

BCG

THE BOSTON CONSULTING GROUP

The Cement Sector: A Strategic Contributor to Europe's Future



Table of Contents

Executive Summary	3
1 The cement industry’s contribution to Europe’s priorities.....	7
1.1 Societal challenges.....	7
1.2 The cement industry: a good fit for Europe	8
2 Return on investment is key for the cement industry.....	14
3 Helping Europe to achieve its goals.....	22
3.1 Investment in sustainable construction: multiplier effect on the European economy.....	22
3.2 The cement industry is committed to innovation in Europe	25
3.3 A competitive cement industry can further Europe’s environmental goals	28
3.3.1 Emissions dropping through the whole production process.....	28
3.3.2 Waste management pioneers.....	31
3.3.3 Concrete as the cornerstone for sustainable construction	34
3.3.4 Contributing to biodiversity and ecosystem services.....	38
4 A call for action.....	40
5 Glossary	42
6 Documents consulted	48
7 Sources of information.....	49
8 Note to the reader	500

Executive Summary

Europe is facing numerous societal challenges, with a population that will continue to grow over the coming decades coupled with the current trend for urbanisation. As a result, more sustainable cities that provide access to affordable, energy-efficient housing, as well as efficient transport systems, are essential. This growth must be harnessed in a sustainable manner, by taking into consideration the environmental, economic and social impacts. In order for this to be achieved, Europe will require an innovative industry that commits to the region on a long-term basis. For this to occur, Europe will need to reactivate its industrial base in the short-term, in order to foster economic growth and jobs.

The cement and concrete industry can play a crucial role in helping Europe accomplish its goals, particularly given its strong contribution to the European Union's policy objectives relating to employment, innovation, education, social inclusion and climate & energy. The sector adds value to Europe, with a local cement and concrete value chain offering numerous benefits.

The European cement and concrete industry:

- Contributes to the economy with a total production value of **€74 billion**, a value added of **€22 billion** as well as **~366 thousand jobs**¹.
- Serves as the backbone for local economies by promoting a **local** industrial base, driving the development of its economy, and relying on a skilled labour force **in smaller communities**.
- Is committed to innovation, developing more **versatile, cost and environmentally efficient** processes and products.
- Can demonstrate an impressive track record regarding production process emission reductions. For example, in 2010 the industry's gross CO₂ emissions were **40 million tonnes** lower than in 1990² thanks to improvements in energy efficiency as well as fuel and clinker substitution.
- Provides the key building materials for the construction of **very low or even zero energy buildings**, thereby contributing towards the EU's goals of improving the energy efficiency of buildings.

¹ Data for cement and concrete for EU-27 and Turkey. Source Eurostat and CEMBUREAU. See notes 8 to 13.

² Data for EU-27. Emissions have been reduced from 163 to 123M gross tonnes (~25 percent) in 1990 and 2010 respectively while cement production has been reduced from 220 to 184M tonnes (~16 percent) in the same years. Source: GNR, WBCSD.

In addition, the industry plays a vital role in generating growth. Investment in infrastructure has one of the highest multiplier effects on the economy, both in degree and velocity, since it can duplicate the initial spending over several quarters, and triplicate it over a period of 20 years. Whilst not forgetting the impact on employment as, for every new job created in construction, two additional jobs are created elsewhere in the economy.

Nevertheless, the recent financial crisis has taken its toll on the European cement industry. Currently, this strategic sector is not obtaining reasonable returns, as average return on capital over the last four years has been between 3 – 5 percent below the cost of capital. This lack of returns has been, in part, due to exogenous factors and imposed liabilities. In order to meet environmental legislation in Europe, operations face major investments and operating costs. In addition, capital requirements are one to two times higher compared to other regions (with the exception of the US) and the cost of electricity is also higher due to CO₂ costs and feed-in tariffs. Also, the high level of regulatory uncertainty in Europe discourages companies from making the investments required in order to improve the efficiency of cement plants and the lack of an appropriate legal framework deters companies from adopting structural adjustments.

These insufficient rates of return are also due to the fact that the cement and concrete sector is unable to pass on rising costs to customers. Cement is one of the few energy-intensive materials that has seen its prices fall by 13 percent between 2007 and 2011, despite a rising cost base of between 6 and 26 percent during the same period. Allegations have been made that the sector benefits from the proceeds of sales of excess allowances as a consequence of production reductions over the period of the economic crisis. The EU Emissions Trading System (EU ETS), however, has been conceived on an ex-ante basis which does not allow for a correction taking into account economic growth or decline. During the EU ETS negotiations, industry has called for such ex post correction but its comments were not taken into account. More importantly, the effect of the sales of these allowances, as indeed reported in publicly available financial statements of the companies, is reflected in the rate of return calculated for this report. Therefore, the sale of excess allowances does not derogate from the fact that the cement sector is suffering from a structural lack of reasonable return on investment.

The lack of returns is slowly undermining the industry's competitiveness, as the investment requirements in terms of new capacity and maintenance and renewal of current operations in Europe face competition from investment requirements in other regions which offer higher returns. As a consequence, in 2008 the

industry started to reduce investments in maintenance. Between 2009 and 2010, these investments were halved, with plants being either mothballed or demolished across Europe.

Both industry and policymakers must work together in order to identify actions to address the current challenges faced by the sector. The European cement industry is at a disadvantage versus other regions as it faces higher capital requirements and operation costs, must meet more stringent environmental regulation and lacks a correct legal framework that facilitates plant rationalisation in economically, environmentally and socially acceptable circumstances. These competitive disadvantages mean that the industry is unable to compete with the export market, to improve its returns in Europe, and is also unable to take action to rationalise capacity.

Within this context, policymakers can play a crucial role in helping maintain a competitive industry in Europe by

- A consistent and predictable legal framework which allows for long-term investment planning and integrates economic, environmental and social considerations within a coordinated and consistent industrial policy at European level
 - Climate change and energy legislation that is characterised by a legal framework where parameters are fixed long-term, and continued security of supply is guaranteed with competitive energy prices, in a unified European market;
 - Stronger coordination of national social policies and incorporation of social and economic feasibility considerations in one industrial policy for Europe in order to allow companies to proceed with long-term and structural investment decisions.
- The right regulatory incentives to drive growth
 - Prioritise public spending and investments on infrastructure and energy efficient construction in order to trigger a multiplier effect across the European economy;
 - Focus European R&D&I funds on targeted key priorities, such as energy and resource efficiency, and align national and EU funding programmes;
 - Reform state aid legislation in order to allow public seed money for bringing existing technologies to market and bridge the gap for investment where return on investment is currently too low across the industry.

- An even playfield in compliance with regulatory requirements to guarantee that all competing players are subject to the same impositions across the region and, at the same time, that European players are not at a disadvantage when facing competition from outside the region
 - Imposing best available techniques in the area of environmental legislation should take into account economic feasibility and should be technology neutral;
 - Challenge unfair subsidy regimes from non EU jurisdictions that have a negative impact on Europe's competitiveness and design proper regulatory mechanisms that can secure a level playing field in full compliance with the World Trade Organization rules as long as no equivalent measures apply to industry globally.
- Policies designed from a full supply chain perspective, which endorse the relevance of the industrial sectors as developers of process innovation as well as innovative products in Europe. Climate change and energy legislation needs to focus not only on the production process but also on the final use of products from that process. Such an approach will allow for fully assessing and appreciating the continued relevance of the cement and the concrete industry for Europe's competitiveness.

1 The cement industry's contribution to Europe's priorities

“Industry is at the heart of Europe and indispensable for finding solutions to the challenges of our society, today and in the future. Europe needs industry and industry needs Europe. We must tap into the full potential of the Single Market, its 500 million consumers and its 20 million entrepreneurs.”

Antonio Tajani, Vice-President of DG Enterprise and Industry, European Commission³

1.1 Societal challenges

Over the coming decades, Europe will face a significant number of societal challenges, some of which will be specific to Europe, whilst others will affect other parts of the world. According to Eurostat⁴, the EU-27's population is expected to grow from 501 million (1 January 2010) to 525 million in 2035, and it will eventually peak at 526 million by around 2040. Considerable differences will be registered amongst the Member States, with the population expected to rise in fourteen Member States and fall in thirteen. According to Eurostat forecasts, in 2060, the Member States with the largest population will be the United Kingdom (79 million), France (74 million), Germany (66 million), Italy (65 million) and Spain (52 million).

In 2011, the European Commission⁵ noted that Europe is one of the most urbanised continents in the world, with more than two-thirds of its population living in urban areas. Cities will play a key role in Europe's further development and, therefore, will need to be both “green and healthy”, which goes far beyond CO₂ emission reductions. A holistic approach to environmental, climate change and energy issues, with a strong focus on sustainability and healthy mobility, will be essential. An increased focus will be placed on multimodal public transport systems, calling for significant investments in infrastructure such as bridges, roads, airports, railways and ports.

³ 28 October 2010, in the framework of the release of the Communication on ‘An integrated industrial policy for the globalisation era’.

⁴ Eurostat news release 80/2011, 8 June 2011.

⁵ European Commission, Regional Policy, Brochure “Cities of tomorrow: challenges, visions, way forward”, October 2011.

Europe's citizens will also need access to affordable housing which provides a higher level of energy efficiency, given the impact rising electricity prices are having on a growing number of families. People will also live for longer, with the number of those aged 65+ rising from 17 percent of the total population in 2010 to 30 percent in 2060. In order to meet this challenge, governments will need to focus on building more nursing homes for the elderly, as well as additional hospitals.

Europe will grow, but this growth will be confronted with the challenges posed by the three pillars of sustainability: namely environmental, economic and social. For example, a growing population should avoid depleting scarce primary raw material resources. Climate change and other important environmental considerations will continue to drive a balanced approach to economic and industrial growth, whilst at the same time giving room to an innovative industry which can commit to Europe on a long-term basis. In this regard, the European Commission has indicated that it aims to increase industry's share of GDP from its current level of around 16 percent of GDP to as much as 20 percent by 2020. According to the European Commission, a strong industrial base is essential for an economically successful Europe⁶.









1.2 The cement industry: a good fit for Europe

The cement sector can help public authorities respond to the challenges faced by Europe if the right conditions are created for the industry to remain competitive. The sector can play a relevant role in Europe's ambition of developing a solid industrial base, by helping to accomplish the region's five broad objectives related to employment, education, social inclusion, climate/energy and innovation⁷.

⁶ European Commission: "A Stronger European Industry for Growth and Economic Recovery", COM(2012)582, 10 October 2012.

⁷ European Commission: "A Stronger European Industry for Growth and Economic Recovery", COM(2012)582, 10 October 2012.

Figure 1: The Cement and concrete industry fits in well with Europe's goals

Europe 2020 strategy	Characteristics inherent to the European cement and concrete sector
<p>Social inclusion and education</p> 	<p>Promotes local industrial base and contributes to prosperity of local community</p> 
<p>Innovation</p> 	<p>Innovation in cost effective and energy efficient products & applications</p> 
<p>Employment</p> 	<p>+360 k skilled jobs €4 B production value €2.0 B value added</p> 
<p>Climate/ Energy</p> 	<p>Helps policymakers achieve energy efficiency goals Reduced over 40 M tonnes gross CO₂/ year</p> 

The cement industry can contribute by offering...

... firm commitment to Europe's development

- Production:** total 2011 cement production in Europe amounted to around 260 million tonnes (MT)⁸, with a production value of €18 billion (bn)⁹. The production value for concrete was ~€6bn¹⁰. Total added value in 2010 for cement and concrete represented ~€7.6bn and ~€14.4bn respectively¹¹.
- Employment:** in Europe, the production of cement provides an estimated 61 000 direct skilled jobs¹², and up to 3 – 5 times as many indirect jobs, translating into a total of ~245 000 to

⁸ For EU-27 and Turkey. Source: CEMBUREAU Annual Report 2011.

⁹ Production value represents the value generated by the production of cement (amount produced and sold of cement). Value for EU-27 and Turkey in 2011. Turkish production value in 2011 has been estimated by applying the growth in Turkish cement production in 2010-2011 to the production value in 2010. Source: Eurostat.

¹⁰ Value for Concrete and Ready Mix for EU-27 in 2010 and Turkey in 2009. Source: Eurostat.

