

A “climate bad bank” to navigate stranded assets? Exploring an emerging policy proposal

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Abstract

Facing the threat of climate change will require a decisive commitment to climate action. However, a rapid shift to a low-carbon economy will bear macro-financial consequences. “Transition risks”, under the form of asset devaluations threatening financial stability, call for policies aimed at ensuring the good health of the financial system along transition paths. To this effect, some authors and practitioners have proposed the recourse to “climate bad banks”. Similarly to past bad banks, these institutions would house those assets most exposed to transition risks in order to cleanse the balance sheet of economic agents from elements endangering their financial viability. Such policies could allow financial institutions to focus on funding low-carbon investments, and avoid adverse financial disturbances in case of asset devaluation. It would also avoid transition-exposed assets being transferred to less regulated and less solid financial agents. Yet, however attractive, these policy proposals are still incipient, and are yet to be examined in detail. This article proposes a first exploration of this still prospective topic, as no climate bad banks have been set up yet. We distinguish three main - intertwined - challenges for such an institution: in terms of economic efficiency, justice and governance. After taking stock of historical bad banks, we propose a way to classify their main features, and build on this classification to identify the shape a climate bad bank could take. We further suggest a bad bank scheme composed of a network of small institutions dedicated to one or a few very exposed financial institutions, coordinated by an umbrella organisation, possibly under the aegis of the central bank. The scheme would be funded by the private and public sectors, without forbidding itself to rely on central bank support. This work paves the way for further investigation on the relative merits of CBBs as compared to alternative solutions to maintain financial stability along the transition path and how it would complement other, more usual, climate policies.

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Introduction

As made clear by the recent release of the first chapter of Assessment Report 6 (IPCC, 2021), our window to transition to a low-carbon economy is shrinking by the clock. Immediate, strong and steady climate action is needed to avoid dramatic damage.

Yet, it would bear its lot of macroeconomic and financial consequences. Mark Carney (2015) notably emphasised a trade-off between long-run physical risks (climate damage) in case of delayed or timid climate action, and short-run transition risks (asset devaluation in high-carbon sectors, stranded assets) if decarbonation goes fast. He also underscored “liability risks”, i.e. higher costs for insurers and financial institutions (FIs) in case of compensation for downside physical and transition risks. As a result, both climate action and climate inaction pose important prudential challenges for financial regulators. Most analyses clearly tilt towards decisive climate action, pointing at the incommensurability of physical risks compared to transition risks (ECB, 2021).

However, Carbon Tracker Initiative (2011) emphasised the idea that fossil companies’ reserves, because they are in excess of carbon budgets (Meinshausen et al., 2009), were overvalued on financial markets, hence giving rise to a “Carbon bubble”. A strong commitment to climate action may make these resources “stranded”, resulting in the carbon bubble’s popping, with possible systemic implications. Subsequent authors (Caldecott, 2018; van der Ploeg and Rezai, 2020) have prolonged the “stranded asset” notion to physical capital, suggesting that energy and extraction infrastructures could also suffer from brisk devaluations, and entail financial disturbances. The low-carbon transition may indeed imply massive transformations and asset decommissions across numerous sectors (Mercure et al., 2019), making many firms unviable. Further, there are high suspicions that financial markets may not adequately price transition risks (Bolton and Kacperczyk, 2020; Delis et al., 2019), and may sharply adjust to unexpected changes linked to the low-carbon transition (Thomä and Chenet, 2017). Finally, the presence of potential amplification mechanisms in financial (Battiston et al., 2017) and production (Cahen-Fourot et al., 2021; Godin and Hadji-Lazaro, 2020) networks invite caution¹ with respect to contagion risks.

The threat of financial disturbances along a decarbonation path has important implications. Malfunctioning or crashing financial markets may hamper the good course of the low-carbon transition. Further, the presence of high-carbon assets on the balance sheet of key FIs is increasingly seen as an obstacle to the transition (Geels, 2013; Giraud, 2020). Indeed, burdened with assets at high loss risks if greener investment prevail, banks and investors could be deterred from funding the latter that would precipitate losses on dirty investments (Institut Rousseau, 2021). Finally, from a political economy standpoint, the threat of a financial crisis could also provide a reason for delaying strong climate action.

Hence a decisive need for a tool able to foster financial stability along transition paths. If some financial regulations have been proposed (D’Orazio and Popoyan, 2019), none of them

¹ Cochrane (2021) (see also Helm, (2015)) has criticised the plausibility of transition risks by suggesting that fossil companies’ future losses along transition paths will only be significant if “the transition comes faster than expected”. Our contention is that, on any kind of path, the transition will have to be fast and disruptive. Also, transformations will reach out far beyond fossil fuel companies (and even energy providers) to touch upon many other sectors in ways that are difficult to anticipate due to the complexity of production and financial networks.

explicitly tackle the issue of asset stranding. To this effect, this article explores the creation of a “climate bad bank”.

Since the 1930s, institutions called “bad banks” have regularly been set up to deal with financial disturbances. They have mostly consisted in buying assets with high loss risks from distressed institutions to cleanse the latter’s balance sheets and allow them to focus on their core activities. Similarly, a climate bad bank would buy those assets most at risk to be depreciated during the transition, and ensure the soft-landing of underlying activities. The resort to a bad bank in the context of the transition is barely covered in the literature, with only mentions of a climate bad bank in an OECD (Fischer and Baron, 2015) and IDDRI reports (Spencer et al., 2018), and a few references in blogs (Driouich, 2020) and interviews (Giraud, 2020). Recent proposals in that direction were made by French think tank Institut Rousseau (2021), UNEP-FI (Vaccaro and Barmes, 2021). BlackRock’s chief executive Larry Fink (Tett, 2021) also suggested that exposed FIs create internal structures to deal with their high-carbon assets.

However, bad banks have been infamously charged with fostering reckless investment behaviours and subsidising bankruptcies (Schäfer and Zimmermann, 2009). If publicly funded, they also socialise the losses entailed by financial crises when most gains have already been privatised. A climate bad bank would pose similar issues, possibly at an even larger scale given the range of activities concerned by asset stranding. In addition, although proposals dub their policies “bad banks”, the context of application of such schemes would be quite different from that of historical bad banks. Instead of a short-run management of financial disturbances, a climate bad bank would likely act on a longer timescale. A climate bad bank would have to organise the extinction of the assets it holds instead of trying to make them perform, hence possibly resulting in higher costs than its historical counterparts. Finally, due to the structural nature of the low-carbon transition, it would dabble in industrial policy, hence going beyond mere stabilisation.

Hence the following question: what can we learn from former bad bank schemes, and how far is the comparison trustworthy to design a good climate bad bank? Our contribution lies in the explicit linking of a prospective climate bad bank with past experiences and on a proposal of institutional design.

Section 1 reviews past bad bank examples and draws broad lessons in terms of challenges and conditions for success. Section 2 explores existing climate bad bank proposals in greater detail, questions the degree of similarity between past bad banks and prospective climate bad banks and identifies challenges specific to climate bad banks in terms of efficiency, ethics and governance. Section 3 builds on the two previous sections to propose a broad “climate bad bank” blueprint, before we conclude.

I. Bad banks as a tool to tackle financial instability

1. Goal and principles

A “bad bank” (BB) or “Asset Management Company” (AMC) can be broadly defined as an institution, public or private, housing non-performing assets² previously held by a financially distressed company³. Once the assets are transferred, the BB may have three different goals. It can seek to liquidate the assets as quickly as possible (by selling them to a third party (Klingebiel, 2002)) while minimising losses, or carry out proper asset management to make non-performing assets eventually perform, or conduct an “extinctive management” of the assets, namely allow for the soft-landing of dying businesses (L’AGEFI, 2014a).

Such schemes have been set up in times of financial turmoil to serve four, non-mutually exclusive goals, divided into two narrow (microeconomic) and two broad (macroeconomic) objectives.

At the microeconomic level, all BBs must fulfill its mandate by either restructuring or quickly liquidating assets at minimal costs. In addition, by taking on toxic assets, the BB cleanses the distressed institution’s balance sheet, allowing the latter to focus on its core activities (lending, etc.) and not be muddled with the management of non-performing assets.

Public BBs have further goals at the macroeconomic level. In the case where they buy assets from its previous owner, they put a price tag on the assets at stake. They therefore reinstate the price signal, and substitutes to the market when it does not deliver. Finally, the most obvious goal is, by isolating toxic assets from the broader financial system, to avert financial contagion and restore the solvency and good functioning of the financial system.

2. A broad historical diversity

AMCs have been highly modulable solutions (Cas Medina and Peresa, 2016) with very distinct concrete implementations. Building on the categorisations by Cas Medina & Peresa (2016) and Sajoy (2019), and a review of the literature, we propose a typology of past bad bank features (see Table 1 for a summary and Table A1a-c for a presentation of 50 BB cases through history).

They have first varied in their **timing of action**. Most schemes have been *ex post* dispositives dealing with troubles once they are declared and sufficiently severe. A tiny minority of BBs, like China’s four AMCs set up in 1999 (Rose, 2005), have acted *ex ante*, before the outburst of large financial disturbances.

BBs have also varied in terms of **width**. Some have been *centralised*, like Ireland’s NAMA (2009), and offered their services to all or large swathes of the financial sector, and took care of a wide range of assets. *Decentralised* institutions have been smaller entities set up to deal with the troubled assets of one or a few FIs of greater or smaller systemic relevance (like Securum and

² A non-performing asset is an asset whose financial payments are late or missing (European Central Bank, 2017).

³ This definition is narrower than others. McKinsey (2009) includes as “bad bank schemes” arrangements in which targeted assets remain on the balance sheet of the concerned institutions, which benefit from public support or set up an internal restructuring unit. However, we prefer, like many (Caprio and Klingebiel, 1999; Elliott, 2009; Schaefer and Zimmermann, 2009) to only consider as “bad banks” clearly identified institutions with their own balance sheets.

