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Climate change mitigation strategies: impacts and obstacles in low- and middle-income countries

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Introduction

Climate change is clearly the biggest existential threat to life on planet Earth. Failure to act swiftly and decisively will inevitably lead to irreversible impacts and insurmountable dangers, according to the most recent assessment report of the Intergovernmental Panel on Climate Change (IPCC), and the window for strategies to prevent catastrophic change is getting ever shorter. United Nations Secretary-General António Guterres has described this report as a "code red for humanity", warning that it provides an "atlas of human suffering and damning indictment of failed climate leadership". Though this crisis was aggravated by the policies of advanced Western economies, the burden is falling disproportionately on lower-income economies. To make matters worse, the current adaptive responses to climate change by one set of agents, countries or regions might adversely impact other regions and peoples. Indeed, the IPCC Sixth Assessment Report notes that various types of maladaptation have adverse and unintended consequences. In addition, mitigation attempts that overlook the various linkage effects and other environmental and associated costs could also have adverse effects, especially on the poorest populations, especially in low- and middle-income countries.

These outcomes primarily result from the failure to understand and assess the root causes of vulnerabilities in low- and middle-income countries. Currently, the uneven distribution of wealth and power between and within countries is one of the key drivers of climate injustice (IPCC, 2022). Constraints to the required energy transition and to a future with massively reduced carbon reliance derive, in the first instance, from the current international economic and legal architecture. As noted in a companion deep-dive paper (Ghosh et al., 2022), some of the most urgent changes that are necessary include:

- **Greater provision of resources to governments, including expansion of new liquidity in the form of the International Monetary Fund's Special Drawing Rights (SDRs).**
- **Addressing and resolving the external debt problems of many countries.**
- **Putting limits and regulations on cross-border financial flows that currently prevent more active public policies and still support "brown" investment.**
- **Restructuring the current intellectual property regime, which restricts the production and transmission of knowledge and technologies required for the energy transition.**

In this paper, we focus on a somewhat more complex issue: the possible adverse effects of well-meaning climate mitigation strategies. We consider how these adverse effects can themselves be mitigated.

As climate mitigation and adaptation strategies start unfolding, we need to examine and evaluate the impacts of these policies not only on rich countries but also low- and middle-income nations. We need to assess the distributional effects of mitigation strategies on various social groups in different geographies for different generations to cover the socio-spatial-temporal dynamics of the consequences. For instance, solar panels, motors for wind turbines, or batteries for hybrid and electric vehicles are crucial in the fight against climate change and their demand is increasing rapidly in advanced economies. But many of these technologies require critical minerals concentrated in low- and middle-income nations, and the way they are extracted can have adverse outcomes, irreversibly damaging the environment and displacing indigenous communities. Similarly, while waste recycling is recognised to be a green activity, waste collected in rich countries has been exported and dumped in low- and middle-income nations without regard to the potential hazards and ecological consequences. Meanwhile, the lack of adequate climate finance and technology transfer constrains lower-income countries in the transition to green energy, while fossil fuel subsidies remain massive and even increase.

In this deep-dive paper, we document some of the knock-on effects of what may appear to be "green" strategies within one country. We also examine the provision of fossil fuel subsidies and compare them with the availability of "green" finance. The point is that these negative outcomes are not inevitable; nor are they necessary "collateral damage" in otherwise positive shifts to green energy use. We argue that avoiding these impacts requires changes in strategy not only for lower-income economies, but even more urgently in rich countries and at the global level. Such change will incorporate climate justice in the transition to clean energy and foster a more sustainable relationship with nature and the planet.

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Critical minerals for renewables: the case of lithium

The transition to a renewable and sustainable economy necessitates a significant increase in the use of some critical minerals, which have already experienced surges in demand and supply in recent years. Projections from the International Energy Agency (IEA) show that the demand for critical minerals will grow at least 30 times from the current level in the next two decades in the Sustainable Development Scenario. Here we consider the specific case of lithium, which is one of the lightest elements of the periodic table, yet will have an increasingly heavy impact on our daily lives. It is crucial to the decarbonisation of the global economy. Rechargeable lithium-ion batteries are essential for electric vehicles, electric tools and portable electronic devices such as laptops, smartphones and tablets, as well as grid storage applications. Apart from its use in batteries (estimated to be around three quarters of end use of this mineral), lithium is required for ceramics and glass, lubricating greases, continuous casting mould flux powders, polymer production, air treatment and other uses (USGS, 2022). In the IEA Sustainable Development Scenario, lithium demand is projected to increase by 42 times by 2040 (IEA, 2021, p. 8).

Currently, lithium is produced and exported mainly by low- and middle-income nations, with the exception of Australia, which is the largest producer of commercial lithium. Pure elemental lithium is highly reactive and hence cannot be found freely in nature. Instead, it is found in the form of concentrations in salt brines or mineral ores. In Australia it is extracted directly from hard-rock deposits called pegmatites, while in Latin America it is extracted from brine reservoirs located in the *salars* (salt flats) of Bolivia, Chile and Argentina. In these locations, vast quantities of brine are pumped from the sub-surface and contained in evaporation ponds that eventually leave behind lithium-rich concentrates. In the process, lots of water gets lost in these water-scarce regions. Lithium mined from hard rocks (concentrated primarily in Australia and Canada) contains higher concentrations of lithium than in brines, but it is much costlier to mine due to energy-use and materials required. Hard rock-derived lithium also generates eight times more solid waste compared with brine-produced lithium (Rioyo et al., 2020; Bell, 2020). The extraction process can be optimised if lithium and other high-value minerals can be recycled to make the process cost-effective and efficient (Gill, 2022).

A nation's lithium "reserves" are defined as sites that meet certain requirements so that economic extraction could legally occur at any time. On the other hand, lithium "resources" are a broader category that includes lithium sources that could theoretically be mined with existing mining techniques if certain criteria are met (USGS, 2022). Identified lithium resources have increased substantially in recent years to almost 89 million tonnes in 2021 due to continued exploration. As indicated in Figure 1, most of the identified lithium resources are in Bolivia (21 million tonnes), Argentina (19 million tonnes) and Chile (9.8 million tonnes). Chile has been the world's leading exporter of lithium carbonate, with a 58% share, followed by Argentina (16%) and China (11%). While China is an important player in this game, particularly in controlling supply chains, its imports currently exceed its exports, making it a net importer of lithium carbonate used for making lithium-ion batteries.