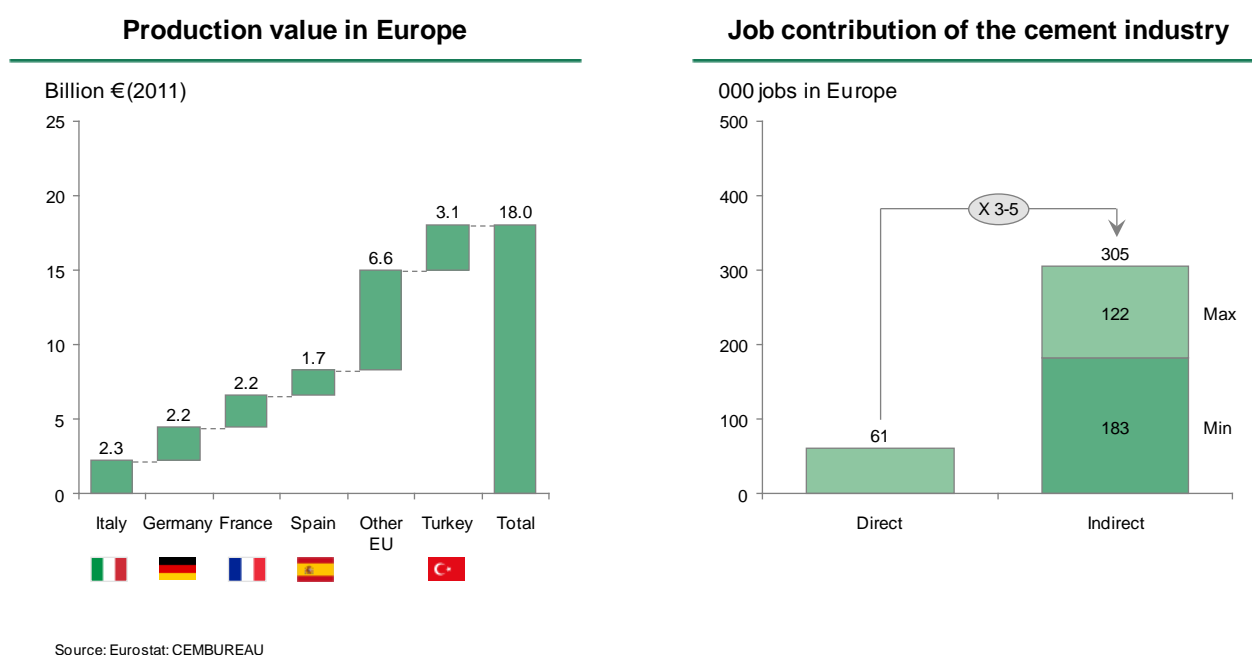
¹¹ Value for Cement in EU-27 and Turkey for 2010. Turkish value added in 2010 has been estimated by applying the growth in Turkish cement production in 2009-2010 to the production value in 2009. Value for Concrete and Ready Mix for EU-27 in 2010 and Turkey in 2009. Source: Eurostat.

¹² Value for EU-27 and Turkey. Source: CEMBUREAU.

~365 000 jobs related to cement production. In addition, over 305 000 people are employed in concrete production¹³.

- **Downstream:** nourishes the construction sector, which accounted for a production value of ~€1 640bn in 2010, a total added value of ~€505bn¹⁴, and 20 million jobs¹⁵.

Figure 2: Contribution of the European Cement Industry to production value and job creation



... strong local presence

- From raw material sourcing all the way through to the final product, the cement industry promotes a local industrial base, drives the development of a local economy and relies on a skilled labour force in smaller communities.
- Cement is delivered on land within a maximum radius of about 300 km from the production plant. The most important use of cement is in the production of concrete. Ready mixed concrete

¹³ Value for Concrete and Ready Mix for EU-27 in 2010 and Turkey in 2009. Source: Eurostat.

¹⁴ Both production value and value added figures for concrete and construction are for EU-27 (2010) and Turkey (2009). Source: Eurostat.

¹⁵ European Commission Communication on a Strategy for the Sustainable Competitiveness of the Construction sector and its enterprises, COM(2012)433, 31 July 2012.

is manufactured, to a large extent, in small and medium size plants from which deliveries are made to nearby construction projects.

- After use, i.e. at the end of life of a building, crushed concrete is often re-used locally as recycled aggregates.
- The industry contributes to the prosperity of local communities. In France, for example, over 50 percent of French cement plants are located in municipalities with less than 5 000 inhabitants. In addition, the hiring of local people contributes towards maintaining positive contact with communities.
- Many companies work with communities at regional and local level offering, for example, educational programs. Companies also develop community collaboration plans to foster activities such as school visits, create foundations to support local community projects or partner with local NGOs to support the underprivileged. Some companies undertake "Community Engagement Plans", whereby companies discuss and agree their yearly support with the community itself. Others have implemented social programs such as the *Social Initiative Policy*, through which companies contribute with at least 1 percent of the Groups' earnings before interest and taxes (EBIT), to promote health, social empowerment, education and community development projects.

... focus on global environmental sustainability

- At global level, the cement industry has developed the Cement Sustainability Initiative¹⁶ (CSI), which offers a sector-based approach to climate mitigation, with the aim of enhancing a large scale, global response to climate change. The CSI has been exploring a variety of policy options to see which may offer opportunities for faster, more effective, large-scale responses to climate change. With this in mind, the CSI has developed, for example, a protocol for the measurement, reporting and verification of emissions, and a global database on CO₂ emissions and energy (entitled 'Getting the Numbers Right' – GNR). In addition, the WBCSD has worked together with the International Energy Agency (IEA) on a global technology roadmap for the cement sector to 2050.

¹⁶ Cement Sustainability Initiative (CSI), under the umbrella of the World Business Council for Sustainable Development (WBCSD).

- According to the GNR¹⁷, in 1990 to 2010, the cement industry in the EU-27 reduced its gross CO₂ emissions per tonne of cementitious by 10.3 percent, alternative fuel usage has multiplied by almost 7, heat consumption to produce a tonne of grey clinker has diminished by almost 9 percent and the clinker to cement ratio has dropped by 4.5 percent¹⁸.
- The European cement industry is the world leader regarding improvements in process and resource efficiency, with a low energy requirement asset base, a production process that complies with the EU's strict environmental and greenhouse emission regulations, and a quarrying activity that complies with responsible sourcing standards.

... pioneering role in product innovation

- Development of innovative, environmentally friendly, cost efficient concrete products and applications that significantly improve the energy efficiency of buildings and transport, two sectors of great concern for policymakers as together they account for more than 50 percent of total European GHG emissions¹⁹.

... solutions to assist Europe in adapting to climate change

- Society needs to adapt and protect itself from the consequences of climate change and infrastructure made out of concrete provides one of the best solutions in this respect by protecting people, property and the environment.
- Concrete provides a safe and secure supply of drinking water during droughts, through dams and reservoirs which are capable of capturing and storing water, as well as thermal comfort in buildings during extreme climatic conditions. It can also guarantee flood protection through barriers along coastlines which are vulnerable to changes in sea levels. Concrete will also provide

¹⁷ Getting the Numbers Right (GNR), is the voluntary, independently-managed database of CO₂ and energy performance information on the global cement industry from the Cement Sustainability Initiative.

¹⁸ From 78.2% in 1990 to 73,7% in 2010. Data for EU-27. Cementitious includes the clinker produced (i.e. excluding purchased clinker) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold; Clinker data refers to clinker produced on-site by the reporting companies; Cement includes clinker consumed (= clinker produced + purchased – sold – stock changes) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold. The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1). Source: GNR, WBCSD.

¹⁹ European Environmental Agency.

protection to agriculture and farming through the development of irrigation systems linked to water management facilities in areas affected by droughts.

- Europe is in a position to respond more rapidly to climate change adaptation requirements, as only those regions which maintain an integrated construction value chain will ensure a supply of resources, local production and investment.

The cement and concrete industry is strongly committed to playing its part in ensuring a sustainable and resource-efficient society where economic growth and respect for the environment go hand in hand. Nevertheless, in order to achieve this, policymakers and authorities must develop an adequate framework in order to drive Europe forward and maintain its economic relevance in a globalised world.

2 Return on investment is key for the cement industry

Europe needs a financially sound cement industry which contributes to growth and employment at local level and which, at the same time, supports the transition to a low-carbon built environment. The sector is currently under pressure due to a combination of a macroeconomic slowdown, low cement prices, rising electricity and energy prices and increasing production and capital investment costs due to factors which are beyond its control.

Currently, the European cement industry is not obtaining reasonable returns. The average return on capital employed²⁰ (ROCE) within the European cement industry during the 2009-2012 period has been 3.1 percent²¹, which is 3-5 percent below the industry's cost of capital²². The problem is affecting the sector as a whole, as all the main European cement companies have returns on capital which are below the weighted average cost of capital since 2009.

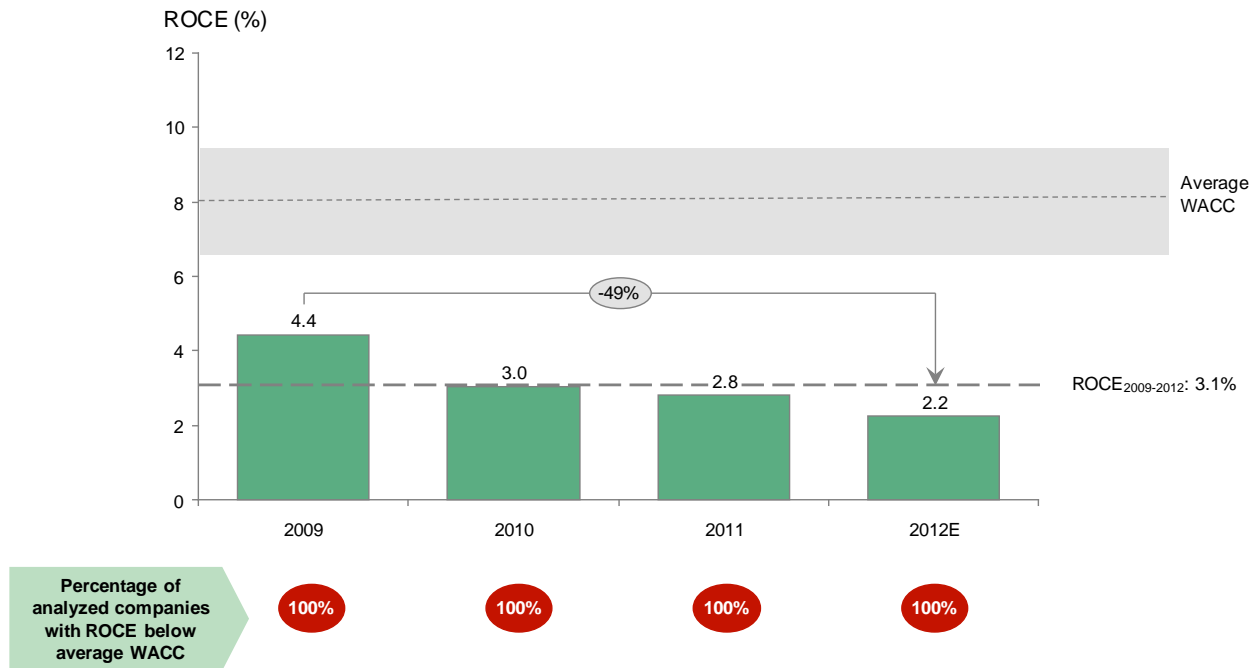
Allegations have been made that the sector benefits from the proceeds of sales of excess allowances as a consequence of production reductions over the period of the economic crisis. The EU Emissions Trading System (EU ETS), however, has been conceived on an ex-ante basis which does not allow for a correction taking into account economic growth or decline. During the EU ETS negotiations, industry has called for such ex post correction but its comments were not taken into account. More importantly, the effect of the sales of these allowances, as indeed reported in publicly available financial statements of the companies, is reflected in the rate of return calculated for this report. Therefore, the sale of excess allowances does not derogate from the fact that the cement sector is suffering from a structural lack of reasonable return on investment.

²⁰ Return on Capital indicates how efficiently a company invests its monetary resources. The ratio should be higher than the company's weighted average cost of capital (WACC) to ensure that the company is creating value.

