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Assessing the Circular Economy Funds: Performance, Fees, Risks, and Sustainability

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Abstract: We studied various fund investing options in the circular economy sector. We found that most circular economy mutual funds and exchange-traded funds charge higher fees and take higher risks than their benchmarks. However, they appear to have underperformed their benchmarks during their short existence so far. Most of these funds are rated as sustainable and low-carbon funds. Investors keen on circular economy startups may consider private equity/venture capital funds, but most of these funds are exclusive to institutional and accredited investors.

Keywords: circular economy; mutual funds; exchange-traded funds (ETFs); private equities; venture capitals; sustainable; low-carbon

1. Introduction

The circular economy (CE) model is evolving and gaining momentum globally. The description of the United Nations Environmental Assembly (UNEP/EA.4/Res.1) offers a common understanding of some of its fundamental principles. It presents the CE as “one of the current sustainable economic models, in which products and materials are designed in such a way that they can be reused, remanufactured, recycled or recovered (4-R) and thus maintained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste, especially hazardous waste, is avoided or minimized, and greenhouse gas emissions are prevented or reduced.”¹ In contrast, in a linear economy, a take–make–use–waste economy, resources are extracted to make products and thrown away after use, resulting in massive landfill issues.

As interest in the CE sector continues to grow, there is an increasing emphasis on financing these initiatives. However, private financial investments, which are crucial for a successful transition to the CE, still lag behind other sectors of sustainable finance. Over the past six years, only a handful of CE funds have been launched, mostly as part of larger sustainability funds.

This article presents an assessment of these newly founded CE funds. We studied their performance, fees, risks, and sustainability characteristics. Given the limited number of funds in our sample (five mutual funds, three ETFs, and seven venture capital funds and private equity funds), our analysis was exploratory and aimed at familiarizing investors with these new investment opportunities and providing insights rather than drawing conclusive statistical inferences. Additionally, our analysis is limited to the mutual funds and ETFs due to the unavailability of public data for venture capital funds and private equity funds.

The sustainable fund sector is relatively well-researched. For example, [Gil-Bazo et al. \(2010\)](#) and [Reddy et al. \(2017\)](#) found that ethical funds or socially responsible funds outperformed conventional funds. [Fang and Parida \(2022\)](#) found that highly sustainable mutual funds outperformed less sustainable ones, and the outperformance significantly increased during the COVID-19 pandemic-induced market crash and in the post-crash period. [Nofsinger and Varma \(2014\)](#) and [Dong et al. \(2019\)](#) found that high-CSR mutual



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funds underperformed during normal market conditions and outperformed during market crises. However, earlier researchers found no statistical difference in the performance between sustainable and conventional mutual funds (for example, [Hamilton et al. 1993](#); [Statman 2000](#); [Schroder 2004](#); [Bauer et al. 2005](#); [Renneboog et al. 2008](#)).

In contrast, the literature on CE financing is relatively limited. A few studies have investigated the financial barriers that hinder the transition to the CE. [Rizos et al. \(2016\)](#) found that medium-sized enterprises cited a lack of initial capital, limited financial opportunities, or a lack of alternatives to private funds and traditional bank financing as the primary barriers to the CE. [Ormazabal et al. \(2016, 2018\)](#) studied small and medium-sized enterprises in Basque Country and reported that the participating companies highlighted the lack of economic resources as a significant obstacle to the implementation of CE practices. [Gonçalves et al. \(2022\)](#) concluded that the initial investment costs are potential hindrances to the growth of the CE. [Abloulamer et al. \(2020\)](#) suggested that a mismatch between the circular business model cycle and investors' investment horizon could pose a challenge in securing more funds for the CE.

Other studies have focused on the development of private and public investments in forging a transition to CE. [Dewick et al. \(2020\)](#) provided an assessment of the commitment and progress made by policymakers, the financial industry, and other stakeholders in providing resources to facilitate the transition to a CE. [Ozili \(2021\)](#) presented an overview of the benefits of the CE to banks and other institutions. [Fang et al. \(2024\)](#) provided a practical overview and research directions for private financing in the CE.

However, to the best of our knowledge, no study has evaluated the CE investment options available to investors. Our study fills this gap by closely examining the recently founded CE funds.

In this study, we included funds that invest primarily in the CE. These funds offer investors opportunities to invest in the CE sector, focusing on initiatives such as recycling technologies, sustainable product design, and waste reduction. As of 2021, these funds collectively hold assets of around \$15 billion (see [Lawlor and Spratt \(2021\)](#)). Funds that invest in the CE alongside other areas were excluded from our analysis.²

The CE mutual funds in our sample generated a net return between -1.60% and 5.27% per annum over the 3 years ending December 2023 while assuming more risk than their benchmark portfolios (the beta of their portfolios ranged from 1.06 to 1.2). These resulted in high negative alphas (risk-adjusted returns) of -9.245% to -3.24% per annum. These and other risk measures, such as negative information ratios and low Sharpe ratios, indicate that the CE fund managers have underperformed the benchmarks during their short existence so far. However, the only ETF for which 3-year performance data are available outperformed its benchmark.

We found that the CE mutual funds and ETFs charge high fees. The four equity funds charge annual fees (expense ratios) of $0.93\text{--}1.94\%$, while the average annual fee for actively managed equity funds was 0.44% in 2022³. The expense ratio of the Anima CE Fund, the only bond mutual fund in our sample, was 1.36% , while the average expense ratio for actively managed bond mutual funds was 0.37% in 2022 (See Note 3). The expense ratios of the three ETFs ranged from $0.3\text{--}0.45\%$, while the average expense ratio for equity ETFs was 0.16% in 2022 (See Note 3).

Most of these CE funds are rated as sustainable and low-carbon funds by Morningstar; hence, they are expected to perform well during market crises and offer relief from climate transition risks.