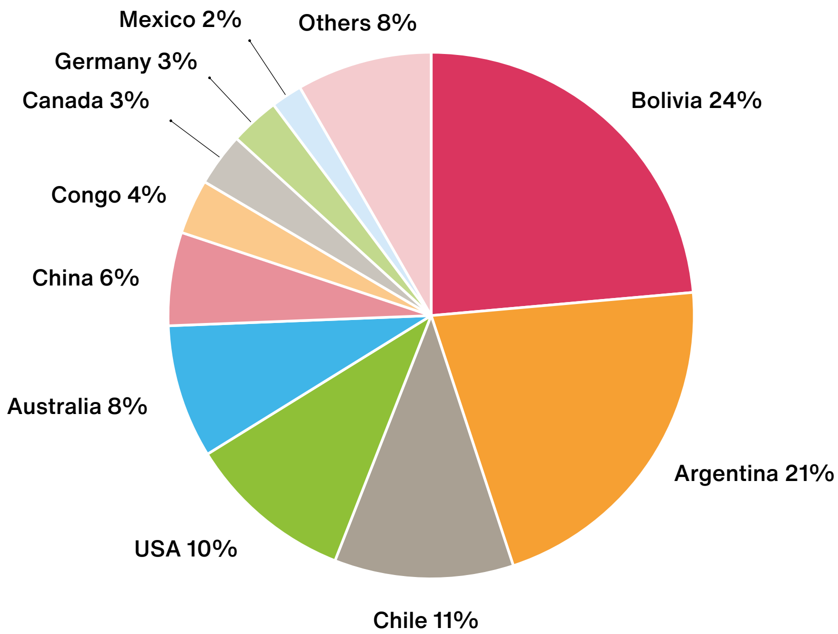

Figure 1 : Countries with identified lithium resources
Source: Constructed from USGS annual report, 2022

One important concern is the environmental impact of lithium mining, especially in low- and middle-income countries. The Lithium Triangle in Latin America, comprising Chile's Salar de Atacama, Bolivia's Salar de Uyuni and Argentina's Salar de Arizaro, holds the largest known lithium reserves in the world, under the salt flats. Brine pumping requires almost 2 million litres of water to produce 1 tonne of lithium (UNCTAD, 2020). Overexploitation of water alters the natural hydrodynamics of these regions (Marazuela et al., 2019) – altering evaporation rates and the water table depth – and reduces availability of water for local communities. Industrial extraction and the resulting commodification of water by the mining industry form the basis for indigenous peoples' contestations over water resources (Babidge, 2016). National and multinational companies often use their power and money to acquire and appropriate water sources from indigenous communities in perpetuity (Budds, 2004; Budds, 2009)[1]. For instance, in the Antofagasta region in Chile, mining companies own almost 100% of water rights where water usage is as high as 1,000 litres per second (Larrain & Schaeffer, 2010).

Disputes over water management have also manifested in the form of disparity in access to groundwater between large-scale farmers and peasant farmers in Chile (Budds, 2004). Mining activities have also resulted in contamination of local streams used by humans and livestock, as well as for irrigation in Argentina's Salar del Hombre Muerto. In China, lithium mining has released toxic chemicals such as hydrochloric acid into the Liqi River, where the associated deaths of yaks and fish have led to disputes and protests among local villagers (Graham et al., 2021). Mining operations and activities related to these strategic minerals also adversely impact the local flora and fauna. There has been significant environmental degradation in Chile's Atacama salt flat over the past two decades in terms of vegetation decline, elevated daytime temperature, decreasing soil moisture and increasing drought conditions in national reserve areas (Liu et al., 2019). Collectively, these effects threaten biodiversity. In Nevada, United States, a proposed lithium mining project near Silver Peak would endanger the rare desert flower Tiehm's buckwheat. A separate large lithium project at Thacker Pass in north-central Nevada could exacerbate risks to the sage grouse – a rare bird already threatened by invasive plants and energy development projects. In northern Chile, pumping activities are compromising lagoon structures, and reducing reproductive success for Andean flamingos (Gajardo and Redón, 2019).

Lithium-rich regions in Latin America are also home to several indigenous Atacameño communities who have traditionally relied on the land and natural resources for their livelihoods – livestock keeping, small-scale mining, textiles and handicraft (Marchegiani et al., 2020). In the absence of formal negotiations, the interests of the mining companies are overrepresented at the expense of the local communities, who are pauperised by the process. Mining operations have been associated with human rights abuse, respiratory ailments, labour exploitation and displacement of the traditional owners of these lands (Riofrancos, 2021). There are additional concerns regarding the quality, accessibility and framing of information needed to obtain consent from these communities (Marchegiani et al., 2020). Compared with these negative externalities, the economic benefits to these regions have been miniscule.

In Latin America, disputes arising from land claims associated with mining have manifested in the form of conflicts in:

- **Argentina between organised movements at municipal levels and provincial governments over mining rents;**
- **Guatemala through collective action by indigenous communities;**
- **Peru via peasant movements holding popular consultations on mining projects;**
- **Venezuela via protests against mining activities in the Orinoco Delta and other regions; and**
- **Chile where tensions between the indigenous Mapuche community and local authorities remain high (Riofrancos, 2017; COHRE, 2009).**

There is evidence of some displacement of indigenous communities. For instance, the rural population in the northern communes of the Tarapacá region in Chile decreased from almost 46% down to 6% between 1940–2002 (Romero et al., 2012). Other forms of dispute are originating from the lack of proper compensation to the indigenous communities, or failure to keep the promised compensation. Minera Exar, a joint Canadian-Chilean venture had arrangements with six local communities to extract lithium in Argentina. With the expected sales to be around US$250 million per year, each of these indigenous communities was promised compensation in the range of US$9,000–60,000 per year. However, testimonies from locals suggest the mining companies have reneged on their promises, as pointed out by Luisa Jorge, a resident and leader in Susques: "Lithium companies are taking millions of dollars from our lands ... they ought to give something back. But they aren't" (Ahmad, 2020).

The divide between promises and practices can mostly be attributed to the lack of formal arrangements and the absence of the state in most of these situations. Marchegiani et al., (2020) show that relevant information needed for consideration of the mining plans is mostly withheld at early stages prior to assembly meetings between the concerned parties. The use of highly technical and specialist language in conversation and in lengthy technical written reports impedes many community members from fully grasping the contents of these contracts. Moreover, these reports are prepared by the mining companies, who overrepresent their case. The lack of independent assessments makes it difficult for the communities to gauge the veracity of these reports.

It is possible to do things differently. Policies need to be considered to ensure that "greening" the North does not result in pauperising the South. Local collective action can also be effective, as was the case in Salinas Grandes, north-western Argentina, where community members began organising before mining exploration activities commenced. Thirty-three communities from this region worked together to define free, prior and informed consent (FPIC) in which they emphasised the need for independent information and the role of the state to ensure transparency in the process (Marchegiani et al., 2020). This case study demonstrates that – with the right institutional and regulatory framework – extraction of lithium need not necessarily be costly for local communities.