Retriva (Sweden, 1992)). Note that asset purchases may not have to occur. A spin-off from a preexisting entity could be created with legacy toxic assets on its balance sheets right from the outset. Finally, a network of decentralised bad banks dealing each with particular institutions, like in Thailand in 1998 (Terada-Hagiwara and Pasadilla, 2005), with or without an umbrella organisation, could also be thought of (Tett, 2021). Widths have been determined by the severity and scope of financial crises, and how much the financial sector is exposed. Spain and Ireland opted for centralised institutions because the shock to their banking sectors was far-reaching (Lane, 2012). Finally, a centralised formula lends itself more easily to economies of scale. A decentralised solution, by contrast, allows for a finer-tuned management of troubled assets (Klingebiel, 2002).

Historical BBs have further exhibited a large spectrum of **ownership structures**. Some have been fully public institutions (e.g. Danaharta, Cambodia, 1998), either of public or private law. Others have been public-private partnerships (e.g. Sareb, Spain, 2010) with different degrees of participation, or purely private spin-offs, directly attached to a parent company (e.g. Grant Street, United States, 1998). If the ownership structure determines how the burden of financial stabilisation is shared between the public and the private sector, it also has important implications in terms of efficiency and governance.

Several kinds of **(re)financing modes** have been deployed. If, for all BBs, the initial equity injection is made of private and/or public funds, refinancing is usually warranted by the issuance of additional equity (at the risk of changing control), or the emission of different types of specific debt securities, like senior State-backed bonds (e.g. KAMCO, Korea, 1997). Direct borrowing from the government was also implemented (e.g. FOBAPROA, Mexico, 1998). In addition, asset sales from liquidation obviously allowed banks to cover expenses. Some historical BBs have also received a banking licence to ease access to private refinancing (e.g. K.A Finanz, Austria, 2013), although it has been advised against it to ensure better control and diminish costs (Fell et al., 2017). In some instances (like Switzerland's setup of StabFund in 2010), a degree of central bank support was provided.

Moving to **management strategies**, past BBs have resorted to two main approaches: a "Warehouse" strategy and a "Factory" strategy (Cas Medina and Peresa, 2016). "Warehousing" is equivalent to a passive rundown of assets, i.e. the bank keeps the assets on its balance sheets and only acts if a certain "bad case" threshold is crossed (McKinsey & Company, 2009). In this case, the BB relies mostly on time to recover asset value (Cas Medina and Peresa, 2016). This strategy was initially adopted by Spain's Sareb (2010). A "Factory" strategy implies a more active approach to bad banking, materializing into various sub-strategies. Several bad banks have actively applied loan restructuring (e.g. NPART, Ghana, 1982) to maximise recovery rates. Many others, like Ireland's NAMA (2009), explicitly aimed at quickly liquidating their assets by selling them to more solid third parties. Finally, a growing number of private BBs are adopting an "extinctive management" approach, i.e. are set up to organise the soft-landing of activities that private operators want to get rid of. UBS adopted such a structure to close its fixed income activity in an orderly manner (L'AGEFI, 2014b). It consists in drawing as much profits from housed assets while following the progressive obsolescence of underlying activities.

Finally, BBs have deployed various **incentive structures** to achieve their mission efficiently. The main tool has been the pricing of purchased assets. This price determines how the burden is

shared between the BB and the seller, and is a key variable to address moral hazard (Sajoy, 2019, see below). Medina Cas and Peresa (2016) recommends setting a purchase price between the asset's current market value and its book value estimated by the distressed institution. Buying above market price incentivises compliance, while remaining below book value ensures that institutions are less than fully compensated. For instance, Slovenia's DUTB purchased assets at only 29% of their book value. However, many BBS have bought assets at 100% of their book value, like Germany's FMS (2010). Other types of incentives have been mobilised to limit moral hazard. In Sweden, publicly funded BBs were complemented with a total or partial takeover of stressed institutions by the State, to ensure both reduced moral hazard and low costs to taxpayers (Jonung, 2009). Specific incentive schemes were also deployed to ensure compliance. For instance, Danaharta adopted a carrot-and-stick approach: the carrot was a guaranteed profit-sharing, while the stick was a forced write-down value in the case where banks would refuse Danaharta's offer (Rose, 2005).

Variations have mostly depended on the precise goal given to the AMC, the severity of the economic situation and political economy considerations (Klingebliel, 2002). For instance, contained financial risks were mostly handled by decentralised, private institutions. States have stepped in when private BBs have failed (as France's Consortium de Réalisation, 1993) or when risks have become too systemic for the private sector to handle alone.

3. Challenges to traditional bad banks: Moral Hazard, Ethics and Governance

Yet, BBs have not been systematic solutions. For instance, France privileged a more direct public-guarantee approach to deal with the 2008 crisis (Jacquillat and Levy-Garboua, 2013). The US also abandoned the first Paulson Plan, aimed at creating a Fed-sponsored BB, to favour an approach similar to France's (Pinedo, 2009).

Indeed, public bad banks have hardly been panaceas. They have most of the time been part of broader policy packages and used in conjunction with other kinds of measures (public takeovers, financial regulations, etc.). Further, public BB schemes have their own deficiencies that render their design difficult. Efficiency-wise, setting up a public BB is a source of moral hazard. BBs act as an implicit insurance for FIs, hence encouraging possibly reckless behaviour and therefore requiring an adequate incentive structure to limit harmful behaviours *ex post*. Ensuring compliance *ex ante* can also prove difficult. Of course, in times of crisis, institutions in need of assistance may willfully accept a rescue scheme, even if it comes for them at relatively high costs, if only for their survival. However, too complex or too penalising schemes may deter subscription to the BB. Early German attempts at setting up an AMC at the beginning of the 2008-2010 financial crisis were quite ill-fated in that respect because of drastic conditions imposed on banks and the scheme's complexity (Ilgmann and van Suntum, 2009).

Table 1 - Institutional Dimensions

Type	Modalities	Explanation	Examples

Timing	<i>Ex post</i>	Dealing with financial disturbances after they hit	Most schemes	46 out of 50
	<i>Ex ante</i>	Prudential purpose	China's four AMCs (1997)	4 out of 50
Width	Centralised	Large, single-window unit open to all or almost all the financial sector	DUTB (Slovenia, 2014)	15 out of 37 bad banks with a public scheme
	Decentralised	Smaller units dedicated to one or a handful of institutions	StabFund (Switzerland, 2009)	22 out of 37 bad banks with a public scheme
Ownership structure (initial equity injection)	Public	Full public participation	KAMCO (Korea, 1997)	28 out of 50
	Public-Private	Public-Private partnership	Resolution Trust Corporation (USA, 1990)	14 out of 50
	Private	Full private participation	Propertize (Netherlands, 2013)	8 out of 50
(Re)Financing	State-backed bonds	Issuance of guaranteed bonds	Arsenal (Finland, 1991)	
	Direct borrowing from government	Government bestows a loan	FOBAPROA (Mexico, 1998)	
	Central Bank support	Long term loans	StabFund (Switzerland, 2010)	
Management strategy	Warehouse	Recovery of asset value through time (Passive rundown)	Sareb (Spain, 2012)	5 (+ 2 Factory that became warehouse) out of 50
	Factory - Liquidation	Quick sale of assets to more solid third parties	NAMA (Ireland, 2009)	45(+ - Factory that became warehouse) out of 50
	Factory - Restructuring	Provision of restructuring services (maturity renegotiation, etc.)	NPART (Ghana, 1982)	
	Factory - Extinctive management	Organise the soft-landing of a non-profitable activity	UBS	
Incentive structures	Pricing - at book value	Ensure compliance	FMS (Germany, 2010)	21 out of 32*
	Pricing - below book value	Tame moral hazard	Royal Park Investment (Belgium & Luxemburg, 2009)	11 out of 32

	Other approaches : Carrot-and-stick	Ensure compliance with burden sharing and severe write-off rules	Danaharta (Cambodia, 1998)	
* Data on pricing was only found for 32 bad banks Source: Literature review by the authors				

Ethically speaking, like any bailout scheme, a BB poses important justice issues, both distributional and retributive. The former is defined as equity in terms of resource dispatch across the population, while the latter can be seen as the right way to punish wrongdoers for past misdeeds. From the standpoint of distributional justice, BB schemes question how the burden for the safeguard of the financial system should be shared between the public and the private sector. Regarding retributive justice, a BB can be seen as a subsidy to a handful of happy few who privately benefited from the situation prior to the crisis and even fuelled the subsequent degradation of financial stability - a public good (Nicolaisen, 2015; Shirakawa, 2012). Hence a conflict between making reckless investors pay and lifting the financial stability-related barriers to the transition.

Finally, in terms of governance, the independence, transparency, and accountability of the bad bank are crucial in carrying out its mission (He et al., 2007; Rose, 2005). Some BBs have turned out to be controversial for favouring some institutions due to political connections or handing out unduly large compensations for some financiers (e.g. Indonesia's IBRA (1997)). Some others, endowed with very large mandates, or muddled in political quarries, have been hampered in delivering expected results, like Mexico's IPAB (Calomiris et al., 2012).

Private BB schemes can face similar challenges if they benefit from public funding, although to a lesser extent due to their intrinsically more limited scope. A more specific danger in the case of private AMC - especially if the latter is a subsidiary - is that it could serve as a window dressing instrument. Asset transfers could be made at inflated prices, hence artificially improving the originating institution's balance sheet, and only perform a cosmetic handling of non-performing assets (Terada-Hagiwara and Pasadilla, 2005).

4. Conditions for a “good bad bank”

Facing these challenges, the literature has examined the conditions for suitable BBs, with an emphasis on efficiency. We review these aspects quickly given the broad agreement on the conditions of success for AMCs within the literature.

A “good” BB would be one that fulfills its own mandate (i.e. limiting the cost of asset management, regardless of the mode), and one that allows for a prompt recovery of the financial system and financial institutions (*ex post* scheme) or for a smooth functioning of financial markets at the lowest possible cost (*ex ante* scheme) (Cas Medina and Peresa, 2016; Klingebiel, 2002).

