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Executive summary

It will be impossible to contain the global temperature rise to 1.5 to 2 degrees Celsius above pre-industrial levels unless emerging market and developing economies (EMDEs) decarbonise much more rapidly. is policy brief examines the economic case for advanced-country nancial support for replacement of coal with renewable energy sources in EMDEs. Such conditional nancial support is *necessary* in the sense that an exit from coal consistent with keeping the global temperature rise to between 1.5°C and 2°C will not happen without it, *desirable* from the perspective of the nancier countries, and nancially *feasible*.

Although the global economic bene ts of phasing out coal are very large, the costs of exiting coal generally exceed the bene ts to EMDEs. However, the collective economic bene ts to advanced countries greatly exceed those costs. ese net bene ts are positive even for small coalitions of advanced countries (G7 or G7 plus EU). e scal costs of nancing the coal exit in EMDEs (without China) are modest as a share of G7+EU GDP at about 0.3 percent of GDP per year, assuming public-sector participation in renewable energy investment costs through blended nance of around 25 percent.

Although providing climate nance to EMDEs is economically desirable and feasible from the G7 perspective, it is not happening at the necessary scale, partly because of incentives and political-economy challenges. Advanced countries are more likely to be willing to commit nancing to climate action outside their borders if they have more control over how this money is spent. Developing countries are reluctant to phase out coal unless su ciently large nancial support is forthcoming for renewable investments that are consistent with their development goals.

These problems could be overcome by tying renewable nance to a coal phase-out. Already-existing Just Energy Transition Partnerships with South Africa, Indonesia and Vietnam are prototypes of this approach. ey should be scaled up, with su cient grants to pay for coal closures and the social transition in coal communities, by explicitly conditioning funding on a coal phase-out and through a stronger governance structure to implement these deals.

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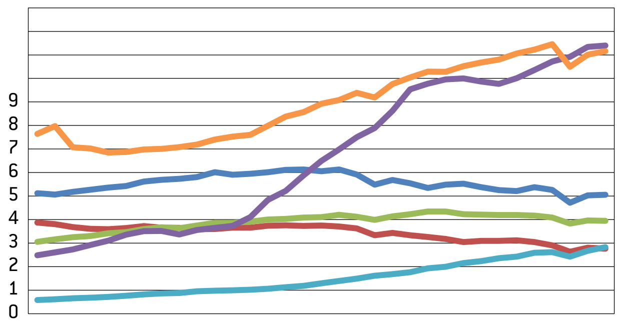
1 Introduction

Global carbon emissions are at a historic high. Emissions in 2023 consumed 10.67 percent of the remaining carbon budget consistent with limiting global warming to 1.5 degrees Celsius compared to pre-industrial levels (Liu *et al*, 2024). On current trends, the remaining budget will be gone in fewer than six years[1]. While commitments made under the 2015 Paris Agreement (referred to as nationally determined contributions, or NDCs) imply a drop in emissions by 2030, this decrease would not be su cient to limit the temperature increase to 2°C, let alone 1.5°C (UNFCCC 2023).

Although *per-capita* emissions in most emerging market and developing economies remain much lower than those of advanced countries (Figure 1, right panel), EMDEs now produce almost 70 percent of global CO2 emissions (Figure 1, left panel). Reflecting their higher populations and GDP growth rates, this share is projected to grow. Putting decarbonisation on track to stay well below 2°C warming will hence require a large step-up in efforts to cut emissions, particularly in EMDEs. Unless advanced countries o er much more conditional nancial support for EMDE decarbonisation than currently, this is unlikely to happen within the framework of the Paris Agreement (which relies on voluntary commitments), given the size of the required investment in renewables.

 is policy brief explores both the desirability and the feasibility of such expanded support from the perspective of the nancier countries, focusing on a particular strategy for accelerating emissions reduction: phasing out the use of coal.

