# 24 Carbon, Confusion and Conflict

## Global Governance Implications of the Net-Zero Energy Transition

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### Introduction

The contours of a fundamental global shift have emerged in less than a decade since the 2015 Paris Climate Agreement (United Nations 2015). That shift has in short order affected every economy, government and community on the planet. It is tempting to think of climate change as 'yet another' crisis on a par with food security or financial stability. That the global decarbonisation pivot is a matter of common survival has only recently been accepted by global decision-makers. It is the only path available to limit global warming to 1.5°C, the benchmark now understood as necessary to avert the kind of climate change that would be catastrophic. It is arguably the first instance of a major pivot in human affairs being impelled by an urgent global scientific consensus—as distinct from war, technological advance, disease or economics.

At the same time, because of its unusual genesis, its speed and its diffuse character — the urgent need for combined shifts in the economic, industrial, technological, and social spheres—this transition is poorly understood, especially by traditional policy communities and social science more widely. Though aspects of this shift may be reminiscent of prior global inflection points such as the Industrial Revolution of the 18th century, post-World War II reconstruction or the 1970s oil crisis, it is unprecedented, and its medium-term global governance implications have only superficially been explored.

This shift has picked up remarkable speed. By June 1, 2023, net-zero targets covered 88 per cent of global emissions, 92 per cent of global gross domestic product (GDP), and 89 per cent of the global population, including 148 of 198 countries and self-governing territories, 931 of the largest 2,000 publicly traded companies, 252 of 1,186 cities over 500,000 population and 146 of 709 regions in the top 25 emitting countries ('Net Zero Tracker' 2023). Between December 2020 and June 2022 alone, the proportion of net-zero targets enshrined in domestic legislation or policy documents (as opposed to general declarations) grew from 10 per cent to 65 per cent of total global greenhouse gases (GHG) emissions covered (Hans *et al*. 2022: 20).

States have adopted mid-century deadlines between 2030 and 2070. Only a few states have set 2030–35 targets, including Bangladesh, Barbados, the Maldives, Mauritania, Finland, Uruguay, and South Sudan. Most states have chosen 2050. Only ten countries set later targets, but they include some of the world's largest emitters (China, 2060; India, 2070), accounting for 55 per cent of all emissions by countries with net-zero targets (Hans *et al*. 2022: 19).

Beyond the work of planetary scientists, it is arguably global business that understood the repercussions of the problem first—viz., the fierce protectionist behaviour of big oil

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since the 1970s—and their reaction is most focused on the shift's economic and financial requirements. Wider mid-century social, governmental, intergovernmental, and global governance implications are yet to be drawn.

Several decades of resistance and denial have given way to a simultaneous race and scramble: a race for new technologies and sources of renewable energy that recall the arms race and the early political economy of oil, and a scramble for the key resources of the future that is reminiscent of bygone colonial resource grabs. No nation or economy can opt out of the shift because it entails both costs and benefits and will determine who leads, prospers and suffers in the next era.

Net-zero commitments today are still very general, and many governments, companies, cities, and communities do not yet know how to make the necessary changes. The Net Zero Stocktake 2022 Report notes that net-zero pledges still lack transparency and integrity:

> More net zero targets alone cannot deliver the temperature goals of the Paris Agreement; the focus needs to be on better targets and identifying the ones that are not credible. While we observe some increase in the robustness of commitments, especially at the national level, an alarming lack of credibility still pervades the entire landscape. (Hans *et al*. 2022: 5)

As targets become universal, the focus moves to pledge integrity and specificity and delivery strategies (Wolf *et al*. 2022). This profound challenge notwithstanding, the direction of travel is now set: the 2015–70 net-zero pivot will define the century.

## From Scientific Concept to Geopolitical Reality

### *Net Zero as Climate Science Concept*

The term 'net-zero emissions' is defined for the purposes of this chapter as 'a balance between ongoing anthropogenic release of GHGs into the atmosphere and active GHG removal either through direct capture and disposal or anthropogenically enhanced natural removal processes; the term may be applied to an individual gas, such as $CO_2$ [carbon dioxide], or a basket of gases combined using a GHG metric' (Allen, Friedlingstein *et al*. 2022: 878).

