

ADAPTING TO CHANGE

Taking Carbon Risk into account



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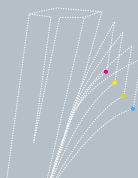
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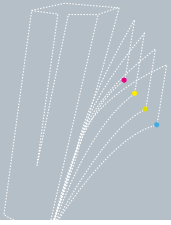
During the last two decades, the OECD members have put in place carbon markets as regulation mechanisms in order to control greenhouse gas emissions (GHG¹). The companies with the highest emissions must increasingly also take into account the cost associated with the emission of CO₂ and integrate the risks and opportunities related to climate change into their strategies. According to a Ceres survey², more than 60% of the surveyed investors state that they integrate regulatory carbon risk into their investment considerations. But only 20% claim to take carbon risk directly into account in their valuation models.

In general, the uncertainty that still exists regarding the involvement of governments in fighting climate change on the global scale, the still limited amount of information communicated by companies about their carbon intensities, and the wait-and-see behaviour of asset managers are all hindrances to the internalisation of carbon risk by the financial community.

The purpose of this article is to analyse the impact of carbon risk for investors on the European market in general and the UK market in particular. A classification of solutions for investors who now want to incorporate carbon risk, and thus climate risk, into their management strategy will also be presented.

This study responds to a specific request initiated by AXA Insurance UK that aims to control the carbon intensity of its portfolio. It uses data from the global research agency Trucost, which provides a standardised, comprehensive reading of the environmental impact of the activity of more than 4,500 companies in the world. Trucost provides direct and indirect data on over 700 environmental impacts including greenhouse gases (GHG), water, waste and air pollution, by standardising and validating company disclosed data. Where companies do not disclose data, Trucost 'completes the gaps' with its advanced environmental profiling model.





Part I - Carbon risk: What and how much

The price of carbon and the quota market of the EU ETS³

Major international agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC) signed in Rio in 1992, and the Kyoto Protocol signed in 1997, have enabled the emergence of new mechanisms for regulating GHG emissions: carbon markets. By providing a price for CO₂, these markets will contribute to the internalisation of the cost of emissions by those companies with the highest emissions.

There are two main markets for carbon quotas: the international market associated with the Kyoto Protocol, which sets targets for greenhouse gas reduction by 2012 for more than 35 countries, and the European quotas market, the European Union Trading Scheme or EU ETS. Since 2005, the latter has imposed an emissions cap on more than 11,000 industrial facilities⁴, thus covering nearly 50% of CO₂ emissions in the European Union. During the first two phases of the EU ETS, 2005-2007, phase I (called the "test" phase), and 2008-2012, phase II, the covered facilities receive an annual allocation of CO₂ quotas, mostly at no charge. At the same time, each year, they must turn in the quotas that correspond to their verified (direct) emissions of the previous year.

Between 2005 and 2007, the quantity of allocated quotas was greater than the emissions of facilities. As quotas could not be carried over into the second period, the price of the first-period quotas

converged towards 0. Since 2008, this constraint no longer exists, which means carbon prices are maintained in phase II - despite the economic downturn between 2008 and 2009 - because of the hedging strategies of the companies with the highest emissions.

The European climate and energy package passed in April 2009 extends the application of the EU ETS until 2020. During the third phase of the EU ETS (phase III - 2013-2020), the cap on permitted emissions will decrease, and the quotas will become increasingly restricted from one year to the next. The constraint will therefore tighten each year in order to achieve the goal of reducing the emissions of the sectors of the EU ETS set at 21% between 2005 and 2020⁵. The main change in the EU ETS in phase III is that the allocation of quotas almost systematically implies payment (starting 2013). The share of allowances put up for auction will thus increase from 0.13% and 3.6% in phase I and II to a minimum of 50% in 2013, reaching up to 75% in 2027. One hundred percent of the quotas for the electricity sector will start to be paid for in 2013 compared to 20% for other sectors (a share that will gradually increase to 70% in 2020 and 100% in 2027). Only those sectors that are intensely competitive (e.g. cement, steel) will continue to receive their quotas for free on the basis of reference emission factors (we then speak of sectoral benchmarks generally based on past emissions). In addition, starting in 2013, the EU ETS will cover other sectors, such as airlines and maritime transport.

The tightening of the carbon constraint and the expansion of the EU ETS in phase III will support the price of CO₂. In September 2010, the Reuters consensus⁶ amounts to €24.5/tonne by 2012 and €30.3/tonne on average in phase III (2013-2020).

It is here key to note that the CO₂ emissions of the countries in Appendix I of the UNFCCC (developed countries and countries in transition⁷) grew by more than 7% between 1990 and 2007. The European Union's emissions were down 1.4% over the same period, and Western Europe's emissions were down by more than 15%. Thus, despite implementation difficulties, the EU ETS has already had virtuous effects, such as, in particular, fuel substitution (coal to biomass or coal to natural gas). In Phase III, greater price transparency should further improve these results. The EU ETS already provides a reference for a more globalised carbon market.

