The Concrete Industry
Sustainability Performance Report

1st Report

Contents

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We are genuinely impressed at the progress that has been made and the quality of leadership shown.

Front cover picture:
New Street Square, London. The building has a concrete frame with post-tensioned concrete floors, which provide thermal mass.

Forum for the Future has been involved in working with the concrete industry for more than seven years – first through the British Cement Association and then through The Concrete Centre and the Industry's Sustainable Construction Forum. This has turned out to be an extremely rewarding collaboration, and all of us in the Forum are genuinely impressed at the progress that has been made and the quality of leadership shown.

Concrete is a crucially important construction material, vital to every economy in the world. Much of the economic development of the last fifteen years or so has been underpinned by increases in the use of concrete, particularly in countries like China and India. The truth is that sustainability doesn't get much tougher than in concrete – in terms of emissions of greenhouse gases from cement works and other key parts of the industry, as well as local air pollution, waste, and health and safety issues.

On health and safety, the record is undoubtedly a good one (see page 20). On environmental impacts, despite the fact that there have been substantial improvements in both energy efficiency and waste reduction, these "decoupling" initiatives in the UK (more economic output for less environmental and social impact) have not been able to compensate for the huge growth in turnover worldwide.

Those boom days are now gone. From one perspective, that makes the industry's sustainability challenge all the more daunting, as commercial pressures bite even deeper. But from another, it provides the perfect opportunity for the industry not just to get the basics sorted (driving efficiency harder than ever to keep costs down) but to pursue a lot of the more innovative approaches that have just started to work their way through the industry.

Industry leaders have no illusions as to how tough this is going to be. Even the task of getting all this non-financial data measured, checked and properly reported has been a huge one. These pages speak to a lot of work done to bring together various sectors of the industry and to stimulate progress.

Engaging stakeholders is more and more important to the continued success of the industry, in its local communities and with its customers. Appendix A shows just how fast the industry needs to move to keep pace with the demands of its external audiences.

These pressures are not unique to the concrete industry. But they are particularly compelling. Direct competitors have had to find common cause in co-developing a new vision and signing up to a set of cross-industry commitments that will put the industry as a whole in a far better position when the economy picks up again.

And we all know what that will mean. When the economy recovers, we will see rapidly rising energy prices, as in 2008; even tougher regulatory pressures on waste and air pollution, and communities demanding higher standards in terms of "good neighbour" practices.

Climate change will be driving unprecedented innovation and radical decarbonisation strategies across the entire economy, with the likelihood of even more ambitious targets for construction and infrastructure.

That's what this Performance Report is all about. Benchmarking current performance, improving efficiencies today whilst "future-proofing" the industry for tomorrow. We wholeheartedly welcome that kind of leadership – and look forward to keeping the pressure on over the next few years!

Part 1 – Concrete Industry Sustainability Performance Report

Introduction

Concrete is one of the most versatile and widely used building materials in the world. It plays a vital role in many aspects of everyday life – from the buildings we work and live in, to the roads, bridges and railways that transport us. It is a key element in the social and economic well being of us all.

Throughout its lifecycle, concrete can deliver real sustainability benefits, but it also has some negative impacts. Sustainability is a key issue for the UK concrete industry. We are tackling the industry's own performance head on, enhancing positive attributes and managing and reducing other impacts through technical innovation and concrete design. The industry is committed to behaving in a responsible way to improve sustainability performance and to deliver sustainable construction solutions.

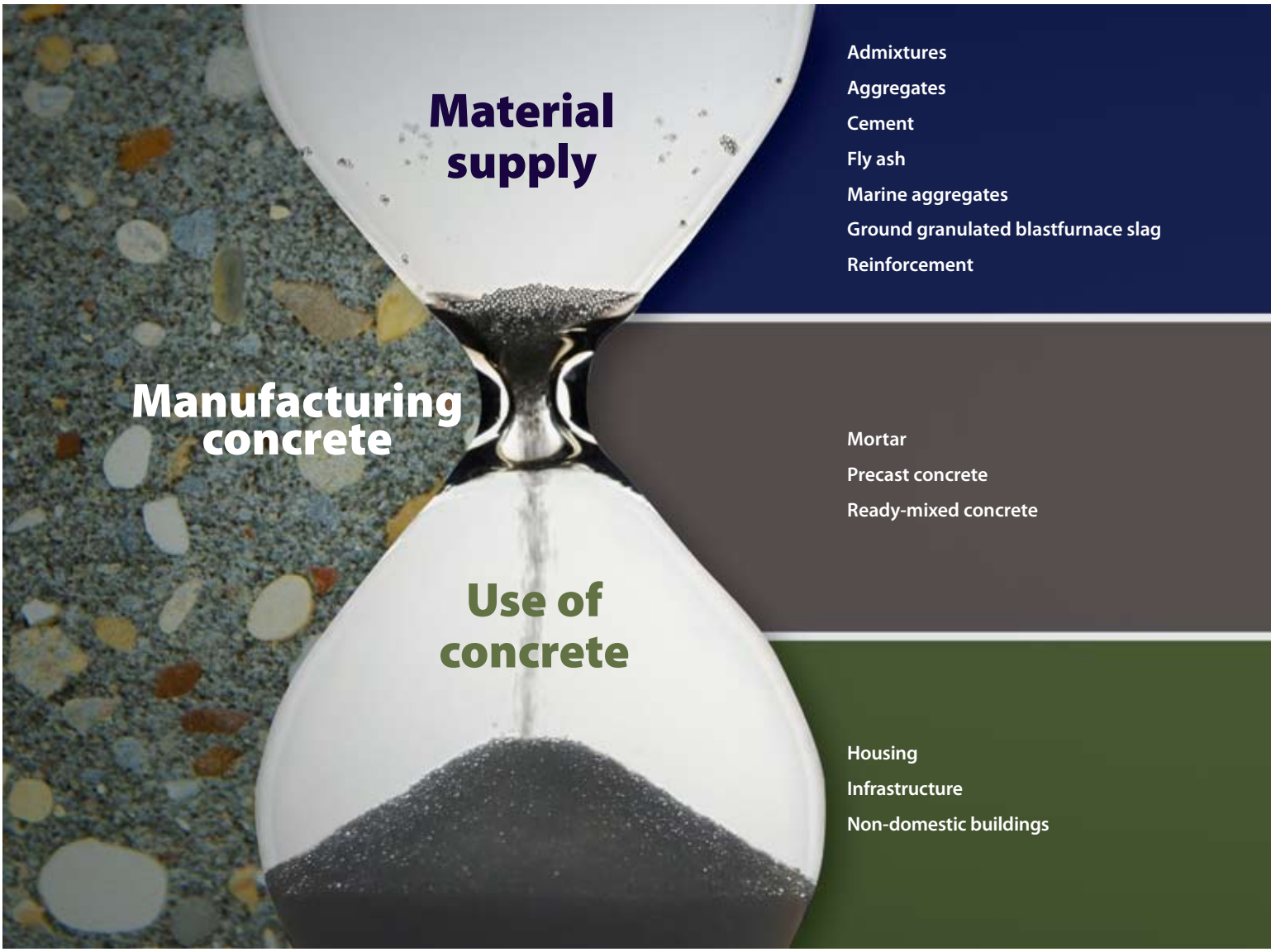
The UK concrete industry is made up of nine sectors, comprising hundreds of companies. Traditionally, sector trade bodies and companies have undertaken stakeholder engagement, improvement programmes and reported sustainability performance[1] separately. These sectors have now come together and committed to a comprehensive cross-industry sustainability strategy which has been developed in collaboration with stakeholders.

