De-Risking Decarbonization: Accelerating Fossil Fuel Retirement by Shifting Costs to Future Winners

Alexander Gard-Murray*

August 30, 2022 (Originally submitted October 26, 2021)

Forthcoming at *Global Environmental Politics*

Abstract

Fossil fuel-rich developing countries should be included in climate change mitigation. But they need finance to do so, above what rich countries have been willing to provide. I argue that existing approaches to international and intergenerational transfers have failed to bridge the gap between developing and developed countries' interests. I present a new model, in which the costs of present climate action are distributed not according to present or historical wealth, but future wealth. I demonstrate the basic feasibility of this approach with an implementation I call "income-adjusted guarantees" (IAG). I argue that such an arrangement can help accelerate fossil fuel retirement in developing countries and break the deadlock over global climate financing.

*Thanks to Joe Aldy, Gloria Ayee, Megan Bailey, Philippe Le Billon, Jeff Colgan, Doyne Farmer, Kyle Fruh, Kelly Sims Gallagher, Ned Hall, Robert Keohane, Sharon Krause, David Morrow, Ask Neve, Sandeep Pai, Lorenzo Pellegrini, John Sullivan, and Dustin Tingley for their feedback on this project, as well as participants at the 6th Environmental Politics and Governance conference, the 2020 Princeton Climate Futures Initiative workshop and the Workshop on Politics and Policies for Supply-Side Climate Change Initiatives.

> "When an entire building is burning, to concentrate firefighting resources on one floor would only delay, not prevent, its destruction."
>
> Kenneth Rogoff (2021)

Introduction

To have the best chance of avoiding catastrophic climate change, a substantial portion of fossil fuels around the world need to be left in the ground (IEA 2021; Trout et al. 2022). This has been a hard enough sell in developed countries that can afford the upfront costs of a low-carbon transition. But it is an especially hard sell for countries with fossil fuel reserves and resources whose economies are still developing. The questions of who will sacrifice fossil fuel wealth and who will pay for these sacrifices are intrinsically linked (Caney 2021).

Governments in fossil fuel-rich developing countries (FFRDCs) are likely to see these resources as key not only to current revenues but to future growth (Manley et al. 2017). Even though developing countries generally face the highest risks from climate change in the long term (IPCC 2022; Burke et al. 2015, p. 17), giving up fossil fuels raises the specter of poverty and instability in the short term, making it tremendously difficult to do. Even if it turns out that countries would actually be richer in aggregate by moving away from fossil fuels (Venables 2016), in the short term politicians are likely to be dependent on those resources.

Rich country governments *could* untangle this dilemma using their wealth, but despite proliferating climate finance schemes they have not yet shown a willingness to pay at the necessary scale. The direct transfers offered so far have been insufficient and held up by slow disbursement. Financing, whether at or below market rates, has not made up the difference. Even at low rates, interest payments exert their own drag on growth, especially when fossil fuel revenues are no longer available to cover them.

The gap between what rich country governments are willing to provide and what terms developing countries are willing to accept remains so large that many "unburnable" fossil fuels will make it through. Narrowing that gap requires reducing cost for rich countries *and* improving terms for recipient countries. If the world cannot do one without sacrificing the other, mitigation is likely to remain too slow.

In this article I argue that instead of allocating responsibility for mitigation costs based on countries' wealth in the present, we should allocate it based on their wealth *in the*

future. More specifically, responsibility for the costs of a low carbon transition in fossil fuel-rich developing countries should be *contingent* on those countries' future growth. If developing countries grow quickly after abandoning fossil fuels, they can eventually afford to pay part of the bill; if they grow slowly, they should be exempt.

This income-contingent approach to mitigation should bring the interests of rich countries and fossil fuel-rich developing countries closer together. For countries providing funds, conditionality should reduce their expected costs compared with a world in which they are entirely responsible. For countries that receive funds, conditionality should blunt concerns that the low carbon transition will slow their growth.

I begin by discussing existing literatures on allocating mitigation costs within and across generations, and why they have not yet resolved some of the key distributional issues blocking action. I show how allocating costs based on future income can improve the viability of international, intergenerational bargains. To establish the feasibility of this approach, I present one potential mechanism for putting it into practice: income-adjusted guarantees (IAGs). I then evaluate the coherence, accountability, determinacy, sustainability, epistemic quality, and fairness of such an arrangement (Keohane and Victor 2011), and conclude that it would be a useful addition to the regime complex for governing climate change.

The Decarbonization Gap

Caney (2021) distinguishes between two fundamental questions in climate justice: who ought to mitigate emissions and adapt to climate change (the 'Climate Action Question'), and who ought to pay for those actions (the 'Burden-Sharing Question'). Though climate action has many elements, in this paper I focus specifically on the problem of mitigation through fossil fuel retirement. Barring a technological *deus ex machina*, any successful effort to reduce greenhouse gas emissions will require accelerated retirement of fossil fuel assets.

Climate Action and Fossil Fuel Retirement

Starting with the first question, the scale of required retirements is so large that it will be difficult and potentially impossible to exclude assets in developing countries. To have even a 50% chance of limiting warming to 1.5 °C, 58% of oil, 56% of methane gas, and 89% of coal reserves worldwide must remain in the ground (Welsby et al. 2021).[1] Assuming

[1]The challenge looms even larger if we include the broader category of fossil fuel 'resources'—known deposits which are technically recoverable but too expensive to extract with current technology. At least

harder-to-extract reserves are abandoned first, many of these reductions will need to occur in developing countries. Depending on fuel type, 38-97% of reserves in former Soviet countries, 47-76% of reserves in China and India, 36-42% of reserves in other developing Asian countries, 51-86% of reserves in Africa, and 73-84% of reserves in Central and South America would need to be stranded for an even chance of hitting the 1.5 °C target. Aiming for a better than 50% chance would require still sharper reductions.

Large-scale asset retirement is difficult in any economy, but the difficulties are deeper in economies that are still developing.[2] By construction, FFRDCs rely on extraction for a high portion of their wealth or revenue (Cust et al. 2017). Because a large share of fossil fuels in developing countries are controlled by state-owned companies, governments are especially exposed: non-OECD governments face four times more losses from asset stranding than OECD governments (Semieniuk et al. 2022). Lost fossil fuel income threatens budgets: low oil prices in 2015 led Angola to cut its public spending in half (Schlösser et al. 2017). Economies built on fossil fuel extraction tend to have weak options for diversification (Peszko et al. 2020). Fossil fuel income creates domestic political coalitions dependent on continued extraction (Colgan et al. 2020). These coalitions can benefit from 'doubling down' on fossil fuels even when other paths would be better in the aggregate (Manley et al. 2017). As Peszko et al. (2020, p. xv) write:

> Stakeholders in [fossil fuel-dependent countries]—especially those in emerging market economies facing the development challenges of poverty and lack of opportunity—are deeply concerned about the costs of suddenly shifting away from foundational infrastructure and systems built up over decades on the back of fossil fuels and related industries.

Not only is losing fossil fuel income harder for developing countries, but replacing that income is harder as well. Sustainable development projects face a range of obstacles, including constrained credit and liquidity, low projected returns, relatively small project sizes, weak equity markets, and macro-level risks like unstable policy environments, volatile currencies, and accelerating climate impacts (UN IATF 2020, p. 66). Asymmetric access to technology slows the transition for late developers (Eicke and Goldthau 2021). Developing countries face a much higher cost of capital, leading to what Ameli et al. (2021) call a 'climate investment trap'. Higher capital costs mean weaker mitigation options, which in aggregate means more emissions and bigger climate damages down the

81% of oil, 86% of methane gas, and more than 97% of coal resources should be retired (Welsby et al. 2021, Supplementary Information p. 3).

