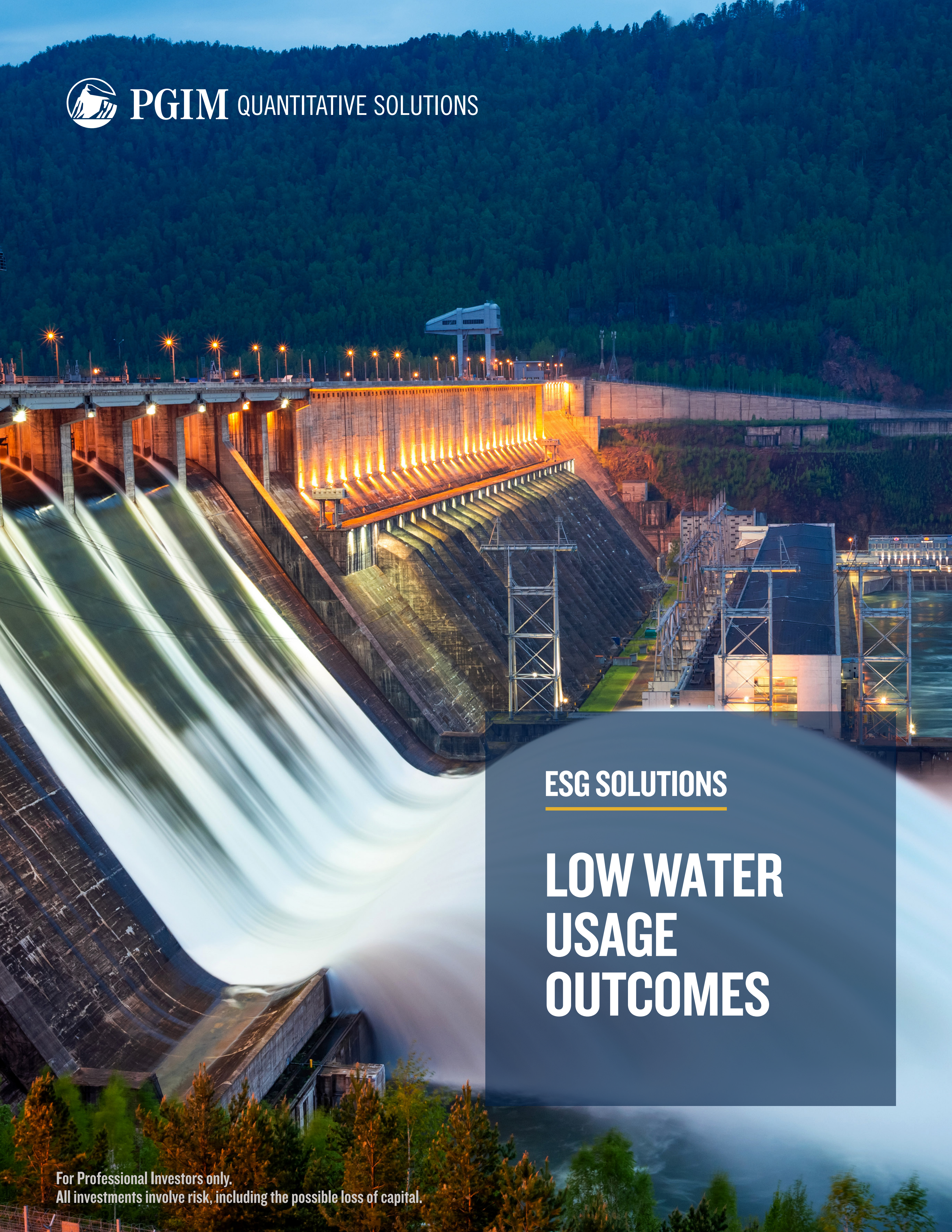
PGIM QUANTITATIVE SOLUTIONS



ESG SOLUTIONS

LOW WATER USAGE OUTCOMES

OUR ESG SOLUTIONS

At PGIM Quant, we recognize the challenges faced by ESG investors. ESG portfolios can create significant tracking error to policy portfolios and traditional benchmarks. Since each client's ESG needs, interests, and definitions can vary widely, what "works" for one investor may not "work" for another. PGIM Quant solves for these challenges by leveraging our robust data science capabilities to develop ESG Solutions, a platform empowering sophisticated investors around the world to construct bespoke portfolios that reflect their individualized ESG views and preferences without introducing material tracking error, sector bets, or unintended risks. Our ESG Solutions capabilities range from portfolios providing comprehensive ESG exposure, to those addressing targeted themes, such as carbon reduction or water usage, all while incorporating specific investor objectives, risk tolerances, and preferences.

