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Actors, instruments, and politics

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Review

Green finance in the global energy transition: Actors, instruments, and politics

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ABSTRACT

All aspects of the global energy transition - from decarbonization to adaptation - require massive investments of several trillion US Dollars annually. In the respective debates in political economy and beyond, the question of how to mobilize adequate volumes of such 'green' finance is central. However, there is little agreement on what constitutes this type of finance and how energy research can employ the concept to critically analyze and evaluate green transitions. In order to advance the conceptual and empirical work on this key issue, I review and describe the main elements of the global landscape of green finance governing its mobilization and proliferation. I first review the major actors involved in the supply and provision of green finance. Second, I evaluate the central instruments of this provision, their volumes and transformative potentials. Third, I analyze key political faultlines and trade-offs in the provision and contestation of green finance, which will shape the coming decades of green transitions. The paper concludes by discussing how this conceptual apparatus can facilitate next research steps.

1. Introduction

The decarbonization of global energy systems and their adaptation to climatic change require massive investments in developed and developing countries. Existing investments are, however, far from what is objectively necessary. As of 2023, global clean energy investments would need to quadruple to around USD 5 tn. annually to keep the 1.5 °C Paris goal alive [1] (p. 19). Similarly, the latest IPCC Working Group III report estimates that, despite policymakers' Paris pledges of USD 100 bn. annual investment, green finance flows are currently falling short by the factor three to six [2]. Notwithstanding the record-beating addition of renewable capacities worldwide in the last years, finance is a major bottleneck for a Paris-aligned acceleration of the global green energy transition [3,4]. This need for green finance applies to both private and public assets and investments as neither of those can fill the green finance gap alone (see [5]). They are also on par when it comes to green finance provision over time (Fig. 1). Likewise, both financial and non-financial firms are important here. While the former need to turn 'brown' into 'green' investment by adjusting their portfolios, the latter need to offer green projects and decarbonization prospects that attract such funding [6,7]. Green finance proponents hope that the channeling of private and public capital to renewable energy projects and assets will promote sustainable economic activities and discourage non-sustainable

ones [8] (p. 5). The list of green finance initiatives is long, as is the list of their critiques. Green finance is notoriously missing the aims and promises set out by investors and governments [9]; financial actors constantly exploit the green transition for a de-risking of their investment by states [10,11]; Global South countries in need of green transition finance do not receive enough capital flows amidst a 'flood' of green money in the Global North [12]; and greenwashing of disclosed financial information is mushrooming [13]. On top of this, a host of definition, scope, measurement, and other analytical problems riddles the important discussions about green finance and render it an analytically unwieldy concept [14–16].

There are, hence, enough controversy and open questions regarding the political economy of green finance and its centrality for a global energy transition. However, similarly to early adoptions of concepts like patient capital [17] or financialization [18], green finance is treated by political economy and transition research often in broad and imprecise ways: it describes, among others, the purpose of financial instruments like green bonds or credit schemes [19,20], the investment strategies of funds or banks [21,22], or the capital flows used to finance 'green' projects [15]. Each of those and further dimensions are important aspects of the phenomenon of green finance, but they also touch upon different aspects of the global financial system, and the global political economy itself. Investment strategies are different from financial

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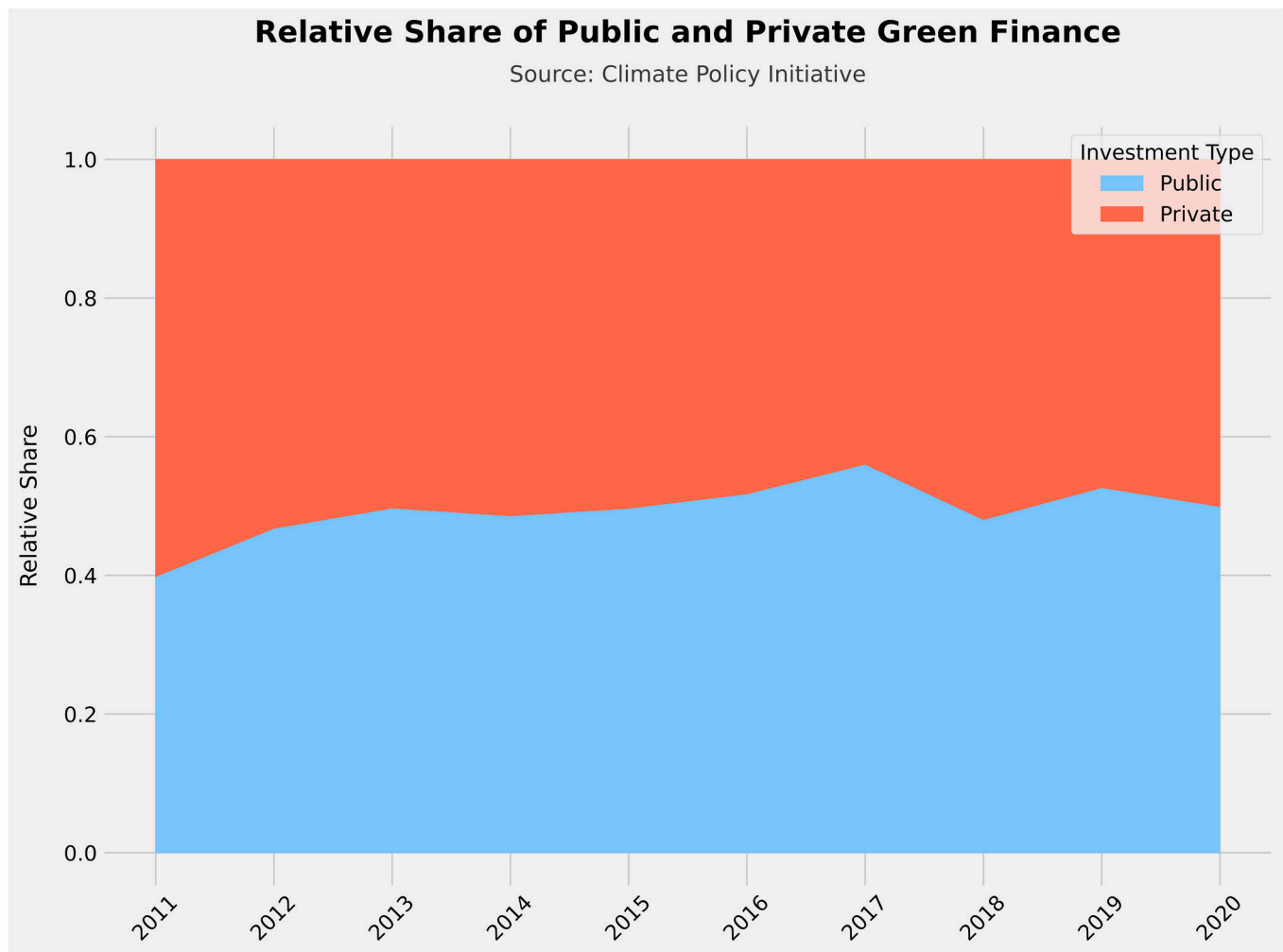


Fig. 1. Shares of private and public green finance provision over time. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

instruments, for example – and subsuming those under umbrella terms is problematic, from accounting and measuring issues to theoretical implications [23]. In order to meaningfully engage with the mentioned problems and debates, political economy and energy transitions research however need to have a shared understanding of the definitions, actors, instruments, and political faultlines of green finance. Such a baseline can then be used to develop analytical frameworks that help us to problematize the politics of green finance; and to carve out analytical and praxis-oriented strategies for global energy transformations (see [24]).

In this paper, I seek to advance the discussion on how the conceptual apparatus of green finance can be more systematically deployed in research on the political economy of energy transitions. Green finance is integrated into a wider landscape of regulations, politics, and power relations that govern its proliferation in fundamental ways. From the question of definition (what counts as green finance?) to the question of actors (who supplies green finance?), instruments (how do actors supply green finance?) and politics (who benefits from its proliferation?), the governance of green finance is shaped by the structures it is embedded in. This also means that green finance is not a fixed entity or instrument like a green bond or a green credit scheme, but that the parameters of what constitutes the phenomenon shift over time. While in the early days the landscape of green finance consisted mainly of international climate funds aimed at mitigation and adaptation activities, it meanwhile developed into a broad and contested ecosystem with manifold actors, instruments, and high volumes of capital flowing through it [25].

