Use of Border Adjustment Measures

A cement sector perspective

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Abstract

This paper aims to increase the knowledge of how carbon pricing impacts the cement sector, in particular on border adjustments made on the basis of embedded carbon in imported products. This paper considers the use of Border Adjustment Measures (BAM) as they might apply in the case of cement. As well as more generic issues concerning the political and legal challenges to their adoption, a number of more sector-specific design and methodological issues require consideration. The principal options are presented along with a discussion of their relative advantages and disadvantages.

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Contents

List of tables and figures

1. Introduction

This paper builds on a background paper by the author (Cook, 2011), which looked at how carbon pricing impacts the cement sector, in particular on the industry's investment decisions in an increasingly globalised world. In so doing it has drawn upon recent market information and empirical evidence, as well as the economic modelling and climate policy literature. It presents an overview of the cement sector through a description of its key characteristics, including market structure and trends, and the role played by trade. The background paper also explores the potential impact of carbon pricing on the sector and assesses the potential effectiveness of response measures designed to address competitiveness and leakage over both the short and long-term.

Border adjustments made on the basis of embedded carbon in imported products have been identified in recent literature, and also by the industry, as a potentially effective response to leakage from the cement sector. Given their potential applicability to the sector, this paper considers the use of Border Adjustment Measures (BAM) as they might apply in the case of cement. As well as more generic issues concerning the political and legal challenges to their adoption, a number of more sector-specific design and methodological issues require consideration. The principal options are presented along with a discussion of their relative advantages and disadvantages in terms of e.g. accuracy, fairness, practicality and effectiveness.

BAM applied to imported products on the basis of product carbon content or 'embedded carbon' have not been employed in any jurisdiction to date, although in the context of emerging ETS schemes they are increasingly being seen as a useful tool by policy-makers in relation to levelling competition and reducing leakage for trade exposed industries. An assessment of the different policy responses available suggests they have significant advantage over other measures such as output-based and fixed free allocation. Advantages identified cover both environmental and economic effectiveness. However, recent studies (Climate Strategies, 2010) indicate that the potential suitability of border measures is highly sector-specific, with factors such as relative cost structures, product and technology characteristics, international competition and market structure all being important. Cement production has been identified as a potentially suitable candidate sector.

Despite the attraction of BAM to internalise carbon costs in production whilst reducing competitiveness and leakage concerns, the detailed design of an effective approach which achieves the economic objective in an equitable, practical and implementable way taking into account real world circumstances is somewhat more challenging. Some of the design considerations are generic (e.g. MRV requirements, legal issues) and some are sector-specific (e.g. product coverage, data availability, source of product emissions and suitability of benchmarking). Prior to implementing such approaches, policy makers need to understand such details when considering the options available.

This paper considers the use of BAM as they could apply to the cement sector. A relative assessment of the options and their likely trade-offs is made along with some concluding remarks on a possible way forward. Much of the existing literature concerning BAM considers the various political and legal challenges to their introduction, particularly in the context of World Trade Organisation (WTO) rules and the potential for resulting trade disputes. Such concerns are broadly generic in their nature and have not yet delved into sector-specific analyses. However, given their importance, some of these issues are briefly considered where relevant. Similarly, the detailed specific administrative and legal implications associated with importer inclusion within the EU ETS (a proposed form of BAM under future phases of the scheme) are not considered within the scope of this paper.

2. Key design issues

An assessment of BAM in terms of their *effectiveness* in a given sector must start with a clear understanding of their policy objective: although terms vary in the literature and various policy proposals, they aim to reduce carbon leakage arising from asymmetric carbon costs facing producers in different regions. Competitiveness-driven leakage may occur through short-term changes in trade flows between the domestic and foreign regions and also long-term choices such as relocation of production. BAM do not seek to address the leakage impacts themselves, but rather the underlying competitiveness disadvantage potentially creating the leakage - by specifically seeking to level the playing field by equalising the carbon costs where products are shipped between ETS and non-ETS regions. In reality, a loss of competitiveness arising from domestic carbon pricing may lead to no carbon leakage. As discussed in Section A, the factors driving leakage are complex and subject to numerous and highly uncertain factors. An important and attractive feature of BAMs is that their design and use requires no assessment of theoretical carbon leakage potential to be made.

Starting from a pure viewpoint, in order to be equitable BAMs must introduce the *same carbon cost* on imported products as those facing domestic firms manufacturing equivalent products i.e. € per tonne of CO_2. This involves the calculation of two components:

1. **Difference in carbon costs of production** (e.g. € per tonne of cement or clinker produced); and
2. **Carbon intensity of imported products** (e.g. tonnes of CO_2 per tonne of cement or clinker)

In theory at least, the effectiveness of a BAM in addressing competitive disadvantage arising from asymmetric carbon prices - without introducing other trade distortions – therefore rests on the *accuracy* of these two factors. There are important issues associated with determining and calculating the correct level of both, as discussed below.