Policies regarding mining of lithium and other minerals must undergo a paradigm shift away from serving the interests of the state and mining corporations to serving local communities. State-led resource extraction in institutionally strong states can effectively collect resource rents and channel them for the benefit of the domestic economy – but such states must be transparent in their dealings and accountable to the local communities as well as to the wider population.

Royalties and corporate income tax are some of the important regulatory measures that can be taken in this regard. Governments can tax profits to raise additional revenue without generating disincentives for corporations, through progressive corporate profit taxation and resource rent taxes. Another way is to levy royalties to secure a stream of revenue upfront. Royalty rates on strategic minerals were lowered drastically in these mineral-rich countries during the peak of the Washington Consensus (in the 1990s), when it was argued that lowering corporate taxes would incentivise foreign direct investment (Perotti & Coviello, 2015). Today, for most economies, royalties are assessed on an ad valorem basis, the range varying between 2–30% (Baunsgaard, 2001). Table 1 summarises the relevant fiscal regulations on lithium for various countries indicating corporate income tax (CIT) and royalties.

China		
Top rate of CIT	25% (federal)	
Argentina		
Lithium royalty	3% provincial mining royalty	
Top rate of CIT	35% (federal)	
Tax on exports	Ore extracted: 5%	
	Processed ore: 5%	
	Refined metal: 5–10%	
Bolivia		
Lithium royalty	12.50%	
CIT	25%	
Chile		
	SQM	**SCL & Rockwood**
Lithium royalty	6.80%	Royalty free
Top rate of CIT	20%	

Table 1: Some fiscal regimes for lithium extraction
Source: Compiled from Perotti & Coviello, 2015

In addition to fiscal and regulatory strategies, there is a need to rethink the institutions that collect rent on these natural resources. Creating horizontal institutions with local representatives in the executive decision-making process is an alternative to the top-down approach, and it could prevent the concentration of rent in the hands of the elite. Transparency in audits can reduce or prevent corruption at local levels. Governments might require independent mechanisms and specific indicators to ensure transparency in profits and costs (Perotti & Coviello, 2015). Once these systems are in place, progressive taxation can be explicitly targeted on rents to maximise the present value of net government revenues (IMF, 2012).

Public-private partnerships (PPP) need to be more explicitly cognisant of the shared-value principle. Formalisation of contracts should be based on complete and accurate information regarding the costs and benefits of projects – not only in the short-run, but also in the medium- and long-runs. This necessarily requires the involvement of the state in the entire process, especially directed to ensure that the rights of local communities are not compromised. (In this context, it has been found that retaining at least 51% rights in the shares of extracting and processing companies can reduce dependence and power-meddling by superpowers such as the United States or China.)

There must be more investment in research and development for cost-effective and environmentally sustainable techniques of lithium extraction, with special emphasis on minimising water wastage.

It is also important to have independent assessments of projects by third parties and ensure that the members of independent committees are selected in a democratic process and rotated or changed after regular intervals so that they remain independent of any form of regulatory capture. Compensation and wages for local communities should be clearly specified and indexed to inflation and other supply-driven shocks, and non-compliers must face consequences for violating contracts. In consultations and decision-making regarding contracts and water- and land-use rights, it is important to involve women and people from other marginalised social groups.

There must be more investment in research and development for cost-effective and environmentally sustainable techniques of lithium extraction, with special emphasis on minimising water wastage. One way would be exploring the Direct Lithium Extraction process, as its proponents claim it saves up to 98% of the processed water by recycling it using water control and recovery technology.

This section has taken lithium extraction as an example of why strategies to promote green energy and electrification need to be thought through more holistically. They should ensure that mining activities do not threaten the environment nor the conditions for people who live and work in places where such extraction occurs. In the next section, we take up another aspect of "going green" widely recognised as positive in rich countries, which can have adverse environmental and health consequences in poorer countries: waste recycling.

Trade in waste and waste recycling

Waste is a natural product of urbanisation, economic development and population growth (Kaza et al., 2018). However, poor waste management has led to problems of pollution and environmental degradation, with associated health hazards. Over the past half-century, increasing volumes of waste generation have been associated with the export of waste from high-income countries to lower-income countries. This was seen as a means of earning foreign exchange in lower-income countries (even though they were not well equipped to properly dispose of and manage such waste in ways that would protect people's health, ecology and the environment) and as more cost-effective in rich countries. For instance, in the United States, the cost of dumping waste in landfills increased from US$16.5 per metric ton in 1980 to $275.6 per metric ton in 1988 (Strohm, 1993). The same waste could be dumped in a landfill in Africa for US$3.03 per metric ton.

The history of the waste trade, especially that related to hazardous waste, has been controversial. International attempts at regulation, for instance the 1989 Basel Convention (an international treaty designed to restrict the movement of hazardous and toxic waste between countries) had many limitations. Regulatory texts often included vague definitions such as "hazardous waste" and "environmentally sound"; they excluded radioactive waste and lacked any liability provisions. Crucially, there was no provision for incentives to reduce waste produced by the advanced countries, so the volume of waste generated continued to grow rapidly.

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Several factors, including differences in disposal costs, tax rates, environmental regulations, shipping costs, technological capabilities and illegal criminal activities, are significant drivers of the international trade in waste. With the imposition of stricter regulations and the associated rise in the disposal costs of hazardous waste in the industrial world from the 1980s, low- and middle-income countries were seen as an inexpensive way of dumping toxic industrial by-products and waste (Clapp, 1994). In addition, transportation costs of these materials influenced the decision of whether it would be cost-effective to dump them domestically or dispose of them abroad (Mazzanti & Zoboli, 2013). Some, like Baggs (2009), have argued that because economic growth increases both waste and the capacity for its management and disposal, large industrial economies will eventually become net importers of waste because of their capacity to process hazardous waste. However, most waste of this type is in the form of residual waste that is dumped, landfilled and incinerated in low- and middle-income countries because it is not recyclable. The perception of poorer countries as "waste havens" results not only from low shipping costs but is also determined by the relative absence of effective environmental regulation in many destination countries. The environmental regulation index is on average 39% lower in low- and middle-income countries than in rich countries (Kellenberg, 2010). As a result, this pattern of discarding waste can have severe adverse effects on the environment and on human safety and health in these countries.

Not all waste trade is in hazardous materials destined for disposal. Scrap metals and recyclable materials destined to be reused constitute a huge chunk of the waste trade. These markets have distinct economic and environmental impacts and, insofar as they enable and encourage reuse and more effective recycling of materials, they are to be welcomed. Hu et al. (2020) find two triangular trade patterns for the scrap metal industry from 1988–2017: East Asia-North America-Oceania, led by China, the United States and Australia; and Europe-South Asia-Middle East, led by India and the United Arab Emirates.