²¹ ROCE calculated for Europe from company data, asset and capacity information and EBITDA split. Weighted average for the 7 biggest players in the European market (Lafarge, Holcim, Heidelberg, Cemex, Italcementi, Buzzi Unicem and Titan Cement). Calculated as EBIT*(1- operational tax rate) for Europe divided by total assets in Europe minus European current liabilities (proportionally estimated taking into account EU's replacement value of assets, which is on average 105 percent higher than total industry asset replacement value).

²² Cost of capital (WACC) represents industry's average WACC range in 2012.

Figure 3: European ROCE of the main cement companies



Source: Jeffries Building Materials, JPM Building Materials; Bloomberg, company annual reports; BCG analysis

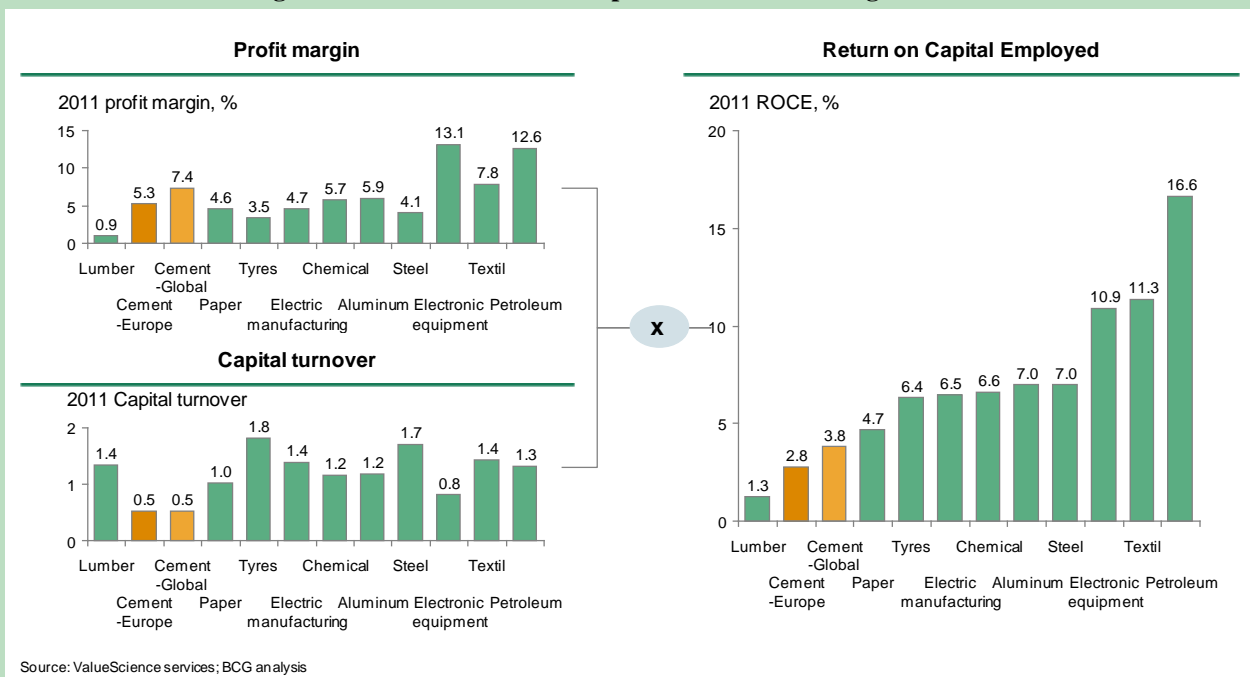
ROCE for a fair evaluation

The cement industry ranks amongst the most capital-intensive industries, with a lower than average capital turnover when compared to others, such as chemical, steel, aluminium or pulp and paper. An appropriate financial assessment of the cement industry should therefore take into account the extent to which returns cover investments in both fixed assets and the maintenance needed to maintain operations. Indicators such as gross margins or earnings before interest, taxes, depreciation, and amortisation (EBITDA) only capture one part of the equation, while ROCE reflects a company's ability to see a return on all the capital that **an industry has invested in order to run its operations**.

$$\text{Return on Capital (ROCE)} = \text{Profit margin} \times \text{Capital turnover}$$

Figure 4 helps demonstrate the low returns in the cement industry. ROCE is obtained by multiplying profit margin²³ and capital turnover²⁴. Despite higher profit margins in the cement industry compared to other manufacturing sectors, it has a very low capital turnover and therefore lower return on capital. This is due to the fact that the cement industry has to invest a high proportion of its annual profits (gross margins or EBITDA) in construction, maintenance and renewal of its production base to ensure that it works in an efficient and cost effective way. Therefore, the sector requires higher profit margins to ensure the business remains sustainable over time.

Figure 4: Global ROCE of Comparable Manufacturing Industries

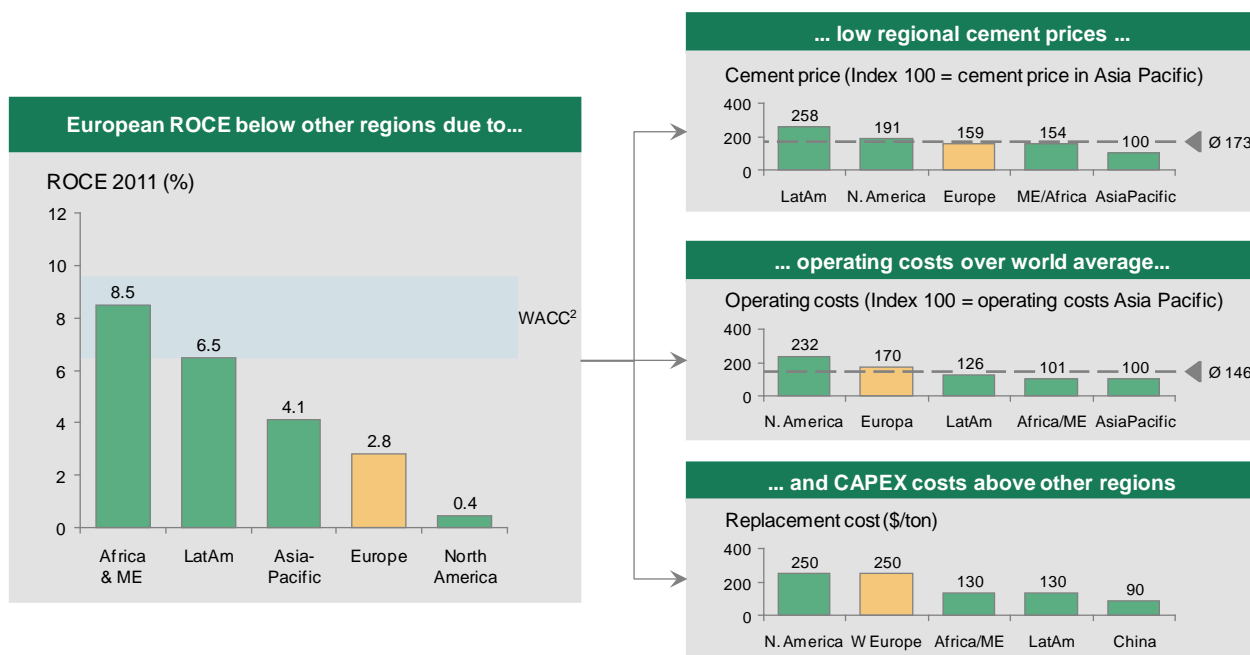


In 2011, Europe, together with North America, was the region which experienced the lowest ROCE for the cement industry. However, returns in North America are expected to have recovered in 2012, due to projected growth in the construction sector, whilst in Europe returns are likely to fall even further. Low returns in Europe are due to the fact that it has the lowest cement prices after Asia-Pacific, combined with one of the highest operating and Capital expenditure (CAPEX) costs due to high energy and electricity prices and external imposed liabilities, including investments which are needed in order to meet regulatory requirements.

²³ Profit margin ratio represents the annual profitability of a company, that is, what percentage of its sales a company keeps in earnings.

²⁴ Capital turnover measures how effectively a company manages the capital invested to produce revenues.

Figure 5: Regional ROCE composition levers



Source: Jefferies Building Materials, JPM Building Materials; Bloomberg, company annual reports; BCG analysis

The continuous rise in costs in the cement industry during recent years, which cannot be absorbed given that the price of cement in Europe is decreasing, has hampered the industry's return on investment. From 2007-2011, cement prices in Europe²⁵ dropped, on average, by 13 percent, whilst fuel costs rose by 26 percent²⁶, raw material extraction costs by 10 percent²⁷, average manufacturing labour costs by 6 percent²⁸ and electricity costs by 12 percent²⁹. In its Communication on industrial policy³⁰, the European Commission states that, "as regards electricity, European industry is on average facing higher prices than industries in other developed countries such as the US, Canada, Mexico and Korea, and this price gap has

²⁵ Eurostat 2007-2009 deflated cement prices with base 2005 for UE-27 and Turkey. 2010, 2011 and 2012 price evolution calculated as weighted average price evolution for EU27 countries and Turkey from Building Materials: Positive on US, Cautious Elsewhere, Downgrading Eagle and Wolseley, February 2012, Jefferies.

²⁶ Energy Index considers average weight of different fuel sources used in the cement production process based on the caloric contribution of each source and excluding electricity and gas usage. Alternative fuels are normally waste and are considered free of charge for the calculation.

²⁷ Source: Datastream: PPI Quarrying of Bl. Stone, Limestone and Gypsum.

²⁸ Source: EIU, Manufacturing labour costs per hour (US\$).

²⁹ Source: Eurostat Industrial Electricity prices for UE-27, band IC.

³⁰ European Commission Communication of 10 October 2012 on "A stronger European Industry for Growth and Economic Recovery", COM (2012) 582 final.

increased over the last decade". It also indicates that the energy price increases which affected European industry were "higher than in most of other industrialized countries, especially US". This clearly shows that the European-based cement industry is at a competitive disadvantage compared to its peers outside Europe. Moreover, industry analysts do not anticipate any major changes in the energy cost trend, which represents 30 percent of the cement industry's total operating expenses³¹, and predicts even further pressure as electricity prices are expected to continue to increase in Europe until 2030. According to the International Energy Agency (IEA), crude oil prices, which are an indicator of petcoke prices (one of the main fuels used in the cement industry together with coal), are expected to increase by 3 percent per year until 2020.

To address this increase, several cost reductions schemes have been implemented by the major cement companies in recent years, translating into a €1.1bn accumulated cost reduction in 2009-2012³². However, these aggressive programs have not been sufficient to help companies achieve reasonable returns on investment, nor returns above the cost of capital.

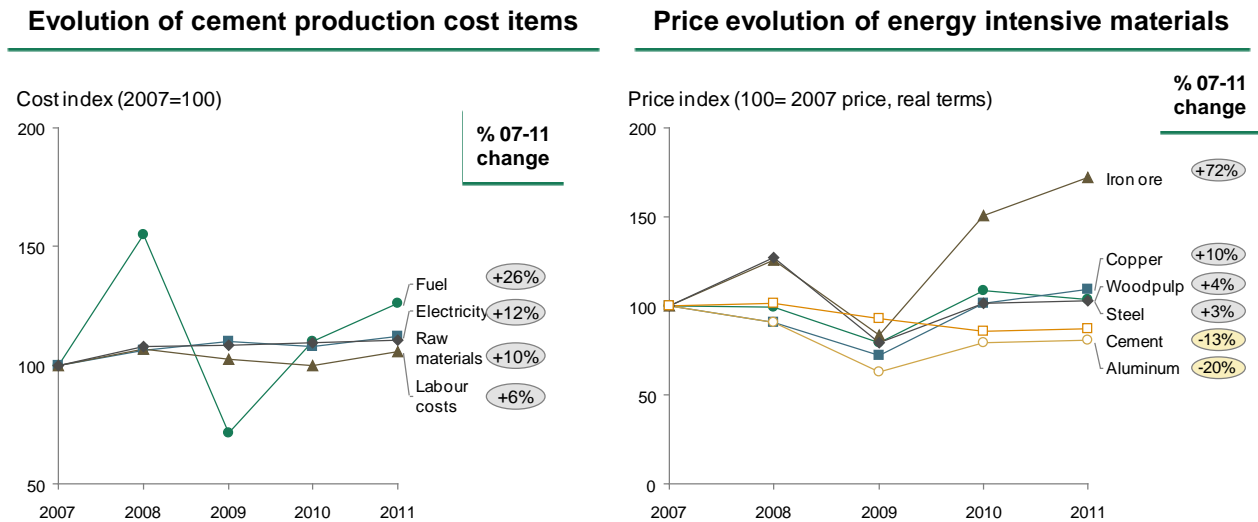
This increase in costs has an impact on the competitiveness of the cement industry, particularly given that the price of cement has dropped so significantly compared to competing sectors. From 2007 to 2011, iron ore prices increased by more than 70 percent, copper by 10 percent and steel by 3 percent³³. The sole exception is the aluminium sector, which has also suffered quite a dramatic price decrease. As a result, neither the cement nor the aluminium industry have been able to pass on any of these cost increases to the end consumer, and this has translated into a sharp decline in returns on investment. This is one of the reasons why the production of aluminium is being moved outside Europe.

