Decarbonising iShares' JPM EMB ETF

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The discussions of strategies for decarbonising fixed income investment portfolios too often bifurcate developed and emerging markets, corporates and sovereigns. To empower the fixed income market to drive the global climate transition, both must be conquered.

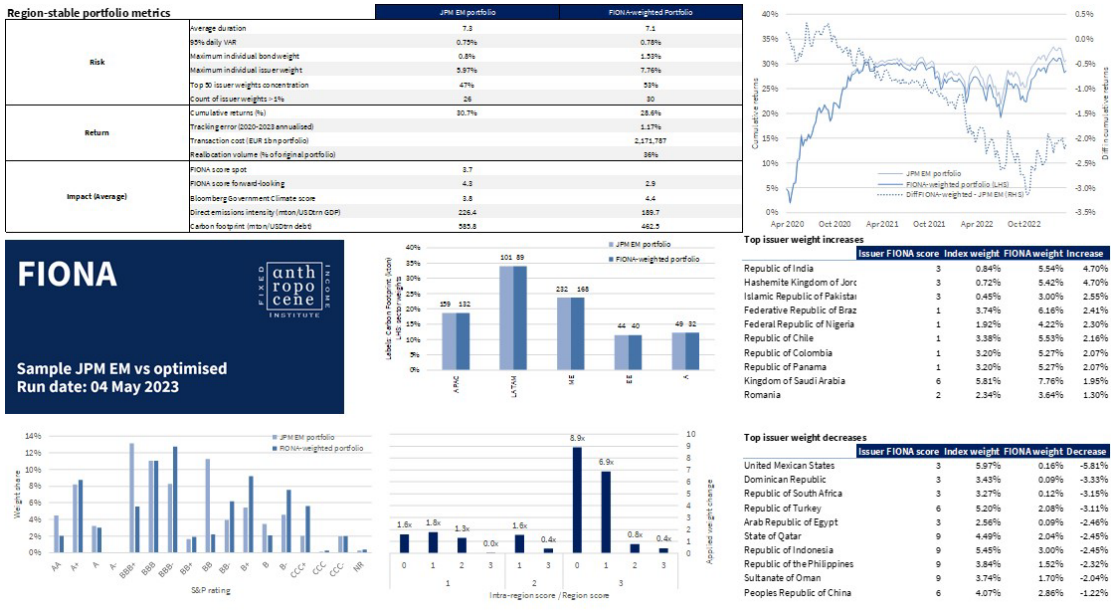
In previous work we introduced the AFII Fixed Income Optimisation for Net zero Alignment (FIONA) framework and used it to analyse developed market investment grade ETFs.[1] In this note we extend the approach to consider the iShares JPM EMB ETF, an emerging market sovereign ETF. [2]

By applying FIONA, we show that it is possible to improve the climate footprint of a sovereign EM portfolio without a significant impact on its historic performance. Climate improvements are more significant when reweighting between regions.

By considering forward-looking climate data, portfolio enhancement can be focused on transition investment, delivering capital to jurisdictions most in need of investment to progress.

This analysis confirms that algorithmic portfolio enhancement methods are useful in the sovereign space, and that it is possible to create passive investments to support transition.

Figure 1. Portfolio dashboard showing JPM EMB and FIONA-weighted solution. Full details are covered in the next few pages. Source: Bloomberg, iShares, accessed 30 Mar 2023.



[1] For earlier work please see "Decarbonising iShares' LQD ETF", AFII, 15 Dec 2022 and "PAB ETFs: A performance and climate alignment review", AFII, 9 Feb 2023.

[2] This ETF has net assets of USD 14.6bn (Source iShares, as of 26 Apr 2023), and is considered the most significant sovereign bond ETF. This note is intended neither as a recommendation nor a critique of the product and its manager.

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Background

Fixed income is a key capital source for funding the climate transition. It is the largest market, slightly larger than global equities,[3] yet asset owners tend to pay greater attention to their equity investments when considering climate impact.

It is estimated that 60% of emissions are from entities not listed on equity markets.[4] Debt has a much wider reach in terms of influence on governments, and privately-owned-entities.

Investors also habitually focus on active portfolios rather than passive investing, even though nearly a third of debt capital is invested through passive products.[5] AFII argues that all capital needs to be effectively utilised to accelerate the transition to climate-aligned portfolios.

In previous work we have used our FIONA framework to enhance investment grade portfolios.[1] In this note, we extend our framework to an emerging market sovereign portfolio, iShares' JPM EMB, one of the largest in the emerging market bonds market. We analyse its climate impact and apply our portfolio enhancement tools to understand how it could be improved, without negatively affecting risk and returns.

Recognising that the climate transition may be more complex in developing economies, we separately consider spot and forward-looking data sets to compare an investment portfolio enhanced for spot carbon footprint compared to transition.

JPM EMB ETF

JPM EMB is a US dollar-denominated government bond ETF offered by iShares, the ETF manager of BlackRock. It is a passive portfolio, designed to track the J.P. Morgan EMBI Global Core Index (ticker JPEICORE). Its inception date was 17 Dec 2007 and has current net assets of USD 14.6bn. It is an open-ended fund, meaning shares can be created or redeemed depending on market demand. The ETF is available to trade via multiple venues on different exchanges, in accumulation or income distribution classes. This is the largest US-traded emerging markets bond ETF on the market,[6] enjoying a high degree of liquidity.

We apply the AFII Fixed Income Optimisation for Net zero Alignment (FIONA) framework to analyse the climate impact of this portfolio and consider parallel portfolios with reduced emissions intensity and improved forward-looking metrics.

We consider the maximum improvements which are possible while maintaining good historic returns, low tracking error, minimised transaction costs, and limited increases in concentration. We demonstrate that improved climate performance is achievable without loss of return or increases in risk.

[3] "Capital Markets Fact Book, 2022", SIFMA, 12 July 2022.
[4] "Listed Company Emissions," Generation IM, 11 Oct 2021.
[5] "Passive likely overtakes active by 2026", Bloomberg, 11 Mar 2021.
[6] Listed as largest on etfdb.com, accessed 08 May 2023.