This paper reviews the main actors, instruments and political faultlines of this contemporary landscape of green finance systematically.¹ The argument I develop is twofold: first, I hold that we should avoid both a too broad and a too narrow reading of what constitutes green finance for energy transition research. The former risks that the concept becomes a catch-all term and hence meaningless; while the latter risks that different studies on similar phenomena can't speak to each other because they (wrongly) assume that their empirical objects are different. Second, to avoid such fallacies, it is necessary to develop a systematic understanding of the main characteristics of what constitutes green finance today. By surveying the main aspects of the landscape of green finance, I both avoid a narrow reading of it as a mere 'instrument' or 'tool', as well as point out that there are boundaries and structures that define what counts as green finance and what not. Such a systematic review allows us to understand the mobilization and proliferation of green finance as both a major tool for the energy transition and a politically contested and often problematic phenomenon. Through this, I lay the foundation for a more streamlined and empirically oriented research agenda in energy transition research that takes the political

¹ Methodologically, I hence follow a political economy approach that centers on actors, instruments and politics and organizes the review in a systematic way along these categories. Such as systematization is common in political economy research, with different aspects being emphasized for different cases (see, e.g., [26]).

economy of green finance seriously.

In the remainder of this paper, I begin by establishing a baseline understanding of the green finance concept for energy transition research. I then draw on existing research and current empirical material in different global financial segments to survey the main actors, instruments and political faultlines of green finance (sections two to four). In doing so, this paper contributes a first step towards building knowledge for energy transition research into the potentials and pitfalls of green finance in the global green transformation.

2. Actors: from public to private

I define ‘green finance’ in the context of the political economy of energy transitions as *investment (equity, bonds, or loans) or fiscal measures (such as tax breaks or subsidies) that aim to either mitigate ecologically harmful energy generation, increase its ecological sustainability, or enable its adaptation to climate change*. This is a transaction- or investment-level definition, which means that it pertains to singular investment or tax policy acts and not to the system level. I focus this definition on investment because common references to ‘financing’ or ‘leveraging’ sustainable projects often stay vague in what they mean by these broad terms. Adding fiscal measures to investment aims to include green finance that does not come in typical flows, but rather as a means of indirectly financing green projects. The outcomes of direct provision or subsidies and tax breaks are the same: energy projects and activities aimed at sustainability, mitigation and adaptation are being financially supported and enabled through either direct financing or fiscal measures foregoing potential tax revenues and enabling green or sustainable projects (see [27], p. 37). This definition furthermore distinguishes between three core purposes of green finance, namely mitigation, increasing ecological sustainability and adaptation. I subsume decarbonization issues under mitigation, since the decarbonization of energy generation is one way of mitigating climate change and biodiversity loss, albeit the most relevant aspect in today’s global economy [28]. Mitigation might also involve the tackling of other ecologically damaging activities, such as reducing methane emissions, which contributed around 30 % to total global warming since the 19th century [29]. The second aim of green finance, ecological sustainability, differs somewhat from mitigation. Economic activities such as energy generation can be made less ecologically harmful (e.g. by reducing the pollution resulting from producing energy) without being long-term sustainable. The discussion around natural gas as less ecologically harmful ‘bridge technology’ exemplifies this. Natural gas can contribute to mitigation if it replaces ‘dirtier’ energy generation - but it is far from being a long-term sustainable alternative [30]. The third core purpose of mobilizing green finance is the adaptation to new climate realities, for example by building resilient energy infrastructure or endowing properly working loss and damage funds [31]. Green finance will often target adaptation rather than mitigation when it is intertwined with developmental objectives and the attempt to ‘[m]aking development investible’ [10] (p. 429). It is hence important to distinguish between these forms, which have different characteristics and aims. Finally, this definition applies to green finance in the context of energy transitions and would need to be adapted for other sustainability-related contexts, such as especially sustainable development finance [32], climate finance [33] and ESG finance [34].

Based on this definition, many relevant actors are involved in mobilizing and providing green finance, from different types of investors and rating agencies, index providers and standard setters, to the various targets and types of assets that profit from green financial flows [34,35]. Determining the key actors in this broad and diffuse landscape should not happen by (investment) size alone. The Global Sustainable Investment Alliance (GSIA) – a forum of European, Anglo-American and Japanese green institutional investor groups – for example states that global sustainable investment topped USD 35 tn. in 2020, which would correspond to more than 40 % of global GDP in the same year. As the

GSIA states itself, the collection and comparison of regional and national data on what constitutes ‘sustainable’ or ‘green’ finance is contested and difficult, making it doubtful to rely only on size measures for determining relevance [36]. This is also a consequence of missing global taxonomy standards (see next section). It is hence more expedient to understand the *function* of different actors to mobilize green finance in the global political economy.

A useful political economy distinction to begin with is between public and private actors supplying green finance in the global economy [37]. Green investments are still widely considered a relatively risky, volatile, and often not profitable asset class [38]. State-owned investment vehicles, state-led investment consortia and state institutions that ‘derisk’ private green investment cushion some of this risk for private capital [10]. Likewise, many state-owned and state-controlled entities, such as public banks, provide green finance directly and to a larger degree than is often assumed in aggregate estimates [5]. Consequently, some of the most prominent and visible green finance suppliers and proliferators are public actors and institutions. The most obvious public actors are state apparatuses that enable green finance through regulation, grants and subsidies such as treasuries, finance ministries and similar institutions. Finance ministries, for example, are not financial actors per se as their primary role is governance of the economy, not partaking in it (see also [39]). They play, however, an important role in the mobilization and even provision of green finance. Through shaping regulatory issues like the taxonomies for sustainable energy sources, or introducing tax breaks and other privileges for renewables, state apparatuses can incentivize economic actors to increase investment into sustainable assets and activities [40]. Reflecting this role, in 2019, 26 countries launched the international *Coalition of Finance Ministers for Climate Action* (CFMCA), which works around six core principles to mitigate climate change (the so-called Helsinki Principles) [41]. With today over 90 members, a key aim of the Coalition is to mobilize climate finance from private sources through expertise and institutional support. But even as *direct* providers of green finance, state apparatuses can play an important role. They, for example, grant green subsidies to boost renewable energy generation or provide loans and guarantees to small and medium businesses in the cleantech sector [42]. They are also key players for reducing government carbon subsidies that in 2022 surpassed USD 1 tn. for the first time; and can hence contribute to actively transforming ‘brown’ subsidies into ‘green’ finance. This more active role as a provider of green finance is becoming a more accepted function of treasuries and ministries as a recent CFMCA report suggests. Here, the Coalition identifies several ‘transformative actions’ that finance ministries should emulate globally, such as actively using their budgets to ‘drive transformation in all sectors of the economy’ [43] (p. 15) or to push forward the green transformation of other state-owned vehicles like state-owned enterprises (SOEs) or sovereign wealth funds (SWFs) (ibid.). This reflects a much more proactive role than just being a regulatory body and points towards the increasing importance of government institutions in directly providing green finance.