In general, except for a few instances of decoupling between waste generation and economic growth (as in France, Hungary, Japan, the Slovak Republic and Spain), the volume of waste generated goes up with economic growth and population level. Globally, daily per capita waste generation increased from 0.74 kg in 2016 to 0.79 kg in 2020, with total estimated waste generation worldwide at 2.24 billion tonnes. It is projected that total waste in 2050 will go up to 3.88 billion tonnes, with daily per capita waste generated at 1.09 kg. In the business-as-usual scenario, the residual waste (that cannot be recovered) would increase to 3.32 billion tonnes, at a daily average per capita rate of 0.94 kg (Kaza et al., 2021), for which the final disposal methods include dumping, landfilling and incineration.

But global averages fail to capture the regional disparity, which is massive, as shown in Table 2. In 2016, sub-Saharan Africa generated the least waste per person, with a daily per capita average of 0.46 kg. North America generated the highest level of average daily waste per capita at 2.21 kg. Even the highest level of waste generation in sub-Saharan Africa or South Asia is lower than the lowest level in North America. In effect, the production structure, high per capita income levels, and consumerist lifestyle of affluent North Americans are primarily responsible for the bulk of global waste generation.

	2016 Average	Minimum	25th Percentile	75th Percentile	Maximum
Sub-Saharan Africa	0.46	0.11	0.35	0.55	1.57
East Asia and Pacific	0.56	0.14	0.45	1.36	3.72
South Asia	0.52	0.17	0.32	0.54	1.44
Middle East and North Africa	0.81	0.44	0.66	1.40	1.83
Latin America and Caribbean	0.99	0.41	0.76	1.39	4.46
Europe and Central Asia	1.18	0.27	0.94	1.53	4.45
North America	2.21	1.94	2.09	3.39	4.54

Table 2: Regional disparity in waste generation (kg per capita per day)

Source: Kaza et al. 2018, p. 22

Within municipal solid waste, the largest category is food and green waste, which made up 44% of global waste in 2016 (Kaza et al., 2018). Dry recyclable waste comprising plastic, paper and cardboard, metal and glass accounted for another 38% of global waste. Once again there is variation across regions. Food and other green composts made up more than half of the waste generated in upper-middle, lower-middle and low-income countries. In high-income countries, dry recyclable waste made up almost half of the total waste, while food and green waste were 32%. In low-income countries, the "other" category comprised almost 27% of the total waste, while it is only 11% in the high-income countries (Kaza et al., 2018).

Globally, nearly 40% of the total waste is disposed of in landfills, while 33% of the total ends up in open dumps. With the development of recycling technology and increasing awareness, almost 19% of the global waste undergoes material recovery through recycling and composting (Kaza et al., 2018). However, recycling-related disposal methods are concentrated in the high-income countries. In 2016, the share of recycling in total waste disposal was 29% in high-income countries but only 4–6% in other countries. Globally, 11% of waste undergoes controlled incineration, with high- and upper-middle-income countries disposing of 22% of the waste in this manner, compared with 10% in other countries. With open dumping, the patterns are reversed: the share of open dumping in the total waste disposal was 93% for low-income countries, 66%

for lower-middle-income, 30% for upper-middle-income and only 2% for high-income countries. Open dumping is highest in South Asia at 75%, followed by Sub-Saharan Africa at 69% and the Middle East and North Africa at 53%. Even landfills, which are usually considered the first step to managing waste sustainably, account for less than 4% of the waste in South Asia.

These patterns of waste disposal influence in turn are affected by patterns of cross-border trade. Data from the UN Comtrade database show that the United States is the world's largest exporter of waste and scrap paper, and paperboard, with its share of such exports increasing from 34% in 2010 to 40% in 2020. The United Kingdom was the second-largest exporter of such waste, followed by Japan. China, India, Indonesia, Germany and the Netherlands were the top five importers. However, it is worth noting that China's share of global imports of this form of waste declined dramatically from a peak of 47% in 2017 to 18% in 2020. This resulted from China's ban on the imports of 24 different kinds of solid waste materials, as it announced on 16 August 2017 that it would stop being the world's dumping ground. This also affected plastic waste (discussed below) and contributed to India recording a rise in its share of global imports from 5% in 2010 to 14% in 2020.

There is considerable intra-European Union trade of recyclable materials such as waste paper and paper cardboard, with Germany, the Netherlands, Austria, Spain and Hungary among the top destinations for paper and cardboard waste from other EU member countries. Germany has a high ratio of waste exported to waste generated because it is unable to cope with the massive amount of waste it generates without shipping it to lower-income countries (Trinomics, 2021).

Ferrous waste, from steel and other metallic products, forms a considerable chunk of the solid waste generated. It is contained in all durable goods such as electrical and other appliances, furniture and automotive parts. Construction sites, locomotives, rails, ships and their containers contain ferrous metals, eventually turning into ferrous waste. The United States, Germany, Japan, the Netherlands and the United Kingdom are the top five exporters of ferrous waste. Some ferrous waste importers, such as Turkey, use the scrap metal for steel production because of reliance on electric arc furnace technology, which uses recycled steel and electricity as inputs to produce new steel.

There has been a substantial decline in the total trade of ferrous waste globally, from US$88bn in 2010 to $62bn in 2020. This is not only due to technology shifts in steel production; it also reflects increased domestic recycling of ferrous waste. For example, there was a sharp decline in the United States' export of ferrous scrap (from 19% of total global exports in 2010 to 15% in 2020) as the recycling rate of all materials in appliances, including ferrous metal, increased by nearly 60%. However, landfills remain significant in ferrous waste disposal: Figure 2 indicates that after declining between 1980–2000, they have since increased in absolute terms.

