OPTIMAL DIVERSIFICATION AND THE ENERGY TRANSITION

IMPACT OF EQUITY BENCHMARKS ON PORTFOLIO DIVERSIFICATION AND CLIMATE FINANCE

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2° INVESTING INITIATIVE

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- Align investment processes of financial institutions with 2° C climate scenarios;
- Develop the metrics and tools to measure the climate performance of financial institutions;
- Mobilize regulatory and policy incentives to shift capital to energy transition financing.

The association was founded in 2012 in Paris and has projects in Europe, China, and the United States. Our work is global, both in terms of geography and engaging key actors. We bring together financial institutions, issuers, policy makers, research institutes, experts, and NGOs to achieve our mission. Representatives from all of the key stakeholder groups are also sponsors of our research.

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EXECUTIVE SUMMARY

CAPITAL ALLOCATION DECISIONS IN EQUITY MARKETS ARE SIGNIFICANTLY INFLUENCED BY MARKET-CAPITALIZATION WEIGHTED INDICES. THEIR PROMINENCE IS A RESULT OF THEIR USE AS 'MARKET PROXIES' FOR SECTOR ALLOCATION AND OPTIMAL DIVERSIFICATION.

Market-capitalization (market-cap) weighted indices are constructed based on the market-capitalization of their constituents. They are widely seen as 'market proxies' – representing the listed equity universe. They are currently the most widely-used type of index by investors in equity markets. Survey data suggests an estimated 75% of European and 87% of Asian investors use cap-weighted indices as benchmarks. Beyond their use by passive investors, who replicate the index in their portfolio, their most prominent use is as sector allocation guidelines. They influence the sector diversification of the majority of equity investors.

SECTOR EXPOSURE BY ITSELF DOES NOT INFORM ON OPTIMAL DIVERSIFICATION. ACHIEVING OPTIMAL DIVERSIFICATION REQUIRES MANAGING DIVERSIFICATION AT SECTOR LEVEL AND ENERGY TECHNOLOGY LEVEL - PARTICULARLY FOR ENERGY-INTENSIVE SECTORS.

There are two main reasons why energy technology diversification in a portfolio needs to be managed. First, key sectors – utility, oil & gas, automobile – exhibit significant variation in energy technology between companies. Thus, a 4% exposure to the utility sector does not by itself inform on whether investors are properly exposed to the utility sector. Second, the transition to the low-carbon economy creates significant uncertainty with regard to changes in the real economy and equity markets. Managing energy technology exposure with regard to today's markets, the investment decisions of companies, and policy roadmaps will contribute to reducing the risks associated with this uncertainty.

MARKET-CAPITALIZATION WEIGHTED INDICES ARE POOR MANAGERS OF ENERGY TECHNOLOGY EXPOSURE. THEIR EXPOSURE WITHIN SECTORS TO VARIOUS ENERGY TECHNOLOGIES IS SIGNIFICANTLY BIASED AGAINST CLIMATE-FRIENDLY TECHNOLOGIES RELATIVE TO THE CURRENT DIVERSIFICATION IN THE SECTORS.

From an energy technology perspective, all market-capitalization weighted indices reviewed in this study under-weight climate-friendly technologies. This is particularly prominent in the utility and automobile sector. In addition, it appears that the French CAC40 and the UK FTSE100 also over-weight high-carbon technologies at sector level – for the oil and gas sector by 5.7% and 3% respectively.

MORE BROADLY, CAP-WEIGHTED INDICES SIGNIFICANTLY OVER-WEIGHT HIGH-CARBON SECTORS RELATIVE TO THE REAL ECONOMY.

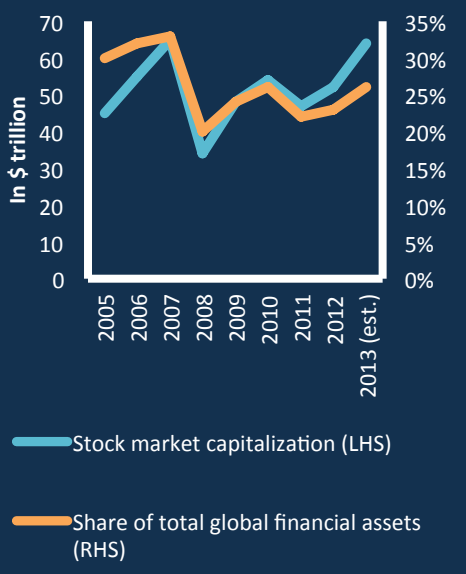
While proxies for equity markets, market-cap weighted indices are frequently considered representatives of the economy. The analysis finds that in fact, from a sector perspective, equity indices and equity markets more broadly significantly over-weight energy-intensive sectors relative to the real economy. For investors seeking optimal exposure to the economy at portfolio level, there are currently no known tools and practices to address this exposure either within or between asset classes.

THE RESULTS SUGGEST THE NEED FOR NEW INDEX PRODUCTS AND PORTFOLIO MANAGEMENT TOOLS.

Given the inability of current indices to ensure optimal energy technology diversification, new indices need to be developed that ensure optimal diversification both from a sector and energy technology perspective. These indices need to serve two functions. First, ensure proper alignment with the current market. Second, in the context of a changing economy and the transition to a low-carbon economy, inform the investor on the alignment of the portfolio with market and policy roadmaps. Optimal diversification in the context of the transition to a low-carbon economy thus does not just imply managing the exposure to the current market diversification, but the 'bet' on the trajectory of this diversification. To date, every index contains this bet 'implicitly'. Managing energy technology diversification ensures this 'implicit' bet is aligned with investors' expectations.

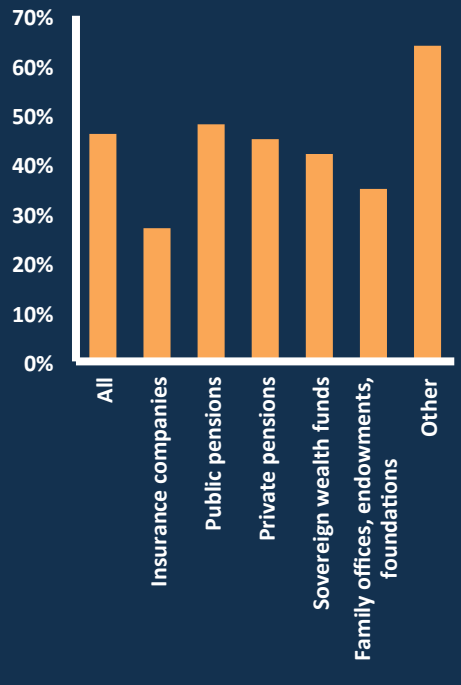
1. INTRODUCTION

FIG 1: STOCK MARKET CAPITALIZATION 2005-2013 (SOURCE: MGI 2014[1])*



*** The share is calculated based on global debt and equity assets, including loans, bonds, and stock market capitalization, but excluding real estate, commodity, private equity, as well as derivatives.**

FIG 2: SHARE OF EQUITY IN INSTITUTIONAL INVESTORS' PORTFOLIO (SOURCE: AMP CAPITAL 2014[2])



Prominence of equities in financial assets. Global financial assets have grown at a current annual growth rate of roughly 6% since 2005 to $242 trillion in 2013.[1] Stock market capitalization holds a significant share in this growth, particularly in the context of the recent bull market, representing an estimated share of 26% of global financial assets in 2013 ($64 trillion) (Fig. 1).This makes listed equities the second largest type of investible financial asset after non-securitized loans outstanding (NB: Private equities and real estate assets, probably representing by far the largest asset classes, are excluded).

Institutions as equity investors. A significant share of equity ownership rests with institutional investors. A recent survey suggests that equities on average make up 46% of institutional investors' portfolio, significantly more than the equity share in global financial assets (Fig. 2).[2] As a result, institutional investors' investment strategies are key determinants of equity market trends. Their impact on equity markets will in turn affect these markets' impacts on capital deployment.

The prominence of equity indices. Within equity investing, indices play an outstanding role. They are used to track performance, define the investment universe, define sector allocation, or are mirrored through passive investing and 'closet indexing'.

Indices as a tool for capital / sector allocation. A key driver behind the use of indices is their apparent role as 'market proxies' – representing optimal diversification for investors. Indices are seen to represent the market and investors seeking to be broadly diversified thus replicate the sector diversification of the index or invest passively in the index.

In the over-whelming majority of cases, the index used for this purpose is a market-capitalization weighted index. These indices are built to include the largest companies in the equity market, weighted based on their market capitalization. The size can range from 30 companies (DAX30) to over 1,000 (MSCI World).

Redefining optimal diversification in the context of the energy transition. The study evaluates the extent to which this premise – that market-capitalization weighted indices provide broad diversification – applies in practice. In this regard it reviews the diversification of the indices not only from a sector diversification perspective but also an energy technology perspective.

From sector to energy technology diversification. The key assumption behind this analysis is that sector diversification as an indicator does not suffice to inform on optimal diversification. Beyond a sector view, diversification also needs to be managed from an energy technology perspective. Energy technology diversification refers to the exposure of a portfolio to various energy technologies in high-carbon sectors and the extent to which this is aligned with the 'market'.

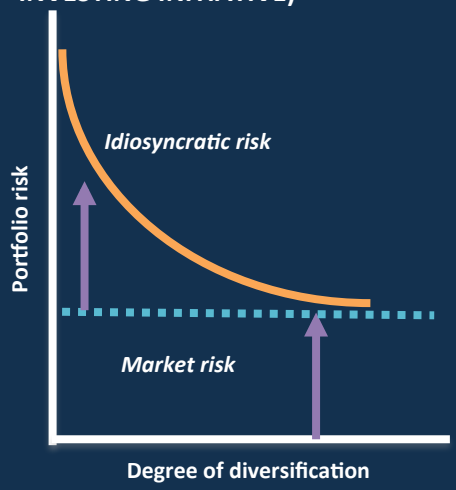
Energy technology diversification becomes a key metric in the context of an economy on a low-carbon roadmap. A transition of this nature is associated both with significant risk and significant uncertainty. Ensuring appropriate diversification to this transition is a key tool to manage risk.

Relevance for investors. Understanding the sector and energy technology allocation of benchmark equity indices ensures optimal diversification in the tradition of the modern portfolio theory (MPT). Portfolio diversification is one of the core mantras of MPT, which provides the theoretical framework for the construction of investment portfolios to achieve the highest return for a given level of risk. Diversification reduces the exposure to idiosyncratic risk by reducing the correlation of risk between assets (Fig. 3 and box). It follows the simple saying 'not [to] put all your eggs in one basket.' Thus, in the first instance, diversification is a risk issue.

Index investing is usually seen as a way to 'bet' in line with the market. In practice however, from an energy technology perspective, this study shows that indices can be significantly misaligned with the market. This misalignment appears both with regard to the current market and the economic roadmap associated with the transition to a low-carbon roadmap. The results suggest that investors need to look beyond cap-weighted indices to ensure a 'bet' in line with their expectations and / or the market / policy scenarios.

Organization of paper. This study reviews the use of six large cap-weighted equity indices – the S&P500 (United States), the FTSE100 (United Kingdom), the DAX30 (Germany), the CAC40 (France), the STOXX600 (Europe), and the MSCI World (developed economies). These are among the dominant equity indices used by funds today. The review suggests that cap-weighted equity indices are not optimally diversified from an energy technology perspective. This has implications for investors in terms of constructing well-diversified investment portfolios. It also signals a potent barrier in mobilizing private sector capital for climate finance. The study concludes by mapping the way forward for investors, both in terms of the potential for current alternatives and 'new tools' that are broadly diversified from an energy technology and sector perspective.

FIG 3: MARKET RISK AND IDIOSYNCRATIC RISK (SOURCE: 2° INVESTING INITIATIVE)



Modern Portfolio Theory and Indices

The growth of index investing can be traced to the rise of modern portfolio theory and Markowitz's seminal 1952 article "Portfolio selection". In the article, he argues that securities should be analyzed in the context of their contribution to the risk-return of the overall portfolio and not simply in isolation. Optimal or 'efficient' portfolios are the portfolios that maximize returns while minimizing the correlation between risks. These portfolios then sit on the 'efficient frontier'.

Subsequently, Tobin (1958)[3] and Sharpe (1964)[4] demonstrated that the 'super-efficient' or 'optimal' portfolio is in fact the market portfolio, containing all assets. The results derive from the Capital Asset Pricing Model developed by Sharpe and the Tobin Separation Theorem, which assumes that differences in investor risk preferences are captured by the ratio of risk-free to non-risk free (i.e. market portfolio) assets.

While subsequently subject to significant criticism,[5] the capital asset pricing model still remains a dominant paradigm in the finance sector, in particular with regard to the objective of optimal diversification vis-à-vis the market.

2. THE USE OF INDICES TODAY

2.1 THE ROLE OF EQUITY INDICES IN INSTITUTIONAL INVESTORS' PORTFOLIO

A prototypical portfolio. Fig. 4 attempts to provide a general overview of the breakdown of a 'sample' institutional investor's portfolio. While the analysis contains a number of caveats, given that it is based on a variety of sources with varying timeframes and methodological approaches, putting together the various analytical pieces is helpful for deriving some idea of the general picture of indices. Indeed, it is unlikely that any particular portfolio looks like the portfolio presented in Fig. 4. For example, an investor may have their entire equity portfolio invested passively in indices. Instead, the analysis seeks to help demonstrate the shares that various equity investing strategies have in equity markets.

