

PREPARING FOR A LOW-CARBON ECONOMY

Focusing on high-quality companies



June 2015

Jordan Dekhayser, CFA
Senior Quantitative
Research Analyst,
jdd3@ntrs.com

Northern Trust defines a "high-quality" company as one that is more profitable, more prudently managed and generates more cash flow than its peers.

Investment in publicly listed equities that consider climate change and carbon emissions continues to gain momentum globally. During 2012-2013, assets under management allocated to strategies incorporating climate change and carbon themes grew 105% to \$275.2 billion from \$134.0 billion, according to The Forum for Sustainable and Responsible Investing (USSIF).¹

A number of approaches exist to manage the carbon exposure of an equity portfolio, ranging from passive-like to fundamental stock selection. Yet carbon-related risks are just one of many possible investment objectives and concerns for asset owners. Others include generating outperformance, limiting tracking error, managing volatility or producing income. In this context, a portfolio that only considers carbon information may not be a viable solution. After all, these strategies may reduce one source of risk, but they are likely to introduce or amplify others.

We believe investors should not give up their broader investment objectives in order to achieve their low-carbon — or any other environmental, social or governance (ESG) — goals. The carbon exposure of an equity portfolio is one risk that has garnered increased attention recently. Of course, every company emits greenhouse gases into the atmosphere, either directly or indirectly. However, as current regulation stands, the potential costs of this externality are not assigned directly or completely to companies creating the emissions. The issue of “who should pay” is complex. For investors, the risk is that high-carbon-emitting companies will face substantial unexpected costs from potential regulation. Further, if these regulations are based on a company’s carbon emissions, then their impact would be felt more acutely in certain sectors, namely utilities, materials, and energy. In addition, oil-and-gas exploration and production companies mainly derive their valuations from their carbon reserves, and therefore could be negatively affected by both divestment campaigns and changing norms and regulations.

The amount of greenhouse gas emissions any company emits into the atmosphere — typically converted to a carbon equivalent and known in the lexicon as its carbon footprint — is directly related to its products and services and the energy intensity needed to produce them. For a subset of companies holding fossil fuel reserves, such as those belonging to the

NORTHERN TRUST WORLD QUALITY LOW-CARBON SOLUTION

The Northern Trust World Quality Low-Carbon solution is designed to provide exposure to high-quality companies while reducing the carbon footprint of the portfolio along two carbon dimensions – carbon emissions and potential carbon emissions (from fossil fuel reserves). This solution combines the virtues of factor-based investing within a low-carbon framework while controlling for other risks. Over an analysis period of slightly more than four years, our solution outperformed the MSCI World index by over 2% per year while realizing modest tracking error and significantly reducing the carbon footprint. Exhibit 9 shows the details to the backtested results.

By providing quality exposure and a reduction in the carbon emissions and potential carbon emissions (from fossil fuel reserves) of a portfolio, our solution will leave investors’ portfolios prepared for a move toward a low-carbon economy.

Objectives: Maximize exposure to quality
Reduce carbon footprint by approximately 80%

Constraints: Country; sector; style factor; turnover



oil-and-gas exploration and production global industry classification standard (GICS) sub-industry, an additional and potentially significant risk exists. These companies are specifically exposed to the risk — known as “stranded asset” risk — that their fossil fuel reserves are written down as increasingly draconian measures are taken to fight the adverse impact of climate change (see Contextualising Stranded Asset Risk below).

CONTEXTUALIZING STRANDED ASSET RISK

At the 2010 United Nations Framework Convention on Climate Change (UNFCCC) meeting in Cancun, governments worldwide agreed “that climate change is one of the greatest challenges of our time” and that keeping the global temperature no greater than 2 degrees Celsius above pre-industrial levels is a goal that requires “urgent action²”. Using the 2 degrees C benchmark, research³ was conducted to calculate the planet’s carbon budget based on a number of probabilistic scenarios. This research has formed the foundation for the conclusion by some⁴ that for the 2 degrees C goal to be achieved, a large portion of fossil fuel reserves held on companies’ balance sheets will need to be written down. Furthermore, some suggest⁵ that financial markets are not appropriately pricing the risk of these write-downs. Alternatively, others contend that there is no carbon bubble and that fossil fuel reserves are being valued appropriately under reasonable assumptions about the path of carbon related regulations.⁶

Only time will tell which school of thought is correct. Yet these risks are compelling investors to consider the following questions:

- Is there a carbon bubble such that markets are systematically underpricing the risk of stranded fossil fuel reserves that publicly listed companies hold on their balance sheets?
- Is the cost of regulation related to emitting greenhouse gases being priced appropriately?
- What can or should investors do about these risks?

For many investors, taking no action to account for stranded asset risk within their equity portfolio may be the proper course. After all, stranded assets are possible in any industry as new technologies render old technologies obsolete, and in any event, efficient market hypothesis suggests that these risks are already priced into valuations. Yet we know that markets can systematically misprice risk, such as they did during the dot-com bubble and the sub-prime credit crisis. Further, unlike with digital cameras rendering camera film obsolete, some investors see a moral imperative as well as a financial one to counteracting climate change. For those investors looking to address the carbon footprint of their portfolio, there are a number of different approaches.

REDUCING THE CARBON FOOTPRINT

Typically, depending on their unique investment objectives and responsible investing policies, investors choose from three different approaches to adjust carbon risk:

1. exclusion and reweighting;
2. exclusion and optimization; or
3. optimization with no exclusions (Exhibit 1).

Many existing solutions under each category are passive-like, meaning they aim to reduce the portfolio’s carbon content without taking on meaningful tracking error to the parent index. Some do a better job of controlling for risk than others.

Here we look at Northern Trust research into a quality low-carbon solution that can deliver a substantially reduced carbon footprint and exposure to a proprietary quality factor. Our analysis shows that high-quality companies have outperformed low-quality companies when measured over a full business cycle.⁷ A high-quality company is more profitable, managed more prudently, and generates more cash flow than its peers. In other words, high-quality companies have the financial strength to meet the coming challenges and costs of a movement toward a low-carbon economy. We believe these features are necessary for success in a low-carbon economy.