The literature has notably emphasised the importance of external conditions. A healthy macroeconomic environment, allowing for easier asset recovery and higher returns and a well-defined legal framework (including some legal powers for the BB) for the management of impaired assets have been key in the success of some historical BBs. Easily accessible data on concerned assets is also a decisive ingredient. Finally, AMCs have been found most efficient in handling relatively homogenous assets allowing for economies of scale (Cas Medina and Peresa, 2016).

Internally, Klingebiel (2002) and others (Terada-Hagiwara and Pasadilla, 2005) have underscored the need for a focus on asset management, without diversification in assistance to non-financial corporations for instance. The literature has also found that BB sticking to a fixed asset management approach performed better than those changing gear during their lifetime (European Commission, 2016). The recruitment of asset disposal specialists, with specific skills (Avgouleas and Goodhart, 2017), have been instrumental. Baudino and Yun (2017) note that short-run AMCs aimed at rapid asset disposal have performed better than other, more long-term schemes aimed at warehousing - although they admit that AMCs should also be evaluated based on their initial mandate. Finally, political independence and political accountability based on well-established evaluation criteria should also be implemented (He et al., 2007).

Despite their challenges and prerequisites, BBs have increasingly been regarded as adequate tools in handling financial instability (Avgouleas and Goodhart, 2017). The idea of isolating risky assets from the broader financial system and allowing a dedicated institution to take corresponding losses has indeed been highly attractive, so far as to make its way to the realm of climate-related matters and the low-carbon transition.

II. A Climate Bad Bank : Proposals, Perks, Challenges

Given the popularity of the BB principle, ideas for a “climate bad bank” (CBB) to handle transition risks have progressively emerged within the policy debate. Based on the BB model, a CBB would allow economic agents to clean their balance-sheet of assets stranded (*ex post*) or at risk of being stranded (*ex ante*). Yet, however attractive, the CBB’s context of application would be different from its historical counterpart’s. The low-carbon transition is a long-run, transformational effort, that contrasts with short-run instability management typical of BBs.

1. Existing Climate bad bank proposals and justifications

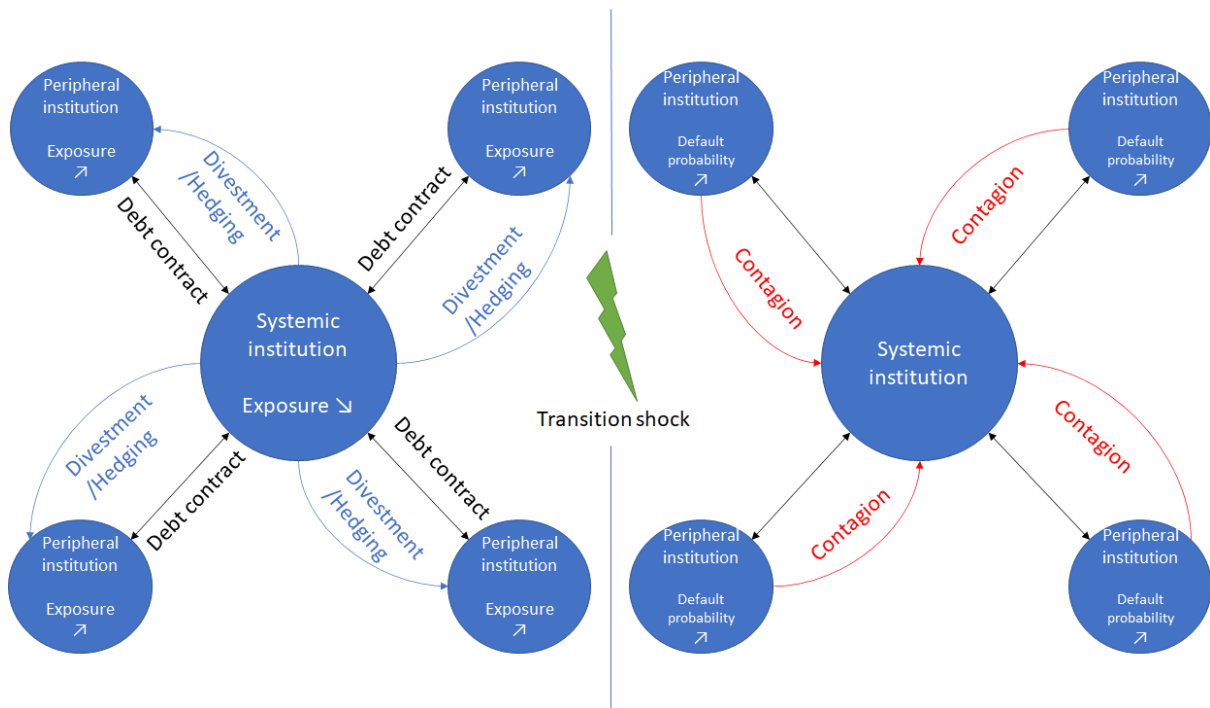
The idea of a climate bad bank has made its way (Gansbeke, 2021; Tett, 2021), and we identified in particular three more elaborate proposals. All of them involve exclusive or near-exclusive public participation to the CBB, and a centralised approach to assets exposed to transition risks.

- The Institut Rousseau’s (2021) European “fossil bank”: An institution backed by the ECB which would buy up to 70% of banks’ high-carbon assets with a 10% haircut that would increase if further purchase rounds are needed. The bank would be funded by the ECB, and house assets for extinctive management purposes.
- The United Nations Environment Programme Finance Initiative’s (UNEP-FI) proposal for national CBBs, which would buy assets *ex ante* with a time-increasing haircut, and a well-established schedule, in accordance with national decarbonation plans (Vaccaro and Barmes, 2021).
- The suggestion by BlackRock Chief Executive Officer Larry Fink (Gansbeke, 2021; Tett, 2021) that the finance industry create bad banks in which they could isolate carbon-intensive activities such as coal.

The CBB would therefore fulfil similar missions to a classic AMC, and, accordingly, pose similar challenges. Its creation is justified in three different ways.

On the one hand, the goal of CBBs would be to limit the extent of transition risks and avoid that potentially systemic agents be exposed to the introduction of climate policy and the transformations linked to the low-carbon transition (Institut Rousseau, 2021). A CBB would indeed isolate exposed assets from the broader financial system, and hence prevent the emergence of disturbances due to asset repricings that banks may not be able to handle, be they brisk (Batten et al., 2016) or progressive (Giese et al., 2021). It would also avoid some perverse effects that may arise from letting markets freely adjust. Along a transition path, it is expectable that exposed institutions hedge against transition risks, and thus get rid of their assets, even at a discount. However, nothing guarantees that such transfers would be made to strong-shouldered institutions. Transition-exposed assets may represent an opportunity for frailer or less regulated agents in search of yields, notably from peripheral financial systems (Bos and Gupta, 2018). If these fragile institutions fail, disturbances could ensue, especially if they are connected to other institutions through financial networks - possibly those who sold the assets in the first place (Fig. 1).

Figure 1 – **A stylised contagion situation despite hedging** - On the left-hand side, a large institution hedges transition risks by selling brown assets to other parties to which it is otherwise linked by debt contracts.



To the extent that such dynamics are difficult to track, setting up a preemptive bad bank like those above could thus be a way to precautionarily solve the information asymmetries between regulators and the financial system as a whole, whose complexity and intractability make it difficult to tame (Battiston and Martinez-Jaramillo, 2018). The CBB would effectively limit the potential increases in financial fragility that may emerge from the reorganisation of the financial sector along a transition path. As a result, it could act as a valuable complement to climate policy, and even foster its introduction, by lifting the fears of financial disturbances.

Second, a CBB is often regarded as a vehicle allowing for an orderly, but firm eviction of those activities most incompatible with a low-carbon economy. It would indeed increase the effectiveness of financial divestment from high-carbon industries, which has so far proven disappointing (Hansen and Pollin, 2018). Fossil assets would be removed from financial markets and not merely reshuffled across agents. Hence, divestment would not be limited to a microeconomic diminution of exposures, but become macroeconomically relevant.

Finally, it has been increasingly noted that the presence of many high-carbon assets on the balance sheets of key financial players (notably banks) may represent a brake to their commitment to a low-carbon world. Transition risks, it is argued, would more than offset the opportunities opened by the low-carbon transition, and thus expose financiers to important losses (Institut Rousseau, 2021). Offering an explicit exit could induce the financial system to fund greener investments, again by lifting the fear of financial disturbances.

2. Bad banks and “climate” bad banks: how far can we compare?

These advantages are attractive as they would facilitate the transition to a low-carbon economy. However, the proposals above are challenging in several respects.

First, the goals of the CBB may not fully match those of its historical counterparts. Crucial here is the timing of the CBB’s operations. If transition risks are understood as an abrupt crisis (Batten et al., 2016), the CBB would just alleviate the negative effects of financial instability *ex post*. It would not differ much from historical BBs, except that it would be dedicated to assets with high carbon content, with the challenges mentioned above. However, as made clear by the proposals, a CBB would ideally defuse financial instability *ex ante* by adopting a preemptive stance, by opening to all FIs. As a result, the objectives of an *ex ante* CBB scheme would be similar to preemptive BB schemes, like China’s. The idea to actively prevent financial instability by housing toxic assets is indeed the same, the only change being that, in the context of the low-carbon transition, asset toxicity is to a large extent based on their carbon content. However, many of the assets bought by the *ex ante* CBB would still be performing. Dealing with them would require an extensive management approach.

