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Marshall Edgeworth: riding the carbon trails of the great investment plains

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Marshall Edgeworth: riding the carbon trails of the great investment plains

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Abstract

This article applies a look-through approach and Marshall-Edgeworth decomposition to trace financed emissions in investment portfolios. By examining both direct and indirect corporate securities holdings of Belgian financial corporations and households, the analysis reveals that indirect investments significantly shape carbon exposure. Between 2018 and 2023, total financed emissions declined, driven by portfolio reallocations and corporate emission reductions. Crucially, the decomposition highlights how revaluation effects can obscure the true impact of investment decisions, underscoring the need for flow-based analysis.

Contents

1. Introduction

This article chronicles the endeavours of Marshal Edgeworth. Like the famed lawmen who brought order to frontier towns in the untamed West, he rides the Great Investment Plains. His mission is not to chase outlaws, but to track the elusive carbon trails left by investment portfolios. Some of these trails stretch clearly across the open plains of direct investments, while others remain hidden, concealed within the shadowed canyons of indirect exposures through investment funds.

Just as the marshals of old relied on sharp instincts and unwavering resolve, Marshal Edgeworth depends on his trusted tracker, Luke Through. With an unrivaled ability to peer into the rugged terrain of indirect investments, Luke uncovers concealed carbon trails within investment funds, ensuring no hidden emissions escape detection. Once the trails are revealed, Marshal Edgeworth applies his decomposition expertise to map the intricate paths of financed emissions, bringing clarity to an otherwise obscured frontier.

Behind this stylised narrative lies a pressing financial reality. Climate change presents growing challenges for the financial sector, reshaping investment strategies and risk assessments. As economies transition toward net-zero targets, investors must integrate climate considerations into their decision-making to ensure both financial resilience and sustainable capital allocation. Monitoring the drivers of a portfolio's carbon footprint is essential for aligning investment strategies with climate goals.

To meet these demands, investors and financial supervisors need robust tools that go beyond surface-level metrics. A well-equipped climate finance toolkit helps monitor portfolio carbon profiles, assess transition risks, and evaluate the financial sector's role in the net-zero shift. It also supports data validation and effective sustainability storytelling. These capabilities are strategic imperatives – enhancing transparency, guiding informed decisions, and reinforcing the financial system's contribution to decarbonisation.[1]

In this article, we apply a look-through approach and Marshall-Edgeworth decomposition to the corporate securities portfolios of Belgian financial corporations and households. The analysis reveals that indirect investments represent a substantial share of their exposure to non-financial corporations. When hidden carbon trails are accounted for, financed emissions rise significantly.[2]

Yet between 2018 and 2023, total financed emissions declined for both financial corporations and households. This decrease was primarily driven by emission reductions within the firms in portfolio and by reallocations away from high-emitting firms. Financial corporations achieved this mainly through direct portfolio adjustments, while households benefited largely from changes in Belgian and Luxembourgish investment fund holdings.[3]

Importantly, the decomposition analysis reveals that revaluation effects can obscure the true impact of investment decisions – particularly for households – highlighting the need to examine underlying flows to accurately assess portfolio decarbonisation. In fact, flow-based analysis shows that households

[1] Also see for instance UN-convened Net-Zero Asset Owner Alliance (2023), which encourages investors to establish their own emissions attribution analyses and to share knowledge on how to do so among financial institutions.

[2] For an earlier application of a look-through approach to analyse the carbon footprint of Dutch insurance corporations' and pension funds' securities holdings, see for instance Berkhout et al. (2024).

[3] Alternative decompositions or attribution analyses of changes in carbon indicators for investment portfolios have been performed by for instance Berkhout et al. (2023), Shemfe et al. (2024) and Statistics Committee Expert Group on Climate Change and Statistics and Working Group on Securities (2024a). To our knowledge, we are the first to apply such decomposition on both direct and indirect holdings and analyse financed emissions of households' securities portfolios. For an application of a look-through approach to euro area households' portfolio holdings, see for instance Carvalho and Schmitz (2021).

did actively shift their portfolios away from high-emitting firms, but this effect was offset by positive revaluation effects.

The remainder of the article is structured as follows: Section 2 introduces the methodological framework; Section 3 details the data sources; Section 4 presents the main empirical findings; and Section 5 offers some concluding remarks.

2. Methodology

This section presents the methodological framework, structured around four logical steps. First, we define the investment portfolio. Second, we identify the relevant carbon emissions indicators. Third, we select the sample used to compute these indicators. Fourth, we analyse the drivers behind changes in the computed carbon metrics.[4]

Look-through methodology

Investors can hold an issuer's securities either directly or indirectly. Direct holdings occur when an investor acquires listed shares or bonds issued by the company. Indirect holdings arise when the investor purchases shares in investment funds that, in turn, include the issuer's securities in their portfolios.

Investor h's direct investment $I^d_{h,j}$ in securities issued by company j is equal to the total market value $H_{h,j,s}$ of all securities s (including listed shares and bonds) issued by company j and directly held by investor h:

$$I^d_{h,j} = \sum_s H_{h,j,s}$$

Indirect investment $I^i_{h,j}$ by investor h in issuer j's securities is determined by the total market value $H_{f,j,s}$ of all securities s issued by company j and held by the investment funds f within investor h's portfolio. However, this investment amount is limited by the ownership share of investor h in fund f, which is calculated as the ratio of the market value $H_{h,f}$ of investor h's participation in fund f to the total market value V_f of investment fund shares issued by f:

$$I^i_{h,j} = \sum_f \frac{H_{h,f}}{V_f} \sum_s H_{f,j,s}$$

Total investment $I_{h,j}$ of investor h in issuer j's securities is the sum of direct and indirect investment:

$$I_{h,j} = I^d_{h,j} + I^i_{h,j}$$

Finally, the total securities portfolio I_h of investor h amounts to the total investment in all issuers of which securities are held by investor h:

$$I_h = \sum_j I_{h,j}$$

[4] All measures are time-specific; however, the time subscript t is omitted where possible to simplify notation.

Note that investment funds held by an investor can, in turn, invest in other investment funds, creating a multi-layered structure. In principle, the look-through methodology can be applied iteratively, tracing exposures through successive layers of fund investments. However, in the analysis below, we apply the look-through approach only once, limiting indirect investments to the direct holdings of investment funds within the portfolio. This approach streamlines the analysis while ensuring a comprehensive reflection of the investment structure and underlying holdings within the portfolio.

Carbon emissions indicators

Carbon emissions indicators for investment portfolios incorporate double materiality, by considering both the environmental impact of the portfolio and the financial risks associated with exposure to high-emitting firms. While the methods in this article can be applied to a variety of carbon emissions indicators, the analysis will focus on financed emissions.

Financed emissions quantify the total greenhouse gas emissions tied to an investor's holdings, offering insight into the climate implications of their financial decisions. This metric is crucial for sustainable finance, as it helps investors assess their contribution to global emissions and align their portfolios with climate goals.

The financed emissions $FE_{h,j}$ associated with issuer j reflect the portion of company j's total carbon emissions that can be linked to investor h's financial support. They are obtained by weighting company j's emissions E_j according to investor h's proportional funding share, which is measured as the ratio of investor h's investment in issuer j's securities ($I_{h,j}$) to issuer j's total company value C_j:

$$FE_{h,j} = \frac{I_{h,j}}{C_j} E_j$$

The total financed emissions of investor h are calculated as the sum of the financed emissions of all issuers in their portfolio:

$$FE_h = \sum_j FE_{h,j}$$

Flex balancing

When tracking financed emissions over time, variations may arise due to changes in firms' emissions or financial data, as well as shifts in portfolio composition. These compositional changes occur due to investment or divestment decisions by security holders and to missing emissions or financial data for certain issuers in some time periods. While one would want to account for shifts in holdings, changes in sample composition due to missing data are less desirable.

To address this, a balancing methodology developed in a statistical paper by the ECB[5] ensures consistency in issuer representation across periods. If a firm appears as a security issuer in an investor's portfolio but lacks financial or emissions data in a given period, it is removed entirely from the holder's portfolio (for all periods) to avoid bias. Conversely, if a firm is absent in some periods but has complete financial and emissions data in others, it remains in the dataset for those periods, reflecting investment

[5] Statistics Committee Expert Group on Climate Change and Statistics and Working Group on Securities (2024a)

and divestment decisions of the holder. This approach ensures a consistent portfolio composition over time while maintaining meaningful financial trends.[6]

Marshall-Edgeworth decomposition

Monitoring financed emissions over time is crucial for understanding their evolution and identifying the key drivers behind observed changes. Decomposition methods serve as powerful tools for breaking down complex trends into their underlying components, helping analysts disentangle the effects of individual factors on overall variations. These techniques are widely applied in economics, finance, and environmental research to analyse time-dependent shifts influenced by multiple variables.