FIONA system for sovereigns

FIONA has been created to provide analysis and climate-positive enhancements for fixed income portfolios. It builds on earlier work conducted by the Anthropocene Fixed Income Institute on developing carbon-intensity scoring methods and analysing impact on returns.[7] We recognise the limitations of data in this space, and so FIONA has been designed as a data-agnostic framework, to use the best current data, and incorporate new data as it becomes available. We also recognise the difficulties with aligning to both spot and forward-looking climate data, and so present a portfolio's impact in both scenarios.

FIONA begins by creating a universe of issuers. In this exercise, the portfolio consists only of sovereigns, hence the issuer universe will be on a country level, with relevant country climate data used to score them. The issuers are grouped into regions; balanced to be large enough to allow differences in climate performance, but small enough that investors would be happy to consider intra-region reallocations as neutral.

FIONA assigns region and intra-region ranks based on algorithmic comparison of environmental metrics within the universe. Figure 2 shows a summary of the issuers (countries) in the FIONA sovereign universe, and the data we use, all of which are government-level metrics. Gov Climate Score[8] is a Bloomberg calculated score, which is explained in more detail on the next page.

Scores for issuers within regions are 1-3; 1 is the best performing (more climate-aligned) and 3 the poorest (less climate-aligned), and green bonds are assigned a score of 0. The final issuer score is the product of the region and intra-region score, giving a range of 0-9. FIONA then applies these issuer level scores to a portfolio of securities, considering individual characteristics such as duration or climate-alignment criteria to generate a portfolio score. This score can then be enhanced subject to risk-based constraints. The portfolio can then be analysed using a dashboard which presents metrics on risk, return and impact.

Figure 2. Summary of FIONA sovereign universe and region rankings. Source: AFII, Bloomberg, accessed 30 Mar 2023.

		Absolute CO2 emissions (mTons)	CO2 Per Capita (Tons)	CO2 Per GDP (Tons)	Gov Climate Score	
Region	Countries	Median	Median	Median	Median	AFII Region rank
Africa	41	7	0.3	121	3.9	1
LATAM	22	16	2.1	150	4.3	1
WE DM	20	35	4.9	124	5.8	2
Eastern Europe	16	47	5.3	231	4.0	2
G7	7	564	8.1	151	6.0	2
APAC	25	107	3.7	235	3.5	3
Middle East	16	71	4.3	351	3.4	3

[7] For our earlier work please see: "What if…the ECB had decarbonised its portfolio from the start", AFII, 20 Sep 2022; "Market update: Recent performance of high carbon emitters in CSPP", AFII, 27 Jun 2022; "Low carbon credit performance 2015-2020", AFII, 27 Jan 2021; "Credit Alpha and CO2 Reduction: A Portfolio Manager Perspective", Ulf Erlandsson, 19 Apr 2017.

[8] "Climate Risk Scores: Governments", Bloomberg, accessed 03 May 2023.

JPM EM issuer scores

In order to balance current climate impact with transition investment, we consider two data-sets (from Figure 2) to produce two scoring systems. For current performance we use CO_2 per GDP which is designed to be an intensity measure for sovereigns, equivalent to emissions / sales which we use for corporates. For transition performance we use the Bloomberg Government Climate Score, which is comprised of three equally weighted pillars; Carbon Transition, Power Sector Transition and Climate Policy.[8] To illustrate how these characteristics change the issuers' scoring we have applied the FIONA scoring framework using both.

Before considering portfolio weights, we want to analyse the difference in scores for individual issuers. Figure 4 and Figure 5 present the countries with the highest GDP and top scores under each ranking, and so illustrate where investment will be focused under each enhancement.

For example, in APAC, Philippines and Sri Lanka are both top-ranked based on their current emission intensities, suggesting low relative levels. They fall lower (ranked 3 and 2 respectively) when using forward-data, suggesting they have not produced credible transition plans, and emissions intensity maybe at risk of growing.

In the other direction, Brazil is ranked 2 using spot analysis, but improves to top-ranked using forward-data. A low starting score seems sensible given the ongoing concerns around deforestation and emissions trends. [9] However, it suggests than an investor enhancing on good transition plans may increase allocations into Brazil.

Since spot data and forward-looking data clearly differ, and they are both important depending on what you prioritise in your scoring, the exercise further below in this article will be conducted using both measures separately as input to the intra-region scores. This way the results can be compared taking both into consideration.

Figure 3 JPM EMB Portfolio weights per intra-region rank dependent on using spot impact data or forward-looking data. Source: AFII, iShares.

Scoring method	Intra-region rank 1	Intra-region rank 2	Intra-region rank 3	Total weight
Spot FIONA	26%	40%	34%	100%
Forward-looking FIONA	26%	32%	41%	100%

An important note identified in Figure 3 is that the JPM EMB portfolio weights differ between the intra-region ranks depending on which metric is used. The forward-looking FIONA score is more heavily weighted in intra-region rank 3 than for the spot FIONA portfolio score. This will lead to the forward-looking FIONA JPM EMB portfolio having a higher starting FIONA score, as can be observed in the case studies further below.

[9] "Brazil's climate change policies – State of play ahead of COP27", European Parliament, Oct 2022.

Figure 4 Issuer countries with best intra-region FIONA score dependent on usage of spot data. Source: AFII, Bloomberg, accessed 30 Mar 2023.

Country	Region	Intra-region rank based on CO_2 per GDP	CO2 Per GDP (Tons)	Part of JPM EM
Republic of Kenya	Africa	1	89.2	Yes
Federal Democratic Republic of Ethiopia	Africa	1	68.9	Yes
United Republic of Tanzania	Africa	1	84.2	No
Republic of the Philippines	APAC	1	160.5	Yes
Democratic Socialist Republic of Sri Lanka	APAC	1	83.8	Yes
Bangladesh	APAC	1	106.8	No
Hungary	Eastern Europe	1	155.8	Yes
Romania	Eastern Europe	1	133.5	Yes
Republic of Turkey	Eastern Europe	1	169.2	Yes
Republic of Colombia	LATAM	1	102.9	Yes
Republic of Panama	LATAM	1	99.0	Yes
Republic of Paraguay	LATAM	1	96.8	Yes
Hashemite Kingdom of Jordan	Middle East	1	237.3	Yes
Israel	Middle East	1	102.8	No
Benin	Middle East	1	200.9	No

Figure 5 Issuer countries with best intra-region FIONA score dependent on usage of forward-looking data. Source: AFII, Bloomberg, accessed 30 Mar 2023.

