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Emissions: where to measure, what to
measure? How the cement industry
shapes the perception of the carbon
supply chain

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Abstract

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The paper looks at the governance of the cement value chain in order to show how the cement industry pursues a strategy of entrenching the use of cement even further by recourse to climate change arguments. It thus deepens the already existing lock-in into the highly carbon emissions intensive cement paradigm and reduce the political feasibility for pricing cement's carbon emissions. The paper identifies narratives the cement industry draws upon in conjunction with other actors from the construction value chain and shows the diverse mechanisms by which it seeks to further entrench its product. It demonstrates the additional insights that can be gained by not just looking at carbon pricing in isolation but by completing the analysis through integrating value chain specific aspects of governance.

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1. Introduction

This paper shows how existing lock-ins into carbon-intensive production forms the construction industry are not only determined through technological and institutional factors but how the benefactors of the status quo use sustainability arguments in order to defend it. The paper contributes towards political economy explanations for the persistence of emissions-intensive processes in industry.

Cement emissions are a difficult to address problem with global environmental significance but that so far lacks a comprehensive agreement to address them. This does make their study less amenable to rigorous hypothesis testing or intricate refinements of existing theories than well-established regimes (Dauvergne and Clapp 2015, 7). However, it is also important to explain prevailing unsustainable practices. The study of climate politics needs to become more specific in explaining the absence of change (non-events) and thus the persistence of high carbon practices within sectors. Ultimately, global environmental politics or governance need to adopt a perspective on the political economy that trace carbon flows through the industrial metabolism. Supply chains have each specific relations with other supply chains and need to be situated in global production networks. More meso-level analysis is needed that looks at the interactions across carbon supply chains and among them.

Cement is a particularly interesting case as cement companies are very good at emphasising certain ecological aspects over others, thus possibly keeping “one eye closed” for longer. Already more than 20 years ago Davidovits (1994) wrote that “the solution to [the cement problem] should not be left to the Portland cement manufacturers alone” as “[i]t seems obvious that the western cement industry will go on in intensively lobbying the US and EC administrations by preventing any regulation focusing on chemical-CO₂ emission”, which would “restrain the flow of pertinent information”.

On important distinction in the assessment of the climate impact of products, services or infrastructures is that between operational and embodied emissions (Connaughton et al., n.d.). Whereas operational emissions are the ones that occur during the use-phase, embodied emissions are those that were emitted during the different stages of production of a good. In the lingo of the Greenhouse Gas Protocol¹ they would be considered as *Scope 3* emissions. The assessment of Scope 3 emissions relies on rather complex and potentially contestable processes of aggregating information and so does the calculation of the relation between embodied and operational emissions.

The NHBC Foundation writes that “[e]mbodied CO₂eq has historically been a niche area of investigation, due to both the difficulty in analysing it, and its perceived lack of importance when compared with operational CO₂” (NHBC, p. 4). The question arises whether this perceived lack of importance has been occurring in a ‘natural way’ or whether there is political agency that biases perception against a more prominent role for embodied emissions.

¹www.ghgprotocol.org

I show how the cement industry allies with other parts of the building sector and the climate change policy-making and action community in order to emphasise operational over embodied emissions, future carbon savings over current ones and markets cements as parts of a climate change adaptation programme. The industry works through processes of institutionalisation via industry initiatives that engage with the whole value chain, standards-setting as well as by working with government.

As the true scope of climate policy and its challenges becomes apparent, climate policy takes on more and more aspects of a wider resource policy. In doing so, climate policy turns the industrial ecology of contemporary societies into its object of evaluation and potential intervention. A ‘mainstreaming’ of climate policy suddenly suffuses architecture and things apparently mundane to social scientist, such as cement blends, with political meaning.

The awareness of the critical role of emissions reductions from the energy intensive industries is relatively novel. Yet, the timeframe that is provided by science and the importance of these sectors are arguments in favour for students of global environmental politics and governance to engage with these sectors and seek to reveal their political dynamics and the complex relations they have with the various institutions and activities that traverse contemporary economies.

A lot has been written about the transformation of the energy-sector. Due to REDD by now there is also a good literature on climate change and forest governance. The impact of agriculture governance on climate change has also been well researched. However, the building sector has largely been dealt with an emphasis on the use phase rather than with an analysis of its embodied carbon. Most of the social science literature on cement and climate, where it refers to policy processes, deals with possibilities for ETS reform (Cook and Ponsard 2011; Boyer and Ponsard 2013; Branger and Sato 2015).

I will demonstrate that the cement industry’s strategy of engaging with the supply chain runs the danger of further entrenching unsustainable consumption practices globally and thereby may lead to higher emissions earlier from the buildings sector than we could have with alternative approaches to buildings policy.

The paper continues with a depiction of cement production as a problem for climate policy. Section 3 contextualises the value chain governance perspective with a problematisation of the effects of the EU emissions trading scheme on the cement industry and shows how it has failed to initiate a transformation of the construction value chain. Section 4 gives a quick overview of the potential challengers to the dominance of the cement paradigm. Section 5 looks at socio-technical lock-in, incumbent power and barriers to innovation. I identifies a number of factors can potentially be in the the way of innovation processes that could help to decarbonise the building sector. Section 6 details the corporate strategy of the cement sector in dealing with the climate challenge and turning it into arguments for even more cement consumption. Section 7 problematises the energy efficiency agenda by pointing out that there are good reasons to discount future emissions and to expect a decarbonisation of energy supply. Section 8 tries to grapple with the question of whether we can attribute the current

neglect of embodied emissions to the agency of industry or whether it is structurally pre-determined.

