

## The Cement Sustainability Initiative (CSI)



### Cement Industry Energy and CO<sub>2</sub> Performance Getting the Numbers Right (GNR)

# Table of Contents

Quotes from CEOs.....	3
Foreword.....	4
About Getting the Numbers Right .....	5
Its beginnings .....	5
The journey .....	6
Data collection and reporting .....	6
Data management .....	7
Data analysis .....	8
Publication of information .....	9
Who is using GNR?.....	10
Some examples .....	10
Benefits of participation .....	10
GNR: 10 years on the go!.....	11
Coverage trends.....	11
GNR results demonstrate the cement sector’s achievement.....	12
Energy efficiency .....	12
Alternative fuel use.....	13
Percentage of clinker in cement .....	14
GNR: Looking into the future .....	16
The Paris Agreement.....	16
Pursuing continuous expansion in coverage .....	16
Addressing other emissions.....	16
Conclusion.....	17
Glossary.....	18
References and resources.....	19

## Quotes from CEOs

The GNR database has played a crucial role in developing the CSI's excellent reputation among all kinds of stakeholders. Building on a rigorous protocol, external validation and independent data aggregation, it provides important information on CO<sub>2</sub> emissions and energy consumption in the cement sector to both CSI member companies and external stakeholders alike, including academia, governments, NGOs and international organizations. GNR is rightly considered a flagship project of the CSI and is certainly a model that other sectors should follow.

**Fernando González Olivieri**, CEO, CEMEX

Building on 15 years of collaboration, the CSI and its members are scaling up their efforts through the implementation of business solutions to the climate challenge. Getting the Numbers Right (GNR) is the focal point of this effort, showing strong commitment of all participating companies. We have to move ahead and further contribute to the transformation of the construction sector towards carbon neutrality. This will require operational excellence, innovation and a collective approach across the value chain.

**Eric Olsen**, CEO, LafargeHolcim

## Foreword

American businessman Henry Ford once said: “Coming together is a beginning, keeping together is progress and working together is success.”

The Cement Sustainability Initiative (CSI) began more than 15 years ago, when 10 cement companies came together to identify possible collaborative ways to better tackle the twin challenges of climate change and CO<sub>2</sub> emissions from their sector. Animated by this collaborative spirit, they have remained together, attracted additional members to join the initiative, and progressed towards elaborating sustainable solutions through the development of transparent and commonly agreed methodologies to measure, report and verify their energy consumption and CO<sub>2</sub> emissions.

Today, several cement companies (CSI members and beyond), representing about 1,000 plants worldwide, report their energy consumption and CO<sub>2</sub> emissions according to the CSI’s *CO<sub>2</sub> and Energy Accounting and Reporting Standard for the Cement Industry* (the *Cement CO<sub>2</sub> and Energy Protocol*). This instrument, known and used worldwide, is customized for use in the cement sector and based on the *Greenhouse Gas Protocol* designed by the World Business Council for Sustainable Development (WBCSD) and the World Resource Institute (WRI).

Once all companies involved started reporting according to the same methodology, the next step was the development of a sectoral database. The Getting the Numbers Right (GNR) database is unique to the industry and remains the most comprehensive public database on CO<sub>2</sub> and energy information of any industry. It offers a sound and verified analytical basis for aggregate CO<sub>2</sub> emissions and energy consumption data and allows the industry to monitor and compare performance across regions, year-on-year. It also allows CSI members to pilot the performance of their plants by benchmarking their own indicators against those of the sector. Developed and managed under strict compliance with anti-trust requirements, the GNR is emblematic of the CSI’s success in working together.

Indeed, what gets measured gets managed. The data—uniform, accurate and verified by third parties—drives understanding of the sector’s CO<sub>2</sub> mitigation efforts and could become a baseline to define individual goals for companies and to sustain dialogue with policymakers. With various national and international schemes to manage carbon likely to emerge in the future, the use of benchmarking tools such as the GNR will become more commonplace in business planning and risk assessment.

The GNR has also underpinned important collaboration with the International Energy Agency (IEA), the International Finance Corporation (IFC) and regional cement trade associations to develop low-carbon technology roadmaps describing the route and levers to reach CO<sub>2</sub> emissions reductions. For example, this powerful tool and its reliable data enabled the development of the ambitious Low Carbon Technology Partnerships initiative (LCTPi) for the cement sector in the run up to the Paris climate conference in December 2015.

The path to deeper success consists in expanding global and regional GNR coverage to enhance the representativeness of the sector’s performance (particularly in regions and countries where coverage is limited). The CSI will continue to work with its partners to encourage industry participation in the GNR and to promote efforts of this kind in diverse areas such that other sectors can gather and develop similar or comparable tools applicable to their sector and compatible with internationally recognized methodologies.

**Philippe Fonta**  
**Managing Director, Cement Sustainability Initiative (CSI)**

## About Getting the Numbers Right

Getting the Numbers Right (GNR) is an independently managed database of CO<sub>2</sub> and energy performance information on the global cement industry. Through the database, all participating companies and interested stakeholders can access standard, Web-based reports. The database's administrators also answer individual queries about specific issues within strict confidentiality guidelines.

The database delivers uniform, accurate and verified data, and includes key emissions and performance drivers. It provides policymakers with current performance data to aid in analysis and decision-making.

The database complies with anti-trust laws and is managed by an independent third party service provider. Individual participants may only see reports based on their individual company data or aggregated results. Confidential information on individual

### Its beginnings

Almost 25 years ago, in 1992, governments came together at the United Nations Conference on Environment and Development (UNCED)<sup>1</sup> to outline a global strategy to reduce human impact on the environment. The so-called Earth Summit was a major milestone in consolidating these concerns into tangible initiatives designed to reconcile worldwide economic development with protection of the environment. The United Nations Framework Convention on Climate Change (UNFCCC)<sup>2</sup> was one of these agreements. By 1996, the participation of business in the Earth Summit evolved into the World Business Council for Sustainable Development (WBCSD).<sup>3</sup>

In 1999, 10 of the world's leading cement producers joined forces under the auspices of the WBCSD, seeking to identify the essentials of sustainability for their sector and to design pathways to improved performance. The group commissioned the Battelle Memorial

companies or plants is neither disclosed nor made accessible, and is protected by contractual and data security measures.

