Reducing Carbon Intensity in Realindex Value Portfolios

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For Institutional investors and Advisers only   July 2023

Following on from our recent work on the trade-off between reducing carbon intensity and increasing tracking error[1], we now turn our attention to our Value portfolios. Below, we take a deep dive into the motivation, background and implementation of this.

To start, we argue the case for reducing carbon intensity in terms of carbon risk and its pricing. We then broaden the discussion to show how we will implement carbon related policies and targets across all of our active strategies.

Next we revisit some of our recent work on the relationship between carbon intensity and Value investing. Finally, we discuss in detail the mechanism we will use and its timing of implementation. In other words – and in the absence of a better metaphor - this paper outlines "where the rubber meets the road".

Why reduce carbon emissions and how do we price these risks?

As there is more focus on climate risk globally and with many countries committing to climate action and a path to net zero, we see carbon as a potential risk in our portfolios that we want to address. Where do we see the source of these risks? The risk from carbon can be many-faceted. This includes the risk of stranded assets, reduction in demand for a company's product as consumers shift away from high carbon to low carbon products, as well as changing government regulation including harsher carbon pricing[2]. Those companies generating higher carbon emissions face a greater risk of some of the issues listed above and a greater potential impact on their revenues and profitability. If we can find a measure of the portfolio's exposure to this risk, as well as a company's adaptation and transition pathway, we can then more accurately construct our portfolios to achieve better potential long term outcomes for our clients.

It is hard to accurately price carbon risk and a number of academic studies have tried to do so. Most have focused on creating a "brown minus green" factor[3] to add to the standard Fama-French factors in explaining returns. This factor looks to determine how "brown" or "green" a company is by looking at not only their current emissions but also how they are adapting and transitioning to a net zero world. Indicators of their adaptation include how stakeholders perceive their carbon policy, investment in clean technology, and measures of climate change risk awareness. Unlike some of the standard Fama-French factors, there is no single agreed way to measure this factor. Mostly, this is due to limitations of data availability and variations in how people define a company's 'adaptation and transitioning'. As we

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[1] Realindex Investments, 'Reducing Carbon intensity in portfolios: Better news than you think', February 2023.
[2] A current domestic Australian example is a significant reset of carbon emission baselines in the safeguard mechanism, due to come into force on 1 July 2023.
[3] Gorgen, M, A Jacob, M Neringer, R Riordan, M Rohlerder and M Wilkend, 'Carbon Risk', SSRN, 2019

can see above, many of the suggested measures are more subjective than objective in nature. One common and objective component of measuring climate risk exposure is to look at the current carbon emissions of the company.

Until data in this area is clearer, and to avoid coming up with our own definition of how the company is transitioning, we have decided to focus on *the current carbon intensity* as a proxy for a "brown minus green" factor to help us determine our exposure to carbon risk. We appreciate that this may not fully capture how brown or green the firm is but it will be a good approximation for it until we have a more satisfactory way of measuring it. As this area evolves we will consider refining this measure to make sure we are capturing the risk in the best way possible.

Realindex has recognised this carbon exposure as a potential risk to our portfolios and we have committed to reducing our carbon exposure across our strategies in order to address this risk. We have articulated this commitment explicitly in our climate statement[4].

Targets[5]

In the Realindex climate statement, we have set a number of targets for our strategies. All strategies will have a focus on **engagement**.

- For our market cap weighted index strategies, engagement is our primary focus:
    o We commit to discuss net zero with all companies that we engage with at least once a year.
    o We encourage them to move up the scale of the Net Zero Investment Framework Implementation Guide (NZIFIG)[6], i.e. from not aligned to commit to aligning etc.
    o In our engagement, we encourage companies to disclose scope 1, 2 and 3 emissions, set science-based short, medium and long term targets on their path to net zero, and align their capital expenditure to meet their net zero goals.
- For our Value Strategies, in addition to engagement:
    o We are progressing towards the target of reducing the carbon intensity of the strategy by 30% by 2025 (AUM adjusted for the 2020 baseline[7]).
    o We will look to increase this to a 50% reduction by 2030.
- For our Diversified Alpha strategies, in addition to engagement:
    o We aim to reduce carbon intensity by at least 20% relative to the benchmark.
    o We look to reassess this target in 2025 and 2030 depending on how the benchmark has evolved.

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[4] https://www.firstsentierinvestors.com.au/au/en/adviser/our-funds/realindex-investments/responsible-investment.html

[5] These targets have been formulated based on: (i) available information and representations made to Realindex by third parties, including, but not limited to, portfolio companies; and (ii) assumptions made in relation to future matters such as the implementation of government policy in climate-related areas, enhanced future technology and the actions of portfolio companies. Such information and representations may ultimately prove to be inaccurate and such future matters may not ultimately be realised. As such, Realindex cannot guarantee the achievement of these targets. These targets are subject to ongoing review and may change without notice.

[6] https://www.iigcc.org/resource/net-zero-investment-framework-implementation-guide/

[7] This baseline is determined by the carbon intensity of the strategy as at 30 June 2020.

Whilst we have started to implement the carbon intensity reduction targets for our Diversified Alpha strategies, we are yet to do so for our Value strategies. This paper explains the research we have done to determine the best way to reduce the risk within our Value strategies. Given the very concentrated nature of carbon exposure not only at the industry level but also within industry, there are a number of ways to achieve this exposure reduction. We could simply exclude the high emitters but this would lead to creating other risks in our model such as industry and stock specific risk.

Rather, we leverage our previous work 'Carbon Reduction Impact on Indices and Portfolios: Better news than you think', to show that a risk optimised approach can provide the reduction in carbon exposure and hence carbon risk within the portfolio whilst maintaining the previous characteristics of the strategy.

1.1 The Carbon Exposure of Value Investing

Many people associate high carbon intensity stocks with 'cheapness' or 'good value'. When implementing the carbon reduction we are cognisant to keep the Value characteristics of the strategy consistent with previous exposures whilst reducing the carbon exposure.

Carbon-intensive stocks have tended to be cheap on many measures. Table 1 below shows the cross-sectional correlations between (scope 1 & 2)[8] carbon intensity and a handful of valuation metrics in Developed Markets (DM), Emerging Markets (EM) and Australia. At the overall index level we can see some correlation between carbon and valuation metrics, however this is particularly strong when we look at the top 5 highest-emitting industries in these regions. This is not surprising as we find that there is a heavy concentration of carbon intensity within relatively few industries, and it is in these industries that the emissions are most material from a valuation perspective.

|	MSCI World		MSCI EM		ASX 200	
	Carbon intensity	Top 5 industries	Carbon intensity	Top 5 industries	Carbon intensity	Top 5 industries
Sales / Price	0.09	0.05	0.14	0.06	0.05	-0.25
Book / Price	0.07	0.29	0.04	0.16	0.25	0.27
Earnings / Price	-0.01	0.18	-0.09	0.02	0.12	0.17
Forward Earnings / Price	0.05	0.34	-0.06	0.10	0.17	0.04

Table 1: Cross sectional correlations of Value metrics with carbon intensity

Source: FactSet, Realindex. Data range Jan 2012- Jun 2022

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[8] Scope 1 are direct emissions, while Scope 2 are indirect emissions caused by purchased electricity, steam, and heat and cooling (see https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance).