This report, produced by the Concrete Industry Sustainable Construction Forum (see page 7), describes the sustainability performance of the UK concrete industry, the current action being taken and its future sustainability strategy. The aim is to help all those with an interest in the supply and use of concrete to develop a better understanding of the industry, its sustainability, and the proactive steps that are being taken to demonstrate its performance.

The approach adopted by the industry is aligned with the UK Government's four sustainable development priorities: Sustainable Consumption and Production, Climate Change and Energy, Natural Resource Protection and Enhancing the Environment, and Creating Sustainable Communities. Under these priorities we have identified 14 sustainability principles, which have been translated into performance indicators.

Part 1 of this report provides an overview of the industry and its sustainability performance. Part 2 gives information on each of our 14 performance indicators in more detail.

Developing a comprehensive sustainable development reporting framework across our industry, with nine sectors and thousands of operating sites, involved considerable commitment. The report provides the latest available information[2]. Historically, companies and sectors have reported individually. Although this will continue, work is now in progress to allow consistent reporting across the industry in the future.



About concrete

In 2007, around 23.5 million cubic metres of ready-mixed concrete and 38 million tonnes of precast concrete products were produced. Depending on its use, different methods of manufacture are practised and a variety of raw materials used. This means that there are a wide range of sustainability issues to consider throughout concrete's life cycle:

- The production and transport of raw materials
- The long term management of our operations and the restoration of our mineral extraction sites
- The production and transport of ready-mixed concrete and precast concrete products
- The process of constructing concrete buildings and other structures
- The operational performance of concrete buildings and structures during use
- The reuse, recycling and disposal of concrete from end of life buildings and structures.

We have considered all of these stages in the life cycle when developing our sustainable construction strategy.

- Approximately 40% of aggregates quarried and dredged in the UK are used for making concrete
- Aggregates for concrete are sourced locally throughout the UK from hundreds of highly regulated operations
- There were 14 cement plants in the UK in 2007 supplying 90% of the country's needs
- Both ground granulated blastfurnace slag (GGBS), a by-product of iron manufacture, and fly ash, a by-product of electricity generation, are used as cementitious materials
- Reinforcing bar for concrete construction produced in the UK is manufactured from recycled steel
- Admixtures are added to concrete to optimise its performance.

- Concrete is a mixture of aggregates, water and cementitious materials
- Most concrete is supplied as either ready-mixed or as precast products
- Nearly 1,000 ready-mixed concrete plants throughout the country supply quality assured concrete
- The local nature of ready-mixed concrete supply is illustrated by the average delivery distance of eight km
- There are around 800 precast concrete factories throughout the UK.

- Concrete is used in virtually every type of construction, from landscaping gardens, to renewing our cities to building the Channel Tunnel Rail Link
- The availability and flexibility of ready-mixed concrete enables designers and builders to produce a huge variety of buildings and structures to meet clients' requirements
- The precast sector produces a vast variety of products ranging from standard size blocks and tiles to custom made bridge beams weighing hundreds of tonnes
- The flexibility that concrete provides means solutions can be found for most building and civil engineering challenges
- The use of concrete is becoming increasingly important in helping society adapt to the consequences of climate change
- Concrete is extremely robust and has a very long life, but is also fully recyclable at the end of life as a raw material for future construction needs.

The contribution of concrete to sustainable buildings and structures

Concrete is extremely versatile, providing designers and builders with the ability to produce aesthetic and functional buildings and structures.

The use of concrete can offer significant sustainability benefits in the life cycle of buildings and structures. Its thermal mass is highly efficient in reducing the energy needed to heat and cool buildings, and it also allows a high level of air tightness. Concrete is highly durable and so needs minimal maintenance and can thus reduce whole life costs. Furthermore, the long life of the material means that concrete structures are appropriate for change of use.

Concrete's mass and damping qualities allow good acoustic performance and minimise movement, reducing floor vibration. This is particularly advantageous for high density accommodation. Concrete is non-combustible and has a slow rate of heat transfer which makes it a highly effective barrier to the spread of fire. The nature of the material also ensures that it is resilient to flood damage.

In July 2008, following 18 months of extensive stakeholder consultation, major companies and trade associations in the industry committed to the overarching 'Sustainable Construction Strategy for the UK Concrete Industry' and to taking a leading role in sustainable construction.

Sustainable Construction Strategy

FOR THE UK CONCRETE INDUSTRIES

We, the undersigned, agree to contribute to the fulfilment of the UK Concrete Industries' vision to be recognised as leaders in sustainable construction; to support the four strategic objectives and to deliver the eight commitments, as outlined in the Concrete Sustainable Construction Strategy dated 30 July 2008 and as summarised here.

We agree as companies to implement these fully, or as trade associations to encourage our members to do so. We will communicate the strategy both internally and externally to try and ensure the commitments become a reality.

As instruments of change, trade associations will facilitate the collection of performance data from members, establish performance benchmarks, agree performance targets with their membership, take part in periodic target setting and reviews at association and industry levels, and contribute to a published annual performance report for the UK concrete industries.

Vision

By 2012, the UK concrete industry will be recognised as the leader in sustainable construction, by taking a dynamic role in delivering a sustainable built environment in a manner that is profitable, socially responsible and functions within environmental limits.

Strategic objectives

1. Agree and adopt a common framework.
2. Improve our environmental profiles.
3. Enable our clients to achieve sustainable construction.
4. Communicate our progress and solutions.

Commitments

1. To launch an annual Sustainability Performance Report for the UK Concrete Industries commencing in March 2009.
2. To set targets for Performance Indicators by the end of 2009.
3. To design an industry R&D Programme to reduce CO_2 and other impacts.
4. To design an industry Skills Transformation Programme aimed at positioning the industry to play a leading role in meeting the challenge of sustainable construction.
5. To provide clients with industry data for LCA (life cycle analysis) models.
6. To develop sustainable construction solutions.
7. To provide clients with the knowledge and tools to adopt new solutions.
8. To demonstrate the benefits of concrete in the built environment.

[Signed] on behalf of [Company]

Bill Bolsover _____ Aggregate Industries
Gonzalo Galindo _____ CEMEX
Patrick O'Shea _____ Hanson
Jim Rushworth _____ Lafarge Cement
Clive James _____ Tarmac
Bill Brett _____ Brett Group
Chris Harrop _____ Marshalls plc
David Walker _____ Trent Concrete
Jeremy Greenwood _____ Lafarge Aggregates

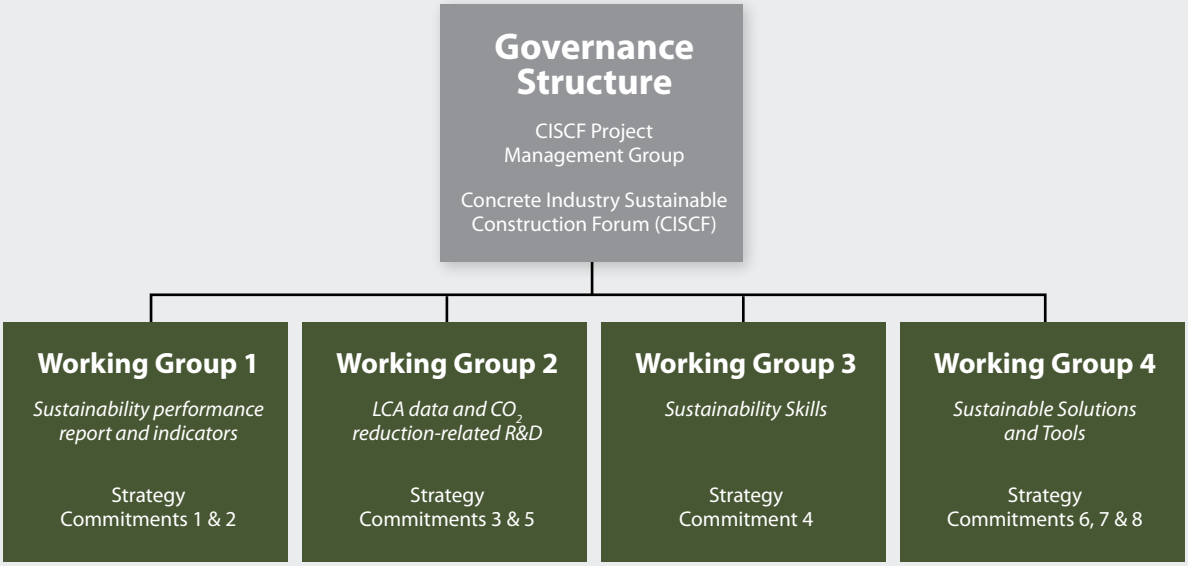
[Signed] on behalf of [Trade Association]

