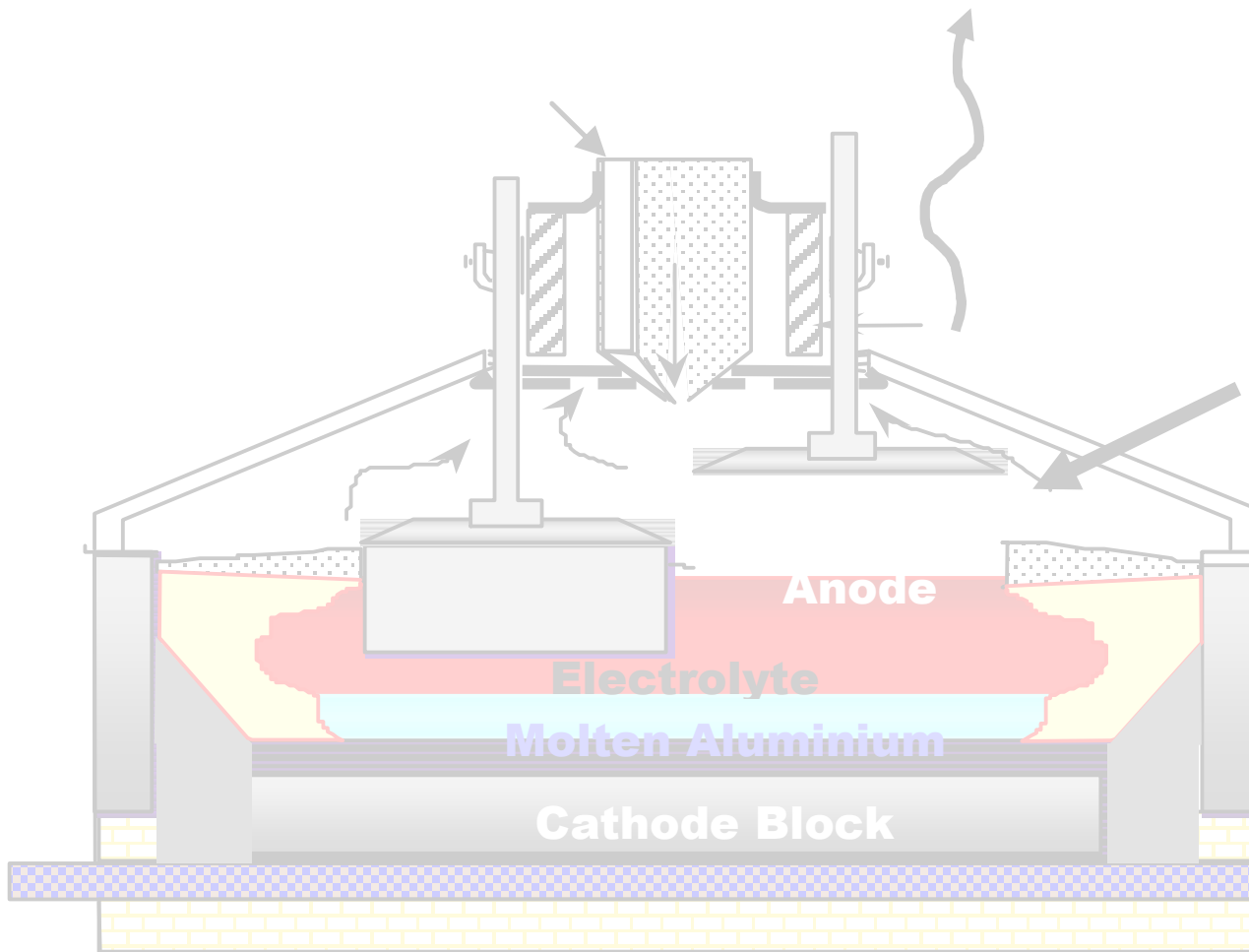




# Aluminium



## Pioneering a Voluntary Global Industry Sectoral Approach

**Version 3  
September 2008**



## ***The Elements of a Global Sectoral Approach to Climate Change***

The International Aluminium Institute (IAI), the global forum for the leaders of the aluminium industry, seeks to encourage the global industry to adopt a path of continuous improvement in its environmental, social and economic performance. The aluminium industry has ten years' experience in the development and implementation of a successful global sectoral approach. The key elements of this approach are as follows:

- IAI Membership of 25 company CEOs representing 80% of world primary aluminium production and a significant percentage of recycled metal production
- Common global voluntary objectives including
  - An 80% reduction in perfluorocarbons (PFCs) per tonne of production by 2010 as compared to 1990. PFCs are potent greenhouse gases, emitted during brief upset periods in the aluminium smelting process
  - A 10% reduction in smelting energy per tonne by 2010 compared to 1990
  - A 10% reduction in alumina refining energy per tonne by 2020
  - Promotion of recycling of used products
  - Promotion of aluminium applications such as for the lightweighting of vehicles.
- Common measurement and GHG emissions calculation methodologies for all primary aluminium production processes, standardised with IPCC national GHG inventory guidelines, ISO GHG management and lifecycle standards and WBCSD/WRI GHG protocol.
- Data collection from 115 smelting facilities out of world total of around 198, representing 64% of total global primary production and a similar percentage of alumina refineries and bauxite mines.
- Driving continuous improvement by benchmarking facility energy, emissions and safety performance
- Employment of a specialized climate change expert consultant to
  - spread best practice;
  - train employees and carry out emission measurements with IAI-sponsored equipment;
  - analyze GHG data and develop methodologies.