Chart 1 below shows that outside five sectors (utilities, materials, energy, transportation and capital goods), the total CO_2 emissions tend to be relatively small.
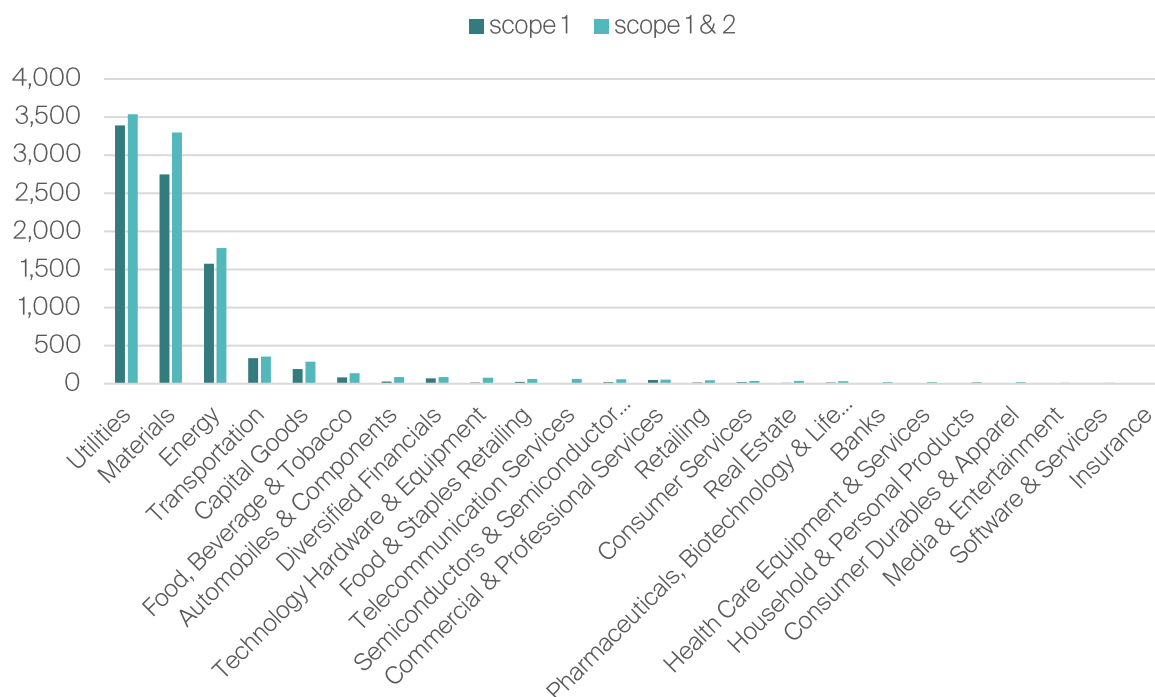
Source: FactSet, MSCI Carbon Metrics,Realindex

Chart 1: Total scope 1 & 2 CO_2equivalent greenhouse gas emissions for MSCI ACWI firms, million tons per annum

Given the large concentration within a relatively small number of industries, we need to be mindful that in making any carbon reductions within a portfolio, we do not skew the characteristics of the portfolio. It would be very easy to reduce the carbon emissions by simply removing these high emitting industries - but then that would add both risk and tracking error to the strategies, as well as very significantly changing the characteristics of the portfolio. Excluding stocks would also miss any future opportunities within this sector, as these industries transition to a net zero world.

In doing our analysis on carbon reduction, we make sure that we maintain the same overall characteristics of the strategy in relation to portfolio exposures and risk. This is achieved by applying an intelligent optimisation process that weighs the carbon reduction against the impact on the portfolio characteristics, to achieve the best outcome rather than simply applying a brute-force carbon reduction method.

Impact of Reducing Carbon Intensity in Global and Australian Value Portfolios

Before focusing on achieving the specific targets set out in our Climate Change Statement, we investigated how carbon reduction would work in a general Value portfolio, and what characteristics the new portfolio would exhibit.

We focus on achieving carbon reduction by reducing the carbon intensity of the portfolio. This is measured using WACI (Weighted Average Carbon Intensity), which is the weighted average of firm level carbon intensities of the portfolio.

In the backtests reported below, this reduction is *relative to the carbon intensity of the Core Value ("Core") portfolio*. The Core portfolio is the portfolio constructed by the combination of the four core accounting weighted components – sales, dividends, cashflows and book value - which results in a Value oriented portfolio.

We ran a number of backtests to examine the impact of imposing a fixed percentage of carbon intensity reduction relative to the Core portfolio (reductions ranged from 0-90%). These are called "Carbon_0" to "Carbon_90". This reduction was achieved as part of the overall portfolio construction and optimisation process rather than as an additional step after the optimisation has been run. Note that as part of this portfolio construction and optimisation process, we applied our usual enhancements/alpha layer.

Chart 2 and Table 2 below show the results for the global portfolio. Here, 'Core Portfolio' represents the portfolio consisting of the four core accounting metrics alone. The 'Carbon_0' portfolio is the Core portfolio with the alpha enhancements layer but *without* any imposed carbon reduction yet. This shows the level of carbon reduction relative to these core metrics that is being achieved purely by the current alpha model. Whilst we do not directly target carbon reduction in the alpha model, there are a number of signals that will lead to a tilt away from carbon intensive stocks; so the Carbon_0 portfolio already shows a sizeable carbon intensity reduction.

The 'Carbon_10' portfolio is the backtest portfolio with a 10% carbon reduction relative to the Core portfolio whilst 'Carbon_20' etc. are defined in a similar manner.

We chart and tabulate the resulting portfolio exposure of carbon through time for the backtests.
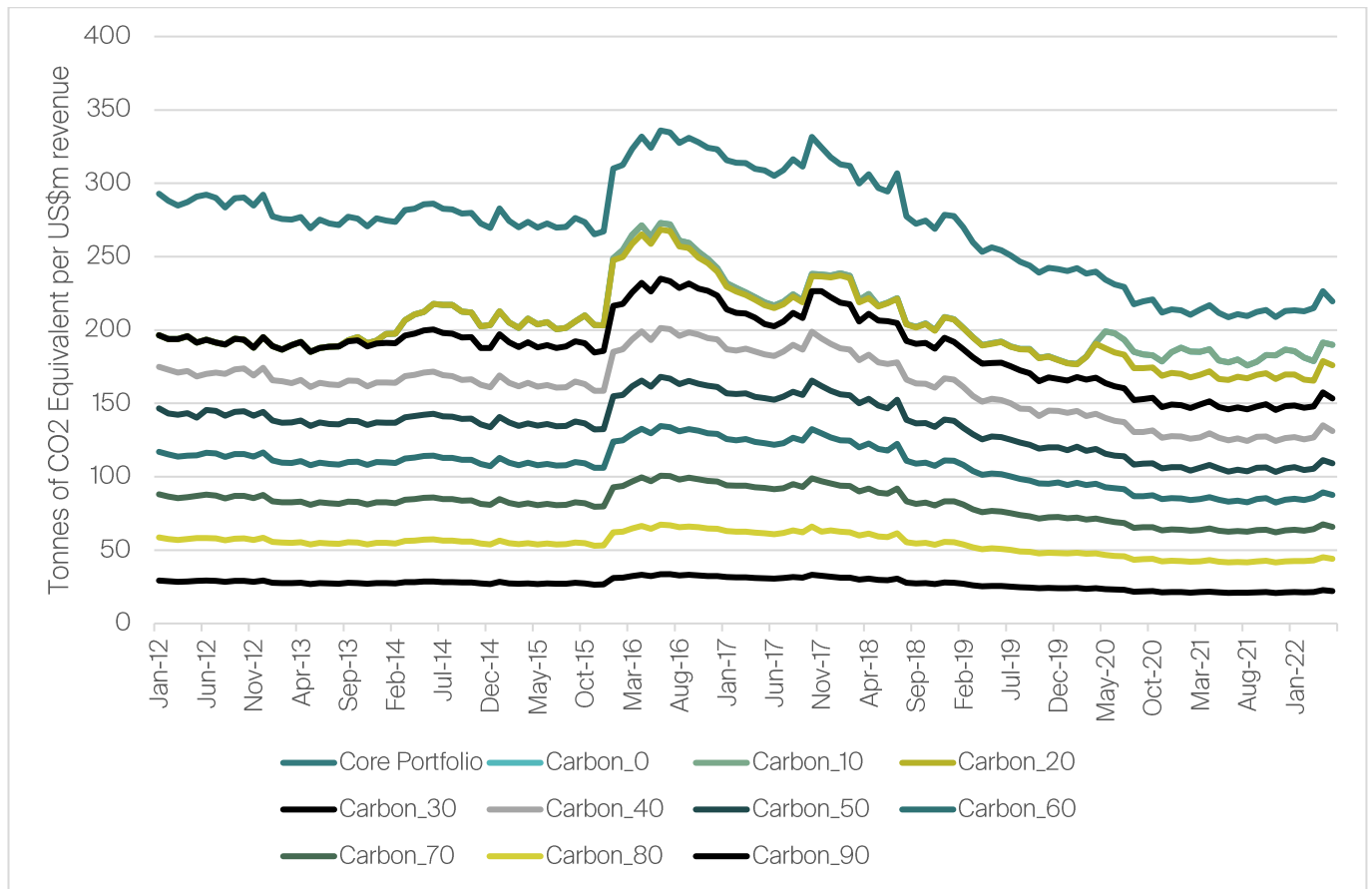
Chart 2: Carbon intensity over time in the Global Portfolio (carbon reduction against Core)

Note: Carbon_0 (teal line) is the same as Carbon_10 (light green line) as the constraint is not binding.

