

Integrating Net Zero objectives into Multi-Factor Equity portfolios

Key Takeways

This paper presents Amundi's approach to integrating Net Zero objectives in multi-factor equity portfolios. Due to the multi-faceted dimensions of Net Zero investing, three aspects are considered in our Net Zero approach: Exclusion, Decarbonization and Transition.

- The Exclusion pillar is an important aspect of a Net Zero strategy as it involves eliminating "Net Zero enemies" i.e. companies showing a high carbon emission pathway that is not aligned with global climate goals.
- Then, managing carbon risk requires reducing carbon emissions at the portfolio level. One way to do this could be to progressively decarbonize the portfolio. However, if the level of the portfolio's carbon intensity is reduced too fast and too drastically, that may lead to a negative impact on diversification and potentially increase the overall risk of the portfolio.
- Besides, it is crucial to define a pathway, and therefore to use a dynamic approach in decarbonizing the portfolio. This approach has to adapt to the evolution of the carbon emissions reported by companies over time, while maintaining the risk and return profile of the portfolio thanks to its exposure to rewarded factors.
- As a result, Amundi's Net Zero strategy seeks to balance the objectives of carbon intensity reduction and of maintaining an adequate level of diversification across equity factors.
- To do so, our Net Zero approach integrates the Transition dimension, which involves investing in companies that will be key to finance the climate transition, thereby working towards the Net Zero objective by 2050.
- Our findings show that the cost in terms of tracking error of integrating Net Zero targets in our multi-factor strategy compared to an unconstrained multi-factor portfolio is low. Moreover, when analyzing the Net Zero portfolio's factor and sector exposures, we find that deviations compared to the unconstrained portfolios are limited. However, we expect these deviations to be amplified in the future as carbon data, especially on Scope 3 emissions, will become more precise and available.
- All in all, our Net Zero methodology for Multi-Factor portfolios provides a framework to control and adjust the portfolio according to evolving targets defined by the portfolio managers, in order to reach the required objectives. We believe that factors are a good way to maintain good portfolio diversification and to find the right trade-off between Net Zero objectives and positive expected returns offered by Equities over the long-term.

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Climate change is one of the biggest challenges that humanity has to face. The Intergovernmental Panel on Climate Change (IPCC) 2018 Special Report on Global Warming of 1.5 °C confirmed the importance of limiting global warming to 1.5° compared to 2°C and reaching the Net Zero emissions target by 2050. Net Zero is defined as a balance between the amount of greenhouse gases produced and the amount of greenhouse gases removed from the atmosphere, resulting in no net increase in atmospheric greenhouse gases.

As financial professionals, we must question ourselves on how we could contribute to reaching Net Zero targets. Asset managers have to consider the financial impacts of climate change on investable assets and to build investment portfolios accordingly. Climate change presents forward-looking risks and opportunities, which will redefine the objective function of all investors.

Reduction of portfolio carbon intensity

The first step that asset managers are taking to address climate risk has been a reduction of portfolio carbon intensity, which involves reducing the overall carbon intensity of a portfolio by underweighting or divesting from companies with high carbon emissions and overweighting or investing in companies with lower emissions. Carbon intensity is calculated by dividing companies' carbon emissions by their revenues¹.

However, there are potential trade-offs to consider when implementing a carbon intensity reduction strategy. One potential

issue is the impact on portfolio diversification, as a strong carbon intensity reduction may involve significantly underweighting or completely divesting from certain sectors or industries which may be more carbon-intensive, such as energy or utilities. This can lead to significant distortions of the portfolio – materialized for example by a much higher level of tracking error than initially expected – and impact its long-term risk-return profile. We also believe that these carbon intensive sectors should not be excluded as they have a key role to play in

the climate transition of the real economy. Engaging with companies in High Impact Climate Sectors (HICS) can indeed be a real lever of change in the real economy, as it provides a concrete way to accompany them in their transition to less carbon-emissive business models.

However, the management of a portfolio's carbon footprint is probably a necessary but insufficient condition to reach carbon neutrality.

Integration of Net Zero objectives

Net Zero by 2050 objectives are ambitious and will require a material change in investment processes used by asset managers: they have to find the “sweet spot” between the reduction of carbon intensity on one hand and the benefits of mitigating wider climate-related risks on the other hand.

It is also important to consider how to integrate those climate-related risks -and opportunities- into investment strategies, while managing well-diversified equity portfolios and maintaining exposure to well-rewarded factors. For instance, the European Commission has introduced the

Climate Transition Benchmark (CTB) and Paris Aligned Benchmark (PAB) to regulate climate investing in passive management. These indices generate a significant reduction in carbon footprint vs. their parent index, but they may have limitations in terms of their impact on portfolio construction and diversification.

According to Roncalli et al. (2022), one comprehensive approach to construct a Net Zero portfolio in a quantitative strategy is to consider different aspects such as exclusion, decarbonization, and transition. Exclusion consists in eliminating companies that are not aligned with ESG or

environmental targets from the investment universe. Decarbonization involves reducing the carbon intensity of the portfolio, while transition refers to investing in companies that are actively working towards the transition to a low-carbon economy.

This paper discusses our approach to integrate Net Zero targets into a multi-factor equity strategy, and how it impacts the portfolio in terms of risk, diversification, sector and factor deviations. Due to the lack of historical data, the impact on the portfolio's past performance is not covered by this study.