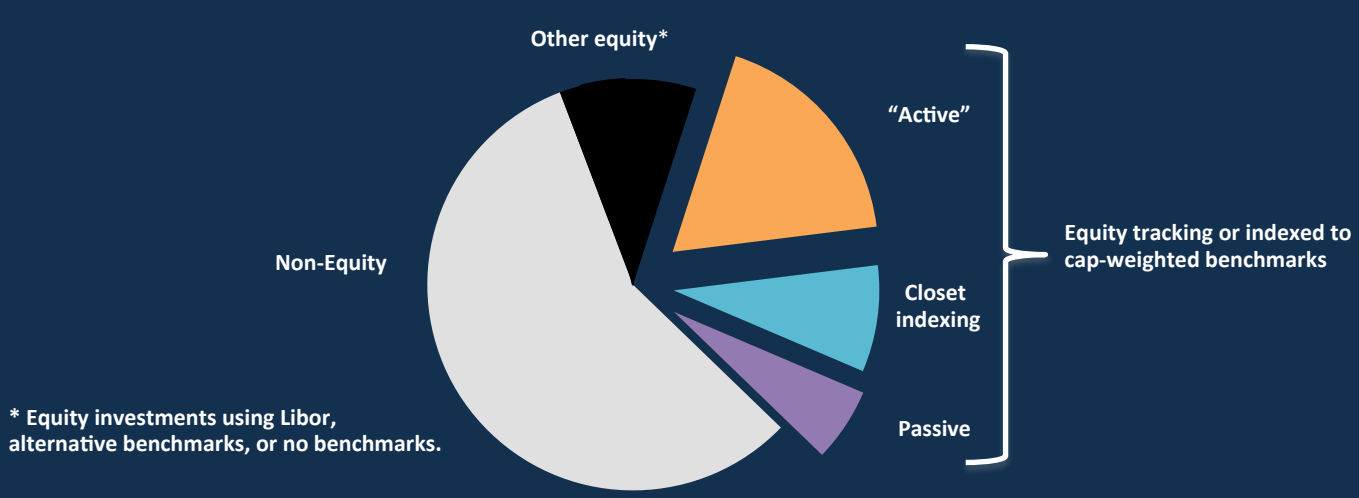
The 'slices' of the average European institutional investor's portfolio can thus be broken down as follows:

• *Non-equity*: The values for the non-equity share of an institutional investors portfolio were derived from the AMP Capital 2014 survey on the relative share of assets in an average institutional investor's portfolio.[1] According to this survey, non-equity assets including cash, fixed income, and alternatives make up 57% of an institutional investor's portfolio. While equity indices obviously do not play a direct role in determining the allocation of these assets, other financial market indices (i.e. fixed income, commodity indices, etc.) may be relevant in this regard.

• *Other equity:* Other equity shares are equities that do not track or are not indexed to cap-weighted benchmarks. Data for this is based on a survey by Fidelity (2013) of European investors, where European investors reported that 25% of their equity portfolio either tracks 'alternative' indices or no indices (13% no benchmark, 8% alternative indices, 4% Libor).[2] For Asian investors, the non cap-weighted share of equity portfolios drops to 14%.

• *Market capitalization-weighted benchmarks:* By extension, 75% of European (and 86% of Asian) investors' equity portfolio tracks or is indexed to cap-weighted benchmarks. This can be broken down into active, closet index, or passive investors. Here, the definitions by Petajisto (2013) were adopted, who defines an active fund as having an active share of at least 60%, 'closet indexers' with an active share of between 20-40%, and passive investors having an active share of less than 20%.[3] In this analysis, the 'passive' share in Petajisto's data from 2009 is 18%. While the data is somewhat outdated, it does seem to be in line with current data from PwC (see next page).[4]

FIG 4: A REPRESENTATIVE PORTFOLIO OF A EUROPEAN INSTITUTIONAL INVESTOR (SOURCE: 2° INVESTING INITIATIVE, BASED ON AMP CAPITAL 2014,[1] PETAJISTO 2013,[3] AND FIDELITY 2013[2])



2.2 THE USE OF CAP-WEIGHTED INDICES

Overview. This section will review the various types of uses of indices (Fig. 7). This includes the use of indices by passive investors, by 'closet indexers', by active investors, and by investors seeking thematic exposure, either to a specific sector or a cap-weighted index 'tilted' by an external criteria (for example GHG-emissions) (cf. Section 4.2).

Passive investing. Passive investors replicate the index. The allocation of their investment is thus entirely determined by the index. While there is naturally a choice in terms of deciding to engage in a passive investing strategy and the selection of indices, the core feature remains. The asset allocation in terms of sectors and by extension technologies is externally determined. In terms of trends, PwC (2014) predicts passive investments (both for equity and other financial assets) to grow from $7.3 trillion to $22.7 trillion by 2020 (Fig. 5).[4]

(Active) closet indexing. Petajisto identifies five categories of active investors (Fig. 6). The most direct use of indices in this categorization is by so-called 'closet indexers' – defined by Petajisto (2013) as investors whose portfolios have a low tracking error and a low active share relative to the benchmark index.[3] A low tracking error implies closet indexers closely mirror the sector diversification of the index (the tracking error measuring the performance deviation from the benchmark). A low active share means these funds replicate a significant share of the index (see next page for methodologies). Based on a review of active US mutual funds, roughly 30% of funds are closet indexers (up from ~5% in the mid 1990s).[3] From a sector perspective, closet indexers are likely to significantly replicate the sector diversification of indices.

FIG 5: SHARE OF PASSIVE MANAGEMENT IN GLOBAL ASSETS UNDER MANAGEMENT (SOURCE: PWC 2014)

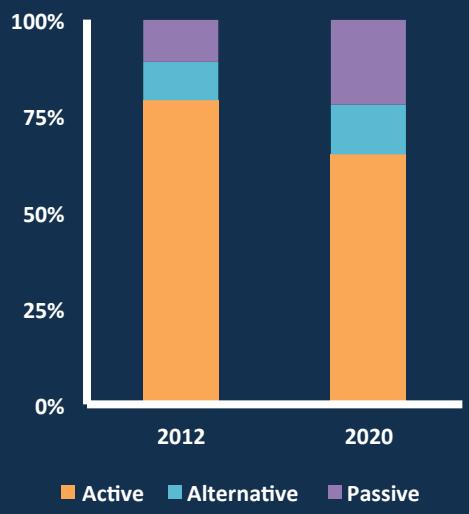


FIG 6: TYPES OF INVESTORS (SOURCE: PETAJISTO 2013[3])

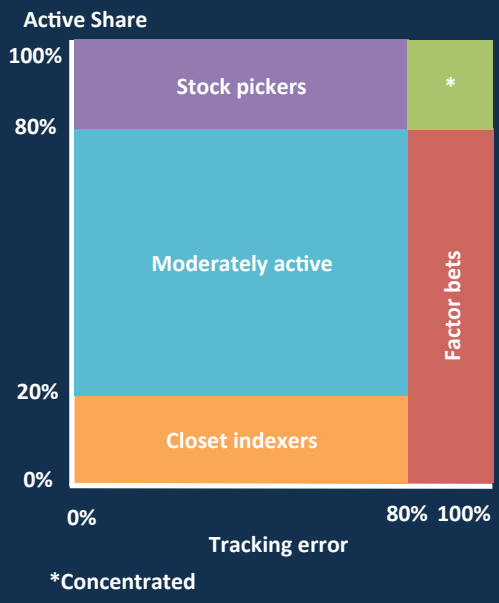


FIG 7: USES OF BENCHMARK INDICES (SOURCE: 2° INVESTING INITIATIVE)

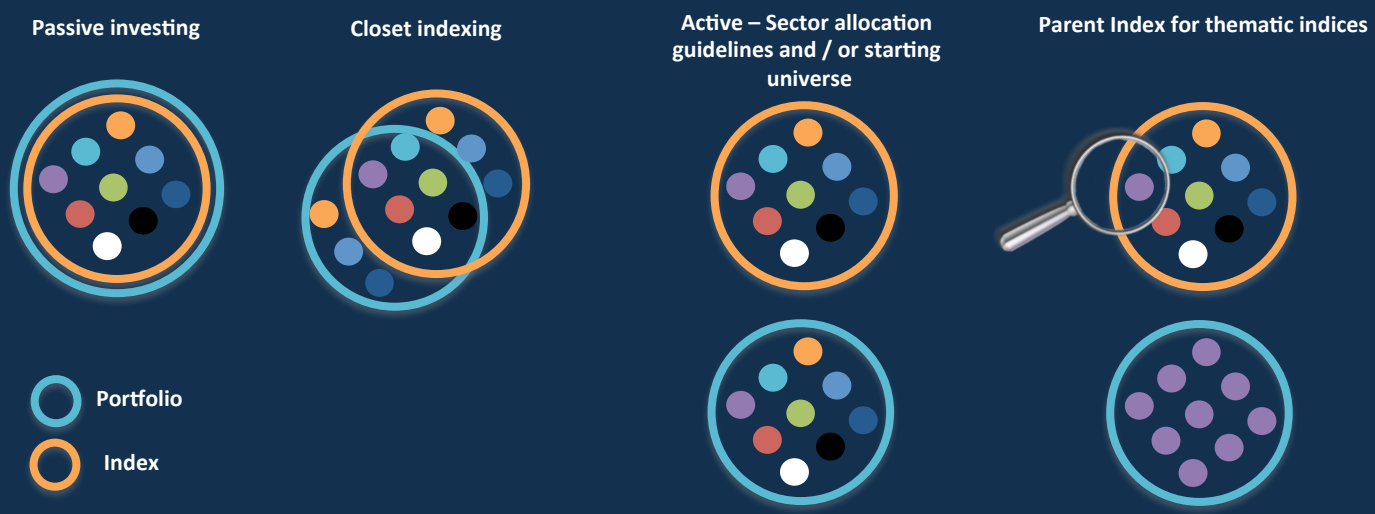
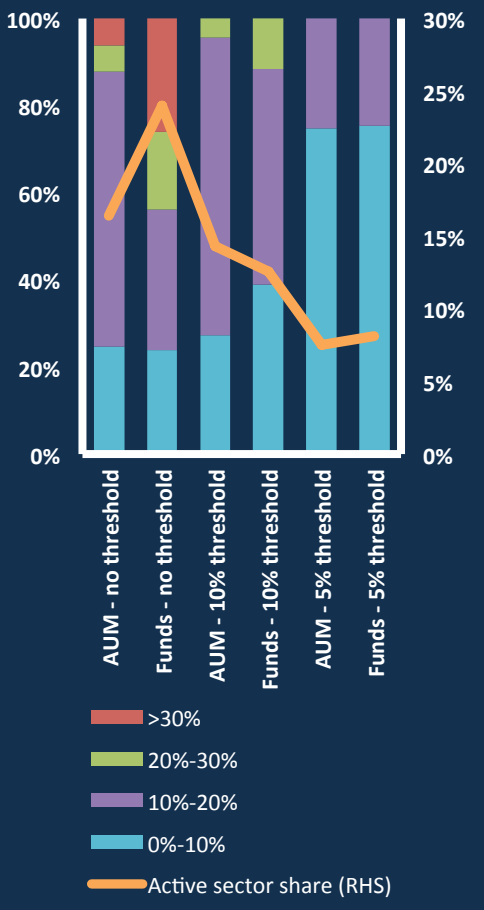


FIG 8: ACTIVE SECTOR SHARE OF ACTIVE FUNDS (SOURCE: 2° INVESTING INITIATIVE, BASED ON MORNINGSTAR DATA)



Calculating active (sector) share

The 'active sector share' was calculated based on the following equation:

$$Active\ Sector\ Share = \frac{1}{2}\sum_{i=1}^{N}|w_{fund,i} - w_{index,i}|$$

with w = weight of the sector. The calculation is based on Morningstar fund data from January 2014. The calculation was performed based on 10 sectors. The methodology is based on Petajisto (2013) in his work on the active share – the difference is the focus on sectors as opposed to stocks. Results are presented both in terms of assets under management (AUM) and number of funds.

Example: If the share of oil and gas in the fund is 12% and the share is 10% in the index, the absolute difference is 2%. If the absolute difference for all sectors is 2%, the fund has an active share of 10%.

Thematic thresholds

To control for funds with factor bets or concentrated stock picking, the figure shows the results for a sample of funds (185 funds), a sample excluding funds that diverge more than 10% from any one sector, and a sample excluding funds that diverge more than 5% from any one sector.

"Active" investors. Beyond closet indexing, Petajisto identifies four additional categories of investors: moderately active investors, stock pickers, factor bettors, and concentrated stock pickers. These investors are distinguished based on their active share and tracking error. The key question for this study is the extent to which index sector diversification influences the sector diversification of this group of investors. For this purpose, the study developed the concept of active sector share, which seeks to quantify the extent to which the weights of the sector in the portfolio differ from the index.

Use of indices beyond 'closet indexing'. While it can be assumed that 'closet indexers' sector allocation is significantly driven by that of the index, it is unclear to what extent indices influence active investors. In principle, there are two types of usages of indices by active investors. First, investors may use indices to define the 'investable universe' among which stocks can be picked. Second, investors will also use indices as sector allocation guidelines. It is in this context that they also appear as performance metrics. The mechanism (in theory) works as follows: Active investors replicate the sector allocation of indices that they are being measured against in order to reduce the tracking error with the index. Risk for the asset manager is then defined by the tracking error to the index.