2.1 Calculating differences in carbon costs

BAM can take different forms in terms of how they seek to extend costs faced by domestic producers to imported products. At the simplest level, product standards could be introduced whereby imported goods would need to demonstrate they meet a certain set of criteria, relating to carbon intensity and/or some other environmental factors. Such measures have been applied in the EU, US and elsewhere on the basis of various domestic product policy requirements (i.e. relating to health, safety and environmental impacts). In the context of a BAM seeking to equalise carbon costs, their use would be limited at best and would likely be illegal under international trade rules. In the specific context of the EU ETS and other ETS proposals, an entry level set high enough to address leakage concerns would necessarily be too stringent to demonstrate that all domestic producers were subject to similar treatment. More fundamentally, such 'on-off' measures would not address asymmetries in production costs arising from differential carbon policies, but rather act as a crude trade barrier, likely provoking similar retaliations to exports from carbon-constrained regions.

Border adjustment proposals associated with the use of ETS have instead focused on the use of border tax adjustments (BTA) or the inclusion of importers within the trading scheme as an alternative to free allowance allocation. The latter option, proposed as a potential response for future phases of the EU ETS, would require importers to *surrender allowances equal to the carbon content of the imported products*. Such an approach, involving the purchase of allowances within the domestic carbon market, serves to internalise the carbon cost of production whilst overcoming the issue of revenue recycling associated with BTA (i.e. how to disburse revenues accrued from the taxes). However, there are methodological and administrative complexities involved in their introduction including, for example, how to define importing installations and practicalities around registration at international borders.

The use of BTA would require choices to be made concerning the level of tax imposed on imports (and potentially rebated to exports). A key choice includes, for example:

1. whether to apply the tax at the **prevailing market allowance price** at the time of import, or;
2. given potential price volatility in the ETS market, whether to base it on a **historic formulation** reflecting the domestic producers' price exposure over a given period

Costs faced by domestic and foreign firms could be different as they will vary according to the day on which allowances, if needed, are purchased on the market (Reinaud, 2009). Given that much international cement and clinker trade is undertaken by long-haul shipping without the use of spot trading, the former approach could unfairly expose importers to volatile carbon prices which domestic producers would be better positioned to manage. Notwithstanding the bureaucratic and legal considerations, the two approaches differ largely in terms of timing aspects regarding carbon prices in the domestic ETS, and there are wider considerations facing both.

A potentially more complex set of issues concerns determining the *actual difference in carbon costs* facing producers in different regions. As noted by Wooders et al (2009), the direct costs arising from a carbon price in a domestic ETS may represent only one element among many within such a formulation. Assuming that all world cement producers respond to a given carbon price similarly in terms of how they are treated as carbon costs, then a BAM levied solely on the basis of domestic carbon price exposure will not account for costs faced by foreign producers arising from existing or planned climate policies and measures. Even in the case of products imported from one region with a carbon tax or ETS with auctioning to another with an ETS, the difference in carbon cost between the two could be complicated by different approaches to production process and installation coverage, emissions scope and price timing issues.

As discussed above, in theory at least, a fully effective BAM needs to adjust at the border for all carbon costs faced by producers (or if only some share is accounted for, then this must be applied equally). These include those incurred domestically, including the costs associated with electricity price increases arising from the ETS. This provision has been included within US proposals but is less clear within the EU proposals. Accounting for such indirect costs would give rise to various accounting and methodological complexities: cement firms pay different electricity prices according to different contractual arrangements and time periods, and their associated impacts are not necessarily straightforward. Although important in the case of electricity-intensive products such as aluminium, the issue is likely to be of less importance to cement production and largely immaterial to clinker production (as a large share of the electricity used in cement production arises from grinding and milling).

A key challenge in correctly assessing the carbon cost difference, and a potentially highly sensitive political consideration, is determining the 'comparability of efforts' from exporting countries. Exporting countries may or may not implement non-pricing climate policies to mitigate emissions, and/or may implement policies that only indirectly reduce CO_2 emissions such as energy efficiency and renewable policies. For example, many clinker or cement exporting non-Annex I countries that do not have direct carbon pricing policies have introduced or are proposing various domestic climate policy measures. China has pledged to reduce its CO_2 emissions per unit of GDP by 40-45% by 2020 (from 2005 levels) with an emphasis on energy efficiency improvements and reduced fossil fuel use, Japan has technology-oriented policies and India has developed a National Action Plan on Climate Change. They will all have different requirements, cost impacts and burdens on industry directly and indirectly arising from energy and carbon policy objectives. The role of internationally-linked Nationally Appropriate Mitigation Actions (NAMAs) in developing countries and the potential emergence of sectoral approaches within the UNFCCC framework, including the use of crediting and linkages with existing ETS will serve to add additional complexity.

There are clearly major challenges in assessing what the impacts of various policies and measures would be in terms of carbon cost equivalents (Wooders et al, 2009). Such an assessment, introduced as a requirement of the US Waxman-Markey Bill, would involve significant methodological challenges -particularly in view of the scarce availability and quality of data across world regions.

2.2 Calculating carbon intensity

The second component requiring calculation is the carbon intensity or 'embedded carbon' in the imported product. In this context, many of the key considerations are common to those involved in designing industrial carbon policies such as ETS: as with the EU ETS and other regional proposals for trading schemes, there are fundamental issues to address relating to emissions accounting, scope of coverage and definition. The accuracy - and therefore the effectiveness and fairness/legality - of a BAM will require a *similar treatment* of domestic and imported products in respect of these factors.