The Marshall-Edgeworth (ME) decomposition, named after Alfred Marshall and Francis Edgeworth for their foundational work on index numbers[7], provides a systematic approach for isolating the contributions of different variables to total change. This method has been extensively used in index number theory and price and quantity analysis, facilitating a clearer understanding of fluctuations in financial indicators over time.[8] By applying this method to carbon accounting and sustainability reporting, investors and policymakers can gain deeper insights into the impact of market dynamics and green initiatives on financed emissions and climate-related financial risks.

For $X = xy$, the ME decomposition amounts to

$$\Delta X = (\Delta x)\bar{y} + (\Delta y)\bar{x}$$

where $\Delta x = x_t - x_{t-1}$ and $\bar{x} = \frac{(x_t + x_{t-1})}{2}$.

For $X = xyz$, it can be shown that

$$\Delta X = (\Delta x)\frac{\overline{yz} + 2\bar{y}\bar{z}}{3} + (\Delta y)\frac{\overline{xz} + 2\bar{x}\bar{z}}{3} + (\Delta z)\frac{\overline{xy} + 2\bar{x}\bar{y}}{3}$$

While many other decomposition methods could be applied, the ME decomposition possesses several desirable properties that enhance the interpretability and transparency of portfolio-level carbon analysis for investors. Notably, it ensures additivity, whereby the total change in carbon emissions indicators can be precisely partitioned into distinct, non-overlapping components whose sum equals the overall change. Furthermore, the decomposition exhibits a zero residual property, meaning that the entire variation in the carbon indicator is fully attributable to its underlying drivers, with no unexplained remainder.[9]

[6] However, a limitation is that firms with incomplete data in any period are removed entirely, even if they have complete information in others. This could potentially result in the sample portfolio no longer being representative in the longer run. However, such effects are minimised by estimating missing emissions and financial data. UN-convened Net-Zero Asset Owner Alliance (2023) suggests a dummy variable approach to include data coverage effects in the decomposition.

[7] The ME decomposition is sometimes also referred to as the Bennet decomposition.

[8] For example, Huerga and Steklacova (2008) provide an application focused on interest rates, while Carlino et al. (2017) examine financial ratios among European non-financial listed companies.

[9] For more detail on the mathematical properties of the ME decomposition, see for instance Huerga and Steklacova (2008).

3. Data and scope

This article examines the directly and indirectly financed scope 1 emissions linked to securities portfolios – specifically listed shares and bonds issued by non-financial corporations – held by Belgian deposit-taking corporations except the central bank, insurance corporations, pension funds (collectively referred to as "financial corporations"), and households over the period 2018–2023. By applying a look-through approach, the analysis captures the full carbon footprint associated with both direct holdings and indirect exposures through investment funds.

A comprehensive assessment of financed emissions requires granular, security-level data on the market value of portfolio holdings, combined with firm-level information on company valuations and greenhouse gas emissions. This integrated dataset enables a detailed decomposition of emission trends, offering insights into how investment decisions and portfolio structures influence carbon exposure across different investor types.

Securities information

Security-by-security data used in this analysis is sourced from the European Central Bank's Securities Holdings Statistics by Sector (SHSS), a rich and granular dataset that offers detailed insights into securities held by euro area resident sectors. These holdings are categorised by multiple dimensions, including holder country and sector, instrument type (e.g. listed shares or bonds), and issuer country and sector. This multidimensional structure enables a nuanced understanding of portfolio composition and cross-border investment patterns. While containing security-by-security information, the data are aggregated at the investor sector level, meaning they reflect the holdings of entire investor sectors – such as the Belgian investment fund sector – rather than those of individual funds or investors.

This aggregation introduces a degree of approximation when analysing the securities held by investment funds in which Belgian financial corporations and households are invested. The methodology assumes that the portfolio of investment funds domiciled in a given country is representative of the portfolio of the funds in that country actually held by Belgian investors. While this assumption is necessary due to data limitations, it may obscure fund-level variations in carbon exposure and investment strategy. Nonetheless, the sector-level granularity still provides valuable insights into the broader trends and structural shifts in financed emissions.[10]

We complement the security-by-security holdings data from the SHSS with country-level data from the ECB's Investment Fund Statistics. The Investment Fund Statistics report the total market value of investment fund shares issued by European funds across jurisdictions. By combining these datasets, we determine the ownership shares of Belgian investors in investment funds domiciled in different countries, which are then used to attribute indirect financed emissions accordingly.

Importantly, both SHSS and Investment Fund Statistics distinguish between outstanding stocks and the underlying flows that drive changes in those stocks. These flows are broken down into components such as transactions, price and exchange rate effects, and statistical reclassifications. This distinction is crucial for disentangling the drivers of changes in financed emissions – whether they stem from active investment decisions, market dynamics, or data adjustments – and adds a layer of analytical depth to the decomposition framework.

[10] In future extensions, fund-by-fund data for Belgian investment funds could be used to refine the analysis.

Issuer information

Company-level scope 1 carbon emissions and enterprise value including cash (EVIC) are sourced from the ISS Climate Core dataset, which offers comprehensive coverage of over 25,000 firms worldwide, with annual data available from 2012 onward. The dataset provides absolute emissions and EVIC figures, enabling consistent and comparable carbon metrics across firms and time. Importantly, our analysis relies exclusively on reported emissions, deliberately excluding modelled estimates by the commercial provider to maintain transparency and data integrity. To address gaps in coverage, missing carbon emissions and EVIC values are imputed using standardised methodologies developed by the Statistics Committee Expert Group on Climate Change and Statistics.[11]

Issuer-level information is linked to the securities holdings using matching tables provided by the Expert Group, ensuring accurate alignment between financial instruments and their corresponding corporate entities. This integration of climate and financial data forms the backbone of the financed emissions calculations and supports robust portfolio-level analysis.[12]

4. Results

This section presents the core findings of our analysis of Belgian financial corporations' and households' financed emissions in their corporate securities portfolios. By tracing both direct and indirect holdings, we uncover how investment decisions and portfolio compositions influence carbon exposure over time. The results offer a nuanced view of the drivers behind emission reductions, highlighting the roles of investor behaviour, fund structures, and the evolving carbon footprint of underlying firms.

Directly and indirectly financed emissions

Applying the look-through approach to the corporate securities portfolio of Belgian financial corporations and households shows that for both sectors indirect investments make up a substantial part of the exposure to non-financial corporations (left-hand panel of Graph 1). For financial corporations this mainly occurs through foreign funds, whereas for households the distribution across Belgian and foreign investment funds is more balanced.

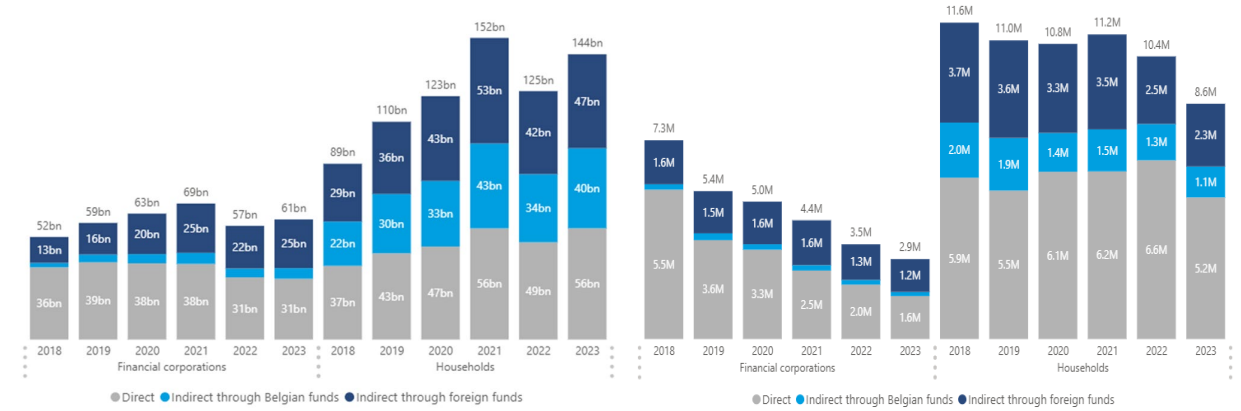
As anticipated, financed emissions increase substantially when indirect investments are included (right-hand panel of Graph 1). Yet, over the sample period, total financed emissions – stemming from both direct and indirect holdings – declined for both financial corporations and households. For financial corporations, this reduction is primarily driven by a decrease in directly financed emissions, which account for 3.9 million of the total 4.4 million ton CO_2e reduction. As a result, the relative share of indirectly financed emissions rose from approximately 25% in 2018 to 45% in 2023. In contrast, households saw a 3 million ton CO2e decline in financed emissions, with indirect investments contributing 2.3 million tons of that

[11] These methods are documented in Statistics Committee Expert Group on Climate Change and Statistics and Working Group on Securities (2024a, 2024b), which outline procedures for estimating missing values while preserving consistency with reported data.

