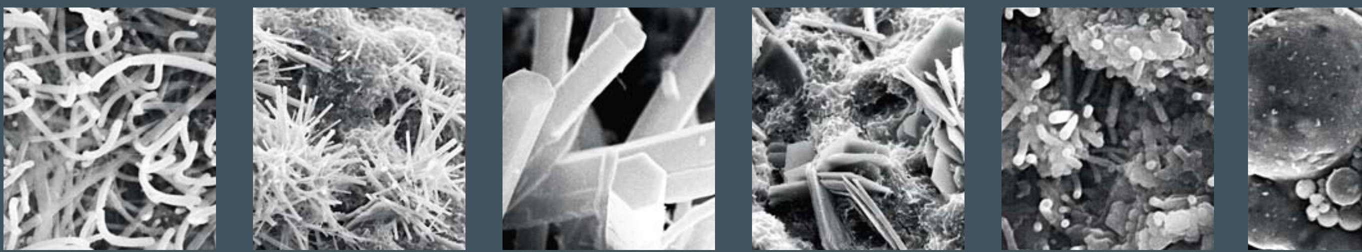
CEMENT INDUSTRY ENVIRONMENT REPORT

CEMENT INDUSTRY FEDERATION



THE CEMENT INDUSTRY FEDERATION

The Cement Industry Federation (CIF) is the national body representing the Australian cement industry and comprises three major cement producers

- Adelaide Brighton Ltd (ABL)
- Blue Circle Southern Cement Ltd (BCSC), and
- Cement Australia Pty Ltd (CAPL).

Together these companies account for 100 per cent of integrated clinker and cement supplies in Australia.

CIF's mission is to help promote and sustain a competitive Australian cement industry that is responsive to the expectations and needs of the community.

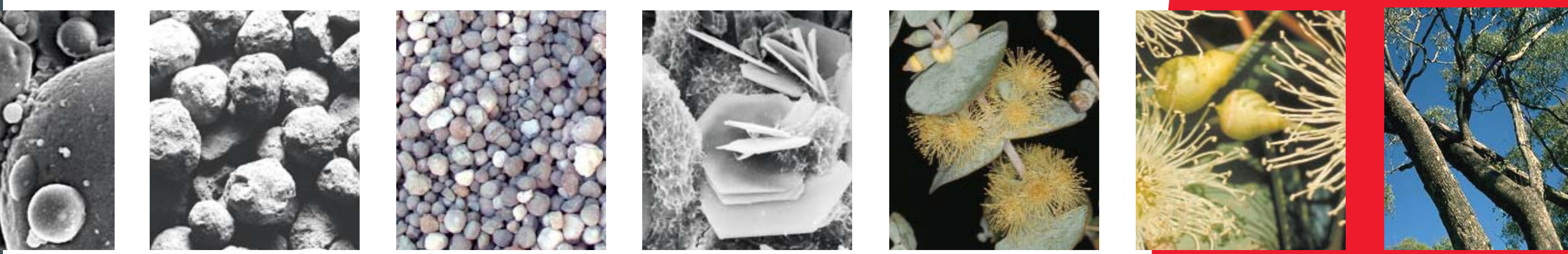
CEMENT INDUSTRY FEDERATION

COMMITMENT TO THE ENVIRONMENT

CIF Member companies are committed to achieving the environmental, social and economic sustainability of local operations. Our goals place compliance with environmental laws as a minimum standard and we work hard to achieve much more.

Our members are continuously working to

- improve their environmental performance
- incorporate environmental factors into planning decisions
- monitor activities impacting on the surrounding environment
- comply with environmental laws and regulations
- invest in capital equipment with state-of-the-art technology
- rehabilitate the environment affected by their activities, and
- engage effectively with their local communities.



MESSAGE FROM THE CHAIRMAN

This is our second environment report on the Australian cement industry. It highlights the challenges and achievements of the industry in the environmental arena. In issuing this report we seek to demonstrate the industry's ongoing commitment to sustainable environmental practices and performance.

As a key constituent in concrete, cement is a fundamental requirement of modern society. The industry recognises that the cement manufacturing process is resource and energy intensive, with the potential to create a substantial environmental footprint. We therefore believe it is important that our industry conducts its business in a responsible and sustainable way, balancing the expectations of all stakeholders. We also play a major role in regional Australia where our cement plants are major employers and significant contributors to local economies.

Over the past decade the cement industry has markedly reduced its greenhouse gas emissions through improved energy efficiency and increased use of alternative fuels and supplementary raw materials. Capital investment and improved operating procedures have also reduced other types of air and water emissions to the environment.

These recycling and waste-to-energy initiatives provide other environmental benefits including decreased consumption of non-renewable natural resources and diversion from landfill. More will be achieved when Federal and State governments adopt nationally consistent policies in line with those in other OECD countries.

At the United Nations World Summit on Sustainable Development held in Johannesburg in 2002, the ten leading global cement companies agreed that sustainable development was central to "creating efficient, effective businesses in the 21st century". The CIF supports this view.

Our priority for the Australian cement industry is to ensure sustainable environmental practices continue to be integrated into our business operations in a way that also supports our competitiveness.

Phil Jobe
CIF CHAIRMAN

SCOPE OF THE REPORT

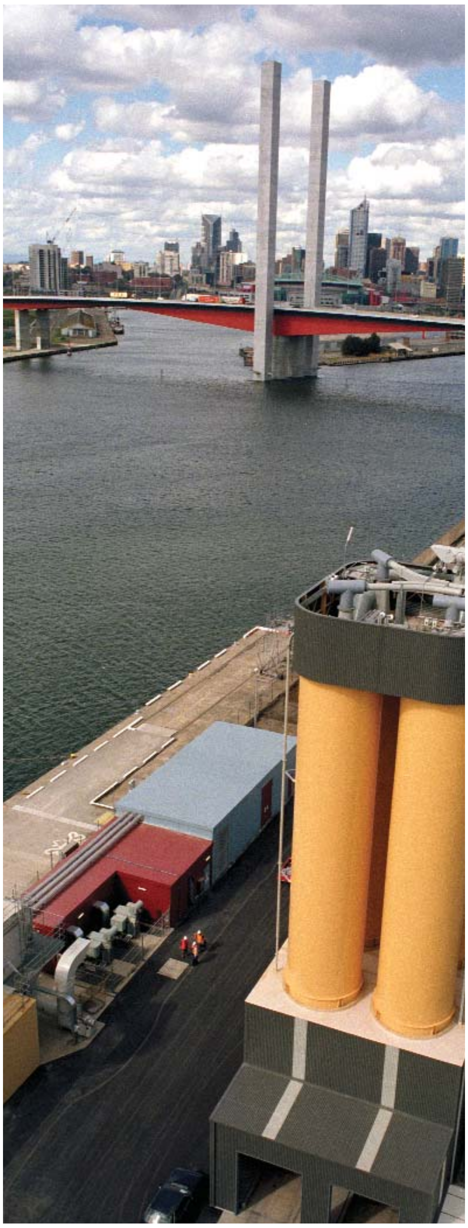
Building on our first industry environment report of 2000, this report provides a snapshot of the cement industry's current environmental performance. The report encompasses environmental performance for each stage of cement production and provides in-depth analysis of specific environmental issues associated with cement production. The report focuses on environmental challenges and achievements and is supported by case studies, from CIF Member companies. Fact sheets and technical notes are available for more detailed information on selected topics.

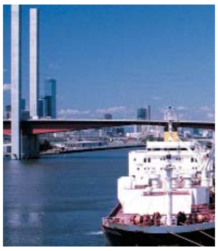
EMISSIONS TO AIR

Fresh air and clean water are becoming increasingly precious resources in Australia. CIF Member companies respect local emission standards and strive to achieve emission performances beyond minimum regulatory requirements. All Australian cement companies report the operating performance of their facilities to State and Territory environment agencies. These companies also report their annual emissions in the National Pollutant Inventory (NPI), a database of pollutant emissions in Australia which is managed by Environment Australia.

Monitoring the range of emissions to the environment is a significant operational cost for all Australian cement plants. The latest technology for pollution control and emission monitoring is generally used within the industry. Typically, the annual emission monitoring cost for a large cement plant will range from $100 000 to $200 000, depending on the nature and frequency of monitoring undertaken beyond licence compliance purposes.

