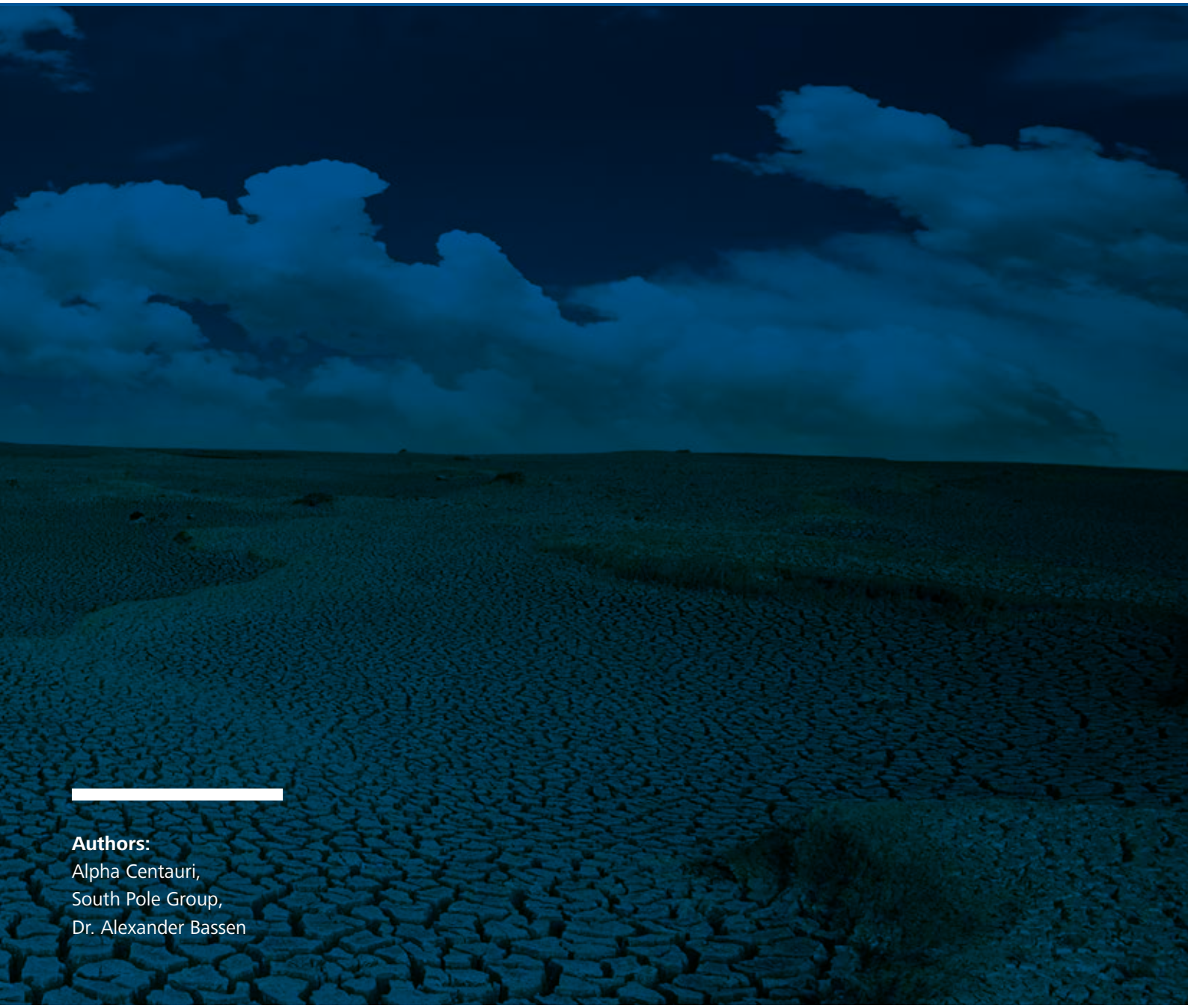
IN SEARCH FOR CLIMATE SMART INVESTMENTS

the case of European equities

March 2017



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INTRODUCTION

Climate change has finally become a mainstream investment topic within the financial industry. The recognition of climate change as potential threat to investment performance is leading a growing number of investors to measure and publicly disclose the climate impact of their investments, and to develop strategies that can minimise climate-related risks in portfolios. Driven by a strong political will that is steering the financial sector towards the implementation of climate disclosure frameworks, such efforts can deepen the understanding of risks, and the standardisation of such analyses and reporting across the entire industry.

The climate change related focus of investors has so far been predominantly on risks. These are investment risks related to climate change legislation and its effects. However, the wider availability of better-quality data, as well as the political will to achieve international climate goals, have brought about a dimension that has so far taken a backseat in this discussion: The focus on investment opportunities. The transition to a below 2-degree world holds tremendous opportunities that can be realised through the construction of climate-smart portfolios.

This joint White Paper by leading experts connects the global context on investment and climate change towards a 2-degree world (South Pole Group) with the status quo of academic research (Prof Alexander Bassen) and presents latest findings on the investment and climate performance of climate smart investments in European Equities (Alpha Centauri).

INVESTING IN A TWO-DEGREE WORLD

by South Pole Group

We are, undoubtedly, at a unique point in time. At the end of 2015, world leaders signed the Paris Agreement and committed to reducing global warming to 'well below 2 degrees Celsius' and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels. The COP-22 held in Marrakesh in 2016 confirmed these targets and ambitions. While the Paris Agreement with its National Determined Contributions (NDCs) is mainly focused on countries, it introduces a set of stunning elements, among which there is an unprecedented call for action targeting the private sector. Businesses – companies and investors – along with other non-state actors, are now explicitly encouraged to step up climate action.

Regarding the financial industry, Article 2.1.c of the Paris Agreement represents a clear mandate for regulators around the world to scrutinise investments, demanding for financial flows that are consistent with a pathway towards a low-carbon, climate resilient economy and society. Looking at the bigger picture, several themes within the Paris Agreement also draw attention to revenue risks and opportunities, and deliver a strong signal that investments in low-carbon assets will pay off. The most prevalent example is the commitment of over 90 countries to use a price on carbon to achieve their climate pledges. The Agreement also highlights, for instance, the need to scale up investments in renewable energy, smart grids, and energy storage, which reflects the global aspirations and necessity to shift capital investments from a high to low-carbon economy.

Other interventions on the regulatory side are also boosting the mainstreaming of low-carbon investing by calling for transparency and disclosure requirements. Although such measures do not necessarily entail the need to reformulate investment decisions in the first instance, regulation on measurement and reporting is playing a vital role in making investors increasingly aware of the investment risks triggered by climate change.

