Carbon Pricing and Investment Response

Ideas emerging from Roundtable 5th February 2010, CPI @ DIW Berlin[1]

Karsten Neuhoff, 28.3.2009

Carbon pricing is a key component of an effective climate policy mix. With five years of experience of the European Emission Trading scheme, it is time to assess how it influences investment and strategic choices, how it feeds through to finance decisions, and how hedging and banking of carbon allowances influence the price over time. This was the topic of a round table with industry and finance representatives, academics, and participants in the policy process. We discussed three sets of questions:

How does carbon pricing influence different types of investment choices?
We explore different categories of investment decisions, e.g. individual projects versus strategic choices, in order to develop a consistent framework for the assessment of climate policy instruments. If different actors in the organisation are responsible for the decision - what are their respective objectives and constraints, and how can they be targeted with generic and tailored policy instruments?

How does finance impact on investment and strategic choices and how responsive is it to policy?
For project investments and for corporations with strong balance sheets, finance is required for low-carbon projects and can drive a shift from carbon-intensive to low-carbon strategies. We explore how a combination of currently implemented policy instrument, long-term climate objectives, and pre-existing regulation can influence decisions in firms and the finance sector.

How do carbon prices evolve over time – the actors and incentives for hedging and banking?
The supply-demand balances are widely studied as the driver and explanation for carbon prices. Banking of CO_2 allowances has been postulated more often than analysed as a further factor for carbon price formation. If large banking volumes would require speculative investment, then this might require rates of return in the order of 15% - we explore the implications for market design and investment.

The first three sections of the report discuss these questions followed by a final section on emerging questions. Presentations of the workshop are available at www.climatepolicyintiative.org → Events → Berlin.

[1] I would like to thank participants at a workshop in Berlin on 5th of February 2010 for the inspiring discussion that initiated this report and special sthanks to Chris Beauman, Barbara Buchner, Jochen Diekmann, Thilo Grau, Ralf Martin, David Nelson, Karoline Rogge, Alex Vasa, Ulrich Wagner, Mike Wilkins and Peter Zapfel for detailed comments on a draft of the report. Financial support from Climate Strategies is gratefully acknowledged.
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The influence of carbon pricing on different types of investment choices

In the first session, each of the workshop presentations focussed on the impact of carbon pricing on decisions made at different levels within a firm, beginning with tactical, project decisions, moving through to strategic plans and finally investment in research and innovation. The contrast between these discussions indicates that carbon pricing may have differentiated impacts depending on the decision level. Significantly, different elements of carbon pricing beyond just pricing levels – for example, the long term credibility and the emission trajectory – will be very important factors for some decisions and not others.

The presentations suggested that for smaller projects, materiality thresholds and internal/employee behavioural issues influence the impact of carbon pricing. Thus, rational economic analysis may overestimate carbon savings at a given price. For larger projects, materiality is less of an issue, with profitability and risk/reward calculations taking precedence. Once decisions are moved to a strategic level, the discussions suggested that long term credibility of carbon pricing, supported by functioning short term instruments, is paramount. Finally, decisions to investment in innovation and research can be supported by carbon pricing, but rarely will carbon pricing on its own be sufficient to motivate such research. Rather, carbon pricing will be just one element of an organisational decision that will be driven by wider market trends, of which carbon pricing will be one element.

Additionally, the structure of a company can have a significant impact on the level at which the decision is made and thus the impact of carbon pricing. While the creation of a Chief Climate Officer (CCO) position can have a positive influence on carbon price related investments, much will depend on the level of that position and the perspectives of the CEO or business heads.

Section 1 below provides more details on the workshop discussions.

A number of questions have emerged from the workshop, including:

- ***Can we differentiate between project choices and strategic choices?***
  An assessment of policy instruments and their combination needs to consider the perspective of private actors, with a differentiation between project and strategic choices, and ensure consistency of short-term responses with long-term objectives. A suitable definition of these two categories with respect to country and sector specific circumstances, time horizons, and organizational structure requires further analysis.

- ***Which short-term policies are required?***
  Tailored policy instruments, like the feed-in tariff for renewables, or building standards, are essential for the implementation of individual projects. Carbon prices are relatively more important for choices of the fuel mix particularly in the power sector and energy-efficiency choices in industrial processes. While there is a consensus among practitioners that a policy mix is required, there is a risk that policy instruments might be championed by individual stakeholder groups. A combination of champions does not, however, constitute an optimal policy mix. The process and political dynamic of the policy implementation must be an essential part of any analysis.

- ***What determines credibility of, and attention devoted to, long-term targets?***

National and international legal frameworks to deliver long-term targets are still evolving and will always be difficult to enforce. Hence political commitment remains an essential factor that determines credibility of long-term targets. Does the stringency of existing climate policies serves as a tangible indicator of this commitment, and can it influence private sector decisions?