One source of particulate emissions is fugitive dust from stockpiles, conveyors and material handling facilities. Cement Australia has recently expanded its joint venture Melbourne Cement Facility (MCF) for the receival, storage and dispatch of bulk cement. The state-of-the-art material handling MCF operation ensures minimal dust emissions and the highly efficient distribution of cement to customers.





Dust emissions

Particulate release from the kiln exhaust stack is a source of dust emissions from the cement plant that is easily measured and therefore commonly regulated. This dust is of a mineral nature with similar constituents to cement – silica, alumina, iron and calcium compounds. During the last decade, the improved operation of dust collection equipment, including electrostatic precipitators and baghouse dust collectors, has resulted in reduced dust emissions from the manufacture of cement.

Blue Circle Southern Cement's, Berrima Plant has reduced the number of times the kiln's electrostatic precipitators are automatically shut down (trips) by more than 80 per cent. This was achieved through improved control of carbon monoxide levels inside the kiln, reduced utilisation of the wet process kiln and modification to the coal feed systems. Improved operational performance of the electrostatic precipitators means that the particulate emissions from the kiln exhaust are reduced.

NOx emissions

In the cement manufacturing process, nitrogen oxides (NOx) are generated from fuel combustion at high temperatures. NOx is formed from chemical reactions of nitrogen in the fuel and by the thermal fixation of nitrogen in the combustion air.

Both the type of fuel and flame temperature used in clinker production will affect the quantity of NOx emissions. For example, natural gas combustion with a high flame temperature and low fuel nitrogen may generate a larger quantity of NOx than the combustion of oil or coal, which have higher fuel nitrogen but burn with lower flame temperatures. The use of waste-derived alternative fuels within the cement industry has contributed to the reduction of NOx emissions through reduced flame temperatures and lower nitrogen content in the fuel composition.

The Australian cement industry is also implementing other measures for the reduction of NOx emissions. These are aimed at optimising steady and continuous kiln operation, for example, introducing strict control limits on process variables. Also, low NOx burners are now installed in many Australian cement kilns.

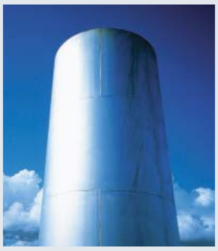
Sulfur dioxide emissions

Sulfur dioxide (SO_2) from cement manufacture originates from both cement raw materials and fuels, however, calcium compounds in the raw materials bind most of the sulfur into the clinker. Thus, the conditions within the cement kiln essentially 'scrub out' the majority of potential SO_2 emissions from cement manufacture. Emission monitoring at Australian facilities has shown that SO_2 emissions generally are at very low levels.

Dioxin emissions

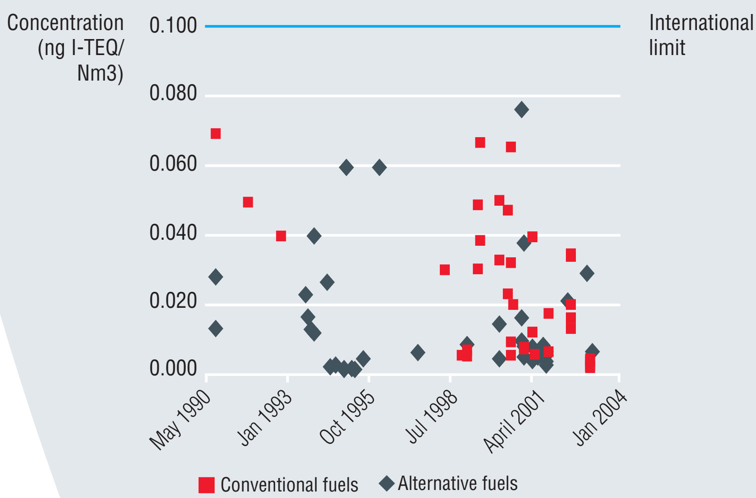
Dioxin compounds (polychlorinated dibenzo-p-dioxins and dibenzofurans) can be formed as unintentional trace by-products of combustion processes. Sources of dioxins include bushfi res, vehicle emissions, wood fires and some industrial processes.

Dioxin emissions have been measured and monitored from a range of Australian cement plants representing different operating processes, different fuel sources and different raw materials. Results of repeated measurements since 1990 show that the levels of dioxin emissions from Australian cement manufacturing are one of the lowest sources of dioxins in Australia. These results are also at the low end of data reported for dioxin emissions from cement plants in Europe and North America.



The temperature distribution and long residence time in rotary cement kilns provides particularly favourable conditions for the destruction of organic compounds such as dioxins. For this reason only very low concentrations of dioxin compounds can be found in the exhaust gas from rotary cement kilns. Investigations have shown that these emissions are independent of the types of raw materials and fuels used for cement manufacture.

Concentration of dioxin emissions from Australian cement plants using conventional and alternative fuels, 1991–2002.

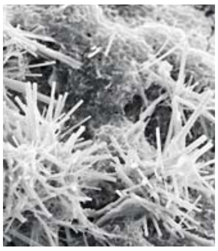


EMISSIONS TO WATER

Increasing proportions of cement produced in Australian are from newer dry process technology, which significantly reduces the water consumption per tonne of clinker. Since 1990, the number of wet process kilns in operation in the Australian industry has reduced from twenty to seven, with corresponding clinker production volumes reducing from almost three million tonnes to less than one million tonnes.

Wet process plants now account for less than 15 per cent of Australian cement production. In these plants, water is used for the slurry preparation of raw materials. Water is also consumed in the cooling of equipment and exhaust gases. All of the water in the slurry is evaporated during the cement production process but other plant water is normally re-cycled in closed loop systems. There is minimal discharge of water to the surrounding environment from these wet process cement plants.

All cement manufacture and handling facilities have been designed to control, separate and treat any surface water (such as storm water) so that there is minimal impact from the discharge of excess water into the local environment. The pollutants initially contained in plant water are mainly dissolved and suspended solids. Control methods including settling ponds, closed circuit water cycles and careful monitoring practices, ensure discharged water is of an equal or higher quality than the water in the local environment.



A community resource

The wetland at ABL's Cockburn Munster operation captures storm water and acts as a supplementary source of plant process water.

The wetland is also an educational resource for local schools and community groups.

Water savings in dry times at Fishermans Landing

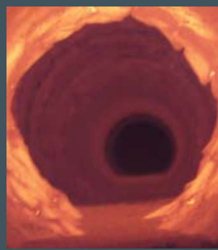
With Australia experiencing one of its worst droughts on record in 2002, industries in the Gladstone region had to respond to industrial water restrictions. The Fishermans Landing plant achieved a reduction in water consumption of an estimated 25 to 30 per cent of normal usage.

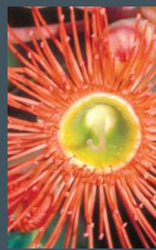
All available storm water collected on site was recycled for dedusting purposes and bore water was used to replace lower quality water needs. The focus on water resource issues has also prompted a review of the plant's storm water management systems. A signficant upgrade of storm water and waste water facilities will have the dual benefits of reducing waste water released to the environment as well as further minimising use of water resources.

ALTERNATIVE FUELS

The environmental benefits of using alternative fuels in the cement industry include

- reduced consumption of non-renewable fossil fuels such as coal and gas
- lower greenhouse gas emissions by replacing more carbon-intensive fossil fuels
- maximum recovery of energy from industrial by-products and wastes – all recovered energy is used directly in the kiln for clinker production





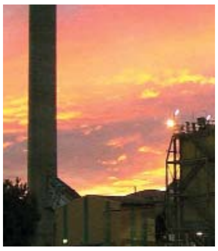
- maximum recovery of the non-combustible part of by-products and wastes and eliminating the need for disposal of slag and ash
- avoidance of other disposal requirements for by-products and wastes, such as used tyres going to landfill.

ALTERNATIVE FUELS AND SUPPLEMENTARY MATERIALS

Alternative fuels

In line with its commitment to sustainable development, the Australian cement industry has increasingly sourced alternative fuels to substitute for the use of traditional fossil fuels. Alternative fuels include used tyres, solvents and used oil amongst many other industrial by-product materials.

