MSCI

Research Insight

Beyond Divestment: Using Low Carbon Indexes

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Executive Summary

Climate change presents one of the biggest economic and political challenges of the 21st century. While world leaders have struggled to arrive at a consensus on how to respond to issues posed by the increase in the Earth's temperature, institutional investors are exploring the potential impact of these changes on financial assets. In particular, investors are probing the long-term portfolio implications of "carbon stranded assets" — assets that may lose economic value before the end of their expected life primarily driven by changes in regulation and technological innovation.

Companies' carbon exposure consists of two dimensions: current emissions and fossil-fuel reserves (representing potential future emissions). In the MSCI ACWI Index, Utilities, Materials and Energy companies accounted for more than four-fifths of the total current carbon emissions. Not surprisingly, Energy companies represent more than 80% of total fossil fuel reserves.

Up until now, much of the pressure to manage carbon stranded assets risks has focused on divesting from companies in the fossil fuel sectors. This approach effectively communicates to various stakeholders an investor's concerns about climate change. But, from a financial perspective, the strategy is not optimal as it can create significant short-term risk by potentially deviating sharply from market risk and returns. In addition, such an approach largely ignores fixed assets from non-Energy sectors in the portfolio that are at risk of being stranded due to their dependence on burning fossil fuel reserves, such as coal-based power plants.

The shortcomings of the divestment approach have led major asset owners to seek more financially practical solutions to managing carbon risk. Instead, investors are starting to turn to strategies that re-weight the market-capitalization portfolio to effectively minimize broad carbon exposure while using optimization to reduce tracking error. These approaches take into consideration both current emissions and fossil-fuel reserves, thus aiming to capture a broader exposure to carbon-intensive companies while seeking to minimize short-term risk.

MSCI offers indexes designed to reflect divestment and re-weighting strategies to reduce carbon exposure. These approaches are summarized below:

- Divestment strategies aim to enable institutions to have simple and clear communications with stakeholders but ignore short-term portfolio risks. For example, a portfolio replicating the MSCI Global ex Fossil Fuels Indexes aims to eliminate 100% of the policy benchmark's carbon reserves exposure by excluding companies that own oil, gas and coal reserves.
- Re-weighting strategies, such as those applied to portfolios that track the MSCI Global Low Carbon Target Indexes, seek to increase exposure to more carbon-efficient companies while reducing short-term risk against the benchmark.
- Combining selection and re-weighting strategies may offer a clear message in communicating with stakeholders while taking into account short-term tracking error and long-term risk exposure to carbon-intensive companies. A portfolio replicating the MSCI Global Low Carbon Leaders Index would include companies with low carbon exposure while seeking to minimize *ex-ante* tracking error.

Introduction

Climate change presents one of the biggest economic and political challenges of the 21st century.[1] Policymakers have struggled to reach a global consensus on how to address the potentially devastating effects of rising sea levels, extreme weather events, and other consequences of the increase in the earth's temperature. On the one hand, the lack of clarity from policymakers has allowed the business and financial community to operate in a business-as-usual mode. On the other hand, as the scientific evidence gains credence, alarm bells are starting to ring. Leaders in the global investment community have kicked off a lively debate over the financial risks from climate change and potential courses of action to mitigate those long-term portfolio risks. A growing number of large asset owners, including the Fourth Swedish National Pension Fund (AP4), the Fonds de Réserve pour les Retraites (FRR) and the United Nations Joint Staff Pension Fund, are allocating assets to low-carbon strategies.[2]

This paper discusses one aspect of the financial risks posed by climate change. Specifically, we focus on the risk that a significant portion of current assets could become "stranded" – and thereby drastically lose value — if carbon emissions are constrained in the future. First, we describe the context and logic behind the "carbon stranded assets" thesis and analyze where those risks may be found in a broad, diversified public equities portfolio such as one that tracks the MSCI ACWI Index. Second, we present a framework for understanding how institutional investors with different motivations and investment beliefs can address carbon-related risks in their portfolios. Finally, we describe current approaches aimed at reducing risks of carbon stranded assets, and explain how recent innovations provide an implementable approach for asset owners seeking to address carbon risk in their portfolios while managing short-term financial risks.

Carbon Stranded Assets

Carbon stranded assets are assets that may lose economic value before the end of their expected life primarily driven by changes in regulation and technology, though market forces, environmental concerns and societal norms are also significant factors.

Two core assumptions underlie this view. The first is that the Earth will be unable to sustain the current rate of increase in greenhouse gas emissions (GHGs) without triggering catastrophic effects. Although there remain notable pockets of skepticism about climate change, the preponderance of mainstream scientific evidence points to a rise in average temperatures, which, based on their current trajectory, would lead to a 2.6-4.8 Celsius degree warming of the earth's temperature by the end of the next century.[3] According to the Intergovernmental Panel on Climate Change (IPCC), the global average sea level has risen by 10 to 20 centimeters over the past hundred years and is projected to rise another 9 to 88 centimeters by the year 2100. Hundreds of millions of people could be affected by coastal flooding and displaced due to land loss by the end of this century. The IPCC therefore has projected that GHG emissions need to be reduced by 40% to 70% by 2050 (compared to 2010 levels) to halt these effects.[4]

[1] United Nations Commission on Sustainable Development

[2] See the Appendix for more detail. MSCI's Low Carbon Indexes were developed at the request of AP4, FRR and Amundi, who offered critical insights in their development. Also, see Hedging Climate Risk, a paper by Mats Andersson, CEO of AP4; Patrick Bolton of Columbia Business School's Department of Economics; and Frédéric Samama of Amundi, which discusses a low carbon index that employs optimization.

[3] See the Intergovernmental Panel on Climate Change's Fifth Assessment Report http://www.europeanclimate.org/documents/IPCCWebGuide.pdf

[4] IPCC: Greenhosue gas emissions accelerate despite reduction efforts, April 13, 2014

A second core assumption is that policymakers or regulators will eventually limit the amount of GHG emissions as a response to the potential catastrophic effects of climate change. In late 2011, world leaders agreed to adopt a "carbon budget" that would keep the Earth's warming to under 2 degrees Celsius from pre-industrial levels.[5] That budget would limit the further release of global GHG emissions to 866 gigatons by 2100,[6] though some observers believe that this budget will be exhausted much sooner.[7]

Carbon stranded assets

Carbon stranded assets are assets that may lose economic value before the end of their expected life because of changes in regulation, market forces, environmental concerns, societal norms and innovation associated with the transition to a low carbon economy. Limits on future greenhouse gas emissions could affect two-thirds of existing fossil fuel reserves (oil, gas and coal) as well as fixed assets, such as power plants, that burn fossil fuels.