It has been less than 15 years since the first scientific papers identified the need for net-zero $CO_2$ emissions or outlined the concept of an atemporal carbon budget (Allen, Frame *et al*. 2022: 850). At first, scientific inquiry on a warming planet focused on $CO_2$ *concentrations* and *final* temperatures. It was only in 2009—in the run-up to the failed Copenhagen summit—that the first published studies showed that it is the *accumulation over time* of emissions of very-long-life GHG like $CO_2$ that principally determines the maximum projected warming of the planet. On the basis of two such studies (which they had contributed to), Allen, Frame and others argued in the journal *Nature* in 2009 that 'the close link between cumulative $CO_2$ emissions and peak warming means that the scientific logic of some kind of limit is inescapable' (Allen, Friedlingstein *et al*. 2009: 56–57).

That fundamental insight was most recently confirmed and upheld by the Intergovernmental Panel on Climate Change (IPCC) in 2021: '[F]rom a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative $CO_2$ emissions, reaching at least net-zero $CO_2$ emissions, along with strong reductions in

other greenhouse gas emissions'. Over the period 1850–2019, an estimated 2,390 billion tonnes of anthropogenic $CO_2$ was emitted, and the IPCC estimated that the remaining global carbon budget for a 50 per cent chance of staying within 1.5 C warming was around 500 billion tones at the start of 2020 (Masson-Delmotte *et al.* 2021: 27–28).

### *Net Zero as Global Norm and Geopolitical Reality*

The science of net zero was first crystallised in 2013 in The IPCC Fifth Assessment Report before being embedded in the 2015 Paris Climate Agreement, though the term 'net zero' itself was not mentioned. Article 4.1 states, 'In order to achieve the long-term temperature goal set out in Article 2 [to maintain global average temperature well below 2°C above pre-industrial levels and limit the temperature increase to 1.5°C], Parties aim… to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHG in the second half of this century' (United Nations 2015).

In 2017, Sweden was the first nation to legislate a mid-century—2045—net-zero target, followed in 2019 by the United Kingdom, the first large G7 economy, which set the target at 2050. A year later, China, the world's largest current emitter, committed to a 2060 target. Having withdrawn from the Paris Agreement in 2017, the United States, the world's largest historical emitter, re-joined the Agreement in 2021 and committed to a 2050 target. By 2021, the Glasgow Climate Pact explicitly called in art. 22 for net zero around mid-century and urged all parties (ar.t 32) to communicate their long-term low-emission development strategies (United Nations 2021).

In sum, net zero is a scientific concept now embedded in various international agreements and a matter of state, diplomatic and C-suite executive action in a remarkably short span of time. It arises out of urgent but inescapable necessity but gives rise to considerable potential opportunity. The world, including its three largest carbon emitters, has started to decarbonise in response. In 2022, investment in the low-carbon energy transition jumped 31 per cent to exceed $1 trillion for the first time and draw level with fossil fuels; one in every seven new cars rolling off the 2022 production line was electric; the global wind energy market passed the 1 terawatt (TW) threshold of installed capacity in 2023 (BloombergNEF 2023; Mackenzie 2023; Meyer 2023).

The rest of this chapter assesses the implications of the 2015–2070 net-zero transition for global governance. It argues that the transition will affect international relations and global governance in two major and distinct ways. First, the transition will expose a set of states to unprecedented vulnerability and threaten their social stability. Second, the transition will itself create new interstate tensions as the materials, technologies and markets needed to prosper or dominate in the next era become a central cause of competition, friction and conflict. These two patterns have implications for global governance for the rest of the 21st century: they will affect existing multilateral (including regional) institutions and processes well beyond the current climate governance architecture; they have already produced a proliferation of new institutions and processes which are likely to need rationalisation; and additional institutions and state groupings are likely to emerge.

## Increased State Vulnerability and Fragility

The net-zero transition will expose a non-negligible number of countries to unprecedented instability. This includes states (a) whose economies are highly dependent on fossil fuels, (b) who will likely see their fiscal oil and gas revenues drop drastically in the

coming decades or (c) who will find it difficult to muster the unprecedented human, capital and technological resources needed to carry out the deep economic transformation required. Any or all of these will be more difficult where countries are (d) already seriously affected by climate change, (e) caught in a low development cycle, (f) already heavily indebted, or (g) already experiencing social fragility or conflict. Drastic change and disruption at the domestic level can be expected to translate into change and disruption at the international level.