In 2002 the Australian cement industry replaced almost six per cent of its thermal energy consumption with alternative fuels. There is potential for the use of alternative fuels to increase substantially, with one plant in Australia – the Blue Circle Southern Cement plant at Waurn Ponds, already meeting some 50 per cent of its thermal energy requirements from alternative fuels.



Tallow residue

In 2001, Blue Circle Southern Cement's (BCSC) Waurn Ponds plant implemented a novel approach to use tallow residue as an alternative fuel for cement manufacture. Tallow residue is a by-product of oleo production which is used in food, lubricants, personal care products and plastics. The calorific value of tallow residue enables it to be used as a replacement for the traditional fuel (natural gas) used at Waurn Ponds, potentially providing up to ten per cent of thermal energy requirements.

Precautionary testing and extensive plant trialling was undertaken by BCSC to ensure there were no detrimental effects through emissions to air and that any low volatile heavy metals were incorporated into the clinker matrix. A spin-off environmental benefit of this project was a reduction in nitrous oxide emissions of between five and seven per cent. However, this has been balanced against an increase in CO_2 emissions of four per cent with the change from a hydrogen-based fuel to a carbon-based fuel.

This use of tallow residue as a fuel for cement manufacture demonstrates the synergies that are possible within the Australian manufacturing environment through integrated solutions.

Solvent-based fuel

Solvent-based fuel (SBF) has been supplied to Cement Australia's Fishermans Landing plant for more than two years, following construction of a world-class liquid fuel handling facility at the plant. The successful adoption of SBF has seen the liquid fuel handling facility expanded, with the addition of a third storage tank, and kiln performance benefiting from the stability and consistency of the fuel. SBF now provides approximately seven per cent of the thermal energy requirements at the plant.

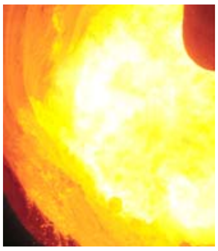
ENSURING THE RESPONSIBLE USE OF ALTERNATIVE FUELS

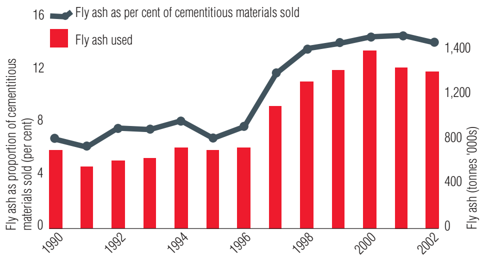
Cement kilns have a number of characteristics that make them ideal installations for the safe use of alternative fuels. The high temperatures and long residence times of raw materials in the kilns ensure the destruction of organic substances.

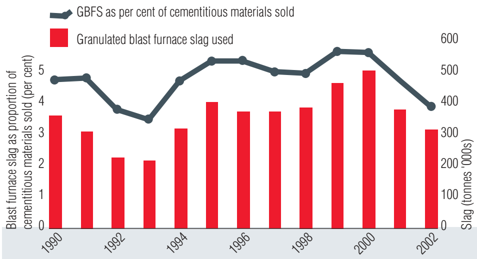
The inorganic components of alternative fuels are trapped and combined in the clinker product, reducing raw material consumption.

The Australian cement industry is subject to strict controls on all aspects of manufacturing activities, including the use of alternative fuels. Increasingly sophisticated and automated emission monitoring equipment is used to ensure the safe environmental performance of each plant. However, the industry recognises that some stakeholders may still be concerned by some issues related to the use of alternative fuels, including emissions from the process, safe operation of the plant and the quality of the cement. The Australian cement industry believes that transparency and community consultation are key success factors in the use of alternative fuels.

Fly ash and Granulated Blast Furnace Slag use in the Australian cement industry







The role of supplementary materials

The conservation of natural resources also extends to the replacement of primary raw materials consumed in cement manufacture with supplementary cementitious materials and mineral additions, including power station fly ash and granulated blast furnace slag or limestone fines. These materials mainly substitute for clinker in cement, however, some supplementary materials such as slags are also used to directly replace raw materials in the manufacturing process.

In 2002, fly ash comprised about 15 per cent of cementitious material sold (1.2 million tonnes of bulk fly ash). Granulated blast furnace slag accounted for nearly four per cent of cementitious material sold in 2002 (300 000 tonnes of granulated blast furnace slag).

Benefits of synthetic gypsum as a supplementary material

A joint effort by Cement Australia, Railton and Pasminco Ltd. is realising benefits from using synthetic gypsum instead of the natural gypsum required in cement manufacture. The synthetic gypsum, a by-product from the Tasmanian zinc smelter process on the Derwent River, was previously destined for landfill. It now partially replaces natural gypsum shipped from South Australia to the Railton plant. This use of synthetic gypsum provides a commercial benefit to both companies as well as important environmental benefits including reduced land-fill and less consumption of non-renewable mineral resources.

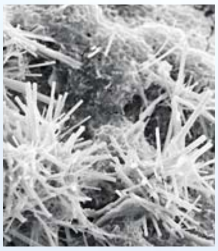
GREENHOUSE PERFORMANCE

Greenhouse gas emissions

The Australian cement industry is committed to reducing greenhouse gas emissions produced from the manufacture of cement. Greenhouse gas emissions are produced from three primary sources associated with cement production

- chemical process of making clinker (52 per cent)
- combustion of fossil fuels in the kiln (36 per cent), and
- indirect emissions from purchased electrical power (12 per cent).

The cement industry is an active participant in the Greenhouse Challenge program through the CIF's cooperative agreement with the Australian Greenhouse Office (AGO). This voluntary program is focused on delivering greenhouse gas abatement and involves annual monitoring and reporting of emission inventories and actions for the industry. As a central part of their Challenge membership, CIF member companies developed a common environmental management system, the Greenhouse Energy Management System (GEMS), which is based on the ISO 14001 environmental standard.



All CIF Member companies integrated GEMS into their management processes so that they could deliver their greenhouse commitments. The system assists them to plan, identify, track and report on their greenhouse emission abatement actions. GEMS methodology for monitoring and reporting emissions inventories is consistent with the Greenhouse Protocol established by the World Business Council for Sustainable Development.

Typical abatement actions reported in 2001–2002 included

- increased use of mineral addition and supplementary cementitious material to reduce the clinker component in cement, resulting in an effective reduction of the chemical process emissions
- increased utilisation of alternative raw materials and fuels, and
- improved energy efficiency performance.

Greenhouse gas emissions reduced by seven per cent

In 1990, the Australian cement industry greenhouse gas emissions from fuel and process sources were 5.87 million tonnes (Mt) of CO_2. The cement industry has achieved a reduction of fuel and process emissions to 5.45 Mt in 2002. This is a seven per cent reduction in absolute direct CO_2 emissions, despite a 6.8 per cent increase in the quantity of cementitious material sold during the same period.

The CIF estimates that through the implementation of GEMS abatement action plans by Member companies since 1997, savings of 0.64 Mt of CO_2 emissions per year had been achieved by 2002. The cement industry forecasts that potential savings of 1.21 Mt of CO_2 emissions per year are likely by 2005, depending on market considerations and the availability of funds for re-investment in new capital equipment.

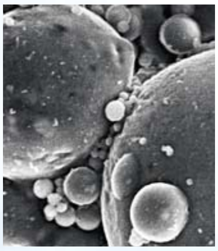
2002 Independent verification

Independent auditors appointed by the AGO verified the Australian cement industry's environmental management systems for greenhouse emission inventory and abatement action plans in October 2002. The verification was undertaken as part of the commitments made by the CIF under the Greenhouse Challenge program.

The 2002 Independent Verification Report concluded

- the *emission baseline* was comprehensive, comparable and free from material discrepancies
- current *emission inventories* were compiled and reported in a comprehensive and comparable manner and are free from material discrepancies, and
- within the context of the CIF Greenhouse Challenge agreement, the company level and aggregated CIF-level *abatement actions* were verified as being compiled and reported in a comprehensive and comparable manner, free from material discrepancies.



'The CIF Annual Survey database and aggregation model is robust, consistent, transparent, securely protected and facilitates verification of emission and production data.'