Compared to most other internationally traded commodities, cement and clinker are both relatively homogenous products (see Cook, 2011) for which the production process and life-cycle energy use and GHG emissions can be readily understood and defined. Complex calculation difficulties arising from most manufactured goods do not apply (manufactured goods requiring ozone-depleting chemicals in their production were excluded from the Montreal Protocol due to the perceived impracticalities of calculation). The main characteristic defining their differentiation is the clinker content in the final product, which is determined by the volume of substitute materials such as fly ash and steel slag blended with clinker. At present, Portland cement which has > 95% clinker content accounts for most international cement trade. There are, however, some complexities regarding common definitions of cement products globally: this is not the case for clinker product.

Reinaud (2008a) has noted that the use of BAM could induce gaming strategies from firms seeking to bypass the adjustment scheme by further transforming their goods to reach a product category that is exempt from the list of product goods. Such perverse incentives are unlikely to pose an issue for clinker and cement production, because secondary products such as concrete and blocks are not subject to international flows. However, it is clear that an effective BAM would need to apply to different categories of cement from Portland through to composite cement products (EN 197 classification codes CEM I to CEM V) and clinker in order to avoid perverse incentives such as substitution of clinker imports for cement imports. Potential problems concerning gaming and product coverage are therefore not significant in the cement sector.[1]

A more important consideration is how to define the *scope of emissions* associated with clinker and cement production. The embedded carbon in the clinker content of imported products comprises both direct and indirect CO_2 emissions. Although only direct emissions associated with clinker and cement production are covered by the EU ETS and other proposed ETS, installations face indirect costs from pass-through effects (from power generators exposed to ETS and other climate policies). Although not an electricity-intensive sector, such costs may become increasingly material to sector production costs as domestic mitigation efforts increase over time. The issue is complicated due to the existence of long-term supply contracts, and the extent to which carbon costs are passed down through industrial tariffs. Furthermore, as illustrated in existing methodologies to calculate grid emissions factors such as those developed under the Clean Development Mechanism (CDM), accounting for emissions from electricity supply are fraught with methodological problems. Cement produced in a given country may be more or less subject to average regional grid factors, and may use electricity generated on site and/or from a small local grid using a significantly different fuel mix. A further question relating to scope is the role of *transport emissions*. Whilst international transportation remains outside of the UNFCCC accounting process - and therefore national GHG inventories – accounting for their inclusion would appear unfeasible within acceptable limits. Despite creating an additional source of leakage once competitiveness-driven leakage were to occur, they would in any case only arise as a secondary consequence of competitiveness disadvantage. Both domestic and foreign exporting producers would be similarly exempt from their potential cost. Designing a BAM to extend to indirect CO_2 emissions would therefore appear largely impractical, with only limited benefits in the case of cement.

Perhaps the key challenge in determining carbon content relates to effective, reliable and transparent data monitoring, reporting and verification (MRV) of emissions from exporting plants. A high level of data quality would be required to underpin an equitable and fair BTA scheme based on the carbon content of imported products. Given that CO_2 emissions from cement and clinker production are predominantly associated with direct emissions from fuel consumption and the calcination process, plant-level MRV would be required for accurate accounting of product carbon content. The administrative requirements, costs and technical practicality of accurately determining the level of emissions linked to the border adjustments may be the greatest barrier to their implementation (Reinaud, 2009). The development of robust plant-level MRV requirements is costly and resource-intensive, requiring a significant amount of political and administrative effort in low-cost producing countries located in e.g. developing Asia and Africa. Major low-cost exporters such as China face additional challenges in collecting reliable data across all provinces, given internal bureaucratic challenges and factors such as the ongoing production from obsolete cement kilns despite official central policy mandating their phase-out.

However, although the use of energy and emissions data collection and reporting varies greatly by world region, the use of MRV is increasing undertaken by multinational firms as part of corporate reporting standards. To facilitate these efforts, voluntary reporting standards such as the GHG Reporting Protocol developed by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) have been developed whilst various national and regional climate and energy efficiency programmes have emerged over recent years, improving the quality of plant level emissions reporting. In addition, progress made during the UNFCCC Cancun climate negotiations regarding the role of an independent MRV mechanism offers a tangible basis for improving the availability and quality of industrial emissions data globally. The WBCSD Cement Sustainability Initiative (CSI) has developed a detailed

[1] Note also that threshold considerations, whereby domestic producers not covered by the domestic carbon price could potentially be advantaged, are likely to be immaterial. Due to scale economies, clinker and cement plants are large and kilns are covered by the EU ETS.

database providing an existing and robust source of data on plant performance and emissions. Their 'Getting the Numbers Right' (GNR) information system is a CO_2 and energy performance information system, based on emissions data reported annually from individual cement plants operated by CSI member companies. GNR includes information from 844 cement installations worldwide, covering over 73% of cement production in Annex I and around 20% in non-Annex I countries (CSI, 2009a), based upon reporting approaches following the WBCSD/WRI protocol. The GNR database has been proposed as a data source for developing baseline clinker and cement benchmarks relating to existing and new production facilities in a new CDM methodology submitted by the CSI to the UNFCCC Executive Board.