Joining the GNR system provides access to state-of-the-art data and analysis of the cement industry's global and regional performance, allowing participants to benchmark their own performance, track their emissions inventories, and develop sound, data-based responses to company and regional climate management issues.

GNR's reliable data reveals the achievements of the cement industry over the years in tackling climate change. In the future, the CSI aims to expand the database's coverage and thus how the global cement industry is viewed, leading to reaching the overarching goal of reducing carbon emissions and energy consumption.

Institute<sup>4</sup> to review the essence of sustainability for the cement industry. The institute's 2002 report identifies critical sustainability issues for the cement industry, catalogues and evaluates industry performance, recommends actions for improvement, and provides tools for all cement producers to use in improving their performance.

Based on the results from the Battelle study, the group published an *Agenda for Action* in the same year and the Cement Sustainability Initiative (CSI) was officially launched. In the very beginning, the initiative focused primarily on CO<sub>2</sub> emissions and climate protection, the responsible use of fuels and raw materials, employee health and safety, emissions monitoring and reduction, and local impacts on land and communities. Importantly, climate change was seen as a priority issue.

---

<sup>1</sup> <http://www.un.org/geninfo/bp/enviro.html>

<sup>2</sup> <http://unfccc.int/2860.php>

<sup>3</sup> <http://www.wbcd.org>

<sup>4</sup> <http://www.battelle.org>

In 2003, the CSI delivered a CO<sub>2</sub> emissions inventory protocol specific to the cement industry. This protocol, aligned with the World Resources Institute (WRI)<sup>5</sup>-WBCSD *Greenhouse Gas (GHG) Protocol*,<sup>6</sup> successfully maps the global standard for how to measure, manage and report GHG emissions throughout the

## The journey

By 2006, society's focus on climate change had intensified. The Kyoto Protocol,<sup>7</sup> agreed in 2005, was the stimulus for the design of many national and regional mitigation programs. The chief executives of CSI member companies were perplexed by the absence of reliable information on the cement sector and, indeed, by the occasional appearance of doubtful data in debates on the climate change performance of the sector. In October 2006, they committed the CSI to develop representative statistical information on CO<sub>2</sub> emissions and the energy performance of clinker and cement production, both worldwide and regionally, to serve the needs of internal and external stakeholders. The Getting the Numbers Right (GNR) database was born. The CSI appointed PricewaterhouseCoopers (PwC)<sup>8</sup> as the

## Data collection and reporting

The *CO<sub>2</sub> and Energy Accounting and Reporting Standard for the Cement Industry*<sup>11</sup> is the basic building block of the GNR. Version 3.1 (published in 2011) is the current version in use. Developments have focused on clearer definitions of emission drivers, such as fuel types, clinker substitutes, power consumption and material chemistry. Each GNR participant reports according to the *Cement CO<sub>2</sub> and Energy Protocol* every year for each of its operating facilities. The facility-level information is grouped into national reports before data is collected by PwC. To ensure a

complicated cement making process. It has become a valuable tool for the cement sector, with its focus on the drivers of emissions in addition to the emissions themselves. It offers users practical insights into their climate change performance and possible mitigation strategies.

database's independent, confidential manager.

The first GNR report was published in 2007. Annual reports have been published each year since, with data available at [www.wbcdcement.org/GNR](http://www.wbcdcement.org/GNR).

Data from GNR has been used in the creation of baselines for Clean Development Mechanism (CDM)<sup>9</sup> projects, in the development of national and global sectoral roadmaps,<sup>10</sup> in the modelling of national mitigation strategies, and in the preparation of corporate carbon emissions reduction plans. GNR has charted the progress of the cement sector since 1990 in improving energy efficiency and reducing CO<sub>2</sub> emissions. It has become the leading sectoral database on climate change.

high standard of data collection and reporting, GNR provides training to all participants.

Complying with strict anti-trust requirements, GNR does not publish data for any year within 12 months of its calendar year end. For that reason, data collection for any year begins in September of the following year. Additionally, reports on individual participants are not available except to the participant alone. Corporate reports are made available to participating companies exclusively.

PwC provides an automated collection tool to help participants in uploading their data. This

---

<sup>5</sup> <http://www.wri.org>

<sup>6</sup> <http://www.ghgprotocol.org>

<sup>7</sup> [http://unfccc.int/kyoto\\_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php)

<sup>8</sup> <http://www.pwc.com>

<sup>9</sup> <https://cdm.unfccc.int>

<sup>10</sup> <http://www.wbcdcement.org/technology>

<sup>11</sup> <http://www.wbcdcement.org/co2protocol>

tool contains a number of macros that identify errors in the reports which must be addressed before data upload. PwC carries out further checks on the uploaded data before proceeding to report development. The whole process takes about four months.

The data collected at facility level includes:

- Clinker and cement production;
- Absolute gross and net emissions;
- Thermal energy consumption and fuel details;
- Power consumption;
- Process emissions;
- Use of mineral components and the proportion of clinker in cement.

## Data management

Verification of data and governance of data handling are crucial elements of the GNR project.

### Verification

All CSI members ensure that the data reported to the GNR is independently verified to the minimum of a “moderate” assurance standard.

The data of those facilities operating within emissions trading schemes (for instance, the European Union Emissions Trading System (EU ETS)<sup>12</sup>) is normally verified to a “reasonable” level to comply with the specific requirements of the respective schemes.

### Governance

**PwC** operates the GNR database according to separate contractual confidentiality agreements with the CSI and with participating companies. Only PwC analysts, who have committed to these confidentiality agreements, have access to the data. All CSI and GNR management teams are strictly forbidden from accessing the data.

As the independent manager of the GNR system, PwC is responsible for ensuring that any data which can be traced back to individual companies or plants will neither be disclosed nor made accessible to any unauthorized internal and external stakeholder. PwC also provides a guarantee of non-disclosure of confidential information and compliance with competition law.

As in all businesses, acquisitions, divestments and mergers occur regularly. To ensure company reports cover the correct scope and include historical data for newly participating facilities, the data collection each year includes all historical data for each participant. Therefore, historical reports for particular regions and countries change occasionally.

Participation in GNR is open to all cement producers and is not limited to CSI members. In the current database, a notable number of cement producers in Europe and in Latin America are reporting via their respective regional trade associations.

GNR expects participating companies that are not members of the CSI to commission independent verification and strongly encourages them to adopt data assurance practices as part of their participation.

In 2014, participants reported that 42% of data was verified to a reasonable standard, with 35% verified to a moderate standard.