2. The cement problem

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Although in popular perception climate change is often confined to its association with energy, the deep decarbonisation necessary to stay within the 2 degrees aim requires to change the way that some of the most fundamental and ubiquitous materials flows that travel through economies. According to the findings of the Deep Decarbonization Pathways Project (2015, p. 11), “deep emissions reduction in industry and freight transportation will pose the greatest challenge, and require intensive efforts in research, innovation, demonstration and commercialization”. For 2005 the World Resource Institute estimated that global emissions from cement were responsible for 5% of global carbon emissions.

The building sector is the single largest contributor to global GHG emissions (Gibbs and O’Neill 2015, 134). In the EU the building sector is responsible for 40% of GHG emissions and 50% of abiotic resource extraction (citing EC 2011: Bringezu et al. 2015, 35).

According to the World Resource Institute (WRI) of total global emissions from 2005² fuel and power for buildings accounted for 16.5% of emissions, cement production for 5.0% and iron and steel production for 4%. As we will see, the construction industry and – as part of its value chain – the cement (as well as the steel industry) makes the argument that these 16.5% of buildings emissions can be reduced by using cement and steel in intelligent ways and perhaps even in greater magnitude. Timber is a potential rival to both cement and steel in the construction industry. In 2005 deforestation accounted for 11.3% of emissions and reforestation for -0.4%. This shows how reforestation and subsequent use of timber for construction may have some potential for rivalling cement and steel in certain applications.

The Intergovernmental Panel on Climate Change (IPCC) cites a UNEP report when saying that “over 80 % of GHG emissions take place during the building operation phase”, and a US Department of Energy report to specify that this is “largely from consumption of electricity for heating, ventilation, and air conditioning (HVAC), water heating, lighting, and entertainment.”³ This shows that many of these operational emissions are not necessarily carbon intensive but that the carbon intensity depends on the provenance of the electricity from the grid. In contrast, there are clear physical limits to reducing the process emissions from the cement production. Clinker, an essential ingredient of conventional cement, is produced by the calcination of limestone in a rotating kiln. This chemical process releases around 0.53 tCO₂ per ton of clinker (Branger and Sato 2015, 6).

²<http://www.theguardian.com/environment/2011/apr/28/industries-sectors-carbon-emissions>

³https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3ar5_chapter5.pdf , p. 383

3. ETS

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Under the EU emissions trading system (ETS) and, in its wake, the Californian ETS (now linked to Quebec's) industries considered to be energy-intensive and under the threat of "carbon leakage" are granted free allocation of emissions permits. For many industries this free allocation is based on the performance benchmarks of specific product categories.

Emissions trading was supposed to let market rationality reign, to enable governance at a distance rather than a closer steering of the decarbonisation of the economy by policy makers. Such a close steering tends to be prone to capture due to information asymmetries between regulators and regulated. It is commonly voiced among economists that market-based policies should be less prone to regulatory capture (Helm 2010). However, the ETS only has limited functionality as fear of carbon leakage and reduced competitiveness stands in the way of fully internalising carbon externalities. This has led to the ETS partially taking on aspects of "command-and-control" regulation that operate with free allocation based on performance benchmarks. As the ETS approaches such more direct form of governing, firms can (still) take advantage of their discursive and technological power, i.e. to exploit information asymmetries. By providing information and thus lowering information asymmetry, industry manages to affect *what* is benchmarked.

What sets apart emissions trading and taxation as market instruments that promises relative immunity from capture is merely the aspiration of these instruments to eventually approach a "pure" form, i.e. that the free allocations themselves and the gates they open to capture will eventually be overcome.

The policy relevance of the benchmarking question and thus potentially the scholarly relevance for years to come is that any attempt to shield companies from the effects of carbon pricing, be it in the form of permits or taxation, in the absence of border adjustment pricing, will need to rely on some form of definition of what is to be shielded against competition and what are the parameters of what development should be incentivised. ETS benchmarking is geared towards incremental improvements and may thus even incentivise investments into more efficient clinker plants rather than in clinker or wholesale cement substitution. While the ETS has the intention of stirring innovation by being technology neutral, in fact it supports technology lock-in. It is thus less transformative than direct target or standard setting, yet also not free of its proneness to capture.

In benchmarking consultations industry contributes to the perception of how the competitive environment looks like, and – even more fundamental – the framing of what performance is going to be benchmarked.

What is to be benchmarked and *how* can be a contested issue. Economists endow a carbon price with the hope that it provides the right incentives to decarbonise the economy in the most efficient way. Yet, by effectively bracketing out certain products from such a transformative endeavour and instead only promoting a greater efficiency in their production rather than a potential substitution of certain products by others, radical innovation is reigned in in favour of incremental innovation.

Yet, for some of the benchmarked products, such as cement and steel, there are either clear physical limits to the decarbonisation of the chemical production processes (in the case of clinker, a central ingredient to cement). However, in the case of cement, innovation could lead to wholesale cement substitution or a greater decrease of the use of clinker, its most carbon intensive part. Yet, current benchmarking practices effectively stop the carbon price from pushing through and stimulating these transformations (Neuhoff, Acworth, et al. 2014; Neuhoff, Vanderborght, et al. 2014; Branger and Sato 2015), up to the point where they effectively subsidise (Bruyn, Schep, and Cherif 2016; Sandbag 2016) and thus further entrench the current production paradigms.

The decision to freely allocate emissions permits based on benchmarking values locks in industrial innovation trajectories. It fails to adjust incentives, even further entrenches them and stabilises the information production in the field around existing products. The focus on progress in the efficiency enhancements of the production of fixed products has diverted attention away from alternative products or downstream innovations. Benchmarking is a highly political act in itself. The process by which it comes about is potentially highly politically charged, too, and has important implications for the innovation trajectories of some of the most carbon intensive industries.

