[tra:ce]
International Center for
Sustainable and Just Transformation
Universität Witten/Herdecke

**[tra:ce] Working Paper Series**

**WP No. 1**

March 2025

# Out of the light, into the dark: how ‘shadow carbon financing’ hampers the green transition and increases climate-related systemic risk

Simon Schairer, Jan Fichtner, Riccardo Baioni, David Castro, Nicolás Aguila, Janina Urban, Paula Haufe, Joscha Wullweber

universität
Witten/Herdecke

# Out of the light, into the dark: how ‘shadow carbon financing’ hampers the green transition and increases climate-related systemic risk

Simon Schairer[a] (simon.schairer@uni-wh.de) Jan Fichtner[a] (jan.fichtner@uni-wh.de), Riccardo Baioni[a] (riccardo.baioni@uni-wh.de), David Castro[b] (dc.ioa@cbs.dk), Nicolás Aguila[a] (nicolas.aguila@uni-wh.de), Janina Urban[a] (janina.urban@uni-wh.de), Paula Haufe[a] (paula.haufe@uni-wh.de), Joscha Wullweber[a] (joscha.wullweber@uni-wh.de)

[a]University of Witten/Herdecke, Department of Philosophy, Politics, and Economics, Germany.
[b]Copenhagen Business School, Department of Organization, Centre for Organizations, Markets and Governance, Denmark.

Corresponding author: simon.schairer@uni-wh.de

ABSTRACT

Recent years saw major regulatory efforts to steer the financial system towards financing the transition to a net-zero carbon economy and phase out carbon financing. However, EU regulation focuses primarily on preventing greenwashing of retail funds and decarbonizing the banking system, while leaving the nexus of offshore finance and the shadow banking system untouched. These blind spots seriously undermine regulatory efficacy because offshore finance enables the obfuscation of financial flows, while shadow banking facilitates alternative financing to high carbon-emitting firms. Drawing on qualitative expert interviews and financial market data, the paper explains how the offshore-shadow-banking nexus hampers the green transition by introducing the concept of ‘shadow carbon financing’, which can operate through the following channels: (1) loan securitization, (2) emissions risk transfers, (3) bond financing, (4) carbon asset partitioning, (5) offshore corporate wealth chains, (6) private credit, and (7) proved developed producing reserves securitization. We demonstrate several instances of financial flows moving away from regulated and transparent forms of financing to less regulated and more opaque shadow carbon financing channels. Consequently, we argue that shadow carbon financing may also pose substantial systemic risk, as climate-related risks (e.g., stranded assets) increasingly accumulate in less regulated parts of the financial system.

KEYWORDS: sustainable finance, offshore finance, shadow banking, green transition, climate-related risks, systemic risk.

## Funding

The research was funded by the German Research Foundation (DFG) under the Heisenberg Professorship Programme, reference WU 780/2-1, and the German Federal Ministry of Education and Research (BMBF) under the programme “Climate Protection & Finance (KlimFi)”, reference 01LA2207A

## Acknowledgments

The authors would like to thank Alison Schultz, Sebastian Mack and participants at SASE 24 conference at University of Limerick as well as Finance & Society conference at the University of Sheffield for valuable feedback and comments. We would also like to thank all our interviewees for the time and effort they have taken to talk to us and share their expertise.

## Suggested citation

Schairer, Simon/ Fichtner, Jan/ Baioni, Riccardo/ Castro, David/ Aguila, Nicolás/ Urban, Janina/ Haufe, Paula/ Wullweber, Joscha (2025): Out of the light, into the dark: how ‘shadow carbon financing’ hampers the green transition and increases climate-related systemic risk, *[tra:ce] Working Paper* No. 1, Available at SSRN.


The International Center for Sustainable and Just Transformation [tra:ce] is an inter- and transdisciplinary research hub dedicated to fostering research, education, and societal dialogue on sustainability and justice.
Based at Witten/Herdecke University, the [tra:ce] connects scholars, practitioners, and policymakers to drive transformative change. Through innovative projects and collaborations, it aims to develop actionable solutions for global sustainability and justice challenges.

More information:
https://www.uni-wh.de/trace/https://www.instagram.com/trace_uwh/

## Introduction

In the landmark 2015 Paris Agreement policymakers ascribed a pivotal role to the financial system in driving the green transition, urgently calling for 'making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development' (UN, 2015). Subsequently, the EU introduced financial regulation that aimed to shift financial flows towards more sustainable aims (Ahlström & Monciardini, 2022). These regulatory efforts are essentially based on two principles: First, non-financial and financial disclosure obligations, which are supposed to enhance the transparency of financial products and thereby enable informed and deliberate sustainable investment decisions by financial investors (Ameli et al., 2020). Second, active monitoring and managing of banks' climate-related financial risks that are meant to improve the pricing-in of these risks and thus facilitate portfolio shifts towards more sustainable financial assets in line with prudential regulation (van't Klooster & Prodani, 2025).

Prima facie, these efforts to increase transparency and shift financial flows towards a Paris-aligned trajectory seem to bear fruit, as fossil fuel financing by banks decreased slightly since its peak in 2021, especially in Europe (Reghezza et al., 2022; Cojoianu et al., 2021; Rickman et al., 2024; RAN, 2024). However, as banks withdraw from fossil fuel financing, other financial market players are filling the gap (McKillop, 2024), and oil and gas firms are turning to alternative financing (Porter & Deveau, 2021). For instance, in 2021, Gulf oil majors were able to raise US$28 billion for their fossil fuel business in private capital markets. A particularly puzzling example in that episode was the case of Saudi Aramco partly tapping ESG-funding for its oil pipeline business via complex financial engineering involving off-balance sheet vehicles registered in Luxembourg, an EU member state – but also an offshore financial center (OFC) (Garcia-Bernardo et al., 2017). According to the analyst who uncovered the scandal, it is 'likely that Aramco's motivation was to try to access the cheaper capital available in opaque private markets' (Ritchie, 2023). Another example includes the surge of private credit to the industry, pointing towards a 'larger trend whereby an ever-greater share of fossil-fuel finance – and the associated emissions – are taking place out of public view' (White, 2024a). In both cases, the opacity inherent in the shadow banking system and offshore finance is crucial for reorganizing and disguising financing structures, thus enabling the continuation of carbon financing by other means.

Despite the topicality, relevance and magnitude of these developments, there has still been little research on this topic so far. This paper aims to fill this lacuna by analyzing how carbon financing flows and ensuing climate-related financial risks (Caldecott et al., 2021; Campiglio et al., 2022) may shift from the regulated, public, and more transparent financial system towards unregulated, private and rather opaque parts of the system. It argues that the above instances form part of a growing trend that undermines the green transition and increases systemic risk. International Political Economy (IPE) scholarship has conceptualized parts of these unregulated constituents of the global financial system as 'offshore finance' from a state-centered perspective (Palan et al., 2010; Sharman, 2010; Binder, 2023), whereas others focused on the 'shadow banking system' from a rather systemic perspective (Pozsar et al., 2010; Mehrling et al., 2013; Gabor, 2016; Wullweber, 2024). Despite their largely separated intellectual emergence, in practice, both phenomena are highly intertwined and 'functionally central to the daily operation of the global financial system' (Palan & Nesvetailova, 2014, p. 31) – forming an 'offshore-shadow-banking' nexus (Haberly and Wójcik, 2017). In the past, these structural constituents of the contemporary global financial system have already been associated with financial instability (Pozsar, 2013; Lysandrou and Nesvetailova, 2015; Haberly and Wójcik, 2017), the redirection and obfuscation of financial flows for purposes of 'regulatory arbitrage' or 'tax evasion' (Palan et al., 2010) as well as environmental degradation (Galaz et al., 2018; Atiles & Whyte, 2025).

We add a new dimension to this debate by arguing that the offshore-shadow-banking nexus redirects carbon financing flows to continue business as usual but outside of public attention and regulatory oversight. To capture this phenomenon, we introduce the concept of *shadow carbon financing* and distinguish it from other existing concepts in the literature. Via seven distinct channels, it describes the redirection and obfuscation of carbon financing flows via alternative financial actors, entities, and instruments – often registered in OFCs. We posit that shadow carbon financing occurs in a bidirectional flow, from the supply (of financing) side, by banks, and from the demand (of funding) side, by firms. On the supply side, it occurs when a regulated financial entity (commercial bank) derecognizes a loan or associated climate-related financial risk to high carbon emitting firms. On the demand side, it occurs when a high carbon-emitting firm relinquishes ownership of carbon assets or accesses financing via non-bank financial intermediaries (NBFI) from the shadow banking system.

Thus, the paper aims to offer a systematic overview of the actors and practices involved in shadow carbon financing. Our work deepens the theoretical connections between offshore finance and shadow banking by building on the earlier works of Palan and Nesvetailova (2014) and Haberly and Wójcik (2017), while also conceptualizing their relation to carbon financing. Hence, the paper pioneers research into an array of issues that merit further examination and aims to stimulate a debate among academics (Gözlügöl & Ringe, 2023), financial practitioners (Allison, 2021), and relevant stakeholders (McKillop, 2024; Vacarro, 2024; Schultz & Mager, 2024). We develop our concept of shadow carbon financing and the seven different channels via which it operates primarily by drawing on 88 expert interviews with asset managers, banks, institutional investors, regulators and non-governmental organizations (NGOs). This is complemented by a content analysis of financial press articles and the use of various kinds of data by commercial providers and NGOs. This allows us to demonstrate several instances of a shift in financing flows from regulated and visible to less regulated and more opaque financing channels.

In the following sections, we first discuss the pertinent IPE literature and introduce our integrated perspective of the offshore-shadow-banking nexus. This enables us to develop our concept of shadow carbon financing in the third section. Fourth, we present and analyze seven different channels through which it can operate. Fifth, we argue that shadow carbon financing may increase systemic risk as climate-related financial risks increasingly accumulate outside the regulated financial system. In conclusion, we call for more regulatory attention and further research on these dynamics.

## The ‘offshore-shadow-banking’ nexus in IPE

This section first outlines the concept of the shadow banking system in IPE literature and augments it with a focus on its capital market dimension. In a second step, we discuss the concept of offshore finance with regard to overlaps with the shadow banking system.

### *The shadow banking system*

The global financial crisis of 2008 gave rise to a burgeoning literature on the complex interweavements of the global financial system known as ‘critical macro-finance’ (Dutta et al., 2020) that seeks to analyze the evolutionary built-up of systemic risk and financial instability through stylized balance-sheet analysis – spawning the key concept of the ‘shadow banking system’ (Pozsar et al., 2010; Mehrling et al., 2013). The Financial Stability Board (2011, p. 1) defines shadow banking as ‘credit intermediation involving entities and activities outside the regular banking system’, however, unlike regular banking, shadow banking draws on ‘money market funding of capital market lending’ (Mehrling et al., 2013, p. 2). Vice versa, from an asset

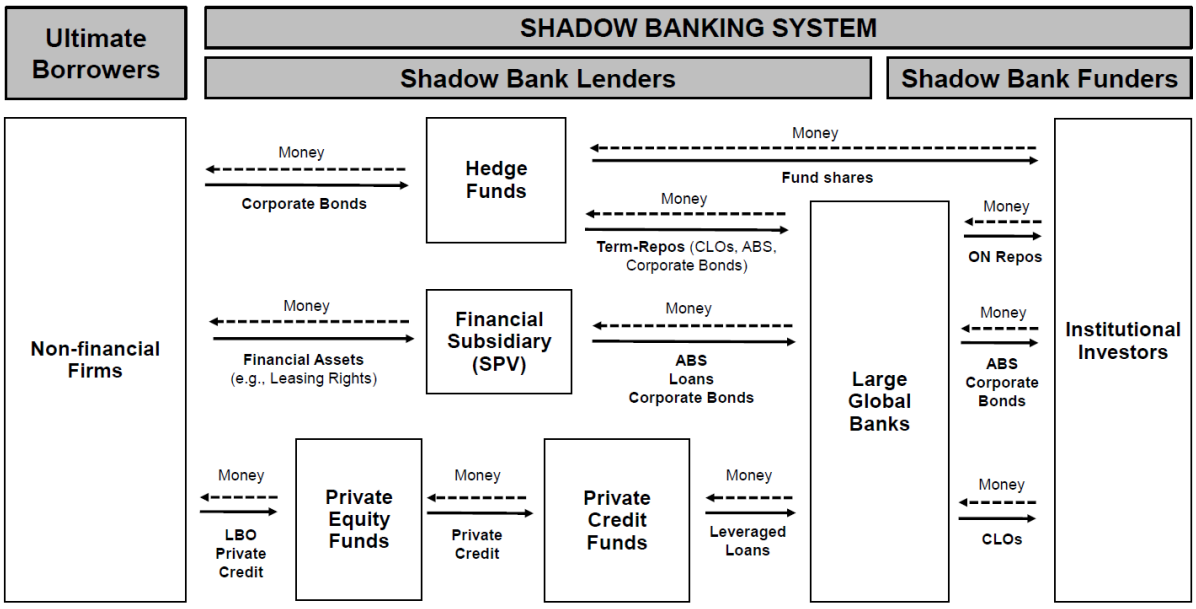
perspective, IPE scholars capture shadow banking as the production of tradable securities linked to funding via collateral-based liquidity creation in repo markets and ultimate passing through to institutional investors (Gabor, 2016; Lysandrou & Nesvetailova, 2015). These contributions see the demand from institutional cash pools for investable debt claims as a main driver of the continuing growth of the shadow banking system (Pozsar, 2013). Shadow banking has grown more rapidly than the regular banking system and roughly equals the latter in size by now, with the share of global financial assets of NBFI standing at 49.1% at end-2023 (FSB, 2024).