The impact of financial investors on investment and strategic choices

In the second session we focussed on the role and impact of financial investors on investment choices. An important area of discussion was the heterogeneity of investors. Bond and fixed income investors seek stable low risk investments where catastrophic risks are covered and where equity investment in the project or company absorbs most risks. For most institutional equity investors, the impact of carbon constraints may not be sufficiently visible or material to have a major impact on their evaluation of investment options. On the other side of the equation, climate change related investments require all types of investors, although the mix of investors will vary markedly depending on the characteristics of the investment itself. For example, start-up new technologies are likely to be risky and therefore seek more venture type funding. Project equity investors, and in particular venture capitalists, will require increasingly high expected returns that increase as risks increase.

In the workshop we discussed whether the institutional investors have adequate information and tools available to assess the impact of carbon positioning on a company or a project's finance-ability. We then discussed whether the policy frameworks adequately address the trade-off between a project or technologies characteristics and the type of funding that will be required. In other words, whether policies have been, or can be, optimized for the types investment they are likely to attract.

Section 2, once again, provides more details on the discussion. A series of questions emerge:

- ***How can the finance sector facilitate deep decarbonisation strategies?***
  Access to finance, cost of finance, and shareholder interests are essential for project investment choices and corporate strategies. At the project level, tailored support schemes, like feed-in tariffs, or government guaranteed credit lines or loans can address policy and other risks to facilitate access and reduce financing costs. At the corporate strategy level, further analysis is necessary to understand how the (perceived) risk of low-carbon strategies can be minimised, so as to reconcile the short-term interests of equity markets and long-term climate policy objectives.

- ***What are risks of high carbon strategies and are they born by investors and management?***
  How can policy instruments, regulatory frameworks, accounting and taxation rules create awareness for strategies that are not incorporating carbon considerations and remove implicit and explicit risk guarantees? Which public and private institutions can address myopic short-term focus in the decisions of finance and corporate investors? Enhanced rating methodologies might capture carbon risk exposure for equity and bond investors. Could this trigger change in organizations that are not sufficiently aware and responsive to the carbon challenge, and turn the financial markets to drive low-carbon strategies?

The evolution of carbon prices over time and the incentives for investors

In the simplest terms, supply and demand for emissions certificates should determine the price. However, for the European Emissions Trading Scheme (ETS) the story is complicated by the issuance of free allowances and the transition to future phases of the ETS in 2012 and 2020.

At the workshop we discussed the observed lack of a strong feedback from future periods. Participants speculated that the lack of feedback is due to the lack of liquidity in post 2012 certificates, or the fact that the market for 2013 and beyond is still a speculative market rather than one based upon physical hedges. Speculative markets are more risky and attract higher required rates of return (estimated at 15% by workshop participants), while hedging transactions are nearly riskless (and are risk reducing) and thus attract much lower rates of return (estimated at around 7% or the cost of capital of the hedgers). The higher required rates of return diminish the pull of forward price expectations on current prices. Another possibility raised was the risk of limited scarcity and low carbon prices if EU targets are not raised to 30% and there is good progress on various carbon reducing initiatives.

Finally, the workshop returned to the impact of longer term prices on investors, once again reaffirming that current prices generally only motivate operational changes (such as switching gas for coal) and investments with short term paybacks, while the long term credibility of prices influences the longer term strategic choices.

See section 3 for more detail.

Some important questions have emerged from the discussion:

- ***Who are the actors and what incentives are required for hedging and banking?***
  Analysis of price formation in emissions trading schemes traditionally focused on a static demand-supply balance. Inter-temporal arbitrage was assumed to result in a smooth carbon price development and thus ensures that current prices can inform long-term investment decisions. The experience from commodity and oil markets shows that only speculative investors can pursue the necessary inter-temporal arbitrage, but require a higher rate of return. This could imply significant year-on-year price increase for the carbon price and could thus compromise environmental objectives and efficiency.

- ***How to design and interpret carbon markets if inter-temporal arbitrage is limited?***
  How to design the trajectory of emission caps, so as to limit the need for inter-temporal arbitrage? If carbon prices are not strongly linked across different time periods, then long-term carbon prices, e.g. for 2020, are not expected to be linked to current carbon prices. What are the experiences from other commodity markets with similar price formation processes and the implications for investment strategies? What is the role of the current institutional design and price formation process for the expectations about and credibility of future carbon prices?

1. How do firms respond to carbon pricing?

This section begins with the discussion on investment choices by firms at the project level followed in the second subsection by their strategic choices about sector, product and technology focus or investment volumes. The third subsection focuses on firms' decisions on investment in innovation. The final subsection explores how organisational structures are a result of strategic choices and also an enabler for project level choices. The final subsection illustrates how the differentiation might support the design and assessment of climate policy instruments, in particular carbon pricing.