Beyond immediate state apparatuses, *Public Development Banks* (PDBs) are important public actors, including local, national, and multilateral ones [44]. Recent estimates find ca. 500 such public institutions around the world with total assets under management (AuM) of ca. USD 12 tn. [45]. PDBs can have various ‘developmental’ functions, often also on the local or regional level. An especially relevant form of PDBs are Multilateral Development Banks (MDBs). These are

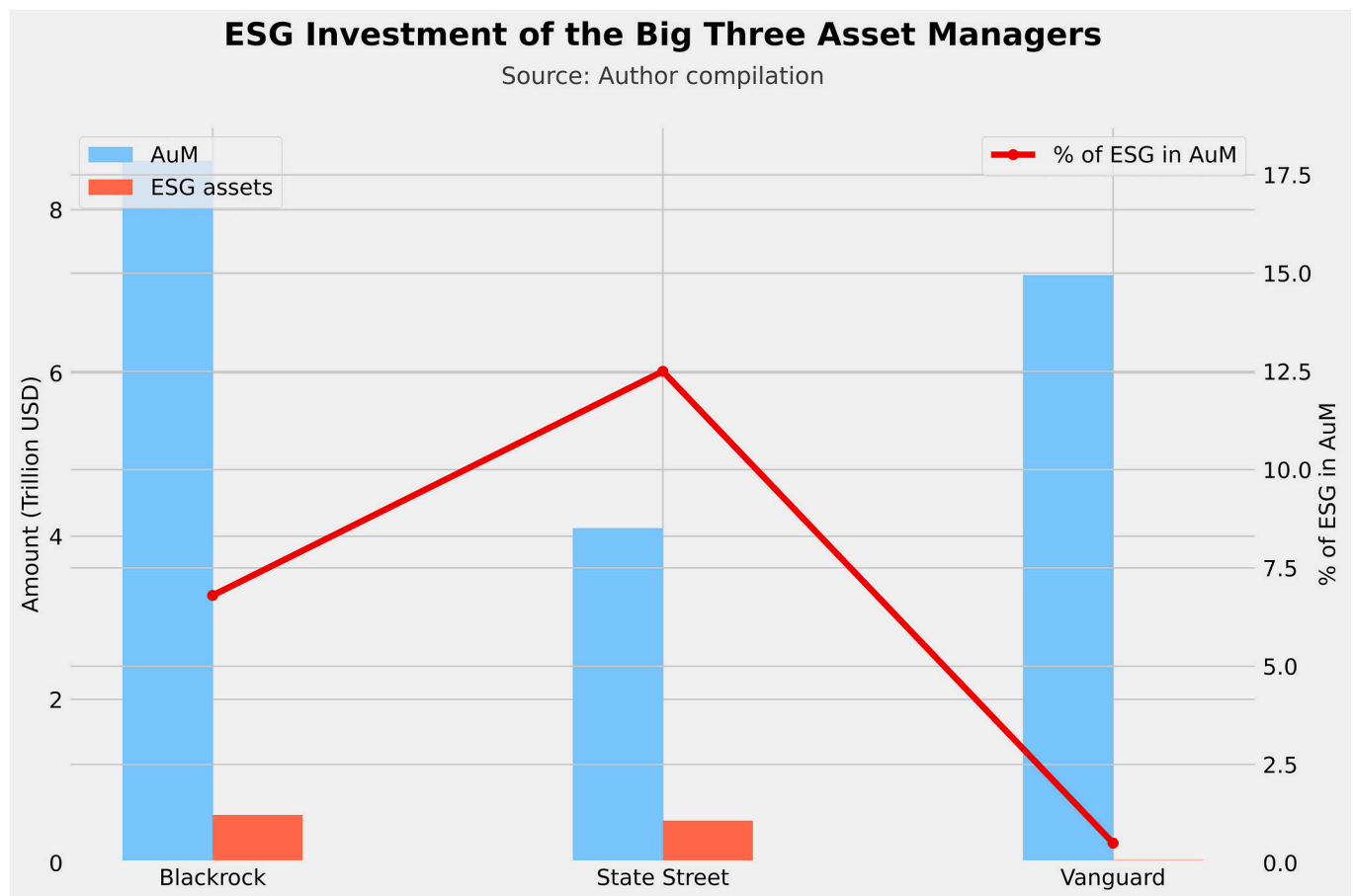


Fig. 2. Large Asset Managers and their ESG portfolios.

supranational financial institutions that essentially provide grants and loans for (sustainable) development purposes. Their shareholders are, typically, developed (non-borrowing) and developing (borrowing) countries; whereby large shareholders like the US exhibit a strong influence over the politics of the world's major MDBs. The World Bank Group, the African Development Bank, and the European Bank for Reconstruction and Development are among the most prominent MDBs. Together, the main global MDBs² self-report to account for over USD 50 bn. in climate finance for low-and middle-income economies and over USD 31 bn. for high-income economies [46](p. viii). This is only a fraction of the actual AuM of these actors, which amounted to around USD 1.5 tn. in 2018.

MDBs provide green finance to support projects aiming at adaptation to or mitigation of climate change. This also involves the co-financing of projects (e.g. in public-private partnerships) or via de-risking of private 'green' investment [46](p. 4). Within the global green finance landscape, they also channel third-party funding. For example, six MDBs are responsible for implementing green finance projects by multilateral

climate funds³ like the Climate Investment Funds (CIF) [47], which approved USD 7.5 bn. of its own funding and expects around the tenfold amount of co-financing from public and private actors as of end-2021 [48]. Similarly, MDBs like the EBRD, ADB, or AfDB function as implementing agencies for the oldest global climate fund, the Global Environmental Facility (GEF), established in 1991. The GEF mobilizes funds for green developmental projects, which are then carried out by one of its implementing agencies, half of which are MDBs. Another large climate fund – the Green Climate Fund (GCF), established in 2010 – likewise uses mainly MDBs and PDBs as accredited implementing partners on a global scale. MDBs hence sit at the implementation wheel that brings together large-scale mobilized green finance with concrete green energy projects on the ground.

Finally, MDBs also shape the major discourses around and global governance of green, climate or sustainable investment and its proliferation [49,50]. As an example, the ongoing reorganization of development finance from a neoliberal 'Washington' towards a de-risking 'Wall Street' consensus is led and mediated by MDBs - and has profound consequences for how green finance is constructed and towards which assets it flows [10]. This relevance of MDBs in defining narratives and practices around green finance is an important source of authority in the global green finance landscape. In comparison, some *national* PDBs, like China's largest financial institution China Development Bank (CDB), are much larger regarding their managed assets. Asset volumes, however, do

² These are the World Bank Group, the African Development Bank (AfDB), the Asian Development Bank (ADB), the China-led Asian Infrastructure Investment Bank (AIIB), the Council of Europe Development Bank (CEB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the InterAmerican Development Bank Group (IDBG), the Islamic Development Bank (IsDB) and the New Development Bank (NDB) (also known as the 'BRICS bank') (see [46]).

³ Multilateral climate funds are internationally agreed and government-sponsored vehicles for providing green finance. They are mostly replenished by public money and have specific mandates and rules for handing out grants, loans and other forms of green finance.

not correspond proportionally to influence, especially when it comes to the *global* role of MDBs, which provide green finance, but also de-risk and mobilize large investment volumes from private actors (see next section).

Next to PDBs and MDBs, there are different state-owned entities or state apparatuses that are relevant actors. On a smaller scale, bilateral lending outside PDB/MDB frameworks also plays a role, for example through Official Development Assistance (ODA) programs. A fraction of total ODA flows is dedicated to green finance issues, for example, the UK's International Climate Finance initiative (ICF) that amounted to just under £ 6 bn. between 2016 and 2021 [51]. Programs similar to ICF from other state-owned entities are, for example, Germany's International Climate Initiative (IKI), which mobilized around EUR 5 bn. since 2008; or the Joint Crediting Mechanism (JCM) run by Japan's foreign ministry, which aims at decarbonization projects in low-income economies. The relevance of such immediately state-controlled actors depends also on their (changing) standing within their domestic governance frameworks, for example, the relevance of the respective ministries responsible for organizing green and developmental finance.

At the intersection of state-owned and private actors, central banks have become more important in the last years in shaping both the discursive and the material reality of global green finance [52,53]. After the proliferation of independence mandates of central banks in the 1990s, recent crises and structural problems have challenged the seemingly 'apolitical' nature of their policies [54,55]. For the energy transition, central banks became a key nodal point in the last years, from rising numbers of green financial instruments to a rethinking of central bank mandates as such [56]. The core *practical* transition role of central banks lies not so much in directly providing green investment, but rather in 'greening' its monetary policy operations [57]. This means that central banks like the European Central Bank (ECB), which engage in equity and bond purchases through either open market operations or large-scale asset purchase programs, should take into account factors like energy system decarbonization when conducting these operations. Estimates of the climate impact of the current monetary policy operations regime suggest that sectors that contribute comparatively less to value-added and emit comparatively large amounts of emissions are also overrepresented in the bond purchase programs of the ECB [58]. This illustrates both the leverage, but also the sustainability gap that central banks as green finance actors face. Moreover, central banks also influence green finance flows through regulation and supervision such as setting reserve requirements; or they influence market actors by forecasting, analyzing global financial markets, and not least by setting key interest rates that can also inhibit the proliferation of green financial flows [59]. They are hence both public and private capital-facing actors, which is also reflected in the (often contradictory) position institutions like the ECB find themselves in discussions on green finance [60].