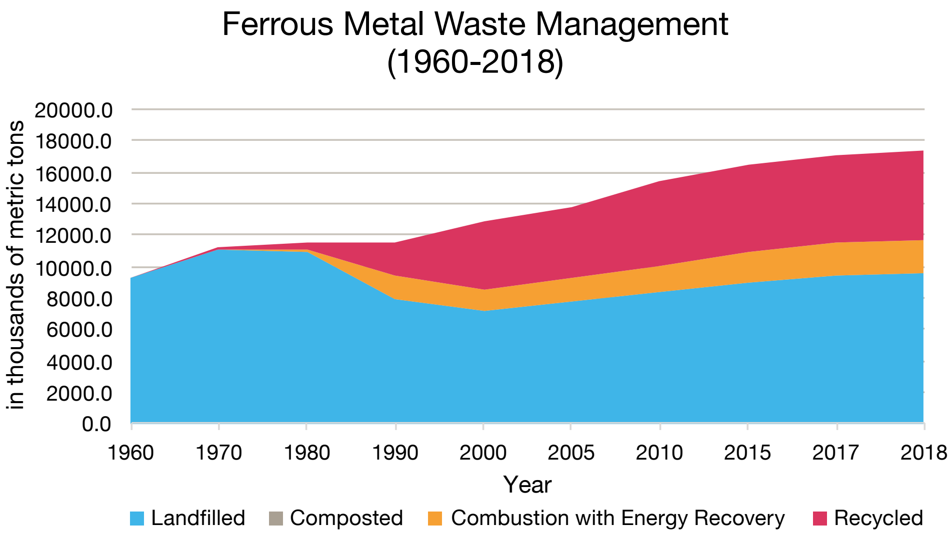

Figure 2

Source: US EPA

Trade in non-ferrous waste shows a similar pattern to that in ferrous waste, with the United States as the world's largest exporter, followed by Germany, United Kingdom, France and Canada. Here too, the share of the United States declined from 19% in 2010 to 16% in 2020, as recycling in the United States increased significantly. China is still the world's largest importer of non-ferrous waste, but its share has fallen substantially from 36% in 2010 to 16% in 2020. This reflected the imposition of strict restrictions and regulations through the "Environmental Protection for Importing Solid Wastes as Raw Materials" in 2017. However, the Chinese government subsequently realised the importance of scrap metals and, across 2019 and 2020, started relaxing the regulations for imports of scrap metals. Regarding non-ferrous waste, there is a significant amount generated through industrial activities, and Figure 3 illustrates how recycling has become much more important in its disposal. Industrial countries, particularly the United States and Germany, are important exporters and importers of non-ferrous waste because they generate substantial waste while also possessing the technology to recycle it.

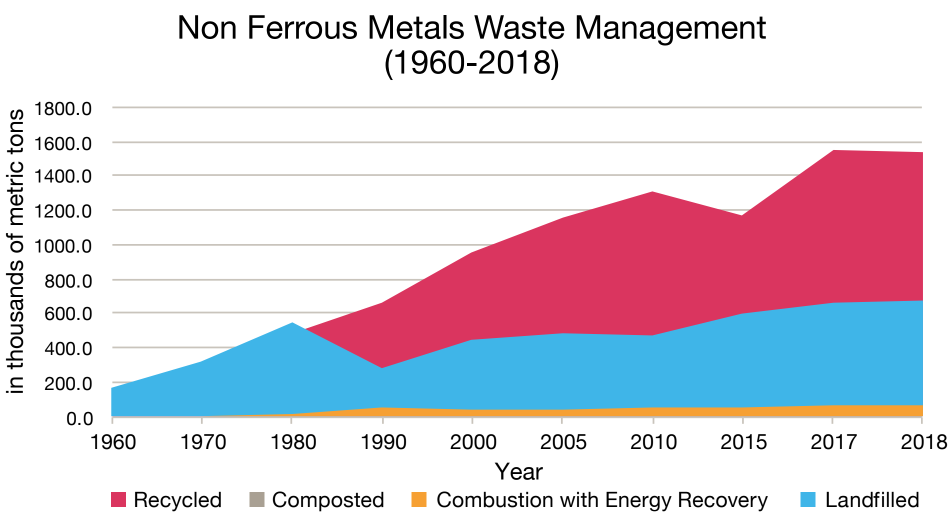

Figure 3

Source: US EPA

Plastic waste and its management are of special significance. The plastic industry experienced a massive boom from the 1950s onwards, and the international trade of plastic waste mirrored the increased production of plastic in advanced economies, which meant that they could avoid bearing the direct consequences of the social and environmental damage created by plastic waste. The United States, Germany, Japan and the United Kingdom are among the top exporters of plastic in the world. Hong Kong, which generally acts as a transport hub, has been a major exporter and importer of plastic waste, strongly linked with China's plastic waste imports. China's trajectory is particularly interesting: its plastic waste imports ranged from 53–65% of total global imports between 2010–2017. Then, in July 2017, China banned the import of plastic waste, which immediately fell drastically and stopped entirely in 2019. Since then, Malaysia, Turkey and Vietnam have emerged as critical destinations for plastic waste from the United States, Japan, the European Union and other regions.

Plastic is a non-biodegradable compound that accumulates on Earth. By 2015, the cumulative global production of plastic since the 1950s reached 7.8 billion tonnes – almost a tonne of plastic for each person living today. As a result, plastic waste is now pervasive in all environments on Earth, contaminating the soil, marine life, freshwater and terrestrial life, farmland and the atmosphere with particulate matter (Environmental Investigation Agency, 2021). Plastic contamination in the form of microplastics has even been found in human blood (Carrington, 2022).

The enormous ever-increasing production of plastic, and the resulting waste, has overwhelmed domestic waste-management infrastructure. Historically, plastic waste has been discarded in open dumps and landfills without any prior processing, a practice that still persists at scale today. Before the 1980s, there was neither incineration nor recycling of plastic products. In 2015, an estimated 55% of plastic waste was still discarded in open dumps and landfills, 25% was incinerated and just 20% recycled (see Figure 4).

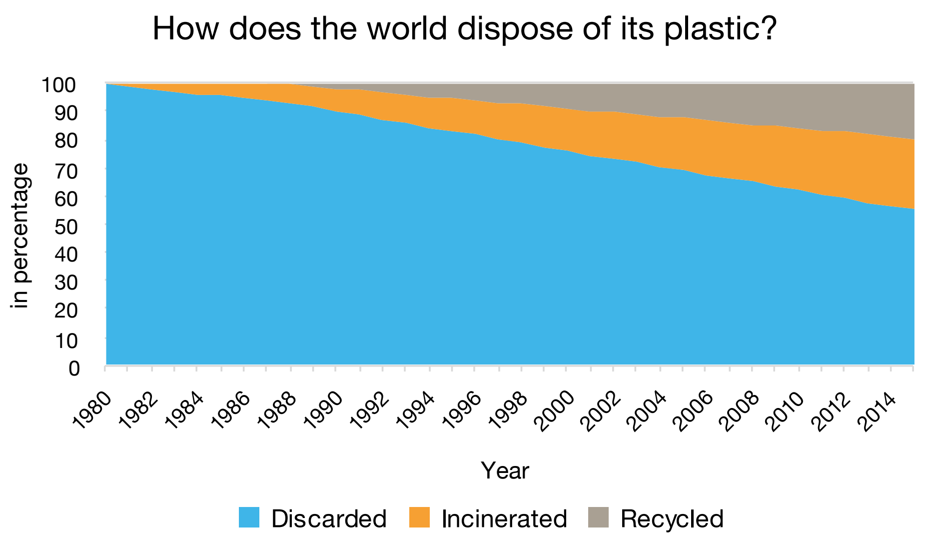

Figure 4

Source: Authors' calculations based on Our World in Data (OWID)

As the majority of plastic waste needs to be disposed of in open dumps and landfills, advanced economies with high levels of plastic consumption export plastic waste to low- and low-middle-income countries. The 38 countries in the Organisation for Economic Co-operation and Development (OECD) accounted for 87% of all plastic waste exports to lower-income countries since reporting of such trade began in 1988 (Environmental Investigation Agency, 2021). One report suggests that more than 68,000 shipping containers of US plastic waste had been exported to lower-income countries with inadequate capacity to manage such waste (McCormick et al., 2019). Moreover, the plastic waste exported by the United States was mostly contaminated with food and dirt, making it difficult to recycle, and eventually landed in open dumps or landfills in poorer countries. This was, in fact, an important reason why China banned its import of plastic waste from the world, especially that of the United States.

