S&P Dow Jones Indices

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S&P Dow Jones Indices Carbon Emitter Scorecard

"Everybody talks about the weather, but nobody does anything about it"

- Charles Dudley Warner.

EXECUTIVE SUMMARY

- This report provides data on aggregate greenhouse gas emissions for major equity benchmarks across the globe.
- Two measures of efficiency, or carbon footprint, are introduced and their relative applications are discussed.
- Sectoral importance and the impact of growth/value biases are examined in the context of emissions-based analysis and investments.

The potential impact that investors may have on climate change has become a "hot" topic. The 2015 United Nations Climate Change Conference committed a majority of the world's governments to an ambitious target: limiting the increase in global temperatures to only 2˚ C above pre-industrial levels. Some corporations have been keen to lead by example; others are being asked by investors to indicate their plans. Retail investors are increasingly aware of the impact their investments may have on the climate; institutional investors are coming under increasing pressure to do the same. Regulators are examining whether or not climate impact might fall within the scope of fiduciary responsibility, while a vocal minority calls for taxation sufficiently onerous to create genuine investment risk from less efficient corporations. Everyone, it seems, is talking about it.

The potential impact that investors may have on climate change has become a "hot" topic.

Yet exactly how investors can, or should, change their behavior remains controversial. Some argue that a fiduciary role precludes choices coming at an expected investment cost. Others, more positively, are searching for ways to navigate the effects both of potential climate change and the efforts—political and otherwise—to reduce it.[1]

Even among those who wish to make "environmentally friendly" investments, there is a wide-ranging debate on how best to do so. In the background, the question remains as to how important the actions of investors can really be in meeting the goal of a "two degree economy."

[1] The economic thesis for carbon-efficient investing, while certainly of importance, is *not* a central object of this paper; a recent examination may be found in Jacob, Angana, "Carbon Efficiency: A Strategic Look," October 2015, S&P Dow Jones Indices.

S&P Dow Jones Indices has traditionally provided its clients with access to data such as earnings, valuations, market capitalization, and so on, aggregated in an appropriate manner to provide insights at the index and market levels.

While data alone cannot settle whether, or how, investors should incorporate climate concerns into their investments, we hope that this report will contribute to a better-informed debate.

OUTLINE OF MEASURES AND SOURCES

Our starting point for analysis is the S&P Global 1200, which is designed to measure large companies listed across the world's markets.

Our starting point for analysis is the S&P Global 1200, which is designed to measure large companies listed across the world's markets. Capturing approximately 70% of global equity market capitalization, the S&P Global 1200 is constructed as a composite of seven headline indices, many of which are accepted leaders in their regions. These include the S&P 500® (U.S.), S&P Europe 350, S&P/TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50, and S&P Latin America 40. Additionally, the S&P Europe 350 can be further decomposed into the S&P United Kingdom and its complement, the S&P Euro Plus. Beyond providing various emission statistics for these headline regional indices and other indices of interest, we also provide sectoral decompositions based on **GICS®** sector classifications.

Emissions are typically measured by mass of **carbon dioxide equivalent (CO_2e)**, where the "equivalent" indicates the application of a scaling factor—applied to greenhouse gasses other than carbon dioxide—that reflects their relative environmental impact. The units of preference throughout this report are **either kilotonnes (kt) or kilograms (kg) of CO_2e.**[2] Emissions data are sourced from **Trucost LLC**, an independent provider of environmental data on corporations and business lines. Trucost provides data on both **direct** and **first tier indirect** emissions on a company-by-company basis; if companies do not report or otherwise make such figures available, Trucost estimates the emissions of each company via a proprietary algorithm.[3]

To provide some real-world context to our units of measurement: a kilotonne of CO_2—that is, carbon dioxide—would fill two medium-sized swimming pools at atmospheric pressure. A kilotonne of CO_2e (carbon dioxide equivalent) is produced by the U.K's bus network approximately once every 26 minutes, and by a business class traveler by his 400th return trip between London and New York. The methane produced in one year by

[2] A kilotonne is 1,000,000 kilograms.

[3] See Appendix for further details of the Trucost classifications and methodology, as well as summary statistics on Trucost's percentage coverage of the S&P Global 1200's constituents.

the digestive processes of five hundred North American dairy cows also works out at around a single kilotonne of CO_2e.[4]

DIRECT EMISSIONS OF MAJOR INDICES

Direct emissions, as the name suggests, encompass emissions of CO_2e produced *directly* by an entity (by burning fossil fuels, for example). Exhibit 1 provides the direct carbon scores for the S&P Global 1200 and its major regional components, obtained by summing the emissions of the constituents. National figures are also shown to provide context.

Comparisons between equity indices and national figures describe the relative importance of investor action.

Note that the national figures in the right hand column of Exhibit 1 are government figures, which include emissions produced by corporations in that country *as well as* those produced by public organizations, small enterprises, the general public, etc.