Notwithstanding the emergence of robust approaches to MRV, there are challenges to harmonising accounting approaches used across regions. The treatment of emissions from non-fossil fuel combustion and the calculation of process (calcination) emissions are just two examples; for the latter, the CSI protocol adopts a default factor of 538 kgCO_2/t clinker, the EU ETS Monitoring and Reporting Guidelines a value of 523 kgCO_2/t clinker and the IPCC Inventory Guidelines a value of 508 kgCO_2/t clinker. A harmonised approach to data accounting and definitions would require agreement across a range of methodological and data issues, and ideally the exclusion of default factors in preference of specific input calculations – or at least agreement on the use of default factors. Such considerations are not particular to cement and clinker production however, and are likely to be more complex in relation to other industrial production processes, given the history of sector-specific benchmarking approaches developed at Member State and EU level for installations covered by the EU ETS.

A final consideration relates to accounting for product carbon content across the *chain of custody*. This is not required under domestic ETS scheme such as the EU ETS, although is a key factor in the literature relating to life-cycle assessment (LCA). Although the LCA implications relating to clinker substitutes have been noted, cement and clinker does not involve the use of input materials with associated embedded carbon contents, when compared to many other traded goods. However, there remains a need to account for the precise origin of exported products in a robust fashion. Due to the high costs of inland cement transport, most international trade occurs between coastal producers and importers, although intra-firm movements and the potential increase in product trading activity reinforce the desirability of sufficiently robust MRV procedures and common GHG accounting frameworks.

3. Assessing the Options

As outlined at the beginning of the paper, equalising carbon costs between imported and domestic products through the use of BAM requires a determination of (a) the difference in carbon costs between the different regions and (b) the carbon content of imports. In the absence of perfect information, both components are subject to methodological and practical challenges, requiring an inevitable degree of approximation. Both are therefore subject to policy design choices involving trade-offs between *accuracy* and *workability*. Given that BAM seek to address competitiveness-driven leakage, the former is important as it determines the effectiveness of the response: under-estimating the correct level only partially addresses competitiveness disadvantage whilst an over-estimation unfairly distorts the market in the opposite direction, most likely leading to political and legal ramifications. Workability - or practicality - relates primarily to the ability to account for carbon content, given MRV requirements at a reasonable cost, the nature of traded products, and the various important policy and legal constraints associated with introducing border measures.

Although the factors determining the carbon cost component of a BAM are critical and require an analysis of economic and policy impacts across regions and sectors, the overriding sector-specific design issue for BAM relates to options for determining the carbon intensity component.

Three broad options can be envisaged for setting the carbon intensity level for a BAM:

1. Plant-by-plant assessment
2. Benchmarking
3. Default values with option for plant-level evidence

Option 1 has been discussed above as the ideal basis for calculating the carbon component of a BAM. In the absence of a common international framework agreement for MRV, it remains unworkable in the near term. The other two options are considered further below.

3.1 Benchmarking

The use of benchmarking presents a practical and familiar approach to calculating the carbon content of imported products, for example with reference to some definition of Best Available Technology (BAT) or plant performance. Benchmarks have been used within the EU ETS since its inception as a means to allocate allowances to new entrants (in Phases I and II) and in Phase III, sectors considered at risk from leakage, including cement, will be subject to free allocation of allowances on the basis of a sector benchmark. However, in the specific context of BAM, their main role would be to approximate the actual carbon content of each imported product in the absence of the required data. Alternative uses would presumably reflect other industrial or environmental objectives, such as restricting imports or incentivising greater domestic abatement than that incentivised by the domestic carbon policy.

The first question therefore relates to where such a level should be set. Compared to other energy-intensive industries, determining a benchmark of carbon intensity based on BAT for the cement sector is relatively straightforward:

- **Process emissions** associated with clinker production[2] typically account for around 60-65% of direct CO_2 emissions and are largely fixed by the chemical process at around 525-540 kg CO_2 per tonne of clinker
- **Energy emissions** account for the remaining 35-40% of direct plant emissions from fuel combusted in the kiln required to produce clinker (around 250-350 kg CO_2 per tonne of clinker within the EU)
- **Indirect emissions** from plant electricity consumption add approximately a further 5%

As shown below in figure 1, the specific energy consumption between different kiln technologies varies by a factor of around two. However, for modern plant there is less variation. Dry rotary-kiln technology with multi-stage preheaters and pre-calcination is now the technology of choice for new build plants globally and

