Aluminium for Future Generations
ALUMINIUM FOR FUTURE GENERATIONS

The Aluminium for Future Generations initiative is a programme of continuous improvement on the part of the global aluminium industry, overseen by the International Aluminium Institute (IAI). It comprises voluntary objectives, currently thirteen in number but increasing year by year, related to all key phases of aluminium’s life cycle. The industry’s performance towards meeting these objectives is measured annually against twenty-two performance indicators. This update reports on year 2005 performance recorded in the annual survey of sustainability data collected from IAI member companies, collectively responsible for over 70% of global primary aluminium production and around 20% of recycled metal production. For further information on IAI members, please visit the World Aluminium website.

This year survey data was collected from:
- 75 smelters representing almost 18 million tonnes of primary aluminium production, a 21% increase on 2004 coverage and equivalent to 55% of total global aluminium production;
- 24 refineries representing over 36 million tonnes of smelter grade alumina, a 41% increase on 2004 coverage and equivalent to around 60% of total global alumina production;
- 11 mines representing over 81 million tonnes of bauxite, a 13% increase on 2004 coverage and equivalent to around 50% of total global bauxite production.

2005 Sustainability Performance

Voluntary Objective 1
An 80% reduction in Perfluorocarbon (PFC) greenhouse gas emissions per tonne of aluminium produced for the industry as a whole by 2010 versus 1990 levels.

PFC emissions from the global aluminium industry have been reduced by 76% per tonne of aluminium produced between 1990 and 2005. Total PFC emissions have been reduced by over 60% between 1990 and 2005, even though total primary production has increased from 20 to over 30 million tonnes per annum in the same period.

PFCs are potent greenhouse gases with long atmospheric lifetimes, formed in the aluminium smelting process during brief upset conditions known as ‘anode effects’. The improvement in PFC emissions performance over the last fifteen years is in part due to a heightened awareness at all levels within companies and the availability of facility benchmarking data and sharing of best practices to reduce the frequency of anode effects.

Current global PFC emissions performance is equivalent to a reduction of over 3 tonnes of CO₂ per tonne of aluminium produced since 1990.

Voluntary Objective 2
A minimum of a 33% reduction in fluoride emissions by IAI member companies per tonne of aluminium produced by 2010 versus 1990.

Data collected from facilities representing 83% of IAI member company production indicate a reduction in total fluoride emissions (gaseous and particulate) of over 50% per tonne of aluminium produced between 1990 and 2005.

Voluntary Objective 3
A 10% reduction in average smelting energy usage by IAI member companies per tonne of aluminium produced by 2010 versus 1990.

The average electrical energy required to smelt one tonne of aluminium from alumina has been cut by 5% between 1990 and 2005, mainly through investment in modern, more efficient technologies. New smelters generally utilise best available technologies, no matter where in the world they are located and the IAI is helping producers to share knowledge and best practice to improve energy efficiency.
Voluntary Objective 4  
A 50% reduction in the lost time accident rate and recordable accident rate by 2010 versus 2000 by IAI member companies, with a review in 2006.

Safety performance data is collected in a separate survey which has a wider reporting base than the IAI membership. The survey was initiated in 1997, with a coverage of 107 million working hours. By 2002 the number of working hours surveyed had risen to 315 million and by 2005 to 411 million. The survey now covers 98 aluminium smelters, 34 alumina refineries and 15 bauxite mines.

The recordable accident rate at reporting plants has been cut by 75% over the period 2000-2005. The lost time accident rate has been reduced by 64% over the same period. A focus on improving accident rates has also seen the number of days lost per accident (the severity rate) decrease by 60% from 1997 to 2005.

The improvement in the industry’s accident rates is being driven by factors including increased top management attention and commitment on safety, more systematic accident follow up and increased involvement of the workforce, as well as mechanization and automation as a means to improving technical conditions.