Jan-2012 to Jun-2022										
	Core Portfolio	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Portfolio Average	271.74	204.99	204.99	201.71	187.63	162.21	135.29	108.37	81.38	54.25	27.17
Portfolio Median	275.23	197.61	197.61	196.43	191.03	164.22	136.96	109.69	82.53	54.98	27.52
Portfolio Min	208.69	175.85	175.86	165.46	145.52	124.36	103.29	82.41	62.10	41.60	20.87
Portfolio Max	335.98	272.92	272.92	268.47	234.98	201.36	168.06	134.54	100.70	67.36	33.56

Table 2: Summary of results in Chart 2 (carbon reduction against Core)

Even without any imposed carbon reduction we can see that the alpha layer of the portfolio (Carbon_0) is already reducing the carbon exposure of the portfolio relative to the 'Core Portfolio'. On average, we have reduced a value of 271.74 in the 'Core Portfolio' to 204.99 in the 'Carbon_0' portfolio (approximately a 25% reduction), simply by applying the alpha enhancements layer. This reduction is being achieved due to the combination of the different signals in the alpha model, some of which tilt away from more carbon intensive stocks.

For example, some of the reduction comes from our carbon alpha signals, which look at carbon intensity as a proxy for a firm's productivity - and so better firms have lower carbon intensity. Although at present we are currently reducing carbon exposure by just using the current alpha scores, this cannot be guaranteed to always occur, so we need a guardrail on carbon to make sure that we maintain this reduction and meet our net zero commitments.

A summary of the return and risk results for the Global ACWI Universe ex Australia for the period Jan 2012 to Jun 2022 is in Table 3 Panel A below (note again all results are versus the Core portfolio).

		Jan-2012 to Jun-2022									
		Scenarios									
	Core Portfolio	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Total Risk	11.22%	11.17%	11.17%	11.17%	11.16%	11.15%	11.13%	11.11%	11.09%	11.10%	11.16%
Total Return (p.a.)	12.77%	13.81%	13.81%	13.81%	13.81%	13.83%	13.87%	13.91%	13.94%	13.89%	12.97%
Sharpe Ratio	1.14	1.23	1.23	1.23	1.23	1.23	1.24	1.24	1.25	1.24	1.13
Active Risk		0.74%	0.74%	0.74%	0.73%	0.73%	0.73%	0.73%	0.76%	0.77%	1.09%
Active Return (p.a.)		1.04%	1.04%	1.04%	1.04%	1.06%	1.10%	1.14%	1.17%	1.12%	0.20%
IR		1.27	1.27	1.27	1.28	1.31	1.36	1.41	1.39	1.23	-0.13
Avg Turnover (1-way)	13.97%	24.62%	24.62%	24.63%	24.65%	24.69%	24.69%	24.86%	25.63%	35.54%	55.76%
Avg Num Stocks	1717	707	707	708	708	708	707	708	713	749	731
Avg Yield (p.a.)	3.08%	3.32%	3.32%	3.32%	3.31%	3.31%	3.31%	3.30%	3.27%	3.19%	3.01%
Hit Rate		58.4	58.4	58.4	59.2	60.8	64	63.2	63.2	66.4	47.2
Worst Period Active		-0.54%	-0.54%	-0.54%	-0.53%	-0.52%	-0.50%	-0.49%	-0.44%	-0.61%	-0.99%
Worst 12m Active		-0.43%	-0.43%	-0.43%	-0.41%	-0.37%	-0.28%	-0.32%	-0.36%	-1.03%	-3.34%
Worst Active Drawdown		-0.87%	-0.87%	-0.85%	-0.87%	-0.84%	-0.74%	-0.70%	-0.91%	-0.91%	-2.93%
Worst Drawdown	-17.23%	-16.45%	-16.45%	-16.45%	-16.44%	-16.39%	-16.33%	-16.21%	-16.04%	-16.09%	-17.07%
Beta		0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Table 3: Panel A: Carbon reduction against Core (full sample Jan 2012 – Jun 2022) in the global portfolio

When we look at these results, we can see that for moderate reductions in carbon intensity, the portfolio maintains its characteristics in relation to active risk and return. It is only when we move to an 80 or 90 percent reduction that we see the Information Ratio (IR) start to fall off and does so significantly for a 90% reduction. The reason is that for 80% and 90% reductions, it is difficult to simultaneously limit the carbon intensity and satisfy the other constraints in our process (such as sector and security limits), with the result that the final portfolio largely fails to align to our alpha model (alpha exposure averages 0.68 unconstrained, 0.67 at a 50% reduction, but 0.52 and 0.19 at 80% and 90% reductions).

As we saw above, given the current tilt away from carbon exposed stocks in the portfolio, this can help explain why at low levels of carbon reduction we are not seeing much change in the performance of the portfolio.

These results differ depending on the time period we consider. See Table 3 Panel B below. If we look at the last two years, when there has been a large outperformance from fossil-fuel related stocks, we see the degradation in performance starting at a lower level of carbon reduction with performance starting to be impacted after a 50% reduction. This is an entirely expected outcome given the recent outperformance of more carbon intensive stocks and the performance reduction is still relatively modest until the 90% reduction.

2 Years to Jun-2022											
		Scenarios									
	Core Portfolio	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Total Risk	11.57%	11.92%	11.92%	11.92%	11.91%	11.88%	11.85%	11.80%	11.78%	11.70%	11.53%
Total Return (p.a.)	14.56%	15.10%	15.10%	15.11%	15.09%	15.09%	15.10%	15.05%	14.86%	14.87%	13.88%
Sharpe Ratio	1.26	1.26	1.26	1.26	1.26	1.26	1.27	1.27	1.25	1.26	1.17
Active Risk		0.88%	0.88%	0.88%	0.87%	0.85%	0.81%	0.77%	0.72%	0.66%	1.17%
Active Return (p.a.)		0.54%	0.54%	0.55%	0.53%	0.53%	0.54%	0.49%	0.30%	0.31%	-0.68%
IR		0.51	0.51	0.51	0.5	0.51	0.54	0.52	0.28	0.31	-0.89
Avg Turnover (1-way)	14.34%	22.75%	22.75%	22.74%	22.75%	22.74%	22.76%	22.81%	23.33%	24.65%	58.94%
Avg Num Stocks	1717	791	791	792	797	794	791	790	790	797	797
Avg Yield (p.a.)	3.01%	3.28%	3.28%	3.28%	3.27%	3.26%	3.25%	3.23%	3.17%	3.06%	2.83%
Hit Rate		58.33	58.33	58.33	58.33	58.33	58.33	45.83	50	54.17	41.67
Worst Period Active		-0.49%	-0.49%	-0.48%	-0.45%	-0.43%	-0.38%	-0.37%	-0.29%	-0.40%	-0.91%
Worst 12m Active		-0.10%	-0.10%	-0.08%	-0.10%	-0.09%	-0.04%	-0.02%	-0.23%	-0.01%	-2.21%
Worst Active Drawdown		-0.87%	-0.87%	-0.85%	-0.87%	-0.84%	-0.74%	-0.70%	-0.91%	-0.76%	-2.72%
Worst Drawdown	-16.14%	-15.00%	-15.00%	-15.00%	-14.97%	-14.92%	-14.85%	-14.76%	-14.66%	-14.91%	-15.63%
Beta		1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.01	0.99

Table 3: Panel B: Carbon reduction against Core (Jun 2020 – Jun 2022) in the global portfolio

