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Energy-Intensive Industries: Decision making for a low-carbon future

The Case of Cement

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September 2012

TRADE INVESTMENT & CLIMATE CHANGE

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IISD's TRI-CC Program

This work is an output of IISD's Trade, Investment and Climate Change Program (TRI-CC). Related research will aim to deepen understanding of energy intensive industries, so as to better understand the effect of policies on these sectors. In particular, it forms part of an assessment of trade impacts of BCAs in developing countries, and will be followed by a complementary analysis of how BCAs affect exports from South Africa. Related research will aim to deepen understanding of energy intensive industries, so as to better understand the effect of policies on these sectors. Together, these analyses will inform research on the practical aspects of developing and implementing a BCA system.

Other similar areas of work in the TRI-CC Program include developing guidance for policy makers in elaborating and implementing BCAs, deepening understanding of climate policy for the steel and cement sectors, and work on emerging issues such as GHG-intensity standards and subsidies for green industrial development. Under TRI-CC's Investment and Climate Change theme, IISD will work with host country governments to develop policies that help catalyse flows of climate friendly investment.

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Key Messages

The cement sector represents a major source of global CO_2 emissions. Emissions of CO_2 from the cement sector are significant and growing: global emissions increased from 1.1 gigatonne (Gt) in 1990 to 1.9 Gt in 2006 and are projected to increase to 4.0Gt by 2030, with ongoing growth in demand for cement (IEA, 2009; WWF International, 2008). While the emissions intensity of production can be expected to decline due to the renewal of obsolete capital stock, introduction of more efficient processes, and increased use of alternative materials, these reductions by themselves will not be of sufficient magnitude to offset the increased volume of production.

Cement is also a key input to the development of viable economies. Cement production is fundamental to the development and renewal of a country's infrastructure and therefore to the viability of economic activity. But this needs to be balanced with the environmental impact of production: how can cement be produced and consumed in a manner that the goal of a low-carbon economy is realized in line with the 50–80 per cent overall emission reductions deemed necessary by the Intergovernmental Panel on Climate Change (IPCC) by 2050? Given long investment cycles and lead times, action is required in the near term, so that the industry is on the right trajectory by 2030.

There is only limited evidence on the effectiveness of carbon pricing policies in reducing emissions. The only unilateral carbon pricing policy that has been implemented to date is the EU Emissions Trading System (ETS). Currently, there is little firm evidence that this has had an effect on either the production of cement from existing plants or on plant location decisions. This is to be expected, given that effects are likely to be obscured by the decreasing share of the EU in global markets and the allocation of allowances in compensation for the carbon costs. The carbon pricing solution adopted by the EU is only one of a possible set of measures that could be used to encourage emissions reductions. Other policies could include regulation, subsidies for emissions reductions measures and imposition of standards.

Carbon pricing is one of many factors influencing company decision making. An average EU ETS emission allowance price of €15/tonne adds approximately €12 to the cost of producing one tonne of cement. This is not insignificant, but it is only one of many factors that contribute to the decision to produce in one location rather than another. In particular, the cost of trade between locations and relative cost of production will bear on the location decision, as will long term trends in demand.

New technologies are key to progress, but will require additional policy and financial support. While scepticism continues as to the likely viability of alternative production techniques and end-products, such technologies need to be pursued if reductions in emissions levels are to be achieved. Key amongst these technologies are carbon capture and storage (CCS) and new low-carbon forms of cement. While both are being explored by research consortia and by individual companies, it is not evident that the development of technologies is proceeding at the rate necessary to ensure that the sector is able to contribute to a step change in emissions. Scaling up of research activity may require new policy structures and will certainly require additional financial resources and appropriate models to deliver these resources.

The challenge of deployment and market penetration will be significant. In addition to the financial costs of basic research, the costs of deploying new technologies will be significant, especially given the legacy capital stock and the market dominance of Portland cement. These costs and the associated risks are likely to be well beyond that which can be sustained by any company acting independently. A potential route forward, albeit one that needs to be appropriately scoped, is to combine resources from the private and public sector in a collaborative approach. Here, it is useful to consider the hypothecation of revenues raised from carbon pricing policies, and whether these revenues should be dedicated to the development of new technologies and solutions.

The goal is that of a low-carbon economy, not just of a low-carbon cement sector. The solutions proposed and adopted need to reflect the prospects and ambitions for both the cement industry and the economy as a whole. Both incremental and breakthrough solutions need to consider the impact that implementation will have on the entire economy, not just the individual sector.

About This Paper

The cement industry is a major source of CO_2 emissions, accounting for about 5% of anthropogenic global CO_2 emissions. Securing reductions in these emissions is therefore critical if wider targets for emissions cuts—including the reductions of 80–95 per cent by 2050 set out in the EU roadmap and the reduction of 50–80 per cent by 2050 deemed necessary by the IPCC—are to be achieved (European Commission, 2011).

The paper aims to shed some light on the ways in which policy-makers can deal effectively with the tension between the need to achieve these ambitious mitigation targets and the need to minimize the economic impacts of climate policy in the very energy-intensive sectors where such mitigation may be most sorely needed. This tension is clearly illustrated within the EU, where the introduction of the Emissions Trading Scheme (EU-ETS) has led to concerns that national competitiveness will be undermined and production relocated, with the result that actions have been taken to compensate the industry. Balanced against this is the question of whether such schemes incentivize producers to make reductions in emissions to the necessary level.

It is hoped that a deeper understanding of the cement sector, as a particularly relevant case study, might help elucidate lessons that have broader relevance in addressing such tensions. First, how can the environmental impacts of cement production, most notably CO_2 emissions, be addressed? Second, in implementing policies to address CO_2 emissions, how can policy-makers avoid penalizing national cement production vis-à-vis overseas producers? Third, how can the industry fit within the vision of a low-carbon future, given that cement is fundamental to the structure of an economy? Finally, how can policy facilitate the transition of the industry to meet this vision?

To answer these questions properly, we need to understand fully the dynamics of the sector and of firm-level decision-making processes. In particular, understanding the factors and processes that drive decisions can help determine the range of effects that a policy may have. As such, the paper aims to further understanding of how decisions are made within the industry and how climate policies may affect and be affected by this decision-making process. This includes not only the response to carbon pricing schemes, but also whether and how best to support the investments that are required in order to realize substantial reductions in carbon dioxide emissions.

The first section of the paper outlines the cement value chain and sets out the key macroeconomic trends in the industry. Section Two links the value chain and macroeconomic trends to the industry decision-making process. Against this background, Section Three explains the issues that policy-makers face with respect to reducing emissions from the sector. Finally, Section Four reviews the actions needed to support the industry in a low-carbon future.

Section One: Industry Issues—Setting the context

Section 1 outlines the cement production process and links this to the drivers for decision making.

This discussion is set in the context of empirical evidence on investment, production and trade. The focus is on decision making by the multinational cement majors—while these companies account for the majority of capacity outside Asia and the Middle East, it should be noted that their total production is only 30 per cent of the global total.

The Value Chain

Figure One illustrates the stages of the cement value chain, giving specific detail for the production stage and the associated outputs. This section describes each stage, with a focus on production.