The requirement to maintain confidentiality also prevents the release of individual facility data in GNR reports. Only consolidated data is published to ensure no inference can be made about specific facilities or individual participants.

As a general rule, there must be four or more independent operators in a country for aggregated reports on the country to be

---

<sup>12</sup> [http://ec.europa.eu/clima/policies/ets/index\\_en.htm](http://ec.europa.eu/clima/policies/ets/index_en.htm)

released. Some GNR charts report detailed performance on a technology basis. Reporting data on a particular technology is allowed only

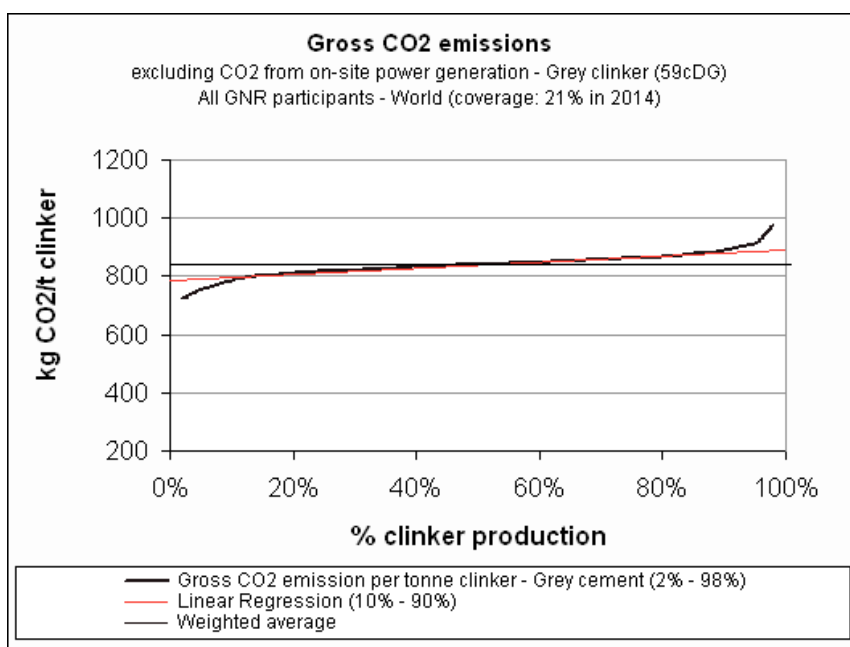
if there are at least three facilities and three companies using that technology within the geographic scope of the report.

The **Project Management Committee (PMC)** responsible for the management of the GNR project comprises representatives of participating companies and trade associations, the CSI Secretariat and PwC. As with all project management teams, the responsibilities of the PMC cover the project budget, the smooth running of the program and the quality of the deliverables.

## Data analysis

All GNR data collected is consolidated and analyzed by PwC. Generally, all published reports are in chart form, including simple pie charts and bar charts describing actual performance and historical performance.

Additionally, cumulative frequency distributions are presented to show the profile of national or regional performance for a particular issue.



Formula of the linear regression between 10% and 90%	$y = 1.02x + 788$
Regression coefficient (r <sup>2</sup> ) between 10% and 90%	0.98

Weighted average	842 kg CO <sub>2</sub> /t clinker
Corresponding percentage	54%
Standard deviation	101 kg CO <sub>2</sub> /t clinker

Number of plants	618
Total production volume in the graph	660 Mt clinker



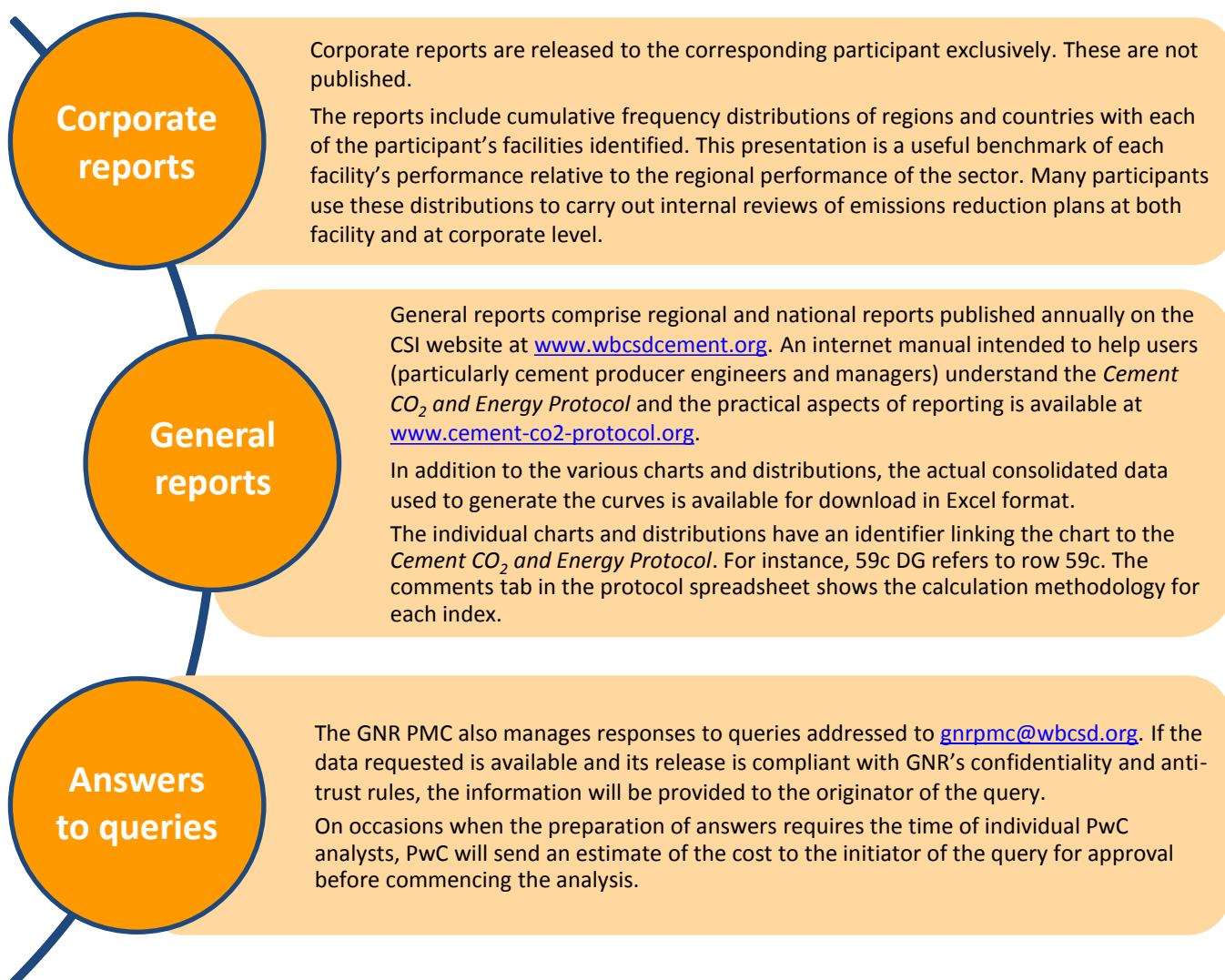
The horizontal axis of cumulative frequency distributions shows the percentage of the total production that has a performance better than or equal to the corresponding value in the vertical axis. These values are called percentiles. The tenth percentile, P10, corresponds to the 10<sup>th</sup> best % in the class.