Country	Region	Intra-region rank based on Gov Climate score	Gov Climate Score	Part of JPM EM
Republic of Kenya	Africa	1	4.2	Yes
Federal Republic of Nigeria	Africa	1	4.6	Yes
Kingdom of Morocco	Africa	1	4.3	Yes
Republic of India	APAC	1	4.4	Yes
Islamic Republic of Pakistan	APAC	1	4.1	Yes
Australia	APAC	1	4.7	No
Hungary	Eastern Europe	1	5.7	Yes
Romania	Eastern Europe	1	5.3	Yes
Republic of Poland	Eastern Europe	1	4.7	Yes
Republic of Chile	LATAM	1	5.3	Yes
Federative Republic of Brazil	LATAM	1	5.6	Yes
Republic of Colombia	LATAM	1	5.3	Yes
Hashemite Kingdom of Jordan	Middle East	1	4.1	Yes
Israel	Middle East	1	4.6	No
Uzbekistan	Middle East	1	4.6	No

JPM EM portfolio dashboard

We first present the JPM EM portfolio using the FIONA dashboard. The dashboard gives metrics categorised as risk, return and impact:

- **Risk metrics** present a view of the portfolio as expected by a traditional manager.
- **Return metrics** analyse historic returns and tracking errors.[10]
- **Impact metrics** show FIONA score, spot and forward-looking numerical metrics, plus discrete aligned buckets, to aid a manager in identifying their enhanced portfolio.

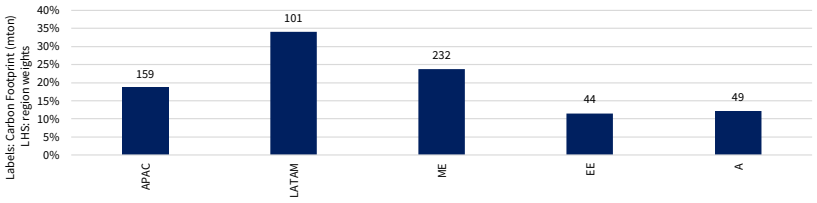
Figure 6 shows the starting dashboard for the JPM EM portfolio.

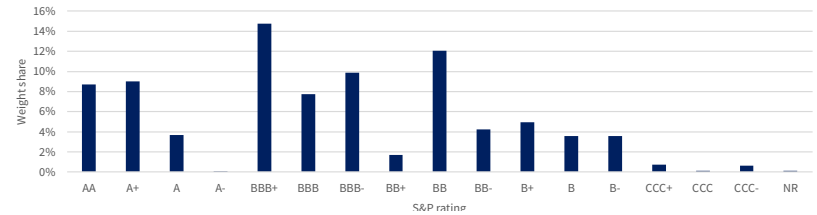
The direct emissions intensity in the dashboard is calculated by taking the weighted average of the countries' respective emissions intensity, which is CO_2 emissions divided by GDP. We consider this to be the appropriate intensity metric for sovereign bonds; for corporates we used emissions over sales.

Figure 6 JPM EM portfolio dashboard. Source: Bloomberg, iShares, accessed 30 Mar 2023.

		JPM EM portfolio
Risk	Average duration	7.3
	95% daily VAR	0.75%
	Maximum individual bond weight	0.78%
	Maximum individual issuer weight	5.97%
Return	Cumulative returns (%)	31%
	Tracking error (%)	
	Transaction cost (EUR 1bn portfolio)	
	Reallocation volume (% of original portfolio)	
Impact (Average)	FIONA score spot	3.7
	FIONA score forward-looking	4.3
	Bloomberg Government Climate score	3.8
	Direct emissions intensity (mton/USDtr GDP)	226.4
	Carbon footprint (mton/USDtr debt)	585.8







Top issuer weights

	Issuer FIONA score	Index weight
United Mexican States	3	5.97%
Kingdom of Saudi Arabia	6	5.81%
Republic of Indonesia	9	5.45%
Republic of Turkey	6	5.20%
United Arab Emirates	6	4.93%
State of Qatar	9	4.49%
Peoples Republic of China	6	4.07%
Republic of the Philippines	9	3.84%
Federative Republic of Brazil	1	3.74%
Sultanate of Oman	9	3.74%
Dominican Republic	3	3.43%
Republic of Chile	1	3.38%
Republic of Peru	2	3.31%
Republic of South Africa	3	3.27%
Republic of Panama	1	3.20%
Republic of Colombia	1	3.20%
Kingdom of Bahrain	6	2.85%
Arab Republic of Egypt	3	2.56%
Oriental Republic of Uruguay	2	2.40%
Federation of Malaysia	6	2.36%

[10] Returns are calculated on a weekly basis, using historic mid z-spreads and durations. Where historic data is not available, because the security is recently issued, portfolios are normalised to the remaining securities.

FIONA simulations

We will now apply FIONA portfolio tools to analyse alternative weightings of this portfolio that deliver better climate-positive performances.

We apply random re-weighting of securities according to FIONA scores and observe how these scores change. The improved portfolios can be compared with the original portfolio against the full set of metrics, to understand the performance of difference metrics, and a preferred portfolio solution can be chosen.

In the case studies presented below, 10,000 simulations have been used to identify the improved portfolio. The closest 500 solutions are further analysed (95% percentile, smallest loss function from the proposed solution), to further find an optimal solution.

To keep the simulated portfolios relatively stable compared to the original the maximum weight change has been set to 10x, the maximum individual issuer weight has been set to 10% of the portfolio, and the average duration cannot deviate more than +-10% from the original portfolio.

Case Study 1: Intra-region enhancement

In this case study we retain fixed region weightings; reasoning that regional allocations can be decided as an overall investment thesis, and we consider enhancing within this restriction, i.e. amending intra-region allocations. We do consider both spot-based scoring as well as forward-looking scoring of the issuers/countries. We choose an enhanced weighting for spot metrics, and another for forward-looking metrics.

Figure 7 shows the chosen enhanced portfolios' metrics compared to the JPM EMB ETF. As can be seen here it is possible to keep the risk and return metrics stable using both methods of scoring.