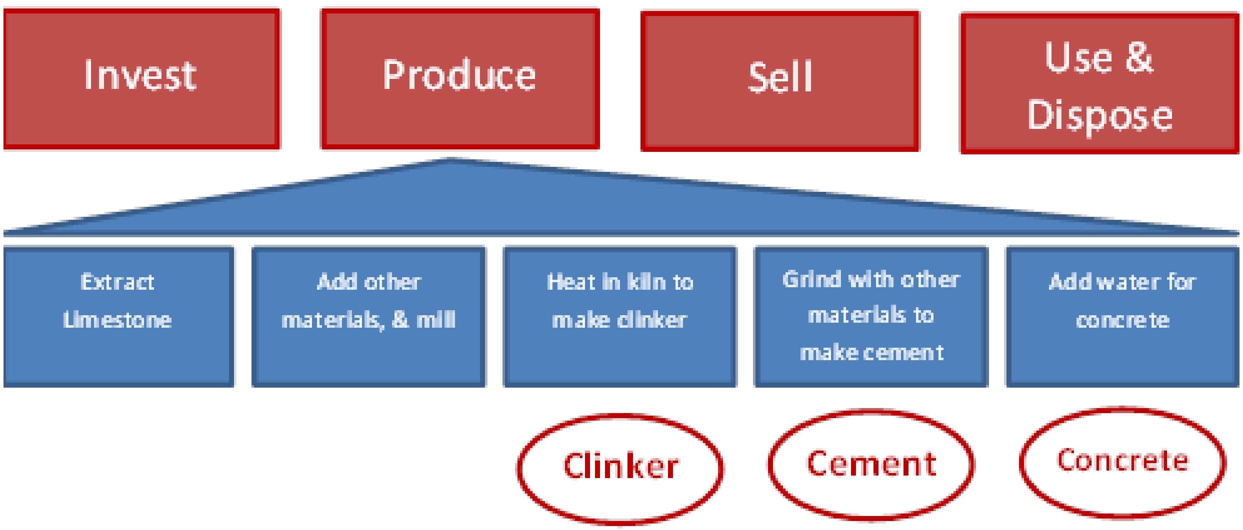

FIGURE ONE: THE CEMENT VALUE CHAIN

Invest: While costs vary by region, building a plant requires significant sums of capital, usually equal to about three years of revenue. High sunk costs and long investment cycles mean that decisions made today have effects well into the future, and that these decisions are subject to significant analysis, involving consideration of location, capacity and technology (see Section Two). Upgrading and extending existing capacity (brown-field investment), is cheaper than building a new plant (green-field investment) but is still a significant expenditure and will also be subject to thorough analysis (see Box One).

Produce: The cement production process can be divided into two basic stages: production of clinker from raw materials and the subsequent transformation of clinker into cement. In stage one, raw materials—predominantly limestone, but also smaller quantities of clay, shale, sand and industrial waste to ensure the correct balance of chemicals—are ground and heated in kilns to a temperature of 1450°C. As a result, limestone is decomposed into calcium oxide and carbon dioxide ($CaCO_3 \rightarrow CaO + CO_2$) in a process called calcination. The resultant calcium oxide then combines with the other raw materials to give calcium silicates and aluminates, the primary components of cement, in the form of cement clinker. In stage two, clinker is ground with other mineral components to produce cement—gypsum is used to control the setting properties while other additives are used to adjust other characteristics such as permeability.

Calcination results in emissions of CO_2 of approximately 0.45 tonnes per tonne of clinker, and accounts for around 55 per cent of total CO_2 emitted during production. The burning of fuel in kilns accounts for a further 35 per cent of total emissions, and electricity use accounts for a final 10 per cent. The average emissions intensity is in the region of 0.8 tonnes of CO_2 per tonne of cement.

Two main differentiators exist between production methods. First, cement production is wet or dry, depending on the water content of the raw materials, with the wet process being less efficient than the dry process. Second, kiln types vary, with the main distinction being drawn between the less-efficient vertical shaft kilns and more efficient rotary kilns—dry process rotary kilns with preheater and precalciner technology are the most advanced available.

Sell: Demand for cement is dependent on the level of construction activity and thus on economic activity. Demand will reflect the stage of the economic cycle in the short term and the stage of economic development over the longer term.[1] In both cases, a producer has to balance changing demand against a fixed capital stock—in some cases this may be through trade, but this tends to be limited due to the high cost of transportation. However, under certain circumstances—such as limited local production capacity and high local demand—imports may be high.

BOX ONE: PRICE AND COST DATA

There is little publicly available information on production costs and selling prices. Cook (2011) suggests a typical cost of around US$30/tonne in mature economies and US$20–25/tonne in emerging economies, with significantly lower costs in certain countries. IEA ETSAP (2010) cite operating costs in the range of €29–32/tonne clinker including fuel and electricity costs, but excluding depreciation. The majority of costs—typically between 30 per cent and 40 per cent of the total—are accounted for by energy, with the exact share depending on the energy efficiency of a given plant and the cost of energy in a given country.

There is similar variety in construction costs across regions. According to Cook (2011), construction costs for a new dry process plant range from US$150–200/tonne cement capacity in developing and emerging economies and from US$250–300/tonne cement in mature markets. This reflects both price differential, but also differences in quality of construction and expected operation and maintenance downtime. The costs of retrofitting are lower than for new plant investment, but still considerable.

Selling prices vary across markets, depending on input costs, demand levels, and the existence or otherwise of spare capacity. BNP Paribas (2010) estimate 2009 prices of US$40–50/tonne in China and East Asia, up to US$100/tonne in Europe, US$60–US$70/tonne in North Africa and up to US$200/tonne in parts of Sub-Saharan Africa. Cook (2011) cites data showing an average EU cement price of €50–70/tonne from 2003 to 2010. Such price differentials can persist over time due to limited international trade.

[1] Economic growth correlates with an increase in consumption until a certain level is reached, when per capita demand stagnates or declines (Inter-American Development Bank, 2010).

Use and Dispose: Portland cement, consisting of 95 per cent cement clinker, is the most widely used cement type. Other types of cement use a lower proportion of clinker, substituting with the other inputs into the production process such as fly ash, slag, and pozzolanas. This makes it possible to reduce the emissions and costs associated with producing a tonne of cement. However, the extent to which such blended cement can be substituted for Portland cement is limited by the availability of substitute raw materials and by established building practices.

Nearly all manufactured cement is used in the production of concrete—this involves blending aggregates, cement, and additives with water. Using a lower proportion of cement reduces the CO_2 intensity of concrete production, but is dependent on the availability of raw materials, the application in which the concrete is used, and building standards (Cement Sustainability Initiative, 2009).

According to European classification, a CEM I cement is a traditional Portland cement, comprising 95 per cent cement. Cements designated CEM II, CEM III, CEM IV and CEM V are factory-made composite cements with a lower percentage of cement and a higher percentage of other materials. For example, CEM IV is pozzolanic cement, comprising up to 55 per cent pozzolanic materials.

Trends in the Industry: Empirical evidence

This section outlines observed changes in production, investment and trade over the past decade, with the aim of putting the decisions made by firms and the effects of policy into context.

Production: Between 2000 and 2010, annual global cement production doubled from 1.6 billion tonnes to over 3.2 billion tonnes, and projections suggest that this will increase to 5.0 billion tonnes by 2030.[2] Figure Two shows that this is largely the result of growth in China, which now accounts for around 55 per cent of global production, with other emerging economies accounting for a smaller proportion of growth. These trends are also reflected in the changes in production and sales in the multinational companies, where emerging markets account for an increasing share of sales and production. In 2000 these markets accounted for about 40 per cent of total cement sales at Lafarge and 50 per cent at Holcim, in 2010 these same numbers were 60 per cent at Lafarge and over 70 per cent at Holcim.[3]

In Europe, America and Africa, the 12 largest multinationals account for the majority of production (Folliet, 2011). Markets are more fragmented outside of these regions, and the multinationals hold a smaller share, but consolidation is occurring, most notably in China where the government is forcing closure of small plants and incentivizing large scale production.

[2] Historical data are from United States Geological Survey, future projection is from WWF International, 2008.

[3] Lafarge total cement sales in 2010 were €10,280 million, of which the Middle East, Africa, Latin America and Asia accounted for €6,298 million; in 2000 these same regions accounted for €1,817 million out of total sales of €4,420 million. Holcim total cement sales in 2010 were 140 million tonnes (mt), of which 103 mt were in the Middle East, Africa, Latin America and Asia; in 2000 these same regions accounted for 40.7 mt out of a total production of 82.2 mt.