### *The First Hurdle: Subsidy Phase-Outs and Energy Volatility*

Energy availability and price are critical to consumers and economic activity. As the energy sector decarbonises, it is forecast that the global average cost of electricity will increase in the near term before decreasing again for good, disproportionately affecting lower-income countries and populations.

States rich in oil and gas (and others too) have used fossil fuel consumer subsidies—usually at the gas pump or through household heating costs—to redistribute mineral wealth to the people who cannot participate in or profit from production or other business activity. Such subsidies often generate overconsumption, are wasteful and benefit wealthier portions of the public, such as car- and homeowners.

Reducing emissions and transitioning to clean energy requires eliminating subsidies early in the transition. Nonetheless, phasing out subsidies can trigger social unrest or violence because it causes consumer energy costs to rise, affects transportation for the poorest and is perceived as a social injustice. In the last 15 years, Bolivia, Ecuador, France, India, Indonesia, Jordan, Kazakhstan, and Yemen (to name a few) have experienced marked social unrest when trying to phase out fuel subsidies or apply new fuel taxes.

The 2021 Glasgow Climate Pact (United Nations 2021: art. 36) called on states to 'phase out of inefficient fossil fuel subsidies, while providing targeted support to the poorest and most vulnerable in line with national circumstances and recognising the need for support towards a just transition' (United Nations 2021). Since 2015, a growing number of countries have been experimenting with (smarter) subsidy reform even as calls grow for the World Trade Organization to reconsider the energy implications of its Agreement on Subsidies and Countervailing Measures (ASCM). But eliminating consumer subsidies precisely when world energy prices are rising sharply compounds the pain for the most vulnerable and can threaten the stability of governments.

In 2021, we saw an alarming preview of how global energy prices can surge and market imbalances can affect consumers. Natural gas price benchmarks in parts of Europe and Asia were ten times higher in October 2021 than one year prior, while U.S. natural gas prices reached their highest level since 2008. International coal prices were also sharply higher, at five times their fall 2020 levels. After a pandemic dip, subsidies rose again, exceeding $1 trillion for the first time. The International Energy Agency (IEA) estimates that 2022 gas and electricity subsidies doubled over the previous year, while oil subsidies increased by 85 per cent. But at present, no country is fully pricing all supply and environmental costs into all fuels. Once 'true' supply and environmental costs are factored in, the International Monetary Fund (IMF) finds that 2020 fossil fuel subsidies were $5.9 trillion or 6.8 per cent of global GDP (Parry, Black and Vernon 2021: 3).

The subsidies are concentrated in emerging markets and developing economies, and more than half were in fossil fuel exporting countries. The largest subsidisers in 2021 were (in order) Russia, Iran, China, India, Saudi Arabia, Egypt, and Indonesia (IEA

2023). Several governments, including India, Japan, South Korea, the United Kingdom, and the United States, also tapped their strategic oil reserves. The pattern is clear: looking ahead, governments will need to manage a demanding energy transition (including the phasing out of fossil fuel subsidies) even as their countries are battered by multiple supply and demand shocks.

### *The Fiscal Fallout: Government Revenue Losses and Social Responsibilities*

The fiscal lens offers one important way to assess vulnerability to the net-zero transition. A 2021 study by the Carbon Tracker Initiative[1] finds that under a low-carbon scenario, worldwide combined global government oil and gas revenues would be $13 trillion lower (51 per cent less) than expected by industry over the next two decades, driven mainly by a drop in prices, but also in volume sold. Of that, $9 trillion would be absorbed by the 40 states with the greatest current fiscal dependence on oil and gas revenues. Of those 40 countries, 23 face a shortfall of more than 50 per cent of their hydrocarbon revenues in the next 20 years (Coffin, Dalman and Grant 2021: 6–10). A similar taxonomy is offered in a World Resources Institute study of transition impacts on workers and communities in middle-income developing countries whose economies rely heavily on oil and gas (Saha *et al*. 2023: 8–9).