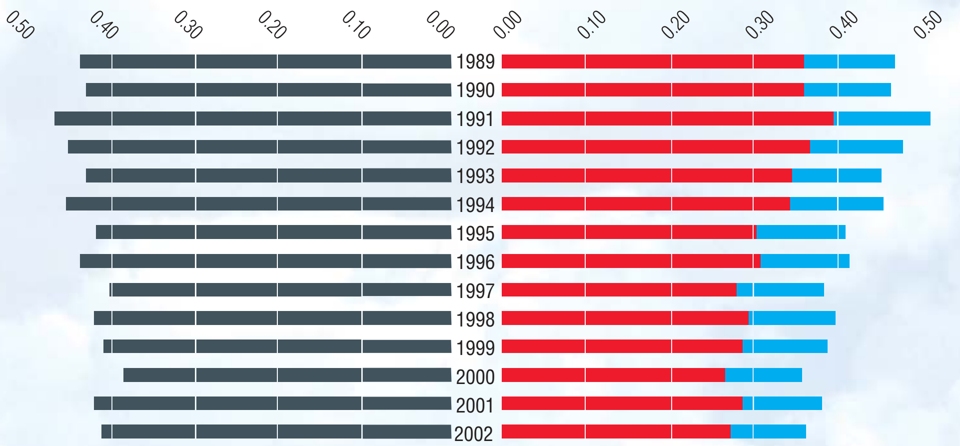
Source: 2002 Independent Verification Report

The report's findings highlight that the industry-wide implementation of GEMS has enabled Member companies to accurately and comprehensively monitor their greenhouse gas emissions. GEMS has provided timely management information on greenhouse emissions performance and options for emissions abatement.

The verification report also recommended that the AGO take the 'learnings', and the quality of, the CIF approach and diffuse them through other industry associations or directly with other Greenhouse Challenge participants.

As part of ongoing management activities, the Australian cement companies are continuing to improve their environmental management systems and refine the integration of GEMS within their company management processes.

Greenhouse gas emissions per tonne of cementitious product sold



Since 1990 there has been a 13% reduction in total emissions per tonne of product sold

4% reduction in process emission per tonne of product sold

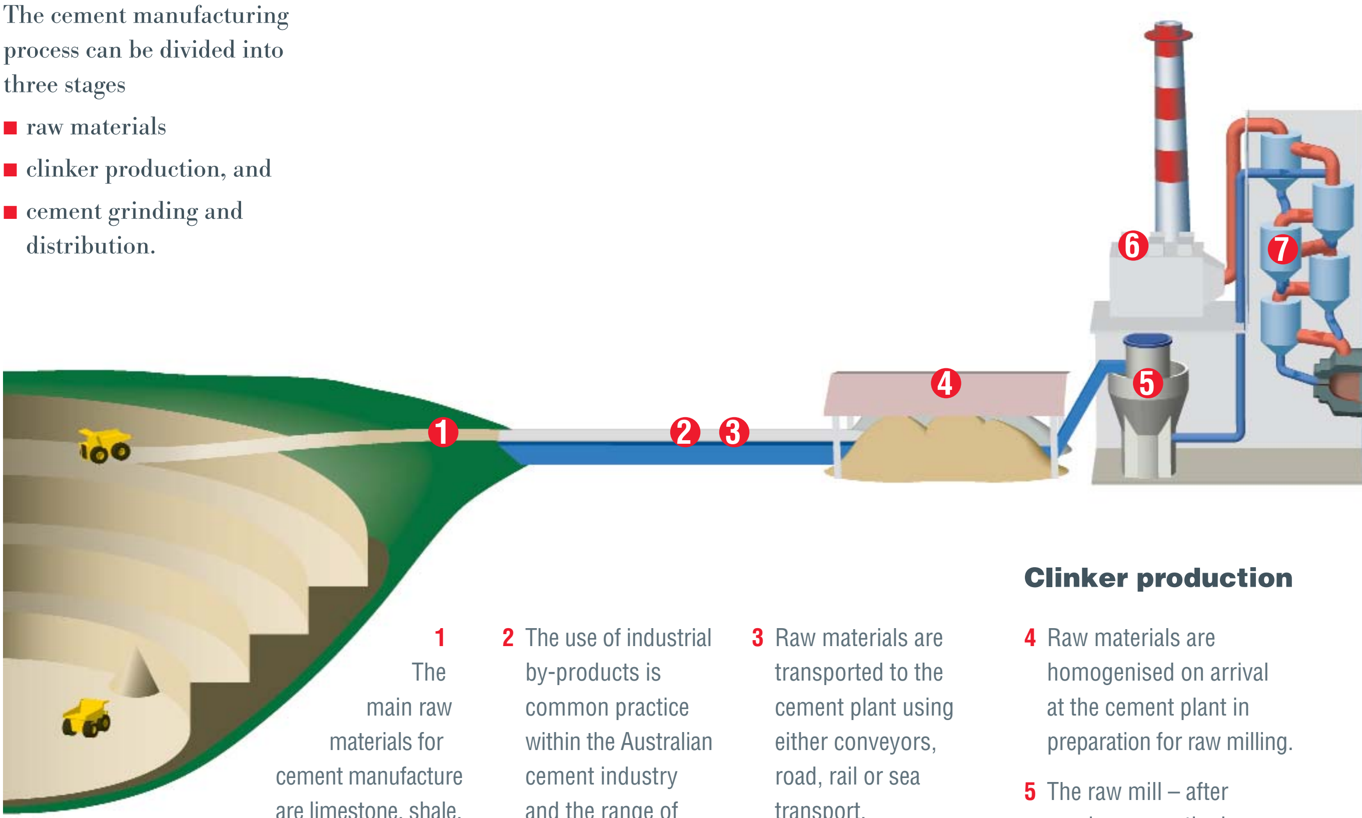
24% reduction in emissions from fuel use per tonne of product sold

15% reduction in indirect emissions from power use per tonne of product sold

THE CEMENT MANUFACTURING PROCESS

The cement manufacturing process can be divided into three stages

- raw materials
- clinker production, and
- cement grinding and distribution.



Raw materials

1 The main raw materials for cement manufacture are limestone, shale, clay, iron ore and sand. These materials are primarily obtained from mines and in some cases from sources such as shell sand.

The main emission from the extraction of raw materials is dust emissions – PM_{10} (particulate matter with a size of 10µm or less). The industry is working towards reducing the impact that mining activities have on the local landscape and ecology (see page 12).

2 The use of industrial by-products is common practice within the Australian cement industry and the range of alternative materials includes alumina and aluminium by-products and slags from the steel industry (see page 4).

The replacement of natural raw materials by alternative raw materials or industrial by-products is a key sustainability outcome for the cement industry.

3 Raw materials are transported to the cement plant using either conveyors, road, rail or sea transport.

The potential for fugitive dust emissions is minimised through careful design of the transportation systems.

Clinker production

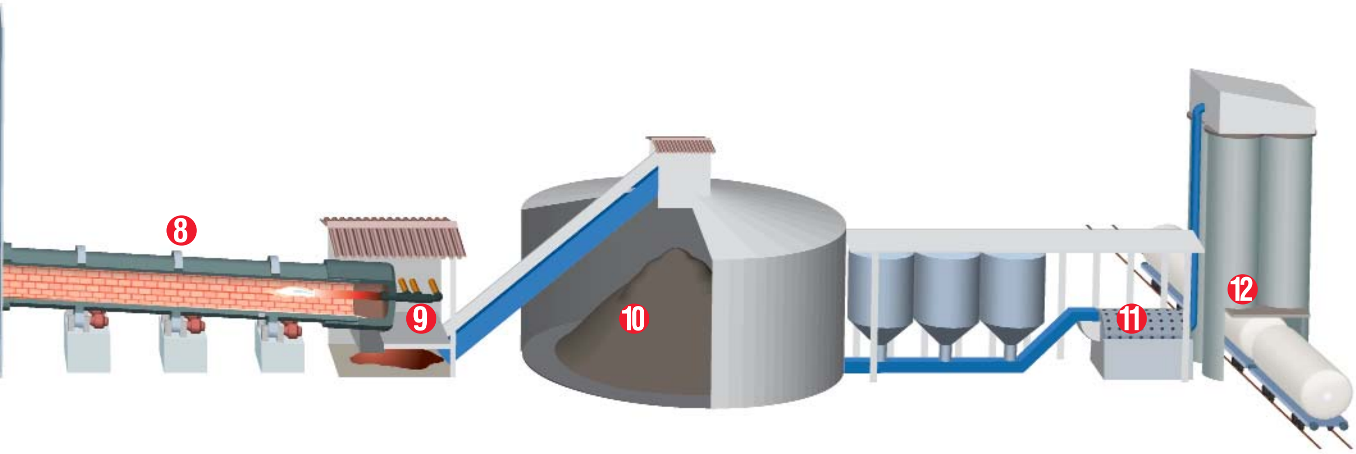
4 Raw materials are homogenised on arrival at the cement plant in preparation for raw milling.