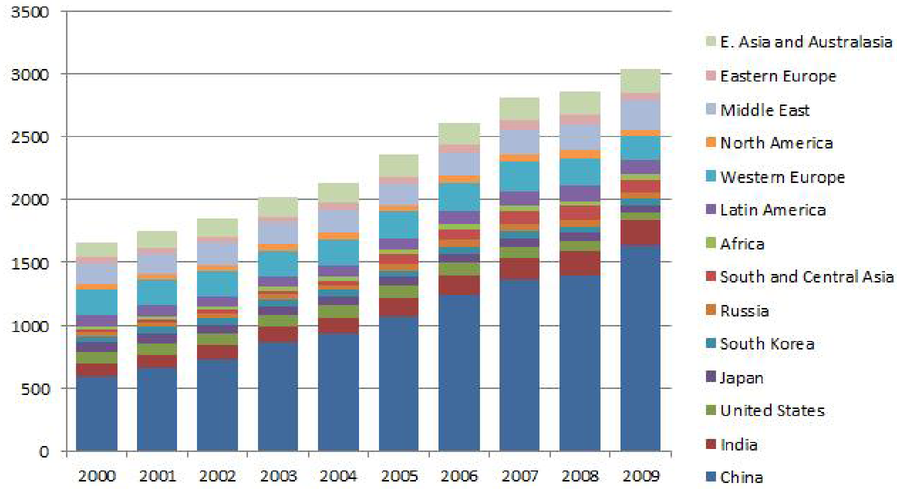

FIGURE TWO: CEMENT PRODUCTION BY LOCATION IN MILLION METRIC TONNES (SOURCE: USGS)

Investment: Reflecting the increase in production, clinker capacity almost doubled between 2000 and 2010, increasing from 1.7 billion tonnes to 3.1 billion tonnes (Figure three). Reflecting production figures, China accounted for over 65 per cent of the growth and for almost 50 per cent of capacity in 2010. Again, this is reflected in firm-level data: over the period, capacity in emerging markets increased from less than 50 per cent of total capacity to around 65 per cent at Holcim and from just over 50 per cent to 64 per cent at Lafarge.[4]

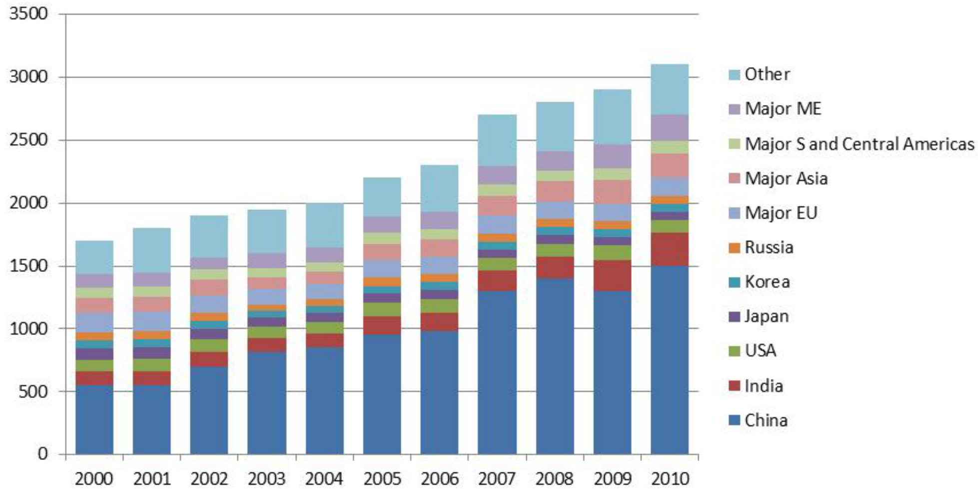

FIGURE THREE: CAPACITY BY LOCATION IN MILLION METRIC TONNES (SOURCE: USGS)[5]

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[4] In 2000, Latin America, the Middle East, Africa and Asia accounted for 50 mt of Holcim's total cement production capacity of 105 mt, and in 2010 for 138 mt of total cement production capacity of 212 mt. At Lafarge, these same regions accounted for 85 mt of a total of 163 mt of capacity in 2000 and for 138 mt of a total of 217 mt of capacity in 2010.

[5] "Major EU" includes France, Italy, Germany and Spain; "Major Asia" includes Pakistan, Indonesia, Thailand and Vietnam; "Major ME" [Middle East] includes Saudi Arabia, Iran, Egypt and Turkey; Major S[outh] and Central America includes Mexico and Brazil.

Regarding the type of capital investment, a review of kiln technology by region indicates an increase in the share of dry process rotary kilns, but with significant differences between regions (Cook, 2009). In particular, the inefficient wet process kilns are more prevalent in North America, Australia and Russia, whereas increased demand in emerging economies has led to the development of large-scale efficient capacity and displacement of small-scale inefficient capacity.

Trade: Figure Four shows the increase in the absolute level of trade in cement and clinker over the last two decades. Despite this increase, trade still only represents a small fraction of production and consumption: trade in cement generally represents only 5–6 per cent of consumption, with 50 per cent of this trade occurring between and within the five largest multinationals as a result of balancing supply and demand (Folliet, 2011). Traditionally, trade has focused on coastal plants with sea transport accounting for up to 80 per cent of international trade in cement.[6] Imports of cement into the EU have declined over the past ten years, with the majority coming from other EU countries.[7] By contrast, imports of clinker into the EU have risen with the majority coming from countries with surplus capacity—initially Turkey, then Egypt and China.

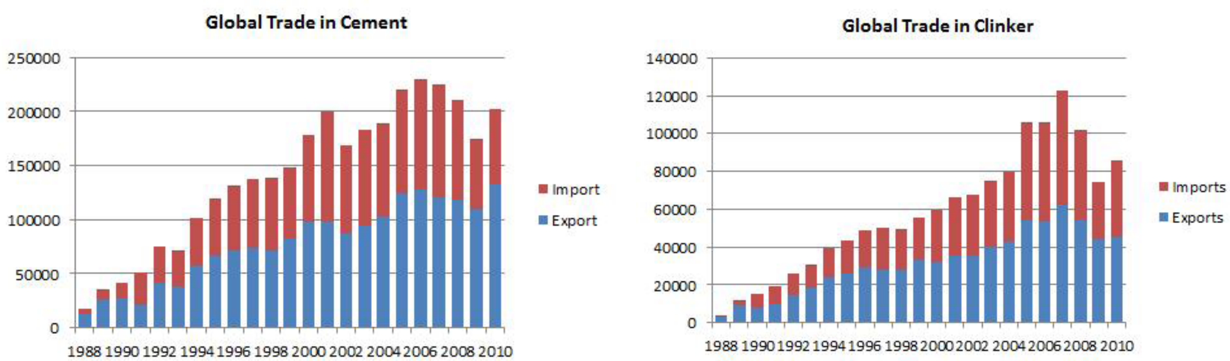

FIGURE FOUR: GLOBAL TRADE IN CEMENT AND CLINKER IN METRIC TONNES (SOURCE: COMSTAT)

[6] Data from Ocean Shipping Consultants, 2008.
[7] For further discussion, see Cook, 2011.

Section Two: Decision Making

The following section assesses factors of importance to decision making in the short and long term. The short term is defined as the period in which the existing capital stock is fixed and only minor modifications possible. In the long term, major modifications or new construction is possible.

BOX TWO: DECISION MAKING USING DISCOUNTED CASH FLOW

The fundamental framework for decision making is a comparison of the income and expenditures expected over the lifetime of a project. The resultant cash flow is discounted to reflect the opportunity cost associated with the project—investment of funds in alternative instruments. The choice of discount rate will vary across companies: generally it is based on the company cost of borrowing from shareholders and financial institutions (Weighted Average Cost of Capital). The effect of discounting is to reduce the values of cash flows further in the future and place a higher value on near-term cash flows. Where the sum of these discounted cash flows is positive, the investment offers a positive return for the investor.