Moving on to the private side of green finance actors, large asset managers have been at the forefront of debates on 'sustainable' and 'green' investment in recent years. The annual letters of Blackrock CEO Larry Fink to the asset managers' portfolio companies recently became more focused on climate issues and sparked debates in the media about these actors becoming new global 'environmental stewards'. Although recent research challenges this positive image (see, e.g., [6]), large asset managers do play a pivotal role in administering and steering green financial flows on a global scale. One reason for this is their sheer size. Today, the three largest asset managers alone (Blackrock, Vanguard and State Street) control over USD 20 tn. in AuM [6]. Although precise quantification is difficult, information from the actors themselves provide useful estimates (Fig. 2). Blackrock self-disclosed USD 586 bn. out of a total of USD 8.6 tn. AuM as being invested in 'dedicated sustainable strategies' at the end of 2022 [61]; and State Street self-disclosed USD 516 bn., or 12.5 % of its total assets under management, as invested in 'ESG assets' [62](p. 29). Vanguard deviates somewhat from this picture with less than 0.5 % of its total AuM allocated in ESG funds in early 2023 [63]. The reasons for Vanguard's limited role in green finance are its

customer base and the nature of its managed assets. Vanguard's customers are mostly retail investors, different from Blackrock and State Street: the latter two are faced with the expectations by institutional investors to increase ESG holdings, while Vanguard is rather being pressured to prioritize returns for its retail investors [64]. Reflecting its customer base, the share of mutual funds and ETFs in Vanguard's AuM is almost 90 %, while for the others it is significantly lower (ibid.). Investment vehicles like ETFs are less flexible in terms of ESG-related divestment possibilities since they are tracking pre-determined indices.⁴

Overall, despite the uncertainties and measurement problems of what counts as 'sustainable' or 'ESG' in these cases, both the share and the volume of green assets are non-negligible, at least for Blackrock and State Street. This makes such actors long-term and important owners on a global scale, exercising power beyond their invested firms only [65]. Within this asset management ecosystem, another important actor type are index providers like MSCI that, among others, decide about the composition of ESG funds and which assets count as 'green'[66]. This gives them leverage about the allocation of green finance for the trillions of Dollars in AuM that large asset managers handle. A recent consequence of their power is the decision of all three big asset managers to curb the support for ESG proposals in light of the global energy supply shocks induced by Russia's war on Ukraine in 2022. Blackrock reduced its support for such proposals by almost 50 % and State Street by 20 % [67]. Vanguard even formally left one of the largest industry alliances committed to decarbonizing their portfolios in December 2022, sparking debates about the changing role of large asset managers in the proliferation of green finance [64].⁵ This Net Zero Asset Managers initiative, which Vanguard left, gathered 301 signatories with close to USD 60 tn. in AuM as of late 2022, making it a central forum for mobilizing commitment to green finance [68]. Beyond the unclear material consequences for green finance flows, such an exit can have an 'inverted' signaling effect for other investors (see [69]): as media discussions around cases of ESG exit suggest, institutional investors have a major influence on the discourse around sustainable investing.

One final key actor type for the mobilization and proliferation of green finance are private banks. These actors are not necessarily at the forefront of actual green investment when it comes to absolute volumes, or the discursive shaping of green finance. Rather, banks occupy an important *mediating* function within the global green finance ecosystem [70]: in their day-to-day business, they decide about the funding of sustainable economic practices and energy projects; and about the potential non-funding of fossil-fueled energy sources such as coal or oil. Through this decision-making, banks influence and often determine global green finance flows, albeit within the limits of regulatory frameworks governing bank activities [71]. Different from other private actors like large asset managers, banks do not typically 'steer' large sums actively into (green) assets or products, but they rather offer different green financial products or underwrite green bonds in their mediating function between investors and targets [35].

The mediating function of private banks hence determines their relevance for the mobilization of green finance. This reflects the potential of these actors for multiplying existing green finance flows. Precisely because banks are not mobilizing massive green financial flows by themselves, they are often underrated as actors for ambitious green transition plans. A recent study on the role of banks in the European green transition argues that banks take an important but underappreciated role both as carbon financiers and as potential sources for filling the green finance gap for the European Green New Deal [72]. Both the budget constraints of many EU member states as well as the lack of

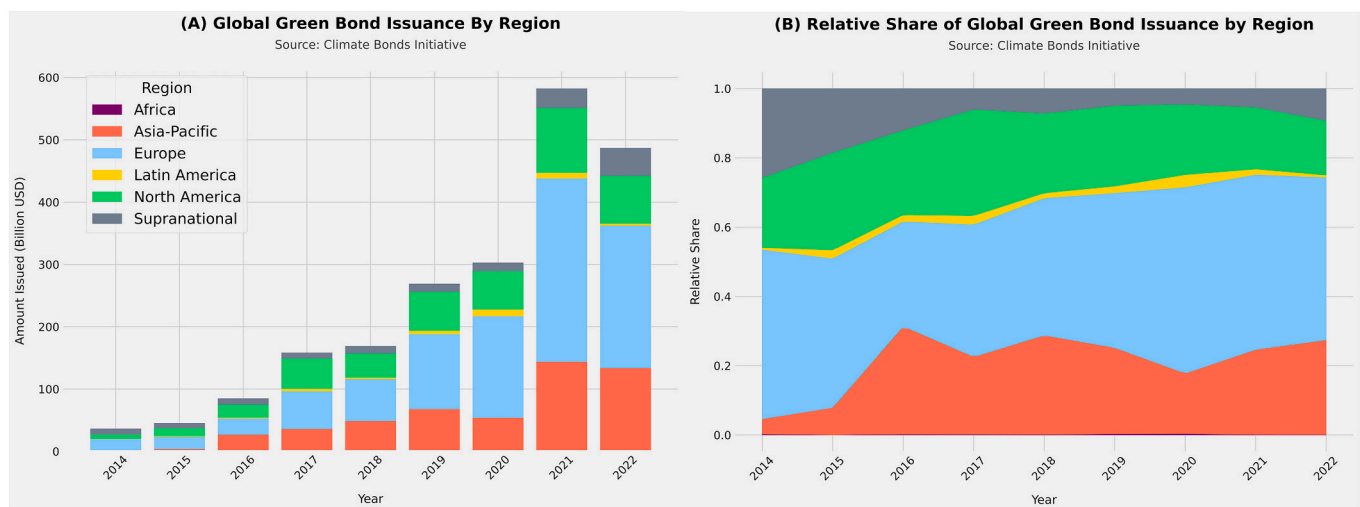
⁴ I thank an anonymous reviewer for pointing this out.

⁵ Given that Vanguard's investment profile is heavily ETF-focused, the company has less direct possibilities to 'green' its portfolio which is mostly tracking existing indices. Again, thanks to an anonymous reviewer pointing this out.

Table 1

The main actors within the landscape of global green finance.

Actor Type	Characteristics	Instruments	Geographies	Relevance for global green finance
Finance ministries/treasuries	Mobilization and provision of green finance, regulatory power, increasing international coordination	Taxes and tax breaks, subsidies and grants, technical and political support for cleantech	National/International	Moderate through regulation, high through active provision of green finance
PDBs	Long-term developmental projects, climate finance, policy-driven	Direct loans, equity investments, grants	National	Moderate-High: Significant national impact
MDBs	Developmental and climate projects, collective action, international focus	Concessional loans, grants, technical assistance	International	High: Broad international impact
State-controlled programs	Bilateral lending, targeted climate initiatives, flexible and specialized	Grants, low-interest loans, technical cooperation	International	Moderate: Targeted, specialized impact
Central Banks	Monetary policy, 'greening' operations, both public and private capital-facing, regulatory influence	Monetary policy, bond purchases, reserve requirements	National/Transnational	High: Pervasive influence on (global) financial system
Large Asset Managers	Large volume of green assets, market discourse shaping, varying commitment to ESG	Equity funds, bond funds, ETFs	Transnational	High: Significant assets under management
Private Banks	Mediating function, underwriting green bonds, potential for multiplying existing green finance flows	Loans, green bonds, depository receipts	National/International	Moderate-Low: Conditional influence

**Fig. 3.** Green bond issuance by region and over time. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

interest of financial markets in financing important aspects of the green transition, such as energy and mobility infrastructures, make banks relevant actors for the mobilization and proliferation of green finance. This is especially relevant for Europe, where large parts of (carbon) economic activity are located in small and medium enterprises that cannot easily access market financing - which is different for large, listed companies that can raise money necessary for the energy transition on global financial markets (ibid.). Table 1 gives an overview of the discussed actors.