There is some evidence that global awareness of the challenges of climate change is increasing and spurring political action at the international, national, and sub-national levels, albeit unevenly and in fits and starts. At the international level, the Conference of the Parties (COP), the governing body for the United Nations Framework Convention on Climate Change, will be held in Paris in November 2015 with the aim of achieving a legally binding and universal agreement on mitigating climate change. At the national level, governments' commitments vary with regards to emission reductions as well as the mechanisms in place to curb them. For example, the European Union has adopted emissions trading schemes; China has seven city- and provincial-level pilot trading schemes which are viewed as forerunners for a projected national trading scheme**;** South Africa is proposing a carbon tax; and Australia has created an emissions reduction fund. At the sub-national level, piecemeal actions have proliferated, including emissions trading schemes in California and nine states in the northeastern United States.

New Energy Sources

While regulatory changes that limit GHG emissions would have the most direct role in triggering the stranding of carbon-intensive assets, the rapid development and falling costs of new technology could also trigger large-scale substitution of current energy sources with cleaner sources of energy. In fact, as with other examples of technology displacement — from the transition of radio-to-television to the ubiquity of personal computers and tablets — energy substitution could be a more disruptive threat than regulations which often allow more time for businesses to adapt *(see box on next page)*.

[5] Report of the Conference of the Parties on its seventeenth session, United Nations Framework Convention on Climate Change, March 15 2012.

[6] IPCC estimates based on 80% probability: http://carbontracker.org/wp-content/uploads/2014/08/Carbon-budget-checklist-FINAL-1.pdf

[7] Understanding the IPCC Reports, World Resources institute. http://www.wri.org/ipcc-infographics

Technology and Stranded Assets

New technologies can lead to dramatic changes in industry and society — sometimes almost overnight. Perhaps the starkest example was the short-lived Pony Express, which provided mail delivery on a 2,000-mile route from St. Joseph, Missouri, to Sacramento, California in only seven days. But the service lasted only 19 months, shuttering operations just two days after the Pacific Telegraph line opened in October 1861, making its horses and stations into an early form of stranded assets. The owners filed bankruptcy.*

Horses again were stranded assets in late early 20th century urban America. But their departure was not mourned. "Horse pollution" had become an epidemic problem by the late 19th century, as horse manure and associated public health and sanitation issues mounted. In fact, in 1894, the Times of London estimated that by 1950 every street in New York City would be buried nine feet deep in horse manure. Not only did this give rise to horrendous odors, disease-transmitting flies and traffic congestion, but their manure was the source of greenhouse gas emissions. Improvements in the internal combustion engine in the 1890s helped automobiles supplant horse-drawn transportation over the next three decades.**

* http://ponyexpress.org/history/
** From Horse Power to Horsepower, Access, Spring 2007Access, Spring 2007.

In recent years, the share of renewable energy in the world's energy mix has grown substantially due to a range of technological improvements that have brought their costs closer to parity with those of fossil fuels.[8] Renewable energy is the fastest growing energy source. According to the International Renewable Agency (IRENA), renewable energy grew 85% over the past 10 years, reaching 1,700 gigawatts (GW) in 2013, accounting for 30% of all installed power capacity. In 2013, for the first time, non-members of the Organisation for Economic Co-operation and Development (OECD) installed more renewable capacity than OECD countries. For example, in 2013, China's solar and wind capacity installation totaled an estimated 27.4 GW — four times higher than Japan, the next largest country in term of renewable capacity installation.[9] The country has committed to having 20% of its primary energy consumption sourced from non-fossil fuels by 2030. This addition to China's generation capacity equates to "more than all the coal-fired power plants that exist in China today and close to total current electricity generation capacity in the United States."[10]

In an increasing number of markets globally, wind and especially solar technology have achieved "grid parity" — that is, they are competitive with the price of electricity from the local grid, even on an unsubsidized basis. Some investment analysts have projected that the falling cost of solar panel and system costs will allow solar to reach grid parity in half of the target markets in the next three years, including in all 50 U.S. states by 2016[11] and in India by 2017-2018 for utility scale projects.[12]

As these alternative sources of energy become less costly, they could challenge the dominance of fossil fuels, even in the absence of stringent regulations on GHG emissions or high carbon prices. If cleaner, renewable energy sources become a viable alternative energy source; fossil fuel reserves and the fixed assets built to burn them could lose significant value and would thus become stranded.

[8] For example, see Deutsche Bank's report on the increasing competitiveness of the solar sector. Also see Lazard Ltd.'s Levelized Cost of Energy Analysis—Version 8.0 which analyzes the costs of various renewable energy sources

[9] Rethinking Energy, International Renewable Energy Agency, 2014.

[10] Fact Sheet: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation, White House, November 11, 2014.

[11] Solar Grid Parity in All 50 US States by 2016, Predicts Deutsche Bank, CleanTechnica, October 29, 2014.

[12] ;The Rising Sun: Grid parity gets closer, KPMG, September 2012.

Energy Efficiency

An important trend that could dampen future demand for fossil fuels is improvements in energy efficiency. Technologies targeting the residential, transport and industry sectors, including more efficient appliances and lighting, improved electric motor systems, better use of automation and control system and electric/hybrid vehicles, have the potential to significantly reduce aggregate energy demand. The International Energy Agency (IEA) estimates that 60% of energy saving will come from the building sector, followed by the industry and transport sectors.

In the automobile sector, the tightening of fuel efficiency standards in major markets, such as the United States, the European Union and China, have changed the growth trajectory for gasoline usage over the next decade. Some analysts estimate that new car efficiency is improving by 3%-4% per year while truck efficiency by 1%-2%.[13] Additionally, growth in sales of fuel efficient and electric vehicles has continued. In the United States, the biggest market for these vehicles, sales of hybrids, electric and fuel-efficient diesel vehicles increased 21% in 2013 compared to 2012. This growth has continued in 2014 with sales of electric vehicles increasing 15.1% for the first five months of the year compared to the same period in 2013.[14]

Limitations on future GHG emissions or substitution by new energy sources, coupled with deceleration in the demand for energy, would have important financial consequences for the energy sector:

- Two-thirds of the fossil fuel reserves that we have already discovered but have not yet extracted could remain unused. According to the IEA, this could represent 50% of current oil and gas reserves and 80% of coal reserves.
- Fixed assets reliant on burning fossil fuels could also be abandoned if future carbon emissions exceed the carbon budget or if new energy sources become economically competitive. This concept is typically referred to as "locked-in" emissions associated with fixed assets, particularly long-lived assets. The most relevant example is power plants that may be prematurely retired because new regulations and/or a shift in energy technology make them uneconomical to operate for their full expected life.