While continuing to improve on these rates, the industry is now focusing on reducing the severity of accidents and on preventing fatalities by compiling guidelines based on best practice from the worldwide industry. Most serious accidents involve mobile equipment and cranes and other lifting devices. In 2004, 35% of all fatal accidents were traffic-related while in 2005 this figure was 25%.

The IAI has developed a set of safety guidelines for mobile equipment based on the shared procedures and experiences of a number of aluminium companies in managing the risks involved in mobile equipment and pedestrian segregation. These guidelines have been made available to the aluminium industry (member and non-member companies) and other industries. Further guidelines on cranes and lifting devices are also being developed.

Future Priority areas include:
- The concentration of management actions on the operation of mobile equipment, cranes and lifting devices;
- Improving rules, procedures and work standards;
- Improving equipment design and engineering;
- Improving training in the use of equipment;
- Addressing behaviour based safety.
- Drafting an IAI Safety Audit Protocol to be used in connection with a generic occupational health and safety audit of member companies.

Voluntary Objective 5  
Implementation of Management Systems for Environment (including ISO 14000 or equivalent certification) and for Health and Safety in 95% of IAI member companies’ plants by 2010.

92% of plants surveyed have such management systems in place, with 82% having ISO 14000, compared to around 60% in 2004, and 20% having OHSAS 18000, compared to around 10% in 2004.

Voluntary Objective 6  
Implementation of an Employee Exposure Assessment and Medical Surveillance Programme in 95% of IAI member companies’ plants by 2010.

Employee exposure assessment and medical surveillance programmes are in place at 89% of IAI member company plants. A detailed industry-wide definition of criteria required to meet this objective was included with the survey questionnaire this year and so the data from 2005 can be considered more robust than those from 2004, which gave a figure of 92%.
Aluminium shipments to the automotive and light truck industries increased by over 20% in the last five years. Global greenhouse gas savings from the use of aluminium for lightweighting vehicles have the potential to double between 2005 and 2020 to 500 million tonnes of CO₂ per year.

Aluminium is a metal that can be recycled and re-used almost endlessly. Further, the recycling of the metal uses as little as 5% of the energy that would be required to produce it from raw materials. This property of recyclability means that the world’s increasing stock of aluminium acts like an “energy resource bank”, over time delivering more and more practical use and value from the energy embodied in the metal at the time of its production. Of an estimated total of over 700 million tonnes of aluminium produced in the world since commercial manufacture began, about three quarters is still in productive use.

The contribution of scrap metal “resource” to the global output of aluminium metal has increased from 17% in 1960 to 33% today and is projected to rise to almost 40% by 2020.

Recycling of post-consumer aluminium now saves an estimated 84 million tonnes of greenhouse gas emissions per year, equivalent to the annual emissions from 15 million cars. Since its inception, the recycling of post-consumer aluminium scrap has already avoided over one billion metric tonnes of CO₂ emissions.

Aluminium recycling benefits present and future generations by conserving energy and other natural resources. The recycling of aluminium requires up to 95% less energy than that required for primary aluminium production, thereby avoiding corresponding emissions, including greenhouse gases. The production of aluminium from scrap also reduces the amount of waste from used products, conserving landfill space. At the end of their useful life, products made from aluminium can be infinitely recycled without any loss of quality to produce new products. That means aluminium can be recycled for use in almost all aluminium applications since its atomic structure is not altered during melting.

The aluminium recycling industry recycles all the aluminium scrap it can obtain from end-of-life products and aluminium by-products. The recycling rate at which end-of-life aluminium is recycled varies depending on the product sector, the lifetime of each product and on society’s commitment to collect aluminium. Each application requires its own recycling solutions. Just over 15 million tonnes of recycled aluminium were produced in 2004 worldwide, which met 33% of the global demand for aluminium. Of the almost 7 million tonnes of aluminium recycled from end-of-life products 28% came from packaging, 44% from transport, 7% from building and 21% from other products. Global aluminium recycling rates are high, approximately 90% for transport and around 60% for beverage cans. Aluminium enjoys a high recycling rate of 85% in the building industry. The global industry is keen to increase collection rates and is working with producers of building applications to enable even more efficient collection of scrap from demolished buildings. In 2004 Delft University of Technology conducted a study into the aluminium content of, and collection rates from, demolished buildings in six European countries, which found that the average collection rate for aluminium was close to 96%.