Executive Summary

Our ESG Solutions framework provides the flexibility and capability to deliver solutions for investors with a variety of objectives, preferences, and risk tolerance levels.

In our previous work, we demonstrated our capability to help investors who have a low active risk budget but want improved ESG exposure. We provide solutions that have significantly improved ESG practices, while delivering index-like risk and return.

The goal of this research is to build portfolios with significantly lower water usage compared to the benchmark, while delivering comparable performance and risk to the underlying index.

Targeting stocks with low water usage that also have other attractive alpha attributes, we carefully controlled key risk exposures. This led to a portfolio with a significantly lower water usage intensity level relative to the benchmark, while delivering modest outperformance* and maintaining comparable risk to the underlying benchmark.

A deeper examination of ESG exposures of the low water usage portfolio demonstrates that our solution delivers improved exposures across several ESG attributes.

OUR PREVIOUS WORK

1. SEEKING A STRONG ALTERNATIVE TO ESG INDEXES
2. ESG INDEXING WITH EXCLUSIONS
3. LOW CARBON EMISSION OUTCOMES

*Past performance is not a guarantee or reliable indicator of future results.

Approach

We focus on water usage to assess a company's water efficiency. Given that water usage data is currently available for nearly ~70% of the universe used in this paper's analysis, our approach provides a more flexible framework to translate a water-related investment preference into a specific portfolio solution. And while a small number of water-related indexes exist, their focus is on identifying water-related businesses such as water supply, water utilities, water treatment, and water-related equipment. This leads to a high sector concentration with a limited number of holdings, and therefore typically delivers a specific performance profile.

We set an explicit reduction target as the primary portfolio objective – in this instance a 90% reduction rate in the intensity of water usage compared to the benchmark. Through simulation and analysis of water usage data, we are able to achieve this reduction. Importantly, this water usage reduction rate can be varied based on clients' preferences.

The benefit of incorporating fundamental alpha insights is to ensure that the low water usage stocks selected in the portfolio are also attractive investments, possessing strong value, growth, and quality attributes. The incorporation of these fundamental attributes in the selection of low water usage companies also helps avoid crowding that can lead to bubbles or traps (i.e., expensive low water).

In addition to targeting a meaningful reduction it is important to ensure the portfolio does not take on other unintended exposures. For example, we want to avoid exposure to companies that demonstrate low water consumption but have high carbon emissions, poor workplace health and safety practices, etc. As such, we incorporate safeguard exposures in our portfolio, specifically controlling exposures to our proprietary E, S, or G scores (which capture a broad set of environmental, social, and governance practices).

Lastly, for this specific solution we aim to produce a portfolio risk level that is comparable to an index (e.g., enhanced indexing). To accomplish this task, we must carefully control for key risk exposures (e.g., active stock/sector industry/country positions). The benefit of this approach is that alpha is generated primarily from stock selection, not from taking large active positions around sectors/industries/countries.

For consistency with our previous studies, we maintain a focus on the MSCI World universe, although our framework can easily be applied to other investment universes. While this research provides one initial portfolio candidate, we can simulate other portfolios at various levels of active risk and water usage reduction to further customize solutions based on clients' specific objectives and preferences.