In Europe, Sweden and France have introduced pioneering regulations in this regard: The French government has passed an Energy Transition for Green Growth Law that, inter alia, contains an article specifically tailored to the financial industry. The article 173, which entered into force in 2016, requires institutional investors with assets over EUR 500 million to report on the climate impact of their investments, and envisages various reporting options in relation to the management of climate-related risks and contribution to the financing of the green economy[i]. Similarly, the Swedish government has pushed for an analo-gous transparency initiative.

In the same way, the EU is placing a growing emphasis on the integration of climate change and sustainability into the financial sector. At the end of 2016, the European Parliament passed the revision of the Institutions for Occupational Retirement Provision (IORP) Directive. Among the new provisions, the IORP II Directive requires Member States to ensure that occupational pension funds with more than 100 members, and at their discretion those with less than 100 members, disclose the entity of environmental, social and governance risks – including climate change, resource scarcity and stranded assets – and relative risk management measures. Furthermore, twenty policy leaders from civil society, the finance sector and academia were recently appointed for the High Level Expert Group on Sustainable Finance, tasked with drawing recommendations for a comprehensive EU strategy on sustainable finance by the end of 2017[ii]. On the other side of the Atlantic, in the United States, California Insurance Commissioner Dave Jones has fully embraced the driver of the divestment movement by launching the Climate Risk Management Carbon initiative[iii]. This initiative, which affects around 3,500 insurance businesses, requires insurance companies to disclose their investments in the carbon economy and explicitly encourages the divestment from thermal coal.

In addition to launching mandatory transparency initiatives for investors, governments are also trying to understand the overall exposure of their economies to climate risks, in line with the 2-degree objective called for by the Paris Agreement. As nearly 200 governments are set to examine the financial flows in their sphere of influence for current climate impacts, ministries in almost every European country have already commissioned and partly carried out such studies. For instance, the Swiss Federal Office for Environmental Protection (FOEN) concluded that the Swiss equity fund market (CHF 336 billion), currently funding around 53 million tonnes of CO_2 annually - about as much CO_2 as Switzerland emits as a country - is not compatible with a 2-degree target[iv]. The side

effects of such 'misalignment' may lead to significant losses in value for individual investors as well as for the entire economy. In Germany, the Federal Ministry of Finance published its first paper on climate change and financial stability in December 2016, and the German Environment Agency has announced a study on the carbon bubble for investments.

This political determination to transform entire sectors of the economy away from fossil fuels and to endorse sustainable technologies will affect investments. Alongside the transitional risks – notably, loss of license to operate, carbon pricing, tighter regulation and societal transformation, the burden of physical risks such as extreme weather events, rising sea levels, droughts, and flooding, although still marginal in the climate change discourse within the financial industry, will likely shake up daily business activities and operations. Climate change has, in other words, clearly started to significantly influence investment decisions. Investors are questioning whether their existing investments and implicit assumptions are in line with a low-carbon scenario, and are looking to limit financial risks and spot opportunities for profitability generated by this massive transition of economies, companies and societies.

Ever since the launch of a study from the Carbon Tracker, which introduced the concepts of a 'carbon bubble' and 'stranded assets' in 2011, the financial world has taken up the issue of climate change. Mark Carney, the governor of the Bank of England, warned that climate change could heavily destabilise global financial markets, and called on financial players to 'deep dive' into the climate impact of their investments.

Investors have also had to respond to growing public pressure through a range of initiatives: Established in 2014, the Montreal Carbon pledge[v] calls on its signatories to measure and disclose their carbon footprints. The Pledge has attracted commitment from over 130 investors from Europe, the United States, Canada, Australia, Japan, Singapore, and South Africa, and currently covers over USD 10 trillion in assets under management. In the same year, the Portfolio Decarbonization Coalition[vi] was launched as a multi-stakeholder initiative that aims to reduce global greenhouse gas emissions by mobilising institutional investors to decarbonise their investment portfolios. Efforts envisaged by the Coalition include, inter alia, the reduction of the carbon footprint of investment portfolios, increased investment in areas such as renewable energy, and the divestment of capital from energy-intensive activities. The 27 investors supporting the Coalition have so far committed to decarbonize USD 600 billion of invested assets.

The transition associated with the integration of climate change considerations into investment decisions is ultimately a journey. Coherent governmental actions and regulatory frameworks targeting the financial industry are crucial in framing the topic of climate change for investors; for training and building capacity; and for developing tools that can be better integrated into investment processes. By having a full understanding of the magnitude of the issues and risks at hand, investors are better equipped to carry out the measurement of the climate impact of investments with sound, comprehensive data. Once a certain level of climate consciousness is reached among investors, it can be expected that associated risks will be gradually priced into the asset valuation.

Measures to factor climate change-related risks into asset valuation have already been taken with, among others, the help of climate-friendly investment products, indexes, and wrappers. Frontrunners in this area include the first generation of low-carbon indexes provided by mainstream index houses. Several investors such as AP4, Calstrs, NYCERS, and FRR have already committed considerable resources to a low-carbon pathway by investing in low-carbon indexes and thus seeking to align their portfolios with the market realities emerging from climate change and related policies. The new generation of climate optimised indexes by STOXX or smart niche players such as Solactive or EDHEC are already much more advanced in their approach and are starting to attract assets. It is, however, important to bear in mind that low-carbon indexes represent the early stage of the integration of climate change in the financial industry. More proactive investment strategies will have to rely on advanced, climate-optimised investment products based on climate targets and a 2-degree focus. The consideration of, for example, carbon pricing through taxes or cap-and-trade systems, provides the means to hedge against carbon risks. An example of such hedging is represented by investments that have been made climate neutral through the purchase of high-quality carbon credits that offset unavoidable emissions. Pioneers in this area include the world's first carbon neutral real estate fund launched by Credit Suisse, and the first carbon neutral superfund pioneered by the Australian superannuation fund Future Super.

The financial sector, shaken up by both investor-led action and regulatory inputs aligned with a decarbonisation pathway, is truly an industry in transition. It is clear that every prudent investor will have to assess the implications of climate change on their portfolio. Climate risk is becoming a tangible investment risk: The world has committed to stick to a 2-degree pathway but, based on current estimations, we are only on track for a '6-degree world'. An unparalleled transition is needed, and this will affect economies, companies, and societies like never before. As a result, numerous investment strategies and products are currently being developed, and more will be launched in the near future, which, in addition to risk and yield considerations, are also aimed at reducing climate impacts.

Investors need to start asking themselves: Do my investments still make sense in a 2-degree world? Where are the risks? Where are the opportunities?

To better answer these questions, it is beneficial to take the latest research on the interaction between non-financial indicators and the financial performance of companies into consideration.