1. Carbon intensity = $\frac{\text{direct} + \text{first tier indirect Trucost carbon emissions (tonne CO}_2\text{)}}{\text{Sales (M€)}}$

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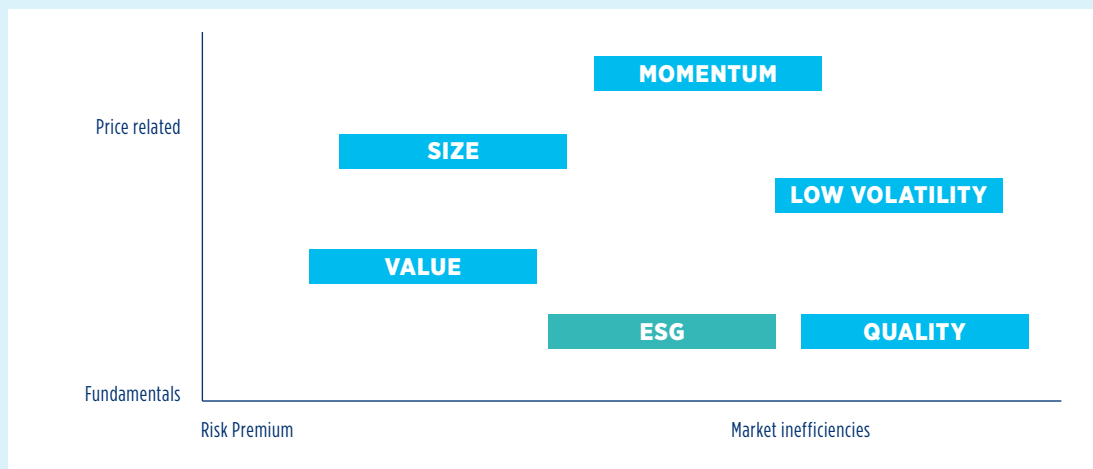
1/ Multi-Factor investing approach

Diversification is an important consideration in portfolio construction, as it can help to reduce risk by spreading investments across different rewarded factors, sectors, and

regions. One way to efficiently diversify an equity portfolio is to invest in stocks exposed to different factors. These factors are expected to deliver positive performance

over the long-term but have different performance cycles due to their underlying characteristics.

Figure 1: Mapping of Amundi Equity factors



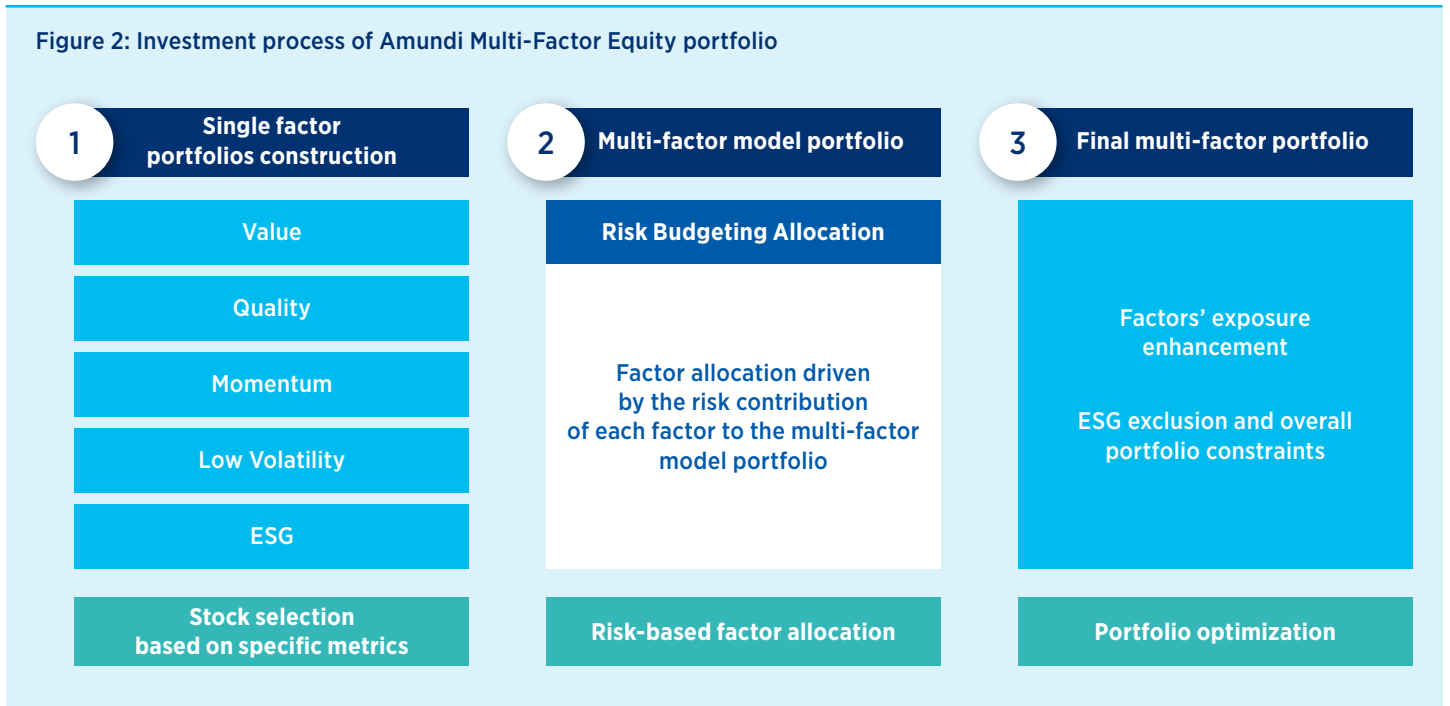
Given for illustrative purpose only

In factor investing, portfolio construction is key. Amundi's Multi-factor strategy is built using three key steps:

- 1) The first one is to construct factor equity portfolios: Low volatility, Value, High quality, ESG and Momentum (Figure 1). Those factors are based on different data (vertical axis) and sources of performance (horizontal axis). Their different characteristics provide a good ground for diversification.
- 2) The second is to assemble and weight these factors in accordance with their risk budget.
- 3) The third step applies optimization techniques to further reinforce the multi-factor exposure of the portfolio (Figure 2). ■

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Figure 2: Investment process of Amundi Multi-Factor Equity portfolio



The outcome of this investment process is a global equity portfolio, well diversified across factors and with the ability to provide consistent outperformance over the long-term, mainly thanks to:

- The reward associated to each factor
- The diversified exposure to these factors enabling the portfolio to efficiently navigate a full equity market cycle
- A dynamic risk-based allocation across these factors, which helps to adapt to changing market conditions and which is a source of a resilient performance over the long-term ■

2/ Management of carbon risk

Achieving carbon neutrality in a portfolio will necessarily require carbon reduction. One approach to evaluate the impact of the carbon reduction on a global multi-factor portfolio is to progressively increase the levels of carbon intensity reduction of the global multi-factor portfolio and analyse the impact on portfolio risk and allocation. Applying this methodology, we found that when the level of carbon intensity² reduction increases, the number of assets in the portfolio decreases. Moreover, carbon reduction in an optimized portfolio leads to underweighting the most carbon-intensive companies and overweighting the least carbon-intensive ones. A high level of decarbonization may lead to compressing entire economic sectors such as energy or

utilities. This in turn has a negative impact on diversification and potentially increases the overall risk of the portfolio. In factor-based strategies, it is crucial to consider the trade-off between reducing carbon intensity and maintaining the diversification of the portfolio across equity factors. As a result, it is necessary to adopt a more gradual approach to decarbonization in order to minimize potential negative impacts on portfolio diversification.

Figure 3 below shows the number of assets for a global multi-factor portfolio compared to a decarbonized multi-factor portfolio. We applied two levels of carbon reduction: -50% and -80%. We find that the number of assets reduces from 545 assets for an unconstrained multi-factor portfolio to

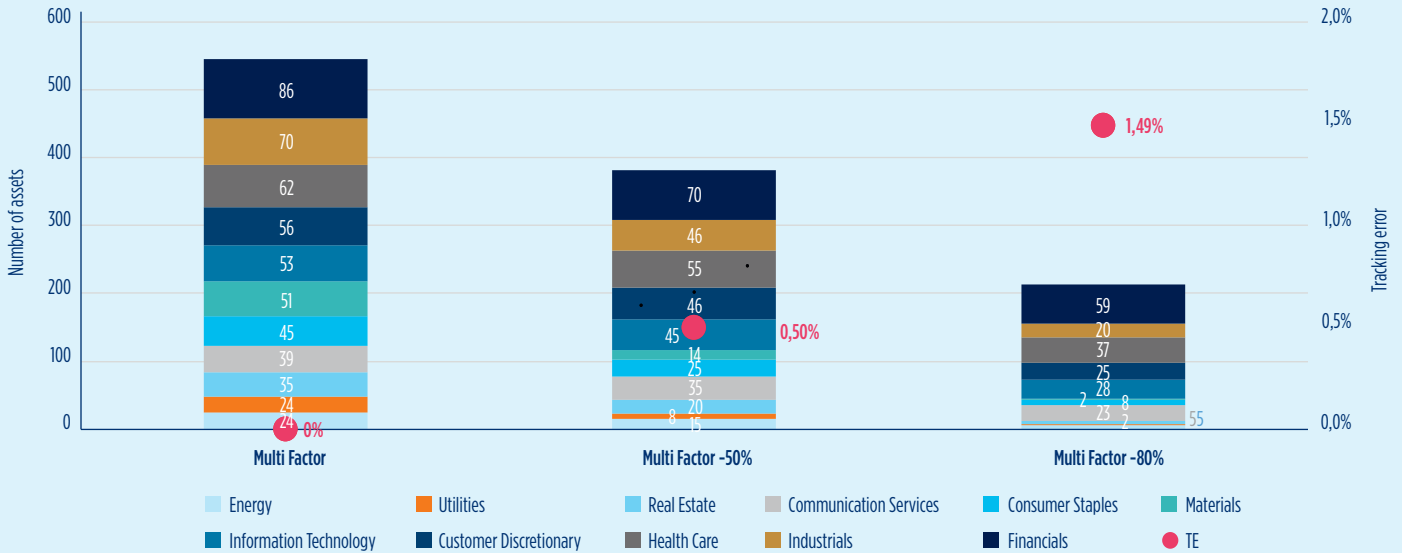
382 assets for the portfolio with a 50% carbon reduction, and to 214 for the portfolio with an 80% carbon reduction. It is clear that the higher decarbonization level deeply hampers portfolio diversification, by significantly reducing the number of assets and by excluding entire sectors such as energy, utilities and materials.

This figure also compares the impact on tracking error for the unconstrained multi-factor portfolio and the decarbonized portfolio at different levels of carbon reduction. An 80% carbon reduction target has a higher impact on tracking error (1.49%), while a 50% carbon reduction target generates 0.50% of tracking error. ■

2. Direct + First Tier Indirect Trucost carbon intensity

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Figure 3: Impact of carbon reduction on a number of assets and tracking error vs. unconstrained multi-factor portfolio



Source: Trucost, MSCI, Amundi, as of 25/10/2022

3/ Challenges regarding the management of carbon risk

The Greenhouse Gas (GHG) Protocol corporate standard classifies companies' greenhouse gas emissions in three scopes:

- Scope 1 refers to direct GHG emissions occurring from sources that are owned and controlled by the issuer.
- Scope 2 corresponds to the indirect GHG emissions from the consumption of purchased electricity, heat or steam.
- Scope 3 are other indirect emissions (not included in scope 2) of the entire value chain.