90%

Target reduction rate in the intensity of water usage

Advantages

- Water usage reduction rate can be varied based on clients' preferences
- Incorporating fundamental insights helps to ensure that the low-water usage stocks selected in the portfolio are also attractive investments
- Helps to avoid overcrowded positions
- Helps to avoid unintended exposures in other ESG areas such as high carbon emissions
- Can produce portfolio risk level solution which is comparable to an index

Portfolio Solution

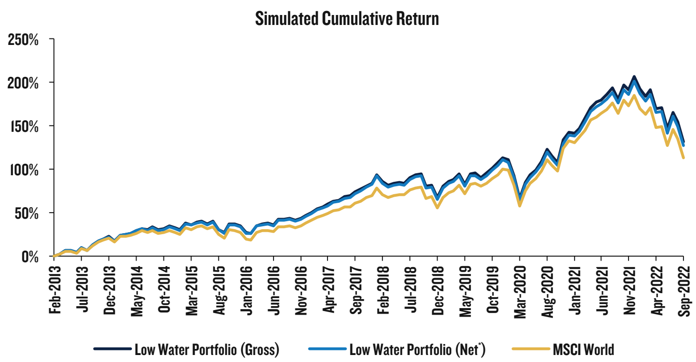
To reach an optimal solution we simulate performance of a portfolio with the previously described specifications to successfully achieve a 90% reduction in water usage intensity (relative to the benchmark) in each period throughout our backtest. The portfolio modestly outperforms the index by +0.90% gross per year (+0.68% net*), demonstrating the benefit of targeting low water usage companies with attractive investment attributes. Our careful risk controls also keep tracking error in check at 1.17%, a level we believe is palatable to low active risk investors.

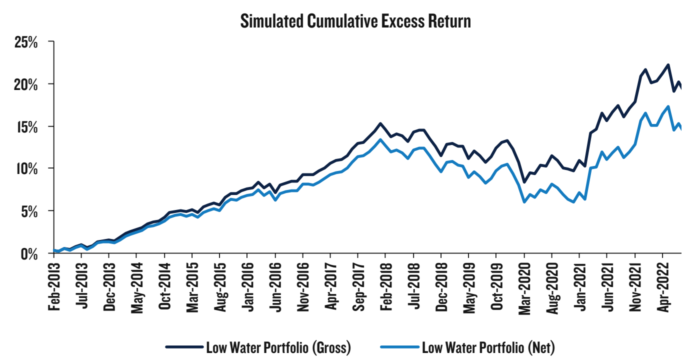
0.90	0.68	1.17	0.77
Excess Return % (Gross)	Excess Return % (Net*)	Tracking Error %	Portfolio IR

From Jan 31, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index.
Source: PGIM Quant, MSCI, Refinitiv.

Figure 1 depicts the cumulative performance of the strategy and benchmark, demonstrating that close tracking of the benchmark is attained. We then plot the cumulative excess performance of the portfolio. Excess performance cumulates in a relatively steady manner through time, again demonstrating the advantages of focusing on low water usage companies with attractive fundamentals. In addition, implementing risk controls helps ensure that key underlying risk attributes are similar to the benchmark and achieve lower tracking error. It should also be noted that our simulated portfolio holds, on average, 600 names. This portfolio selectivity (relative to the MSCI World Index) helps to avoid many of the highest water usage companies while providing diversification to manage the portfolio's risk profile.

Figure 1: Cumulative Performance



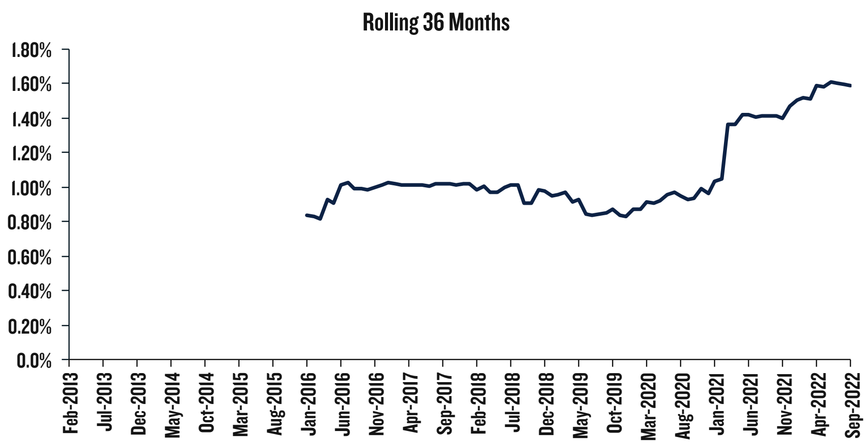


From Jan 31, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index. Past performance is not a guarantee or reliable indicator of future results.
Source: PGIM Quant, MSCI, Refinitiv.