[12] Further technical details and documentation are available in Statistics Committee Expert Group on Climate Change and Statistics and Working Group on Securities (2024a, 2024b).

reduction. This shift led to a decrease in the share of household-financed emissions stemming from indirect holdings, falling from nearly 50% in 2018 to 40% in 2023.

Directly and indirectly financed corporate emissions Graph 1

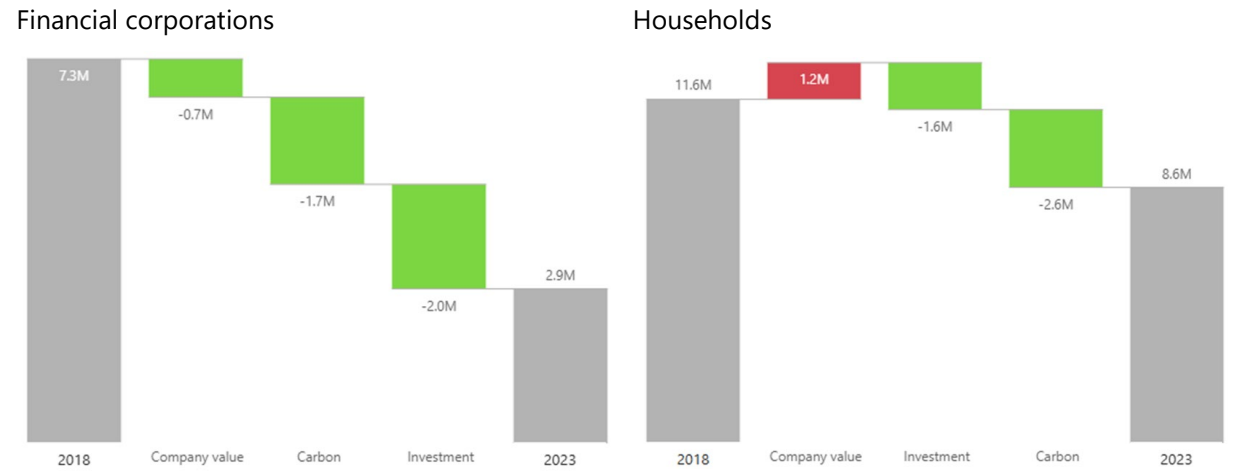


Investment is the market value in EUR at year-end of holdings of listed shares and bonds issued by non-financial corporations after initial data cleaning (e.g. removal of short positions). Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds.

Source: NBB, ECB, ISS

Delving into the drivers behind this decline (Graph 2), two key factors emerge. First, both financial corporations and households have reduced their exposure to high-emitting firms. This reallocation of investments accounts for a decrease of approximately 2 million tons of CO_2e for financial corporations and 1.6 million tons for households. Second, the non-financial firms held within these portfolios have lowered their greenhouse gas emissions over the sample period, contributing a negative carbon component of –1.7 million tons of CO_2e for financial corporations and –2.6 million tons for households.

Baseline decomposition Graph 2

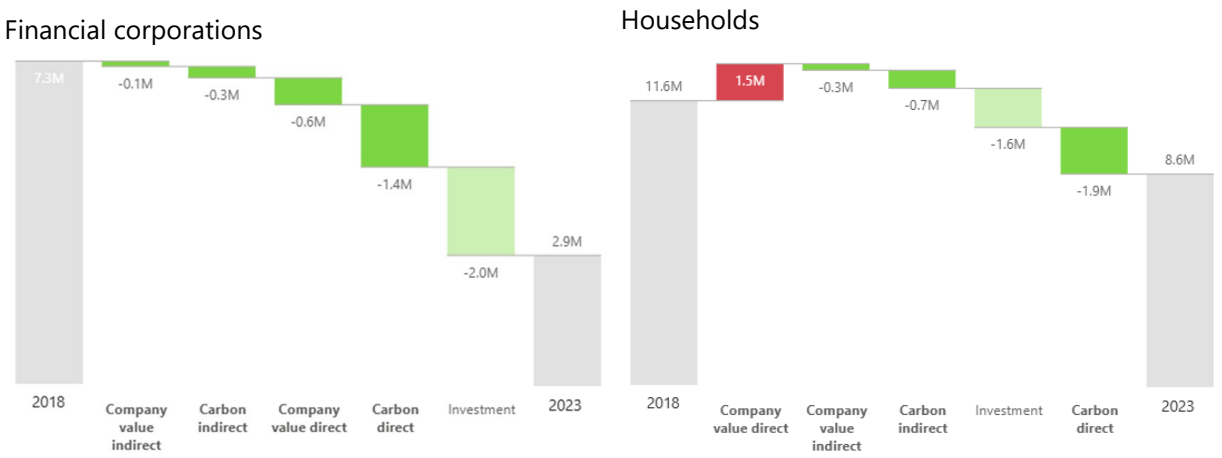


Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds.

Source: NBB, ECB, ISS

These reductions in financed emissions originate from both direct holdings and indirect investments via funds, though Graph 3 reveals that the bulk of the carbon effect stems from directly held firms. Specifically, over 80% of the 1.7 million ton reduction for financial corporations and nearly 75% of the 2.6 million ton reduction for households are attributable to emission cuts by directly invested companies.

Firm characteristics decomposition — Graph 3

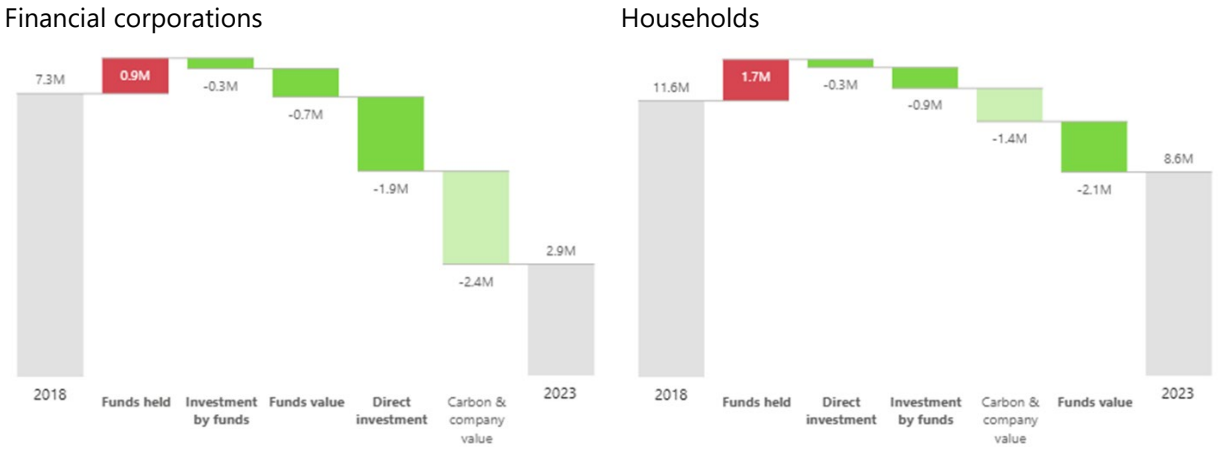


Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds.

Source: NBB, ECB, ISS

An additional noteworthy observation is that all company value components contributing to changes in financed emissions are negative, except for the one in households' direct portfolios. This may suggest that financial corporations and investment funds actively adjust their portfolios to avoid firms in distress, while households tend to follow a more passive investment strategy.

Investment components decomposition — Graph 4



Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds.

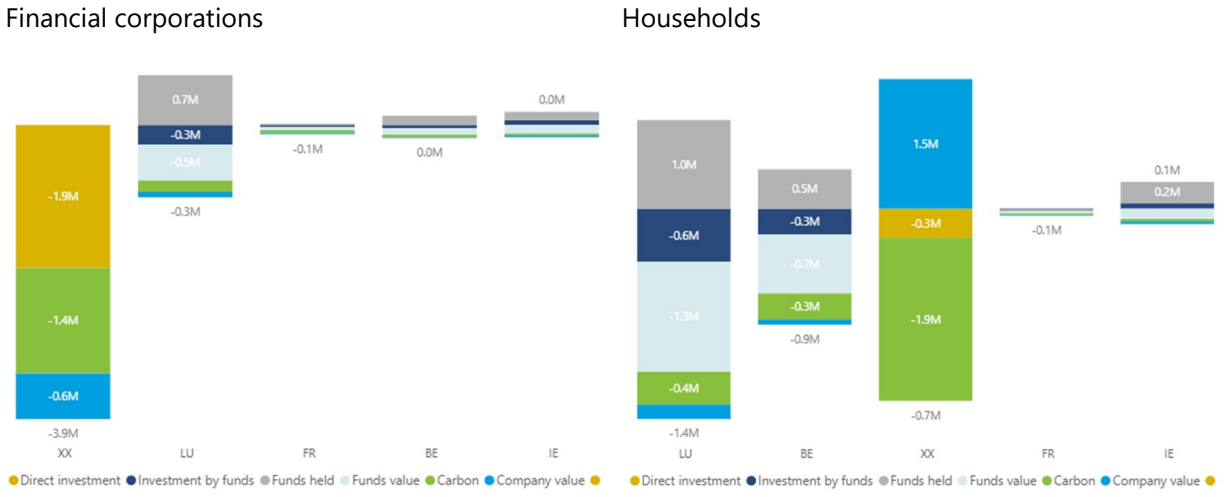
Source: NBB, ECB, ISS

A closer decomposition of the investment component in Graph 2 into direct and indirect effects reveals that the 2 million ton CO_2e reduction in financed emissions by changes in financial corporations' portfolio composition is predominantly driven by adjustments in their direct holdings (left-hand panel of Graph 4). This indicates a reallocation away from high-emitting firms within their directly managed portfolios. In contrast, the decline in household-financed emissions is chiefly attributable to changes in their indirect investments via investment funds (right-hand panel of Graph 4).