1.1 Firms' response to carbon pricing at project level

The survey conducted in 2009 by the London School of Economics (LSE) of 800 managers in the European manufacturing industries suggests that 7% energy savings/emission reductions are possible through cost-effective improvements to manufacturing processes. The survey suggests that the average payback period for these energy-saving projects is less than four years. The workshop discussion pointed to one important reason: managers not only assess the internal rate of return a project can deliver, but also the absolute expected profit from a project (materiality). As many energy-efficiency improvement projects are small, firms do not want to use up scarce management resources that can be more fruitfully employed on other projects. In addition, technicians and managers might be reluctant to identify savings potential, which they themselves had failed to realise in preceding years. Carbon-pricing can increase profitability and materiality of energy efficiency improvement projects, but might not suffice on its own.

Additional management attention could be prompted by (i) additional regulatory devices that support or require monitoring and auditing, so as to limit the incremental effort for managers to pursue energy-efficiency projects; (ii) standards or direct regulation that require managers to choose or update energy-efficient processes and operational procedures; and (iii) compliance markets incentivised with penalties and/or public reporting. Positive experiences have been gathered both with autonomous initiatives of firms, e.g. the BP internal carbon trading scheme, which ran for two years from 1999; and with external policies that trigger such internal action, such as the Climate Change Agreement or subsequent Energy Performance Commitment in the UK.

For large-scale energy-efficiency/ low-carbon projects, the constraint for implementation is more likely to lie in their profitability, or more precisely, their risk-return ratio. The risk associated with the new technology, new organisational requirements, new business partners, and the policy regime might not justify the expected return from the project. Policy choices can reduce the risk and increase the returns of low-carbon projects by (i) increasing the costs and risks of the status quo with more stringent carbon caps to increase carbon prices (ii) reducing the risk of low-carbon options with credit and risk guarantees, long-term contracts/feed-in tariffs, price floors for carbon; and/or (iii) tailored subsidies, or renewable support schemes, both with detailed phase-out strategies. If mandates and standards can be clearly defined, e.g. for energy efficiency of new buildings, they can also be a very effective policy mechanism.

1.2 Firms' response to carbon pricing at strategy level

Deep decarbonisation is achieved through a shift to low-carbon inputs (commodities and fuels), low-carbon production processes, and a shift to products and services with low life-cycle emissions. This transformation will be driven by (i) strategic choices at the board level of incumbent firms; (ii) entry of innovative firms delivering new technology and services; and (iii) exit of firms that fail to anticipate and respond to climate policy frameworks.

The Fraunhofer ISI & ETH Zurich survey, conducted end of 2009, showed that long-term emission targets (2020 and beyond) are most important for firms' strategic responses (as reflected, for example, in their visions, organisational structures, investment in R&D). Long-term targets have been defined by cities, states, countries, and supranational groups such as the EU, G8, G20, and in Copenhagen. This raises the question of what determines the credibility of any such long-term target. For example, the legally-binding EU directive on Emission Trading defines an emission trajectory for sectors covered by EU ETS that declines by 1.74% from 2012 into the future beyond 2020 – but this legally embedded trajectory has not (yet) captured the full attention of, or become sufficiently credible to, industry.

Policymakers can easily commit to mid- and long-term targets that expand beyond the time-frame they expect to remain in office. Targets can only derive credibility from the policies that are pursued in the short-term. If policymakers invest political capital and overcome domestic opposition to implement carbon-pricing schemes, renewable support schemes, regulations and standards, this increases the credibility of their commitment to mid- and long-term targets.

Firms struggle to interpret or respond to political announcements as long as they are not reflected in their bottom line. For example, the survey by LSE showed that the more stringent firms expected the EU ETS to be, the more they act to reduce carbon intensity. In this interpretation, mid- and long-term emission-reduction targets, which are essential to guide low-carbon strategies, are only credible and capture the attention of firms – and therefore effective - if they are complemented with a compatible short-term policy package.

1.3 Firms' response to carbon pricing with respect to innovation

The LSE survey results suggest that firms are more likely to pursue research energy and carbon efficient technologies, if they expect a stringent EU ETS in the period leading up to 2020 and beyond. This suggests that the EU ETS contributes to the long-term credibility of carbon constraints, and thus creates expectations of market opportunities for low-carbon products.

Research activities can target (carbon) efficiency improvements of production processes and explore alternative products and services with lower life-cycle carbon footprints. The LSE survey illustrated that exposure to EU ETS increases the research of firms on how to improve the carbon efficiency of their production processes so as to reduce production costs. But firms exposed to EU ETS also pursue more research on alternative products and services than firms not covered by EU ETS. EU ETS apparently creates attention and signals commitment to climate policy, and thus enhances the effectiveness of long-term emission targets.