## ***Why Adopt a Global Sectoral Approach***

Given the sector's responsibility for 1% of global manmade greenhouse gas emissions, the IAI Board established a task force of member company CEOs, assisted by a panel of technical experts, to review and quantify the climate impacts of both the aluminium production process as well as aluminium applications in major markets such as transport and construction. This global initiative makes sense for what is a globalised industry with a globally traded and priced product. Since the 1990s there has been a dramatic expansion of aluminium production outside OECD countries. Well over half of all primary aluminium production capacity is now located in non OECD countries, which are also seeing most of the growth in new capacity. This global sectoral approach was and is facilitated by the fact that the primary aluminium industry is a relatively homogenous sector, with only two standard technologies and over 200 plants (mines, refineries and smelters) worldwide (of which over a third are in China).



## ***The Full Life Cycle Approach***

The Institute's global sustainability initiative involves looking at the full aluminium life cycle from bauxite mining through the refining of alumina, primary aluminium smelting, casting, the production of semi-fabricated and manufactured products into the product use phase and the recycling of products at the end of their useful life. This initiative has developed into the global *Aluminium for Future Generations* sustainability programme, which comprises some 12 voluntary objectives supported by twenty performance indicators. The voluntary objectives address the environmental, economic and social aspects of sustainability. Advisory committees, made up of experts from IAI member companies, develop these voluntary objectives for submission to the IAI Board of Directors. The Board ultimately decides on the selection of the voluntary objectives, on their supporting performance indicators and on the necessary data to be collected. For instance, the IAI's Greenhouse Gas Task Force developed a set of calculation methodologies for the 2006 IPCC Guidelines for National Greenhouse Gas Inventories ([www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm](http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm)), which improved the accuracy of results compared to the previous set of guidelines. In parallel with this process, the same group developed an update to the aluminium sector's Greenhouse Gas Protocol ([www.world-aluminium.org/cache/fl0000127.pdf](http://www.world-aluminium.org/cache/fl0000127.pdf)), reflecting changes to the WBCSD/WRI GHG Protocol ([www.ghgprotocol.org](http://www.ghgprotocol.org)), the IPCC Guidelines and ISO Standard 14064 (GHG Quantification & Reporting – [www.iso.org](http://www.iso.org)) into which the group also had an input. The Asia-Pacific Partnership on Clean Development & Climate's (APP – [www.asiapacificpartnership.org](http://www.asiapacificpartnership.org)) Aluminium Task Force has adopted the IAI indicators and data definitions for the reporting of sustainability metrics from the APP countries and has contracted the Institute to provide the statistical support to the task force.

## ***The Mechanics of Data Collection***

The effectiveness and credibility of the Sustainability Programme depends on the quality of the Institute's confidential statistical data collection system. The IAI's data collection system has as its cornerstone the confidentiality of company and plant data. The IAI's confidential statistical team de-identifies all data received from reporting companies prior to any analysis and all the information is then collated by region or as global metrics in order to disguise plant or company specific numbers. The data is collected by the Confidential Statistical Officer, whose procedures for handling the data have been developed based on the guidance of the IAI's Legal Counsel. All data undergoes a quality checking process by the statistical team at the point of reporting and is further checked at the point of collation and analysis. Global sustainability metrics are published regularly (mostly on an annual basis) on the IAI website ([www.world-aluminium.org](http://www.world-aluminium.org)) and in written reports.

## ***Using the Data***

The IAI employs its data in a number of different ways, for instance to drive improvements in performance, to meet the demands of stakeholders for current and accurate sustainability indicators and to develop models about the future of the industry and its potential impact on the societies, economies and environments in which it operates. The key tool by which the Institute promotes this among its members and non-members is benchmarking. For a number of key indicators – safety, energy use, greenhouse gas emissions – the performance of all reporting facilities is plotted against the performance of all the other (de-identified) facilities in the same class (e.g. process category, hours worked or technology type). In this way, facilities can see the current best level of performance, which they could achieve and are motivated to improve. Within these groupings, best practices are exchanged and poorer performers are given advice on how best to make progress towards benchmark performance. Thus the industry improves its collective performance through the



sharing of information among peers, while at the time maintaining the confidentiality of individual plant data.