Notably, while households have increased their overall investments in funds during the sample period, this has not translated into a proportional rise in financed emissions. This is due to a dilution effect: as the total value of these investment funds has grown, the relative ownership share held by households has diminished. This dynamic results in a net reduction of approximately –0.4 million tons of CO_2e. In addition, the investment funds themselves have shifted their portfolios away from carbon-intensive firms, further reducing household-financed emissions by an estimated –0.9 million tons of CO_2e. Together, these effects underscore the significant role that indirect investment channels can play in shaping the carbon footprint of household portfolios.

Graph 5 provides a detailed summary of our findings by further disaggregating the time series components of financed emissions according to the country of origin of the investment funds held. The right-hand panel reveals that the bulk of the indirect investment effects on households' financed emissions stem from Luxembourgish and Belgian funds, contributing reductions of –1.4 million and –0.9 million tons of CO_2e respectively. This geographic breakdown highlights the pivotal role that cross-border fund allocations play in determining the carbon footprint of household portfolios.

Decomposition by fund country (2018-2023) Graph 5



Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds. Country "XX" on the x-axis refers to direct holdings.

Source: NBB, ECB, ISS

The granularity of this analysis underscores the analytical precision enabled by the decomposition framework – in combination with a look-through approach – in tracing the evolution of financed emissions. By isolating the impact of specific fund jurisdictions, we gain a clearer understanding of how investment flows across borders contribute to decarbonisation. This level of detail not only enhances transparency but also supports targeted policy interventions and investor strategies aimed at accelerating the transition to a net zero economy.

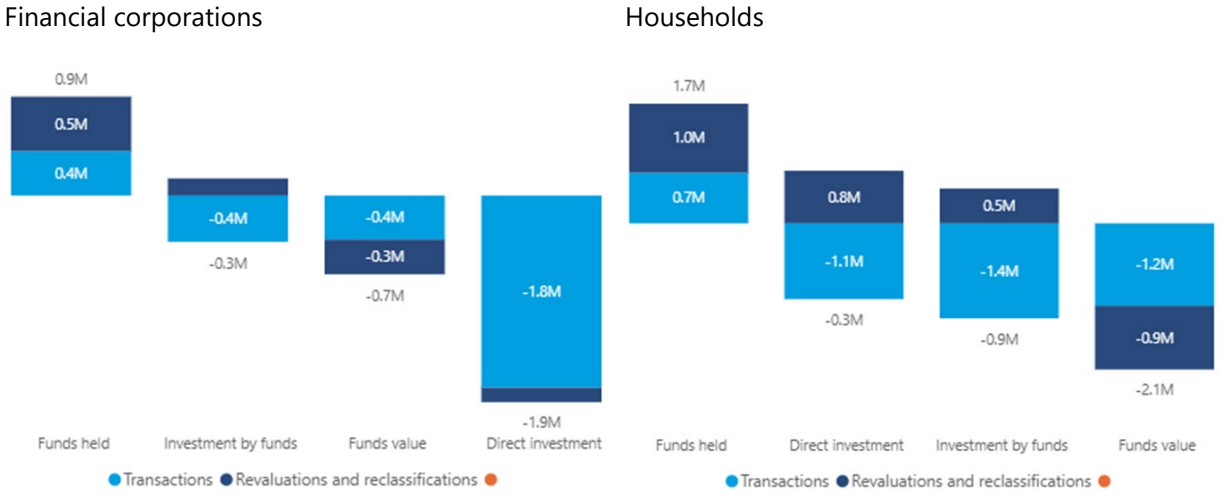
Moreover, the same decomposition logic can be extended to other dimensions of portfolio analysis. For instance, similar breakdowns could be performed by sector or industry of the firms held within the portfolios, revealing which economic activities are most responsive to investor pressure or regulatory shifts. Likewise, country-level emissions effects of the underlying firms could be examined to assess the global reach of domestic investment decisions. These extensions would further enrich the narrative around sustainable finance and provide actionable insights for both policymakers and market participants.

Underlying flows of investment effects

The findings presented in the previous sub-section underscore the influence of investment decisions by financial corporations and households on their financed emissions. Specifically, financial corporations have primarily reduced their exposure to high-emitting firms through adjustments in their direct portfolios. In contrast, households have achieved similar reductions largely through indirect channels, particularly via investment fund holdings.

It is important to recognize, however, that these exposures are measured in market values, which can be influenced not only by actual investment transactions but also by valuation effects. For instance, an investor's exposure may shift due to asset price fluctuations even in the absence of portfolio rebalancing. Additionally, statistical reclassifications – such as correcting a misclassified counterparty from the financial to the non-financial sector – can alter exposure figures without reflecting real-world investment changes. This highlights the need to examine the underlying flows that drive changes in portfolio market values.

Underlying investment flows (2018-2023) Graph 6



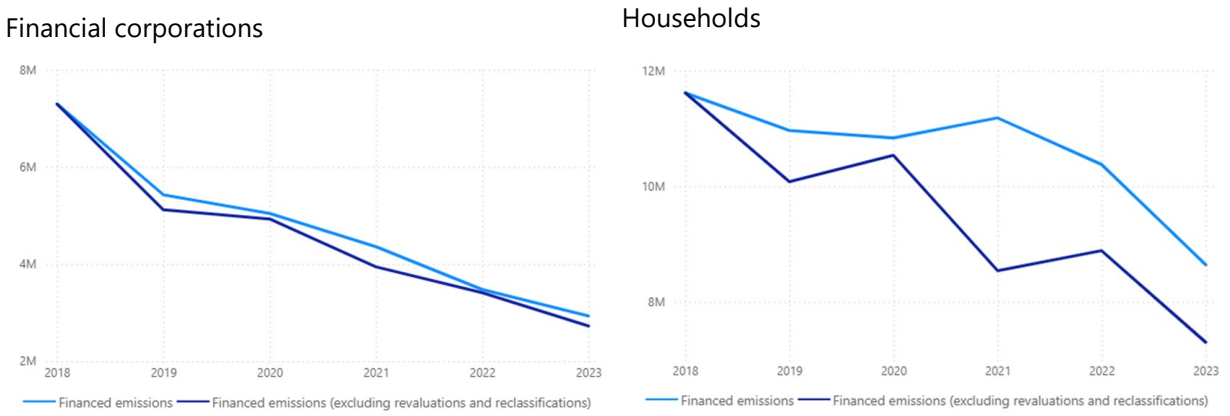
Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds.

Source: NBB, ECB, ISS

Graph 6 disaggregates the investment components underlying the change in financed emissions shown in Graph 4 into transactions and revaluation and reclassifications. The left-hand panel reveals that nearly the entire reduction in financial corporations' financed emissions stemming from direct investments (1.8 million out of 1.9 million tons of CO_2e) is attributable to investment transactions. This indicates a deliberate shift away from high-emitting firms over the sample period.

For households, a surface-level analysis of market value changes (Graph 4) might suggest little movement away from high-emitting firms in their direct portfolios. However, the right-hand panel of Graph 6 tells a more nuanced story; direct transactions led to a substantial reduction in financed emissions (–1.1 million tons of CO_2e), nearly matching the impact of investment fund reallocations. Yet, this effect was offset by positive valuation changes (+0.8 million tons of CO_2e) in households' direct holdings. These findings reinforce the importance of analysing investment flows alongside stock data to accurately assess portfolio decarbonisation. Based on flow data, households did actively steer their direct investments away from high-emitting firms.

Financed emissions: excluding revaluations and reclassifications — Graph 7



Financed emissions are scope 1 emissions expressed in tons of carbon dioxide equivalent (CO_2e). Financial corporations include deposit-taking corporations except the central bank, insurance corporations and pension funds.

Source: NBB, ECB, ISS

The preceding analysis raises an important question: how would financed emissions appear if we excluded revaluation and reclassification effects from the picture? Graph 7 provides a compelling answer. For financial corporations, these effects have minimal influence over the sample period, suggesting that changes in financed emissions are largely driven by actual investment decisions. In contrast, for households, abstracting from revaluation effects leads to a significantly lower estimate of financed emissions, revealing that valuation changes can obscure the true impact of portfolio shifts.