We researched the topic of quality extensively, and many of our equity strategies use our proprietary quality definition as a key component. We find that in addition to strong

EXHIBIT 1: APPROACHES TO REDUCE THE CARBON FOOTPRINT

	Approach 1: Exclude and Reweight	Approach 2: Exclude and Optimize	Approach 3: Optimize with no exclusions
Description	Exclude companies that meet carbon criteria (for example, potential carbon emissions > 0) then cap-weight the remainder	Exclude companies that meet carbon criteria, then optimize to desired specifications	Optimize to reduce the carbon footprint while controlling for other risks or seeking other objectives
Examples	FTSE Fossil Fuel Free S&P/IFCI Carbon Efficient Index	MSCI Low Carbon Leaders S&P U.S. Carbon Efficient Index	MSCI Low Carbon Target Northern Trust World Quality Low-Carbon
Benefits	Effective at reducing carbon footprint Well-defined exclusions Lower Turnover	Effective at reducing carbon footprint Well-defined exclusions Lower Tracking Error	Effective at reducing carbon footprint Lower Tracking Error Consistent investable universe
Considerations	Exclusions are somewhat arbitrary No risk controls Higher tracking error	Potentially higher turnover Exclusions are somewhat arbitrary Less transparent	Potentially higher turnover Wide range of tracking error Less transparent

Sources: MSCI, FTSE, Northern Trust. S&P Dow Jones

performance as a stand-alone factor, quality pairs well with other factors such as volatility, value, ESG datasets or in this case, carbon data. The Northern Trust World Quality Low-Carbon solution focuses on high-quality companies and judiciously uses the portfolio’s “carbon budget.”

To help explain the Northern Trust World Quality Low-Carbon solution, we use a “budget” analogy. The solution has a carbon budget amounting to approximately 20% of the carbon footprint of the parent index, the MSCI World index. We look to spend that budget wisely on companies that bring other benefits, primarily high quality, to the portfolio. Generally speaking, we focus on owning companies that are simultaneously high quality and low carbon emitters. Further, we look to control other risks – such as sector, country and style factor exposures – in order to provide this portfolio at a modest amount of tracking error to the parent index.⁸

CALCULATING CARBON FOOTPRINT

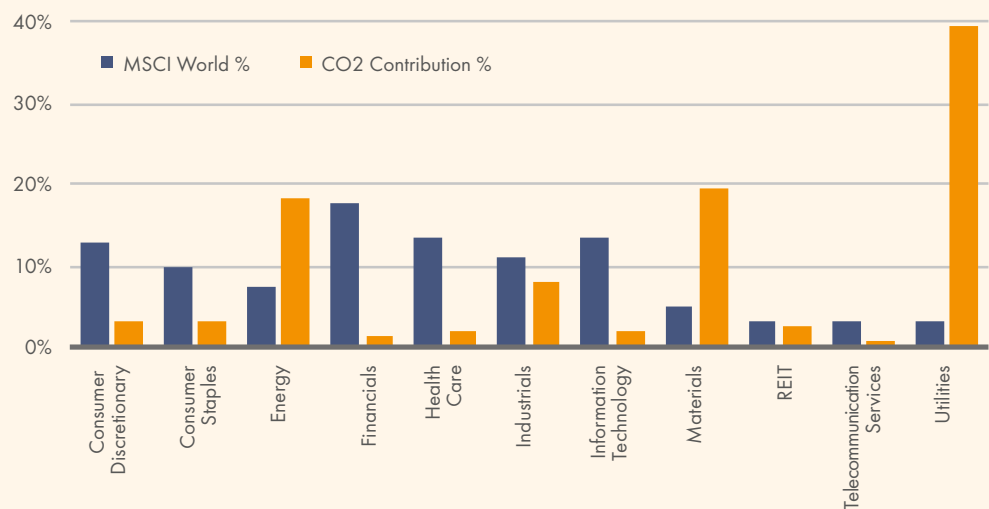
A stock's or stock portfolio's carbon footprint is typically measured along two dimensions: carbon emissions and potential carbon emissions (from fossil fuel reserves). The emissions and potential emissions numbers are then scaled to control for the size of underlying companies. Thus, the term "carbon intensity" refers to a company's carbon emissions in tons divided by its sales (tons/million dollars in sales); a company's potential carbon emissions in tons are divided by its market capitalization (tons/millions of dollars of market cap).

To determine the carbon footprint of an equity portfolio, we add all the carbon emissions (or potential emissions) and divide this by the sum of all the sales (or market capitalization). To determine the amount of carbon footprint reduction, we use the same process for the portfolio and the index to calculate the carbon footprints of each and compute the reduction by subtracting the ratio of the portfolio footprint to the index footprint from the number one.⁹

BALANCING THE RISKS

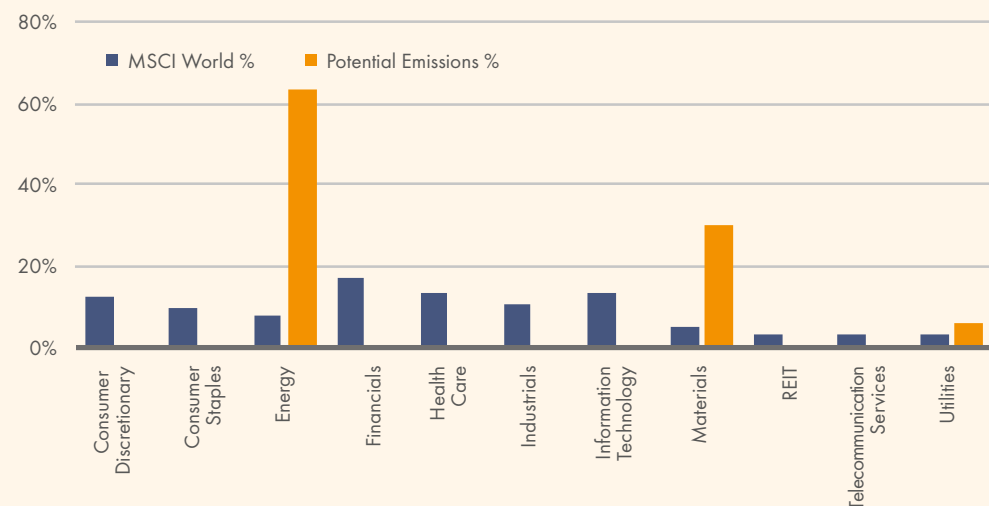
Unsurprisingly, emissions and potential emissions within the MSCI World Index both are concentrated in certain sectors, as Exhibits 2 and 3 show. The energy, materials and utilities sectors contribute disproportionately to their weight in the index. This is an important reminder that managing carbon risk can introduce other sometimes-obvious risks, such as sector risk. It also can introduce other less-obvious risks such as volatility, since utilities stocks tend to be lower in volatility than other sectors. Eliminating utilities stocks will, all else equal, increase the remaining portfolio's volatility. These observations support the use of optimization techniques to manage the portfolio's more-traditional investment risks.