Our study is the first to evaluate the performance of CE funds. We hope it encourages other researchers to pursue research questions regarding the poor performance of CE funds and the insufficiency of private financing in the CE sector as more data becomes available. Additionally, our study aimed to draw practitioners' attention to the risks and returns involved in CE investments, empowering them to make well-informed investment decisions.

The remainder of the article is organized as follows. Section 2 introduces the methodology and data. Section 3 discusses the key information, holdings, and sustainability ratings

of CE mutual funds and ETFs and compares and contrasts their fees, risk profiles, and performance where data are available. Section 4 briefly introduces CE private equity funds and venture capital funds. Section 5 concludes the article.

2. Methodology and Data

In this research, we studied five mutual funds, three ETFs, and seven venture capital funds and private equity funds that invest primarily in the CE.

We obtained key information on the mutual funds and ETFs' risk, return, and rating data from [ft.com](#) and [Morningstar.com](#), and information about venture capital and private equity funds from their official websites. Note that the information differed across fund types, as some of them are not applicable or available for all the fund types.⁴

The funds' risk-adjusted return, α , was estimated with respect to the benchmark (see [Sharpe 1964](#); [Lintner 1965](#); [Mossin 1966](#)), as in Equation (1). To obtain the 1-year α and β of Fund i , for example, the daily returns of the fund in the past year were regressed on the daily returns of the benchmark.

$$r_{i,t} = \alpha_i + \beta_i r_{b,t} + \varepsilon_{i,t} \quad (1)$$

where $r_{i,t}$ is the return of Fund i on Day t , and $r_{b,t}$ is the return of Benchmark b on Day t .

A fund's information ratio (IR), which is another measure of the risk-adjusted return of the fund against a certain benchmark (see [Treyner and Black 1973](#)), was calculated as the ratio of the difference in the return between the fund and the benchmark to the tracking error, which was measured as the standard deviation of the differences between the fund's returns and the benchmark's returns, as in Equation (2).

$$IR_i = \frac{\overline{r_{i,t} - r_{b,t}}}{\text{Tracking Error}_t} = \frac{\overline{r_{i,t} - r_{b,t}}}{\sqrt{\text{Var}[r_{i,t} - r_{b,t}]}} \quad (2)$$

where $r_{i,t}$ is the return of fund i on Day t , and $r_{b,t}$ is the return of Benchmark b on Day t .

As a measure of a fund's performance compared with a risk-free asset, a fund's Sharpe ratio was defined as the difference between the returns of the fund and the risk-free return, divided by the standard deviation of the fund's returns (see [Sharpe 1966](#)), as in Equation (3).

$$\text{Sharpe Ratio}_i = \frac{\overline{r_{i,t} - r_{f,t}}}{\sqrt{\text{Var}[r_{i,t} - r_{f,t}]}} \quad (3)$$

where $r_{i,t}$ is the return of Fund i on Day t , and $r_{f,t}$ is the return of risk-free Asset f on Day t .

We analyzed the funds' risk-adjusted performance using the α , information ratio, and Sharpe ratio, wherever they were available.

3. Discussion and Data Analysis

3.1. CE Mutual Funds

3.1.1. Key Information

CE mutual funds invest in companies pursuing circular business models as an alternative to the traditional linear economic model. We investigated five CE mutual funds: four equity funds and one bond fund.

BlackRock, the world's largest asset manager, launched the BlackRock Global Funds—Circular Economy Fund (BGF CE Fund) in October 2019 with \$20 million in seed capital. It is now the largest mutual fund in the CE, with \$1516 million in assets (as of 30 November 2023). The fund invests in large and growing stocks in all industry sectors that benefit from or contribute to the advancement of the CE (please see Table 1). Launched in April 2020, the Carndrim CE Fund invests primarily in the equities of mid-size companies worldwide that are involved in activities contributing to the recycling, replacement, repurposing,

and rationalization of products and resources. The Carndrim CE Fund has total assets of \$418 million under management (as of 30 November 2023).

Table 1. Key information: CE mutual funds.

Fund Name	Type	Inception Date	Domicile	Size (Millions)	Style	Morningstar Rating
BGF CE Fund	Equity	2 October 2019	Luxembourg	\$1516	Large, growth	★★★
Candriam CE Fund	Equity	27 April 2020	Luxembourg	\$418	Mid, blend	★★★★
RobecoSAM CE Fund	Equity	22 January 2020	Luxembourg	\$238	Mid, growth	★★★★★
Decalia CE Fund	Equity	30 May 2018	Luxembourg	\$43	Large, growth	★★
Anima CE Fund	Bond	2 January 2020	Italy	\$395	Large, blend	—

This table reports the key information for the five CE mutual funds, including BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund), where data are available. The funds' sizes are as of 30 November 2023. The Morningstar *Star* rating measures fund performance. It ranges from one to five stars, with five indicating the top financial performers.

RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund) was incorporated in Luxembourg in January 2020. It has \$238 million in assets (as of 30 November 2023) and invests globally in mid-size and growing companies that support the paradigm shift to the CE by fostering resource-efficient business models with regard to the production and consumption of goods. As one of the earliest equity funds dedicated to the CE, the Decalia Circular Economy Fund (Decalia CE Fund) was founded in May 2018 and invests in large and growing companies that stand to benefit from the transition to the CE. The size of the Decalia CE Fund is \$43 million (as of 30 November 2023), about one-tenth the size of the Candriam CE Fund.

Anima Investimento Circular Economy 2025 Fund (Anima CE Fund), a fixed-income mutual fund, was founded in January 2020 and has total assets of \$395 million (as of 30 November 2023).