The drivers for the adoption of new technologies differ significantly across sectors. EU ETS is typically only one of many factors considered in adoption decisions. Other policy instruments, e.g. contributing to incremental costs, reducing risk and providing necessary infrastructure are often seen to be more decisive. EU ETS is a necessary factor for technologies, like CCS, that are in the long-term only viable with constraints on carbon intensive competitors (coal plants without sequestration units) and hence require current policies that demonstrate commitment to such a constraint.

The discussions pointed to the importance of a careful assessment of the market structure and technology supply-chain to tailor policy design to the sectoral patterns of technological change.[2] Innovation might be pursued by manufacturers, but is equally likely to appear within the domain of manufacturing equipment suppliers. This has to be considered in the choice and targeting of technology policy instruments such as R&D support and the assessment of constraints for innovation

[2] Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. Research Policy, 13(6), 343-373. doi:doi: DOI: 10.1016/0048-7333(84)90018-0

(access to finance, resources, etc.). As innovative firms naturally prefer technology options that build on their core competencies, this can create additional incentives for innovation. But it needs to be balanced with opportunities for entry by new firms with alternative technological concepts to avoid constraints for optimal technology choices

1.4 The role of organisational structure for firms' response to carbon pricing

During the round table, we discussed the role of organisational structures for the pursuit of carbon- and energy-efficiency projects and strategies, primarily in order to improve our understanding of the response of firms to climate policy instruments, rather than with a normative objective of defining optimal organisational structures.

The survey results both from LSE and Fraunhofer ISI & ETH Zurich suggest that organisational structure can serve as an indicator (as well as catalyst) for the response of an organisation to climate change policies. Particularly during the current recession in which firms are executing fewer large-scale investment projects, the adjustment of organisational structures, including the creation of a climate change officer (CCO), signals attention devoted to climate change policy and suggests that firms are ready to respond to climate policy by changing their own management processes.
The LSE survey furthermore pointed out that the seniority granted to the CCO correlates with the stringency of the energy-/carbon-efficiency measures implemented by a firm. However, the causality has not yet been analysed: does a more senior CCO reflect increasing commitment or does he/she trigger climate change choices?

Further analysis is also required to better understand the mandate of such CCO. Their role can include PR functions, the objective of identifying/pursue marginal (carbon) efficiency opportunities, responsibility for presenting low-carbon strategies at the board level, or merely combining compliance functions (e.g. inclusion of carbon trading in the portfolio of energy procurement departments).

One hypothesis which emerged from the workshop was that a CCO could effectively contribute to the identification and implementation of (carbon) efficiency improvements on the project level. However, for the strategy level, it might not be desirable to "outsource" the assessment of implications of carbon constraints to a person who was not centrally involved in the formulation of corporate strategy.

1.5 Implications for effective policy design

Governments can set short-term policies and long-term targets. Long-term targets are only effective if they can derive credibility and attract attention through current policies. Without long-term targets, corporate strategies in response to current policies are not compatible with deep decarbonisation objectives:

- Low-carbon and energy-efficiency improvements require an organisational structure and processes that allow for low-carbon and energy-efficiency projects to go forward even where their size is not significant enough to otherwise warrant management attention. Sector specific policy frameworks can provide information (energy audits), reduce financing costs, and limit policy risks, to improve risk/return ratio. Where suitable, direct regulation and standards can be applied.
- To ensure that investment in (carbon) efficient production processes and product lines is compatible with long-term emission targets, these targets must be woven into corporate strategy. A supportive policy framework might be necessary to (i) facilitate development of complementary infrastructure and institutions, (ii) contribute to initial learning investment, and (iii) cover risks associated with less-established policy frameworks and instruments.

- To facilitate low-carbon innovation, it is necessary for the incumbent and new companies to build strategies that are compatible with long-term emission targets. They are necessary to explore and realization opportunities for novel production processes and products. Where there are finance constraints, or difficulties of appropriating innovation, tailored financial support for research, development and deployment is necessary.
- Many factors beyond climate policy influence corporate strategy. It is therefore essential to align climate policy with other national and international policy objectives like energy security, so as to ensure they mutually reinforce rather than undermine each other.