This distinction underscores a broader methodological challenge in monitoring carbon footprints of investment portfolios, namely the importance of correcting for inflation and exchange rate effects when calculating carbon metrics over time.[13] However, the findings here suggest that inflation correction to firms' financials alone is not sufficient. Revaluation effects – stemming from asset price fluctuations unrelated to investor actions – can similarly distort the interpretation of carbon metrics.

5. Concluding remarks

As the financial sector advances toward a net-zero future, the tools wielded by today's carbon trackers must be as sharp as those of any lawman riding the plains. The decomposition method applied in this article, paired with a look-through approach, offers a powerful framework for tracing the carbon trails left

[13] Inflation and exchange rate adjustments ensure that changes in carbon indicators reflect real economic activity rather than nominal price movements (see e.g. Janssen et al. (2022), Shimfe et al. (2024) and Statistics Committee Expert Group on Climate Change and Statistics and Working Group on Securities (2024a)).

by investment portfolios. By disentangling the effects of firms' financials, their carbon reductions, investment flows and revaluation dynamics, this toolkit enhances transparency and supports more informed investment strategies.

A key methodological insight is the importance of accounting for revaluation effects. While inflation adjustments are increasingly used to refine carbon metrics, they alone may not capture the full picture. Revaluation effects can similarly distort the interpretation of portfolio decarbonisation, highlighting the need for more nuanced approaches in carbon accounting. Adjusting for revaluation effects enables a more accurate attribution of changes in a portfolio's carbon profile to genuine investment decisions, rather than to shifts in asset valuations beyond investor control. By equipping investors and policymakers with sharper tools and clearer metrics, we can ensure that the journey toward a net-zero economy is guided not only by ambition, but by analytical precision.

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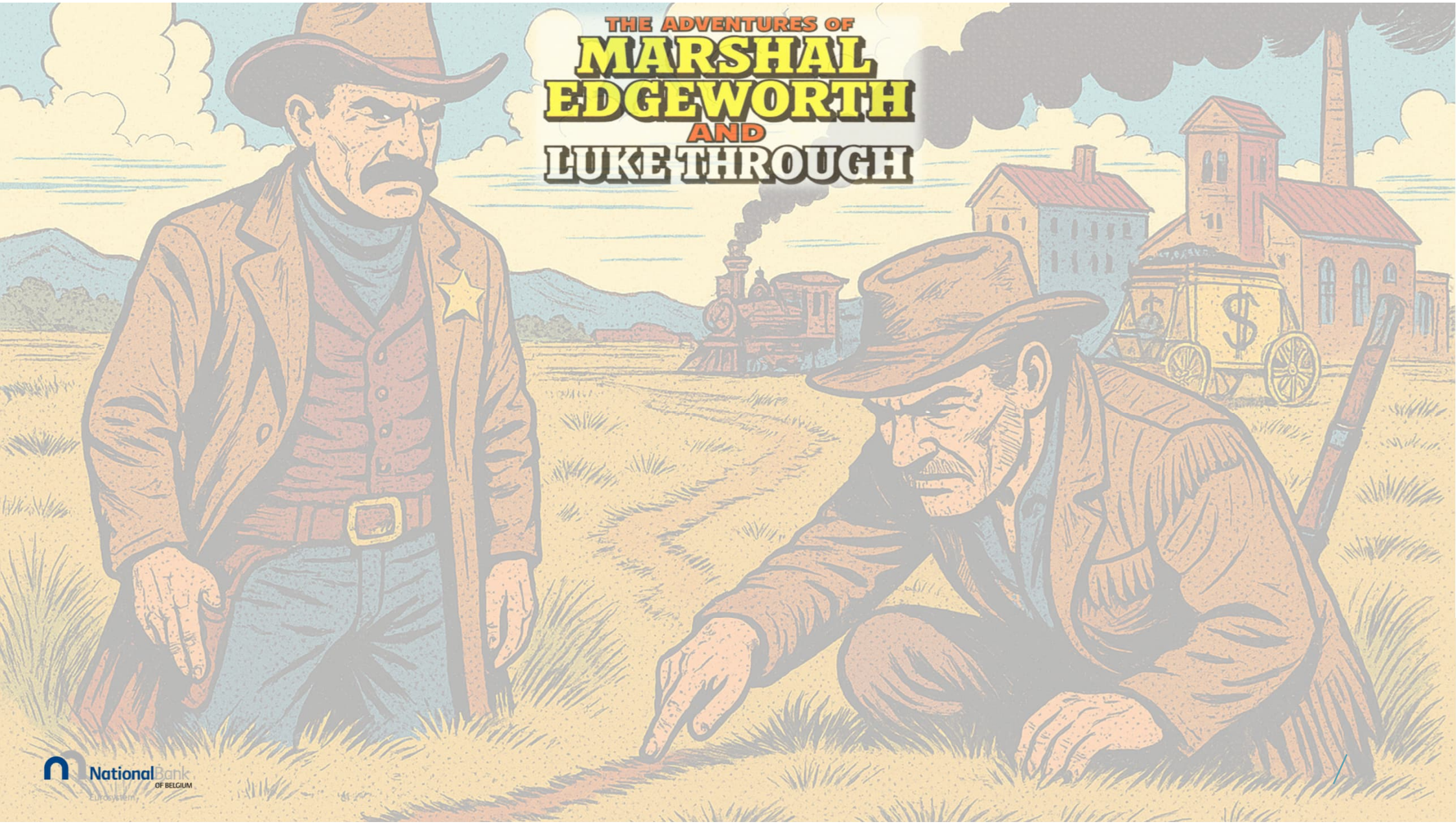

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THE ADVENTURES OF
MARSHAL EDGEWORTH
AND
LUKE THROUGH
Carbon profile of investment portfolios
Marshall-Edgeworth decomposition
Look-through approach

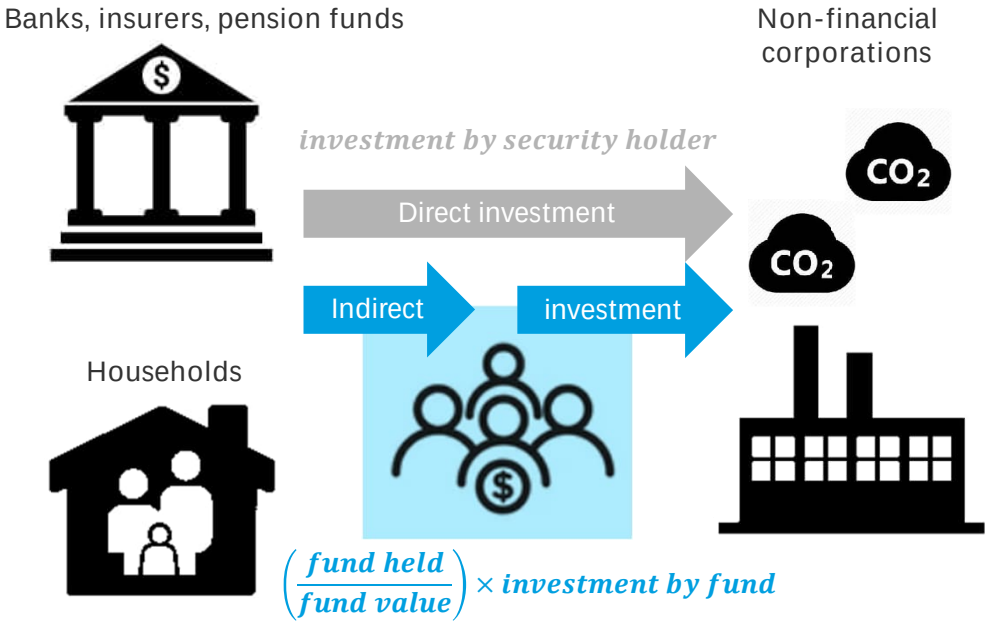
Toolkit for investors and financial supervisors (including central banks) for

1. Monitoring investment portfolios' carbon profile and exposure to transition risk
2. Evaluating the greening of the financial sector and its contribution to a net zero economy
3. Facilitating data validation and storytelling

Key insights on corporate emissions financed by Belgian financial corporations' and households

1. Corporate securities portfolios held by Belgian financial corporations and households are showing a decline in financed emissions
2. Including indirect investments significantly increases corporate financed emissions
3. Emission reductions by directly invested firms have beneficial impact on financed emissions
4. Direct investment transactions drive down emissions financed by financial corporations
5. Indirect investments via Luxembourgish and Belgian funds play a key role in reducing household-financed emissions…
6. … though aligned direct transactions highlight the need to examine underlying flows

Belgian financial corporations and households hold corporate securities both directly and through funds