However, the bulk of the shadow banking literature has a strong focus on the money market side as the central locus of the financial crisis, after having initially unfolded in the US subprime housing market, that is, in capital markets (Murau, 2017). Conversely, the capital market side of shadow banking has been explored far less, not least because the 'revolution' in bank funding that began in the 1960s with the rise of liability management enabled large global banks to dramatically increase leverage and expand their balance sheet by tapping money markets (Knafo, 2021). Yet, this evolution towards market-based banking also enabled (investment) banks to provide such leverage to NBFIs that operate in capital markets (such as hedge funds), particularly via repo-markets (Sgambati, 2019). In this way, large global (investment) banks function as 'market-makers' at the intersection of money and capital markets (Mehrling et al., 2013; Wullweber, 2024). At the same time, innovations on the asset side of bank balance sheets, such as securitization, allowed banks to tap shadow bank funding to move loans off-balance sheet (Lysandrou & Nesvetailova, 2015).

Based upon these considerations, we focus on three groups of actors operating on the capital market side of the shadow banking system. First, financial subsidiaries of both banks and non-financial multinational corporations (MNCs). Banks often temporarily create separate legal entities off-balance sheet called special purpose vehicles (SPVs) to which they transfer illiquid loans and turn them into tradable asset-backed securities (ABS) – a process called securitization (Lysandrou & Nesvetailova, 2015). MNCs also use financial subsidiaries permanently integrated into their corporate structure to either conceal conventional financing or access alternative financing (Schultz & Mager, 2024). Second, private equity and credit funds increase leverage via secured bank loans (so-called 'leveraged loans') to conduct leveraged buyouts (LBOs), finance mergers and acquisitions (M&A) or grant private credit. Leveraged loans typically provide between 60–80% of the necessary financing for LBOs and are mostly refinanced via securitization into collateralized loan obligations (CLOs), which are then sold on to NBFIs such as institutional investors (Sissoko, 2023). Third, hedge funds refinance and leverage their securities portfolio (including ABS, corporate bonds and CLOs) by posting them as collateral in term repos with market-makers (Sgambati, 2024).

Figure 1 illustrates the stylized constellation of these actors and the instruments linking them to each other on the capital market side of the shadow banking system, connecting borrowers (non-financial firms) with leveraged NBFIs (shadow bank lenders) and institutional investors (shadow bank funders). The latter may also fund leveraged NBFIs via money market instruments, such as overnight (ON) repos (see e.g., Murau, 2017).

**Figure 1.** Stylized depiction of the capital market side of the shadow banking system.




Legend: LBO = Leveraged Buyout; SPV = Special Purpose Vehicle; ABS = Asset-backed Security; CLO = Collateralized Loan Obligation; ON Repos = Overnight Repurchase Agreement

Source: Authors' own illustration.

### *Offshore finance*

The concept of 'offshore finance' goes back to 1957 when the Bank of England *de facto* created a regulatory space outside of its jurisdiction by treating US-dollar denominated transactions between City of London banks as if taking place elsewhere – or 'offshore' (Burn, 2006; Green, 2016). Accordingly, the IMF (2000) defines offshore finance as 'the provision of financial services by banks and other agents to non-residents' such as e.g., 'lending to corporates and other financial institutions, funded by liabilities to offices of the lending bank elsewhere, or to market participants'. Apart from this 'non-resident' principle, OFCs are typically jurisdictions with low taxation and lax financial regulation (especially disclosure and reporting requirements), thus rendering financial flows, ownership, and liabilities largely invisible to the public and regulators (Binder, 2023). This opacity enables global financial institutions, MNCs and high-net-worth individuals to employ 'calculated ambiguity' in their financial accounts to avoid taxation and regulatory oversight (Sharman, 2010). These features render OFCs pivotal nodes in what Seabrooke and Wigan (2017) have termed 'global wealth chains' that facilitate the extraction, relocation and concentration of pecuniary wealth regardless of the underlying global value chains (Bair et al., 2023). For instance, a case study on profit extraction of private equity funds from care homes in France, Germany and the UK has shown that the OFCs of Luxembourg and Jersey are crucial in this process (Bourgeron et al., 2021).

This example also suggests that offshore finance and shadow banking are interlinked, an issue that has so far only been sparsely discussed in IPE literature (for notable exceptions, see Palan & Nesvetailova, 2014; Fernandez & Wigger, 2016; Haberly & Wójcik, 2017). Despite these notable exceptions, there does not yet exist a thorough theoretical conceptualization of the nexus between both phenomena. Palan and Nesvetailova (2014) suggest a certain equivalence between the two in functioning as 'black holes' of the global financial system – with their gravity attracting half of the world's capital flows that then disappear behind a veil of opacity. Departing from these findings, other accounts aimed to open the black box of OFCs further to differentiate between classical tax havens and pass-through jurisdictions: while the majority of OFCs serve as 'sinks' to global capital flows, a handful of mostly advanced capitalist

countries rather function as ‘conduit’ jurisdictions, in particular the Netherlands, Luxembourg, and Ireland – frequently utilized by MNCs and global financial institutions in their financing operations (Garcia-Bernardo et al., 2017).

This conduit-function of OFCs provides an analytical entry point to understanding the strong interlinkages between the shadow banking system and offshore finance. For instance, prior to the global financial crisis, OFCs were disproportionately involved in hosting crisis-prone SPVs that issued the most unstable asset classes (Haberly & Wójcik, 2017). SPVs are typically set up offshore for regulatory and tax arbitrage purposes (Lysandrou & Nesvetailova, 2015). Likewise, most hedge funds are legally based in OFCs in the Caribbean while their managers operate from New York or London (Fichtner, 2016), pointing towards deliberate ‘regulatory positioning’ in offshore jurisdictions to launch novel financial products or instruments (Fichtner & Morgan, 2023). Furthermore, private equity and credit funds as well as institutional investors rely heavily on OFCs to conduct their operations and invest capital (Bourgeron et al., 2021; Fernandez and Wigger, 2016; White, 2024b). Taken together, this suggests that OFCs play a key role in the shadow banking system.

Therefore, Haberly and Wójcik (2017) suggest that ‘offshore-shadow-banking’ is rather characterized by the ability of OFCs to foster Minskyian financial and concomitant regulatory ‘innovation’ than merely regulatory arbitrage or tax evasion. This also points to the role of the offshore-shadow-banking nexus in the inherent evolutionary built-up of financial instability (Dafermos et al., 2023) and the systemic need for regulatory and institutional innovation in response to it (Schairer, 2024). A contemporary instance of such Minskyian financial ‘innovation’ emerging out of the offshore-shadow-banking nexus involves disguising and rerouting fossil fuel financing flows, resulting in less regulatory oversight and the continuance of carbon business as usual – underlining the continuing importance of opacity, secrecy and obfuscation as one of offshore finance’s core principles.

## The concept of shadow carbon financing

The offshore-shadow-banking nexus also underpins the institutional infrastructure of fossil fuel financing, which stood at least at US$ 705.8 billion globally in 2023 (RAN et al., 2024). Large global banks utilize offshore-shadow-banking to channel financing towards high carbon-emitting firms – in fact, 68% of fossil fuel financing provided by the world’s 60 largest banks is being granted to corporate subsidiaries in OFCs (Schultz & Mager, 2024).

There are several concepts describing related but distinct phenomena regarding the financing of carbon emissions via parts of the offshore-shadow-banking nexus. The term ‘financial carbon leakage’ has been discussed by a few contributions (Blanchard & Tirole, 2021; IEA, 2024), but there is not yet a uniform definition. In general, financial carbon leakage describes the fact that capital is easily substituted in contemporary global finance, i.e., when some banks stop to provide credit to carbon-intensive firms, other banks usually step in (Reghezza et al., 2022; Rickman et al., 2024); similarly, when sustainability-minded investors divest from publicly listed fossil fuel firms other investors buy the divested shares with the effect that high-carbon assets do not have a significantly higher cost of capital (Blanchard & Tirole, 2021). Financial carbon leakage can happen within jurisdictions or across borders, given that capital mobility is high in most high-income economies. The IEA (2024) has recently suggested ‘financial carbon leakage’ to describe the potential increase in cross-border lending by banks from capital markets with more lax environmental regulation towards hard-to-abate sectors in comparably tighter regulated jurisdictions. However, this term does not comprise the crucial dimension of shadow banking, instead remaining in the sphere of the regulated banking system.

This dimension was in turn captured as ‘emissions laundering’ due to loopholes in climate-related financial disclosure (Vacarro, 2024), but the concept lacks any reference to the offshore component that complicates the proper accounting of financing flows and ownership relations even in the case of conventional financial business. In a recent report by the Tax Justice Network, Schultz and Mager (2024) introduced the term ‘greenlaundering’ to cover exactly this aspect by arguing that OFCs are instrumental to obfuscate banks’ fossil fuel exposure from the public and regulators. However, their work leaves out key elements of shadow banking by excluding private equity and confining the scope of their research to financing enabled by banks.

To address these shortcomings and explain how offshore-shadow-banking is hampering both private-led decarbonization of listed corporations (Fichtner et al., 2025) and government-led efforts to advance the green transition via regulation (Chenet et al, 2021), we introduce the concept of shadow carbon financing. To develop our new concept, we proceeded in three steps. First, we evaluated the existing literature from IPE, economics, economic geography and related fields as well as the pertinent financial press and NGO reports. We looked specifically for market actors and (new) financial instruments whose primary or secondary function is to provide financing to fossil fuel firms and/or to avoid emerging climate-related regulation. Second, we interviewed 88 experts working for asset managers, banks, institutional investors, regulators and NGOs in Belgium, France, Germany, Italy, the Netherlands, Switzerland, the UK, and the US. We achieved access to the interviewees through personal referrals and subsequent snowball sampling. Through an inductive content analysis, triangulated with the relevant academic literature, the financial press and the use of descriptive data by commercial providers and NGOs, we identified potential channels via which offshore-shadow-banking is undermining the green transition.

This approach allowed us to develop the concept of shadow carbon financing. It describes the obfuscation and/or redirection of carbon financing flows via alternative financial actors, entities, and instruments that are part of the offshore-shadow-banking nexus. On the supply side, it occurs when a regulated financial entity (commercial bank) derecognizes a loan or associated climate-related financial risk to high carbon-emitting firms. On the demand side, it occurs when a high carbon-emitting firm relinquishes ownership of carbon assets or accesses financing via non-bank financial intermediaries (NBFI) from the shadow banking system. Based upon this distinction, we identify seven different channels through which shadow carbon financing operates (see Table 1). The first two channels constitute *risk management* techniques and are primarily used by banks, whereas the other five channels are about creating *alternative financing* for carbon-intensive firms. All forms of shadow carbon financing have in common that they enable the continuance of carbon financing ‘by other means’, respectively the circumvention of regulatory attempts to steer financial flows away from carbon-intensive activities. All seven channels will be discussed below in more detail.

**Table 1.** Channels of shadow carbon financing.

| Channel | Actors/Entities | Instruments | Logic |
|---|---|---|---|
| (1) Loan securitization | commercial banks, SPVs, institutional investors | ABS, CLOs | *risk management* |
| (2) Emissions risk transfers | commercial banks, hedge funds | carbon emissions-weighted risk transfers, synthetic securitization (SRT) | *risk management* |
| (3) Bond financing | fossil fuel MNCs, investment banks, institutional investors | corporate bonds | *alternative financing* |
| (4) Carbon asset partitioning | fossil fuel MNCs (subsidiaries), private equity funds | LBOs, mergers & acquisitions, CLOs | *alternative financing* |
| (5) Offshore corporate wealth chains | fossil fuel MNCs (subsidiaries), commercial banks institutional investors | loans, bonds, equity | *alternative financing* |
| (6) Private credit | (small) fossil fuel firms, private credit funds, institutional investors | private credit | *alternative financing* |
| (7) PDP securitization | (small) fossil fuel firms, investment banks, institutional investors | PDP reserves ABS | *alternative financing* |

Source: Authors' own elaboration.

## Channels of shadow carbon financing

In this section, we present and discuss the seven different channels through which shadow carbon financing can occur. We begin with the two risk management channels and then proceed with the five alternative financing channels.