Case Study: Early asset write downs in European utilities

In the past year, European utilities have announced hefty write-downs on coal- and gas-fired power plants, in large part due to a shift to renewable energy in Germany. Renewables increased their share of the German power market to 30% in early 2014 through subsidies and preferred access to the grid. The result has been significant for conventional utilities. In early 2014, GDF-Suez and RWE took write-downs on coal and gas-fired power plants of EUR 14.9 Bn and EUR 3.3 Bn, respectively.[15] Meanwhile, EON, Germany's largest utility, announced in late 2014 that it would take a EUR 4.5 billion write-down on conventional power plants, saying it would spin off that business to focus on renewable energy.[16] GDF-Suez CEO, Gérard Mestrallet, recognized that "the deterioration of gas storage and thermal-energy production in Europe is deep and long-lasting." RWE's CEO, Peter Terium, recently acknowledged the company's mistake in entering the renewables market "possibly too late."

[13] Citi Group, Global Oil Demand Growth – the End is Nigh, March 2013

[14] MSCI ESG Research, Industry Report: Automobile, July 2014

[15] GDF Suez writes off 14.9bn as value of power plants falls, *Financial Times,* February 27, 2014. *(Subscription required)*

[16] EON Banks on Renewables in Split from Conventional Power, *Bloomberg*, December 1, 2014

Identifying Sources of Risk

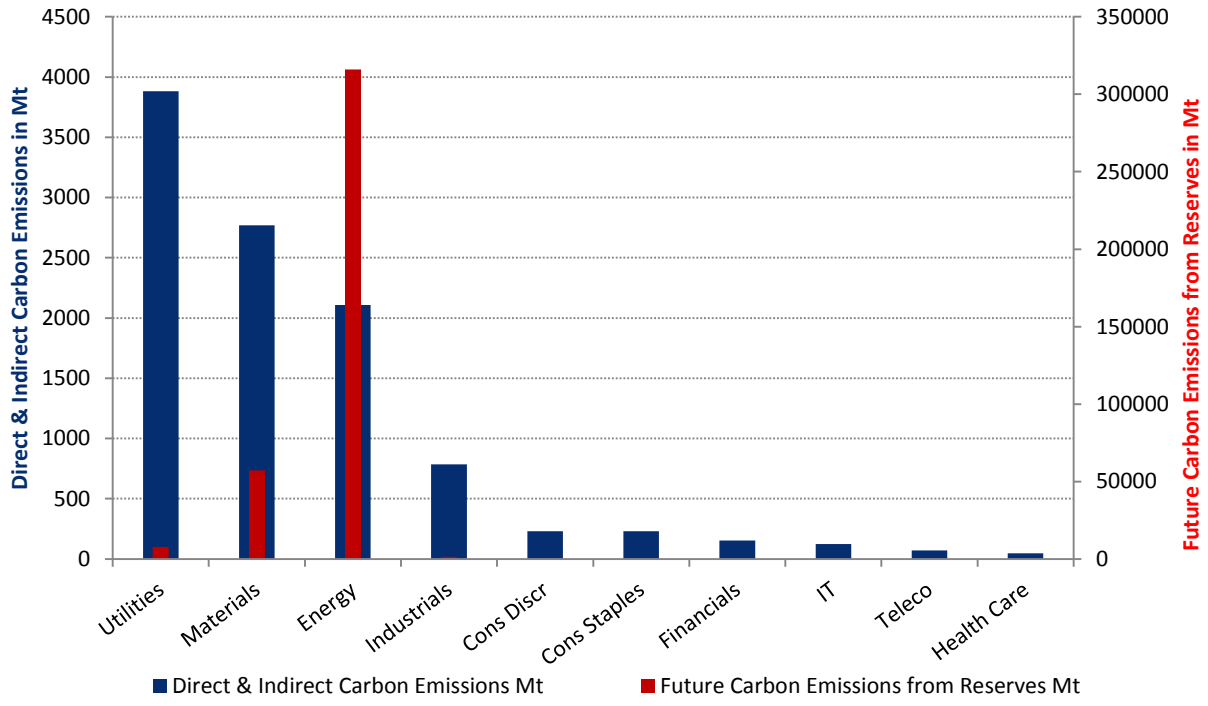
Stricter regulations and energy substitution may present direct risks to the value of fossil fuel reserves and indirect risks to the value of fixed assets that are "locked in" to burning fossil fuel reserves. Hence, the first step in addressing risks of carbon stranded assets requires identifying holdings in companies that *own fossil fuel reserves* and companies whose *business activities are highly carbon-intensive*.

Concentration in a Few Sectors

Measuring the extent of fossil fuel reserves holdings and carbon-intensity of business activities across a broad, diversified portfolio replicating the MSCI ACWI Index shows the risk of potential carbon stranded assets was highly concentrated, as of January 15, 2015.

- **Proven and probable coal, oil and gas reserves**: Unsurprisingly, the risk of stranded assets was highest in the Energy sector, representing more than 80% of total fossil fuel reserves.
- **Sector exposure**: The three most intensive sectors – Utilities, Materials, Energy — accounted for more than 80% of the total direct and indirect carbon emissions in the sample portfolio replicating the MSCI ACWI Index as of January 15, 2015 (Exhibit 1). This measure can act as a proxy for identifying long-lived assets at risk of stranding as well as for evaluating a company's contribution to climate change.
- **Issuer exposure**: In the sample portfolio, the top fifth of companies with direct and indirect emissions in absolute terms accounted for more than 80% of the total emissions of the universe during the examination period. Similarly, 13 companies accounted for more than 50% of the total potential future emissions from burning current reserves held by MSCI ACWI Index constituents, as of June 2014 (Exhibit 2).

Exhibit 1: Current and Future Carbon Emissions



Source: MSCI ESG Research
As of January 15, 2015

Exhibit 2: Leading ACWI Constituents in Carbon Reserves and Emissions

Top 5 companies with Reserves in ACWI	Top 5 largest emitters in ACWI (scope 1+2)
1. Coal India	1. Huaneng Power
2. GAZPROM	2. Kepco
3. China Coal	3. Datang
4. China Shenhua	4. NTPC
5. PEABODY	**5.** China Resources Power