The financial impact of climate change on the economy

The classification of emissions provided by the GHG Protocol⁸ makes it possible to refine the analysis of the consequences of climate change on the economy. The GHG Protocol provides three levels of definition for GHGs:

- Level 1 (Scope 1), which represents the direct GHG emissions during the production process, the source of which is controlled or directly owned by the company.
- Level 2 (Scope 2), which represents the indirect emissions from electricity use and other processes (heating, steam, cooling) in the manufacture of products.

- Level 3 (Scope 3), which represents the indirect emissions from the purchase of products/raw materials (upstream) but also from products sold (use by consumers – downstream).

Scope 1 emissions, which are those taken into account by the regulatory authority as part of the EU ETS, are the subject of very rigorous reporting. The regulator establishes mandatory, harmonised procedures for the monitoring, reporting, and verification of direct emissions⁹. In particular, the regulatory authority has the emissions reporting procedure verified by an independent third party on the same model as the one used for the auditing of corporate financial statements. Although it is not yet mandatory, it is currently estimated that 80% of facilities under the EU ETS communicate about Scope 2 emissions. However, for now, the reporting of Scope 3 emissions remains less systematic and is not aligned from one sector to another.

Direct financial impacts:

The sectors covered by the EU ETS are the most impacted

By 2013, in a context of an even more transparent EU ETS market and the end of free CO₂ quotas, climate change is expected to be a clear liability in financial terms for the sectors with the greatest emissions (in the sense of Scope 1 direct GHG emissions). In order to be compliant, the concerned companies will have to "buy" their CO₂ quotas at market price and will internalise the carbon cost. The free nature and over-allocations of quotas in phase I of the EU ETS, combined with the slowdown in production in the most cyclical sectors (i.e. Iron

& Steel and Building Materials, which have seen their emissions decrease accordingly) in phase II have generated large extraordinary profits in certain sectors. In the sectors with the highest emissions (e.g. Utilities), players have benefited from their ability to pass the cost of their excess emissions onto electricity prices — particularly in the most deregulated markets, such as Germany and the UK.

In phase III, these favourable conditions should disappear and weigh in on margins. Electric Utilities are clearly most at risk¹⁰, since they incur and will continue to incur for years to come a deficit on the carbon quota market, which they will have to fully fund. Although more gradually, the other sectors covered by the EU ETS (e.g. building materials, paper, refineries) will not be spared and will also have to fund their quotas themselves (20% in 2013, 70 % in 2020, and 100% in 2027) in phase III.

To make the analogy with a sectoral classification recognised on the European stock markets, the sectors with the most emissions (direct emissions), as defined in the ICB classification¹¹ covered by the EU ETS by 2013 are Oil & Gas, Utilities, Basic Materials (Iron and Steel), Building Materials, as well as Airlines (Travel & Leisure) and Marine Transport, which will enter the scope of the EU ETS starting phase III.

Indirect financial impacts:

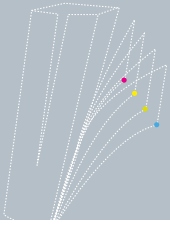
The "upstream" and "downstream" effects

One of the main indirect impacts of climate change is channelled through the supply chain. Sectors with low carbon

emissions resulting from their activity will indirectly emit because of their use of carbon-intensive production processes. This is known as the "upstream" effect. This effect will weigh in all the more on the company if its suppliers have the ability to pass the carbon cost they must face onto their prices. Climate change can therefore present itself as an opportunity i) for companies upstream in the production chain through the new constraint that faced by their customers with regards to the choices they make in terms of manufacturing processes and therefore suppliers, and ii) because of the change in behaviour of the end consumers themselves.

Moreover, beyond the direct impact of carbon cost on corporate margins, the change in final demand (increasingly affected by climate change) and the resulting product regulations will constitute a growing source of competitive advantage for companies. This is known as the "downstream" effect. The downstream effect may potentially weigh on the company if it does not properly manage the opportunities related to climate change.

The indirect impacts of climate change are measured by Scope 2 and 3 emissions. Scope 2 indirect emissions (from the use of electricity) will be particularly high for the sectors that are high consumers of electricity, such as Basic Materials in the broad sense (paper, aluminium, chemicals) as well as Food & Beverages. Scope 3 indirect emissions (from suppliers other than electricians and the use of products by consumers) particularly involve automobile manufacturers, through aluminium



consumption and vehicle use by consumers, as well as Food & Beverages, through the transport of goods and storage. In general, the consumer goods sectors that are further down the "supply chain" will face new risks (input prices and the services of suppliers who pass on the carbon cost to their customers). Oil companies - through, among other things, fuel consumption - are also major contributors to Scope 3 emissions. Lastly, Capital Goods and Technology can also control their Scope 3 emissions by developing innovative techniques with low carbon emissions, which, through their use by other industries, will reduce their total intensity.