When observing the impact metrics, it becomes clear that the enhanced spot portfolio has better improvements to carbon footprint and intensity (the spot metrics) compared to the forward scoring, which is intuitive as these are the metrics being enhanced. There is barely any change to the forward-looking metric.

Similarly, the forward-looking portfolio has significantly improved Bloomberg Government Climate scores, improved by 15%. However, the forward-looking enhancement achieves nearly 80% of the reduction in emissions intensity, and 65% of the reduction in carbon footprint, despite enhancing on a forward-looking metric.

We observe the enhanced spot portfolios does so with lower transaction costs, and lower tracking error, suggesting that less of the portfolio has been reallocated.

In conclusion, it is possible to improve both the spot and forward-looking climate metrics without high cost to historic returns. Enhancing on forward-looking metrics offers improvements to all metrics, however with slightly higher tracking error.

Figure 7 Region-fixed portfolio metrics for spot data scored portfolio and forward-looking scored portfolio. Source: AFII, Bloomberg, iShares.

		JPM EM portfolio	FIONA-weighted spot portfolio	FIONA-weighted forward-looking portfolio
Risk	Average duration	7.3	7.7	7.1
	95% daily VAR	0.75%	0.83%	0.78%
	Maximum individual bond weight	0.8%	1.6%	1.53%
	Maximum individual issuer weight	5.97%	8.82%	7.76%
	Top 10 issuer weights concentration	47%	63%	53%
	Count of issuer weights > 1%	26	24	30
Return	Cumulative returns (%)	30.7%	29.8%	28.6%
	Tracking error (2020-2023 annualised)		0.92%	1.17%
	Transaction cost (EUR 1bn portfolio)		1,860,122	2,171,787
	Reallocation volume (% of original portfolio)		30%	36%
Impact (Average)	FIONA score spot	3.7	3.1	
	FIONA score forward-looking	4.3		2.9
	Bloomberg Government Climate score	3.8	3.9	4.4
	Direct emissions intensity (mton/USDtr GDP)	226.4	180.3	189.7
	Carbon footprint (mton/USDtr debt)	585.8	401.3	462.5

Detailed Results

Figure 10 and Figure 11 show the full FIONA dashboards with comparative metrics. Weight changes can be seen in the middle bottom graph; for example, a high-ranked issuer (score 1) in a poor region (score 3) has had its weight increased by 6.9x. Within each region the total weight has remained the same; this graph shows reallocations within the regions. Separate tables are included to highlight the largest increases and decreases; the weight increases are the strongest climate-aligned issuers within a region, and the weight decreases are the poorer climate-aligned issuers.

Figure 8 and Figure 9 show the simulations, which demonstrate that the FIONA score can be decreased without materially increasing the tracking error. The portfolios chosen as the solutions are highlighted in both figures in green.

As can be seen in the right-hand side of the figures; achieving a lower FIONA score comes with a larger decrease in cumulative excess returns for the forward-looking portfolio compared to the spot portfolio. Hence, it is slightly easier to lower the spot climate impact data in the region-fixed portfolios than the forward-looking data if one would want to keep the tracking errors and excess returns difference to a minimum.

Figure 8 Simulations for 10,000 FIONA weighted portfolios using forward-looking scoring. Source: Bloomberg, iShares, accessed 30 Mar 2023.

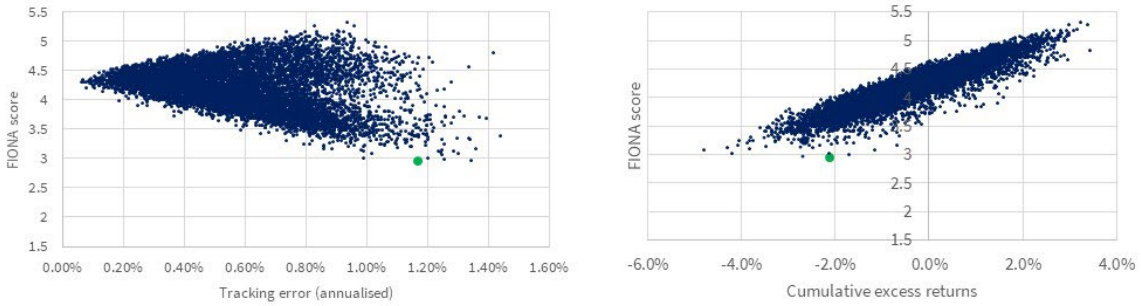


Figure 9 Simulations for 10,000 FIONA weighted portfolios using spot data scoring. Source: Bloomberg, iShares, accessed 30 Mar 2023.

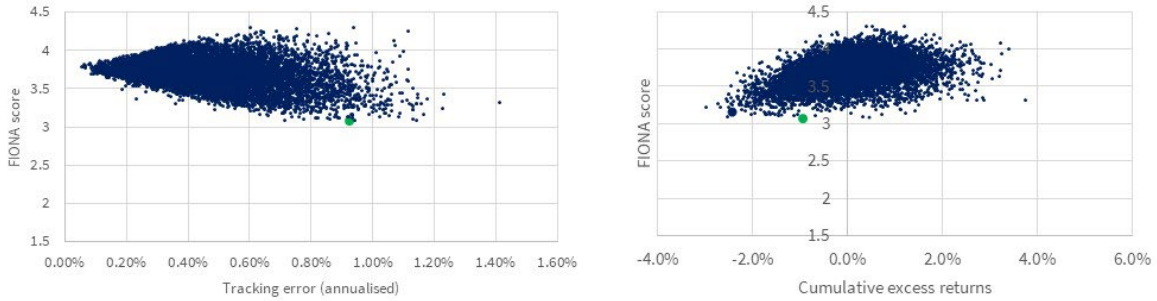
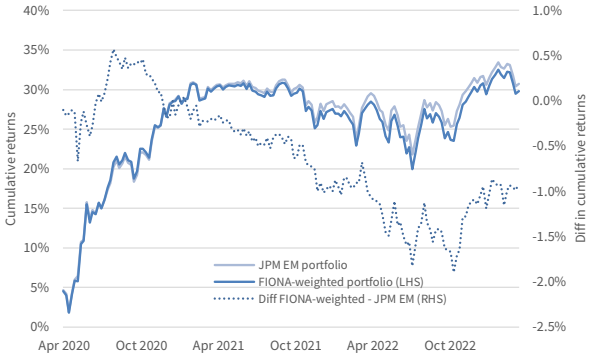