[2] See Ploeg and A. Rezai (2020) for a review of work on asset stranding generally, and Author (2022a) for a critical perspective on this literature.

road, harming future economic prospects.[3] This raises the expected risk for new investments, which in turn leads to higher capital costs in the present—hence the trap. Between 2007 and 2018, African countries were only able to issue $2 billion of green bonds—far less than the $1.3 trillion those countries say they need for climate action (Georgieva and Tshisekedi 2021). All of these problems are compounded by uncertainty about how fast sustainable development can take the place of fossil fuel revenues (Peszko et al. 2020, p. xviii).

Even when financing is available, it is not always easy to access. Of the nearly $30 billion pledged between 2003 and 2017 by multilateral climate funds, only 20% made it out in that period (Bodnar et al. 2020, p. 8). And even concessional interest rates can become a burden if the investments take too long to pay off.

Consider the dilemma faced by the leaders of a state with large fossil fuel assets, who are thinking of winding down extraction and making investments in clean development instead. They will be confronted by a few hard questions. How will their countries afford those new investments if fossil fuel revenue is declining? If the new investments are funded by borrowing, how high will the interest payments be? When will revenue from clean investments—net of interest payments—start to make up for the lost fossil fuel income?[4] How long hard will the intervening period be? If they make the switch, will growth be higher, the same, or lower than it would have been? And how will all this affect the likelihood that those same leaders are still in power in the next few years?

Without intervention, many FFRDC leaders face two unenviable paths forward. They can keep extracting fossil fuels, trying to make as much of their assets as they can, and risk losing out on a low carbon transition.[5] Or they can plan to retire their fossil fuels and replace them with uncertain investments at potentially high costs, potentially threatening both immediate stability and long-term growth. Neither option is easy, but the first one has the advantage of incumbency and familiarity behind it.

Another way out of this dilemma is for FFRDCs to invest in low-carbon technology without abandoning fossil fuel revenues. Decarbonization involves (at least) two distinct kinds of costs: the stranding costs of abandoning climate-forcing assets, and the investment costs of creating new clean assets. Governments and economic actors can choose to pay one cost without paying the other. Rich countries like Saudi Arabia (Kiyasseh 2022)

[3]Developing countries, especially in hot climates, will face climate impacts equal to or greater than those in developed countries (Burke et al. 2015; Kahn et al. 2019).

[4]See Sovacool (2016) for a discussion of timing and the energy transition.

[5]Even if FFRDCs were allocated all of the remaining carbon extraction budget, they could still suffer from drops in demand as rich countries decarbonize (Peszko et al. 2020), which the latter would have to do in order to surrender the carbon budget in the first place. In other words, exempting FFRDCs from voluntary asset stranding could end up leading to involuntary stranding instead.

and Norway (Simpson 2021) have both made investments in clean technology while continuing to exploit their fossil fuel reserves. China's simultaneous investment in renewables and fossil fuels shows that the two paths are not mutually exclusive (Collins and Erickson 2022).

There are severe limits to this approach. To meet reach net zero by 2050 and remain within the 1.5 °C target, *no* new fossil fuel extraction infrastructure should be developed (IEA 2021). This sharply constrains the opportunities for developing countries who have large but unexploited fossil fuel resources, since those resources must all be stranded. In the IEA's net zero pathway, coal demand will fall by 98%, gas by 55%, and oil by 75% between now and 2050. This means even countries that continue to exploit fossil fuels must face seriously diminished demand for their products. Even existing developed reserves—those that are not only proven but which are actively being exploited already—must leave 40% of their contents unextracted to remain within 1.5 °C (Trout et al. 2022) say . The continuously shrinking carbon budget leaves little room for any country to safely pursue dirty and clean strategies simultaneously. And many FFRDCs lack the financial firepower that has allowed China to 'do both.'

Turning to the Burden-Sharing Question, this dilemma could be loosened if other countries helped pay for FFRDC decarbonization. There is no shortage of proposals to do this, either by making international transfers from developed countries in the present, or by making intergenerational transfers between present and future generations. As I will show in the next two sections, both approaches face barriers to success.

International Burden-Sharing

The dominant perspective in climate justice scholarship is that rich, developed countries have a heightened responsibility to pay for climate action. There are a range of perspectives on how, precisely, this responsibility ought to be portioned out. The 'polluter pays' approach divides responsibility based on historical emissions (Meyer and Roser 2010). The 'beneficiary pays' approach traces how much countries have actually enjoyed the products of historical emissions (Page 2012). The 'ability to pay' approach looks at which countries have the resources to act today, regardless of historical emissions (Moellendorf 2014). Caney (2010) offers a 'hybrid view', arguing that polluter-pays and ability-to-pay approaches should be blended based on how unjustly current wealth was accumulated. Yet another approach would be to assign equal per capita emissions rights to everyone living and then trade them (Singer 2002).[6]

[6]Puaschunder (2020) proposes that country contributions today should be weighted by their expected future benefits from climate change. In doing so, she represents a rare middle ground between the historical

It is beyond the scope of this paper to adjudicate between these theories and other variations on them. Those interested in a good overview should consult Caney (2021). What is important here is that they all ultimately point towards some variation of having rich countries pay. While the precise allocation of responsibilities will vary, as a general rule most wealthy, industrialized countries will be on the hook under any of these principles. This convergence recalls the apocryphal robber who, when asked why he stole from banks, answered: "because that's where the money is."

While this may be ideal in theory, in practice it has not worked out this way. The governments of rich countries have not been willing to commit to transfers or financing at anywhere near the required scale. Levels of funding have been insufficient. Krishnan et al. (2022) estimate that global funding for climate action needs to increase by more than $3.5 trillion *annually*. Buchner et al. (2021) estimate that climate finance needs to increase by 590% above its current levels. The terms on which this funding has been provided also fall short of philosophers' hopes: despite the moral case for transfers, most of the money wealthy countries have been willing to provide has been in the form of loans or other financing mechanisms (J. Bos and Thwaites 2021). And though delay just makes the problem harder, "global progress is stalling" (Climate Action Tracker 2019).

Any international mechanism that requires countries to go against their own interests is unlikely to succeed (Weisbach 2022). Rich country governments are clearly willing to make *some* transfers, but their willingness to multiply those transfers many times over seems limited. Equity is undoubtedly important (Klinsky et al. 2017), but it must be weighed alongside effectiveness. If a maximally equitable answer to the Burden-Sharing question undermines climate action, long-term equity is itself undermined as well. This does not mean that rich countries should be absolved of responsibility altogether. It does mean that arrangements which deviate from a strict historical reckoning but increase climate action are worth considering.

Intergenerational Burden-Sharing

There is a growing momentum behind an alternative answer to the Burden-Sharing Question, which argues that we can overcome present obstacles to climate action by postponing costs into the future. Broome (2010) even argues that the world can achieve "decarbonization without sacrifice" through such an intergenerational transfer.

Climate change creates an intergenerational externality: present people create emissions which impose a cost on future people. This arrangement is not only unjust, but

or contemporary focus of most distributional formulas, and my proposal to postpone allocation decisions entirely.

inefficient. The damage being done to the future is very likely to be greater than the cost of decarbonizing now. If decarbonization succeeds, the benefits to future "winners" could be bigger than the costs to present "losers." If this gap is large enough, then future winners may be able to compensate present losers and still come out ahead (Bovenberg and Heijdra 1998; Foley 2007; Sachs 2014; Karp and Armon Rezai 2014).

A growing body of evidence suggests that this difference is indeed large enough to make cost-shifting viable (Below et al. 2016; Flaherty et al. 2017; Orlov et al. 2018; Andersen et al. 2020; Kotlikoff et al. 2021). Moving away from the "infinitely-lived agent" common to traditional climate economics, these studies combine "overlapping generations" with the integrated assessment models (IAMs) used to estimate climate damages over time. Their results suggest that current costs could be shifted into the future—with interest—and both present and future generations would either be better-off or no worse-off than on our current trajectory. That is, cost-shifting would be Pareto-superior to inaction. In principle, this validates Broome's claim that decarbonization does not require sacrifice.