3. Instruments: from debt to equity

Green finance flows are not only determined by the actors and institutions mobilizing and providing it, but also by the instruments which enable these. Instruments consist of any means that, nominally or de facto, enable money to become green finance (e.g. by redirecting existing flows or creating new ones). Instruments hence comprise but are not reducible to financial products such as green bonds, practices such as sustainable lending or indices such as the ESG standards for asset classes. Fiscal measures can also be regarded as instruments, although their impact is indirect and harder to measure than the market-based instruments that I am focusing on in this review. As with the discussed actors, a core set of instruments is relevant from a political economy perspective.

Green bonds are the largest and most prominent sustainable financial instruments globally (see Fig. 4). Different from conventional bonds, their green alternative promises to finance exclusively 'green' projects and goals.⁶ Green bonds are otherwise normal debt instruments that pay interest to the bondholder and are in some instances more 'patient' than conventional bonds because investors aim to finance long-term sustainability [74]. The first green 'Climate Awareness Bond' was issued by the European Investment Bank in 2007, which prides itself on still being a 'world leader issuer' of such instruments [75]. At the time, green bonds were seen as a useful 'model' to mobilize private capital for greening energy systems as they would crowd in investors interested in sustainable assets and projects [76]. Since then, global green bonds have grown to a trillion-dollar industry with governments, municipalities and international organizations but also prominent firms such as Apple, Google's Alphabet, Toyota and even Starbucks raising money via their issuance. At the same time, little progress has been made to direct green

⁶ A new development in this respect are so-called sustainability-linked bonds (SLBs), which do explicitly *not* promise to invest their proceeds in sustainable projects. Rather, they are linked to pre-defined sustainability goals of the issuer and evaluated against those goals, with potential benefits for bondholders if they do not meet these targets [73]. SLBs are still in their infancy with the first bond having been issued in 2019.

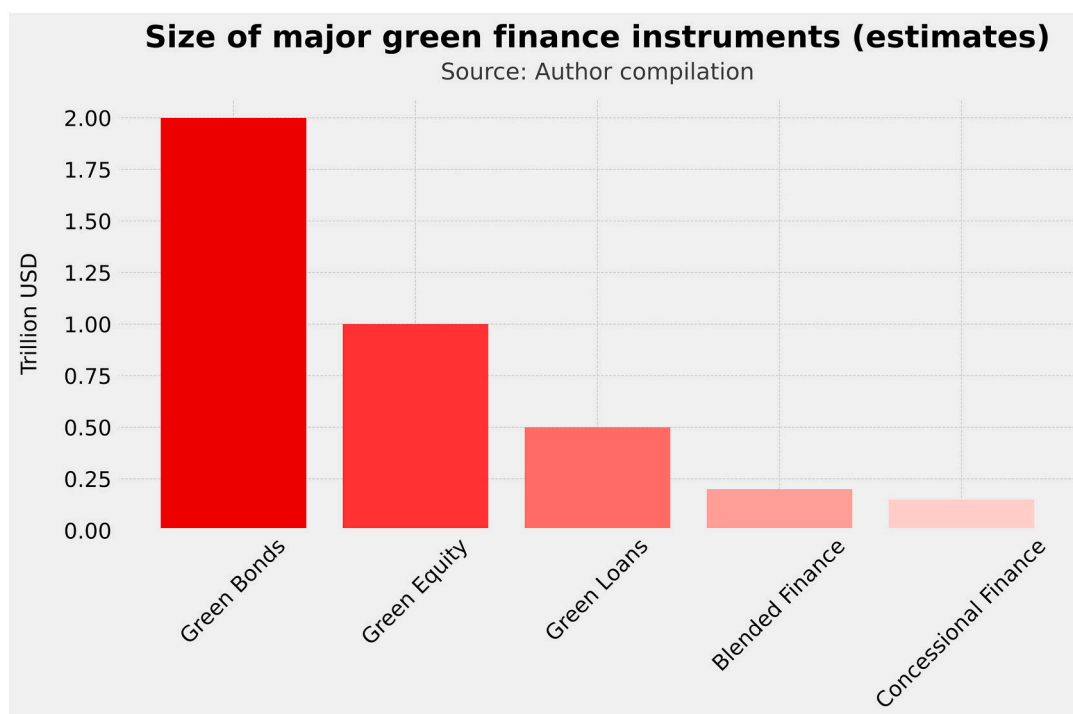


Fig. 4. Comparison of different green finance instruments. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

financial flows via green bonds to the Global South, where bodies like the IPCC see the most pressing need for green transition finance today [77] (see also Fig. 3). State-led attempts to ‘de-risk’ these bonds and other investment targets in the Global South seem at this point not effective enough to redirect global green finance flows where they are mostly needed [10,12]. Another obstacle to the effectiveness of green bonds is the lack of regulatory and legal certainty over what constitutes them. Next to the voluntary green bond principles (GBP) as defined by the International Capital Market Association, the European Union and China define them in their own ways, contributing to the confusion and insecurity about what green bonds are [74]. This is even more problematic given that legal and practical certainty, for example through certification by third parties, is a major determinant of the environmental effectiveness and hence the real ‘greenness’ of these bonds [78]. Recent efforts aimed to achieve such standardization, for example the European Union’s green finance taxonomy or the ISO standard 14,030 (‘Green bonds – Environmental performance of nominated projects and assets’), which seek to harmonize widely used standards such as GBP [79]. For green bonds to become effective instruments for greening energy systems, clear global taxonomies are hence paramount. Despite these problems, the green bond industry is one of the major sources of green finance as of today and remains an important building block for a green transition.

Green equity investment is the second relevant instrument of green finance. This instrument differs from debt-based types like green bonds, as equity investment usually comes with a certain degree of control over the investment firms, which increases its longevity. Equity investment can either be ‘green’ by default through investing in green assets, or it can become ‘green’ in two fundamentally different ways: by shareholder engagement (or: voice) or by divestment (or: exit). Investors can engage their fossil portfolios to become ‘greener’ and turn this investment into sustainable equity; or they can opt to divest from fossil firms and hence signal to other market participants that this investment is becoming less attractive. Large ETF funds and asset managers are at the forefront of green equity investment since they are able to channel large capital volumes towards it. A most prominent case here is the Norwegian

Sovereign Wealth Fund GPF-G, which owns and controls around 1.5% of all global corporate shares (not only ‘green’ ones, see [80]). GPF-G always had an image of a rather ‘ethical’ equity investor but derives much of its injected capital from oil revenues that, among others, Norway’s state-owned firm Statoil generates [81]. Until a few years ago, the fund itself was invested in oil and gas exploration around the world but got rid of these shares in a push for more sustainability [82]. However, becoming a true ‘net zero’ fund and provider of green finance would mean being only invested in net-zero energy producers and firms. In 2022, the Norwegian parliament openly demanded a plan for the fund managers to push their invested firms to reduce emissions without necessarily divesting from them and losing profits [83]. Later that year the fund decided to hold only net zero firms in its equity portfolio by 2050 and hence become an exclusively green financier. The fund management as well as Norwegian experts do not advocate for divestment from these companies but rather for an active equity ownership role, demanding change at shareholder meetings and in dialogue with invested fossil (energy) firms with divestment only as the last option [84]. On the other side, large equity investors like the Dutch pension fund, managing around EUR 500 bn. in assets, or UK-based pension investor Nest decided to opt for (temporary) divestment rather than shareholder engagement [83]. Both represent the two different ways of greening existing portfolios through either divestment or shareholder engagement. In reality, these two ideal-typical strategies and others are being combined for decarbonization goals as we can for example see in the efforts of state-owned entities to green their equity portfolios [39]. Equity is hence a more direct instrument that allows for a greening of brown portfolios and not only the support of already green energy projects or firms (Table 2).