Some orders of magnitude

The Trucost data allows us to uniformly quantify and compare emissions on a sector-by-sector basis. They provide a measurement of GHG emissions expressed in CO₂ equivalents (CO₂e). According to the 2009e Trucost data, the EU ETS sectors each have a direct carbon

intensity of more than 200 tonnes of CO₂e per million dollars of income. It is here key to note that the intensity of the Utilities sector alone amounts to more than 1,400 tonnes/\$Mln.

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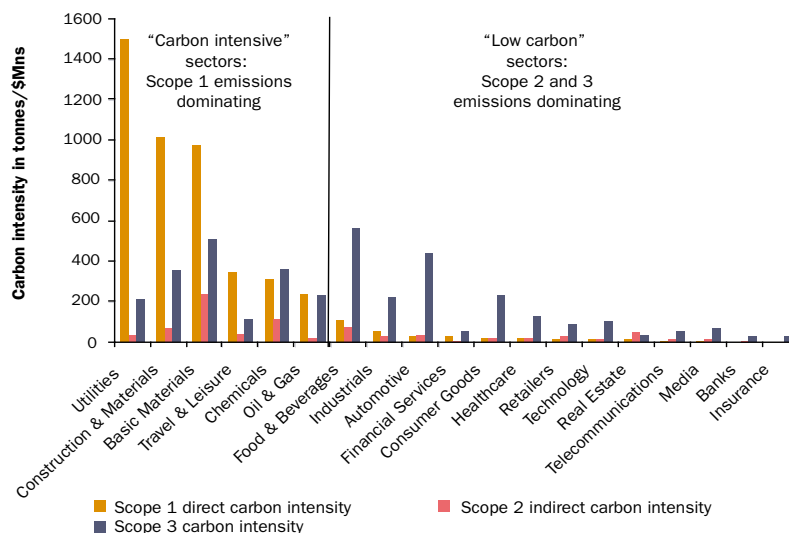
We measured the impact in % of 2009^e EBITDA of 2009^e CO₂e emissions assuming a CO₂ price of €25/tonne¹² (compared to €15 today). The share of the cost of directly emitted carbon in the EBITDA of sectors such as Utilities and Building Materials is more than 20%. And

let us remind ourselves that in phase III of the EU ETS, the Utilities sector will need to pay for its quotas in full (100% of allocations put up for auction for electricians) and that other sectors will also need to pay for an increasing share of their carbon quotas at a gradual pace. As for the total impact of carbon on EBITDA, which includes Scope 2 and Scope 3 indirect emissions, it may be significant — up to more than 30% for Building Materials for example.

Thus we observe that the direct carbon impact of sectors such as Automotive and Food & Beverages remains modest (< 2% EBITDA), while the total impact — that takes indirect emissions into account — exceeds 13% of EBITDA. Here we see a way to measure the indirect cost or even the opportunity cost of climate change for sectors considered as less carbon-intensive.

One of the main indirect impacts of climate change is channelled through the supply chain. Sectors with low carbon emissions resulting from their activity will indirectly emit because of their use of carbon-intensive production processes. This is known as the "upstream" effect. This effect will weigh in all the more on the company if its suppliers have the ability to pass the carbon cost they must face onto their prices

Graph 1: Carbon intensity in tonnes/\$Mln Scope 1, 2, and 3



Sources: AXA IM, Trucost 2010

Table 1: Direct and indirect impacts of the cost of 2009^e carbon emissions as a % of 2009 EBITDA – DJ Stoxx 600
(CO₂ price = €25/tonne)

	Direct impact	Indirect impact 1 st Tier (1)	Total impact (2)
Construction & Materials	22.5%	6.8%	33.1%
Utilities	20.5%	2.5%	24.4%
Travel & Leisure	18.8%	2.5%	25.0%
Basic Materials	14.9%	9.0%	27.5%
Chemicals	7.7%	6.1%	18.5%
Oil & Gas	5.6%	5.3%	13.9%
Industrial Goods & Services	4.3%	3.5%	12.3%
Food & Beverages	1.3%	6.3%	13.3%
Distribution	0.7%	2.0%	6.2%
Financial Services	0.6%	1.0%	2.5%
Automotive	0.6%	3.4%	16.9%
Consumer Goods	0.4%	2.2%	5.6%
Technology	0.2%	1.1%	3.4%
Healthcare	0.2%	0.5%	1.4%
Real Estate	0.1%	0.4%	0.6%
Media	0.1%	0.4%	1.2%
Telecommunications	0.1%	0.3%	0.8%
Insurance	0.0%	0.3%	2.0%
Banks	0.0%	0.2%	0.7%

(1) Indirect emissions 1st tier = emissions from main suppliers (Scope 2 + main suppliers of Scope 3)

(2) Scope 1 + Scope 2 + Scope 3 emissions

Sources: AXA IM, Datastream, Thomson Reuters, Trucost 2010

Part II - Risk/Return characteristics of "low-carbon" portfolios: The case of the UK market

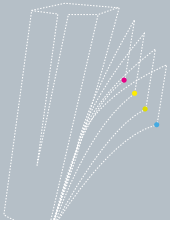
In the article "The Economic Geography of Carbon Market Trading: how legal regimes affect share performance and Environmental Performance Under a carbon market," Eric Knight¹³ uses an econometric demonstration, based on EU ETS data for the period covering the first phase 2005-2007, to show that companies with the strongest environmental performance outperformed their competitors. Other authors like Jeroen Derwall show that environmental

efficiency was a factor of outperformance in its own right between 1995 and 2003 on equity markets¹⁴. In the study below, we will seek to quantify the consideration of the carbon factor on the equity markets by focusing on the United Kingdom.