Currently, PwC’s analysis generates reports for the following regions, countries and agencies.

Africa	Czech Republic	Morocco, Algeria & Tunisia
ASEAN <sup>13</sup>	Egypt	North America
Asia	EU 28 <sup>14</sup>	Philippines
Austria	Europe	Poland
Brazil	France	South America (excluding Brazil)
Canada	Germany	Spain
CEMBUREAU	India	Thailand
Central America	Italy	UK
China, Japan & Korea	Latin America	US
CIS	Middle East	World

## Publication of information

GNR releases information and analysis in three ways:



<sup>13</sup> Association of Southeast Asian Nations

<sup>14</sup> The 28 member states of the European Union (EU)

## Who is using GNR?

GNR reports are available to the public at [www.wbcscement.org/GNR](http://www.wbcscement.org/GNR). An average of more than 200 visits (for 1,175 page views) per month reflects keen interest in the cement sector's climate protection performance.

### Some examples

- The California Air Resources Board<sup>15</sup> consulted GNR when modelling strategies to implement Assembly Bill 32, the California Global Warming Solutions Act of 2006.<sup>16</sup>
- Both Italcementi and CRH, global cement manufacturing companies and CSI members, developed baselines and monitoring programs for Joint Implementation and CDM projects using GNR data and the *Cement CO<sub>2</sub> and Energy Protocol*.
- The UNFCCC has used GNR in the development and testing of standardized baselines to assess additionality of CO<sub>2</sub> emissions reduction projects under the CDM.
- Information from the GNR provided the baseline for the 2009 *Global Cement Technology Roadmap*<sup>17</sup> developed in partnership by the IEA<sup>18</sup> and WBCSD.
- Bain and Company<sup>19</sup>, a leading business consultancy, used GNR data to prepare an energy-efficiency program for the cement sector in the Kingdom of Saudi Arabia.
- Quantis International<sup>20</sup> relied on GNR information to support default values in the Environmental Product Declaration (EPD) tool for concrete.
- The US Department of Energy<sup>21</sup> used GNR data for research into climate change mitigation.

The most regular users of GNR data are the participating companies that regard the confidential corporate reports as excellent

benchmarking tools that clearly identify underperformers and provide reasonable signposts towards improvement.

### Benefits of participation

For a **cement company**, participation in GNR provides a set of well managed tools to:

- Build and manage company-wide CO<sub>2</sub> inventories;
- Simulate impacts on emissions from production changes, new plant additions, closures, and technology changes;
- Benchmark company performance with other industry players at global and regional levels.

As the monetary value of CO<sub>2</sub> emissions grows, such tools are increasingly part of normal business and project analysis.

For **trade associations**, the GNR provides a credible source of verified industry-wide and regional information to anchor discussions about climate policies and their potential impacts with their respective governments.

---

<sup>15</sup> <http://www.arb.ca.gov>

<sup>16</sup> <http://www.arb.ca.gov/cc/ab32/ab32.htm>

<sup>17</sup> <http://www.wbcscement.org/technology>

<sup>18</sup> <http://www.iea.org>

<sup>19</sup> <http://www.bain.com>

<sup>20</sup> <http://www.quantis-intl.com>

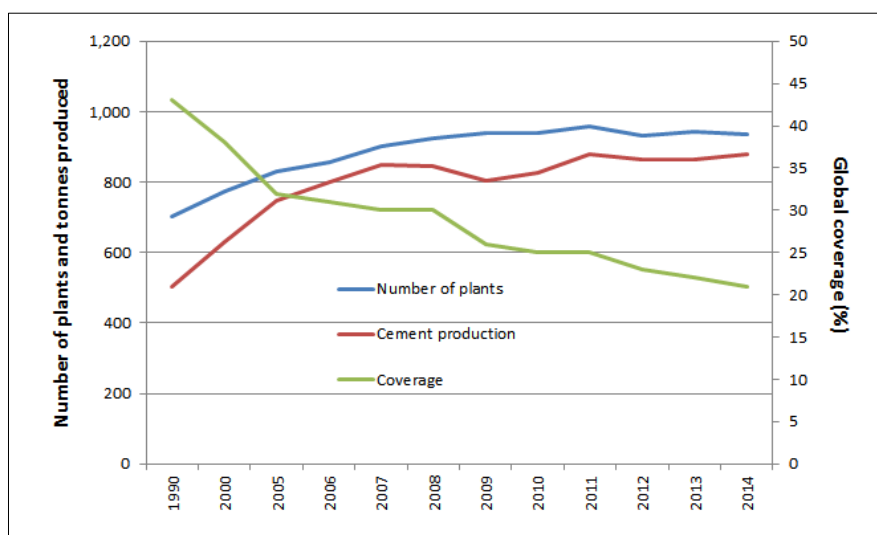
<sup>21</sup> <http://www.energy.gov>

# GNR: 10 years on the go!

## Coverage trends

Since 2006, the CSI has focused on the GNR database's coverage. In absolute terms, the number of participating plants has grown by 33% since 1990, the initial baseline year. GNR has welcomed the participation of all cement producers, not just CSI members, since the beginning of the project.

