

The prospects for development in a climate-changed world

Anticipating cross-border effects of climate change and climate action

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Abstract

Climate change impacts and the effects of country responses spill across borders. These cross-border, transmitted effects are reshaping the global economy. Flows of natural resources and ecosystem services, traded goods and services, investment and ideas, as well as migration and travel, are shifting. Major economic powers, including the European Union (EU), the United States (US) and China, have launched policies and investment programmes to tackle climate change, but also to boost jobs, growth and innovation at home. Without consideration of transmitted effects such actions could knock away the ladders of development. That in turn could undermine the fragile global consensus to tackle climate change. At the same time, there are opportunities for all countries in a global economy reshaped by climate change. Further attention to the cross-border impacts of climate policy is needed to mitigate any potential threats and ensure greater coherence between climate and development efforts. Here we evolve a framework for anticipating the transmitted effects of climate change. The framework maps cross-border spillovers from mitigation, as well as adaptation measures and direct climate change impacts through five channels: biophysical, trade, finance, people and technology.

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1 Introduction: our shared economy and climate

We share a planet and a global economy, entwined by our climate system, physical resources and ecosystems – as well as the exchange of goods, finance, services and ideas, and the movement of people. The impacts of climate change and the effects of decisions about how to respond, both to mitigate climate change and to adapt, ripple across national borders.

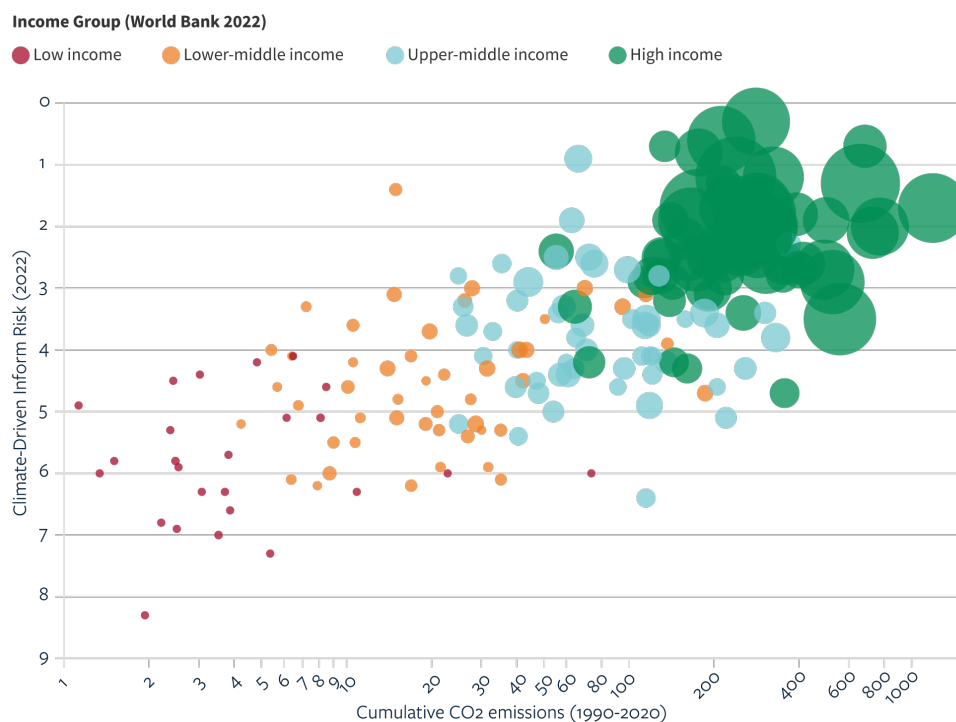
The risks and opportunities posed by these cross-border, transmitted effects of climate change are hugely diverse across different countries. Many countries most at risk from the direct impacts within their borders are also highly exposed to transmitted effects, while bearing little responsibility for climate change. As shown in Figure 1, many poorer countries face higher climate risk while contributing little to emissions (lower left). They will feel cross-border, transmitted effects sharply as the large, polluting economies (upper right) seek to mitigate and adapt to climate change.

The major economic powers are increasingly casting climate action as a future ‘development’ opportunity at home, to support structural transformation and competitive advantage. In the US, the Inflation Reduction Act (IRA) has been presented as supporting new job opportunities through large-scale subsidies. The EU is debating its own green industrial policy and subsidy regime – worth at least as much as expected IRA subsidies but with (presently) less protectionism (Kleimann et al., 2023). By November 2022 countries announcing or considering net-zero targets accounted for 90% of global emissions, including China (by 2060, 28% of emissions), the US (2050: 14%), the EU (2050: 8%) and India (2070: 7%) (New Climate Institute and Climate Analytics, 2022). Implementation is starting to alter the dynamics of supply and demand, and prices, in the global economy.