The BGF CE Fund, Candriam CE Fund, and Decalia CE Fund have received either three or two stars as their Morningstar Star rating⁵, indicating average or below-average performance. RobecoSAM CE Fund was rated four stars (above-average performance) by Morningstar.

All five mutual funds discussed above are domiciled in Europe. As shown in Panel A of Table A1, Candriam Fund, RobecoSAM CE Fund, and Decalia Fund invest more than half their capital in the US, whereas the BGF Fund invests about 47% in the US. Anima CE Fund invests all over the world. The CE mutual funds invest most of their assets in industrial, technology, consumer cyclical, consumer defensive, and basic materials sectors, as shown in Panel A of Table A2. For the top 10 holdings of the CE mutual funds discussed above, please see Panel A of Table A3.

3.1.2. Risks, Returns, and Fees

All the funds' share classes have the same holdings but may have different expense ratios, which affect the net returns of the share classes. For example, institutional share classes usually charge lower fees than retail share classes. To evaluate a fund's return, we picked the earliest A, B, or C share classes, which are three main types of retail share classes of mutual funds. If there were no A, B, or C share classes, we selected the largest share class among the earliest share classes.

The share classes we included were BlackRock's Circular Economy Fund A2 USD Acc (benchmark: Morgan Stanley Capital International's All Country World Index Net Return EUR, MSCI ACWI NR EUR⁶), Candriam's Sustainable Equity Circular Economy C USD Acc. (benchmark: Morgan Stanley Capital International's All Country World Index Net Return EUR, MSCI ACWI NR EUR), RobecoSAM's Circular Economy Equities Fund I USD (benchmark: Morgan Stanley Capital International's World Index Net Return EUR,

MSCI World NR EUR⁷), Decalia's Circular Economy R USD P (benchmark: Morgan Stanley Capital International's World Index Net Return USD, MSCI World NR USD⁸), and Anima's CE Fund.

We present the risk and return metrics of the CE mutual funds in Table 2. For example, the BGF CE Fund (BlackRock Circular Economy Fund A2 USD Acc) had an expense ratio of 1.81% as of 30 November 2023. It generated a net return (net of expenses) of 1.62% per annum over the 3 years ending December 2023. It held a portfolio with a beta of 1.09, suggesting that it was exposed to more risk than the benchmark. However, it significantly underperformed the benchmark. It generated an alpha (risk-adjusted return) of -6.51% and an information ratio of -0.91 , suggesting negative stock-picking skills.

Table 2. Risks and returns of CE mutual funds.

Fund Name	Net Return	Expense Ratio	Alpha (α)	Beta (β)	Information Ratio	Sharpe Ratio	Standard Deviation
BGF CE Fund	1.62%	1.81%	-6.51%	1.09	-0.91	0.00	14.74%
Candriam CE Fund	-1.60%	1.94%	-8.87%	1.09	-1.40	-0.17	13.90%
RobecoSAM CE Fund	5.27%	0.93%	-3.02%	1.06	-0.53	0.26	13.01%
Decalia CE Fund	-0.37%	1.40%	-9.24%	1.20	-1.51	0.15	15.04%
Anima CE Fund	-3.30%	1.36%	-	-	-	-	-

This table reports the expense ratios as of 30 November 2023, and the 3-year net returns (net of expenses) ending December 2023 for fund share classes. This also reports the 3-year alpha (α), beta (β), information ratio, Sharpe ratio, and standard deviation of the net returns ending November 2023, where data are available. The five CE mutual funds included are BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund).

The CE mutual funds charged high fees overall. The four equity funds charged annual fees (expense ratio) of 0.93–1.94%, while the average annual fee for actively managed equity funds was 0.44% in 2022. The expense ratio of Anima CE Fund, the only bond mutual fund in our sample, was 1.36%, while the average expense ratio for actively managed bond mutual funds was 0.37% in 2022.

The funds generated a net return between -1.60% and 5.27% per annum over the 3 years ending December 2023. The beta of these fund portfolios (see Model 1 in Section 2) ranged from 1.06 to 1.2, suggesting that these funds assumed more risk than their benchmark portfolios.










The funds' alphas (risk-adjusted returns, see Model 1 in Section 2) during this time, ranged between -9.245% and -3.24% . This indicates that the funds severely underperformed their benchmarks. The fund managers had negative stock-picking abilities. The negative information ratios (ranging between -0.53 and -1.51) and the negative and smaller sharp ratios (between -0.17 and 0.26) confirmed the same.

Overall, we found that the CE mutual funds underperformed the benchmarks significantly during the last 3 years.

3.1.3. Sustainability

Considering their endorsement of CE initiatives, it is unsurprising that the three equity mutual funds, BGF CE Fund, Candriam CE Fund, and Decalia CE Fund, all received four or five globes from the Morningstar Sustainability (Globe) rating⁹, indicating high sustainability, as shown in Table 3. RobecoSAM CE Fund was rated as three globes (average sustainability), and Anima CE Fund was rated as two globes (below average sustainability). All four equity mutual funds were designated as sustainable investment low-carbon¹⁰ funds and sustainable investments by Morningstar. We also found that these CE mutual funds were all managed by experienced portfolio managers.

Table 3. Morningstar’s sustainability and low-carbon ratings of the CE mutual funds.

	Morningstar Sustainability (Globe) Rating	Morningstar Sustainable Investment	Morningstar Low-Carbon Designation
BGF CE Fund		Yes	
Candriam CE Fund		Yes	
RobecoSAM CE Fund		Yes	
Decalia CE Fund		Yes	
Anima CE Fund		No	No Designation

This table reports the Morningstar sustainability and low-carbon ratings for the five CE mutual funds including BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund), where data are available. The Morningstar Sustainability (Globe) rating measures how funds’ investments meet the ESG challenges. It ranges from one to five globes, with five indicating the top sustainable funds. The Morningstar Low Carbon Designation is an indicator that the portfolio’s holdings overall are in general alignment with the transition to a low-carbon economy.