5 The raw mill – after precise proportioning, raw materials are finely ground, dried and further blended in the raw mill.

6 The dust filter – baghouse filters or electrostatic precipitators remove particles from kiln and mill exhaust gases.

Various emissions to air from clinker manufacture include NOx, SOx, particulate emissions and dioxin emissions (see pages 2 & 3).

The majority of CO_2 emissions arise from the clinker production process (see pages 8 & 9).



Cement grinding and distribution

7 The preheater – raw materials are heated to around 900˚C in counter-flow heat exchange resulting in the decarbonation of calcium carbonate in the raw mix.

8 The kiln – raw materials are further heated to 1450˚C in the rotary kiln. At this temperature, raw materials are transformed into clinker.

Clinker production requires high temperatures which are generated by the combustion of fossil and other fuels. Alternative fuels can be used in the kiln, reducing the consumption of fossil fuels and often reducing emissions to atmosphere. Alternative fuels include wastes or by-products previously destined for landfill such as used tyres, used engine oil and spent solvents (see pages 5–7).

9 Clinker cooler – clinker is rapidly cooled to ensure the desired mineralogy is formed in the final product. Heat recovered from the kiln and cooler is recycled in the process to reduce fuel requirements.

10 Clinker is stored on site until required for grinding into cement or distribution to another site for finish grinding.

11 Clinker is ground with gypsum and supplementary cementitious materials and mineral additions (including limestone) to form the final cement product.

Mineral additions and supplementary cementitious materials include limestone, granulated slags and power station fly ash (see page 6). These materials reduce the requirement for clinker in the cement and hence reduce the use of natural materials and the emission of CO_2 from clinker production.

There are approximately 755 kg of CO_2 emissions released for every tonne of cementitious product sold (see pages 8 & 9).

12 Distribution of cement products occurs via road, rail or sea transport. The final cement products are delivered to customers in bulk or in bags.

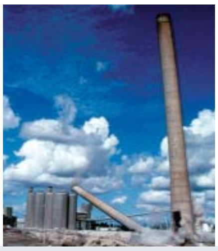
WHOLE OF LIFE APPROACHES

Rehabilitation of the land

A cement manufacturing site or limestone mine has many stages in its lifetime – from exploration and development to continuous operation to closure and restoration. CIF Member companies are committed to the restoration and rehabilitation of sites once the mining and cement manufacturing activities have ended. All cement-related mines are required by local authorities to have up-to-date mine operation plans, which specifically include site rehabilitation. Wherever possible rehabilitation activities are integrated into the ongoing operational activities at the site.

Long term benefits

The restoration focus also extends to the enhancement of the biodiversity and wildlife habitats of the industry's existing sites. Australian cement companies have undertaken many different rehabilitation projects including buffer sites, wetlands and community biodiversity projects, some of which are highlighted in the CIF's 2000 environment report. The quality of these projects has been recognised through various awards for excellence.



Site rehabilitation

Australian cement companies have closed several production sites in the last decade, the most recent being Darra, near central Brisbane, and Geelong in Victoria.

In 1998, Queensland Cement Limited (QCL) – now Cement Australia – ceased cement manufacturing at its Darra facility after 80 years of continuous operation. After extensive remediation, part of the Darra site is now a modern and vibrant commercial and industrial area, named QCL Industrial Park. A quiet and leafy residential estate has also been developed, while the Brisbane City Council is working on an extensive riverside parkland to be opened on the site in November 2003.

After 110 years of operation, Adelaide Brighton's (ABL) Geelong Cement plant located at Fyansford was closed in June 2001. An extensive environmental assessment was conducted to identify areas where material stockpiles, fuel storage, waste disposal, and built up areas might have had an impact on the soil and groundwater. Remediation and site improvement is continuing, with part of the land earmarked for commercial purposes and selected areas zoned for residential use.

Tree farms act as CO_2 sink

One of Cement Australia's first greenhouse projects at Railton was to develop a tree farm that would act as a 'CO_2 sink'. In May 1999, more than 300 000 Eucalyptus globulus (Tasmanian Blue Gum) were planted over some 275 ha of land adjoining the Railton plant.

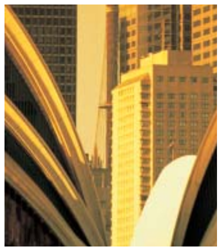
The trees are estimated to absorb an average of over 10 000 tonnes of CO_2 per annum through photosynthesis. Growth rates to date have been better than expected, with trees currently eight to ten metres high. Survival rates appear to have exceeded 95 per cent. In addition to the plantation acting as a CO_2 sink, the tree farm has created an attractive view for people approaching the Railton plant from the north.

Sustainable design and building products

Designers and builders are increasingly aware that many environmental issues need to be considered in the design, construction and operation of buildings to ensure that the built environment is sustainable. Life cycle assessment (LCA) provides a practical tool for achieving ecologically sustainable outcomes for building design.

LCA is a method that systematically assesses the environmental effects of a product, a process or activity holistically, by analysing its environmental impact over its entire life cycle. This includes identifying and quantifying energy and materials in production and wastes released to the environment, assessing their environmental impact and evaluating opportunities for improvement.

The Cement & Concrete Association of Australia used LCA to assess different building types with various forms of construction in a study released in 2002.



Community action at Schroder Park

Adelaide Brighton (ABL) formed a group of community members and community organisations to look after and manage Schroder Park – a green buffer and storm water retention pond at ABL's Birkenhead cement plant. The site has been planted with thousands of locally indigenous trees and several frog species have been released into the ponds on the site.

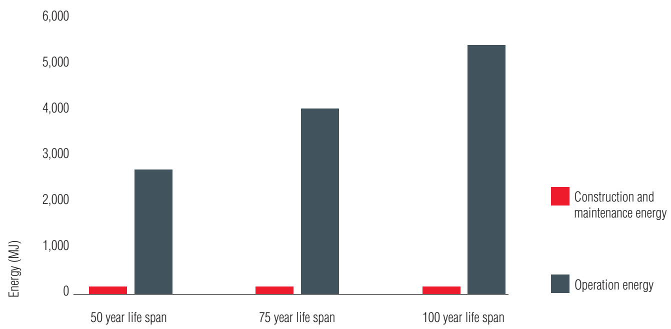
The project was a winner of the Community Groups category of the 2001 WaterCare Awards in South Australia.

> *'This group is an excellent example of establishing an interface between industry and the community, with local residents from the site taking an interest in the long-term aims of this project to screen the factory facilities and provide an area that is aesthetically improved with genuine biodiversity outcomes.'*
>
> Source: WaterCare Awards

Across the range of environmental factors evaluated, the study demonstrated for houses and buildings that concrete-based construction provides good overall environmental performance. The study also showed that the use of one environmental indicator, such as CO_2 emissions, is inadequate to describe or assess the environmental performance of a building.

One aspect of the life cycle assessment evaluates the energy use associated with the construction, operation and demolition of typical buildings, as well as the energy use associated with the manufacture of various building materials (or embodied energy). The energy required to operate (heat/cool) the building, over the life of the building is ten times larger than the embodied energy of the building, as shown below, for a detached house. Similar trends are evident from case studies for commercial and industrial buildings.

Operational energy compared to construction and maintenance energy for the life of a detached house



Cement Australia supports AirWatch Tasmania program

Cement Australia's sponsorship of the AirWatch Tasmania program is developing environmental awareness in primary and secondary school students, specifically about air pollution. Through AirWatch, students are learning about the quality of their local air and how they can contribute to keeping it clean.