For the seven most fiscally vulnerable countries, Angola, Azerbaijan, Bahrain, Equatorial Guinea, Oman, South Sudan, and Timor-Leste, average revenue shortfalls between 54 per cent and 93 per cent will compound rates of fiscal dependence on oil and gas between 52 per cent and 81 per cent. In the second tier, 12 countries: Surinam, Gabon, Chad, Algeria, Trinidad and Tobago, Nigeria, Congo, Brunei, Saudi Arabia, Libya, Kuwait, and Iraq, combine slightly lower but still paralysing revenue shortfalls and oil and gas fiscal dependence. For example, Nigeria's oil and gas revenues currently account for 45 per cent of its fiscal intake, and it stands to lose 69 per cent of it over the next 20 years; Libya is dependent on oil and gas for 72 per cent of its current revenues and faces an expected shortfall of 44 per cent (Coffin, Dalman and Grant 2021: 49–50).

In the third tier are three consequential cases: Russia is dependent on oil and gas for 23 per cent of its total fiscal revenues and faces a 47 per cent shortfall; Iranian oil and gas make up 37 per cent of its revenues which are expected to drop by 39 per cent; Mexico, which relies on oil and gas for only 18 per cent of its revenues, will lose 84 per cent of it. Together, these countries account for 760 million people.

The fiscally vulnerable states differ in their financial position and ability to respond to these changes. While some have significant sovereign wealth funds, many are already at historically high levels of indebtedness or are struggling to secure basic credit (Coffin, Dalman and Grant 2021: 36–39). Falling gas and oil revenues have multiple repercussions. They erode a government's ability to provide national education, healthcare, security, and transportation. But they also mean less revenue for the sub-national governments that deliver vital social services locally. Public-sector employment falls, as does indirect industry-related employment at the community level. Finally, they can also cause governments to cut subsidies too abruptly (Saha *et al*. 2023: 13).

Though policy prescriptions are not the focus here, there are a number of measures governments can take, including diversifying their economies into services, capturing greater revenue from declining oil and gas resources, expanding tax revenues, incentivising the reinvestment of fossil fuel revenues into long-term non-fossil-fuel assets, boosting innovation, and regulating limits on investment in further oil and gas development (Coffin, Dalman and Grant 2021: 13–14; Peszko *et al*. 2020).

***The Capacity Quandary: Jobs and Capital for Infrastructure Investments***

A second lens for assessing vulnerability is to look at how well a country is positioned in its capacity to make the required economic pivot, to both seize its opportunities and weather its difficulties. One way to assess this 'transition exposure', as McKinsey did in a 2022 study, is to look at the share of an economy's jobs and capital stock in sectors with emissions-intensive operations, products and supply chains.[2]

Broadly speaking, the net-zero transition will require a set of urgent and disruptive labour reallocations across sectors and countries. Beyond early energy bumps and oil and gas fiscal weakness, it is unevenly distributed job losses and gains that could prove most socially disruptive as economies transition. The McKinsey study estimates about 200 million direct and indirect jobs gained and 185 million lost by 2050. Some 40 million of the 200 million new jobs will relate to the surge in capital spending (such as building solar or wind farms) and are essentially temporary. The 185 million jobs lost are related strictly to the transition itself and not to other factors like population growth or other societal or industrial shifts, such as remote work, automation, digital commerce, which may in fact be considerably larger (McKinsey 2022: 25–27).

In the energy sector worldwide (65 million people in 2019), the IEA projects considerable shifts in employment as renewables scale up. Job growth will accompany the building of low-emissions infrastructure; job losses will flow from reduced fossil fuel (oil, gas, coal) power and related industrial activities. Across all regions except the Middle East and Russia, clean energy jobs (33 million) already exceed fossil fuel jobs (32 million) and will grow to almost 55 million by 2030 (IEA 2022b: 6; IEA 2022c: 22).

The scale of these numbers translates into considerable uncertainty and fluidity across economies. For example, the fossil fuel power sector's demand for workers would decrease by four million jobs (60 per cent of today's workforce), while the renewable power sector's demand will grow by six million jobs by 2050, though some of those are temporary. The timing of the two trends relative to each other is critical: When specifically in a given economy will demand ramp up for the 'new' jobs, relative to the decrease in demand for the 'old' jobs? In another example, as food consumption shifts to low-carbon, emissions-intensive meat or livestock farming could lose 19 million jobs, while poultry farming could gain 10 million jobs (McKinsey 2022: 25–27).