Figure 1: Global CO2 emissions from fossil fuels since 1990



Our analysis does not imply that conditional nancial support provided by advanced countries should be the only instrument to accelerate EMDE decarbonisation. Carbon border adjustment mechanisms (CBAMs) or other schemes that tax imported goods based on their carbon content can o er additional incentives to adopt meaningful carbon pricing in exporting jurisdictions. International emissions trading – as envisaged in Article 6 of the Paris Agreement – can support mitigation projects in EMDEs and help exploit e ciency gains associated

1 S L *et al* (2024). A … M R I C C (https://www.mcc-berlin.net/en/research/co2-budget.html).

with lower abatement costs (Glennerster and Jayachandran, 2023; Piris-Cabezas *et al*, 2023)[2].

However, these instruments are unlikely to be sufficient. CBAMs do not offer incentives for decarbonisation of non-traded goods and services. Carbon tariffs levied on countries with lower mitigation standards could capture such activities (Nordhaus 2015, 2020), but would violate World Trade Organisation rules and are likely make EMDEs worse off (Bekkers and Cariola, 2022). Voluntary carbon markets require governance structures that verify that mitigation projects are being implemented, while cross-border mandatory carbon markets (ie linking emissions trading systems) require compatibility.

For these reasons, it is hard to imagine that the required acceleration in EMDE emissions reduction will happen without advanced country financial support being stepped up. Any such support would need to encourage both emission reduction policies and private investment in renewable energy sources (One Planet Lab, 2021; Bhattacharya *et al*, 2022, 2023; IEA and IFC, 2023).

The remainder of this brief is structured as follows.

Section 2 makes the case for the desirability of climate finance at scale, both from a global perspective and from the perspective of advanced countries, in three steps: (i) the global economic benefits of decarbonisation exceed their costs, even over relatively short (2024-30 or 2026-35) investment horizons; (ii) the individual economic benefits of country-level decarbonisation are unlikely to exceed their costs, except for the US and China, underscoring the need for international coordination; (iii) the collective economic benefits to advanced countries from EMDE decarbonisation exceed their costs to advanced countries, even if one were to make the extreme assumption that advanced countries bear the entire cost of EMDE decarbonisation. This analysis implies that a cornerstone of the Paris Agreement – the principle of common but differentiated responsibilities, with advanced countries contributing more – is justified not only on fairness grounds, but is also supported by hard economic calculations, which reflect the expectation that physical damages from climate change will be greater in richer countries.

Climate finance at scale may be unaffordable even for advanced countries, if it exceeds normal public borrowing limits

Section 3 examines the feasibility of north-south climate finance at scale. Although this is in the collective interests of advanced countries, it may not be feasible for three reasons. First, there could be a free-rider problem across donor countries. Second, climate finance at scale may be unaffordable even for advanced countries, in the sense that it exceeds normal public borrowing limits. Third, the conditionality that would be required to reassure advanced countries that climate finance at scale achieves its intended decarbonisation purposes may not be feasible.

We argue that the first problem can be addressed through coalitions of advanced countries that are small enough – the G7, or the G7 plus the EU – to prevent free riding, while still being large enough to reap a large part of the benefits of EMDE carbonisation. On the second problem, we show that climate finance at scale would raise the fiscal burden of the G7+EU countries by about 0.3 percent to 0.6 percent of GDP per year. Upfront funding of the carbon phase-out required during 2024-30 would raise the debt of G7+EU countries by 2-4 percent of GDP, well within their borrowing capacity. For the third problem, we examine briefly an emerging governance structure for climate finance at scale: Just Energy Transition Partnerships (JETPs). We conclude that these have the necessary ingredients to address monitoring and verification problems, but only if advanced countries contribute more (grant) funding and technical assistance. This will likely require a more explicit link between policy actions and climate finance than is evident from the present JETP implementation plans.

2 [illegible]

2 The desirability of climate finance at scale

We use a dataset (Adrian *et al*, 2022, 2024) of estimates of the costs and benefits of phasing out coal use – the largest single source of carbon emissions – and replacing the phased-out coal energy with renewable energy[3]. To our knowledge, this is the only analysis that links the plant/mine-level costs of replacing fossil fuels to their emissions benefits. Costs include investment outlays in renewable energy development, the costs of expanding battery and grid

Table 1: The gersSee leQ5276 Tm[(T)neqab.91406te63IE7le f0 (are31[(8IE)2.071 7311.1le f0 (are39)-181IE)2.071 7311.1le f

Overall, these comparisons o er some reassurance that the cost numbers reported in Table 1 are in a reasonable range. Unfortunately, IEA and IFC (2023) did not report the avoided emissions attributable to these investments, making it impossible to conduct a cost-bene t comparison as in Table 1[5].