In early 2003, there were twelve schools with weather monitoring stations sending live data to AirWatch via the Internet. The AirWatch program is coordinated by the Tasmanian Department of Primary Industries, Water and Environment.

The Gracemere project

Cement Australia (CAPL) is indirectly assisting one Queensland community with the legacy left by a person jailed for breaching environmental orders. Nearly 650 drums containing a range of potentially dangerous materials including solvents, fuels, paints and other chemicals had been left on a property in Gracemere, Queensland. Teris, a Victorian-based subsidiary of CAPL, was called on by Queensland's Environment Protection Agency to assist in the clean-up. Teris will process these waste materials, together with used solvents from a range of other sources, into SBF – a liquid-based fuel meeting stringent specifications for use as an energy alternative for the cement kiln at Fishermans Landing.

The Australian cement industry recognises the importance of establishing and maintaining open and responsive relations with the community and other stakeholders who are interested in the industry's commercial and environmental activities.

CIF Members have established a community liaison committee (CLC) at most of their production sites around Australia. The CLCs are made up of members of the local community and representatives of the cement plant. Community members can voice their concerns and have them addressed through regular meetings. This process helps the cement plant to gain the respect and confidence of its community.

The cement industry has found that the CLC experience, while sometimes difficult, is definitely beneficial.

Involving the community is critical to achieving better outcomes in the cement industry

Overall, CIF Members believe this approach to community relations provides:

- better outcomes by involving the community at an early stage and hence changing the traditional thinking that surrounds the formulation and implementation of major projects
- mechanisms to explain and resolve issues before they escalate into major community concerns
- a credible network that understands the business, its direction, its environmental impact, and can communicate with others in the community on the basis of first hand information, and
- all stakeholders of the business with a heightened awareness of their responsibilities and obligations to the local community.

Community stakeholders are regarded by CIF Members as strategic partners in improving the sustainability of the cement business. For example, the CAPL Kandos Works has established a Works Community Liaison Group where plant management meets quarterly with a wide range of local community representatives to better understand local environmental issues and the range of solutions possible.

STATE OF THE ART TECHNOLOGY

Cement manufacture is capital intensive resulting in assets with very long economic lives of at least 30 years. For this reason, upgrades of the production processes can be expected to include state-of-the-art technology. Improved environmental performance is a key consideration in new capital investment within the Australian cement industry.

The cement industry has made significant capital investments during the last ten years resulting in substantial technological change in the cement manufacturing process. From an environmental perspective, significant gains have been achieved through technological change that has focused on:

- improvements in energy efficiency and hence lower greenhouse gas profiles of fuel consumption
- reduction in stack and fugitive dust (and other) emissions
- reduction in plant noise and in water usage
- reduction in the use of non-renewable raw materials and energy sources, and
- increased automation leading to optimised plant performance.

New technology

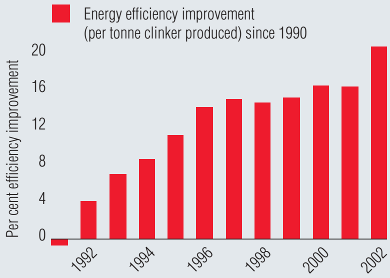
A recent upgrade of the cement grinding operation at BCSC's Waurn Ponds facility involved the installation of a high pressure rolls pre-crusher in the cement milling circuit, which is the first time this type of world-class equipment has been installed in Australia.

The increased product throughput and improved dust collection system associated with the grinding mill upgrade have reduced the overall impact of the manufacturing operation on the environment. The project is expected to achieve a reduction in greenhouse gas emissions of 4600 tonnes of CO_2 annually. A 40 per cent reduction in dust emissions will also dramatically improve the environmental performance of the cement grinding process.

Energy efficiency

Energy efficiency, in terms of specific energy consumption per tonne of cement produced, has steadily improved through the 1990s as a result of increased dry process kiln capacity and the introduction of more energy efficient processes and equipment. Between 1990 and 2002, energy efficiency improved by more than 20 per cent in the Australian cement industry. The environmental benefits associated with increased energy efficiency are reduced consumption of non-renewable resources and a proportional decrease in greenhouse gas emissions to the atmosphere.

Energy efficiency actions by the cement industry include optimisation of heat recovery, upgrade of clinker coolers and maintenance and monitoring of cement mill parameters.



CHALLENGES FOR THE INDUSTRY

Moving towards a durable and sustainable cement industry is not without challenges for CIF Member companies.

The import-competing nature of the Australian industry creates extra pressures when it comes to achieving environmental change. Australian producers are competing with foreign companies that generally do not have the same environmental obligations or commitments and, therefore, do not carry the same costs of environmental performance.

As price-takers, Australian companies have limited ability to pass these costs on. They are also constrained in absorbing the costs as this could damage their commercial viability in a highly competitive market.

For these reasons, the industry seeks to improve environmental performance as part of more general productivity improvements. The timing of investments in new capital stock has a critical impact on when environmental goals can be achieved.

Community consultation

Australian facilities will continue to be upgraded and refurbished over the next few years. While existing consultation processes will provide an avenue for discussion, local community and council concerns are still likely to arise. CIF members expect that more extensive dialogue will be required with local communities and authorities to ensure that plans are fully understood, options for improving the plans are explored, and all community concerns are properly considered.

For example, in 2003, a new environmental licence was established for the operation of ABL's Cockburn Cement facility in Western Australia, after considerable community discussion. CIF Members will continue to work with their local communities to improve the transparency and effectiveness of their external communication, while managing the implementation of their environmental improvement programs.

Consistent national approach

Predictable and durable government policies can enhance the role of the cement industry in achieving broader environmental goals. Currently, State and Territory governments have inconsistent approaches to waste management, particularly in the landfill, resource recovery and resource use areas. An integrated, consistent national approach is needed to enable cement companies to invest time, skill and capital in the further use of waste materials.

Reliable and commercially attractive supplies of alternative fuels are essential if cement plants are to provide viable solutions to unsustainable waste management practices. For example, the ongoing low cost disposal of used vehicle tyres in landfill means the tyres are generally not available for use as fuel in cement kilns. Different approaches by governments across Australia to the use of landfill facilities and the recovery of waste materials also limit the development of effective alternative fuel supply chains.

Inconsistent approaches by governments to the combustion of waste materials as alternative fuels further complicate the achievement of broader community goals for sustainable waste management. Extensive testing programs in Queensland and Victoria have demonstrated the environmental acceptability of using alternative fuels in the cement industry. Policies and practices have been approved by these States that are similar to well established approaches in other OECD countries. These experiences provide a very sound and environmentally safe basis for extending the use of alternative fuels to cement plants in all Australian States.

CEMENT SUSTAINABILITY INITIATIVE

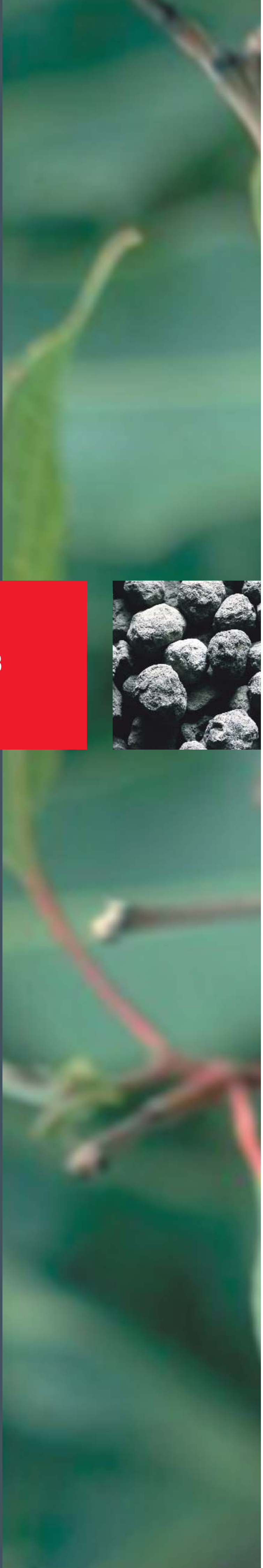
The World Business Council for Sustainable Development launched the Cement Sustainability Initiative (CSI) in 1999, in pursuit of sustainable development in the cement industry worldwide. The CIF and its Member companies have contributed to the Cement Sustainability Initiative.