Structure of the UK market

Along with Germany, the United Kingdom is among the countries with the greatest greenhouse gas emissions. In 2007, CO₂ emissions for the United Kingdom

and Germany were 8.6 tonnes per capita and 9.7 tonnes per capita respectively, compared to 7.7 for the European Union¹⁵. In 2009, the United Kingdom issued 232 million tonnes of CO₂. Although emissions were down 12% compared to 2008, a 6% deficit of quotas remains (18% for the combustion sector alone, excluding refineries) compared to a 5% surplus for the entire European Union. Moreover, regarding the equity markets, the UK market's direct GHG emissions



contribute more than 18% of the total direct emissions of the companies of the DJ Stoxx 600. Lastly, within the DJ Stoxx 600, among the sectors most exposed (directly or indirectly) to carbon risk as part of the EU ETS¹⁶, British securities weigh the most (10.5%), far ahead German (7.2%) and French (6.0%) securities.

It is important to note that with the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme¹⁷, operational since April 2010 in the United Kingdom, the UK economy has taken another step in its goal of reducing greenhouse gases. More than elsewhere in Europe, the carbon constraint is now a reality impossible to ignore for the English market.

Simulation of carbon strategies

Although the lack of history on carbon data leads us to stay cautious with regards to the main results of this case study, some interesting structural points arise from our analysis.

Methodology

Positioning ourselves within the FTSE 350 universe, we simulated different strategies based on the behaviour of GHG emissions:

- Model 1: **direct carbon intensity** = ratio between direct emissions (scope 1) and turnover;
- Model 2: **indirect carbon intensity 1st tier** = ratio between indirect emissions 1st tier (= emissions from main suppliers (Scope 2 + main suppliers of Scope 3).

We performed simulations according to an equally-weighted method in order to avoid a large cap bias. The components

are ranked in ascending order of emissions and grouped by quartiles, with the first quartile (Q1) containing the securities with the lowest emissions and the last quartile (Q4) containing the highest emitters. The quartiles are defined for each Level 1 industry of the ICB classification. This "Industry-neutral" approach allows us to avoid sectoral biases, in particular too strong a concentration of the more carbon-intensive industries in the last quartile as well as a too strong a concentration of the least carbon-intensive industries in the first quartile.

We used the annual GHG emissions data from 2004 to 2008 provided by Trucost. The emissions for a given year are not published until the end of the following year. The portfolio is therefore rebalanced at the end of each year, from December 2005 to December 2009. Performance figures are calculated from December 2005 to the end of August 2010. The results are given by quartile, and we have refined the research by breaking down the results according to their affiliation with large (FTSE 100) or mid caps (FTSE 250) and according to the level of their rates of return¹⁸ (high = FTSE 350 High Yield; low = FTSE 350 Low Yield). We also analysed the results by sector.

Of all of the models tested, model 1, based on direct carbon intensity, is the one with the most telling results. Model 2, based on indirect carbon intensity, leads to more mixed findings.

Strategies based on direct carbon intensity: A profitable investment criterion for most sectors of the EU ETS

Between 2005-2010, the lower the carbon intensity, the higher the annualised market share performance.

More specifically, the annualised relative performance of Q1 compared to Q4 is 6% over the period. The information ratio is better for the least carbon-intensive quartiles than for the most carbon-intensive quartiles.

The direct carbon intensity criterion is a "lucrative" topic regardless of the management style analysed (low yield vs. high yield) and regardless of the size of the market cap. We note that the carbon intensity criterion has been profitable for the riskier Mid Caps and High Yield segments.