## ***The Aluminium Industry's Climate Change Strategy***

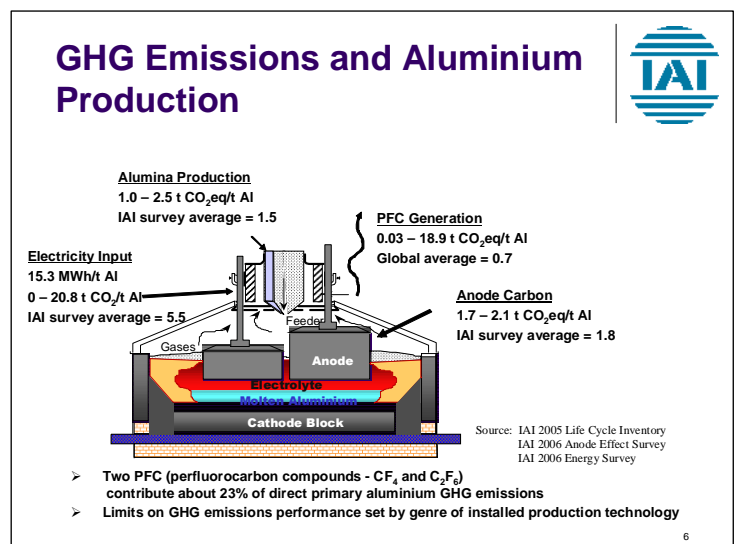
The IAI has adopted a four pronged strategy towards the mitigation of greenhouse gases:

1. Reduce perfluorocarbon (PFC) emissions per tonne of primary metal produced through:
  - investment in modern technology;
  - attention to good operating practices.
2. Improve energy efficiency performance throughout the production chain.
3. Maximize the potential for the recycling of used aluminium products.
4. Encourage aluminium's application in transport (a sector responsible for a third of GHG emissions globally) towards the reduction of vehicle weights and GHG emissions from fuel consumption.

## ***Global PFC Emissions Reduction Programme***

The programme to reduce significantly PFC emissions from the industry's smelting operations involves the elimination of "anode effects" – brief moments of increased cell voltage in the electrolytic process – during normal operating conditions through:

1. Identification and sharing of best practice;
2. Benchmarking of industry performance in accordance with key performance criteria by technology type;
3. Investment by Member Companies in cell control technologies;
4. Encouragement of greater accuracy in plant, national and global industry GHG inventories through standardised reporting methodologies;
5. Annual published progress report and the briefing of the IAI CEOs at the six monthly IAI Board meetings;
6. IAI consultant and equipment to carry out PFC measurements towards more accurate facility-specific Tier 3 greenhouse gas calculations and to provide in plant training.

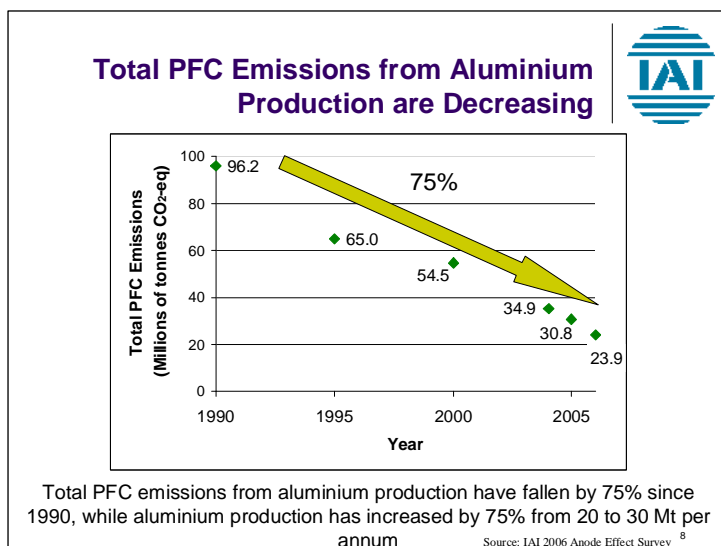
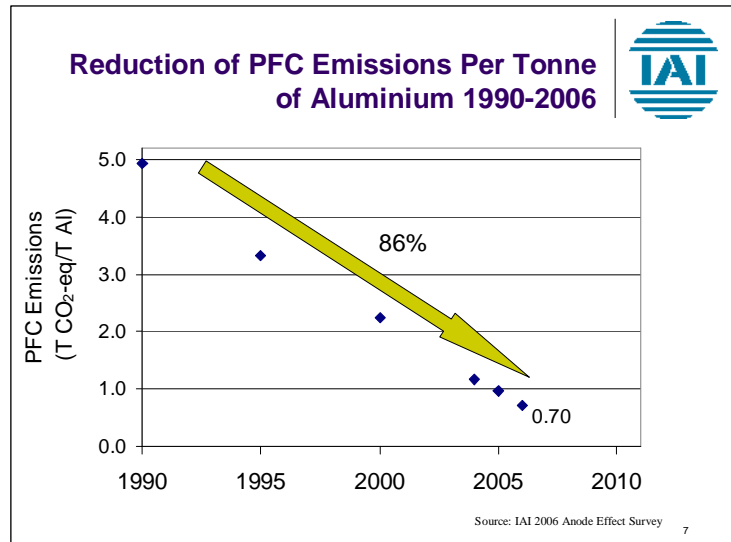


Annual surveys of anode effects covering over 60% of global production, are carried out in accordance with standardised greenhouse gas measurement and calculation methodologies. The surveys request participants to report primary production, average anode effect frequency duration as well as over voltage data (if applicable). These anode effect performance data allow for the calculation, by the Intergovernmental Panel on Climate Change (IPCC) Tier 2 method, of tetrafluoromethane (CF<sub>4</sub>) and hexafluoroethane



(C<sub>2</sub>F<sub>6</sub>) emission rates per tonne of aluminium produced. Total PFC emissions are then calculated for each participating facility by multiplying emissions per tonne of primary aluminium by the production level in tonnes. In order to improve the accuracy of the survey results, participants are also asked to report if a facility-specific direct measurement of PFC emissions had been made and if an IPCC Tier 3 coefficient is available for calculating PFC emissions from the facility. Of the one hundred and nine reporting facilities, twenty six respondents reported facility-specific Tier 3 coefficients for the 2007 survey and these data were used in calculating PFC emissions per tonne of aluminium produced for those facilities.