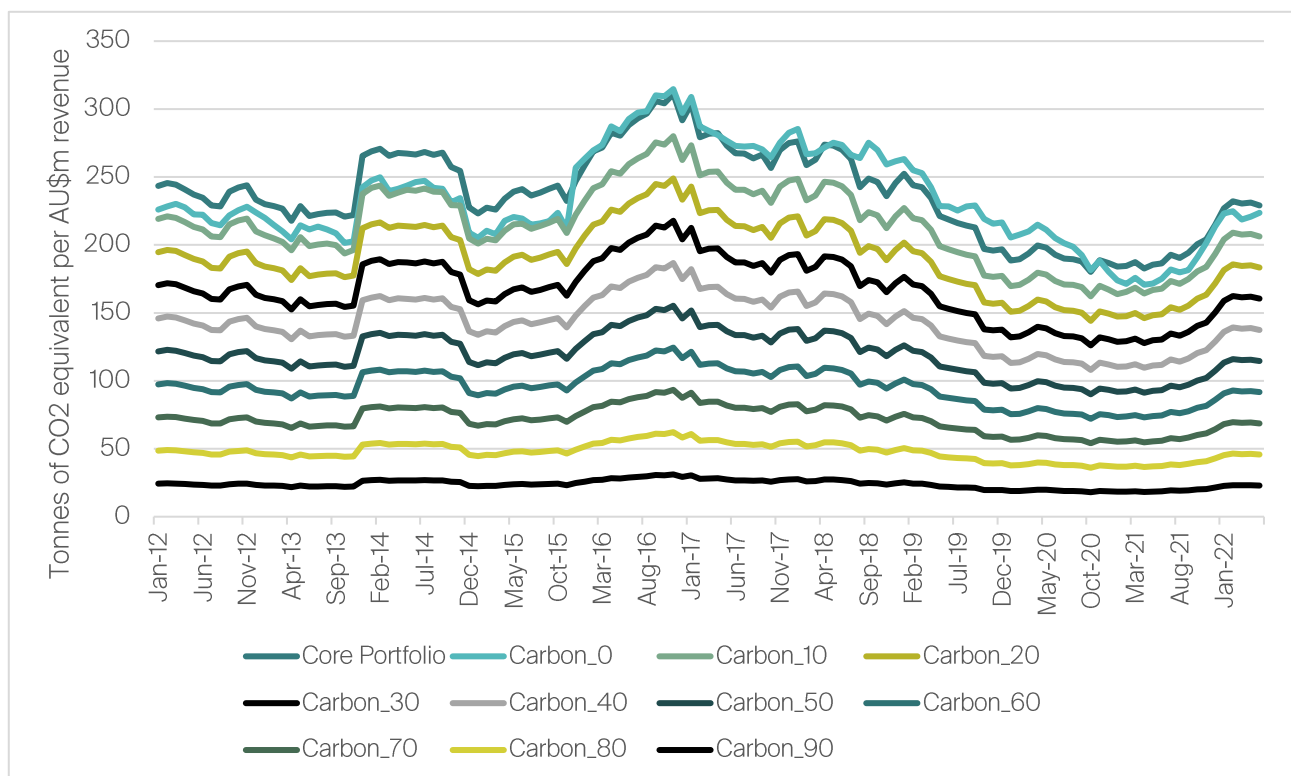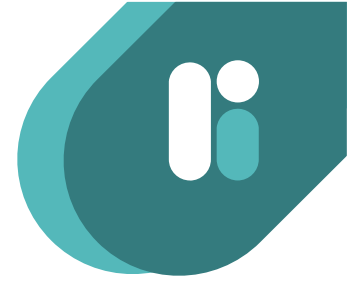The Australian portfolios show similar results to what we see globally, as per Chart 3 and Tables 4 and 5 below.

Chart 3: Carbon intensity over time in the Australian Portfolio (carbon reduction against core)

Jan-2012 to Jun-2022											
	Core Portfolio	**Carbon_0**	**Carbon_10**	**Carbon_20**	**Carbon_30**	**Carbon_40**	**Carbon_50**	**Carbon_60**	**Carbon_70**	**Carbon_80**	**Carbon_90**
Portfolio Average	238.38	234.57	214.30	190.71	166.86	143.01	119.18	95.35	71.51	47.68	23.84
Portfolio Median	238.41	225.55	214.04	190.74	166.92	143.02	119.21	95.39	71.53	47.68	23.84
Portfolio Min	180.16	170.71	162.17	144.14	126.10	108.03	90.09	72.07	54.05	36.03	18.02
Portfolio Max	311.15	314.70	280.06	248.96	217.82	186.72	155.26	124.47	93.36	62.23	31.12

Table 4: Summary of results in Chart 3 (carbon reduction against Core)

In the Australian context, without any imposed carbon reduction, we can see that the alpha layer of the portfolio (Carbon_0) is already reducing the carbon exposure of the portfolio relative to the 'Core Portfolio'. On average, we have a value of 238.38 in the 'Core Portfolio' reduced to 234.57 in the 'Carbon_0' portfolio (approximately a 1.6% reduction) simply by applying the alpha enhancements layer. This is smaller than what we saw in the global portfolios due to the more concentrated nature of the universe.

A summary of the return and risk results for the Australian Large Universe for the period Jan 2012 to Jun 2022 is in Table 5 Panel A below.

Jan-2012 to Jun-2022											
Scenarios											
	Core Portfolio	**Carbon_0**	**Carbon_10**	**Carbon_20**	**Carbon_30**	**Carbon_40**	**Carbon_50**	**Carbon_60**	**Carbon_70**	**Carbon_80**	**Carbon_90**
Total Risk	14.00%	13.97%	13.98%	13.99%	13.99%	13.95%	13.94%	14.04%	14.07%	14.06%	14.86%
Total Return (p.a.)	10.24%	10.89%	10.92%	10.96%	11.00%	11.06%	11.19%	11.12%	11.26%	11.85%	10.90%
Sharpe Ratio	0.73	0.77	0.78	0.78	0.79	0.79	0.80	0.79	0.80	0.84	0.73
Active Risk		0.99%	1.01%	1.01%	1.02%	1.01%	1.13%	1.45%	1.70%	2.28%	3.84%
Active Return (p.a.)		0.65%	0.68%	0.72%	0.76%	0.83%	0.95%	0.88%	1.03%	1.61%	0.66%
IR		0.46	0.67	0.71	0.75	0.82	0.84	0.61	0.61	0.71	0.17
Avg Turnover (1-way)	10.91%	26.34%	26.52%	26.57%	26.54%	27.13%	38.74%	41.09%	44.78%	45.49%	54.04%
Avg Num Stocks	216	141	142	144	145	147	146	126	107	88	79
Avg Yield (p.a.)	4.63%	4.69%	4.69%	4.68%	4.67%	4.67%	4.76%	4.76%	4.73%	4.71%	4.46%
Hit Rate		58.4	57.6	59.2	60	56.8	56.8	53.6	56	54.4	52.8
Worst Period Active		-0.60%	-0.61%	-0.64%	-0.65%	-0.65%	-0.99%	-1.33%	-1.50%	-1.89%	-3.01%
Worst 12m Active		-1.38%	-1.54%	-1.72%	-1.83%	-1.98%	-2.01%	-2.35%	-3.02%	-4.18%	-9.38%
Worst Active Drawdown		-2.12%	-1.99%	-1.82%	-1.96%	-2.14%	-2.14%	-2.79%	-3.45%	-4.65%	-8.94%
Worst Drawdown	-28.76%	-28.35%	-28.35%	-28.37%	-28.33%	-28.13%	-28.01%	-28.08%	-28.08%	-27.70%	-28.32%
Beta		1	1	1	1	0.99	0.99	1	1	0.99	1.03

Table 5: Panel A: Carbon reduction against Core (full sample Jan 2012 – Jun 2022) in the Australia portfolio

When we look at these results we can see that for moderate reductions in carbon intensity, the portfolio maintains its characteristics in relation to active risk and return. It is only when we move to an 80 or 90 percent reduction that we see the active risk start to increase significantly, from 1% to around 3.8%. Returns throughout the time period and across different levels of reductions hold up reasonably well.

As we saw above, given the current tilt away from carbon exposed stocks in the portfolio, this can help explain why at low levels of carbon reduction we are not seeing much change in the performance of the portfolio.