When applied to the free allocation of emission permits, regulatory capture is usually treated as directed at the amount of emissions allocated. However, the definition of what is to be benchmarked, i.e. which elements or what stages of the value chain, also plays an important role. The implications of different benchmarking methods for energy-intensive industries have so far been mostly discussed by economists and policy consultants (Fraunhofer Institute for Systems and Innovation Research, Ecofys, and Öko-Institut 2009; Egenhofer and Georgiev 2010; Cook and Ponssard 2011; Boyer and Ponssard 2013; Neuhoff, Vanderborght, et al. 2014; Sartor, Pallière, and Lecourt 2014). As such, a political economy perspective – that also concerns itself with the conflicts of interests and ideas underpinning the development and use of benchmarks – is largely lacking (for a political economy treatment of the steel industry and the EU ETS see Okereke and McDaniels 2012). Most policy-learning studies rather focus on ETS writ large. A holistic treatment of energy-intensive industries is severely complicated by the additional complexity that their links to the resource efficiency and here – in particular – the Ecodesign agendas induce. Without taking these links into account, however, it is impossible to fully appreciate the role of benchmarking in the governance of these industries' innovation trajectories. Separating climate from resource politics in favour of analytical neatness runs the danger of missing the puzzle for its pieces.

Benchmarking is framing the sphere of intervention and its perimeters, the selection of targets, as it determines which point of the supply chain is targeted. This is a process that is not necessarily just driven by pure interest or neutrality but also by practical considerations. As such, there is a desire to regulate upstream in order to reduce complexity and arrive at practical solutions, however, this leads to less carbon savings and innovation downstream, at least as long as permissions are freely allocated and thus the price signal cannot exert its effects.

What would a price signal accomplish without alternatives? If elasticity is low a higher price wouldn't help so much in cutting down emissions, which could pose a barrier to future deep decarbonisation efforts.

If the carbon price was really passed through to consumers, from a certain magnitude on certain Eco-Design ambitions would already be fulfilled in a price-responding manner. Yet, as the carbon price is not pushed through, more direct forms of market intervention might be necessary for decarbonising these sectors. If these policies were successful, resistance to higher carbon pricing would probably lessen. In this sense, we can see a strong relationship between Eco-Design and carbon pricing, as both try to grapple with the issue at different segments of the value chain.

A carbon price could help to reduce demand by providing the right incentives for substitution and more efficient use. However, the current ETS, in conjunction with the trade regime, is not designed to allow for full transmission of the carbon price signal to energy-intensive industries.

The ETS was even a subsidy for some European installations and possibly led to a higher share of carbon-intensive clinker in European cement blends than without the ETS (Sandbag 2016).

As we will see, cement companies' climate strategies are not limited to influencing the shape of the ETS but are also accompanied by attempts at governance along the value chain.

4. Alternatives

As it becomes clear that a further expansion of the consumption of cement, under the present production paradigm⁴, is incompatible with deep decarbonisation, the question of a transformation of the sectors of the economy that rely on cement is raised. From a holistic perspective, one shouldn't focus entirely on the decarbonisation potentials of the cement sector proper but should also take downstream sectors into account, whose transformation could contribute to a relative demand reduction for cement.

More potential than cement alternatives or improvements can be found in concrete (Bringezu et al. 2015, 36f.). Even more potential than in cement or concrete innovation can be found in wholesale architectural innovation and better adaptation to local climatic conditions and raw material availabilities.

Suppliers of alternative low carbon building materials may not be organised enough.

Adopting a sustainability transitions perspective, Gibbs and O'Neill (2015, 133) focus on "the niche green building sector outside the dominant building regime".

Gibbs and O'Neill (2015, 133f.) emphasise that that the eco-pioneering niche actors in the building sector are not a cohesive set but better be conceptualised as a "set of nested sub-niches". This lack of cohesiveness, while encouraging for experimentation and innovation, also means that it is more difficult for policy-makers to pick a challenger that may be worthy of support in the face of incumbents. Even worse, if solutions are confined

⁴And without a massive roll-out of CCS.

to locally appropriate measures, it is more difficult to galvanise support for them beyond their local context.

In the interviews with niche actors in the building sector conducted by Gibbs and O’Neill (Gibbs and O’Neill 2015, 139) there emerged a theme focusing on the “use of natural and locally-based materials”.

As long as the cement industry can command the loyalty of downstream users and regulators, their grip on market dominance can make seem seem without alternative and thus any significant carbon pricing will meet resistance as it seems not to dis-incentivise a specific form of construction but to punish construction itself.

5. Lock-in, incumbent power and barriers to innovation

A number of factors can potentially be in the the way of innovation processes that could help to decarbonise the building sector by reducing the utilisation of clinker.

First, in the building sector there is a requirement for tried and tested products and processes. With investments made with a perspective of decades or even centuries house-builders don’t want to experiment.

Second, cement producers should have an interest in ensuring that the productions facilities with new cement types can be well integrated with their existing plants in order to prevent a devaluation of their assets. The cement industry is very capital intensive. It takes about 25-30 years for a clinker plant to amortise. If demand increases for cement and new facilities are built, the companies are going to have incentives for keeping up demand. However, this can severely limit the range of potential innovation pathways. For example, Imabi et al (Imbabi, Carrigan, and McKenna 2012, 214) suggest that the problem of integrating the production of Novacem’s⁵ carbon-reducing cement with operational cement plants, in addition to the substantial startup costs involved, may contribute to this novel cement eventually being overlooked.