The CSI Agenda for Action identified six key areas for action by the global cement industry towards a more sustainable society

- *climate protection* – development of a Carbon Dioxide (CO_2) Protocol for the cement industry (completed) and work with organisations to investigate public policy for reducing CO_2 emissions
- *fuels and raw materials* – develop guidelines for the responsible use of conventional and alternative fuels and raw materials in cement kilns
- *employee health and safety* – establish an information exchange on health and safety issues to promote awareness of options for improved performance
- *emission reduction* – develop an industry protocol for measurement, monitoring and reporting of emissions, and find solutions to more readily assess emissions of substances such as volatile organic compounds and dioxins
- *local impacts* – develop guidelines for an environmental and social impact assessment process which can be used at all cement plants and associated quarries, and
- *internal business processes* – identify best methods to track the environmental performance of the cement industry, including development and use of key performance indicators.

The activities of the CIF and its Task Forces are ensuring that the Australian cement industry is well advanced in developing and applying Australian solutions in these areas consistent with the CSI. In this process the Australian cement industry is drawing on the international experience and expertise available through the CSI and is also contributing to ongoing CSI activities. Queensland Cement Limited (now CAPL) played a leading role in the development of the industry-wide CO_2 Protocol. Through the experience gained from CIF Member participation in the Greenhouse Challenge, valuable contributions to the methodologies for monitoring and reporting of CO_2 emissions were possible.

The Cement Sustainability Initiative – a major contribution to the World Summit on Sustainable Development, Johannesburg 2002.



COMMITMENT TO THE FUTURE

The Australian cement industry is committed to improving its environmental performance, and sustaining returns to shareholders, into the future. In the last decade it has worked hard to demonstrate this commitment in many diverse ways

- significant investment and industry rationalisation has brought much of the industry operations to world's best practice
- investment in new and upgraded technology has significantly reduced industry emissions to air, land and water
- a focus on operational performance has produced substantial improvement in energy efficiency
- increasing use of supplementary cementitious materials and mineral additions has reduced greenhouse gas emissions per tonne of cementitious product sold and has provided waste solutions for the electricity and steel industries
- use of alternative fuels has reduced fossil fuel use per tonne of clinker and has enabled safe waste re-use
- use of mineral industry residues as alternative raw materials has contributed to the conservation of non-renewable raw materials
- site rehabilitation strategies have progressively reduced the industry's environmental footprint and have contributed to improving the level of biodiversity in the locality
- the provision of cements that enable more durable products to be created has helped to reduce the environmental impacts of buildings and construction, and
- cooperative interaction with governments has assisted with the development of cost-effective solutions for improving environmental performance consistent with Australian conditions.

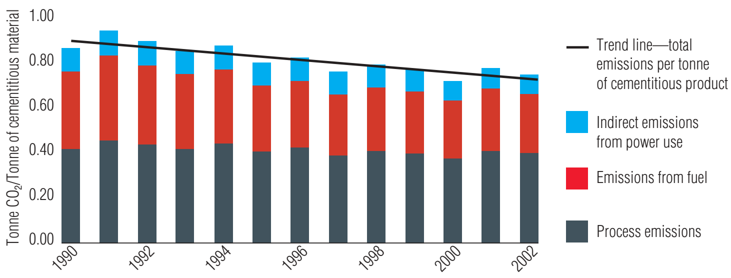
In order to increase value to all key stakeholders and achieve a balance in our environmental, social and economic objectives, the Australian cement industry will continue to

- establish and implement appropriate company policies, procedures, guidelines and good management practices to meet environmental responsibilities
- evaluate, monitor and report on the industry environmental performance in an open and transparent way
- communicate routinely with stakeholders on environmental matters concerning our operations, and
- integrate sustainable development policies into industry business practices.

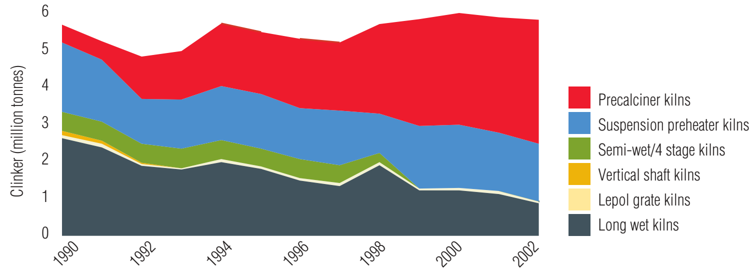
to achieve a balance in our environmental, social and economic objectives

KEY ENVIRONMENTAL PERFORMANCE INDICATORS: 2002

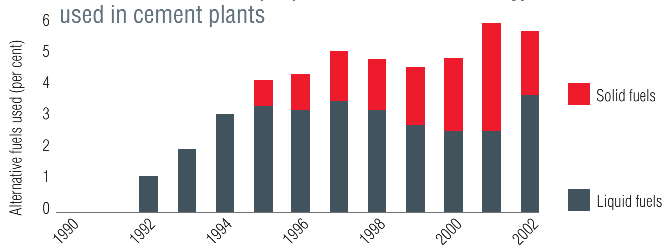
Greenhouse gas emissions per tonne of cementitious materials sold



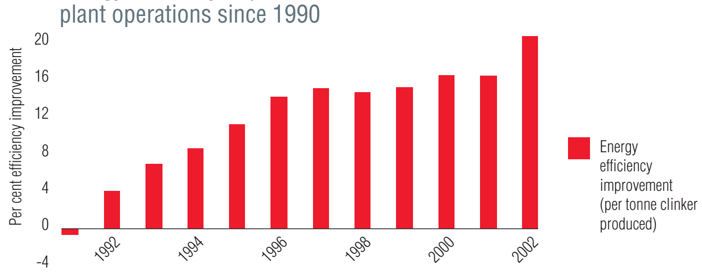
Australian clinker production by kiln type



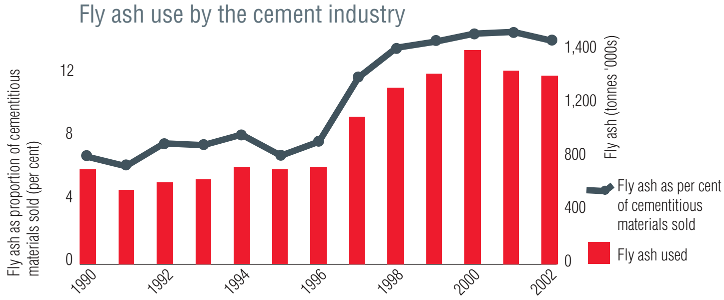
Alternative fuels as a proportion of thermal energy used in cement plants



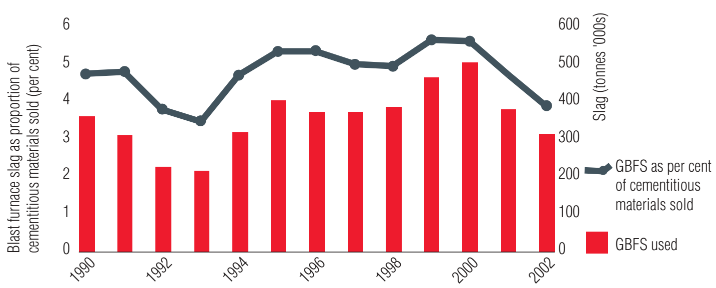
Energy efficiency improvement in cement plant operations since 1990



Fly ash use by the cement industry



Granulated blast furnace slag use by the cement industry



Greenhouse

Greenhouse gas emissions reduced by 13 per cent since 1990 per tonne of cementitious material sold.

Greenhouse gas emissions from fuel reduced by 24 per cent since 1990 per tonne of cementitious material sold.

Greenhouse gas emissions from power usage decreased by 15 per cent since 1990 per tonne of cementitious material sold.

Energy efficiency

Energy efficiency improved by more than 20 per cent since 1990.

Alternative fuels

In 2002, the Australian cement industry replaced almost six per cent of its thermal energy consumption with alternative fuels (1.4 PJ).