Active sector share. While the usage of indices in the way described above is widely recognized at a qualitative level, there is currently no quantitative data on the extent of this usage, beyond tracking error. The study seeks to bridge this quantitative gap by identifying the 'active sector share' of a sample of active funds benchmarked to the MSCI World. Fig. 8 presents the results of this analysis (see box for methodological explanation). The chart shows that the weighted average active sector share of assets under management in the sample is 7.5% - 14.3% (depending on cut-off point) and average active sector share by fund is 8.1 - 12.6%. *In other words, the average fund replicated roughly 85%-92% of the sector allocation of the index.*

Analysis on a smaller sample of funds benchmarked to the S&P500 yielded similar results. The results suggest that indices act as 'hard' sector allocation guidelines for roughly 25% of funds (assuming a 10% thematic threshold) and 'soft' sector allocation guidelines for an additional 68% of funds. It appears likely that a significant share of the funds with little sector diversification are not also closet indexers – when looking at the active *industry share* (based on 148 sectors), no fund had an active share of less than 50%. If the active investors had a similarly low 'active industry share', it could be assumed that a significant share of the stocks in the portfolio are similar (see box on next page for a discussion of sector and industry classification).

Parent index for thematic indices. Many thematic indices such as carbon-tilted indices or 'green' indices will use a cap-weighted benchmark index as the starting investment universe (cf. Section 4). Examples for this are the environmental innovators' indices from MSCI, where 'environmental innovators' are identified *among* the MSCI World (or ACWI) universe. Similarly, many so-called 'sustainability' or 'carbon-tilted' indices use a best-in class approach, where they replicate the sector diversification of the indices, but re-weight the equities within the index based on ulterior criteria (such as the carbon intensity of the company). The discussion of the role and perspective for these indices will be returned to in Section 4.2

2.3 DRIVERS OF INDEX INVESTING

Index investing = optimal diversification. The 'original' raison d'être of indices relates to the rise of the modern portfolio theory in academia and practice. The combined research of Markowitz, Tobin, and Sharpe suggests that the optimal investment strategy, assuming a mean-variance (risk-return) maximization objective, is to hold the market portfolio. Given that in practice it is impossible to hold all financial assets, indices in general and in particular cap-weighted equity indices are seen as a tool to achieve diversification. Cap-weighted equity indices are frequently advertised as representing a significant share of outstanding equities.

Exposure to what? Equally, there are a number of question marks when it comes to defining diversification. Thus, as outlined above, there is the question to what extent equity indices are meant to represent just the equity market or the larger economy. Equity indices are frequently used as an indicator for 'economic health'. While in principle the current use of equity indices is clearly related to their role as benchmarks for equity markets, the broader diversification question remains, in particular with regard to the interplay of exposure between asset classes and, by extension, at portfolio level. Furthermore, while equity indices may not be designed to mirror the diversification of the economy, the investment strategy is predicated on the idea that the exposure to the sector (e.g. utilities) is largely aligned with the economy. Indeed, experience of the authors suggest many trustees view indices as representing the economy.

Other drivers. Beyond the issue of optimal diversification, there are also other drivers behind the use of cap-weighted equity indices. These are notably behavioral – investors replicate the index not due to larger considerations of optimal diversification, but rather as a result of an interest to not deviate from market practices. Indeed, these behavioral drivers may figure equally prominent vis-à-vis the motivation to achieve optimal diversification. While this may be the case, the original market practice is still a function of the underlying logic of seeking to benchmark performance against the 'market'.

SECTOR AND INDUSTRY CLASSIFICATIONS

Optimal diversification is usually measured with regard to sector diversification. Indeed, the results on the previous page demonstrate this. Funds are significantly aligned, from a sector diversification perspective, with the mainstream index, but significantly misaligned from an industry level perspective. This suggests that industry diversification with regard to the benchmark is not managed.

The prominence of sector classification however then raises the question to what extent sector diversification captures optimal diversification. It also raises the question of the classification methodology underlying this practice. There are a range of different classifications currently being used, all with smaller or larger differences with regard to grouping companies. Indeed, the analysis in Chapter 3 on energy technology diversification required 'matching' the sector classification of the listed equity data with that of the index classification. At sector level, this is usually relatively straight-forward however.

One obstacle to managing optimal diversification at industry level is the backward looking nature of the business segment classification. The 1000 categories US statistics sector classification provides an example: A category exists for tortilla manufacturing, but renewable, coal-fired, gas-fired, and nuclear power plants are all accounted in the same category. There are currently a number of initiatives being developed, notably by FTSE100,[5] on mapping industry and business segment classification more accurately with regard to climate and sustainability exposure. These have not been launched to date.

2.4 FINANCIAL PERFORMANCE OF INDEX INVESTING

Passive investing wins. Based on the academic MPT and questions around principal-agent problems, the theoretical drivers of index investing are supported by a growing body of empirical evidence that index investing yields superior financial performance relative to active asset management. The literature of Vanguard, a major index provider, is a case in point. Vanguard advertises lower costs and better average financial performance (Fig. 9 & Fig. 10). It also claims more tax-efficient performance, at least in the United States.[8] While this analysis is not from a 'neutral' source, it reflects the larger direction and body of evidence of in the academic literature.

Exceptions to the rule. While active management tends to underperform, there are of course exceptions to this rule. Beyond examples of individual active funds that are able to outperform the market, there are some patterns that emerge when active management performs best. With regard to this, a noteworthy result is that of Petajisto (2013). Here, "funds with the highest *Active Share* significantly outperform their benchmarks, both before and after expenses, and they exhibit strong performance persistence. Non-index funds with the lowest *Active Share* underperform their benchmarks."[3] This active share should not be confused with 'high levels of activity'. Instead, it is really a measure of divergence. Thus a 'high active share' is independent of transaction volume.

Divergence within passive investing. Naturally, the discussion would not be complete without at least a brief reference to the fact that not all passive investing is created equal, to the extent that passive investors can invest in different types of indices. The discussion on cap-weights versus alternatives for example is fiercely contested. It is frequently connected to the debate on the superior performance of 'monkey investing' (i.e. random investment strategies).[9] Andrew Clare (2013) has found similar results, stating that "random process for choosing equity index weights would have often outperformed more 'intelligent index designs,' but in particular, such an 'unintelligent' approach would nearly always have outperformed the market-cap based approach to the formulation of constituent weights."[10]

Conclusions for optimal diversification. The study does not directly contribute to the debate on the relative performance of active versus passive investing strategies and differences between the performance of various type of passive investing strategies. Instead, the debate is meant to underscore the drivers behind the growing use of benchmark indices and the growing contention around what classifies as the optimal index. In this regard, optimal diversification will be one driver of performance. Similarly, the extent to which indices capture the diversification with regard to market trends (for example with regard to the nature and diversification of capital expenditure) will likely also be a key factor with regard to performance. This implies that diversification should not just be considered vis-à-vis the current market but also the profile of investment decisions of listed companies.

FIG 9: SHARE OF ACTIVE FUNDS THAT OUTPERFORMED THE BENCHMARK 2002-2012 (SOURCE: VANGUARD 2014)[6]

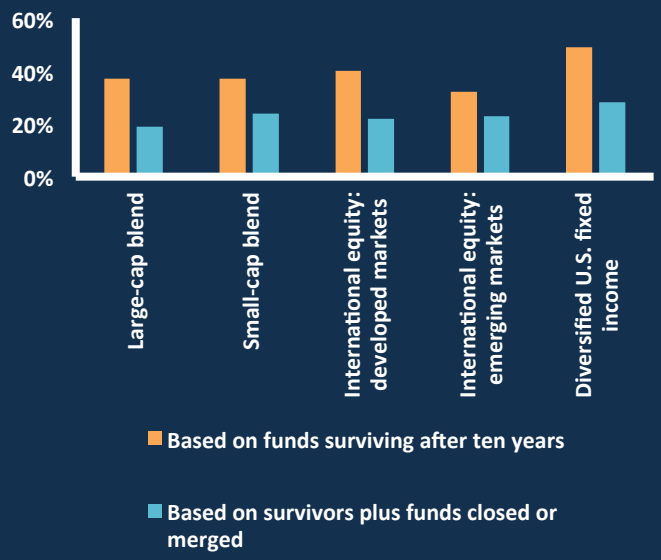
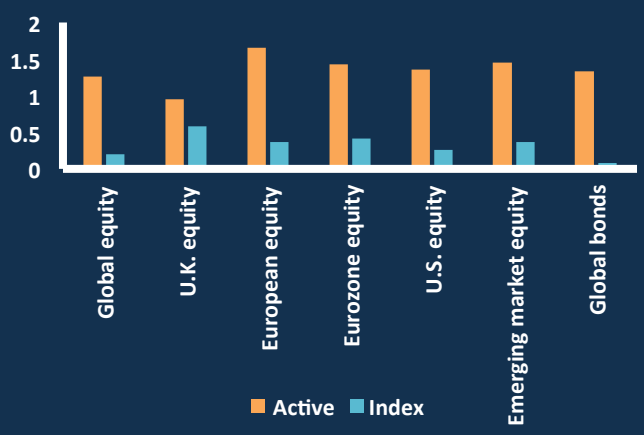


FIG 10: VALUE-WEIGHTED EXPENSE RATIO OF ACTIVE & PASSIVE INVESTMENTS (SOURCE: VANGUARD 2013[7])*



* Average expense ratio quoted for each category of funds represents the asset-weighted average expense ratio based on information in latest available annual report at 31/12/2013.

2.5 QUESTION MARKS AROUND DIVERSIFICATION

Overview. The diversification of cap-weighted equity indices is significant for passive investors, closet indexers, and active investors that use cap-weighted indices as investment guidelines. It also relates to their relevance as performance metrics. In this respect, the 'optimal' diversification of these indices is key, in terms of their impact on asset allocation and their legitimacy as diversification tools. To date, this diversification is already being question from a number of vantage points.

Geography. Equity indices either operate as 'national' indices (i.e. FTSE100, DAX30, etc.) or international indices (i.e. MSCI World). While these apparent geographies are frequently used to define indices, there are a number of questions around the actual geographic exposure. Thus, the location of the headquarters does not necessarily correspond to the location of the bulk of economic activity – BP and Rio Tinto are two cases in point. The geography of economic activity is in turn only partly available in financial databases – usually limited to distinguishing 'home' and 'foreign' activity without further detail. This does not by itself imply a geographic bias, but rather that geographic exposure is not accurately captured by mainstream, domestic indices.

Time horizon. In theory, market valuation should integrate the short- and long-term value of the companies. In practice, however, the value of stocks is frequently driven by 'short-term' considerations that are disconnected from fundamental factors.[11] These trends can persist for several years before market prices revert to fundamentals. Cap-weighted indices responding to these asset bubbles may thus be exposed to a short-term bias (see focus below).

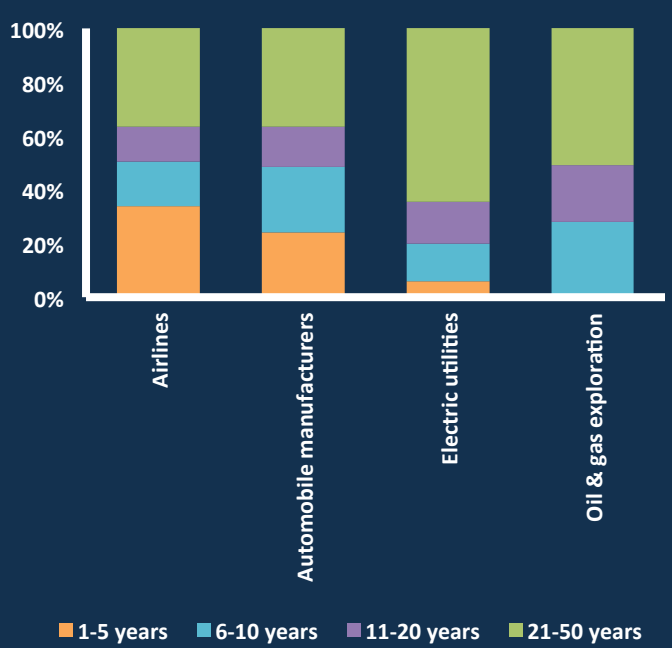
Size. Finally, there is the large cap bias. Within market-cap weighted indices, so called 'large-cap' indices, built based on the market valuation of the largest companies, are the dominant types.[2] These will generally be companies in highly-concentrated industries, such as in the utility or the oil & gas sector. The 'size bias' can naturally be off-set by diversifying the equity portfolio through exposure to companies with small or medium-size market capitalization.

Sector / Industry. Finally, this study focuses on the extent to which sector diversification accurately captures the optimal diversification of an index. The following chapter will review this question in detail.

FOCUS – SHORT-TERMISM IN PRICE FORMATION

Company valuation. There is significant evidence that in many cases the fundamental value of a company is driven by long-term cash flows (Carbon Trust / McKinsey 2008). Particularly for high-carbon sectors such as airlines, utilities, and oil & gas exploration, with significant long-term investments, the majority of company value is likely to be determined by cash flows >10 years. These long-term cash flows are also reflected in the mainstream discounted cash flow models (Fig. 11). In this context, the market valuation of the companies in these sectors becomes a key question. For debt financial assets, obviously the relevant time horizon is the cash flow related to the maturity of the debt. For equities however, the value should in theory be aligned with the fundamental long-term value of the company – as realized through its cash flows.