In a sense, these intergenerational transfers are already happening. Any public investments funded by long-term borrowing (a routine part of rich governments' budgeting) are in effect transferring costs to the future. And existing international aid programs like the Green Climate Fund or the IMF's new Resilience and Sustainability Trust rely on rich government's capacity to borrow cheaply.

Yet at the same time, we are far from living in a world where climate action comes with no near-term sacrifice. Governments have not yet been willing to borrow to offset all costs of climate action. Even if aggregate costs can be fully and efficiently shifted to the future, this does not ensure that the costs faced by individual people, firms, and countries are allocated fairly or in a way that maximizes climate action.

On its own, cost-shifting does not solve the distributional problems in the present. While the intergenerational modelling literature clearly establishes a case for having the future pay, it rarely addresses who in the present should be paid or who in the future should do the paying.[7]

If the borrowing is done by poor countries at insufficiently concessionary rates, debt service drags on growth. If the borrowing is done by rich countries, the fact that they can generally borrow cheaply is offset by the fact that the money is still leaving the country. For rich countries with little appetite to spend in the wake of a pandemic, major war, and

[7] As a modelling decision this is perfectly reasonable. Excluding "any within-generation heterogeneity" (Andersen et al. 2020, p. 11) helps keeps the analysis tractable. But in terms of politics, intragenerational conflicts represent a significant roadblock to implementing cost-shifting.

inflation, the more concessional their financing, the more fiscal burden they accrue. Even if by rights rich country governments *ought* to accept a higher burden and are *capable* of doing so, it is prudent to consider how their expected cost can be reduced. This logic helps explain why, despite the existence of proven mechanisms to transfers cost into the future, climate finance remains so far beyond the necessary levels (Buchner et al. 2021). Until the world has a financing arrangement that improves outcomes for both developing and developed countries, the 'no-sacrifice' scenario will not be realized.

Postponing the Distributive Question

We need an arrangement that increases the money available to FFRDCs who decarbonize, but also reduces the expected cost for rich countries. To meet these goals, I propose combining the intra- and inter-generational approaches discussed above into a new hybrid model. The core principle is simple: responsibility for the costs of FFRDC decarbonization should be proportional to future rather than present prosperity.

The upfront cost of capital for FFRDCs should be as low as possible, with the bulk of the costs being postponed for a generation or more. If they grow quickly, they can afford to bear some of the costs of those earlier subsidies when they come due. If they grow slowly, however, the costs should be covered by whichever countries are rich in the future. Such an arrangement should minimize the downside risk for FFRDC leaders.[8]

Adjusting responsibility based on future income also helps rich countries. In most present models, rich countries bear the full cost of any concessionality they offer. In this model, however, their expected future cost is reduced in proportion to the likelihood that recipient countries grow quickly.[9] If some recipient countries end up growing extremely quickly—something China's rise has proven possible—responsibility will be diluted even further.

This kind of income-contingent liability would mirror (in some respects) the approach taken by the UK government to higher education financing. In that model, universities charge students substantially higher fees than before, but those fees are covered by the government upfront, and students are only required to begin repaying when their income rises above a given threshold. Though highly controversial, this program does not appear to have distorted graduate earnings (Britton, van der Erve, et al. 2019), and graduates in the bottom two income quintiles can expect to pay less than under the previous, non-

[8]Risk is not eliminated, of course. There are still domestic battles to fight and commitment problems to overcome. This will be discussed more in the next two sections where I present a specific implementation.

[9]Any marginal change in their expected cost will depend on the specific terms of the liability formula, but in principle any reduction should increase their overall willingness to lend.

contingent system (Britton and Gruber 2019).

This is decidedly a 'non-ideal' theory. It represents a radical break from the idea that responsibility for mitigation costs should be allocated solely or primarily on the basis of countries' current or historical wealth or emissions. Like income-contingent student loans in the UK, it may end up being controversial.

A 'pay-as-you-grow' model means that some FFRDCs could end up funding some of their own subsidies. At first this might seem paradoxical: why would FFRDCs sign up to an arrangement that could *increase* their future cost? But all future costs have to be evaluated relative to future ability to pay. If developing countries only share responsibility for costs *if* they grow, while at the same time facing fewer climate change impacts, they should end up in a Pareto-superior state. The best justification is that runaway climate change has such catastrophic potential—*especially* for people in developing countries—that mitigation should take priority over a perfectly just allocation of responsibility.

This does not mean that the goal of just burden-sharing is being dismissed: in a sense this whole proposal can be viewed as a simple modification of the classic ability-to-pay approach. If the income gap between rich and poor countries remains stable or widens, ultimate responsibility will reflect a traditional ability-to-pay approach anyway. And if the income gap narrows, then ability-to-pay is still being taken into account, but just calculated at a more politically-convenient time.

Guaranteeing the Future

The justification of this approach only holds together if the proposal is actually feasible. In this section, therefore, I lay out one possible mechanism for implementing an income-contingent approach to climate finance. This may not be the optimal mechanism: that would be beyond the scope of this paper. My goal here is simply to show that there is at least one reasonable model for shifting costs based on future wealth.

I call this model an income-adjusted guarantee (IAG). In an IAG model, a consortium of developed countries and fossil fuel-rich developing countries collectively issue bond guarantees for decarbonization in the latter group. As with traditional guarantees, this brings down the cost of capital, "crowding in" private funding for developing-country decarbonization without stretching developed country budgets in the present. Unlike traditional guarantees, however, liability is not fixed, but is allocated according to the income of each consortium member at the time of default.

Conditional Leverage

Only developing countries that retire fossil fuel reserves and forego new exploration would be eligible for guarantees. The guarantees would back the sale of long-dated, low-coupon bonds for development projects (Sachs 2014; Puaschunder 2017). These development projects could also include mitigation and adaptation investments, and where possible these should be prioritized in support of a global "green new deal" (Aronoff et al. 2019). But the basic value proposition is that retirement of fossil fuel assets will be good for the climate, regardless of whether the development projects also manage to accomplish climate goals.

Using a low coupon rate minimizes the interest payments recipients would need to make, leaving the bulk of repayment until maturity. This reduces the risk that the investment will default early. Combining a low coupon rate with a distant maturity date—e.g. twenty to thirty years—shifts most associated costs into the future. In the event that investments mostly perform well and defaults are rare, the downstream costs for consortium members will be minimized.

Guarantees are a useful tool for mitigating the risks of lending to developing countries, because in theory they require minimal upfront expenditure. The potential for leveraging high amounts of private capital means "guarantees are one of the most catalytic forms of blending" (Blended Finance Taskforce 2018, p. 28). Yet despite their potential, "[t]he use of guarantees and equity has remained very limited" (Averchenkova et al. 2020, p. 30).

For developing countries, just because a loan is available at below-market rates does not mean it will enhance development. FFRDCs are likely to be very wary of taking on even concessional debt if they are also expected to give up fossil fuel income. So a guarantee has to not only reduce the cost of loans, it needs to lower them enough that their effects on the budget are minimal.

For rich countries, a key problem with traditional guarantees is that the initial guarantors bear a fixed share of risk. This means their appetite to make guarantees is bounded by the likelihood of default, because there is no opportunity for them to diffuse that risk.[10] But under the program proposed here, rich countries' expected losses in the future is mitigated by the possibility that newly developed countries might covers some of those losses. The degree to which this shifts the overall volume of financing will depend on the likely growth trajectories for the recipient countries. But in principle, any marginal

[10]Limits on the tradability of guarantees, for example, have made it difficult for banks to fully benefit from holding them under Basel III accounting rules (Blended Finance Taskforce 2018, p. 54-55). Adjusting accounting practices to treat guarantees more favorable would also help expand their use (Betru and Lee 2017).

decrease in future risk should increase rich governments' lending appetites.