Exhibit 1: S&P Global 1200 Direct Emissions Versus Select National Equivalents

CATEGORY	KT CO_2E	NATIONAL DATA	KT CO_2E
Global Listed Equity (Estimated)*	7,485,382	World	37,168,300
		China	7,465,862
EQUITY INDICES	**KT CO_2E**	U.S.	6,649,700
S&P Global 1200	5,239,767	Brazil + Russia + India	5,246,745
S&P 500	2,051,120	France + Germany + UK	2,023,130
S&P Europe 350	1,812,166	Japan + Australia	1,949,724
S&P Euro Plus	1,510,880	India	1,523,767
S&P/TOPIX 150	673,162	Republic of Korea	688,300
S&P United Kingdom	301,286	Turkey	459,102
S&P Latin America 40	280,009	Saudi Arabia	296,060
S&P Asia 50	200,935	Vietnam	266,049
S&P/TSX 60 Index	128,380	Czech Republic	127,114
S&P/ASX All Australian 50	93,995	Belgium	119,242

Sources: S&P Dow Jones Indices LLC, Trucost Plc, and the United Nations as of Dec. 31, 2015. Table is provided for illustrative purposes. *Global equity estimate is obtained assuming S&P Global 1200 direct emissions represent 70% of the total (N.B. the S&P Global 1200 represents approximately 70% of global equity market capitalization); it is likely an underestimate. Further national data is available at http://unfccc.int/ghg_data/items/9354.php.

The figures of Exhibit 1 require careful interpretation: the emissions attributable to blue-chip corporations constitute only a fraction of the national and global totals, and the emissions of any large company may occur over a wide selection of countries. Nevertheless, comparisons between index and national emissions figures provide an important context:

[4] Sources: "UK Greenhouse Gas Emissions Statistics," U.K. Department of Energy & Climate Change (2015); "Transatlantic Airline Fuel Efficiency Ranking, 2014," ICCT (2015); "Livestock's long shadow: Environmental issues and Options," Food and Agriculture Organization of the United Nations (2006); S&P Dow Jones Indices calculations.

national emissions frame the opportunity set for diplomacy; the emissions of major benchmarks frame the influence of investors.

ON THE RELATIVE IMPORTANCE OF CORPORATE EMISSIONS

In the context of global emissions reduction, Exhibit 1 demonstrates that corporate participation may be both significant and necessary, but not sufficient. Only around 15% of global emissions are directly produced by the world's blue-chip corporations, while the reduction required for global temperature to remain within 2°C of pre-industrial levels is arguably as much as 75%.[5]

While corporate emissions compose only a small fraction of the overall problem, the potential contribution from large companies should not be understated.

While large companies only produce only a small fraction of total emissions, their potential contribution should not be understated: Exhibit 1 shows that **if every constituent of the S&P Global 1200 could reduce its direct emissions to zero, then the impact would be roughly equivalent to removing all the emissions produced in Brazil, Russia, and India combined.**[6]

Exhibit 1 also allows for engaging comparisons between political and investment influence. For instance: **at what level of equity exposure does your investment account for greater emissions than the average individual**? As one of roughly 7.3 billion current inhabitants of our planet, the reader's theoretical pro-rata share of worldwide CO_2e emissions equates to around 5,000 kilograms (0.005 kt) per year. In comparison, only USD 34,000 is required for an investment in a global equity benchmark to capture the same amount. For the roughly 320 million American citizens and using the S&P 500 as the benchmark, the equivalent figure is around USD 192,000.[7] **Thus, many individual equity investors—and professional portfolio managers—exert potentially one thousand-times greater potential influence on emissions by voting at shareholder meetings than by voting in elections.**

Of course, there is more to corporate engagement than just voting at meetings, just as there is more to political action than voting in national elections. The point remains that, in comparison, **equity investing may offer a particularly productive route for engagement.**

[5] Estimates of the required reductions vary considerably and even then are based on probabilistic, opposed to absolute, levels of certainty. The 98% reduction is based a target 1,000,000 Kt per annum level of CO_2e emissions, as suggested by M. Meinshausen, "Greenhouse-gas emission targets for limiting global warming to 2°C," Nature (2009). The scale of the reduction required suggests that replacement and removal (via capture and storage, or otherwise) may be just as important; reducing emissions alone will unlikely suffice.

[6] We stress "roughly." While both index and national emissions are based on December 2015 data, emissions from previous years are included in both totals. The applicable years of emissions data for the S&P Global 1200 are summarized in the Appendix.

[7] Based on a USD 35.4 trillion market cap for the S&P Global 1200 and a USD 19.0 trillion market cap for the S&P 500, as of Dec. 31, 2015. Population figures via www.census.gov.

The emissions per million U.S. dollars of market capitalization for the major regional equity benchmarks will return in Exhibit 2, although the latter figure includes indirect emissions, as introduced in the next section.