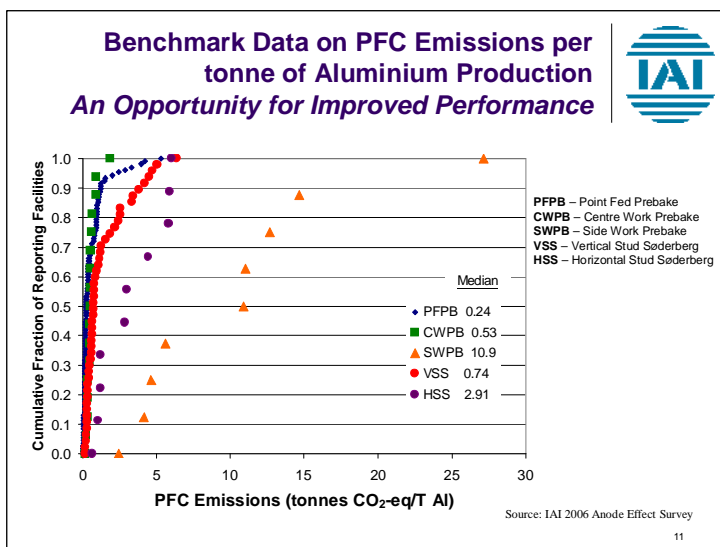
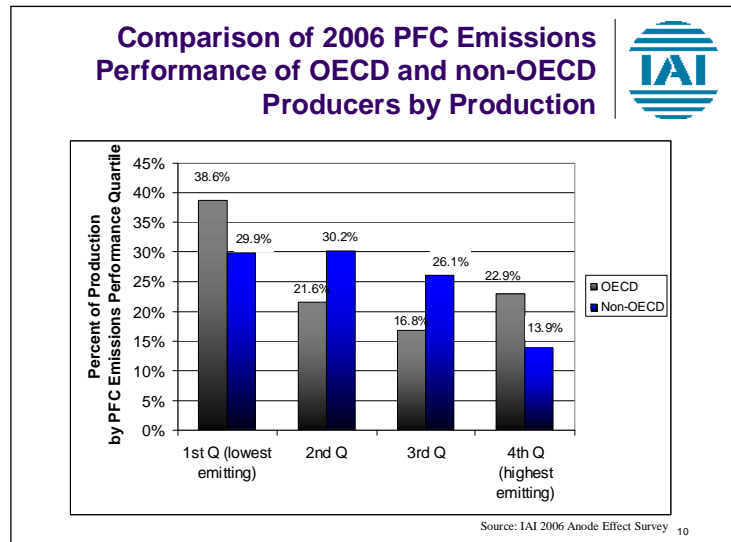
The IAI voluntary objective of an 80% reduction in PFC emissions per tonne of aluminium produced between 1990 and 2010 was formulated as a global goal, covering 100% of global aluminium production. The fact that only 64% of producers participate in the IAI Anode Effect Survey requires an estimate of emissions from survey non-participants. The data show that globally the goal has also been met and exceeded, with an eighty seven percent reduction, from 4.9 tonnes CO<sub>2</sub> equivalents per tonne of aluminium in 1990 to 0.6 tonnes in 2006. If results for survey participants only are considered, the IAI reduction goal was met in 2006, with an 84% result. The small difference in PFC emissions for 2006 survey participants from the global average PFC arises from the convention of using the survey participants' median performance level to estimate emissions from survey non participants.



It is notable that total emissions have been reduced from ninety eight million tonnes CO<sub>2</sub> equivalents in 1990 to twenty nine million tonnes CO<sub>2</sub> equivalents in 2006, a reduction of over seventy percent, while total primary production has increased over that same period from twenty to thirty four million tonnes, an increase of almost seventy five percent.



The effectiveness of this voluntary programme can be seen from the fact that the performance of non OECD located plant, most of which are locally owned, compares very favourably with the performance of plants in OECD countries. The non OECD plants are well run and often employ the most modern technology. This progress has been much helped by the careful briefing of the CEOs, who personally receive benchmarking graphs showing their plants' energy and emissions performance as compared to plants of a similar technology type.