*Loan securitization*

In general terms, securitization is a process in which assets are transferred to an SPV, usually called 'originator', which can pool and repackage previously non-marketable assets into an interest-bearing security. In a so-called 'true sale' securitization this process entails selling the illiquid assets (e.g. loans), to an SPV that then issues ABS and sells them to institutional investors or other NBFIs (e.g., hedge funds). The purchasers of the ABS then receive the interest from the underlying assets. As long as they can generate a relatively steady and predictable cash flow, a multitude of assets can play the role of underlying assets, including physical ones. In this subsection, our focus lies on 'on balance sheet securitisation', and particularly on loans as underlying assets in what we term *loan securitization* by banks.

Against this background, this section argues that loan securitization may be increasingly used as a means of shadow carbon financing: banks are using securitization to distribute 'carbon' assets to less regulated shadow banking actors, to shift 'carbon emissions risk' (the associated climate-related financial risk; see Caldecott et al, 2021; Campiglio et al.,

2022) off their balance sheets via securitization, free up capital, as well as present balance sheets with fewer 'financed emissions' (the greenhouse gas emissions associated with their loans) to improve their reputation (Cusano et al., 2024; Müller et al., 2024). As one interviewee put it, 'securitisation, it feels like it's coming back into fashion' (Interview 82).

Müller et al. (2024) focus on banks' corporate carbon-intensive syndicated loans offloaded to collateralized loan obligation (CLO) managers. First, they find that banks are significantly more likely to securitize a loan if the borrowers' carbon emission intensity or level increases. Second, using the election of Donald Trump in 2016 as an exogenous shock that reduces carbon emissions risk, they show that banks are less likely to securitize high-carbon loans compared to other loans in an environment characterized by lower transition risk. Third, they show – contrary to expectations of financial supervisors (Interview 85) – that securitization is not enabling banks to fund more green loans.

Crucially, the authors argue that 'regulatory efforts that aim to reduce lending to carbon-intensive borrowers can be circumvented by transferring such loans to shadow banks which, in turn, has the potential to undermine the effectiveness of bank climate policies' (Müller et al., 2024, p. 1). A similar study focusing on the Italian securitization market shows that 'banks' securitized loans to carbon-intensive economic activities grew much more rapidly than green activities suggesting that banks preferred to keep loans to green activities on their balance sheet and to derecognize loans to less sustainable ones' (Cusano et al. 2024, p. 7). Besides the inherent link to shadow banking, loan securitization is also linked to OFCs. The Netherlands and the Cayman Islands, two of the most central OFCs (Garcia-Bernardo et al., 2017), already rank among the top five jurisdictions involved in securitization identified by Cusano et al. (2024). Loan securitization may thus facilitate the shift of climate-related financial risk from the transparent and regulated banking sector to the much less transparent offshore-shadow-banking sector.

*Emissions risk transfers*

Instead of outrightly transferring loans from their balance sheet to NBFIs, banks may also employ other forms of risk-management techniques to rid themselves of the credit risk attached to loans, including those to carbon-intensive firms. In a so-called 'synthetic' or 'on-balance sheet' securitization the bank retains ownership of the assets, remaining on its balance sheet. However, the credit risk – typically the first loss tranche – is transferred to investors to achieve a 'significant risk transfer' (SRT) and hedge credit risk. Usually, those assets that are not easy to sell in a true sale securitization are involved in a 'synthetic' securitization, such as trade finance, lending to small-and-medium sized enterprises, etc. (Interview 9). SRT poses an instance of shadow carbon financing because financial flows move from regulated and transparent forms of financing to less regulated and more opaque ones: the market for SRT has grown to more than US$ 1 trillion in size but the 'magnitude of the interconnections' between the banking and the shadow banking system 'is difficult to assess because the market remains opaque, with only a fraction of deals being made public and no centralised repository for data on SRTs' (Wigglesworth, 2024).

Regarding carbon-credit risk in particular, a new financial technique has recently emerged that also has the potential to facilitate a shift of carbon emissions risk from quite transparent and regulated segments of the financial system to less regulated and less transparent actors from the shadow banking system. The novel and still emerging instrument is called emissions-weighted risk transfers and reportedly has been pitched by hedge funds to commercial banks (White, 2024b; Levine, 2024). In such an emissions risk transfer, banks would essentially shift the climate-related financial risks of the loans that they have made to carbon-intensive companies to actors outside of the regulated banking system. Thus, these

instruments allow banks to effectively outsource the carbon emissions risk by passing it on to investors, akin to a credit default swap (Interview 74): in case the asset becomes stranded (Caldecott et al., 2021), the party holding the emissions-risk after the transaction pledges to reimburse the bank for the losses the bank has incurred from the loan (White, 2024b).

Such a transaction would allow banks to reduce their financed emissions and thus cut the carbon footprint of their balance sheets in front of regulators, which is especially relevant for banks in Europe, where climate-related financial regulation is more advanced than in other jurisdictions (RAN et al., 2024; Rickman et al., 2024). Notwithstanding the fact that the rules and guidelines on how to assign monetary value to such climate-related financial risk are still in progress, it seems likely that hedge funds and banks will pursue such transactions in the coming years (Interview 80, 82, 86). More research is needed to determine the precise consequences of such emissions risk transfers, but observers believe that they have the clear potential to circumvent regulatory attempts to steer financial flows away from high carbon activities and to obfuscate climate-related financial risk, as an emissions-weighted risk transfer 'isn't innovation, this is engineering,' with '[t]he purpose […] to cut the link between emissions and risk,' but the result may 'threaten both direct action and the steer of sustainable finance'(cited in White, 2024b).

Moreover, such emissions risk transfers could potentially make the global financial system more crisis-prone as climate-related financial risks are shifted from transparent financial entities to opaque actors from the shadow banking system. These first two channels of shadow carbon financing constitute risk management techniques and are mainly used by large banks; the following five channels are primarily about creating alternative financing for carbon-intensive firms.

*Bond financing*

Carbon-intensive firms can draw on various instruments to access alternative financing via shadow banking. However, in the oil and gas industry, there exists a crucial difference in financing structures between large MNCs (both privately and nationally owned) on the one hand, and smaller 'independent' oil companies on the other (Hanieh, 2024). While the former may utilize a global web of subsidiaries to source financing via corporate bonds and other instruments for the overall corporate group (Casey, 2014), the latter can typically not rely on large corporate balance sheets and concomitant investment-grade credit ratings. Therefore, they either tap private credit markets or collateralize their productive assets through securitizations (see following subsections).

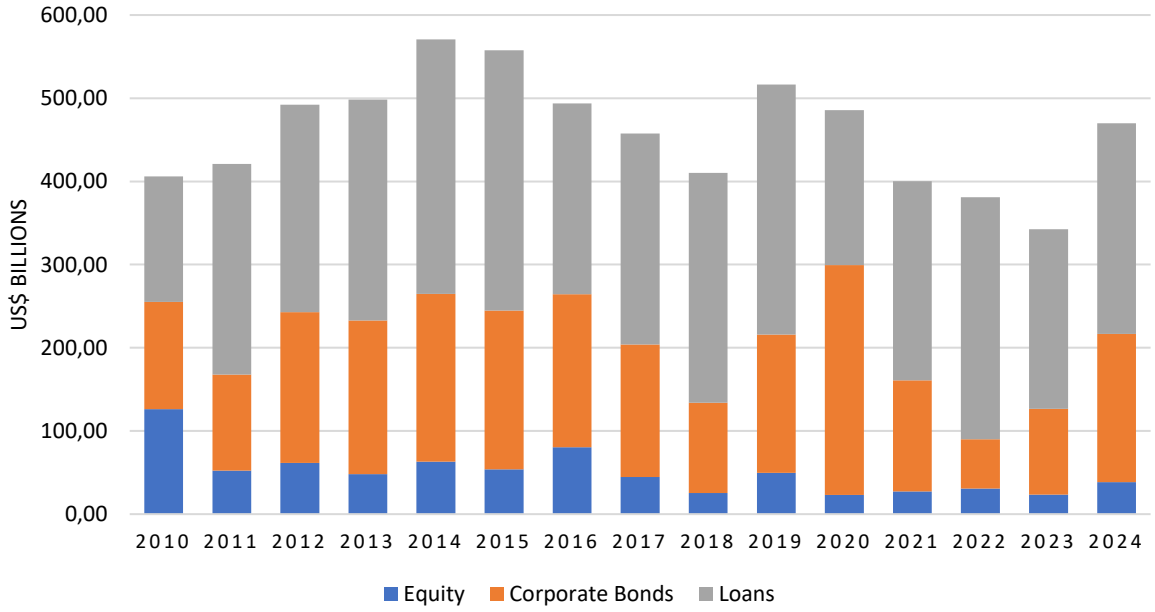
Corporate bonds constitute a well-developed capital market instrument, rendering it a convenient choice for MNCs to access financing from institutional investors and other NBFIs. Additionally, corporate bonds require less reporting and scrutiny than bank loans because bonds are typically not issued for a specific project but against the overall cash flow of a corporation's balance sheet. Arms-length market relations and the fact that credit risk is shared among multiple investors also means that MNCs need to make less concessions to get funding than for bank loans (Altunbaş et al., 2010). Crucially, access to a broader investor base across several world regions may also enable fossil fuel MNCs to access financing where climate-sentiment is less pronounced, e.g., from sovereign wealth funds of major petrostates such as Qatar, the UAE or Saudi Arabia (Interview 21, 31, 39, 69, 70). Because bond financing is typically not earmarked as carbon-intensive but rather hidden behind more generic tags such as 'general corporate purposes', MNCs may conceal the ultimate use of proceeds (Schultz & Mager, 2024). As one interviewee working at a large global bank confirmed to us, bond financing is attractive to fossil fuel MNCs 'because that's where you can hide it [financed emissions]' (Interview 45).

In fact, only 3% of fossil fuel financing by the world's 60 largest banks between 2016 and 2022 took the form of project finance (disclosing its carbon content), whereas 41% were corporate loans (general purposes), and 56% investment banking activities, i.e., by underwriting corporate bond or equity issuance (RAN et al., 2024). For banks, corporate bond underwriting does not occupy costly balance sheet space contrary to every loan made and kept on the bank's ledger. Furthermore, bond financing does typically not count into banks' financed emissions because (investment) banks typically do not hold corporate bonds on their books, as one interviewee working at a large British bank clarified: 'We're just an intermediary facilitator' (Interview 46). Instead, they only 'hold them for a logical second' (Interview 31) upon issuance to then immediately pass them on to other investors (Interview 26, 39). Therefore, it is often quite hard to tell even for banks themselves how many emissions they have financed or facilitated exactly, as one interviewee from a large global US bank stated:

> [...] if somebody asked us the question, how much money do you lend to the coal industry? You know, you wouldn't believe how long it could take to answer that question. Like a simple thing. But, you know, the reality is there's all these things floating around in the air [such as] securities and [...] pretending that you can kind of track all that, I think, has always been challenging for us (Interview 80).

In 2023, corporate bond issuance by the largest fossil fuel MNCs since the Paris Climate Agreement in 2015 amounted to more than €1 trillion (Joosten et al., 2023), while cumulative total bonds issuance by coal, oil and gas companies almost stood at US$3 trillion by the end of 2022 (Flinders and Buller, 2023). In 2020, corporate bonds have become the primary source of financing for fossil fuel MNCs ahead of bank loans that used to dominate fossil fuel financing in the years before (see Figure 2). Subsequently, plummeting fossil fuel demand due to the Covid-19 pandemic and record profits of the fossil fuel industry following the Russian invasion of Ukraine have on the one hand contributed to lowering fossil fuel MNCs' financing needs – at first due to lower demand, later due to record profits and concomitant retained earnings to finance operations independently – while on the other hand, rising interest rates in response to soaring inflation rendered corporate bonds less attractive because of potentially locking-in high interest rate payments in the long run.

**Figure 2.** Global fossil fuel funding by source in US$ billions.




Source: LSEG data, GOGEL (Urgewald).

Arguably, a contributing factor to this development until 2020 – the heyday of sustainability efforts in the financial industry – is that bond underwriting allows banks to reconcile the opposing objectives of decarbonizing their balance sheets without losing profitability (Aguila et al., 2024). Bond financing epitomizes the dilemma of competition between the regulated and the shadow banking system underlying shadow carbon financing, as 'shadow banks are typically involved in two-thirds' of the entire refinancing process of corporate bond issuance, distribution and holding (Plender & Fray, 2024). This comprises NBFIs such as insurers that prefer low-risk fixed-income portfolios including investment-grade rated corporate bonds (Cataldi, 2023) but also hedge funds that are very active in US fixed income trading (Fichtner & Morgan, 2023). As captured by one interviewee working at a large global bank: 'someone else will do it because it's profitable' (Interview 39). Another interviewee told us:

> Even if banks pull back: all they're going to do is underwrite, and if they don't underwrite, someone else will underwrite, or they'll just do private transactions. Let's say every investment bank, public investment bank and bank in the world said, we're not going to do any more fossil fuel financing. I guarantee you 20 bankers from all these places would set up a new shingle and just step right in. The markets will just find a way (Interview 70).