THE CONNECTION BETWEEN ESG AND PERFORMANCE – A RESEARCH REVIEW

by Prof. Dr. Alexander Bassen

For several decades, the academic debate on the linkage of environmental, social, and corporate governance aspects (ESG) and corporate financial performance (CFP) endures. Environmental, social, and corporate governance aspects of business activities are steadily gaining importance for managers, investors, and researchers. In order to derive a more comprehensive picture, Friede, Busch and Bassen (2015) provide aggregated evidence based on more than 2,000 empirical studies, which have been released since the 1970s examining the ESG-CFP link. They show that the large majority of studies report positive findings on the impact of ESG on CFP, which appears stable over time. A more focused set of studies in this field examines the relationship of corporate environmental and financial per-formance (Albertini, 2013; Ambec & Lanoie, 2008; Dixon-Fowler, Slater, Johnson, Ellstrand, & Romi, 2013). Within the corporate environmental performance debate, there is increasingly more academic attention focused on the impact of carbon emissions.

Climate change is one of the greatest challenges of the 21st century and imposes large consequences for organisational practices and performance (Howard-Grenville, Buckle, Hoskins, & George, 2014). The consequences organisations may face due to climate change are diverse: Besides reputational and regulatory risks, especially organisations from carbon-intensive industries face massive business risks (Backman, Verbeke, & Schulz, 2015; Lenox & Eesley, 2009; Slawinski, Pinkse, Busch, & Banerjee, 2015). Moreover, investors are now gradually considering corporate carbon performance when making investment decisions. Evidence of this behaviour can be found in the unprecedented rise of investor initiatives related to climate change in the past few years (e.g. UNEP-FI, CERES Investor Network, International Investor Group on Climate Change, UN PRI).

Although the relevance of corporate carbon performance for financial performance has been investigated in several empirical studies, contradictory results prevail. Several reasons help to explain these differences - namely small samples with respect to geography or industry precision, and inconsistencies in measurement (Trumpp & Guenther, 2015). Therefore, the existing literature related to corporate carbon and financial performance is contradictory with regards to their positive or negative relationship. Several studies conclude that better carbon performance leads to worse financial performance (e.g. Lee, Min, & Yook, 2015; Wang, Li, & Gao, 2014). A number of these studies attribute this negative linkage to accounting-based financial performance (Busch & Hoffmann, 2011; Delmas, Nairn-Birch, & Lim, 2015; Iwata & Okada, 2011).

In contrast, numerous studies propose a positive linkage between corporate carbon performance on financial performance, especially when evaluating for market-based performance (e.g. Aggarwal & Dow, 2012; Jung, Herbohn, & Clarkson, 2014; Kim, An, & Kim, 2015; Matsumura, Prakash, & Vera-Muñoz, 2014; Misani & Pogutz, 2015).

As a result, the extant literature cannot conclusively identify the relationship between corporate carbon and financial performance. However, when focusing on accounting- or market-based performance the results become more consistent. In particular, Tobin's q shows a positive link when evaluating for market-based performance in most recent studies. Interestingly, the results for mutual fund studies imply a more neutral impact of ESG on CFP. Potential reasons for this context seem to lie in the following three factors: First, many overlapping effects in a portfolio (Peloza, 2009), second, the cancellation of ESG alpha if negative and positive ESG screened funds are analysed in parallel (Derwall et. al 2011) and, third, 2.5% p.a. in various fees for the average mutual fund tend to wipe out existing alphas (Friede et al., 2015). Thus, it is of particular interest to examine the impact of carbon performance on CFP in a portfolio study.

IMPLICATION OF CO_2 REDUCTION IN EUROPEAN EQUITIES

by Alpha Centauri

Given South Pole Group´s and Prof. Dr. Bassen's introductions into where the indicators stand with respect to low-carbon investing, our core questions explored in the following chapters have been around whether and how carbon emissions are currently priced in European equity markets, and what type of investment solutions might be possible. To dive deeper into the topic, we set out to respond to the following detailed questions:

Q1. What should be expected economically for investors by adopting different routes of greenhouse gas (GHG) reduction?

Q2. Is carbon risk priced and paid in European equity markets, even under restrictive constraints given by our process outlined below?

Q3. What level of carbon reduction is possible when simultaneously aiming for a low tracking error with respect to a broad benchmark?

Q4. What level of carbon exposure reduction can be obtained by striving for performance in a strategy setup with several factors while simultaneously tilting the portfolio to a low-carbon footprint?

Q5. Is there a chance to achieve a negative portfolio carbon footprint?

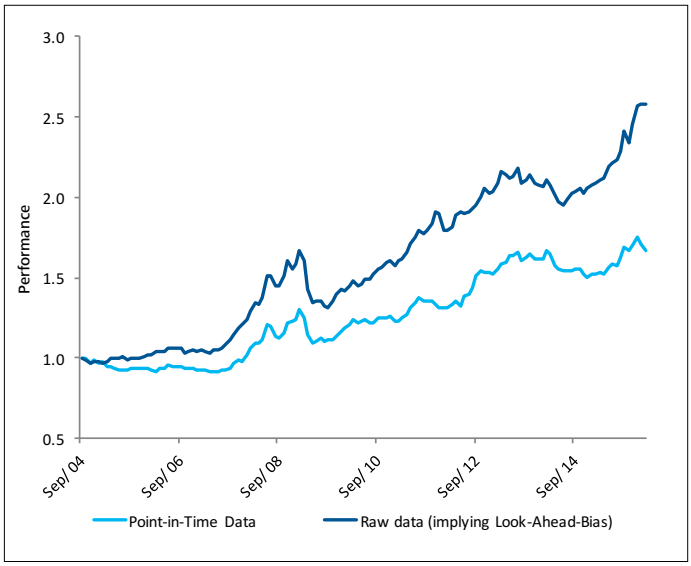
Q6. What about the impact on overall portfolio risk using different ways of implementation?

Q7. Is there a use case for reducing a company's GHG-balance beyond pension or treasury investments?

Before starting to answer these questions, we would like to give a short overview of our approach to factor investing.

We typically try to extract "the purest possible" factor- and risk premia, regardless of the performance of this factor premia during recent years. Our approach requires an intense examination of the economics involved, which is also the first stage of our four-step procedure. This is followed by a factor test — well known from academic working papers — where stocks are sorted alongside certain metrics, which seem to be economically appropriate and have been examined by empirical research. In the equity space, we make use of "Point in Time" databases in research such as company datasets, which contain the full revision history of balance sheet-, income- and cash flow statements. This leads to more realistic research results than using standard databases. There can be a significant difference as a research paper by Breitschwert (2015)[vii] and Exhibit 1 show.