Pooled Liability

Responsibility for the guarantees would be spread across the consortium members, in proportion to their per capita incomes and their relative shares of global income at the time of default.[11] Making obligations dependent on future rather than present income sidesteps the current distributive dilemmas between states. Developing countries, wary of paying for a problem that wealthier countries have done so much more to create, only pay insofar as they develop successfully. Developed countries, wary of making transfers to rapidly growing rivals, pay less if their economic dominance diminishes. Governments are unlikely to sabotage growth for the sake of reducing their obligations, given that maintaining growth is a core imperative for most politicians.[12]

Previous efforts to arrange compensation for fossil fuel forbearance in developing countries have foundered. The Yasuní-ITT Initiative, an attempt by the government of Ecuador to get $3.6 billion in international funding to forgo development of some of its oil resources, raised only $13 million (Sovacool and Scarpaci 2016). The amount sought by Ecuador represented less than half of the projected revenue from development, yet rich countries were largely uninterested in simply paying for stranding directly.

An IAG model could help reduce the mismatch between the financial needs of developing countries and the willingness of rich country governments to meet them. In a straight compensation model, rich country governments are on the hook for the entire cost of the transfers. But in an IAG, rich countries' expected global costs are lower, because they can expect some recipient countries to ultimately grow and bear some of those costs.

Governments would only be liable for guarantees extended during their time in the consortium. But to maintain the credibility of guarantees in the face of exit risk, all participating governments would provide the consortium with conditional call options on their debt as collateral. These options can only be exercised after a given government withdraws from the scheme. These options should themselves be income-adjusted, so that governments expecting to grow in the future do not have an incentive to exit the program first.

[11] The International Monetary Fund uses a similar procedure for its Special Drawing Rights quotas.

[12] Using a multi-year rolling average of income would smooth out the effect of sudden shocks like a recession or commodity boom, and make it difficult for a government to game the statistics in a single year.

Decentralized Control

Currently most blended climate finance has gone to high- and middle-income countries, "largely bypassing" the least developed countries (UN IATF 2020, p. 14). In 2019, only 6 percent of blended finance reached low-income countries (Bodnar et al. 2020, p. 9). Since they involve more parties and more complicated terms, guarantees tend to have higher transaction costs than direct loans or transfers (Bhandary et al. 2021). This particularly affects the least developed countries, who are less likely to have the administrative capacity to overcome these costs: "developing countries continuously point to the difficulty in accessing theoretically available resources" (Bodnar et al. 2020, p. 9). At least one in six LDCs is either already reliant on fossil fuel income (Manley et al. 2017, p. 9-10) or has recently discovered new fossil fuel sources (K. Bos and Gupta 2019, p. 2).

Dealing with this issue is crucial to making sure that the low-income FFRDCs have the same access as their middle-income peers. 1 in 6 of the world's least developed countries (LDCs) is either already fossil fuel-rich (Manley et al. 2017) or has recently discovered new fossil fuel sources (K. Bos and Gupta 2019). This means the IAG can play a role in addressing decarbonization needs in LDCs, but only if it can actually get financing disbursed.

To address these issues, IAGs should take advantage of the "Enhancing Direct Access" model recently piloted by the Green Climate Fund (GCF). Instead of approving every project individually, financing decisions are delegated to the regional, national, or sub-national level through intermediate bodies called Direct Access Entitites (DAE). Each DAE receives funding through the GCF, but then oversees the financing of local projects itself. Guarantees are already one of the financing mechanisms open to DAEs, but without the income-contingency proposed here (Innocenti et al. 2020).[13]

This arrangement has several advantages. The DAEs can pass on their low cost of capital to their financed projects. Negotiating a guarantee for a single institution should have lower transaction costs overall than doing so on a project-by-project basis. Because they focus on specific regions or countries, DAEs provide more space for local control. Should DAEs take some equity in their projects, they could make their whole portfolio safer (because profits from one project could make up for losses in another) while maintaining local ownership of assets.[14] And because DAEs can be set up below the country level, they can potentially help reduce the kind of domestic inequality that can accom-

[13]DAEs can take multiple forms, including "ministries or government agencies, development banks, climate funds, commercial banks, private foundations and non-governmental organizations" (Innocenti et al. 2020).

[14]Caldwell and Larsen (2021) offer a number of recommendations for improving DAEs that should be addressed when bringing them over to the IAG program.

pany rapid growth.

Incentives

The core logic of an IAG is that reducing the expected cost of climate finance should increase the incentive of both developed and developing countries to participate.

For developed country governments, an IAG allows for a portfolio approach in a way that transfers do not. Some of projects will fail, and not all recipient countries are likely to grow, so developed countries are almost certainly going to bear some of the cost of guarantees in the future. But every project that succeeds reduces the amount of guarantees that get paid out. Ss discussed above, every developing country that successfully develops reduces the share of costs borne by the initial set of developed country governments. Together, these effects reduce the expected cost of providing guarantees compared with a straight transfer.

Insofar as developed countries have any interest in hitting the 1.5 °C target, doing so while minimizing upfront costs is politically advantageous. Because guarantees push costs into the future, they should allow politicians to offer 'efficiency without sacrifice' to current voters and taxpayers (Broome 2010).

For developing country governments, voluntarily stranding fossil fuel resources and reserves will never be easy. Even if the costs are covered by an IAG, the interests of FFRDC elites may not always align perfectly with those of their countries. Leaders are likely to rely on fossil fuel revenues to stay in power, even if it comes at a cost to development (Ross 2012). For leaders who benefit financially from fossil fuels, any program to incentivize early stranding—including an IAG—may have limited appeal.

But while fossil fuel wealth is easier for a narrow elite to capture, leaders may also be interested in diversifying their personal sources of wealth. While such diversification normally requires upfront spending, the money mobilized by an IAG carries little upfront cost. This could give FFRDC leaders an opportunity to build new sources of rents.[15] Crucially, the fact that an IAG postpones cost to the distant future could actually suit the interests of leaders with short time horizons (Wright 2008). Furthermore, Lockwood (2015) argues that energy subsidies are not only used to distribute political rents; they can also be used as a development tool. Since such subsidies are often enabled by fossil fuel wealth, development spending supported by an IAG offers a potential substitute for this tool.

[15]While rent-seeking should generally be discouraged, getting leaders to both abandon fossil fuels and their own hold on power seems like a tall order.

Finally, the value of fossil fuel assets is itself endogenous to expectations about future policy. Even if only a small set of FFRDC governments initially agree to participate in an IAG, their choice to strand assets voluntarily should shift expectations among other governments about the future of fossil fuels. So there is potential for a self-catalyzing policy, as each additional participant creates additional incentives for the next country to join.

Estimated Scale

A robust assessment of the feasibility of this program would require more detailed economic analysis than is possible here. But "back-of-the-envelope" calculations suggest that the program is within the range of plausibility.[16]

Manley et al. (2017) estimate that FFRDCs face a total asset stranding risk of $4.15 trillion. Their sample includes middle- and low-income countries in which fossil fuel reserves represent at least 25% of national wealth or production 10% of GDP. They assume an annual decrease in fossil fuel prices of 2%, which strands between 6–20% of each country's asset value. Estimates from Welsby et al. (2021) do not track individual countries, but as discussed above they project a much higher rate of stranding. If we assume that 60% of reserves must be stranded, for example, then the countries in Manley et al. face a collective stranding risk of $17.82 trillion.

Guarantors will not pay the whole amount, however. They will only be paying in the event of investment project default. One way to estimate the default risk is to look at the co-financing track record of other institutions. Historically, the Global Environmental Facility has achieved climate change co-financing leverage ratios of 15.45 in China, 10.14 in India, 9.02 in other Asian economies, 7.27 in the Middle East, 6.88 in Central and South America, 6.52 in Africa, and 9.16 in the rest of developing countries (Cui et al. 2020). Conservatively assuming that only the lowest leverage rate can be obtained (6.52:1) suggests a guarantee risk of only $2.73 trillion. Compared with the estimate in Krishnan et al. (2022) that total decarbonization costs through 2050 will be $275 trillion, this is a relatively small portion of the needed expenditure. Furthermore, not all countries will participate. Assuming that Russia and China do not take part (which seems likely) cuts expected costs in half.