These results differ depending on the time period we consider. See Table 5 Panel B below. If we look at the last two years, where there has been a large outperformance from carbon stocks, we see the degradation in performance starting at a lower level of carbon reduction with performance starting to be impacted after a 50% reduction, again

very marginally until a 90% reduction. This is an entirely expected outcome given the recent outperformance of more carbon intensive stocks.
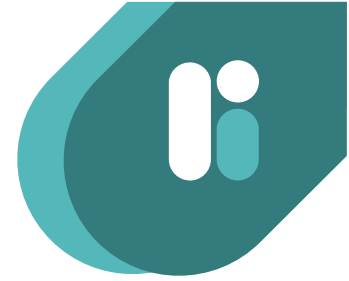
		Scenarios									
		2 years to Jun-2022									
	Core Portfolio	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Total Risk	14.34%	14.25%	14.26%	14.26%	14.25%	14.24%	14.34%	14.44%	14.35%	14.62%	16.22%
Total Return (p.a.)	14.39%	13.72%	13.82%	13.95%	14.12%	14.20%	14.33%	14.98%	14.81%	15.05%	14.06%
Sharpe Ratio	1	0.95	0.95	0.96	0.98	0.98	0.98	1.01	0.99	0.98	0.82
Active Risk		0.86%	0.91%	0.99%	1.07%	1.20%	1.28%	1.52%	1.85%	2.67%	4.63%
Active Return (p.a.)		-0.66%	-0.56%	-0.43%	-0.26%	-0.19%	-0.05%	0.60%	0.42%	0.66%	-0.32%
IR		-1.01	-0.85	-0.65	-0.44	-0.33	-0.27	0.1	-0.11	-0.01	-0.24
Avg Turnover (1-way)	14.42%	27.17%	27.18%	27.13%	27.27%	27.86%	34.95%	46.07%	58.63%	56.88%	61.79%
Avg Num Stocks	224	156	157	158	160	163	170	152	125	92	81
Avg Yield (p.a.)	4.22%	4.38%	4.38%	4.37%	4.35%	4.32%	4.25%	4.14%	4.11%	4.01%	3.56%
Hit Rate		41.67	41.67	45.83	45.83	45.83	50	54.17	54.17	50	45.83
Worst Period Active		-0.55%	-0.53%	-0.47%	-0.54%	-0.65%	-0.90%	-1.14%	-1.25%	-1.65%	-2.74%
Worst 12m Active		-1.38%	-1.54%	-1.72%	-1.83%	-1.98%	-2.01%	-1.55%	-2.15%	-1.73%	-3.13%
Worst Active Drawdown		-2.12%	-1.99%	-1.82%	-1.96%	-2.14%	-2.14%	-1.80%	-2.50%	-2.78%	-4.38%
Worst Drawdown	-18.12%	-17.54%	-17.36%	-17.26%	-17.11%	-16.85%	-16.60%	-16.20%	-16.19%	-14.96%	-17.07%
Beta		0.99	0.99	0.99	0.99	0.99	1	1	0.99	1	1.09

Table 5: Panel B: Carbon reduction against Core (Jun 2020 – Jun 2022) in the Australian portfolio

Why do we get these results?

As we saw above, carbon emissions is concentrated in a small number of industries. As we achieve the carbon intensity reduction through portfolio construction, rather than a targeted removal or exclusion of stocks, we see that the active weights to industries also remain relatively constant, even as the level of reduction increases.

Tables 6 and 7 below shows the active weights of the carbon reduced portfolios relative to the market cap benchmark for the global and Australian portfolios respectively. The first column shows the current portfolio without any carbon reductions ('Carbon_0') as above. In the global portfolios, it is overweight banks and energy and underweight software, biotech and media. Whilst in the Australian portfolios it is overweight materials, energy, food & staples retailing, telecommunications, capital goods and utilities, and underweight banks, pharmaceuticals, real estate and healthcare relative to the cap-weighted benchmark. As the level of carbon reduction increases, these active weights do not vary greatly - showing that the carbon reduction is being achieved across the total portfolio rather than focused on a specific sector. We do find that as the carbon reduction reaches over 70%, the active weights to carbon intense industries (e.g., energy) do show more significant changes.

Jan-2012 to Jun-2022

	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Automobiles & Components	-0.05%	-0.05%	-0.05%	-0.04%	-0.04%	-0.02%	0.02%	0.11%	0.08%	-0.08%
Banks	1.04%	1.04%	1.04%	1.06%	1.07%	1.11%	1.20%	1.35%	1.42%	1.03%
Capital Goods	0.27%	0.27%	0.28%	0.33%	0.40%	0.51%	0.77%	1.23%	1.20%	0.39%
Commercial & Professional Services	0.35%	0.35%	0.35%	0.36%	0.35%	0.35%	0.35%	0.37%	0.35%	0.59%
Consumer Durables & Apparel	-0.40%	-0.40%	-0.39%	-0.39%	-0.38%	-0.36%	-0.33%	-0.24%	0.02%	0.82%
Consumer Services	-0.30%	-0.30%	-0.30%	-0.29%	-0.28%	-0.27%	-0.26%	-0.23%	-0.26%	-0.37%
Diversified Financials	-0.52%	-0.52%	-0.51%	-0.52%	-0.53%	-0.56%	-0.68%	-0.81%	-0.97%	-1.41%
Energy	0.39%	0.39%	0.39%	0.38%	0.37%	0.35%	0.25%	-0.14%	-0.46%	-0.48%
Food & Staples Retailing	-0.16%	-0.16%	-0.15%	-0.15%	-0.15%	-0.16%	-0.14%	-0.08%	0.12%	0.46%
Food, Beverage & Tobacco	-1.36%	-1.36%	-1.36%	-1.35%	-1.33%	-1.32%	-1.31%	-1.33%	-1.47%	-1.65%
Health Care Equipment & Services	-0.46%	-0.46%	-0.46%	-0.45%	-0.43%	-0.41%	-0.35%	-0.19%	0.09%	0.73%
Household & Personal Products	1.07%	1.07%	1.06%	1.06%	1.05%	1.04%	1.02%	0.99%	0.91%	0.69%
Insurance	-0.08%	-0.08%	-0.07%	-0.07%	-0.06%	-0.06%	-0.03%	-0.04%	0.07%	0.86%
Materials	0.30%	0.30%	0.28%	0.26%	0.24%	0.19%	-0.02%	-0.38%	-0.43%	-0.48%
Media & Entertainment	-0.07%	-0.07%	-0.07%	-0.07%	-0.07%	-0.07%	-0.07%	-0.02%	0.13%	1.05%
Missing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Pharmaceuticals, Biotechnology & Life Sciences	0.10%	0.10%	0.10%	0.10%	0.09%	0.09%	0.08%	0.11%	0.08%	-0.23%
Real Estate	0.31%	0.31%	0.31%	0.35%	0.38%	0.39%	0.42%	0.44%	0.42%	0.41%
Retailing	0.34%	0.34%	0.34%	0.34%	0.34%	0.33%	0.32%	0.34%	0.25%	-0.20%
Semiconductors & Semiconductor Equipment	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.14%	-0.18%	-0.26%	-0.36%	-0.29%
Software & Services	0.43%	0.43%	0.44%	0.45%	0.46%	0.47%	0.50%	0.56%	0.58%	0.65%
Technology Hardware & Equipment	-0.05%	-0.05%	-0.05%	-0.05%	-0.04%	-0.01%	0.04%	0.09%	0.22%	0.11%
Telecommunication Services	-0.30%	-0.30%	-0.29%	-0.28%	-0.26%	-0.25%	-0.21%	-0.12%	-0.05%	-0.68%
Transportation	-0.55%	-0.55%	-0.56%	-0.57%	-0.61%	-0.71%	-0.91%	-1.26%	-1.43%	-1.43%
Utilities	-0.19%	-0.19%	-0.22%	-0.33%	-0.43%	-0.48%	-0.50%	-0.50%	-0.50%	-0.49%

Table 6: Industry active weight changes due to carbon reduction against Core in the global portfolio