This framework allows for the incorporation of a range of factors and sensitivities. For example, efforts associated with securing permits can be captured through the cost of doing so, and economic growth estimates through revenue forecasts. However, there are aspects that are more difficult to capture, including company strategies and ambitions for a given market.

The discounted cash flow model can be modified to incorporate an analysis of the risks associated with a project. Statistical modelling techniques or sensitivity analysis can be employed, or the discount rate modified to reflect the risk associated with a particular project, country, or cash flow. However, an investment decision is ultimately likely to be informed as much by qualitative assessment as quantitative analysis. In either case, companies will be looking to achieve a higher return for those projects with a higher risk level.

Short-Term Decision Making

In the short term a producer faces a number of decisions. Key amongst these are how much to produce and at what price, where production takes place and the method of production. The following discusses the drivers underlying these decisions.

The Quantity and Pricing Decision

A firm facing an increase in an input cost has a number of alternative responses, including increasing the price charged, accepting a decline in profit at current prices, or cutting costs elsewhere. The approach adopted will depend on a number of factors, both external to the firm (such as the level of competition in the market and employment legislation) and internal to the firm (such as company strategy and feasibility of other cost savings). Together, these factors make it difficult to generalize about the likely effects of a change in costs. However, location in particular is likely to exert a strong influence. For example, a manufacturer located in the centre of Europe and insulated from competition is more likely to pass on an increase in costs to its customer than a manufacturer located in a coastal region which is vulnerable to imports.

The Location Decision

In the short term, the decision on where to produce is constrained by the location of current plants. However, within this framework, there is the possibility that firms can increase or decrease the level of production at any one of their facilities. This decision may be taken for a variety of reasons, most notably to balance demand and supply positions—the opportunity cost of idle capacity is such that producers may choose to produce and export to areas of demand.[8] Alternatively, trade may be an opportunistic strategy to take advantage of price differentials, or serve as a first step to establishing a presence in a country, allowing companies to test new markets before committing to construction.

The feasibility of trading is dependent on the relative costs and prices in the importing and exporting region, and on the cost of transport between the two regions. Table One, based on Cook (2011), shows a case in which it is profitable for an East Asian producer to export to the EU, given short run costs and prices, and undercut EU production in doing so. An increase in carbon price in the EU would further support this case, while an increase in shipping costs would weaken it. Over the longer term, the capital costs of investment would need to be added to the analysis, eroding the margin available to both producers, with the outcome dependent on relative capital costs.

TABLE ONE: ILLUSTRATIVE EXAMPLE OF SHORT-TERM TRADING DECISION (US$/T)

	EUROPE	EAST ASIA
Production Cost	30	20
Carbon Cost	12	0
Transport Cost (to other region)	20	20
Sale Price in EU	80	80
Sale Price in East Asia	30	30
Margin on sale in EU	38	40
Margin on sale in East Asia	-32	10

(Source: Based on Cook, 2011)

The Technology Decision

While the technology of a plant is fixed in the short term, a producer may be able to adjust the method of production by making changes to inputs and outputs. First, the conventional fossil fuels burnt in the kiln can be replaced with alternative fuels such as industrial or plant waste. Second, a proportion of limestone can be substituted with industrial waste (e.g., slags or coal ashes), or a proportion of clinker can be substituted for alternative raw materials (e.g., blast furnace slag, fly ash or pozzolanas). Finally, emissions from electricity use can be reduced through process improvements (e.g., installing more efficient motors and using additives in grinding) and through use of alternative sources of energy (e.g., using hydroelectricity).

[8] Opportunity Cost is the difference between the net value of a given option and the net value of an alternative. For a manufacturer, leaving a plant idle or operating below full capacity represents an opportunity cost in that the facilities could be productively used in producing for export.

In each case, the choices made will be dependent on energy costs, the cost of any plant alterations necessary,[9] availability of alternative materials, local environmental impacts and legislation, financial incentives, product standards and carbon prices, and be made by reference to the current situation against the alternative. The specifics of the plant in question and the broader economy will also be important. The introduction of new techniques may be constrained by the existing specification of a plant or may have an adverse impact elsewhere in the plant (e.g., the moisture content of alternative fuels may result in greater heating requirements). Factors external to the industry such as demand for alternative fuels in other sectors or decreased supply of clinker substitutes as a result of new processes will also influence the decisions of the cement producer.

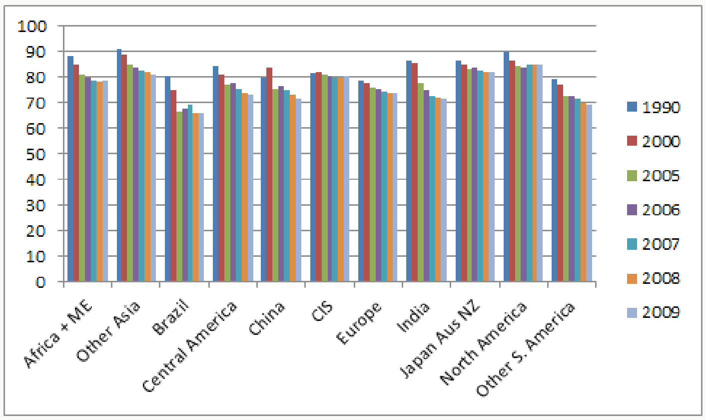

FIGURE FIVE: CLINKER TO CEMENT RATIO (SOURCE: CSI GNR DATABASE)[10]

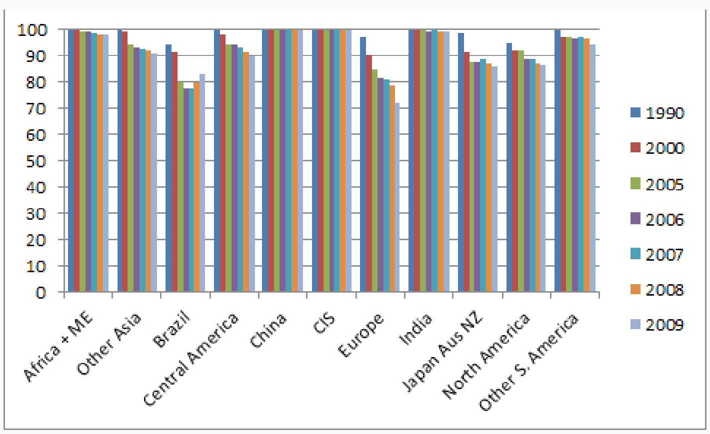

FIGURE SIX: PERCENTAGE OF THERMAL ENERGY FROM FOSSIL FUELS (SOURCE: CSI GNR DATABASE)[11]

[9] For example, a plant may need modification if it is to accept whole as well as chipped tires.
[10] Data extrapolated between 1990 and 2000, and between 2000 and 2005. The data covers approximately 30 per cent of global cement production, mainly from the multinational companies.
[11] Data covers approximately 30 per cent of global cement production, mainly from the multinational companies.

For alternative fuels use, the cost savings from lower operation costs are usually in excess of any costs that are incurred in making modifications to plants. Further, these lower operation costs can give companies a cost advantage in relation to competitors. A review of the U.S. industry indicates that alternative fuel use is primarily driven by cost considerations, with many plants considering it necessary for ongoing competitiveness (see Murray & Price, 2008; Environmental Protection Agency, 2008; Heidelberg Cement, 2010). Substituting a proportion of clinker with alternative raw materials is similarly often cost negative, even once costs of capital upgrades and any increased grinding requirements are included. One study quotes a return of 90 per cent based on a 50 per cent cement blend and a plant with a capacity of 1 million tonnes. However, such returns are dependent on price and availability of alternative fuels—prices may increase with competition from other users (e.g., co-firing) and there are limits to availability of alternative materials.

BOX THREE: THE ROLE OF CO_2 PRICING IN THE SHORT AND LONG TERM

At the simplest level, a CO_2 price is a cost just like any other and will be treated as such in the decision-making process. The concerns around the impact relate mainly to the differential impact that it has, with some economies exposed and others not. Further, this impact works against the competitiveness of those economies that are already facing high costs for other inputs. While free allowances and BCAs aim to correct for differential carbon impacts, they cannot address declines in relative competitiveness due to other factors.