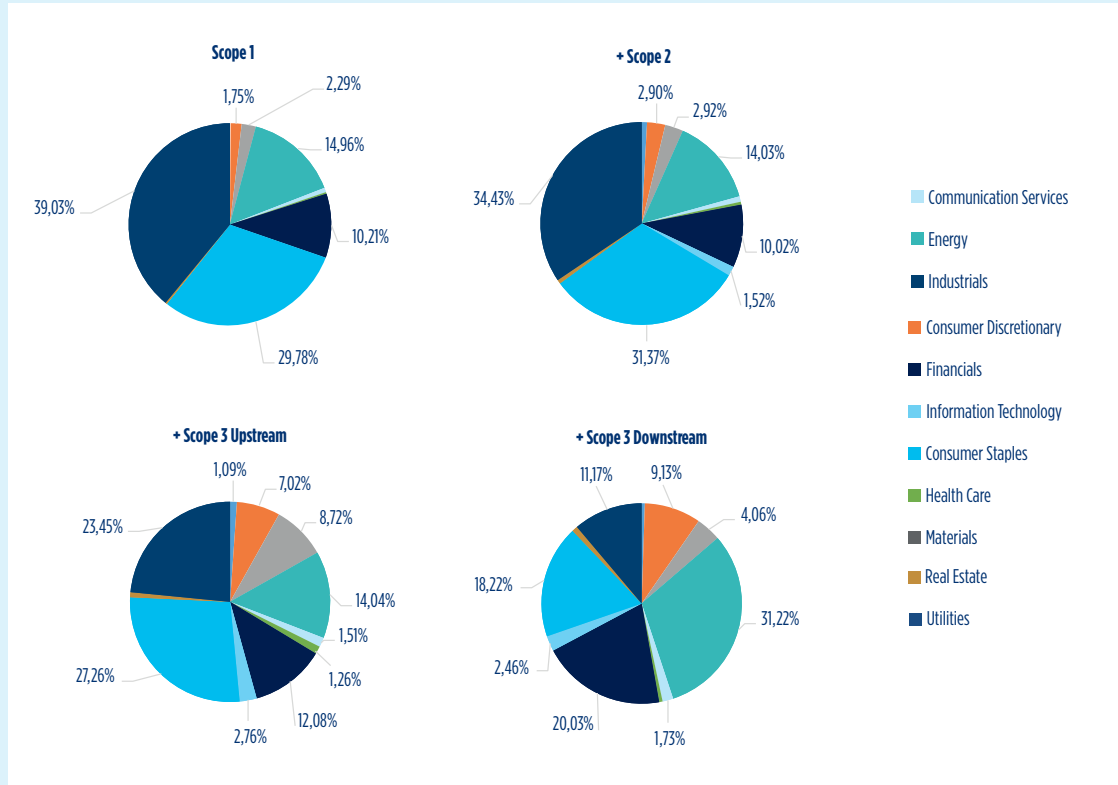
They can be divided into two main categories:

- Upstream scope 3 emissions are defined as indirect carbon emissions related to purchased goods and services.
- Downstream scope 3 emissions are defined as indirect carbon emissions related to sold goods and services.

The accuracy of GHG data is crucial to achieve carbon neutrality, but measuring and tracking emissions can be challenging in some areas, especially for Scope 3 emissions. Nonetheless, integrating Scope 3 emissions would be critical as they can significantly affect the assessment of the companies' contribution to overall GHG emissions.

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Figure 4: Sector contribution (in %) to the three scopes of GHG emissions, illustrated by the 2019 carbon emissions per Global Industry Classification Standard (GICS) sector



Source: Trucost, Amundi Institute - Roncalli & et al. (2022), "Net Zero Investment Portfolios / Part 1. The Comprehensive Integrated Approach"

