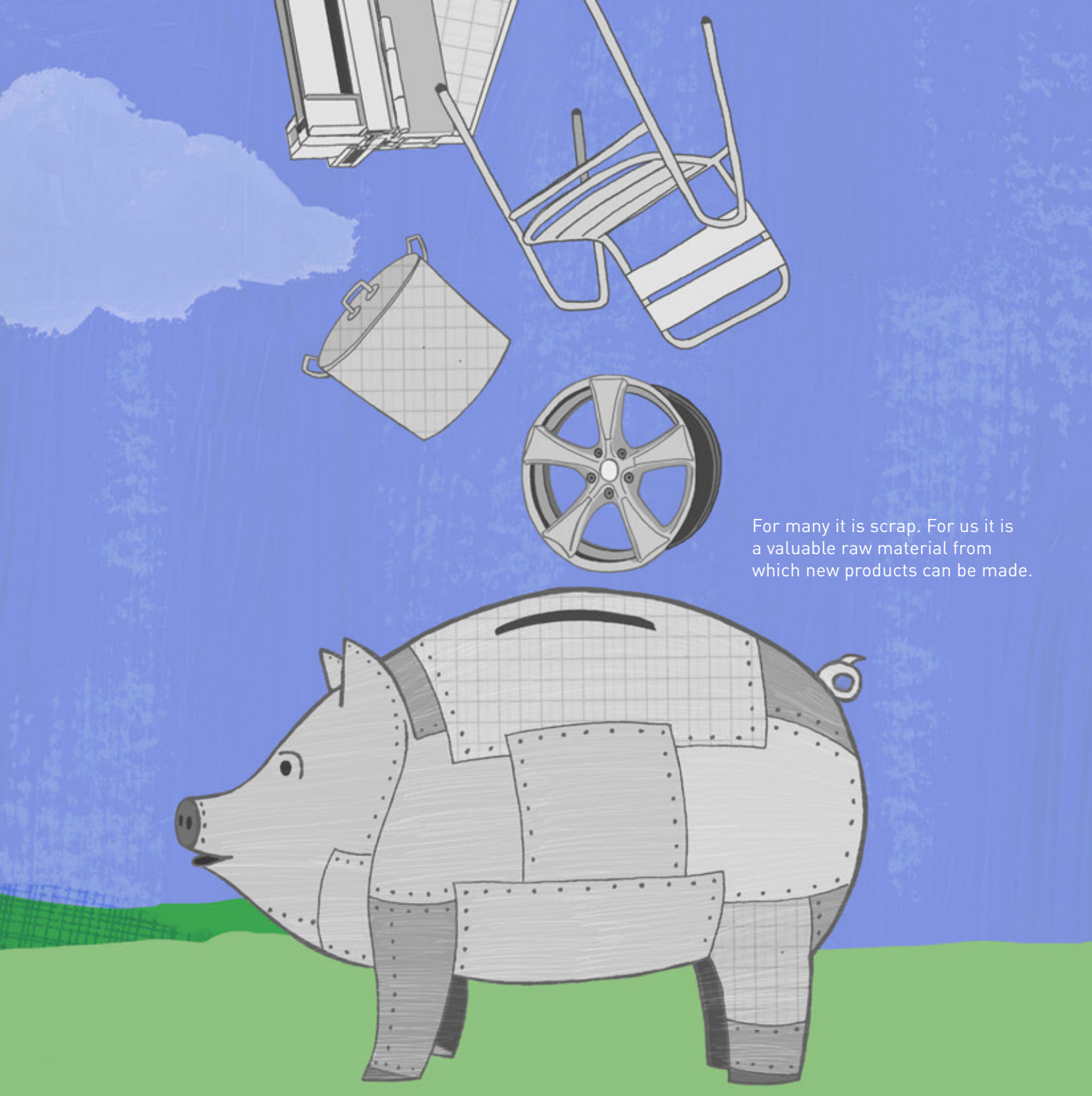
PEFC

Aluminium for Future Generations

1.500 | 01-2011

It is easy to see the benefits of using aluminium in carmaking: it saves energy, reduces emissions and has a high scrap value.


For many it is scrap. For us it is
a valuable raw material from
which new products can be made.

Invest in knowledge.
The aluminium industry is a sector with a future.


So light yet extremely efficient:
aluminium can be recycled
time and again.
Good when full, good when empty:
aluminium packaging offers reliable
protection, is light and easy to transport,
and can be recycled time and time again.