More broadly, there is significant potential for corporations to fund the infrastructure and technology that could enable a change in global emission patterns or maintain the productive force of our economies in light of the restrictions imposed. For a simple example, corporations may, if they like, procure an energy supplier that produces less emissions in meeting their needs. A majority procuring electricity suppliers in this way would increase the financial rewards to "clean" energy suppliers, and most likely increase the pace of investment in related technologies. Measuring the potential impact of such "downstream" activities requires a secondary level of emissions measurement, introduced in the next section.

INDIRECT EMISSIONS OF MAJOR INDICES

As a practical matter, one can expect the blue-chip corporations measured by the S&P Global 1200 to have an influence over emissions produced elsewhere.

The impact of potential changes in corporate behavior is, in fact, somewhat understated by Exhibit 1. As a practical matter, one can expect the blue-chip corporations measured by the S&P Global 1200 to have an influence over emissions produced elsewhere, a topic that this section considers in greater detail.

Indirect emissions are those associated with, but not directly produced by, a company's activities. They are classified into several tiers. **"First tier"** emissions are those produced in the provision of goods and services to that company. **"Second tier"** emissions pertain to suppliers of suppliers, and so on through increasing levels of separation. Common examples of emissions that would be included in the first tier are those arising from the supply of materials and equipment, utilities such as electricity, and business travel.

It is not always optimal to include all emissions at every tier. As the levels of disintermediation between company and emissions increase, the certainty of attribution, reliability of data, and clarity of comprehension decreases. **The inclusion of indirect emissions also typically results in double counting.** For example, if both an electricity supplier and one of its customers were members of the same index, the emissions of the former would be counted twice at the index level; once as direct emissions and again as a component of indirect emissions. **We take the sum of direct and first tier indirect emissions to represent "total" emissions** although, as this discussion indicates, other measures are possible.

This double counting can be mitigated. One example is by only considering companies in the same sector (where one might assume more limited cross-selling). A sector-based analysis follows in the next section; Exhibit 2 provides the total direct and indirect emissions of the S&P Global 1200 and its major regional components.

Exhibit 2: S&P Global 1200 Direct and First Tier Indirect Emissions

INDEX	DIRECT ($KT CO_2E$)	INDIRECT ($KT CO_2E$)	TOTAL ($KT CO_2E$)
S&P Global 1200	5,239,767	3,008,499	8,248,266
S&P 500	2,051,120	1,128,126	3,179,246
S&P Europe 350	1,812,166	1,055,430	2,867,596
S&P Euro Plus	1,510,880	715,534	2,226,415
S&P United Kingdom	301,286	339,896	641,182
S&P/TOPIX 150	673,162	362,334	1,035,497
S&P Asia 50	280,009	224,108	504,116
S&P Latin America 40	200,935	98,005	298,940
S&P/ASX All Australian 50	128,380	74,565	202,944
S&P/TSX 60	93,995	65,932	159,927

Sources: S&P Dow Jones Indices LLC, Trucost Plc. Data as of Dec. 31, 2015. Table is provided for illustrative purposes.

THE CARBON "FOOTPRINT" OF AN INDEX

Naturally, when moving to the concerns of investment, the objective becomes one of measuring efficiency.

Both Exhibits 1 and 2 provide figures for each region that are highly correlated with the size of the market. Naturally, when moving to the concerns of investment, the objective becomes one of measuring efficiency, sometimes called a "footprint."

For a single company, an "investment footprint" and a "revenue footprint" may be defined as the total (annual) emission of CO_2e for each USD 1 million of market capitalization, and for each USD 1 million of revenues, respectively. At the portfolio or index level, the revenue footprint and the investment footprint may be calculated via a weighted sum of contributions from each constituent, albeit with a careful treatment of revenues.[8] The use of the term "footprint," as opposed to "efficiency," is a matter of taste, driven by the observation that a decrease in emissions will—all else being equal—cause the relevant metric to decline. Exhibit 3 summarizes the two measures.

[8] The situation is analogous to that of price/earnings ratios, where similar care must be taken in aggregation if the result is to express the price/earnings ratio of a portfolio or index from those of the constituents (specifically, the average of earnings/price instead of price/earnings must be used). In short, the revenue footprint of an index is not the index-weighted average revenue footprint of its constituents.

Exhibit 3: Footprint Calculations for Equity Indices

SCORE	INTERPRETATION	CALCULATION
Investment Footprint	Total emissions per USD 1 million investment tracking the index	The sum of index constituents' investment footprint multiplied by index weight.
Revenue Footprint	Total emissions per USD 1 million of revenue generated by index constituents	The index's investment footprint divided by the index-weighted average of constituent revenue/price ratios.

Source: S&P Dow Jones Indices LLC. Table provided for illustrative purposes.

A revenue-based approach may be better suited to managing the investment risks arising from a putative "carbon tax."