FIG 11: DISCOUNTED CASH FLOWS IN MORNINGSTAR MODEL BY TIME HORIZON (SOURCE: 2° INVESTING INITIATIVE, BASED ON MORNINGSTAR DATA 2014)



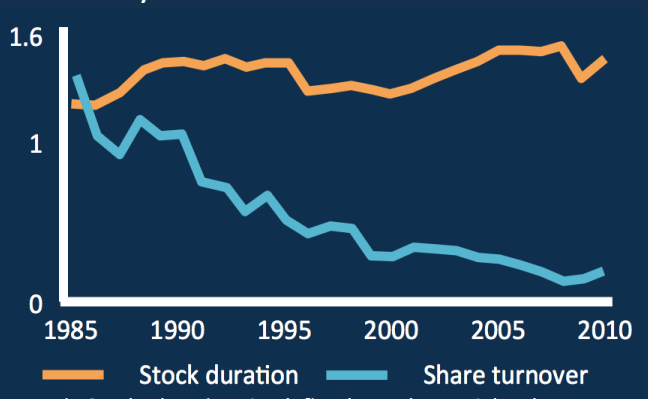
FOCUS – SHORT-TERMISM IN PRICE FORMATION

Time horizons in the investment chain. In practice, the finance sector suffers from short-termism that suggests that stock prices (and by extension market capitalization) is determined by short-term factors. Short-termism can be seen throughout the investment chain (Fig. 12). The models for credit and equity research analysis for the risk-return of financial assets in the short-term are quite sophisticated. Beyond 3-5 years, however, these models usually extrapolate current trends. By extension, stock picking recommendations are based on short-term valuations. This short-termism is partly a function of fund managers' time horizon – expressed both through the stock duration of roughly 1.5 years (Fig. 13) and the performance incentives of portfolio mangers (Fig. 14).

Time horizon and liquidity. The World Economic Forum found that long-term investors invest 9% of their portfolio in illiquid assets and that they could, in theory, more than double this exposure while still meeting their liability and regulatory constraints.[14] The preference for liquidity in this context may be partly be a function of time horizons.

Stock prices and short-termism. Given that cap-weighted indices are built based on current stock prices and that these stock prices appear 'short-term', the indices themselves may contain a 'short-term' bias. To date, there is little research as to the interaction of this investment chain and its relationship for stock prices. There is also a poor understanding of what this implies for optimal diversification.

FIG 13: STOCK DURATION AND SHARE TURNOVER IN YEARS (SOURCE: CREMERS 2013[12])*



* Stock duration is defined as the weighted-average length of time that institutional investors have held a stock in their portfolios, based on their quarterly holding reports and weighted by the dollar amount invested across all institutions

FIG 14: TIME HORIZON OF FUND MANAGERS' COMPENSATION (SOURCE: MFS 2014[13])

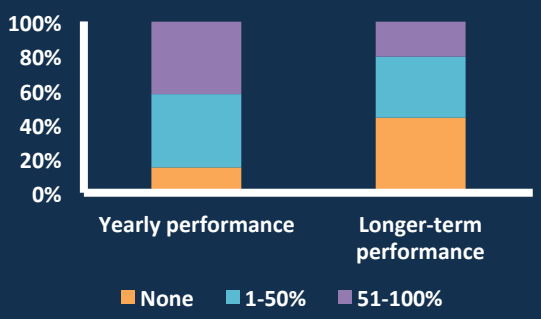
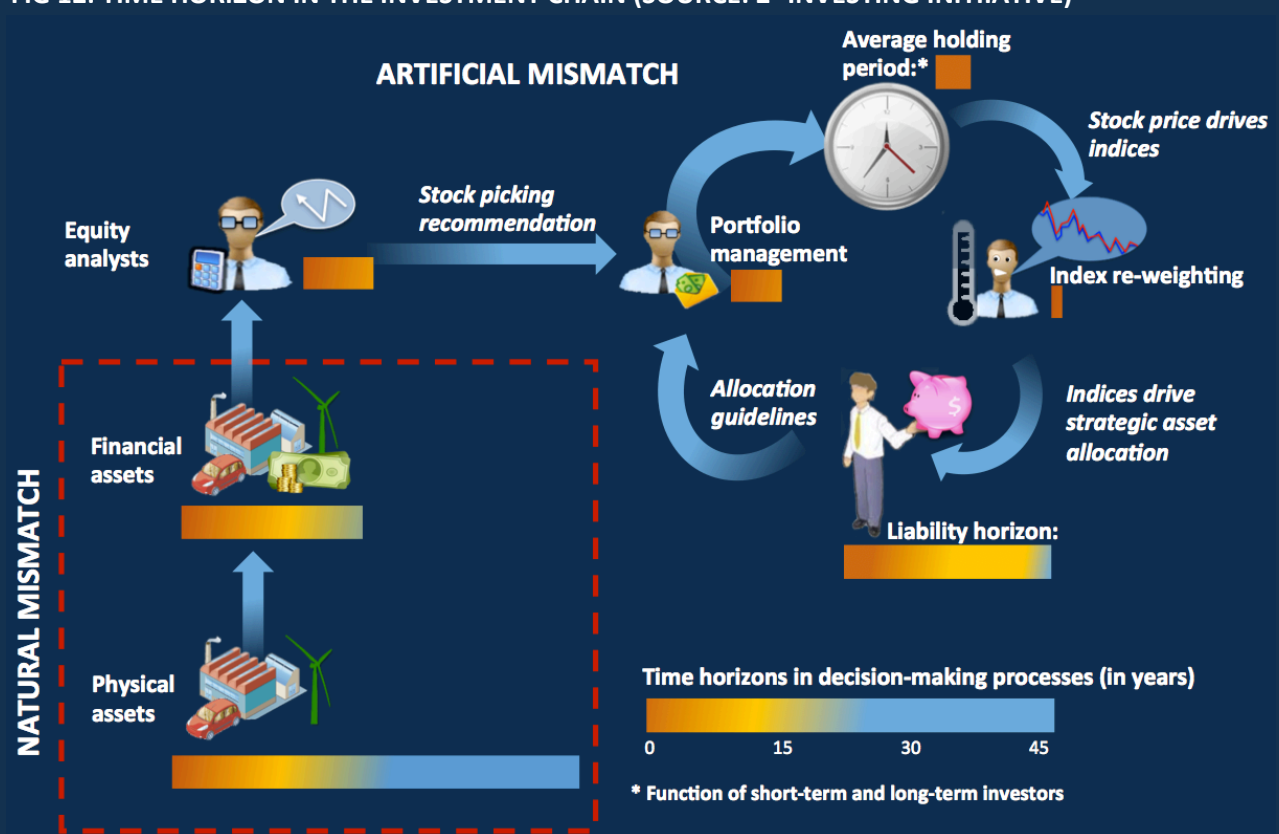


FIG 12: TIME HORIZON IN THE INVESTMENT CHAIN (SOURCE: 2° INVESTING INITIIATIVE)



3. ENERGY TECHNOLOGY DIVERSIFICATION

3.1. CONCEPT OF ENERGY TECHNOLOGY DIVERSIFICATION

From optimal diversification to sector diversification. As outlined in the previous section, traditional tests of optimal diversification relate to the sector exposure of portfolios and their alignment with the benchmark – in the majority of cases the market-capitalization weighted equity index. This strategy relies on two core assumptions. First, that the index accurately reflects the sector allocation of the 'market' – however the market may be defined. The second assumption relates to the idea that sectors are a rational way to organize and categorize companies, given the homogeneity of the companies within sectors. That does not necessarily imply that all companies in a sector perform similarly. Instead, the idea is broadly that – take the finance sector as an example - the performance of financial institutions will be roughly aligned throughout the economic cycle. By extension, diversification (in theory) ensures that the common price movement of one sector – the finance sector in this case – can be offset by exposure to a different sector with a different dynamic.

Introducing energy technology diversification. This study argues that managing sector diversification is insufficient to ensure 'optimal diversification'. In particular, sector diversification does not take into account energy technology diversification, which will be a key factor in ensuring optimal exposure to the transition to a low-carbon economy. Energy technology diversification can be defined as the diversification in a portfolio related to the different energy technologies (i.e. renewables, wind, biomass, hybrid vehicles, different types of oil, etc.) in energy-intensive sectors. Managing energy technology diversification is a key instrument to managing the risks and uncertainty associated with the energy transition. It may also be associated with a broader realization of 'optimal diversification'.

Example: Utility sector. The utility sector as an example will help to elucidate this concept. Thus, from a sector diversification perspective, the key aspect to manage is whether the share of the utility sector in the portfolio or the benchmark index is aligned with the 'market'. At the same time, there is a significant variation in energy technologies in the utility sector – renewable, gas, coal, nuclear, etc. (Fig. 15). Electric utilities in turn generate electricity with significant differences in the 'energy technology mix'. In the context of the transition to a low-carbon economy, these different energy technologies are likely to have significant differences in terms of long-term viability – and relative performance. Thus, even if the sector exposure is aligned with the market, buying a utility that generates 100% of its electricity through coal implies a significant lack of diversification.

Chapter outline. This chapter will first review mainstream cap-weighted indices based on the traditional category of sector diversification. It will then attempt to identify the associated energy technology diversification for three key energy-intensive sectors: oil & gas, automobile, and utilities.

FIG 15: MANAGING SECTOR AND ENERGY TECHNOLOGY DIVERSIFICATION – THE CASE OF THE UTILITY SECTOR (SOURCE: 2° INVESTING INITIATIVE)

FIG 16: OIL & GAS SECTOR IN INDEX AND LISTED EQUITY UNIVERSE (SOURCE: 2° INVESTING INITIATIVE, BASED ON INDEX FACTSHEETS,[1] DAMODARAN[2] & DATASTREAM)

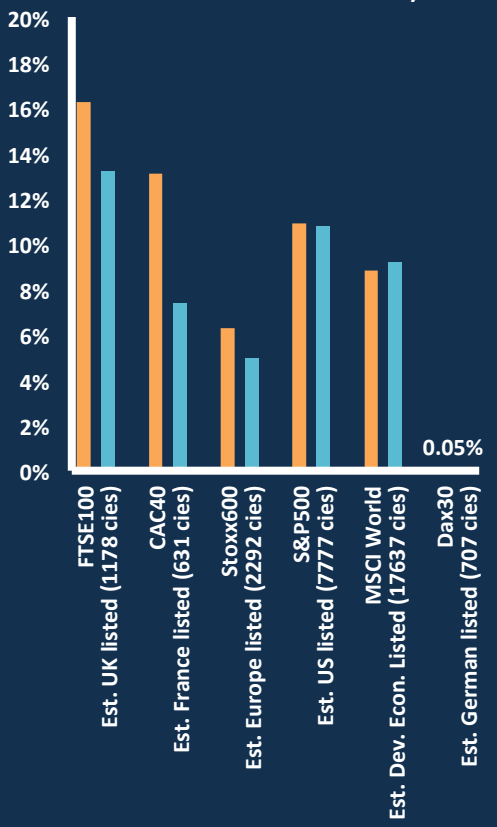
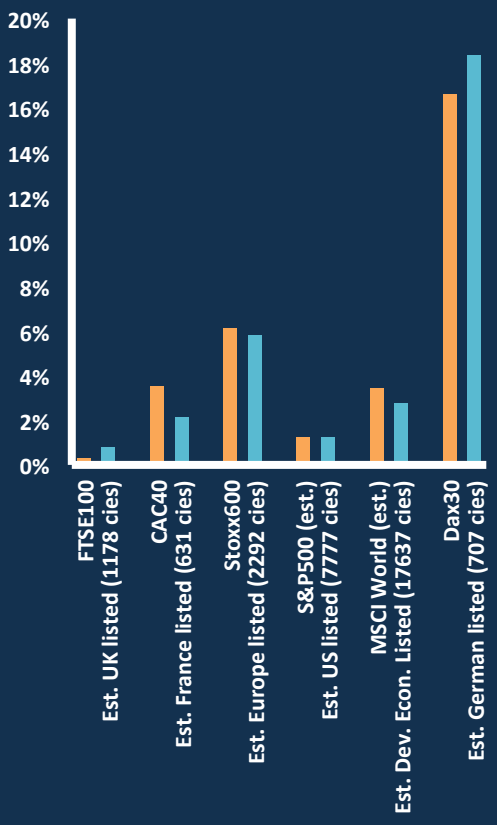


FIG 17: AUTOMOBILE SECTOR IN INDEX AND LISTED EQUITY UNIVERSE (SOURCE: 2° INVESTING INITIATIVE, BASED ON INDEX FACTSHEETS,[1] DAMDOARAN[2] & DATASTREAM)



3.2. DIVERSIFICATION BY SECTOR

Calculating diversification by sector. This section will compare the sector diversification of the index with the sector diversification of the listed equity markets. In principle, cap-weighted equity indices should not diverge significantly from the listed equity universe they are designed to represent. They frequently represent a significant share of the market. The FTSE100 for example covers 84.35% of the market capitalization of the UK equity market. The review will focus on six major indices, notably the FTSE100 (United Kingdom), CAC40 (France), DAX30 (Germany), STOXX600 (Continental Europe), S&P500 (United States), and MSCI World (Developed Economies). Three sectors were chosen for the review: the oil & gas sector, the utility sector (including non-electric utilities), and the automobile sector (including automobile parts, but excluding retail).

Share of oil and gas. Fig. 16 shows the share of oil & gas in the index and the equity market the index is meant to represent. The results show that despite the significant share of the FTSE100 and CAC40 in their domestic equity market, both indices significantly over-weight the oil & gas sector - in the case of the CAC40 by 5.71%, and the FTSE100 by 3%. While this divergence may partly be a function of changes in equity prices (indices usually get reweighted quarterly), they appear significant from a diversification perspective. One way to understand this difference is to treat the index as a fund and the listed equity market as an index. In other words, what would be the active sector share for the index versus the listed equity market and how would that compare to the sample of funds reviewed earlier. Based on this 'active sector share', the CAC40 would, in the sample analyzed in the previous chapter, appear in the top 15% in terms of active funds (using a 10% thematic threshold for the sample). The FTSE100 would appear in the top 30%.