However there are still a number of plants which are underperforming: facilities representing 20% of global aluminium production are responsible for over 50% of the PFC emissions. There is still a considerable margin for improvement utilising improved working practices and process control algorithms that act to prevent anode effects or to react quickly to "kill" anode effects once initiated. There are great differences between the best performers and the worst performers in each of the technological groups. Comparing the performance of the tenth percentile of reporting plants with

the ninetieth percentile the difference between the two is a factor of 3 to 5. The exception is the point fed prebake (PFPB) technology group, where there is a factor of eleven times better performance between the tenth and ninetieth percentiles.

If all plants were to achieve the benchmark best in their category another 14 million tonnes of CO<sub>2</sub> equivalents could be saved as compared to the 2006 which would reduce the 0.7 of CO<sub>2</sub> equivalent emissions per tonne of aluminium down to 0.2. If the performance of the underperformers could be significantly improved, we would see a continuing decline in emissions despite an annual 3 to 4% growth in production. However current technology is still dependant on carbon anodes, so as aluminium production increases so do the CO<sub>2</sub> emissions. Therefore, while PFC emissions have been reduced by 70% since 1990, CO<sub>2</sub> emissions have increased by 62%. Nevertheless overall there has been a 30% reduction in total direct greenhouse gas emissions thanks to the remarkable progress in reducing PFCs.

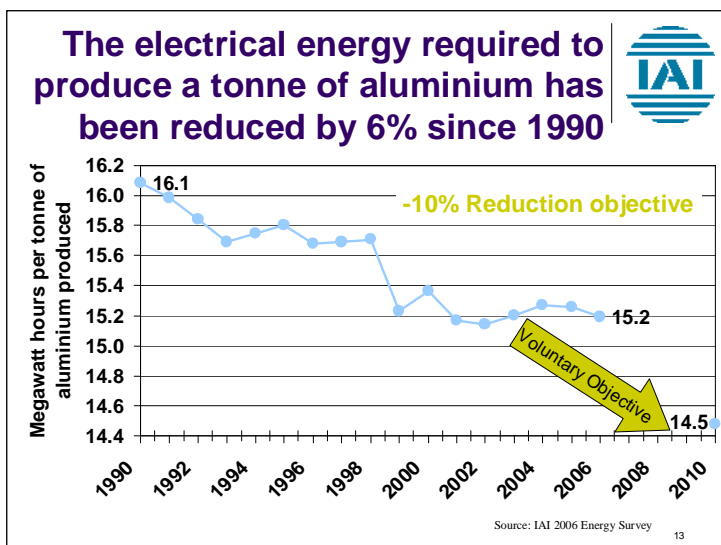
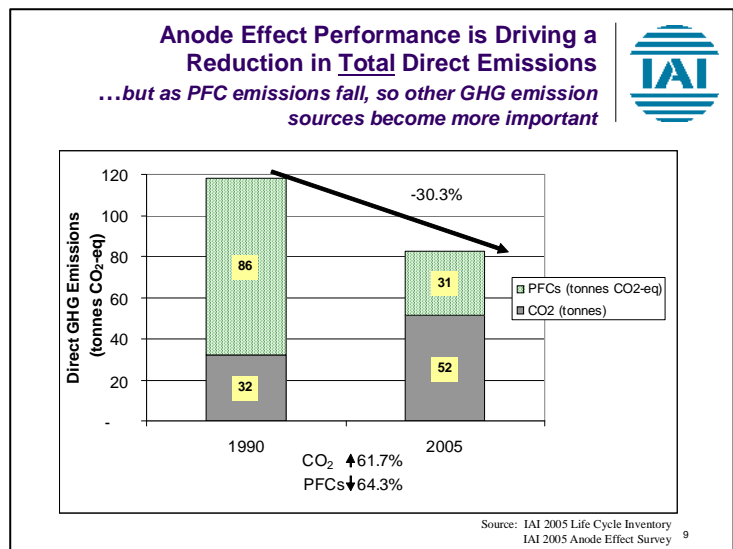
### Next Steps

The industry is looking at every stage of the production process to reduce greenhouse emissions and improve energy efficiency. Smelting accounts for 66% of greenhouse gases from primary aluminium production in direct emissions and 80% when indirect greenhouse



gas emissions from electrical power generation are included. Alumina refining is the next biggest contributor at 31% of total greenhouse gas emissions. The IAI Climate Change Task Group is currently considering proposing to the IAI Board a new voluntary objective involving a further reduction in PFC emissions per tonne of aluminium produced. In order to address the problem of poor performers, all annual survey participants will be expected to operate with PFC specific emissions no higher than the 2005 median level for their technology by 2020. In order to improve the statistical coverage all the Member companies' plants will be expected to report annually on their PFC emissions. In particular this involves expanding the data collection from China, which currently includes only 4 plant out of a total of more than 60. A number of companies conduct verification of their corporate sustainability data and the IAI sees third party assurance of collated industry data as a further step towards the credibility and accuracy of its statistical systems and performance objectives.