In common with many other factors of production, carbon policy is both uncertain and evolving. In the EU, the inclusion of shipping within the ETS, for example, could adversely impact the economic feasibility of trade. On a global basis, carbon policies are receiving increased attention, and may impose a different but important cost on firms operating in these regions.

Long-Term Decision Making

The decisions taken by a firm in the short term will reflect the situation at any one point in time and are often reversible. For example, the possibility of using spare capacity to produce for export markets is only likely to be feasible for as long as freights costs and sale prices are at a certain level. However, over the longer term, these decisions and associated effects can become embedded in the structure of the economy, with plants being mothballed and subsequently closed, acquisitions being made in new territories, and technological innovations being recognized as standard. The high sunk costs and long investment cycles that characterize the industry mean that when these decisions are made, they have effects well into the future, changing the structure of the industry. This section examines three such decisions: location of production, technology deployed and research activity.

The Location Decision

A whole range of factors affect the decision of where to invest—Table Two lists some of these , categorizing by stage of the project life cycle. The influence of each factor needs to be considered over the lifetime of the plant. For example, a firm will need to consider the long-term prospects for the evolution of carbon prices in those markets that already exist and the introduction of prices in markets which have not yet adopted a pricing scheme. Further, companies also have to consider issues that are not currently being addressed to any great extent, such as the availability and management of water resources. The decision-making process is therefore subject to considerable uncertainty. While this can be analysed through the techniques referred to in Box One and mitigated by taking measures to maintain the flexibility of investments, it cannot be eliminated. Producers need to assess the level of risk that they are ready to accept and the return required.

TABLE TWO: FACTORS IN THE LOCATION DECISION (SOURCE: AUTHOR COMPILATION)

BUILD	PRODUCE & SELL			DECOMMISSION
BUILD (OR UPGRADE) PLANT	SECURE RAW MATERIALS	PRODUCE CLINKER AND CEMENT	TRANSPORT AND SELL OUTPUT	DECOMMISSION QUARRY & PLANT
• Planning conditions for quarry and plant • Tax incentives for capital expenditure • Availability and accessibility of labour & equipment • Environmental risks • Cost & availability of financing • Local procurement requirements • Kyoto Mechanisms	• Availability and accessibility of limestone, other raw materials and fuel • Cost of limestone and other raw materials • Legislation on quarry operation • Infrastructure for transport • Availability and cost of manpower	• Availability and accessibility of limestone, other raw materials and fuel • Cost of limestone and other raw materials • Legislation on quarry operation • Infrastructure for transport • Availability and cost of manpower	• Existence of local markets • Market growth potential • Potential for export • Infrastructure • Distribution network • Trade incentives and restrictions • Procurement requirements • Output standards • Ease of market entry	• Legal Requirements
THROUGHOUT				
• Legislation • Institutional factors	• Company strategy • Company outlook	• Infrastructure • Health and Safety	• Support for R&D • Macroeconomics	• Previous experience in the market

While the weighting and emphasis given to each of the factors listed in Figure Two will vary across companies and regions, some can be considered fundamental. First, the ease of accessing inputs and distributing outputs will be crucial. Facilities are usually located close to quarries due to the cost of transporting inputs, which in turn makes it necessary to secure licenses for the quarry and plant. Similarly, accessibility, availability and cost of other raw materials and fuel sources will influence the decision. On the sale side, the existence of current and future local demand, price projections, and potentially transportation options to other markets will be of key importance.

More broadly, company strategy and outlook will have a bearing on all decisions taken by a company, including technology deployed and research activity as well as location. Company strategy is also linked to a range of other factors, including growth of markets and views on legislation. Legal and institutional factors will also be vitally important—where governance is less stable and legal frameworks less established, companies are likely to require a higher expected rate of return in order to compensate for risk. As with company strategy, this links to a range of other factors—such as access to resources and tax environment—being affected by institutional stability.

Company Strategy in Action

The multinational cement companies continue to focus on the emerging markets of Africa and Asia. Heidelberg Cement cites a strategy targeting growth of the cement business in these areas of growing demand and has announced an additional 10 million tonnes of capacity in these markets by 2013 (see Heidelberg Cement, 2011; Heidelberg Cement, 2010). Citing strong growth in these markets, Lafarge declares "continuing development on emerging markets" as one of its strategic priorities, and states that such markets are the target for most additions to production capacity (Lafarge, 2012).

Finally, the role of price and costs should also be considered, since these have an obvious effect on project economics. Capital construction costs will vary significantly by location, and will improve the economics of a project in one country versus another. Operation costs also vary across countries and may in some cases be subsidized, further widening the differential that would be seen in a free market. Balanced against these costs is the price realized, which will also vary across countries in line with input costs, capacity levels and demand for cement. The evolution of these costs and prices over time is again difficult to predict—a country that is currently a low-cost producer may not be in 10 years (see Box One for further discussion of costs and prices).

The Technology Decision

In the long term, a producer is not constrained by the existing capital stock, but can choose to invest in new capacity or make major changes to existing capacity. The latter enables modern technologies and capacity expansions to be accommodated, such as kiln efficiency improvements, waste heat recovery systems, conversion to dry processes, control systems to optimise kiln systems, and the addition of extra production lines.

When making investment in new plants or upgrades to existing plants, a number of factors need to be considered, including cost of installation, cost of operation and maintenance, emissions (not only CO_2 but also particulates and dust), energy efficiency, health and safety performance, flexibility to additions and alterations, suitability for local circumstances, and availability of technology, parts and inputs. This will be balanced against expected income over the life of the plant for new facilities or over the remaining life of the plant in the case of retrofits.

In terms of investment in kiln technology, economic factors generally support the uptake of dry process rotary kilns—the best available technology (BAT). In particular, BAT is not only associated with lower CO_2 emissions but also more efficient use of energy and raw materials, explaining uptake in countries that are currently not affected by carbon pricing. However, local factors may mean that modifications in plant design away from the most efficient possible—for example, where raw materials have a high water content, the deployment of wet processes may be necessary.

The speed at which new, more efficient technologies are introduced will be limited, since shifting to BAT is only possible with the construction of new plant. It can therefore be expected that the greatest opportunities for introduction will be seen in those countries outside of the Organisation for Economic Co-operation and Development (OECD) in which demand is growing quickly. Absent further intervention, such as impositions of technology or performance standards, there is limited possibility of introducing such technologies in mature markets.

Looking beyond the kiln technology, variations in plant design reflect locally specific factors. Producers may build electricity generation plants so as to avoid having to rely on unreliable and costly centrally delivered power, construct road and rail links where these do not exist or are below required standards, or may commit to providing services such as water to local populations.

The Research and Development Decision

Aside from the investment in facilities and output, a producer may also choose to invest in research projects such as the development of new manufacturing processes or new forms of cement. It is unlikely that there will be significant improvements in the fuel efficiency of modern dry process rotary kilns (IEA, 2009). Fluidized bed reactors have been successfully employed in other industries, and there may be some potential for application in the cement industry. However, the greater part of the research agenda has focused on carbon sequestration technologies, in particular post-combustion capture and oxy-combustion. Post-combustion technologies can be integrated into new-build plants or retrofitted to existing facilities, and are estimated to capture up to 90 per cent of emissions. Oxy-fuel technology involves using pure oxygen to combust fossil fuel and is only likely to be employed in new plants due to the costs and technical challenges of retrofitting. While these technologies are still some way from maturity, it is possible that they could be commercially available by 2020 (IEA; Cement Sustainability Initiative, 2009).

Beyond carbon capture and sequestration, recent years have seen the early-stage development of low or negative carbon cement, based on a range of technologies and processes (van Oss, 2011). Of these options, belite-sulfoaluminate cements, which are produced using different raw materials but in standard cement kilns, are the most advanced. Other, more innovative, solutions such as geo-polymer and magnesium-base cements are further away from maturity, and are generally considered to be longer-term prospects than carbon capture and storage (CCS).