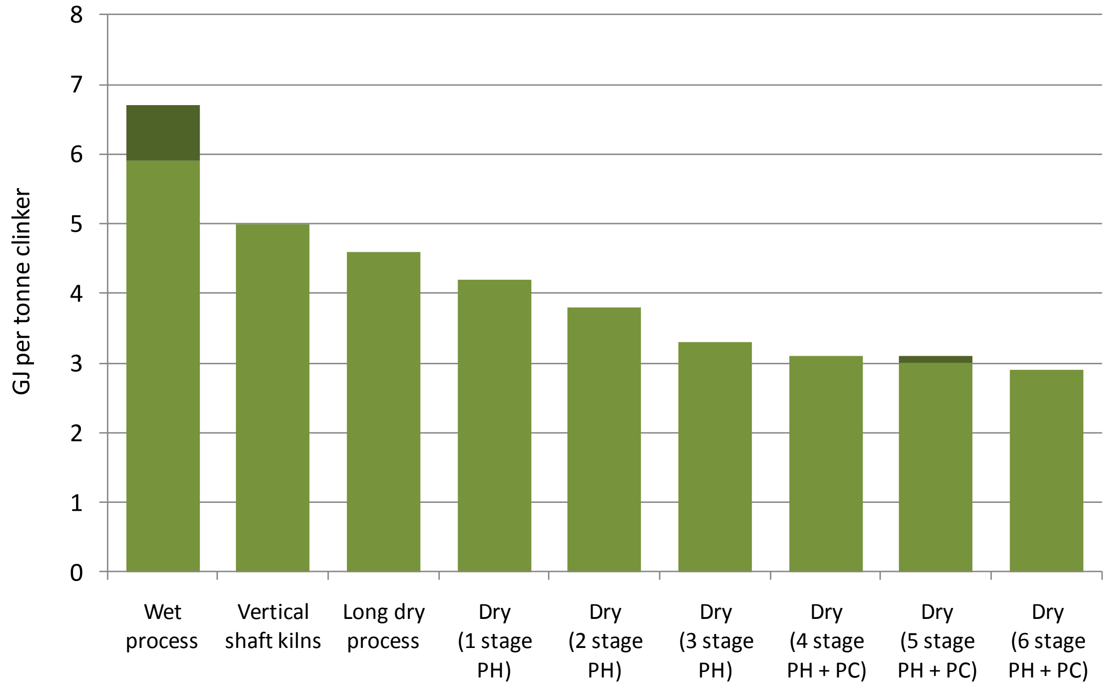
[2] arising from the calcination of limestone ($CaCO_3$) into lime (CaO)

is approaching the limits of its energy efficiency potential. BAT can therefore be defined relatively easily, based on one global process and a standardised kiln technology[3].

However, the existing distribution of kiln technology varies considerably by region (see figure 1). Although dry process BAT kilns are becoming increasingly significant within the technology mix, regions such as North America and parts of the Former Soviet Union still produce a large share of cement using the relatively inefficient wet and long dry processes. Most countries also have a mix of older and new kilns, and their share varies by region. The average age of plant tends to be much higher in mature markets such as OECD America and Europe, compared to emerging economies such as India and China.

Fuel mix also varies by region. Fossil fuels currently account for over 90% of fuel used in the cement sector globally, most of which come from pet-coke and coal where these are available. Natural gas use is common in parts of East Europe and the Middle East and heavy fuel oil is still common in regions of the Middle East and Latin America. The use of biomass and waste has increased over recent years, and waste materials such as tyres and plastics are combusted in large quantities and have reached levels of over 70% of energy demand in some European plants. The resulting variability in kiln technology, age and fuel mix gives rise to a significant distribution in thermal emissions intensity (tCO_2 per tonne cement).

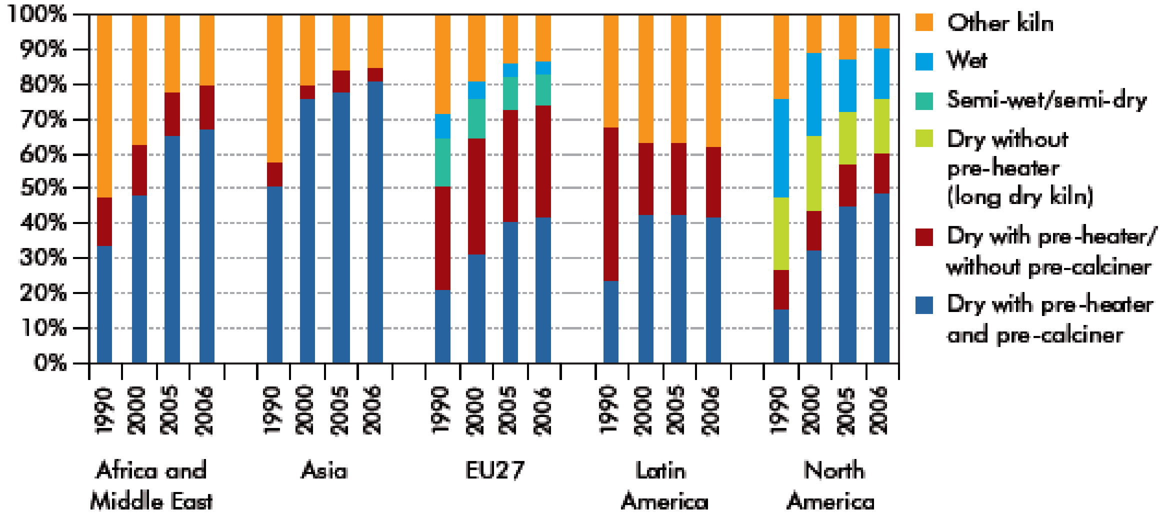
Figure 1. Specific energy consumption of different cement kiln technologies



Source: FLSmidth (2006)

[3] Except in some regions where only wet limestone is available, requiring wet or partially wet production at higher energy consumption rates