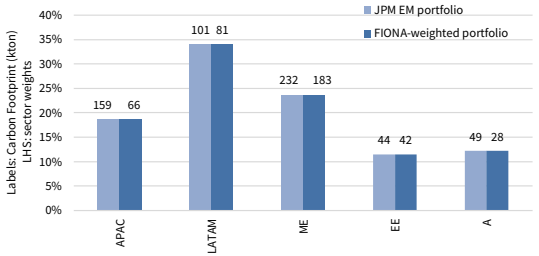
Figure 10 Portfolio dashboard showing JPM EM and spot FIONA-weighted solution. Source: Bloomberg, iShares, accessed 30 Mar 2023

Region-stable portfolio metrics

		JPM EM portfolio	FIONA-weighted Portfolio
Risk	Average duration	7.3	7.7
	95% daily VAR	0.75%	0.83%
	Maximum individual bond weight	0.8%	1.55%
	Maximum individual issuer weight	5.97%	8.82%
	Top 50 issuer weights concentration	47%	63%
	Count of issuer weights > 1%	26	24
Return	Cumulative returns (%)	30.7%	29.8%
	Tracking error (2020-2023 annualised)		0.92%
	Transaction cost (EUR 1bn portfolio)		1,860,122
	Reallocation volume (% of original portfolio)		30%
Impact (Average)	FIONA score spot	3.7	3.1
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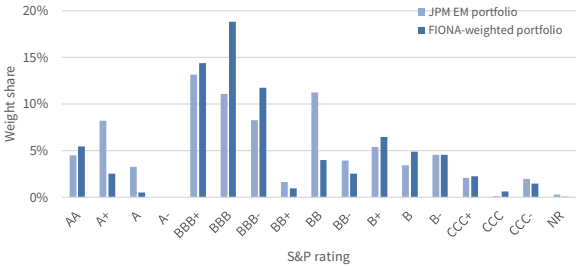


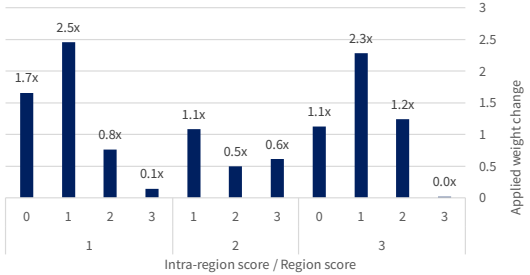




Top issuer weight increases

	Issuer FIONA score	Index weight	FIONA weight	Increase
Republic of the Philippines	3	3.84%	8.82%	4.98%
Republic of Colombia	1	3.20%	6.78%	3.57%
Republic of Panama	1	3.20%	6.78%	3.57%
Republic of Kenya	1	0.90%	4.46%	3.56%
Oriental Republic of Uruguay	1	2.40%	5.07%	2.67%
Republic of Indonesia	6	5.45%	6.97%	1.52%
Kingdom of Saudi Arabia	6	5.81%	7.03%	1.21%
United Arab Emirates	6	4.93%	5.99%	1.06%
State of Qatar	6	4.49%	5.45%	0.97%
Hashemite Kingdom of Jordai	3	0.72%	1.56%	0.85%



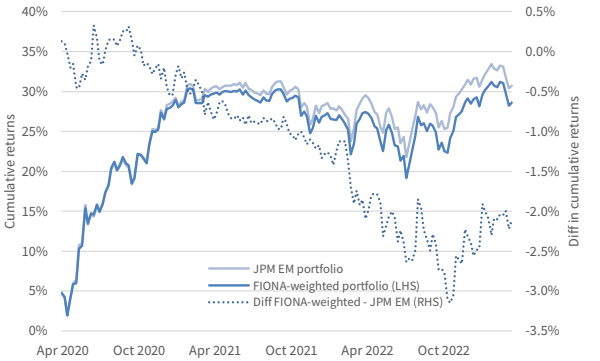


Top issuer weight decreases

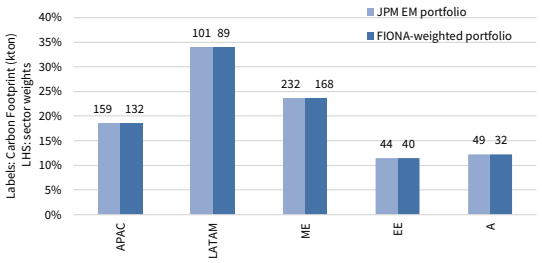
	Issuer FIONA score	Index weight	FIONA weight	Decrease
Peoples Republic of China	9	4.07%	0.09%	-3.99%
Sultanate of Oman	9	3.74%	0.08%	-3.66%
Republic of South Africa	3	3.27%	0.55%	-2.71%
United Mexican States	2	5.97%	3.60%	-2.38%
Federation of Malaysia	9	2.36%	0.05%	-2.30%
Arab Republic of Egypt	3	2.56%	0.43%	-2.13%
Federative Republic of Brazil	2	3.74%	2.25%	-1.49%
Dominican Republic	2	3.43%	2.06%	-1.36%
Republic of Peru	2	3.31%	1.99%	-1.32%
Argentine Republic/The	3	1.34%	0.10%	-1.25%

Figure 11 Portfolio dashboard showing JPM EM and forward-looking FIONA-weighted solution. Source: Bloomberg, iShares, accessed 30 Mar 2023.