Another difference is that the CBB would be at grips with not only one negative externality (financially destabilising behaviours) but with two, climate externality adding up. Both would be tackled simultaneously, hence additional constraints. For instance, it seems inevitable that an *ex ante* scheme should make sure that banks freed from their toxic assets do not invest back in high-carbon assets, and even actively support greener investments. As a result, the CBB would inevitably dabble in industrial/credit policy, something historical BBs have never done - although options of that kind have been contemplated (Klingebiel, 2002). It further questions the means employed to achieve those goals. In this respect, it is not always clear in some proposals (Broome and Foley, 2016; Spencer et al., 2018) whether the CBB should handle only financial assets (loans, securities) or also bailout non-financial companies. In this latter case, the CBB would be more explicitly geared to a transition-facilitation goal than to a financial stability mandate. This questions the CBB’s scope of activity, which could be radically different from historical BBs.

Table 2 - Comparison of historical and climate bad banks' goals

	Historical bad bank	<i>Ex post</i> Climate bad bank	<i>Ex ante</i> Climate bad bank
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Narrow	Free balance sheets	Restore credit-making		Reorient credit towards low-carbon activities
	Asset management	Restructuring/Factory/ Restructuring/Extinctive management		Extinctive management
Broad (or macro)	Pricing	Give price to illiquid assets		Force climate externality into asset prices
	Avert financial instability			
	<i>Ex ante</i>	Isolation of still performing but very risky loans	Irr.	Isolation of still performing carbon-intensive assets
	<i>Ex post</i>	Isolation of non-performing assets		Irr.

What's more, the proposals above are problematic in view of the "good" bad bank recommendations reviewed in Section 1. First, these versions of a CBB would isolate transition-exposed assets from the financial sector, without trying to liquidate them. In other words, transfers to third parties would be at least very limited, and most assets would be warehoused by the CBB. This would increase costs, since asset recovery could not be done by selling assets to third parties (Baudino and Yun, 2017). Second, assets managed by the CBB will be heterogeneous unless particular sectors (e.g. energy, extraction) and/or specific asset types (equity, assets) are targeted. Third, if the transition is costly in terms of growth, assets will be depreciated faster than in a high-growth case, increasing costs. Finally, stranded assets may be difficult to identify due to scarce data on carbon content of assets and still incipient methodologies, as well as a rather uncertain or ill-defined climate policy schedule. These four aspects may not be solved by taking inspiration from past BBs, and may render the CBB costlier.

Because the broad principles of past BBs would apply to a CBB, much can certainly be learnt from past experiences. However, a very peculiar context of application and distinct goals pose additional challenges.

3. Challenges

a) Economic efficiency

i) Costs

Although no definite estimate of “high-carbon” financial assets exist currently at the world level, several regional or national estimates do. Nieto (2019) reports that, altogether, the syndicated loan exposure of the EU, US, Chinese, Japan and Swiss amounts to US\$1.9 trillion (almost 10% of 2020 US nominal GDP), while Baer (2020), by considering bond and equity, reports a US\$3 trillion exposure for the US alone (15% of 2020 US nominal GDP). Although it is unlikely that all assets accounted for in these studies will be purchased by the CBB (for instance if a degree of burden-sharing is introduced), orders of magnitude are high, and possibly underestimated given the multi-sectoral aspect of the transition (Cahen-Fourot et al., 2021; Godin and Hadji-Lazaro, 2020). For comparison, large bad banks like Sareb (Spain) purchased up to \$350 billion of non-performing loans, but the potential costs of the CBB could be far higher. In the case of an *ex ante* scheme, costs are also likely to be high due to additional expenses to foster compliance (see below).

The issue of costs directly relates to what would be the narrow goal of the CBB. If, as noted above, liquidation to third parties is hardly envisageable⁴, the narrow goal should be to limit costs as much as possible while assets are held. This includes managing the assets efficiently to ensure suitable returns. However, because underlying firms would most likely have to exit business (or at least underlying projects be cancelled) the losses that will have to be incurred by the CBB will likely be structurally high, well-possibly higher than that of historical BBs.

ii) Compliance

An important difference between an *ex ante* BB and an *ex ante* CBB is that historical BBs have targeted non-performing assets that banks could not easily restructure. In the CBB case most assets exposed to transition risks are still performing and profitable today. As a result, the opportunity cost for relinquishing them may be quite high - unless there is a broad agreement about future asset value losses and their timing, in which case firms would be induced to sell dearer now rather than incurring losses later. Hence, banks would probably only take part in the scheme late in time, once they have sufficiently benefited from their assets’ earnings, if at all. Making the scheme acceptable could entail buying such assets above their book value. *Ex post* schemes, by contrast, are somewhat shielded from such issues, though only on certain conditions (Ilgmann and van Suntum, 2009).

iii) Moral Hazard

On top of moral hazard issues common to all BBs, CBBs may deter voluntary decarbonation through innovation or business evolutions, or condone new high-carbon investments. Even if such investments are banned conditionally on CBB assistance, additional liquidity may be redirected to

⁴ If it seems straightforward in the case of an *ex ante* scheme, note that devalued assets in the case of an *ex post* scheme will be extremely unattractive, since underlying companies, unless they reconvert swiftly, will have to exit business. In other words, once assets are stranded, little recovery can be expected, by contrast for instance to some real-estate contracts, that can be restructured.

risky or speculative assets (housing, derivatives (Vague, 2019)), fuel investments in unviable green assets or even prompt “green bubbles” (Nauman, 2021), that also represent a risk to financial stability.

iv) Scope of action

Although most CBB proposals explicitly target FIs and banks (Institut Rousseau, 2021; Vaccaro and Barmes, 2021), some others are much more blurred as to the sectoral scope of the CBB’s operation. For instance, it is unclear whether the “coal bad bank” advocated by Spencer et al. (2018) would remove financial liabilities emitted by coal producers and coal-plant operators on the balance sheet of financial operators, or whether it would organise explicitly the extinctive management of physical assets.

Targeting physical assets would have several advantages. It would limit the extent of stranded assets and their impact on non-financial companies. By directly targeting creditors, it would avoid corporate bankruptcies, allow for the soft-landing of doomed activities, and boost the profitability of convertible ones. Further, it would explicitly allow for the decommission of production units incompatible with the transition and open investment space for new, less polluting production processes. Such policies would be extremely useful in the energy sector in which the plain replacement of high-carbon energy sources by low-carbon ones is currently hampered by a “piling-up” of energy sources (Perthuis, 2019).

Yet, such dispositives would likely have very high costs, especially if the CBB targets financial and physical assets at the same time. The functioning of the institution would also have to be adapted to numerous industries, hence an important need in terms of skills.

v) Choice criteria for assets

Finally, defining future stranded assets, notably in the *ex ante* case is a daunting task.

First, as sketched above, there are important technical limits to the generation of univocal and readily usable metrics to determine the environmental friendliness of financial assets (Monasterolo et al., 2017). For a given company, the complexity of value chains renders the estimation of some emission scopes difficult (Haslam et al., 2018), and the plurality of metrics makes it hard to come up with a unified picture (Bingler et al., 2020; Bingler and Colesanti Senni, 2020). Politically, the controversies over natural gas in drafting the EU Green Taxonomy testify of the difficulties in finding a compromise (Simon, 2021). Finally asset stranding depends not only on the carbon content of activities, but also on the probability and stringency of carbon policy, as well as on technological opportunities (Spencer et al., 2018).

Further, even if stranded assets were defined, determining which companies are the most at risk of stranding may expose regulators to information asymmetries. Firms will be incentivised to either overestimate their amount of potential stranded assets, financial or physical to benefit more from the CBB, or to the contrary to underestimate it to keep running their (still profitable) activities as much as possible.

2) Ethics

CBBs further pose questions of distributive and retributive justice relatively similar to those posed by most bailout schemes. However, because it relates to the low-carbon transition, a CBB is doubly problematic from the joint standpoints of retributive and distributive justice.

i) Distributive justice

For the latter, the question is obviously that of who should (or in what proportion) pay for the CBB and the compensation of fossil companies and/or investors. This directly relates to the CBB's funding structure, which can rely on three different sources:

- Present resources, either from private entities or the public sector (taxpayer money, for instance carbon tax receipts).
- Future resources, under the form of debt.
- Central bank backing, through money creation.

However, given possibly large costs for the CBB, it seems unlikely that the bill be footed exclusively with current resources, especially given that the sacrifices linked to other climate policies, like carbon taxes, have been difficult to accept for populations. Hence a necessary recourse to public debt, which would put future generations at contributions, or even central bank monetisation, which would, arguably, not spoil anyone. These three possibilities (current resources, debt, monetisation) will ultimately determine how the burden will be distributed.

ii) Retributive justice

All this said, even a scheme totally acceptable from the standpoint of distributional justice would face ethical objections. Indeed, the CBB poses further issues in terms of retributive justice, i.e. encroaches on the principle according to which wrongdoers should be punished.

We suggested elsewhere a broad policy principle we named “stranded-compensated” (Daumas and Salin, 2020). The general idea is, in order to accelerate decarbonation and effectively displace some technologies, to effectively buy some companies and/or investors out of business. Obviously, the CBB would obey this principle, especially if it targets non-financial entities. Broome and Foley (2016), as well as Guttman (2018), follow a similar line of thought, by respectively advocating compensation for net transition losers or rewarding companies for their decarbonation efforts under the form of liquidity.

This principle, albeit not mandatorily exclusive to it, runs intuitively in opposition to the usual “polluter pays” principle. Indeed a “stranded-compensated” principle would entail to plainly pay past polluters to cut their emissions. This may rightly shock our sense of fairness.

Yet, on the one hand, it could be fair to help out a business or a sector suffering from the transition due to lack of knowledge - which is unlikely, due to the long availability of evidence of human-induced climate change - or too small margins of adaptation. However, what if some agents deliberately prevented or slowed down the struggle against climate change, or greenwashed away

their commitment to a sustainable future? Many FIs like BlackRock (Coste, 2021; Gilbert, 2021) or large banks (Rainforest Action Network et al., 2021) have been charged with either greenwashing or relative indifference with regards to climate issues. Further, some fossil fuel companies have jammed scientific information on the reality of climate change to avoid strong regulation (Franta, 2021; Oreskes and Conway, 2010). As such, handing out free cash to these agents and offering them an exit has something of paying off a ransom. But not committing resources to save them (and us) from the stranding of their own assets could severely hamper the good course of the transition - by increasing transition risks - and equally decrease the well-being of future generations - and of current ones in the future.