In summary, CE mutual funds charged higher annual fees, took more risks than the market, and were rated as sustainable/low-carbon funds. However, most of them performed poorly compared with their benchmark portfolios during the limited time since their inception.

3.2. CE ETFs

3.2.1. Key Information

The three CE ETFs included were BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF Cap (BNPP CE ETF, managed by BNP Paribas Asset Management), VanEck Circular Economy UCITS ETF (VanEck CE ETF, managed by VanEck), and Rize Circular Economy Enablers UCITS ETF (Rize CE ETF, managed by IQ-EQ Fund Management), all of which are equity ETFs domiciled in Europe. Table 4 reports the key information of CE ETFs.

Table 4. Key information: CE exchange-traded funds.

Fund Name	Type	Inception Date	Domicile	Underlying Index	Size (Millions)	Style	Morningstar Rating
BNPP CE ETF	Equity	24 April 2019	Luxembourg	ECPI CE Leaders Equity Index	\$943	Large, blend	★★★★★
VanEck CE ETF	Equity	21 October 2022	Ireland	MVIS Global CE ESG Index	\$6	Mid, blend	—
Rize CE ETF	Equity	24 May 2023	Ireland	Foxberry SMS CE Enablers Index	\$2	Mid, blend	—

This table reports the key fund information for the three exchange-traded funds, including BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF), VanEck Circular Economy UCITS ETF (VanEck CE ETF), and Rize Circular Economy Enablers UCITS ETF (Rize CE ETF), where data are available. The funds’ sizes are as of 30 November 2023. The Morningstar *Star* rating measures fund performance. It ranges from one to five stars, with five indicating the top financial performers.

BNPP CE ETF, incorporated in Luxembourg, replicates the ECPI Circular Economy Leaders Equity Index, a basket of 50 stocks of major companies whose selection is primarily based on environmental, social, and governance (ESG) criteria. The index is designed to include companies that either operate in sectors that are circular by nature or that are most likely to benefit from adopting practices and business models typical of the CE. VanEck CE ETF is domiciled in Ireland and designed to replicate the MVIS Global Circular Economy ESG Index, which provides exposure to companies involved in recycling and other forms of resource efficiency. Rize CE ETF is also incorporated in Ireland and it invests in the

leading enabling companies that potentially stand to benefit from the transition to a CE by replicating the Foxberry SMS Circular Economy Enablers Index.

Out of the three, the oldest one is the BNPP CE ETF, launched in April 2019. The other two were founded recently, VanEck CE ETF in October 2022 and Rize CE ETF in May 2023. BNPP CE ETF is a large ETF with \$938 million in assets as of August 2023. The other two, VanEck CE ETF and Rize CE ETF, are small and have about \$6 million and \$2 million in assets under management, respectively.

BNPP CE ETF and VanEck CE ETF have the highest investments in US stocks, followed by Eurozone stocks, as shown in Panel B of Table A1. All three funds invest most of their assets in the industrials, consumer cyclical, basic materials, technology, and consumer defensive sectors, as shown in Panel B of Table A2. Panel B of Table A3 shows the top 10 holdings of the CE ETFs.

3.2.2. Risks, Returns, and Fees

For BNPP CE ETF, we included the share class of BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF Cap EUR. It generated a net return of 10.84% per annum over the 3 years ending December 2023 and had an expense ratio of 0.30%. Using Morningstar's Global Growth Target Market Exposure NR USD (Gbl TME NR USD)¹¹ as the benchmark, the fund held a portfolio with a beta of 1.09, more than the benchmark (with a beta of 1), suggesting that the portfolio was exposed to more systematic risk than the benchmark. However, unlike the mutual funds discussed earlier, it produced a positive alpha (risk-adjusted return) of 1.65% and a positive information ratio of 0.33. BNPP received five stars (the highest) for Morningstar's overall rating, suggesting a strong financial performance. Table 5 shows the expense ratios, risks, and returns of the share class.

Table 5. Risks and returns of a CE exchange-traded fund: BNPP CE ETF.

ETF Name	Net Return	Expense Ratio	Alpha (α)	Beta (β)	Information Ratio	Sharpe Ratio	Standard Deviation
BNPP CE ETF	10.84%	0.30%	1.65%	1.09	0.33	0.62	13.28%

This table reports the expense ratio as of 30 November 2023 and the 3-year net return ending December 2023 for BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF). We also report the 3-year alpha (α), beta (β), information ratio (IR), Sharpe ratio, and standard deviation of the net return ending November 2023.




The other two ETFs (VanEck CE ETF and Rize CE ETF) are very new funds, and we were unable to report their 3-year performance and other risk-related metrics. The 1-year net return of VanEck CE ETF was -5.40% , as shown in Table A4. It had an alpha of -19.48% (using MVIS Global Circular Economy ESG NR USD (MVCIRC)¹² as the benchmark) and an information ratio of -4.24 , attesting to the fund managers' negative stock-picking skill. The Rize CE ETF was established in May 2023, and there was not enough data to assess its performance.

The expense ratios of the three ETFs ranged from 0.3–0.45%, while the average expense ratio for equity ETFs was 0.16% in 2022—the CE ETFs charge high fees.

3.2.3. Sustainability

BNPP CE ETF received five globes in Morningstar's sustainability rating (the highest rating), and VanEck CE ETF received four. Both BNPP CE ETF and VanEck CE ETF were rated as sustainable investments by Morningstar. In addition, BNPP CE ETF was also designated as a low-carbon fund by Morningstar, while VanEck CE ETF did not receive the low-carbon designation. Due to its short track record, Rize ETF has no Morningstar sustainability or low-carbon rating. Table 6 reports the ratings.