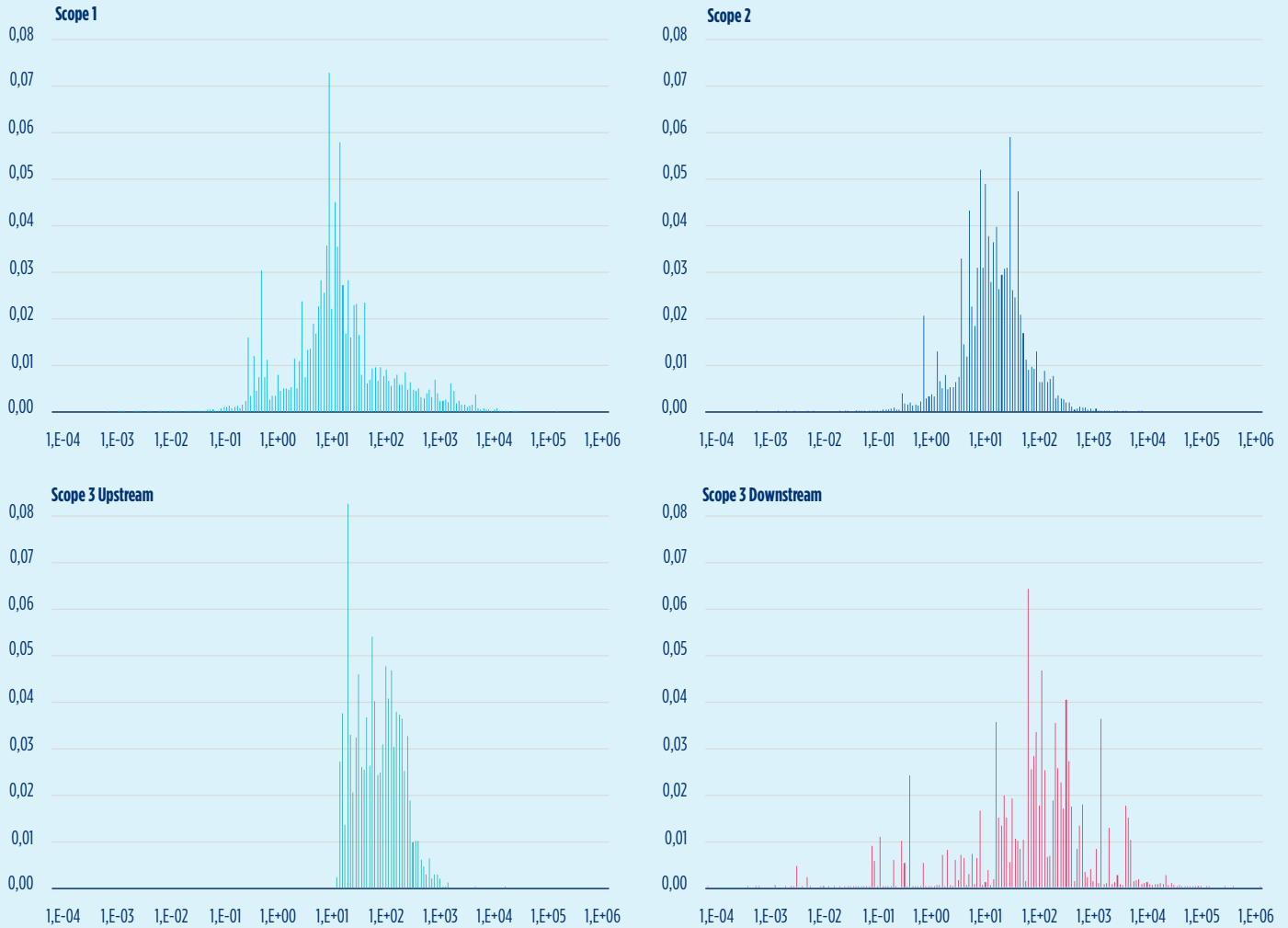
Figure 4 shows the contribution of different sectors to GHG emissions when each scope is added to the calculation. In order to assess the whole value chain behind the carbon footprint of a company, integrating the three GHG scopes may seem attractive. The

problem lies in the quality of data available. In portfolio optimization, it is crucial to assess the quality and robustness of the data used in the optimizer. While the data from Scope 1 and 2 emissions exhibit similar

distributions – close to a kind of Gaussian distribution – upstream and downstream Scope 3 data exhibit very different types of distribution and fat tails issues (Figure 5).

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Figure 5: Distribution of Scope 1, 2 and 3 data



Source: Trucost, Amundi Institute - Roncalli & et al. (2022), "Net Zero Investment Portfolios / Part 1. The Comprehensive Integrated Approach"

With the current state of data quality, using full Scope 3 measures can represent a challenge for quantitative portfolio managers. ■

4/ Integrating the energy transition

Our Net Zero quantitative strategy aims to integrate Net Zero objectives in our factor-based equity portfolios. Reaching this objective by applying a drastic carbon reduction would harm the philosophy of the strategy designed to achieve a high level of diversification in the portfolio. The question would then be: How can portfolio managers align their multi-factor portfolio with a Net Zero scenario?

To go beyond decarbonization, financing the climate transition is an important aspect to consider when targeting a Net Zero

objective by 2050. For instance, transition metrics would enable portfolio managers to better evaluate the companies who demonstrate a willingness to transition to a more sustainable and low-carbon economy. Green CAPEX for example is an indicator that could be used as a proxy for a company's dynamic transition policy. This can include investments in renewable energy, energy efficiency, and other "green" initiatives.

In addition to the environmental aspect, the social dimension – social inequalities,

access to resources and services, etc...- is also very important and must be taken into consideration to achieve a "just transition" to a green economy. However, there are limitations today due to the availability and robustness of these data.

A lack of high quality data makes it difficult for portfolio managers to accurately assess the overall sustainability of their portfolio. Going forward, the development of higher data quality both in the measurement of carbon footprint, the energy transition and the social dimensions will be key. ■

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5/ Our Net Zero approach

The integration of additional constraints to an optimized process might lead to a significant distortion of the portfolio. Integrating Net zero objectives in a quantitative investment process can be complex as it redefines the objective function. The impact depends on the portfolio structure and the set of constraints applied to reach carbon neutrality. It could affect the risk and return profile of the portfolio as well as its factor and sector exposures. Due to the multi-faceted dimensions of Net Zero investing, three aspects are considered in our Net Zero approach: Exclusion, Decarbonization and Transition.

Exclusion is an important aspect of a Net Zero strategy, as it involves eliminating from the portfolio companies with the worst ESG and Environmental ratings and companies which could be considered as

“Net Zero enemies” e.g. showing a high carbon emission pathway. This can include companies involved in coal development or unconventional oil and gas, as well as assets with a high contribution to temperature increase. Indeed, using a temperature estimate allows to assess the trajectory of an issuer’s carbon intensity with respect to a required pathway to meet global climate goals. By excluding these assets, investors can help reducing the global carbon intensity of their portfolio and align it with Net Zero goals. This can also filter out some companies, which would target non-credible carbon reduction pathways.

In addition to exclusions, decarbonization and transition are essential in any climate investment process.