EXHIBIT 2: CARBON INTENSITY SECTOR CONTRIBUTIONS



As of March 31, 2015. Sources: Northern Trust Quantitative Research, MSCI. Scope 1 and Scope 2 emissions.

EXHIBIT 3: POTENTIAL EMISSIONS SCALED BY MARKET CAPITALIZATION SECTOR CONTRIBUTIONS



As of 31 March, 2015. Sources: Northern Trust Quantitative Research, MSCI ESG Research.

EFFICIENTLY REDUCING CARBON EXPOSURE

It is essential to consider the bigger picture and understand the investor's overall objectives for the portfolio when determining an appropriate approach to reduce a portfolio's carbon footprint. Is the main objective carbon footprint reduction, low tracking error, alpha generation, or some combination thereof? Even if reducing a portfolio's carbon footprint is most important, it is unlikely to be the only objective. Exhibit 4 shows how stocks of varying carbon intensity are distributed along the quality dimension. Companies are placed into one of five quintiles based on their carbon intensity (5 being the highest carbon intensity), and we then show the quality quintile distribution within each carbon intensity bucket. Within each carbon intensity quintile, there are both high- and low-quality companies. For example, out of the 15.7% of the index in the highest carbon-intensity bucket, 47.2% of those companies are either in the first or second quality quintile.¹⁰

Exhibit 4 shows the distribution demonstrating that quality and carbon intensity are fairly independent of each other. This distribution is desirable in a portfolio construction context as it allows us to focus on companies that are both high quality and low carbon intensity with more diversified results.

EXHIBIT 4: MSCI WORLD'S CARBON INTENSITY DISTRIBUTION, BY QUALITY

	(Highest Quality) 1	2	3	4	(Lowest Quality) 5	Total
(Lowest Carbon) 1	7.76%	4.16%	3.72%	3.65%	3.66%	22.94%
2	3.74%	5.35%	3.84%	5.25%	2.41%	20.60%
3	5.63%	4.04%	5.97%	4.69%	3.30%	23.64%
4	3.87%	3.93%	4.50%	3.09%	1.75%	17.13%
(Highest Carbon) 5	4.66%	2.75%	3.90%	2.52%	1.86%	15.69%
Total	25.66%	20.23%	21.93%	19.20%	12.98%	100.0%

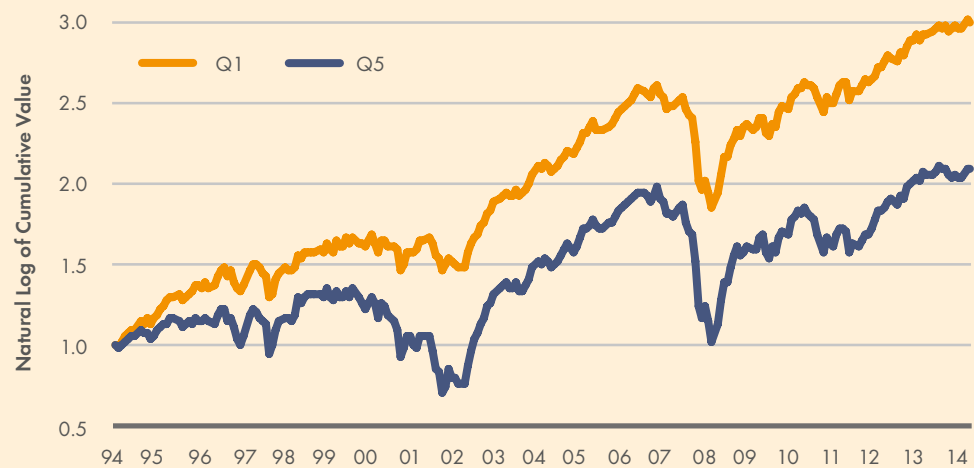
As of March 31, 2015. Weights represent the market cap weight of the carbon-quality combination.

Sources: Northern Trust Quantitative Research, MSCI. Emissions used for calculation are Scope 1 and Scope 2.

Note: Both the carbon and quality buckets are sector-neutral in order to focus on the distribution within sectors and not between them.

Until recently, performing analysis of incorporating carbon datasets into a quantitative investment process encountered immediate issues of coverage and history. These limitations are the reason for restricting our analysis to a four-year period; however, the results indicate that a low-carbon strategy can work in conjunction with a factor-based approach focused on high-quality companies. Furthermore, although the carbon data availability does introduce limitations, our research in “What is Quality” (2014) on the long-run performance of high-versus low-quality companies is more comprehensive. Exhibit 5 shows the performance of the top and bottom quintiles of quality from December 31, 1994, through March 31, 2015. Over that horizon, the highest-quality quintile (Q1) outperformed the lowest-quality quintile (Q5) by 4.9% per year with 3.8% less volatility (see Exhibit 6). This exhibit also displays a factor-mimicking portfolio that is equal parts long Q1 and short Q5 and rebalances monthly. This portfolio is labeled “high minus low.”

EXHIBIT 5: PERFORMANCE OF TOP- AND BOTTOM-QUALITY QUINTILES FOR MSCI WORLD¹¹



December 31, 1994 — March 31, 2015. December 1994 marks the beginning of our dataset. Portfolios are equal-weighted. Sources: Northern Trust Quantitative Research, Factset.