Pal Chana _____ BCA
Lynda Thompson _____ QPA
Martin Clarke _____ BPCF
Denis Higgins _____ CSMA
John Dransfield _____ CAA
Lindon Sear _____ UKQAA

[Signed] on behalf of The Concrete Centre

Ian Cox _____ The Concrete Centre

30 July 2008



Bringing the industry together

As a core part of the strategy we have developed a vision for the concrete industry in 2012. To achieve this we have signed up to four strategic objectives. To deliver these objectives the industry has made eight commitments which are set out on the certificate opposite. The first commitment is to launch an annual sustainability performance report for the UK concrete industry which will provide clarity to our stakeholders about our sustainability performance.

Part 2 of this report gives further details of the industry's performance and the contribution of the various sectors of the industry. The industry will work to ensure that the performance indicators continue to be appropriate and reflect the needs of both industry and external stakeholders.

Governance structure

The concrete industry has taken steps to ensure successful implementation of the strategy by establishing the Concrete Industry Sustainable Construction Forum (CISCF) and associated Working Groups, as shown in the diagram above.

The industry is now committed to an annual reporting cycle. The quality of data and analysis will improve as this process continues to address areas where sectors are collecting data based on different methodologies. The industry will use the reporting structures as a basis for seeking further performance improvements in the sustainability of concrete.

The working groups are also active on Responsible Sourcing and Stakeholder Engagement.

The industry will use the reporting structures as a basis for seeking further performance improvements in the sustainability of concrete.

Representatives of the organisations present at the signing of the sustainable construction strategy declaration (as shown opposite).

Concrete sustainability highlights

Our collective approach to sustainable construction builds upon initiatives and examples of good practice which have been implemented by companies and trade bodies. Some important elements of industry sustainability highlighted by stakeholders are set out below within the framework of the UK Government's four sustainable development priorities.

1. Sustainable consumption and production

- The Sustainable Construction Strategy has been signed up to by all sectors of the concrete industry and by major manufacturers/suppliers.
- Commitment to annual reporting has been made against 14 performance indicators.
- Innovative products have been developed to support sustainable construction.
- The use of quality and environmental management systems are widespread throughout the industry.
- First industry to develop Responsible Sourcing Guidance to accompany the Building Research Establishment's (BRE) Framework Standard for the Responsible Sourcing of Construction Products (BES 6001).

The concrete sector and responsible sourcing

The concrete industry has been at the forefront of the construction industry in the development of responsible sourcing standards.

Responsible sourcing of materials provides a holistic approach to managing a product from the point at which a material is mined or harvested in its raw state through manufacture and processing until its final disposal as waste with no further value.

The concrete industry is the first to issue a guidance document on compliance with the BRE Responsible Sourcing standard BES 6001. The production of this guidance provides a basis for the implementation of this standard in the concrete industry and our supply chain.

Responsible sourcing is demonstrated through an ethos of supply chain management and product stewardship and encompasses social, economic and environmental dimensions. It addresses aspects such as stakeholder engagement, labour practices and the management of supply chains serving materials sectors upstream of the manufacturer.

The launch of the concrete sector guidance took place at an event with BRE on 18 December 2008, at the Building Centre, London. The guidance can be downloaded from **www.sustainableconcrete.org.uk**

The UK concrete industry is committed to playing a full part in helping the Government reduce greenhouse gas emissions by at least 80% between 1990 and 2050.

2. Climate change and energy

- Concrete is used to construct highly energy efficient buildings. Its use can reduce the energy needed for heating and cooling by up to 15% per annum, with an associated reduction in CO_2 emissions.
- CO_2 emissions from cement production have been reduced by over 27% since 1990.
- Reductions in specific energy consumption from cement and ground granulated blast furnace slag (GGBS) manufacture have surpassed their voluntary reduction target for energy efficiency through climate change agreements.
- The average transport distance from ready-mixed concrete plants to the construction site is just eight km.

Carbon management

Carbon dioxide (CO_2) is the most significant greenhouse gas for the concrete industry. CO_2 emissions arise from concrete production and its transport to the construction site. Intelligent concrete design can significantly reduce the CO_2 emitted throughout the life of a building.

CO_2 emissions from buildings represent 40% of total CO_2 emissions in the EU, according to the Energy Performance of Buildings Directive (2002/91/EC). Concrete, due to its high thermal mass, can reduce heating energy consumption by 2 – 15%. In addition, intelligent combinations of heating, natural ventilation, solar shading and building design can reduce energy use for cooling and related CO_2 emissions by up to 50%[3]. The UK concrete industry recognises its key role in delivering innovative construction solutions and in providing information to enable the development of CO_2 efficient designs of buildings and other infrastructure.

In the UK, the embodied CO_2 associated with the production and transport of an average tonne of concrete is 95kg CO_2.

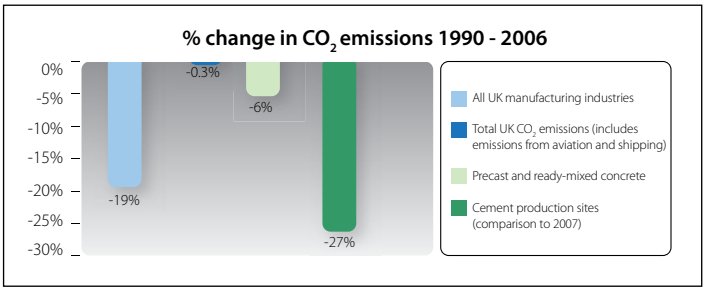
When the total CO_2 emitted by the UK concrete industry is considered, cement is estimated to account for around 85% of these emissions[4]. The rest arises from the production and transport of the other raw materials and from the mixing of concrete and its transport to the construction site.

During cement production about 60% of the CO_2 emissions arise from the chemical reaction which takes place in the kiln. The other 40% come from the combustion of fuels. The cement sector CO_2 performance is closely regulated under the EU Emissions Trading Scheme and the UK's Climate Change Agreements. Through a significant programme of investment in more energy efficient technologies and in using biomass and other waste-derived fuels, the UK cement sector has reduced its CO_2 emissions by 27% since 1990. Consequently, in 2007 CO_2 emissions were over 3.7 million tonnes lower than in 1990.

Further work is in progress but a long term possibility for dealing with the remaining emissions could rest with carbon capture and storage (CCS). The cement industry is undertaking research on CCS solutions but the technology is in its infancy and will take some years to develop.

The UK concrete industry has also been successful in reducing the embodied CO_2 of concrete through the extensive use of GGBS and fly ash as cementitious components in the concrete mix and through the use of factory-made composite cements. The use of these materials can lower the embodied CO_2 of a concrete mix by up to 40%.