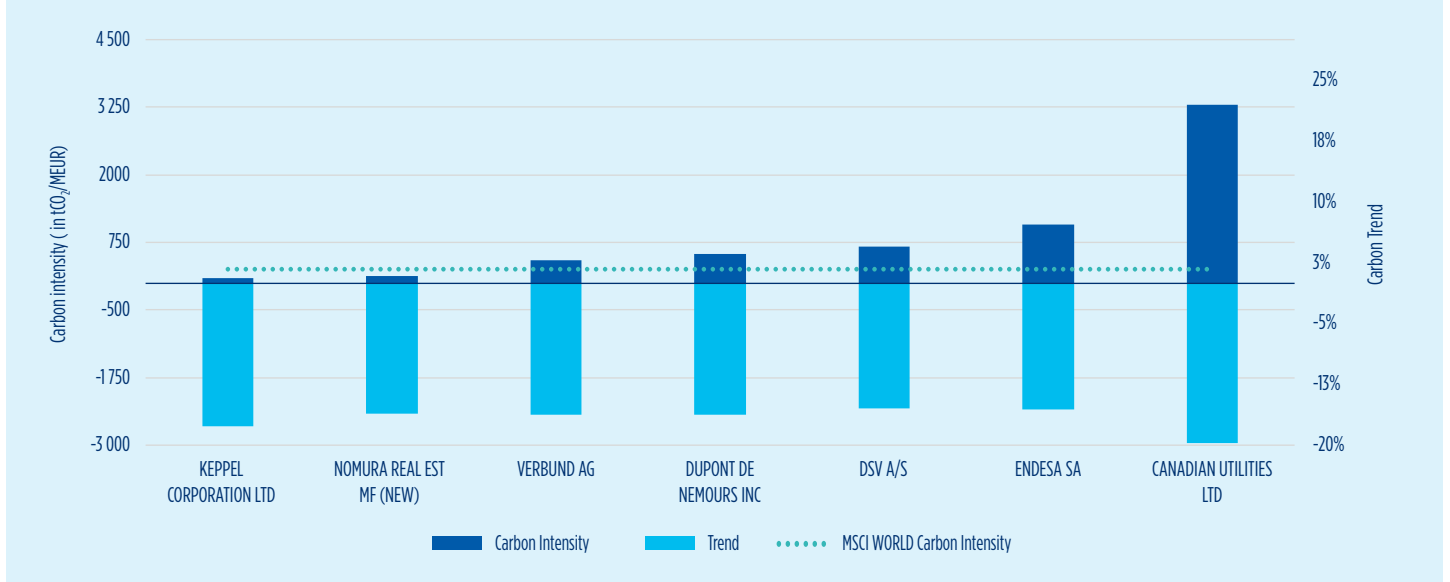
Decarbonization involves reducing the portfolio’s carbon intensity by 30%

-compared to the base year of 2019- by 2025. It would also involve defining and monitoring a carbon reduction pathway after 2025 in order to gradually converge to Net Zero in 2050.

Additionally, Roncalli et al. (2022) introduce the concept of self-decarbonization of a portfolio using a carbon trend metric. This can lead to endogenous carbon reduction in the portfolio, which complements carbon reduction from an exogenous effect. The carbon trend is based on a linear regression of carbon emissions of each issuer (direct + first tier indirect emissions), over the recent past.

Figure 6 shows that some companies currently showing high carbon intensity could have a better carbon trend than some other companies with lower carbon intensity. ■

Figure 6: Carbon intensity (left axis) and carbon trend (right axis)



Source: Trucost, Amundi, as of 31/08/2022

Then, the transition aspect refers to supporting the transition to a low-carbon economy through investments in green energy.

Among different transition metrics we can use:

- “Green revenues”³ which measures the share of a company’s business in sustainable activities
- “High impact climate sector” which defines sectors that are essential to low carbon transition such as Agriculture, Forestry and Fishing, Mining and Quarrying, Manufacturing, Electricity, etc.

3. Data based on a combination of different providers such as MSCI, Trucost and FTSE

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6/ Integration of Net zero targets in our quantitative and factor-based investment process

It is generally expected that a Net Zero portfolio will have different factor and sector exposures compared to a portfolio without Net Zero constraints. Indeed, the investment universe is reduced due to asset exclusions, and the Net Zero portfolio will be affected by certain environmental, social, and governance (ESG) data, as well as carbon

and transition metrics. This can result in a different portfolio composition in terms of factor and sector exposures.

We believe it is possible to implement a Net Zero equity strategy while controlling the impact on factor and sector deviations vis-à-vis the initial multi-factor portfolio. Our quantitative investment process designed

to target Net Zero objectives goes beyond a simple carbon intensity reduction approach. Our methodology is more comprehensive and enables the portfolio managers to build a multi-factor portfolio with the desired ESG, carbon intensity and transition targets while considering other aspects such as risk, and diversification across rewarded factors.