Figure 2. Share of cement kiln technology by region 1990 to 2006

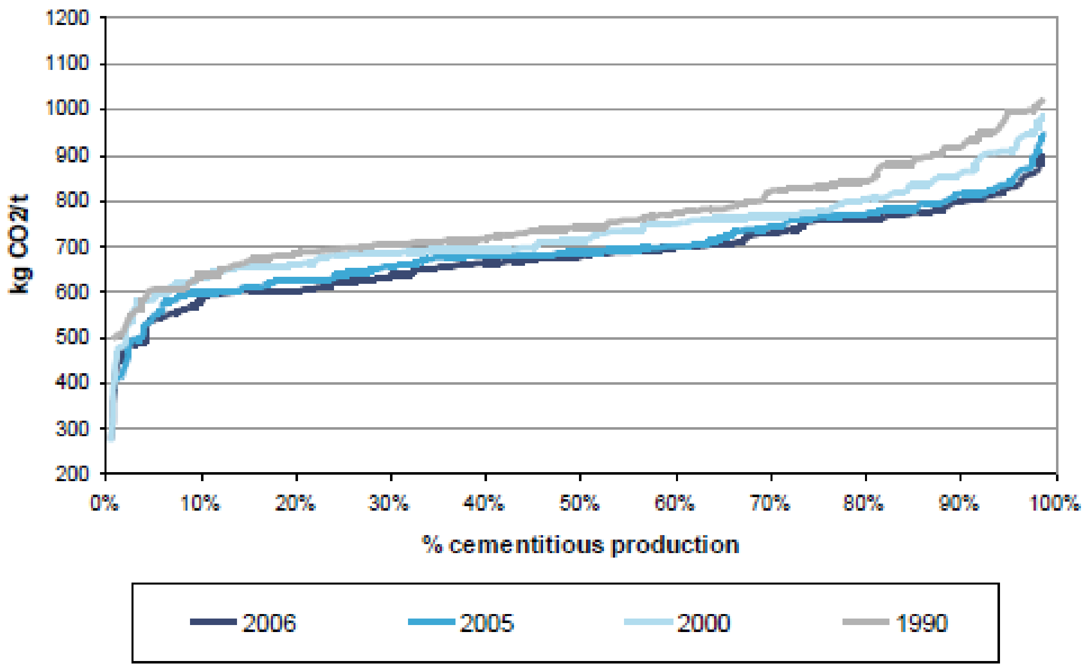


Source: IEA (2010)

The final significant factor determining the carbon intensity of cement production is the extent to which alternative materials can be blended with clinker to produce cement – thereby reducing the process and energy-related emissions associated with clinker manufacture. The use of clinker substitutes such as fly ash, blast furnace slag and volcanic ash also varies considerably by world region according to the local availability of such materials and varying requirements for product specifications. The average world blending ratio is currently around 22%, varying from around 16% in North America to 27% in China.

Therefore, while BAT can be readily defined, specific CO_2 emissions per tonne of cement are influenced by various factors - the most important of which are the clinker content in cement, the specific energy consumption, and the fuel mix used to provide the required energy. Importantly, some of these factors lie outside the direct control of cement firms (e.g. availability of material, regional energy mix). The resulting distribution of total carbon intensity of sector production within a large sample of global production is shown in figure 3. It can be seen that the difference between the worst and best performers varies by a factor of around two.

Figure 3. Gross CO_2 emissions per tonne cementitious product



Note: Cementitious products include all cement and clinker
Source: CSI (2009a)

The key benefit of a benchmarking approach to BAM would be the lack of MRV requirements and administrative burden. In this context, Ismer and Neuhoff (2007) suggest the advantage of benchmarking in eliminating the need for extensive plant-by-plant data collection. However, the graph demonstrates the central problem for benchmarking, whether using BAT or a performance-based approach based on existing sector data (e.g. top 20% of CSI/GNR installations). If the benchmark(s) were set too generously for importers i.e. the carbon intensity level is set too low, then the carbon costs would be only partially equalised. For example, were a benchmark to be set on Portland Cement at 700 kgCO_2/t cement, imports produced at a carbon intensity of 900 kgCO_2/t cement would avoid 200 kgCO_2/t cement of adjustment Conversely, if the level were set too stringently i.e. the carbon intensity level were set too high, then some imports would likely to be penalised, thus increasing the chances of a dispute under WTO. In order not to unfairly penalise the least carbon-intensive products, a level would therefore need to be set at very low rate, resulting in a sub-optimal scheme.

Differentiated benchmarking on the basis of some key criteria would appear a sensible approach to reducing the inaccuracy of a simple BAT or similar approach. Under most US proposals for BAMs, for example, the carbon content of imported goods would be assessed using a nation-wide average for the country of origin (Houser et al., 2008). However, whilst regional factors may be important in determining the carbon content of cement production, they are not a straightforward determinant: carbon intensity can vary widely between producers located in the same country. For example, China has significant numbers of ageing inefficient shaft kilns as well as large modern BAT plants. A national intensity factor may also be unreflective of plants producing cement or clinker for export in a given country. Finally, developing a robust set of national cement carbon intensity factors (which would need regular updating) would necessarily require a large degree of the effort required in developing plant-level MRV procedures.