Although much progress has now been made by sector trade bodies to measure CO_2 performance, with the exception of the cement sector this information does not date back to 1990. Therefore, to explore the overall performance of the precast and ready-mixed concrete industry Office for National Statistics (ONS) data has been used[5]. The CO_2emissions from the sites manufacturing precast and ready-mixed concrete have reduced by 6.4% between 1990 and 2006. The 27% reduction in CO_2 emissions achieved by the cement sector compares very favourably with the reductions achieved by the UK economy as a whole, and by the manufacturing sector.



When available close to site, recycled aggregates can improve the sustainability of concrete. However, the increased CO_2 generated by transporting recycled aggregates over longer distances by road can result in a less sustainable solution than the use of locally available primary aggregates.

3. Natural resource protection and enhancing the environment

- Concrete manufacture uses by-products from other industries, such as fly ash from power stations, GGBS from the steel industry and recycled and secondary aggregates.
- 100% of the reinforcement bar made in the UK is from recycled scrap.
- The concrete industry is working hard to reduce water consumption and increase the recycling of water.
- The cement industry uses over 1.3 million tonnes of waste from other industries.
- The industry is working to enhance biodiversity at its operations. The UK's Sites of Special Scientific Interest (SSSIs) include 700 current and ex-mineral extraction sites.

Resource use and recycling in the concrete and aggregates sectors

Great Britain produced 23.5 million cubic metres of ready-mixed concrete and around 38 million tonnes of concrete products in 2007. A smaller volume of concrete was also mixed on construction sites.

Aggregates: it is estimated that 80 million tonnes of aggregates were used for manufacturing concrete in 2007. Virtually all of these aggregates were sourced domestically. In addition, an estimated five million tonnes of recycled and secondary aggregates were used to make concrete.

Recycled materials are principally sourced from the demolition of buildings and structures. Research indicates that virtually all "hard" demolition materials are reused in aggregates markets[6]. Secondary materials are by-products of industrial processes such as iron and steel making and other extractive processes. The fine sand arising from china clay extraction in Cornwall and Devon, for example, is used for concrete manufacture.

Twenty-five per cent of the total Great Britain aggregates market, including concrete manufacture and other aggregates uses, is supplied from recycled and secondary sources. This is over three times higher than the recycling rate elsewhere in Europe.

"Aggregates are plentiful in the UK. Friends of the Earth estimated that minerals such as aggregates would last hundreds of thousands of years at current rates of extraction in the UK." [7]

Cement: In 2007 GB cement production was 11.6 million tonnes, while overall market demand was 15.8 million tonnes. The difference was accounted for by imports (1.4 million tonnes) and other cementitious materials (2.8 million tonnes). These other cementitious materials, ground granulated blastfurnace slag and fly ash, accounted for 18% of total supply.

The production of cement required over 16.6 million tonnes of chalk, limestone, sand, clay, and shale. In addition, over one million tonnes of waste-derived materials were used in cement manufacture to supplement the use of these primary materials, and 315,000 tonnes of processed waste materials were used as fuel in cement manufacture.

Concrete in buildings can provide much needed capacity to reduce the need to heat a building in winter and cool it in the summer.

4. Creating sustainable communities

- Sustainable Communities: Building for the Future – government plan launched in 2003.
- A sustainable community is a place where people want to live and work now and in the future, that will improve everyone's quality of life.
- Good design and selection of the right materials can make buildings more sustainable throughout their whole life.
- The civic realm has not always used concrete in the best ways possible – it is up to the industry to show what can be achieved.

Creating sustainable communities with concrete at the core

Sustainable communities need durable, adaptable places for people to live and work in a future that looks very uncertain, both in terms of population demands and climatic and environmental conditions. While we may never see drought conditions that contributed to the ferocity of the wild fires in Australia in February 2009, we can expect to see changes in temperatures, especially in our summers, over the course of the 21st century.

We therefore need to design and build sustainable communities that provide protection from the elements, adaptability during change and security to occupants. All of these goals can be achieved through the intelligent use of concrete – maximising its basic characteristics – in our vertical and horizontal structures.

Thermal mass

Fabric energy storage (FES) or thermal mass provided by exposed concrete can make buildings more comfortable to live in, with lower external energy inputs and therefore lower costs, as shown above in the BREEAM rated 'Excellent' Innovate Green Office, Leeds.

As we face rising temperatures and the subsequent demand to provide comfortable working and living conditions without using air-conditioning, more and more design teams are incorporating the use of thermal mass into their structures.

The dynamic thermal response of high thermal mass buildings with exposed concrete is characterised by a slow response to changes in ambient conditions and the ability to reduce peak temperatures. This is particularly beneficial during the summer, when the concrete absorbs internal heat gains during the day, helping to prevent overheating.

For the best result and the greatest thermal mass or FES effect, concrete needs to be left exposed. Floor coverings, false ceilings and raised floors can severely limit the concrete's ability to absorb and release heat within the occupied space.

The industry has a responsibility to better inform customers, designers and the users about the benefits of exposed concrete, so that our material can be used as more than the strengthening element of the building. So much more can be delivered in order to make communities more sustainable if the thermal mass of concrete is recognised and then used to make a positive contribution to creating high quality internal conditions for occupants throughout the life of a building. The positive contribution from concrete in terms of space heating and cooling can pay back many times over the impacts from creating the material in the first place.

Part 2 – Report on performance indicators

Developing a comprehensive sustainable development reporting framework across our industry, with nine sectors and thousands of operating sites, involved considerable commitment. Historically companies and sectors have reported individually. Work is now in progress to allow consistent reporting across the industry in future. Unless otherwise stated all data in this report is for 2007.

Widespread use of environmental management systems

Three parts of the industry have achieved 100% coverage of certified environmental management systems across their production sites (cement, fly ash and GGBS).

Performance Indicator 1: Environmental management systems

Have systems in place to operate in a legal and sustainable manner with continual performance improvements.

As the concrete industry is UK-based, it operates in a highly regulated environment to exacting standards. Environmental management systems (EMS) are used extensively by the industry. The majority of trade body members have introduced voluntary EMS systems that go beyond legal requirements and are publicly certified.

Different parts of the supply chain face different environmental issues – consistent and robust systems have been implemented to address these issues.

The industry will continue to expand implementation of certified EMS and introduce new Responsible Sourcing Standards to demonstrate sustainable supply chain management and product stewardship.

Sector	**% of production sites covered by a certified Environmental Management System** (such as ISO 14001, EMAS and for SMEs, BS8555 2003)
Materials supply sectors	
Aggregate	61% (654 of 1072)[8]
Fly ash	100% (18 of 18)
GGBS	100% (5 of 5)
Admixtures	86% (6 of 7)
Cement	100% (14 of 14)
Concrete product sectors	
Ready-mixed	51% (estimate)
Precast	81% of production tonnnage[9]

The concrete industry has been at the forefront of the construction industry in the development of Responsible Sourcing. It is the first to issue a guidance document on Responsible Sourcing Standards in compliance with BRE standard BES 6001.

In addition to reducing production waste some companies have introduced take-back schemes to increase recycling rates from construction sites.

Minimising landfill

The concrete industry uses more by-products and secondary materials from other industries than the industry produces in waste.

Performance Indicator 2: Waste minimisation

Manage all waste streams effectively and minimise waste disposed to landfill.

The industry plays an important part in the UK's objective to reduce waste sent to landfill.

Much of the production waste produced in ready-mixed and precast concrete production plants is reused onsite.

Sector	kg of waste to landfill as a proportion of each sector's production output
Aggregate	Unavailable in 2007
Fly ash	0
GGBS	<1kg/t
Admixtures	<1kg/t
Cement	8.5kg/t
Ready-mixed	<10kg/t (25kg/m^3) estimate
Precast	4.9kg/t

The industry will continue to exemplify good practice on waste minimisation and diversion from landfill.