Amundi’s methodology for the integration of Net Zero into quantitative equity investment solutions

We focus on three pillars:

- Decarbonization :

- Reduction of the carbon intensity vs. the base year by 2025, and with a defined pathway towards the Net Zero objective by 2050
- Better carbon trend than the benchmark
- Exclusion of coal developers and unconventional oil and gas companies

- Energy transition :

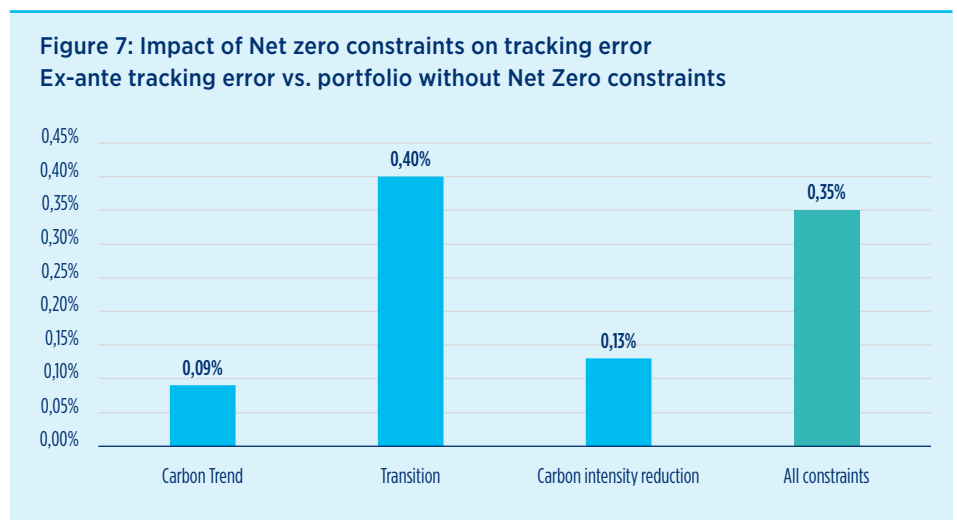
- Green revenues
- SBTi targets
- Exposure to “High impact climate sectors”
- Exclusion of Net Zero enemies based on companies’ contribution to the temperature increase: companies having a contribution to the temperature increase above 3.5°C are excluded

- ESG :

- Better average ratio of the ESG score vs. the benchmark
- Exclusion of the worst rated companies and those with controversies in their environmental practices

Figure 7 shows the results of a study we conducted on a past portfolio rebalancing to analyze the impact of introducing Net Zero targets in our multi-factor strategy. It shows that the cost of these targets in terms of tracking error compared to the model portfolio is low. The multi-factor portfolio with Net Zero constraints has a tracking error of 0.35% compared to a portfolio without such constraints. We note for this study, that the transition constraints had the highest cost (0.40%). The impact on the tracking error of the carbon trend improvement is low (0.09%).

The impact of these constraints could be different depending on the Multi-Factor portfolio composition.



Source: MSCI, Amundi, as of 08/02/2023

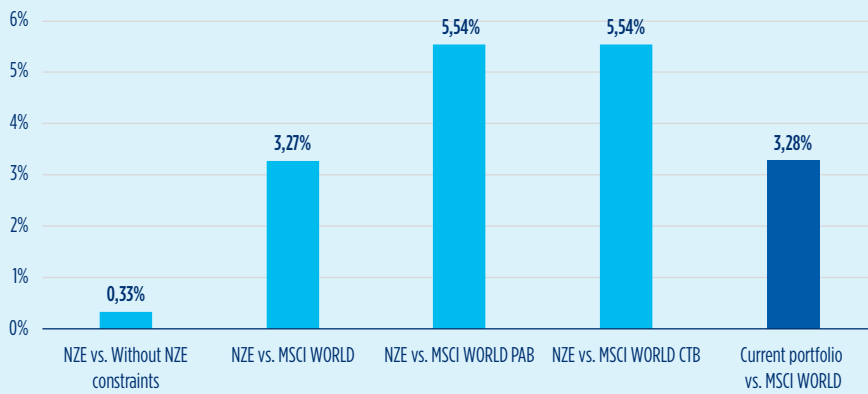
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We also analyze the tracking error of the portfolio relative to three different benchmarks: the MSCI World index, the MSCI World Climate Change PAB Select

index and MSCI World Climate Change CTB Select index (Figure 8). We observe that the tracking error for the multi-factor Net Zero portfolio relative to the MSCI World index is

close to the multi-factor portfolio without Net Zero constraints (3.28%). However, the tracking error relative to the PAB and CTB indices is higher (higher than 5%), which means that our Net Zero constraints are not fully aligned with PAB and CTB constraints. This difference is notably due to the large exclusion list used in the CTB and PAB methodologies, and a high level of carbon reduction applied particularly in the PAB methodology, which also leads to a substantial reduction of the exposure to the most carbon-intensive sectors. As mentioned, we believe that having a residual exposure to some companies within these higher carbon-intensive sectors is important for the overall energy transition objective, as long as they are committed to long-term carbon reduction and are investing in the development of greener energy sources. Keeping an allocation to these sectors via appropriate quantitative stock selection is one outcome of our investment process.

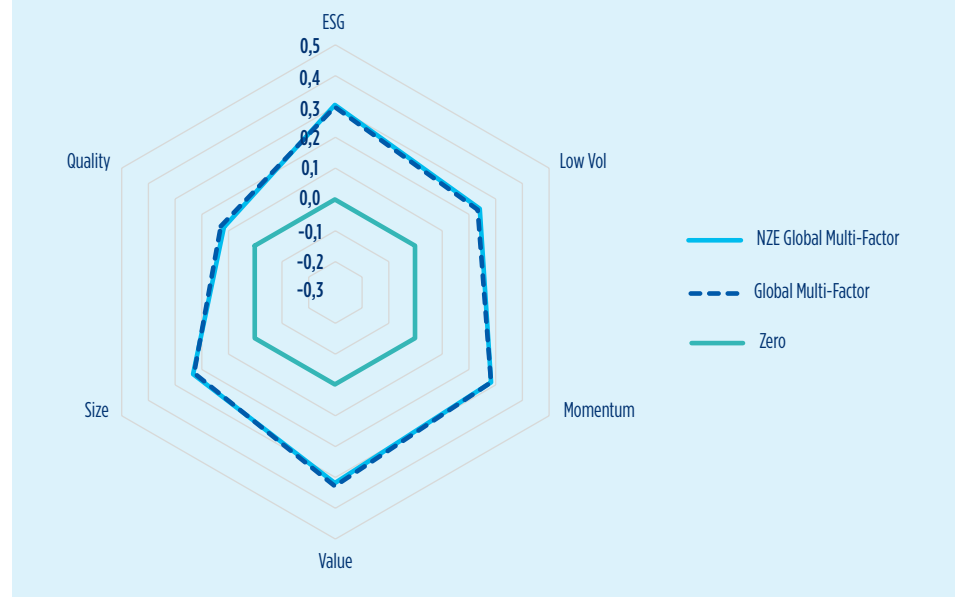
Figure 8: Multi-factor ex ante tracking error vs. MSCI indices