It is possible that use of benchmarking may encounter legal difficulties in respect of the *principle of national treatment.* This principal, established in GATT Article III requires WTO members to treat foreign goods similarly to domestic goods. Article III.2.1 requires that any tax imposed on imported and *like* domestic products must be identical. In this context, Meyer-Ohlendorf and Mehling (2008) note that a GATT panel succeeded in striking down a US gasoline product regulation because it assigned a standardised baseline to imports while domestic producers were allowed to present individualised data. GATT Article III.2.2 allows that for directly competing products (e.g. Portland cement or clinker) the tax imposed may be slightly different between imported and domestic products. However, a *de minimis* level must still be established such that any taxes are not applied in a protective measure, suggesting a benchmark would need to be set at a high carbon-intensity level, in theory at least. Note that these considerations would equally apply to calculating carbon content in the case of a BAM based on purchase of allowances, as similar provisions are required under GATT Article III.4 in the case of measures other than taxes and charges.

The use of benchmarking to determine carbon content in cement and clinker imports involves a clear trade-off between practicality and effectiveness. It would appear that even were simple benchmarking approaches - based on BAT or performance levels – considered legal under WTO, any chosen level could act either to unfairly penalise low carbon-intensity third-party producers or significantly underestimate the carbon content of imports. The latter outcome would be most likely to arise through the use of benchmarking, thereby only partially addressing the carbon cost differential between domestic and foreign producers from the outset.

3.2 Default values

The discussion above indicates that while a plant-by-plant approach to determining product carbon content is ideally required, the costs and administrative challenges involved in the required MRV arrangements across all producing world regions are likely to be prohibitive at least in the short-term. Considerable political will be required to develop a common approach acceptable to all parties. An alternative approach is to use benchmarking on clinker and (the clinker content of) cement imports. However, although differentiated benchmarking on the basis of country of origin, and potentially other factors - may partially reduce the problem, such an approach faces the problem of where to set such a level. Setting the level too high would likely represent a discriminatory measure under international trade rules; setting the level too low would reduce the effectiveness of the BAM in equalising carbon costs, which is the objective.

Wooders et al (2009) and others have noted an alternative, 'third way' which may act as a compromise, in which a 'default' value is chosen but with the option available to producers to demonstrate that their plant emissions are lower than the chosen level(s). Such an approach could reduce the administrative burden associated with a full plant-by-plant assessment whilst retaining a reasonably high level of stringency. Carbon emissions factors would need to be set at a reasonably high level, for example based on average emissions intensity of clinker production in the country of origin, thereby incentivising producers to challenge them by providing evidence that their processes emit less CO_2. To avoid discrimination, importers must be allowed to prove their individual emissions, and national circumstances in exporting countries would need to be taken into account.

What would be the most appropriate basis for such an approach within the cement sector? The use of default factors based on CO_2 per tonne clinker is likely to be the most workable approach. Developing cement factors would be more complex, given that cement product definitions are not clear and common globally and cement production (from clinker) processes add complexity to emissions accounting e.g. grinding stations and mixing plants. However, applying pure clinker benchmarking to all products would have the disadvantage of not directly rewarding greater use of clinker substitution (a key abatement lever for the sector). A potential approach could therefore be the use of a pure clinker benchmark combined with average national clinker content factors - based on equivalent cement, meaning cement produced from own produced clinker. Both the clinker carbon intensity and clinker content factors could be determined from the CSI GNR data on an annual basis.

If companies in developing countries were able to prove the carbon content of their exported goods, this might encourage exporters to improve their emissions intensity, as they would be rewarded by lower adjustments at the importer's border. The way in which this might occur in practise is unclear and would be subject to the cost of abatement options in the exporting country compared to the marginal cost of the BTA and the transportation cost to the border. In the absence of national carbon pricing in the exporting country, and presuming that trade was economic, it may be more likely that exporters would be incentivised to export their least carbon-intensive products, thereby retaining more carbon-intensive products for domestic markets (such an outcome does not however present an additional source of carbon leakage). Finally, such an option may actively encourage a sector-based approach to developing plant-level MRV, perhaps building on and extending the coverage of the CSI/GNR scheme. As such, it could potentially act as a bridge to a plant-by-plant determination of carbon content.

4. A practical way forward?

Despite the benefits of BAM and their potential suitability to the cement sector, there are obstacles to their introduction. A number of technical, legal, and not least political details have to be carefully considered (Dröge, 2008). Some of these are common to a general discussion of border adjustments applied to all products or sectors and are not considered within the scope of the current paper: however, others have sector-specific dimensions requiring further consideration.

Table 1 summarises the advantages and disadvantage associated with the three broad options considered for determining the carbon content for a BAM applied to cement and clinker. There are clearly trade-offs involved in the design of such a policy, the primary one being workability versus accuracy. A similar trade-off relates to determining differences in carbon costs facing producers between regions. The ideal basis for determining an appropriately equitable BAM level is a plant-by-plant assessment based on a suitably robust and common approach to MRV. The administrative burden and time and effort required to achieve such a framework poses a significant obstacle, at least in the short-term. However, the ongoing development of the CSI GNR database and reporting protocol suggests that the cement sector is likely to be closer to such a goal than other trade-exposed carbon-intensive sectors such as iron and steel and aluminium.