[16]The full cost of IAGs would ultimately depend on many factors, including investors' risk appetites, the number of participants, and the capacity of developing countries to absorb investment. Even with the necessary economic data, reliable estimates would not be possible without the institutional details being ironed out. My goal here is not to provide a definitive cost calculation, but merely to show that the program is sufficiently within the realm of possibility to make it worth considering.

Evaluation

The financial feasibility of such a scheme is only one element in evaluating its suitability. To assess it more holistically, I use the criteria outlined in Keohane and Victor (2011): coherence, accountability, determinacy, sustainability, epistemic quality, and fairness.

Coherence

Regime coherence requires elements that are "compatible and mutually reinforcing" (Keohane and Victor 2011, p. 16). This program would fit naturally into the existing regime complex without requiring major institutions, perhaps as part of the Green Climate Fund, the IMF's Resilience and Sustainability Trust, or the World Bank's climate portfolio. It does not undermine the Paris process of "Pledge and Review": it simply offers a new route for countries to achieve their goals. IAGs would not prevent developed countries from ramping up domestic mitigation spending through "Green New Deals" either: the low short-term impact on rich countries' balance sheets would minimize conflict with domestic spending.

Broadly speaking, the current international financing landscape offers similar responses to developing countries with and without fossil fuel resources. This fails to address the significantly different challenges faced by FFRDCs. The program proposed here would not address the needs of the many developing countries, including many least-developed countries and small island developing states, without fossil fuels. But by offering a targeted respond to the problem of asset stranding in FFRDCs, an IAG could free up the rest of the climate finance complex to provide more tailored responses to other countries' needs.

IAGs also do not have to compete with other climate finance institutions for projects to fund. If there is a dearth of suitable mitigation and adaptation projects in the pipeline, an IAG can still advance climate action because the swapping of investment for fossil fuel retirement still achieves mitigation goals. And if the domestic costs of mitigation and adaptation are low relative to stranding costs, the IAG deal can still work, because the money can be spent on other development projects.

Each country that retires its own fossil fuels sends a signal to both domestic and international investors that confidence in the future of carbon-intense development is waning. That said, we might worry about a perverse effect where removing fossil fuel sources raises prices, encouraging remaining producers to keep extracting. But prioritizing funding for fossil fuel substitutes wherever possible will help reduce demand alongside sup-

ply.

Another potential risk is that even loans restricted to climate-related projects might still free up budgetary space for other carbon-intensive projects. This problem could affect any form of climate finance: many many countries invest in renewables while still providing subsidies for fossil fuels (Parry et al. 2021). One way to address this would be to incorporate countries' carbon-intensive investment plans into the evaluation criteria for allocating the pooled bonds. Another way would be to increase decarbonization funding and financing further, to render fossil fuels even less competitive.

An IAG can also benefit from recent innovations in other parts of the climate finance regime complex. The GCF's Direct Access Entity model is already integrated into the proposal. The Climate Finance Access Network is working to strengthen the technical capacity of developing countries to seek funding, which should help streamline future financing efforts (Bodnar et al. 2020). IAGs could learn from or even potentially be integrated into the new Resilience and Sustainability Trust (RST) recently set up by the IMF. Initial proposals called for an institution that would support at climate-vulnerable developing countries "in order to build a resilient economic system and to fill resource gaps to deal with non-financial shocks" (Steele et al. 2021). These goals are in line with the objective of displacing fossil fuel revenues, especially since many of the RST's countries are also FFRDCs. A 20-year loan term and 10½ year grace period match the IAG's emphasis on long-dated financing with low upfront costs (Amr 2022).

Accountability

Any international program that delegates power to a multilateral institution and involves commitments beyond individual governments' terms will be less accountable to publics than purely domestic policies. In exchange for this weakened domestic accountability, IAGs at least provide a higher level of accountability between states and firms than the current regime complex does. Keohane (2006) outlines six forms of accountability in global governance: *supervisory, fiscal, legal, market, peer,* and *reputational*. IAGs provide at least some degree of all six.

1. First, IAGs would have *supervisory* accountability to both the developed and developing countries in the consortium. The precise allocation of voting rights is beyond the scope of this paper, but robust supervisory accountability depends on acknowledging that both the rich countries and FFRDCs have a right to oversee the institution. Voting rights at the beginning should therefore weigh not only initial

contributions but also expected future contributions.[17] Second, individual recipient countries can have a much greater say in the management of regional or national DAEs than they could have over a global fund. This would provide stronger recipient supervision over financing allocation than the current system does.

2. The fact that countries can choose to leave the consortium provides *fiscal* accountability. Guarantors who are dissatisfied with the operation of the program can exit and refuse to back future rounds of financing.[18] DAEs' liability for making coupon payments and eventually repaying the principal incentivizes them to manage their investments well.

3. Instead of operating through voluntary pledges like the Paris Agreement, IAGs create *legal* accountability through specific, well-defined contractual obligations. Countries or firms who feel their rights are not being respected gain a legal right of action against the consortium or other participants.[19] These would be adjudicated as international law cases, ideally in an existing forum like the WTO.

4. The program also employs *market* accountability: if countries fail to meet their obligations or the investment opportunities are too poor, the pool of interested investors will simply dry up.

5. Linkage with other climate institutions such as the UNFCCC and IPCC can help create *peer* accountability, as can partnerships with other multilateral finance institutions. For example, if IAGs were implemented through the Green Climate Fund, they could still co-finance projects with the World Bank.

6. Insofar as governments and firms are interested in at least appearing to "do their part" to stop climate change, participation in the IAG program and compliance with its obligations create opportunities for *reputational* accountability. Governments and firms will want to advertise their participation to highlight their green credentials. Withdrawal or noncompliance will threaten those credentials. Breaching a contract provides a relatively clear signal compared to watering down climate regulations in ways that are hard for other governments to observe (Author 2020).

[17] Including recipient countries in the management of the consortium reduces the risk that developed countries will simply direct funds based on national preferences and strategy rather than climate goals. A multi-lateral system also reduces this risk compared with bilateral finance.

[18] They will still be on the hook for guarantees made during their membership, however, a commitment backed by the conditional options on their debt submitted earlier.

[19] Providing a legal cause of action for third parties who believe that projects fail to meet their stated decarbonization goals could offer an additional check.

Determinacy

Accounting difficulties are a core problem for climate finance (Roberts and Weikmans 2017). Determining what counts as mitigation (let alone adaptation) is hard. Some climate finance is simply a repackaging of old commitments. An advantage of focusing on fossil fuel retirements is that they are much clearer to assess.

Judging supply-side asset retirements, while it may require some investment in monitoring, is simpler than judging the scale of demand-side reductions. In the case of fossil fuel reserves, producers are either drawing them down or not, and remote sensing can help keep the cost of monitoring compliance low (Gray et al. 2018). Since countries are receiving a continual benefit from keeping their assets retired, they can be required to provide access to monitors. In the case of physical capital that can be irreversibly dismantled, like a coal plant or oil tanker, this process can be observed once without the need for further monitoring.

Responsibility for monitoring could be housed inside an existing multilateral institution with experience assessing country performance, like the World Bank or the International Monetary Fund. The infrastructure to conduct such monitoring would not need to be built from scratch. Existing scientific projects already attempt to monitor emissions from sources that include fossil fuel extraction and processing, such as the Emissions Database for Global Atmospheric Research (Crippa et al. 2021). A prototype for a Global Registry of Fossil Fuels is already in development (Byrnes 2020). Attempts to monitoring compliance could build on these efforts. Assessment of compliance could also be incorporated to the Paris Agreement's framework for regular stock-taking efforts.

Sustainability

Governments face a credible commitment problem. Both states and investors may fear that other future governments may decide to renege on their guarantees, especially if the guarantees are very lengthy. Even if some consortium members are credible, others may be less so.

The key mechanism to discourage non-compliance by guarantors is the conditional call option on countries' debt. While countries may still attempt to renege on their obligations, they are effectively bound by the same constraint that keeps countries from reneging on their national debt generally. This is not a perfect instrument—countries do sometimes fail to pay their debts—but the consortium structure limits the impact of any one country's actions on the viability of the whole arrangement.