OFCs are also central to corporate bond markets, as the example of Abu Dhabi's national oil company (ADNOC) illustrates, which raised US$10 billion in capital from a private equity (Brookfield) and sovereign wealth fund (Singapore) via an SPV registered in an OFC (Jersey) that in turn issued bonds to tap the ESG-funds of Goldman Sachs as well as Legal & General (Ritchie, 2023). Another example from a systematic investigation of 1,600 fossil fuel bonds issued since 2015 by NGOs and international media involved the British, Irish and Luxembourg branches of a large global bank funding Norwegian Aker BP – and the authors stress that almost all bonds in their database reflected an 'amalgam of jurisdictions' (Joosten et al., 2023).

*Carbon asset partitioning*

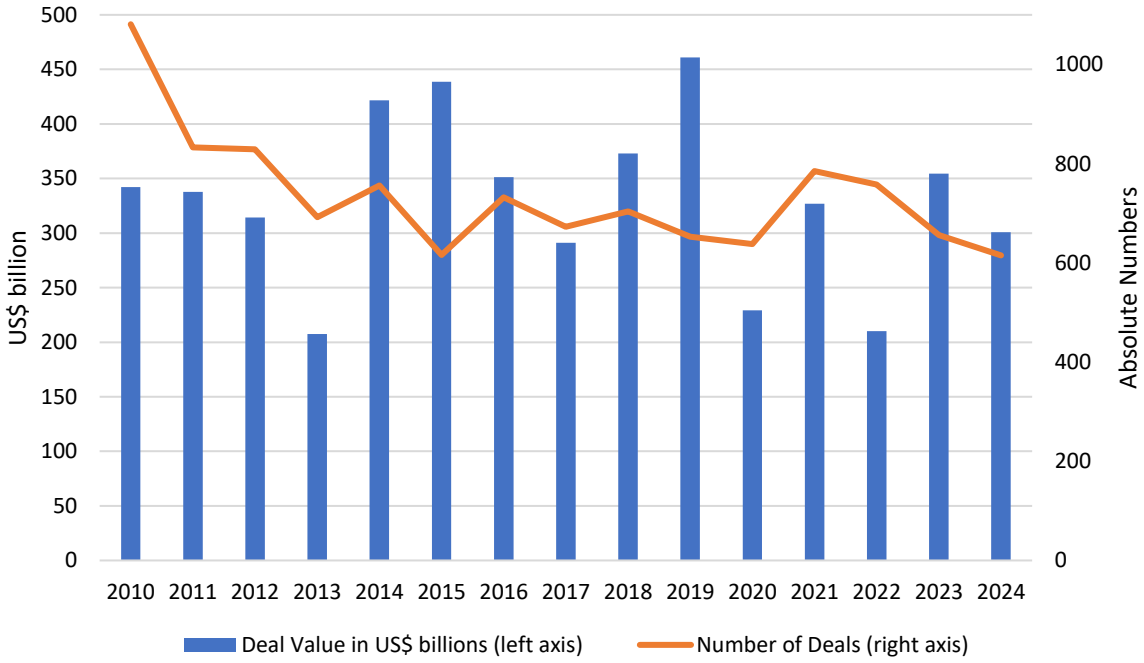
The most straightforward way for publicly listed carbon-intensive corporations to reduce their emissions footprint is to sell the divisions with the highest carbon-intensity. As the buyers are frequently private firms this constitutes a shift of high-carbon assets from transparent and regulated public markets to opaque and often unregulated markets. Strictly speaking, this channel does not constitute alternative financing for fossil fuel MNCs but a change of ownership. However, as this has financial consequences for the selling firm itself, but also for the future financing of the sold productive asset, we maintain that this poses a form of shadow carbon financing.

Arnold et al. (2023) find that between 2017 and 2021 Western oil majors indeed sold very emission-intensive assets. Moreover, many buyer firms had a worse environmental track record than the selling oil majors, which are publicly listed firms. Armour et al. (2022) call this behavior 'climate-driven asset partitioning' which has the potential to run counter to climate mitigation efforts from current and emerging regulation. Similarly, Gözlügöl and Ringe (2023) argue that one of the consequences of recent net-zero transition commitments by MNCs has been the growth of divestments from carbon-intensive assets via mergers & acquisitions (M&A). A study by Malek et al. (2022) finds that between 2015 and 2021 the value of such transferred emissions M&A deals grew significantly to US$192 billion globally. A particularly striking finding is that there has been a large net-asset flow from transparent public markets to opaque private markets. This means that carbon assets are shifting from listed firms with net-

zero commitments to mostly private firms that do not have such commitments (Malek et al., 2022).

One of the major groups that have been acquiring carbon-intensive assets from listed fossil fuel firms are private equity funds, which have also bought smaller 'independent' oil and gas firms (Hanieh, 2024). According to a study by Giachino and Mehta-Neugebauer (2021), private equity funds have invested over US$1 trillion in energy assets, 80% of which were fossil fuel assets and only about 20% renewables. Based on data regarding private equity oil and gas M&A by the Private Equity Stakeholder Project (PESP) we find that there has been a constant stream of fossil fuel productive assets switching from public to private ownership to the tune of US$5 trillion for the entire period 2010-2023 (see Figure 3). Given that data on private equity is virtually always incomplete (due to missing reporting obligations), the real number is most likely significantly larger.

**Figure 3.** Private Equity Oil & Gas M&A deals in US$ billion, 2010-2024.




Source: PECR – Energy Tracker, LSEG Data.

More research is needed on this development to ascertain whether private equity funds acquire the most emissions-intensive fossil fuel assets and how the emissions of these assets develop after being acquired. Private equity firms have fewer reporting obligations, which means that the transparency of these fossil fuel assets decreases significantly for investors, researchers and regulators. For example, financed emissions by private equity giant KKR in 2023 were 6,500 times higher than officially disclosed (Duong et al., 2024). Three case studies conducted by Malek et al. (2022) of oil and gas assets being acquired by private equity firms suggest that harmful practices such as flaring worsen after the acquisition. This concern was also shared by one of our interviewees, who also linked this development to banks' withdrawal from financing such activities:

> I mean, most of, let's say, our peers or Western banks have stepped out [from financing] Anglo American sold its South African coal assets to a local company, and I think coal production from those mines has doubled or tripled. And of course, probably now the lenders and investors of that company are not really scrutinizing the operational

performance of that company as probably they used to do with Anglo American (Interview 80).

Carbon asset partitioning enables fossil fuel firms to circumvent or negate various regulations that aim to advance decarbonization as the ownership of carbon-intensive assets is being shifted from relatively transparent public markets to opaque private markets with the help of the shadow banking system. As one interviewee put it, 'once people go private, it's just much harder to see what's happening and it's much harder to find levers to kind of make change' (Interview 80). Another interviewee adds: 'if you look at, coal activities, I think a lot of those are turning to private. Just run it down and it's out of the public markets. [...] And that's something that I think is a risk' (Interview 46). Instead of outrightly divesting from carbon-emitting productive assets, fossil fuel firms may also employ other instruments to access alternative financing via offshore-shadow-banking.

*Offshore corporate wealth chains*

It is a well-developed practice for large MNCs to create subsidiaries in OFCs to minimize taxes and regulation; this holds particularly for subsidiaries engaged in riskier activities that impair access or increase costs to external financing on the group level (Casey, 2014). Financing is typically shifted across multiple jurisdictions, mostly via subsidiaries registered in OFCs within the corporate group as well as an array of instruments including interest payments, royalties, dividends or profit repatriation – and is thus almost impossible to trace empirically (Garcia-Bernardo et al., 2017). This opacity is an inherent part of MNCs' 'global wealth chains', designed to obfuscate and thereby protect their financial wealth (Seabrooke & Wigan, 2017). However, offshore corporate wealth chains also enable MNCs to access financing rather than merely preserving their financial wealth. The same is true for global finance – opacity underpins the shadow banking system's complex network of financial pass-through entities (SPVs) that links major financial centers such as New York or London to OFCs and typically serves the purpose of removing risky debt from parent company balance sheets and acquire financing for the overall corporate group (Fernandez & Wigger, 2016). In many OFCs, such entities can be established within just a few days and little to no regulatory scrutiny. Thus, the offshore-shadow-banking nexus is the essential fabric into which global wealth chains are embedded.

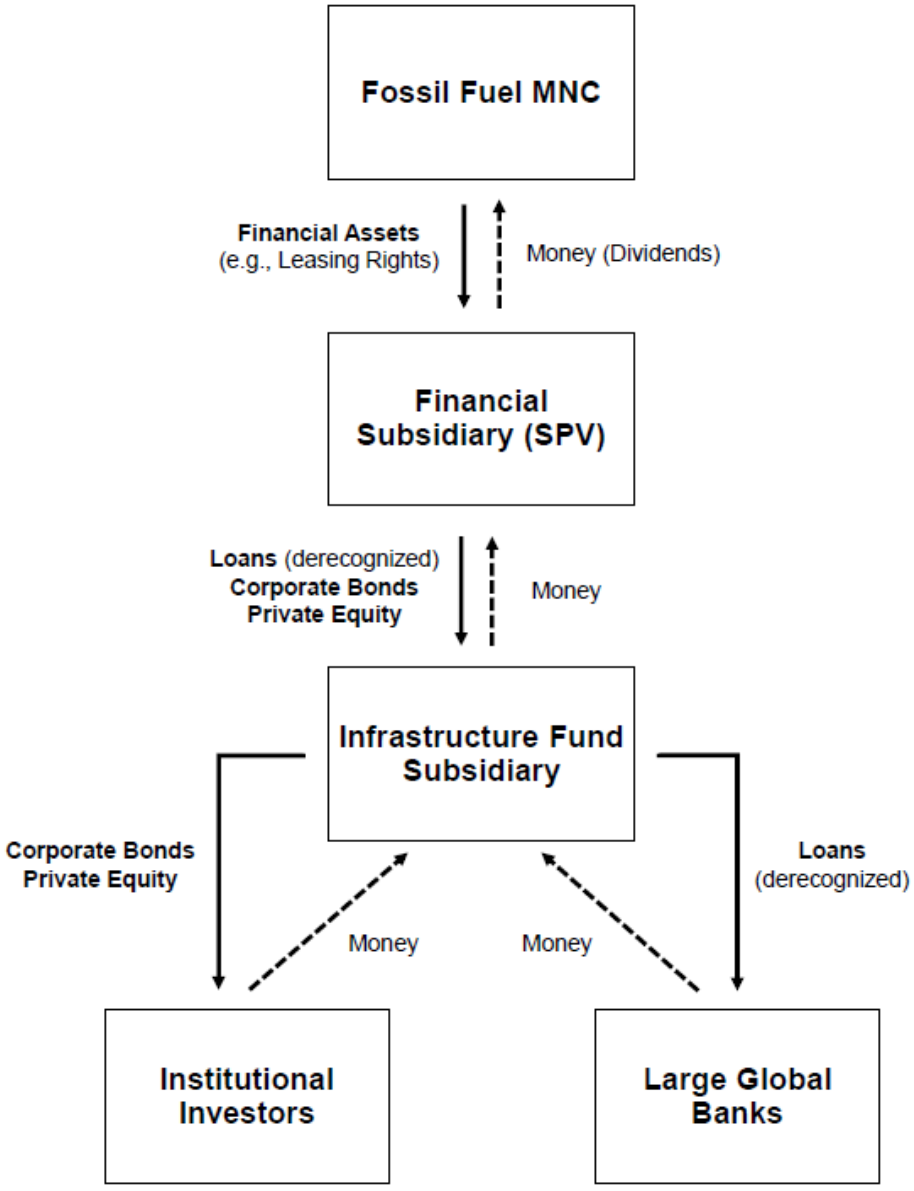
In the context of shadow carbon financing, fossil fuel MNCs can draw on these structures to access external funding for activities elsewhere. Typically, such funding is not earmarked as 'fossil fuel financing' but rather bearing more generic tags such as 'general corporate purposes', thus entailing favorable financing conditions regarding costs and tenure (Schultz & Mager, 2024). In this way, fossil fuel MNCs may also circumvent both investors' and banks' internal exclusion policies, as well as regulatory disclosure requirements regarding ESG-risks (EBA, 2021; Interview 86, 87). For instance, Citigroup helped to raise US$3.5bn for the UAE's national oil company ADNOC without affecting its climate commitments because the funding was arranged via a chemicals subsidiary instead of the parent company directly. A banker familiar with the deal stated that

> If you try and get a loan approved to an oil major, you get asked all sorts of questions: blah, blah, the ESG [...] ranking of the borrower. Basically, it's a huge pain to get organised. So, if you want to lend to a chemicals company instead, it's much easier (cited in Moulds & Crisp, 2024).