Individual companies are already working with their clients to reduce waste produced on construction sites. The industry will investigate ways of working with client representative bodies to minimise waste onsite. This will support the UK Government Strategy for Sustainable Construction target of reducing construction waste by 50% by 2012.

The cement sector used 1.3 million tonnes of waste as raw materials or fuels in 2007. Against that figure it disposed of less than 83,000 tonnes of process residues, making it a net user of waste.

Investing to reduce emissions

All ready-mixed concrete plants have dust suppression systems in place at the point of manufacture.

Performance Indicator 3: Emissions (excluding CO_2)

Minimise emissions to air and water from the production process (excluding CO_2).

The industry is actively seeking to minimise emissions through a significant programme of investment. The nature of emissions will vary across the concrete supply chain. In the cement sector the major focus has been on successfully reducing emissions such as sulphur dioxide, oxides of nitrogen and dust. In concrete production, issues such as dust suppression, noise pollution and light pollution have been the main focus of emission reduction efforts.

In 2007 there were three convictions relating to emissions (two from the aggregates sector[10] and one from the cement sector[11]).

There are a number of different indicator definitions currently used by different parts of the industry. For instance, the cement manufacturers have collected an array of emissions data, and have set a number of improvement targets[12]. A common data collection methodology is being developed to ensure comparable data can be presented in future reports.

All bulk cements are stored in silos with dust suppression systems.

Being transparent and accountable

The sustainable construction strategy has been developed through extensive stakeholder engagement with sector trade bodies and focus groups with a range of clients. In addition, Forum for the Future has independently reviewed the principles and performance indicators.

Performance Indicator 4: Stakeholder engagement

Communicate and work constructively with the supply chain and other key national stakeholders (see separate 'Local Community' principle for local stakeholder engagement).

This collaboration of the nine production sectors making up the concrete industry is a good example of engaging a supply chain to make a greater impact in improving sustainability performance.

At a concrete industry level, we will focus on engaging with the stakeholder organisations representing our construction industry clients and advisors. We will also engage with government departments, political parties, trade unions, European institutions and other groups with an interest in sustainable development. This will enable joint issues to be identified and actions developed to help achieve the objectives of the UK Government Sustainable Construction strategy.

We will engage with and report annually to our stakeholders.

Individual companies and their representative bodies will also continue to carry out their own stakeholder engagement and report their performance in a transparent manner[1].

As the concrete industry, we will continue to engage with the users of our materials and report annually to all our stakeholders.

Developing sustainable products and services

The industry contributes to sustainable construction through innovative new products and services, such as low embodied CO_2 products, paving that absorbs harmful atmospheric emissions and take-back and recycling schemes for concrete block waste from construction sites.

Performance Indicator 5: Quality and performance

Continue to develop materials and products that contribute to a sustainable built environment.

Quality standards are a well established part of the concrete production supply chain. The industry has produced best practice guidance in this area and will continue working to improve coverage of quality standards, where required.

Increasingly, individual companies are improving the sustainability performance of individual products. There are examples of innovation in products with low embodied carbon, high recycled material content and materials that absorb and 'lock-in' harmful atmospheric emissions.

The industry will continue working to develop an additional performance indicator to measure its contribution to sustainable construction through innovation.

The industry produces a wide range of resources to support designers, specifiers and all users of our products.

Sector	% of production sites covered by a certified ISO 9001 quality management system
Materials supply sectors	
Aggregate	63% (estimate)
Fly ash	100% (18 of 18)
GGBS	100% (5 of 5)
Admixtures	100% (7 of 7)
Cement	100% (14 of 14)
Concrete product sectors	
Ready-mixed	100%[13] (950 of 950)
Precast	80% of production tonnage[14]

Fly ash, GGBS, cement, admixtures and ready-mixed concrete have all achieved 100% coverage for Quality Standards.

Performance data is supplied to support the use of industry standards and tools such as the Green Guide, BREEAM and the Code for Sustainable Homes.

Improving energy efficiency

Energy used during the lifetime operation of the building accounts for about 90% of total energy consumption[15]. Using concrete can reduce the energy needed for heating and cooling by 15% per annum.

Performance Indicator 6: Energy efficiency

Use energy efficiently in production.

Both the cement and GGBS parts of the industry have already exceeded their voluntary reduction target for energy efficiency through climate change agreements. The cement sector improved by 28% compared to a target of 23% and the GGBS sector improved by 15% compared to a target of 12%.

The aggregates and precast concrete sectors also publish energy efficiency performance indicators.

For this and some subsequent indicators, ready-mixed concrete figures are shown on a per metre cubed and per tonne basis to meet the requirements of different stakeholder groups[16].

The industry will continue to look for energy efficiency improvements and is promoting good practice.

The industry will investigate the practicality of developing a performance indicator to measure the energy-efficiency savings made by utilising the thermal mass of concrete in energy efficient buildings.

Sector	Energy used in production as a proportion of each sector's production output
Aggregate	12.7 kWh/t[17]
Fly ash	9.3 kWh/t[18]
GGBS	238 kWh/t[19]
Admixtures	2500 kWh/t[20]
Cement	1194 kWh/t[21]
Ready-mixed	4.6 kWh/t (10.9kWh/m^3) [22]
Precast	52.9 kWh/t[23]

Innovations like self-compacting concrete mean that vibration is no longer needed to ensure compaction. This means that the process is quieter, safer and significantly reduces energy consumption.

Reducing CO_2 emissions associated with production

CO_2 emissions from cement production have reduced by over 27%, from a 1990 baseline. This equates to a reduction in annual CO_2 emissions of over 3.7 million tonnes.

Performance Indicator 7: CO_2 emissions (production)

Minimise CO_2 emissions associated with the production of materials and products.

Sector	CO_2 emissions as a proportion of each sector's production output
Aggregate	4.0 kg/t[24]
Fly ash	4.0 kg/t[24]
GGBS	52 kg/t[24]
Admixtures	380 kg/t[25]
Cement	819 kg/t[26]
Ready-Mixed	1.8 kg/t (4.3 kg/m^3)[24]
Precast	13.5 kg/t[24]

The figures in the above table relate to CO_2 emissions as they were measured and reported by each sector in 2007. Within each sector there is a different mix of energy sources used.

The figure of 819kg CO_2/t of cement refers to the direct CO_2 emissions from cement manufacture in 2007. The industry has also calculated more detailed carbon footprint information for cementitious materials, including the indirect CO_2 emissions associated with electricity and transport. Accordingly, the embodied CO_2 of Portland cement CEM I and of an average cement are 930 kg/t and 880kg/t respectively. This industry research has calculated that the embodied CO_2 emissions associated with the production and transport of an average tonne of concrete in the UK is 95kg. This and more information on embodied CO_2 and concrete is available at: www.sustainableconcrete.org.uk.

Approximately 60% of the CO_2 associated with the production of cement comes from the chemical reactions that are part of transforming raw materials, such as limestone, into Portland cement. The remainder comes from combustion of the fuels used in the process. The cement sector also has a target of reducing direct CO_2 emissions by a further 5.4% per tonne of cement by 2015 (from 2007 levels).

Significant progress has been made in reducing the overall CO_2 emitted during cement production by reducing the fossil fuel consumption through investment in more efficient processes and by using alternatives to virgin fossil fuels. Further work is in progress in this area but a long term possibility for dealing with the remaining emissions potentially rests with carbon capture and storage (CCS). The cement industry is undertaking research on CCS solutions but the technology is in its infancy and will take some years to develop. Concrete is able to react with CO_2 in the atmosphere, a process called recarbonation, and so can recover a proportion of the CO_2 emitted during production thus reducing its overall carbon footprint.