All other indices under review exhibited significantly lower or no active sector share.

Share of automobile sector. For the automobile sector (including auto parts and automobile manufacturers), all indices seem largely aligned with the listed equity universe. Interestingly, the DAX30 even appears to slightly under-weight the sector relative to the German listed equity universe (Fig. 17). It is important to note in this context that the STOXX600 does not represent the entire European listed equity universe – excluding the United Kingdom for example. If the entire European listed equity universe were taken as the benchmark, the STOXX600 would over-weight this sector by 3%. It should be noted that here too the caveat applies in terms of the potential fluctuations in prices altering the results.

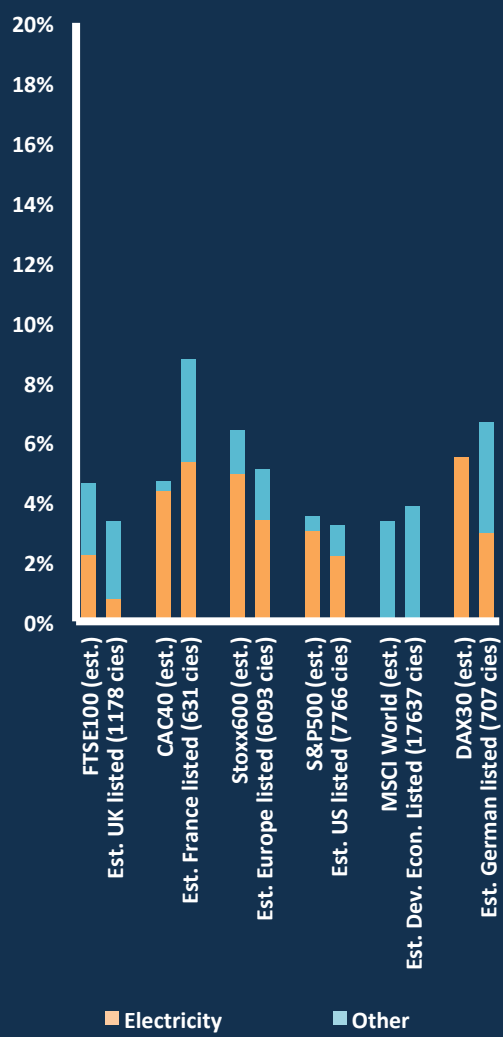
Share of utility sector. For the utility sector, the results show a divergent picture. When looking at all types of utilities (electricity, gas, and water), it appears that a number of indices – notably the DAX30 and the CAC40 – actually *under-weight* the utility sector (Fig. 18). The divergence of the other indices is limited – in the range of 0.3% - 1.2%. At the same time, from an energy transition perspective, the real question naturally evolves around the *type* of utility and the fuel mix (cf. Section 3.5).

Looking at electric utilities. The utility sector includes electric utilities, water utilities, and gas utilities. Some utilities have their business in a combination of these categories and are thus difficult to classify. Nevertheless, using a mix of industry classification codes and a review of annual reports, the analysis seeks to distill the share of electric utilities in the index versus the share of electric utilities in the listed equity universe. For simplicity, utilities were either classified as 'electric' or 'other'. The results here show increased active sector shares: 2.5% for the DAX30, 1.9% for the FTSE100, and 1.6% for the STOXX600.

It should be noted that the results are subject to significant caveats. Thus, industry classification codes were used for the listed equity universe, which may not appropriately assess the business model of a utility. By extension, a more granular analysis may reveal a significantly lower (or higher) active share. Thus, given the potential errors, the results cannot be described as conclusive. At the same time, they suggest that managing exposure by type of utility may improve optimal diversification, in particular given the different challenges to utilities' business models in the context of the transition to a low carbon economy.

Other sectors. The analysis presented in this study limited the focus on three prominent sectors associated with the energy transition. The logic of this choice was partly a function of the consistent representation of these sectors in the indices under review. Except for the DAX30, all indices contain an oil & gas company and all indices contain companies in the utility and automobile sector, albeit to varying degrees. This allowed for a comparative analysis. Moreover, data at this sector level is readily available and relatively unambiguous in terms of sector classification. Equally, the authors concede that in some sense the analysis remains incomplete, notably with regard to coal (see box), other transport sectors (airlines), and high-carbon manufacturing.

FIG 18: UTILITY SECTOR IN INDICES AND LISTED EQUITY UNIVERSE (SOURCE: 2° INVESTING INITIATIVE, BASED ON INDEX FACTSHEETS,[1] DAMODARAN[2] & DATASTREAM)*

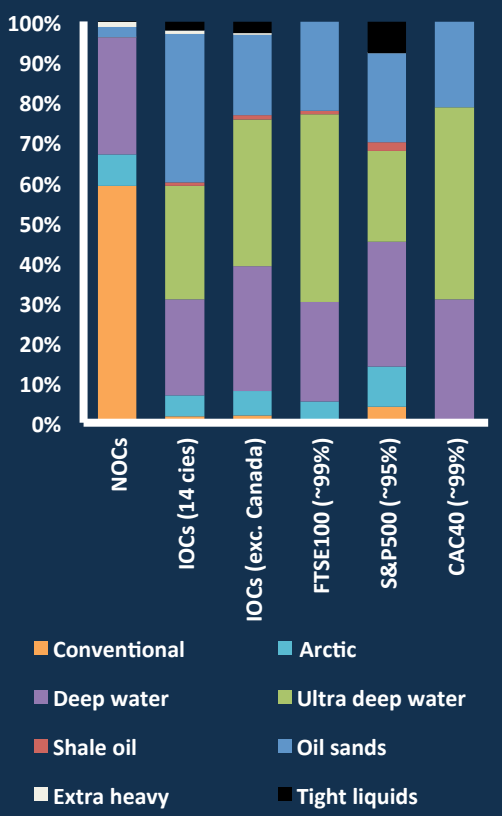


* MSCI World was not estimated given the number of utilities and the associated potential error.

COAL AND EQUITY MARKETS

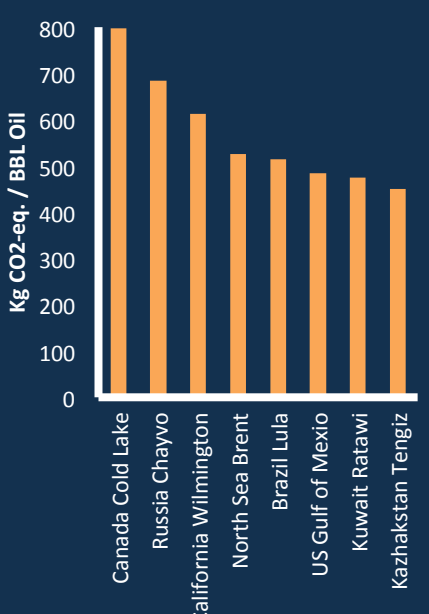
The coal sector is notably absent from the analysis presented in this report. This is due to the limited representation of the coal sector in equity markets. Thus, the coal sector only constitutes 0.13% of the US and 0.49% of the European listed equity universe. By extension, the analysis of the coal sector becomes potentially a lot more relevant when looking at bond indices and markets.

FIG 19: HIGH-COST OIL CAPITAL EXPENDITURE BY ENERGY TECHNOLOGY 2014-2025 (SOURCE: 2°INVESTING INITIATIVE, BASED ON CTI 2014[3] AND ANNUAL REPORTS[4])*



*Numbers in parentheses indicates the share of oil capital expenditure captured by the data. MSCI World & STOXX600 were not estimated. Shares were weighted by capital expenditure and not the share of the company in the index.

FIG 20: ESTIMATED CLIMATE INTENSITY BY TYPE OF OIL (SOURCE: CARNEGIE OIL INDEX 2014[5])



3.3 FOCUS ON THE OIL & GAS SECTOR

Energy technology as criteria for diversification. From an energy transition perspective, it is not just the sector but also the energy technology that matters. Thus, the potential alignment of an index with the equity market by itself does not inform on adequate or optimal diversification. For the oil & gas sector, a key question in this regard is the diversification of indices by energy technology. This applies in particular with regard to high-cost projects, defined by Carbon Tracker (2014) as projects that require a $80 price to break even.[3]

Diversification of capital expenditure. The breakdown of the capital expenditure of high-cost projects by type of oil demonstrates significant differences, both between indices, and a sample of international oil companies (IOCs) and national (state-owned) oil companies (NOCs) (Fig. 19). While national oil companies may not provide a good benchmark, as they are frequently unlisted, the comparison between indices suggests that - beyond managing the exposure to the oil sector – the energy technology needs to be managed. Naturally, given the international nature of oil companies' operations, it does not make sense here to attempt to compare these numbers for national indices to national oil production.

Question of risk. The analysis presented here only focuses on the question of energy technology diversification and not the risk associated with high-cost / low-cost capital expenditure. Thus, larger oil companies generally have a lower share of high-cost projects than smaller companies and thus indices may in fact be less exposed to high-cost capital expenditure. Nevertheless, it may also be relevant to monitor this exposure, although not an energy technology indicator.

Implications for climate change. An additional way to address energy technology exposure in the oil and gas sector is by looking at the GHG-emissions diversity of the oil and gas exposure. Thus, different oils will vary widely in terms of their climate impact (measured in GHG-emissions) (Fig. 20). By extension, exposure to different types of oils will be significant not just from a broader diversification perspective, but also specifically from the perspective of exposure to the transition to a low-carbon economy.

Other types of diversification. The discussion presented here is limited to the diversification of capital expenditure – the key forward-looking indicator to measure the exposure of companies to the energy transition. There are naturally additional relevant indicators that can be explored in this regard, notably the nature of current oil and gas reserves (proved and otherwise), the ratio of oil to gas reserves, and ratio of oil to gas capital expenditure (although this is difficult given current data availability and the nature of some oil plays (fields) as a mix of oil and gas).

3.4 FOCUS ON THE AUTOMOBILE SECTOR

Measures related to diversification. There are a number of different ways to identify diversification within the automobile sector – notably the breakdown of sales by light vehicles, SUVs, etc. Alternative measures can relate to the fuel efficiency of the automobile manufacturer's car fleet or even the exposure to automobile manufacturers versus auto parts – although there are likely to be limited diversification benefits when investing according to this measure. Moreover, the industry concentration in the listed automobile sector is very high. In other words, there are limited choices – there are only 16 automobile manufacturers in the European listed equity universe.

Fuel efficiency. One of the most prominent indicators from a climate change perspective for the automobile sector is the fuel efficiency of the vehicle fleet. While not a measure of diversification, it demonstrates the alignment of a company with the regulatory trajectory. In Europe, this trajectory is clearly mapped, with average mandated increases in fuel efficiency of 27% by 2020 (Fig. 21). Whereas predictably German carmakers and the DAX30 have currently higher emissions due to a larger share of high-powered vehicles, the interesting question arises in terms of the extent to which carmakers will be in line with targets (and the costs of meeting them).

Exposure plus weights. The crucial aspect is the relative weight of the different car companies, particularly for European indices. Thus, the German DAX30 for example captures to a significant extent the German automobile manufacturing industry. Here the issue appears less in the form of the index 'excluding' companies (at least not with regard to the DAX30), but more importantly the relative weighting of the car manufacturers. The analysis presented in Fig. 21 misses this weighting and is thus not meant as a guideline, but rather to demonstrate the importance of trajectories and the significant differences that can arise in terms of the response by companies.

Hybrid and other emerging technologies. Beyond the fuel efficiency question the energy technology question will become more prominent. This relates to both the R&D by companies in sustainable propulsion technologies and to the integration of these technologies in the car fleet. While these markets are still in their infancy, and thus likely subject to significant upheaval in the next decade, the current trends are clear. Looking at the US index, the S&P500 companies are only marginally represented in their domestic hybrid and electric vehicle sales (albeit interestingly slightly over-represented among plug-in hybrids) (Fig. 22). The crucial message here is not with regard to a hierarchy of technologies, but, given the uncertainty about the nature of road transport, the need for an investment tool that manages the exposure to these competing technologies.