Several commentators have suggested that such challenges could be overcome through the use of benchmarks based on BAT or other performance levels (e.g. Ismer and Neuhoff, 2007). Although carbon intensity across producers and regions is less pronounced than in other sectors, the significant variability in emissions performance within the sector poses the problem of where to set the appropriate level. Here, there is an unattractive trade-off to be made between fairness (and potentially, WTO legality) and policy ineffectiveness. An alternative approach, based on a set of suitably stringent default factors but with the option available to producers to demonstrate plant-level emissions intensity would appear to represent a sensible and practical compromise. Importantly, it may incentivise greater use of plant-by-plant MRV, thereby acting as useful bridge to a full plant-by-plant assessment of carbon content.

Table 1. Summary of design options for BAM applied to cement and clinker

Option	Advantages	Disadvantages	Overall assessment
Plant-by-plant assessment	Carbon intensity of imported products determined with greatest level of accuracy, thereby maximising BAM effectiveness and limiting legal disputes under WTO	Imposes significant administative burden, cost and time to develop robust MRV approaches. Requirement for foreign action would require much policy effort	Practical and politcal challenges likely to limit feasibility in the short-term. CSI-GNR programme may provide workable basis for such an approach over longer-term
Benchmarking	Benchmarking on basis of BAT of performace is simple and avoids extensive MRV requirements with associated political issues	Determning appropriate level poses significant challanges. A too stringent level would penalise some exporters, raising WTO legal issues; a level set too low could only partially equalise carbon costs, limiting effectivenss of BAM	Choice of level based on BAT or best performance would be relatively workable and potentially avoid legal issues. However, competitvness and leakage concerns would only be partially addressed
Default factors with option for plant-level evidence	Combines simplicity of bechmarking approach with stringency (and therefore effectiveness) of plant-by-plant asessment. May incentivise greater use of MRV within sector globally	Many design issues relavant to other options remain, including e.g. choice of appropriate default factor and basis for MRV protocol acceptable to domestic regulator	Presents potentially workable compromise in the context of the cement sector and potential bridge to plant-by-plant assessment

The consideration of what impact the use of BAM may have upon decision-making behaviour in the cement sector, in particular investment decisions, essentially rests on the ability of such a response to accurately equalise carbon costs between domestic and foreign producers. If carbon costs are equalised, then any factors influencing investment choices (e.g. relocation) attributable to domestic carbon pricing would be similar between ETS and non-ETS regions. Furthermore, the abatement incentive of the ETS carbon price is preserved. In other words, the desired effects of the ETS are kept, and the undesired effects are avoided. Although it can be seen that in the case of cement sector, the use of BAM with benchmarking could significantly reduce competitiveness-driven leakage, the inherent degree of inaccuracy introduced through their use would reduce the effectiveness of the BAM.

The use of default clinker factors, based on regional data, with the option for plant-level data to be provided appears the most effective and workable approach. The data required to develop such factors exists within the sector via the CSI-GNR database. A series of important methodological and practical issues would need to be addressed in applying such a scheme to imported cement and clinker. Some key questions to resolve include e.g:

1. **What exact products would the 'default values' apply to?** (existing NACE categories covering all clinker and cement products are likely to be sufficient, given negligible use of cement and clinker in secondary traded products)
2. **What scope of emissions should be covered?** (methodological complexities and the need for equal treatment would suggest direct plant emissions only; cement production is not electricity-intensive and carbon costs of indirect emissions to domestic producers would be difficult to establish).
3. **What level should be chosen for 'default values'?** (the chosen levels would need to be sufficiently stringent to overcome the limitations of benchmarking whilst not provoking WTO disputes under e.g. GATT Article I. Average carbon intensity of clinker in clinker and cement imports, based on regional emissions clinker content factors, may serve as a workable basis).
4. **What level of data MRV would be deemed acceptable?** (the ability for plants to demonstrate that their carbon intensity was below the default factor would need to meet a sufficiently stringent level of accounting and third-party verification to be acceptable to the domestic regulator. In the absence of a common UNFCCC agreement on MRV, participation in the sector-led CSI-GNR programme may prove a practical and sufficiently robust way forward).
5. **How could MRV approaches covering domestic and imported production be reconciled?** (methodological, boundary and data assumption differences occur between ETS MRV regimes such as the EU MRG and voluntary approaches such as WBCSD/WRI. Some degree of harmonisation between schemes would likely be required).
6. **How should BAM revenues be recycled?** (BTA levies accrued at the border, and potentially also any revenues generated through auctioned allowances in the case of an importer allowance requirement, could possibly be used to improve emissions abatement opportunities within the cement sector. Funds could also be used to develop the required MRV and associated capacity in developing countries needed for plant-by-plant emissions data).

Resolving such important issues will clearly require further detailed study and effort from policy-makers. However, it appears that at least in the case of the cement sector, such considerations are not insurmountable. In the words of one EU cement firm: "the major challenge will be the willingness of governments to create a global level playing field for the cement industry. Technically, there is not a major challenge, as the required data can easily be made available."[4]

[4] Personal communication with official from EU-based multinational cement firm

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