GNR global coverage



The European Cement Association (CEMBUREAU)<sup>22</sup> joined the GNR in 2007 and the Federacion Interamericana del Cemento (FICEM)<sup>23</sup> joined in 2011. In addition to valuable reports for their members, GNR offers insights to cement trade associations on their performance relative to the rest of the world.

GNR organizes training courses for all participants and to trade associations that wish to encourage their members to participate.

The courses cover the *Cement CO<sub>2</sub> and Energy Protocol* in addition to the GNR reporting tools and interpretation of reports.

The dramatic rise in China's cement production in relation to global cement volume has reduced GNR's global coverage percentage. The CSI continues to engage in discussions with Chinese cement producers and the Chinese authorities to encourage participation in the project.

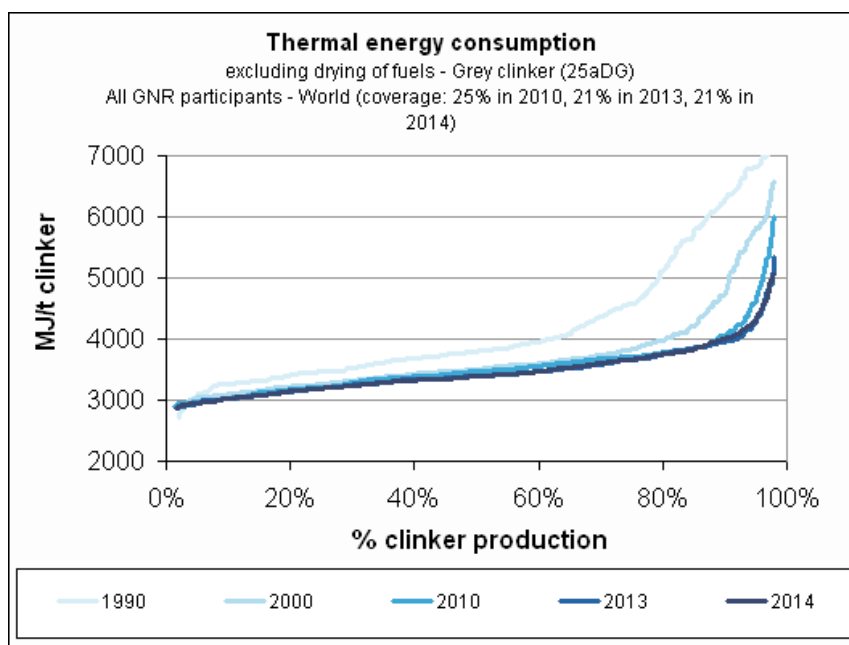
<sup>22</sup> <http://www.cembureau.be>

<sup>23</sup> <http://www.ficem.org>

# GNR results demonstrate the cement sector's achievement

## Energy efficiency

Within the cement sector, the two most significant uses of energy are kiln fuel to make clinker and electricity to power all drives.



Since 1990, the sector has invested heavily to reduce kiln fuel use. The cumulative frequency diagram (cfd) of global thermal energy consumption shows the impact of the investment at the high-energy-use end of performance. The proportion of clinker produced using more than 4,000 MJ/t has reduced from 38% to only 7%. This transition, at a standard capacity cost of €150 per annualized tonne of clinker, represents an investment of over €30 billion in energy-efficient projects by GNR participants.

An effect of the transition to energy efficiency has been the phasing out of the traditional wet process kiln. From 1990 to 2014, wet production by GNR participants fell from 61 million to 16 million tonnes. Wet kilns now operate only to produce niche products, supply small markets or to use very wet raw materials.

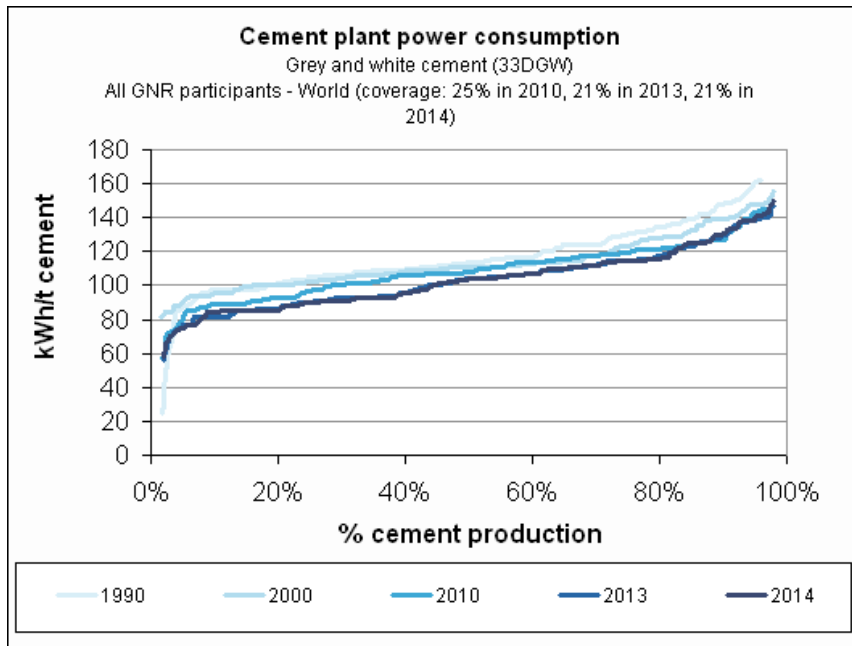
It is worth noting that the change in the proportion of clinker made using less than

3,000 MJ/tonne has hardly changed because the most efficient technologies are close to the theoretical thermodynamic limit of energy consumption for cement clinker manufacturing. These technologies have been available since 1980. Such technological barriers push the sector to use lower cost and less carbon-intensive fuels to control kiln fuel costs and to reduce carbon emissions.

Progress has also been achieved in reducing electricity use. The sector has reduced power consumption per tonne of cement by 10% across its spread of performance.

The wide spread of performance is due to the large range of cement product fineness required by concrete makers for the many products their customers need.