In May 2019, some 187 countries decided to significantly restrict international trade in plastic scrap and non-recyclable plastic waste to help address the improper disposal of plastic and reduce its leakage into the environment.

China dominated world trade in plastics from 1991–2017, accounting for more than three fifths of the world's imports, while Asia as a whole accounted for 64% of world plastic imports, mainly from Europe and North America (Wang et al., 2020). Therefore, China's notification to the World Trade Organization on 18 July 2017, of its ban on the imports of solid waste, caused a stir. It initiated discussion among member nations of the Basel convention, such that in May 2019, some 187 countries decided to significantly restrict international trade in plastic scrap and non-recyclable plastic waste to help address the improper disposal of plastic and reduce its leakage into the environment. As a result of these changes, transboundary shipments of most plastic scrap and waste are controlled or regulated for the first time, under a treaty called the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, effective from 1 January 2021. International shipments of most plastic scrap and waste are now only allowed with the prior written consent of the importing country and any transit countries. High-income countries have indeed sought new waste havens and found new destinations such as Malaysia, Indonesia, Thailand and Turkey. Nevertheless, overall global trade in plastic waste has declined substantially (Figure 5) because rich countries were forced to process more plastic waste within their borders.[2]

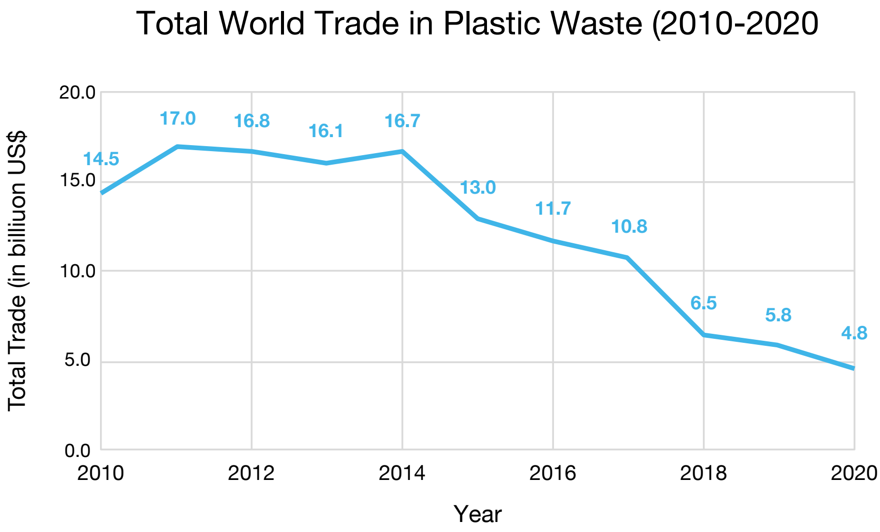

Figure 5

Source: Authors' calculations based on UN Comtrade

China's ban on importing plastic waste had a significant impact on the world economy, in addition to leading to changes in the global regulatory regime for such trade. It clearly led to declines in trade volume and a change in the pattern of trade flows, generating more recycling within high-income countries (Wen et al., 2021). Several environmental indicators also improved globally, including reductions in fine particulate matter formation, freshwater ecotoxicity and human carcinogenic toxicity (Wen et al., 2021).

The larger economies, however, have grappled in the short term to cope with the huge demand for recycling plastic waste. China, too, is facing constraints in recycling domestically generated plastic and has increased the use of virgin materials and recycled pellets. Some Chinese plastic-recycling factories have relocated to Southeast Asian countries, Japan and Taiwan (Yoshida, 2022). Inevitably, the regulatory measures also led to an increase in illegal activities in the plastic waste trade, with countries in Southeast Asia, South Asia and Europe experiencing a surge in **illegal trade in plastic waste** as shipments from North America and Europe were diverted to them (Interpol, 2020).

The global impact of China's 2017 ban on importing plastic waste and the subsequent amendment to the Basel Convention adopted in 2019 show that regulations can work. Because of these changes, advanced economies have had to manage more of the plastic waste within their geographical boundaries. They are supposed to recycle all of their plastic waste and entirely stop the use and export of single-use plastics within their economies; and to transfer the recycling technologies free of cost to poorer countries where they have been dumping these products. Such technology would help poorer countries improve their recycling capability and curb illegal trading activities. However, much remains to be done to implement this convention properly. Low- and middle-income countries need to present a united front to negotiate for better access to technological resources and higher prices for recycling waste, as well as further amendments in the Basel Convention to stop the open dumping of plastic waste onto their lands.

Climate finance

As noted in a companion deep-dive paper for The Club of Rome (Ghosh et al., 2022), rich nations have been primarily responsible for creating the present climate crisis, but poorer nations face disproportionate burdens of the impact and are more financially constrained in implementing green policies. To address this imbalance, in 2009 at the COP 15 UN climate summit in Copenhagen, rich nations pledged to provide climate finance to low- and middle-income nations of US$100bn annually. This amount was certainly far short of the actual need, as a recent IPCC report notes: estimations of adaptation costs alone (not including mitigation) range between US$15bn–411bn per year for climate change impacts to 2030, with most of these estimates exceeding $100bn (IPCC, 2022). Even this does not take into account new estimates of the financial impact of "loss and damage" resulting from climate change that is already impacting much of the world.

However, even this relatively paltry annual sum has never been provided, as Figure 6 shows. The latest estimate for 2020 suggests that around US$80bn was mobilised – but a significant part, around one third of this, was through multilateral institutions, and another significant portion was through mobilised private finance, neither of which strictly speaking should be seen as part of the climate finance commitments of the rich countries. Bilateral public finance, which is really what was promised, has amounted to between a quarter to one third of the amount, coming to the pitiful average of less than US$18bn per year in the period 2013–2019. Contrast this with the massive amounts of money, literally several trillions of dollars, that the rich country governments were able to produce "out of a hat" as additional fiscal spending to deal with the COVID-19 pandemic and its impact within their own economies in 2020 and 2021.