In 2004, approximately 30% of wrought and casting alloys put on the market were used in cars, commercial vehicles, aeroplanes, trains, ships, etc. Increasingly, aluminium products are being employed to reduce vehicle weights, without loss of performance, improving safety and potentially reducing greenhouse gas emissions from vehicles’ use-phase. Consequently, the transport sector is also a major source of aluminium at the end of vehicle lifetimes. The transport sector has high rates of recycling, currently about 90% globally because dismantlers and recyclers recognise the high intrinsic value of end-of-life aluminium
products. The aluminium industry is working with manufacturers to enable easier dismantling of aluminium automotive components to improve the sorting and recovery of scrap aluminium. The Japanese Aluminium Association, for example, is currently undertaking a study of advanced separation techniques to identify ways in which aluminium components from Shinkansen ‘Bullet Train’ carriages can be efficiently separated from other materials, thus increasing the recycling rate and the quality of scrap collected. Electromagnetic sorting is a powerful tool, currently used in many regions of the world, which separates even the smallest aluminium shards from waste material. Applying heat to end of life vehicle parts to separate the lacquer from the aluminium also facilitates recycling.

Used beverage cans are normally back on sale as new beverage cans or other aluminium products in five to eight weeks in those countries which have dedicated can collecting and recycling schemes. Can collection is around 60% globally and in some countries the collection rate is already above 80%. Sweden and Switzerland collect 86% and 88% of their aluminium beverage cans, respectively. Sweden’s success lies in a deposit/refund system whereas in Switzerland a voluntary prepaid recycling charge covers the costs of collection. In Japan a collection rate for used beverage cans of 92% is achieved with a voluntary system.

Used aluminium cans are worth six to twenty times more than any other used packaging material. Recycling is not mandatory in Brazil, but every region in Brazil has a recycling market which facilitates the collection and transportation of end-of-life products. This has encouraged communities, supermarkets, condominiums, shopping centres and clubs to collect. As a result in 2005, 96% of cans were recycled in Brazil and this is being considered the world’s highest recycling rate for used beverage cans.

To gain additional knowledge about the recycling rates of aluminium contained in consumer durables (e.g., cooking utensils, consumer electronics) and machinery further investigations are under way. The principal limiting factor on increasing the recycling rate is not aluminium itself but the collection of end-of-life product material. Societies, governments and communities need to work alongside the industry to create effective recycling systems to ensure the constant improvement of recycling rates in all applications sectors.

The IAI has designed a mass flow model (critically reviewed by Yale and Delft Technical Universities) to track aluminium throughout its lifecycle from mining to product use to recycling. The main objective for creating the model is to identify present and future recycling flows and the scope for further recycling. The model traces the flow of aluminium from 1888 to the present along the complete value chain. Eight major processes are investigated: bauxite mining, alumina refining, aluminium and aluminium ingot production, fabrication (rolling, extrusion and casting), manufacturing (production and assembly of finished products), use and recycling. New scrap is generated immediately during the production and processing stages, not having yet reached the use phase. Old scrap is generated when an aluminium containing product reaches its end-of-life and is collected for recycling. To calculate the amount of aluminium still in productive use and leaving the use stage a product residence time model is applied. Here the average lifetime of each of the main products in which aluminium is used, and the historical tonnage of aluminium in those products is considered. The results for 2004 are shown in mass flow diagram below.