FIG 21: EUROPEAN VEHICLE EMISSIONS TRAJECTORY (SOURCE: 2° INVESTING INITIATIVE, BASED ON ICCT DATA[6])

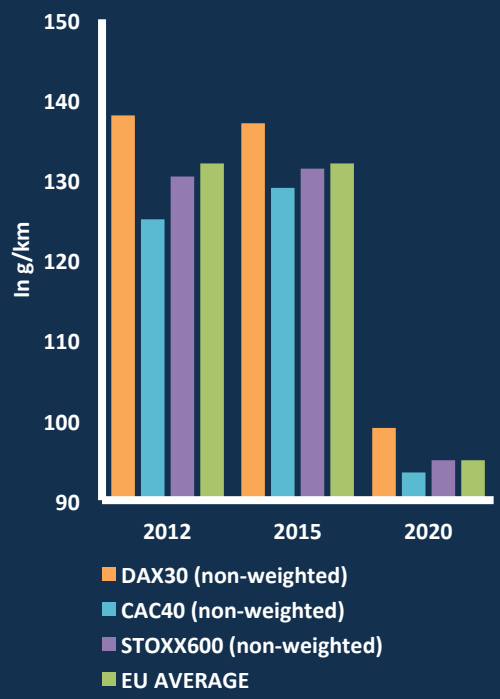
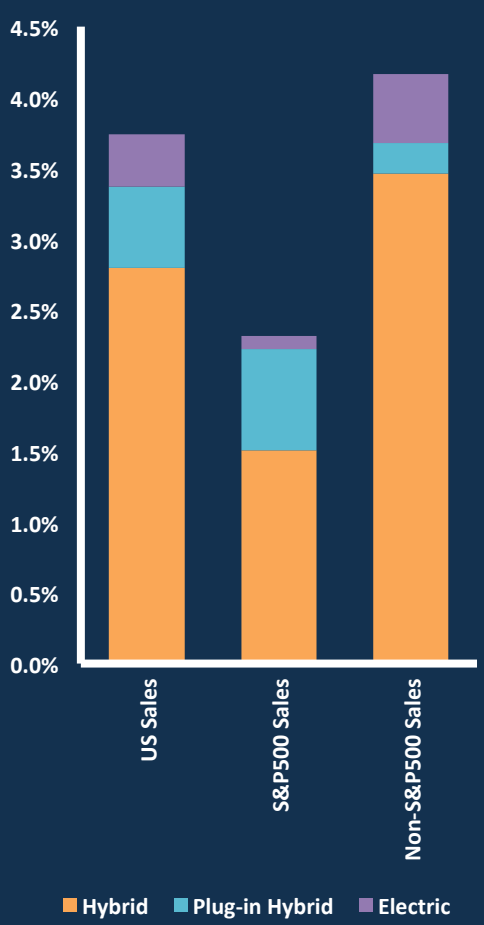


FIG 22: ESTIMATED SHARE OF ALTERNATIVE FUELS IN US CAR SALES NOV 2013 – OCT 2014 (SOURCE: 2° INVESTING INITIATIVE, BASED ON NADA[7] AND HYBRIDCARS.COM[8] DATA)



3.5 FOCUS ON THE UTILITY SECTOR

Index vs. electricity generation. The utility sector is arguably the most interesting sector to analyze at energy technology level, as here there is a 'true' competition between high-carbon and low-carbon technologies. At the same time, the analysis is complicated by the fact that it is challenging to measure the fuel mix of the listed equity universe given the number of utilities. As a result, the analysis compares the electric utilities in the indices to the electricity mix of the economy. At this stage, the analysis just focuses on three indices in detail: S&P500, DAX30, and FTSE100.

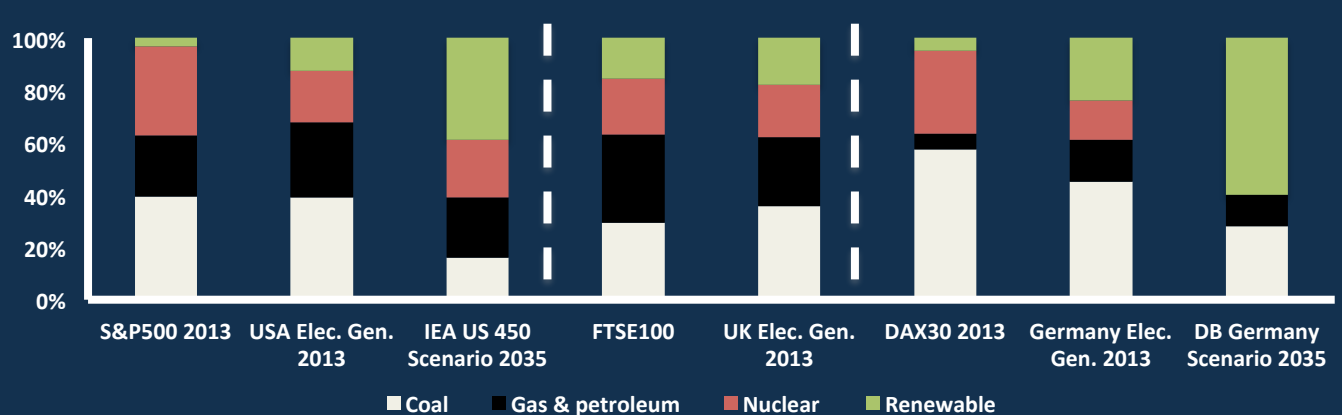
The missing 'green'. The results suggest that cap-weighted equity indices do not over-weight high-carbon fuels relative to the electricity generation. At the same time, the S&P500 and the DAX30 under-weight renewable energy to the tune of 10% and 19% respectively (Fig. 23). This suggests significant sub-optimal diversification. Interestingly, while the FTSE100 is the worst performer in terms of exposure to the oil & gas sector, it appears as the best performer for the utility sector with a well-diversified fuel mix.

A view towards the future. To date, the annual reports of companies and relevant databases do not provide the breakdown of capital expenditure of utilities by energy technology. As a result, it is currently impossible for investors to measure their diversification, or exposure, to the future. While the data is missing, the trajectory is clear: IEA scenarios suggest a significant increase in green in the United States. Similarly, the German policy roadmap suggests a 60% share of renewable electricity generation in 2035 and a phasing out of nuclear power. Interestingly, from an investor's perspective, a key difference in managing this exposure is first, whether action takes places in response to a direct policy target (Germany) or to market predictions (US), and then deciding on a position. Thus, given the changes in electricity generation, explicitly managing the corresponding exposure to these changes (as opposed to the current implicit management of mirroring the S&P500) will be key.

Caveats to the analysis. As outlined above, the analysis is not 'clean' as it does not compare the fuel mix of the index with the fuel mix of the listed equity universe. In the United States, this is likely to be relevant with regard to electricity generation by public agencies like the Tennessee Valley Authority, which is not listed on the US stock market. In turn, in Germany renewable power generated by households or by municipalities is similarly not captured. While this may balance the results, it is unlikely to explain the respective 10% and 19% divergences.

From energy technology to sectors. The energy transition and the associated rise of distributed renewable electricity generation and smart grids pose significant challenges to the long-term business model of electric utilities. In Germany, these challenges are already evident in the development of equity prices of utilities such as RWE. From a forward-looking perspective, these trends are likely to be significant not just in terms of energy technology, but the future size and share of the electric utility sector in equity markets more broadly.

FIG 23: COMPARISION OF THE INDEX ELECTRICITY GENERATION WITH DOMESTIC ELECTRICITY GENERATION AND ELECTRICITY SCENARIOS (SOURCE: 2° INVESTING INITIATIVE, BASED ON US EIA,[9] BUNDESNETZAGENTUR,[10] DEUTSCHE BANK 2013,[11] IEA WEO 2012,[12] AND ANNUAL REPORTS[4])*



*The energy technology diversification of the index is calculated based on the total electricity generation of the companies in the index.

3.6 COMPARING EQUITY INDICES TO THE REAL ECONOMY

'Economic' diversification. The benchmarks used so far to analyze the diversification of cap-weighted equity indices at sector level were related to the listed equity universe. At sub-sector level, this standard was somewhat loosened as it can be argued that exposure to the sector achieved through equity markets is largely designed to mirror the diversification of the sector. In any event, it seems unlikely that any bias within a sector is managed and actively 'counter-biased' at portfolio level. Beyond, the broader question arises with regard to 'economic' sector exposure. It should be said in advance that when comparing equity indices to the real economy, it is not a fair comparison as they are not built to mirror the real economy. Nevertheless, it is a helpful exercise when thinking about diversification.

Example: Oil & gas. To demonstrate the relationship between the equity index and the economy, this study looks at the share of the oil & gas sector in the United States and the United Kingdom, the only two 'national' economies that have significant domestic upstream oil & gas exploration and production. Fig. 24 demonstrates that although significant in the index and listed equity universe, the oil and gas sector constitutes a fraction of private sector economic output and value-added. Given that this 'over-weight' can also be seen in equity markets more generally, this raises the larger question of the 'diversification bias' of equity markets.

3.7 CLIMATE SHARE IN INDICES

Defining a climate share in indices. The analysis so far has shirked the question of the share of climate-friendly companies in indices overall. This is largely a result of the very limited data on this – and question marks around defining green. This question was partly addressed in the previous discussion of diversification within sectors. Thus, the climate-friendly share of an index can be defined as the sum of the 'climate-friendly' shares of the constituents' business models, defined for example through the share of automobile sales related to sustainable propulsion technologies.

Climate is lacking. The data that does exist from MSCI ESG Research suggests a very limited share of green in the indices under review (Fig. 25). The notable outlier CAC40 is likely partly a function of the classification of nuclear power. However, given the question marks around data, these results should be treated cautiously. MSCI ESG Research is currently updating the data. Despite the limited data, these results are globally in line with the previous analysis of the share of 'climate-friendly' technologies in energy-intensive sectors.

FIG 24: SHARE OF OIL AND GAS IN FTSE100 AND S&P500 RELATIVE TO THE LISTED EQUITY UNIVERSE AND REAL ECONOMY (SOURCE: 2° INVESTING INITIATIVE, BASED ON INDEX FACTSHEETS,[1] US BEA DATA,[13] AND UK ONS DATA[14])

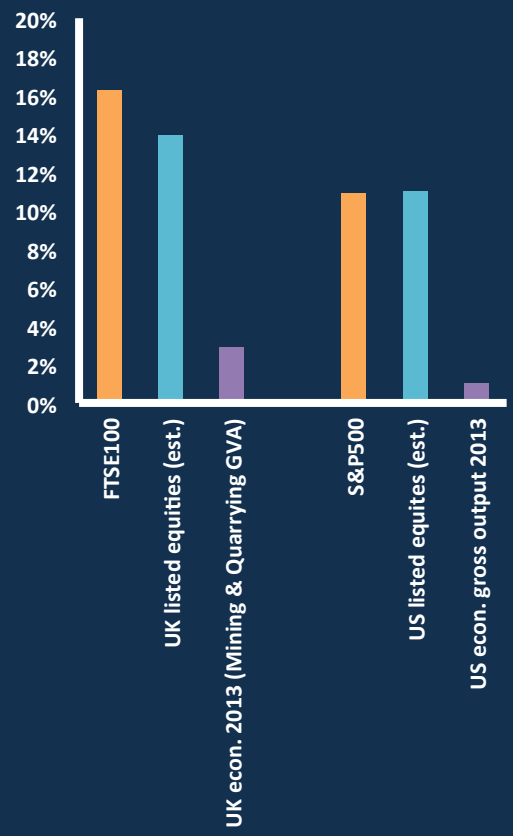
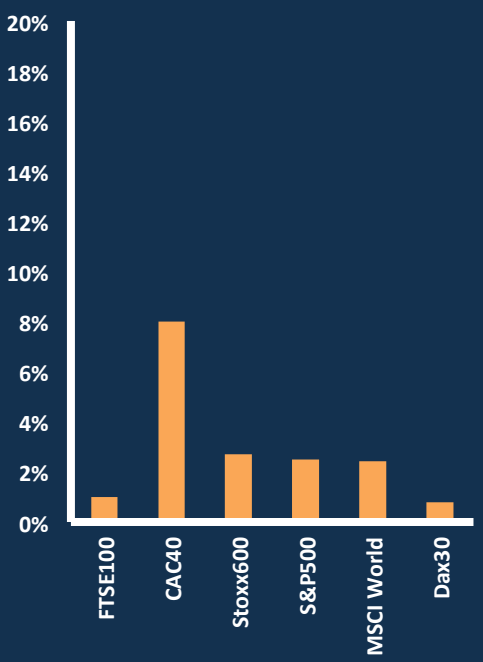


FIG 25: SHARE OF 'CLIMATE' IN MAJOR INDICES (SOURCE: 2° INVESTING INITIATIVE, BASED ON MSCI ESG RESEARCH DATA[15])



Size bias = green bias. The low share of 'climate' (based on MSCI ESG Research data) is a function of the size bias of market-cap indices. This can be clearly seen when using the MSCI ESG Research data and their 'environmental' thematic indices. Given the emerging nature of many climate-friendly industries and technologies, and the less-concentrated nature of these industries (e.g. renewable energy sector), they are likely to be less prominent among the largest companies in the market, compared to concentrated, high-carbon sectors (Fig. 26). Indeed, the average market capitalization of the companies MSCI identifies as 'green innovators' is a fraction of that of the market capitalization-weighted indices and the thematic indices related to high-carbon companies (Fig. 27). While the tools and data are currently lacking to frame these results as a 'bias' vis-à-vis the listed equity universe, in particular given the question marks around the data more generally, the existing evidence is compelling that 'green' companies are under-represented in cap-weighted indices relative to the listed equity market.

3.8 THE BIAS IN EQUITY MARKETS

Equity markets over-weight high-carbon sectors. The preliminary analysis presented on the previous page suggests that high-carbon sectors are significantly represented in cap-weighted equity indices, but also in listed equity markets more generally. Thus, the ~10% share of oil & gas in the S&P500 is largely aligned with the US listed equity universe. At the same time, the analysis also showed that this weight in listed equity markets, at least in the case of the oil & gas sector in the United Kingdom and the United States, is not in line with the domestic economies. This suggests a larger 'carbon bias' in equity markets relative to the real economy.

Who cares? On the one hand, this may simply be a function of capital markets. While optimal diversification in academic theory may have once dreamt of a 'market portfolio' holding all assets, this is indeed not feasible in practice. On the other hand, the energy transition creates a new set of challenges with regard to diversification. One step in this direction is for example a more diversified exposure to different energy technologies relevant in the context of the energy transition. Another step may be questioning the sector diversification more broadly.