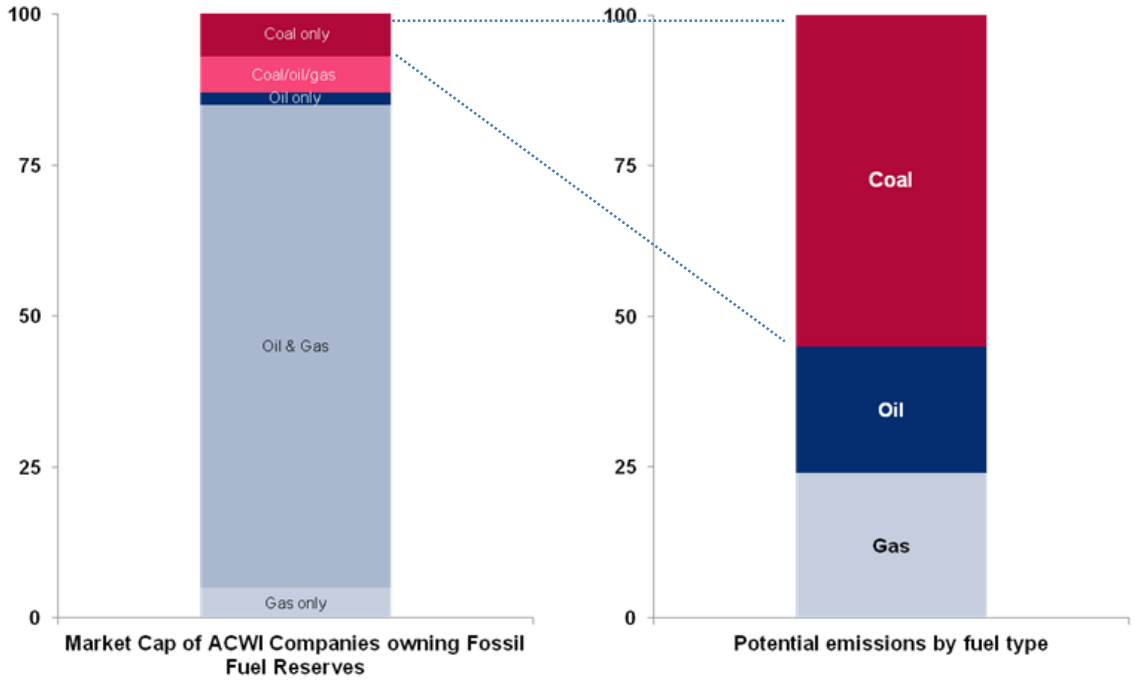
Source: MSCI
Data as of June 2014

Concentration by Fuel Type

Fossil fuels vary quite dramatically in their carbon content, resulting in concentration of carbon stranded risks in a relative handful of companies and industries. Coal is by far the most carbon intensive fuel type, emitting roughly twice as much carbon emissions per kilowatt hour (kwh) than natural gas. While companies with coal reserves represented a small proportion of the total reserves in ACWI constituents, those companies accounted for more than half of the potential future emissions embedded in the MSCI ACWI Index constituents as of February 25, 2015 (Exhibit 3).[17]

[17] Only companies with fossil fuel reserves used for energy purposes were taken into account in this analysis. Steel companies owning metallurgical coal reserves were not included as there is no viable alternative to make steel than using metallurgical coal.

Exhibit 3: Fossil Fuel Reserves Held by ACWI Constituents



Source: MSCI ESG Research
As of February 25, *2015*

Unconventional resources (e.g., oil sands, shale oil/gas) have higher carbon content than conventional fuels. In addition to higher carbon intensity, their extraction can be costly because of various geological, technical and environmental challenges. Although oil sands have been targeted as being particularly climate-unfriendly, they comprised a very small amount of potential emissions from MSCI ACWI constituents. We estimate that oil sands accounted for approximately 1% of the total future potential emissions of the MSCI ACWI Index and that less than 20% of companies with oil and gas reserves in the Energy sector owned oil sands reserves.

Key Parameters for Institutional Investors

Now that the sources of current and future emissions have been discussed, let's examine how investors can address carbon risk exposure in their portfolios.

Asset owners differ widely in terms of their investment beliefs and constraints when it comes to assessing their carbon-related risk. Thus, the approaches they use may vary significantly. Investors may fall along a wide spectrum based on four key parameters.

- Short-term risk
- Long-term thesis
- Stakeholder communication
- Public stance

Short-term Risk

Institutional investors differ in the constraints they face or the appetite they have for deviating from the benchmark and market exposure in the short term. How much tracking error risk they are willing to bear is a major factor in determining which approaches to lowering carbon exposure are acceptable.

Long-Term Thesis

Investors fully convinced of the stranded asset thesis may take into account long-term risks to their portfolios. Hence, they may amend their traditional risk/return investment analysis and integrate this long-term view as a key determinant in their investment strategy. The strength of their belief in the long-term thesis may have to be weighed against potential return deviations. In addition, it is not clear how long it may take for long-term risks that impact asset values to materialize.

Stakeholder Communication

In addition to their investment beliefs, institutions face pressure from stakeholders that may affect their choice of approach to lowering carbon exposure; some approaches are much simpler to communicate to a less financially sophisticated audience. The fossil fuel divestment campaign that is being championed by the non-profit organization 350.org is one example of the pressure that some U.S. university endowments are facing.

Public Stance

Many large institutional investors regard themselves as permanent or "universal" owners[18] who cannot diversify away long-term risks to their portfolios. Hence, some investors may employ a variety of tactics to reduce those risks by taking a more public stance. For example, they may engage with companies with poor corporate practices, selectively divest a small set of companies to help set minimum corporate standards and collaborate with other asset owners to influence policymaking. Some institutions also have committed to display high levels of transparency on the impact of their investments on social and environmental issues, including their contribution to climate change.[19]

Reducing Carbon Risk Exposure

Investors' sensitivity to the four key parameters will affect how they approach reduction in their exposure to carbon-intensive companies. In this section, we explore more traditional selection-based options available to investors as well as a more innovative approach based on weighting and a hybrid approach that combines selection and weighting approaches.

The choice of the investment strategy – re-weighting versus selection – will depend on sensitivity to the above-mentioned four key parameters: short-term risk, long-term thesis, stakeholder communication and public stance.

[18] A Universal Owner is defined as a long-term owner of a diversified investment portfolio that is spread across the entire market or markets. As a result, Universal Owners collectively own a share of the economy and are effectively tied into this share in the longer term. They depend on the global markets to produce economic growth on a sustainable basis and thus manage their longer-term risk through asset allocation and active ownership practices.

[19] In fact, a movement among institutional investors to measure and publicly disclose their carbon footprint has been gaining momentum. Signatories to the Montreal Pledge commit to measure and disclosure the carbon footprint of their investments annually, beginning with their equity portfolios. Similarly, members of the Portfolio Decarbonization Coalition commit to measuring and disclosing the carbon exposure of their portfolios but also to reducing their portfolios' carbon exposure by at least USD 100 billion. In addition, nearly 350 institutional investors representing more than USD 24 trillion in assets signed the Global Investor Statement, asking policymakers to create a meaningful price for carbon emissions[19] and to reach an ambitious climate change agreement that would affect corporate and regulatory behavior. http://investorsonclimatechange.org/

Exhibit 4: Re-weighting vs. Selection

	Re-weighting	Selection
Short-term risk	Allows for different techniques (e.g., optimization) to manage short-term risk	Tracking error is ignored in favor of longer-term considerations
Long-term thesis	Aims to minimize exposure to companies most vulnerable to stranded assets	Exposure to companies most vulnerable to stranded assets depends on selection approach
Stakeholder communication	Communication to stakeholders is more challenging due to the more complex nature of the approach	Conducive to public communication with stakeholders when targeting key sectors or high profile companies
Public stance	Allows investment in the full universe and keep communication channels open with companies	Makes strong public statement that investor aims to influence corporate behavior

Selection Strategies: Simpler Communications but Short-Term Risk

Up until now, much of the attention on reducing carbon exposure has focused on divestment of companies in the fossil fuel sectors.[20] This selection-based approach partially reduces carbon exposure risk, focusing on avoiding potential long-term risks from holding stocks of companies whose value is derived from reserves that may be unburnable in a future regulatory or technological scenario. However, a selection-based approach ignores short-term financial risks of deviating from the benchmark. Additionally, a selection-based approach focused on fossil fuel reserves fails to capture the risk that "fixed assets" that are locked into burning fossil fuels become stranded in a carbon-constrained future.