There are arguments in favor of both revenue and investment-based approaches to measuring efficiency. In the case of a hypothetical widget manufacturer, one would ideally calculate the emissions required to source, build, market, and deliver each widget. However, while "emissions per widget" corresponds closely to a common-sense estimate of efficiency, it only allows like-for-like comparisons with other widget manufacturers. Annual revenues provide a natural proxy for commercial output and allow for cross-industry comparisons. In such context, revenue footprint provides a broad measure of management quality: indicating efficient use of electricity, travel, supply lines and general resources.

From a practical perspective, a revenue-based approach may provide two further benefits. The first and most obvious is that it is less sensitive to fluctuations in the stock price. If one plans to buy or sell portfolio positions on a day-to-day basis, their value is relevant. However, if one plans to buy and hold positions indefinitely, the investment footprint demonstrates an irrelevant volatility that is driven by valuations.

The second practical benefit is perhaps more controversial. A revenue-based approach may be better suited to managing the investment risks arising from a putative "carbon tax." This is relevant because the impact of carbon taxation is frequently offered as primary *investment* motivation for tilting portfolio allocations toward companies that are more efficient.

A market cap-based approach may be better suited to measuring proportional responsibility.

The arguments for price-based approaches arise, as they often do, from the perspective of proportional ownership. Equity investing entails rights that are determined solely by the percentage of ownership, and the value of that ownership follows the share price, not a company's revenues. Thus, the total emissions per unit of market capitalization—the investment footprint—provides a common-sense estimate of what an investor is "responsible" for. As our minor digression into carbon taxation illustrated, which measure is more suitable to the task may depend on the problem in hand. **Both measures provide meaningful gauges of efficiency; both certainly have their applications.**

Exhibit 4 provides the investment and revenue footprint for the constituent regions and sectors of the S&P Global 1200. The full decomposition of each region into constituent sector emissions is provided in Exhibit 5.

Exhibit 4: S&P Global 1200 Carbon Footprint by Region and Sector

REGIONS	INVESTMENT (KT CO_2E/USD 1 MILLION)	REVENUE (KT CO_2E/USD 1 MILLION)	SECTORS	INVESTMENT (KT CO_2E/USD 1 MILLION)	REVENUE (KT CO_2E/USD 1 MILLION)
S&P Global 1200	0.232	0.290	Financials	0.019	0.029
S&P 500	0.174	0.303	Health Care	0.021	0.049
S&P Europe 350	0.292	0.280	Information Technology	0.029	0.072
S&P Euro Plus	0.309	0.299	Consumer Discretionary	0.068	0.077
S&P United Kingdom	0.253	0.238	Telecommunication Services	0.082	0.108
S&P/TOPIX 150	0.381	0.292	Consumer Staples	0.135	0.168
S&P Latin America 40	0.361	0.236	Industrials	0.204	0.216
S&P Asia 50	0.656	0.422	Energy	0.797	0.391
S&P/TSX 60	0.192	0.248	Materials	1.191	0.966
S&P/ASX All Australian 50	0.190	0.328	Utilities	2.216	1.916

Sources: S&P Dow Jones Indices LLC, Trucost Plc. Data as of Dec. 31, 2015. Table provided for illustrative purposes.

Regional comparisons of benchmark indices are particularly sensitive to the sector makeup of their respective markets.

A note on the importance of sectors: to the casual observer, the results of Exhibit 4 would suggest that, for example, the members of the S&P 500 were much more efficient than those of the S&P Latin America 40, and indeed, this is true overall. However, such comparisons are particularly sensitive to the sectoral makeup of the markets being compared. The combined weighting of the energy, utilities, and materials sectors accounts for 26% of the S&P Latin America 40 and less than half as much (12.3%) of the S&P 500. Differences in sector compositions account for a significant part of the relative differences in efficiency, and accordingly, we refer the reader to the breakdown by sector of each component, provided in Exhibit 5.

Differences in sector compositions account for a significant part of the relative differences in efficiency.