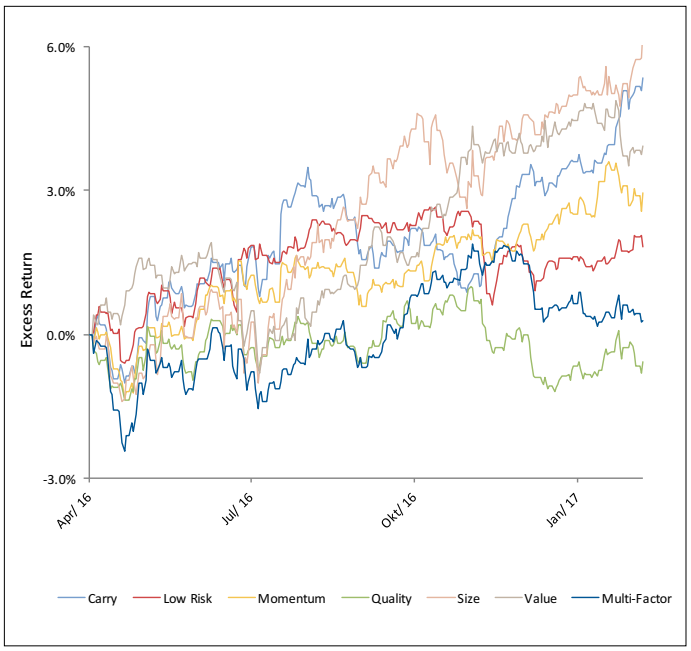
Exhibit 1: Different outcomes between PiT and Non-PiT data



In contrast to academic papers, where after checking for the typical Fama / French / Carhart (FFC) factors, alpha is statistically validated and the conclusion is drawn, we move over to our third step. Taking the numerical results of our research findings, "realistic" portfolios are constructed by using the award-winning APT risk engine by FIS Global, constraining all systematic risk to a minimum. As the risk model is PCA (principal component analysis) based, it is not prone to the typical "factor alignment problems"[viii] of many factor-based risk models. In the fourth and final step, results are analysed in the context of the economic inputs of step one.

Based on this methodology, we developed the iSTOXX Europe factor indexes for STOXX, which went live in April 2016.

Exhibit 2: Excess return of iSTOXX Europe factor indexes since April 2016



Factor investing or "Smart Beta" is gaining momentum worldwide, but investors should be aware of the fact that, in contrast to market cap-based investments, factor performance and risk across different vendor offerings can vary dramatically. For the same regional factor (i.e. Value), not only performance levels but even sign can be different. Nevertheless, the performance of a single risk- or factor premia can be negative for years, as they are not alpha but a compensation for bearing systematic risk beyond market risk.

Different approaches and the question of risk premia

As more and more investors aim to reduce the carbon footprint of their investments, motives and ways of implementation vary. There are typically two methods that are favored: A **divestment approach**, where companies with the highest GHG emissions are eliminated from investment universes, or alternatively a **devestment approach**, where full universes are used to build portfolios with a low carbon footprint.

Besides investors' motives, which are not considered in this White Paper, and from a pure economic point of view, a rigorous divestment approach should yield different results in the long run than a devestment strategy, as it aims to reduce the carbon footprint to the lowest levels possible given a set of constraints. As we are an investment manager, Grinold/Kahn´s "fundamental law of active management" came to the forefront when examining this topic. The formula

$$IR = IC \cdot \sqrt{BR}$$

with

IR = the information ratio
IC = information coefficient ("skill")
BR = independent bets per year ("breadth")

states that investment performance is a function of investment managers' skill times breadth, which is determined by the number of independent active bets in a given timeframe (i.e. a year). Breadth typically is a function of how often a decision making process is conducted per unit of time and the opportunity set - in equities - how many stocks are part of the universe. A divestment approach, where companies with a high GHG footprint are eliminated from a universe should lead to a lower performance if Grinold/Kahn holds, all other things unchanged. This finding is independent of the fact, that an empirical investigation over the last few years might deliver different results. Companies with higher GHG footprint might have suffered because of other economic reasons like low commodity prices (oil companies) or regional political impact (utilities in Germany).

From a fundamental point of view, the political commitment to limit global warming to 2 degrees will have an impact on cash flows, earnings, and balance sheets of companies affected. A recent article by Baranova, Jung and Noss[ix] shows,that the carbon potential of global fossil fuel reserves is several times higher than the remaining carbon budget. As these proven reserves represent future cash flows and asset values on balance sheets, a 2-degree limit might lead to stranded assets. Required risk premia should rise, forcing stock and bond prices to fall - up to a point of either distress or default.

A straightforward notion is that everyone trying to offload investments with high CO_2 footprint needs a buyer for his/her assets. Any divestor should be reminded that there will always be investors out there trying to benefit from distress, default, or exclusions - as the performance of several arms manufacturers shows. These stocks performed well for several years, even with integrated ESG approaches gaining more awareness. Exclusion offers opportunities for "migration premia" - well known in classic equity and corporate bond indexes - where equity and bond prices suffer pre-exclusion only to revert after the fact.

As long as companies do not default, a risk premium for buyers might become available due to selling pressure of divestors, driving asset prices below fair value. If, when, and to what extend these risks deliver a premia is a question difficult to answer today, given the notion that phases of underperformance might last quite long. Japanese equities are a good example of this as they are in a drawdown for nearly 30 years now, without anyone calling a risk premia in Japanese equities in question.

Given that a fundamental risk premia should be expected on the buyer's side, what about behavioural finance related or institutional sources of risk premia for lower GHG stocks? Both explanations for possible excess returns seem economically plausible and interconnected as market share of these investments are still quite low and, due to recent political, social, and corporate developments, might be a reason for outperformance of less carbon intensive stocks. In contrast to other company fundamentals, availability and transparency of GHG data vary, and might also be a reason for delayed investor reaction. As investors start to realise the need to hedge against carbon exposure, a momentum effect might develop. A momentum premium is paid for bearing the risk of reversals. In the context of climate related investments, these reversals might occur if, for example, the political support fades.

Q 1. Conclusion: Different approaches to reducing GHG exposure should lead to different outcomes in the long run and as a fundamental risk premium should be on a buyer´s side, behavioral and institutional reasons can be a reason for a "GHG factor premium".

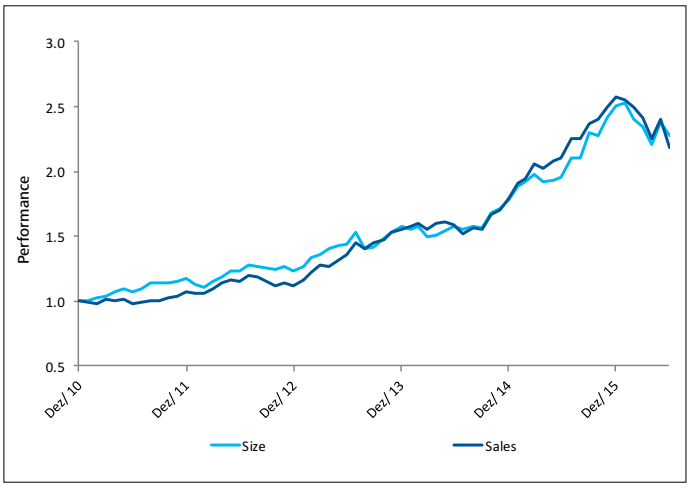
Low Carbon factor in European equity markets

To find out whether there is a "carbon factor" in European equity markets, we followed the same process as described above. Using the data series of South Pole Group (SPG), we scaled the GHG data alongside figures of market cap, sales and revenue, balance sheet, cash flow- and income statement. After that, we checked for the typical statistical factors, bearing in mind that reliable data series for GHG emissions are quite limited in comparison to other company data.