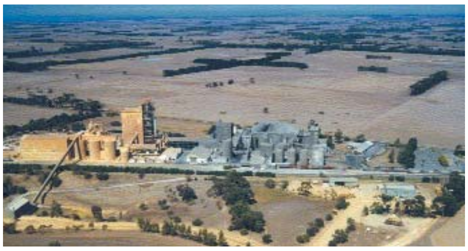
Alternative materials

In 2002, flyash comprised about 15% of cementitious material sold (1.2 million tonnes of bulk flyash).

In 2002, granulated blast furnace slag accounted for nearly four per cent of cementitious material sold (300 000 tonnes of granulated blast furnace slag).

INDUSTRY PROFILE

Distribution of major cement plants across Australia.



Cement is a key constituent of concrete, the most common building and construction material in the world. It is a global commodity that makes an important contribution to economic activity and is a strategic resource for Australia's housing and infrastructure development. This strategic role, together with the energy and capital intensive nature of cement manufacture, makes the Australian industry a significant player in the development of long-term greenhouse and environment policies.

Cement plants are sited close to sources of raw materials and are located in Queensland, New South Wales, Victoria, Tasmania, South Australia and Western Australia. Over the last decade, the industry has invested nearly $1.5 billion in new and upgraded plant and the total capital replacement value of the industry is now $2.5 billion. Rationalisation of old, inefficient plant and strategic investment in upgrading technology to world's best practice has significantly improved the productivity and efficiency of Australian cement production. The Australian cement industry employs around 1750 people across regional Australia, has an annual turnover of around $1 billion per year and is cost competitive with the industry in other countries.

The pre-cursor to cement: nodules of clinker.

Casuarina glauca Photo: © Murray Fagg, Australian National Botanic Gardens (ANBG)

Eucalyptus ficifolia Photo: Arthur D Chapman

Scanning Electron Micrograph (SEM) of fibrous calcium silicate hydrate products in cement (x 5,000) Photo: Cementech

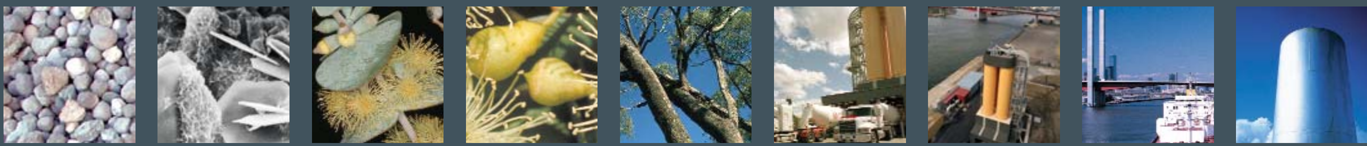
SEM of radiating clusters of cement hydration products (x 1,000) Photo: Cementech

SEM of well developed hexagonal crystals of cement hydration products (x 10,000) Photo: Cementech

SEM of calcium silicate hydrate products in cement (x 1,000) Photo: Cementech

SEM of hydration products in blended cement (x 5,000) Photo: Cementech

SEM of power station flyash (x 2,500) Photo: BCSC



Nodules of clinker

SEM of hydration products in cement (x 1,500) Photo: Cementech

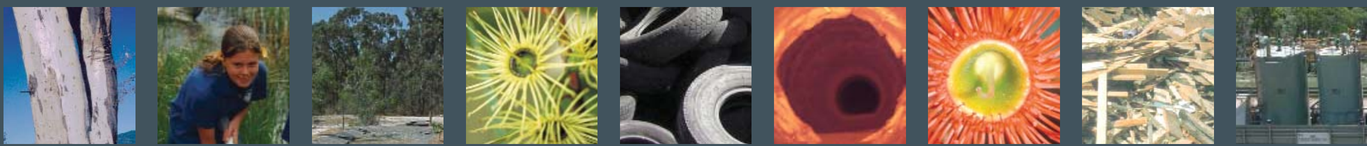
Eucalyptus pulverulenta Photo: Murray Fagg © ANBG

Eucalyptus calophylla Photo: © ANBG

Eucalyptus bridgesiana Photo: D Kelly © ANBG

The Melbourne Cement facility has state-of-the-art material handling technology that minimises dust emissions Photo: CAPL

Cement kiln exhaust stack Photo: CAPL



Eucalyptus pauciflora Photo: Andrew Lyne © ANBG

Wetlands at Cockburn Munster plant Photo: ABL

Reed bed at Fishermans Landing plant Photo: CAPL

Eucalyptus occidentalis Photo: © ANBG

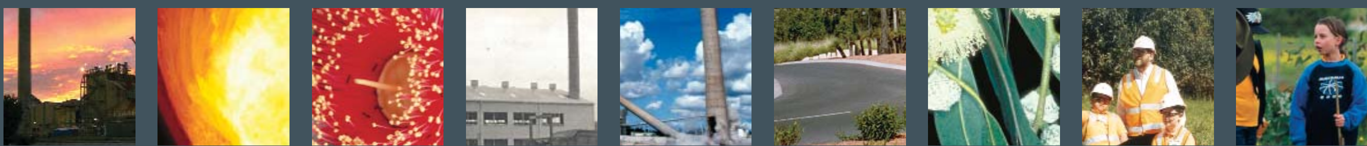
Used tyres are an alternative fuel for cement kilns Photo: BCSC

Inside a rotary cement kiln Photo: BCSC

Eucalyptus ficifolia Photo: Denise Greig © ANBG

Scrap timber is an alternative fuel for cement kilns Photo: BCSC

Alternative liquid fuel handling facility at Fishermans Landing plant Photo: CAPL



The Maldon plant Photo: BCSC

Inside a rotary cement kiln Photo: ABL

Eucalyptus rhodantha Photo: © Murray Fagg, ANBG

Power plant removed during upgrade of Maldon plant Photo: BCSC

Removal of the kiln stacks at the Darra plant Photo: CAPL

Rehabilitation of the Darra site Photo: CAPL

Eucalyptus globulus Photo: Ron Hotchkiss © ANBG

The tree farm at the Railton plant Photo: CAPL

Schroder Park adjacent to the Birkenhead plant Photo: ABL

The cement manufacturing process: Adapted from an illustration provided by Holcim

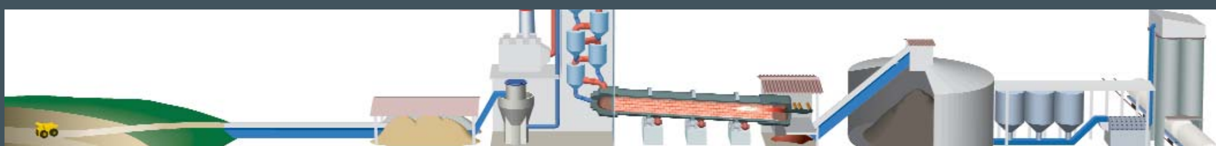


Photo: Cement and Concrete Association of Australia

Cement is an energy-efficient building material that offers flexibility in architectural design

CAPL is a sponsor of the Airwatch Tasmania program Photo: CAPL

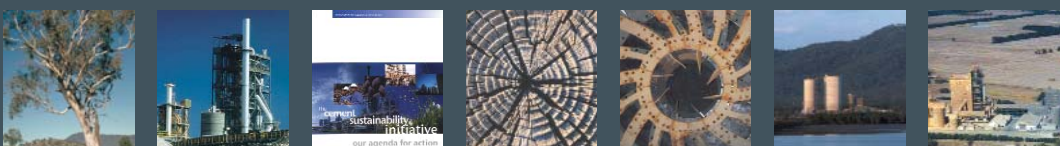
Abandoned waste material at Gracemere Photo: CAPL

Residential area adjacent to the Birkenhead plant Photo: ABL

Waste heat is used to dry raw materials Photo: CAPL

New mill pre-crusher at Waurn Ponds plant Photo: BCSC

Eucalyptus ptychocarpa Photo: Denise Greig © ANBG



Eucalyptus blakelyi Photo: Andrew Lyne © ANBG

State-of-the-art cement plant at Fishermans Landing Photo: CAPL

The Cement Sustainability Initiative

Cross-cut of an old tree

Inside a cement mill discharge system Photo: BCSC

Fishermans Landing plant Photo: CAPL

Waurn Ponds plant Photo: BCSC

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