***Net performance reflects the deduction of the highest model fee for the proposed portfolio. Past performance is not a guarantee or reliable indicator of future results.**

The goal of the research is to build portfolios with significantly lower water usage intensity levels relative to the benchmark, while delivering performance and risk comparable to the underlying index. Risk is a sensitive point for investors who may be transitioning from a passive ESG allocation to an active solution, like the one described in this note. Therefore, we further examine the active risk profile of the portfolio. As seen in our low carbon portfolios, although active risk typically remains at ~1%, it has recently increased due to several unexpected market events, including the COVID shock. Importantly, this is not due to low water usage or ESG-related constraints. **Figure 2** depicts the rolling three-year tracking error of our low water usage portfolio solution. Although it is evident that the portfolio experiences an increase in tracking error following the COVID shock, we believe this to be a transitory impact.

Figure 2: Tracking Error

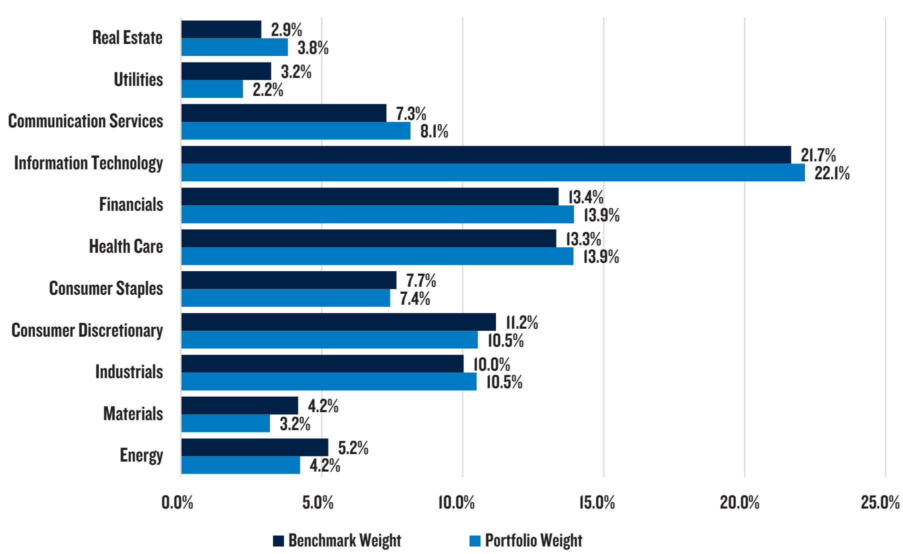


From Jan 31, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index

Source: PGIM Quant, MSCI, Refinitiv.

To accomplish this low active risk result, we carefully control for key risk exposures (e.g., active stock/sector/industry/country positions). **Figure 3** demonstrates portfolio and benchmark sector weights, providing insight into these controls. We can achieve a large reduction in portfolio-level water usage intensity without significant variation in sector exposures, particularly to the Utilities and Materials sectors, which typically contain stocks with the highest water usage intensities. We will demonstrate later other features related to the distribution of water usage intensity that facilitate this large reduction. However, the key is how our portfolio construction approach balances risk management and the water usage intensity target to deliver a portfolio that satisfies an investor's risk and sustainability objectives.