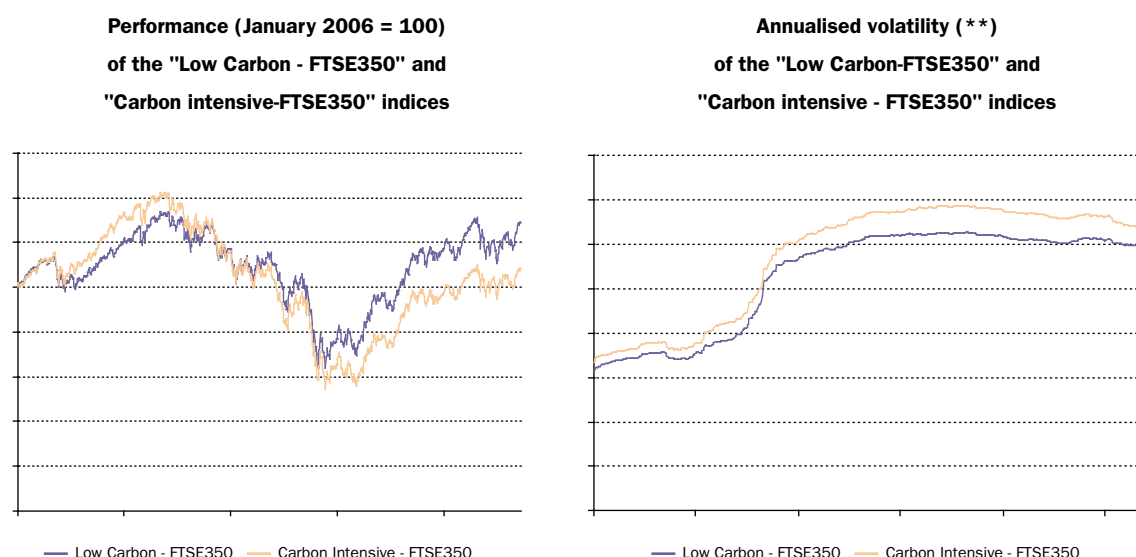
Along with Germany, the United Kingdom is among the countries with the greatest greenhouse gas emissions. In 2007, CO₂ emissions for the United Kingdom and Germany were 8.6 tonnes per capita and 9.7 tonnes per capita respectively, compared to 7.7 for the European Union

Table 2: Annualised relative returns of the least carbon-intensive quartile compared to the most carbon-intensive quartile – FTSE 350 period 2005-2010, indirect CO₂e emissions

FTSE 350	6%
Large Caps	1%
Mid Caps	9%
High Yield	4%
Low Yield	7%

Sources: AXA IM, Trucost 2004-2010

We call "Low carbon-FTSE350" the portfolio made up of Q1 and Q2 securities, which we compare to the "Carbon intensive – FTSE 350" portfolio,

Graph 2: Performance and volatility of the "Low Carbon-FTSE350" and "Carbon Intensive – FTSE350" portfolios (*)

(*) The portfolios are equi-weighted and rebalanced each year.

(**) Standard deviation of weekly performance over 104 weeks

Sources: AXA IM, Trucost 2004-2010

made up of Q3 and Q4 securities. Despite two "hesitant" initial years (2006, 2007), the "Low Carbon" strategy started to pay off in 2008. The risk profile is also attractive with the volatility of the Low Carbon – FTSE350 portfolio lower than that of the Carbon intensive – FTSE 350 portfolio starting 2009.

The sectoral analysis shows that the good results observed at the global level of "Low Carbon" strategies on the UK market are found in most sectors of the EU ETS: Oil & Gas, Basic Materials, and Industrialists.

However, it should be noted that for the Utilities sector, carbon intensity does not seem to have had any impact on performance at the start of the period but seems to have started to weigh in more over the past three years. Note that in this sector, deregulated in the United

Kingdom, players have so far been able to benefit from their ability to pass on the funding of their carbon quota deficit on the EU ETS market to their customers. Extraordinary profits have even been reaped. However, the approach of phase III of the EU ETS and the end of free quotas should weaken this sector. Its stock performance will be all the more sensitive to the carbon intensity signal. The case of Financial Services is particular. The very good stock response of this sector to carbon risk comes mainly from the underperformance of real estate values in 2009 and 2010. Indeed, because of its exposure to the Construction sector, the carbon intensity of Real Estate is higher than that of Banks and Insurance. Note here that the exposure of Banks and Insurance to carbon risk is undoubtedly largely underestimated because of the difficulty in assessing the carbon intensity of

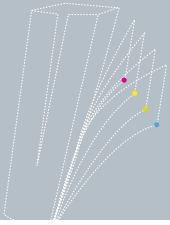
portfolios and investment projects held and supported by these sectors.

Table 3: Annualised relative returns of the least carbon-intensive quartile compared to the most carbon-intensive quartile – FTSE 350 period 2005-2010, direct CO₂e emissions

Financial	21.9%
Telecommunications (*)	16.4%
Basic Materials	8.5%
Oil & Gas	5.6%
Healthcare	4.4%
Industrialists	2.0%
Consumer Goods	-4.0%
Utilities	-5.7%
Technology	-7.0%
Consumer Services	-10.9%

(*) For this sector, the indicated performance is the difference between Q1 and Q3, with the last quartile Q4 not being represented for 2005.

Source: AXA IM, Trucost 2004-2010



Strategies based on indirect carbon intensity: the sectors indirectly impacted by carbon risk still remain unaffected in terms of their market performance

The simulations based on indirect carbon intensities show that the market performance of sectors such as Consumer Goods seems rather insensitive to carbon risk despite the high exposure of certain sub-sectors such as the Automotive and Food & Beverages sectors. The market performance of the Industry sector, naturally exposed to carbon risk even indirectly, is also little affected by the criterion of indirect carbon intensity.