Nicolaisen (2015), in the case of bank bailouts, suggests in this respect that rescue should be directed explicitly to safeguarding banks' functions, not to compensating shareholders (and management) for their losses. Yet, fully bypassing owners and managers may not be practicable, as compliance would be endangered.

3) Governance

Finally, on top of generic issues of accountability, transparency and independence faced by all kinds of BB schemes, a CBB would have to solve two additional problems.

i) Scope of action and multiple mandates

First, whether the CBB would target financial or physical assets would largely determine its goal with respect to the low-carbon transition. In the former case, the CBB would be primarily directed towards financial stability and the freeing of banks' balance sheets to fund the low-carbon transition. In the latter instance, the institution would be primarily an industrial policy tool, offering liquidity with the aim to facilitate the conversion of companies highly exposed to the low-carbon transition⁵.

Yet, if the CBB offers the two services at the same time, its precise purpose would be blurred, possibly weighing on its efficiency. History has shown that BBs with mandates going beyond strict financial-stability purposes (corporate support, etc.) have proved less efficient than more focussed counterparts (Klingebiel, 2002). On the other hand, transition risks being endogenous to the smoothness of the low-carbon transition (Monasterolo, 2020), disentangling the goal of financial stability and of ensuring a swift transition is arduous. The two goals may thus be pursued jointly, although whether they should be by the same institution begs questioning.

ii) Geographical scope and governance

Then, whether the (network of) CBB(s) should be implemented at a (sub)national, regional, or international level is not clear.

All historical BBs have been implemented at a national or subnational level - with possible foreign participation in some developing countries (Terada-Hagiwara and Pasadilla, 2005), suggesting that, in times of financial turmoil, the costs of international cooperation are too high

⁵ One could question then whether the "bad bank" label would still be legitimate.

and needs too pressing. On the other hand, some perennial BB proposals at the European Union level have been put forward to tackle the legacy of bad loans left by the 2008 crisis (Avgouleas and Goodhart, 2017). Several CBB proposals are explicitly meant to be set up at the supranational (Institut Rousseau, 2021) or even world level (Broome and Foley, 2016). Given the interconnectedness of the world's financial system (Guttman, 2016) and the global nature of climate change (IPCC, 2021), a degree of international coordination seems necessary, although its extent and precise embodiment are far from given.

These challenges laid down, we can move on to proposing some ways to, if not completely solve them, limit their detrimental consequences.

III. Taking up challenges: What would a good climate bad bank look like ?

In this section, we discuss how a climate bad bank could be thought of in the light of the multiple designs historical BBs have exhibited in order to tackle the challenges highlighted in the previous section. We review those dimensions of design into more details before examining how they could be modulated to fit the CBB's particular constraints.

1. Time frame

Despite possibly higher costs, an *ex ante* (or preemptive) dispositive could be more suited than an *ex post* one (that would act only when transition risks unravel). If transition risks are indeed material, waiting for their unraveling could severely hamper the good course of the transition, even if the mess is cleaned afterwards by an *ex post* institution. Of course, if transition risks are not so high (Cochrane, 2021), such a preemptive institution could represent a waste of time and resources. However, given the significant uncertainties surrounding transition risks (Monasterolo, 2020) and the dire need for decisive action (IPCC, 2021), setting up an *ex ante* CBB could represent a precautionary approach to transition risks in the vein of (Chenet et al., 2021).

2. Width

Given the broad scope of transition-risk exposed assets, and especially if the CBB deals also with physical assets, a purely decentralised solution seems unsuited. In our view, the choice lies between a network of decentralised institutions with an umbrella coordinator, and a single-window centralised unit. The choice criterion should be how transition-exposed assets - as defined by the institution - are concentrated in a few hands or, to the contrary, equally distributed across the financial sector. The literature suggests that transition exposures are actually quite concentrated in large, systemic FIs (Ceres et al., 2015; ESRB, 2020). Hence a network approach may be more adapted.

3. Ownership structure

Most of the proposals mentioned in Section II tilt towards fully public institutions. Indeed, a fully public structure would have the advantage of limiting transaction costs - by limiting interactions with private parties - and would give full discretion to the public regarding the handling of stranded assets. However, a degree of participation from the private sector, either directly concerned parties or external investors, could be envisaged. Indeed, private participation could reduce the cost to public finance and induce greater compliance, by organising an explicit profit sharing that may render the abandonment of assets easier. BBs involving private stakeholders, apparently incentivised to manage assets correctly, have performed better (Rose, 2005). Some private participation could therefore be justified, with sufficient public funding, to strike a balance between control, costs, and efficiency.

4. Funding mode

The funding mode is crucial in tackling justice issues. If relying on private funds for equity injection limits the commitment of taxpayer money, it cannot be the only solution given the sizable value of stranded assets. Hence the need to commit both present (taxpayer receipts) and future resources (through debt) to create a viable dispositive.

The resort to public debt has received several justifications. Because future generations are directly concerned by future climate damage, one could argue that they could be willing to pay for an efficient transition, without financial crisis to perturbate its good course. A certain amount of public debt, paid with future tax receipts may thus be legitimately committed to the low-carbon transition, as put forward by Broome and Foley (2016) and Rendall (2011), possibly to fund a CBB. Broome and Foley notably emphasise that public debt is appealing because it reconciles the aspiration of current and future generations. The use of public debt is for them a way to prompt a “no-sacrifice” transition for current generations, who currently shun bearing the costs of the transition, and therefore to solve the political stalemate faced by climate policies. Costs would be borne by future generations, who are incentivised to pay for the transition in view of possibly catastrophic climate damage. However, Gardiner (2017) suggested that such arguments could be used to unduly extort future generations instead of organising a fair intergenerational burden-sharing. Using public debt would also likely have intra-generational distributional effects, by favouring lenders.

To seemingly escape these distributional issues Institut Rousseau (2021) and Giraud (2020) suggest by contrast a resort to money creation. Indeed, purchasing power created *ex nihilo* apparently does not spoil any private agent, yet, if it is spent in purchases of goods, inflation could ensue if production cannot meet new demand. If the purchasing power is rather invested in financial markets, it can give rise to wealth effects and fuel yet another financial crisis by fostering asset price inflation, for instance on green securities. What’s more, monetisation does not tackle retributive justice. Opening up a manna of liquidity for past polluters and funders of high-carbon projects is an extreme version of the stranded-compensated principle. Regardless of the funding mode, rescue should not come without conditionality on the use of funds and good investment practices. The CBB would then hardly work satisfactorily on its own, and would have to be part of a broader policy package.

All in all, we suggest an imbricated system of backing for the funding of the CBB. Private funding, under the emission of debt securities, possibly guaranteed by States⁶, should be sought first. Public government debt should be used as a second option, when all affordable (in view of the cost-minimising mission of the CBB) private funding opportunities will have been exhausted. Finally, central bank monetisation should be used as a last resort when States themselves are constrained.

⁶ State guarantees would further have the advantage to limit the commitment of present funds or the contraction of debt by States typically rationed on financial markets, like many Southern countries.

5. Management strategy

Obviously, an *ex ante* CBB would not be able to follow either a liquidation, a restructuring or a passive warehousing strategy, as most BBs. It would have to adopt an extinctive management approach. This could entail finding renegotiating creance terms with debtors, like reducing interest rates while, in the meantime, shortening maturities⁷. Note that, respecting a degree of distributional justice in a bailout scheme is tightly linked to the scheme's efficiency in dealing with non-performing assets. Sound practices in following the strategy will limit the final losses born by the State.

6. Incentive modes

We suggest that moral hazard issues should be prioritised, and that assets be bought at a discount. A time-increasing haircut as proposed by Vaccaro and Barmes (2021), based on a clearly established schedule seems sensible, as it would allow banks to determine their optimal sale time, and for a smooth alignment of expectations. To be consistent and justified, haircut schedules should be accompanied by a credible, inflexible commitment to climate policy, signalled indirectly by a carbon price path or a well-defined schedule for asset stranding (Scott Cato and Fletcher, 2020). However, committing to long-run policies is subject to time inconsistency complicating their implementation. Ensuring compliance may therefore require more aggressive dispositives (see D'Orazio & Popoyan (D'Orazio and Popoyan, 2019)). The simplest solution would be to render the scheme mandatory, as has been suggested (Gros, 2009; Ilgmann and van Suntum, 2009).

7. Additional features

Several very specific questions remain unanswered, that we tackle quickly in this subsection.

a) Should the CBB target non-financial companies?

Given the already sizable costs of purely finance-oriented CBBs, setting up an institution targeting both FIs and non-financial companies seems unfeasible.

Yet, it could be imagined that the CBB should target only real assets, or at least non-financial companies. Challenges would roughly be the same as in the finance-oriented case (see Section III), and solutions likely similar. However, the large sectoral scope of the low-carbon transition would make it difficult to set up a centralised institution dealing with all relevant physical assets at a time. This would effectively put up a huge, multi-industry holding with likely prohibitive coordination costs and skill requirements. A network of decentralised units, by contrast, all working

⁷ Historically, such operations have mostly been conducted by debtors and the emitters of securities (public debt restructuring is a case in point). Yet, several bad banks who took distressed assets on their balance sheet did offer restructuring services, explicitly accepting to renegotiate lending terms in the case of distressed loans for instance. For instance, the oldest bad bank, the American Home Owner Corporation did refinanced loans contracted by stressed households. The Indonesian Danaharta also offered restructuration services to its debtors (REF).

closely with one or a few companies seems relatively attractive. Industry specifics would be dealt with efficiently, and costs possibly quite reduced.