³¹ European Building Sector, August 2012, Deutsche Bank.

³² Building Materials: Positive on US, Cautious Elsewhere, Downgrading Eagle and Wolseley, February 2012, Jefferies.

³³ Steel (Flat Products / HRC / Northern Europe domestic Ex-Works), deflated average annual prices. Source: SBB Steel Business Briefing; Iron Ore Brazilian FOB, transport costs from Brazil Tubarao To Netherlands Rotterdam; deflated average annual prices, Source: Steel Times International, AXS Marine; Copper (London Metal Exchange, grade A, minimum 99.9935 percent purity); Woodpulp (softwood, sulphate, bleached, air-dry weight, cost and freight in North Sea ports); Aluminum (London Metal Exchange, unalloyed primary ingots, high grade, minimum 99.7 percent purity). Source: The World Bank.

Figure 6: Price and cost Evolution of Basic Materials



Source: Eurostat; Datastream; EIU; The World Bank; Steel Times International; AXS Marine; SBB Steel Business Briefing; BCG analysis

One additional element which is more difficult to quantify, but which has an impact on long-term investments in the cement industry, is the high degree of regulatory uncertainty. When taking investment decisions, companies look for a stable regulatory framework that allows for long-term business planning. In addition, companies adopt a holistic approach to the three pillars of sustainability in each of their investment or restructuring decisions. Therefore, legal certainty is essential.

Whilst Europe does provide a stable political environment, the lack of coordination between the European and national levels of government complicates the integrated approach of social, economic and environmental considerations and seriously hampers companies in designing a strategy for Europe. In addition, the uncertainties surrounding climate change legislation, with essential parameters constantly under discussion and the lack of a coherent and coordinated energy policy coupled with limited attention for economic feasibility when imposing new environmental legislation, deter investment or long term restructuring discussions in Europe with a direct impact on growth and competitiveness.

A good example is the need for a correct legal framework which allows companies to adapt capacity to requirements. For example, capacity rationalisation allows companies to focus investments on the most efficient and sustainable plants. Nevertheless, in 2010, capacity utilisation in the European cement industry across the main European countries was less than 60 percent. In this respect, the regulatory framework

should facilitate such capacity rationalisation in economically, environmentally and socially acceptable circumstances, placing an equal emphasis on each of these three pillars of sustainability.

In a recent Communication³⁴, the European Commission states that “Public intervention should create the right market environment and come up with remedies to market failures. Industry must itself develop its competitive advantages and strengths”. This quote clearly emphasises the role of both government and industry, and highlights the facilitating role of policy. The role of governments is to provide a stable legal framework that responds to both urgent economic challenges and opportunities, leaving industry to create added value for society.

The low returns on investment, combined with the high level of regulatory uncertainty, could deter further investments in the cement industry in Europe, particularly when funds are competing against investments in other regions with higher returns. This trend is becoming a reality in the European cement sector. Historically, the European cement industry has required a sustainable maintenance of CAPEX over tangible assets of ~6.5 percent. Nevertheless, in 2009 and 2010, this ratio declined by 3.5 percent³⁵.

Moreover, in 2008 cement companies began to announce important plant closures across Europe, as a consequence of this lack of return on investment. One recent example is the announcement in May 2012 by one company which confirmed that it would not be restarting production at one of its plants in the UK, originally mothballed in 2008. Instead, the plant is to be demolished. Another cement company has closed two of its plants in the UK and mothballed several of its other plants in Northern France, Spain and Greece since 2008. Although the decision regarding the closure of a plant in Northern France was blocked until November 2012, the French High Court recognised that the economic reasons put forward in favour of stopping production at this site were valid. Additional write downs in the Czech Republic, Germany, Hungary, Italy, Spain and the UK have also been announced by other cement companies in 2012. These developments bear a strong resemblance to the situation in the aluminium industry whereby capacity decreased by 1 percent per year and production was moved outside of Europe, despite constant aluminium consumption rates in Europe since 2008³⁶.

If the challenges faced by industry are not addressed in time, future demand will be increasingly covered by imports. In spite of the current perception that cement cannot be traded over long distances, clinker can

³⁴ European Commission Communication of 10 October 2012 on “A stronger European Industry for Growth and Economic Recovery”, COM (2012) 582 final.

³⁵ Deutsche Bank, European Building Materials, August 2011.

³⁶ Source: RBC Capital Markets estimates.

be in a cost competitive way if transported by boat. In fact, certain countries located close to Europe's borders with lower environmental constraints and lower electricity costs can produce clinker and cement for less, and are exporting their production to Europe. Currently, over 60 percent of total European clinker and cement production is located less than 150-200 kilometres from the coasts or inland ports. As a result, these plants are exposed to a real risk of being offshored. Moreover, the delocalisation decision will be taken in a cost effective way, as most big European players already have plants in peripheral countries from where they could address Europe's demand just by shifting production from European plants to plants in neighbouring countries if it becomes more economically viable.

Being able to maintain a local, healthy cement industry in Europe will also guarantee a security of supply. The countries which are mainly exporting to Europe, such as China, Thailand, Colombia, Venezuela or Northern Africa, are either unstable or have a high economic growth potential, which means that an increase in local demand for infrastructure development is expected, potentially putting current export rates at risk. Egypt, for example, banned exports in 2009 in order to ensure stabilisation of local cement prices, which had been rising due to a 26 percent increase in cement demand in the local market caused by growth in the construction sector. Saudi Arabia also banned cement exports this year for the same reason, to prevent product shortages and stabilise prices in the Arab world's largest economy.

3 Helping Europe to achieve its goals

The cement industry is committed to encouraging innovation in Europe and improving its environmental performance, and will be a key driver in boosting economic development. However, it requires that the correct regulatory framework be put in place in order to assist the sector in obtaining reasonable returns.

3.1 Investment in sustainable construction: multiplier effect on the European economy

The European economy is experiencing the deepest recession since the 1930s. In 2009 real GDP in Europe decreased by 4.3 percent. Whilst it attained ~2 percent growth in 2010 and 2011, it is expected to decrease once again in 2012 by 0.3 percent³⁷.

There is no one single solution to the current economic downturn and opinions on which paths should be followed differ. In addition to the strict austerity plans which are being implemented in order to offset the drop in revenues and reduce budgetary deficit, there are suggestions that an increase in the level of public investment could trigger economic recovery.

The Europe 2020 strategy establishes priorities aimed at increasing the industrial competitiveness of the EU and, in turn, encouraging a return to growth. One of the areas which should be developed is support to innovation in the construction sector in order to make it more sustainable. With a total average contribution of 5.3 percent to GDP growth in 2000-2008³⁸, construction has clearly become a priority for the EU's economy. However, its contribution to the EU's economic growth during the financial crisis suffered a 10 percent drop in 2011 versus the 2000-2008 average. By returning to its normal level of contribution, it could become one of the levers to trigger economic recovery in Europe.

It is clear that any increase in public spending will be more effective if the funds are dedicated to investments such as infrastructure and buildings rather than to maintaining current expenditure. The reason for this is, according to several recent economic studies, that infrastructure has one of the largest multiplier effects on the economy, accounting for 2 to 3 times the initial investment³⁹. This multiplier effect also

³⁷ Europe includes EU-27 and Turkey. Source: Economist Intelligent Union.

³⁸ Measured as Cement's VAB / GDP. Source: Eurostat.

³⁹ The Economic Impact and Financing of Infrastructure Spending, 2012, The College of William & Mary Thomas Jefferson Program in Public Policy.

applies to job creation. The European Commission has assessed that for every new job created in construction two additional jobs are created in other parts of the economy⁴⁰.

Infrastructure investment to trigger economic growth

Several comprehensive economic reports analyse the short- and long-term economic effects of investments, quantifying how the money spent on infrastructure has an impact on various sectors. For example, a recent estimate by the US Congressional Budget Office⁴¹ determines that each US dollar invested in infrastructure increased GDP by up to 2.5 US dollars over several quarters. In line with this assessment, an economic report published in the UK⁴² estimates that for every pound spent in construction, an additional economic activity of £3 is generated.

More particularly, a 2012 report from The College of William & Mary Thomas Jefferson Program in Public Policy⁴³ in the US assesses these short-run effects using an input-output model based on national data from the Bureau of Economic Analysis. Using benchmark 2002 data on non-residential structures, the report establishes that the multiplier effect of new non-residential construction investments totals US\$1.92 from every US\$1 initially spent, leading to increased economic activity in several sectors of the economy.

The same report states that, in the long-run, investments in infrastructure continue to generate beneficial returns for the economy as a whole, finding that US\$1 spent on infrastructure could generate up to US\$3.21 in GDP over a twenty-year period.

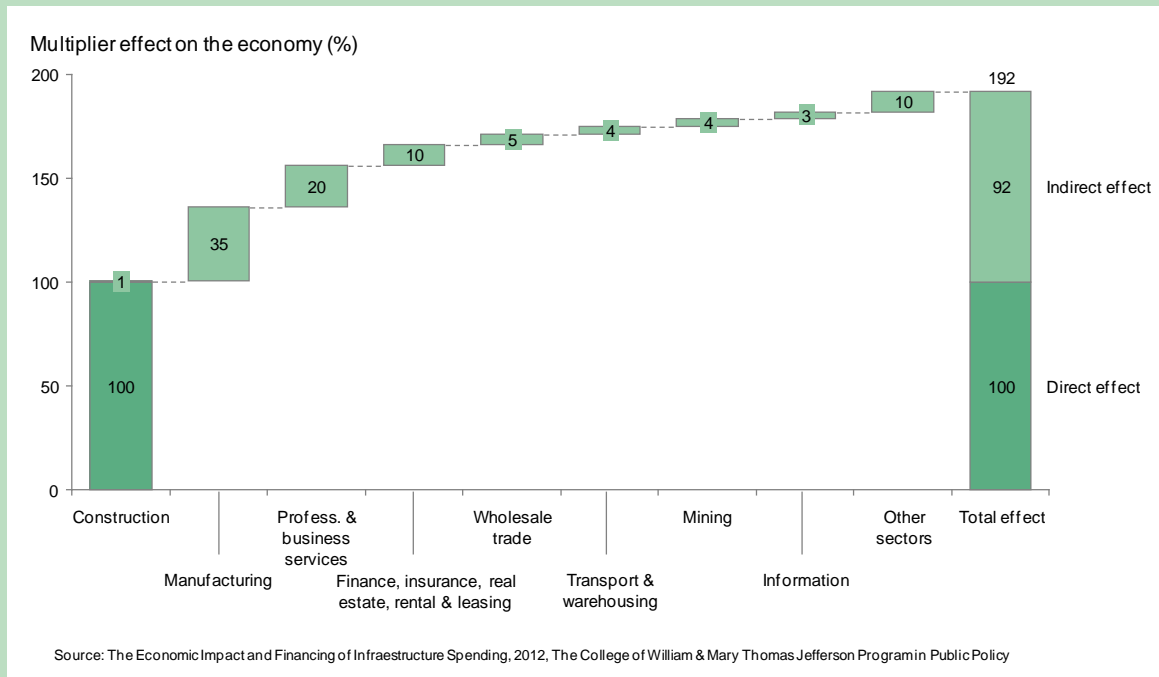
⁴⁰ Communication from the Commission “The Competitiveness of the Construction Industry”, COM(97) 539 of 4/11/1997.

⁴¹ The Role of Public Works Infrastructure in Economic Recovery, September 2010, Congressional Research Service.

⁴² Construction in the UK Economy: The Benefits of Investment, October 2009, LEK Consulting.

⁴³ The Economic Impact and Financing of Infrastructure Spending, 2012, The College of William & Mary Thomas Jefferson Program in Public Policy.