Exhibit 5: S&P Global 1200 Regional and Sector Breakdowns

SECTOR/INDEX	INVESTMENT FOOTPRINT (KT OF CO_2E/USD 1 MILLION INVESTED)	REVENUE FOOTPRINT (KT CO_2E/USD 1 MILLION REVENUES)	DIRECT (KT CO_2E)	TOTAL (KT CO_2E)
CONSUMER DISCRETIONARY				
S&P Latin America 40	0.052	0.079	31,988	127,771
S&P/ASX All Australian 50	0.074	0.069	17,480	91,526
S&P 500	0.116	0.079	11,170	76,147
S&P Europe 350	0.145	0.076	1,743	13,904
S&P/TOPIX 150	0.119	0.122	700	8,145
S&P/TSX 60	0.028	0.046	259	1,111
S&P Asia 50	0.031	0.073	35	207
CONSUMER STAPLES				
S&P Asia 50	0.130	0.176	47,236	262,939
S&P 500	0.125	0.167	31,202	169,726
S&P Europe 350	0.209	0.192	8,508	48,347
S&P Latin America 40	0.157	0.185	2,181	16,391
S&P/ASX All Australian 50	0.202	0.106	1,189	12,830
S&P/TSX 60	0.158	0.084	2,014	9,773
S&P/TOPIX 150	0.052	0.182	108	635
ENERGY				
S&P 500	0.560	0.456	372,344	657,854
S&P/TSX 60	0.955	0.374	274,304	560,452
S&P/ASX All Australian 50	4.448	0.241	100,513	213,471
S&P Europe 350	0.610	0.655	93,459	128,121
S&P/TOPIX 150	2.132	0.498	80,633	112,890
S&P Asia 50	0.994	0.818	33,207	39,750
S&P Latin America 40	1.617	0.257	18,066	34,602
FINANCIALS				
S&P Asia 50	0.025	0.056	49,704	89,663
S&P/ASX All Australian 50	0.019	0.018	33,655	51,835
S&P/TSX 60	0.014	0.017	1,052	6,297
S&P/TOPIX 150	0.008	0.021	401	3,664
S&P Latin America 40	0.006	0.007	584	3,538
S&P Europe 350	0.009	0.014	774	3,278
S&P 500	0.016	0.012	432	1,752
HEALTH CARE				
S&P/TSX 60	0.019	0.039	12,342	54,239
S&P/ASX All Australian 50	0.025	0.079	8,690	29,225
S&P 500	0.024	0.064	1,568	5,061
S&P/TOPIX 150	0.015	0.061	225	857
S&P Europe 350	0.014	0.058	182	475
S&P Asia 50	N/A	N/A	N/A	N/A
S&P Latin America 40	N/A	N/A	N/A	N/A

Sources: S&P Dow Jones Indices LLC, Trucost Plc. Data as of Dec. 31, 2015. Table is provided for illustrative purposes.

These figures allow for perhaps the most meaningful comparison among the corporate segments of different regions.

Exhibit 5: S&P Global 1200 Regional and Sector Breakdowns (cont.)

SECTOR/INDEX	INVESTMENT FOOTPRINT (KT OF CO_2E/USD 1 MILLION INVESTED)	REVENUE FOOTPRINT (KT CO_2E/USD 1 MILLION REVENUES)	DIRECT (KT CO_2E)	TOTAL (KT CO_2E)
INDUSTRIALS				
S&P Asia 50	0.177	0.256	225,034	327,376
S&P/ASX All Australian 50	0.187	0.151	144,975	236,418
S&P/TSX 60	0.340	0.229	104,453	182,210
S&P 500	0.947	0.596	17,276	23,648
S&P Europe 350	0.164	0.249	9,046	11,569
S&P/TOPIX 150	0.049	0.117	2,646	6,565
S&P Latin America 40	0.060	0.215	1,971	3,139
INFORMATION TECHNOLOGY				
S&P/ASX All Australian 50	0.116	0.134	17,071	54,948
S&P 500	0.014	0.048	6,947	52,712
S&P/TSX 60	0.130	0.101	3,332	33,145
S&P Europe 350	0.020	0.049	1,381	6,456
S&P Asia 50	0.020	0.027	56	495
S&P/TOPIX 150	0.002	0.013	1	39
S&P Latin America 40	0.006	0.014	2	26
MATERIALS				
S&P Latin America 40	1.347	0.875	550,986	837,993
S&P/TSX 60	2.401	1.228	278,101	366,691
S&P 500	0.663	0.859	189,252	336,928
S&P/ASX All Australian 50	1.908	1.123	100,414	133,617
S&P Europe 350	2.491	1.394	71,960	111,231
S&P Asia 50	0.829	1.036	35,555	76,992
S&P/TOPIX 150	0.476	0.628	21,801	35,440
TELECOMMUNICATION SERVICES				
S&P Latin America 40	0.160	0.242	1,894	69,796
S&P/TSX 60	0.033	0.040	2,087	16,024
S&P/ASX All Australian 50	0.044	0.109	463	14,145
S&P Europe 350	0.041	0.039	635	8,539
S&P/TOPIX 150	0.032	0.068	56	1,576
S&P Asia 50	0.051	0.024	285	1,504
S&P 500	0.021	0.033	261	1,343
UTILITIES				
S&P/TSX 60	2.245	3.529	1,114,919	1,200,532
S&P Latin America 40	2.049	1.076	747,460	868,473
S&P Asia 50	4.802	1.629	246,278	274,456
S&P/ASX All Australian 50	1.165	4.128	56,466	63,295
S&P Europe 350	1.039	0.779	27,907	30,375
S&P 500	1.436	2.289	19,934	22,850
S&P/TOPIX 150	0.165	0.255	912	1,247

Sources: S&P Dow Jones Indices LLC, Trucost Plc. Data as of Dec. 31, 2015. Table is provided for illustrative purposes.

The comparative inefficiency of the Latin American market relative to the U.S. observed in Exhibit 4 may, for instance, be seen to be far from universal: the U.S. has a larger investment footprint in the utilities, information technology, financials, telecommunication services, and consumer discretionary sectors.