The main conclusions that can be drawn from our study of the UK market are the following:

- Direct emissions controlled by a "Cap & Trade" type scheme constitute a signal taken seriously by the stock market. This is one of the key points Eric

Knight¹⁹ discusses in his study: low carbon strategies are, today, efficient only within the framework of a regulated carbon market. One of the directions being the EU ETS is taking, beyond the hardening of conditions by which quotas can be obtained, is the enlargement of its scope to cover more sectors (in particular the Transportation sector by 2013). The risk should on the one hand become greater for those sectors that are the stronger carbon emitters and whose stock performance is still to be fully penalised (eg. Utilities), and on the other become a progressive reality for those sectors as they integrate the EU ETS.

- On the other hand, we believe indirect emissions are not as of yet sufficiently taken into account by investors. Admittedly, they are not yet a part of the EU ETS mechanism. But the new constraints faced by companies

that are upstream of the production process, along with the evolution of end customer demand and changes in consumer behaviour are all factors that will, sooner or later, have an indirect impact on company bottom lines (see Part I). The market is still struggling with the integration of this paradigm, and arbitrage opportunities are already starting to present themselves.

■ **The direct carbon intensity criterion is a "lucrative" topic regardless of the management style analysed (low yield vs. high yield) and regardless of the size of the market cap. We note that the carbon intensity criterion has been profitable for the riskier Mid Caps and High Yield segments**

Part III - What are the solutions for incorporating carbon risk in portfolio management? A classification

In order to better apprehend carbon risk and more generally the environmental performance of a portfolio, we can implement various categories of solutions.

The Integrated Solution

This approach – undoubtedly the most radical – involves incorporating carbon risk directly into financial valuation models and/or risk measurements. Although the market is still struggling to incorporate the carbon risk that weighs indirectly on the economic fabric, we have seen that the "Low-Carbon" strategies constructed from

direct GHG emissions on the UK market have, on average, paid off over the past five years for sectors highly exposed to carbon risk. In addition, the risk profile of these strategies is also better than that of "Carbon Intensive" strategies over this same period for the sectors most exposed to carbon risk.

The next steps of the analysis would involve more precisely estimating the relationship between stock market or financial performance and carbon risk. In particular, the analysis of the relationship between risk premium and carbon intensity could be the subject of a later study.

The Ex-ante Solution

This involves defining an eligible universe as well as an allocation to minimise the carbon intensity of a portfolio. This solution can be suitable for both passive and active asset managers and can be implemented in three ways:

a - Carbon Optimisation: this approach takes into account the weight of each security/emitter in the universe.

The carbon intensity is minimised by underweighting the securities with the most emissions and overweighting the securities with the least emissions while keeping the portfolio's sector allocation

unchanged. This type of method is used particularly for "Low Carbon" indices aiming to replicate a benchmark index while reducing its carbon intensity (Example: S&P US Carbon Efficient Index).

b - Best-in-Class approach: this involves defining an eligible universe by keeping only the least carbon-intensive securities/emitters. In the example of the UK market set forth in the previous analysis, the "Low Carbon - FTSE 350" portfolio²⁰ is constructed according to this method. It represents all of the least carbon-intensive securities in the FTSE350 in their respective sector. Here, we deliberately exclude the least "clean" securities from the portfolio²¹. This approach is therefore more suitable for active management in which the alpha source would be environmental performance.

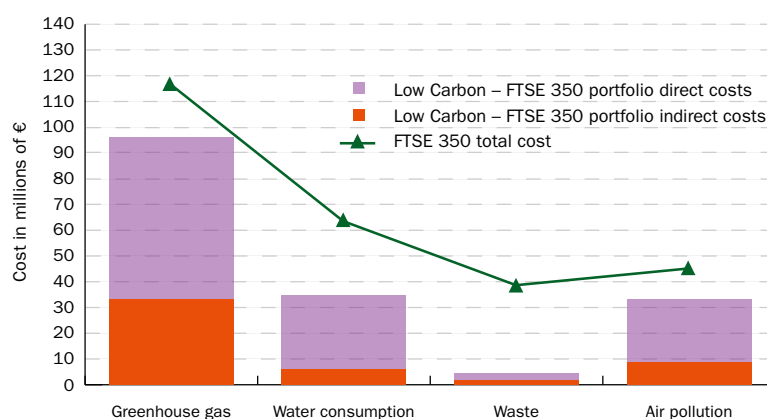
c - Exclusion funds: this involves excluding the sectors with the greatest emissions (e.g. Energy, Basic Materials) upstream of the investment process. It is therefore an absolute approach in contrast to the previous two (Optimisation and Best-in-Class), which do not remove any sector from the eligible universe. In essence, this method – rather purist – of course generates a high tracking error, with the carbon-intensive sectors constituting a significant portion of the market.