Figure 7: Assessment of the Short-Term Multiplier Effects of Infrastructure Spending on the US Economy



Two other reports, published by the Political Economy Research Institute⁴⁴ and the Department of the Treasury⁴⁵, analyse the jobs created by investments in infrastructure. The main findings include that for every US\$1 billion spent in infrastructure a total of 18,000 jobs are created. It also notes that most jobs are created in sectors that have an unemployment rate which is one and a half times higher than the national unemployment rate, demonstrating one of the values to society of investing in infrastructure.

If investments in construction have the potential to help Europe out of the crisis, then maintaining a local cement industry is essential, as this will guarantee a local supply chain within the construction sector that takes advantage of the full potential of the multiplier effect of public investments. Economists state that the more integrated industry is within an economy, the larger the multiplier effect: if the entire business remains in the region, so will investment throughout the whole value chain, ensuring maximum potential of

⁴⁴ How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth, January 2009, Political Economy Research Institute.

⁴⁵ An Economic Analysis of Infrastructure Investment, October 2011, The Department of the Treasury with the Council of Economic Advisers.

the multiplier effect. Otherwise, this benefit would go to those countries to which the business has relocated.

3.2 The cement industry is committed to innovation in Europe

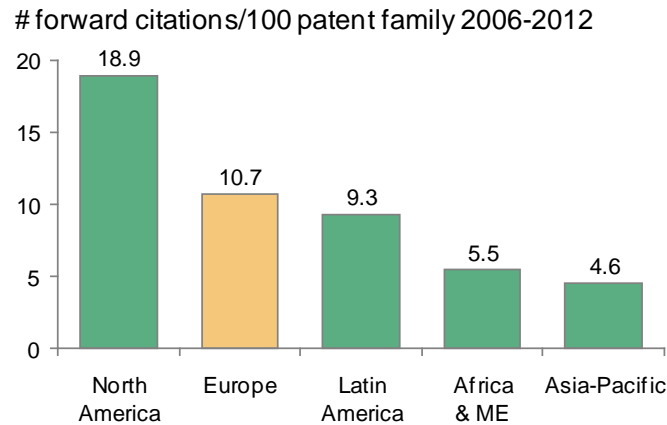
The cement industry already invests heavily in research and innovation. In this respect, the industry has founded the European Cement Research Academy (ECRA), a platform of over 40 leading cement producers worldwide which supports, organises and undertakes research activities within the context of cement production and its application in concrete in terms of sustainable development. ECRA is, in itself, part of a network of research facilities which includes universities, federal institutes and the research centres of cement companies or equipment suppliers. It further develops joint research projects with the cement industry. One of the projects currently under development concentrates on the technical and economic feasibility of Carbon Capture and Storage (CCS) as a potential application in the cement industry. In this respect, research currently focuses on the capture process only; more particularly oxyfuel technology. ECRA places a strong emphasis on the global perspective of its research as well as sustainability aspects. This implies that not only CO₂ emissions as such, but also the huge energy demand for operating CCS plants will be taken into account. ECRA's CCS project is a long-term research project which started in 2007. More information on this project can be found here: <http://www.ecra-online.org/226/>. In addition to these long-term projects, ECRA is engaging in research on grinding technologies, recycling and reuse of concrete.

Individual cement companies also invest in research and innovation. One cement player has a Research Centre in France which employs 250 experts of over a dozen nationalities and allocates 15 000 square meters to laboratories where scientific research on building materials is undertaken. More than 50 percent of the company's research focuses on sustainable construction, through the development of cement and concrete solutions that offer, for example, greater strength, higher durability, and better insulation. Another top player employs 170 people in the field of research and innovation in Europe, including chemists, geologists and engineers, with an annual budget of approximately €13 million.

These innovation efforts have turned the cement and concrete industry in Europe into the second most active in terms of patent filing in 2011, after Asia-Pacific (excluding China), accounting for more than 800 patents. Moreover, the contribution of European innovation to the cement and concrete technology arena, measured as the number of references to each innovation cited in subsequent investigation works, is of

great importance as the region is the second in number of forward citations per patent family from 2006-2012, after North America⁴⁶.

Figure 8: Innovation in the Cement and Concrete Industry by Region



Source: Thomson Innovation, BCG analysis

A consistent focus on research and innovation has resulted in new, more environmentally-friendly production technologies, innovative products and increased resource efficiency in the sector. For example, at production level, a reduction in emissions has been achieved through the substitution of fossil fuels with alternative fuels, avoiding the emission of 15.6 million tonnes of CO₂ according to 2010 data from the Getting the Numbers Right (GNR) project⁴⁷. In addition, the increased use of industrial by-products, such as fly ash (from coal combustion) or slag (from iron and steel production) which substitutes part of the clinker in cement, represented a reduction of around 7.2 million gross tonnes of CO₂⁴⁸ in 2010 compared to 1990 levels according to the GNR. Also, Europe is the main global equipment supplier to the cement

⁴⁶ Analysis made based on data from Thomson Innovation.

⁴⁷ Emissions saved due to the usage of alternative fuels (biomass and waste) in cement production compared to the use of coal. Calculation based on WBCSD, GNR project data for EU.

⁴⁸ Calculation compares the total CO₂ emissions associated to the clinker required to produce 2010's cement production (184 M tonnes of cement) in EU with the clinker to cement ratio in 1990 vs to the one in 2010. Clinker data refers to clinker produced on-site by the reporting companies; Cement includes clinker consumed (= clinker produced + purchased – sold – stock changes) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold. The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1). Source: WBCSD, GNR Project data for EU.

industry, accounting for over 60 percent of the global market⁴⁹ (excluding China). It should also be borne in mind that technologies developed in Europe are often then transferred to other parts of the world.

In terms of product innovation, efforts in R&D focus on raising the quality of concrete in construction, improving its properties and constantly developing new applications. Over the last 50 years, innovation in this field has led to a fourfold⁵⁰ increase in the compressive strength of commercially produced concrete, allowing the use of less concrete for the same or better functional performance.

Many other new concrete applications have also been developed, including:

- Photo-catalytic concrete, which can reduce air pollution by 25 percent to 60 percent⁵¹.
- Pervious concrete, which is a porous pavement material that allows for better soil conservation by capturing rainwater and allowing it to penetrate the underlying soil in a natural way.
- Insulated concrete formwork, which consists of an expanded polystyrene insulation cast into which concrete is pumped during construction, allowing for a more cost-efficient, quicker to build and energy-efficient structure.
- Joint-less concrete, a concrete that has a low shrinkage ratio and thus helps reduce cracks and future points of stress.
- Translucent concrete, which transmits light through the structure by means of embedded optical fibres.

These are just a few examples of the many applications of this versatile construction material which have been developed.

Innovation has also focused on new recycling schemes in order to achieve high levels of material recovery thereby reducing dependence on natural resources and associated transportation costs. It also limits the need for landfill. According to the European Commission, construction and demolition waste accounts for 25 percent of the European Union's total waste production per year, amounting to ~500 million tonnes of waste, out of which 320 to 380 million is concrete. The cement and concrete industry's commitment to material recovery and recycling has led to a reduction in construction and demolition waste, and resulted in

⁴⁹ Data refers to Sold Kiln Capacity 2006 – 2011. FLSmidth Capital Markets Day Presentation, 17/04/2012.

⁵⁰ In the 1950s, 5000 psi (34 MPa) was considered high strength in Precast; whilst ultra-high-strength concrete is now manufactured with strengths in excess of 21,750 psi (150 MPa). Source: Portland Cement Association

⁵¹ Emissions abatement significantly varies depending on site conditions. Source: The active photocatalytic principle by Italcementi.

a recycling rate of ~46 percent (which, although highly uncertain, according to the study, falls ‘within the range of estimates proposed by experts and literature: 30 to 60 percent’), implying a reduction of ~250 million tonnes of all the waste landfilled in Europe⁵². As a result, in Europe⁵³ (excluding the UK) on average 8 percent of aggregates are recycled and recovered aggregates.

3.3 A competitive cement industry can further Europe’s environmental goals

Sustainability is a key element of the European cement industry’s decision-making process. In relation to the environmental pillar of sustainability, the cement industry has made significant progress in reducing the environmental impact of the industry. This applies throughout the entire supply chain, including the rehabilitation of the quarry from which the raw materials have been extracted, more efficient clinker and cement production processes that reduce greenhouse emissions and provide waste management solutions, and more innovative concrete which can reduce the energy consumption of buildings and roads, without forgetting its indispensable role in adaptation to climate change.

3.3.1 Emissions dropping through the whole production process

The European cement industry has made tremendous efforts to reduce its greenhouse gas emissions. As a result, and according to the GNR, the cement industry in EU-27 has a low CO₂ emission rate per tonne of product (0.65 million tonnes of gross CO₂ emissions and 0.59 million tonnes of net emissions per tonne of cementitious respectively).

Emissions reductions have been achieved at the level of

- The kiln, through both fuel switch and energy efficiency measures
- Clinker substitution
- Concrete optimisation

Around 40% of emissions related to the clinker production are linked to the fuel combustion. Efforts to reduce CO₂ emissions in this part of the process have resulted in an increase of the usage of alternative

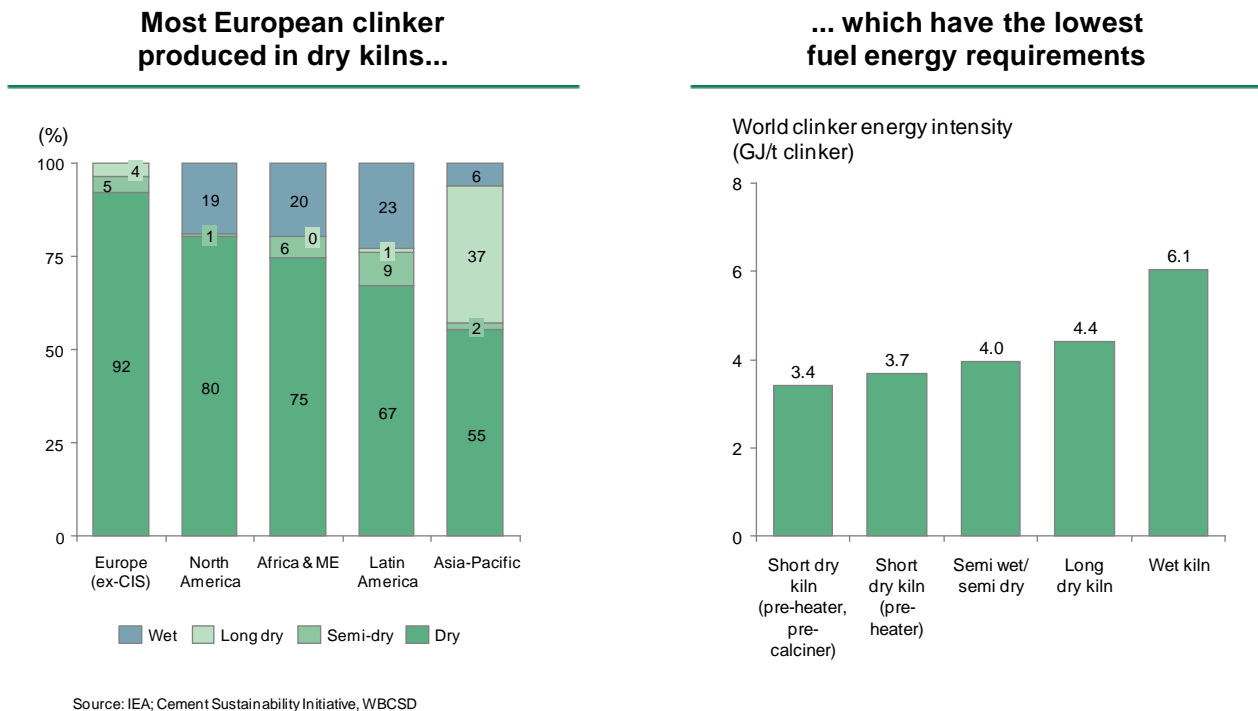
⁵² According to the study, information on CDW has a high level of uncertainty due to the lack of specified reporting. All estimated data on CDW has a high level of variability. Source: Service contract on management of construction and demolition waste, February 2011, European Commission, DG Environment.