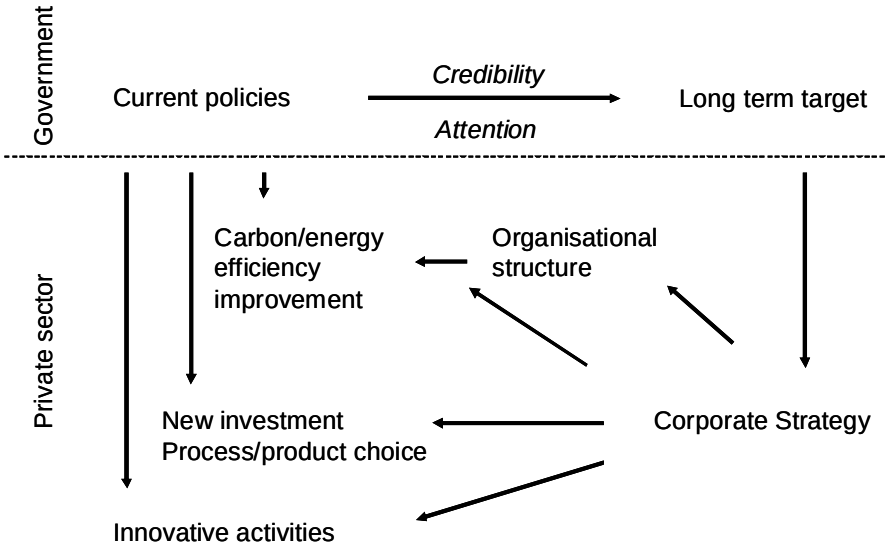

Figure 1: *Current policy frameworks can have some direct effect on private sector innovation and investment choices. Current policy frameworks and programs are also essential to lend credibility to long-term targets of government. This credibility will determine whether long-term public policy targets will be reflected in corporate strategy. The corporate strategy directly determines some investment and innovation choices, and is also essential for aspects like organisational structure that enable and enhance private sector responsiveness to current climate policies.*

The workshop discussions illustrated the large differences across sectors and technologies – emphasizing the importance of policy design that is tailored to meet the sector and country specific needs. These needs are not only determined by the technological and economic circumstances, but also by decision structures of companies and market structures.

The discussion suggests that a public policy framework must align short-term incentives with long-term targets, in order to achieve a low-carbon transformation. However, in many instances it is technically or politically difficult to provide tailored support that aligns short-term incentives with long-term trajectories. Governments have insufficient and biased information and are subject to political pressures which limit their ability to micro-manage such an economic transformation. Hence short-term policy frameworks can only provide *some* incentives for low-carbon transformation, and must in addition build on firms' strategic interests in taking leadership in new market opportunities or avoiding exposure to high carbon risks. Thus a low-carbon transformation does also require long-term commitment from the private sector. The next section explores some of the factors that might contribute to such a long-term commitment both from a finance and policy perspective

2. The role of finance for investment choices

Decisions on project level investment and on corporate strategy are strongly influenced by the financial sector. It determines the availability and cost of financing through bonds and new equity and in listed companies, management which is judged "underperforming" by the financial sector, risks being replaced.

2.1 Differentiating between finance sources and requirements

Figure 2 illustrates three types of finance sources and their relative importance for different actors.

(1) Early-stage technology investment is inherently risky, and is thus principally funded with venture capital, business angels or as part of on-balance sheet investment by firms themselves. The main driver for such investment is expectations about future market shares. Hence, expectations about policy frameworks implementing emission reductions up to 2020 and beyond are crucial to facilitating such investment. Public financial support can contribute to the incremental costs if appropriation of benefits of technology innovation is limited. Public finance can also provide opportunities for new entrants where incumbent companies do not explore the technology space outside of their own expertise.

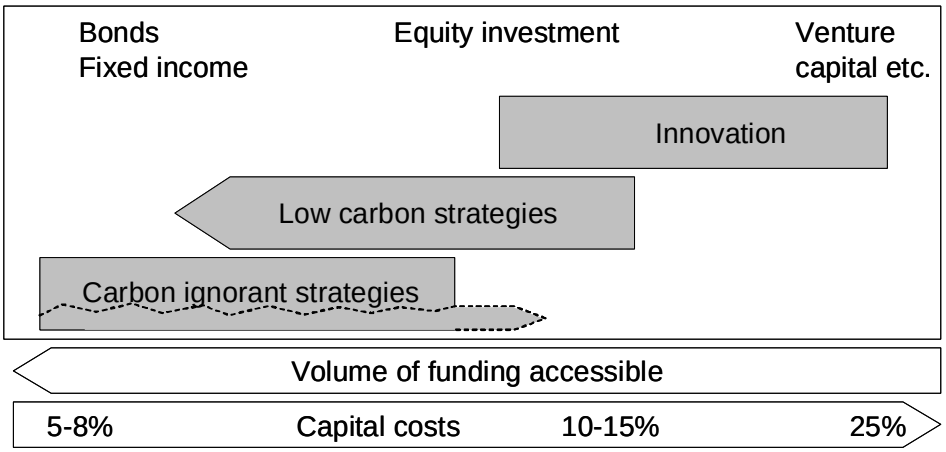

Figure 2: *Market categorisation of risk determines finance structure, access, and cost*