Table 6. Morningstar’s sustainability and low-carbon ratings of CE exchange-traded funds.

	Morningstar Sustainability (Globe) Rating	Morningstar Sustainable Investment	Morningstar Low-Carbon Designation
BNPP CE ETF		Yes	
VanEck CE ETF		Yes	No designation
Rize CE ETF	—	—	No designation

In this table, we report the Morningstar sustainability and low-carbon ratings for the three CE ETFs, including BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF), VanEck Circular Economy ETF (VanEck CE ETF), and Rize Circular Economy Enablers UCITS ETF (Rize CE ETF), where data are available. The Morningstar Sustainability (Globe) rating measures how funds’ investments meet the ESG challenges. It ranges from one to five globes, with five indicating the top sustainable funds. The Morningstar Low Carbon Designation is an indicator that the portfolio’s holdings overall are in general alignment with the transition to a low-carbon economy.

In summary, similar to the CE mutual funds discussed earlier, the CE ETFs charged higher fees and tended to be rated sustainable and low-carbon funds¹³. We had 3-year performance data for BNPP CE ETF only. It took more risks than the market but generated positive risk-adjusted returns.

4. Private Equity and Venture Capital Funds

Four private equity and three venture capital funds were included in our sample. Some of them are currently closed to new investors.

Founded in 2014, Closed Loop Partners is a New York-based investment firm that targets leading innovations in material science, robotics, agritech, sustainable consumer products, and advanced technologies that further the CE. It launched Closed Loop Venture Fund I in 2017, which is dedicated solely to investing in early-stage companies developing breakthrough solutions for the CE. The Closed Loop Venture Fund II builds on the venture capital group’s first fund’s strategy. Table A6 shows the investment portfolio of the Closed Loop Venture Fund.

Closed Loop Leadership Fund, the private equity fund of Closed Loop Partners, was launched in 2019 with a buyout strategy. The fund buys and builds CE businesses that mitigate waste and strengthen circular supply chains. The fund announced its final close in June 2022, with more than \$200 million of total assets under management. Table A6 shows the five companies in which the Closed Loop Leadership Fund invests.

Circular Innovation Fund (CIF) was launched as a global venture capital fund in April 2022, focusing exclusively on circular innovation, led by Cycle Capital and Demeter. Based in Montreal, CIF invests in growth-stage companies in the supply chain sector across North America, Europe, and Asia, which bring forward breakthrough technologies and business models within the CE, including new materials, circular packaging, recycling and waste innovations, logistics and distribution, clean technologies and eco-efficient processes, and circular business models. As shown in Table A6, CIF has four investments, including Closed Loop Partners, the managing company of Closed Loop Venture Capital, as discussed above.

Circulate Capital Ocean Fund I-B, launched in 2021, is a buyout private equity fund managed by Circulate Capital. The fund is based in New York and invests in small and medium-sized enterprises in South and Southeast Asia, targeting investments in waste management and CE solutions. The fund invests through two complementary strategies: Circulate Capital Recycling Supply Chains and Circulate Capital Disrupt. Circulate Capital Recycling Supply Chains targets investments that transform recycling and waste management supply chains. Circulate Capital Disrupt targets disruptive innovations that represent milestone “leaps of progress” toward circularity, including novel reusable materials and alternative delivery models. The fund’s investment portfolio is shown in Table A6.

As one of the first private equity funds in the world to focus on CE, Taaleri Circular Economy Private Equity Fund (Taaleri CE PE Fund), established by Taaleri, a Nordic

investment and asset manager, was opened to investors in March 2016. The fund focuses particularly on three themes: renewable energy, recycling and material processing, and energy-saving solutions. The fund is currently closed and is no longer accepting new investors.

The Future of Plastics Fund is a venture capital fund managed by Archipelago Eco Investors. It is an impact-led investment firm focused on late-stage venture capital investments into startups developing new and novel technologies, products, and processes designed to reduce the environmental and social impacts of plastic waste. It supports technologies that address key barriers to plastics in the CE and invests for impact into early-stage technologies in the artificial intelligence and machine learning sector in Europe and the UK within the plastic supply chains.

Founded in 2015, Circularity Capital is a private equity firm based in Edinburgh, UK. The fund seeks to invest in innovative, market-leading businesses that create value across three circular growth themes: circular use models, circular products and materials, and enabling solutions.

Among all the CE private equities and venture capital funds discussed above, two private equity funds, Closed Loop Leadership Fund, and Taaleri Circular Economy Fund, are currently closed to new investments. Among the open funds, Circulate Capital Ocean Fund I-B and the Future of Plastics Fund focus on circular plastics, while the others invest in a variety of areas in the CE. Closed Loop Venture Capital, CIF, and Circulate Capital Ocean Fund I-B are located in North America. The Future of Plastics Fund and Circularity Capital are domiciled in Europe.

5. Conclusions

The transition to a circular economy is gaining momentum, attracting increased attention from investors. In recent years, a variety of options, including mutual funds, ETFs, and venture capital/private equity funds, have emerged for investors contemplating opportunities in the CE.

To the best of our knowledge, ours is the first research to assess these newly founded funds. We found that CE mutual funds (both equity and bond funds) charged high fees and were exposed to more systematic risk than the market while generating significant negative risk-adjusted returns in most cases during their short existence. The only exception was BNPP CE ETF, which performed very well over the past 3 years, generating positive risk-adjusted returns. The CE ETFs also charged high fees.

Most of the CE mutual funds and ETFs scored high on sustainability measures, receiving four- or five-globe (the highest) sustainability ratings from Morningstar. Moreover, many of them were designated low-carbon funds by Morningstar, offering protection from climate risk.

Investors interested in private companies, such as startups, involved in CE practices may consider CE private equity/venture capital funds. However, some of them are closed, and they primarily cater to institutional/accredited investors.