In the same vein, the aforementioned example of Saudi Aramco is illustrative. Here, the company employed a complex legal structure involving the majority-owned subsidiary 'Greensaif Pipelines Bidco S.à.r.l.', registered in the OFC of Luxemburg, to source financing

from a range of institutional investors and large global banks (Ritchie, 2023). Endowing Greensaif with the leasing rights to its own pipeline system (and thus a formidable income stream) provided the entity with the cash flow necessary to receive a high credit rating and enabled it to pay out dividends to both Aramco and the other shareholder facilitating the financing structure, EIG Pearl, which in turn marketed bonds issued by Greensaif (Fitch Ratings, 2024). Interestingly, one of the leading ESG rating agencies (Sustainalytics) placed the entity among the top fifth of its ESG-ranked businesses, an instance that was related to shortages in the research capacity of Sustainalytics concerning SPVs (Ritchie, 2023). In fact, practitioners from the industry admit that a lot of ESG data – in some cases up to 50% or more – are based on estimates rather than actual sound analysis (Interview 34, 79). These examples corroborate that the opacity of offshore-shadow-banking facilitates 'greenlaundering' (Schultz & Mager, 2024) by obfuscating financing to high-carbon activities via MNCs' offshore corporate wealth chains. Figure 7 gives a stylized depiction of how such shadow carbon financing via offshore corporate wealth chains may play out on a disaggregated entity level.

**Figure 7.** Alternative financing via offshore corporate wealth chains.




Source: Authors' own illustration.

For banks, offshore corporate wealth chains also play a role in both borrowing and lending. Recent IPE research on offshore finance finds that more US dollars are created, borrowed and lent offshore (so-called 'Eurodollars') than onshore, that is, outside instead of inside the US (Binder, 2024). In the context of shadow carbon financing, this means banks can for example source dollar funding via SPVs situated in one OFC and subsequently pass it on via their offshore corporate wealth chains towards other subsidiaries located in other OFCs that then lend to fossil fuel firms (Schultz & Mager, 2024).

*Private credit*

Smaller fossil fuel companies that cannot rely on offshore corporate wealth chains have increasingly drawn on private credit to access financing in recent years. Within the short period of 2021-2023, the volume of private loans granted to the oil and gas industry has increased from just US$450 million to at least US$9 billion, probably much more because data quality is low as there are no reporting obligations (White, 2024a). Total global private credit has quadrupled over the past decade to over US$2 trillion in 2023 (IMF, 2024). Private credit is shadow banking par excellence – lightly regulated and largely invisible to most market participants and regulators, as one of our interviewees stated:

> This is economically one-to-one like securitization, but because the order is different, it is outside the securitization regulation, so you are completely in an unregulated area. The lawyers say why, there's the Alternative Investment Funds Directive, that's fully regulated! No, it's not economically regulated, it's legally regulated, but that's about it (Interview 9).

Private credit funds take investment from institutional investors and grant private credit to firms directly (Park, 2023) or via private equity funds that own them (Interview 84). The industry is quite diverse, with the ten largest private credit fund managers comprising large private equity firms such as Apollo, Ares or Blackstone, but also well-known asset managers such as BlackRock, Goldman Sachs Asset Management and the investment arm of the French Insurer AXA (Private Debt Investor, 2024). In general, most private credit funds are domiciled in OFCs, with the Cayman Islands and Luxembourg being the two preferred offshore jurisdictions (Dechert, 2023).

The unprecedented growth of shadow carbon financing via private credit is an undesired byproduct of regulatory efforts and societal pressures to decarbonize the banking system, too. One of our interviewees from a large public asset owner told us:

> […] we had a big discussion with the head of stewardship for a large asset manager and who, in discussing about our absolute targets and proposals said: "look, if these [targets and proposals] went through it would reduce the banks' ability to finance fossil fuels. And then it's just going to go over to dark pools, to private sites, where there's no scrutiny. And that's a bad thing" (Interview 68).

Indeed, banks are increasingly selling carbon-intensive loans to private credit funds out of environmental concerns. For example, Deutsche Bank recently sold a portion of a US$600 million loan financing of an Australian coalmine to a group of private credit funds (Wijaya & Klyne, 2024). Such transactions contributed to giving these market players a foothold in the fossil fuel credit market, prompting some of the leading private credit lenders such as Ares and Blackstone to very competitive pricing vis-à-vis banks' leveraged loan offerings to gain market shares (Brown, 2024). These effects of tighter climate-related financial regulation were

amplified by surging interest rates and ensuing reduced risk appetite, leading banks to withdraw from the leveraged loan market and ceding business to private credit funds (Hidalgo & Brown, 2023; Interview 83).

However, these expansionary strategies of private credit funds are also crucially underpinned by increased demand for high yields by institutional investors (White, 2024c). Such demand is increasingly nurtured by private equity firms themselves, as some of them have acquired insurance companies and tilted their portfolio holdings towards CLOs – which are key to refinancing private credit issuance and thus lowering the cost of borrowing for private equity funds, as the US Treasury Department reported (Cataldi, 2023; Platt & Gandel, 2023). Institutional investors now allocate 28-35% of their assets under management to private markets (Palladino & Karlewicz, 2024), pointing towards ample capital to back private credit issuance for years to come.

*Proved developed producing securitization*

As of late, smaller fossil fuel firms also engage in shadow carbon financing via so-called 'proved developed producing' (PDP) securitization, creating new ABS based upon the expected cash flows generated by proved, developed and producing wellbores as underlying asset (Allison, 2021; Dawson et al., 2023; Parekh & Shodeinde, 2023). PDP reserves denote the amount of oil and gas reserves that are proven to exist, whose capital expenditure has been already incurred and that are already exploited, guaranteeing predictable revenues and profits for companies. Oil and gas assets are moved to an SPV, pooled and split into different tranches according to risk levels. As the prices of the underlying physical asset (PDP reserves) can be subject to fluctuations, these operations are usually complemented by hedging and backup servicer agreements conducted by the SPV issuer, resulting in an investment grade rating which means that large institutional investors such as pension funds may invest in them.

Notably, the first PDP reserves securitization issuance happened in 2019 when, as argued by Fitch Ratings (2020), 'diminished availability of traditional funding sources has prompted oil and gas companies to tap the securitization markets with new transaction structures.' Accordingly, PDP securitization is another instance of carbon financing flows shifting towards shadow banking due to the reduced availability of more traditional financing in response to regulatory efforts and societal pressures to decarbonize the banking system. Notwithstanding the recent introduction of this new product, PDP securitizations are already attracting a diverse array of investors, including pension funds, large asset managers, and insurance companies (Dawson et al., 2023). As argued by O'Leary et al. (2023) 'these investors also may not harbor the same reservations regarding energy investments that traditional oil & gas investors have developed toward the industry because of concerns related to sustainability and the clean energy transition'.

According to data from Guggenheim Securities, the market is growing fast from US$1.2 billion in 2021 to US$3.9 billion in 2022 (Paraskova, 2022). Based on a systematic analysis of publicly announced PDP securitization transactions, we compiled a table listing information on the issuer's name, transaction date, and deal size (see Table 2). Typically, the issuers of these securities are North American upstream 'independent' oil and gas companies such as Diversified Energy Company, PureWest Energy, or Jonah Energy. According to Carpenter (2022), big integrated oil and gas firms, such as ExxonMobil, have chosen to avoid this instrument because companies issuing these securities must enter derivative arrangements to hedge against price volatility. While these arrangements provide a steady income that is attractive to investors, they also limit potential gains from oil price increases.

**Table 2**. Recent PDP securitization deals.

| Company | Date | Size deal |
|---|---|---|
| Raisa Energy LLC | September 2019 | Undisclosed |
| Diversified Energy Company PLC | November 2019 | $200 million |
| Diversified Energy Company PLC | April 2020 | $200 million |
| Diversified Energy Company PLC | April 2021 | $200 million |
| Presidio Investment Holdings LLC (Presidio Petroleum) | August 2021 | Undisclosed |
| PureWest Energy LLC | November 2021 | $600 million |
| Diversified Energy Company PLC | February 2022 | $365 million |
| Diversified Energy Company PLC | February 2022 | $160 million |
| Diversified Energy Company PLC | May 2022 | $445 million |
| Raisa Energy LLC | June 2022 | Undisclosed |
| PureWest Energy LLC | August 2022 | $365 million |
| Jonah Energy | October 2022 | $750 million |
| Raisa Energy LLC | February 2023 | $636 million |
| Raisa Energy LLC | July 2023 | Undisclosed |
| Maverick Natural Resources | October 2023 | $640 million |
| Diversified Energy Company PLC | 2024 | $1.7 billion |

Source: Authors' elaboration, publicly available data from firm websites.

So far, the largest example of PDP securitization involves Diversified Energy Company, a US company active in the production of natural gas. The transaction was oversubscribed with over US$1.7 billion in orders from a composite group of 18 investors (Diversified Energy, 2024), meaning there was more demand than supply for its PDP ABS. Interestingly, Sustainable Fitch has provided a Second Party Opinion confirming that the instrument's Key Performance Indicators are in accordance with the International Capital Markets Association's framework for sustainability-linked bond principles. As argued by the CEO of the company, '[t]he offering was assigned the first "A" rating on an operated PDP securitization and allowed the Company to achieve an extremely competitive cost of capital' (Diversified Energy, 2024). This suggests that PDP securitization could develop into a significant mechanism that enables smaller fossil fuel firms to secure financing at attractive rates while circumventing regulatory attempts to steer financial flows towards decarbonization.

## The proliferation of climate-related systemic risk

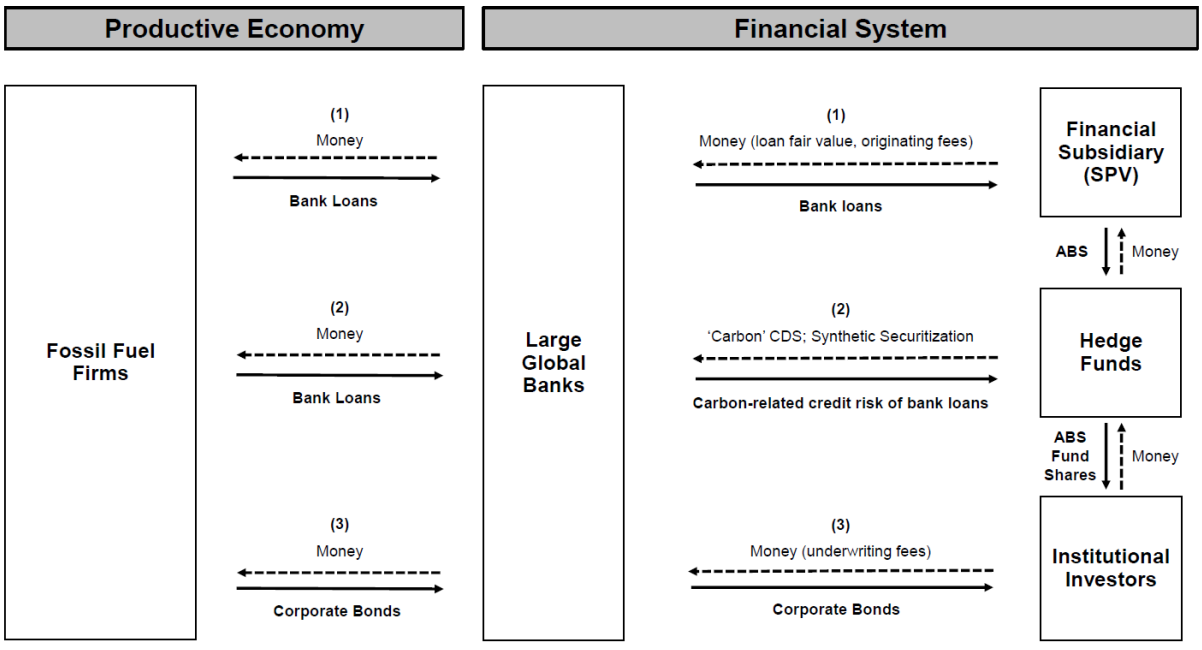
Climate-related financial risks accrue because physical, transition and litigation risks may cause a significant share of fixed-capital and intangible assets with high carbon-intensity to become 'stranded assets', losing value and thereby also affecting their corresponding financial asset valuations negatively (Caldecott et al., 2021). An ongoing stream of assets towards shadow carbon financing may imply that such risks are obfuscated and spread throughout more opaque parts of the global financial system. This dynamic may increase systemic risk (Campiglio et al., 2022; van't Klooster & Prodani) that may cause a 'climate Minsky moment' (Bolton et al., 2020; Miller & Dikau, 2022), triggering a global financial crisis. One interviewee told us that 'things going offshore and […] all of that […] makes it harder for even governments to kind of manage what's going on' (Interview 80). This new form of 'climate-related' systemic financial risk – captured by the term 'green swan' (Bolton et al., 2020) – resonates with Haberly

and Wójcik's (2017) conceptualization of OFCs as hubs for risk-prone financial innovation via offshore-shadow-banking.