(2) Low-carbon strategies involve investment in low-carbon technologies. Their risk declines with their larger-scale application, e.g. as part of deployment programs for renewable energy technologies. The remaining risk exposure determines the type of financing available. Equity investment is required to cover technology, policy or market risk. Loans are typically the cheapest finance and are available at low interest rates, but they require a high certainty that the money can be paid back. For example, on-shore wind supported with guaranteed feed-in tariffs only requires 20-30% equity and can use loans to provide the remaining finance. Less mature technologies, less established firms, or less stable policy frameworks require significantly larger equity investments and are thus more expensive to finance.

If low-carbon technologies can be clearly identified, then tailored support schemes can be defined and can provide long-term price guarantees insulating the investor from market and policy risk, and, where necessary, increase returns. For other technologies, governments are less likely to be in a suitable position to identify and support individual process improvements such as in the chemical or refining industry. In such instances, a robust carbon price signal is likely to be more important, and will be discussed in section 3.

(3) Firms pursuing carbon ignorant strategies typically act with limited consideration of future carbon constraints. Yet such "carbon-ignorant firms" are still considered to be low-risk choices in investment portfolios, as they are using established technologies and existing business models and business relationships.

2.2 Evaluating investments and business models in a changing world

Private sector initiatives like the Carbon Disclosure Project; financial products like a low carbon index tracker, the Low Carbon 100 Europe Index or the Standard and Poors/IFCI Carbon Efficient indices; as well as rating agencies are starting to tackle this ignorance. This is essential, because pension funds and other investors seeking fixed income from 15-20 year bonds require transparency about the risks they are facing. One early identification of the carbon-exposed business model was the downgrading of the credit rating for the stock-market listed coal power station DRAX, by Standard and Poor's May 15th, 2009, also responding to "Drax's rising business risk because of its focus on coal-based generation, which is subject to increasingly stringent regulatory and environmental requirements".[3] Three stages of the evolution of assessments for carbon risk exposure can be identified:

- Initial evaluations compare the direct and indirect carbon emissions of a company against its financial performance. Thus carbon-intensive businesses could be identified.
- Recent work considers whether firms that produce carbon-intensive products can pass on the carbon price to their consumers. This information could decrease concerns about carbon-intensive firms, if they can demonstrate that they can increase product prices without losing competitiveness. It also allows for intra-sector comparisons. Firms will have a competitive disadvantage and increased risk exposure, if they are more carbon-intensive than their peers in the same sector.[4]
- Deep decarbonisation of our economies will be delivered through changing and optimising production processes and product and service portfolios. Carbon intensity, availability of low-carbon substitutes and innovation of low-carbon alternatives, and evolving consumer preferences create new market opportunities. But they also imply declining demand for many carbon intensive products. Declining markets not only reduce production volumes, but can result in long-periods of excess capacity and therefore low margins. Sectoral shifts associated with a deep decarbonisation have yet to be understood and considered by investors and rating agencies in their evaluation of the business models and strategy of firms.

2.3 The role of policy frameworks

The workshop discussion illustrated that access to finance and the involvement of financial investors through corporate governance structures are crucial components for investment choices. This will facilitate a shift of financial resources, away from firms that fail to define and implement low-carbon strategies, toward more innovative business models, technologies and product portfolios. Such a shift will have to be embedded in a broader transition strategy, because carbon intensive infrastructure can only be decommissioned once low-carbon alternatives are in place. Also, societies have to acquire sufficient awareness of carbon risk-exposed assets so as to move these assets off the portfolio of pension funds and avoid government intervention to protect pension funds.

Policy frameworks are effective, if they can be used for net present value calculations or appears on an income statement, thus draw attention by strategic management and shareholders. Further

[3] Standard & Poor's. (2009). Drax Power Ltd. Issuer Rating Cut
To 'BB+' On Weak U.K. Power Prices And Increasing Business Risk; Outlook Negative (Ratings Direct).
[4] Standard & Poor's. (2010). European Companies Look To Carbon Markets And Reduction Measures To Manage Their Emissions Exposure (Global Credit Portal).

development of accounting standards and investment requirements for pension funds might be necessary.

The finance sector can also be pro-active in influencing carbon performance of client firms. For example, the European Bank for Reconstruction and Development (a publicly owned bank) requires an energy audit, financed by the EBRD, to gain access to loans for large-scale investment projects. This focuses management attention and creates awareness of energy efficiency and low-carbon opportunities, and serves as a starting point for the complementary implementation programs which are also supported by EBRD.