THE S&P GLOBAL 1200 CARBON EFFICIENT INDEX SERIES

Efficiency measures, such as those of the previous section, are by design particularly suitable tools for the construction of efficient indices and portfolios. Utilizing the revenue footprint, as defined above, in September 2015, **S&P Dow Jones Indices launched the S&P Global 1200 Carbon Efficient Index Series and the S&P Global 1200 Carbon Efficient Select Index Series**, derived from the constituents of the S&P Global 1200 and its regional components.[9] The indices in the S&P Global 1200 Carbon Efficient Index Series comprise the same constituents as their respective benchmarks, overweighting those that have lower carbon revenue footprints and underweighting those with higher footprints in their respective sectors. The S&P Global 1200 Carbon Efficient Select Index Series excludes altogether those companies in each sector that have the largest revenue footprint and reweights the remainder in order to minimize tracking error with respect to the parent benchmark.

Efficiency measures are particularly suitable tools for the construction of efficient indices and portfolios.

Exhibit 6 shows the reduction in carbon footprints that may be achieved by substituting a carbon efficient or carbon efficient select alternative index for the regions of the S&P Global 1200.

[9] See Jacob *op cit*.

Exhibit 6: Carbon Efficient and Carbon Efficient Select Index Footprints

INDEX	INVESTMENT FOOTPRINT (KT CO_2E/ USD 1 MILLION)	REVENUE FOOTPRINT (KT CO_2E/ USD 1 MILLION)	INVESTMENT FOOTPRINT VERSUS BENCHMARK (%)	REVENUE FOOTPRINT VERSUS BENCHMARK (%)
S&P Global 1200 Carbon Efficient Index	0.158	0.177	-32	-39
S&P Global 1200 Carbon Efficient Select Index	0.118	0.145	-49	-50
S&P 500 Carbon Efficient Index	0.119	0.190	-32	-37
S&P 500 Carbon Efficient Select Index	0.093	0.156	-46	-48
S&P Europe 350 Carbon Efficient Index	0.199	0.152	-32	-45
S&P Europe 350 Carbon Efficient Select Index	0.134	0.122	-54	-56
S&P/TOPIX 150 Carbon Efficient Index	0.231	0.183	-40	-37
S&P/TOPIX 150 Carbon Efficient Select Index	0.167	0.144	-56	-51
S&P/TSX 60 Carbon Efficient Index	0.148	0.170	-23	-31
S&P/TSX 60 Carbon Efficient Select Index	0.157	0.181	-18	-27
S&P/ASX All Australian 50 Carbon Efficient Index	0.138	0.233	-28	-29
S&P/ASX All Australian 50 Carbon Efficient Select Index	0.160	0.233	-17	-29
S&P Asia 50 Carbon Efficient Index	0.314	0.204	-13	-13
S&P Asia 50 Carbon Efficient Select Index	0.199	0.139	-45	-41
S&P Latin America 40 Carbon Efficient Index	0.352	0.242	-48	-43
S&P Latin America 40 Carbon Efficient Select Index	0.198	0.159	-71	-63

Sources: S&P Dow Jones Indices LLC, Trucost Plc. Data as of Dec. 31, 2015. Table provided for illustrative purposes.

It is not surprising to discover that, via fairly simple and transparent means, one can construct indices that offer a significant improvement in revenue footprint.

It is not surprising to discover that, via fairly simple and transparent means, one can construct indices that offer a significant improvement in revenue footprint. What Exhibit 6 demonstrates further is that building portfolios using a method serving as a measure of management's efficiency (revenue footprint) can also serve the goal of reducing the investor's "responsibility"; the investment footprint is also significantly reduced in every line of Exhibit 7 and in many cases, by similar degree. This "convenient truth" is more surprising, since the two metrics are related to each other through valuations (in the sense of revenue/price ratios) and, as the next section explains greater in detail, there are additional relationships at play.

VALUE INVESTING AND CARBON FOOTPRINT

Returning to the regional comparisons of Exhibit 4, note that comparing indices by revenue footprint can result in a different conclusion from a comparison by investment footprint; the S&P 500 and S&P/TOPIX 150 provide an example of this. By revenue, Japan has a slightly smaller footprint; by market capitalization, it is twice as big. This dissonance is simply a reflection of the fact that price/revenue multiples for Japanese stocks are markedly lower than those for U.S. stocks, whatever the sector. In other words, in selecting stocks for their lower footprint, the choice between revenue and investment footprint carries an implicit judgment on the importance of valuations. But the question can also be asked in the other direction: **is it harder to be environmentally friendly as a value investor?**

Notwithstanding regional differences, common sense suggests that the archetypical "value" company will be more carbon intensive. Value companies are associated with large fixed assets like factories and land, and otherwise the concept of "cheapness" itself indicates a larger business (and operations) than the share price would suggest. Meanwhile, growth archetypes are found in technology, capabilities, and intellectual property—activities traditionally powered more by caffeine than by fossil fuels.