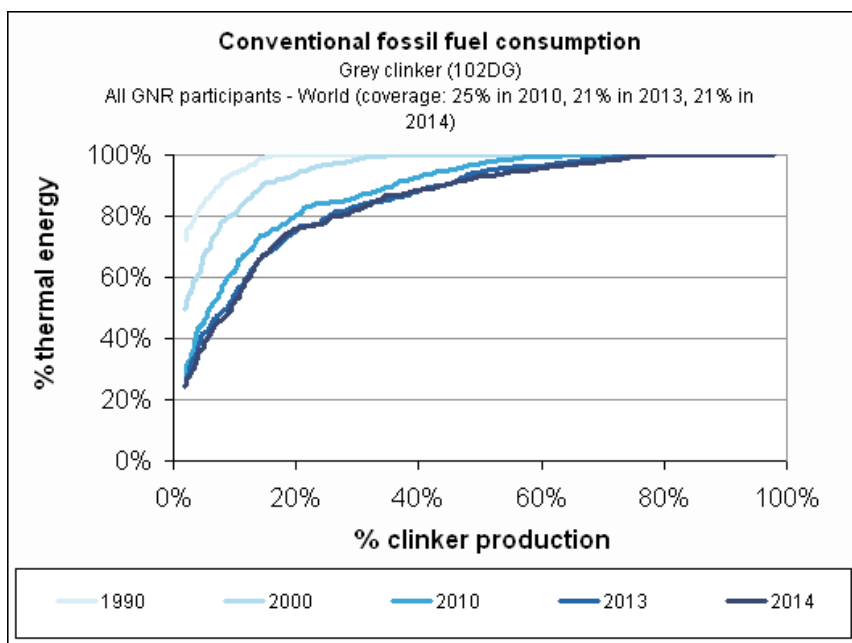
The ease of grinding raw materials also drives power consumption: milling hard limestone is harder than milling soft chalk.



### Alternative fuel use

The cement sector has traditionally used oil, gas, coal or petcoke as kiln fuel. In recent years, various alternative fuels have emerged as practical, lower cost and less carbon-intensive replacements for conventional fuels. The array of alternative fuels now in use is diverse, ranging from rice husks to fuels recovered from refuse, and to spent solvents from other industry sectors.

The CSI has led change in the sector by publishing the *Guidelines for Co-Processing Fuels and Raw Materials in Cement Manufacturing (2014)*<sup>24</sup> and *Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process (2005)*. These two publications outline criteria and operational standards for the use of alternative fuels and materials. In 1990, 85% of clinker produced by GNR participants was made using conventional fuels exclusively. By 2014, this had fallen to only 23%.



<sup>24</sup> <http://www.wbcscement.org/fuels>

Of course, the use of alternative fuels varies around the globe. In some countries, alternative streams are not available. In others, it is difficult to obtain permits for the use of alternatives. These barriers notwithstanding, the use of alternative fuels is one of the important opportunities available to the

The lower carbon intensity of alternative fuels is due to the fraction of biomass and to the higher contribution of hydrogen to the calorific value compared to coal or oil.

cement sector to impact carbon emissions. Using alternative fuels also serves the communities in which plants operate by using waste streams from other industries and indeed from the communities themselves as fuels.

Region	% conventional fuel (2014)
CIS	99
China	98.2
India	97
North America	85.6
Brazil	85.6
Europe	59.4

Fuel	Carbon intensity (Kg CO <sub>2</sub> /GJ)	% of carbon as biomass
Coal	96	0
Fuel oil	77.4	0
Gas	56.1	0
Paper	110	100
Tires	85	27
Mixed industrial waste	83	40

## Percentage of clinker in cement

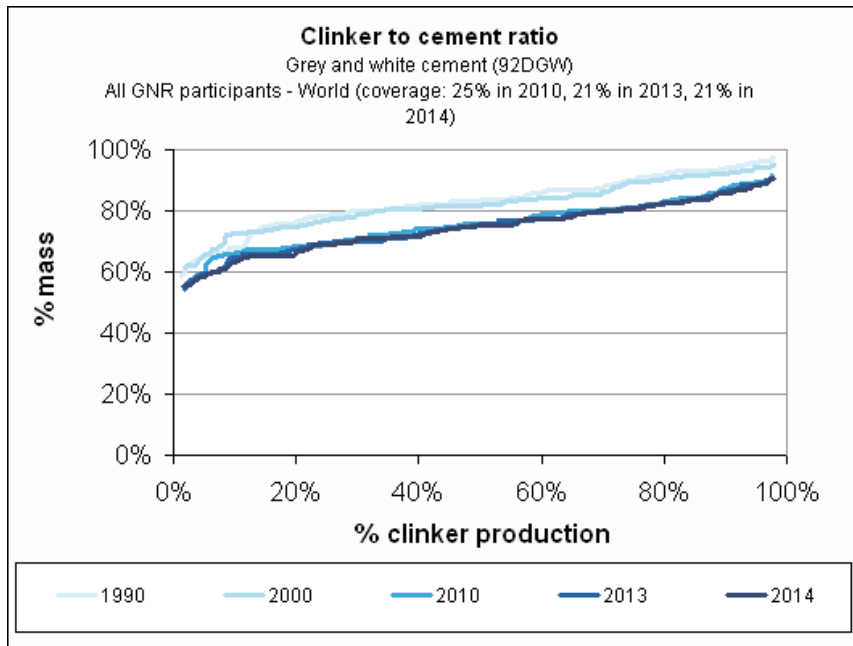
Clinker is the carbon-intensive component of cement. Cement is made by milling clinker with gypsum and other minerals into a fine powder. The other minerals include limestone, blast furnace slag and fly ash.

Reducing the clinker-to-cement ratio is a strong driver of carbon emissions reductions in cement manufacturing.

Since 1990, the mean of clinker use in cements produced by GNR participants has fallen from 83% to 75%. Because of the wide range of cement products, the spread of clinker content is also wide. While the availability of replacement mineral components contributes to this spread, the key factor lies with the

Mineral component	Millions tonnes (2014)
Gypsum	38
Limestone	62
Pozzalana	16
Blast furnace slag	42
Fly ash	35
Others	9

customs and practices in many countries of adding mineral components to the concrete mixer rather than to the cement mill. In the United States for instance, the mean clinker in cement is 84.5% because all fly ashes and slags are added at the concrete plant.