In each case, there are winners and losers, but they are not the same people, not mutually replaceable, not transferable, nor even co-located. To give one illustration from the United States: a Gulf Coast oil rig worker might hypothetically transition into a Maine wind farm technician or a Texas cattle rancher into an Arkansas chicken farmer, but not without considerable planning, government support and business investment.

***Inequality within: High-Emissions Sectors Will Suffer Disproportionately***

The transition will affect all sectors of the economy connected to energy and land-use systems but will have the largest impact on those sectors that produce high emissions, sell high-emissions products or services, or are marked by high-emissions supply chains. Combined, this is roughly 30 per cent of global GDP. The other 70 per cent, though less exposed, is still dependent on that core 30 per cent (McKinsey 2022: 31). Job losses and gains will unduly affect specific sectors and sub-regions, especially those heavily associated with coal, oil and gas extraction, mining, refining, power generation, and auto manufacturing. Some but not all of these effects can be mitigated.

The energy transition has special implications for the oil and gas sector. Like other extractive industries, it creates far more indirect and induced jobs than formal direct jobs. These indirect jobs are often more insecure and informal in character. Their operations are highly concentrated in specific regions where they usually capture the local economy. Rates of unionisation vary considerably, which affects bargaining power. Contract workers are ubiquitous and may be left out of transitional discussions. Direct employees have higher wages than average and may not find non-oil jobs with equal pay. Finally, though women make up a small portion of formal employment, they represent a significant portion of the indirect jobs and will be significantly affected (Saha *et al*. 2023: 16–18).

The more these sector transitions are disorganised, disjointed or unmanaged, the more disruptive they will become socially and economically, with domino effects at national and international levels. How this very complex but vital part of the net-zero transition is managed will be critical and may determine its success or failure. Governments will come under strain if vulnerable or low-income segments of society are hard hit by job losses in specific sectors simultaneous with the wider impact of rising consumer energy costs. And several additional factors can compound the situation: lack of job transition support, hiccups in the energy transition itself (energy blackouts, transportation problems, loss of service) or the perception that the transition is socially unfair. This has prompted the IEA to call for a new approach to energy security:

> During energy transitions, both systems are required to function well in order to deliver the energy services needed by consumers, even as their respective contributions change over time. … Inclusive, people-centred approaches are essential to allow vulnerable communities to manage the upfront costs of cleaner technologies and ensure that the benefits of transitions are felt widely across societies. Even as transitions reduce fossil fuel use, there are parts of the fossil fuel system that remain critical to energy security, such as gas-fired power for peak electricity needs, or refineries to supply residual users of transport fuels.
>
> (IEA 2022c: 25)

### *Inequality Without: Lower GDP or Fossil Fuel-Dependent Countries Are Most Vulnerable*

The world's largest economies—the United States, China, the European Union, Australia, Canada, Japan, and the United Kingdom—will need to spend about 6 per cent of their combined GDP from 2021 to 2050 to build up the physical assets they need for the transition related to decarbonisation and low-carbon growth. By comparison, countries in sub-Saharan Africa, Latin America, India, and some parts of Asia will need to spend about 10 per cent of regional GDP for the same purpose. Countries in the MENA (Middle East and North Africa) and CIS/CA regions (Commonwealth of Independent States/Central Asia) will have to spend an average of 18 per cent of regional GDP (McKinsey 2022: 34–36).

Two categories of countries are most vulnerable. First, countries with a greater proportion of their jobs, infrastructure, GDP and capital committed to high-emissions activities will require a disproportionate effort to reduce that dependency and build a more diversified economy. Even if their higher GDP and/or diversifying economy makes them

less vulnerable than others, oil and gas producers like Russia, Saudi Arabia and Qatar have highly dependent economies and will face an arduous economic transition.

More dramatically, developing countries with lower GDP per capita will have to make a greater proportional economic effort to reduce emissions, build a low-emissions economy and continue to advance economic development. But the greatest challenge falls to countries which have a lower GDP *and* whose economies are exposed to the risks of the net-zero transition. They must simultaneously continue to grow, decarbonise their economy, protect against the increasing physical disruptions of climate change itself, *and* minimise their exposure to various destabilising transition risks; moreover, they often have less access to capital markets and technology (McKinsey 2022: 36–37).