As a first result in this step, we came to the conclusion that market cap and top line figures deliver better results than other metrics down the corporate reporting lines. Scaling by size within every sector is economically reasonable contrary to scaling across a whole universe, as one should expect a mid or small cap energy company to have a higher GHG footprint number than, for example, a large cap software company. Results with respect to fundamental factors might be due to the fact that the relationship between GHG and figures in the corporate reporting process – from cash flow to income statement and to balance sheet – are prone to dilutions in comparison to 'top line' numbers, such as sales.

In a recent BNP Paribas Research Paper[x], the authors claim that carbon risk is "underpriced" in asset prices. The conclusion is supported by the notion that current prices per ton of CO_2 are below estimates of USD 65-85. It seems to us that this is always a question of "to what extend?" If not properly discounted, for example, by not fully recognizing the question of stranded assets – the fact that proven reserves might be partially worthless in the light of reaching the climate goals – the prices of GHG-intense stocks might be too high and might have even outperformed stocks with low GHG intensity Exhibit 3 shows decile spread portfolio performances for size and sales scaling.

Exhibit 3: Outperformance of stocks with lower GHG footprint



One might have expected a superior performance given the difference between current CO_2 market prices and estimated economic costs per tonne. But this view implies a general consensus of "true prices" of around USD 65-85 per tonne, which is difficult to prove, as there is no liquid market for CO_2.

Q 2. Conclusion: By scaling by size and several company fundamentals, **low GHG** outperformed **high GHG** in European equity markets from an "academic view" during the last six years.

Tradeoff between tracking errors and a low carbon footprint

As most institutional investors deploy risk budgeting approaches, we tried to gain a comprehensive view on how to implement the tradeoff between tracking errors, a lower carbon footprint, and tradability.

We followed the process described above, combining sales and company size into one final 'Low Carbon factor'. We used the final score as an input into a portfolio construction process.

As tracking error is a merely generalised figure for risk, we're always interested to keep a lid on risk decomposition. Optimisers act like human beings in a certain sense – searching for the way of least resistance. As a result, tracking risk might exhibit larger systematic risk exposures beyond the targeted tilt – a typical problem in factor investing. As outlined above, we constrained all systematic risk exposures beyond the factor tilt to a minimum.

Exhibit 4: Trade-off between tracking error and GHG reduction.

Target Tracking Error	Realised Tracking Error	Excess Return p.a	Portfolio Positions	GHG Emissions (Aggregate)*	GHG exposure Reduction**
3,00%	3,47%	2,73%	97	1.094.157	-88,8%
2,00%	2,63%	2,18%	116	1.875.822	-80,8%
1,00%	1,64%	2,06%	225	4.226.549	-56,6%
0,50%	1,16%	1,03%	239	6.784.946	-30,4%

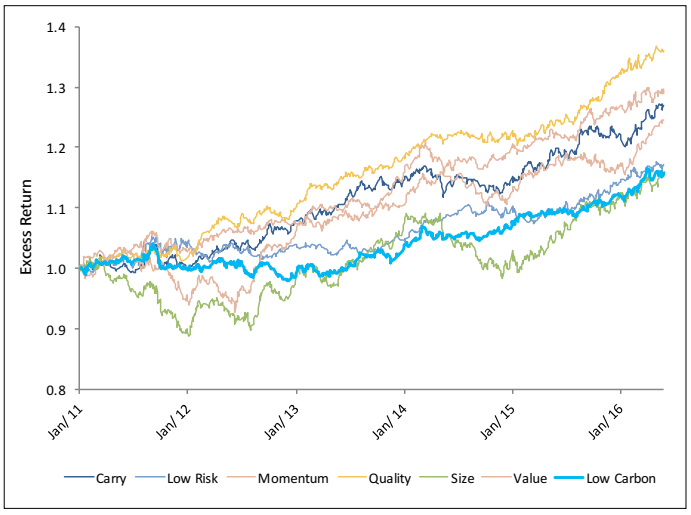
* Weighted aggregate of GHG in tons CO_2 equivalent

** Compared to the Benchmark (STOXX Europe 600)

When comparing the excess return of the Low Carbon factor to the existing iSTOXX Europe factor family, it becomes apparent that the performance has been at the lower end, even if 2,73% p.a. outperformance for a 3% tracking risk budget (as in the other iSTOXX Europe factor indexes) seems to be a large number. But the Low Carbon Factor also shows the lowest realised tracking error – even lower than the Low Risk Factor.

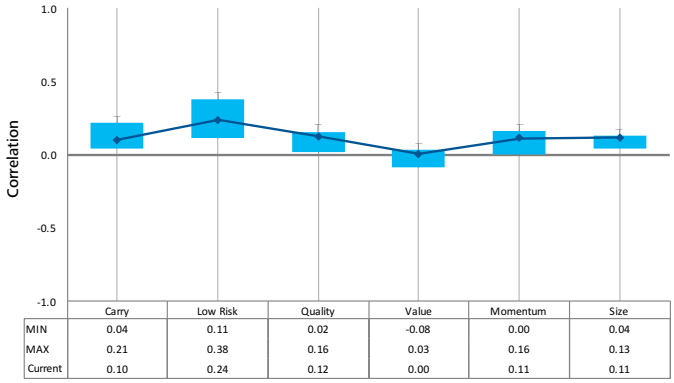
The following graph shows a comparison of excess returns between already established iSTOXX Europe Factor indexes and those of the Low Carbon Factor (in bold), based on the same methodology.

Exhibit 5: Comparison of excess returns



Checking for correlations of excess returns using the APT risk engine again, the "Low Carbon"- factor seems to be quite uncorrelated to the already existing iSTOXX factor family. If any, a small tilt in the direction of "Low Risk" is visible.