There is also a further disincentive, which is that investors in rich countries will resist

attempts by their own governments to unpick guarantee arrangements. The guarantees are likely to have diffused into mutual funds, pension funds, etc. So even if governments are no longer interested in the climate goals of the program, it would be hard to undo guarantees without threatening domestic savers.

Another issue for sustainability is whether a changing global balance of power will alter the incentives for countries to participate. China's rise, in particular, has already begun disrupting the ability of countries in the Global North to direct outcomes in the Global South through control of capital. A global competition for influence may work in the program's favor, however. If China does not join, Western countries may see the IAG consortium as a way to counter authoritarian influence-building in a constructive way.

Epistemic Quality

A well-functioning program needs to both provide and act upon reliable information. IAGs give participating governments a material reason to agree to monitoring of their mitigation and adaptation projects. By discouraging fraud or poor management among borrowers, monitoring decreases the risk that governments will have to cover large losses. While each government would prefer to avoid scrutiny of its own firms and projects, the collective nature of the guarantees gives each government an interest in monitoring the other participants.

Extraction and mitigation technologies will change over time, as will emissions levels. To enhance "consistency between their rules and scientific knowledge" (Keohane and Victor 2011, p. 17), guarantors should include third-party scientists (perhaps drawn from the IPCC) in the process of determining fossil fuel asset eligibility. Civil society organizations in both developed and developing countries should be granted formal access to the consortium's core decision-making venues as well as the Direct Access Entities. Giving scientists and other non-governmental actors a formal and ongoing role in the system should broaden the perspectives brought to bear on its operation.

Fairness

As mentioned in the discussion on justice above, this is decidedly a piece of non-ideal theory. If the IAG model works properly, countries that are currently rich, which have used more than their share of the carbon budget, and which have the greatest resources to act will pay for less climate action than they would in more equitable proposals for action (Raupach et al. 2014; Baer et al. 2008). This is clearly less than ideal.

One potential advantage of an IAG program is that it does not leave FFRDCs behind

in the transition. Some climate plans could inadvertently widen the gap between developed and developing nations. For example, if rich countries succeed in cutting domestic fossil fuel demand or imposing carbon border tax adjustments, what happens to FFRDCs who have not transitioned? We are at risk of a two-track transition, where rich countries decarbonize and reap the economic and health benefits while FFRDCs remain locked into carbon-intense economic models (Manley et al. 2017). FFRDCs could end up losing both economically (from lost demand for their fuel exports) and from climate impacts (exacerbated by their continued emissions growth). By explicitly incorporating FFRDCs into the transition, an IAG may end up being more inclusive and equitable than alternatives.

Recipient governments can also use the money they receive to undertake just transitions within their own countries. DAEs can be set up at sub-national level, for example, in communities most affected by fossil fuel retirements. Because the only hard condition on aid is that fossil fuel assets remain retired, recipients have the flexibility to pursue domestic Green New Deals of their own.[20]

That said, because the financing comes from long-dated bonds that are ultimately secured by future governments' debt, future generations potentially bear more financial risks than they would if the present generation paid for mitigation up front. But this unfairness is reduced by the fact that future generations will receive most of the benefits from avoided climate change (Broome 2010; Aldy 2016), and will see a Pareto improvement in their welfare from cost-shifting. Also, the guarantees are only activated when loans fail: investments that pay off do not impose extra costs on the future.

Another potential criticism is that rich countries, having benefited most from past emissions, *ought* to pay more. In this view, any attempt to shift liability away from historical emitters would be normatively counter-productive. From the perspective of ideal theory, this criticism may well be correct. And without time pressure, environmentalists might profitably hold out for a better deal that apportions liability in line with responsibility. But the window for mitigating with a reasonable chance of success is narrowing (IPCC 2018), and getting rich countries to do more to support global decarbonization in the near-term is crucial. Furthermore, this proposal does not absolve rich countries of liability—insofar as countries that are rich now are likely to remain so, they will still bear a significant share of costs in the future.

[20]Some caution is in order here. Some of the funds will likely end up enriching incumbents and their allies. As with any finance scheme it is important to fight corruption vigorously. But corruption that accompanies decarbonization is at least preferable to corruption that inhibits it.

Conclusion

The regime complex for climate change is nearly three decades old. A great deal of progress has been made. But we remain far behind where we need to be, and delay has made the problem harder rather than easier to solve.

We have arrived at a unique moment in the history of climate governance, in which both promise and peril have intensified. Despite hopes that the COVID-19 pandemic would usher in a new wave of green spending (Hepburn et al. 2020), recovery plans have generally done more harm than good to climate goals (Nahm et al. 2022). Fossil fuel incumbents are more vulnerable than they have ever been before, and have begun to recognize that at least some of their assets will not be recoverable (Toplensky 2020). But these same incumbents have continued to push for carbon-intense spending (Le Billon et al. 2021). Russia's invasion of Ukraine has made the strategic risks of fossil fuel dependence clearer than ever before, but has also driven up fossil fuel prices and therefore the rewards to producers (Author 2022b). Meanwhile, the drumbeat of warnings from the scientific community have only increased in intensity (IPCC 2022).

Fossil fuel-rich developing countries should be included in climate change mitigation. But they should not have to bear the burden alone. To encourage rich countries to finance the retirement of fossil fuel assets in developing countries, we should loosen the standard requirement that responsibility for costs be allocated primarily based on current or historical wealth. Instead, we should seek to postpone the reckoning until the future, when the gains or losses from the transition have been realized.

The approach outlined here cannot address all the challenges of climate action, and is not intended to do so. In particular, mitigation and adaptation in the least developed countries and small island developing states need urgent attention. But the hope is that a specialized response to the issues facing FFRDCs will enable more tailored responses to these other crucial challenges.

The fate of the climate depends on whether countries see a green growth path as more financially and politically feasible than a dirty one. Developing countries both need and deserve help pursuing climate action alongside growth: they should not have to sacrifice one for the other. Developed countries already have a range of methods to provide this help, and to postpone the costs of action into the future. But without adjusting responsibility for these costs as countries grow—or fail to grow—we risk being locked into the same distributional traps that have held back action so far.

References

Aldy, Joseph E. (2016). "Mobilizing Political Action on Behalf of Future Generations". *The Future of Children* 26.1, pp. 157–178 (cit. on p. 21).

Ameli, Nadia et al. (2021). "Higher cost of finance exacerbates a climate investment trap in developing economies". *Nature Communications* 12.1, pp. 1–12. DOI: 10.1038/s41467-021-24305-3 (cit. on p. 4).

Amr, Wafa (2022). "IMF Executive Board Approves Establishment of the Resilience and Sustainability Trust" (cit. on p. 17).

Andersen, Torben M., Joydeep Bhattacharya, and Pan Liu (2020). "Resolving Intergenerational Conflict over the Environment under the Pareto Criterion". *Journal of Environmental Economics and Management* 100. DOI: 10.1016/j.jeem.2019.102290 (cit. on p. 8).

Aronoff, Kate et al. (2019). *A Planet to Win: Why We Need a Green New Deal*. Verso (cit. on p. 11).

Averchenkova, Alina et al. (2020). *Delivering on the $100 Billion Climate Finance Commitment and Transforming Climate Finance*. Independent Expert Group on Climate Finance (cit. on p. 11).

Baer, Paul et al. (2008). "Greenhouse Development Rights: towards an equitable framework for global climate policy". *https://doi.org/10.1080/09557570802453050* 21.4, pp. 649–669. DOI: 10.1080/09557570802453050 (cit. on p. 20).

Below, David von, Francis Dennig, and Niko Jaakkola (2016). "The Climate-Pension Deal: an Intergenerational Bargain". Working Paper, available at https://www.nottingham.ac.uk/climateethicseconomics/documents/papers-workshop-2/jaakkola-et-al.pdf (cit. on p. 8).