Shadow carbon financing may increase climate-related systemic risks in various ways shown in Figure 5. Loan securitization (1) and emission risk transfers (2) such as synthetic securitizations enable banks to move existing loans or their carbon-credit risk from their balance sheet into the shadow banking system by passing it on to NBFIs. Such originate-to-distribute models of lending have already faced criticism regarding moral hazard impacts on loan underwriting standards, such as exaggerated earnings and income statements of borrowing firms (Park, 2023), as well as creating negative feedback loops during crises (IMF, 2024). As one interviewee put it, the problem is that 'all of these things create more distance between the providers of capital and the users. And it's always that distance that creates problems' (Interview 80).

Bond financing (3) allows banks to continue profiting from financing fossil fuel MNCs off their balance sheets too by acting as underwriters, while climate-related risks end up on institutional investors' balance sheets. Reputational and regulatory pressures have already changed the composition of investor ownership of corporate bonds exposed to such risk after the Paris Agreement, with more climate-conscious investors opting out, leading to a higher concentration of risks among fewer actors (Seltzer et al., 2022). This point suggests a shift of climate-related risks to less transparent and less accountable investors, potentially raising systemic risk. Lastly, the world's largest fossil fuel producers have increased their issuance of long-dated debt, exposing investors to substantial risks well into 2050, when net-zero should be achieved (Richardson, 2024). Moreover, even though banks are crucial enablers of fossil fuel financing in channels (1) – (3), from a financial supervisor's perspective, 'it basically moves risks out of the balance sheet of banks' (Interview 86), thus lowering the metric of so-called financed emissions (EBA, 2021; Interview 9, 85, 87).

**Figure 5.** Shadow carbon financing channels (risk management and bond financing).




Legend: SPV = Special Purpose Vehicle; CDS = Carbon Credit Default Swap

Source: Authors' own elaboration.

Shadow carbon financing via private capital markets also opens several avenues for the proliferation of climate-related risks (see Figure 6). In the case of carbon asset partitioning (4), such risks increasingly accumulate in private equity markets (Gözlügöl & Ringe, 2023) and among private equity funds in particular. Private equity M&A operations, including fossil fuel assets, often take the form of LBOs which are typically financed through 'leveraged loans' (60-80%) that are primarily provided by large global banks which have historically played – and continue to play – a crucial role in facilitating LBOs (Sissoko, 2023). Leveraged loans (or tranches thereof) are then often turned into CLOs, as large commercial and investment banks do not usually want to keep this exposure on their balance sheet.

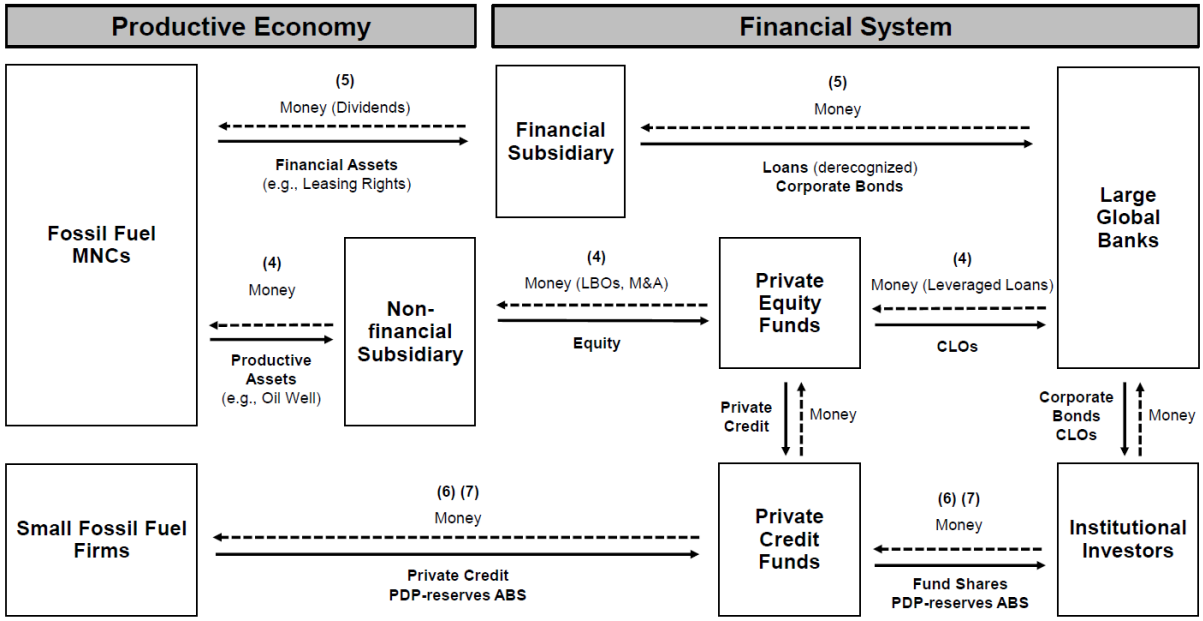
CLOs, whose originating SPVs are often legally domiciled in OFCs such as the Cayman Islands (Tempkin, 2022), constitute a financial instrument with the clear potential to make systemic risk much more opaque and thus harder to assess. This is because most refinancing instruments involved in private equity activities bear little to no disclosure requirements (Park, 2023): all CLOs and most junk bonds and subprime corporate loans are not required to file public statements with the US' Security and Exchange Commission. By now, CLOs may well have overtaken the outstanding levels of CDOs, which played a pivotal role in triggering the financial crisis of 2008 (Sissoko, 2023). Hackenberg et al. (2024) have found that CLOs exploit situations in which other investors divest from fossil fuel assets by increasing their investments in carbon-intensive industries, thus taking on more climate-related risks.

Fossil fuel MNCs can access and obfuscate carbon financing via offshore corporate wealth chains (5), meaning that creditors holding their loans, bonds and equity may accumulate more climate-related risks than they would like to. Such 'greenlaundering' (Schultz & Mager, 2024) poses a challenge for banks that strive to live up to their climate pledges, as one interviewee working at a French bank told us:

> Coal can kill your reputation, […] we try to avoid it as much as possible but sometimes, you lose. […] every six month we have people downstairs protesting [mostly because of] financing some big trader. He has some SPVs, financing some other SPVs that are in the end financing some coal via shadow banking (Interview 27).

But also financing smaller fossil fuel firms via (6) private credit and (7) PDP securitization is likely to spread climate-related risks through institutional investors' direct exposure to private credit funds and holdings of PDP ABS. This risk is aggravated by the complexity and opacity of private credit intermediation that many institutional investors may not be aware of. According to some observers form the industry, private credit funds are unlikely to face the consequences of materializing climate-related risks because of their legal structure as limited partnership funds – meaning that 'the liability is all with the investors' (Agnew et al., 2025). In Europe, regulators are particularly focusing on private equity and credit markets as sources of financial instability, with an ECB supervisory board member stating that arguments from the industry about the benefits of risk diversification across multiple balance sheets 'reminded [her] of the subprime crisis' (Arnold & Mourselas, 2024) that brought the global financial system to the brink of collapse between 2007-9. One interviewee from the securitization industry told us: 'I think this is extremely critical from a macroeconomic point of view, because bank lending is being replaced by non-banks' (Interview 9).

**Figure 6.** Shadow carbon financing channels (alternative financing).




Legend: LBOs = Leveraged Buyouts; M&A = Mergers & Acquisitions; CLO = Collateralized Loan Obligations; PDP-reserves ABS = proved-developed-producing reserves asset-backed securities

Source: Authors' own elaboration.

Therefore, climate-related systemic risk is increasingly occupying macroprudential supervisors in the EU: in a joint report, the European Central Bank and the European Systemic Risk Board highlight that 'evidence accumulates on the systemic dimension of climate-related financial risk' (ESRB, 2022). Hence, (sustainable) financial regulation must address shadow carbon financing via offshore-shadow-banking with the aim of 'preventing a climate Minsky moment' (Miller & Dikau, 2022). The relevance and urgency of this issue lies in the fact that the NBFI sector continues to grow rapidly, surpassing the regulated banking system (Palladino & Karlewicz, 2024). Therefore, even if commercial banks manage to align their balance sheet and risks with the green transition, the shadow banking system will still provide financing to high carbon activities (Kedward et al., 2024). Yet current sustainability-related regulation has focused primarily on enhancing non-financial disclosure as well as an improved monitoring and management of climate-related financial risks of banks, not NBFIs.

## Conclusion

In this paper, we have introduced the concept of shadow carbon financing, which describes the redirection and/or obfuscation of carbon financing flows via alternative financial actors, entities, and instruments that are often registered in offshore jurisdictions. We identify seven different channels through which shadow carbon financing can operate: (1) loan securitization, (2) emissions risk transfers, (3) bond financing, (4) carbon asset partitioning, (5) offshore corporate wealth chains, (6) private credit, and (7) proved developed producing (PDP) reserves securitization. The first two channels correspond to a logic of *risk management* and primarily pertain to commercial banks. The last five channels are different means via which high-carbon firms are able to access *alternative financing*. All channels involve the shadow banking system and offshore finance to some degree. Moreover, all channels of shadow carbon financing facilitate the circumvention of regulatory attempts to steer financial flows away from high carbon activities and thus ultimately enable the continuance of carbon financing.

In essence, shadow carbon financing makes it much more difficult for investors and for regulators to trace and assess climate-related financial risk, because the involved actors and instruments from the offshore-shadow-banking nexus are much more opaque than regulated commercial banks. The secrecy provided by offshore jurisdictions and NBFI effectively hides risks related to decarbonization. This echoes the argument made by Galaz et al. (2018) and more recently Atiles and Whyte (2025) that disentangling the complex web of MNC's subsidiaries in offshore jurisdictions is key to understanding the impact of global finance on the environment and climate change.

More research is needed on every shadow carbon financing channel to assess its impact more precisely. However, we can already conclude that if the offshore-shadow-banking nexus is not included in regulation aiming at advancing the green transition it seems very likely that due to the high mobility and fungibility of capital more and more carbon financing will shift *out of the light* – the regulated financial system – *into the dark* – the shadow banking system. This would essentially thwart the objective set in the Paris Agreement to make finance flows consistent with decarbonization pathways. Climate science findings are clear – the negative impact from global climate change will increase every decade. Shadow carbon financing will likely lead to a migration of assets, funding and risks related to carbon-intensive activities to NBFIs from the opaque shadow banking system that most likely do not have the (balance sheet) capacity to absorb the substantial losses that will materialize at a certain point in the next decades. This might threaten financial stability and, once again, require a public bailout of overly risky and opaque financial activities. Therefore, we also call for more research on the potential proliferation of climate-related risks via the various shadow carbon financing channels discussed in this paper.

**List of interviews**

1. Former senior managing director investment banking, Germany (16 November 2022).
2. Member of supervisory board of large bank, Germany (14 December 2022).
3. Policy director of civil society organization, Germany (10 July 2023).
4. Research director financial markets at institute for research, Germany (13 July 2023).
5. Member of supervisory board of small bank, Germany (1 September 2023).
6. Executive director of civil society organization, Netherlands (16 February 2023).
7. Staff member of civil society organization, Germany (6 September 2023).
8. Head of division of central bank, European Union (18 September 2023).
9. Managing director of financial service provider, Germany (18 September 2023).
10. Manager of sustainable investment fund, Germany (20 September 2023).
11. Head of sustainable finance at civil society organization, Germany (4 October 2023).
12. Staff member of European Union, Belgium (11 October 2023).
13. Staff member of civil society organization, Belgium (11 October 2023).
14. Staff member of European Union, Belgium (11 October 2023).
15. Staff member of European Union, Belgium (11 October 2023).

16. Economist at central bank, South America (25 October 2023).
17. Staff member of European Union, Belgium (26 October 2023).
18. Member of private association on reporting standards, Germany (26 October 2023).
19. Staff member of European Union, Belgium (27 October 2023).
20. Head of research at civil society organization, Belgium (27 October 2023).
21. Head of sustainable finance of large bank, Germany (7 November 2023).
22. Director of civil society organization, Netherlands (1 November 2023).
23. Chief economist of reinsurance company, Germany (10 November 2023).
24. Staff member of central bank, European Union (14 November 2023).
25. Staff member of civil society organization, Belgium (17 November 2023).
26. Head of sustainable finance of large bank, Germany (20 November 2023).
27. Head of sustainability of asset manager, France (22 November 2023).
28. Sustainable finance expert at large bank, France (22 November 2023).
29. Sustainable finance and regulation expert at large bank, France (22 November 2023).
30. Head of sustainable finance at civil society organization, Germany (27 November 2023).
31. Head of sustainable finance of large bank, Germany (4 December 2023).
32. Project manager sustainability of large bank, Germany (4 December 2023).
33. Member of supervisory board of asset manager, Germany (4 December 2023).
34. Chief executive officer of financial service provider, Switzerland (11 December 2023).
35. Climate investment analyst at insurance company, Switzerland (12 December 2023).
36. Managing director at asset manager, Germany (13 December 2023).
37. Head of sustainability of small bank, Germany (13 December 2023).
38. Managing director at asset manager, France (19 December 2023).
39. Head of sustainability for markets and securities at large bank, UK (15 January 2024).
40. Sustainability expert at consulting firm, UK (15 January 2024).
41. Head of sustainability risk at large bank, UK (15 January 2024).
42. Head of ESG at reinsurance company, UK (16 January 2024).
43. Chief responsible investment officer at asset manager, UK (16 January 2024).
44. Head of risk monitoring at public asset owner, UK (17 January 2024).
45. Vice president Sustainability at large bank, UK (17 January 2024).
46. Head of sustainability at large bank, UK (17 January 2024).
47. Vice president of climate and ESG at large bank, UK (17 January 2024).
48. Senior engagement manager at civil society organization, UK (18 January 2024).