Third, there is a tension between regional raw materials availability and multinational corporations’ (MNCs) desire to streamline processes: For Phair (2006, 772) “Green chemistry encourages innovation in the methods and technology for cement processing so that they may be transferable to different regions and adaptable to local supplies of raw materials for the manufacture of a desired product.” As Bringezu et al line out (2015, 36), a secure raw materials basis is important for the development of alternative cements. This points to the importance of stirring innovation that is regionally differentiated according to local raw materials availability (and perhaps also climatic conditions). However, MNCs tend to be interested in streamlining operations across regions and jurisdictions. For example, Imbabi et al (2012, 207) mention that the raw materials for Novacem are not as abundant or uniformly distributed on land as those for Ordinary Portland Cement (OPC)⁶. Due to concerns with economies of scale MNCs

⁵Now out of business, with intellectual property rights bought by Calix.

⁶The standard cement with about 95% clinker content.

in the cement industry may lack interest to invest in locally specific, idiosyncratic solutions.⁷

6. Cement corporate strategy

The cement producers' corporate strategies towards dealing with the challenges of climate change regulation can be usefully distinguished into those *internal* to the cement production process and those that are targeted *externally* at the level of policy-makers or at the value chains in which cement forms a (potential) part of.

6.1. Internal to cement

The cement industry seeks to reduce emissions by using different fuel types for heat generation, increasing energy efficiency, reducing the clinker content of cement and aspiring to use carbon capture and storage (CCS).

By now often waste such as old car tyres are used for heat generation. Energy efficiency is regularly increased. Clinker is often blended with by-products from coal-firing and virgin steel production to reduce the clinker content in cement. As these are not attributed emissions, cement seems to become less emissions-intensive. While in one way this is indeed the case, this decrease in emissions intensity is only possible on the basis of highly emissions intensive way of generating electricity and increasing the stock of steel. This could be described as a form of high carbon 'industrial osmosis'. The process emissions from the clinker production themselves cannot be reduced beyond a certain minimum as they are the results of the underlying chemical reaction (Neuhoff, Vanderborght, et al. 2014; Hicks, Caldarone, and Bescher 2015; Bringezu et al. 2015). CCS for the cement industry is still at an early state of development.⁸ These strategies are partly coordinated and benchmarked by the Cement Sustainability Initiative (CSI), a sector initiative of the World Business Council for Sustainable Development (WBCSD). The CSI "is a global effort by 25 major cement producers with operations in more than 100 countries who believe there is a strong business case for the pursuit of sustainable development. Collectively these companies account for around 30% of the world's cement production and range in size from very large multinationals to smaller local producers."⁹ CSI data is widely cited in the research literature (Cook and Ponsard 2011) and has been instrumental in the design of ETS benchmarks (Fraunhofer Institute for Systems and Innovation Research, Ecofys, and Öko-Institut 2009).

In addition, the cement industry also actively seeks to shape innovation processes in the building materials realm. Like other topics in environmental policy, cement is a highly technical one. This endows the cement industry with technological power (Falkner 2008). As they are

⁷Also (national) building codes and innovation programmes may neglect the regional availability of (potential) building resources.

⁸http://ieaghg.org/docs/GeneralDocs/IEAGHGPresentations/J.DavisonIEAGHG-Cement_IndustrySEC.pdf

⁹<http://www.wbcscement.org/>

most invested in and most knowledgeable about the subject, they can both steer innovation processes towards certain directions and shape the impression of what's technologically feasible. This technological power can thus easily be converted in "discursive" power.

6.2. External to cement

The question arises to what extent, in parallel to a moving towards downstream regulation, if only in a conceptual sense or with the intent, the upstream incumbents also direct their political activities towards shaping innovation and industrial transformation further downstream.

As free allocation based on benchmarks effectively limits the decarbonisation of the sectors to incremental progress, with rather clear physical limits in sight, the alternative attempts at decarbonisation further downstream also need to be taken into account as they interact with the ETS as the EU's "flagship" climate policy. By largely bracketing out cement from carbon pricing, decarbonisation is largely left to the downstream policy field of construction. When it comes to energy-intensive industries, in order to understand industry resistance to decarbonisation efforts, it is not sufficient to look at policy that is explicitly framed as mainly climate policy. We need to look at how the products of energy-intensive industries flow through the economy along the value chain and analyse how, on the one hand, multiple actors defend the status quo, and how on the other hand, how others have latent or manifest interests in change. This requires a holistic perspective on industrial lock-ins jointly block climate and resource policy. In order to understand how the cement industry is governed by and how it co-governs climate policy we need to adopt a perspective that doesn't just focus on the regulation of cement emissions proper but that encompasses the entire production network (Henderson et al. 2002; Levy 2008) in which cement is embedded. We need to understand lobbying as value chain lobbying. From such a perspective the *carbon supply chain* of cement can be delineated and analysed.

A value chain or rather a production-network perspective needs to be taken into account in order to understand policy response to the challenge of decarbonising economies. As different parts of the value chain are regulated by different branches of the executive at multiple levels, with different parts of the legislative, civil society, research and industry having each specific interests and competences, the impetus for change may at times be taken up and strengthened and at other times weakened. Cement companies show are conscious they are of value chain approaches to governance in their express desire to streamline the cement value chain

downstream towards energy efficiency.¹⁰¹¹

We have to understand the market/non-market strategy of the cement industry as intricately intertwined with the downstream construction sector. It is by harnessing the epistemic and lobbying power of the downstream users that the cement industry can preserve high cement utilisation rates. I would call this *forward*-lobbying along the value chain. This notion of forward and potentially backward lobbying points to the the need to trace political-ecological conflicts along industrial ecology streams (relate to industrial metabolism).