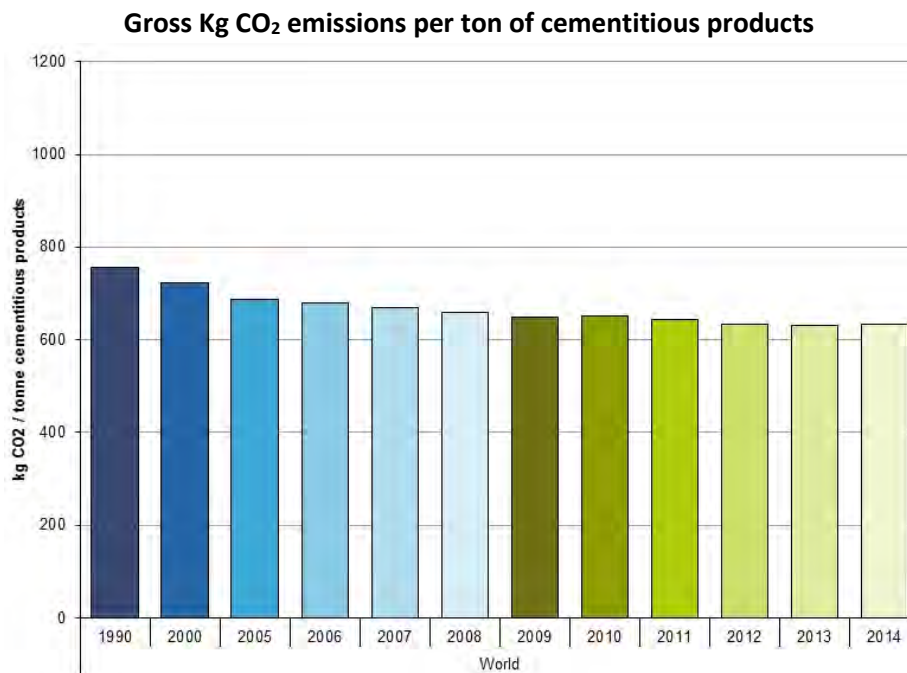


Participants in the GNR use massive volumes of mineral components. Other sectors often control the availability of these minerals. For instance, the phasing out of coal-fired power generation will reduce the volumes of fly ash available and will change the composition of cement.

The mineralogy and reactivity of the clinker is the key enabler of clinker content reductions in cement. Improvements in the chemical

stability of kiln feed and the optimization of flame profiles have been the twin drivers of the development of clinker mineralogy allowing for this reduction.

Significant investment in more efficient kilns, higher fossil fuels substitution, increased use of biomass and improved clinker mineralogy, as mentioned above, has allowed the cement industry to continually improve its emissions reductions.



# GNR: Looking into the future

## The Paris Agreement



The December 2015 Paris Agreement was a significant watershed moment for the global climate change strategy of States, governments, businesses and stakeholders. The key aim of this UNFCCC accord is the curtailment of the increase in the global average temperature to well below 2°C above pre-industrial levels. Countries ratifying the

Agreement will implement national plans to reduce GHG emissions in order to achieve nationally determined contributions (NDCs)<sup>25</sup> according to the overall UNFCCC program. The regional and national reports from databases like GNR are useful tools for plan design and modelling for NDCs that feature the cement sector.

## Pursuing continuous expansion in coverage

GNR coverage of regions and countries is robust, with the exception of China, the Middle East and CIS. A key target of the CSI is to

enhance the significance of the GNR database in these regions by increasing the participation of their cement facilities.

## Addressing other emissions

Regular queries made to the GNR seek information on other emissions, typically NOx and SOx.

While these emissions are not relevant to climate change, the GNR system offers a well-

tested methodology for the collection and reporting of emission data. Therefore, the CSI may consider developing the scope of the database to encompass these other emissions from cement plants in the future.

<sup>25</sup> [http://unfccc.int/focus/ndc\\_registry/items/9433.php](http://unfccc.int/focus/ndc_registry/items/9433.php)



## Conclusion

Cement is the key constituent of concrete, which is the second most consumed material on the planet. Modern cement plants have capacities well in excess of 1 million tonnes per year. It requires the equivalent of 60 to 130 kilograms of fuel oil and 110 kWh of electricity to produce one tonne of cement. The cement industry produces 5% of global man-made CO<sub>2</sub>. Plants in the developing world, where the industry continues to expand and develop new sites, may be cleaner and more efficient than those in the developed world which were built 10, 20 or even 30 years earlier.

Given this backdrop, CSI member companies designed and built the Getting the Numbers Right database in order to help the cement industry and policymakers alike better assess the influence of kiln technology, fuel selection, plant location and other variables on global and regional plant performance and emissions management.

Data is collected by GNR system participants using the CSI-developed *CO<sub>2</sub> and Energy Accounting and Reporting Standard for the Cement Industry* (2011). The most recent version includes new indices with data on electricity use in clinker production and on electricity generation using waste heat. The use of the *Cement CO<sub>2</sub> and Energy Protocol* as the basis of the data ensures consistency in

both data input and analysis, and thus reliable and broadly applicable output.

The GNR database now covers data up to 2014 (competition law concerns recommend a one-year time lag in publishing data). It has grown over the years to cover 934 individual facilities producing 889 million tonnes of cement. This represents 21% of global cement production.

The 2014 results show the cement industry maintaining the improvements of recent years. Specific net emissions (discounting the use of alternative fuels) are 19% below 1990 levels. Including the emissions saved by using biomass, participating companies have avoided 110 million tonnes of CO<sub>2</sub> emissions. This has been achieved through significant investments in more efficient kilns, greater substitution of fossil fuels, increased use of biomass, and improvements in clinker mineralogy, reducing the clinker content of cement.

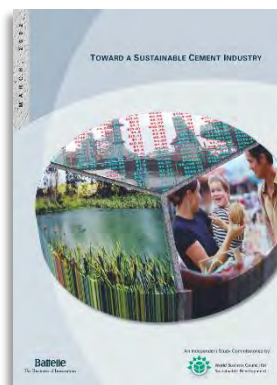
The CSI has designed the GNR system as an open platform to encourage organizations globally to join and participate, contributing data in order to build the broadest dataset possible for analysis and use. The ultimate goal is to use the database to drive further improvements by the sector—in terms of technologies, sustained energy management and innovation.