Betru, Aron and Christopher Lee (2017). *Clearing a Path for Global Development Finance: Enabling Basel and Development Guarantees to Deliver on Sustainable Development Goals*. Santa Monica, CA: Milken Institute (cit. on p. 11).

Bhandary, Rishikesh Ram, Kelly Sims Gallagher, and Fang Zhang (2021). "Climate Finance Policy in Practice: a Review of the Evidence". *Climate Policy* 21.4, pp. 529–545. DOI: 10.1080/14693062.2020.1871313 (cit. on p. 13).

Blended Finance Taskforce (2018). *Better Finance, Better World*. London, UK: Business & Sustainable Development Commission, pp. 1–120 (cit. on p. 11).

Bodnar, Paul et al. (2020). *Climate Finance Access Network: Program Document*. Boulder, CO: Rocky Mountain Institute (cit. on pp. 5, 13, 17).

Bos, Julie and Joe Thwaites (2021). *A Breakdown of Developed Countries' Public Climate Finance Contributions Towards the $100 Billion Goal*. Tech. rep. October. Washington, DC: World Resources Institute. DOI: 10.46830/writn.20.00145 (cit. on p. 7).

Bos, Kyra and Joyeeta Gupta (2019). "Stranded assets and stranded resources: Implications for climate change mitigation and global sustainable development". *Energy Research and Social Science* 56.June 2018, p. 101215. DOI: 10.1016/j.erss.2019.05.025 (cit. on p. 13).

Bovenberg, Lans A. and Ben J. Heijdra (1998). "Environmental tax policy and intergenerational distribution". *Journal of Public Economics* 67.1, pp. 1–24. DOI: 10.1016/S0047-2727(97)00064-9 (cit. on p. 8).

Britton, Jack and Jonathan Gruber (2019). "Do Income Contingent Student Loan Programs Distort Earnings? Evidence from the UK". *NBER Working Paper Series*. Cambridge, MA: National Bureau of Economic Research (cit. on p. 10).

Britton, Jack, Laura van der Erve, and Tim Higgins (2019). "Income Contingent Student Loan Design: Lessons from around the World". *Economics of Education Review* 71.March 2017, pp. 65–82. DOI: 10.1016/j.econedurev.2018.06.001 (cit. on p. 9).

Broome, John (2010). "The most important thing about climate change". *Public Policy: Why ethics matters*. Ed. by Jonathan Boston, Andrew Bradstock, and David Eng. Australian National University E Press, pp. 101–116. DOI: 10.22459/pp.10.2010.06 (cit. on pp. 7, 8, 14, 21).

Buchner, Barbara et al. (2021). *Global Landscape of Climate Finance 2021*. December. Climate Policy Initiative, p. 44 (cit. on pp. 7, 9).

Burke, Marshall, Solomon M. Hsiang, and Edward Miguel (2015). "Global non-linear effect of temperature on economic production". *Nature* 527, pp. 235–239. DOI: 10.1038/nature15725 (cit. on pp. 2, 5).

Byrnes, Rebecca (2020). *A Global Registry of Fossil Fuels*. Tech. rep. Fossil Fuel Non-Proliferation Treaty Initiative (cit. on p. 19).

Caldwell, Molly and Gaia Larsen (2021). "Improving Access to the Green Climate Fund: How the Fund Can Better Support Developing Country Institutions". Washington, DC. DOI: 10.46830/wriwp.19.00132 (cit. on p. 13).

Caney, Simon (2010). "Climate change and the duties of the advantaged". *Critical Review of International Social and Political Philosophy* 13.1, pp. 203–228. DOI: 10.1080/13698230903326331 (cit. on p. 6).

Caney, Simon (2021). "Climate Justice". *The Stanford Encyclopedia of Philosophy*. Ed. by Edward N. Zalta. Winter 2021. Metaphysics Research Lab, Stanford University (cit. on pp. 2, 3, 7).

Climate Action Tracker (2019). *Climate crisis demands more government action as emissions rise*. New Climate Institute and Climate Analytics (cit. on p. 7).

Colgan, Jeff D, Jessica F Green, and Thomas N Hale (2020). "Asset Revaluation and the Existential Politics of Climate Change". *International Organization*, pp. 1–22 (cit. on p. 4).

Collins, Gabriel B. and Andrew S. Erickson (June 2022). "China's Energy Nationalism Means Coal Is Sticking Around" (cit. on p. 6).

Crippa, M et al. (2021). *GHG emissions of all world countries - 2021 Report*. EUR 30831 EN. Luxembourg: Publications Office of the European Union. DOI: 10.2760/173513 (cit. on p. 19).

Cui, Lianbiao et al. (2020). "Co-financing in the Green Climate Fund: Lessons from the Global Environment Facility". *Climate Policy* 20.1, pp. 95–108. DOI: 10.1080/14693062.2019.1690968 (cit. on p. 15).

Cust, James, David Manley, and Giorgia Cecchinato (2017). "Unburnable Wealth of Nations". *Finance and Development* 54.1, pp. 46–49 (cit. on p. 4).

Eicke, Laima and Andreas Goldthau (2021). "Are we at risk of an uneven low-carbon transition? Assessing evidence from a mixed-method elite study". *Environmental Sci-*

ence and Policy 124.February, pp. 370–379. DOI: 10.1016/j.envsci.2021.07.009 (cit. on p. 4).
Flaherty, Michael et al. (2017). "Financing Climate Policies Through Climate Bonds – A Three Stage Model and Empirics". *Research in International Business and Finance* 42, pp. 468–479. DOI: 10.1016/j.ribaf.2016.06.001 (cit. on p. 8).
Foley, Duncan K (2007). "The Economic Fundamentals of Global Warming". Santa Fe Institute Working Paper 2007-12-044 SFI (cit. on p. 8).
Georgieva, K. and F. Tshisekedi (Dec. 2021). "Africa cannot confront climate change alone". *Project Syndicate* (cit. on p. 5).
Gray, Matt et al. (2018). *Nowhere to hide: Using satellite imagery to estimate the utilisation of fossil fuel power plants*. Carbon Tracker Initiative (cit. on p. 19).
Hepburn, Cameron et al. (May 2020). "Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?" *Oxford Review of Economic Policy*. DOI: 10.1093/oxrep/graa015 (cit. on p. 22).
IEA (2021). *Net Zero by 2050*. Paris: International Energy Agency (cit. on pp. 2, 6).
Innocenti, Demetrio, Baptiste Gaydon, and Ani Waiba (2020). *Enhancing Direct Access (EDA): Guidelines for EDA project development with the Green Climate Fund*. Incheon, Republic of Korea: Green Climate Fund (cit. on p. 13).
IPCC (2018). "Summary for Policymakers". *Global Warming of 1.5 degrees C. An IPCC Special Report on the impacts of global warming of 1.5 degrees C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of*. Ed. by Myles Allen et al. In Press, pp. 1–21 (cit. on p. 21).
IPCC (2022). "Summary for Policymakers". *Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Ed. by Hans-Otto Pörtner et al. Cambridge University Press (cit. on pp. 2, 22).
Kahn, Matthew E et al. (2019). "Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis" (cit. on p. 5).
Karp, Larry and Armon Rezai (2014). "The Political Economy of Environmental Policy with Overlapping Generations". *International Economic Review* 55.3, pp. 711–733. DOI: 10.1111/iere.12068 (cit. on p. 8).
Keohane, Robert O. (2006). "Accountability in World Politics". *Scandinavian Political Studies* 29.2, pp. 75–87. DOI: 10.4324/9780203874714 (cit. on p. 17).
Keohane, Robert O. and David G. Victor (2011). "The Regime Complex for Climate Change". *Perspectives on Politics* 9.1, pp. 7–23. DOI: 10.1017/S1537592710004068 (cit. on pp. 3, 16, 20).
Kiyasseh, Lama (Jan. 2022). "Strong momentum in Saudi Arabia's drive toward renewables and infrastructure". *Middle East Institute* (cit. on p. 5).
Klinsky, Sonja et al. (2017). "Why equity is fundamental in climate change policy research". *Global Environmental Change* 44, pp. 170–173. DOI: 10.1016/j.gloenvcha.2016.08.002 (cit. on p. 7).
Kotlikoff, Laurence et al. (Feb. 2021). "Making Carbon Taxation a Generational Win Win". *International Economic Review* 62.1, pp. 3–46. DOI: 10.1111/IERE.12483 (cit. on p. 8).
Krishnan, Mekala et al. (2022). *The Net-Zero Transition: What it Would Cost, What it Could Bring*. January. McKinsey & Company, p. 224 (cit. on pp. 7, 15).