The cement industry pursues a range of discursive strategies in order to legitimise *more* rather than less cement use.

First, it points to its *internal* (see previous section) action aimed at reducing emissions from cement production.

Second, it seeks to shift the focus on how cement can contribute to energy efficiency in the building sector.¹²

Third, they seek to focus attention on operational rather than embodied emissions. As long as cement emissions are only allocated to cement producers they are not likely to affect building practices. Only when the “embodied” emissions of a building are attributed to the building itself, a comparability across designs emerges. Cement producers thus have a clear interest in focussing more on operational than on embodied emissions.

Fourth, it emphasises the contributions cement can make for a more climate-resilient built environment. Even the climatic effects of emissions and the thus arising need for adaptation is put into the service of more and heavier ‘resilient’ architecture.

These strategies are pursued at different levels, targeting architects, construction companies, academia, city officials, UN bodies, national government and the European Commission.

Cement producers seek to influence discourses, institutions and regulations by pushing for more emphasis on energy efficiency, shaping labelling

¹⁰LafargeHolcim is one of the 11 companies that joined the Low Carbon Technology Partnerships initiative on Energy Efficiency in Buildings (LCTPi-EEB). LCTPi-EEB is an action plan that was announced at the Lima Paris Action Agenda thematic session on Buildings. According to the WBCSD the “fragmentation of the complex building value chain is a significant barrier to the improvement of energy efficiency in buildings solutions at scale”. “The 11 companies joining LCTPi-EEB . . . will work with WBCSD and other partners to bring together building value chain stakeholders in local markets to develop a common understanding of these market barriers and initiate actions that tackle them”. <http://www.wbcd.org/launch-of-the-global-alliance-for-buildings-and-construction.aspx> 2.6.16

¹¹Peter Hoddinott, President CEMBUREAU, points out that “it is important to remember that the cement industry does not stand alone. It is part of the European construction sector. . . . We do look forward to working with the construction sector, policy-makers, research communities and civil society . . . (CEMBUREAU Low Carbon Economy - Concrete Action for 2050 <http://www.cembureau.be/cembureau-low-carbon-economy-concrete-action-2050>)

¹²CEMBUREAU communicated on its website that “On 29 April 2016, [i] responded to a European Commission consultation on policy supporting actions and market uptake priorities for the future Work Programme 2018-2020, Horizon 2020.” There it “indicated that Horizon 2020 projects should provide support to three EU Directives, namely the energy efficiency, renewable energy and the energy performance of buildings Directives. In particular, attention should be paid to provisions which tackle important issues such as building renovation strategies, Nearly Zero Emission Buildings (NZEB) and financial incentives.” (<http://www.cembureau.be/horizon-2020-projects-should-promote-whole-life-thinking-energy-efficiency-buildings> 3.6.16)

and certification schemes in ways that make cement products appear benign and emphasise the need for resilience in a way that is beneficial to cement demand.

6.2.1. Resilience

Efforts to make cities more resilient are seen as new business opportunities for the cement industry.¹³ Along the value chain, the interests of cement producers are directly affected by regulation. New building codes may result in a increase or decrease in concrete demand.¹⁴

6.2.2. Shifting the emphasis from cement emissions to its contribution to energy efficiency

The Sustainable Concrete Forum notes that the UK concrete industry is committed to “Contribute to the delivery of a zero carbon built environment” (MPA The Concrete Centre 2012). This can, of course, have different implications, depending on whether only looks at use-phase or also at embodied emissions. On its website, describing the Concrete Sustainability Strategy, the communicative strategy is made explicit: “The overall theme of the extended strategy is a widening of focus from the sustainability of concrete production to the contribution concrete can make to a sustainable built environment.”¹⁵ This points to a conscious emphasis on use-phase emissions. In contrast to that, McAlinden (2015) advocates moving “from a vision where zero-operational emissions is the ultimate aspiration to one where minimising whole-life carbon emissions is the norm”. A study co-financed by cement producer Lafarge¹⁶ predicts increased cement demand under carbon constraints vis-a-vis business as usual.¹⁷¹⁸ Construction companies conspire with what consumers probably

¹³Holcim sees such environmental regulations as an opportunity where “[r]egulators and cities increase focus on building resilience to climate change. Therefore building codes and customer behavior could value more long lasting and strong material such as concrete”. This might result in “Increased demand for existing products/services” (from CDP 2015).

¹⁴In order to ‘manage’ this opportunity “. . . Holcim screens and contributes to the development of policies aiming at increasing the resilience of the built environment”. Lafarge similarly expects that “[i]n order to adapt to climate change, governments at all levels (national, regional, local) could develop planning regulations to enforce mandatory climate adaptation systems to ensure cities’ resilience such as flood barriers, pervious pavements, etc. Concrete products are well positioned for such usage thanks to their inherent properties”. (all quotes from CDP 2015)

¹⁵http://www.sustainableconcrete.org.uk/topnav/concretesustainable_strategy/commitments.aspx 19.5.16

¹⁶Now LafargeHolcim.

¹⁷Key messages of the report are that a “coherent strategy for the stabilization of CO2 at the global level requires the reinforcement and accelerated renovation of infrastructures” and “The scenarios reducing emissions and stabilizing atmospheric CO2 concentrations at 450 ppm not only require a significant increase in energy efficiency, but also massive and rapid deployment of new technologies: very-low energy buildings, electric vehicles, carbon capture and sequestration in power stations” (Entreprises pour l’Environnement and Institut du développement durable et des relations internationales 2008). Here, clearly the assumption is that higher energy efficiency leads to a reduction in energy demand. However, one could also have a bigger roll-out of renewables and do with less energy efficiency in turn.