Nevertheless, if the primary objective of the CBB is to ensure financial stability along transition paths, dealing only with financial assets (rather than physical ones) would be preferable for several reasons. First, given the current separation between financial-monetary regulation and democratic representation, it seems more cautious to endow a non-elected institution with prudential rather than an industrial policy mandate⁸ (see Baer et al. (2021) for the risks of the emergence of a “green technocracy” within non-elected prudential institutions). Similarly, in a finance-oriented approach, skill requirements are likely to be lower. Dealing with the extensive management of financial assets, even from various sectors, arguably requires a lesser knowledge of said sectors than if physical assets were dealt with. It also diminishes the number of parties to negotiate with. An industry-oriented scheme would have to also ensure a sound reconversion plan for concerned workers, a prerogative that may fall beyond a CBB scheme’s scope.

b) How should assets be chosen?

A taxonomy of “green” and “dirty” activities should be established in accordance with top-notch scientific evidence on transition risks and environmental sciences. Very importantly, it should be a single-window initiative, and therefore trump existing private initiatives on the matter. It should finally be made stricter along the transition path and adapt to changes in policies and technology opportunities, preferably according to a well-established schedule. The European Commission’s Green Taxonomy, although it so far includes only “green” activities, is a key step in that direction. Finally, the choice of assets should be made as much as possible based on the financial soundness of concerned institutions. Not all firms will be equally exposed or vulnerable to transition risks. Hence that asset purchases, as much as available information allows it, should concern in priority those firms most vulnerable from a financial standpoint with lesser reconversion potentials.

c) Geographical scale and governance

A first-best solution would be to set up a worldwide agency which could help the coordination of individual bad bank units, which could deal with national subsidiaries of large FIs or non-financial corporations (NFCs). Such an institution could possibly arrange transfers between nations to ease the burden of some asset purchases for some States, and could be thought of as a subsidiary of already established financial institutions, such as the BIS, the IMF or the World Bank. It could also be part of Broome and Foley’s (2016) proposal for a World Climate Bank.

However, it is likely that the coordination costs of such institutions will be high. As climate negotiations have sourly illustrated, coordinating national policy at a world scale is extremely difficult. As such, supranational levels could be targeted where high degrees of cooperation have already been achieved, like in the EU. Elsewhere, national institutions could be prioritised, with international coordination coming next, once CBBs will have been implemented. This does not

⁸ Although the CBB targets stocks, it could get a controlling stake in companies, and therefore possibly exert power indirectly. See below for a discussion.

prevent countries from favouring information exchanges, for instance on ownerships and international financial flows, or on best practices.

8. What would the climate bad bank look like?

Table 3 - Climate Bad Bank Design

Type	Modalities	Precision
Timing	<i>Ex ante</i>	Well-defined schedule for asset purchases/Pricing
Ownership Structure	Public-Private	Mainly private, sufficient public participation to ensure reasonable control
Width	Decentralised with umbrella coordinator	Network of small entities aimed in priority at most exposed agents, coordinated with an umbrella organisation
Management strategy	Factory	Extinctive management
Incentive structures	Pricing below book value	Tame moral hazard, force externality into balance sheets
	Clear taxonomy	Avoid information asymmetries
	Compliance incentive	Mandatory scheme for systemic actors (1st best) Subsidies (2nd best)
Other	Degree of international cooperation	Desirable but not a priority
	Sectoral target	In priority financial assets

In short, the dispositive would act *ex ante* to primarily defuse financial instability and then remove transition brakes on financial markets. It would consist of a network of decentralised institutions, gathered under an umbrella organisation, that would deal with systemically important actors in priority. It would include some private participation (for instance on the part of less systemic investors), be mainly supported by fiscal authorities, but be offered a window of support from the central bank. Its management strategy would follow an extinctive management model, e.g. by renegotiating debt contracts to extract some profits, while in the meantime reducing interests and maturities. Assets would be bought at a time-increasing haircut to prevent moral hazard, with possibly companion legislation limiting dirty investment. Mandatory compliance would be a first-best. If not possible, other means should be employed in cooperation with supervisory agencies, such as stricter refinancing opportunities, or more penalising prudential ratios. The CBB could also either target financial or non-financial companies, but not both, with goals modified accordingly. A clear and evolutive taxonomy of assets or activities, possibly at the umbrella organisation's initiative, should be established. Finally, a degree of international coordination would be desirable, although it should not be a policy priority, except in very particular cases. Table 3 summarises our proposal.

Conclusion

Our endeavour was to explore past bad bank experiences in order to draw insights for the setup of a “climate bad bank” for the low-carbon transition. After reviewing the key features of bad bank policies, we studied some climate bad bank proposals and mapped how much they overlapped with their historical counterparts.

Highlighting that the analogy was accurate, but incomplete, we moved on to study specific challenges faced by a potential climate bad bank in terms of efficiency, ethics, and governance. We showed notably that, in terms of efficiency, climate bad banks are likely to be costlier than past schemes. Similarly, because they should act *ex ante*, they face a trade-off between ensuring compliance and taming moral hazard. We further showed that ethical costs may be difficult to fully eliminate, and that climate bad banks faced uncertainty regarding their mandates. We finally came up with a sketch of what an efficient climate bad bank scheme could be. In particular, a network of small bad banks, coordinated by an umbrella organisation seemed the architecture most able to reduce part of climate bad banks’ defects. Although no clear criteria stood out as to whether target financial or non-financial companies, we suggested prioritising the financial stability goal and aim at financial institutions as a way to remove potential barriers to bold climate policies. .

In real-world terms, such a scheme could draw inspiration from Larry Fink’s (Tett, 2021) call for the setup of private climate bad banks by FIs to handle their transition-exposed assets. Supervisors could actively encourage the creation of such institutions, by ensuring in return that they are strongly regulated and include some public participation. Regulators would impose that assets be bought below book value, and that they all follow standardised practices, under the supervision of an umbrella organisation. Fiscal support or guarantee (Elliott, 2009), or preferential access to central bank backing could be bestowed on such companies on some conditions.

Because of its qualitative approach, this study did not venture too much into the details and technicalities of a potential climate bad bank. A real-world study on a particular geographical zone, for instance prolonging Institut Rousseau’s proposal for Europe, could be performed by considering how our broad blueprint would apply (see also Institut Rousseau (2021)). This could for instance take the form of a more precise study of the institutional possibilities (political economy, mandates) for the creation of a CBB within the EU, and of its costs in terms of asset purchases and management. Another path would be to compare this climate bad bank proposal to other similarly radical suggestions, such as green nationalisations and vast public spending plans, and see in what respect a carbon asset management would be better or not. It could also be worthwhile to examine how the CBB would interact and possibly complement other, more usual, climate policies. These endeavours could allow for a better assessment of the strengths and weaknesses of such schemes than the kind of one-sided exercises we have performed in this article.

However, it goes without saying that the design of a climate bad bank should not be a mere technical question but should first and foremost result from a democratic debate, in particular given the ethical questions at stake.

Annex

Table A1-a: A sample of Bad Bank schemes - Subsidiary BB

Bad Bank Name	Country - Operating years	Ownership/ Governance	Centralised/ Decentralised	Equity Funding	Model	Pricing of purchased assets(Average)	Other incentive structures	Targeted Assets
Grant Street National Bank	US - 1988	Mellon Bank	Irr.	Private	Factory	57% of book value	Irr.	All
Institutional Restructuring Unit	Germany - 2003-2005	Dresdner Bank	Irr.	Private	Factory	100% of book value		
Phoenix	Ireland/Germany - 2008	WestLB (PPP)	Irr.	Public-Private	Factory	100% of book value		
Financial Resolution & Recovery & Ektornet	Sweden - 2009	Swedbank	Irr.	Private	Factory	100% of book value		
Citi Holdings	US - 2009	Citi Bank	Irr.	Public (38%)-Private (62%)	Factory	n.a		
Heta Asset Recovery	Austria - 2014	Hypo Alpe Adria Bank	Irr.	Public	Factory	No transfer (institution created with their portfolio)		

“All” denotes Bonds, Equity, Loans and Complex products. “n.a” denotes “not available”, and “Irr.” stands for “Irrelevant”.

Table A1-b: A sample of Bad Bank schemes - Spin-off BB

Bad Bank Name	Country - Operating years	Ownership/ Governance	Centralised/ Decentralised	Equity Funding	Model	Pricing of purchased assets(Average)	Other incentive structures	Targeted Assets
Magyar Hitel Bank	Hungary - 1996	Magyar Hitel Bank	Irr.	Public	Factory	No transfer : institution created with their portfolio	Irr.	Loans
BIH	Germany - 2006	BIH	Irr.	Public	Factory			All
KA Finanz	Austria - 2013	KA Finanz	Irr.	Private	Factory			All
Reverta	Latvia - 2010	Parex	Irr.	Public	Factory			All
UK Asset Resolution	UK - 2010	UK Asset Resolution	Irr.	Public	Factory			All
Bank of America	US - 2011	Bank of America	Irr.	Private	Factory			All
Dexia	Belgium - 2011	Dexia	Irr.	Private	Factory			All
Banco Espírito Santo (BES)	Portugal - 2014	Banco Espírito Santo (BES)	Irr.	Private	Factory			All

“All” denotes Bonds, Equity, Loans and Complex products. “n.a” denotes “not available”, and “Irr.” stands for “Irrelevant”.