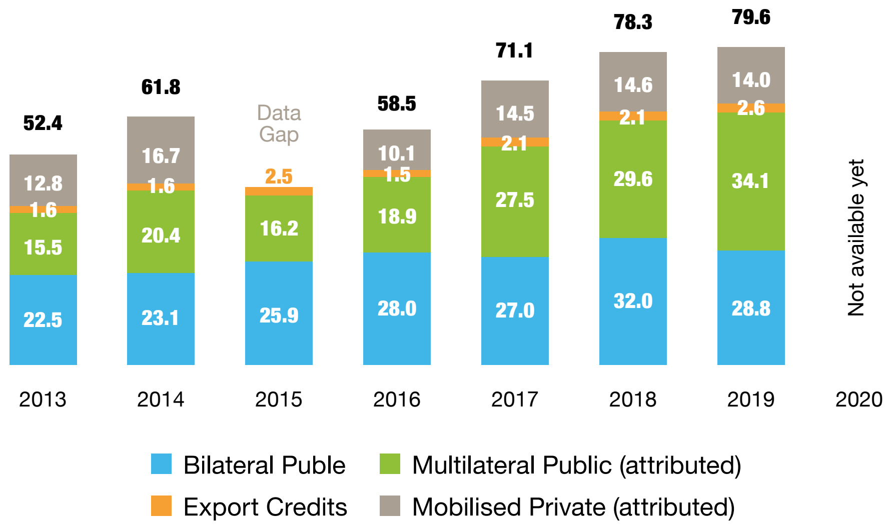

Figure 6 : Climate finance provided and mobilised by high-income countries for low- and middle-income countries (billion USD)

Source: OECD report, Zhongming et al. (2021)

The extraordinary stinginess of rich nations in addressing the climate finance needs of the rest of the world is even more striking when it is evident that such finance could also be provided almost costless, for example through the recycling of the new SDRs recently issued by the International Monetary Fund (IMF) (of which the rich countries received around US$400bn). Yet commitments made as at April 2022 by rich nations to the IMF's Resilience and Sustainability Trust, set up to provide climate finance (admittedly to a very limited group of countries and under possibly problematic conditions), came to only around US$40bn.

The paucity of climate finance is even more conspicuous when compared with the fossil fuel subsidies being provided by rich nations. These governments have been heavily subsidising their own fossil fuel industries even as they exhorted much poorer countries to do more to reduce greenhouse gas emissions. But the full extent of these subsidies has been hidden by the methods used to measure them. The standard way to measure government support for fossil fuel production or consumption is to look at direct budgetary transfers and subsidies, as well as tax breaks for the sector. Using this method, the OECD and the IEA have estimated that governments across 52 advanced and emerging economies – accounting for about 90% of global fossil fuel energy supply – provided fossil fuel subsidies worth an average of US$555bn per year from 2017–2019 (Timperley, 2021). Though it has been argued that the IMF's higher estimate of implicit subsidies that includes unpaid environmental costs is flawed and excessive.

Governments across 52 advanced and emerging economies – accounting for about 90% of global fossil fuel energy supply – provided fossil fuel subsidies worth an average of US$555bn per year from 2017–2019.

However, this massively understates the actual fossil fuel subsidies that governments provide. A more comprehensive measure used by IMF researchers that includes both explicit subsidies, or undercharging for supply costs, and *implicit* subsidies, or undercharging for environmental costs and foregone consumption taxes (Parry et al., 2021), provides a much more significant total for fossil fuel subsidies. According to this, global fossil fuel subsidies in 2020 totalled US$5.9 trillion, more than 10 times the OECD-IEA estimate, and implicit subsidies accounted for 92% of the total.

With these estimates, China was the largest provider of fossil fuel subsidies in absolute terms, followed by the United States, Russia, India and the European Union. According to IMF figures, the total subsidy provided just by the United States to the fossil fuel industry was $662bn in 2020, with most of this in the form of implicit subsidies (see Figure 7). In contrast, the Biden administration's commitments to climate finance totalled less than $6bn in that year. Indeed, the IPCC estimates that global climate finance from both public and private sources totalled only about US$640bn in that year. This highlights the extent to which government intervention is skewing prices and, therefore, market incentives in favour of fossil fuels rather than against them.

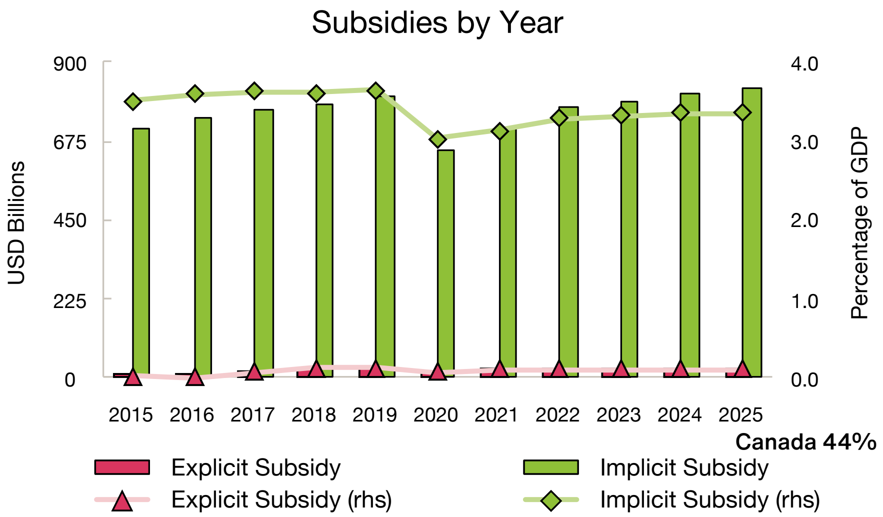

Figure 7: Fossil fuel subsidy for the United States

Source: IMF, retrieved on 22 February 2022

Note: Total subsidies cover subsidies on petrol, diesel, kerosene, liquid petroleum gas, other oil, natural gas, coal and electricity. Explicit subsidies are those due to supply costs being higher than retail prices, while implicit subsidies are those due to efficient price being greater than retail price, exclusive of any explicit subsidy. The left vertical axis shows explicit and implicit subsidies in USD billion, while the right vertical axis shows the corresponding numbers as a percentage of GDP.

In such a context of skewed incentives driven by public subsidies to fossil fuel industries, it is not surprising that private finance remains heavily oriented towards these "brown" energy investments, despite all the talk of public-private partnerships, Environmental, Social and Governance (ESG), and "blended finance" to enable "green" energy investments. Effective analysis of private financial flows is hampered by the lack of reliable, systematic and transparent data related to cross-border financial flows, particularly in fossil fuel industries. Better data disclosure on fuel finance by source, destination and their corresponding power generation capacity is essential for policy coordination (Ma & Gallagher, 2021). But the available data suggest that the majority of the overseas finance to coal industries comes from private entities, particularly commercial banks and institutional investors primarily from the advanced economies. Urgewald (2021) notes that the top three lenders to the coal industry in 2019–2021 were three Japanese companies: Mizuho Financial, Mitsubishi UFJ Financial and SMBC group. Out of the top 15 lenders, 14 were based in advanced economies (see Figure 8). Similarly, the dominant institutional investors in bonds or stocks of fossil fuel companies are also from the advanced Western economies, the top three being BlackRock, Vanguard and Capital Group – all from the United States (see Table 3).