To secure development gains in a global economy reshaped by climate change, countries need to anticipate not only the direct impacts but also the indirect, transmitted effects. Recognising these transmitted effects can help shift the discourse away from a binary distinction between ‘climate’ versus ‘development’ investment. Some transmitted effects – like increasing demand for ‘cleaner’ goods and services – present new opportunities to accelerate development. However, those transmitted effects can also kick away the ladders of

development, for example, if major economic powers increase protectionism or distortive subsidies in favour of their own green industries. This in turn will undermine the consensus we need across nation states to address climate change.

Figure 1 Country CO₂ emissions per capita, climate-driven risk and GNI per capita



Source: X-axis (log scale): World Bank, 2023a. Y-axis: IMF, 2023. Bubble size (GNI per capita, Atlas method, current USD): World Bank, 2023b/latest available estimate. Bubble colour (World Bank income group classification): World Bank, 2022

Note: Bubble size: GNI per capita

Many developing countries recognise the risks and are looking to seize opportunities. For example, Indonesia is set to account for over half of the global growth in nickel production by 2025, largely to meet the growing demand for batteries. To capture more value it has promoted foreign investment in nickel processing and progressively restricted nickel ore exports (IEA, 2021; 2023).

However, a more systematic approach is needed to map and address the cross-border, transmitted effects of climate change and climate action. This can support the growing momentum for major reforms to address intertwined development and climate change challenges, including the Bridgetown Initiative, the 2023 Summit for a New Global Financing Pact and the Africa Climate Summit.¹ With the right support, poorer and more vulnerable countries can identify the

¹ See [Bridgetown 2.0: Urgent and Decisive Action to Reform the International Financial Architecture](#), April 2023; [Summit for a New Global Financing Pact](#); and [Africa Climate Summit](#).

most relevant issues and trade-offs as they seek to shift their development pathways and adjust to the new reality. The major powers have options to reduce or increase the barriers to access finance, ideas and markets internationally, even as they increasingly compete for economic gains in tackling climate change. Meanwhile, international institutions can increase the policy space, for example by mitigating the worst effects of protectionism; building an architecture for sustainable finance that is consistent and interoperable between countries; or facilitating safe, dignified and productive migration opportunities.

This paper offers a framework to support a more systematic approach to the transmitted effects of climate change. It consolidates prior work on transboundary climate risk and spillovers from climate action, framed around five transmission channels. The next section explains these channels, and offers concrete examples of transmitted effects. The third section looks ahead to our further research in this area, which will examine implications for individual countries and international institutions.

2 The cross-border effects of climate change

2.1 Five transmission channels

The direct impacts of climate change are well documented and ever more visible. Based on current country commitments, global warming will reach 1.5°C this century, with every increment intensifying multiple, concurrent hazards (Calvin et al., 2023). Around one-third of the global population could reside outside the ‘human climate niche’ by 2100 (Lenton et al., 2023). These changes will have major implications for how a country can develop.

Overlaying and interacting with the direct impacts are shifts in the global economy as flows of finance, people, goods, ideas and natural resources are disrupted. These cross-border, ripple effects can arise from the direct impacts of climate change. But they also arise from how individual nation states respond to climate change, whether seeking to mitigate it by reducing emissions, or adapting to the impacts.

Countries – and especially smaller economies – therefore face climate change as an exogenous reality shaping their development pathway on two fronts: the direct, within-border impacts, and the secondary impacts arising from these cross-border, transmitted effects.

The importance of transmitted effects is increasingly recognised. For example, the UN’s new Multidimensional Vulnerability Index (MVI) seeks to measure countries’ structural vulnerabilities and lack of resilience, including to climate change. Proposed indicators measure countries’ interconnectedness – such as export concentration, food and fuel import dependence and regional violence (UN, 2023). The International Monetary Fund (IMF)’s 2021 climate strategy recognises that climate change will ‘affect macroeconomic and financial stability through numerous other transmission mechanisms, including fiscal positions, asset prices, trade flows, and real interest and exchange rates’, as well as through direct impacts (IMF, 2021: 1).

However, understanding of transmitted effects is still nascent. Most MVI indicators remain internally oriented and do not help us to understand the shifts in, for example, access to international financing or value chains emerging with the global green transition. In

2023, the independent Taskforce on Climate, Development and the IMF highlighted that the Fund still needs to increase its attention to 'medium- and long-term cross-boundary spillovers from climate policies' particularly for 'developing countries with diverse circumstances' (Task Force on Climate, Development and the IMF, 2023: 13). The lack of a consistent framework to understand and assess transmitted effects leaves blind-spots in countries' development strategies and in the support offered by most international institutions.