Although there has been some recent growth, investments in the circular economy remain relatively limited compared with other areas of sustainable finance. This could be attributed to several factors, including the complexity of implementing circular practices, uncertainty about the returns on investment, and a general need for increased awareness and understanding of the potential benefits among investors. A substantial increase in funding is necessary to facilitate a global transition to a circular economy. The importance of private financing in this transition underscores a crucial new research focus.

Author Contributions: Conceptualization, F.F. and S.P.; methodology, F.F. and S.P.; validation, F.F. and S.P.; formal analysis, F.F. and S.P.; investigation, F.F. and S.P.; data curation, F.F.; writing—original draft preparation, F.F. and S.P.; writing—review and editing, F.F. and S.P. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The original data presented in the study are publicly available at ft.com, Morningstar.com, and the official websites of the venture capital and private equity funds. We obtained key information on the mutual funds' and ETFs' risk, return, and rating data from ft.com and Morningstar.com, and information about venture capital and private equity funds from their official websites.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Top five investment regions of the CE mutual funds and ETFs.

Panel A CE Mutual Funds									
BGF CE Fund (as of 31 August 2023)		Candriam CE Fund (as of 31 May 2023)		RobecoSAM CE Fund (as of 31 October 2023)		Decalia CE Fund (as of 31 May 2023)		Anima CE Fund (as of 31 May 2023)	
United States	47.73%	United States	61.05%	United States	55.87%	United States	65.89%	Emerging market	3.87%
Eurozone	24.69%	Eurozone	13.84%	Eurozone	18.52%	Eurozone	16.11%	Eurozone	3.18%
Europe, ex Euro	10.31%	Europe, ex Euro	9.56%	United Kingdom	8.83%	Europe, ex Euro	9.76%	Asia, emerging	3.03%
Japan	5.73%	United Kingdom	3.71%	Europe, ex Euro	7.42%	Japan	3.78%	United States	2.81%
Australasia	4.80%	Canada	3.15%	Latin America	2.24%	United Kingdom	1.21%	Asia, developed	2.29%
Other	3.68%	Other	5.63%	Other	4.86%			Other	4.58%
Panel B CE ETFs									
BNPP CE ETF (as of 31 October 2023)									
United States	59.40%								
Eurozone	18.92%								
Japan	11.41%								
UK	4.30%								
Europe-ex Euro	3.81%								
Other	2.08%								

In this table, we report the top five investment regions for the CE mutual funds (Panel A) and exchange-traded funds (Panel B) included in our sample, where data are available. The five CE mutual funds are BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund). The exchange-traded fund is BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF).

Table A2. Top five investment sectors of the CE mutual funds and ETFs.

Panel A CE Mutual Funds									
BGF CE Fund (as of 31 August 2023)		Candriam CE Fund (as of 31 May 2023)		RobecoSAM CE Fund (as of 31 October 2023)		Decalia CE Fund (as of 31 May 2023)		Anima CE Fund (as of 31 May 2023)	
Industrials	32.40%	Industrials	24.02%	Industrials	43.46 %	Industrials	22.97%	Technology	3.09%
Consumer cyclical	17.85%	Technology	22.29%	Technology	15.73%	Technology	26.57%	Financial services	2.63%
Technology	15.21%	Consumer defensive	18.34%	Consumer cyclical	14.27%	Healthcare	10.52%	Consumer cyclical	2.25%
Basic materials	15.20%	Consumer cyclical	13.98%	Healthcare	7.82%	Consumer defensive	10.02%	Industrials	1.58%
Consumer defensive	11.04%	Basic Materials	8.14%	Consumer defensive	5.21%	Financial services	6.07%	Healthcare	1.43%
Other	5.23%	Other	8.32%	Other	9.01%	Other	20.62%	Other	4.67%

Table A2. Cont.

Panel B CE ETFs					
BNPP CE ETF (as of 31 October 2023)		VanEck CE ETF (as of 27 December 2023)		Rize CE ETF (as of 27 December 2023)	
Technology	22.48%	Industrials	62.30%	Industrials	37.51%
Industrials	21.99%	Basic materials	18.08%	Consumer cyclical	29.94%
Consumer defensive	19.87%	Consumer cyclical	10.70%	Basic materials	12.80%
Basic materials	16.72%	Consumer defensive	4.67%	Technology	12.66%
Consumer cyclical	14.89%	Utilities	4.20%	Consumer defensive	3.84%
Other	3.88%			Other	3.25%

In this table, we report the top five investment sectors for the CE mutual funds (Panel A) and exchange-traded funds (Panel B) included in our sample, where data are available. The five CE mutual funds are BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund). The three CE ETFs are BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF), VanEck Circular Economy ETF (VanEck CE ETF), and Rize Circular Economy Enablers UCITS ETF (Rize CE ETF).

Table A3. Holdings of the CE mutual funds and ETFs.