¹⁸“[In [CEMEX] public and institutional relations efforts, [they] highlight the large and relatively low-cost potential for emission reductions in the building sector, e.g. in position

want anyway or at least with what they have never learnt to question. A building's lower operational energy consumption is an attractive economic proposition and can increase its value and "de-risk" it in the face of potential future energy price increases. The ostentatious display of renewable energy generation on site or futuristic/modern architectural elements can portray its inhabitants in a positive light. It's a more marketable solution to the climate crisis than a complicated "embodied emissions" narrative.

6.2.3. Engaging in forms of networked with a plethora of internationally active organisations

A diverse range of organisation drives the energy efficiency agenda forward at the international level and the cement industry forms a supportive part of that. Here incumbent power aligns with energy efficiency experts and advocates in a baptist/bootlegger coalition (Yandle and Buck 2002; Meckling 2011; Yandle 2012; Clapp and Meckling 2013; Meckling 2015).

For e.g. The WBCSD hosts both the *Energy Efficiency in Buildings project* (EEB) as well as the CSI. LafargeHolcim is one of the EEB Co-chairs. Amongst its partners is the World Green Building Council (WGBC).

The Global Buildings Performance Network (GBPN) also seems to focus entirely on operational emissions. William Sisson, GBPN's Director of Sustainability, serves "as Chair for the World Business Council for Sustainable Development's Energy Efficiency in Buildings Projects".

The C40 city network measure cities' carbon emissions over time. By choosing the city as its boundary, emissions from cement manufacture may be excluded while energy efficiency savings may make a city look better.

In December 2015, as part of COP21, Ségolène Royal, Minister of Ecology, Sustainable Development and Energy, and Head of the French delegation together with Ibrahim Thiaw, UNEP Deputy Executive Director, launched the Global Alliance for Buildings and Construction to combat Climate Change.¹⁹ Next to 20 countries among the "major groups" one can find Lafarge Holcim again and over 50 "national and international organisations, professional networks and funders."²⁰ The WBCSD is a "co-lead of the GABC Value Chain cluster" and "will work with partners to promote sustainability across the building value chain, specifically to scale up local action plans on energy efficiency in buildings and harmonization of building-level sustainability assessment."²¹ It lists a range of Cement Sustainability Initiative members as part of the "contribution" and locates responsibility for mainstreaming LCA for buildings and materials – amongst others – with LafargeHolcim. The World Green Building Councils Global Collective Commitment as part of the GABC is to support the achievement of the Alliance's goals to "advance by 2030 and achieve by 2050 two fundamental goals:

1. Net Zero carbon new building

papers, marketing materials, but also in direct interaction with political and other decision makers". (all quotes from CDP 2015).]

¹⁹<http://web.unep.org/climatechange/buildingsday/about-us>

²⁰<http://web.unep.org/climatechange/buildingsday/about-us>

²¹<http://drustage.unep.org/climatechange/buildingsday/wbcscd>

2. Energy efficiency and deep refurbishment of existing stock²²

Green Building Councils (GBCs) have also committed “to collaborate with their countries, national stakeholders, and Alliance partners in supporting the development and implementation of green building policies and strategies including launching national renovation strategies in 13 countries through www.buildupon.eu”²³

Here one can see how diverse organisations and stakeholders orchestrate (Abbott et al. 2014) global governance towards ways of dealing with the climate crisis that overwhelmingly emphasise energy efficiency over considerations of embodied emissions.

6.2.4. Influencing building regulations

Cement companies advocate changing buildings codes, norms, standards and standards towards a stronger emphasis on use-phase energy efficiency.²⁴ There is a danger of further lock-in via buildings practices and building codes. It is building codes that structure how buildings are made, what innovation has a good chance to work, and subsequently what inventions are sought after. In the case of the UK “[o]perational carbon emissions are being reduced via successive changes to the Buildings Regulations, and this often involves greater use of material resources (e.g. extra insulation, thermal mass, etc.” (Connaughton et al., n.d., 2). While this may reduce operational emissions, embodied carbon doesn’t just increase in relative but also in absolute terms.

“The continued tightening of the Building Regulations’ requirements for operational efficiency (BRE 2006, p.4) may have the unintended consequence of increasing the embodied energy of the buildings they serve. This in turn offsets the carbon savings of the whole-life cost. It is therefore very important to standardise the industry’s reporting of embodied energy to prevent merely shifting the time at which energy is ‘spent’ and actually reducing the net carbon cost of any project.”²⁵

²²<http://web.unep.org/climatechange/buildingsday/wgbc>

²³<http://web.unep.org/climatechange/buildingsday/wgbc>

²⁴Lafarge hopes that “Regulation focused on buildings’ overall performance rather than the use of specific buildings materials might boost sales of concrete products which have inherent properties that increase buildings’ energy efficiency”. Acting on this, “Lafarge advocates for changing building codes, norms and standards to accept new low-carbon innovative products”.