Fortunately, there is substantial research from which to draw a more systematic understanding. Our approach brings together two strands of work – on transboundary risks from climate change impacts and adaptation, and on cross-border spillovers from mitigation policies. Much of the first has coalesced around an analytical framework that identifies four key transmission channels through which the impacts of climate change, and adaptation responses to them, have cross-border implications: biophysical, trade, finance and people (Benzie, Hedlund and Carlsen, 2016; Ansimov and Magnan, 2023). The second strand of work is more diffuse. A small set of specific international spillover effects from mitigation policies have received substantial attention, especially carbon leakage and technology transfer/diffusion, since at least the second report of the International Panel on Climate Change (IPCC, 1995). More recently an increase in major green economic policy programmes and financial market initiatives has stimulated wider recognition that climate change mitigation is reshaping the global economy. Relevant studies model the impacts of specific decarbonisation policies on other economies, such as the EU's Carbon-Border Adjustment Mechanism (CBAM) (He, Zhai and Ma, 2022; Magacho, Espagne and Godin, 2023); or assess the effects of transition policies on global financial markets (Yang, Caporin and Jiménez-Martin, 2022; Wu and Wan, 2023).

We build on the transboundary impacts/adaptation risks work to provide a frame to assess three kinds of transmitted effects arising from direct impacts, attempts to adapt to those impacts, and efforts to mitigate climate change.² We use the four channels mentioned above and add a fifth, technology, recognising the existing and rapidly expanding importance of innovation and data, especially on the cost fundamentals of the energy transition. Each transmission channel involves distinct flows within the global economy:

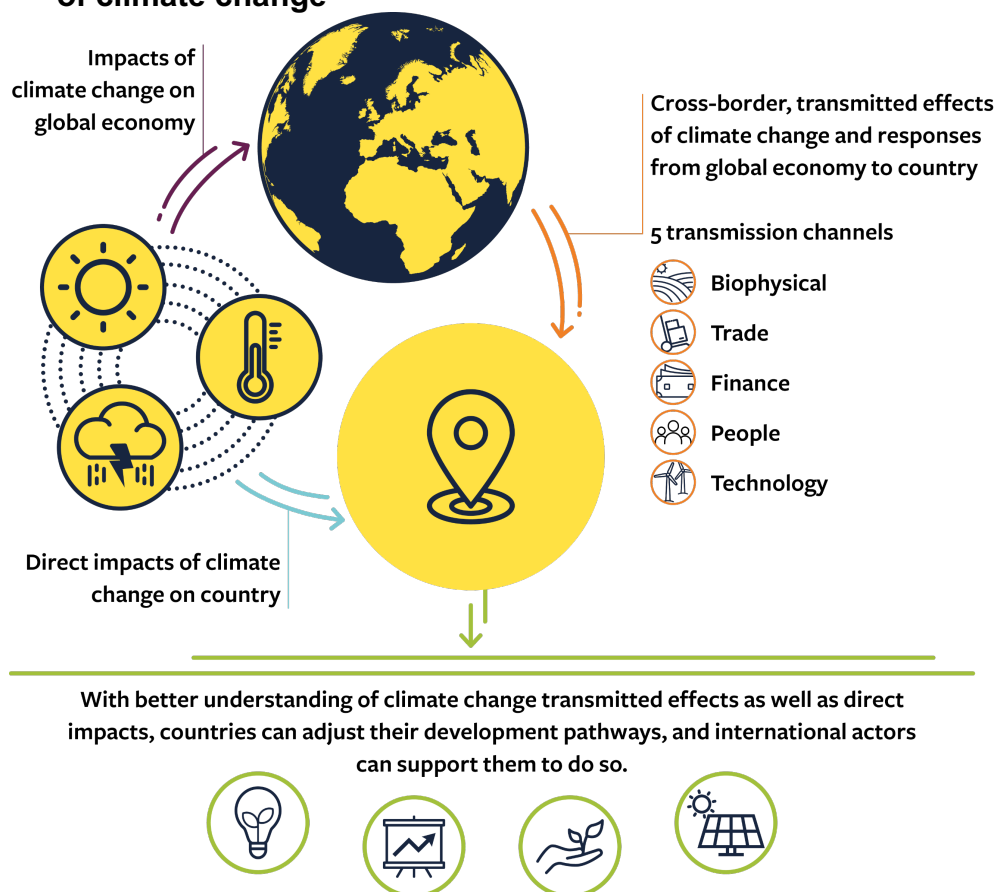
- 1 Biophysical: flows of natural resources and ecosystem services
- 2 Trade: flows of goods and services
- 3 Finance: flows of capital
- 4 People: flows of migrants and tourists

² We prefer 'transmission channels' following Ansimov and Magnan (2023) and 'transmitted effects', but recognise that several other terms are used for equivalent concepts, including 'spillover' and 'secondary' effects (as summarised in (Benzie, Hedlund and Carlsen, 2016)).