Role of counter biases. Another question relates to the larger asset allocation and portfolio management strategies. The Barclays Global Bond Aggregate for example only has an estimated share of oil & gas of roughly 1-2% (partly a function of the dominant share of public sector bonds), but potentially has a larger share of coal relative to equity markets. By extension, the asset allocation between bonds and equities is equally likely to significantly influence the diversification from an energy transition perspective. In this context, it becomes relevant to start managing the energy technology diversification at portfolio level. At present, there are two ways to manage this 'carbon bias': The first is to align the sector diversification of the equity portfolio with the real economy. The second is to seek counter-biases in other asset classes to 'balance' the portfolio. However, whichever strategy is chosen, it should integrate both questions of sector and energy technology diversification.

FIG 26: DISTRIBUTION OF HIGH-CARBON SECTORS IN MSCI WORLD (SOURCE: 2° INVESTING INITIATIVE, BASED ON DATASTREAM DATA)

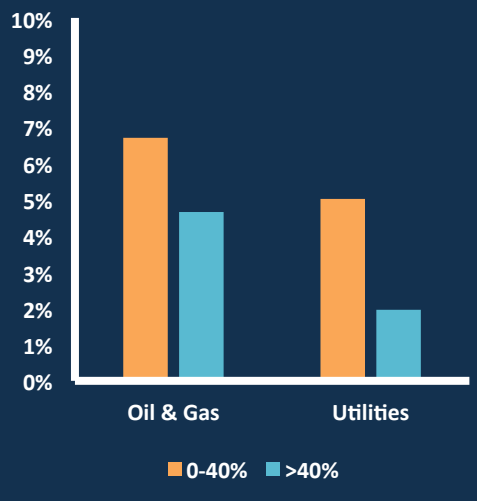
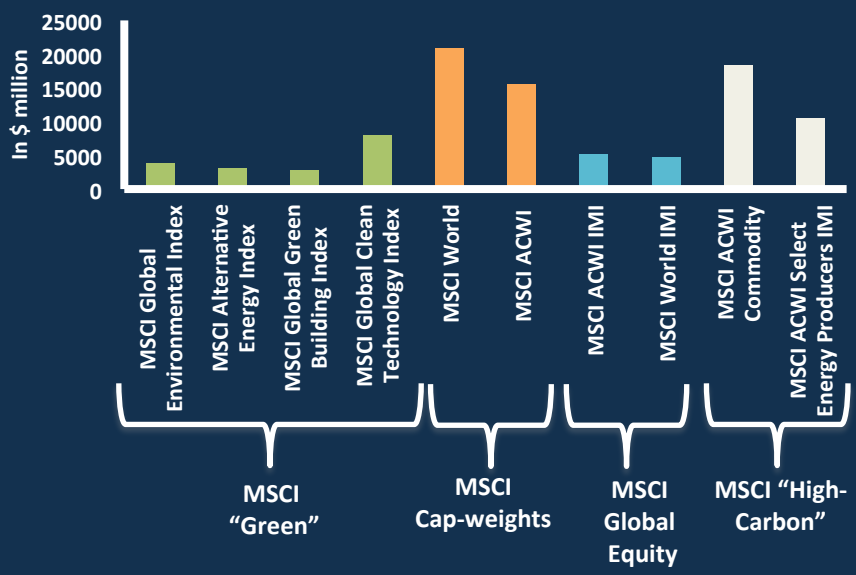


FIG 27: AVERAGE MARKET CAPITALIZATION OF MSCI CAP-WEIGHTED PARENT INDEX AND THEMATIC INDICES (SOURCE: 2° INVESTING INITIATIVE, BASED ON INDEX FACTSHEETS[1])



4. IMPLICATIONS FOR INVESTORS

4.1 SUB-OPTIMAL DIVERSIFICATION AND RISK

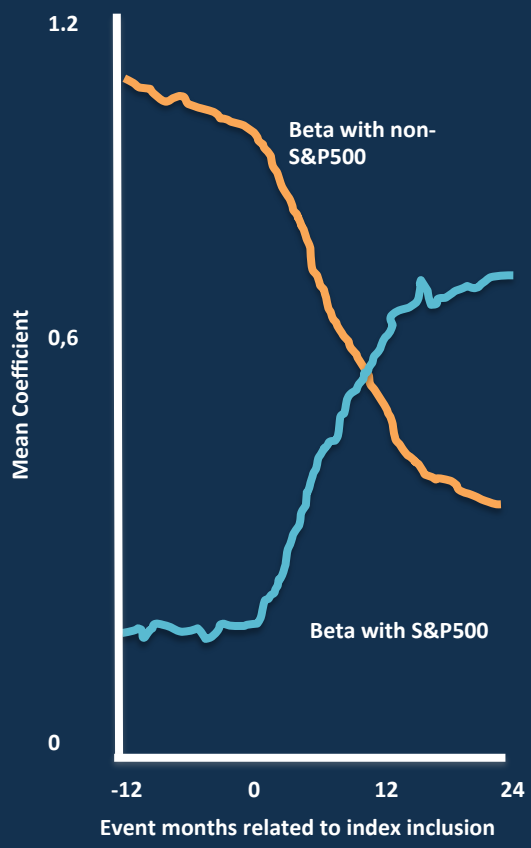
Sub-optimal energy technology diversification. The analysis in the previous chapter suggests that, with the exception of the FTSE100 and CAC40, major cap-weighted indices largely mirror the sector diversification of the listed equity universe. Thus, they appear well-diversified from a sector allocation perspective. At the same time, from an energy technology perspective, the indices under review appear poorly diversified. The results suggest that market-capitalization weighted indices are not optimally diversified from an energy technology perspective – and thus poor investment tools for investors seeking broad market diversification.

Crucially, the study does not comment on the potential nature of the risks that may be associated with the energy transition. While it appears clear that the changes in the economic system will give rise to winners and losers, the analysis on diversification does not specifically comment on who these winners and losers will be. Instead, the message relates to managing this uncertainty and the role of diversifying in line with the market trajectory to reduce the risk associated with this uncertainty.

Exposure to idiosyncratic risks. Failure to manage energy technology diversification will likely expose investors to significant idiosyncratic risks. In particular, passive investors and closet indexers mirroring the index will be affected by this type of risk. Similarly, active investors not managing the sector and energy technology exposure are likely to face similar risks. The analysis adds to the growing literature on the shortcomings and challenges to index investing, both in terms of different types of biases (e.g. geography, size, etc.) and new types of risks appearing with the growth of index investing (see box on left).

Betting on the future. The notion of idiosyncratic risk appears in the context of the modern portfolio theory. Perhaps more important than this is that the analysis shows that investors replicating these indices (in whichever form) make an implicit bet on a certain type of future – the index constituents and their investment decisions representing that future. Crucially, the question then is not whether betting on such a future is risky or not, but rather the extent to which this implicit bet, not properly identified in non-climate specific sector breakdowns of indices, is an explicit part of the investor's strategy.

FIG 28: BETA OF AN EQUITY FOLLOWING THE INCLUSION INTO AN INDEX WITH INDEX AND NON-INDEX EQUITIES (12 MONTHS BEFORE TO 24 MONTHS AFTER INCLUSION) (SOURCE: WURGLER 2011[1])



EXPOSURE TO ENDOGENOUS RISK

The growth of index investing has had an impact on the role of 'index inclusion' on the stock price of index constituents. These effects give rise to 'endogenous risk' associated with index investing. Thus, while indices are meant to be a tool to diversify risk, index constituents in fact increasingly move in lock-step *as a result of being both represented in the index.* In other words, the beta increases with the index inclusion (Fig. 28).

ENERGY TRANSITION MANAGEMENT AND FIDUCIARY DUTY

According to the prudent investor rule, trustees are supposed to set an optimal decision-making process, reflected in asset allocation, the design of mandates (delegates to equity managers), and performance overview. What matters is not the actual performance of the portfolio, but the rationality, coherence, and rigorous deployment of the investment process. This prudent investor rule is not only a question of good practice, but also may have legal ramifications, with examples of lawsuits related to fiduciary duty, especially in the United States.

The connection between the issue of fiduciary duty and energy technology diversification appears in the context of managing portfolios in an economy on the pathway towards a low-carbon economy. Ensuring appropriate exposure through broad diversification to this transition is likely to be a core feature of what qualifies as fiduciary duty. In this regard, investing in indices or benchmarking portfolios to indices that are not broadly diversified may, be considered a violation of fiduciary duty.

Managing the energy transition. In the context of the energy transition, it no longer suffices to aim for a diversified exposure to sectors - investors also need to manage their exposure to energy technologies. The relevant metrics in this regard are then not only related to current diversification (such as installed capacity for the utility sector) but also to the forward-looking exposure of companies, notably via their capital expenditure decisions. This management is likely to also be relevant from a fiduciary duty perspective (cf. box on left).

Indeed, the notion of fiduciary duty suggests that managing the energy transition should not be an objective limited to investors that care or have an interest in climate change and its impact, but every investor. This is particularly the case in the context of a dynamic economy that is changing. Preserving the sector diversification of today's economy is, in this context, a bet that this sector diversification will be aligned with the diversification of tomorrow. Similarly, reflecting a high-carbon energy technology exposure is a 'bet' that tomorrow's economy will be high-carbon.

The crucial question then is whether this bet – the current bet of cap-weighted equity indices – is in line with investor expectations or not. Transparency is key. Once the 'bet' of indices is revealed, investors can choose the type of index that is aligned with their expectations regarding the economic trajectory – and insure a broad diversification to the energy technologies associated with this trajectory.

Other implications. Beyond the issue of energy technology diversification and energy transition management, there is a broader question regarding the future of cap-weighted equity indices. In particular, they remain prominent in their use as market proxies. In this role, they are frequently used as performance metrics to measure the performance relative to the 'market'. If it then turns out that these indices do not accurately represent the market, the implication is that performance metrics are similarly skewed. Beating a cap-weighted equity index does not then by extension mean that an investor beats the market. In this context, new broadly-diversified indices that capture the exposure of an investor to the future may actually contribute both to improving the short-term performance metrics used by investors, but also the broader challenge highlighted previously of artificial short-termism in the finance sector.

4.2 CLIMATE-RELATED INDICES AS ALTERNATIVES

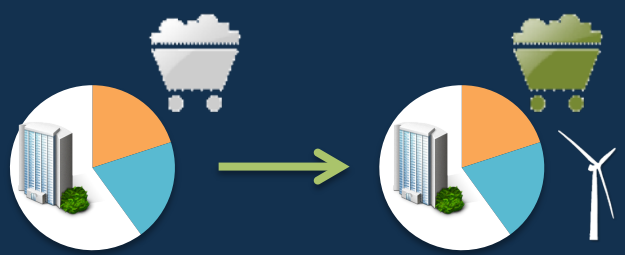
Momentum around climate-related investment products. The momentum leading up to the climate change negotiations in Paris in 2015 and a growing narrative around the potential risks associated with the energy transition have given rise to a proliferation of 'climate-related' indices. Given the focus on energy technology diversification, this class of indices then appears as a potential alternative to mainstream cap-weighted equity indices in terms of achieving 'optimal' energy technology exposure. Fig. 29 summarizes the three types of climate-related indices currently in the market: carbon-tilted indices, sector exclusion indices, and pure-play thematic indices. The figure also provides a brief review of their advantages and disadvantages, both from the perspective of having mainstream adoption potential and from addressing the core issue of optimal energy technology diversification.

Shortcomings of current alternatives. A key challenge with regard to these alternative products is that they do not fundamentally act as a tool to manage energy technology exposure from a diversification perspective. Thus, while carbon-tilted indices seek to reduce the GHG-emissions footprint of the index by taking a best-in class approach, this does not by itself ensure broad diversification to different technologies. Similarly, these indices preserve the existing sector diversification of the 'parent index', which, given the high exposure to high-carbon sectors, is unlikely to be aligned with low-carbon economic roadmaps. Beyond the sector and energy technology diversification issue, there are additional growing pains associated with these products, mostly related to the nature of the data used to perform carbon-tilting. Equally, the approaches related to sector exclusion or thematic indices similarly do not address the fundamental issue of broad energy technology and sector diversification.

Implications for investors. A key challenge for these products is their 'niche' status, frequently a result of the perception that they deviate from optimal diversification. Indeed, this is a key reason why carbon-tilted indices for the most part replicate the sector allocation of the parent index – reducing the associated tracking error is a way to suggest that these indices are broadly diversified. At the same time, an energy technology diversification strategy may have more mainstream appeal. Given the analysis above, climate-related investment products that actively manage sector *and* energy technology diversification are likely to be more diversified and better proxies for the market than both market-cap weighted indices and the current crop of climate-related alternatives. They also may be more impactful from a climate perspective.