EXHIBIT 6: RISK AND RETURN FOR TOP- AND BOTTOM-QUALITY QUINTILES FOR MSCI WORLD

	High Quality	Low Quality	High minus Low
Return	10.40%	5.53%	3.76%
Std. Deviation	15.22%	19.02%	5.93%
Return/Risk	0.68	0.29	0.63

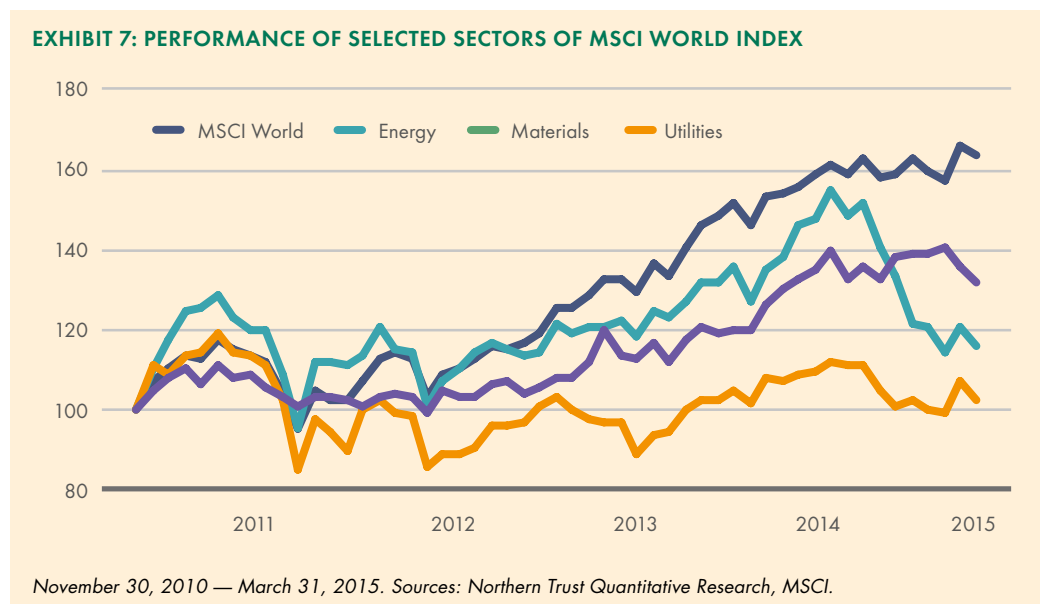
December 31, 1994 — March 31, 2015. Portfolios are equal-weighted. Return and standard deviation figures are annualized. Sources: Northern Trust Quantitative Research, Factset.

The Northern Trust World Quality Low Carbon solution is constructed to maximize exposure to our quality factor while reducing the carbon footprint (both emissions and potential emissions) by approximately 80%.¹² This carbon footprint reduction target is intended to achieve a meaningful reduction while allowing for flexibility to achieve the portfolio’s other objectives. We then add a number of constraints designed to manage unintended exposures and to make the solution investible, such as country, sector, style factor, and turnover. And finally, we limit the estimated tracking error to a modest 1.0%.¹³

INVESTMENT RESULTS

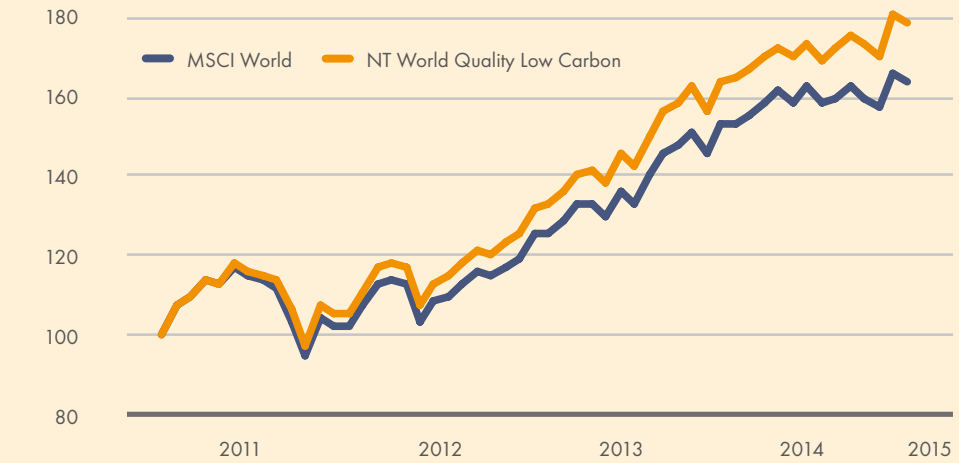
Over an analysis period of slightly more than four years, the Northern Trust World Quality Low Carbon solution has outperformed the MSCI World index by an annualized 2.21% per year since inception, with a realized tracking error of 1.08%. Dividing the active return by the realized tracking error yields an impressive information ratio of 1.84. Some of the performance is due to the natural sector exposures that will occur when managing a portfolio with a substantially reduced carbon footprint. These exposures are controlled but not eliminated in our solution. In fact, we would have likely benefited had we decided to let these exposures go unmanaged, but the resulting portfolio would not be stable out of sample. For example, three of the four worst-performing sectors on a risk-adjusted basis over the analysis period are “high-carbon” sectors (see Exhibit 7). Our testing period was a particularly difficult time for commodity-related sectors (and for the low-volatility utilities sector). With a longer perspective starting in December 1994, these same “high-carbon” sectors rank third, fourth, and 10th, indicating that the more-recent results are a time-specific phenomenon. We discuss return attribution in greater detail later in this section.

Exhibits 7 and 8 show the performance of certain “high-carbon” sectors, and the performance of the Northern Trust World Quality Low-Carbon solution versus the MSCI World index, respectively. Exhibit 9 shows selected risk-and-return characteristics. Exhibit 10 compares the quality profile of the resulting portfolio to the MSCI World index.



The Northern Trust World Quality Low Carbon solution is constructed to maximize exposure to our quality factor while reducing the carbon footprint (both emissions and potential emissions) by approximately 80%.

EXHIBIT 8: PERFORMANCE COMPARISON OF NORTHERN TRUST WORLD QUALITY LOW CARBON VERSUS MSCI WORLD



November 30, 2010 — March 31, 2015. Sources: Northern Trust Quantitative Research, MSCI.

EXHIBIT 9: SELECTED RISK-AND-RETURN CHARACTERISTICS

As of March 31, 2015	Returns			
	1 Year	2 Years	3 Years	Since Inception *
MSCI World	6.56%	12.96%	12.83%	12.06%
NT World Quality Low Carbon	8.12%	14.19%	14.64%	14.27%
Excess Return	1.56%	1.23%	1.81%	2.21%

	Returns		Sharpe Ratio	
	3 Years	Since Inception *	3 Years	Since Inception *
MSCI World	10.37%	12.68%	1.29	1.02
NT World Quality Low Carbon	10.48%	12.65%	1.45	1.19

	Tracking Error		Information Ratio	
	3 Years	Since Inception *	3 Years	Since Inception *
NT World Quality Low Carbon	1.15%	1.08%	1.42	1.84

*Inception Date of November 30, 2010. From November 30, 2010 through March 31, 2015. Sources: Northern Trust Quantitative Research, MSCI.