	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Automobiles & Components	-0.04%	-0.04%	-0.04%	-0.04%	-0.05%	-0.04%	0.00%	0.10%	0.12%	0.18%
Banks	-1.14%	-1.12%	-1.05%	-0.94%	-0.75%	-0.44%	-0.29%	-0.26%	-0.29%	-1.01%
Capital Goods	1.40%	1.42%	1.48%	1.56%	1.67%	1.54%	1.37%	1.44%	1.95%	2.25%
Commercial & Professional Services	0.51%	0.54%	0.56%	0.59%	0.62%	0.49%	0.57%	0.66%	0.85%	0.88%
Consumer Durables & Apparel	0.03%	0.04%	0.04%	0.04%	0.06%	0.07%	0.01%	0.01%	0.01%	0.08%
Consumer Services	-0.71%	-0.71%	-0.70%	-0.70%	-0.75%	-0.70%	-0.47%	-0.55%	-0.71%	-0.66%
Diversified Financials	-0.76%	-0.74%	-0.69%	-0.59%	-0.43%	-0.47%	-0.47%	-0.58%	-0.53%	0.19%
Energy	1.39%	1.35%	1.21%	1.00%	0.84%	0.64%	0.43%	0.22%	0.17%	0.16%
Food & Staples Retailing	1.65%	1.66%	1.69%	1.71%	1.74%	1.66%	1.31%	1.06%	0.81%	0.86%
Food, Beverage & Tobacco	-0.16%	-0.15%	-0.13%	-0.11%	-0.13%	-0.21%	-0.49%	-0.59%	-0.71%	-0.53%
Health Care Equipment & Services	-1.17%	-1.14%	-1.08%	-1.01%	-0.91%	-0.49%	-0.16%	0.07%	0.24%	0.18%
Household & Personal Products	-0.09%	-0.09%	-0.09%	-0.09%	-0.09%	-0.09%	-0.05%	-0.01%	0.16%	0.23%
Insurance	0.62%	0.65%	0.69%	0.75%	0.86%	1.04%	1.06%	1.13%	1.11%	1.14%
Materials	1.20%	1.15%	1.05%	0.81%	0.24%	-0.05%	-0.08%	-0.07%	-0.09%	-0.70%
Media & Entertainment	-0.09%	-0.07%	-0.03%	0.02%	0.09%	0.42%	0.60%	0.76%	0.92%	0.96%
Pharmaceuticals, Biotechnology & Life Sciences	-2.96%	-2.94%	-2.92%	-2.91%	-2.90%	-3.11%	-3.31%	-3.34%	-3.77%	-3.73%
Real Estate	-1.23%	-1.18%	-1.11%	-1.04%	-1.02%	-1.36%	-1.52%	-1.58%	-2.10%	-2.17%
Retailing	0.98%	1.00%	1.03%	1.06%	1.11%	1.10%	1.07%	1.14%	1.67%	1.55%
Semiconductors & Semiconductor Equipment	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%
Software & Services	-1.46%	-1.45%	-1.43%	-1.38%	-1.27%	-0.99%	-0.78%	-0.58%	-0.39%	-0.60%
Technology Hardware & Equipment	-0.02%	-0.02%	-0.02%	-0.01%	-0.01%	0.01%	0.02%	0.03%	0.04%	0.25%
Telecommunication Services	1.61%	1.64%	1.68%	1.72%	1.76%	1.54%	1.53%	1.47%	1.31%	1.17%
Transportation	-0.58%	-0.59%	-0.60%	-0.64%	-0.78%	-0.63%	-0.42%	-0.47%	-0.69%	-0.82%
Utilities	1.04%	0.81%	0.47%	0.21%	0.11%	0.09%	0.10%	-0.04%	-0.07%	0.14%

Table 7: Industry active weight changes due to carbon reduction against Core in the Australian portfolio

This is similar to the results we found in our earlier paper 'Carbon Reduction Impact on Indices and Portfolios: Better news than you think', which showed that the carbon reduction was not achieved via large rotation from sectors but from stock selection within sectors. By rotating to another stock with a similar alpha and risk profile but with a lower carbon exposure, a similar overall return could be achieved whilst reducing the carbon exposure.

The relationship between Core Value factor exposure and carbon intensity is such that dropping high carbon intensity stocks, in favour of lower carbon intensity, has little effect on portfolio alpha. If, for example, we build an optimal portfolio, and then drop the top 10 highest carbon intensity stocks in favour of the next best 10 alpha stocks, carbon intensity drops sharply but alpha exposure hardly moves at all.

Chart A below shows the scatterplot of alphas – blue markers are included stocks, grey is excluded stocks, red crosses are the 10 dropped high carbon intensity stocks and green pluses are the 10 next best alpha stocks that are added. Note the log scale for carbon intensity. Table B shows that carbon intensity drops sharply but alpha exposure drops but only a small amount.
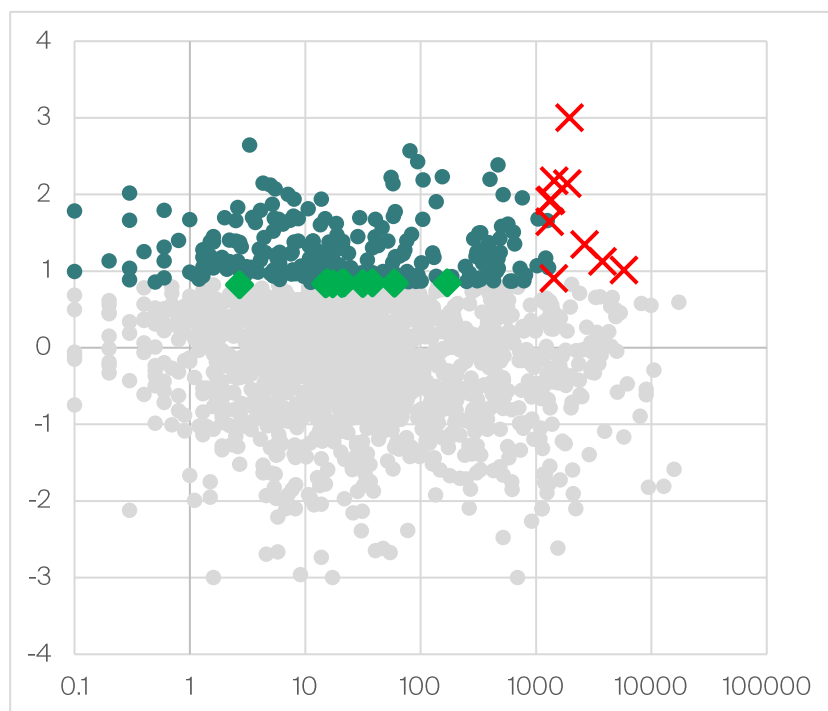

Chart A: Scatterplot of stocks: Alpha against carbon intensity Global (ex-Aus) Accounting Weighted Universe, Dec 2022

Dark green dots – 250 included stocks.
Grey dots - excluded stocks.
Red crosses - 10 dropped high carbon intensity stocks.
Green diamonds - 10 added "next best" alpha stocks.

	Average alpha	Average carbon intensity
Starting portfolio	1.282	207.4
"Switched" portfolio	1.246	117.4

Table B: Alpha and carbon intensity change after 10 stock switch

What about the Value Characteristics?

Given the higher correlation of carbon stocks to Value characteristics, we wanted to make sure that there was no impact to the characteristics of the portfolio especially in relation to its Value characteristics. In Tables 8 and 9 below, we have a number of common Value factors and their exposures in the different back-tested global and Australian portfolios.

Ave Exposure	Core Portfolio	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Book Yield	0.708	0.654	0.654	0.654	0.654	0.653	0.652	0.653	0.655	0.665	0.685
Dividend Yield	0.029	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.028
Earnings Yield	0.059	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.065	0.060
Cash Flow Yield	0.148	0.155	0.155	0.155	0.155	0.154	0.154	0.153	0.151	0.148	0.139

Table 8: Value metrics within carbon reduced global portfolios (carbon reduction against Core)

Ave Exposure	Core Portfolio	Carbon_0	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Book Yield	0.596	0.550	0.549	0.549	0.550	0.553	0.566	0.571	0.568	0.570	0.591
Dividend Yield	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.042
Earnings Yield	0.042	0.046	0.046	0.045	0.045	0.045	0.045	0.045	0.044	0.042	0.032
Cash Flow Yield	0.101	0.103	0.103	0.102	0.102	0.100	0.098	0.096	0.095	0.094	0.090

Table 9: Value metrics within carbon reduced Australian portfolios (carbon reduction against Core)

For all portfolios up to an 80% carbon reduction, there is no noticeable difference in the exposures across all the Value measures.

By implementing the carbon reduction as part of the combined portfolio construction process we have been able to achieve carbon reduction across the portfolio whilst maintaining the Value characteristics and achieving similar return and risk profiles. This has been achieved as our enhancement layer is already drawing us away from high carbon stocks and we have reduced carbon across the whole portfolio rather than a focused reduction which would lead to additional risk and tracking error.