²⁵<https://www.ice.org.uk/disciplines-and-resources/briefing-sheet/embodied-energy-and-carbon>

6.2.5. Engaging with the whole value chain to push for energy efficiency in buildings

Cement companies aim at engaging with the whole value chain to advance their energy efficiency narrative.²⁶²⁷²⁸

6.2.6. Using efficiency narrative to emphasise virtue of cement

Cement companies market cement as particularly suitable for lowering operational emissions.²⁹

6.2.7. Emphasis on replacing buildings in order to increase energy efficiency of building stock

Cement companies expect the efficiency narrative to result in building more rather than less.³⁰

6.2.8. Shaping labelling and certification schemes

Cement companies seek to influence labelling and certification schemes to promote the virtues of cement.³¹³²

6.2.9.1. Incumbent power and lock-in copy

²⁶“Lafarge is leading initiatives such as EEB (Energy Efficiency in Buildings), launched under the auspices of the World Business Council for Sustainable Development (WBCSD) . . . Bringing together players from across the construction sector .. investors, regulators, architects and engineers, material and equipment suppliers, and end users of solutions .. this project is focused on developing new forms of collaboration to achieve an 80% reduction in building energy consumption by 2050.” (all quotes from CDP 2015).

²⁷Lafarge wants “100% of countries to have a partnership to promote stronger specifications and work with urban planners and architects towards sustainable cities.” to “Promote the implementation of sustainable construction solutions for cities” (Lafarge 2015). Via such partnerships the company can shape the sustainable construction agenda.

²⁸Lafarge also “co-chair[s] the WBCSD’s Energy Efficiency in Buildings (EEB) initiative. Bringing together major companies across the construction value chain, the project aims to achieve a transformation of the building sector, to reach an 80% reduction in energy use by 2050” (Lafarge 2015). Once more, this provides an avenue of emphasising use-phase over embodied emissions.

²⁹“It is widely recognized that concrete’s thermal properties make it an excellent structural material for energy-efficient buildings in both cold and hot climates, implying that under more stringent efficiency standards the consumption of concrete per unit is likely to increase.” (CEMEX in CDP 2015).

³⁰“Significantly lowering total energy consumption of buildings will most likely require an increased replacement of existing buildings, which means more construction activity.” (CEMEX in CDP 2015).

³¹“Holcim is developing a protocol for accounting GHG avoided emissions along the value chain through cement-based products” (in CDP 2015).

³²Lafarge also “takes a leading role in working groups and trade associations. As part of its”Sustainability Ambitions 2020“, Lafarge committed to become an active member in Sustainable Building Certification organizations in 35 countries (13 at end 2014).”(in CDP 2015).

7. Problematising the energy efficiency agenda

The strong emphasis on energy efficiency to the detriment of wider climate consideration can be criticised on at least two grounds: it rests on the assumption that it is better to emit more now in order to save emissions later and it downplays the decarbonisation potential from renewable energy.

7.1. Cumulative emissions and the deferral of carbon savings into the future

According to the World Resource Institute (WRI): “To have a likely chance of limiting warming to below 2 degrees C, we need to reduce GHG emissions according to the following timeframe: Carbon dioxide emissions have to drop to net zero between 2060 and 2075. Total GHG emissions need to decline to net zero between 2080 and 2090.”³³

Of course, the emissions curve in the run-up to these years does make a difference. Any emissions created now limited the space for additional emissions later on. For communicative and political reasons people often invoke the idea that emissions need to decline over time. However, if less carbon is emitted now, in the future the decline in emissions needs to be less steep.

As carbon dioxide (CO₂) emissions are essentially cumulative, it makes sense to discount future emissions and put a higher weight on current emissions. The idea of a rising price of carbon, however, provides incentives to emit more now and save emissions later (Rhys 2011). This is analogue to the energy efficiency in buildings argument that seeks to emit carbon now for construction purposes in order to save emissions later. Energy efficiency in buildings thus can be regarded as a partial deferral of sectoral responses to climate crisis into the future, which permits a more or less business as usual scenario, even more highly carbon intensive construction activity, with the promise of less emissions in the future. There is a perverse incentive potentially at work. If one assumed rising carbon prices over time, it would make economic sense to use cement now, as long as its carbon content isn't effectively priced, to build more energy efficient buildings for later, when the carbon price is higher.

The fact that disclosure is located at the level of cement companies makes the construction process appear less problematic. Even where the embodied emissions of buildings are measured, they are already expended carbon costs. Unlike operational emissions they are not associated with potential future carbon costs, yet they represent already expedited carbon, thus limiting the future development space in terms of possible carbon emissions.

³³<http://www.wri.org/blog/2015/12/cop21-qa-what-ghg-emissions-neutrality-context-paris-agreement>

7.2. Efficiency vs. Electrification

European cement lobby organisation CEMBUREAU also includes direct and indirect emissions from electricity generation as part of the use-phase emissions that are supposed to be avoided.³⁴ The juxtaposition of such emissions, which in principle could be reduced with renewable energy sources, with the chemically unavoidable emissions from cement production can be misleading when used for the assessment of low-carbon transition pathways.

The industry argues that not acting on energy efficiency would lock economies into a high carbon pathway. Here the argument of a lock-in into energy inefficient infrastructures is used in order to secure the prevailing lock-in into the Portland cement paradigm. However, here carbon and energy efficiency are (consciously?) conflated. For even if the energy efficiency of buildings doesn't increase, a decarbonisation of the electricity supply could make buildings more carbon efficient over time.³⁵

With this in mind it is also questionable whether current ways of relating embodied emissions to operational emissions and thus claims regarding future emissions savings from energy efficient architecture with relatively high embodied emissions are plausible.

8. Interpreting contestation along the cement value chain

Standards can take a long time to establish. Once they are established, it can be difficult to switch to a new standard (lock-in). Where regulation is designed around incumbent products, it can have negative effects on the competitiveness of new applications (Grubb, Hourcade, and Neuhoff 2014, 346). Just as in the fossil fuel sector, incumbents have an interest in the incremental improvement of existing technologies and not in a wave of Schumpeterian creative destruction that could shift value creation or capture along the value chain or result in new value creating activities which could undermine the basis for their industrial dominance (Grubb, Hourcade, and Neuhoff 2014, 330).