Table 2: Comparison of coal phase-out cost estimates (annual averages, $ billions)

	IEA-IFC (2023) estimates		Adrian *et al* (2022) estimates			
	Investment needs		Investment needs		Opportunity costs	
	2026-31	2031-35	2026-31	2031-35	2026-31	2031-35
Total EMDEs	2222	2805	998	892	0.4	0.8
China	853	947	340	318	0.1	0.2
EMDEs excluding China	1369	1858	658	573	0.3	0.5
India	263	355	206	200	0.1	0.1
Southeast Asia	185	244	99	78	0.1	0.1
Other Asia	85	112	38	26	0.0	0.0
Africa	203	265	79	72	0.0	0.1
Latin America	243	332	25	20	0.0	0.0
Europe and Eurasia	188	232	209	174	0.1	0.2
Middle East	202	318	2	2	0.0	0.0

5 IEA IFC (2023) T 1 ( ) 2.3 (EMDE). S IEA IFC (2023), . 75.

total of investment and opportunity costs[7]

2.3 Funding the coal phase-out in EMDEs is in the collective self-interest of advanced countries

e last step in the argument in this section involves computing the collective net bene ts to advanced countries of funding: (1) their own phase-outs; (2) phase-out in emerging market countries, and (3) phase-out in developing countries not classi ed as emerging markets[8]. Figure 4 reports the net bene ts to the group of advanced countries, assuming public-sector shares to cover the renewable investment costs of 50 percent and 25 percent, in two funding scenarios: rst, in which the advanced countries pay the public sector share in full, and second, in which they merely provide a 'top up' equal to the portion of the costs that exceeds the bene ts of phasing out coal to the developing country being funded[9]. Figure 4 also assumes a 100 percent public sector share (ie a subsidy) to cover the opportunity cost of early coal closure. e lower bound $80/tCO2 SCC is used, since the point is to examine whether avoided-emissions bene ts are large enough.

Figure 4: Net bene t to advanced countries of funding coal phase-out
(% of present value of costs, based on $80/tCO2 SCC)

8 W A *et al* (2022), IMF W E O ., 27 , 52 26 .

9 F , B , $176.6 2050 . A 50 $88.4 , B (B ' SCC $80) $8.1 . 'T ' $88.4 $8.1 = $80.3 B 2050.

The results confirm that the collective economic benefits to advanced countries from funding EMDE decarbonisation are positive and generally very large[10]. For example, for a 25 percent public investment share, the net benefit to advanced countries of fully funding an emerging market coal phase-out would be 131 percent (benefits are more than twice the costs), while the net benefit of fully funding developing country decarbonisation would be 205 percent (benefits are more than three times cost). A few further points are noteworthy:

- The benefits to advanced countries from funding EMDE investments are generally greater than the benefits of collectively funding their own investment (the left column tends to be the smallest).
- The benefits of fully funding developing countries (fourth column) are always greater than the benefits of fully funding emerging markets (second column).
- From the perspective of advanced countries, cost sharing makes a huge difference over longer horizons, particularly for emerging markets (third column). Because the recipients are assumed to contribute their private share to the investment cost, this contribution becomes very large as the horizon lengthens for China and a few other emerging markets with large SCC shares. Consequently, the subsidy required from advanced countries declines sharply.

The first two points confirm the view that emissions abatement costs – the mitigation 'bang for the buck' – are higher in EMDEs (and particularly in developing countries) than in advanced countries (see Glennerster and Jayachandran, 2023; IEA and IFC, 2023).