Practical Application to Realindex Portfolios

The analysis above showed that we could achieve a carbon reduction in our Value portfolios whilst still maintaining the same Value, risk and return characteristics that our clients expect. Based on this analysis we have set a 2025 target to reduce our carbon intensity of the portfolio by 30%, relative to the carbon intensity of the portfolio *at a fixed point in time - 30 June 2020*. So, when we talk about *implementing* carbon reduction, it is not in relation to the core portfolio, but rather an absolute limit for the total holdings of the portfolio (which is the combined core and enhancement/alpha layer).

The date of 30 June 2020 was chosen as it was the end of the previous financial year when we initially started looking at the carbon reduction in our portfolio and our potential future net zero commitments. At that date, the carbon intensity of the global strategy was 255.2 tonnes of CO_2 equivalent per million US dollars of sales revenue.

We have run a number of backtests to look at the carbon reduction of the portfolio from this fixed point in time. These are for the period July 2020 to Dec 2022.

Chart 3 below shows the carbon intensity over the last 2.5 year period for the global portfolio. As noted above, the value of carbon intensity at that time was 255.2 – this is our anchor point, so our carbon reductions are relative to that. For example, the portfolio with a carbon reduction of 10% can, at any time, have a maximum carbon intensity of 229.68.

Throughout this period, the current portfolio was already reducing its carbon exposure and has for the last 2 year period remained at least 10% below the anchor point. Hence, we see a strong similarity between the results for the current baseline backtest and the 10% reduction portfolio.

Likewise, the 20% reduction portfolio can have a maximum carbon intensity of 204.16 at any point in time. We can again see that the current portfolio was at these levels of reduction by March 2021 and hence we can see the similarities between the current portfolio and the one required to achieve the 20% reduction. As these levels of reduction are already been achieved (via the current alphas), these constraints are not binding. For larger levels of carbon reduction, e.g. 40% and over, the carbon exposure is fairly constant over time as the constraint is binding throughout the period.
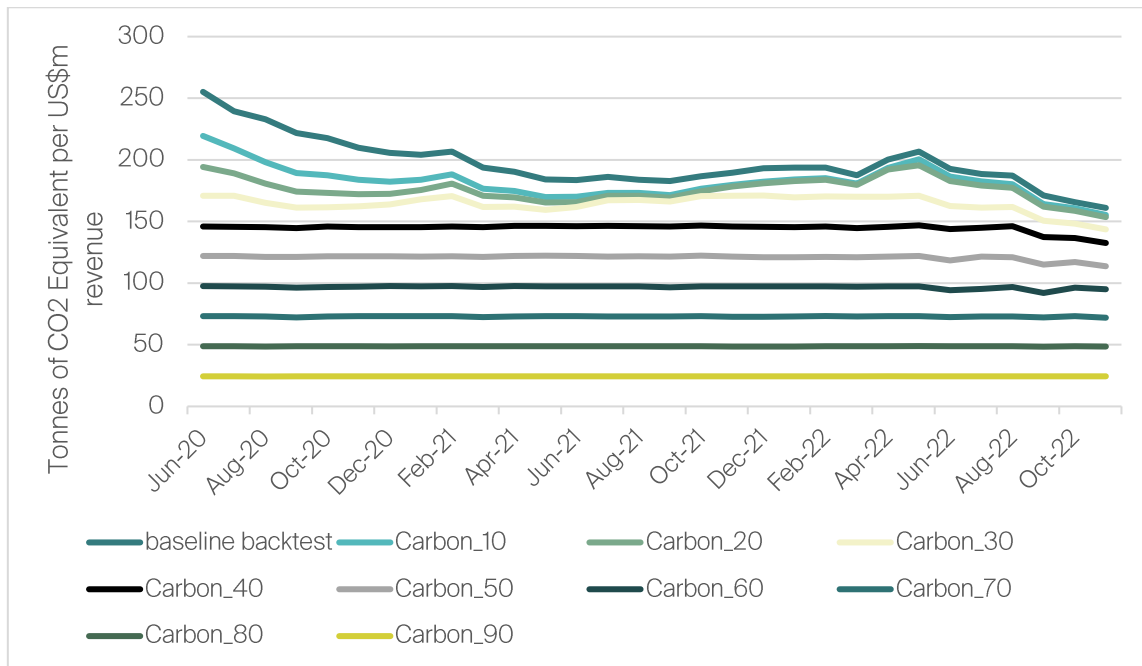
Chart 3: Carbon intensity of various carbon reduced Global portfolios since June 2020

As we saw above, the baseline backtest was looking to reduce carbon intensity over this time period which means that we find very little difference in the performance statistics for these low levels of carbon reduction. Over this short time period even for reductions up to 50% we see very little difference in risk and return characteristics.

Jun-2020 to Dec-2022										
	baseline backtest	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Total Risk	12.59%	12.59%	12.59%	12.59%	12.58%	12.57%	12.54%	12.49%	12.39%	12.04%
Total Return (p.a.)	15.32%	15.33%	15.34%	15.35%	15.34%	15.33%	15.35%	15.37%	15.33%	15.05%
Sharpe Ratio	1.2	1.21	1.21	1.21	1.21	1.21	1.21	1.22	1.22	1.23
Active Risk	6.28%	6.28%	6.27%	6.27%	6.26%	6.25%	6.25%	6.25%	6.24%	6.15%
Active Return (p.a.)	6.69%	6.70%	6.71%	6.72%	6.71%	6.71%	6.72%	6.75%	6.70%	6.43%
IR	1.04	1.04	1.04	1.05	1.05	1.05	1.05	1.06	1.05	1
Avg Turnover (1-way)	34.25%	34.26%	34.26%	34.29%	34.27%	34.18%	34.07%	34.14%	34.15%	56.73%
Avg Num Stocks	713	712	711	712	708	706	702	699	693	734
Avg Yield (p.a.)	3.39%	3.38%	3.38%	3.38%	3.38%	3.36%	3.35%	3.30%	3.17%	2.87%
Hit Rate	56.67	56.67	56.67	56.67	56.67	56.67	56.67	56.67	56.67	63.33
Worst Period Active	-2.34%	-2.35%	-2.35%	-2.36%	-2.36%	-2.36%	-2.38%	-2.40%	-2.53%	-2.84%
Worst 12m Active	0.99%	0.99%	0.98%	0.97%	0.95%	0.91%	0.94%	0.86%	0.56%	0.74%
Worst Active Drawdown	-4.80%	-4.82%	-4.82%	-4.82%	-4.82%	-4.85%	-4.88%	-4.91%	-5.03%	-5.33%
Worst Drawdown	-13.37%	-13.35%	-13.36%	-13.37%	-13.39%	-13.36%	-13.28%	-13.15%	-12.99%	-12.76%
Beta	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.93	0.93	0.9

Table 10: Carbon reduction against a fixed point in time in the global portfolio

We finally also consider the exposure to the Value composite of the portfolio with the different levels of carbon reduction in Table 11 below.

	baseline backtest	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Portfolio Average	0.228	0.226	0.226	0.224	0.221	0.217	0.212	0.202	0.184	0.067
Portfolio Median	0.225	0.224	0.223	0.222	0.218	0.213	0.207	0.198	0.179	0.075
Portfolio Min	0.153	0.153	0.153	0.151	0.148	0.143	0.138	0.125	0.101	-0.067
Portfolio Max	0.336	0.335	0.334	0.333	0.331	0.327	0.323	0.320	0.305	0.164

Table 11: Portfolio Value Exposure through time in the global portfolio

This confirms what we saw in the previous backtests: that at the low-medium levels of carbon reduction (up to 40%) we see very little difference in the Value characteristics of the strategy.

The results for the Australian portfolios are below. Chart 5 below shows the carbon intensity over the last 2.5 year period. As noted above, the carbon intensity at that time was 194.6[9] – this is our anchor point, so our carbon reductions are relative to that. For example, the portfolio with a carbon reduction of 10% can at any time have a maximum carbon intensity of 175.14. Whilst for the first 18 months the portfolio was below this baseline level without any additional carbon constraints, due to the strong performance of carbon intensive stocks in Australia more recently and the smaller universe, this has resulted in the baseline model actually increasing its carbon intensity over time. Hence throughout all of the time period the carbon reductions of 20 percent or more were binding on the portfolio. This is in contrast to the global portfolios and is a result of the limited stocks within the universe.