- MSCI's Fossil Fuel Exclusion Indexes and MSCI ex Coal Indexes aim to reflect these approaches by focusing exclusively on fossil fuel reserves. The MSCI Fossil Fuels Exclusion Indexes aim to eliminate 100% of carbon reserves exposure by excluding companies that own oil, gas and coal reserves. The MSCI ACWI ex Fossil Fuels Index eliminated the parent index's exposure to potential carbon emissions by excluding 127 stocks, representing 8.0% of the MSCI ACWI Index's market capitalization, as of November 28, 2014. This approach incurred tracking error of 100 basis points over the analyzed period, as can be seen in Exhibit 5.
- The MSCI ex Coal Indexes aims to significantly reduce carbon reserves exposure found in the parent index by excluding solely companies that own coal reserves. The MSCI ACWI ex Coal Index experienced a 44% reduction in potential carbon emissions by excluding only 28 stocks, representing just 1.1% of the MSCI ACWI Index market capitalization. The ex coal investment strategy experienced only 30 bps in tracking error over the study period while still enabling investors to maximize the communication aspect of this approach.

[20] Some investors also have examined "clean energy" indexes that tend to be focused on companies principally engaged in alternative energy field. However, such indexes tend to be very narrow, small cap-oriented and thus capacity-constrained.

During the four-year period studied, returns for both the MSCI ACWI ex Coal Index and MSCI ACWI ex Fossil Fuels Index surpassed the MSCI ACWI Index, reflecting the poor performance of the energy sector.

Exhibit 5: Key Metrics of the MSCI ACWI ex Coal and Ex Fossil Fuels Indexes

	MSCI ACWI	MSCI ACWI ex Coal Index	MSCI ACWI ex Fossil Fuels Index
Total Return* (%)	11.4	11.7	12.5
Total Risk* (%)	13.3	13.1	12.8
Return/Risk	0.86	0.89	0.97
Sharpe Ratio	0.84	0.88	0.96
Active Return* (%)	0.0	0.3	1.1
Tracking Error* (%)	0.0	0.3	1.0
Information Ratio	NA	1.18	1.06
Historical Beta	1.00	0.99	0.96
Turnover** (%)	2.0	2.2	2.3
Active Share (%)^	NA	1.1	8.0
#securities excluded	NA	28	127
% market cap excluded	NA	1.1	8.0
Carbon emissions (Gt)^	7.0	6.7	5.7
Reduction from benchmark		4%	18%
Carbon reserves (Gt)	175	98	0
Reduction from benchmark		44%	100%
Carbon Emission Intensity (t CO2/mm USD)	248	239	217
Reduction from benchmark		4%	13%
Carbon Reserves Normalized by Market Cap (t CO2/mm USD)	4,964	2,763	0
Reduction from benchmark		44%	100%

* Gross returns annualized in USD for the 11/30/2010 to 11/28/2014 period

** Annualized one-way index turnover for the 11/30/2010 to 11/28/2014 period

Weighting Strategies: Short-Term vs. Long-Term Financial Risk

Institutional investors face a trade-off between short-term and long-term risk when seeking to *increase* exposure to more carbon-efficient companies and to *lower* exposure to large current and future carbon emitters. In the long run, investors may reduce the risk of emitters' stocks underperforming from future and unforeseen changes in environmental regulations, technological changes or market forces. In shorter time periods, however, the low carbon portfolio may lag a "traditional" broad equity market portfolio because of differences in their weighting strategies, e.g., an underweight in energy stocks may cause relative underperformance relative to the benchmark when energy sectors outperforms the market, and thus be considered sub-optimal. The alternative of trying to keep a low carbon indexed portfolio as close as possible to a broad market portfolio may have no significant impact on the carbon exposure of the portfolio and thus may not mitigate related long-term financial risks related to carbon stranded assets.

The MSCI Global Low Carbon Target Indexes aim to resolve this dilemma by first re-weighting the portfolio to minimize carbon exposure and then using portfolio optimization techniques to reduce short-term risk to the parent index.[21] Thus, the indexes attempt to address both short-term and long-term risks.

The MSCI ACWI Low Carbon Target Index exhibited ex-post tracking error of 40 basis points relative to the parent MSCI ACWI Index for the four-year period ended November 28, 2014 (Exhibit 6). This low ex-post tracking error was achieved while significantly lowering the carbon exposure of the index compared to the parent index. Carbon emission intensity (defined as tons of CO_2 equivalents emitted per million

[21] For more detail, see MSCI Global Low Carbon Target Indexes Methodology.

dollars of sales) was reduced by 78% compared to the parent index; the reduction in the potential carbon emissions normalized by market cap (measured as tons of CO_2 equivalent per million dollars of market capitalization) was 97%.

Exhibit 6: Key Metrics of the MSCI Global Low Carbon Target Index

	MSCI ACWI	MSCI ACWI Low Carbon Target
Total Return* (%)	11.4	11.8
Total Risk* (%)	13.3	13.2
Return/Risk	0.86	0.89
Sharpe Ratio	0.84	0.88
Active Return* (%)	0.0	0.4
Tracking Error* (%)	0.0	0.4
Information Ratio	NA	0.98
Historical Beta	1.00	1.00
Turnover** (%)	2.0	12.5
Active Share (%)^	NA	21.8
#securities excluded	NA	0
% market cap excluded	NA	0.0
Carbon emissions (Gt)^	7.0	1.3
Reduction from benchmark		81%
Carbon reserves (Gt)	175	5
Reduction from benchmark		97%
Carbon Emission Intensity (t CO2/mm USD)	248	54
Reduction from benchmark		78%
Carbon Reserves Normalized by Market Cap (t CO2/mm USD)	4,964	155
Reduction from benchmark		97%