EXHIBIT 10: QUALITY PROFILE OF NORTHERN TRUST WORLD QUALITY LOW CARBON VS. MSCI WORLD

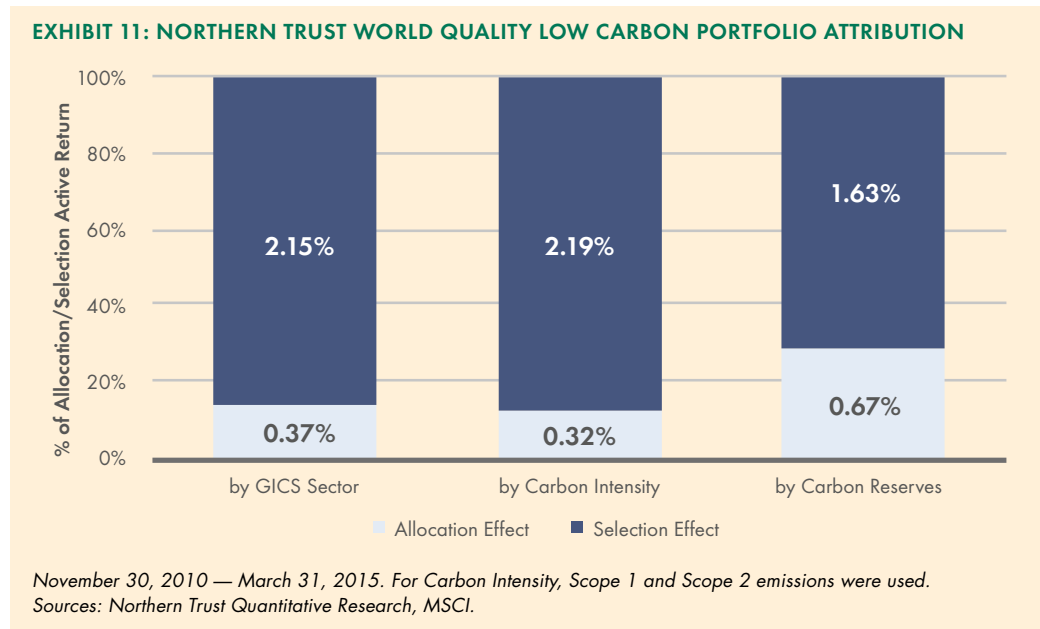
Quality quintile	NT World Quality Low Carbon %	MSCI World %	Active %
Q1	78.37%	25.66%	52.71%
Q2	19.17%	20.23%	-1.07%
Q3	1.83%	21.93%	-20.10%
Q4	0.63%	19.20%	-18.57%
Q5	0.00%	12.98%	-12.98%

*Inception Date of November 30, 2010. From November 30, 2010 through March 31, 2015. Sources: Northern Trust Quantitative Research, MSCI.

The incremental risk and tracking error that reducing the carbon footprint of a portfolio produces can be diversified when paired with a known and compensated risk factor,

Exhibit 11 illustrates a Brinson analysis along several dimensions in order to attribute performance to various sources. The three grouping variables used are: GICS Sector, Carbon Intensity, and Carbon Reserves. For Carbon Intensity, we create five sector neutral quintiles in order to control for the distribution of Carbon Intensity across sectors noted in Exhibit 2. For Carbon Reserves we simply create two groups based on whether a company has reserves or not. Exhibit 11 shows the breakdown of the total allocation and selection effects. Full results are shown in Appendix I.

We can see that the selection effect is the predominant driver of portfolio returns for the Northern Trust World Quality Low-Carbon solution. For example, looking at ‘by Carbon Intensity’, we see that 87.2% of the 2.52% active return due to allocation and selection is from the selection effect. And, because the selection effect is primarily due to the Quality content of the portfolio, we conclude that much of the alpha in the portfolio can be attributed to Quality.¹⁴



We believe it is essential to look at attribution through multiple lenses as important information can be gleaned through each method. The results of this analysis cover a relatively short time horizon of four years and include a period of general commodity¹⁵ and global demand weakness. The key takeaway, however, is that the incremental risk and tracking error that reducing the carbon footprint of a portfolio produces can be diversified when paired with a known and compensated risk factor, in this case, quality. This pairing of exposures leads to a positive skew of expected tracking error outcomes, which we see when looking at the realized simulated results.

CARBON FOOTPRINT ANALYSIS

The investment results are one element of the objective of the Northern Trust World Quality Low-Carbon solution. Also of high importance is the carbon footprint of the resulting portfolio. Exhibit 12’s three panels show the information technology sector for illustrative purposes. Here, we place stocks from the information technology sector into one of five quintiles along quality and carbon intensity dimensions, with Q1 representing the highest

quality and the lowest carbon intensity. The strategy will favor stocks that fall into Q1 and Q2 on both dimensions. The first two panels show weights for the example sector in the MSCI World index and the Northern Trust World Quality Low-Carbon solution, respectively. The final panel lists the companies held along with their quality and carbon intensity quintile. Within the information technology sector, the Northern Trust World Quality Low-Carbon solution holds greater weight in stocks that are desirable along both dimensions – high quality, low carbon intensity. This is not to say that the strategy does not hold any stocks that fall outside of these bounds. In fact, given other objectives such as modest tracking error, these holdings become necessary.

These results hold generally across sectors, though the carbon intensity and carbon reserve content of certain sectors will necessarily create deviations. For example, if we look at the utilities sector, slightly more than 93% of the market cap weight belongs to the quintile with the highest carbon intensity (Q5), which causes the portfolio to be underweight at the sector level. Exhibit 13 shows sector weights of the ending portfolio.