3 The feasibility of climate finance at scale

The fact that advanced-country funding of EMDE decarbonisation is in the advanced countries' own collective economic interest is, however, not a guarantee that it will happen – and it is not happening fast enough. Box 2 shows that, up to 2022, north-south climate funding fell short of even the $100 billion per year goal set at COP15 in 2009, even including mobilised private financing. In 2022, it finally surpassed the $100 billion goal (OECD, 2024), but continues to fall far short of the much larger volumes that are required to finance the energy transition in EMDEs (Table 2).

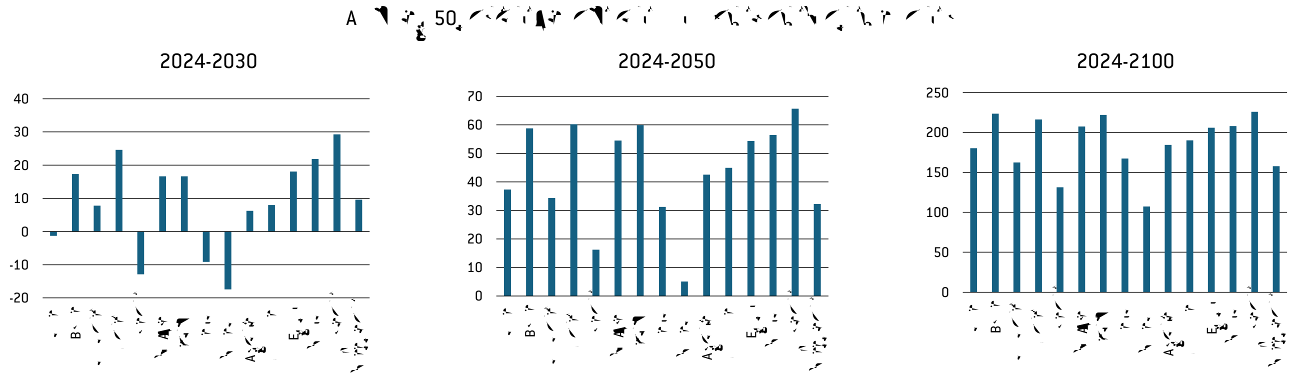
Setting aside the possibility that advanced-country governments may not understand fully that funding a coal exit in EMDEs is in their own economic interests, there could be three reasons why climate finance at scale is not yet happening:

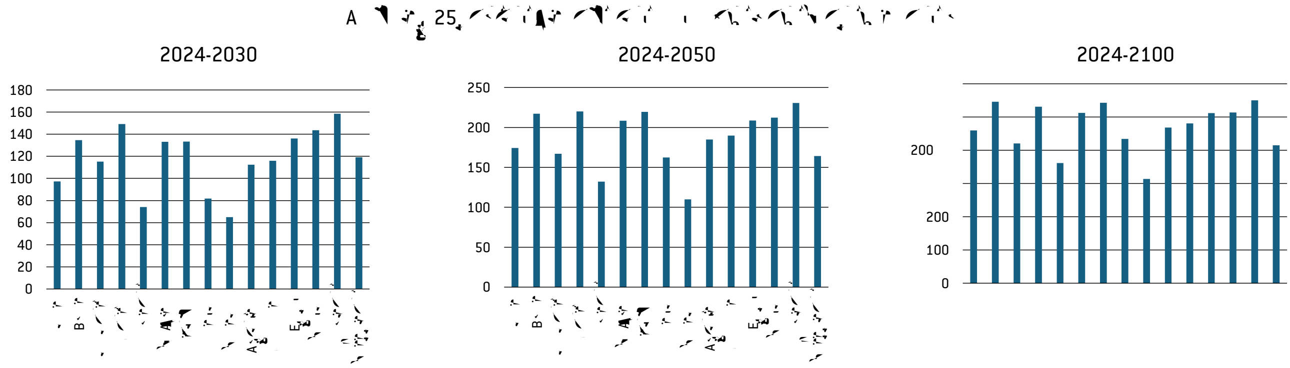
1. There is a free-rider problem within the group of advanced countries. The calculations in section 2.3 ignored this problem, by focusing on the collective benefits to advanced countries.
2. The scale of financing required to fund the EMDE's exit from coal may just be too high, in the sense that the public share of the required investment might exceed the borrowing capacity even of advanced countries, or would require borrowing at very high interest rates. This could undermine the argument that advanced countries are necessarily better off by funding EMDE decarbonisation (the calculations in section 2.3 did not take into account the costs of debt write-offs or very expensive borrowing).