Region-stable portfolio metrics		JPM EM portfolio	FIONA-weighted Portfolio
Risk	Average duration	7.3	7.1
	95% daily VAR	0.75%	0.78%
	Maximum individual bond weight	0.8%	1.53%
	Maximum individual issuer weight	5.97%	7.76%
	Top 50 issuer weights concentration	47%	53%
	Count of issuer weights > 1%	26	30
Return	Cumulative returns (%)	30.7%	28.6%
	Tracking error (2020-2023 annualised)		1.17%
	Transaction cost (EUR 1bn portfolio)		2,171,787
	Reallocation volume (% of original portfolio)		36%
Impact (Average)	FIONA score spot	3.7	
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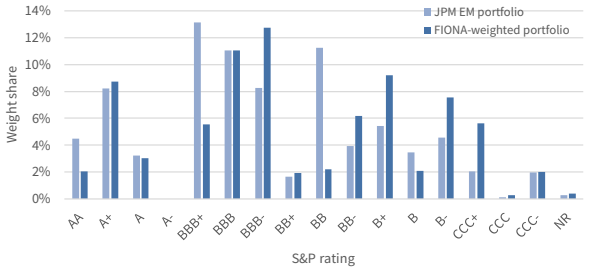


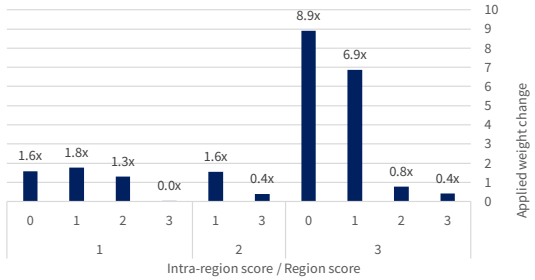




Top issuer weight increases

	Issuer FIONA score	Index weight	FIONA weight	Increase
Republic of India	3	0.84%	5.54%	4.70%
Hashemite Kingdom of Jord	3	0.72%	5.42%	4.70%
Islamic Republic of Pakistar	3	0.45%	3.00%	2.55%
Federative Republic of Braz	1	3.74%	6.16%	2.41%
Federal Republic of Nigeria	1	1.92%	4.22%	2.30%
Republic of Chile	1	3.38%	5.53%	2.16%
Republic of Colombia	1	3.20%	5.27%	2.07%
Republic of Panama	1	3.20%	5.27%	2.07%
Kingdom of Saudi Arabia	6	5.81%	7.76%	1.95%
Romania	2	2.34%	3.64%	1.30%





Top issuer weight decreases

	Issuer FIONA score	Index weight	FIONA weight	Decrease
United Mexican States	3	5.97%	0.16%	-5.81%
Dominican Republic	3	3.43%	0.09%	-3.33%
Republic of South Africa	3	3.27%	0.12%	-3.15%
Republic of Turkey	6	5.20%	2.08%	-3.11%
Arab Republic of Egypt	3	2.56%	0.09%	-2.46%
State of Qatar	9	4.49%	2.04%	-2.45%
Republic of Indonesia	9	5.45%	3.00%	-2.45%
Republic of the Philippines	9	3.84%	1.52%	-2.32%
Sultanate of Oman	9	3.74%	1.70%	-2.04%
Peoples Republic of China	6	4.07%	2.86%	-1.22%

Case Study 2: Inter-region enhancement

In this case study we relax our requirement to keep regional allocations fixed; we now allow re-allocations within and between regions. We still separately consider spot-based rankings as well as forward-looking rankings of the issuers/countries, to create two enhanced portfolios.

Figure 12 shows the chosen enhanced portfolios' metrics compared to the JPM EMB ETF. When comparing this result to Figure 7 one can note that it is possible to improve the climate metrics further, albeit with higher transaction cost and tracking error. For the inter-region case study the forward-looking portfolio has similar and even better spot climate metrics compared to the spot portfolio, as well as a better Government Climate score. It does however still seem that one can achieve lower portfolio emissions through the spot ranking enhancement with a lower transaction cost and tracking error. In general, the two enhanced portfolios look much more similar to each other, than in case study 1.

One explanation is that reallocations between regions are the same in both scenarios; the regional rankings do not change, and in both enhancements, we see weight decreases in APAC and Middle East, with corresponding increases in LATAM. This can be seen in the tables in Figure 15 and Figure 16 showing the largest individual increases and decreases in the portfolio dashboard.

This suggests that choosing a climate-aligned regional allocation has great influence on your ultimate portfolio impact.

In conclusion, choosing a climate-aligned regional allocation has great influence on your ultimate portfolio impact. Different intra-region enhancements create similar results.

Figure 12 Region-free portfolio metrics for spot data scored portfolio and forward-looking scored portfolio. Source: AFII, Bloomberg, iShares.

		JPM EM portfolio	FIONA-weighted spot portfolio	FIONA-weighted forward-looking portfolio
Risk	Average duration	7.3	7.6	7.6
	95% daily VAR	0.75%	0.83%	0.88%
	Maximum individual bond weight	0.8%	1.8%	1.32%
	Maximum individual issuer weight	5.97%	8.58%	9.33%
	Top 10 issuer weights concentration	47%	62%	65%
	Count of issuer weights > 1%	26	24	23
Return	Cumulative returns (%)	30.7%	31.9%	31.1%
	Tracking error (2020-2023 annualised)		2.26%	2.86%
	Transaction cost (EUR 1bn portfolio)		2,134,563	2,708,151
	Reallocation volume (% of original portfolio)		35%	44%
Impact (Average)	FIONA score spot	3.7	2.0	
	FIONA score forward-looking	4.3		1.8
	Bloomberg Government Climate score	3.8	4.5	4.8
	Direct emissions intensity (mton/USDtr GDP)	226.4	156.9	157.3
	Carbon footprint (mton/USDtr debt)	585.8	338.6	310.3

Detailed Results

In Figure 12 above, the spot portfolio has lowered the emissions intensity and carbon footprint by 30% and 42% respectively while increasing the Government Climate score by 18%. The forward-looking portfolio has lowered the emissions intensity and carbon footprint similarly as the spot portfolio (30% and 47% respectively) and has improved the Government Climate score by 26%.

Figure 13 and Figure 14 show the simulations, and the portfolio we have chosen to analyse further in green. The graphs show that when freeing up regional weights the FIONA score of the portfolio can be reduced more than in the first case study, albeit by trading a higher percentage of the portfolio, and therefore potentially incurring higher transaction costs. The right-hand graph gives a drill-down into the paths closest to the optimal solution.

Figure 13 Simulations for 10,000 forward-looking FIONA weighted portfolios and 500 closest paths to proposed solution. Source: Bloomberg, iShares, accessed 30 Mar 2023.