While investment in such technologies may have a financial payoff at some stage in the future, it will generate little income in the near term. The extent to which manufacturers will invest in such technologies will depend on their view of market and political trends, long-term price and cost forecasts, the feasibility of the technology under examination, company strategy, and the importance attached to establishing knowledge and a position in the market. There are certainly enough resources in the industry as a whole to fund development of CCS—deployment in 70 plants by 2030 is estimated to cost in the region of US$50 billion, compared to a combined net profit of the five major multinationals of US$30 billion in 2010 alone.[12] However, the economic case for making the investment at company level is unlikely to be sufficiently compelling absent any other forms of incentive. This is especially the case give that the additional operational costs of a post-combustion CCS plant is estimated to be between €10 and 50 per tonne of clinker—assuming full capture of process emissions, and assuming the ability to sell CCS-based mitigation credits into a functioning carbon market, a CO_2 price of €15 per tonne would barely cover the low-end estimate.

[12] Based on business as usual emissions of 2.2 gigatonnes in 2030, deployment in 70 commercial plants would capture just 12 per cent of emissions from the industry (IEA; Cement Sustainability Iniative, 2009). Financial data is from Bloomberg and covers all divisions, not just cement.

Section Three: Questions for Policy-Makers

Policy makers face a number of challenges in relation to the cement sector. First, how can the environmental impacts of cement production, most notably CO_2 emissions, be addressed? Second, in implementing policies to address CO_2 emissions, how can policy makers avoid penalizing national cement production vis-à-vis overseas producers? Third, how can the industry fit within the vision of a low-carbon future, given that cement is fundamental to the structure of an economy? Finally, how can policy facilitate the transition of the industry to meet this vision? This section examines the first three of these questions and section five concludes by exploring the last. In each case, the influence of company decision-making and how this can be affected by policy initiatives is considered.

How to Address the Environmental Impacts of Production

While cement production is associated with a range of environmental impacts—including airborne pollution in the form of dust and gases, land use effects arising from quarrying, and local impacts in the form of noise and vibration—the greatest scrutiny has been directed towards emissions of CO_2. Despite declines in intensity that have occurred since 1990, the intensity of CO_2 emissions is amongst the highest in the industrial sector, with approximately 0.8 tonnes of CO_2 emitted for each tonne of cement produced (see Figure Seven). In terms of absolute levels, emissions of CO_2 are significant and growing climbing from 1.1 Gt in 1990 to 1.9 Gt in 2006 and projected to reach 4.0 Gt by 2030 (WWF International, 2008). Declines in emissions intensity at the rate seen to date will not outweigh these increases.

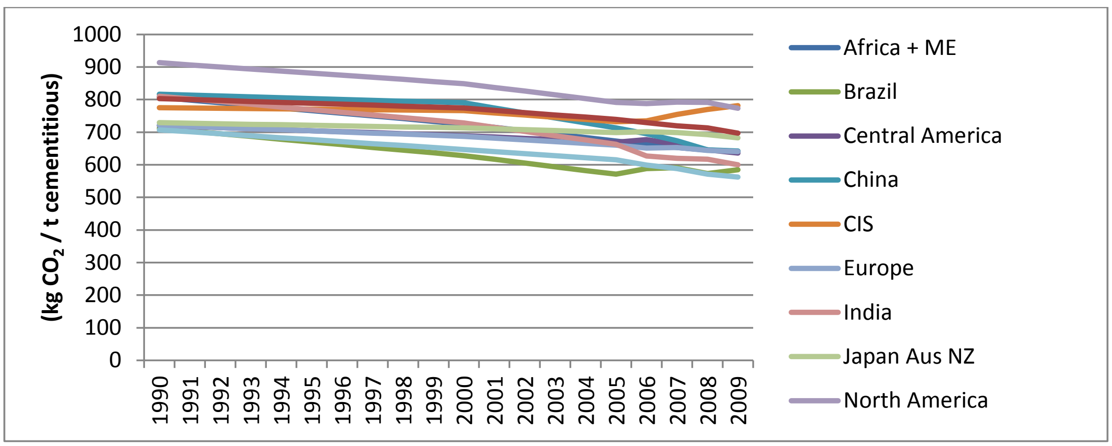

FIGURE SEVEN: EMISSIONS PER TONNE OF OUTPUT BY REGION (SOURCE: CSI GNR DATABASE)[13]

Given both the absolute level and intensity of emissions from the sector, the policy-making debate, in the EU at least, has focused on how to reduce emissions, or at least how to ensure that emissions are properly priced. The EU ETS and other pricing schemes are aimed at changing the behaviour of firms by placing a price on emissions and thereby giving a price incentive to make cuts through efficiency or other measures. To date, empirical evidence on the effect of these policies is unclear—while Figure Seven shows declines in emissions intensity in Europe, this pattern is mirrored in almost every other region.

[13] Data extrapolated between 1990 and 2000, and between 2000 and 2005. The data covers approximately 30 per cent of global cement production, mainly from the multinational companies. See http://wbcsdcement.org/GNR-2009/index.html.

On the one hand, this decline in emissions intensity is likely to reflect, at least in part, the cost advantages bestowed by use of alternative fuels, deployment of BAT, or efficiency improvements. The analysis set out in Section Two suggests that the introduction of such measures will be economic without the support of a carbon price, and would be implemented by manufacturers in any event. This also explains uptake of such measures and decrease in emissions intensity observed in all regions, not just the EU. On the other hand, the additional support provided by a carbon price may incentivise the implementation of more costly measures.[14]

However, even assuming that carbon pricing has been effective in incentivising a decrease in emissions intensity, manufacturers may still not implement such measures due to the existence of additional barriers which cannot necessarily be alleviated by financial incentives such as availability of materials, standards and legislation, or local acceptance. In addition, there is a limit to the extent to which reductions in emissions intensity can be achieved using currently available technology, and more substantial reductions will require that the technologies discussed in Section Three (or alternatives) are developed and deployed at scale. However, in achieving reductions, policy-makers need to consider the potential impact on the viability of domestic industry, and whether this justifies compensatory measures.

Maintaining the Competitiveness of the Industry

The effectiveness of policy measures can be undermined by firms' decisions. A firm facing a CO_2 price may find it more financially advantageous in the short term to relocate production and meet demand through trade. In the long term, this change can be made permanent by relocating production facilities overseas. In both cases the domestic economy suffers, and there is potential for adverse environmental impact should relatively efficient production be replaced by less efficient production overseas (for example, because there are no, or less rigorous, carbon constraints). Such competitiveness and leakage effects are the subject of ongoing debate and analysis within the EU and elsewhere. For policy-makers, the challenge is to identify the likelihood that they will occur and how they can be prevented.

In response, the EU has chosen to allocate free allowances to those sectors considered to be at risk of leakage. In Phases One and Two (2005–12) the allocation was based on historical emissions, in Phase Three (2013–2020), a benchmarking approach was adopted with allocations based on the carbon intensity of clinker production in the 10 per cent best performing installations. However, while free allocation compensates firms for loss of profitability, it does not prevent firms from reducing production within Europe and using their allocations to fund investment overseas—in particular, this could be a rational strategy for plants in coastal locations which face higher competition from outside the EU but which are also better placed to meet local demand through importing. Nor do free allowances prevent a firm from using allocations to support investment or other activities unrelated to emissions reduction—particularly where the more economically advantageous emissions reductions measures have already been implemented (see, for example (Demailly & Quirion, 2006). Finally, the incentive for emissions reductions is directed solely at clinker production and does not give any incentive to reduce the proportion of clinker in the cement end product – one of the sector's major abatement opportunities. By contrast, allocating in line with emissions intensity of cement production may encourage producers to circumvent restrictions by importing clinker for blending within the EU.