The cement industry is a participant in the EU Emissions Trading Scheme (EU ETS) and has fully met its obligations to date. The third phase of EU ETS will start in 2013 with a severe tightening of the overall emissions cap. A remaining concern is that unless overseas manufacturers face the same carbon costs as EU manufacturers, production and jobs may simply move overseas. Government level discussions to protect against this possibility are underway.

Providing a locally sourced material

The local supply network for concrete means travel distances are short and the fuel used (and associated CO_2 emissions) during haulage is minimised.

Performance Indicator 8: CO_2 emissions (transport)

Minimise CO_2 emissions associated with the transportation of materials and products.

The industry sources its materials from local suppliers, with almost 100% of aggregates coming from within the country. The average delivery distance of ready-mixed concrete to construction sites is eight km, and just over 150km for precast concrete products.

A significant amount of material is delivered using rail, ship and barge, leading to lower CO_2 emissions.

The cement sector has calculated that (based on 2004/2005) the CO_2 emissions relating to cement transport were less than 1% of total CO_2 emissions associated with cement production and transport.

Sector	Average delivery distance by mode	Average load
Material supply sectors		
Aggregate	Road - 35 km	21.3 t
	Rail - 144 km	1726 t
	Inland barge - 49 km	256 t
Concrete product sectors		
Ready-mixed	Road - 8.3 km	14.3 t (6m^3)
Precast	Road - 155 km	28 t

The data available to report fully on transport CO_2 emissions requires more development. We are working to include this in future reports.

Recycling for the most sustainable solution

Recycled aggregates can improve the sustainability of concrete when the aggregates are available close to the manufacturing site.

Performance Indicator 9: Materials efficiency

Use all primary, secondary and recycled materials in the most efficient manner.

The concrete industry used around 100 million tonnes of raw materials in 2007. Action is being taken to substitute primary materials by secondary and recycled materials. However, more recycled content does not always lead to the most sustainable solution, for example due to increased road transport distances. When available close to site, recycled aggregates can improve the sustainability of concrete. However, the increased CO_2 generated by transporting recycled aggregates over longer distances by road can result in a less sustainable solution than the use of locally available primary aggregates. Bulk supply of recycled or secondary materials by rail or water can be a sustainable option. The proportion of recycled materials in the GB aggregates supply chain, currently at 25%, is the highest in Europe.

	Secondary/recycled aggregates
Total GB aggregates sales (2007) of which:	285 mt
Primary aggregates	214 mt
Secondary/recycled materials	71 mt
Secondary/recycled share	25%

The concrete industry also plays a significant role in solving the waste disposal challenges of other industries. For example, the cement sector now uses over 315,000 tonnes of processed waste materials as fuel and over one million tonnes of waste as raw materials. This approximate 20% replacement of fossil fuels with waste-derived materials equates to a saving of over 330,000 tonnes of coal. The aggregate sector also used 23 million litres of recovered fuel oil.

The industry will continue to work to increase our levels of waste-derived fuel use as a proportion of total fuel. This will provide a valuable continuing solution for disposal of waste from other industries. It is a cost effective approach to achieving improved sustainability performance for the industry and also the wider economy.

The cement sector aims for a 50% replacement of fossil fuels by fuel comprising waste material by 2020 as part of its Environment Agency Sector Plan. BCA member companies now use a wide range of waste-derived fuels. In 2007, the amount of replacement of fossil fuels consumed reached 19%, of which four per cent was classed as biomass. Substitute liquid fuels, produced from the by-products of solvent recycling, have been used for 15 years in the UK. In the same period, the industry has introduced tyres – used both chipped and whole – meat and bone meal, sewage sludge pellets and paper and plastics as energy sources. Whatever the source material, the criteria remain the same: fuels must be compatible with cement manufacture, while their use must be both safe and have no negative impact on the environment.

Other cementitious materials (fly ash and GGBS – both of which are by-products from other industrial processes) account for around 18% of total cementitious consumption.

	Cementitious materials
Total cementitious consumption	15.8 mt
GB cement production	11.6 mt
Cement imports	1.4 mt
Other cementitious materials	2.8 mt
Other cementitious materials share	18%

The industry will continue to develop and use more additional cementitious materials to reduce the amount of primary materials used and reduce embodied CO_2.

In total, millions of tonnes of industrial by-products are used in the manufacture of concrete with no effect on performance other than a reduction in environmental impact.

Improving monitoring and management of water

Water is a limited resource. The concrete industry is making efforts to increase efficiency and recycling.

Performance Indicator 10: Water

Use water efficiently and minimise demand on mains water.

Water is used both as a constituent material and as part of the production process, for example in cooling plant at cement works, to clean out ready-mixed trucks and in recovering aggregates from returned concrete.

Sector	Mains water used as a proportion of each sector's production output
Aggregate	48 l/t
Fly ash	0
GGBS	11 l/t
Admixtures	650 l/t
Cement	45 l/t
Ready-mixed	59 l/t (140 l/m^3)
Precast	110 l/t

Total mains water use by the industry is estimated at just over 12 million cubic metres[28].

The industry is working to spread good practice in minimising mains water use. Further indicators are being developed to measure groundwater use.

Contributing to biodiversity, geodiversity and heritage

Seven hundred Sites of Special Scientific Interest (SSSI) in the UK are current and ex-mineral extraction sites.

Performance Indicator 11: Site stewardship

Be responsible stewards of sites used, by recognising the importance of national heritage, biodiversity and geodiversity during use and after the end of life of each site.

Biodiversity is a key element of the concrete industry's sustainable construction strategy at the mineral extraction phase.

Numerous bird species breed in quarries and pits including the Sand Martin, Ringed Plover, Peregrine Falcon, Kestrel and Raven. Leaving areas of suitable habitat undisturbed during the breeding season can encourage these birds to nest in non-operational areas. In this way, they can be encouraged to nest where they will be undisturbed by quarry operations and other human activity.

Archaeologists recognise that mineral working often provides them with valuable opportunities to recover and investigate evidence of the past.

Aggregate and cement companies have ongoing programmes for the restoration of their quarries in consultation with local communities, which has resulted in a broad range of developments such as housing, recreation and leisure activities, shopping centres, wildlife conservation, education centres and cycle paths.

The industry will continue to promote good practice on the stewardship of its production sites. The minerals industry is actively supporting the Nature After Minerals initiative of RSPB and Natural England, designed to encourage greater awareness and understanding of the opportunities for habitat creation.

Reducing incidents towards a zero target

All parties recognise that even a single injury is unacceptable. Significant progress has been made to reduce incidents, but more must be done to achieve a target of zero.

Performance Indicator 12: Health and safety

Operate in a responsible manner to protect the health and safety of employees, contractors and visitors.

Significant improvements have already been made:

- Reportable injuries down 75% (1999 – 2007) – *Quarry Products Association*
- Lost time incidents down 59% (2003 – 2007) – *British Cement Association*
- Reportable injuries down 65% (2000 – 2007) – *British Precast Concrete Targets 2010 scheme*

Much of this improvement has been achieved through identifying and disseminating best practice. For example, the safequarry.com website is one element of a package of resources that encourages the sharing of health and safety knowledge across the quarrying and quarry products industry. "Sharing Good Practice" is the new name for a series of hard copy guides that contain examples of best practice. The first of these also contained a DVD featuring over 60 video clips presenting innovations in health and safety.

The quarrying sector has set a further target of reducing Lost Time Incidents by 50% by 2014 (from a 2009 baseline).

Sector	Reportable injuries per 100,000 direct employees per year	Absolute number
Material supply sectors		
Aggregate	549	77
Fly ash	0	0
GGBS	1030	2
Admixtures	0	0
Cement	742[29]	24
Concrete product sectors		
Ready-mixed	636	36
Precast	731	219

The industry is currently developing the indicator for health and safety to include contractors and visitors, and continues to work towards zero incidents.