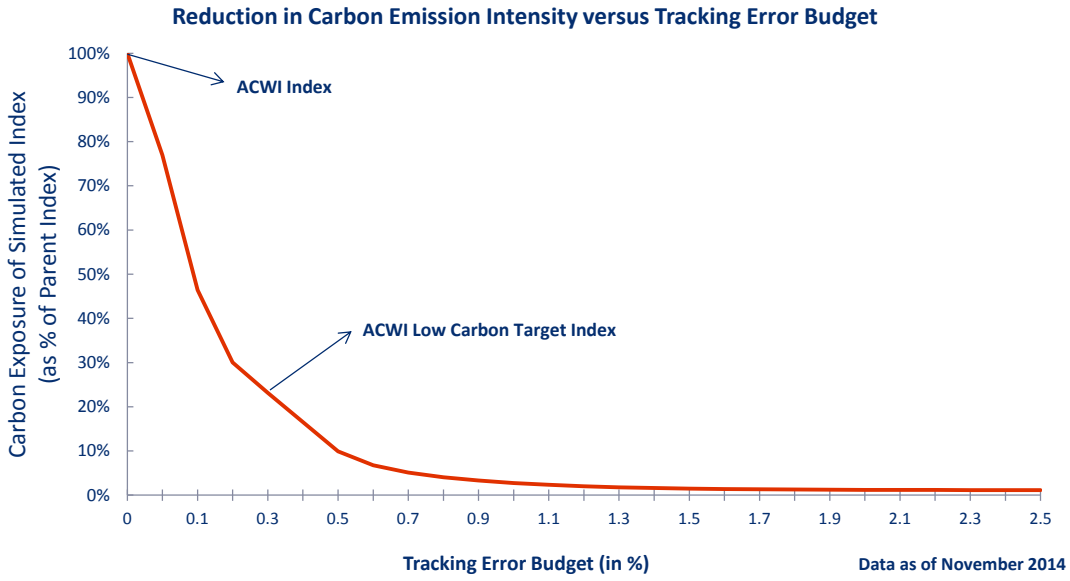
* Gross returns annualized in USD for the 11/30/2010 to 11/28/2014 period

** Annualized one-way index turnover for the 11/30/2010 to 11/28/2014 period

Finding the optimal level of carbon exposure

Investors can also expand the desired level of tracking error in an effort to reduce carbon exposure. However, empirical evidence suggested that increases in the *ex-ante* tracking error budget beyond a certain limit resulted in only a marginal corresponding reduction in carbon exposure, as can be seen in Exhibit 7.

Exhibit 7: Increasing Tracking Error Budget Yields Diminishing Results



Over-Weighting and Selecting Strategies: The Middle Road

A strategy that accounts for short-term and long-term financial risks while retaining the ability to make strong public statements offers another option. Under this approach, re-weighting and selection may very well be combined into one single strategy. The MSCI Global Low Carbon Leaders Indexes aim to select the companies with low carbon emissions relative to sales and those with low potential carbon emissions per dollar of market capitalization. They also aim to minimize the *ex-ante* tracking error relative to the market-cap weighted parent index while reducing carbon exposure by at least 50%.

The result is that the Leaders Index may have had an overall smaller reduction in carbon impact than the Target Index.[22] A comparison of the tracking error budgets of the Global Low Carbon Target Index and the ACWI Low Carbon Leaders Index can be seen in Exhibit 8; further detail is presented in Exhibit 9.

Exhibit 8: Comparison of Tracking Error Budget of Low Carbon Target and Leaders Indexes

	MSCI Global Low Carbon Target Index	**MSCI ACWI Low Carbon Leaders Index**
Tracking Error Budget	Aims to minimize carbon exposure with 30 bps *ex-ante* tracking error budget	Aims to minimize *ex-ante* tracking error after least carbon-efficient companies are excluded
Carbon Emission Intensity (t CO2/mm USD)	78%	50%
Carbon Reserves Normalized by Market Cap (t CO2/mm USD)	97%	50%

[22] For details, see MSCI Global Low Carbon Leaders indexes Methodology

Exhibit 9: Key Metrics of the MSCI ACWI Low Carbon Leaders Index

	MSCI ACWI	MSCI ACWI Low Carbon Leaders
Total Return* (%)	11.4	11.6
Total Risk* (%)	13.3	13.3
Return/Risk	0.86	0.88
Sharpe Ratio	0.84	0.86
Active Return* (%)	0.0	0.2
Tracking Error* (%)	0.0	0.5
Information Ratio	NA	0.49
Historical Beta	1.00	1.00
Turnover** (%)	2.0	6.2
Active Share (%)^	NA	16.2
#securities excluded	NA	497
% market cap excluded	NA	15.5
Carbon emissions (Gt)^	7.0	3.7
Reduction from benchmark		47%
Carbon reserves (Gt)	175	88
Reduction from benchmark		50%
Carbon Emission Intensity (t CO2/mm USD)	248	124
Reduction from benchmark		50%
Carbon Reserves Normalized by Market Cap (t CO2/mm USD)	4,964	2,482
Reduction from benchmark		50%

* Gross returns annualized in USD for the 11/30/2010 to 11/28/2014 period

** Annualized one-way index turnover for the 11/30/2010 to 11/28/2014 period

The MSCI ACWI Low Carbon Leaders Index also experienced higher tracking error (0.5%) with respect to the parent index than the MSCI ACWI Low Carbon Target Index (0.4%). As a reminder, the *ex-ante* tracking error is constrained for the Target Index; in contrast, *ex-ante* tracking error is minimized after the selection of most carbon-efficient securities for the ACWI Leaders Index. As a result, there is no upper bound on the value of the tracking error for the Low Carbon Leaders Index.

Comparing the Different Approaches: What Matters?

Institutional investors have a variety of options dependent upon their investment beliefs and constraints, as well as their available resources and willingness to take a public stance.

MSCI Low Carbon Indexes, which can form the basis for portfolios, target different levels of carbon exposure reduction, across both dimensions of carbon risk, i.e., current carbon emissions and fossil fuel reserves, at different levels of tracking errors while offering similar risk and return profiles.

- Selecting companies not active in the coal industry is the closest to a "traditional" market capitalization-weighted portfolio as the MSCI ACWI ex Coal Index excluded fewer than 30 stocks globally and thus yields the lowest realized tracking error to the parent index among all solutions, though it achieves only a 44% reduction in future potential carbon emissions. Use of such an approach does, however, provide a clear and targeted statement.

- The pure re-weighting approach using optimization, illustrated with the MSCI Global Low Carbon Target Indexes, yielded by far the largest carbon exposure reduction both in terms of current and future emissions while keeping a tight control on tracking error. The Target Indexes have a complex methodology, making it tougher to explain stances to stakeholders but they also allow investors to engage carbon-intensive companies over their practices.
- The balanced approach of re-weighting stocks that first excludes carbon-intensive companies from the universe, i.e., the MSCI Global Low Carbon Leaders Indexes, exhibited as expected a reduction in both carbon exposure reduction and tracking error during the relevant period. This approach has slightly underperformed the pure re-weighting approach using optimization to yield the highest carbon reduction and outperformed the pure selection approach as it did not use any re-weighting techniques in the period studied. Investors can readily communicate to stakeholders that the Leaders Indexes explicitly exclude major polluters (though the optimization methodology is more complex).