Figure 3: Portfolio and Benchmark Sector Weights

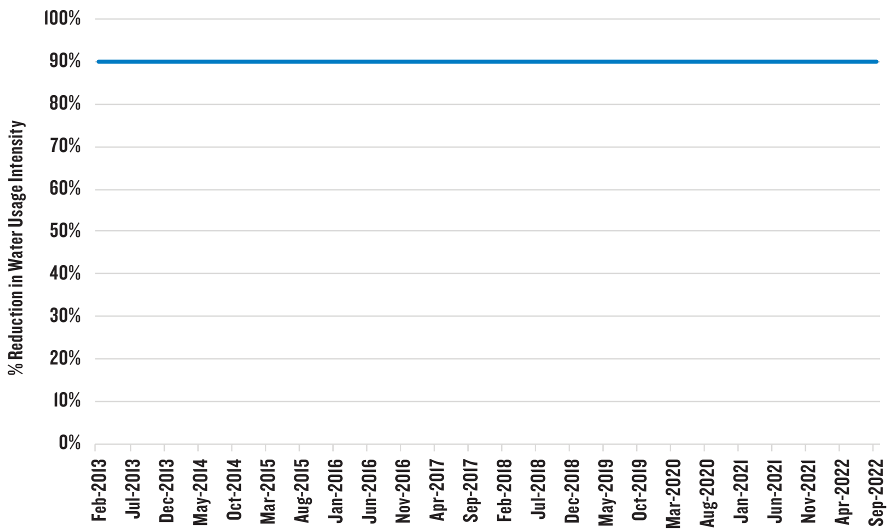


As of 9/30/2022. Benchmark: MSCI World Index.

Source: PGIM Quant, MSCI, Refinitiv.

Our analysis so far has focused on the risk and return attributes of the ESG portfolio solution. The key feature, however, is the 90% reduction in water usage intensity. We have achieved this result in every month throughout our backtest period (**Figure 4**). While perhaps a seemingly innocuous chart, it is powerful in that it demonstrates the consistency and intentionality of the water-usage exposure that is incorporated into the portfolio. It is here that we believe quantitative approaches can excel in building ESG portfolios, particularly with the backdrop of SFDR and scrutiny of investment products for greenwashing.

Figure 4: Water Usage Intensity Reduction

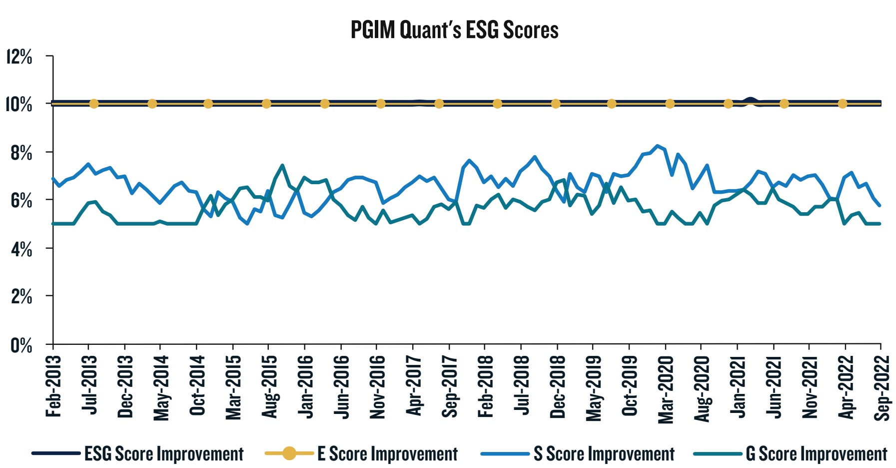


From 1/31/2013 to 9/30/2022. Inception of the Simulated 90% Water Usage Reduction strategy is 1/31/2013. Benchmark: MSCI World Index.

Source: PGIM Quant, MSCI, Refinitiv.

In addition to the fundamental attributes that we target to help fulfill water consumption targets, we also target additional ESG attributes to help limit positions in low water consumption names that harm the environment or society in other ways. Exposure to stocks with unattractive E, S, or G attributes is possible while still achieving a low water consumption outcome. Our simulation results reveal the importance of these additional targets on E, S, and G. We find our E constraint is binding, suggesting that low water usage companies could have other harmful E practices (impacts on biodiversity, carbon emissions, etc.). Certainly, an investor concerned about water usage would not find this acceptable. As such, these insights help illustrate the need to go beyond simple single-factor low water consumption approaches to more sophisticated, multi-dimensional approaches that ensure investor objectives and preferences are met. **Figure 5** illustrates the separate and consolidated ESG score improvements.