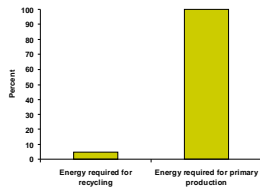
While the industry is being successful in reducing direct emissions from its facilities, there still a challenge of reducing indirect emissions from electrical power generation. Average indirect emissions from electricity generation amount to around 5 tonnes, whilst the average direct emissions from the smelting process amount to just under 3 tonnes. The aluminium industry is therefore looking to reduce its electrical power and fuel consumption through voluntary energy efficiency objectives. The IAI has a voluntary objective of a 10% reduction in energy use per tonne of production for the smelting process over the period 1990 to 2010 and survey results for 2007 show that the industry has achieved around a 6% reduction. The Climate Change Task Group is also considering a new voluntary objective for a 10% reduction in energy consumption per tonne of alumina produced by refineries by 2020 and also an objective to improve anode consumption and ingot casting efficiencies.



Overall, reductions of direct and indirect greenhouse gas emission have resulted in a decrease of 2 tonnes of CO<sub>2</sub> equivalents for every tonne of aluminium produced since 2000.



## Recycling Aluminium Conserves Energy



- The recycling of aluminium requires up to 95% less energy than that required for primary aluminium production.
- Recycling aluminium from used products saves close to 80 million tonnes of greenhouse gas emissions per year.

**Beverage cans – 63%**

**Building – up to 98%**

**Automotive – up to 95%**

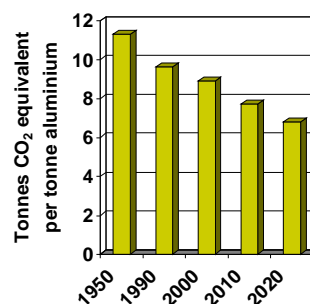
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## Recycling

A key element of the IAI sectoral approach is the promotion of recycling. Aluminium recycling benefits present and future generations by conserving energy and other natural resources. It saves up to 95% of the energy required for primary aluminium production, thereby avoiding the corresponding emissions, including greenhouse gases. The growing markets for aluminium are being sourced by both primary and recycled metal.

Aluminium can be recycled over and over again without the loss of its properties. The recycling of aluminium from used products saves an estimated 84 million tonnes of greenhouse gas emissions per year. Since the 1880s over 700 million tonnes of aluminium have been produced of which about three quarters of this metal is still in productive use. Recycling the metal currently stored in use would equal 15 years primary aluminium output. There are some important regions where no recycling data has been collected and where little data is available on the amount of metal being lost annually to landfill. Because of this gap, actual data collection has been complemented by the development of a software based material resource mass

## Worldwide, aluminium products are becoming less GHG intense on a per tonne shipped basis



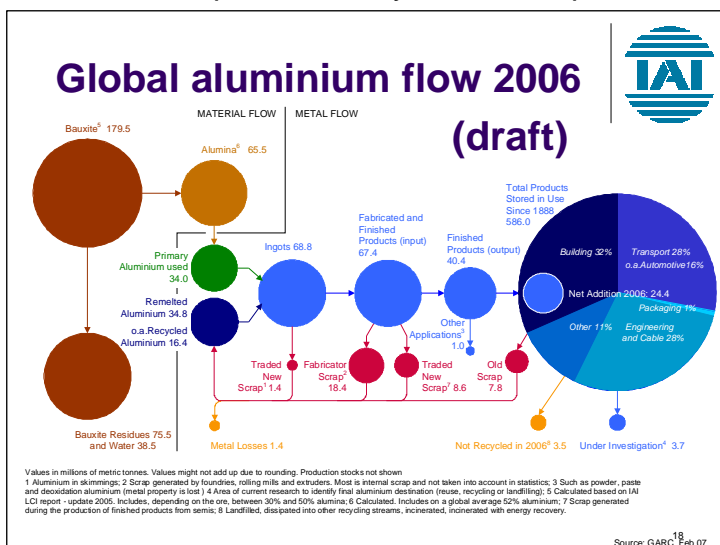
This is due to:

- Lower emissions from primary aluminium facilities
- Improvements in energy efficiency

AND

- Increases in the percentage of recycled metal relative to primary metal

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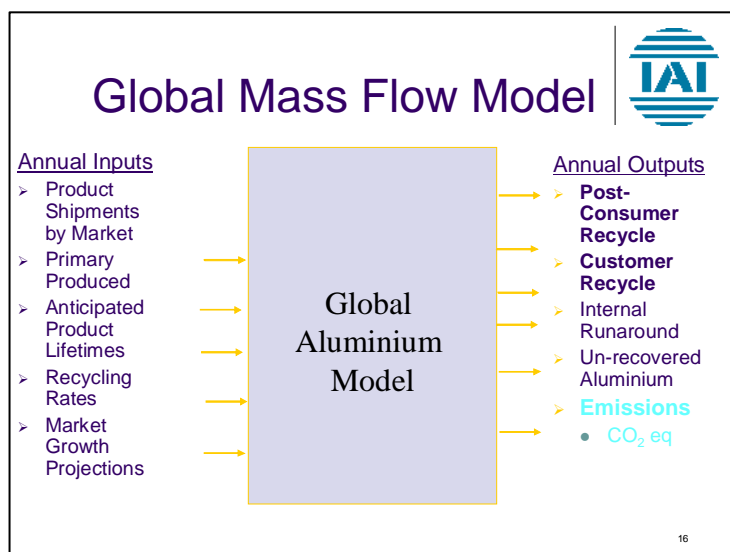
flow model. The Model helps identify applications through its global mass flow charts where aluminium is not yet being recycled to its full potential. The IAI's Global Aluminium Recycling Committee is investigating possible ways to promote the better recovery of these products in order to maximise aluminium's recycling potential and thus minimise energy use and greenhouse gas emissions.