Exhibit 6: Excess return correlations of Low Carbon to iSTOXX Europe factor indexes



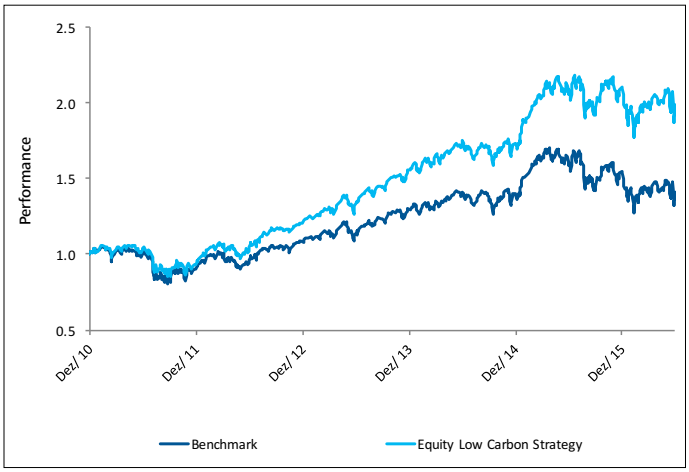
	Carry	Low Risk	Quality	Value	Momentum	Size
MIN	0.04	0.11	0.02	-0.08	0.00	0.04
MAX	0.21	0.38	0.16	0.03	0.16	0.13
Current	0.10	0.24	0.12	0.00	0.11	0.11

Q 3. Conclusion: Appropriate portfolio construction offers the opportunity to isolate a Low Carbon factor and allows for GHG reduction up to nearly 90% in comparison to a broad market cap-based European equity benchmark. Correlations to other systematic risk factors are low on average, and investors have been awarded with excess performance during the last six years.

Aiming for performance and carbon reduction simultaneously

As there is always a strong desire for performance in a low return world, we tried to find out how Low Carbon might contribute in a strategy setup with multiple factors. We combined the Low Carbon factor score with factor scores for well-known equity risk premia into one final number while constraining the optimizer with respect to tracking error and systematic risk beyond the final factor tilt. Results show that carbon footprint reduction and better performance seem to be possible.

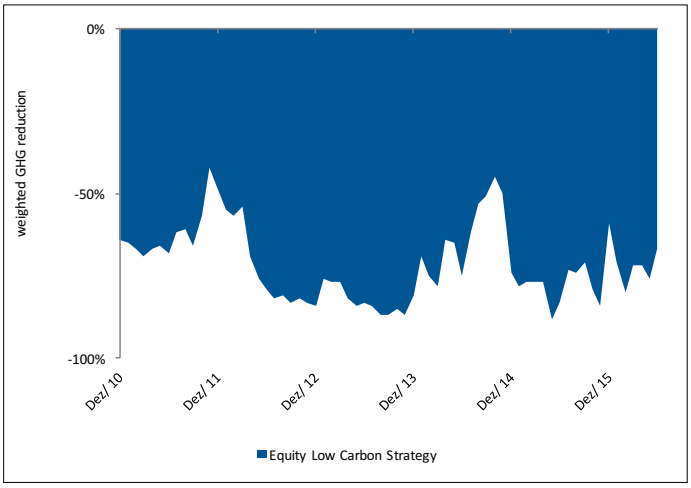
Exhibit 7: Low Carbon strategy outperformed STOXX 600



As factor premia are a compensation for bearing systematic risk, expected returns should be positive in the long run[xi] – in contrast to alpha, where expected returns are zero[xii] in aggregate.

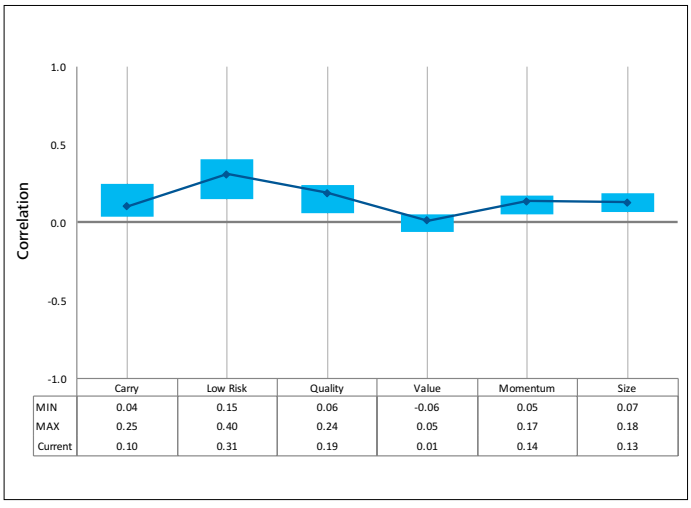
When checking for GHG reduction in comparison to the benchmark, the strategy delivers a 60% lower GHG footprint on average.

Exhibit 8: 60% footprint reduction over time



Beyond performance per se, investors should always be interested in risk decomposition and we typically run a great deal of of analytics to find out where risk is coming from. Multi-Factor strategies are sometimes prone to large impacts of certain individual factors. Well-diversified programs should display an independent behaviour and low correlations.

Exhibit 9: Correlation of Equity Low Carbon strategy



	Carry	Low Risk	Quality	Value	Momentum	Size
MIN	0.04	0.15	0.06	-0.06	0.05	0.07
MAX	0.25	0.40	0.24	0.05	0.17	0.18
Current	0.10	0.31	0.19	0.01	0.14	0.13

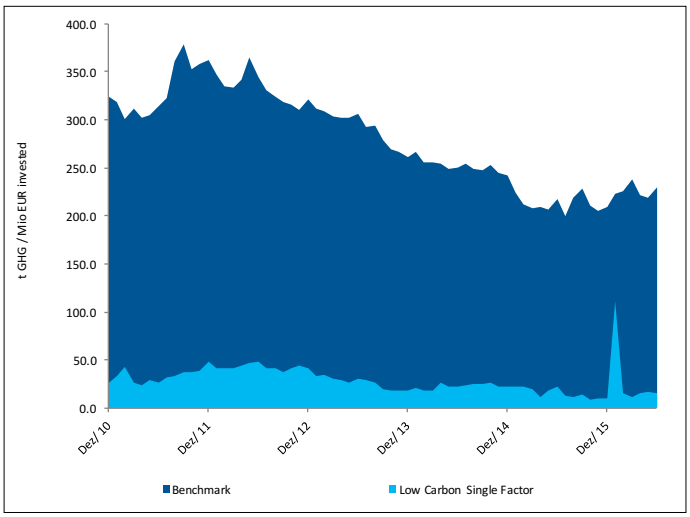
Q 4. Conclusion: Striving for risk-controlled performance while reducing GHG footprint seems to be possible. Adding a "Low Carbon score" to well-known risk factors should simultaneously deliver a premium over time and satisfy investors' desire to reduce GHG footprints in equity investments.

Is a negative GHG footprint possible?