A third key aspect are direct financing instruments such as loans or credits that are provided for renewables and other green projects. Similar to bonds, there is a green loans definition (‘Green Loan Principles’) provided by the International Capital Market Association to standardize borrowing practices globally. These principles relate to the disclosure of the borrowing aim, the transparency of the process and management of the funds, and the regular reporting duties of the

Table 2

The main instruments within the landscape of global green finance.

Instrument	Type	Size	Possibilities	Problems
Green bonds	Debt-based	Cumulative issuance until 2023: over USD 2 tn. globally [86,87].	Pushing of green projects; disinvestment	Most capital raised in Global North; missing/ competing standards and certification schemes
Green equity	Equity-based	Difficult to say; probably in the trillions of USD as the green AuM by large asset managers surpasses USD 1 tn.	Participating in green projects/ firms; disinvestment; shareholder engagement	Investors need to be committed to decarbonization (and have the possibility to engage)
Green loans	Debt-based	Around USD 33 bn. outstanding in 2021 [88]; Around USD 500 bn. issued until 2020 [86]	Direct financing of green projects; direct 'creation' of green finance	Standardization and certification are problematic; Global South receives only a fraction of these loans
Concessional Finance	Mixed	Around USD 150 bn. in 2022 (or: 16 % of total green finance), but difficult to estimate due to overlap with other categories [106]	Below-market-rates access to green finance, especially for low-income countries and projects	Concessional can be volatile or changing and hence represent re-financing challenges for borrowers that are dependent on concessional loans, grants etc.
Blended Finance	Mostly debt-based	Around USD 200 bn. mobilized until 2023 [99]	De-risking and drawing in of private finance to fund the green finance gap	Projects/ countries where green finance is most needed have low public-private funding ratios

borrower [85](p. 121–22). The IMF estimates that green loans worth around USD 500 bn. have been issued until the end of 2020, which is considerably less than the cumulatively issued green bonds of around USD 2 tn. at the end of 2022 [86,87]. At the same time, green loan markets are expected to outpace the growth of the green bond market in the next years, potentially becoming more relevant in the near term as the main green finance debt instrument [88,89]. As with green bonds, most of the issuers and borrowers are located in the Western Hemisphere, Europe and the Asia-Pacific, with the Global South and Africa in particular only marginally participating in these green financial flows [86](p. 15). This is problematic as green loans would be one way of securing sustainable development as also pointed out by the World Bank's development finance institution IFC, which is an important provider of these types of loans [90]. Another aspect of green loans is that they usually involve a more direct relationship between issuer and borrower, potentially allowing for better control of the issued funds than with other debt- or equity-based instruments. Since loans are usually held until maturity and tied to specific projects or aims, green loans can be a more patient, direct and reliable source of green finance. This is especially the case for smaller enterprises and renewable projects that cannot issue bonds or cannot raise much green capital otherwise. Institutions like IFC and other development banks also have specific programs that aim at smaller borrowers down to the issuance of green microfinance loans to individual entrepreneurs. This type of green loans

targets individuals specifically in the Global South (especially women) but has been criticized for contributing to over-indebtedness and increased precarity among vulnerable groups [91].

Other types of green finance instruments are for the most part either sub-types or recombinations of the discussed three main instruments. Two prominent recombined instruments are *concessional* and *blended* green finance. The former represents any green finance tool in which either debt or equity instruments are offered below the respective market rate. Concessional is thereby a question of degree as conditions for borrowers can be 'harder' or 'softer', depending on the instrument [92]. Practically, this means that, for example, loans are issued at below-market interest rates or investors 'overpay' for equity stakes in projects and firms [93]. This makes concessional green finance especially interesting for the Global South, where green finance flows are hard to establish outside of major de-risking pledges by development banks and states [94]. Concessional finance is consequently by far the largest green finance source for Sub-Saharan Africa and other low-income regions [95]. A major issue here is that concessional finance can be relatively volatile if the concessional of loans is dependent on either the goodwill of the lenders or a classification scheme for low-income countries that is subject to changes [96].

Beginning in 2015, blended forms of green finance take the de-risking logic further by aiming to crowd in various forms of private money through the use of public funds [97]. The OECD is actively promoting and monitoring this instrument, e.g. by regularly publishing on blended finance as well as establishing global principles for its mobilization [98]. The total capital committed to such projects has tripled over the last decade, indicating blended finance's potential for green capital mobilization [99]. At the same time, global crises like Covid-19 or high inflation have redirected global public commitment towards providing direct relief and crisis measures, leaving less room for the growth of blended finance projects overall [100](p. 17). Between 2019 and 2021, newly mobilized blended finance fell by half; and investment in global energy projects declined even further since then (ibid.). Importantly, blended finance that specifically aims at climate-related projects seems to be in retreat (ibid., p. 20). The main reason for this decline is, according to an industry survey, 'a lack of bankable investment opportunities with appropriate risk-adjusted returns' (ibid.). According to the industry network *Convergence*, this is also a function of overlapping macroeconomic crises that worsen the environment for blended finance projects (ibid.). An additional problem from a global green finance perspective is that the share of private funds, whose 'crowding in' is the goal of blending, seems to decline where it would be needed most. This is the case for regions like Sub-Saharan Africa, where 'blended' finance consists essentially of public money with little to no private engagement [101,102]. Some explanations see the role of short-term oriented intermediaries as key for the existing gap. They suggest to 're-localize' the operations of capital providers such as institutional investors in order to remove barriers for the mobilization of private capital in relevant dimensions [103]. Other perspectives see the role of MDBs critically, which have a risk-averse profile that prevents them from crowding in sufficient private capital to make a difference [104]. The incentive structure is thereby not conducive for MDBs to change their risk profile as this could risk their shareholder-mandated excellent credit ratings [105].⁷ These are some of the core challenges that govern the proliferation of blended finance in the green finance ecosystem. Table 2 summarizes the discussed instruments.

Taken together, two key characteristics plague the majority of green finance instruments: first, the standardization and clear delimitation of green finance is difficult for most instruments, be they debt- or equity-

⁷ Excellent (AAA) credit ratings mean that MDBs can continue to borrow relatively cheaply. If, through higher risk-taking, MDBs' credit ratings would fall, it would restrict their ability to borrow and lend below market prices. This contributes to the 'conservativeness' of many MDBs.

based. Missing global standards make it especially difficult to engage in targeted green finance mobilization, for example by states or international institutions that are not primarily driven by the profit motive. Second, the lionshare of green finance is raised domestically [106] and circulated within the Global North. This situation is problematic given that most calls and analyses demanding higher volumes of green and transition finance actually mean green finance flowing to energy projects in the Global South. In addition, attempts at improving this imbalance resort to de-risking instruments which are being criticized in the political economy literature for their inefficiency and waste of public money [10,107]. In addition, instruments such as debt-for-nature swaps have been resurfacing to tackle the 'double crisis' of mounting sovereign debt and green finance provision, but have only been able to 'green'-around USD 3 bn. in the last decade [108]. Alternative mechanisms such as carbon offsets and credits can mobilize larger volumes, being valued at around USD 330 bn. in 2022 [109], while it remains unclear how much of this sum is actually 'green' finance due to accounting issues [110]. The following section on the politics sitting at the heart of the ecosystem of green finance takes these challenges up and discusses them in a broader context. While the politics of green finance inherit some of the contradictions and contestations of global finance as such, there are also new cleavages and debates that emerge with the question of how to green the global financial system.

4. Politics: from redistribution to expansion

The politics of global green finance are broad and affect many relevant policy areas. I limit myself here to five overarching issue areas that each contain a specific faultline or trade-off around which the respective politics revolve. With this, I aim to describe the major political conflicts that emerge out of the mobilization and proliferation of green finance over time. I start with the most concrete and end with the most abstract or generalized issue area.