⁵³ UK accounts for a total of 28 percent of recycled supply. The mineral products industry’s contribution to the UK, 2012, Mineral Products Association.

fuels (such as waste tyres, sewage sludge, waste oils and biomass) or an optimisation of the energy efficiency of the kiln.

The energy intensity of cement production and, as a result, its efficiency, varies significantly depending on the cement production process and the kiln technology. Over the past decades, the cement industry in Europe has heavily invested in kiln technology with now more than 90 percent of the kilns being highly efficient dry kilns, and less than 10 percent semi-wet and wet kilns⁵⁴. These developments have improved thermal and heat efficiency, reduced the amount of water that needs to be evaporated in the kiln, and, overall, improved energy efficiency in the clinker production process. In addition to installing cleaner technologies, the cement industry also focuses strongly on the operational efficiency of a plant. This is an important aspect of emissions management as, after installation, equipment must be operated efficiently and maintained correctly to ensure that the maximum potential savings are achieved.

Figure 9: Energy Efficiency in the Cement Manufacturing Process by Region



⁵⁴ Source: Tracking Industrial Energy Efficiency and CO₂ Emissions, 2007, IEA

Given that over 60 percent of the total CO₂ emissions from the clinker production process are inherent to the mineralogical transformation process of limestone, the cement industry has also focused on replacing part of the clinker in cement in Europe with locally available by-products such as fly ash and blastfurnace slag. Additionally, of European cement⁵⁵ contains 6.8 percent of ground un-burnt limestone. These replacements reduce both absolute “process” CO₂ emissions arising from the de-carbonation of limestone and “fuel” emissions arising from the burning at very high temperatures of the raw materials to produce clinker, thereby substantially reducing carbon emissions per tonne of cement.

Other innovative binder technologies not requiring the high temperature firing of limestone and silica materials are being researched. This research is at an early stage and significantly more time and work will be required to identify whether they are economically viable and suitable for the production of durable concrete.

In addition, concrete optimisation has also made possible further CO₂ emission reductions by optimising the cement content of concrete, whilst maintaining equal performance. According to the German Cement Industry Association⁵⁶, CO₂ emissions per tonne of cement produced in Germany over the last 50 years have been reduced by ~33 percent, whilst CO₂ emissions per cubic meter of concrete have been reduced by 44 percent during the same period of time.

As well as CO₂ emission reductions, notable improvements have been achieved in other areas such as NO_x, SO_x and dust emissions reduction. From 1995 to 2010, the EU-27 cement industry reduced NO_x emissions by a total of 20 percent⁵⁷, which represents the emissions of 870,000 cars in one year, and SO_x emissions by 34 percent⁵⁸.

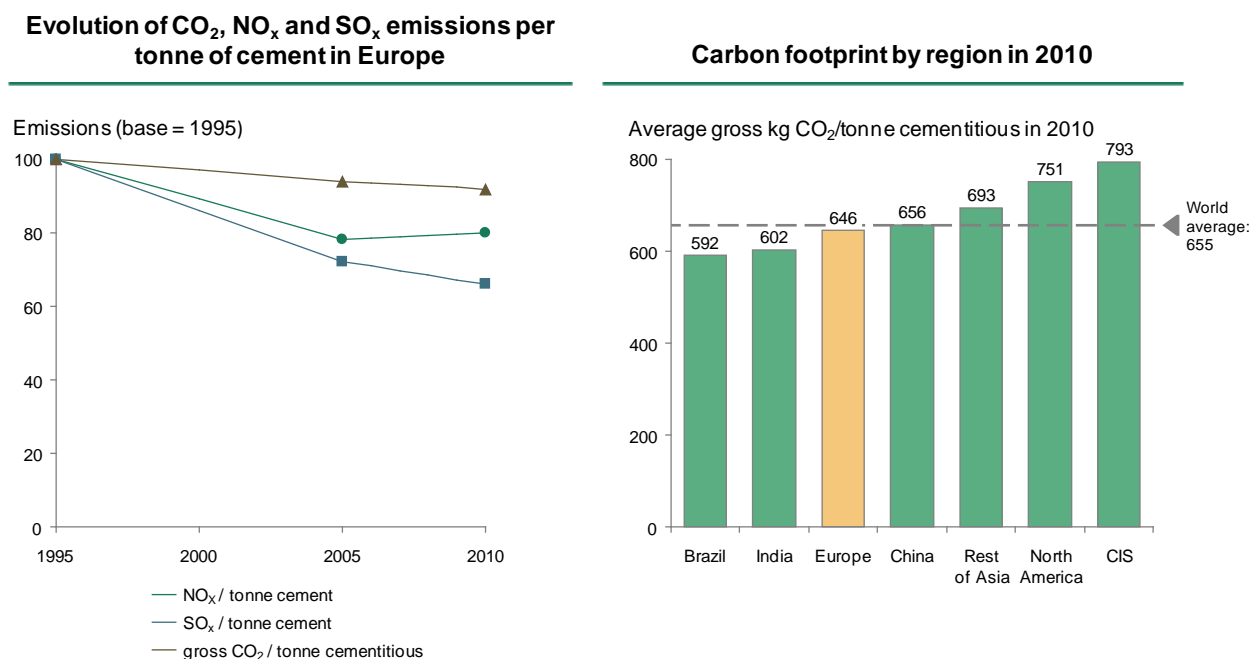
⁵⁵ Data for grey Portland and blended cements in the EU-27 in 2010, source: WBCSD, GNR Project Data.

⁵⁶ Data from VDZ.

⁵⁷ Data for EU-27. Source: Environmental Energy Agency.

⁵⁸ Data for EU-27. Source: Environmental Energy Agency.

Figure 10: Evolution of emission reductions and regional carbon emissions



Source: Cement Sustainability Initiative, WBCSD; European Environmental Agency

3.3.2 Waste management pioneers

Over the last 20 years, the cement industry in Europe has played an increasingly relevant role in waste management, by effectively recovering waste materials that would otherwise have required more expensive or less sustainable disposal alternatives, and contributing to industrial symbiosis. The recovery of waste in the cement sector, which is also referred to more commonly as ‘co-processing’, is the optimum way of recovering energy and material from waste. Waste symbiosis by the cement industry includes:

- The use of alternative raw materials to replace the traditional raw materials extracted from quarries, such as clay, shale and limestone, which are used in the kiln. Examples of these alternative materials include contaminated soil, waste from road cleaning and other iron-, aluminium-, and silica-containing waste. The chemical suitability of alternative raw materials is important to ensure that they provide the necessary constituents for the formation of clinker.
- The use of alternative fuels as a substitute for fossil fuels in kilns. Examples include used tyres, waste oils, plastics, sewage sludge, and animal meal and fats. A major advantage of the energy recovery from waste in a cement kiln is that the non-combustible ash fraction is recovered as a

raw material. Consequently, a simultaneous recovery of **energy** and **materials** (non combustible part of the waste) takes place. The cement industry is capable of using waste with a significant calorific value, waste with no significant calorific value but with mineral components, and waste which offers both a significant calorific value and a mineral component.

- The use of alternative constituents as a substitute for clinker, as mentioned before. Two major examples are granulated blastfurnace slag, a by-product of the iron manufacturing process, and fly ash, one of the residues generated from coal combustion.

Co-processing offers a win-win-win solution for society, as it is beneficial to the environment, is cost competitive, and reduces the consumption of natural resources. On certain occasions, the cement industry has provided a solution to problems in various European Member States. One example is the management of animal meal at the height of the outbreak of mad cow disease. In addition, the industry contributes to the reduction of landfills (it should be noted that landfills emissions consist of about 60 percent methane, a gas with a global warming potential which is 21 times higher than CO₂) and reduces the need for solid waste incineration in Europe.

In relation to alternative fuels, the cement industry has significantly increased its use of such fuels resulting in a reduction of 15.6 million tonnes of CO₂ emissions⁵⁹. Having increased from 3 percent in 1990 to 31 percent in 2010, resulting in a total usage of 9.2 tonnes of waste⁶⁰, the cement industry in Europe uses by far the highest amount of alternative fuels in the world, followed by North America with a 13 percent substitution rate⁶¹. However, the use of waste as an alternative energy source varies widely across the different European countries, and is mainly influenced by the proximity of industries supplying alternative materials, regulatory frameworks and enforcement, the waste collection infrastructure and local environmental awareness.

Another reason why using waste as an alternative fuel when producing cement is good for the environment is that it preserves non-renewable fossil fuels, such as coal or oil, and it also lowers the region's dependence on such fuels. According to CEMBUREAU, every year the cement industry in the European Union saves the equivalent of about 7Mt of coal.

Industrial by-products with specific hydraulic properties such as blastfurnace slag, fly, as well as other alternative cementitious materials such as natural pozzolana can be used to partially substitute clinker in

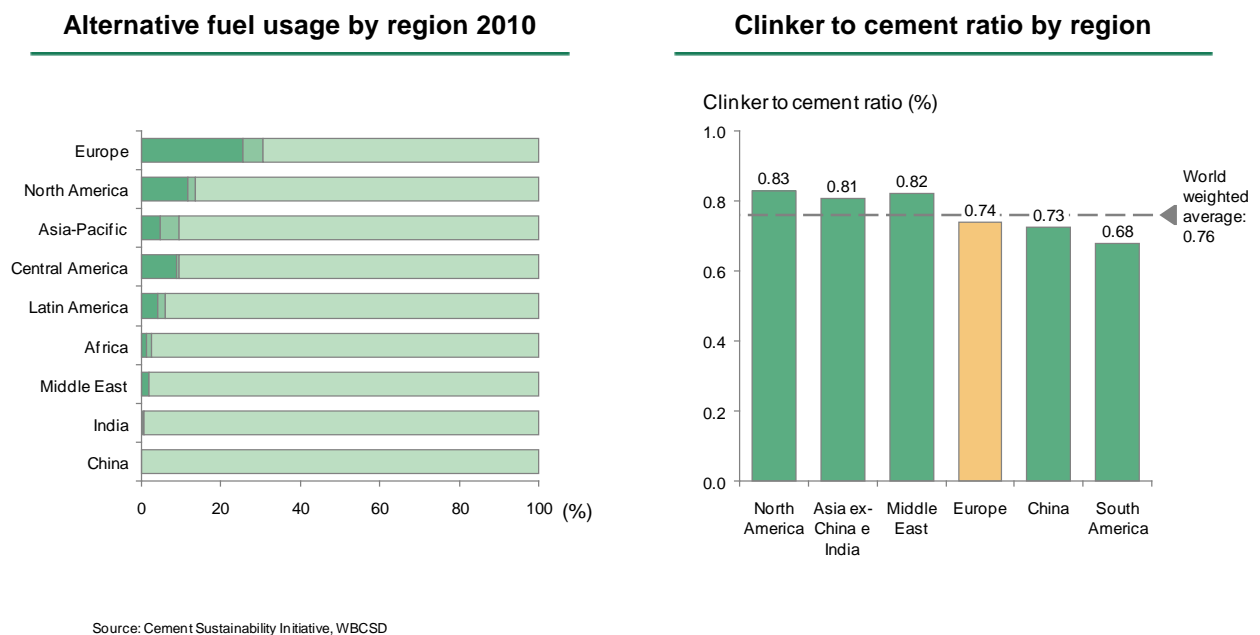
⁵⁹ Absolute emissions saved by the usage of alternative fuels (biomass and waste) in cement production compared to the use of coal. Calculation based on WBCSD data for EU.

⁶⁰ Data for biomass and alternative fossil fuels for EU in 2010, source: WBCSD, GNR Project Data.

⁶¹ Calculation based on WBCSD, GNR Project Data for EU in 2010.

cement. In Europe, for instance, an additional 8.3 million tonnes of clinker were substituted with by-products in 2010⁶² compared to 1990, according to the GNR. Lower-clinker cements have become a widely-used hydraulic binder in the production of concrete for specific applications, such as infrastructure in chemically aggressive environments.

Figure11: Alternative Fuel Usage and Clinker to Cement Ratio⁶³ by Region



The concrete industry is also investing in techniques to effectively recycle concrete, reducing both the use of raw materials and the need for landfill. The UK is leading the way in Europe, with a total of 28 percent of aggregates sourced from recycled and recovered aggregates⁶⁴. Moreover, the industry is supporting the development of materials which are easier to collect or re-use, as well as solutions to facilitate the

⁶² Calculation compares the total clinker required to produce 2010's cement production (184 M tonnes of cement) in EU with the clinker to cement ratio in 1990 vs to the one in 2010. Clinker data refers to clinker produced on-site by the reporting companies. Cement includes clinker consumed (= clinker produced + purchased – sold – stock changes) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold. The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1). Source: WBCSD, GNR Project.