49. Director for green finance at public development bank, UK (18 January 2024).
50. Executive director green finance at research institute, UK (19 January 2024).
51. Staff member of European Union, Belgium (22 January 2024).
52. Managing director responsible investment at public asset owner, NL (22 January 2024).
53. Director sustainable finance at industry association, UK (1 February 2024).
54. Head of sustainability client advisory at asset manager, NL (5 February 2024).
55. Head of sustainability at industry association, Germany (22 February 2024).
56. Head of sustainability at industry association, Germany (22 February 2024).
57. Staff member of European Union, Belgium (22 February 2024).
58. Expert in Sustainable Finance at central bank, European Union (29 February 2024).
59. Director of technical development at not-for-profit organization, UK (6 March 2024).
60. Senior analyst at national regulator, European Union (11 March 2024).
61. Senior Researcher at civil society organization, Germany (28 March 2024).
62. Former regulator, Germany (19 March 2024).
63. Staff Member at civil society organization, Germany (27 March 2024).
64. Expert at public-private partnership, Germany (11 April 2024).
65. Finance expert at civil society organization, Germany (22 April 2024).
66. Senior researcher at civil society organization, France (26 April 2024).
67. Lead ESG fixed income capital markets at bank, US (17 May 2024).
68. Chief ESG officer at public asset owner, US (28 May 2024).
69. Executive director at civil society organization, US (28 May 2024).
70. Former fund manager fixed-income, US (28 May 2024).
71. Managing director at civil society organization, US (29 May 2024).
72. Capital markets analyst at large bank, US (30 May 2024).
73. Capital markets analyst at large bank, US (30 May 2024).
74. Sustainable finance lead at large bank, US (31 May 2024).
75. Sustainable investment strategist at asset manager, US (31 May 2024).
76. Co-founder of civil society organization, US (25 June 2024).
77. Sustainable finance regulator, Belgium (3 April 2024).
78. Campaigner at fossil fuel divestment initiative, Germany (28 August 2024).
79. Head of research at financial service provider, UK (10 September 2024).
80. Head of EMEA Sustainable Finance Debt Capital Markets at large bank, UK (10 September 2024).

81. Renewable energy investment officer at private equity firm, UK (11 September 2024).

82. Executive Director of sustainable finance think tank, UK (18 September 2024).

83. Team Lead at central bank, European Union (1 October 2024).

84. ESG investment officer at private credit firm, UK (7 October 2024).

85. Team Lead at central bank, European Union (15 October 2024).

86. Financial Stability Expert at central bank, European Union (16 October 2024).

87. Head of ESG Risks Unit at EU regulator, European Union (18 October 2024).

88. Sustainable Finance Policy Expert at EU regulator, European Union (18 October 2024).

**References**


Agnew, H., Platt, E. & Pollard, A. (2025). 'Accidents waiting to happen' in private credit, says Wellcome Trust. *Financial Times,* 14 January. Retrieved from: https://www.ft.com/content/62a40125-0f58-4855-b443-f3385c16a604

Aguila, N., Haufe, P., Baioni, R., Schairer, S., Fichtner, J., Urban, J. & Wullweber, J. (2024). The green banking gap or why are banks not financing the green transition. Retrieved from https://www.boeckler.de/data/downloads/OEA/Veranstaltungen/2024/v_2024_10_25_aguila.pdf

Ahlström, H., Monciardini, D. (2022). The Regulatory Dynamics of Sustainable Finance: Paradoxical Success and Limitations of EU Reforms. *Journal of Business Ethics,* 177, 193–212.

Allison, D. (2021). Oil and Gas Securitizations: A New Financing Tool in the Upstream Toolbox. *Hart Energy*, 8 November. Retrieved from https://www.hartenergy.com/exclusives/oil-and-gas-securitizations-new-financing-tool-upstream-toolbox-197136

Altunbaş, Y., Kara, A. & Marques-Ibanez, D. (2010). Large debt financing: syndicated loans versus corporate bonds. *The European Journal of Finance*, 16(5), 437–458.

Ameli, N., Drummond, P., Bisaro, A., Grubb, M. & Chenet, H. (2020) Climate finance and disclosure for institutional investors: why transparency is not enough. *Climatic Change*, 160(4), 565–589.

Atiles, J., & Whyte, D. (2025). Fossil Capital in the Caribbean: The Toxic Role of "Regulatory Havens" in Climate Change. *Regulation & Governance*.

Armour, J., Enriques, L. & Wetzer, T. (2022). Dark and Dirty Assets: Greening Climate-Driven Asset Partitioning. Retrieved from https://blogs.law.ox.ac.uk/business-law-blog/blog/2022/06/dark-and-dirty-assets-greening-climate-driven-asset-partitioning

Arnold, J., Lockman, M., Toledano, P., Dietrich Brauch, M., Sen, S., & Burger, M. (2023). Transferred Emissions Are Still Emissions: Why Fossil Fuel Asset Sales Need Enhanced Transparency and Carbon Accounting. Retrieved from https://scholarship.law.columbia.edu/sustainable_investment/14/

Arnold, M. & Mourselas, C. (2024). Top ECB official sounds alarm on rising risks from shadow banking. *Financial Times*. https://www.ft.com/content/3adfcfe4-b4fd-4247-bb8c-1af675369a98

Bair, J., Ponte, S., Seabrooke, L., & Wigan, D. (2023). Entangled chains of global value and wealth. *Review of International Political Economy*, 30(6), 2423–2439.

Binder, A. (2023). *Offshore finance and state power*. Oxford: Oxford University Press.

Binder, A. (2024). Outsourcing Empire: International Monetary Power in the Age of Offshore Finance, *International Studies Quarterly*, 68(4).

Blanchard, O. & Tirole, J. (2021). *The major future economic challenges*. Retrieved from https://www.strategie.gouv.fr/english-articles/major-future-economic-challenges-olivier-blanchard-and-jean-tirole

Bolton, P., Despres, M., Da Silva, L.A.P., Samama, F. & Svartzman, R. (2020). *The green swan*. BIS Books: 31.

Bourgeron, T., Metz, C. & Wolf, M. (2021). *They don't care - How financial investors extract profits from care homes*, Berlin. Transformative Responses to the Crisis. Retrieved from https://transformative-responses.org/wp-content/uploads/2021/10/Finanzwende-Boell-Foundation_2021_They-Dont-Care-Private-Equity_BourgeronMetzWolf.pdf

Brown, S. (2024). Private Credit Is Eyeing Bigger Margins on Loans: Credit Weekly. *Bloomberg*, 8 October. Retrieved from https://www.bloomberg.com/news/articles/2024-08-10/private-credit-is-eyeing-bigger-margins-on-loans-credit-weekly

Burn, G. (2006). *The re-emergence of global finance*. Palgrave Macmillan: Basingstoke, Hampshire.

Caldecott, B., Clark, A., Koskelo, K., Mulholland, E. & Hickey, C. (2021). Stranded Assets: Environmental Drivers, Societal Challenges, and Supervisory Responses. *Annual review of environment and resources*, 46(1), 417–447.

Campiglio, E.; Daumas, L.; Monnin, P.; Jagow, A. (2022). Climate-related risks in financial assets. *Journal of Economic Surveys*, 12525.

Carpenter, S. (2022). Novel Asset-Backed Bonds Lure Shale Sector Away From Bank Loans. *Bloomberg*, 27 October. Retrieved from https://www.bloomberg.com/news/articles/2022-10-27/novel-asset-backed-bonds-lure-shale-sector-away-from-bank-loans

Casey, A.J. (2014). The New Corporate Web: Tailored Entity Partitions and Creditors Selective Enforcement. *Yale Law Journal*. 124(8), 2680–2745.

Cataldi, M. (2023). *Risky Business: Private Equity's Life Insurance Gambit*. Retrieved from https://ourfinancialsecurity.org/wp-content/uploads/2023/12/Private-Equitys-Life-Insurance-Gambit-02.pdf.

Cojoianu, T.F., Ascui, F., Clark, G.L., Hoepner, A.G.F. & Wójcik, D. (2021). Does the fossil fuel divestment movement impact new oil and gas fundraising? *Journal of Economic Geography*, 21(1), 141–164.

Cusano, F., Liberati, D., Piermattei, S. & Rubeo, L. (2024). *A First Analysis on the Green Securitizations in Italy*. Journal of Climate Finance, 9, 100048.

Dafermos, Y., Gabor, D. & Michell, J. (2023). FX swaps, shadow banks and the global dollar footprint. *Environment and Planning A: Economy and Space*, 55(4), 949–968.

Dawson, K., Rumball, J. & Patton, D. (2023). Alternative Financing for Oil and Gas Producers: The Securitization of Oil and Gas Assets. *Bennett Jones*, 5 October. Retrieved from https://www.bennettjones.com/Blogs-Section/Alternative-Financing-for-Oil-and-Gas-Producers-The-Securitization-of-Oil-and-Gas-Assets

Dechert (2023). Navigating Fund Domicile Choices in Private Credit: Why Familiarity Matters. Retrieved from https://www.dechert.com/knowledge/the-cred/2024/3/navigating-fund-domicile-choices-in-private-credit--why-familiarity-matters.html

Diversified Energy (2024). Diversified Energy Closes Market Leading Securitized Financing. Retrieved from https://ir.div.energy/news-events/us-press-releases/detail/170/diversified-energy-closes-market-leading-securitized-financing

Duong, D., Moore, A., Hurley, A. & Valdés Viera, O. (2024). 93 Million: The Carbon Emissions KKR Didn't Disclose. Private Equity Climate Risks Report. Retrieved from https://www.peclimaterisks.org/wp-content/uploads/2024/06/KKR-Carbon-Emissions-Report-PECR.pdf

Dutta, S.J., Kremers, R., Pape, F. & Petry, J. (2020). Critical macro-finance: An introduction. *Finance and society*, 6(1), 34–44.

EBA (2021). Mapping climate risk: Main findings from the EU-wide pilot exercise. EBA/Rep/2021/11.

ESRB (2022). The macroprudential challenge of climate change. Report by ECB/ESRB Project Team on climate risk monitoring. Retrieved from https://www.esrb.europa.eu/pub/pdf/reports/esrb.ecb.climate_report202207~622b791878.en.pdf

Fernandez, R. & Wigger, A. (2016). Lehman Brothers in the Dutch offshore financial centre: The role of shadow banking in increasing leverage and facilitating debt. *Economy and Society*, 45(3-4), 407–430.

Fichtner, J. (2016). The anatomy of the Cayman Islands offshore financial center: Anglo-America, Japan, and the role of hedge funds. *Review of International Political Economy*, 23(6), 1034–1063.

Fichtner, J. & Morgan, J. (2023). Why Hedge Funds Matter: An interview with Jan Fichtner. *Real-World Economics Review*, 104, 17–48.

Fichtner, J., Schairer, S., Haufe, P., Aguila, N., Baioni, R., Urban, J., & Wullweber, J. (2025). Channels of influence in sustainable finance: A framework for conceptualizing how private actors shape the green transition. *Finance and Society*, 1–25.

Fitch Ratings (2020). Oil and Gas Securitizations, PDP Operating Risk Lower than U.S. Whole Business. Retrieved from https://www.fitchratings.com/research/structured-finance/oil-gas-securitizations-pdp-operating-risk-lower-than-us-whole-business-20-02-2020

Fitch Ratings (2024). Fitch Assigns GreenSaif Pipelines' Senior Secured Notes 'A+(EXP)' Expected Rating; Outlook Stable. Retrieved from https://www.fitchratings.com/research/infrastructure-project-finance/fitch-assigns-greensaif-pipelines-senior-secured-notes-a-exp-expected-rating-outlook-stable-16-07-2024

FSB (2011). Shadow Banking: Strengthening Oversight and Regulation. Retrieved from https://www.fsb.org/uploads/r_111027a.pdf

FSB (2024). Global Monitoring Report on Non-Bank Financial Intermediation 2024. Retrieved from https://www.fsb.org/2024/12/global-monitoring-report-on-non-bank-financial-intermediation-2024/

Gabor, D. (2016). The (impossible) repo trinity: the political economy of repo markets. *Review of International Political Economy*, *23*(6), 967–1000.

Galaz, V., Crona, B., Dauriach, A., Jouffray, J.-B., Österblom, H. & Fichtner, J. (2018). Tax havens and global environmental degradation. *Nature Ecology & Evolution*, 2(9), 1352–1357.