Figure 5: Improvement in ESG Scores



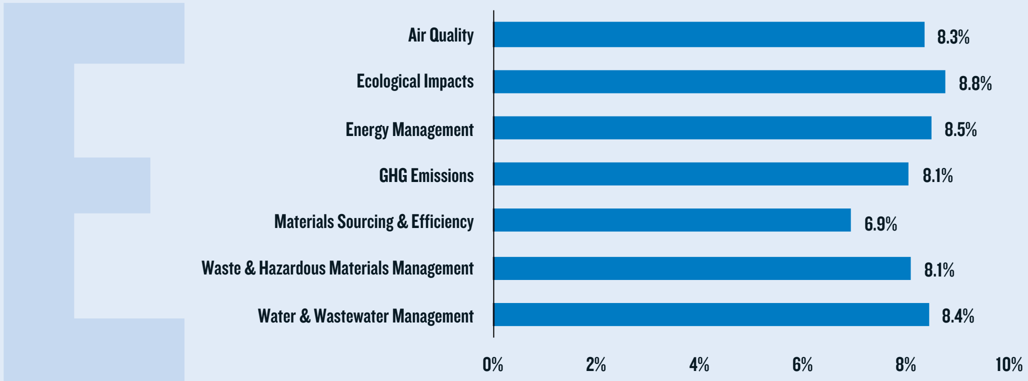
From Feb 28, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index.

Source: PGIM Quant, MSCI, Refinitiv.

Detailed ESG Attributes

While the primary goal of our research was to significantly decrease the portfolio's water-usage intensity, we were also careful to not introduce any adverse E, S, or G exposures in the process, as was shown in **Figure 5**, above. We know that investors desire higher transparency into their portfolio solutions. With that in mind, we utilize multiple data sources to construct a set of sub-scores — lower-level attributes that measure ESG improvements compared to the benchmark. To do this we look at a broad set of sustainability measures used to build our E, S, and G scores. **Figures 6-8** demonstrate that our portfolio solution delivers positive exposure relative to the benchmark across each of these 28 attributes.

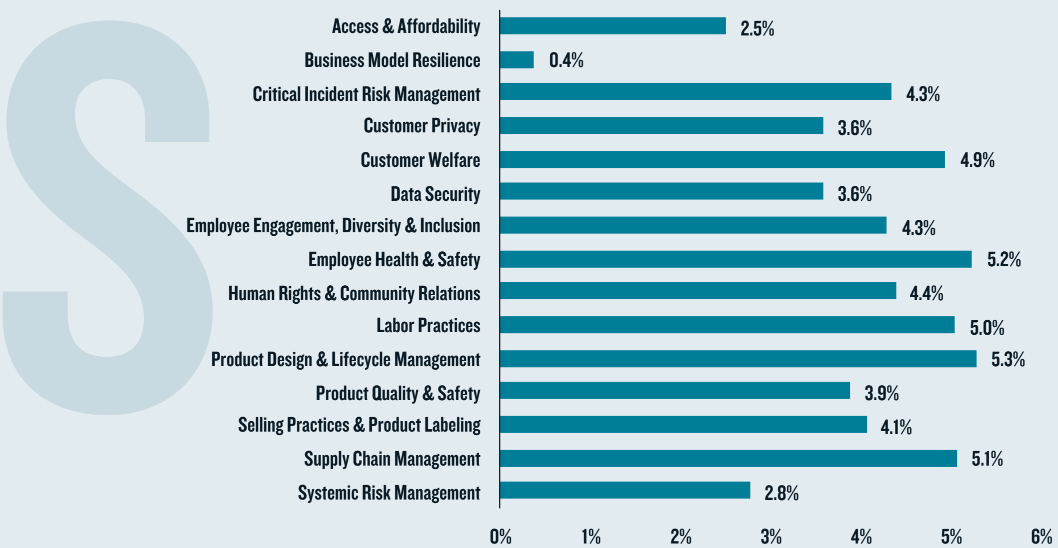
Figure 6: Improvement in Environmental Exposures: Average Monthly Improvement in Low-level Scores within E Composite



From Feb 28, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index.