Panel A CE Mutual Funds				
BGF CE Fund	Candriam CE Fund	RobecoSAM CE Fund	Decalia CE Fund	Anima CE Fund
Microsoft Corp. (4.32%)	Waste Management Inc. (4.25%)	Compass Group PLC (3.00%)	Microsoft Corp. (4.72%)	TRS-LONG-CTP_446-TIT NE728919VT48 Index (−53.35%)
Republic Services Inc. (3.94%)	American Water Works Company Inc. (3.47%)	EssilorLuxottica SA (2.87%)	Alphabet Inc. (4.00%)	ANIMA Star High Potential Europe I (8.89%)
Coca-Cola Europacific Partners PLC (3.68%)	Darling Ingredients Inc. (3.38%)	Relx PLC (2.70%)	Cisco Systems Inc. (3.23%)	Anima Obbligazionario Emergente Y (8.85%)
VEOLIA Environment SA (3.60%)	Nestle SA (3.15%)	Wolters Kluwer (2.68%)	Adobe Inc. (2.91%)	Anima Obbligazionario High Yield Y (6.71%)
Ecolab Inc. (3.07%)	Graphic Packaging Holding Co. (2.94%)	Clean Harbors Inc. (2.54%)	Salesforce Inc. (2.66%)	Anima Emergenti Y (5.90%)
Xylem Inc. (3.05%)	Ecolab Inc. (2.79%)	Xylem Inc. (2.51%)	Hoya Corp. (2.46%)	Anima Obbligazionario Flessibile F (5.65%)
UPM Kymmene Oyj (2.99%)	Procter & Gamble Co. (2.78%)	NVIDIA Corp. (2.49%)	Autodesk Inc. (2.42%)	ANIMA Global Macro I EUR (5.44%)
SIG Group AG (2.99%)	Unilever PLC (2.76%)	Quanta Services Inc. (2.47%)	Novo Nordisk A/S Class B (2.37%)	Anima Sforzesco F (4.10%)
CRH PLC (2.98%)	Microsoft Corp. (2.66%)	Tetra Tech Inc. (2.47%)	Danaher Corp. (2.27%)	United States Treasury Notes (3.51%)
Avery Dennison Corp (2.96)	Crown Holdings Inc. (2.57%)	AECOM (2.34%)	S&P Global Inc. (2.23%)	Anima Pacifico F (3.34%)
Panel B CE ETFs				
BNPP CE ETF		VanEck CE ETF		Rize CE ETF
International Business Machines Corp. (2.43%)		Waster Connections Inc. (7.93%)		Carmax Inc. (4.61%)
Intel Corp. (2.40%)		Waste Management Inc. (7.62%)		Cintas Corp. (4.56%)
UPM Kymmene Oyj (2.37%)		UPM-Kymmene Qyj (6.73%)		Herc Holdings Inc. (4.42%)

Table A3. Cont.

Panel B CE ETFs		
BNPP CE ETF	VanEck CE ETF	Rize CE ETF
Relx PLC (2.35%)	Republic Services Inc. (6.61%)	Kurita Water Industrials Ltd. (4.37%)
TJX Companies Inc. (2.34%)	Veralto Corp. (6.14%)	ANSYS Inc. (4.31%)
Cisco Systems Inc. (2.32%)	Brambles Ltd. (5.42%)	Badger Meter Inc. (4.27%)
Adobe Inc. (2.30%)	Smurfit Kappa Group PLC (5.00%)	Ashtead Group PLC (4.16%)
Linda PLC (2.26%)	GFL Environmental Inc. (4.89%)	Trex Company Inc. (4.16%)
Colgate-Palmolive Co. (2.24%)	Darling Ingredients Inc. (4.67%)	Ball Corp (4.15%)
Hitachi Ltd. (2.22%)	Umicore NV/SA Shares (4.57%)	Dassault Systemes SE (4.08%)

In this table, we report the top 10 holdings for the CE mutual funds (Panel A) and CE ETFs (Panel B) included in our sample, where data are available. The five CE mutual funds are BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund). The three CE ETFs are BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF), VanEck Circular Economy ETF (VanEck CE ETF), and Rize Circular Economy Enablers UCITS ETF (Rize CE ETF). The data are as of December 2023.

Table A4. Risks and returns of the CE Mutual Funds.

Fund Name	Net Return	Alpha (α)	Beta (β)	Information Ratio	Sharpe Ratio	Standard Deviation
CE Mutual Funds						
BGF CE Fund	9.03%	−4.40%	0.94	−1.08	−0.38	9.02%
Candriam CE Fund	−0.13%	−13.18%	1.06	−2.95	−1.03	11.05%
RobecoSAM CE Fund	13.66%	−2.25%	1.05	−0.42	−0.05	11.35%
Decalia CE Fund	7.21%	−8.67%	1.08	−2.62	−0.61	11.16%
Anima CE Fund	1.61%	-	-	-	-	-
CE ETFs						
BNPP CE ETF	16.12%	−0.40%	1.06	−0.05	0.12	10.97%
VanEck CE ETF	−5.40%	−19.48%	0.84	−4.24	−2.67	7.15%

In this table, for each fund's selected share class, we report the 1-year net returns ending December 2023, and the 3-year alpha (α), beta (β), information ratio, Sharpe ratio, and standard deviation of the net returns ending November 2023, where data are available. The five CE mutual funds included are BlackRock Circular Economy Fund (BGF CE Fund), Candriam Sustainable Equity Circular Economy Fund (Candriam CE Fund), RobecoSAM Circular Economy Equities Fund (RobecoSAM CE Fund), Decalia Circular Economy Fund (Decalia CE Fund), and Anima Investimento Circular Economy 2025 Fund (Anima CE Fund) and the two CE ETFs included are BNP Paribas Easy ECPI Circular Economy Leaders UCITS ETF (BNPP CE ETF) and VanEck Circular Economy ETF (VanEck CE ETF).

Table A5. Key information of the CE private equity funds and venture capital funds.

Fund Name	Type	Inception Date	Domicile
Closed Loop Venture Fund	VC	2017	US
Closed Loop Leadership Fund	PE (closed)	2019	US
Circular Innovation Fund	VC	21 April 2022	Canada
Circulate Capital Ocean Fund I-B	PE	2021	US
Taaleri Circular Economy Fund	PE (closed)	03/2016	Finland
Future of Plastics Fund	VC	2022	UK
Circularity Capital	PE	2015	UK

In this table, we report the key fund information for the seven CE private equities (PEs) and venture capitals (VCs), including Closed Loop Venture Fund, Closed Loop Leadership Fund, Circular Innovation Fund, Circulate Capital Ocean Fund I-B, Taaleri Circular Economy Fund, Future of Plastics Fund, and Circularity Capital, where data are available. The funds' sizes are as of 30 November 2023.