EXHIBIT 12: INFORMATION TECHNOLOGY SECTOR ANALYSIS¹⁶

Panel 1: MSCI World

		Quality					Total
		Q1	Q2	Q3	Q4	Q5	
Carbon Intensity	Q1	27.7%	1.0%	0.8%	2.3%	0.7%	32.6%
	Q2	4.0%	0.7%	5.6%	3.9%	2.6%	16.7%
	Q3	2.9%	9.1%	1.9%	7.8%	0.6%	22.3%
	Q4	4.0%	2.2%	5.0%	0.2%	3.6%	14.9%
	Q5	2.6%	2.5%	2.7%	5.4%	0.3%	13.4%
	Total	41.2%	15.4%	16.0%	19.7%	7.7%	100.0%

Panel 2: Northern Trust World Quality Low Carbon

		Quality					Total
		Q1	Q2	Q3	Q4	Q5	
Carbon Intensity	Q1	49.4%	3.3%	0.0%	0.0%	0.0%	52.8%
	Q2	11.9%	1.3%	0.0%	0.0%	0.0%	13.2%
	Q3	8.3%	8.8%	0.0%	0.0%	0.0%	17.2%
	Q4	11.2%	2.2%	0.3%	0.0%	0.0%	13.7%
	Q5	2.9%	0.3%	0.0%	0.0%	0.0%	3.1%
	Total	83.8%	16.0%	0.3%	0.0%	0.0%	100.0%

Panel 3: Information technology stocks held in Northern Trust World Quality Low Carbon

Name	Emissions Intensity Quintile	Quality Quintile	Country	Name	Emissions Intensity Quintile	Quality Quintile	Country
Apple Inc.	1	1	United States	Keyence Corporation	3	1	Japan
MasterCard Incorporated Class A	1	1	United States	Motorola Solutions Inc.	3	1	United States
QUALCOMM Incorporated	1	1	United States	Oracle Corporation Japan	3	1	Japan
Visa Inc. Class A	1	1	United States	Fujitsu Limited	3	1	Japan
Accenture Plc	1	1	United States	Microsoft Corporation	3	2	United States
SAP SE	1	1	Germany	NetApp Inc.	3	2	United States
F5 Networks Inc.	1	1	United States	International Business Machines Corporation	4	1	United States
Intuit Inc.	1	1	United States	United Internet AG	4	1	Germany
Amadeus IT Holding SA Class A	1	1	Spain	Yahoo Japan Corporation	4	1	Japan
Otsuka Corporation	1	1	Japan	VeriSign Inc.	4	1	United States
COLOPL Inc.	1	1	Japan	Gungho Online Entertainment Inc.	4	1	Japan
KLA-Tencor Corporation	1	2	United States	Seiko Epson Corp.	4	1	Japan
Dassault Systemes SA	1	2	France	Canon Inc.	4	2	Japan
Oracle Corporation	2	1	United States	Flextronics International Ltd.	4	2	United States
Paychex Inc.	2	1	United States	Intel Corporation	4	3	United States
Xilinx Inc.	2	1	United States	Seagate Technology PLC	5	1	United States
CA Inc.	2	2	United States	Linear Technology Corporation	5	1	United States
Hewlett-Packard Company	3	1	United States	Texas Instruments Incorporated	5	1	United States
Computer Sciences Corporation	3	1	United States	Western Digital Corporation	5	2	United States
Harris Corporation	3	1	United States				

As of March 31, 2015. Sources: Northern Trust Quantitative Research, MSCI. For Carbon Intensity, Scope 1 and Scope 2 carbon emissions were used.

EXHIBIT 13: SECTOR BREAKDOWN OF NORTHERN TRUST WORLD QUALITY LOW CARBON SOLUTION

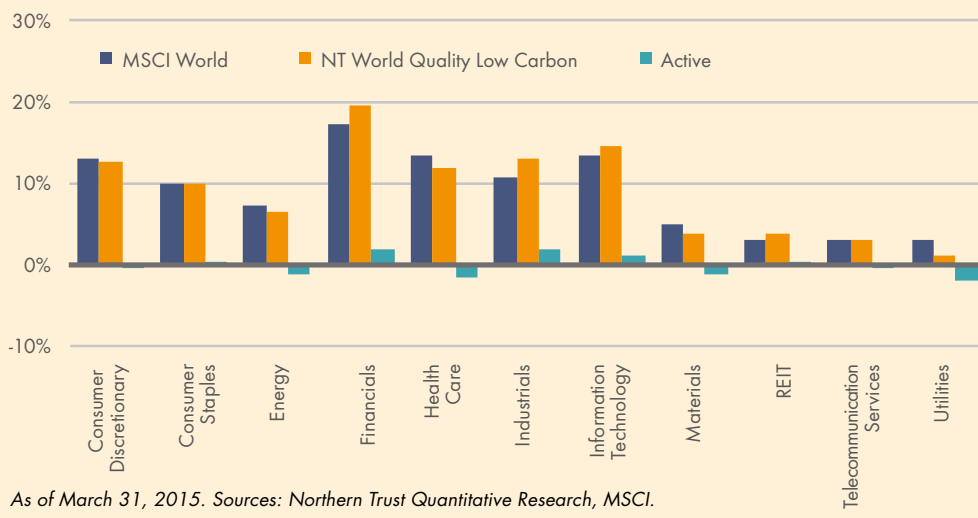


Exhibit 13 highlights the construction results for an individual sector. When we take a top-level view of the Northern Trust World Quality Low-Carbon solution, we can see that the overall carbon footprint is substantially reduced. Exhibits 14 and 15 show the carbon footprints of the MSCI World index as well as the Northern Trust World Quality Low-Carbon solution. Both dimensions of the carbon footprint — emissions intensity and potential emissions scaled by market cap — are reduced by nearly 80% in the ending portfolio.

EXHIBIT 14: CARBON (CO₂) INTENSITY (T/\$MN SALES)