3. Short- versus long-term price formation in EU ETS

The balance of demand and supply for CO_2 allowances creates a carbon price. The static perspective is frequently analysed, including the supply of allowances by the cap set in National Allocation plans, the allocation provisions including auctions and free allocation, the additional supply of Clean Development Mechanism offset credits and the demand of allowances by installations to cover their CO_2 emissions. The inter-temporal dimension introduced by hedging demands and banking of CO_2 allowances still requires further empirical assessment,[5] and are subject of this discussion.

3.1 Hedging demand for CO_2 allowances

Post-2012, installations in the power sector will not receive free allowance allocation in most European countries. This can create front-loaded demand, as power companies must hedge their fuel and carbon costs for power they are selling on forward or long-term contracts. An Eurelectric study suggests that packages of 25% of total contracted power are sold one, two, three and four years, respectively, ahead of production. According to the Eurelectric calculations, this creates an additional one-off demand of 1,300 Mt CO_2 allowances for hedging of power sales post-2012. This demand is only matched with about 361-831 Mt. of excess supply including CER use in the EU ETS up to 2012 (Estimations by Societe Generale, Deutsche Bank, RWE).

It is possible to envision that other parties satisfy the hedging demand. For example, firms in sectors which continue to receive free allowance allocation post-2012, and can pass part of the carbon price through to product prices, can serve as counterparties for hedging contracts. It is also not clear to what extent power companies are selling fixed-price contracts, or can include, and have included, carbon-price indexation into their contracts, so as to limit their need to hedge carbon prices.

3.2 Inter-temporal arbitrage in CO2 allowance markets

This leads to the broader question of whether third parties would provide hedging by signing forward contracts with similar risk structures or bank CO_2 allowances. Across most commodity markets, including CO_2 allowance markets, actors are prepared to take open positions in pursuit of inter-temporal arbitrage. However, the focus is typically on short-term arbitrage covering periods from hours to months. Imbalances in the short-term demand-supply balance in carbon markets might however require longer-term and larger scale arbitrage.

Longer term and large scale arbitrage in commodity markets is a speculative investment. An investor takes a position and bears the risk associated with this position. In commodity markets such risks are considered to be high, hence investors require rates of return for such investments in the order of 15%. This rate of return (ROR) requirement is higher than for shorter-term investments, as for shorter time frames the maximum possible change is expected to be smaller than over longer periods. Policy developments have in the past resulted in dramatic shifts in carbon prices; therefore they are likely to be considered a rather risky commodity for some time.

The implication of this risk dimension is that speculative investors will only bank CO_2 allowances if they expect the carbon price to increase by about 15% per year. A current carbon price of about €14 /tonne CO_2 corresponds in this case to a carbon price close to €60/t CO_2 for the year 2020 and €230 for the year 2030. Such a price trajectory is undesirable for a set of reasons:

[5] The design of the European Emission Trading scheme also allows for a limited amount of borrowing within compliance periods. Installations receive free allowances already in February of the calendar year of the emissions but only need to present CO2 allowances to cover their emissions by the end of April of the calendar year following the emission. This has created opportunities to sell allowances during periods of cash-flow constraints e.g. from the financial crisis, and has thus may have resulted in a back-loading of demand. This behavior was limited, as it creates open positions with risk exposure for actively trading companies.

- It results in inefficient mitigation choices over time, due to the difference between public and private rate-of-return expectations. Assume an interest rate for public cost-benefit appraisals of 5%, then a carbon price of €60 /t CO_2 in 2020 would translate into a carbon price of €37 for 2010. Private actors, however, only pursue mitigation actions up to a carbon price of €14, meaning all of the opportunities in the range €14-37 /t CO_2 are wasted.
- The low spot prices that result in such a situation do not signal political commitment to mid- and long-term targets, as low carbon spot prices are politically not challenging and economically only of limited effectiveness.

3.3. Policy options to match allowance demand and supply

The high rate of returns required by private if they are required to take risk on CO_2 prices raises the question whether policy design should contribute to a closer match of CO_2 allowance supply and demand.

In the shorter-term, Eurelectric asks whether hedging demand emerging with the shift to full auctioning of CO2 allowances to the European power sector in 2013 should be satisfied by early auctioning of CO_2 allowances. It raises questions on whether regulators understand commercial practices well enough to define a suitable timing and schedule for such auctions. Experience from long-term contracts in natural gas markets shows that contract structure and duration can change significantly over time. A decline in contract duration, as has been observed in natural gas markets, decreases the hedging demand for CO_2. An increased linkage of contract prices to spot prices, as observed in the natural gas environment, further reduces hedging demand for CO_2 allowances. The experience from commodity markets shows that accounting standards, which currently differ between the US and the EU, can impact the attractiveness of hedging.