## Modelling the future

The aluminium industry may be the only industry that currently tracks its material through the full life cycle from mining to use and recycling. The IAI's Global Mass Flow Model employs current and historic production, market supply, emissions and recycling data along with predictions of market growth to develop scenarios of the potential environmental implications of the worldwide aluminium industry out to 2030. For instance, forecasts for the recovery of scrap from used products, based on average product life, are being utilized to estimate the greenhouse gas emission intensity of the industry's facilities and of the impact of recycling on lowering the overall carbon footprint of aluminium products. These scenarios are also being shared with the International Energy Agency (IEA) as it develops future energy and climate change scenarios as part of the IEA's advisory role to the G8 Gleneagles Dialogue.

The modelling indicates that the industry's average recycle metal supply from outside the Industry (i.e. post consumer and customer recycled metal) has increased as a proportion of the total global supply from 17% in 1960 to over 32% today. It is also predicted to increase to 37% by 2020. Reduced greenhouse gas emissions from aluminium smelters, combined with an ever greater percentage of recycled metal relative to the total metal produced from bauxite, means that aluminium is becoming less greenhouse gas intensive on a per tonne shipped basis.



## Vehicle Lightweighting

Serving our customers in a carbon-constrained world

1 Tonne of aluminium

20 Tonnes of CO<sub>2</sub>e Emissions

Cars for today and tomorrow

1 Tonne of aluminium

48-80 Tonnes of CO<sub>2</sub>e Emissions

Sustainable Trains

15 tonne reduction in weight due to new aluminum alloys & techniques

300,000 tonnes less CO<sub>2</sub>e emissions

Cooperation with customers in aerospace

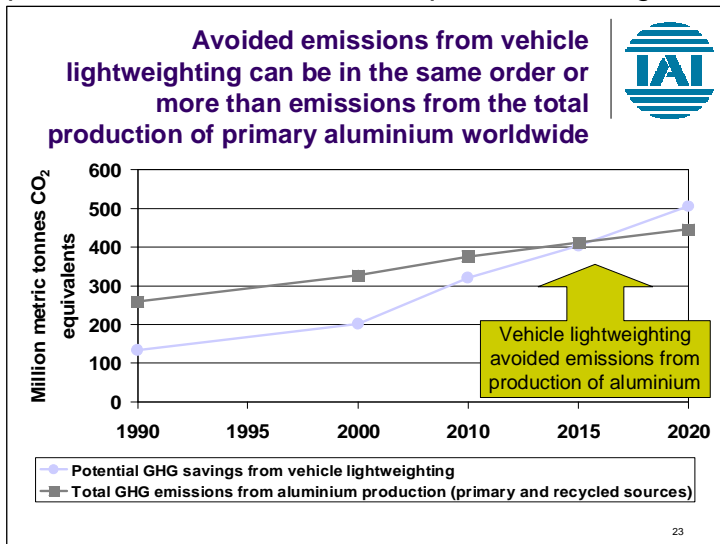
The application of aluminium for light weighting in transport provides an interesting example of product use to reduce emissions. The average aluminium content of cars has nearly tripled over the past 30 years. Transport is now responsible for 19% of global manmade emissions. The annual sale of cars and light vehicles are according to the IEA expected to rise from around 60 million in 2008 to 140 million by 2050. The results of a study by the respected Institute for Energy and Environmental Research (IFEU) in Heidelberg, concluded that

the lightweighting of passenger cars, trucks, rail vehicles, aircraft and ships would have a significant impact on global transport related greenhouse gas emissions. The IAI's life cycle study results show that in automotive applications each kilogram of aluminium replacing



heavier cast iron or mild steel saves depending on the case (bumper and motor block of a compact car, front hood of a large family car, body-in white of a luxury car) between 15 and 20 kg of greenhouse gas emissions. The study for the metro/subway carriage has shown savings of approximately 26 (operating in Europe) and 51 (operating in the USA) kg of greenhouse gas emissions per kilogram of aluminium.

The IAI has also developed a life cycle model that can be used for evaluating specific components for all forms of transport. Aluminium substitution in cars and light trucks produced in 2006 will lead to potential savings over life cycle of about 140 million tonnes of CO<sub>2</sub>-equivalent and of primary energy equivalent to about 55 billion litres of crude oil. Current forecasts show a strong growth in the use of aluminium for vehicle lightweighting, which could result in potential greenhouse gas savings of 500 million tonnes by 2020.



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According to the IAI Mass Flow Model, on present progress the greenhouse gas savings from PFC reduction, increased recycling and expanded shipments of aluminium to the transport sector could offset all the direct and indirect greenhouse gas

emissions from the production of primary aluminium by 2020. The intention is to apply the same analytic approach to other key applications such as construction and packaging.