We summarize the pros and cons of the global Low Carbon indexes and the MSCI Fossil Fuels Exclusion Indexes and compare key metrics of the indexes to the parent in Exhibits 10, 11 and 12, respectively.

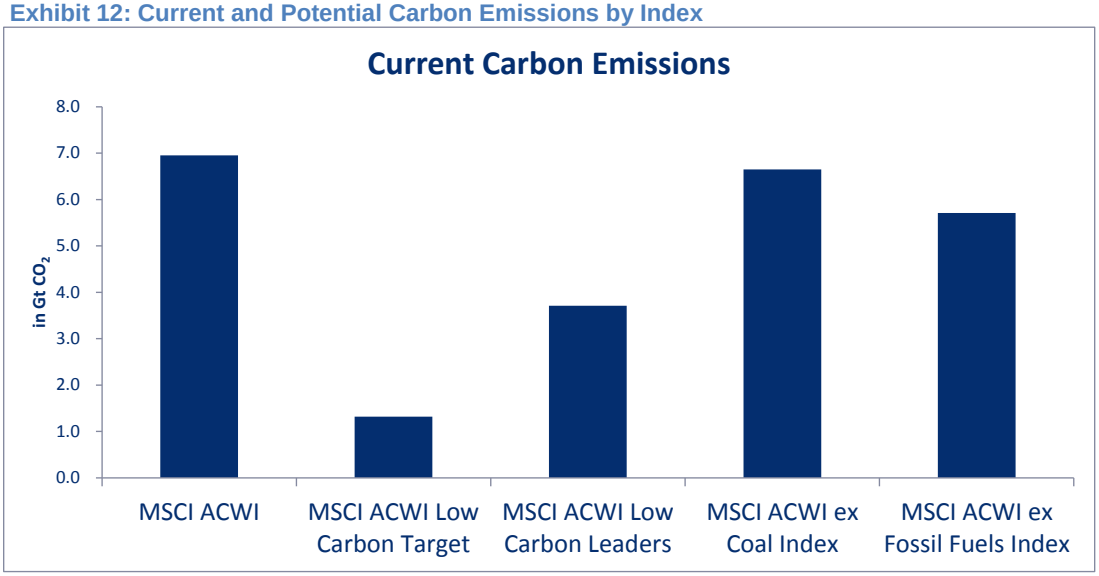
Exhibit 10: Comparison of Global Low Carbon and Global Fossil Fuels Exclusions Indexes

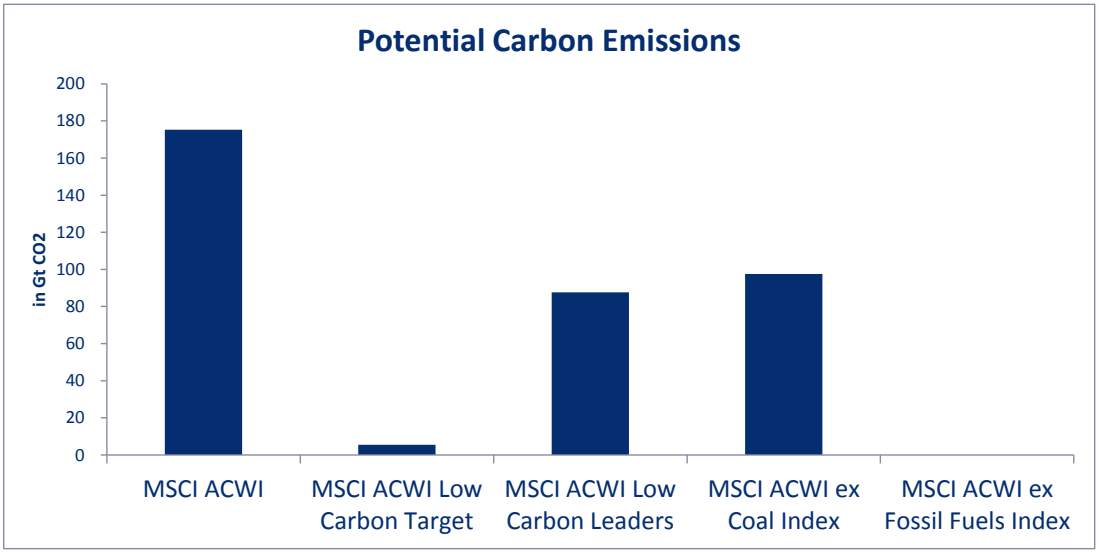
	MSCI Global Fossil Fuels Exclusion Index	MSCI Global Low Carbon Target Index	MSCI Global Low Carbon Leaders Index
Approach used in index design	*Selection*	*Re-Weighting*	*Selection + Re-Weighting*
Short term risk	Not considered	Uses optimization to reduce tracking error to parent index	Uses optimization to reduce tracking error to parent index
Long term thesis	Exposure reduction based solely on selecting companies with low fossil fuel reserves	Uses optimization to reduce exposure to companies most vulnerable to stranded assets (i.e., exposed to current and future emissions) while retaining complete opportunity set	Exposure reduction based on selecting companies with low current carbon emission and low fossil fuel reserves
Stakeholder communication	Transparent and simple methodology	Sophisticated methodology, could be more difficult to explain	Selection methodology is transparent and simple BUT weighting methodology could be more difficult to explain
Public Stance	Excluding stocks makes strong public statement	Allows for engagement with companies	Excluding stocks makes strong public statement

Exhibit 11: Key Metrics of MSCI ACWI Low Carbon Indexes

	MSCI ACWI	MSCI ACWI Low Carbon Target	MSCI ACWI Low Carbon Leaders	MSCI ACWI ex Coal Index	MSCI ACWI ex Fossil Fuels Index
Total Return* (%)	11.4	11.8	11.6	11.7	12.5
Total Risk* (%)	13.3	13.2	13.3	13.1	12.8
Return/Risk	0.86	0.89	0.88	0.89	0.97
Sharpe Ratio	0.84	0.88	0.86	0.88	0.96
Active Return* (%)	0.0	0.4	0.2	0.3	1.1
Tracking Error* (%)	0.0	0.4	0.5	0.3	1.0
Information Ratio	NA	0.98	0.49	1.18	1.06
Historical Beta	1.00	1.00	1.00	0.99	0.96
Turnover** (%)	2.0	12.5	6.2	2.2	2.3
Active Share (%)^	NA	21.8	16.2	1.1	8.0
#securities excluded	NA	0	497	28	127
% market cap excluded	NA	0.0	15.5	1.1	8.0