10 F 2050 2100 , 75 , 2050 2100 . F 2024-2030 .

3. Advanced countries may not be willing to fund an EMDE coal exit (at least not at levels that exceed normal development aid) because they are not convinced that the recipient countries would take the required policy actions. at is, they fear that their money would be wasted.

e remainder of this paper investigates these three obstacles, assuming that





3.2 Fiscal cost

Funding the coal-phase out in EMDEs may be in the interests of the G7+EU, but is it affordable? Table 3 gives the answer. It shows the costs, expressed in three ways, for 2024-2030 and 2024-2050, of compensating the coal industry and funding renewables investment, assuming a public-sector share of either 50 or 25 percent. The estimates in percent of G7+EU GDP should be interpreted as the average fiscal cost the G7+EU would need to shoulder each year of the 2024-30 or 2023-50 investment horizon, while the numbers in percent of 2024 G7+EU GDP denote the increase in public-sector debt if the G7+EU were to borrow upfront to finance the entire coal phase-out programme for the following six years (left columns) or 26 years (right columns).

Table 3: Fiscal cost to the G7+EU of funding the coal exit

	Public sector share = 50 percent		Public sector share = 25 percent	
	2024-2030	2024-2050	2024-2030	2024-2050
		in $ billions		
India	1017.6	1923.59	509.0	963.11
Brazil	47.3	88.37	23.6	44.23
Indonesia	132.7	283.72	66.4	142.69
Mexico	16.1	34.44	8.0	17.24
Turkiye	85.6	179.36	42.8	89.81
South Africa	283.1	577.99	141.6	289.67
Vietnam	77.9	150.91	39.0	75.53
Pakistan	22.9	39.43	11.5	19.73
All EM ex China	2507.5	4963.6	1254.4	2486.9
All developing	162.1	291.2	81.1	145.8
		in percent of G7+EU GDP		
India	0.24	0.10	0.12	0.05
Brazil	0.01	0.00	0.01	0.00
Indonesia	0.03	0.01	0.02	0.01
Mexico	0.00	0.00	0.00	0.00
Turkiye	0.02	0.01	0.01	0.00
South Africa	0.07	0.03	0.03	0.01
Vietnam	0.02	0.01	0.01	0.00
Pakistan	0.01	0.00	0.00	0.00
All EM ex China	0.59	0.25	0.30	0.13
All developing	0.04	0.01	0.02	0.01
		in percent of 2024 G7+EU GDP		
India	1.77	3.35	0.89	1.68
Brazil	0.08	0.15	0.04	0.08
Indonesia	0.23	0.49	0.12	0.25
Mexico	0.03	0.06	0.01	0.03
Turkiye	0.15	0.31	0.07	0.16
South Africa	0.49	1.01	0.25	0.50
Vietnam	0.14	0.26	0.07	0.13
Pakistan	0.04	0.07	0.02	0.03
All EM ex China	4.4	8.6	2.2	4.3
All developing	0.3	0.5	0.1	0.3

Table 3 con rms, rst, that the scal cost of funding the coal exit is high in absolute terms: for example, $500 billion to $1 trillion for India alone, and $1.3 trillion to $2.5 trillion for all EMDEs excluding China over 2024-2030, depending on the assumed public-investment share. However, the cost is small as a share of G7 plus EU GDP over the same period (0.3-0.6 percent to fund the coal phase out for all EMDEs excluding China). For 2024-2050, the funding requirements are larger in absolute terms ($2.5 trillion to $5 trillion for all EMDEs excluding China), but smaller as a share of G7 plus EU GDP (just 0.13-0.25 percent). Even prefunding the entire 2024-30 investment programme in one year would raise 2024 debt in the G7+EU by just 2.2-4.4 percent of GDP. is is clearly within the scal capacity of the rich countries.

relief. e challenge is to adapt them to the much larger nancial ows (and possibly deeper accompanying policy actions) that are required for emissions mitigation, and to bring in private sector nancing, in the form of 'blended nance' (Box 1, One Planet Lab, 2021; IEA and IFC, 2023; Bhattacharya *et al* 2022, 2023).