Ex-post solution: Monitoring of environmental KPIs

a - Carbon cost and other environmental impacts

Besides the carbon cost, through the Trucost base, we now have data on other resources and environmental indicators,

Graph 3: Environmental cost of a portfolio
("Low Carbon-FTSE 350" versus FTSE 350) – September 2010



Sources: AXA IM, Trucost 2010

such as water consumption, waste, and use of natural resources in the broader sense. These measures are expressed in the form of cost related to turnover. The environmental impact expressed as a percentage of turnover is a summary of the total direct and indirect environmental cost for a business.

b - Carbon analysis of sectors/securities

More suited to benchmarked management, this approach involves calculating the sectoral contribution, by instrument, to the difference in carbon intensity between a portfolio and its benchmark. More specifically, this entails analysing the contributions of the sectoral allocation and the choice of securities to the relative carbon intensity of the portfolio — keeping in mind that other KPIs may also be taken into account. This makes it possible to target at which level — allocation or stock-picking — the necessary adjustments should be made in order to improve the relative environmental performance of the portfolio.

The sectoral allocation impact is measured by:

$$(W_s^P - W_s^B) * (CF_s^B - CF_B)$$

The selection or « picking » impact is measured by:

$$W_s^P * (CF_s^P - CF_s^B)$$

With:

W_s^P = weight of sector s in the portfolio

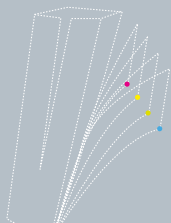
W_s^B = weight of sector s in the benchmark

CF_s^B = average carbon intensity of sector s in the benchmark

CF_B = average carbon intensity of the benchmark

CF_s^P = average carbon intensity of sectors in the portfolio

In table 4, the difference in total (direct and indirect) carbon intensity is broken down between a Low Carbon bond fund (that we will call Green Bond here) and



its benchmark. Their respective carbon intensity is 207.7 tonnes/\$Mln and 372.2 Tonnes/\$Mln. The carbon intensity differential between the Green Bond portfolio and its benchmark is therefore -167.5 tonnes/\$Mln. This differential is broken down into -172.5 tonnes/\$Mln for the emitter selection impact and + 5 tonnes/\$Mln for the sector allocation impact. In this example, the sector allocation impact acts rather unfavourably on the relative carbon intensity of the portfolio in relation to its benchmark, while the selection of emitters contributes very favourably.

c - Carbon risk and full environmental profile

Climate risk for a long-term investor is not limited solely to the carbon risk as measured by the carbon emissions of a company. The following must also be taken into account:

- The ability of management to manage and reduce this risk, which includes compliance with existing regulations;
- The ability of management to recognise what may constitute one or more opportunities, from the point of view of climate risk reduction.

In order to supplement the carbon footprint as an indicator of risk, we suggest using three other indicators provided by MSCI – Riskmetrics:

- Environmental risks: Global measurement of past environmental damages, compliance with regulations, toxic emissions, waste, energy efficiency;
- Environmental management and governance: Environmental strategy (policy commitments, integration into the business, etc.), environmental management systems put into place,

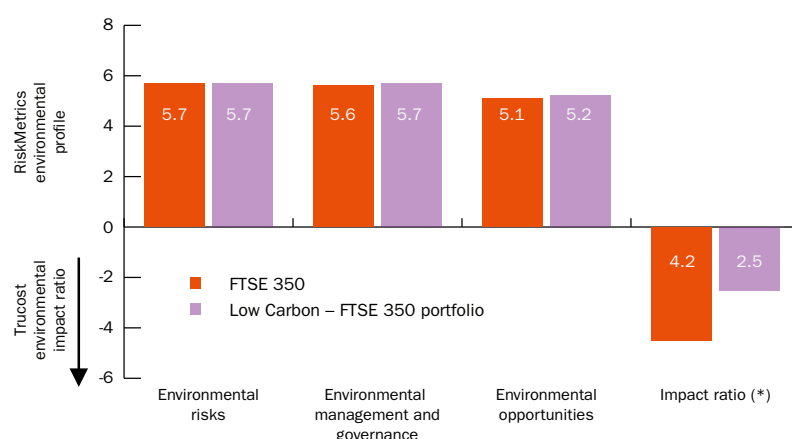
Table 4: The carbon intensity differential

	Sector allocation (1)	Selection of emitters (2)	(1)+(2)
Automotive	-1.7	0.0	-1.7
Banks	43.2	-1.4	41.8
Basic Materials	2.0	-6.0	-3.9
Chemicals	3.9	-4.3	-0.4
Construction	-2.1	-13.2	-15.3
Financial Services	15.3	-3.7	11.6
Food & Beverages	0.1	0.8	0.9
Healthcare	-1.8	-0.2	-1.9
Industrial Goods & Services	-3.7	-12.0	-15.7
Insurance	-2.7	-3.5	-6.2
Media	-3.0	-0.3	-3.3
Oil & Gas	-3.8	-7.9	-11.7
Consumer Goods	2.6	0.5	3.0
Real Estate	-11.8	-1.2	-13.0
Retail	2.4	-0.2	2.3
Technology	-6.1	-0.7	-6.8
Telecommunications	-9.9	-0.8	-10.6
Travel & Leisure	-0.7	-1.3	-2.0
Utilities	-17.2	-117.2	-134.4
TOTAL	5.0	-172.5	-167.5

Source: AXA IM, 2010

Graph 4: Complete environmental profile

"Low Carbon – FTSE 350" portfolio - September 2010



* The environmental impact is expressed as total cost in relation to turnover (negative measurement).
Sources: AXA IM, Trucost 2010, MSCI-Riskmetrics 2010

auditing, reporting, training and certification, and existence of "eco labels";

- Environmental opportunities: Environmental activity development

strategy, geographic and demographic exposure (environmental sensitivity of the regions), development of activities or "green" products.