Table A6. Holdings of the CE private equity funds and venture capital funds.

Closed Loop Venture Fund			Closed Loop Leadership Fund	CIF	Circulate Capital Ocean Fund	Taaleri Circular Economy Fund	Future of Plastics Fund	Circularity Capital
Accelerated Filtration	Easy Aerial	Rebound Technologies	Apkudo	Closed Loop Partners	Lucro Plastecycle Private Limited	Chempolis	Greyparrot	Bike Club
Algaeing	Evrrnu	Rebundle	Balcones Resources	European Circular Bioeconomy Fund	Neptra Resource Management Pvt Ltd.	Lämpöhuolto Group		REBIKE
Algramo	Fillogic	Retrievr	ERI	Lizee	Srichakra Polyplast Pvt Ltd.	Smartvatten		Cocogreen
AMP Robotics	For Days	SOLARCYCLE, Inc.	Single Stream Recyclers	Evoco LTD	Rapidue Technologies (Recykal)	Naps Solar		Lendis
Ansa	HomeBiogas	The Renewal Workshop	Sims Municipal Recycling		Ricron Panels Pvt Ltd.	Wastewise Group		P2i
Atlas Organics	Hyran	Thrilling			Dalmia Polypro Industries	Touchpoint		ZigZag
By Rotation	LOLIWARE	Thrive Lot			ACE Green Recycling	Volter		Winnow
CoLoadX	Molg	TradeLanes			Reciki	OptiWatti (already exited)		Grover
Dai	Mori (Combridge Crops)	ucrop.it			Prevented Ocean Plastic Southeast Asia	Ecomation (already exited)		Green Home Group
Dimpora	Natural Machines	VALIS			Deluxe Recycling Private Limited			Shark Solutions
Earthodic	Partsimony				Tridi Oasis			PackBenefit
								Advanced Clothing Solutions
								CERAFILTEC
								CEMASys

In this table, we report the holdings of the CE private equities and venture capitals (Panel CE) included in our sample, where data are available. The seven private equities and venture capitals are Closed Loop Venture Fund, Closed Loop Leadership Fund, Circular Innovation Fund, Circulate Capital Ocean Fund I-B, Taaleri Circular Economy Fund, Future of Plastics Fund, and Circularity Capital. The data are as of December 2023.

Notes

- See https://www.un.org/sites/un2.un.org/files/circular_economy_14_march.pdf, accessed on 10 January 2024.
- For example, Althelia Sustainable Ocean Fund, a private equity fund, has a blended portfolio of sustainable seafood, CE, and conservation-focused businesses. Even though it invests in CE, it also invests in other areas. Therefore, it was not included in the discussion of our article. For a list of funds with investments including, but not limited to, CE, please refer to Table 17 of [Lawlor and Spratt \(2021\)](#).
- See the 2023 *Investment Company Fact Book*.
- For example, the risk, return, and sustainability data of venture capital funds and private equity funds were not available and therefore were not included in our study.
- Morningstar's (overall) rating for funds, often called the star rating, is a measure of a fund's risk-adjusted return relative to similar funds. The rating ranges from one to five stars, with five stars indicating the top financial performers.
- The MSCI ACWI Index (EUR) captures large and mid-cap representation across 23 developed markets and 24 emerging Markets countries. With 2946 constituents, the index covers approximately 85% of the global investable equity opportunity set. See MSCI ACWI Index (EUR) Factsheets, <https://www.msci.com/documents/10199/1ee87397-6313-4f46-87ae-6761f666558e>, accessed on 2 January 2024.
- The constituents of the MSCI World Index (EUR) are the same as the ones in the MSCI World Index (USD), only in different currencies. See the MSCI World Index (EUR) Factsheets, <https://www.msci.com/documents/10199/890dd84d-3750-4656-87f2-1229ed5a5d6e>, accessed on 3 December 2023.

- 8 The MSCI World Index captures large and mid-cap representation across 23 developed markets. With about 1509 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country. See the MSCI World Index (USD) Factsheets, <https://www.msci.com/documents/10199/178e6643-6ae6-47b9-82be-e1fc565ededb>, accessed on 2 January 2024.
- 9 The Morningstar sustainability rating, which is known as the globe rating, “was designed to be a reliable, objective way to evaluate how investments meet environmental, social, and governance (ESG) challenges,” with five globes indicating the most sustainable funds.
- 10 According to Morningstar, the low-carbon designation is “an indicator that the portfolio’s holdings overall are in general alignment with the transition to a low-carbon economy” and “is intended to allow investors to easily identify low-carbon funds across the global universe.”
- 11 “This index measures the performance of large- and mid-cap growth stocks listed in developed and emerging countries around the world. These stocks represent the more growth-oriented half of the parent benchmark, the Morningstar Global TME Index, and are weighted by float-adjusted market capitalization. This Index does not incorporate Environmental, Social, or Governance (ESG) criteria.” Please see <https://indexes.morningstar.com/indexes/details/morningstar-global-growth-target-market-exposure-FS000H8UV?currency=USD&variant=NR&tab=overview>, accessed on 2 January 2024.
- 12 “The MVIS Global Circular Economy ESG Index (MVCIRC) tracks the performance of companies contributing to the circular economy. This includes water purification and treatment products/services, waste-to-energy and biofuels, waste management services that include recycling services, and metal recycling services. MVCIRC covers at least 90% of the investable universe.” Please see <https://www.marketvector.com/indexes/sector/mvis-global-circular-economy-esg>, accessed on 2 January 2024.
- 13 The CE mutual funds and ETFs that are rated as low-carbon funds were all founded before 2020.

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