Source: PGIM Quant, MSCI, Refinitiv.

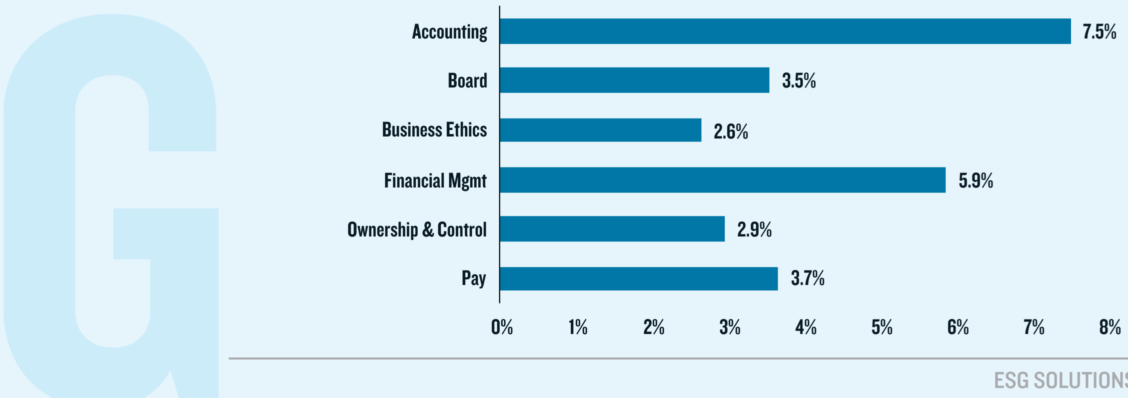
Figure 7: Improvement in Social Exposures: Average Monthly Improvement in Low-level Scores within S Composite



From Feb 28, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index.

Source: PGIM Quant, MSCI, Refinitiv.

Figure 8: Improvement in Governance Exposures: Average Monthly Improvement in Low-level Scores within G Composite



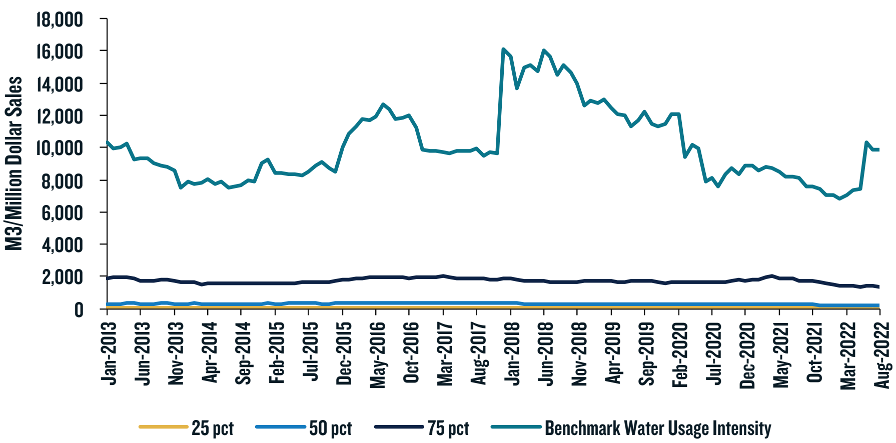
From Feb 28, 2013 to Sep 30, 2022. Inception of the Simulated 90% Water Usage Reduction strategy is Jan 31, 2013. Benchmark: MSCI World Index.

Source: PGIM Quant, MSCI, Refinitiv.

In contrast to the E, S, and G composite scores, these 28 lower-level attributes show the impact of our solution with more detail and granularity. Combining related metrics to construct the scores leads to improved coverage in comparison to each individual data item. As a result, our measure of impact is more comprehensive and meaningful.

Examining the distribution of water usage intensity provides transparency into how we achieve a large reduction in water usage intensity without introducing large sector over/underweights to the portfolio. **Figure 9** plots the water usage intensity for the benchmark along with the water usage intensity of stocks at different points in the distribution within the universe (e.g., 25th percentile, median, 75th percentile). Strikingly, we find that more than 75% of stocks in the universe exhibit lower water usage compared to the benchmark. This allows for larger water usage intensity reductions compared to improvements in other ESG-related targets (e.g., ESG scores, etc.).