### ***A Summary of the Benefits of the Sectoral Global Approach to Industry and the Global Community***

- Clear criteria for both industry and outside stakeholders to evaluate performance e.g. governments, CDM and JI.
- Transparent performance indicators, objectives and reporting on performance annually
- Programme is global and applies to developed, emerging economies and developing countries alike
- CEO Peer Group pressure and benchmarking stimulate improved performance
- Encourages spread of good practice as well as awareness of possible technological and operational improvement
- Seeks cooperation with the national authorities to improve scrap collection and recycling in order to conserve energy and resources.
- Helps to promote more efficient use of energy and raw materials
- Data enables IAI model to make forecasts out to 2030 on future aluminium production GHG emissions levels
- **Demonstrable results as shown by a 14% reduction in total direct GHG emissions between 2000 and 2005 despite a 20% growth in aluminium production.**



## ANNEX 1 – IAI Data Collection and Reporting

Data form/ Survey name	Data type	Collection frequency	Output
Form 100	Primary aluminium production	Monthly	<ul style="list-style-type: none"> <li>Form 150 - monthly and annual stats published on website</li> </ul>
Form 200	Primary aluminium capacity	Semestral	<ul style="list-style-type: none"> <li>Form 250 - annual stats published twice per annum</li> </ul>
Form 301	Primary aluminium inventory	Monthly	<ul style="list-style-type: none"> <li>Form 351 - published monthly on website</li> </ul>
Form 500	Alumina capacity	Semestral	<ul style="list-style-type: none"> <li>Form 550 - annual stats published twice per annum</li> </ul>
Form 600	Alumina production	Quarterly	<ul style="list-style-type: none"> <li>Form 650 - quarterly &amp; annual stats published on website</li> </ul>
Form 750	Aluminium recovered from scrap	Annual	<ul style="list-style-type: none"> <li>Form 751 – stats published annually on website</li> </ul>
Form 1000A	Accidents and near misses	Quarterly	<ul style="list-style-type: none"> <li>"Safety Incidents Summary" published quarterly on INTERNAL Extranet</li> </ul>
Form 1001A	Safety benchmarking	Annual	<ul style="list-style-type: none"> <li>"Benchmarking Report" published annually on INTERNAL Extranet</li> <li>Annual sustainable development Key Performance Indicators</li> </ul>
Form ES001	Electrical energy use/ fuel mix in smelting	Annual	<ul style="list-style-type: none"> <li>Form ES002 - annual stats published annually on website</li> <li>Annual sustainable development Key Performance Indicators</li> <li>5 yearly Life Cycle Inventory (indirect GHG emissions)</li> </ul>
Form ES001A	Anode use	Annual	<ul style="list-style-type: none"> <li>5 yearly Life Cycle Inventory (direct GHG emissions)</li> </ul>
Form ES001B	Prebake anode production	Annual	<ul style="list-style-type: none"> <li>5 yearly Life Cycle Inventory (direct GHG emissions)</li> </ul>
Form ES001C	Søderberg anode paste production	Annual	<ul style="list-style-type: none"> <li>5 yearly Life Cycle Inventory (direct GHG emissions)</li> </ul>
Form ES001D	Energy used in casting	Annual	<ul style="list-style-type: none"> <li>5 yearly Life Cycle Inventory (indirect GHG emissions)</li> </ul>
Form ES011	Energy use/fuel mix in alumina production	Annual	<ul style="list-style-type: none"> <li>Form ES012 - stats published annually on website</li> <li>5 yearly Life Cycle Inventory (direct GHG emissions)</li> </ul>
Form PFC 001	Anode effect performance	Annual	<ul style="list-style-type: none"> <li>"Benchmarking Report" circulated to participating companies annually – INTERNAL</li> <li>"Anode Effect Survey Report" published annually on website</li> <li>Annual sustainable development Key Performance Indicators</li> </ul>
Sustainable Development	Fluorides emissions	Annual	<ul style="list-style-type: none"> <li>Annual sustainable development Key Performance Indicators</li> </ul>
	Health leading indicators	Annual	<ul style="list-style-type: none"> <li>Annual sustainable development Key Performance Indicators</li> </ul>
	Water consumption	Annual	<ul style="list-style-type: none"> <li>Annual sustainable development Key Performance Indicators</li> </ul>
	Spent Pot Lining management & reuse	Annual	<ul style="list-style-type: none"> <li>Annual sustainable development Key Performance Indicators</li> </ul>
	Mine rehabilitation rate	Annual	<ul style="list-style-type: none"> <li>Annual sustainable development Key Performance Indicators</li> </ul>
Life Cycle	Environmental indicators	5 yearly	<ul style="list-style-type: none"> <li>Life Cycle Inventory published every 5 years on IAI website</li> <li>Life Cycle Assessments for product applications as required</li> </ul>
Bauxite Mine Rehabilitation	Sustainability metrics	5 yearly	<ul style="list-style-type: none"> <li>"Bauxite Mine Rehabilitation Survey Report" published on website</li> </ul>
Bauxite Residue Management	Sustainability metrics	5 yearly	<ul style="list-style-type: none"> <li>UNDER DEVELOPMENT</li> </ul>