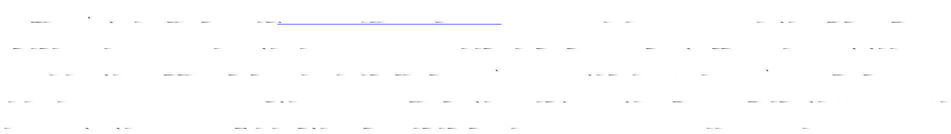
As it turns out, this approach already exists to some degree, in the form of Just Energy Transition Partnerships (JETPs), inaugurated at the 2021 Glasgow UN climate summit (COP26). Four JETPs have been announced so far, to accelerate the energy transitions in South Africa, Indonesia, Vietnam and Senegal (Table 4). In each case JETPs consist of 'country platforms' – a coordination forum involving a secretariat, country authorities and a funding consortium ('International Partners Group') including G7 members, the EU, other advanced countries such as Norway and multilateral development banks. In all but the most recent case, these platforms have worked out detailed investment plans focusing mostly on replacing local mined coal with renewables (Republic of South Africa, 2022; JETP Indonesia, 2023; Socialist Republic of Vietnam, 2023, referred to collectively as JETP implementation plans below). e exception is Senegal, which mines and uses little coal, and where the objective is to reduce dependence on imported fossil fuels.

Table 4: Just Energy Transition Plans (JETPs) announced by March 2024

C	D	F	I ?	P ($)	N 2030 ($)	
					JETP	A *et al* (2022)
South Africa	Nov-21	US, EU, UK, France, Germany, Denmark, Netherlands, Spain, World Bank	Yes	11.9	68.7 1/	566
Indonesia	Nov-22	G7+EU, Norway, Denmark, World Nank, ADB, GFANZ	Yes	20.0	97	265
Vietnam	Dec-22	G7+EU, Denmark, Norway, ADB, FMO, GFANZ	Yes	15.5	134.7	156
Senegal	Jun-23	France, Germany, EU, UK, Canada	No	2.7	n/a	1

countries[15]. However, according to standard estimates, these fall significantly short of the emissions reductions needed to stay within the Paris temperature objectives (Figure 7). As a result, it is not surprising that the estimated financing requirements of JETP plans are much less than the financing requirements estimated by Adrian *et al* (2022), particularly for South Africa and Indonesia (last two columns of Table 3). The 2030 renewables electricity generation capacity targeted in South Africa's and Indonesia's JETPs remains significantly below, and 2030 estimated electricity generation based on coal is significantly above, the level corresponding to a Paris-consistent net-zero scenario (see Annex 3 for more details). The discrepancy is particularly large for Indonesia.

Figure 7: NDC/JETP based emissions targets for 2030 compared to Paris-aligned emissions (megatonnes of CO_2)



Second, the financing pledges offered by the funding consortia so far – which include private sector pledges coordinated by the Glasgow Financial Alliance for Net Zero, and loans in addition to grants and guarantees – are an order of magnitude smaller than the financing requirements estimated in the JETP implementation plans[16]. As a result, most of the cost associated with JETPs is currently unfunded. The proposal that the difference could be raised through domestic revenue or sovereign borrowing seems illusory, given the orders of magnitude involved, except possibly in Indonesia. Based on IMF GDP projections for 2024, the unfunded gap is about 22 percent of GDP for South Africa, 5 percent for Indonesia, and 25 percent for Vietnam.