## Glossary

<b>Alternative fossil fuels</b>	Products of fossil origin used as a source of thermal energy and not classified as traditional fossil fuel. This is mainly fossil waste such as plastics, solvents, waste oil, end-of-life tires, etc.
<b>ASTM</b>	American Society for Testing and Materials.
<b>Biomass</b>	Products from biogenic origin used as a source of thermal energy, including from animal or plant origin. This is mainly waste from agriculture, forestry, biological waste water treatment and agro-industry.
<b>Cement</b>	The finished product of the cement plant delivered to the customer, obtained by grinding clinker together with various mineral components such as gypsum, limestone, blast furnace slag, coal fly ash and natural volcanic material. While cement qualities are defined by national standards (such as the European CEN and American ASTM standards), there is no worldwide harmonized definition of or standard for cement. In the <i>Cement CO<sub>2</sub> and Energy Protocol</i> and the GNR database, “cement” includes all hydraulic binders that are delivered to the final customer, i.e., including all types of Portland, composite and blended cements plus ground granulated slag and fly ash delivered to the concrete mixers, but excluding clinker. The precise definition of cement in this context is according to section 6.3 of the <i>Cement CO<sub>2</sub> and Energy Protocol</i> .
<b>CSI</b>	Cement Sustainability Initiative
<b>Cementitious products</b>	Total of all cements and clinker produced by a cement company, excluding the clinker purchased from another company and used to make cement. The precise definition of cementitious product in this context is according to section 6.2 of the <i>Cement CO<sub>2</sub> and Energy Protocol</i> . Cement is equal to cementitious product when the net balance of clinker sold and purchased is neutral (at the corporate level).
<b>CEN</b>	European Committee for Standardization, Comité Européen de Normalisation.
<b>Clinker</b>	Intermediate product in cement manufacturing and the main substance in cement. Clinker is the result of calcination of raw materials in the kiln.
<b>Climate neutral</b>	CO <sub>2</sub> emissions that are equal to the amount of CO <sub>2</sub> absorbed from the atmosphere during the growth of biomass.
<b>Company level</b>	Used for the performance indicators for cement or cementitious product at the level of a company, possibly including several clinker and/or grinding installations, for the production of cement or cementitious products.
<b>Gross CO<sub>2</sub> emissions</b>	All direct CO <sub>2</sub> emissions (excluding on-site electricity production) excluding CO <sub>2</sub> emissions from biomass, which are considered climate neutral.
<b>Installation or plant level</b>	Used for any performance indicator, excluding cement or cementitious product, at the level of an individual installation for the production of clinker and/or cement.
<b>Net CO<sub>2</sub> emissions</b>	Gross CO <sub>2</sub> emissions minus emissions from alternative fossil fuels.
<b>System limits of CO<sub>2</sub> emissions</b>	Direct CO <sub>2</sub> emissions related to the production of clinker and cement according to the <i>Cement CO<sub>2</sub> and Energy Protocol</i> , excluding emissions from on- and off-site electric power production.
<b>Traditional fuels</b>	Fossil fuels defined by the Intergovernmental Panel on Climate Change (IPCC) guidelines, mainly including: coal, petcoke, lignite, shale, petroleum products and natural gas.
<b>WBCSD</b>	World Business Council for Sustainable Development

# References and resources

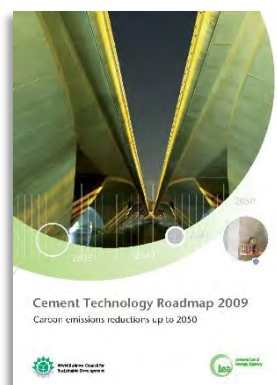
All CSI publications are available at [www.wbcscement.org/publications](http://www.wbcscement.org/publications)



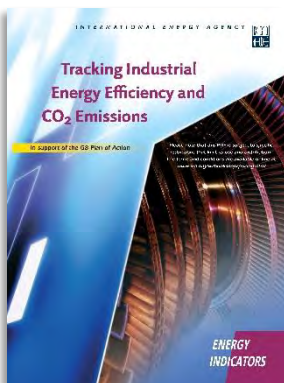
- **Battelle Scoping Study Battelle: Towards a sustainable cement industry** (2002) – study made on behalf of the WBCSD



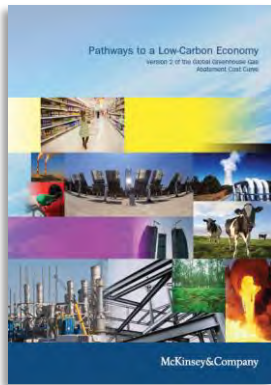
- **CO<sub>2</sub> and Energy Accounting and Reporting Standard for the Cement Industry** (v3.0, 2011)



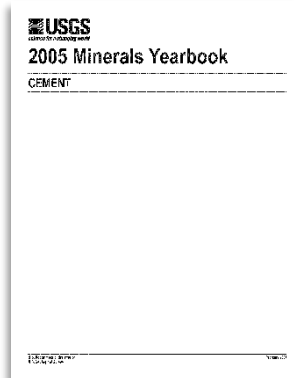
- **Cement Technology Roadmap: Carbon emissions reductions up to 2050** (2009) – details available at [www.wbcscement.org/technology](http://www.wbcscement.org/technology)



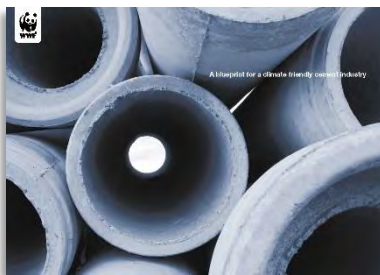
- International Energy Agency's (IEA) **Tracking Industrial Energy Efficiency and CO<sub>2</sub> Emissions** (2007) – [www.iea.org/publications/freepublications/publication/tracking\\_emissions.pdf](http://www.iea.org/publications/freepublications/publication/tracking_emissions.pdf)



- McKinsey & Company's *Pathways to a low-carbon Economy, version 2 of the Global Greenhouse Gas Abatement Cost Curve* (2009) – [www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/pathways-to-a-low-carbon-economy](http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/pathways-to-a-low-carbon-economy)



- United States Geological Survey's (USGS) *2005 Minerals Yearbook: Cement* (2005) – [minerals.usgs.gov/minerals/pubs/commodity/cement/cemenmyb05.pdf](http://minerals.usgs.gov/minerals/pubs/commodity/cement/cemenmyb05.pdf)



- World Wide Fund for Nature's (WWF) *A blueprint for a climate friendly cement industry* (2008, by Nicolas Müller and Jochen Harnisch, Ecofys Germany) – [wwf.panda.org/wwf\\_news/?151621/A-blueprint-for-a-climate-friendly-cement-industry](http://wwf.panda.org/wwf_news/?151621/A-blueprint-for-a-climate-friendly-cement-industry)