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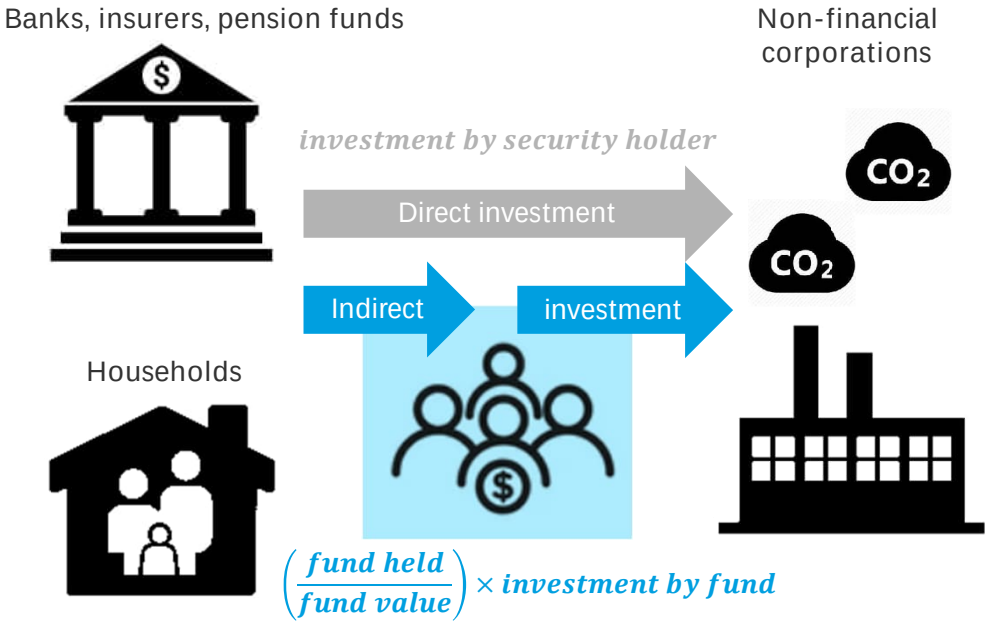
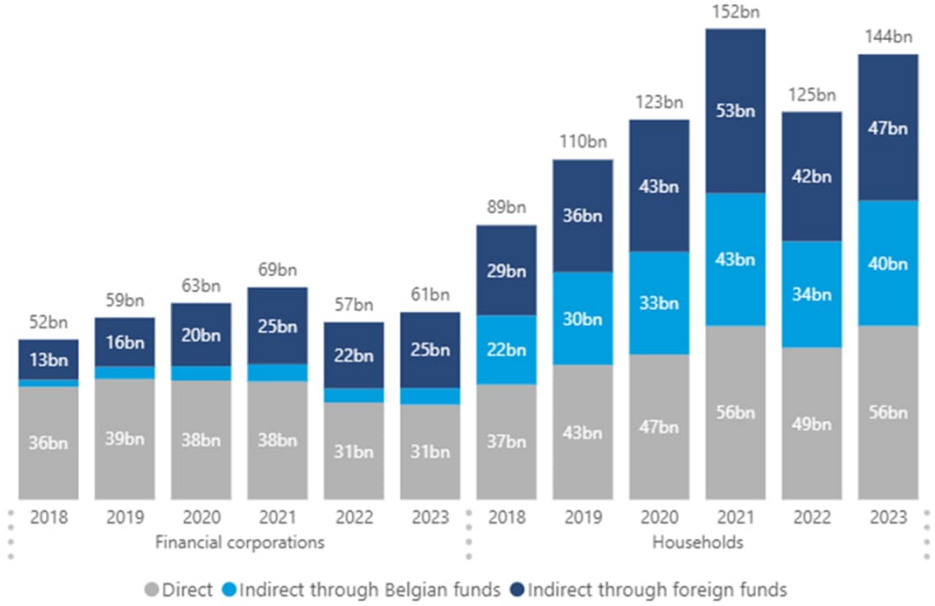


Direct and indirect investment in non-financial corporations



Source: NBB, ECB, ISS

Including indirect investments significantly increases corporate financed emissions

Financed emissions

$$= \boldsymbol{carbon\ emissions} \times \left(\frac{\boldsymbol{investment}}{\boldsymbol{company\ value}} \right)$$

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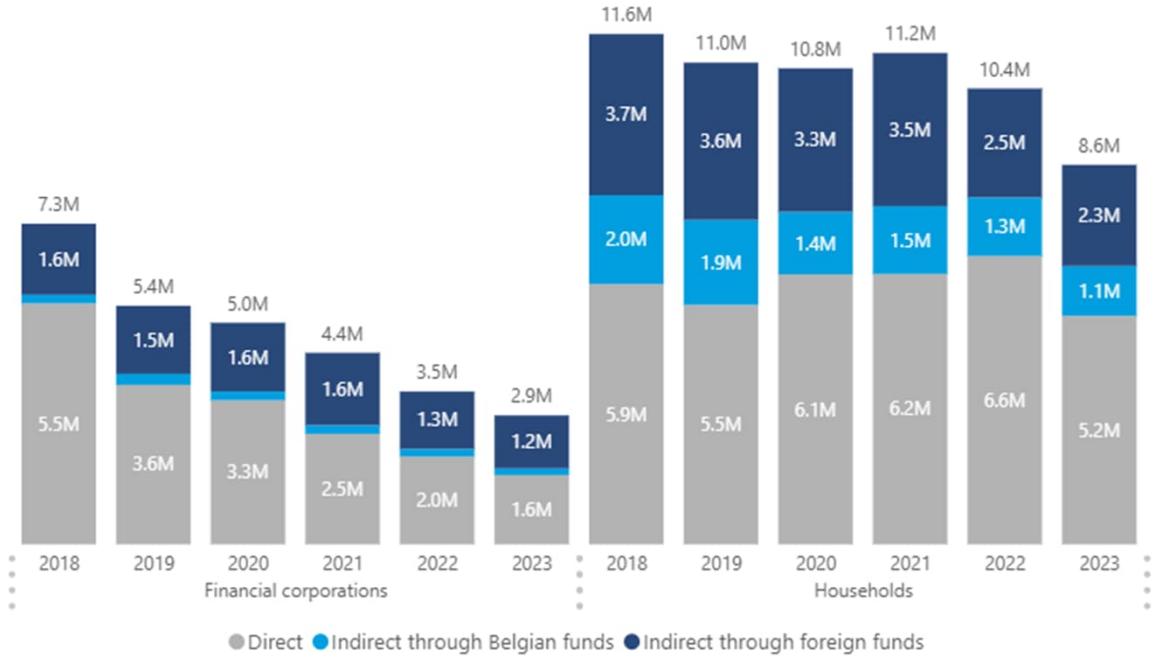
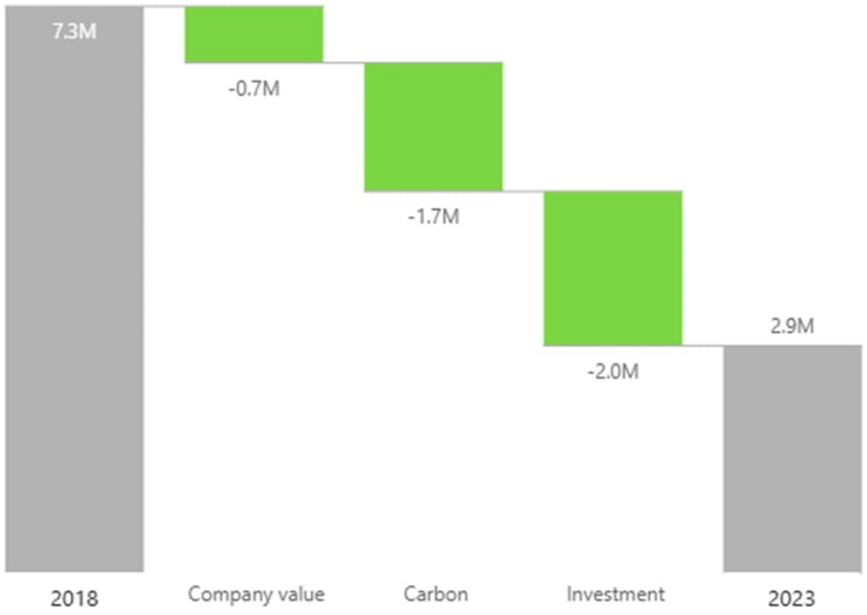
Directly and indirectly financed corporate emissions (scope 1)