Table A1-c: A sample of Bad Bank schemes - Public BB

Bad Bank Name	Country - Operating years	Ownership	Width	Equity Funding	Model	Pricing of purchased assets (Average)	Other incentive structures	Targeted Assets
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Danaharta	Malaysia - 1964-2005	State	Centralised	Public	Factory	56% of book value	Compulsory write-offs at loss if refusal of Daharta's bid	All
Fondo de Garantía de Depositos	Spain - 1977-...		Centralised	Public	Factory	No transfer : Takeover	n.a	Loans
Asset Privatization Trust	Philippines - 1987-2000		Centralised	Public	Factory	100% of book value	n.a	Loans
Resolution Trust Corporation	US - 1989-1990		Decentralised	Public-Private	Factory	90% of book value	Ability to exert large control on failing institutions	Mortgages
Konsolidační Banka (1990-2001), then Česká konsolidační agentura (2001-2007)	Czech Republic - 1990-2007		Centralised	Public	Warehouse	n.a	n.a	Loans
NPART	Ghana - 1990-1997		Centralised	Public	Warehouse	100% of book value minus accruing interest	n.a	Loans
Securum	Sweden - 1992-1994		Decentralised	Public-Private	Factory	100% of book value	None	Debt
Retriva	Sweden - 1992-1994		Decentralised	Public-Private	Factory	100% of book value	None	Debt
Consortium de réalisation then Etablissement Public de financement et de restructuration	France - 1993-2006	Credit Lyonnais, then French State	Decentralised	Public - Private	Factory, then Warehouse	100% of book value	None	All

Omaisuuudenhoitoyhtiö Arsenal	Finland - 1993-...	State	Decentralised	Public	Warehouse	100% of book value	n.a	Mortgages Properties
Sponda	Finland - 1993-...		Decentralised	Public	Warehouse	100% of book value	n.a	Mortgages Properties
FOBAPROA (1994-1998) then IPAB (1998-)	Mexico - 1994-...		Centralised	Public-Private	Factory, then Warehouse	100% of book value (minus provisions)	Losses assumed up to 80%	All
KAMCO	Korea - 1997-...		Centralised	Public	Warehouse	40% of book value	None	Loans
BBC	Thailand - 1998		Decentralised	Public	Factory	> 100% of book value	None	Loans
Indonesian Bank Restructuring Agency (IBRA)	Indonesia - 1998-2004		Centralised	Public	Warehouse	100% of book value	Takeover of some banks and corporations	All
CINDA	China - 1999-...		Decentralised	Public	Warehouse Preemptive action	100% of book value	Restriction to loans extended before end-1995	Loans
Oriental	China - 1999-...		Decentralised	Public	Warehouse Preemptive action	100% of book value	Restriction to loans extended before end-1995	Loans
Great Wall	China - 1999-...		Decentralised	Public	Warehouse Preemptive action	100% of book value	Restriction to loans extended before end-1995	Loans
Huarong	China - 1999-...		Decentralised	Public	Warehouse Preemptive action	100% of book value	Restriction to loans extended before end-1995	Loans

UOBR	Thailand - 1998		Decentralised	Public	Factory	> 100% of book value	None	Loans
KTB	Thailand - 2000		Decentralised	Public	Factory	>100% of book value	None	Loans
Thai Asset Management Company (TAMC)	Thailand - 2001-...		Centralised	Public	Factory	33% of book value	Loss and profit-sharing agreements	All
BMB	Thailand - 2002		Decentralised	Public	Factory	> 100% of book value	None	Loans
SCIB	Thailand - 2002		Decentralised	Public	Factory	>100% of book value	None	Loans
Finansiel Stabilitet	Denmark - 2008-...		Centralised	Public	Warehouse	n.a	None	All
Parvalorem	Portugal - 2008-...		Decentralised	Public-Private	Warehouse	100% of book value	n.a	All
Parups	Portugal - 2008-...		Decentralised	Public-Private	Warehouse	100% of book value	n.a	All
Parparticipadas	Portugal - 2008-...		Decentralised	Public-Private	Warehouse	100% of book value	n.a	All
Royal Park Investments SA/NV	Belgium & Luxemburg - 2008-...		Decentralised	Public	Warehouse	83% of book value*	n.a	All
StabFund	Switzerland - 2008-2013		Central Bank	Decentralised	Public-Private	Factory	95% of book value	n.a
Erste Abwicklungsanstalt	Germany - 2009-...	State	Decentralised	Public	Warehouse	n.a	n.a	Structured Securities, Loans, Advances
National Asset Management Agency (NAMA)	Ireland - 2009-...		Centralised	Public (49%) - Private (51%)	Factory	43% of book value	n.a	Mortgages
FMS Wertmanagement	Germany - 2010-...		Centralised	Public	Warehouse	100% of book value	n.a	All

Sareb	Spain - 2012-...		Centralised	Public (45%) - Private (55%)	Warehouse	53% of book value	n.a	Mortgages Properties
Propertize	Netherlands - 2013-...		Decentralised	Public-Private	Warehouse	63% of book value	n.a	All
DUTB	Slovenia - 2014-...		Centralised	Public	Factory	29% of book value	n.a	All
NARCL	India - 2021-...		Centralised	Public	Warehouse	n.a	n.a	All
<p>"All" denotes Bonds, Equity, Loans and Complex products. "n.a" denotes "not available", and "Irr." stands for "Irrelevant".</p>								

Bibliography

- Avgouleas, E., Goodhart, C., 2017. Utilizing AMC's to Tackle the Eurozone's Legacy Non-Performing Loans. *European Economy*.
- Baer, M., 2020. The Impact of Stranded Fossil Fuel Assets on International Financial Institutions: A financial exposure.
- Baer, M., Campiglio, E., Deyris, J., 2021. It takes two to dance: Institutional dynamics and climate-related financial policies. *Ecological Economics* 190, 107210. <https://doi.org/10.1016/j.ecolecon.2021.107210>
- Batten, S., Sowerbutts, R., Tanaka, M., 2016. Let's talk about the weather: the impact of climate change on central banks.
- Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., Visentin, G., 2017. A climate stress-test of the financial system. *Nature Climate Change* 7, 283–288. <https://doi.org/10.1038/nclimate3255>
- Battiston, S., Martinez-Jaramillo, S., 2018. Financial networks and stress testing: Challenges and new research avenues for systemic risk analysis and financial stability implications. *Journal of Financial Stability* 35, 6–16. <https://doi.org/10.1016/j.jfs.2018.03.010>
- Baudino, P., Yun, H., 2017. Resolution of non-performing loans - policy options (FSI Insights No. 3). Bank for International Settlements.
- Bingler, J.A., Colesanti Senni, C., 2020. Taming the Green Swan: How to improve climate-related financial risk assessments. *Economics Working Paper Series*.
- Bingler, J.A., Senni, C.C., Monnin, P., 2020. Climate Financial Risks: Assessing Convergence, *Exploring Diversity* 27.
- Bolton, P., Kacperczyk, M., 2020. Do Investors Care about Carbon Risk? 85.
- Bos, K., Gupta, J., 2018. Climate change: the risks of stranded fossil fuel assets and resources to the developing world. *Third World Quarterly* 39, 436–453. <https://doi.org/10.1080/01436597.2017.1387477>
- Broome, J., Foley, D.K., 2016. A World Climate Bank, in: González-Ricoy, I., Gosseries, A. (Eds.), *Institutions For Future Generations*. Oxford University Press, pp. 156–169.

- <https://doi.org/10.1093/acprof:oso/9780198746959.003.0009>
- Cahen-Fourot, L., Campiglio, E., Godin, A., Kemp-Benedict, E., Trsek, S., 2021. Capital stranding cascades: The impact of decarbonisation on productive asset utilisation. AFD Working Papers.
- Caldecott, B. (Ed.), 2018. Stranded assets and the environment: risk, resilience and opportunity, Routledge explorations in environmental studies. Routledge, Taylor & Francis Group, London ; New York.
- Calomiris, C.W., Klingebiel, D., Laeven, L., 2012. Seven Ways to Deal with a Financial Crisis: Cross-Country Experience and Policy Implications ¹. *Journal of Applied Corporate Finance* 24, 8–22. <https://doi.org/10.1111/j.1745-6622.2012.00397.x>
- Carbon Tracker Initiative, 2011. Unvernable Carbon: Are the World's Financial Markets Carrying a Carbon Bubble?
- Carney, M., 2015. Breaking the Tragedy of the Horizon - Climate Change and Financial Instability - Speech at Lloyds.
- Cas Medina, S., Peresa, I., 2016. What Makes a Good 'Bad Bank'? The Irish, Spanish and German Experience 48.
- Ceres, Zii, ETA, CTI, 2015. Carbon Asset Risk: from rhetoric to action.
- Chenet, H., Ryan-Collins, J., van Lerven, F., 2021. Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. *Ecological Economics* 183, 106957. <https://doi.org/10.1016/j.ecolecon.2021.106957>
- Cochrane, J.H., 2021. The Fallacy of Climate Financial Risk | by John H. Cochrane [WWW Document]. Project Syndicate. URL <https://www.project-syndicate.org/commentary/climate-financial-risk-fallacy-by-john-h-cochrane-2021-07> (accessed 8.5.21).
- Coste, P., 2021. Opération greenwashing pour BlackRock – Libération. Libération.
- Daumas, L., Salin, M., 2020. To avoid shipwreck, imagine a “stranded-compensated” principle. Banque de France. URL <https://blocnotesdeleco.banque-france.fr/en/blog-entry/avoid-shipwreck-imagine-stranded-compensated-principle> (accessed 1.6.21).
- Delis, M.D., de Greiff, K., Ongena, S.R.G., 2019. Being Stranded with Fossil Fuel Reserves? Climate Policy Risk and the Pricing of Bank loans. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3451335>
- D’Orazio, P., Popoyan, L., 2019. Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies? *Ecological Economics* 160, 25–37. <https://doi.org/10.1016/j.ecolecon.2019.01.029>
- Driouch, R., 2020. Pour une structure de défaisance climat | Agir pour le Climat - Pacte Finance-Climat. URL <https://www.pacte-climat.eu/fr/pour-une-structure-de-defaisance-climat/> (accessed 3.25.21).
- ECB, 2021. Financial Stability Review, May 2021.
- Elliott, D.J., 2009. “Bad Bank”, “Nationalization”, “Guaranteeing Toxic Assets”: Choosing among the options (Initiative on Business and Policy). Brookings.
- ESRB, 2020. Positively green: measuring climate change risks to financial stability. ESRB.
- European Central Bank, 2017. En quoi consistent les créances douteuses ? [WWW Document]. European Central Bank. URL <https://www.ecb.europa.eu/explainers/tell-me/html/npl.fr.html> (accessed 8.31.21).
- Fell, M., Grodzicki, M., Martin, R., O’Brien, E., 2017. A Role for Systemic Asset Management Companies in Solving Europe’s Non- Performing Loan Problems. *European Economy*.
- Fischer, D., Baron, R., 2015. Divestment and Stranded Assets in the Low-carbon Transition, in: *OECD Background Paper for the 32nd Round Table on Sustainable Development*. OECD Paris.
- Franta, B., 2021. Weaponizing economics: Big Oil, economic consultants, and climate policy delay. *Environmental Politics* 1–21. <https://doi.org/10.1080/09644016.2021.1947636>