Location of the top 15 lenders financing the coal industry

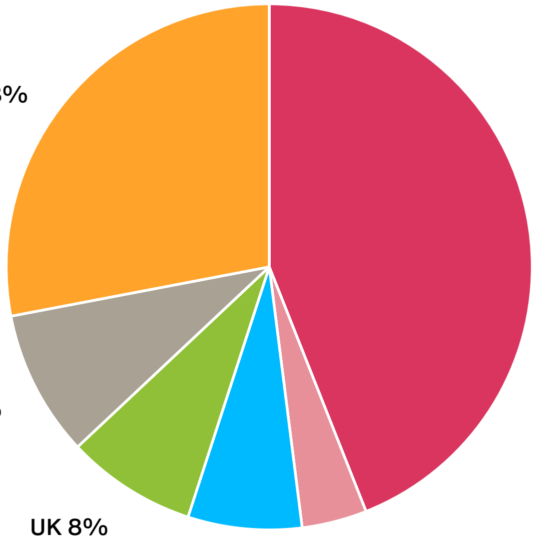

Figure 8
Source: Constructed from data in Urgewald (2021)

INVESTOR	COUNTRY	BOND HOLDING	SHARE HOLDING	GRAND TOTAL
Black Rock	United States	9,842	98,945	108,787
Vanguard	United States	12,325	88,793	101,119
Capital Group	United States	3,297	47,795	51,092
State Street	United States	1,550	34,186	35,736
Government Pension Investment Fund (GPIF)	Japan	3,811	24,229	28,040
Fidelity Investments	United States	2,852	15,872	18,724
JP Morgan Chase	United States	2,816	15,498	18,314
Franlin Resources	United States	3,114	12,706	15,820
Life Insurance Corporation of India	India	98	14,604	14,702
TIAA	United States	6,744	7,595	14,339
Government Pension Fund Global	Norway	2,395	11,774	14,170
Geode Capital Holdings	United States	–	13,799	13,799
CITIC	China	138	13,287	13,425
T. Rowe Price	United States	689	12,527	13,216
National Pension Service	South Korea	8,013	4,881	12,894
Caixa de Previdência dos Funcionários do Banco do Brasil	Brazil	–	12,028	12,028
Sun Life Financial	Canada	1,788	10,101	11,889
Wellington Management	United States	3,437	7,824	11,262
Japan Mutual Aid Association of Public School Teachers	Japan	224	10,035	10,259
Allianz	Germany	7,687	1,728	9,416

Table 3: Top 20 bond and shareholders (in million USD)
Source: Urgewald (2021)

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This persistent tendency to opt for short-term knee-jerk reactions to particular problems, making governments deviate from longer-term goals and prior commitments, bodes ill for feasible climate action and must be resisted as strongly as possible.

It seems obvious that any serious policies aimed towards mitigation and adaptation should redress this imbalance between climate finance (for both mitigation and adaptation) and the subsidies and finance that continue to be provided to traditional fossil fuel industries. Unfortunately, the Ukraine war has meant that many governments – especially advanced country governments that can afford to take a more medium-term view – have quickly reneged on even the relatively meagre and obviously inadequate climate pledges they made only a few months ago at the United Nations Climate Change Conference (COP 26) in Glasgow, Scotland. Instead of seeing the oil price spike as an opportunity to hasten the shift away from fossil fuels, governments in advanced economies have opted to keep domestic energy prices low, for short-term political reasons, rather than seeking other ways of compensating those who are affected. This persistent tendency to opt for short-term knee-jerk reactions to particular problems, making governments deviate from longer-term goals and prior commitments, bodes ill for feasible climate action and must be resisted as strongly as possible.

Conclusion

This paper has indicated that inequality is not just a major outcome of current patterns of carbon emissions, but also a major determinant of such emissions; and that current climate alleviation policies are also deeply unequal in terms of their recognised and unrecognised impacts on countries at different levels of per capita income. Mitigation policies that appear well intentioned and desirable when seen within the silo of an individual country can have adverse environmental, social and health impacts in other countries – and dominantly on the poor in low- and middle-income countries. The example of lithium mining, which is essential and will necessarily grow significantly as electrification and the use of batteries reliant on renewable energy expands, shows how mining can adversely affect local populations who are mostly not adequately compensated for their land and livelihood losses or for the ecological impact. Similarly, the examples provided by waste recycling have pointed to the neo-colonial patterns in the global waste trade, most of all in plastics but also in other materials. Finally, the recent trends in climate finance show how existing efforts to make available the necessary finance for climate mitigation, adaptation, and loss and damage, are simply not being provided to most of the world, even as public subsidies and private finance for fossil fuels are massive in relation to the small amounts of climate finance.

The point is that none of this is necessary and can be easily changed by government policies with the requisite political will. Clearly, all mining associated with minerals and materials associated with new green energy sources and technologies must be governed by regulations ensuring environmental standards, the social and economic rights of affected populations, and sufficient compensation for income and other losses. The case of the plastics industry shows clearly that regulations can indeed work in changing both trade patterns and incentives for improving recycling conditions within countries, and this should provide a positive example for regulatory efforts in other areas. With respect to climate finance, a combination of regulatory moves that prevent or limit new private investment in fossil fuels, as well as a major re-orientation of public subsidies – explicit and implicit – away from fossil fuels and towards green renewable energy sources, is essential.

All this can be done, and even without too much difficulty. But it requires popular pressure on governments to counter the lobbying powers of big businesses active in these sectors, which in turn requires more awareness in society and wider social and political mobilisation for these strategies. Given the urgency of the current moment, as climate change accelerates, and its effects are ever more devastating, such mobilisation is all the more essential.

Footnotes

[1] See Budds (2009) for a detailed discussion on how water use rights were dramatically changed in Chile as a part of the 1981 Water Code, designed by the Monetarist economists from the United States known as the "Chicago boys".

[2] It should be noted that as recycling technology developed, global trade in plastic waste had started declining before that, falling from US$17bn in 2014 to $11bn in 2017. This was also due to China's policy of "Green Fence" in 2013 when it decided to impose a temporary restriction on waste imports that required significantly less contamination. The decline continued steeply thereafter with the imposition of import bans in several countries; by 2020 plastic waste trade came to less than US$5 billion.

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