Garcia-Bernardo, J., Fichtner, J., Takes, F.W. & Heemskerk, E.M. (2017). Uncovering Offshore Financial Centers: Conduits and Sinks in the Global Corporate Ownership Network. *Scientific Reports*, 7(1), 1–10.

Giachino, A. & Mehta-Neugebauer, R. (2021). *Private Equity Propels the Climate Crisis: The risks of a shadowy industry's massive exposure to oil, gas and coal*. Retrieved from https://pestakeholder.org/wp-content/uploads/2021/10/PESP_SpecialReport_ClimateCrisis_Oct2021_Final.pdf.

Gözlügöl, A. A. & Ringe, W.-G. (2022) 'Private companies: the missing link on the path to net zero', *Journal of Corporate Law Studies*, 22(2), pp. 887–929.

Green, J. (2016). Anglo-American development, the Euromarkets, and the deeper origins of neoliberal deregulation. *Review of International Studies*, *42*(3), 425–449.

Haberly, D. & Wójcik, D. (2017). Culprits or bystanders? Offshore jurisdictions and the global financial crisis. *Journal of Financial Regulation*, 3(2), 233–261.

Hackenberg, K., Klaus, V., Klingler, S., & Sondershaus, T. (2024). CLO Trading of Brown Loans. Retrieved from http://dx.doi.org/10.2139/ssrn.4344497

Hanieh, A. (2024). *Crude Capitalism: Oil, Corporate Power, and the Making of the World Market*. London: Verso Books.

Hidalgo, K. & Brown, S. (2023). Barclays, Societe Generale, Deutsche Bank Tap into Private Credit Market. *Bloomberg,* 14 September. Retrieved from https://www.bloomberg.com/news/articles/2023-09-14/banks-rush-to-gain-foothold-in-1-5-trillion-private-debt-market

IEA (2024). *World Energy Investment 2024*. Retrieved from https://iea.blob.core.windows.net/assets/b7f43616-e90d-4314-be5e-47f66a89a4b0/WorldEnergyInvestment2024.pdf

IMF (2000). *Offshore Financial Centers*. IMF Background Paper. Retrieved from https://www.imf.org/external/np/mae/oshore/2000/eng/back.htm#II

IMF (2024). *Global Financial Stability Report*. Retreived from: https://www.imf.org/-/media/Files/Publications/GFSR/2024/October/English/textrevised.ashx

Joosten, T., van Heugten, Y. & Koens, R. (2023). How banks helped the fossil fuel industry raise more than a trillion euros. Retrieved from https://www.ftm.eu/articles/ggii-2-fossil-finance-trillion-euros-oil-gas-bonds

Kedward, K., Gabor, D. & Ryan-Collins, J. (2024). Carrots with(out) sticks: credit policy and the limits of green central banking. *Review of International Political Economy*, 1–25.

Knafo, S. (2021) 'The Power of Finance in the Age of Market Based Banking', *New Political Economy*, 27(1), pp. 33–46.

Levine, M. (2024). Banks Can Get Emissions Off the Books. *Bloomberg*. Retrieved from https://www.bloomberg.com/opinion/articles/2024-03-19/banks-can-get-emissions-off-the-books

Lysandrou, P., & Nesvetailova, A. (2015). The role of shadow banking entities in the financial crisis: a disaggregated view. *Review of International Political Economy*, *22*(2), 257–279.

Malek, G., Baxter, A., Watson, D., Howell, A., Davis, M., Sagingaliyev, G., Swartzwelder, G. & Staib-Kaufman, C. (2022). Transferred emissions: how risks in oil and gas M&A could hamper the energy transition. *Environmental Defense Fund*. https://business.edf.org/wp-

content/blogs.dir/90/files/Transferred-Emissions-How-Oil-Gas-MA-Hamper-Energy-Transition.pdf

McKillop, P. (2024). *As commercial bank lending to oil and gas shrinks, other sources of capital fill the gap,* 23 May. Retrieved from https://greencentralbanking.com/2024/05/22/commercial-bank-lending-oil-gas/

Mehrling, P., Pozsar, Z., Sweeney, J. & Neilson, D.H. (2013). Bagehot was a Shadow Banker: Shadow Banking, Central Banking, and the Future of Global Finance. *SSRN Electronic Journal*. Retrieved from https://doi.org/10.2139/ssrn.2232016

Miller, H. & Dikau, S. (2022). Preventing a 'climate Minsky moment': environmental financial risks and prudential exposure limits. *Policy Report*. Retrieved from: https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/03/Preventing-a-climate-Minsky-moment.pdf

Moulds, J. & Crisp, W. (2024). Citigroup helped funnel $3.5bn to UAE state oil company, 13 September. Retrieved from https://www.thebureauinvestigates.com/stories/2024-09-13/citigroup-helped-funnel-3bn-to-uae-state-oil-company/

Müller, I., Nguyen, H., & Nguyen, T. (2024). *Carbon transition risk and corporate loan securitization* (No. 22/2022). IWH Discussion Papers. Retrieved from https://www.econstor.eu/bitstream/10419/286322/1/iwh-dp2022-22rev.pdf

Murau, S. (2017). Shadow money and the public money supply: the impact of the 2007–2009 financial crisis on the monetary system. *Review of International Political Economy*, *24*(5), 802–838.

O'Leary, G. M., Hiner, T. Y., Dedyio, J. J. (2023). Oil & Gas Asset-Backed Securitizations. *Practical Law – Thomson Reuters*. Retrieved from https://www.huntonak.com/media/publication/89927_oil-and-gas-asset-backed-securitizations.pdf

Palan, R., Murphy, R. & Chavagneux, C. (2010). *Tax havens: How globalization really works*. Ithaca: Cornell University. Press.

Palan, R. & Nesvetailova, A. (2014). 'Elsewhere, ideally nowhere: Shadow banking and offshore finance', *Politik*, 16(4), pp. 26–34.

Palladino, L. & Karlewicz, H. (2024). The Growth of Private Financial Markets. *PERI Working Paper*, 600. Retrieved from: https://peri.umass.edu/wp-content/uploads/joomla/images/publication/WP600.pdf

Paraskova, T. (2022). A New Type Of Oil And Gas Funding Is Booming. *Oil Price*, 24 December. Retrieved from https://oilprice.com/Energy/Crude-Oil/A-New-Type-Of-Oil-And-Gas-Funding-Is-Booming.html

Parekh, S., Shodeinde, M. (2023). Tapping into securitization: Oil & gas companies digging for new funding sources. *Miller Thomson*, 25 January. Retrieved from https://www.millerthomson.com/en/insights/structured-finance-and-securitization/securitization-oil-gas-companies-new-funding-sources/

Park, A. (2023). *A Giant in the Shadows: Subprime Corporate Debt*. Retrieved from https://ourfinancialsecurity.org/wp-content/uploads/2023/01/1.6.23-Subprime-Corporate-Debt-A-Giant-in-the-Shadows.pdf

Platt, E. & Gandel, S. (2024) Wall Street's complex debt bonanza hits fastest pace since 2007. *Financial Times,* 12 October. Retrieved from https://www.ft.com/content/5219f962-3499-4928-8c73-5610b7a0109e

Plender, J. & Fray, K. (2024). The overlooked threats to the global financial system. *Financial Times,* 16 April. Retrieved from https://www.ft.com/content/0b78c68b-c65c-4080-b779-17041c290eaa

Porter, K. & Deveau, S. (2021). Shadow Lenders Pile Into U.S. Energy Debt After Bank Retreat. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/articles/2021-06-25/shadow-lenders-pile-into-u-s-energy-debt-after-bank-retreat

Pozsar, Z., Adrian, T., Ashcraft, A. & Boesky, H. (2010). 'Shadow banking', *Federal Reserve Bank of New York Staff Report No. 458*. Retrieved from https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr458_July_2010_version.pdf

Pozsar, Z. (2013). Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System. *Financial Markets, Institutions and Instruments*, 22(5), 283–318.

Private Debt Investor (2024). Top Private Credit Firms. Retrieved from https://www.privatedebtinvestor.com/pdi-200/

RAN (2024). *Banking on Climate Chaos 2024: Fossil Fuel Finance Report*. Retrieved from https://www.bankingonclimatechaos.org/

Reghezza, A., Altunbas, Y., Marques-Ibanez, D., Rodriguez d'Acri, C. & Spaggiari, M. (2022) Do banks fuel climate change? *Journal of Financial Stability*, 62, 101049.

Richardson, J. (2024). Buyers of long-dated oil bonds beware. Available from: https://anthropocenefii.org/climate-risk-pricing/buyers-of-long-dated-oil-bonds-beware

Rickman, J., Falkenberg, M., Kothari, S., Larosa, F., Grubb, M. & Ameli, N. (2024). The challenge of phasing-out fossil fuel finance in the banking sector. *Nature Communications*, 15(7881). https://doi.org/10.1038/s41467-024-51662-6

Ritchie, G. (2023). Saudi Aramco Getting Cash Meant for Sustainable Investment Reveals ESG Loophole. *Bloomberg,* 7 November. Retrieved from https://www.bloomberg.com/news/articles/2023-07-11/saudi-aramco-getting-cash-meant-for-sustainable-investment-reveals-esg-loophole

Schairer, S. (2024). The contradictions of unconventional monetary policy as a post-2008 thwarting mechanism: financial dominance, shadow banking, and inequality. *Review of Evolutionary Political Economy*, 5(1), 1–29.

Schultz, A. & Mager, F. (2024). How "greenlaundering" conceals the full scale of fossil fuel financing. *Tax Justice Network,* 9 November. Retrieved from https://taxjustice.net/2024/09/11/how-greenlaundering-conceals-the-full-scale-of-fossil-fuel-financing/

Seabrooke, L. & Wigan, D. (2017). The governance of global wealth chains. *Review of International Political Economy*, 24(1), 257–263.

Seltzer, L., Starks, L. & Zhu, Q. (2022). *Climate Regulatory Risk and Corporate Bonds*. National Bureau of Economic Research.

Sgambati, S. (2019). The art of leverage: a study of bank power, money-making and debt finance. *Review of International Political Economy*, 35(1), 1–26.

Sgambati, S. (2024). The invisible leverage of the rich. Absentee debtors and their hedge funds. *Competition & Change*, *28*(5), 625-642.

Sharman, J. (2010). Offshore and the new international political economy. *Review of International Political Economy*, 17(1), 1–19.

Sissoko, C. (2023). 'Private' Equity Is a Misnomer: Government Support Has Been Driving the Restructuring of US Corporate Structure and the Transfer of Wealth to Buyout Firms Over

the Past 40 Years. *SSRN Electronic Journal*. Retrieved from https://doi.org/10.2139/ssrn.4547079

Tempkin, A. (2022). EU's Cayman Ban May Mean CLO Headaches. *Bloomberg Law*. Retrieved from https://news.bloomberglaw.com/capital-markets/structured-weekly-eus-cayman-ban-may-mean-clo-headaches

UN (2015). *The Paris Agreement*. Retrieved from https://unfccc.int/process-and-meetings/the-paris-agreement

Vacarro, J. (2024). Closing the financial disclosure loophole to prevent 'emissions laundering'. *Green Central Banking*. Retrieved from https://greencentralbanking.com/2024/03/14/financial-disclosure-loophole-emissions-laundering-james-vaccaro/

van 't Klooster, J., & Prodani, K. (2025). Planetary financial policy and the riskification of nature. *Review of International Political Economy*, 1–25.

Wigglesworth, R. (2024) Inside Wall Street's booming $1tn 'synthetic risk transfer' phenomenon. *Financial Times,* 20 December. Available from: https://www.ft.com/content/d91d35fc-93ab-4963-8587-7a00fe5c63b4

White, N. (2024a). Private Credit Funds See Huge Rise in Fossil Fuel Deals as Banks Walk Away. *Bloomberg.* March 25. Retrieved from https://www.bloomberg.com/news/articles/2024-03-25/private-credit-funds-see-huge-rise-in-fossil-fuel-deals-as-banks-walk-away

White, N. (2024b). Hedge Fund Veteran Pitches First-Ever Emissions Risk Transfers. *Bloomberg*. March 17. Retrieved from https://www.bloomberg.com/news/articles/2024-03-17/hedge-fund-veteran-pitches-first-ever-emissions-risk-transfers

White, N. (2024c). US Regional Banks Dramatically Step Up Loans to Oil and Gas. *Bloomberg*. April 14. Retrieved from https://www.bloomberg.com/news/articles/2024-04-14/us-regional-banks-dramatically-step-up-loans-to-oil-and-gas

Wijaya, M. & Klyne, S. (2024). Deutsche Bank Sells Down Coal Mine Loan to Private Credit Funds. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/articles/2024-08-05/deutsche-bank-sells-down-coal-mine-loan-to-private-credit-funds

Wullweber, J. (2024): *Central Bank Capitalism. Monetary Policy in Times of Crisis.* Stanford: Stanford University Press.