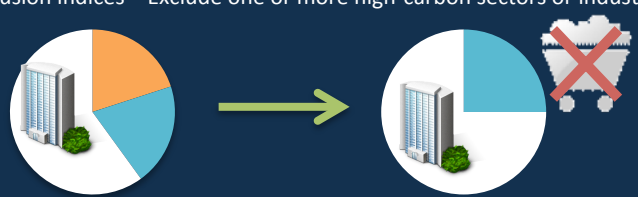
FIG 29: CLIMATE-RELATED ALTERNATIVES TO MAINSTREAM INDICES (SOURCE: 2° INVESTING INITIATIVE)

Carbon-tilted indices – Preserve sector allocation, but use best-in class approach based on GHG-emissions



- ✔ Minimize tracking error versus benchmark
- ✘ Does not address equity market sector bias
- ✘ Does not manage energy technology diversification

Sector exclusion indices – Exclude one or more high-carbon sectors or industries from index



- ✔ Simple narrative for B2C marketing
- ✔ Good recent performance
- ✘ Not in line with optimal diversification – does not manage energy technology diversification

Pure play indices – Focus on thematic exposure to a certain type of sector / technology ("cleantech")

- ✔ Simple narrative for B2C marketing
- ✔ Thematic opportunity
- ✘ High volatility and poor recent performance
- ✘ Not in line with broad diversification strategy

THE SEI / 2° INVESTING METRICS PROJECT

In response to the need for more sophisticated energy transition and climate performance tools, a European research consortium is currently pursuing a three-year, $3 million development program to develop viable alternatives to mainstream metrics and products. The consortium is led by the 2° Investing Initiative and involves the Climate Bonds Initiative, the CDP, the Frankfurt School of Finance – UNEP Center, Cired / SMASH, the University of Zurich, WWF (Germany and European Policy Office), and Kepler Cheuvreux, The consortium also engages support from Energy Transition Advisors, Collaborase Advisory, Riskergy, IODS, and the Oxford University. The project has to date received a range of support letters from policymakers, financial institutions, public stakeholders, and international organizations.

The objective of the three-year research program is to develop climate performance metrics that help inform financial institutions on the alignment of their loan book or financial portfolio with energy transition roadmaps, such as the ones developed by the International Energy Agency (IEA) in their annual World Energy Outlook and their World Energy Investment Outlook.

The project includes research and development on defining climate-friendly assets, measuring and benchmarking a portfolio's exposure to energy transition scenarios, developing index and portfolio optimization tools based on these climate performance metrics, updating data frameworks, and research on integrating these metrics and tools into financial regulatory frameworks.

The project provides a research and development response to the needs for indicators that inform on energy technology diversification. All results will be publicly available and without intellectual property rights, ensuring a possibly broad adoption by mainstream data and index providers.

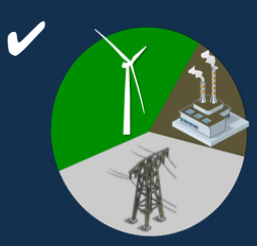
4.3 THE WAY FORWARD

A need for new indices. The review of current low-carbon indices suggests that they do not provide credible alternatives to existing mainstream indices – both from a climate perspective and from the perspective of more optimally-diversified alternatives. What is needed thus are viable alternatives that ensure optimal diversification from both a sector and energy technology perspective. The key contribution of these indices would be their ability to make the 'implicit' bet of investors on a certain low-carbon economic roadmap or decarbonization scenario explicit. This type of index can act as both a diversification tool and an exposure indicator in the context of the transition to the low-carbon economy. It would allow investors to align their investment strategy with their 'beliefs' on the ultimate policy and climate roadmap that will be realized. For climate-friendly investors, this could become a key tool to align their portfolio with climate goals.

New developments. To date, 'plug-in' tools informing on energy technology diversification do not exist. Main barriers relate to the need for better data, the lack of fundamental research with regard to defining optimal energy technology diversification, and, ultimately, the demand for managing this type of diversification, beyond sector diversification. Research initiatives have begun addressing this gap however (see box on left). Moreover, as this study highlights, 'basic' energy technology diversification management does not require sophisticated tools.

Growing demand. A key challenge for these new products will be challenging the entrenched use of cap-weighted indices. One way to address is this challenge is by using these tools, in the beginning, as 'goalposts' for asset managers to prevent a significant deviation of the energy technology diversification with market trends – while keeping traditional metrics as performance benchmarks (Fig. 30). Using new metrics in this way in the beginning ensures that they are applied for their core use – ensuring optimal diversification of portfolios.

FIG 30: MODEL FOR A DUAL MANDATE FOR ASSET MANAGERS (SOURCE: 2° INVESTING INITIATIVE)



1. FORWARD-LOOKING DIVERSIFICATION LIMITS VIS-À-VIS ENERGY TRANSITION

2. PERFORMANCE METRICS BASED ON TRADITIONAL BENCHMARKS

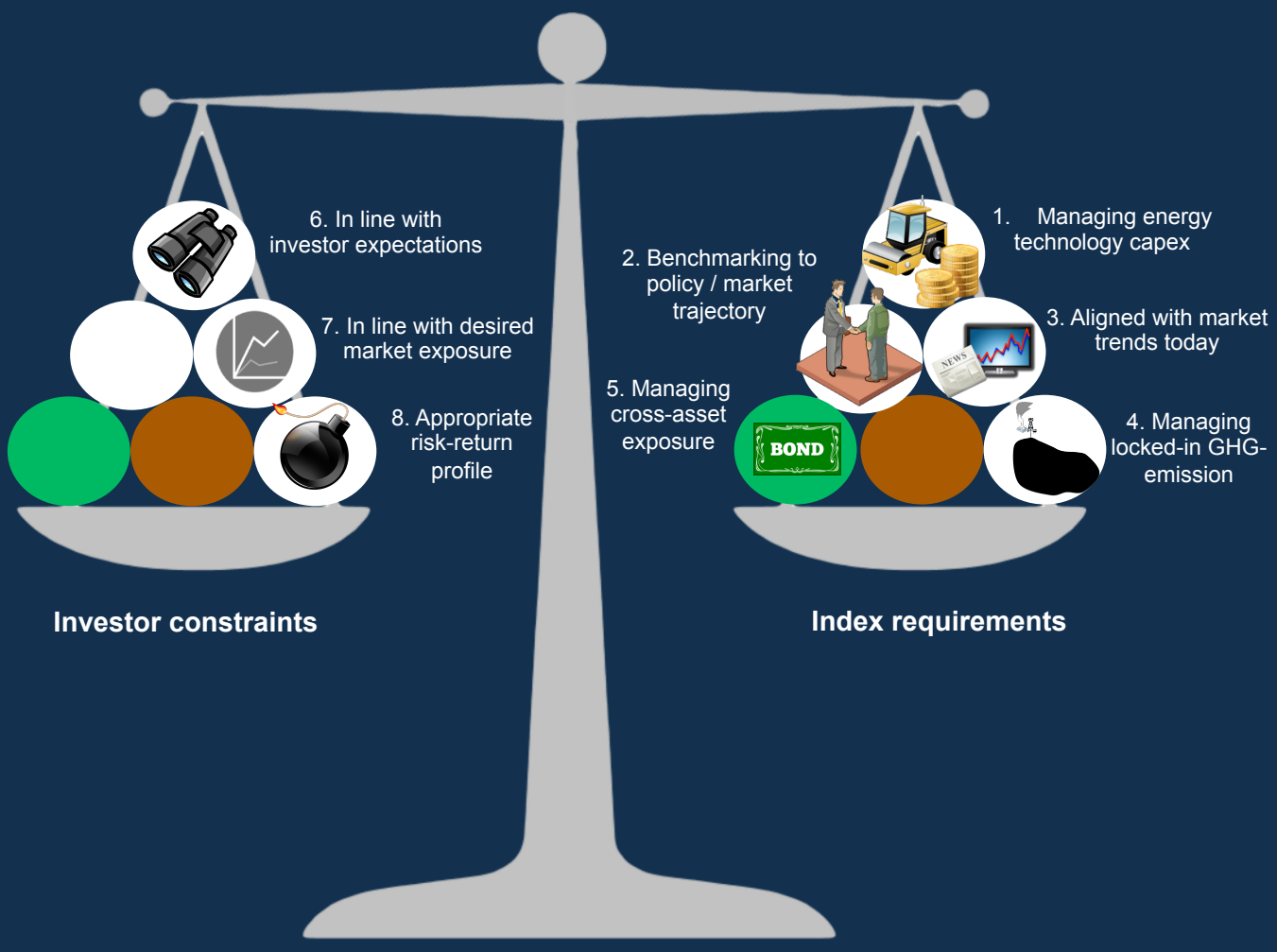
Demands for a new index. Moving from theory to practice, the following summarizes the potential features or vision of a broadly diversified index that manages both sector and energy technology exposure:

1. **Managing energy technology capital expenditure:** Capital expenditure by energy technology will inform on the 'bet' of the index and thus should be integrated into the index construction (once data is available).
2. **Benchmarking to policy / market trajectory:** To allow investors to benchmark their portfolio, the index should inform on its alignment with a specific economic roadmap, such as the roadmap of the IEA.
3. **Aligned with market trends today:** The index does not function as a tool that mirrors tomorrow's economy, but rather the *trajectory* that takes the investor to tomorrow's economy.
4. **Managing locked-in GHG-emissions:** In the spirit of 'betting' on a future, a broadly-diversified index needs to take into account not just the current, annual GHG-emissions, but the locked-in assets. An example is the lifetime of the power plants of a utility, which provides a profile of the exposure to the energy transition.
5. **Managing cross-asset exposure:** Given different financing structures of different industries, the equity index need not necessarily by itself reflect the energy technology diversification of the whole economy.

Satisfying investor constraints. While there are a number of asks to the index, the objective is for such a tool to provide a mainstream alternative to current cap-weighted indices. By extension, these indices need to recognize and respond to the constraints of investors

6. **In line with investor expectations:** A variety of indices should allow the investor to pick the index in line with their expectations with regard to the economic and decarbonization trajectory.
7. **In line with desired market exposure:** The index needs to be aligned with the desired exposure of the investor not just to the economic trajectory but also today's markets, from a sector and energy technology perspective.
8. **Appropriate risk-return profile:** The index needs to reflect the desired risk-return and liquidity profile.

FIG 31: THE WAY FORWARD FOR A BROADLY-DIVESRIFIED INDEX (SOURCE: 2° INVESTING INITIATIVE)



ENDNOTES

1. Introduction

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2. The Use of Indices Today

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3. Energy Technology Diversification

1 Index factsheets were sourced online. Data from index factsheets represents the most recent index factsheet at time of publication.
2 Data on the market capitalization of companies in the listed equity universe was sourced from Damodaran webpage and last updated January 2014.
3 Carbon Tracker Initiative (2014) "Carbon Supply Cost Curves: Evaluating Financial Risk to Oil Capital Expenditures.
4 Datastream data was complemented, where necessary, with data from the annual reports of listed companies. Annual reports from 2014 were used where available.
5 The data is a sample from the preliminary results of the Carnegie Oil Index work.
6 International Council on Clean Transport (ICCT) (2014) "EU Vehicle Market Statistics" Pocketbook".
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4. Implications for investors

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ANNEX I – INDICES UNDER REVIEW

S&P500 – The S&P 500® is widely regarded as the best single gauge of large cap U.S. equities. There is over $5.14 trillion benchmarked to the index, with index assets comprising approximately $1.6 trillion of this total. The index includes 500 leading companies listed at NYSE or NASDAQ and captures approximately 80% coverage of available market capitalization. Stocks are free-float weighted.

FTSE100 - The FTSE 100 is a market-capitalization weighted index representing the performance of the 100 largest UK listed blue chip companies, which pass screening for size and liquidity. The index represents approximately 84.35% of the UK's market capitalization and is suitable as the basis for investment products, such as funds, derivatives and exchange-traded funds. The FTSE 100 Index also accounts for 8.02% of the world's equity market capitalization (based on the FTSE All-World Index as at 30 June 2011). FTSE 100 constituents are all traded on the London Stock Exchange's SETS trading system. Stocks are free-float weighted.

Stoxx600 - The STOXX Europe 600 Size indices are fixed component number indices designed to provide a broad yet liquid representation of large, mid and small capitalization companies in Europe. The index covers Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Stocks are free-float weighted subject to a 20% cap.

MSCI World - The MSCI World Index captures large and mid cap representation across 23 Developed Markets (DM) countries. With 1,615 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

DAX30 - The DAX® Index tracks the segment of the largest and most important companies – known as blue chips – on the German equities market. It contains the shares of the 30 largest and most liquid companies admitted to the FWB® Frankfurt Stock Exchange in the Prime Standard segment. The DAX® represents about 80% of the aggregated prime standard's market cap. The DAX® is primarily calculated as a performance index. It is one of the few major country indices that also takes dividend yields into account, thus fully reflecting the actual performance of an investment in the index portfolio. The DAX® serves as the basis for the sub-indices DAX® ex Financials and DAX® ex Financials 30, which excludes all components from the sectors banks, financial services, insurance and real estate.

CAC40 - The CAC 40® is a free float market capitalization weighted index that reflects the performance of the 40 largest and most actively traded shares listed on Euronext Paris, and is the most widely used indicator of the Paris stock market. The index serves as an underlying for structured products, funds, exchange traded funds, options and futures. Stocks are screened and selected to ensure liquidity and free float weighted to ensure that the index is investable.

The 2° Investing Initiative [2°ii] is a multi-stakeholder think tank working to align the financial sector with 2°C climate goals. Our research work seeks to:

- Align investment processes of financial institutions with climate goals;
- Develop the metrics and tools to measure the climate performance of financial institutions;
- Mobilize regulatory and policy incentives to shift capital to energy transition financing.

The association was founded in 2012 in Paris and has projects in Europe, China and the US. Our work is global, both in terms of geography and engaging key actors. We bring together financial institutions, issuers, policy makers, research institutes, experts, and NGOs to achieve our mission. Representatives from all of the key stakeholder groups are also sponsors of our research.

The name of the initiative relates to the objective of connecting the dots between the +2°C climate goal, risk and performance assessment of investment portfolios, and financial regulatory frameworks.

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