The quarrying sector is making progress in achieving its 'hard target' of a 50% reduction in reportable injuries by 2009 (from 2004). There were 152 reportable injuries recorded by all members of the QPA in 2007, down 75% since 1999.

Providing jobs and training our workforce

Over 50,000 people are directly employed in the UK concrete industry, often supporting rural economies.

Performance Indicator 13: Employment and skills

Continue to support sustainable communities by providing employment and economic activity and recognise the importance of developing a skilled and competent workforce.

The industry provides employment opportunities throughout the UK, often in rural locations where limited alternatives exist.

The concrete industry has a majority of production sites certified to BS EN ISO 9001. This standard provides an audited process to ensure each member of staff has the relevant qualifications for their current activities and provides a framework for developing competence for future career progression.

The UK Government Strategy for Sustainable Construction includes a target for the *'development of an action plan for driving a training culture in the building products sector'* [30]. The industry will continue to develop activities in skills development in line with the action plan as it emerges.

Sector	Number of employees and contractors	% of employees covered by certified ISO 9001/ ISO 14001/ OHSAS 18001 systems (Training & Competence)
Material supply sectors		
Aggregate	36.686 direct and 49,674 indirect[31]	61%[32]
Fly ash	50 direct	100%
GGBS	190[33] direct	100%
Admixtures	Not available for 2007	100%
Cement	3,233 direct and 15,000 indirect[34]	100%
Concrete product sectors		
Ready-mixed	2,800 direct	100%[13]
Precast	20,666 direct	80%

The industry is working to develop a performance indicator for skills that supports the achievement of the relevant Government Sustainable Construction targets. Indicators such as the proportion of employees with NVQ II or equivalent qualifications are currently under consideration.

Engaging with the local community

Community involvement has been a major part of the concrete industry for many years. Liaison with local communities minimises conflict and seeks to maximise benefits to the wider community.

Performance Indicator 14: Local community

Positively engage with the local community.

There are around 3,200 quarries and concrete production sites in the UK. Most sites are on industrial parks or physically shielded from local communities. However, some sites are close to neighbours.

It is acknowledged that, as with any other production industry, there is potential for these local communities to be adversely affected by impacts associated with production, such as transport movements and noise pollution, if these impacts are not managed in a sensitive manner.

The industry is very active in working with local communities to maintain good working relations. The industry applies the most appropriate community engagement tools including liaison groups, newsletters, forums and websites.

Sector	Indicator - % of relevant production sites with community liaison activities
Materials supply sectors	
Aggregate	55% (307 of 554 sites responding)[35]
Fly ash	100% (18 of 18)[36]
Cement	100% (14 of 14)[37]
Concrete product sectors	
Ready-mixed	Unavailable in 2007
Precast	32% (39 of 122 sites responding)[38]

The industry will continue to develop proactive communications with local communities. We would like to encourage feedback, and ask for suggestions on how the measurement and reporting of this activity should be developed.

Appendix A – Stakeholder interest, our current activity and future plans

UK Government 'Shared Priority'	Sustainability Principle	Stakeholder Interest	What we are doing	What we will do next
Sustainable Consumption and Production	Environmental Management Systems	Are firms managing the environmental implications of their businesses in a responsible manner? Are products sourced legally?	Environmental management systems are used widely in the concrete industry. We have also been closely involved with developments of new Responsible Sourcing Standards	Our focus will now be to maximise the number of companies that build Responsible Sourcing into the way they do business
	Waste Minimisation	Too much waste is going to landfill from construction sites and industry in general	We use more by-products and secondary materials from other industries than we produce (as wastes or by-products) ourselves	We will increase the amount of by-products and secondary materials we use and work to reduce the amount of waste both we and construction sites produce that goes to landfill
	Emissions (excluding CO_2)	Concern about pollution to the air from cement kilns	The cement sector has worked closely with the Environment Agency to reduce harmful emissions and has exceeded reduction targets	The cement sector has established a new sector plan to 2020 which will lead to further reductions in emissions
		Concern about noise, light and dust pollution and discharges to watercourses from concrete production	Management systems include monitoring of discharges and action plans to ensure compliance and continual improvement	Work as trade organisations to develop best practice with regulatory authorities and then disseminate best practice throughout the industry
		Concern about amount of traffic to and from quarries (associated road safety, noise and congestion)	The quarrying industry has promoted the use of safe driving schemes and engaged with local communities at site level to agree acceptable operational arrangements	Continue to review modes of transport used, vehicle specification and utilisation to minimise impacts
	Stakeholder Engagement	Concern about companies today only prioritising their bottom line and not considering their responsibilities to other stakeholders, organisations and the wider public	The Concrete Industry Sustainable Construction Forum is working with stakeholders outside the industry. The strategy development process consulted with external stakeholders on the development of the 14 performance indicators	We have developed a strategy for sustainable construction which has four key objectives and eight commitments. A wide range of stakeholders will be involved in delivering these commitments
	Quality & Performance	Receiving products that are consistently best-in-class is a key requirement for UK construction. The industry is also now demanding new and more sustainable products and solutions	Quality systems are widely used in the concrete industry. There are an increasing number of examples of innovation resulting in sustainable products and services	We are developing a more coordinated approach to research & development to increase the level of innovation and the development of more sustainable products and services
Climate Change and Energy	Energy Efficiency	Energy costs are rising and fossil fuel sources becoming more difficult to access. The industry needs to reduce its energy consumption	The cement and ground granulated blastfurnace slag sectors have worked with Defra on voluntary Climate Change Agreements. They have both exceeded their energy reduction targets of 23% (actual 28%) and 12% (actual 15%) respectively	We will do more to reduce energy use across the industry. This will include targeted programmes of activity to spread good practice
	CO_2 Emissions (Production)	Concrete production must be responsible for a sizeable amount of CO_2 emissions in the UK. Significant reductions are needed in CO_2 emissions to help the UK meet the 80% reduction target by 2050	The cement sector has reduced CO_2 emissions by over 27% since 1990. Our activities have included investment in more efficient factories, replacing fossil fuels with waste-derived fuels and using materials with lower embodied CO_2	We will do more to improve energy efficiency and substitution of fossil fuels with waste-derived fuels and renewables. The cement sector has a target to reduce direct CO_2 by an additional 5.4% per tonne of cement by 2015 (from 2007 levels)
	CO_2 Emissions (Transport)	Shipping products long distances is not sustainable because of the CO_2 emissions	We are a local supplier with low delivery distances from our factories to our clients. Therefore, our transport CO_2 emissions are low. The quarrying industry uses transport modes such as rail and inland barge, which accounts for around 15 million tonnes	Continue to strive to maintain local sources of supply and develop improved data on transport to fully understand and minimise our impact. While we have some data on transport miles we are planning more work to develop the way we collect data to fully understand our impact
Natural Resource Protection and Enhancing the Environment	Materials Efficiency	Concrete uses a lot of natural materials and the industry needs to be smarter to use less materials	We recycle most of our process waste and help our clients reduce waste on site by better design and initiatives such as take-back schemes	We will continue to promote good practice in design and activities which will reduce the amount of waste our clients send to landfill. This will be done through targeted sector programmes
		The industry needs to reuse and recycle more to minimise use of virgin material	We support the use of recycled materials where this results in the most sustainable solution. We use by-products and secondary materials as both waste fuels and a substitute for virgin material	We will continue to promote the use of the most sustainable products and solutions - we will use recycled material where it is appropriate
	Water	Concrete production uses a lot of water in the manufacturing process. The industry should use as little water as possible and recycle as much as possible	There is widespread use of water-reducing admixtures in concrete production - which can reduce water consumption by up to 30%. There are numerous company-level examples of water recycling	We will do more to encourage the adoption of good practice in water minimisation across the industry and will develop an indicator for groundwater use in addition to mains use
	Site Stewardship	Concern about a negative impact on wildlife and biodiversity. More should be done to minimise this impact and restore the damage at the end of use	Mineral extraction sites provide many opportunities to improve habitat in comparison with previous land use - we minimise impacts on existing habitats. Over 700 Sites of Special Scientific Interest are current or ex-quarries	Will continue to develop action plans on sites where appropriate and continue to work with stakeholders who have an interest in our sites
Creating Sustainable Communities	Health & Safety	One incident is too many - Industry, in general, should do more to protect their workforce	We have worked hard to reduce incidents in the industry with individual sectors achieving significant reductions. However, more continued effort is required	Our future activity will continue towards our aim for zero injuries
	Employment & Skills	Businesses need to respect, support and develop their workforces. What sort of employers are your companies?	Management systems in place include the review of training needs of staff and the provision of training required	We will work to develop a performance indicator for skills, such as the proportion of employees with NVQ II or equivalent qualifications or other similar metric linking into certified ISO9001/ISO14001 systems (Training and Competence sections)
	Local Community	Local communities can experience positive and negative impacts associated with quarrying, cement production and concrete production. The industry needs to work with communities to maximise the former and minimise the latter	As a part of their local community, our production sites engage with other members of the community formally and informally. There are numerous examples of the positive contribution industry members have made	We will continue to develop and promote good practice in local community engagement, such as that encapsulated in the Cement Makers Code