---

**VALUES IN MILLIONS OF METRIC TONNES**

1. Aluminium in skimmings; 2. Scrap generated by foundries, rolling mills and extruders. Most is internal scrap and not taken into account in statistics; 3. Such as powder, paste and deformation aluminium (metal property is lost); 4. Area of current research to identify final aluminium destination (reuse, recycling or landfilling); 5. Calculated: Includes, depending on the one, between 30% and 50% alumina; 6. Calculated: Includes on a global average 12% aluminium; 7. Scrap generated during the production of finished products from semis; 8. Landfilled, dissipated into other recycling streams, incinerated, incinerated with energy recovery.
The energy needed for primary aluminium production is stored, to a large extent, in the metal itself. The aluminium metal serves an energy bank. The metal, whether primary or recycled, stores the same amount of energy per tonne. Today, the “energy bank” in use accounts for almost 50,000 petajoules. This is higher than the current combined annual energy demand of Africa and Latin America and is equivalent to the annual total electrical energy generated globally from coal. If this metal is recycled, the banked energy and metal resources can be made available, reducing the energy needed for production by approximately 95%, not just once but repeatedly and benefit future generations. If landfilled, the energy stored is consequently landfilled too and potentially lost forever.

Voluntary Objective 9 & 10
The IAI member companies will seek to reduce their fresh water consumption per tonne of (9) aluminium and (10) alumina produced.
IAI member companies will concentrate efforts to minimise fresh water consumption where there are limited available fresh water resources.

IAI continues to collect data on fresh water consumption. Due to differences between regions and facilities in the definitions of fresh water consumption and in the level of fresh water stress, further analysis and development of indicators is required.

Voluntary Objective 11
The IAI member companies will seek to reduce GHG emissions from the production of alumina per tonne of alumina produced.

The three main sources of GHG emissions from alumina refining processes are fuel combustion, electricity production and energy use in lime production. These three sources are monitored together as the total energy used in alumina production. The average energy used to produce one tonne of metallurgical alumina has decreased by 5% between 1990 and 2004. The IAI is developing a quantitative voluntary objective for alumina refining energy efficiency.

Voluntary Objective 12
The IAI member companies will seek to continue to increase the proportion of bauxite mining land rehabilitated annually.

The area of land rehabilitated as a percentage of land mined since operations began, in currently operating mines, is 70%. Globally, bauxite mining disturbs only 25 km² a year, an area equivalent in size to only one third of Manhattan Island, NY. Every year around 20 km² is rehabilitated.

Voluntary Objective 13 New
The Aluminium industry recognizes that spent pot lining has properties that makes it a valuable material for use in other processes and will therefore strive either to convert all spent pot lining into feedstock’s for other industries, which include cement, steel, mineral wool and construction aggregate companies or to re-use and or process all SPL in its own facilities.
Pending final deposition, the industry will endeavour to store all spent pot lining in secure, waterproof, ventilated buildings/containers that will maintain the spent pot lining in a dry state with no potential for the build up of noxious gases.

Spent pot lining (SPL) is an unavoidable by-product of the aluminium smelting process, being the material that lines the electrolytic cells known as pots. After time, usually 5-7 years, the carbon and refractory pot lining reaches the end of its useful life and the pots are then taken out of service and relined. On average, 25-35 kg of SPL is produced per tonne of aluminium. In 2005, 38% of SPL output was recycled externally out of a total reported output of 331 thousand tonnes of SPL.

The industry has systematically worked to minimize the amount of SPL produced by extending the lifetime of the lining in the smelter pots. Since the 1970s, SPL has been recognised as a valuable resource for other industries, including as a feedstock in the cement, mineral wool and steel production processes. However, the main barrier to supply of SPL as a feedstock has been economics. Individual smelters do not produce enough SPL to provide a continuous supply of feedstock for a cement plant to justify their conversion to receiving this material. Through collaboration with potential customers, and between companies to increase regional supply, the recycling of this material has become more viable and widespread.

International Aluminium Institute
New Zealand House, Haymarket, London, SW1Y 4TE
Tel: +44 (0) 20 7930 0528
Fax: +44 (0) 20 7321 0183
Email: iai@world-aluminium.org
Website: www.world-aluminium.org