The most vulnerable states combine GDP per capita under $5,000 and an economy highly exposed (between 45 and 59 per cent) to the transition: Bangladesh, Bolivia, Egypt, Ghana, India, Kenya, Nigeria, Pakistan, Ukraine, Vietnam fall in this category. Many of these countries are also exposed to high physical risks (storms, drought or flooding). Additionally, a second group of countries with GDP per capita below $30,000 and a transition exposure score between 30 and 45 per cent are notable for their pivotal roles in global governance today, such as Brazil, China, Mexico, Russia, and Saudi Arabia.

### *Painting a Picture: The Transition Will Compound Existing Challenges*

It is known that the physical risks of accelerating climate change disproportionately affect certain regions. This brief review highlights the degree to which decarbonisation will also burden the same vulnerable regions, countries and people. Table 24.1 identifies a set of 51 countries (roughly a quarter) that combine some of the aforementioned factors.

The relationship between low (or slow) development, political instability, underlying state fragility, and conflict is well established and the subject of a considerable literature beyond the scope of the present chapter. Of the 51 countries identified in Table 24.1, 9 are classified as Least Developed Countries (LDCs), 6 as Heavily Indebted Poor Countries (HIPCs) and 14 as 'fragile and conflict-affected situations' (FCS) by the World Bank. Using the Stockholm International Peace Research Institute's (SIPRI) annual 2021 survey of global conflict, two are classified as 'major armed conflicts' (10,000+ annual deaths: Yemen and Myanmar), ten as 'high-intensity armed conflicts' (between 1,000 and 10,000 deaths: Nigeria, the Democratic Republic of the Congo, Iraq, South Sudan, Sudan, Cameroon, Pakistan, Mexico, Brazil, and Colombia) and three (India, Pakistan and Azerbaijan) are engaged in more rare interstate conflicts (SIPRI 2023: 2). Finally, the table accounts for about a dozen current UN peacekeeping and special political missions (United Nations 2023).

## Increased Interstate Competition and Conflict

There is a difficult truth at the heart of the net-zero transition. As critical as the transition is to the health of the planet, it is going to require far greater amounts of critical mineral materials. Clean energy technologies—solar plants, wind farms, electric vehicles, high-capacity batteries—all require more minerals than the oil-based technologies they replace: copper for next-generation electricity technologies and systems; lithium, cobalt, nickel, graphite, and manganese for new battery technologies; 'rare earth' elements[3] (REEs) for magnets and motors; and the chemicals needed to refine them all.