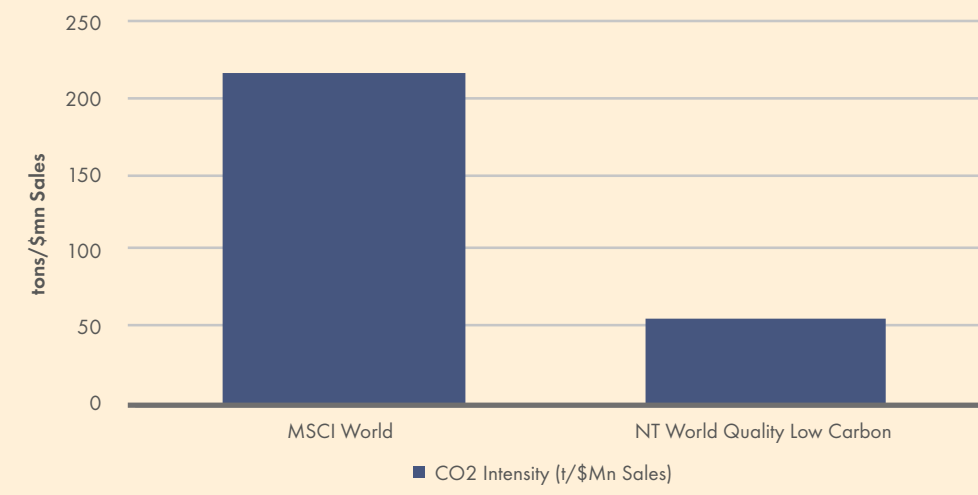
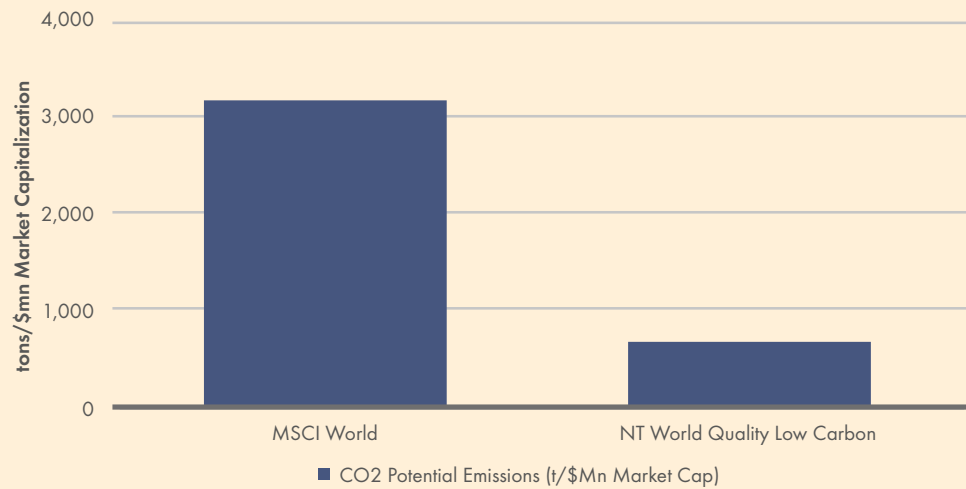


EXHIBIT 15: POTENTIAL CARBON (CO₂) EMISSIONS (T/\$MN MARKET CAPITALIZATION)



As of March 31, 2015. Sources: Northern Trust Quantitative Research, MSCI ESG Research.

MANAGING CARBON FOOTPRINT

The idea of managing the carbon footprint of an equity portfolio is relatively new. Many of the solutions currently available tend to focus solely on the footprint reduction without considering other potential sources of risk and return.

Quality is of particular interest because it focuses on a company's financial strength, which is necessary to meet the cost of potential carbon-based regulations. Investors concerned with the carbon risk embedded in their equity holdings seek an approach such as the one Northern Trust offers with our World Quality Low-Carbon solution that not only addresses this risk but seeks outperformance through exposure to a proprietary quality factor in a risk-controlled framework.

TO LEARN MORE

If you would like to learn more about how you could incorporate quality and low carbon themes within your investment portfolio, please contact your Northern Trust relationship manager or contact us at:

Email: GlobalEquityStrategy@ntrs.com

Telephone: USA: +1 312 557 6117

Europe: +44 207 982 3988

Asia Pacific: +852 2918 9884

Australia & New Zealand: +61 3 9947 9385

APPENDIX I: ATTRIBUTION DETAILS

The following tables provide the support for Exhibit 11. They each provide a different lens into portfolio attribution, but in all three tables the selection effect provides the majority of the active return during the analysis horizon.

The Carbon Intensity Quintiles in Table 2 are sector-neutral in order to display the results net of sector effects. Without the sector neutralization, the highest carbon 5th quintile would primarily consist of three sectors: utilities, energy, and materials. So, for example, each quintile roughly contains a cross-sectional slice – from a sector perspective – of the underlying index.

TABLE 1: ATTRIBUTION BY GICS SECTOR

Carbon Quintiles	Average Portfolio Weight	Average Benchmark Weight	Active Weight	Portfolio Return	Benchmark Return	Total Allocation Effect	Total Selection Effect	Total Interaction Effect	Total Effect
Consumer Discretionary	11.87%	11.30%	0.57%	17.46%	16.62%	0.00%	0.13%	-0.01%	0.12%
Consumer Staples	10.55%	10.29%	0.27%	16.38%	14.11%	0.04%	0.27%	0.01%	0.32%
Energy	8.46%	10.24%	-1.78%	7.84%	3.46%	0.08%	0.37%	-0.05%	0.40%
Financials	19.02%	17.08%	1.95%	12.56%	10.66%	0.00%	0.28%	0.03%	0.31%
Health Care	10.75%	10.93%	-0.18%	24.48%	22.61%	-0.02%	0.16%	0.00%	0.14%
Industrials	13.07%	11.08%	1.99%	11.64%	11.54%	0.00%	0.00%	0.00%	0.00%
Information Technology	12.96%	12.20%	0.76%	14.03%	14.68%	0.01%	-0.04%	0.00%	-0.03%
Materials	5.19%	6.58%	-1.39%	8.38%	0.42%	0.15%	0.49%	-0.09%	0.55%
REIT	3.42%	2.89%	0.53%	12.34%	11.71%	0.00%	0.04%	0.01%	0.05%
Telecommunication Services	3.09%	3.88%	-0.79%	8.20%	10.49%	0.01%	-0.07%	0.01%	-0.06%
Utilities	1.61%	3.54%	-1.93%	20.78%	6.62%	0.10%	0.53%	-0.21%	0.42%
Total	100.00%	100.00%	0.00%	14.27%	12.06%	0.37%	2.15%	-0.31%	2.21%

TABLE 2: ATTRIBUTION BY CARBON INTENSITY QUINTILE

Carbon Quintiles	Average Portfolio Weight	Average Benchmark Weight	Active Weight	Portfolio Return	Benchmark Return	Total Allocation Effect	Total Selection Effect	Total Interaction Effect	Total Effect
(Lowest Carbon) 1	28.76%	15.05%	13.72%	14.97%	14.99%	0.33%	0.03%	0.04%	0.40%
2	27.28%	18.42%	8.86%	14.36%	12.56%	0.05%	0.27%	0.13%	0.46%
3	22.10%	23.07%	-0.97%	12.07%	8.81%	0.03%	0.69%	-0.06%	0.67%
4	14.29%	23.11%	-8.82%	15.67%	11.74%	0.03%	0.79%	-0.24%	0.58%
(Highest Carbon) 5	7.56%	20.35%	-12.78%	14.37%	13.38%	-0.11%	0.40%	-0.19%	0.11%
Total	100.00%	100.00%	0.00%	14.27%	12.06%	0.32%	2.19%	-0.30%	2.21%

TABLE 3: ATTRIBUTION BY CARBON RESERVES

Reserves (yes/no)	Average Portfolio Weight	Average Benchmark Weight	Active Weight	Portfolio Return	Benchmark Return	Total Allocation Effect	Total Selection Effect	Total Interaction Effect	Total Effect
no	96.83%	89.98%	6.86%	14.58%	13.28%	0.06%	1.25%	0.11%	1.42%
yes	3.17%	10.02%	-6.86%	4.00%	0.30%	0.60%	0.38%	-0.20%	0.79%
Total	100.00%	100.00%	0.00%	14.27%	12.06%	0.67%	1.63%	-0.09%	2.21%

Sources for Tables 1, 2, and 3: Northern Trust Quantitative Research, MSCI. From November 30, 2010 through March 31, 2015.