In the longer-term, if the current EU targets for emission reductions are not strengthened from 20% to 30%, large-scale banking of CO_2 allowances becomes an essential element to focus on. The workshop discussions suggest that the EU renewables targets and complementing policies to unlock energy efficiency potentials can deliver the emission reductions necessary for the 20% target, resulting in a very low carbon price.

Two options were discussed to avoid this situation. The EU could commit to very stringent targets post-2020 in the expectation that private sector investors bank significant large volumes of CO_2 allowances from the period 2010-2020, thus increasing current prices. However, speculative investments would be required to pursue this large-scale banking, creating the negative effects of a very steep forward curve. Alternatively, the EU could strengthen the emission reduction target to 30%, reflecting the provisions in the Directive in combination with submissions by most parties of the UN Framework Convention under the Copenhagen Accord, and the long-term mitigation requirement.

Of additional concern for the development of a stringent emissions trading scheme to support a robust carbon price are the generous provisions for the use of CDM offset credits. In the current framework, up to 50% of emissions reductions in the covered sectors can be replaced by offset credits. This limits the emissions reduction effort necessary, and given the uncertainty about offset supply, creates uncertainty for investors.

3.4. The role of emission trading for low-carbon investment

A detailed analysis of the role of carbon prices for different types of investment choices and decisions leads to a question on the objective of emissions trading schemes. In the discussions and analysis, two objectives were identified. First, current carbon prices and carbon-pricing mechanisms influence operational choices (coal/gas etc.), and are reflected in appraisal of investment projects with shorter

pay-back periods. Second, expectations about 2020 emissions caps and their credibility (e.g. whether they are created through an established emissions trading scheme) influence corporate strategy and large-scale investment choices, and might increasingly be considered in assessments of carbon-risk exposure by conventional investment.

In the literature and policy discussions, a third objective of emissions trading schemes is listed – inter-temporal optimization. According to theoretical papers and models, banking of allowances across years is supposed to increase economic efficiency. It would thus also translate information about future scarcity to today's prices and providing market based information about long-term policy credibility and effectiveness. However, the workshop discussions suggest that this in theory well-defined objective might not be delivered in practical applications. This is because speculative investors, those who would be required to undertake such CO_2 banking, require rates of return of about 15%, instead of rates of 3-5% typically assumed in economic models.[6]

This assessment is supported by evidence from oil markets. Despite the ability to store oil (albeit at higher costs and typically with constrained capacity compared to CO_2 allowances), current oil prices are rarely interpreted as the most likely long-term price. Even forward prices for oil have not been an unbiased predictor for oil prices, as OPEC is interested in deterring investment in oil production capacity and thus oversupplies the market with forward hedging opportunities to signal excess supply.

In the absence of banking of CO_2 allowances over several years at acceptable conditions (e.g. 3-5% ROR), emissions caps must be defined so as to match more closely the desired emissions trajectory over time. Carbon prices can fall more rapidly during periods of excess supply (e.g. during economic downturn), as large-scale banking will only kick in with forward curves increasing at 15% per year. The ROR requirements to attract investors to pursue banking could also limit the ability of banking to compensate for temporary excess supply and needs to be considered in the discussion on price floors in emissions trading schemes.

As current prices might not be fully linked to prices in, for example, the year 2020, they might not convey the desired level of information for long-term investments to take place. The experience in natural gas markets suggests one possible institutional response: long-term contracts to provide revenue security to finance gas projects. Alternative options are public commitments to minimum levels of stringency (e.g. reserve price in auctions, long-term put options), or technology and infrastructure-specific regulatory frameworks.

The absence of a direct linkage between current carbon prices and future carbon prices does however not imply that current design choices (e.g. tax versus trade) can be pursued without consideration of private sector expectations about credibility of and price formation in future carbon pricing schemes.[7] Current carbon price formation is essential for operational and short-term investment decisions. It also provides commitment towards a future institutional setting that allows investors to anticipate future market price formation compatible with future emission reduction targets.

[6] See Bessembinder, H. (1992). Systematic Risk, Hedging Pressure, and Risk Premiums in Futures Markets. The Review of Financial Studies, 5(4), 637-667, Garleanu, N., Pedersen, L. H., & Poteshman, A. M. (2009). Demand-Based Option Pricing. Rev. Financ. Stud., 22(10), 4259-4299, Wang, C. (2001). Investor sentiment and return predictability in agricultural futures markets. Journal of Futures Markets, 21(10), 929–952.

[7] The short-term objectives of emissions trading schemes might be equally achieved through carbon taxes. However, it is difficult to design schemes that provide long-term commitments to increasing tax levels. Automobile manufacturers do considers existing excise taxes on fossil fuels in their product design, but might consider announcements of increasing fuel taxes to be less credible, as such schemes were easily abandoned e.g. after the oil price increase in 2003 in the UK.