*Table 24.1* Countries most vulnerable to the net-zero transition—by region

| | ***Country Overall Vulnerability to the Net-Zero Transition***[a] | ***Lost Revenue:*** *Potential oil and gas revenue shortfall over 20 years (%)*[b] | ***Fossil Fiscal Dependence:*** *Current oil and gas share of total govt revenues (%)*[c] | ***Transition Exposure:*** *Share of jobs, capital and infrastructure in exposed sectors (%)*[d] | ***2021 GDP per Capita:*** *(US$, market exchange rates)*[e] | ***Fragility:*** *Status as an LDC, HIPC or FCS country*[f] |
|---|---|---|---|---|---|---|
| | | *Carbon Tracker Initiative* | *Carbon Tracker Initiative* | *McKinsey* | *International Monetary Fund* | *United Nations, World Bank* |
| AFRICA | | | | | | |
| 1 | Algeria | 70 | 39 | | 4,160 | |
| 2 | Angola | 76 | 56 | | 4,000 | LDC |
| 9 | Cameroon | 88 | 15 | | 1,610 | HIPC FCS |
| 10 | Chad | 79 | 29 | | 754 | LDC HIPC FCS |
| 13 | Congo (DRC) | 67 | 54 | | 703 | LDC HIPC FCS |
| 16 | Equatorial Guinea | 70 | 81 | | 10090 | |
| 18 | Gabon | 81 | 35 | | 9,850 | |
| 17 | Ghana | | | 50 | 2,130 | HIPC |
| 24 | Kenya | | | 53 | 2,260 | |
| 30 | Nigeria | 69 | 45 | 50 | 2,580 | FCS |
| 39 | South Sudan | 72 | 78 | | 569 | LDC FCS |
| 41 | Sudan | 87 | 12 | | 929 | LDC HIPC FCS |
| CENTRAL ASIA + CIS | | | | | | |
| 23 | Kazakhstan | 41 | 32 | | 12,430 | |
| 37 | Russia | 47 | 23 | 39 | 14,700 | |
| 45 | Turkmenistan | 2 | n/d | | 13,020 | |
| 48 | Uzbekistan | 35 | n/d | | 2,550 | |
| MIDDLE EAST = NORTH AFRICA | | | | | | |
| 4 | Bahrain | 70 | 72 | 37 | 29,080 | |
| 15 | Egypt | 45 | 7 | 49 | 4,440 | |
| 21 | Iran | 39 | 37 | | 23,620 | |
| 22 | Iraq | 30 | 89 | | 6,320 | FCS |
| 25 | Kuwait | 38 | 67 | 34 | 35,260 | |
| 26 | Libya | 44 | 72 | | 6,390 | FCS |
| 32 | Oman | 54 | 76 | 35 | 23,190 | |
| 36 | Qatar | 41 | 34 | 52 | 89,420 | |
| 38 | Saudi Arabia | 44 | 69 | 47 | 27,010 | |
| 46 | UAE | 34 | 52 | 43 | 48,260 | |
| 51 | Yemen | 0 | n/d | | 871 | LDC FCS |
| AMERICAS | | | | | | |
| 6 | Bolivia | 76 | 19 | 49 | 3,790 | HIPC |
| 7 | Brazil | | | 33 | 9,570 | |
| 12 | Colombia | 88 | 3 | 41 | 6,940 | |
| 14 | Ecuador | 80 | 19 | 42 | 6,590 | |
| 28 | Mexico | 84 | 18 | 31 | 11,250 | |
| 35 | Peru | | | 42 | 7,350 | |
| 42 | Suriname | 94 | 28 | | 5,040 | |

(*Continued*)

*Table 24.1* (Continued)

| | ***Country Overall Vulnerability to the Net-Zero Transition***[a] | ***Lost Revenue:*** *Potential oil and gas revenue shortfall over 20 years (%)*[b] | ***Fossil Fiscal Dependence:*** *Current oil and gas share of total govt revenues (%)*[c] | ***Transition Exposure:*** *Share of jobs, capital and infrastructure in exposed sectors (%)*[d] | ***2021 GDP per Capita:*** *(US$, market exchange rates)*[e] | ***Fragility:*** *Status as an LDC, HIPC or FCS country*[f] |
|---|---|---|---|---|---|---|
| | | *Carbon Tracker Initiative* | *Carbon Tracker Initiative* | *McKinsey* | *International Monetary Fund* | *United Nations, World Bank* |
| 44 | Trinidad and Tobago | 70 | 35 | | 20,640 | |
| 49 | Venezuela | 76 | n/d | 40 | 3,270 | FCS |
| ASIA + PACIFIC | | | | | | |
| 5 | Bangladesh | | | 53 | 2,850 | LDC |
| 8 | Brunei | 61 | 43 | | 41,710 | |
| 11 | China | | | 48 | 13,630 | |
| 19 | India | | | 48 | 2,690 | |
| 20 | Indonesia | | | 44 | 5,010 | |
| 27 | Malaysia | 43 | 19 | 37 | 13,940 | |
| 29 | Myanmar | 45 | n/d | | 1,170 | LDC FCS |
| 33 | Pakistan | | | 59 | 1,562 | |
| 34 | Papua New Guinea | 0 | 6 | | 3,570 | FCS |
| 40 | Sri Lanka | | | 42 | 3,742 | |
| 43 | Timor-Leste | 93 | 52 | | 1,490 | LDC FCS |
| 50 | Vietnam | | | 56 | 4,680 | |
| EUROPE + CAUCASUS | | | | | | |
| 3 | Azerbaijan | 68 | 64 | | 6,870 | |
| 31 | Norway | 44 | 15 | 29 | 88,750 | |
| 47 | Ukraine | 74 | n/d | 45 | 4,827 | FCS |

*Note*

[a] Based on author analysis, the darkest shading denotes a country that is considered highly vulnerable to the net-zero transition because it has received the highest classification in at least two of the four other columns or been assigned a transition exposure indicator of 45 per cent and above.