5 Technology: flows of ideas and data

With a better understanding of these transmitted effects and how they intersect with the direct impacts of climate change, countries can adjust their own policy responses to address threats, build resilience and seize new opportunities. Moreover, international actors can expand the available policy space to help countries to do so (Figure 2).

Figure 2 A framework for assessing the transmitted effects of climate change



Source: Authors

2.2 Biophysical

Transmitted effects in the biophysical channel specifically concern cross-border flows of natural resources, biota and/or pollution.³ As with the other transmission channels, those flows can be altered by direct impacts of climate change, as well as by adaptation and mitigation responses. In the first case, flows can be altered by a climate shock, such as a wildfire which increases air pollution in other countries, or stresses such as increased aridity that threaten a wetland or forest ecosystem on which several countries depend.

³ Noting that changes in the climate system and resultant direct, within-border impacts are also ultimately biophysical in nature.

In the second case, adaptation responses to climate change can also alter biophysical flows, with consequences for neighbouring and sometimes more distant countries. For example, countries' fisheries may come under increasing pressure from deep-water fleets of distant countries seeking to preserve catch levels as climate change causes declines or shifts in their own fish stocks (Ansimov and Magnan, 2023). Although a less certain prospect, adaptation through geoengineering, such as stratospheric aerosol injection, could also have significant transboundary consequences (Reynolds, 2019).

In the third case – mitigation responses – an example with largely negative consequences is the unilateral development of large hydropower dams on transboundary rivers. While this can provide lower-carbon energy generation, it can also reduce water, fish and sediment flows downstream. For example, fisheries and agriculture in Cambodia and Vietnam have been deprived of crucial silt transfers by development of hydropower for lower-carbon energy on China's Lancang River (Soukhaphon, Baird and Hogan, 2021). Opportunities may also arise where neighbouring countries have abundant renewable energy potential that they can develop for export – including hydropower, but also solar, wind and geothermal.

Table 1 provides further examples. Red shading indicates largely negative economic impacts, green largely positive. In all cases, there is potential for social and environmental trade-offs. For example, large dam development underpinning regional sharing of hydropower energy between Laos and other countries carries an ecological and social cost (Ming, 2022).

Table 1 Biophysical channel: example transmitted effects

Physical impact	Adaptation response	Mitigation response
India, Pakistan: future climate change plus socio-economic development in upper transboundary Indus basin could drive 25% reduction in seasonal water availability in lower basin, putting pressure on irrigated agriculture and industry (Smolenaars et al., 2022).	Faroe Islands: in adapting to range expansion of Atlantic mackerel due to environmental shifts in the 2000s, the Icelandic fishing industry captured significantly higher share of total allowable catch, threatening fishing industry of the Faroe Islands (Palacios-Abrantes et al., 2022).	Thailand, Malaysia, Singapore: Laos is developing its significant hydropower potential in the Mekong basin. Regional states have increasing opportunities to import hydroelectric power through the Power Integration Project (Ming, 2022).

2.3 Trade

The global trade system already transmits climate change shocks on one country to others, for example where food prices have increased globally in the wake of climate-related disasters affecting major producers. There are likely to be a few winners, as well as many losers, as geographically differential climate impacts are mediated through the trade system. For example, US maize production could fall by 46% with climate change, driving up global prices, especially for major importers in the Caribbean like Jamaica. At the same time, a small set of countries, including Russia, Canada and Chile, could see increases in maize production, though this will be vastly insufficient to offset losses in the US and elsewhere (Adams et al., 2021; Table 2).

Responses by individual countries, ostensibly to adapt to climate change, can also ripple through trade networks. India's ban on exports of non-basmati white rice in July 2023 responded in part to floods in Pakistan which had contributed to rising global prices, with the likely effect of increasing prices further in other countries (Glauber and Mamun, 2023; Mamun and Glauber, 2023). Such patterns will not be limited to the global food trade. Already, the mantra of resilient supply chains coupled with security concerns is driving trends towards re-shoring and friend-shoring of manufacturing.