Figure 9: Water Usage Intensity

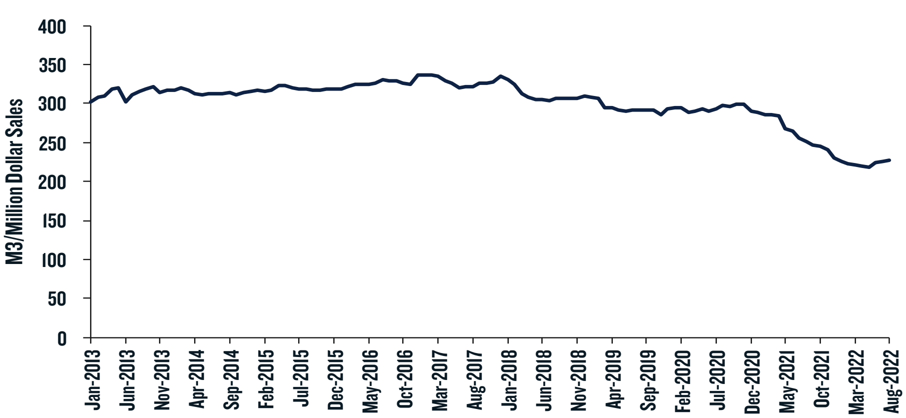


From Jan 31, 2013 - Aug 31, 2022. Source: PGIM Quant, Refinitiv.

For illustrative purposes only. There can be no guarantee that the objective will be achieved. Please see 'Notes to Disclosure' page for Important Information including risk factors and additional disclosures.

Furthermore, we demonstrate that the median water usage intensity has decreased through time (**Figure 10**), which is in line with our findings on carbon emissions. Although this could make it more challenging to achieve the same water reduction level while maintaining a constant risk threshold in the future, it demonstrates that corporate behavior is changing. The visible decline in activities harming the environment and society is an added benefit of investment solutions that influence the evolution of corporate behavior.

Figure 10: Median Water Usage Intensity



From Jan 31, 2013 - Aug 31, 2022. Source: PGIM Quant MSCI, Refinitiv.

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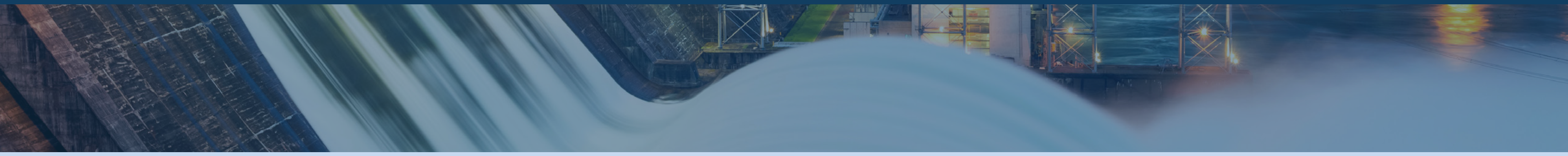
Conclusion

Our research set out to build a portfolio with a low water usage intensity level compared to the benchmark by establishing the water usage intensity outcome as an explicit portfolio objective. Targeting stocks with low water usage that also have other attractive alpha attributes, we carefully controlled key risk exposures. This led to a portfolio with a significantly lower water usage intensity level relative to the benchmark, while delivering modest outperformance and maintaining comparable risk to the underlying benchmark.* A deeper examination of ESG exposures of the low water usage portfolio demonstrated that our solution delivers improved exposures across each of these detailed attributes.

Our ESG Solutions capability offers asset owners the flexibility and customization to develop solutions that can be used as alternatives to traditional PABs and CTBs, or further adapt portfolios to target different ESG attributes such as carbon emissions and diversity measures. PGIM Quant can accommodate varied and specific investor preferences to deliver robust investment solutions that align with the ESG requirements of asset owners.



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***Past performance is not a guarantee or reliable indicator of future results.**

Notes to Disclosure

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