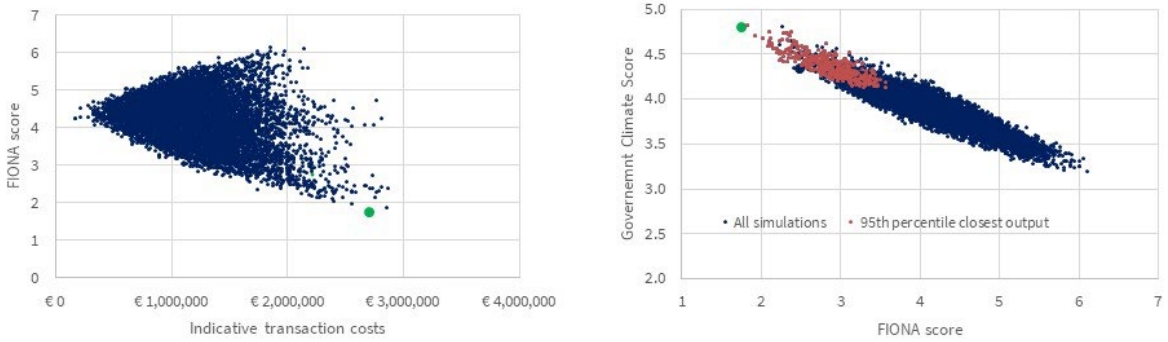


Figure 14 Simulations for 10,000 spot FIONA weighted portfolios and 500 closest paths to proposed solution. Source: Bloomberg, iShares, accessed 30 Mar 2023.

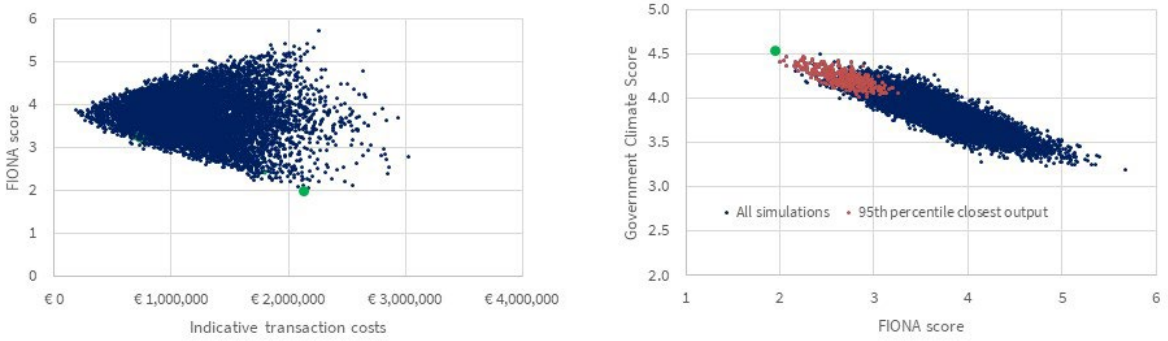
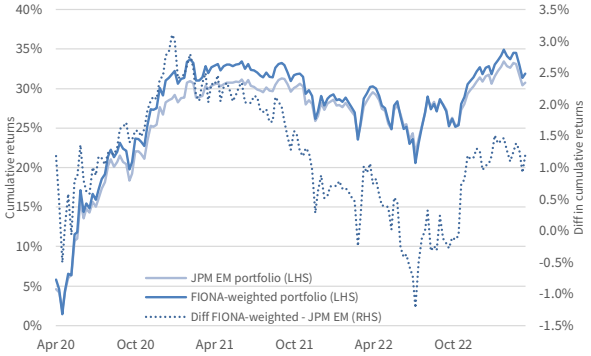


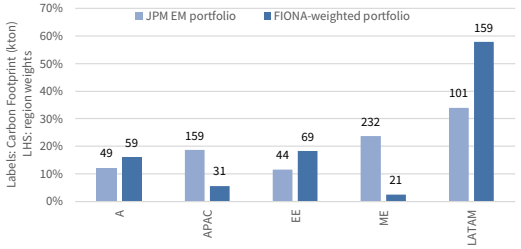
Figure 15 Portfolio dashboard showing JPM EM and spot FIONA-weighted solution. Source: Bloomberg, iShares, accessed 30 Mar 2023.

Region-free portfolio metrics

		JPM EM portfolio	FIONA-weighted Portfolio
Risk	Average duration	7.3	7.6
	95% daily VAR	0.75%	0.83%
	Maximum individual bond weight	0.78%	1.77%
	Maximum individual issuer weight	5.97%	8.58%
	Top 50 issuer weights concentration	47%	62%
	Count of issuer weights > 1%	26	24
Return	Cumulative returns (%)	30.7%	31.9%
	Tracking error (2020-2023 annualised)		2.26%
	Transaction cost (EUR 1bn portfolio)		2,134,563
	Reallocation volume (% of original portfolio)		35%
Impact (Average)	FIONA score spot	3.7	2.0
	FIONA score forward-looking	4.3	
	Bloomberg Government Climate score	3.8	4.5
	Direct emissions intensity (ton/USDmm GDP)	226.4	156.9
	Carbon footprint (kton, EUR 1bn portfolio)	585.8	338.6

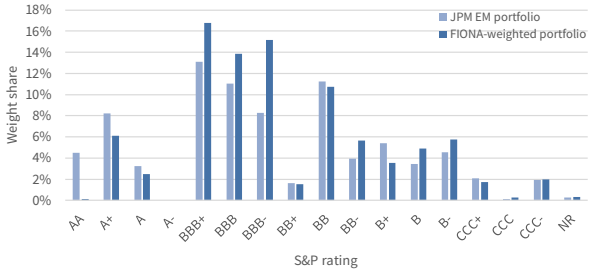


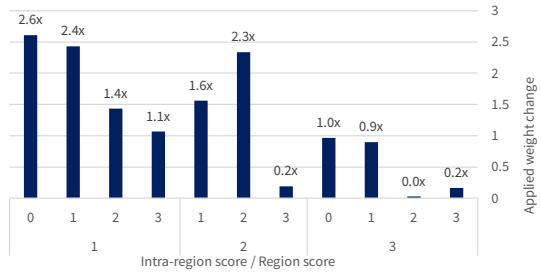




Top issuer weight increases

	Issuer FIONA score	Index weight	FIONA weight	Increase
Republic of Colombia	1	3.20%	7.79%	4.58%
Republic of Panama	1	3.20%	7.79%	4.58%
Oriental Republic of Urugua	1	2.40%	5.82%	3.43%
Republic of Turkey	2	5.20%	8.12%	2.92%
United Mexican States	2	5.97%	8.58%	2.60%
Republic of Chile	2	3.38%	5.29%	1.91%
Federative Republic of Braz	2	3.74%	5.37%	1.63%
Dominican Republic	2	3.43%	4.92%	1.49%
Republic of Peru	2	3.31%	4.75%	1.44%
Romania	2	2.34%	3.65%	1.31%