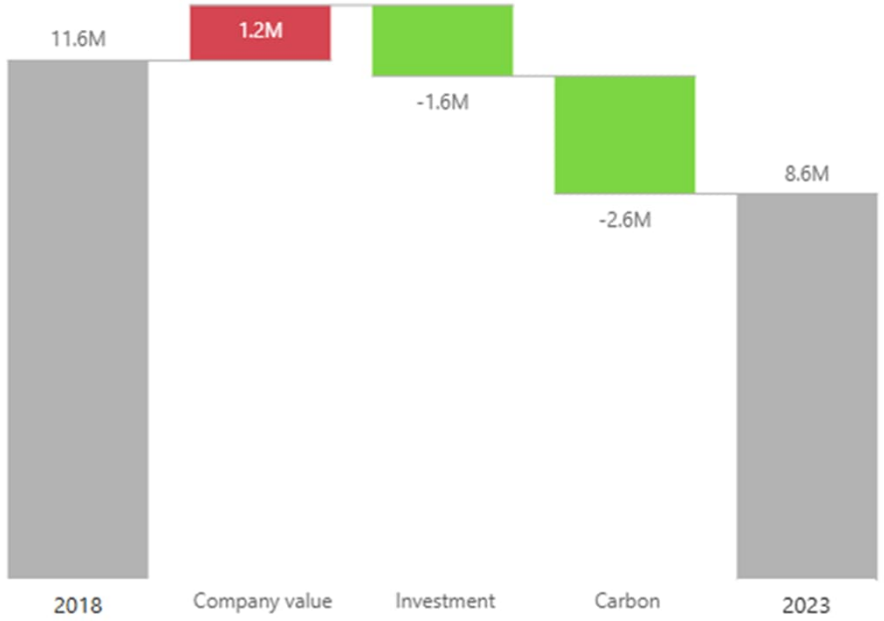
Source: NBB, ECB, ISS

Investment decisions and carbon emission reductions are the main drivers of declining financed emissions

Financial corporations: baseline decomposition



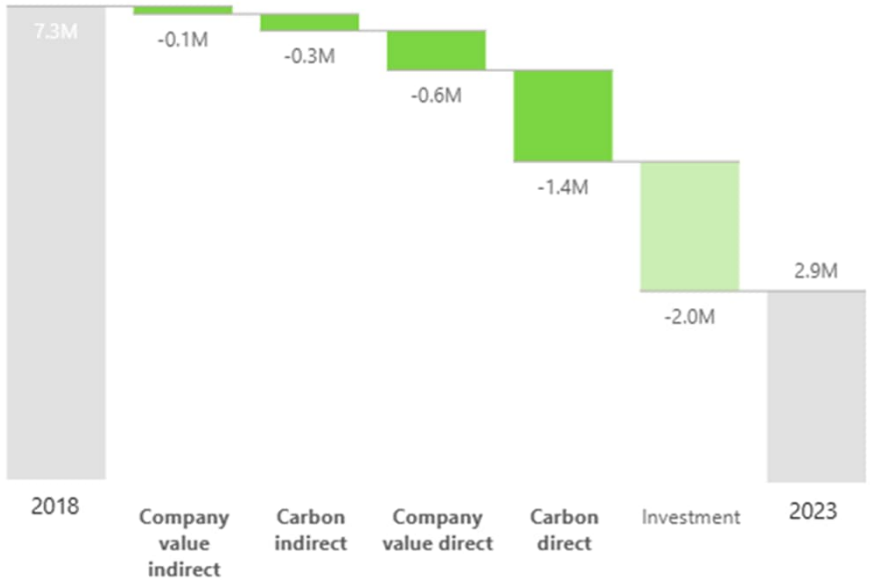
Households: baseline decomposition



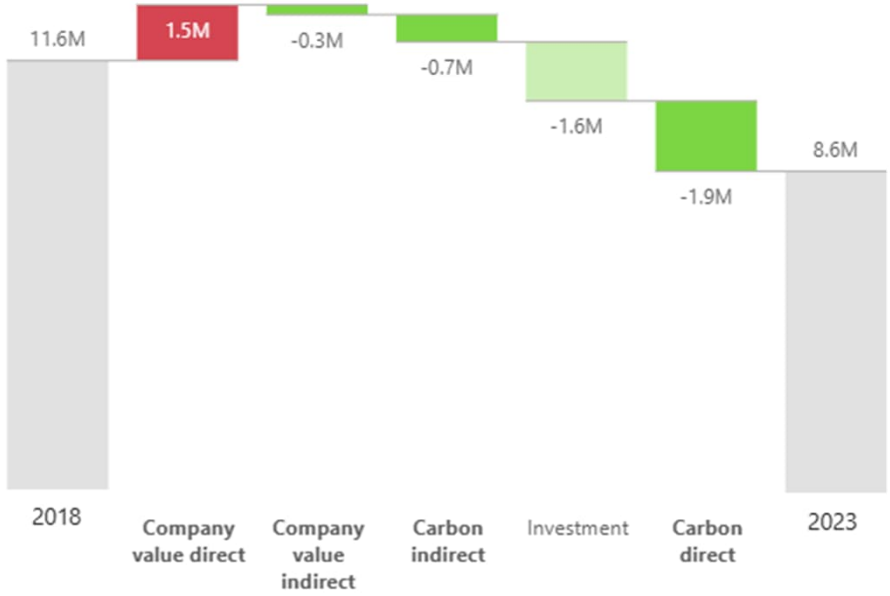
Source: NBB, ECB, ISS

Beneficial impact of emission reductions stems mainly from directly invested firms

Financial corporations: firm characteristics decomposition



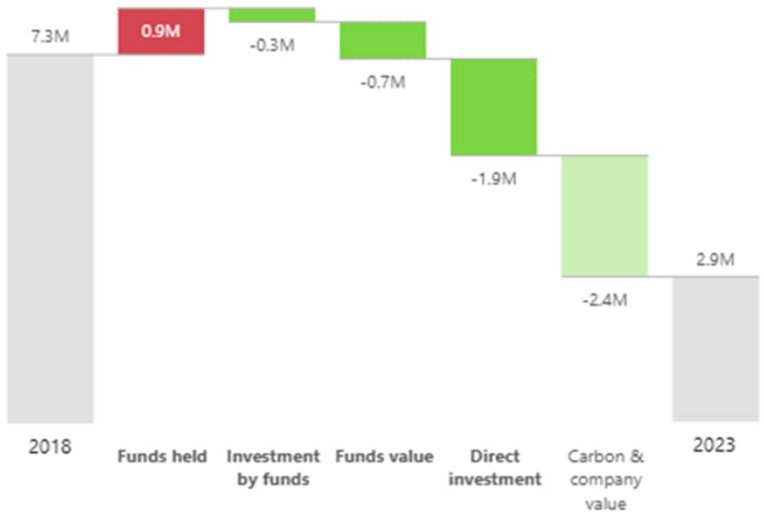
Households: firm characteristics decomposition



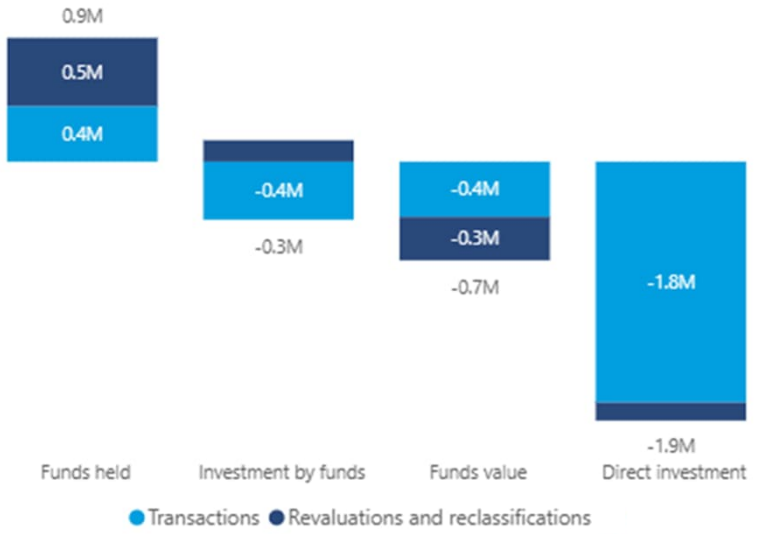
Source: NBB, ECB, ISS

Direct investment transactions have most pronounced impact on emissions financed by financial corporations

Financial corporations: investment components decomposition



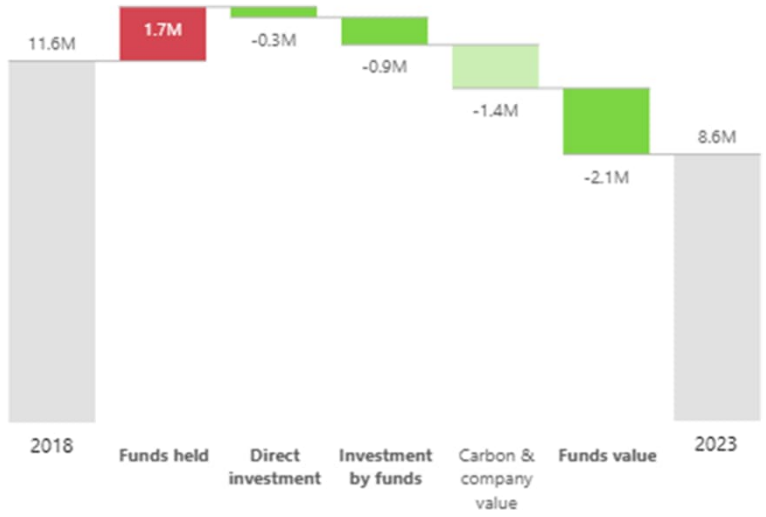
Financial corporations: underlying investment flows (2018-2023)