Turning to mitigation policy responses, the green shift in current and potential export markets presents opportunities and challenges. On the one hand, producers of 'critical minerals' for green technologies, such as lithium, copper, cobalt and nickel, are expected to experience major increases in demand. Global demand for lithium alone is expected to increase by 500% by 2025 (Business for Social Responsibility (BSR), 2021). On the other hand, fossil fuel producers face an uncertain future. As noted, Indonesia has opportunities in nickel, yet it is also a major coal producer. A shock to Chinese coal demand could reduce Indonesia's gross domestic product (GDP) by nearly 10% through the cascading impacts from suppressed coal exports (Gourdel, Monasterolo and Gallagher, 2023). Other countries including Uganda and Somalia have undeveloped oil and gas reserves and, having contributed little to climate change historically, will require substantial support to achieve a just transition away from petroleum-led economic development (Marcel et al., 2023).

Major economies are seeking to ensure their own companies face a level playing field internationally, as they tighten climate regulations domestically. This could reduce poorer countries' access to their markets and create a 'green squeeze' on producers unable to meet the increased costs of compliance. The most discussed example is the EU CBAM, entering into transitional application from October 2023. This levies a tax on imported goods proportionate to the carbon content to guard against carbon leakage. It could have

significant implications for EU trading partners, especially in Africa and Eastern Europe, if they are unable to adjust production in affected industries (see Table 2).

Table 2 Trade channel: example transmitted effects

Physical impact	Adaptation response	Mitigation response
Chile: while modelling has suggested a reduction in global maize production of 27% with climate change, Chile could stand to increase production by more than 60%, with new trade opportunities potentially opening up as major exporters struggle (Adams et al., 2021).	Madagascar: India's 2023 rice export ban, introduced after price spike following floods in Pakistan, is likely to drive up prices further (Glauber and Mamun, 2023).	Mozambique: EU CBAM covers aluminium imports to the EU from producer countries such as Mozambique, threatening employment and wages in its aluminium sector and related supply chain if production cannot be decarbonised (Magacho, Espagne and Godin, 2023).

2.4 Finance

The direct impacts of climate change already impose a penalty on countries seeking to access finance from international capital markets. Vulnerability to climate shocks increases the cost of borrowing and sovereign creditworthiness for developing countries, limiting their ability to fund capital-intensive long-term investments (IMF, 2020; Beirne, Renzhi and Volz, 2021).

Adaptation responses in major economies could amplify these effects. For example, mandatory disclosure requirements for physical impact risks from climate change could further deter investment from the most exposed and vulnerable locations (Table 3). That said, to date there is a lack of empirical evidence that the financial sector's adaptive measures are deterring investment or inducing capital flight (Cooper, 2020). Voluntary and mandatory climate risk disclosure can, however, imply a non-trivial information and compliance cost for financial institutions. This could be an additional challenge for low- and middle-income countries and their financial institutions if they seek to access international commercial finance (Colenbrander et al., 2023).

As with the other channels, policy and market responses to mitigate climate change within other economies also transmit effects internationally. These include the evolving financial architecture to address 'transition risk' arising from the shift to a low-carbon economy. Regarding physical impact risks, this includes action by financial regulators, such as the EU Sustainable Finance Disclosure

Regulation, as well as voluntary initiatives such as those in the banking and insurance sectors.⁴

In principle these trends could increase commercial finance flows into countries that can provide low-carbon investment opportunities. Demand certainly appears to be surging, exemplified by the growth of green bonds, nearly a quarter of which were from emerging market issuers in 2022 (CBI, 2022). However, because of wider barriers to investment, the actual effect of these trends on capital flows to low- and middle-income countries is so far limited and concentrated in China (UNCTAD, 2023a).

External demand for investments supporting decarbonisation could also come through other channels. Foreign direct investment (FDI) remains an important source of investment for renewable energy and other green projects (see Indonesia example, Table 3). The nascent voluntary carbon market also holds promise for low- and middle-income countries (UNCTAD, 2023a). Modelling suggests that nature-based carbon removal opportunities could provide \$6 billion in revenue per year and 63 million jobs across Africa, at a carbon price of \$30/ton CO₂ (CAP-A, EarthGenome, and Dalberg, no date).

As in all pathways, there is potential for losers as well as winners. Considering concessional, public financing, various governments have announced that their board representatives at multilateral development banks (MDBs) will vote against MDB investment in certain fossil fuels.⁵ Much less progress has been made in increasing the volume of low-cost finance for renewables, which typically involve larger up-front capital investment. Despite increases in international climate finance, overall MDB investment in the energy sector fell in the decade following the initial \$100 climate finance pledge (Miller et al., 2023).

⁴ The Glasgow Financial Alliance for Net Zero (GFANZ) was established in 2021 to expand a coalition of financial institutions committed to transitioning the global economy to net zero emissions. See: <https://www.gfanzero.com/about/>. The Net Zero Insurance Alliance (NZIA) was convened under UNEP and the GFANZ to transition to net zero for insurance and reinsurance portfolios (<https://www.unepfi.org/psi/wp-content/uploads/2021/07/NZIA-Commitment.pdf>).