The most widely discussed alternative to free allocation is the use of Border Carbon Adjustments (BCAs), which requires that that goods imported from countries with less stringent carbon constraints be assessed charges equivalent to what domestic producers of the same goods would pay under their carbon pricing regime. BCAs retain the competitiveness

[14] For further discussion of the possible effects of carbon pricing in the short term, see Cook, 2011.

of domestic production vis-à-vis overseas competition and reduce the likelihood of leakage. Further, the incentive to reduce emissions is retained for both domestic and overseas producers to the extent that this offers a cost advantage over competitors, although again the extent to which reductions will be realized will depend on the relative cost of implementation versus emissions charges. The key challenges for such a scheme focus on the practical and legal aspects of implementation, and suitability is likely to depend upon the sector in question. Analysis suggests that the relative homogeneity of the end product and manufacturing process would make BCAs an appropriate mechanism for the industry, since this implies a relatively light administrative burden (Droege, 2009).

Discussion of the decision-making framework highlights that a producer balances a range of factors when choosing where and how to invest. These factors reflect the specific circumstances of the plant—e.g., proximity to markets, raw material availability, permitting conditions—as well as broader economic, regulatory, and environmental circumstances. The relative importance of each factor will vary over time with the evolution of the industry and the broader environment. As a result of this interaction, it is unlikely that the importance of carbon policy in the location decision of firms will ever be isolated. Rather, it will be one of many factors that contribute to the evolution of the industry over time to a greater or lesser extent in one or other location. Indeed, the empirical evidence on the competitiveness and leakage effects of carbon pricing is largely inconclusive, reflecting a range of complicating factors such as long investment cycles, free allocation of permits, and macroeconomic trends. While a number of possible trends could be identified to suggest relocation of production—including construction of excess capacity in the Middle East and increased clinker import in the EU (Cook, 2011)—the evidence remains fragmentary.

The Place of the Industry in a Low-Carbon Future

The discussion of national competitiveness prompts questions as to the place that the industry should assume within a national economy: to what extent do policy-makers wish to support industry, and how can this be reconciled with plans for a low-carbon economy? These questions are particularly challenging since cement remains a fundamental component in maintaining and building the infrastructure of an economy. While this is most notably true of developing countries where the infrastructure stock is still under development, it also applies in developed economies where construction is less rapid but where renewal of infrastructure is still necessary (Mortelier & Sireyjol, 2011). There are no direct substitutes for cement, and little likelihood that there will be significant reductions in usage. How then, should cement be produced and used in a manner that minimizes the current and future environmental impact? And how can policy-makers best support this goal?

Section Three sets out the options for reducing the environmental impact of cement production based both on current technology and technological developments over the longer term. These technologies hold out the possibility that cement, or similar materials, can be produced with much lower emissions of CO_2 than is currently the case. In addition, the use of the cement end product—concrete—needs also to be considered. Here, the most relevant metric is the full lifecycle emissions of an application, since this accounts for both the emissions during production and the emissions that are associated with the final material in use. Notably, the global warming potential of concrete buildings is lower than for wood-framed buildings over a 60-year period due to lower emissions of carbon dioxide during the use phase of the building (Oschendorf, Norford, & Brown, 2011). Furthermore, the appropriate use of a given blend and quality of cement can improve the longevity and durability of a construction, thereby reducing use of natural resources and environmental impact over the lifetime of a building (WWF International, 2008). The disposal and recycling of concrete also should be considered, since this offers opportunities for reducing overall emissions (see IEA; Cement Sustainability Initiative, 2009 for further details).

Identifying the place of cement in a low-carbon future and the appropriate supporting policies requires that the debate extend beyond the sphere of carbon pricing into other policy areas. At a strategic level, planning the place of the industry will draw upon policies relating to industry, business, employment, energy, and technology. At the level of individual solutions, the realization of new production methods will require the support of expertise from the industrial and innovation policy areas while the development and implementation of lifecycle assessment approaches will draw upon government and industry bodies specialized in construction. It will be necessary to draw upon a range of policy solutions to support the realization of each of the individual solutions. These policies should be designed with an understanding of all the factors that can hinder or support sustained implementation, including the decision-making processes of firms.

Section Four: Actions for a Low-Carbon Future

While 2050 seems like a distant time horizon, many of the solutions identified in previous sections require that action is implemented in the near term if reductions are going to be achieved by that date. This is particularly the case given the long investment cycles in the industry—investments that are currently being considered are likely to still be in operation in 2050. This section proposes actions to support the development of the industry in line with a low-carbon economy, possible supporting policies, and considers the effect that such policies are likely to have on company decision making.

Deployment of Current Technologies

There are a number of measures that can be taken to reduce emissions using currently available techniques, in particular deployment of BAT, use of alternative fuels and clinker substitution. In most cases, the deployment of these techniques not only leads to reductions in emissions, but also to cost savings. Where this is not occurring, policy-makers should consider what factors prevent it.

Accelerating the deployment of best available technology *(BAT)* is one means by which CO_2 reductions can be achieved using available technology. Deployment in new plants is generally supported by market forces, but, where this is not the case, policy-makers could consider incentive payments or subsidized technologies to ensure that BAT is financially viable for manufacturers and therefore more likely to be deployed. Alternatively, regulation could be implemented to ensure that new plants are built to certain specifications. There may also be a case for accelerating introduction either through financial incentive, standard or regulation. Forced closure of inefficient plants has been implemented in some cases, most notably China, where a program of shaft-kiln closures has been in place since 1999, and all inefficient capital stock is expected to be replaced with state-of-the-art technology by 2020 (Batelle Institute, 2002; Gupta, 2011).

Use of alternative fuels for heating the kiln is widespread in some European countries, with some plants being almost fully fired with alternative fuels. Elsewhere, alternative fuel use is close to zero, offering potential for significant emissions abatement. The use of alternative fuels often offers cost savings, but, where this is not the case, financial support measures may be required, such as subsidies for the use of alternative fuel, increasing tax on the use of conventional fuel, and providing grants or loans for necessary plant adaptions. Implementation of such policies can change the financial viability of implementation, if properly designed and implemented, although consideration would need to be given as to how to support such measures over the longer term. Further, these measures will not necessarily prompt uptake if non-financial factors apply—for example, where waste management legislation and processes are inadequate or raw materials unavailable. Here, changes in legislation and processes, development of guidelines, research into the range of potential fuels, and education programs for industry, local government and the public may be necessary.

Clinker substitution is one of the most efficient ways to reduce emissions of CO_2, with high substitution rates possible for certain products. In addition, clinker substitution is, in many cases, strongly cost negative. However, there is significant variation in uptake, reflecting the availability and price of substitution materials on the one hand and policy constraints on the other hand. Possible measures to alleviate the former include facilitation of markets, further research into the range of substitution materials with the aim of identifying new sources, and financial support as necessary for use of these materials. Together these measures can broaden availability and improve the financial viability of clinker substitution for manufacturers.

On the policy side, significant research and outreach work is needed to revise building standards to incorporate use of blended cements to their full potential and to ensure acceptance within the global construction industry.[15] Policy-makers need also to consider the role of the construction sector in incentivizing the use of blended cements since higher levels of demand will—subject to financial viability—likely lead to greater production of these cements. Such increased demand can be prompted through a number of measures including setting of standards and criteria for the environmental performance of buildings and by procurement policies in the public sector.

In the case of both policy and financial measures, however, it is important to consider the effects of policy measures beyond those directly relating to substitution. For example, as previously mentioned, allocation of free allowances based on carbon emissions from cement production will not incentivize firms to decrease the proportion of clinker in blended cements. Further, any BCA regime should distinguish between imports of clinker and cement to ensure that the integrity of incentives associated with each is maintained.

Development and Deployment of Carbon Capture and Sequestration (CCS) Technologies[16]

While CCS has not yet been proven at scale, a number of pilots have commenced, and it is possible that the technology will be commercially available in the medium term. This will require further research and demonstration projects, and a supportive economic and political environment.