Source: MSCI, Amundi, as of 08/02/2022

When analyzing the Net Zero portfolio's factor and sector exposures, we find that it is also not deviating significantly compared to the portfolio without Net Zero constraints. Our quantitative investment process leads to target the model portfolio exposure and mitigate the portfolio sector distortion. Figure 9 shows the factor exposures of the Net Zero multi-factor portfolio and the standard multi-factor portfolio without Net Zero constraints.

Figure 9: Impact of Net zero constraints on factor exposures
Factor exposures in Z-score, relative to MSCI

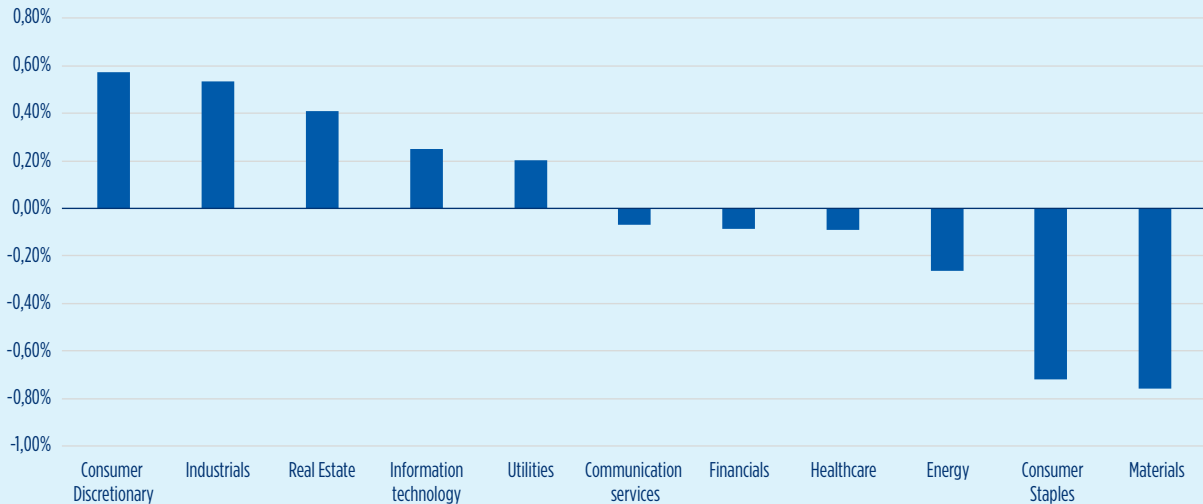


Source: Amundi, MSCI as of 08/02/2023

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Figure 10: Impact of Net Zero constraints on sector exposures

Difference in sector allocation between the Net Zero constrained and unconstrained portfolio



Source: Trucost, Amundi, as of 08/02/2023

When analysing these charts, one may have the feeling that Net Zero objectives only have a marginal impact on multi-factor portfolio construction.

However, it is important to bear in mind that the ESG factor and climate related risks have been integrated in the investment process since 2021. On ESG for instance, Bennani et al. (2018) showed that the integration of ESG as a factor in the investment process alongside traditional factors reinforced the diversification benefits of the portfolio.

Besides, our standard multi-factor strategy already has lower carbon intensity vs. the benchmark. Thus, implementing additional targets to achieve Net Zero objectives is generating today marginal deviations compared to the original multi-factor portfolio.

However, we expect these deviations to be amplified in the near future. Indeed, data will become increasingly precise, such as scope 3 emissions, which means they will have a higher influence within portfolio

optimizers. Asset pricing will also better reflect the materiality of climate risk in the managed portfolios. Besides, to converge gradually to Net Zero objectives over time, the portfolio managers will need to reinforce their guidelines and to use more binding constraints.

Our Net Zero methodology provides a framework to control and adjust the portfolio according to evolving targets the portfolio managers will define in order to reach the required objectives. ■

Conclusion

Net Zero objectives are ambitious and will require a material change in investment processes used by asset managers. The metrics used within the Net Zero framework are multi-faceted, complex and often not fully mature.

In Equity portfolio management, Net Zero goes beyond a simple and static reduction of the portfolio carbon footprint: the Net Zero framework should be comprehensive and focus on both the decarbonization and energy transition aspects.

Besides, this framework will have to evolve over time depending on the emergence of new data as well as new guidelines provided by IPCC or regulation entities. It is crucial to design an investment process that can adapt to this changing framework.

We believe that quantitative portfolio managers have an edge as they have the tools and the experience to handle different variables from different sources and to use them to structure a disciplined investment process. Factors are a good way to maintain good portfolio diversification and to find the right trade-off between Net Zero objectives and positive expected returns offered by Equities over the long-term.

We believe that Net Zero and Factor Investing are indeed a perfect match.

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