References and Notes

1. For the most recent versions of sector reports, please contact the trade associations overleaf.
2. Unless otherwise stated, all data quoted in this report are for 2007.
3. *Concrete for Energy-Efficient Buildings: The benefits of thermal mass,* European Concrete Platform ASBL, 2007.
4. *Cement, Concrete & Sustainability – a report on the progress of the UK cement and concrete industry towards sustainability,* British Cement Association, 2002.
5. Estimate based on Office for National Statistics data for 'Concrete, Stone etc' CO2 emissions. Greenhouse Gas Emissions by 93 Economic Sectors 1990 to 2006. (see: www.statistics.gov.uk/statbase/Expodata/Spreadsheets/D5695.xls).
6. Survey of Arisings and Use of Alternatives to Primary Aggregates in England 2005, Construction and Waste, DCLG, 2007.
7. McLaren, Bullock & Yousef, *Tomorrows World: Britain's Share in a Sustainable Future,* Earthscan, 1997.
8. Figure includes aggregates, asphalt, ready-mixed concrete, mortar and industrial sand operations as published in QPA SD report 2008 (see www.qpa.org).
9. British Precast collect data as a per cent of production rather than as a per cent of production sites.
10. Refers to *'pollution and planning infringements',* as published in QPA SD report 2008 (see www.qpa.org).
11. Reported as *'number of successful prosecutions'* in BCA Performance report 2008 (see www.cementindustry.org.uk), acccording with the Environment Agency sector plan as *'Number (number by type) of enforcement notices, formal cautions and successful prosecutions'.*
12. These can be viewed in the BCA Performance Report 2008 (see www.cementindustry.org.uk).
13. Reflects sites operated by BRMCA / QPA members – whole number of sites for the whole UK industry is estimated to be 1,100.
14. British Precast collect data as a per cent of production rather that per cent of production sites.
15. Smith S., Matthew J. and Whitelegg N., *Life cycle analysis of Housing,* Housing Studies, 1997.
16. Customers of ready-mixed concrete typically specify in cubic metres. To be able to compare figures across different parts of the industry data has also been converted into tonnes using a factor of 1 cubic metre = 2.38 tonnes.
17. Energy sources include delivered electricity, natural gas, gas oil, diesel and fuel oil.
18. Energy source is electricity only expressed in terms of primary energy.
19. Energy source is delivered electricity expressed in terms of primary energy and mains gas.
20. Figure refers to average of all admixtures production. Figures are taken from industry Environmental Product Declarations which cover cradle to factory gate.
21. Energy sources include delivered electricity expressed in terms of primary energy and combustion fuels used as a source of thermal energy in cement production in accordance with the UK Climate Change Agreement guidance and definitions.
22. Energy source is electricity only expressed in terms of delivered energy.
23. Energy sources include electricity, gas and gas oil/diesel with electricity expressed in terms of delivered energy.
24. Conversion factors taken from Guidelines to Defra's Greenhouse Gas Conversion Factors (June 2007).
25. Figure is based on data from six Environmental Product Declarations for different admixture types, averaged by UK sales volumes. The figures available at www.sustainableconcrete.org.uk for carbon footprint calculations show data for a Water Reducing Admixture, at 220 kgCO_2/t.
26. The cement figure 819 kg CO_2/t of cement refers to the direct CO2 emissions from cement manufacture in 2007 as reported in the BCA Performance report 2008. Specific conversion factors are in accordance with EU ETS Monitoring and Reporting Guidelines.
27. New objectives and targets for 2015 of the Environment Agency Sector Plan for the cement sector, as reported in BCA Performance report, November 2008.
28. This estimate does not include water used in admixture production due to lack of available data.
29. Figure refers to Lost Time Accident (LTA). BCA definition of an LTA = an accident at work, which renders an employee or contractor unable to perform their normal range of duties for a period of one or more days. (Note HSE RIDDOR uses a three day period).
30. *Strategy for Sustainable Construction,* HM Government in association with the Strategic Forum for Construction, 2008.
31. Figures include totals for aggregates, ready-mixed concrete and concrete products. Future work will aim to clarify the sector employment figures.
32. Estimated based on the coverage of production sites by Environmental Management Systems (see PI 1).
33. Based on number employed by Civil & Marine.
34. Actual figure for 2007 number of direct employees; BCA estimate for number of indirect employees based on previous data.
35. Based on number of quarries recorded with community liaison groups.
36. All UKQAA member power stations have a community engagement programme, a formal system of complaints, provision of work experience positions and support for community projects including school visits.
37. Based on the BCA indicator *'Proportion (and number) of plants using community communication tools'* as reported in BCA Performance report 2008.
38. Based on British Precast indicator *'Number of factories operating formal local liaison schemes during the year'.*

Concrete Industry Sustainable Construction Strategy is supported by:

Aggregate Industries
Brett Group
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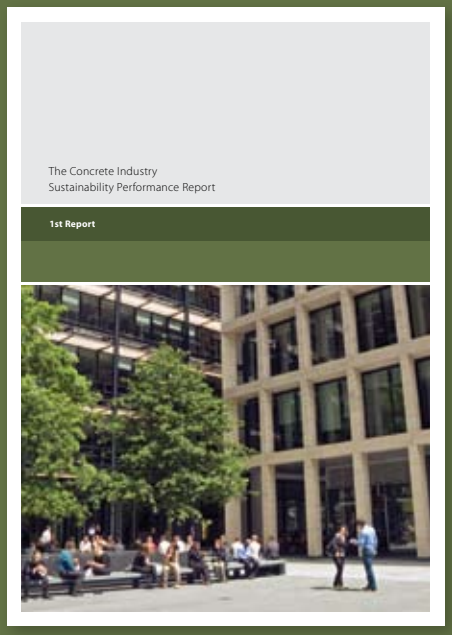
British Cement Association*
British Precast
Cement Admixtures Association
Cementitious Slag Makers Association
Quarry Products Association*
The Concrete Centre*
UK Quality Ash Association

For details of all companies that have supplied data in this report, please contact the relevant trade associations.

* The British Cement Association, Quarry Products Association and The Concrete Centre merged in March 2009 to form the Mineral Products Association.



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