⁵ See for example US Treasury guidance on fossil fuel investment: <https://home.treasury.gov/news/press-releases/jy0323>

Table 3 Finance channel: example transmitted effects

Physical impact	Adaptation response	Mitigation response
Vulnerable 20 countries: ⁶ pay a 10% premium on the interest on their sovereign debt, due to their climate vulnerability (Kling et al., 2018)	Insurance sector: integrating climate impacts (rising risk of catastrophes and 'unhedgable risks') into business models may increase conservatism towards insuring/ investing in climate-vulnerable projects or countries (CISL, 2015).	Indonesia: surging demand for nickel, particularly from Singapore, China and Hong Kong, was a key driver in increasing FDI in Indonesia by over 40% in 2022 (Sulaiman and Suroyo, 2023).

2.5 People

The people channel captures the effects on temporary and permanent movements of people across international borders – including labour migration, forced displacement and tourism.

Direct impacts of climate change elsewhere may increase immigration and displacement to a given country, particularly from impacted neighbours or countries joined by cultural ties. These impacts may also affect opportunities for emigration and associated remittance flows. In the worst case, climate hazards in destination and transit countries can be fatal to migrants, especially those forced into unsafe journeys or work (Table 4). Overall, however, the effect of climate change on migration of different kinds is disputed, with most climate-related movements likely to occur within countries (Cissé et al., 2022).

In terms of policy responses, migrant destination countries may make (mal)adaptive changes to their border controls in response to the perceived threat of climate-driven migration. This could have significant implications for migrant-sending countries and individual migrants (Wright, 2023). In tourism, the way consumers in tourist-sending markets adapt to climate change could open up some limited opportunities – including for 'last chance' tourism to destinations significantly threatened by climate change (Table 4). However, such opportunities will be short-lived. Other forms of adaptive behaviour by tourists, such as avoiding locations increasingly affected by wildfires or drought, could reduce arrivals in destination countries (Rosselló, Becken and Santana-Gallego, 2020). In South Africa, tourists' decisions not to visit Cape Town during the 2015–2018 drought cost Western Cape province revenue and jobs (Dube, Nhamo and Chikodzi, 2022).

⁶ <https://www.v-20.org/>

In terms of the transmitted effects of mitigation-related policy, considerations for tourism include the effects of aviation levies or other demand-suppressive policies on international travel (Table 4). For migration, new opportunities for labour migration may open up to meet changing labour and skill needs as countries seek to decarbonise. Recent estimates suggest a net gain of 18–37 million jobs through the low-carbon transition. Migration could provide an important mechanism to balance labour and skill supply and demand during rapid green transitions (Mason et al., 2022).

Table 4 People channel: example transmitted effects

Physical impact	Adaptation response	Mitigation response
Mexico; other countries of origin: migration to the US from Mexico via informal channels will likely become more hazardous due to heat. More than 100 migrants died of heat near the US–Mexico border in the year to July 2023 (Vinall, 2023).	Tanzania: international demand for ‘last chance tourism’ in Kilimanjaro National Park may increase, with reducing snowfall, change in flora/fauna and improved trekking conditions (though with likely reduced demand in the long term) (Kilungu et al., 2019).	Barbados: suppression of aviation (e.g. via reduced subsidies) in tourist-sending markets could reduce tourism revenue, with modelled loss to Barbados GDP of up to 38% (Gourdel and Monasterolo, 2022).

2.6 Technology⁷

Green technologies, including photovoltaics, biofuels, wind energy, green hydrogen and electric vehicles, had an estimated market size of \$600 billion in 2020. This could increase to \$2.1 trillion by 2030 (UNCTAD, 2023b). Alongside concurrent revolutions in data and digital, they open new green windows for economic growth.

The direct impacts of climate change outside country borders could disrupt access to data and technology. For example, subsea telecommunications cables are vulnerable to natural hazards, made worse and more frequent by climate change (Clare et al., 2023; Table 5). Furthermore, actions by other countries, especially significant green investment programmes, are likely to affect the price and deployability of both mature and early-stage green technologies.

Such effects are, to date, less evident for climate adaptation technologies. Patent analysis suggests adaptation technologies have a slower pace of innovation than low-carbon technologies and see relatively little international diffusion, especially to low-income countries (Touboul et al., 2023). Nonetheless, adaptation-adjacent technologies have seen falling costs and increased uptake, which

⁷ This transmission channel primarily concerns the flow of intangibles including intellectual property and data, whereas the movement of technological goods is captured under trade.

could in turn unlock adaptation innovations. Examples include solar PV as a power solution for irrigated agriculture (Hartung and Pluschke, 2018), and remote sensing, big data and cloud computing for forecasting, early warning systems and weather index insurance (Perera et al., 2019; Table 5).