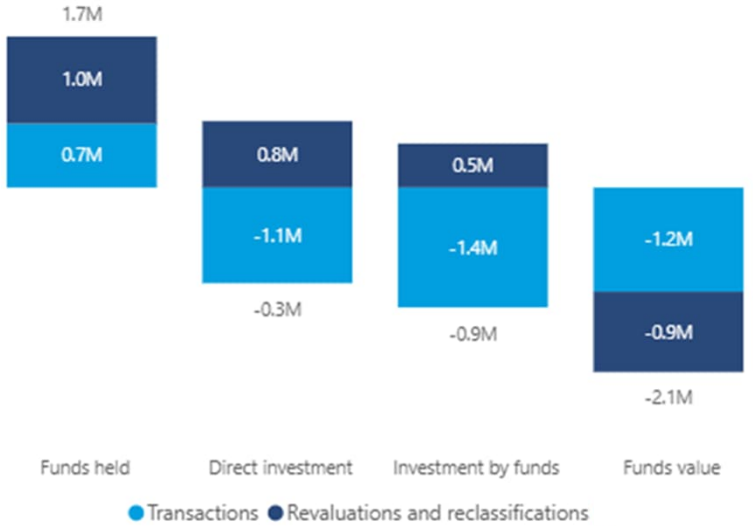
Source: NBB, ECB, ISS

Indirect investments play a key role in reducing household-financed emissions, though aligned direct transactions highlight the need to examine underlying flows

Households: investment components decomposition



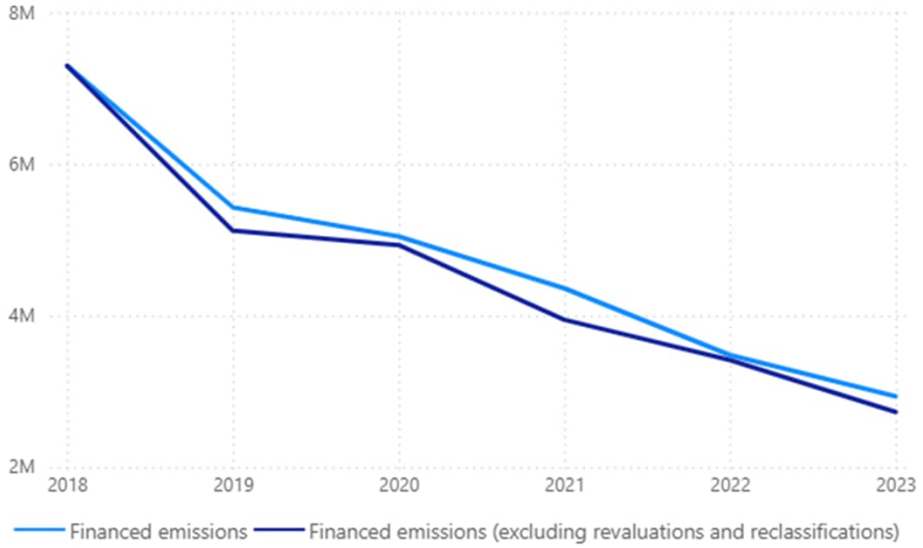
Households: underlying investment flows (2018-2023)



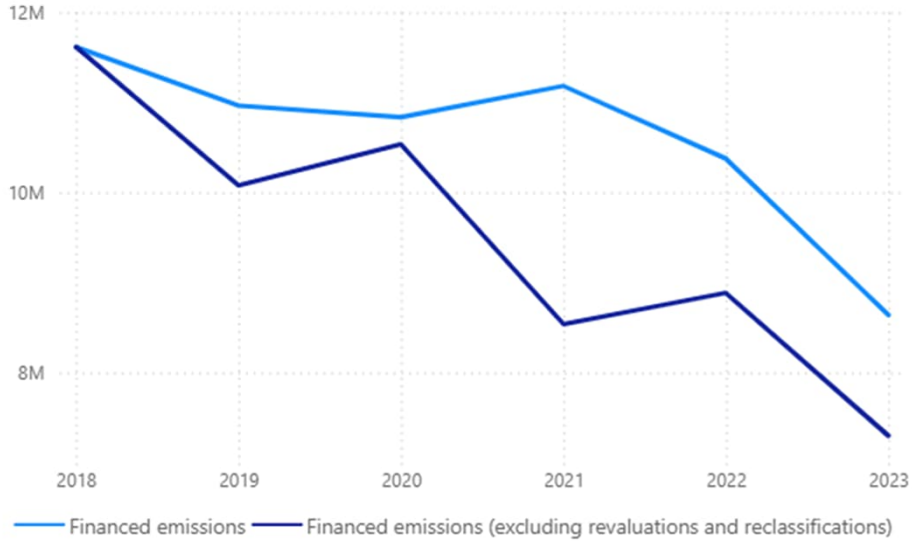
Source: NBB, ECB, ISS

Filtering out revaluation and reclassification effects reveals even stronger decline in financed emissions

Financial corporations: excluding revaluations and reclassifications



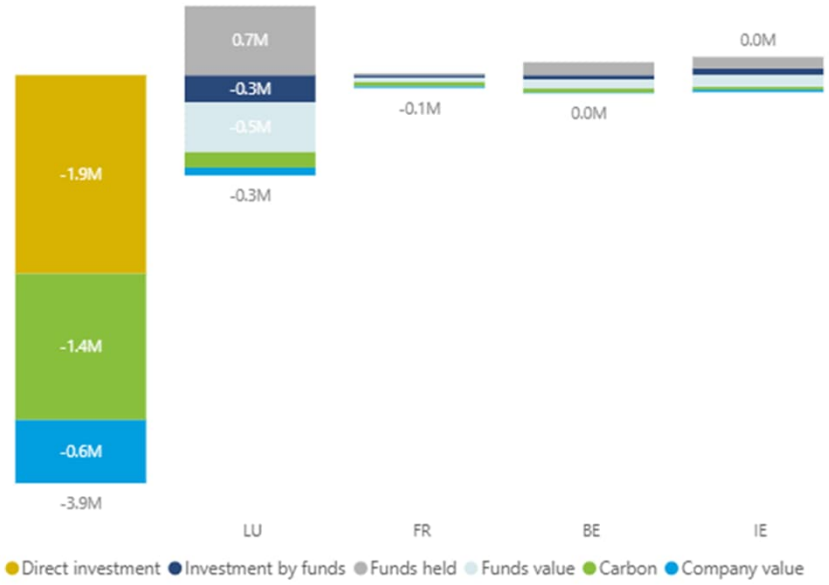
Households: excluding revaluations and reclassifications



Source: NBB, ECB, ISS

The marshal and his tracker: precision in pursuit along the carbon trails of the great investment plains

Financial corporations: decomposition by fund country (2018-2023)



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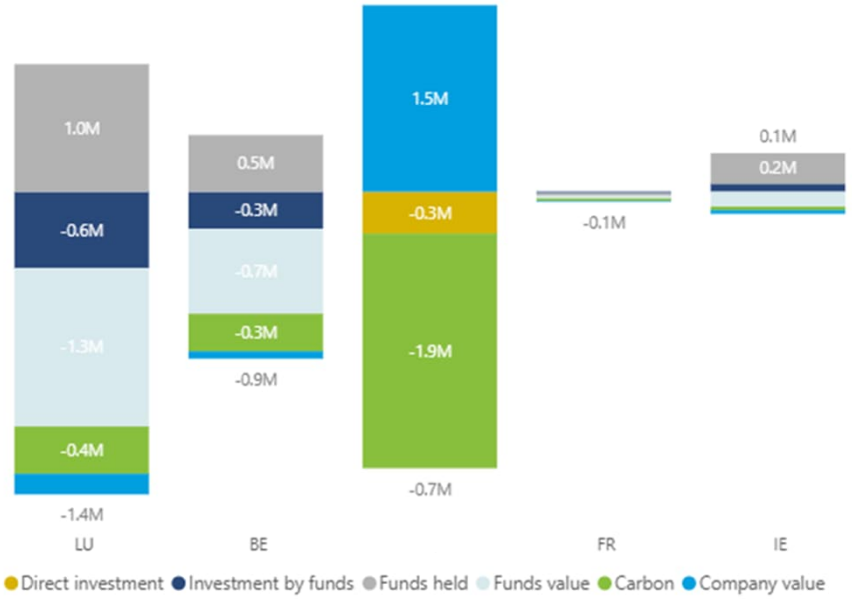

Source: NBB, ECB, ISS

CONCLUSIONS AND WAY FORWARD

The Marshall-Edgeworth decomposition provides a powerful framework for monitoring the carbon profile of investment portfolios

Way forward

1. Data improvements (e.g. holdings of individual (Belgian) funds rather than sectoral holdings)
2. Application to other carbon measures (e.g. weighted average carbon intensity)
3. Further deep-dives for data validation (e.g. assessing impact of data imputations) and storytelling