Notwithstanding regional differences, common sense suggests that the archetypical "value" company will be more carbon intensive.

As we shall see in this section, the answer appears to be "yes," value indices are indeed more carbon intensive, at least according to the most recent year-end growth/value classifications and emissions figures. Exhibit 7 provides a comparison of the carbon footprints associated with growth and value investment styles, assuming a global perspective for value classifications.

Exhibit 7: Growth and Value Carbon Footprints[10]

INDEX	INVESTMENT FOOTPRINT (KT OF CO_2E/USD 1 MILLION INVESTED)	REVENUE FOOTPRINT (KT CO_2E/USD 1 MILLION REVENUES)
S&P Global 1200	0.233	0.290
Growth	0.137	0.199
Value	0.292	0.309
S&P 500	0.174	0.303
Growth*	0.091	0.175
Value*	0.228	0.335
S&P Europe 350	0.292	0.280
Growth	0.224	0.242
Value	0.355	0.289
S&P/TOPIX 150	0.381	0.292
Growth	0.176	0.161
Value	0.448	0.306
S&P/TSX 60	0.192	0.248
Growth	0.190	0.287
Value	0.199	0.254
S&P Asia 50	0.361	0.236
Growth	0.122	0.154
Value	0.470	0.241
S&P Latin America 40	0.656	0.422
Growth	0.155	0.134
Value	0.812	0.491
S&P/ASX All Australian 50	0.190	0.328
Growth	0.128	0.246
Value	0.238	0.355

Sources: S&P Dow Jones Indices LLC, Trucost Plc. Data as of Dec. 31, 2015. Table is provided for illustrative purposes.

Value indices are indeed strongly associated with larger carbon footprints—by either measure

As Exhibit 7 demonstrates, value indices are indeed strongly associated with larger carbon footprints—by either measure. Further, and as might be expected, the difference is less significant when revenue footprint is considered rather than investment footprint. The contrast is perhaps best illustrated by the S&P/TSX 60, wherein "value" companies (as judged relative to a global peer group) produce more emissions in aggregate than "growth" companies, and have a larger investment footprint, yet nonetheless have a *lower* revenue footprint.

Exhibit 7 also provides grounds for a particular optimism regarding the coherence of climate-sensitive investments. If an investor wishes to position himself in companies traditionally associated with innovation and cutting edge development, such as may be required to develop an economy less dependent on greenhouse gas emissions, they are likely to favor growth companies. Exhibit 7 shows that in doing so, they are also likely to reduce their current emissions in tandem. Combined with the observation earlier that both revenue and investment footprints may be

reduced together, **there is a real hope for those who wish to balance the competing conceptions of what it means to be an "environmentally friendly investor."**

As a final qualifier to the observations of this section, it is important to note that the data are pertinent to a particular moment in time, in particular the end of 2015. The sector weights of an index will likely drive both emissions and efficiency in the first instance, and the sectoral predominance within value and growth classifications (and the relative valuation of each sector in comparison to its colleagues) varies. Thus, with regard to indices and styles that require frequent rebalancing and a fast-changing sector composition, their carbon efficiency may vary greatly at each rebalance. **In our view, the sector biases within growth and value classifications are stable enough to make such comparisons meaningful.** But, in the case of other popular investment styles (or factor indices) such as low volatility and momentum, dynamic sector allocation prevents presenting similar metrics or reaching similar conclusions.

The S&P Dow Jones Indices Carbon Emission Scorecard provides carbon production and efficiency metrics for major indices and styles across global markets.

CONCLUSIONS

The S&P Dow Jones Indices Carbon Emission Scorecard provides carbon production and efficiency metrics for major indices and styles across global markets. These carbon "scores" may be used to estimate the carbon-specific environmental impact of certain market segments or index-linked investments, and they can provide benchmarks for the efficiency of specific portfolios.

Emissions can be classified as direct or indirect. Direct emissions allow for aggregations across portfolios and markets, and their sum permits valid comparisons with national or world figures. However, direct emissions only provide a lower-bound estimate for the overall emissions attributable to a company's operations. The total amount of direct and indirect emissions provides a clearer picture of an organization's environmental impact, and hence is particularly germane to the calculation of single-company scores. However, at the aggregate level, simply summing indirect emissions can create issues of double counting.

Any comparisons between the efficiency of markets and indices are better served if made among those operating in the same sector.

While various measures exist to apply the concept of “carbon efficiency” to indices and portfolios, the two most commonly encountered attribute emissions on a pro-rata basis to either market capitalization or to revenues. The normalization and averaging process used in the calculation of these metrics enables valid comparison between markets and segments: each index may be provided with an “investment footprint” based on market capitalization and a “revenue footprint” based on revenues. In the first instance, the difference in scores among investment styles and geographies has a critical dependence on sectoral biases. Thus, any comparisons between the efficiency of markets and indices are better served if made among those operating in the same sector.