Due to the fact that the resulting Low Carbon Single factor has a tracking error of 3%, a target beta of 1 and only minimal systematic risk beyond the target factor tilt compared to benchmark, it is possible to build a market neutral equity position (long: Low Carbon factor, short benchmark) which has a net-negative carbon footprint. We put the "CO_2 - load-factor" in context using South Pole Group´s data and the Investment Leaders Group methodology[xiii]:

- A Long Only equity investment of EUR 1 Mln. in STOXX Europe 600 exhibits a CO_2 footprint of 230 tonnes per year currently
- The Low Carbon factor exhibits a CO_2 footprint of 15 tons per EUR 1 Mln. a year cur-rently
- The net difference in a market neutral setting is equivalent of -215 tonnes of CO_2 per year and EUR 1 million invested

Exhibit 10: CO_2 footprints per EUR 1 Mln. invested



This structure is liquid, market risk- as well as country- sector- and currency neutral with respect to the benchmark. So it can be used to lower the CO_2 footprint independently of already existing investment structures – a "portable CO_2 beta".

Exhibit 11: Net exposure of the market neutral strategy (in%)

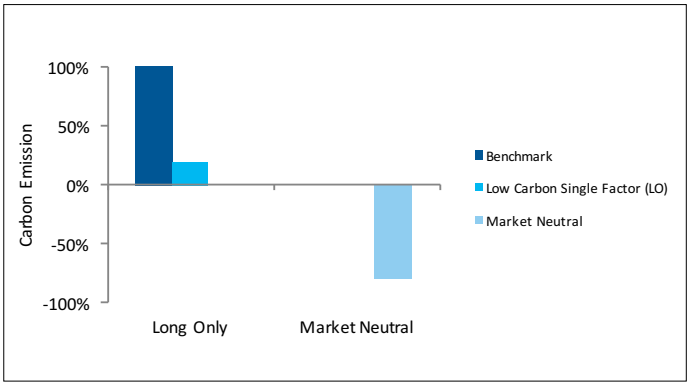


Exhibit 12: Implementation of the market neutral structure

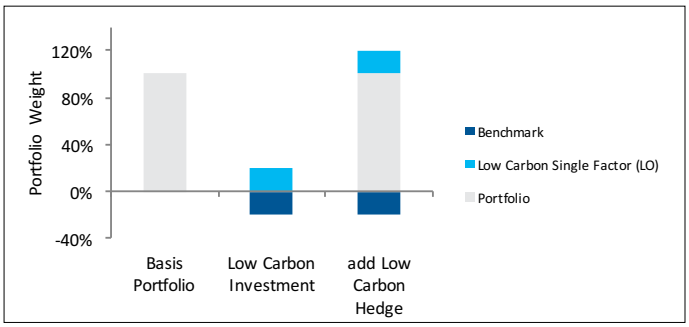
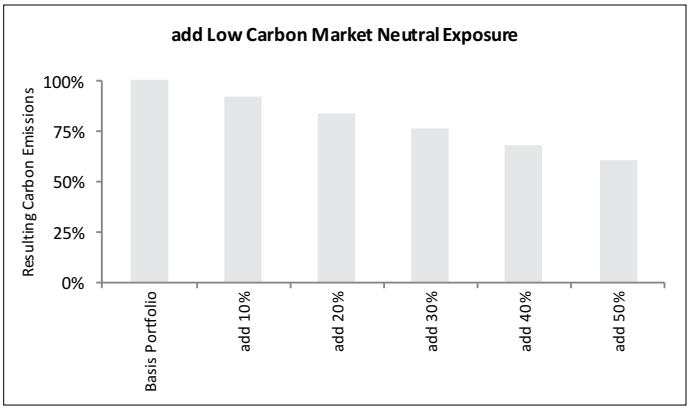


Exhibit 13: Impact of the market neutral structure



Q 5. Conclusion: Given the features of the Low Carbon single factor, a market neutral position with negative portfolio carbon footprint is possible. Given South Pole Group´s emission data at the end of 2014, the structure currently delivers a net position of -215 tonnes of CO_2 per EUR 1 million a year.

As the design is independent of the market, it can be plugged on many liquid and even illiquid investment portfolios to satisfy an investor´s goal for a lower CO_2 footprint.

What about impact on portfolio risk?

Typically, investors care about portfolio risk using absolute or relative risk budgeting approaches to control for these risks. A simple replacement of existing exposures is often the first solution. That is one of the reasons why index vendors offer solutions with low tracking error, coming at a cost of only limited reductions in GHG footprint in many cases.

From a perspective of overall portfolio risk, an investment in a portfolio component with a 3% tracking error might be a better solution. As a very low tracking error portfolio exhibits more or less no diversification potential, total risk might be lowered, if a 3% tracking error is acceptable.

As the Low Carbon factor outperformed while having a lower total volatility as STOXX Europe 600 and a correlation below 1, return is enhanced, overall portfolio risk lowered and tracking risk increased. The table shows the impact of a gradual replacement of passive STOXX Europe 600 exposure using the Long Only Low Carbon single factor (LC) portfolio outlined above.

Exhibit 14: Volatility and Tracking Error of a replacement

	STOXX Europe 600		
	Return (p.a.)	Volatility	Tracking Error
Basis	6,64%	17,21%	0,00%
+ 10% LC	6,84%	17,08%	0,35%
+ 20% LC	7,03%	16,96%	0,70%
+ 30% LC	7,23%	16,84%	1,05%
+ 40% LC	7,42%	16,73%	1,40%
+ 50% LC	7,61%	16,63%	1,74%

Institutional investors like pension plans, sovereign wealth funds, endowments, and foundations are able to "swap" CO_2 footprint into capital markets using the market neutral position. On top of their current holdings, investment managers can use it to lower the footprint of their funds or client portfolios.

As this structure exhibited a positive excess return during the last six years, overall portfolio return increased, leaving portfolio volatility unchanged, while tracking risk to STOXX Europe increased with position size gradually.

Exhibit 15: Volatility and Tracking Error using the market neutral overlay structure (OLC)

	STOXX Europe 600		
	Return (p.a.)	Volatility	Tracking Error
Basis	6,64%	17,21%	0,00%
+ 10% OLC	6,92%	17,17%	0,34%
+ 20% OLC	7,19%	17,13%	0,68%
+ 30% OLC	7,46%	17,10%	1,02%
+ 40% OLC	7,73%	17,07%	1,36%
+ 50% OLC	8,00%	17,05%	1,70%

Starting from an overall risk focus, gradual replacement or overlay strategies tend to lower the overall portfolio risk, as low carbon investments exhibit lower volatility and add diversification, provided that investors are able to tolerate a tracking risk of around 3 %.

Q 6. Conclusion: From solely a risk budgeting point of view, the best solution for investors always depends on whether risk budgets are allocated from a single investment- or an overall portfolio- risk point of view, independent of whether total volatility or active risk is considered.

What about a use case for a company's overall CO_2 balance?