The first one deals with the issue of standardization and harmonization of global green finance classifications, standards and taxonomies. As we have seen throughout the various debates covered in this review, agreeing on and standardizing what is actually meant by 'green' or 'sustainable' bonds, equities, loans, projects and so on is far from easy. There is a plethora of jurisdictional differences between Europe, China, the US and other markets for green products; and attempts at global criteria and principles are often private-led [111]. This is on the one hand filling the gap that stalling interstate negotiations around sustainable energy systems left open (see [112]). On the other hand, private sustainability standards and classifications are not necessarily regulated and often fragmented, adding to collision and conflicts between governments and market actors and confusion among consumers [113]. The crucial politics of this global governance issue come in where gaps in global governance arrangements or confusion about regulatory competencies are exploited by different actors seeking to circumvent or bend rules. Greenwashing may be the most prominent consequence of this regulatory gap. As has been shown for ESG standards in green finance, greenwashing is a pervasive issue that stems from either intentional exploitation of a moral hazard situation or confusion about what counts as 'green' in global finance [13]. The other side of these regulatory gaps, however, is the necessary pace for a global energy transition that seeks to keep the world within 'safe' environmental conditions [114]. Standardizing and harmonizing regulation within green finance is necessary to avoid greenwashing, but it is a slow and politically difficult endeavor that is far from finalized [66]. To rapidly increase green financial flows also means to do so in a less-than-perfect regulatory environment. The costs of additional pace could be misallocation and greater moral hazard situations as green financial flows often come in the form of concessional finance and are hence attractive assets for recipients and borrowers compared to other types of finance. Likewise, the costs of standardizing and harmonizing regulation globally before proceeding to increase green finance flows might lead to a closing window of opportunity for

quickly expanding renewable energy capacity. This ticking clock is by now also recognized among top policymakers in the EU and beyond (see, e.g., [115]). The political conflicts arising out of this faultline involve regulators, investors and potential recipients of green financial flows as well as the public in cases where public money is being invested in green projects. This trade-off between greenwashing risks and pace will shape the coming years unless globally accepted green finance standards emerge.

The second faultline in global green finance politics revolves around the question of the geographical unevenness of both climate change impacts and the financial resources to build a green transition. Critical research in political economy and geography has documented the pervasive unevenness and inequality that, e.g., shapes the realization of climate resilience projects in the Global North and South [116]. The emphasis on the green finance gap by international institutions from the IPCC to the IMF and others is de facto a (sustainable) development finance gap (see [2,117]). For developed regions, green finance is not so much a question of 'availability', but more of redistribution and mobilization of existing capacities (see also [4]). In developing countries, however, the lack of financial capacities represents a real material obstacle to sustainable development in the first place [118]. How to mobilize the financial space for a rapid and just green transition is hence conditioned by geographical unevenness and dependency relations [119]. This unevenness has been described as 'a bifurcated state of flood and drought' [12] regarding green finance: private capital is flowing into projects and assets in the Global North while developing countries face a dire lack of green finance, often only sustained by minimal public funding. This also means that green finance commitments are, in developed countries, a way of attracting funding and raising capital, hence turning the climate crisis into potential profits. At the same time, the consequences of geographical unevenness in access to green finance, and the problematic consequences of particular types of financial instruments such as debt, increase global inequalities through *both*, the lack of particular types of 'green' finance and the access to other, more problematic instruments for developing countries [120]. To address these inequalities, low-income countries spearheaded by Barbados have created the so-called 2022 Bridgetown Initiative aiming at closing the green finance gap [121]. The measures demanded from the initiative address some of the shortcomings of green finance provision directly, such as expanding multilateral green loans or mobilizing private sector savings for green finance instruments implemented by MDBs. Regarding the politics of this unevenness, the major tradeoff for this issue area hence consists in redirecting the 'flood' of available capital to places where it is needed while accounting for the fact that this redirection might result in new inequalities fuelled by debt and increased dependency. Again, speed matters since the ongoing climate crisis will worsen the conditions for sustainable development the more time passes.

The next issue area for the politics of green finance is the question of scale. In political economy debates, green finance is intentionally treated as a *global* phenomenon and it is described as comprising transnational ties and connections. This stems partly from the insight that finance itself is only meaningfully understood as a global phenomenon, for example when it comes to financial contagion and other crises [122]. Green finance is hence an aspect of the broader network of global finance, which is not nationally contained or determined [123]. Consequently, much of the debate between international organizations, MDBs and governments revolves around how to mobilize finance for a global energy transition, including global green climate funds, instruments and programs. At the same time, many efforts to boost a green transformation are located on the national level, for example green industrial policies which also require substantial funding and redirection of capital flows into green sectors [124]. The American Inflation Reduction Act - in essence the most comprehensive green industrial policy effort to date - contains potentially trillions of US Dollars spent on tax breaks, new clean manufacturing jobs and privately mobilized

finance for renewable energy industries. Nationally organized industrial policy can be understood as a large-scale shift of financial state capacity towards green projects and assets and hence as a form of nationally contained green finance. Green industrial policy also means that states allocate (public) money to renewable energy projects, fix financial market failures that uphold carbon lock-ins, or enable new green technologies to enter markets by removing financial barriers [125]. However, the furthest such industrial policy attempts go beyond the national scale is within Europe – but even there it might be rather a vision than reality shaping industrial policy today [126]. There is hence a tension between mobilizing finance for the green transition domestically – mostly embedded within broader green industrial policy programs – and the transnational character of green finance and its global ecosystem – mostly embedded within international organizations and fora. In fiscal hindsight, there are clear tradeoffs between allocating green finance at home and abroad given the backlash against climate policies in many developed countries and its framing as a matter of (financial) costs [127,128]. Industrial policy is often portrayed against this perception of green finance as a cost or burden, as it promises to deliver jobs in renewable industries and growth as a form of investment into the future [129]. Here, the political faultline revolves around the question of where to allocate (seemingly) scarce financial resources as well as where to spend de facto limited political capital and resources for the green transition. Although the financial trade-off between the global and the domestic might be less clear-cut than often portrayed, the political contestation of ‘overspending’ on the energy transition exploits precisely this topic. Empirically problematic ideas of a ‘race’ between nations towards the renewable industries of the future (see, e.g., [130]) and the need to invest in national industrial ‘competitiveness’ are strong political drivers of contemporary climate policy on the national level. Reconciling this with mobilizing and providing financial means for a global energy transition, also with and against international organizations, will be key in the next decades.

Moving into the more abstract yet no less political conflicts around green finance, a crucial question concerns the monetary side of the debate. Theoretically, the green transition can be financed in two distinct ways. First, states (and to a lesser degree private actors) can aim to redirect financial flows such as investment and lending from climate-damaging towards climate-friendly industries and assets. States can do so by providing tax breaks to sustainable businesses or by punishing carbon-intensive assets and producers through additional tax burdens (see [4]). This also involves mobilizing fiscal space for an energy transition, for example by increasing tax revenue from fossil activities, using or selling state ownership stakes, or rerouting subsidies towards green assets (see also [131]). All of these measures end up in some form of *redistribution* of available financial resources and fiscal space. A second and analytically distinct way is to employ monetary policy tools proper, for example through central banks, which go beyond the standard climate policy instruments such as carbon pricing or taxes [132]. This stance can be expanded to include all potential monetary policy channels available from a balance sheet or ‘monetary architecture’ view [4]. Various public entities such as development banks or off-balance-sheet fiscal agencies provide new fiscal space at different points in time, leading to a greening of the entire financial system and safeguarding the green transition (ibid.). Different from the redistributive approach, such a procedure is *systemic* in the sense that it activates and uses all available (public) balance sheets to green the financial system over a longer period. It relies on the availability of different types of instruments and balance sheets that fulfill different functions in this large-scale transformation. In essence, systemic approaches are much more planning-oriented than redistributive approaches as they rely less on different forms of de-risking and private sector engagement over time. Both approaches are however only analytically separable: in reality, we should expect (and indeed see) a mixture of redistributive and systemic approaches working together. Off-balance-sheet fiscal agencies such as the German Climate Transformation Fund that aims to mobilize