⁶³ Data for EU-27. Cementitious includes the clinker produced (i.e. excluding purchased clinker) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold; Clinker data refers to clinker produced on-site by the reporting companies. Cement includes clinker consumed (= clinker produced + purchased – sold – stock changes) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold. The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1). Source: GNR, WBCSD.

⁶⁴ The mineral products industry's contribution to the UK, 2012, Mineral Products Association.

deconstruction of buildings and reuse of materials. These efforts are in line with the Waste Framework Directive which aims at re-using, recycling and/or recovering 70 percent of construction and demolition waste by 2020.

3.3.3 Concrete as the cornerstone for sustainable construction

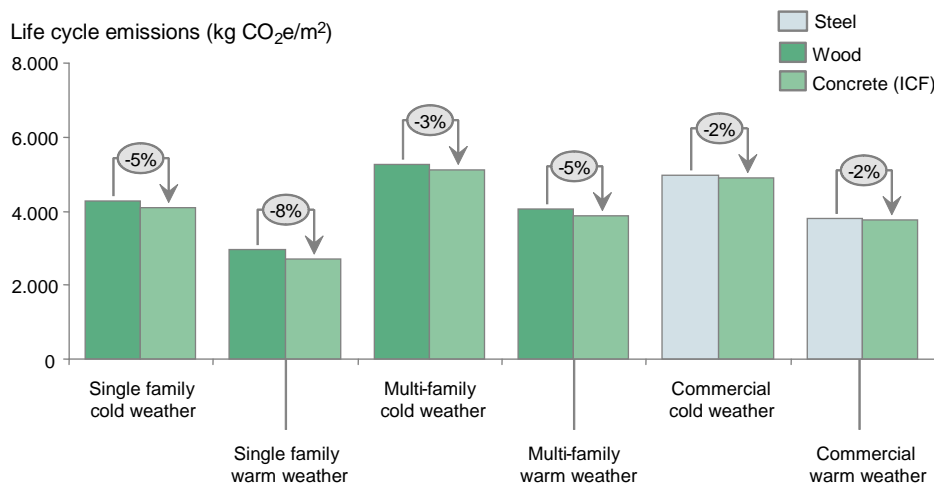
The opportunity of reducing emissions is not limited solely to the cement production process, but also lies in the whole life cycle of downstream products, namely concrete. Concrete can contribute significantly towards achieving the EU's objectives in terms of reducing CO₂ emissions. The energy consumption of buildings is one of today's major environmental concerns, as buildings account for ~35 percent of total EU greenhouse gas emissions⁶⁵ (including direct and indirect emissions from electricity generation). In order to address this problem, the EU recently adopted the Energy Efficiency Directive which aims at making the entire building sector more energy efficient by 2050. As concrete construction offers a higher energy saving potential compared to other construction materials, it offers great potential in terms of achieving the EU's ambitious carbon reduction goals, through the construction of very low energy buildings that significantly reduce or even eliminate their impact on the environment.

According to a study elaborated by the Massachusetts Institute of Technology (MIT), the life cycle emissions of concrete buildings are 2-8 percent lower compared to those built in steel and wood⁶⁶. As an example, the use of concrete in a 12-story commercial building represents a reduction of 2 percent in life cycle emissions in comparison to a steel building. Whilst concrete buildings do have higher embodied emissions compared to, for example, wood, resulting from the manufacture of clinker, they also offer a higher energy saving potential during their lifetime. This is due to the high level of insulation offered by concrete which means that the indoor temperature remains stable even when there are fluctuations in the temperature outside. Given that 88 to 98 percent of total building life cycle emissions are linked to the in-use phase, the saving potential provided by concrete buildings during their lifetime offsets the initial emissions resulting from the production of cement.

⁶⁵ European Environmental Agency.

⁶⁶ Methods, Impacts, and Opportunities in the Concrete Building Life Cycle, August 2011, MIT.

Figure 12: Comparison of Concrete, Wood and Steel Buildings Life Cycle Emissions



Source: MIT

The research by MIT concludes that by increasing the substitution of clinker with by-products from other industries, such as a fly ash from coal combustion or blastfurnace slag from the steel manufacturing process, the industry can reduce the embodied emissions of concrete buildings by an additional 4 to 14 percent.

In addition to this insulating potential, concrete also facilitates the installation of enhanced cooling systems, such as radiant cooling schemes with chilled-water pipes embedded in concrete structures. Concrete also offers improved air tightness, and allows for the taking advantage of the enhanced installation of ventilation systems and shading structures that minimise solar gains and maximise the amount of hot or cold air which comes into contact with the concrete.

By combining all of the above, the thermal mass potential of concrete can be maximised, giving it a strong advantage versus other materials, and allowing for the construction of low energy concrete buildings that reduce energy usage from an average of 200-150 kWh/m² to 50 kWh/m², or even to zero emission⁶⁷.

⁶⁷ Energy efficiency in Buildings, April 2009, WBCSD; Qualité environnementale des bâtiments BBC, October 2009, Infociments.

Zero or significantly low CO₂-emission concrete buildings

Cameleon shopping centre, Brussels

Low energy shopping centre constructed with insulated sandwich elements in concrete. Location and direction of windows and shadings are designed to obtain high utilisation of the solar radiation to take optimise the thermal inertia of the concrete. This is combined with natural ventilation inlets in the bottom of the building and outlets near the roof. As a result, the primary energy consumption of the building is reduced to 21 kWh per m².



Royal Danish Playhouse, Copenhagen

A 12 000m² building designed with a focus on reducing energy consumption for heating and cooling plus the application of green concrete in order to cut material related CO₂ emissions. The project quantified CO₂ emissions of up to 75 percent compared with traditional building design. Concrete structures are used as a heat sink and, in connection with a highly intelligent energy management system, this contributes to reducing energy consumption and CO₂ emissions.



Torre Verde resident building, Lisbon

Concrete building with a 7 200 m² floor area, hosting 41 apartments. The annual energy need for heating and cooling is stated to be 6 kWh/m². This level is only about 20 percent of the normal level imposed by national regulations in Portugal.



For additional case studies please visit: <http://www.europeanconcrete.eu/case-studies>

In the transport sector, which represents 20 percent of total European greenhouse gas emissions⁶⁸, concrete also contributes to reducing CO₂ emissions in a cost-effective way. According to EUPAVE, concrete

⁶⁸ European Environmental Agency.

pavements can reduce the fuel consumption of heavy trucks by up to 6 percent, by reducing the rolling resistance between the road and the truck as concrete pavements offer a smoother surface with fewer undulations than asphalt pavements. Further reductions in fuel consumption can also be achieved through a reduction in the need for maintenance and therefore lower traffic congestion. Concrete also has a high albedo compared to asphalt, due to its lighter colour. This means that it can reduce the need for street lighting and can also reduce the heat island effect in built up areas. Furthermore, the total life cycle costs of concrete are lower than those of asphalt. A study published by the Highway Administration of Belgium's Walloon region⁶⁹ concludes that concrete structures become more cost advantageous than bituminous ones as of the 7th year following construction, out of a lifetime of more than 30 years.

Concrete and its contribution to society

Concrete is one of the main enablers of modern construction. It is composed of aggregates, namely gravel (~55 percent) and sand (~30 percent), ~15 percent cement and additions, and mixed with water. Fresh concrete is malleable and takes the form of the mould into which it is poured. Once concrete has hardened, it is as strong as natural stone and is resistant to water, frost, mechanical constraints and fire. Concrete's main properties are its durability, resilience, resistance to pressure, workability under different weather conditions and strength.

Concrete is an essential material used in all types of construction both in housing and civil engineering. In housing, concrete provides the best choice for internal comfort as it limits temperature fluctuations, and therefore reduces the need for heating and cooling. In addition, it also provides airtight buildings, is a good noise insulator, provides protection and safety against fire and is resistant to extreme weather events. In relation to civil engineering, concrete is able to withstand moisture and varying weather conditions, as well as mechanical wear and high temperatures. It is commonly used in flood-prone areas due to its resilience to flooding, in tunnels due to the benefits it offers in terms of fire safety, in power plants due to the provision of safe and secure storage of potentially dangerous fuels and in water treatment, run-off catchment and water distribution systems which provide fresh water.

Regarding architecture, concrete is widely used since it combines functionality, practicality and design with the ability to express complex and dynamic forms. Concrete is a malleable material and can be moulded into any desired shape, providing architects with the freedom to express themselves by playing with light and using different textures and colours. In fact, some of the most famous buildings are made out of concrete, such as the Guggenheim Museum and JFK airport in New York, the Opera House in Sydney or the Sagrada Familia in Barcelona. All of them, as well as many others, show the design potential offered by concrete.

⁶⁹ Bituminous and continuously reinforced concrete pavements for motorways – An economic comparison – Les cahiers du MET Nr. 24, Walloon Ministry for Infrastructure and Transport, General Directorate of Motorways and Roads, Namur, 2006.

3.3.4 Contributing to biodiversity and ecosystem services

The cement sector is dependent on access to raw materials for the production of clinker. As a result, nature conservation, biodiversity and ecosystems management play an important role in its long-term resource and reserve strategy.

Quarrying and biodiversity are compatible through correct resource management before, during and after extraction. Companies often work closely with nature conservationists and scientific bodies in order to develop rehabilitation activities. In addition, many companies are developing, on a voluntary basis, Biodiversity Action Plans and Biodiversity Management Plans for a consistent management of flora and fauna. These are typically applied to sites which are located within or adjacent to protected areas. Ecosystems are sometimes even enhanced post-rehabilitation in comparison with the site prior to the initiation of extraction activities. One example of this can be found in France (Altkirch), whereby almost half of the exploited area has been completely rehabilitated and has resulted in significant biodiversity enrichment. Over 100 different species have been identified on site, including several that are registered on the IUCN Red List of Threatened Species.

Cement companies have successfully undertaken a wide range of actions to protect and promote biodiversity. For example, correct quarry rehabilitation can help minimise the impact of invasive species through the introduction of native species, as seen in Portugal. In this instance, one site is developing actions to gradually manage the density of several Acacia species which cause significant damage to the region's ecosystems. Quarry rehabilitation can also contribute to the development of biological corridors (also referred to as green corridors) or green infrastructure. In the UK, for example, a site has built an artificial bat cave, which is intended to provide an alternative long-term safe haven for bats. Some companies focus on the rehabilitation of ecosystem services, which can include flood resilience, pollination, leisure facilities, as well as support for the local heritage, and in many instances these actions address the needs of the local community. For example, in Spain one site has rehabilitated its quarry to provide not only habits for particular species, but also leisure facilities (such as cross-country cycling, picnic areas, botanic paths...) for the enjoyment of the local communities.

The cement industry also has a long history of successful collaboration with conservation organisations, which has allowed for significant improvements in terms of knowledge and preservation of ecosystems and biodiversity. By involving stakeholders in the process and integrating their expertise, the industry is able to ensure that its biodiversity strategy is as effective as possible. An example of this can be found in the UK

whereby, following the discovery of the Small Blue butterfly, which is in rapid decline, the site established a partnership with Butterfly Conservation to maintain the Small Blue population in the area. Other examples of partnerships include Birdlife Europe, WWF, and IUCN (International Union for the Conservation of Nature).

The industry has also developed partnerships, commitments and protocols with public and private entities such as universities, schools or research centres to promote environmental education, scientific research and environmental awareness and communication. By working together, stakeholders are able to share knowledge, know-how and solutions across all sectors.

4 A call for action

Governments worldwide are trying to identify solutions to the current downturn. Fostering investments in infrastructure could be a way to generate growth throughout the economy, providing support both to business and job creation. Cement and concrete, which are two of the main basic materials for construction and public works, will become an important lever in navigating Europe out of the current crisis.

The cement and concrete sector adds value to Europe. The industry is committed to innovation through more versatile, cost and environmentally efficient products and processes. It can also demonstrate an impressive track record given that, at production level, it has achieved a 40M tonne gross CO₂ emission⁷⁰ reduction through fuel and clinker substitution from 1990 to 2010. It further plays a critical role in waste management at a local level and has become a champion in biodiversity conservation. In addition, the cement and concrete industry clearly contributes towards achieving policymakers energy efficiency goals in the building sector.