- ¹ "US Sustainable, Responsible and Impact Investing Trends, 2014.
- ² UNFCC, "Cancun Climate Change Conference – November 2010."
- ³ Meinhausen, et al, "Greenhouse-gas emission targets for limiting global warming to 2 °C", Nature 458, 1158-1162 April 30, 2009.
- ⁴ "The Carbon Underground: The World's Top 200 Public Companies, Ranked by the Carbon Content of their Fossil Fuel Reserves," April 2014.
- ⁵ Longstreth, B. "The Financial Case for Divestment of Fossil Fuel Companies by Endowment Fiduciaries," Huffingtonpost.com, December 6, 2013.
- ⁶ "Deflating the carbon bubble: Reality of oil and gas company valuation," HIS Energy September 2014.
- ⁷ See Understanding Factor Tilts (2013).
- ⁸ A number of factors act to determine the weight of a company in the Northern Trust World Quality Low Carbon solution. Carbon and quality content are the primary dimensions although a company may be held to satisfy other constraints, such as tracking error.
- ⁹ For further information see the July 2013 UNEP FI Investor Briefing "Portfolio Carbon: Measuring, disclosing and managing the carbon intensity of investments and investment portfolios" for an excellent resource.
- ¹⁰ We show carbon intensity because each company in the parent index has a value. Focusing on potential carbon reserves, there are only 82 out of 1635 companies that have relevant carbon reserves which would make this analysis less robust.
- ¹¹ The natural logs of the portfolio values are allow for a better visual comparison than a cumulative value chart would. Showing the cumulative value would underemphasize volatility earlier in the period.
- ¹² We say approximately because of feasibility issues. We relax the carbon footprint reduction constraint in increments of 5% until we find a solution. The actual carbon reduction constraint uses the weighted average carbon intensity/potential emissions scaled by market cap. For consistency with MSCI's carbon index series, we present the reductions in ownership terms as detailed in Appendix I of MSCI'S Low Carbon Methodology. The approaches produce similar results.
- ¹³ Tracking error measured using Barra risk models (GEM2 for the World strategy discussed in this paper).
- ¹⁴ Looking at the 'by GICS Sector' we note that the selection effect would include both quality as well as carbon information. However, this dual attribution of the selection effect would be primarily impact three sectors: utilities, energy, and materials. The carbon dimension did not play a substantial role in most other sectors that are relatively less intense.
- ¹⁵ As an example, on 31 December 2010, the active NYMEX light, sweet crude oil contract (ticker CL1) closed at 91.38. On 31 December 2014, the same contract closed at 53.27. More than 100% of this decline was in 2014.
- ¹⁶ Information Technology comprises 13.4% of MSCI World. Northern Trust World Quality Low Carbon had a 14.6% allocation to this sector as of March 31 2015. Carbon Intensity Quintile represents the quintile within the Information Technology sector.

Northern Trust © 2015. Head Office: 50 South La Salle Street, Chicago, Illinois 60603 U.S.A. Incorporated with limited liability in the U.S. Products and services provided by subsidiaries of Northern Trust Corporation may vary in different markets and are offered in accordance with local regulation. Northern Trust Asset Management comprises Northern Trust Investments, Inc., Northern Trust Global Investments Limited, Northern Trust Global Investments Japan, K.K., NT Global Advisors, Inc., and investment personnel of The Northern Trust Company of Hong Kong Limited and The Northern Trust Company.

Northern Trust Global Investments Japan, K.K. is regulated by the Japan Financial Services Agency. The Northern Trust Company has a branch in China mainly regulated by the China Banking Regulatory Commission, People's Bank of China and State Administration of Foreign Exchange. The Northern Trust Company of Hong Kong Limited is regulated by the Hong Kong Securities and Futures Commission.

In Singapore, Northern Trust Global Investments Limited (NTGIL), Northern Trust Investments, Inc. and The Northern Trust Company of Connecticut (NTCC) are exempt from the requirement to hold a Financial Adviser's Licence under the Financial Advisers Act and a Capital Markets Services Licence under the Securities and Futures Act with respect to the provision of certain financial advisory services and fund management activities. In Australia, The Northern Trust Company of Hong Kong Limited (TNTCHK) is exempt from the requirement to hold an Australian Financial Services Licence under the Corporations Act. TNTCHK is authorized and regulated by the SFC under Hong Kong laws, which differ from Australian laws.

This material is directed to professional clients only and is not intended for retail clients. For Asia Pacific markets, this material is directed to expert, institutional, professional and wholesale investors only and should not be relied upon by retail clients or investors. For legal and regulatory information about our offices and legal entities, visit northerntrust.com/disclosures. Past performance is no guarantee of future results. All material has been obtained from sources believed to be reliable, but its accuracy, completeness and interpretation cannot be guaranteed. This information does not constitute investment advice or a recommendation to buy or sell any security and is subject to change without notice. Returns of the indexes also do not typically reflect the deduction of investment management fees, trading costs or other expenses. It is not possible to invest directly in an index. Indexes are the property of their respective owners, all rights reserved.

Important Information Regarding Hypothetical Returns – Where hypothetical portfolio data is presented, the portfolio analysis assumes the hypothetical portfolio maintained a consistent asset allocation (rebalanced monthly) for the entire time period shown. Hypothetical portfolio data is based on publicly available index information. Hypothetical portfolio data contained herein does not represent the results of an actual investment portfolio but reflects the historical index performance of the strategy described which were selected with the benefit of hindsight. Components of the hypothetical portfolio were selected primarily utilizing actual historic market risk and return data. If the hypothetical portfolio would have been actively managed, it would have been subject to market conditions that could have materially impacted performance and possibly resulted in a significant decline in portfolio value.