Exhibit 12: Current and Potential Carbon Emissions by Index

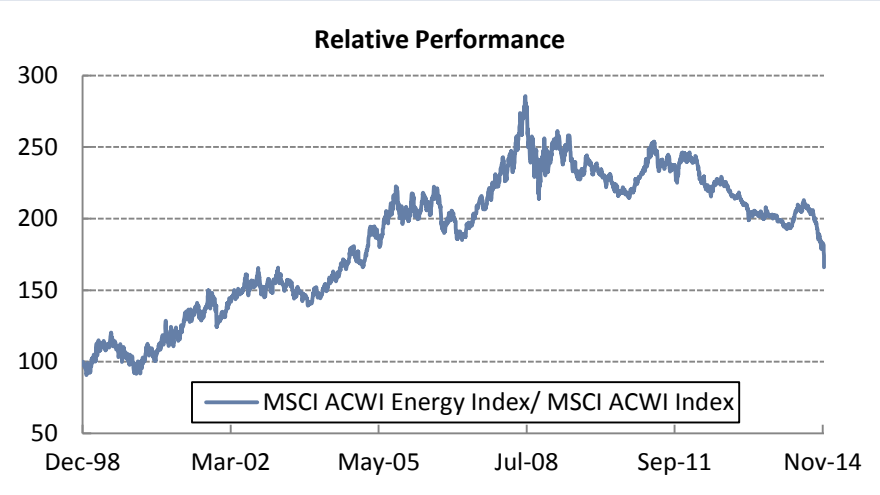




Structurally under weighting energy

Low carbon and fossil fuels exclusion approaches generally displayed significant underweights to the energy sector. Consequently, funds tracking these indexes generally underperformed the parent index when energy stocks thrived. Conversely, these indexes outperformed the parent when the energy sector posted negative performance.

Exhibit 13: Cyclicality of Global Energy Sector



Source: MSCI

As illustrated above, the global energy sector displayed cyclical behavior with years of outperformance followed by years of underperformance. This is one of the important drivers of the positive relative performance of the MSCI Low Carbon and MSCI Fossil Fuels Exclusion Indexes described above for the period November 2010 to November 2014.

As a word of caution, it is important to understand that if and when the energy sector recovers, these indexes may experience periods of underperformance compared to broad market benchmarks.

Conclusion

Approaches based on divesting certain sectors effectively can help asset owners communicate their concerns about the risks of climate change to stakeholders. However, they ignore short-term benchmark risk. Further, a focus on divesting reserves disregards fixed assets that are at risk of losing value because they depend on burning fossil fuel reserves. This paper provides a framework for evaluating ways to reduce two dimensions of carbon exposure – current carbon emissions and potential future emissions embedded in fossil fuel reserves. Moreover, it explores new and more financially viable ways of managing carbon risk based on institutional investors' tolerance for short-term risk, the long-term risk of holding stranded assets, the importance of stakeholder communications and their readiness to take a public stance.

Investors can evaluate different MSCI index options that could be used as the basis for portfolios. They are designed to meet the needs of various institutional investors:

- The MSCI Fossil Fuels Exclusion Indexes seek to exclude companies owning fossil fuel reserves. This selection-based approach enables investors to reflect a desire or need for clear stakeholder communication but it ignores short-term tracking error risk.
- The MSCI Global Low Carbon Target Indexes use a re-weighting methodology that seeks to increase exposure to more carbon-efficient companies and decrease exposure to large current and future emitters. These indexes are designed to account for both short-term and long-term risks and use optimization techniques to manage exposures while aiming to minimize deviation from the parent index in terms of risk and return characteristics.
- The MSCI Global Low Carbon Leaders Indexes methodology uses a hybrid approach, selecting companies with low current carbon emissions and low potential carbon emissions while optimizing the index to take short- and long-term risks into account. This approach excludes the least carbon-efficient companies, helps investors to communicate their views to stakeholders and support a public stance, though the indexes may not achieve the same level of carbon reduction as the Target Indexes.

With the use of more sophisticated techniques, investors can now explore index-based approaches that aim to reduce short-term risk as well as the long-term risk associated with carbon exposure. In addition, these approaches are more expansive than traditional approaches, encompassing both current and future emissions, going to the heart of risk mitigation.

Appendix: Asset Owners Embrace Low Carbon

Over the past 12 to 24 months, a growing number of large asset owners globally have announced that they plan to gear an increasing portion of their investments towards the "green" investments in general and towards low carbon solutions in particular. Some major asset owners believe that global warming may be a key risk factor in the long run that could affect their ability to meet future obligations. A growing number are integrating low carbon investments in their tactical or even strategic asset allocation.

Institutions Adopt Low Carbon Approaches: Use Cases

Fourth Swedish National Pension Fund (AP4) and Fonds de Réserve pour les Retraites (FRR)

AP4 and FRR announced jointly in September 2014 that they would each invest up to 1 billion Euros in low carbon investment solutions to reduce the carbon footprint of their global portfolios.[23] Both institutional investors have been active in environmental issues for a number of years and believe that carbon is a major issue for the broad investment community, for environmental and financial risk reasons. Both invested in passive indexed solutions based on the MSCI Global Low Carbon Leaders Index methodology.

The United Nations Joint Staff Pension Fund (UNJSPF)

Following the UN Secretary-General's Climate Summit in September, the UNJSPF provided seed capital totalling USD 150 million to two low carbon Exchange Traded Funds based on the MSCI Global Low Carbon Target Index methodology.[24]

Stanford University

Stanford University said in May 2014 that its endowment fund would sell off all its holdings in coal mining companies,[25] becoming the largest U.S. institution to join the growing number of colleges divesting from fossil fuels because of concerns about climate change. The decision to divest from coal mining companies was based on the view that "burning coal for electricity created high levels of carbon dioxide emissions, and there were other sources for power that could be readily substituted and did less damage to the environment." The university's endowment fund would not sell its holdings in oil and gas companies, on the grounds that suitable alternatives to those fuels are not readily available.

[23] MSCI Launches Innovative Family of Low Carbon Indexes, September 2014.

[24] UNJSPF Performance and Asset Allocation, December 2014

[25] Stanford to divest from coal companies, Stanford Report, May 2014

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The company's flagship product offerings are: the MSCI indexes with over USD 9.5 trillion estimated to be benchmarked to them on a worldwide basis1; Barra multi-asset class factor models, portfolio risk and performance analytics; RiskMetrics multi-asset class market and credit risk analytics; IPD real estate information, indexes and analytics; MSCI ESG (environmental, social and governance) Research screening, analysis and ratings; and FEA valuation models and risk management software for the energy and commodities markets. MSCI is headquartered in New York, with research and commercial offices around the world.

[1] *As of June 30, 2014, as reported on September 30 2014 by eVestment, Morningstar and Bloomberg*

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