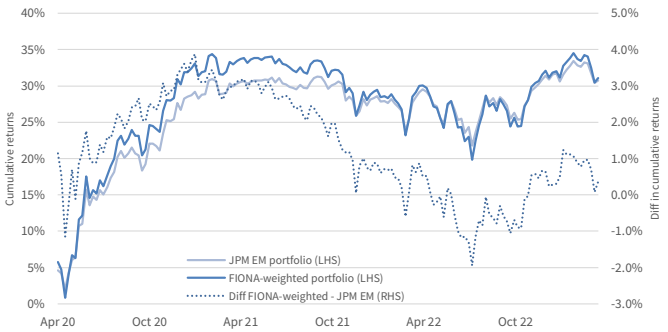
Top issuer weight decreases

	Issuer FIONA score	Index weight	FIONA weight	Decrease
Kingdom of Saudi Arabia	6	5.81%	0.52%	-5.29%
Republic of Indonesia	6	5.45%	0.27%	-5.18%
United Arab Emirates	6	4.93%	0.15%	-4.79%
State of Qatar	6	4.49%	0.13%	-4.35%
Peoples Republic of China	9	4.07%	0.69%	-3.38%
Sultanate of Oman	9	3.74%	0.64%	-3.10%
Kingdom of Bahrain	6	2.85%	0.08%	-2.77%
Federation of Malaysia	9	2.36%	0.40%	-1.95%
Republic of India	9	0.84%	0.14%	-0.70%
State of Kuwait	9	0.78%	0.13%	-0.65%

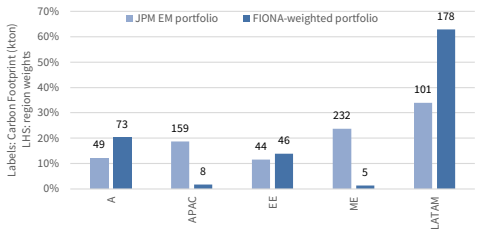
Figure 16 Portfolio dashboard showing JPM EM and forward-looking FIONA-weighted solution. Source: Bloomberg, iShares, accessed 30 Mar 2023.

Region-free portfolio metrics

		JPM EM portfolio	FIONA-weighted Portfolio
Risk	Average duration	7.3	7.6
	95% daily VAR	0.75%	0.88%
	Maximum individual bond weight	0.78%	1.32%
	Maximum individual issuer weight	5.97%	9.33%
	Top 50 issuer weights concentration	47%	65%
	Count of issuer weights > 1%	26	23
Return	Cumulative returns (%)	30.7%	31.1%
	Tracking error (2020-2023 annualised)		2.86%
	Transaction cost (EUR 1bn portfolio)		2,708,151
	Reallocation volume (% of original portfolio)		44%
Impact (Average)	FIONA score spot	3.7	
	FIONA score forward-looking	4.3	1.8
	Bloomberg Government Climate score	3.8	4.8
	Direct emissions intensity (ton/USDmm GDP)	226.4	157.3
	Carbon footprint (kton, EUR 1bn portfolio)	585.8	310.3

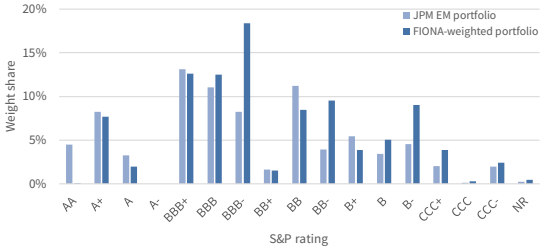


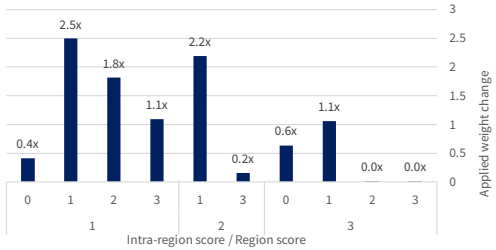




Top issuer weight increases

	Issuer FIONA score	Index weight	FIONA weight	Increase
Federative Republic of Brazil	1	3.74%	9.33%	5.59%
Republic of Colombia	1	3.20%	7.99%	4.79%
Republic of Panama	1	3.20%	7.99%	4.79%
Republic of Chile	1	3.38%	7.64%	4.27%
Federal Republic of Nigeria	1	1.92%	4.79%	2.87%
Romania	2	2.34%	5.11%	2.78%
Republic of Peru	2	3.31%	6.00%	2.69%
Hungary	2	2.24%	4.91%	2.67%
Oriental Republic of Uruguay	2	2.40%	4.35%	1.95%
Republic of Kenya	1	0.90%	2.24%	1.34%





Top issuer weight decreases

	Issuer FIONA score	Index weight	FIONA weight	Decrease
Kingdom of Saudi Arabia	6	5.81%	0.31%	-5.50%
Republic of Indonesia	9	5.45%	0.13%	-5.32%
United Arab Emirates	6	4.93%	0.06%	-4.87%
State of Qatar	9	4.49%	0.05%	-4.44%
Republic of Turkey	6	5.20%	0.82%	-4.38%
Peoples Republic of China	6	4.07%	0.05%	-4.02%
Republic of the Philippines	9	3.84%	0.04%	-3.80%
Sultanate of Oman	9	3.74%	0.04%	-3.70%
Kingdom of Bahrain	6	2.85%	0.04%	-2.81%
Federation of Malaysia	6	2.36%	0.03%	-2.33%

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