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[9] For carbon intensity in the Australian portfolios, we have converted the sales from USD to AUD, based on the exchange rate at the end of each firm's fiscal year.
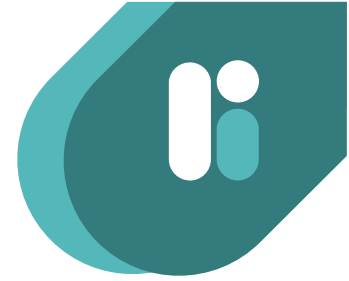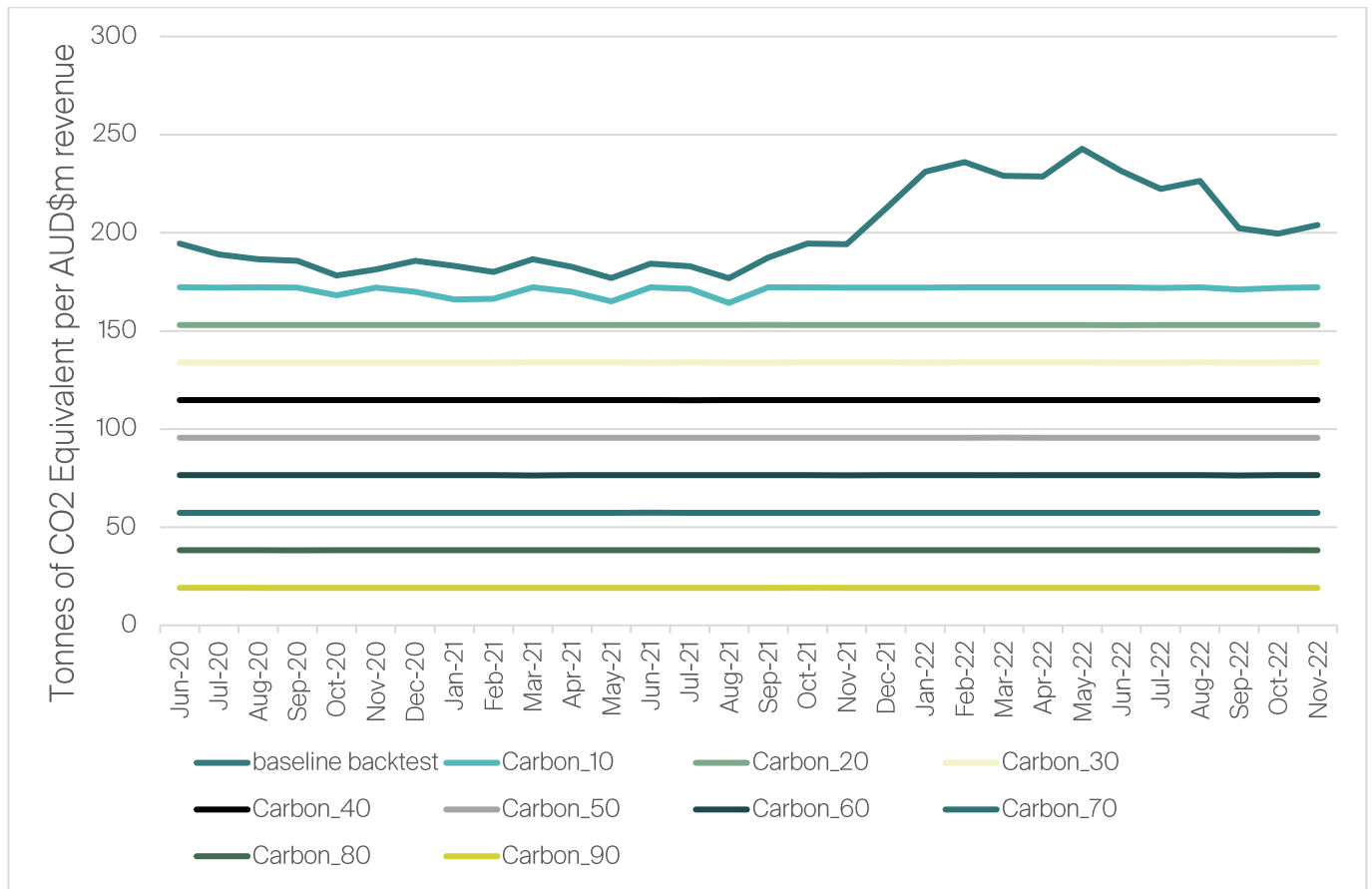
Chart 5: Carbon intensity of various carbon reduced Australian portfolios since June 2020

Whilst it was observed above that the carbon reduction was binding on the portfolio we find that the overall risk and return results are similar. Although risk starts to slightly increase if we have a carbon reduction of over 50%, at the same time we have seen an improvement in returns. For reductions of up to 30% we find that active risk and returns are comparable to the current baseline backtest.

Jun-2020 to Dec-2022										
	baseline backtest	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Total Risk	14.70%	14.66%	14.63%	14.66%	14.73%	14.75%	14.79%	14.78%	15.18%	16.94%
Total Return (p.a.)	16.30%	16.23%	16.20%	16.15%	16.22%	16.58%	17.34%	17.28%	16.70%	15.88%
Sharpe Ratio	1.1	1.1	1.1	1.09	1.09	1.11	1.15	1.15	1.08	0.92
Active Risk	0.84%	0.93%	0.94%	0.95%	1.04%	1.17%	1.49%	1.66%	2.48%	4.83%
Active Return (p.a.)	-0.32%	-0.40%	-0.42%	-0.47%	-0.40%	-0.04%	0.72%	0.66%	0.08%	-0.74%
IR	-0.38	-0.43	-0.45	-0.49	-0.38	-0.03	0.48	0.40	0.03	-0.15
Avg Turnover (1-way)	31.44%	31.67%	33.25%	41.24%	46.42%	48.87%	56.67%	60.72%	68.27%	71.27%
Avg Num Stocks	151	153	155	158	160	161	147	118	89	79
Avg Yield (p.a.)	4.69%	4.68%	4.65%	4.62%	4.55%	4.50%	4.41%	4.39%	4.31%	3.86%
Hit Rate	40	40	40	36.67	50	56.67	63.33	50	46.67	50
Worst Period Active	-0.51%	-0.50%	-0.58%	-0.66%	-0.79%	-0.89%	-1.12%	-1.21%	-1.29%	-2.59%
Worst 12m Active	-1.50%	-1.99%	-2.12%	-2.45%	-2.30%	-2.33%	-2.13%	-2.24%	-3.33%	-7.15%
Worst Active Drawdown	-1.83%	-2.12%	-2.10%	-2.42%	-2.46%	-2.32%	-2.20%	-2.22%	-3.62%	-6.59%
Worst Drawdown	-10.67%	-10.62%	-10.64%	-10.71%	-10.88%	-10.74%	-10.74%	-10.99%	-11.84%	-14.54%
Correlation	1	1	1	1	1	1	0.99	0.99	0.99	0.96
Beta	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.01	1.1

Table 12: Carbon reduction against a fixed point in time in the Australian portfolio

We finally also consider the exposure to Value in the portfolio with the different levels of carbon reduction in Table 13 below.

	baseline backtest	Carbon_10	Carbon_20	Carbon_30	Carbon_40	Carbon_50	Carbon_60	Carbon_70	Carbon_80	Carbon_90
Portfolio Average	0.060	0.056	0.051	0.042	0.024	0.010	-0.009	-0.025	-0.033	-0.031
Portfolio Median	0.062	0.058	0.055	0.047	0.028	0.015	-0.004	-0.023	-0.028	-0.043
Portfolio Min	0.027	0.018	0.008	-0.010	-0.038	-0.043	-0.052	-0.093	-0.111	-0.134
Portfolio Max	0.096	0.084	0.078	0.070	0.066	0.060	0.023	0.039	0.022	0.092

Table 13: Portfolio Value Exposure through time in the Australian portfolio

This confirms what we saw in the previous backtests: that at the low-medium levels of carbon reduction (up to 30%) we see very little difference in the Value characteristics of the strategy.

How will Realindex implement the reduction?

Realindex has committed to reducing the level of carbon intensity relative to the 30 June 2020 baseline by 30% by December 2025 for our Value portfolios. Given this risk is less certain and harder to measure than some of the other common risk factors that have been identified, to deal with this we have taken a pathway approach. Rather than a step-change reduction that occurs at a point in time, we will gradually reduce the carbon exposure to achieve our stated targets. From the analysis above, we expect this to have very limited impact on the portfolio and the portfolio characteristics.

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