While the investment footprint is germane to measuring one’s pro-rata “responsibility,” the revenue footprint is potentially better suited for the construction of portfolios that mitigate investment risks from carbon taxation or to identify management skill in resource efficiency. Conveniently, the reduction of one frequently achieves a reduction in the other, at least at the portfolio level. The two metrics are related to each other via fundamentals, and we conclude with the observation that growth companies may have particular merit in the context of environmentally sensitive investment styles.

APPENDIX: FURTHER DETAIL ON SOURCES, INDEX COVERAGE, AND DEFINITIONS

Trucost Carbon Figures

For each index and each company that is part of the S&P Global 1200, carbon scores are sourced from Trucost Plc (Trucost). Trucost has analyzed the environmental performance of over 6,000 companies worldwide, and has the world's largest bank of standardized greenhouse gas (GHG) emissions data, which provides a proxy for carbon performance. To calculate the carbon intensity of any company included in the S&P Global 1200, Trucost reviews company annual reports and accounts, environmental and sustainability reports, public disclosures, and corporate websites.

However, many companies do not disclose their environmental or carbon impacts. Where there is no public disclosure, Trucost employs its environmental profiling system. This proprietary input-output model maps the GHG impacts of business activities in 464 sectors. Trucost's broad coverage seeks to ensure that all non-disclosing companies are considered for index eligibility, not just those that disclose environmental information. Six greenhouse gases (GHGs) are included in the analysis; these are all the GHGs regulated under the Kyoto protocol. Each gas has a different capacity to cause global warming. Although carbon dioxide (CO_2) is the least potent of the GHGs, it is one of the most prevalent in terms of man-made emissions. The GHGs have been calculated for each company and converted into tons of carbon dioxide equivalents based on the appropriate Global Warming Potential (GWP) factors. The GWP index, published by the Intergovernmental Panel on Climate Change (IPCC), assesses the effect of the emissions of different gases over a 100-year period, relative to the emission of an equal mass of CO_2. The GWP index enables all the GHGs to be expressed in terms of CO_2 equivalents, or CO_2e, and it has been used as the basis for the analysis for these reports.

Direct Emissions and Indirect Emissions From First Tier Suppliers (First Tier Indirect Emissions)

Trucost measures direct greenhouse gases emitted from a company's operations, as well as upstream emissions that result from purchases of goods and services from direct (first tier) suppliers. The most significant sources are typically purchased electricity (Scope 2 of the GHG Protocol) and employee business air travel (Scope 3 of the GHG Protocol). Trucost's approach enables companies and investors to take account of emissions that are effectively outsourced. For a number of companies, indirect emissions from first tier suppliers are greater than direct emissions.

Carbon Dioxide Equivalents

Carbon dioxide equivalents (CO_2e) is the term used for the standardization of all GHGs to reflect the global warming potential relative to carbon dioxide. The analysis includes the six GHGs covered by the UN Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Each gas has a GWP measured as the ratio of heat trapped by one metric tonne of the gas to that of one tonne of CO_2 over a specified time period. The emission of a GHG is multiplied by its GWP to calculate the equivalent level of CO_2 emissions. For example, one tonne of SF_6 equates to 23,900 tonnes of CO_2. Conversions of greenhouse gases to CO_2e are based on the GWP index published by the IPCC, which assesses the effect of the emissions of different gases over a 100-year time period relative to the emission of an equal mass of CO_2.

Index Coverage

Both direct and first tier non-direct emissions are provided by Trucost for a significant majority of the constituents of the S&P Global 1200, including all the companies based in Japan, Canada, Australia, and across Asia, but the coverage does not cover the full set of index constituents. Data can be unavailable for various reasons, including a lack of historical context: one example is Ferrari, which was spun out of Fiat late in 2015 and, at the time of writing, the contribution to Fiat's emissions attributable to Ferrari cannot easily be ascertained.

The coverage (by index weight) of Trucost's data can be summarized as follows for the S&P Global 1200 and its component regions.

Exhibit 8: Emissions Coverage by Index Weight

INDEX	EMISSIONS COVERAGE (BY INDEX WEIGHT) (%)
S&P Global 1200	99.6
S&P 500	99.4
S&P Europe 350	99.9
S&P/TOPIX 150	100
S&P/TSX 60	100
S&P/ASX 50	100
S&P Asia 50	100
S&P Latin America 40	98.5

Source: S&P Dow Jones Indices LLC, Trucost Plc. Table provided for illustrative purposes.

Although we use the most recent emissions data available (year-end 2015), the reporting and estimation of emissions frequently occurs on a delayed basis. To provide perspective on the timeliness of the inputs to our scores, at year-end 2015, the most recent emissions data available for the S&P Global 1200 were current for only 1.5% of constituents (by index weight). For 94.5% of companies, data for 2014 was the most up-to-date available, while 3.5% relied on 2013 data, and no data were available for 0.5% of companies.

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