over EUR 200 bn. of additional green finance over the next years works alongside the country’s regular federal budget and redistributive environmental measures such as carbon taxes [133]. Similarly, Chinese experiences with monetary policy tools such as green ‘window guidance’ show how systemic approaches to greening the financial system aim to redistribute credit from brown to green economic activities [134]. The political faultline emerging out of these two approaches is whether governments should prioritize redistributive and market-shaping measures or a systemic approach towards greening the financial system. While the former represents a more concrete and immediately doable set of measures, the latter would need long-term planning as well as the safeguarding of systemic transformation against political interference over multiple election cycles [4,127]. At the same time, a redistributive approach is already hitting its limits in many countries around the world due to the strong politicization of climate politics, decreasing the likelihood that such policies will on their own ensure a greening of the financial system by 2050 [135,136]. Systemic approaches are more ‘technocratic’ in both their language as well as in the measures they propose. Expanding and contracting balance sheets are not as politically loaded as carbon taxes or redistribution of subsidies and could ensure a long-term viable strategy of greening the financial system. In any case, policy-makers need to invest political and financial capital in either of these approaches and depending on how this trade-off is framed, the monetary politics of green finance will look differently in the coming decades.

The final issue area shaping the contemporary politics of green finance is the question of financialization. This is not limited to green finance: financialization changed the fabric of global capitalism over the last decades, from corporate governance to development and aid [18]. It describes the increasing sway that financial interests (for example by large asset managers), logics (for example shareholder value) and practices (for example shadow banking) gained over other parts of economies and societies (see [137]). A main critique of financialization is that it affects the well-functioning of other parts of the economy by imposing its logic of ‘quarterly capitalism’ on societal subsystems whose function is undermined by their pervasion by financial interests. For green finance, this problem is mirrored in the tension between profit-seeking and sustainability goals that shape iterative attempts at greening the global financial system. As Sarah Bracking [138] shows, the rise of climate or green finance in the last three decades took place against the background of the financialization of the global economy. In subsequent phases of this increasing financialization, various green finance instruments and entities aimed to ‘account’ for different climate crisis phenomena in different ways, with the consequence that valuating issues such as the ‘greenness’ of assets or financial risk remains problematic and stuck in financialized logics. This casts notions of (green) finance as a ‘firewall that prevents real change’ [139](p. 255), for example in financing the large-scale expansions of renewable capacity. However, not all treatments of green finance would agree with this characterization. Many analyses follow the fundamental IPCC standpoint that finance plays an important role for investing in green energy projects, providing financial assistance or concessional forms of finance for sustainable development and decarbonization [4,8,140]. Green finance is here seen rather as a tool (albeit critically) to achieve a green transformation; and the main issue in these debates is its mobilization rather than its nature. In analytical terms, both standpoints can be commensurable as they address different layers of the debate, namely the critique of financialization and the practical question of how to enable a green energy transition under the conditions of a financialized global economy. Politically, however, there is an emerging faultline that has practical implications for climate governance. Instrumental approaches could turn out to fuel financialization logics rather than to effectively and comprehensively green the financial system. Mobilizing finance could end up being another ‘dangerous’ distraction for climate action that prevents more radical and effective change by relying on large investors and similar ‘incumbents’ [141] known for fueling

Table 3

Key debates and trade-offs regarding the politics of global green finance.

Issue area	Level of abstraction	Faultlines/Trade-offs	Transitional dimension	Transformational dimension	Time horizon
Standardization	Concrete	Greenwashing vs. Pace	Important to mobilize 'enough' green finance	Important to green the entire financial system	Short run
Geographical unevenness	Medium	'Flood' vs. 'Drought'	De-risking will enable flows to the Global South	Publicly financed transition in the Global South	Medium run
Scale	Medium	(National) Industrial Competitiveness vs. (International) Collaboration	National and global policies can co-exist	Prioritize global transformation	Medium run
Monetary politics	Abstract	Redistributional vs. Systemic	Redistribution will (likely) suffice	Without a systemic approach: no green transition	Medium to long run
Financialization	Abstract	Finance as Instrument vs. Finance as Problem	Finance is in most cases an instrument	Financialization is a key obstacle to the green transition	Long run

financialization [142]. This affects especially developing countries, where escaping the problematic logic of financialized capitalism that traps many low-income countries in a seemingly endless cycle of debt refinancing is difficult [143]. 'Green' or 'sustainable' forms of finance might end up reproducing well-known patterns of loss of domestic financial control and increased financial volatility that disrupts (sustainable) development processes. Transformational approaches aiming at changing this situation, however, threaten to go at the cost of more practical and immediate steps towards greening the financial system. If funding is required to green assets, industries and projects, forms of concessional or strictly 'green' finance can go a long way in decarbonizing global energy systems [140]. The challenge here is to recognize when transformational opposition to financialization starts to hinder quick and useful decarbonization efforts in the medium run and to act accordingly. It still remains a key political trade-off to pool financial and political resources for one or the other alternative in the present situation of accelerating climate catastrophe and the necessity to accelerate transition efforts [24].

5. Conclusion: towards a political economy of green finance in the global energy transition

Greening the global financial system and ensuring a rapid global energy transition are not identical processes, but they have a clear relationship. Without massive, long-term and reliable funding there will be no energy transition that is compatible with a world that stays within a 2 °C temperature rise compared to pre-industrial levels [2]. This bare minimum of climate change mitigation is currently being jeopardized by missing investment into renewable energy sources, from macro-level industrial policies to micro-level loans for sustainable development projects. A current evident example are the interest rate hikes by many central banks around the world as an inflation-fighting measure. The ensuing rising costs for financing large-scale energy infrastructure recently led to the cancellation of two major offshore windfarm projects in the US by Danish renewables pioneer Ørsted [144]. Such bottlenecks in the provision of green finance will have significant effects on national decarbonization pathways as the infrastructure for a green energy transition is less likely to be built at the necessary pace. Green finance hence sits at the heart of the challenges and possibilities of a global energy transition; and political economy and energy transition research need to grapple with its contradictions and possibilities in the coming years. This review paper lays one of the building blocks for such an intensified engagement by describing the main characteristics of the landscape of green finance, its actors, instruments and political faultlines.

Next to the open questions described in Table 3, research into the political economy of green finance can and should grapple with how a changing global environment will affect the mobilization and provision of green capital. In the last years, we have observed the rise of a more geoeconomic and statist global order, with economic nationalism and various forms of protectionism gaining more traction among

policymakers around the world [145]. This not only affects trade and investment on an aggregate and abstract level but also threatens the supply of green (developmental) finance while the demand for it grows amidst worsening climate conditions. A major question for political economy and energy transition research is under which circumstances and through which institutions and tools the mobilization of unprecedented volumes of (cross-border) green finance can be safeguarded for the next decades. Existing political economy research taught us that renewable industries and green technologies thrive in a world of 'collaborative advantage' [130] - which is very different from the geoeconomic world that we are entering. A globalized world economy allowing for high volumes of cross-border trade and capital flows is, at least in theory, conducive to the global provision of green finance. If previous channels of potential green finance mobilization are closing, which (political) alternatives are on the horizon that could salvage and even accelerate a rapid and just global energy transition (see also [146])? While there is no easy answer, potential avenues are being debated at the moment. One example is the creation of special drawing rights (SDRs) by the IMF during Covid-19 that allowed low-income countries to cushion some of the socioeconomic impacts of the pandemic. Current proposals aim to expand this SDR instrument to the climate crisis, allowing MDBs to channel much-needed green finance to low-income countries [147]. The discussed Bridgetown Initiative for reforming global green finance provision has SDR expansion as one of its main pillars [121]. This suggests that, even amidst the crisis of globalization, some global governance institutions could overcome the current geoeconomic gridlock and mobilize green finance for a global energy transition. This is an open question that requires us to engage more thoroughly and from interdisciplinary angles with the question of green finance and integrate it better into research on the political economy of energy transitions.

CRediT authorship contribution statement

Milan Babic: Writing – review & editing, Writing – original draft, Visualization, Resources, Methodology, Investigation, Conceptualization.

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Data availability

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