Graph 4 shows that the environmental profile of our "Low Carbon – FTSE 350" portfolio is more attractive than that of the benchmark. With comparable environmental risks (recall that this measurement integrates not only the current GHG emissions but also their evolution over time and energy efficiency in a broad sense), management and environmental governance as well

as management of environmental opportunities are better for the "Low Carbon – FTSE 350" portfolio than for the FTSE 350 benchmark. In addition, in financial terms, the environmental impact on the bottom line is almost twice less significant for our "Low Carbon – FTSE 350" portfolio as for the FTSE350 benchmark (2.5% compared to 4.5%).

Conclusion

Starting from 2012, the European sectors covered by the carbon quota system of the EU ETS (Utilities, Building Materials, Oil & Gas, Basic Materials, Airlines, Maritime Transport) will be financially impacted by the entry into phase III. Moreover, other sectors are potentially and indirectly affected by an increased carbon cost, such as the Automotive, Capital Goods, Chemicals, or even the Food & Beverages sectors, a significant share of the "bottom line" of which is exposed to carbon risk. Although the market is still struggling to incorporate the carbon risk that weighs indirectly on the economic fabric, with regard to the UK market, the "Low-Carbon" strategies constructed from direct GHG emissions have paid off over the past five years on average for most of the sectors most exposed to carbon risk. In addition, the volatility of these strategies is slightly lower.

The integration of carbon and climate risk ex-ante (definition of an eligible universe) or ex-post (monitoring of environmental KPIs) is made possible by the availability of standard measurements, such as the direct and indirect emissions provided by the Trucost agency or the MSCI - RiskMetrics environmental scores. Some of these indicators are also already available to AXA IM's managers through AXA IM's ESG proprietary platform, the RI Search.

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VALIDITY OF INFORMATION

Trucost has made every effort to ensure that all statements and information provided are accurate but accepts no liability for any error or omission in the same.

¹ CO₂, CH₄, N₂O, HFC, PFC, SF₆

² Investors Analyse Climate Risks and Opportunities. A survey of Asset Manager Practices, January 2010, study conducted with the world's 500 largest asset managers

³ This part is based on the report "Les marchés du carbone expliqués" [Carbon markets explained] - Climate Mission of the Caisse des Dépôts et Consignations - 2009

⁴ Combustion (electrical production, urban heating, cogeneration, and refineries included), ferrous metals (iron and steel), cement, glass, and paper.

⁵ This objective could be even more ambitious in case of a post-Kyoto international agreement. See our study 'The Copenhagen Accord: an agreement on many intentions' January 2010, AXA IM

⁶ Consensus built from a pool of 10 European raw materials brokers

⁷ These constitute the majority of countries of Appendix B of Kyoto

⁸ This protocol was established by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) and constitutes the standard used in the Carbon Disclosure Project (CDP). The CDP is an organisation bringing together shareholders and companies, working for the publication of the greenhouse gas emissions of the world's top companies.

⁹ MRV for monitoring, reporting, and verification

¹⁰ See our study "CO₂ and Utilities: How to deal in a carbon economy" December 2008, AXA IM.

¹¹ Industry Classification Benchmark (FTSE and DJ Stoxx sectoral classification)

¹² The 2012 consensus is €24.5/tonne

¹³ JEL – November 2008. Eirck Knight is from the Oxford University Center for the Environment.

¹⁴ "The Eco-Efficiency Premium Puzzle" J. Derwall, N. Günster, R. Bauer, K. Koedijk – JEL May 2004

¹⁵ Source: AIE

¹⁶ Oil & Gas, Basic Materials, Utilities, Industrials, Airlines, and Automotive

¹⁷ The CRC Energy Efficiency Scheme is the leading UK carbon market mandatorily applied to the non-energy sectors consuming more than 6,000 MWh per year (around 5,000 organisations in the United Kingdom). The programme should permit a reduction in carbon emissions in the United Kingdom of 1.2 million tonnes per year by 2020.

¹⁸ Rate of return in terms of dividends, calculated as the ratio of the most recent dividend paid to the share price.

¹⁹ See below

²⁰ See below – Part II

²¹ Note that in a "positive" variant of this type of approach, only the most carbon-intensive quartile may be excluded, and the companies of the third quartile having reduced their carbon intensity over a given period may be conserved.