Concentrated incumbent power needs to be located in the specificities of industry structure. Just being a big company in a highly concentrated industry doesn't necessarily translate into sufficient political power for preserving the status quo. One needs to look at the specific lock-in effects due to industrial structure in order to truly grasp the "stickiness" of arrangements. Lock-in effects need to be grasped as complex, mutually re-enforcing economic advantages of incumbent technologies and industries, comprising the physical and institutional infrastructures in which the struggles between different interests and ideas are fought out (Grubb, Hourcade, and Neuhoff 2014, 362). We need to integrate the study of technical characteristics with political institutions. Whereas evolutionary

³⁴<http://lowcarboneconomy.cembureau.eu/index.php?page=sustainable-construction> 2.6.16

³⁵"Grid electricity CO2 intensity is expected to drop over the 120-year study period due to the gradual introduction of renewable generation and carbon-capture technology. Expected impacts have been reflected in this research." NHBC, p. 6

economics focuses on the evolutionary dynamics, a political science lens can help to locate agency amongst the co-evolutionary dynamics (on co-evolution see Bleischwitz, Andersen, and Latsch 2005, 170).

Both the discursive effect of the establishment of a focus on rigidly delineated efficiency enhancement around product categories as well as the expectation that emissions trading as the flagship policy should one day usher in a global carbon price lock in current trajectories even further, as they can be used in order to defer alternative solutions.

Lock-in mechanisms have been extensively explained with relation to the transformation of the energy system in light of climate change mitigation demands. So far, however, systematic case studies of energy-intensive industries are lacking.

Can this development be solely attributed to the logic of the industry in conjunction with the wider institutional field that centres on carbon pricing or can we locate agency in the way the industry uses its discursive and technological power via the provision of information?

Where agency can be found, responsibility can be claimed and the claims that decisions were taken solely based on objective criteria can be questioned.

One could think of shift of focus from operational to embodied emissions as a natural sequence. However, as I have shown, there are indications that this shift is consciously slowed down.

Possibilities for why embodied and operational emissions are dealt with differently by different associations and by different policy-makers:

1. Knowledge gap
2. Industry interests

Incumbents generally don't have much interest in being forced to change their business model. Low emissions homes mean incremental improvements but they don't question what buildings are made of. Knowledge gaps can easily interact with special interests that try to keep embodied emissions off the agenda or at least slow down the diffusion of this idea.

One could analyse the spread of energy efficiency stipulations in building codes in terms of policy learning, transfer or diffusion (Stone 2008; Evans 2009; Dunlop and Radaelli 2013; Jordan and Huitema 2014).

We can identify a struggle over embodied vs operational emissions – i.e. over how material states, locations and temporal sequencings are evaluated through accounting principles.

Could also well be that it is easier to keep embodied emissions off agenda or more difficult to put them on the agenda at international level than at the national level or in countries where the discussion is more advanced as already a lot of energy efficiency measures have been implemented.

While the direct material resource at the disposal of the cement industry are considerable, i.e. what may be termed “relational power”, one can also say that they benefit from “structural power”, not only due to the physical qualities of cement (pun intended), but also because as providers of an element that is pivotal to modern built infrastructure it is strongly associated with “development” and – as a basis for residential housing – with people's aspiration, too (on relational and structural power see

Falkner 2008). Policy-makers trying to interrupt such flows or introducing uncertainties and risks would quickly risks backfire. If sectors are highly relevant for the economy, their interests are easily defined as the national or supranational interest. If no clean alternative for accumulation and growth is presented, it is difficult for environmental interests to prevail. As long as conventional cement is seen as necessary downstream, there will be much stronger resistance to carbon pricing. However, without pricing, alternative measures may not be sufficient.

What makes it difficult to assess the influence of the cement industry on the climate policy landscape is that the situation may possibly be overdetermined: Even if the cement industry didn't actively pursue its strategies, it is still easy to imagine that the simple inertia in the building sector and prevailing cultural values and ideas would lead to the same outcome. The cement industry's political strategy may thus perhaps just bolster an already strong tendency. However, this bolstering could help to secure the prevailing lock-in against reform attempts.

The question at hand is not a binary choice of either-or use/non-use but a graded approach is necessary. This makes it much easier for incumbents to structure the cognitive situation towards more rather than less use.

9. Conclusion

Cement producers present themselves as striving for more sustainable cement but, of course, that doesn't entail using less cement. The danger is that the current non-market strategies of the cement industry drive out alternative approaches towards reducing building's embodied emissions.

For further research, students of policy learning and policy diffusion could analyse the actual changes that have been take place in the realm of national building codes and urban governance.

The case shows that market- and non-market strategy (Levy 2008) and within non-market strategy CSR and political corporate strategy (CPA) shouldn't be thought of as analytically distinct.

It shows the importance of tracing lobbyism along the value chain and has the potential to generate new thinking on the dynamics of baptists-and-bootleggers coalitions. It shows how disclosure, accounting and framings of temporality are drawn upon as strategic devices.³⁶

It points to the the importance to look jointly at carbon pricing and the intricacies of the value chains that are sought to be transformed.

The disclosure of embodied emissions information has the potential to fracture the political unity of the building sector as it unsettles by now fairly stable entrenched assumptions about relative prices of materials.

³⁶Sustainability tropes have been adopted by the industry to shape processes and perceptions in a way convenient to them.

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