Le Billon, Philippe et al. (2021). "Fossil fuels, climate change, and the COVID-19 crisis: pathways for a just and green post-pandemic recovery". *Climate Policy* 21.10, pp. 1347–1356. DOI: 10.1080/14693062.2021.1965524 (cit. on p. 22).

Lockwood, Matthew (2015). "The Political Dynamics of Green Transformations: Feedback Effects and Institutional Context". *The Politics of Ggreen Transformations*. Ed. by Ian Scoones, Melissa Leach, and Peter Newell. Earthscan, pp. 86–101 (cit. on p. 14).

Manley, David, James Cust, and Giorgia Cecchinato (2017). "Stranded Nations? The Climate Policy Implications for Fossil Fuel-Rich Developing Countries". Oxford, UK (cit. on pp. 2, 4, 13, 15, 21).

Meyer, Lukas H. and Dominic Roser (2010). "Climate Justice and Historical Emissions". *Critical Review of International Social and Political Philosophy* 13.1, pp. 229–253. DOI: 10.1080/13698230903326349 (cit. on p. 6).

Moellendorf, Darrel (2014). *The Moral Challenge of Dangerous Climate Change: Values, Poverty, and Policy*. Cambridge University Press. DOI: 10.1017/CBO9781139083652 (cit. on p. 6).

Nahm, Jonas M, Scot M Miller, and Johannes Urpelainen (2022). "G20's US$14-trillion economic stimulus reneges on emissions pledges". *Nature* 603.March, pp. 28–31. DOI: 10.1038/d41586-022-00540-6 (cit. on p. 22).

Orlov, Sergey et al. (2018). "Green Bonds, Transition to a Low-Carbon Economy, and Intergenerational Fairness: Evidence from an Extended DICE Model". *SSRN Electronic Journal*. DOI: 10.2139/ssrn.3086483 (cit. on p. 8).

Page, Edward A. (2012). "Give it up for Climate Change: a Defence of the Beneficiary Pays Principle". *International Theory* 4.2, pp. 300–330. DOI: 10.1017/S175297191200005X (cit. on p. 6).

Parry, Ian, Simon Black, and Nate Vernon (2021). "Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies". *IMF Working Papers*. International Monetary Fund (cit. on p. 17).

Peszko, Grzegorz et al. (2020). *Diversification and Cooperation in a Decarbonizing World: Climate Strategies for Fossil Fuel-Dependent Countries*. Washington, DC: World Bank (cit. on pp. 4, 5).

Ploeg, F. van der and A. Rezai (2020). "Stranded assets in the transition to a carbon-free economy". *Annual Review of Resource Economics* 12, pp. 281–298 (cit. on p. 4).

Puaschunder, Julia (2017). "Financing climate justice through climate change bonds". *ACRN Journal of Finance and Risk Perspectives* 6.3, pp. 1–10. DOI: 10.2139/ssrn.2850697 (cit. on p. 11).

Puaschunder, Julia (Jan. 2020). *Governance & Climate Justice: Global South & Developing Nations*. Palgrave Macmillan, pp. 1–312. DOI: 10.1007/978-3-319-63281-0 (cit. on p. 6).

Raupach, Michael R. et al. (Sept. 2014). "Sharing a quota on cumulative carbon emissions". *Nature Climate Change 2014 4:10* 4.10, pp. 873–879. DOI: 10.1038/nclimate2384 (cit. on p. 20).

Roberts, J. Timmons and Romain Weikmans (2017). "Fragmentation, failing trust and enduring tensions over what counts as climate finance". *International Environmental Agreements: Politics, Law and Economics* 17.1, pp. 129–137. DOI: 10.1007/s10784-016-9347-4 (cit. on p. 19).

Rogoff, Kenneth (Jan. 2021). "A Fairer Way to Help Developing Economies Decarbonize". *Project Syndicate* (cit. on p. 2).

Ross, Michael L. (Mar. 2012). "The oil curse: How petroleum wealth shapes the development of nations". *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations*, pp. 1–289. DOI: 10.1093/afraf/adt051 (cit. on p. 14).

Sachs, Jeffrey (2014). "Climate change and intergenerational welfare". *The Oxford Handbook of the Macroeconomics of Global Warming*. Ed. by L Bernard and Willi Semmler. Oxford University Press, pp. 248–259 (cit. on pp. 8, 11).

Schlösser, Tim et al. (2017). *From Riches to Rags? Stranded Assets and the Governance Implications for the Fossil Fuel Sector*. Berlin: Deutsche Gesellschaft für Internationale Zusammenarbeit (cit. on p. 4).

Semieniuk, Gregor et al. (2022). "Stranded fossil-fuel assets translate to major losses for investors in advanced economies". *Nature Climate Change*. DOI: 10.1038/s41558-022-01356-y (cit. on p. 4).

Simpson, Brett (Sept. 2021). "Norway has one of the world's most ambitious climate change targets. But it's also a major oil producer and exporter". *The World* (cit. on p. 6).

Singer, Peter (2002). *One World: The Ethics of Globalization*. New York: Yale University Press (cit. on p. 6).

Sovacool, Benjamin (2016). "How long will it take? Conceptualizing the temporal dynamics of energy transitions". *Energy Research and Social Science* 13, pp. 202–215. DOI: 10.1016/j.erss.2015.12.020 (cit. on p. 5).

Sovacool, Benjamin and J. Scarpaci (2016). "Energy justice and the contested petroleum politics of stranded assets: Policy insights from the Yasuní-ITT Initiative in Ecuador". *Energy Policy* 95, pp. 158–171 (cit. on p. 12).

Steele, Paul, Sejal Patel, and Ulrich Volz (2021). *Creating a Resilience and Sustainability Trust (RST) at the IMF : How to Support Climate-vulnerable Countries*. Tech. rep. International Institute for Environment and Development & Centre for Sustainable Finance (cit. on p. 17).

Toplensky, Rochelle (June 2020). "No End in Sight for Big Oil's Write-Downs". *Wall Street Journal* (cit. on p. 22).

Trout, Kelly et al. (May 2022). "Existing fossil fuel extraction would warm the world beyond 1.5 °C". *Environmental Research Letters* 17.6, p. 064010. DOI: 10.1088/1748-9326/ac6228 (cit. on pp. 2, 6).

UN IATF (2020). *Financing for Sustainable Development Report 2020*. New York, NY: United Nations Inter-agency Task Force on Financing for Development (cit. on pp. 4, 13).

Venables, Anthony J. (2016). "Using Natural Resources for Development: Why has it Proven so Difficult?" *Journal of Economic Perspectives* 30.1, pp. 161–184. DOI: 10.1257/jep.30.1.161 (cit. on p. 2).

Weisbach, David A (2022). "Feasibility and Climate Justice". *Climate Justice and Feasibility: Normative Theorizing, Feasibility Constraints, and Climate Action*, pp. 15–31 (cit. on p. 7).

Welsby, Dan et al. (2021). "Unextractable fossil fuels in a 1.5 °C world". *Nature* 597.7875, pp. 230–234. DOI: 10.1038/s41586-021-03821-8 (cit. on pp. 3, 4, 15).

Wright, Joseph (2008). "To Invest or Insure? How Authoritarian Time Horizons Impact Foreign Aid Effectiveness". *Comparative Political Studies* 41 (7) (cit. on p. 14).