Transmitted effects arising from mitigation-oriented international policy responses in the people channel are potentially more profound and immediate. Policy and investment programmes of major powers will have a long-term impact on the cost and availability of low-carbon technologies, potentially increasing their transfer and diffusion to emerging markets. This includes the US IRA (see Table 5), EU Green Deal and China's Green Belt and Road Initiative, as well as its internal decarbonisation commitments.⁸ There is also a potential downside, for example, growing dependence on technology imports/transfer, and exposure to cost fluctuations, as poorer countries struggle to compete in the global subsidy race.

Table 5 Technology channel: example transmitted effects

Physical impact	Adaptation response	Mitigation response
Taiwan: underwater sediment flows triggered by extreme river discharge associated with Typhoon Morakot in 2009 damaged the undersea telecommunications cables on which Taiwan depends (Carter et al., 2014).	Kenya: global advances in remote sensing technology and satellite networks contribute to the Index-Based Livestock Insurance system, which provides automated, pre-emptive payments to drought-affected pastoralists, reducing risk of drought-induced conflict (Gehring and Schaudt, 2023).	Global: modelling suggests the US IRA could significantly reduce costs of emerging climate technologies for other countries, inducing a reduction of 2.4–2.9 tonnes of CO ₂ globally for every tonne reduction in the US (Larsen et al., 2023).

⁸ China has committed to: achieve carbon neutrality by 2060; ensure 25% renewables in total energy consumption; and reduce the carbon intensity of its GDP by 65% by 2030, among others (Maizland, 2021).

3 Navigating a climate-changed and connected world

3.1 Why transmitted effects matter

Climate change has major macro-economic implications, not just through direct impacts, but also through transmitted effects. Every economy will be affected through the five transmission channels, but exposure and vulnerability, levels of resilience and ability to take advantage of opportunities all vary. Moreover, transmitted effects do not arise in isolation. Risks associated with transmitted effects can interact with other exogenous risks, such as conflict or pandemics. They will also interact with risks arising within countries' borders, including the physical impacts of climate change and transition risks and non-climate risks – all with potential for unpredictable cascading and compounding effects (Carter et al., 2021).

Transmitted effects of climate change must be approached and navigated with greater political sensitivity, both by individual countries and international institutions. If not, their consequences will exacerbate tensions between climate and development objectives. Low-carbon, climate-resilient development has been promoted for years and is central to the Paris Agreement.⁹ Achieving it is essential for a safe climate: even excluding China, emerging markets and developing economies will likely emit more than half of global emissions as early as 2030 (Bhattacharya, Kharas and McArthur, 2023). Yet in a context of unfulfilled promises of financial and technical support from rich countries, and debt challenges amplified by Covid and inflation, the rational choice for many low- and middle-income countries in the short term is not inevitably a low-carbon path.

Ignoring transmitted effects will further undermine incentives for low- and middle-income countries to reduce emissions. Without due consideration of such effects, there are risks that unilateral actions unleash exclusionary rather than inclusive forces within the accelerating green transition, amplifying poorer countries' vulnerability (Rajan, 2023). In turn, the logical choice could be to exploit fossil fuels and carbon sinks, and to spend on shoring up their

⁹ E.g. Article 2(b): 'foster climate resilience and low greenhouse gas emissions development'; Article 2(c): 'Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development'.

defences to, or recovering from, climate disasters – rather than paying for decarbonisation measures that still entail high upfront costs, especially given higher costs of capital.¹⁰ Furthermore, if low- and middle-income countries do not choose a low-carbon path, the fragile global consensus on climate action will be strained still more.

While much of the attention has been on finance – in a context of mounting global need and large green subsidies being deployed domestically – attention must expand to include the other transmission channels. That means flows of goods, services, natural resources, people and ideas, as well as finance. Measures to boost concessional finance or to restructure and reduce debt are urgently needed. But they will be a short-term fix for countries if their transitions fail because major economic powers hoard climate-related intellectual property or do not expand trade or migration opportunities in the green economy.

3.2 Opening up opportunities

Currently, most transmitted effects, just like the direct impacts of climate change, have negative implications for development. But there are opportunities too, which governments are already advocating for and seizing. President William Ruto of Kenya urges European leaders to make Africa in general – and Kenya specifically – a key partner in its energy transition efforts, including via the continent’s reserves of critical minerals (Republic of Kenya, 2023). The Chilean government has released a three-phase Green Hydrogen Strategy to 2035 and beyond targeting development of the domestic market initially, and then exports (UNCTAD, 2023b). Tuvalu’s migration policy promotes temporary/circular options in which the Pacific island’s labour force contributes to other countries’ economies while remittances support household resilience at home (Farbotko et al., 2022).