The cement industry will clearly benefit from continued investment in Europe as the region is characterised by (i) a stable political regime, firmly grounded in its respect for democracy and the fundamental principles of law; (ii) access to a skilled labour force and (iii) the availability of a well-developed port, rail and road infrastructure.

In order to deliver growth in Europe, the cement industry needs to achieve reasonable returns on investment. This is where policymakers also have a role to play. From this regulatory and policy perspective, the factors that can contribute include:

- A consistent and predictable legal framework which allows for long-term investment planning and integrates economic, environmental and social considerations within a coordinated and consistent industrial policy at European level
 - Climate change and energy legislation that is characterised by a legal framework where parameters are fixed long-term, and continued security of supply is guaranteed with competitive energy prices, in a unified European market;

⁷⁰ Data for EU-27. Source: GNR, WBCSD

- Stronger coordination of national social policies and incorporation of social and economic feasibility considerations in one industrial policy for Europe in order to allow companies to proceed with long-term and structural investment decisions.
- The right regulatory incentives to drive growth
 - Prioritise public spending and investments on infrastructure and energy efficient construction in order to trigger a multiplier effect across the European economy;
 - Focus European R&D&I funds on targeted key priorities, such as energy and resource efficiency, and align national and EU funding programmes;
 - Reform state aid legislation in order to allow public seed money for bringing existing technologies to market and bridge the gap for investment where return on investment is currently too low across the industry.
- An even playfield in compliance with regulatory requirements to guarantee that all competing players are subject to the same impositions across the region and, at the same time, that European players are not at a disadvantage when facing competition from outside the region
 - Imposing best available techniques in the area of environmental legislation should take into account economic feasibility and should be technology neutral;
 - Challenge unfair subsidy regimes from non EU jurisdictions that have a negative impact on Europe's competitiveness and design proper regulatory mechanisms that can secure a level playing field in full compliance with the World Trade Organization rules as long as no equivalent measures apply to industry globally.
- Policies designed from a full supply chain perspective, which endorse the relevance of the industrial sectors as developers of process innovation as well as innovative products in Europe. Climate change and energy legislation needs to focus not only on the production process but also on the final use of products from that process. Such an approach will allow for fully assessing and appreciating the continued relevance of the cement and the concrete industry for Europe's competitiveness.

5 Glossary

Albedo: The diffused reflectivity or reflecting power of a surface. It is defined as the ratio of reflected radiation from the surface to incident radiation upon it. Being a dimensionless fraction, it may also be expressed as a percentage, and is measured on a scale from zero for no reflecting power of a perfectly black surface, to 1 for perfect reflection of a white surface.

Blastfurnace slag: by-product resulting from the manufacture of iron and steel. Granulated blastfurnace slag is used as a cementitious material and air-cooled blastfurnace slag is used as an aggregate.

Capital expenditures (CAPEX): Expenditures creating future benefits. A capital expenditure is incurred when a business spends money either to buy fixed assets or to add to the value of an existing fixed asset with a useful life extending beyond the taxable year.

Capital turnover/equity turnover: A company's annual sales divided by its average stockholders' equity. Equity turnover is used to calculate the rate of return on common equity, and is a measure of how well a company uses its stockholders' equity to generate revenue. The higher the ratio is, the more efficiently a company is using its capital.

Carbon capture and storage (CCS): The process of capturing waste carbon dioxide (CO₂) from large point sources, such as fossil fuel power plants, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation. The aim is to prevent the release of large quantities of CO₂ into the atmosphere. It is a potential means of mitigating the contribution of fossil fuel emissions to global warming and ocean acidification.

Cement: A calcium alumina silicate with hydraulic properties that enable it to act as a glue binding other materials together and used in construction.

For the purpose of CO₂ reporting and in order to publish meaningful and specific emissions data, the definition used in the present report is based on the WBCSD-CSI Protocol ('The Cement CO₂ Protocol') and is as follows:

Cement: = clinker consumed (= clinker produced + purchased – sold – stock changes) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold.

The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1).

Cementitious Material: Materials that have similar properties to cement and can be used to supplement clinker or cement, eg blastfurnace slag and fly ash.

For the purpose of CO₂ reporting and in order to publish meaningful and specific emissions data, the definition used in the present report is based on the WBCSD-CSI Protocol ('The Cement CO₂ Protocol') and is as follows:

Cementitious: = clinker produced (i.e. excluding purchased clinker) + all additives used to make cement with the consumed clinker + ground slag and fly ash sold.

The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1).

Clinker: The artificial calcium silicate rock formed in the kiln and then ground finely to make cement.

For the purpose of CO₂ reporting and in order to publish meaningful and specific emissions data, the definition used in the present report is based on the WBCSD-CSI Protocol ('The Cement CO₂ Protocol') is as follows:

Clinker (CK): when clinker is mentioned, results are presented per quantity of clinker produced on-site.

The present definition differs from the one given in the European Standard commonly used in Europe (EN 197-1).

Cost of capital: A term used in the field of financial investment to refer to the cost of a company's funds (both debt and equity), or, from an investor's point of view "the shareholder's required return on a portfolio company's existing securities". It is used to evaluate new projects of a company as it is the minimum return that investors expect for providing capital to the company, thus setting a benchmark that a new project has to meet.

Concrete: A measure combination of cement, sand, water and aggregates that through the hydraulic properties of the cement bind together to achieve a building and architectural material with high compressive strength.

Dry process: Modern kiln technology that accepts the raw material as a fine dry powder, ready for calcining and clinkerising.

EBITDA: An acronym for earnings before interest, taxes, depreciation, and amortisation. All interest payments, tax, depreciation and amortisation entries in the income statement are reversed out from the bottom-line net income. It is intended to measure and enable profitability comparison between different companies by cancelling the effects of different asset bases (by cancelling depreciation), different takeover histories (by cancelling amortization often stemming from goodwill), effects due to different tax structures, as well as the effects of different capital structures (by cancelling interest payments).

Environmental Management Systems: A structured approach for determining, implementing and reviewing environmental policy through the use of a system which includes organisational structure, responsibilities, practices, procedures, processes and resources.

ETS (Emissions Trading Scheme): a scheme launched in 2005 by the EU to combat climate change. Under the 'cap and trade' principle, a cap is set on the total amount of greenhouse gases that can be emitted by all participating installations. 'Allowances' for emissions are then auctioned off or allocated for free, and can subsequently be traded. Installations must monitor and report their CO₂ emissions, ensuring they hand in enough allowances to the authorities to cover their emissions. If emission exceeds what is permitted by its allowances, an installation must purchase allowances from others. Conversely, if an installation has performed well at reducing its emissions, it can sell its leftover credits. This allows the system to find the most cost-effective ways of reducing emissions without significant government intervention

Fly ash: A by-product of the combustion of pulverised coal in power-generation plants. It is extracted by the dust collection system as a fine particulate residue from the combustion gases before they are discharged into the atmosphere. The use of fly ash as a supplementary cementitious material is a very effective utilisation of a by-product. Fly ash is used as a supplementary input for the manufacturing of clinker, as a cement constituent, as well as an addition to concrete.

Greenhouse gas: A gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone. The burning of fossil fuels has contributed to the increase in carbon dioxide in the atmosphere. Anthropogenic carbon dioxide (CO₂) emissions (i.e., emissions produced by human activities) come from combustion of carbon based fuels, principally wood, coal, oil, and natural gas and some industrial processes such as the production of clinker in the cement industry.

Gross emissions: total direct CO₂ emissions from a cement plant or company in a given period. Gross emissions include CO₂ from alternative fossil fuels, but exclude CO₂ from biomass fuels, since the latter is treated as a memo item.

This definition used in the present report is based on the WBCSD-CSI Protocol ('The Cement CO₂ Protocol') and differs from the one given in the European Standard commonly used in Europe (EN 197-1)

Net emissions: gross emissions minus credits for the use of waste fuels.

This definition used in the present report is based on the WBCSD-CSI Protocol ('The Cement CO₂ Protocol') and differs from the one given in the European Standard commonly used in Europe (EN 197-1).

Heat Island Effect: An effect that occurs when temperatures in the built-up areas are higher than nearby rural areas.

Life cycle emissions: account for the total emissions associated with all the stages of a product's life, from raw material extraction, through to material processing, manufacture, distribution, usage, repair and maintenance, and recovery or recycling.

Limestone: A sedimentary rock composed largely of the minerals calcite and aragonite, which are different crystal forms of calcium carbonate (CaCO₃). Limestone has numerous uses: as a building material, as aggregate for the base of roads, as white pigment or filler in products such as paints, and as a chemical feedstock.

Net profit margin: Net income/revenue (where Net Income = Revenue – Cost).

NO_x: A generic term for mono-nitrogen oxides NO and NO₂ (nitric oxide and nitrogen dioxide). They are produced from the reaction of nitrogen and oxygen gases in the air during combustion, especially at high temperatures. In areas of high motor vehicle traffic, such as in large cities, the amount of nitrogen oxides emitted into the atmosphere as air pollution can be significant. NO_x gases are formed everywhere where there is combustion – like in an engine. In atmospheric chemistry, the term means the total concentration of NO and NO₂. NO_x react to form smog and acid rain. NO_x are also central to the formation of tropospheric ozone.

Oxy-fuel: A technology that burns oxygen with gaseous fuel. As compared to air, which contains 20.95 percent oxygen, higher temperatures can be reached using pure oxygen. Approximately the same total energy is produced when burning a fuel with oxygen as compared to with air; the difference is the lack of temperature diluting inert gases. The most common fuel burned in a torch with oxygen is acetylene; even though it presents special handling problems, it has the greatest heat output.

Patent family: A patent family is a collection of patent records that represent the same invention/innovation that is patented in various countries to protect a single invention (when a first application in a country – the priority – is then extended to other countries). It is the same invention disclosed by a common inventor(s) and patented in more than one country.

Petcoke (petroleum coke): A carbonaceous solid derived from oil refinery coker units or other cracking processes.

Pozzolana: A siliceous or siliceous and aluminous material which reacts with calcium hydroxide in the presence of water at room temperature (cf. pozzolanic reaction). In this reaction insoluble calcium silicate hydrate and calcium aluminate hydrate compounds are formed possessing cementitious properties.

Profit margin: A measure of profitability. It is calculated by finding the net profit as a percentage of the revenue. The profit margin is mostly used for internal comparison.

Return on capital employed: An accounting ratio used in finance, valuation, and accounting. It is similar to Return on Assets (ROA), but takes into account sources of financing. The return on the capital employed should be measured in after tax terms.

Slag: See BlastFurnace Slag.

Silica (silicon dioxide): An oxide of silicon with the chemical formula SiO_2 . It has been known for its hardness since ancient times. Silica is most commonly found in nature as sand, as well as in the cell walls of diatoms. Silica is used primarily in the production of glass for windows, drinking glasses, beverage bottles, and many other uses. The majority of optical fibers for telecommunications are also made from silica. It is a primary raw material for many whiteware ceramics such as earthenware, stoneware, porcelain, as well as industrial Portland cement.

Sludge: The residual, semi-solid material left from industrial wastewater, or sewage treatment processes. It can also refer to the settled suspension obtained from conventional drinking water treatment, and numerous other industrial processes. The term is also sometimes used as a generic term for solids separated from suspension in a liquid; this 'soupy' material usually contains significant quantities of 'interstitial' water (between the solid particles).

Sulphur oxide: Refers to many types of sulphur and oxygen containing compounds such as SO , SO_2 , SO_3 , S_7O_2 , S_6O_2 , S_2O_2 , etc.

Thermal mass: a concept in building design that describes how the mass of the building provides "inertia" against temperature fluctuations. For example, when outside temperatures are fluctuating throughout the day, a large thermal mass within the insulated portion of a house can serve to "flatten out" the daily temperature fluctuations, since the thermal mass will absorb thermal energy when the surroundings are higher in temperature than the mass, and give thermal energy back when the surroundings are cooler, without reaching thermal equilibrium.

Waste oil: Any petroleum-based or synthetic oil that, through contamination, has become unsuitable for its original purpose due to the presence of impurities or loss of original properties.

Wet process: kiln technology that requires the raw materials to be fed to the kiln process as a slurry for calcining and clinkerising.

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8 Note to the reader

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