- Gansbeke, F.V., 2021. Climate Change, CFTC, CBDC, And Federal Reserve Bank Audacity [WWW Document]. Forbes. URL <https://www.forbes.com/sites/frankvangansbeke/2020/09/16/climate-change-cftc-cbdc-and-federal-reserve-bank-audacity/> (accessed 8.2.21).
- Gardiner, S.M., 2017. The threat of intergenerational extortion: on the temptation to become the climate mafia, masquerading as an intergenerational Robin Hood. *Can. J. of Philosophy* 47, 368–394. <https://doi.org/10.1080/00455091.2017.1302249>
- Geels, F.W., 2013. The impact of the financial–economic crisis on sustainability transitions: Financial investment, governance and public discourse. *Environmental Innovation and Societal Transitions* 6, 67–95.
- Giese, G., Nagy, Z., Lee, L.-E., 2021. Deconstructing ESG Ratings Performance: Risk and Return for E, S, and G by Time Horizon, Sector, and Weighting. *JPM* 47, 94–111. <https://doi.org/10.3905/jpm.2020.1.198>
- Gilbert, M., 2021. Former BlackRock Executive Blows the Whistle on Greenwashing. Bloomberg.
- Giraud, G., 2020. Banques et marchés financiers: quels obstacles à la transition écologique? *Regards croisés sur l'économie* 164–178.
- Godin, A., Hadji-Lazaro, P., 2020. Demand-induced transition risks - A systemic approach applied to South Africa (Research Papers No. 19). Agence Française de Développement, Paris.
- Gros, D., 2009. Why a bad bank needs to be big. *VoxEU.org*. URL <https://voxeu.org/article/bad-banks-must-be-big-and-mandatory> (accessed 8.18.21).
- Guttmann, R., 2018. *Eco-capitalism: carbon money, climate finance, and sustainable development*. Palgrave Macmillan, Cham, Switzerland.
- Guttmann, R., 2016. *Finance-led capitalism: shadow banking, re-regulation, and the future of global markets*. Springer.
- Hansen, T., Pollin, R., 2018. *Economics and climate justice activism: Assessing the fossil fuel divestment movement*. Department of Economics and Political Economy Research Institute (PERI).
- Haslam, C., Tsitsianis, N., Lehman, G., Andersson, T., Malamatenios, J., 2018. Accounting for decarbonisation and reducing capital at risk in the S&P500, in: *Accounting Forum*. Taylor & Francis, pp. 119–129.
- He, D., Ingves, S., Seelig, S.A., 2007. *Issues in the Establishment of Asset Management Companies*, in: Hoelscher, D.S. (Ed.), *Bank Restructuring and Resolution*. Palgrave Macmillan.
- Helm, D., 2015. *Stranded assets—a deceptively simple and flawed idea*. Energy Futures Network, <http://www.dieterhelm.co.uk/sites/default/files/EFN%20Stranded%20Assets>.
- Ilgmann, C., van Suntum, C., 2009. *Bad Banks: The Case of Germany (CAWM Discussion Paper No. 22)*. Center of Applied Economic Research Münster.
- Institut Rousseau, 2021. *Actifs fossiles, les nouveaux subprimes ?* Paris.
- IPCC, 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (Assessment Report No. 6)*.
- Jacquillat, B., Levy-Garboua, V., 2013. *Les remèdes*, in: *Les 100 mots de la crise financière, Que sais-je ?* Presses Universitaires de France, Paris cedex 14, pp. 87–103.
- Jonung, L., 2009. *The Swedish model for resolving the banking crisis of 1991-93: Is it useful today?* *VoxEU.org*. URL <https://voxeu.org/article/how-fix-banks-lessons-sweden> (accessed 5.24.21).
- Klingebiel, D., 2002. *The Use of Asset Management Companies in the Resolution of Banking Crises - Cross-Country Experience (Policy Research Working Paper No. 2284)*. The World Bank.
- L'AGEFI, 2014a. *Les structures de défaillance ne sont plus nécessairement des bad banks - Actualités Banque & Assurance [WWW Document]*. L'AGEFI. URL <http://www.agefi.fr/banque-assurance/actualites/hebdo/20160210/structures-defaisance-ne>

- sont-plus-necessairement-154389 (accessed 4.30.21).
- L'AGEFI, 2014b. Bad banks, les plaies de la crise [WWW Document]. L'AGEFI. URL <https://www.agefi.fr/banque-assurance/actualites/hebdo/20160210/plaies-crise-154391> (accessed 8.31.21).
- Lane, P.R., 2012. The European Sovereign Debt Crisis. *Journal of Economic Perspectives* 26, 49–68. <https://doi.org/10.1257/jep.26.3.49>
- McKinsey & Company, 2009. Bad banks: Finding the right exit from the financial crisis.
- Meinshausen, M., Meinshausen, N., Hare, W., Raper, S.C., Frieler, K., Knutti, R., Frame, D.J., Allen, M.R., 2009. Greenhouse-gas emission targets for limiting global warming to 2 C. *Nature* 458, 1158–1162.
- Mercure, J.-F., Knobloch, F., Pollitt, H., Paroussos, L., Scrieciu, S.S., Lewney, R., 2019. Modelling innovation and the macroeconomics of low-carbon transitions: theory, perspectives and practical use. *Climate Policy* 19, 1019–1037.
- Monasterolo, I., 2020. Climate Change and the Financial System 22.
- Monasterolo, I., Battiston, S., Janetos, A.C., Zheng, Z., 2017. Vulnerable yet relevant: the two dimensions of climate-related financial disclosure. *Climatic Change* 145, 495–507. <https://doi.org/10.1007/s10584-017-2095-9>
- Nauman, B., 2021. 'Green bubble' warnings grow as money pours into renewable stocks. *The Financial Times*.
- Nicolaisen, J., 2015. Should banks be bailed out?
- Nieto, M.J., 2019. Banks, climate risk and financial stability. *Journal of Financial Regulation and Compliance* 27, 243–262. <https://doi.org/10.1108/JFRC-03-2018-0043>
- Oreskes, N., Conway, E.M., 2010. Merchants of doubt: how a handful of scientists obscured the truth on issues from tobacco smoke to global warming, 1st U.S. ed. ed. Bloomsbury Press, New York.
- Perthuis, C. de, 2019. Le tic-tac de l'horloge climatique: une course contre la montre pour le climat. De Boeck Supérieur, Louvain-la-Neuve.
- Pinedo, A.T., 2009. Removing toxic assets from balance sheets: Structures based on the good bank-bad bank model 21.
- Rainforest Action Network, Banktrack, Indigenous Environmental Network, Oilchange, Reclaim Finance, Sierra Club, 2021. Banking on Climate Chaos (Fossil Fuel Finance).
- Rendall, M., 2011. Climate Change and the Threat of Disaster: The Moral Case for Taking Out Insurance at Our Grandchildren's Expense. *Political Studies* 59, 884–899. <https://doi.org/10.1111/j.1467-9248.2010.00877.x>
- Rose, T.A., 2005. A Practical Guide to a national AMC (Working Paper). World Bank.
- Sajoy, P.B., 2019. Bad banks: Historical genesis and its critical analysis. *International Journal of Research and Analytical Reviews*, January 6.
- Schäfer, D., Zimmermann, K.F., 2009. Bad Bank (s) and the Recapitalisation of the Banking Sector. *Intereconomics* 44, 215–225.
- Scott Cato, M., Fletcher, C., 2020. Introducing sell-by dates for stranded assets: ensuring an orderly transition to a sustainable economy. *Journal of Sustainable Finance & Investment* 10, 335–348. <https://doi.org/10.1080/20430795.2019.1687206>
- Shirakawa, M., 2012. International Financial Stability as a Public Good 7.
- Simon, F., 2021. LEAK: EU to table 'climate taxonomy', leaving gas and nuclear for later. www.euractiv.com. URL <https://www.euractiv.com/section/energy-environment/news/leak-eu-to-table-climate-taxonomy-leaving-gas-and-nuclear-for-later/> (accessed 4.30.21).
- Spencer, T., Berghmans, N., Sartor, O., 2018. Coal transitions in China's power sector: A plant-level assessment of stranded assets and retirement pathways 26.
- Terada-Hagiwara, A., Pasadilla, G., 2005. Experience of Asian Asset Management Companies: Do They Increase Moral Hazard? - Evidence from Thailand. *SSRN Journal*. <https://doi.org/10.2139/ssrn.694965>

- Tett, G., 2021. Cleaning dirty assets needs fair regulation and a “bad bank” model. *Financial Times*.
- Thomä, J., Chenet, H., 2017. Transition risks and market failure: a theoretical discourse on why financial models and economic agents may misprice risk related to the transition to a low-carbon economy. *Journal of Sustainable Finance & Investment* 7, 82–98.
<https://doi.org/10.1080/20430795.2016.1204847>
- Vaccaro, J., Barmes, D., 2021. Aligning finance for the net-zero economy: new ideas for leading thinkers - Financial stability in a planetary emergency: The role of banking regulators in a burning world 57.
- Vague, R., 2019. *A brief history of doom: two hundred years of financial crises*, 1st edition. ed. University of Pennsylvania Press, Philadelphia.
- van der Ploeg, F., Rezai, A., 2020. *Stranded Assets in the Transition to a Carbon-Free Economy*.