There are many more examples. But the windows of opportunity need to be opened wider, both by the major economic powers and by international institutions. For example, Ghana’s cabinet has approved a Green Minerals Policy, with legislative amendments expected to target higher levels of domestic participation and royalties than for existing mining resources, including gold (Ngnenbe, 2023). But Ghana, and other countries in Africa with relevant reserves and, in some cases, policy measures, are currently locked out of a key incentive mechanism of the US IRA. This subsidises electric vehicles only if batteries contain a certain share of critical minerals extracted or processed in countries with a free trade agreement with the US (or

¹⁰ Without action to reduce the cost of capital, countries with hydrocarbon reserves could find themselves accepting finance for fossil-fuel based projects to meet immediate development needs, rather than directing scarce resources to position themselves in new green value chains (Allan, Lewis and Oatley, 2021; IEA, 2022). African countries could achieve net-zero emissions around a decade sooner if the high regional weighted average cost of capital was reduced to the global average level (Ameli et al., 2021).

in the US itself). In Africa, that means Morocco alone (Schneidman and Songwe, 2023). Similarly, Ruto has pointed out that Africa's contribution to European and global decarbonisation depends on not being locked out by EU trade measures, including the CBAM (Republic of Kenya, 2023). Currently, climate policies of richer countries – including tighter import controls and fossil fuel financing bans – look to many poorer countries too much like sticks, rather than carrots. This contrasts with the largesse being deployed at home, to subsidise green industries and compensate losers in domestic 'just transitions'.

International institutions also have key roles in helping countries to identify and capitalise on the opportunities implied by transmitted effects (and in building resilience to the downsides). Some have begun to provide the supporting frameworks. In 2022, the World Bank launched its Country Climate Change and Development Reports, which integrate climate change and development considerations. In 2023, the IMF provided the first batch of climate resilience loans for Bangladesh, Barbados, Costa Rica, Jamaica and Rwanda. Also in 2023, the World Trade Organisation, World Bank and the World Economic Forum launched a joint effort to provide tailored advice to help countries use trade to meet their climate change adaptation and mitigation goals.

Many of the key reforms will require some level of multilateral negotiation. There is growing momentum, encapsulated in the Bridgetown Initiative and the 2023 Summit for a New Global Financing Pact and ensuing processes (albeit still broadly finance-focused). Yet there is also a need for significant acceleration, including on disbursement of rechannelled special drawing rights; on MDB reform; on debt relief, standstills and sustainability; and, in the context of the UNFCCC framework, on the Loss and Damage fund and New Collective Quantified Goal on climate finance. Frameworks for sustainable commercial finance also need to pay greater attention to how they affect capital flows and financing costs for poorer economies (Ameli et al., 2021). In most of these efforts, a lens that captures the transmitted effects of climate change more systematically could be beneficial.

Not all challenges posed by the transmitted effects of climate change will require global cooperation. Regional initiatives will often be more effective and faster. In the people channel, members of regional economic communities have established intergovernmental migration agreements to explicitly recognise climate migrants – notably in East Africa (Mbiyozo, 2022). In the finance channel, Just Energy Transition Partnerships (JET-Ps) have been initiated, so far by South Africa, Indonesia, Vietnam and Senegal, in which each has committed to the decarbonisation of their energy systems (particularly away from coal) in return for programmatic financial support from a subset of development partners (Torres Gunfaus et al., 2023). Such 'minilateral' deals, clubs and agreements may point

towards an emerging new frontier for climate (and development) diplomacy.

Whatever the forum for deal-making, the ultimate metric for success is meeting the Paris Agreement commitments. That depends on reducing and minimising the political frictions that will increasingly be felt, if the playing field for developing in a climate-changed world is too uneven. Understanding the full spectrum of transmitted effects of climate change in each channel is a starting point. Our further work in this space seeks to inform critical deliberations and decision points in 2023 and 2024, starting with the Africa Climate Summit in Nairobi.¹¹ We will look at how transmitted effects arise in specific countries, and their interactions with direct impacts of climate change. We will seek to help countries identify their policy options – given differing exposure, vulnerabilities and endowments – to seize opportunities and build resilience. And we will look to articulate key measures that the international community and major economic powers can take to help increase the available policy space.

¹¹ And thereafter including the G20 Summit in New Delhi and the SDG Summit in New York (September 2023); the IMF/World Bank Annual Meetings in Marrakech (October 2023); COP 28 in Dubai (October/November 2023).

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