Businesses can also use this overlay structure to lower their CO_2 balance on a company level: Using South Pole Group´s data, we can conclude that a consumer-facing company like Adidas needs an investment of around EUR 260 million. Euro to be climate neutral on a company level, Commerzbank roughly EUR 720 million., and car manufacturer BWM EUR 7,3 billion. If risk premia for companies with higher carbon footprint tend to rise over time, the market neutral position can serve as a reasonable "hedge", as business models of many companies don´t allow for faster CO_2- reduction, cannot incur high costs of necessary technology, or the necessary technology is simply not available yet.

The following table shows the overlay investment required achieving climate neutrality for selected German companies (approximation[xiv]):

Exhibit 16: Overlay exposure necessary to achieve climate neutrality (excerpt, latest data available)

	Emissions	CO_2_Neutrality (in Mln EUR)
RWE AG	158.000.000	734.884
E.ON SE	101.800.000	473.488
HEIDELBERGCEMENT AG	59.835.714	278.306
THYSSENKRUPP AG	33.700.000	156.744
DEUTSCHE LUFTHANSA-REG	27.801.092	129.307
DEUTSCHE POST AG-REG	6.728.846	31.297
CONTINENTAL AG	6.370.699	29.631
SIEMENS AG-REG	6.241.966	29.032
LANXESS AG	5.752.562	26.756
COVESTRO AG	5.660.000	26.326
DEUTSCHE TELEKOM AG-REG	3.550.990	16.516
FREENET AG	160.270	745
COMMERZBANK AG	155.006	721
ADIDAS AG	55.731	259
GFK SE	44.492	207
DEUTSCHE WOHNEN AG-BR	43.222	201
STADA ARZNEIMITTEL AG	42.774	199
PUMA SE	33.446	156
PROSIEBENSAT.1 MEDIA SE	31.726	148
GENERALI DEUTSCHLAND HOLDING	29.925	139
FIELMANN AG	29.792	139
DUERR AG	29.528	137
SMA SOLAR TECHNOLOGY AG	25.155	117
HUGO BOSS AG -ORD	23.200	108
RATIONAL AG	20.922	97

Q 7. Conclusion: Using the market neutral position as a "hedge" on a company´s "CO_2 balance sheet", a cheap and easy to implement structure can serve as an insurance against rising company risk premia up to the point of climate neutrality.

Exhibit 17: Alpha Centauri solutions available to reduce CO_2 footprints

Focus	Construction	Long	Short
• Replacement of European Long Only exposure • Focus on Low Tracking Error and Carbon Reduc-tion • On average **85 % less carbon emission** compared to benchmark **	Long Only	Low Carbon Factor Index	---
• "Overlay" to already existing investment exposure • Achieving climate neutrality for companies • Focus on Low Tracking Error and Carbon Reduction • Negative **Carbon footprint of ~ 85 %** with respect to benchmark **	Market-neutral "Overlay"	Low Carbon Factor Index	STOXX Europe 600 Index / Future
• Replacement of European Long Only exposure • Focus on Performance and still reduce Carbon emissions • On average **60 % less carbon emission** compared to benchmark **	Long Only	Equity Low Carbon Strategy	---
• Market-neutral / Absolute Return Investment • Focus on Performance and negative carbon footprint • **Negative Carbon footprint of ~ 60 %** with respect to benchmark **	Market-neutral Absolute Return	Equity Low Carbon Strategy	STOXX Europe 600 Index / Future
• Long Short Investment • Focus on Performance and negative carbon exposure • **Negative Carbon footprint of ~ 200 %** with respect to benchmark **	Long Short	Equity Low Carbon Long Short Strategy	

** STOXX Europe 600

CONCLUSION

Using South Pole Group´s database, "point-in-time" company datasets and FIS Global´s APT risk engine, we tried to find out whether low carbon footprints are priced and paid in European equity markets, what level of CO_2 reduction might be possible in the light of tracking error constraints, and whether there are opportunities of lowering CO_2 footprints while aiming for outperformance vs. equity benchmarks simultaneously. Recognising the fact that data series for GHG emissions are quite short in comparison to other company fundamentals, our results show that

- CO_2 footprints are priced and have been paid during the last six years
- CO_2 reductions with low tracking errors up to 88% on average are currently possible
- Investors can expect a reasonable degree of excess return over time by combining well-known systematic factor premia with a "Low Carbon factor"
- It is possible to build an equity market neutral position with even negative portfolio CO_2 footprint to hedge (or lower) current footprints in financial and non-financial assets.

Given these findings, more academic studies showing a positive impact of low-carbon investing should be expected, if political and social desires to fulfill climate goals prevail. More inflows will ultimately lead to "buying pressure", driving prices of low CO_2 footprint assets higher. As investors sell their corporate bonds and stocks of these companies, their risk premia will increase.

Should this be the case, companies with an inherent high CO_2 business model should think about investing for example pension or treasury assets in low carbon footprint- investments or well-designed overlay strategies as a natural hedge against rising cost of capital on the liability side of their balance sheet. Alternatively, as Daniel, Litterman and Wagner (2014)[xv] put it:

"The less certain we are about the risk facing us in the future states of the world, the greater is the need for climate action today".

About South Pole Group

The South Pole Group is one of the world's leading climate action solution providers, measuring and reducing climate impact for its clients. Headquartered in Zurich, Switzerland, with 16 offices around the globe and over 150 climate change professionals, the company has achieved savings of over 50 million tonnes of CO_2 since being incorporated in 2006. With the largest and deepest coverage of high quality company GHG information in its proprietary database, South Pole Group has screened over EUR 500 bn assets under management for their climate impact. The company pioneered high volume portfolio carbon screening that is now available on Bloomberg terminals (APPS CARBON), YourSRI.com and CleanCapitalist.com. South Pole Group has been a strong contributor to the Montreal Carbon Pledge (www.montrealpledge.org).

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Alexander Bassen is full professor of capital markets and management at the University of Hamburg, Faculty of Business, Economics and Social Science, Germany. He teaches course in finance and investment, ESG and capital markets and reporting. He is a member of the German Council for Sustainable Development - advisory body of the German Federal Government, co-chair of the UN PRI Academic Network Steering Committee, member of the corporate governance commission and the investor relations commission of the Society of Investment Professionals Germany (DVFA), member of the Commission on Environmental, Social & Governance Issues (CESG) of the European Association of Financial Analysts Societies (EFFAS) and member of the advisory panel for sustainability of Deutsche Asset Management (Deutsche Bank). His work is published in including Energy Economics, Journal of Sustainable Finance & Investment, Journal of Business Economics, Applied Economics, International Journal Technology Management.

About Alpha Centauri

Alpha Centauri is an independent multi-asset management boutique founded in 2005 and based in Hamburg, Germany.

It is an investment manager specialised in innovative liquid alternative products, with factor investing at the core of its business. Risk competence and financial index know-how based on a unique in-house infrastructure enables Alpha Centauri to fully address client needs in today's complex world.

Within the investment industry, we are known for our high data quality solutions and risk management capabilities.

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