Third, financing pledges support JETP emission-reduction objectives and their broad strategy (replacing coal-based electricity with renewable energy sources) without linking the funding to specific policy actions and technical assistance. This may reflect the timing of the financing pledges, which mostly accompanied the original political declarations announcing the JETPs, before implementation plans were developed. That said, the financing pledges could have been upgraded and linked to specific investments and policies as part of the implementation plans. This has not yet happened. Hence, JETPs currently remain incomplete conditional finance pacts, which do not explicitly tie large volumes of funding promises to difficult policy measures on the ground.

Fourth, the JETP financing packages have primarily been offered in the form of concessional loans and guarantees to support investments in renewables and supporting technologies to replace coal, while not enough subsidies have been offered to pay for the stranded-asset value of coal, or compensation for coal communities and retraining costs. For instance, the Indonesian JETP only has a 3 percent grant component, much of which is allotted to technical assistance. Consequently, hardly any money is set aside to pay for early coal closures. As Indonesia already has an oversupply of electricity, the renewable supply will not be developed without closures of coal-fired power plants. Similarly, the South Africa JETP deal does not offer sufficient grants to pay for coal closures and the social transition of coal communities.

There are four interpretations for these gaps in the JETPs as they currently exist and JETPs as they would be ideally financed and structured.

1. Advanced-country policymakers may not understand that large-scale conditional funding for a coal phase-out is in the best economic interests of their own countries. Instead, funding is framed as a form of development aid. Given the low level of funding, recipient countries have no interest in accepting meaningful conditionality.
2. Pledged financing volumes may be small because of the (initial) lack of an explicit link to

4 Conclusion

Our results imply that there is a strong economic case for wealthy countries to provide climate finance at scale, beyond their moral obligations under the Paris Agreement's principle of common but differentiated responsibilities.

A template for conditional funding of coal phase-out exists already: the JETPs agreed with South Africa, Indonesia and Vietnam. But the funding levels committed to these JETPs are tiny compared to what is needed. Furthermore, unlike other forms of conditional assistance (for example, EU grants and loans supporting the recovery and resilience programmes of EU countries), the link between funding and specific climate mitigation policy actions does not appear

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Annex 3: How ambitious are South Africa's and Indonesia's JETPs?

Comparing the ambitiousness of the coal phase-out envisaged in Adrian *et al* (2022) and the JETPs is complicated by the fact that Adrian *et al* (2022) consider a phase-out of all coal production and consumption, whereas the JETPs focus only on the replacement of coal in electricity production (the power sector). It is therefore unclear whether the much larger nancing requirements in Adrian *et al* (2022) re ect mainly the broader scope of phase-out considered by Adrian *et al* (2022), or also the fact that the JETPs are not as ambitious as they might need to be to achieve a Paris-consistent coal phase-out in the power sector.

To address this question, we use the fact that the latest NGFS Global Change Assessment Model (GCAM 6.0, see https://data.ece.iiasa.ac.at/ngfs/#/docs) provides updated scenario-based estimates of both wind and solar electricity generation capacity, and electricity production using coal for 32 countries/regions, including Indonesia and South Africa. ese can be compared with the actual wind and solar capacity targets as well as coal electricity production targets for 2030 stated in the JETP implementation plans. e gates of both wctric (e)1 (a)7 (t)1 (esn(oth)7 e main result is that in both the South African and Indonesian JETPs, 2030 renewables capacity and coal electricity generation phase-out targets fall well short compared to the latest NGFS net zero scenario, in the sense that planned renewables capacity would be smaller, and coal based electricity production larger, than consistent with the NGFS net-zero emissions path. e shortfall is much larger for Indonesia than for South Africa. While South Africa's 2030 JETP solar and wind target is 61-71 percent of the net-zero requirement according to CGAM 6.0, Indonesia's target is 58 percent; and while South Africa's 2030 JETP coal electricity production target exceeds the net-zero-consistent target by 40-70 percent, Indonesia's exceeds its by 350 percent.

e results for Indonesia are surprising in the sense that the JETP coal-production target is higher than what the NGFS GCAM model considers consistent with Indonesia's NDCs. However, the gap with the net zero-consistent estimate (just 46.1 TWh) would remain very large even if one were to substitute the NDC estimate (152.2 TWh) for the JETP target (208.3 TWh).