While any one manufacturer may be engaged in research and demonstration projects, deployment at scale will require substantial investment across the industry. Not only is an individual manufacturer unlikely to be able to finance this (and to bear the associated risk), but implementation is dependent on an industry-wide solution. There is no incentive for any single manufacturer to support the development of a technology that will subsequently be used across the entire industry.

In particular, carbon prices are neither high enough nor certain enough to support development and deployment of CCS, and additional sources of financial support will therefore be necessary. Here, the most productive route forward seems to be through a combination of industry and government financing aimed at supporting research and pilot projects in the near term, demonstration plants and deployment over the longer term. One example of joint funding would be the grant recently awarded by the U.S. Department of Energy to CEMEX to explore the commercial application of CO_2 capture. In regions subject to carbon pricing or a carbon tax, there is the possibility of recycling any revenue collected and allocating it to help fund projects.[17] Based on 2010 emissions of 153 million tonnes from the cement sector, and a permit price of €15/tonne, this would raise in the region of €2.3 billion per annum.[18] By itself, this would not come close to meeting the projected investment needs for commercial deployment of CCS, although collaboration with other industries where CCS could be applied would be additional source of funding.[19] In addition to

[15] Notably, performance-based rather than content-based standards are important.
[16] Data in this section comes from (IEA; Cement Sustainability Iniative, 2009)
[17] There is already a precedent for this: NER300 is a financing instrument managed jointly by the European Commission, European Investment Bank and Member States, which sets aside 300 million EU ETS allowances for subsidising installations of renewable energy technology and CCS.
[18] Including revenues raised from a BCA would raise additional funds, but these would not be significant given low import levels. 2010 data from Eurostat suggests a total import of cement of 3 million tonnes from outside the EU15 countries. Assuming an emissions intensity of 0.8 tonnes per tonne of cement, and a carbon price of €20, this would result in total revenue of approximately €50 million.
[19] See (Cooper & Grubb, 2011) and (Cooper, Grubb, & Fazekas, 2011) for further discussion on revenue dimensions of EU ETS.

raising finance, this may also lessen resistance to carbon pricing amongst the industry. The political environment also needs to be considered, with the government and industry working together to identify and establish research agendas and requirements, appropriate legal and regulatory frameworks, and public acceptance. Developing and implementing a global solution will require that governments and companies from all regions work together. In doing so, it may be useful to draw upon the experiences and frameworks established by existing research consortia and programs such as the European Cement Research Academy (ECRA) and the programs run by the Portland Cement Association in the United States. The growth in emerging markets is also crucial, and a first step to addressing this would be to draw on the experience and frameworks of international financing mechanisms such as the Clean Development Mechanism and Joint Implementation. However, the success of such cross-country and cross-company initiatives measures is dependent on having agreements that recognize and protect concerns regarding industrial development and commercial confidentiality.

In addition to incentives and funding for new construction of CCS projects, it is also important to consider retrofits to the existing capital stock and how these can be best facilitated. It is likely that deployment, as for new build, will require financial and other forms of support in order to incentivize companies to invest. However, there may also be a role for regulation of new cement facilities so that they are built so as to enable subsequent retrofitting.

Development and Deployment of New Cement Technologies

Given the range of new cement forms under development, it is difficult to generalize as to appropriate policy measures and recommendations. However, it is clear that support will need to be applied not only in the research stage, but also in the market penetration stage where new forms of cement will be competing with the established output of Portland cement, but at much higher prices. The most appropriate form of support in the early stages of development is funding for pilot and demonstration projects—examples could be fiscal incentives or grants for investment. In the deployment stages, per unit subsidies for production or sales are likely to be required in order to facilitate market entry and promote competitiveness against existing products. While these measures should improve the financial viability of new cement technologies, they will also have an effect on existing production, with each company having a view on the overall effect.

In addition to the supply–push measures, policies on the demand-push side also need to be considered. In particular, and as for blended cements, the role of the construction sector and the development of building codes and practices will be important in ensuring and embedding market acceptance.

Addressing Product Use

Cement manufacture is one part of the product life cycle, and emissions arise throughout this lifecycle. For example, transportation of raw materials and end-products results in emissions and other environmental impacts. At the other end of the life cycle, using cement rather than any other building material will affect the emissions from that building over the course of its life. A low-carbon economy will need to address this life cycle rather than just one part of it. This will require coordination between the cement and construction sectors, and a role for government in facilitating and incentivizing low-carbon building design. For cement manufacturers, addressing the product lifecycle rather than just emissions from production offers opportunity to present the possible benefits of cement use, and to ensure its continued use and validity. On the other hand, it will extend the sphere of action and analysis into areas that have not previously been part of manufacturer's remit and over which they have less control and influence.

Addressing Competitiveness and Leakage Concerns

Concerns remain that measures taken in the EU to reduce emissions may reduce competitiveness and result in relocation. As well as having economic implications, this may also have detrimental environmental outcomes. In order to address these issues and build industry consensus, some kind of mechanism aimed at correcting these effects may be necessary. Initial research suggests that BCAs could be appropriate, but as with any other measures, care will need to be taken to structure them appropriately to ensure that the administrative burden is not too high and that that there is no contravention of WTO laws while ensuring that desired economic and environmental outcomes are achieved. For example, two different schemes are likely to be required—one covering cement and a second covering clinker in order to incentivize clinker substitution.[20]

Fitting the Industry into the Economy

Many decisions made in the industry will have an impact on other sectors of the economy and on society more broadly, with emissions from cement sector needing to be considered in a holistic manner. For example, the choice of gas rather than coal as a fuel will reduce emissions from the sector, but will affect the price and availability for other sectors of the economy. Similarly, the decisions made in other parts of the economy will affect the choices of the cement sector. For example, the relocation of the steel sector, for example, will limit the extent to which a cement plant can use slag as a limestone substitute. There are also opportunities for positive impacts, with cement plants being used as a source of heating for local households and businesses. The framework for a low-carbon economy needs to be designed with these payoffs and opportunities in mind. This will require analysis of the entire economy and consultations with a wide range of stakeholders.

[20] For further discussion see Cook, 2011.

Summary

Progress in reducing emissions intensity can still be achieved by using technologies and processes currently available, and government and industry should work together to ensure that these measures are implemented as far as possible. However, securing significant reductions in intensity and absolute levels of emissions relies on implementation of new technologies.

The current level of support provided under emissions trading schemes is insufficient for development and deployment of these new technologies at the scale required. Significant additional financial support is required, and this needs to be complemented by political and regulatory support measures. These measures need to take account of the decisions that are taken within firms and how these decisions are made. In particular, they need to take account of the shifts that are occurring in industrial structure—such as increasing investment in emerging economies—if reductions in emissions are to be achieved. To date, the use of Joint Implementation and the Clean Development Mechanism has allowed some support through the carbon markets, but again this is unlikely to provide resources at the level required. Technical and financial co-operations across countries, while needing to be properly scoped, could relieve the financing burden and can help spread technologies beyond the mature markets.

TRI-CC Summary

Together with a companion paper on the steel sector, this paper is being published following an IISD conference on "Deepening the Understanding of Energy Intensive Industries," held in Brussels on September 26, 2011. Both the workshop and papers are part of IISD's Trade, Investment and Climate Change Program (TRI-CC).[21]

The TRI-CC Program is sponsored by the Ministries of Foreign Affairs of Norway and Sweden. As part of the Program's Competitiveness and Leakage theme, it is aimed at deepening understanding of Energy Intensive Industries, so as to better understand the effect of climate policies on these sectors. Other areas of work in the TRI-CC Program include research on the practical aspects of designing and implementing a BCA system, an assessment of trade impacts of BCAs in developing countries, and work on emerging issues such as GHG-intensity standards and subsidies for green industrial development.

[21] See http://www.iisd.org/trade/crosscutting/tri-cc/ for further details on this program

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