[b] Source: Appendix II, Table 4, Beyond Petrostates, Carbon Tracker Initiative (2021). Draws on data from Rystad Energy, IEA, IMF, SSB (Norway), CBL (Libya), CTI analysis. Darkest shading denotes potential oil and gas revenue shortfall above 63 per cent or 1/3 of last decade of revenues.

[c] Source: Ibid. Darkest shading denotes oil and gas fiscal dependence above 63 per cent or 1/3 of total government revenues.

[d] Source: The net zero transition: What it will cost, what it will bring, McKinsey (2022). McKinsey's Global Institute identifies a net-zero exposure score for each of the 69 countries in their study. The exposure score (%) is based on the average share of jobs, GDP and capital stock in exposed sectors, which are categorised based on their scope 1, 2 and 3 emissions intensity. Individual country scores provided care of the MGI. They draw on the following sources: Oxford Economics, OECD, ILO, World Input-Output Database, IHS Connect, World Bank, International Energy Agency, U.S. Bureau of Labor Statistics, India NSS Employment Survey, China National Bureau of Statistics, United Nations, International Renewable Energy Agency (IRENA), MINSTAT, INDSTAT, Global Solar Atlas, Global Wind Atlas, U.S. Geological Survey, WEF, McKinsey Nature Analytics, McKinsey Global Institute analysis. Darkest shading denotes the most vulnerable category (4).

[e] Source: Data Source: IMF WEO April 2022 and IMF WEO October, 2022.

[f] For the United Nations' list of 2021 Least Developed Countries (LDCs), see https://www.un.org/development/desa/dpad/least-developed-country-category/ldcs-at-a-glance.html. For World Bank's Heavily Indebted Poor Countries (HIPC) list, see https://data.worldbank.org/country/XE. For World Bank's 2023 classification of Fragile and Conflict-affected situations (FCS), see https://www.worldbank.org/en/topic/fragilityconflictviolence/brief/harmonized-list-of-fragile-situations.

### *A Transition Indeed: From Fossil Fuels to Minerals*

An electric car requires six times the mineral inputs of a combustion engine car, while an onshore wind plant requires nine times more mineral inputs than a gas-fired power plant. The IEA anticipates a 4 per cent to 600 per cent increase in minerals demand by 2040. Demand for electric vehicles (EVs) and battery storage minerals will grow fastest: lithium by a factor of 40, graphite, cobalt and nickel by a factor of 20 to 25 (IEA 2021: 8). This demand creates significant new economic opportunities for mineral exporting countries, which will face a situation not unlike that of oil exporting countries. As Daniel Yergin notes, 'big shovels' are replacing 'big oil' (Yergin 2020: 422).

This surge in demand prompts 'energy security' concerns about availability and reliability. Existing supply chains are geared toward old models and volumes of demand. Energy transition minerals are more highly geographically concentrated than oil or gas. A very small number of nations control the global production of lithium, cobalt and rare earth elements. Australia and Chile produce 70 per cent of lithium, the Democratic Republic of the Congo (DRC) 70 per cent of cobalt, China 60 per cent of REEs, Indonesia 30 per cent of nickel and Chile and Peru 40 per cent of copper.

The midstream processing of these minerals is even more concentrated. At present, China refines 35 per cent of nickel, 50–70 per cent of lithium and cobalt and 90 per cent of REEs. Finally, the extraction and production of these transition minerals are capital intensive, require very long lead times and are subject to declines in ore quality (a growing concern in recent years) and high exposure to physical climate risks (Bazilian and Brew 2022; IEA 2021: 11–12). Quasi-monopolistic concentrations in critical commodity markets can create bottlenecks and uncertainty around steady supply. For the first time in a decades-long decline in the cost of clean energy technologies, recent price increases in lithium, copper and several other materials have translated into higher manufacturing costs for wind, solar and EV batteries (Birol and Canfin 2023).

### *The Next Great Power Competition?*

The result of a surging global demand and an inadequate, geographically concentrated supply is accelerating competition. At the great power level, that competition has been in evidence in Sino-U.S. relations for some years, even if not clearly understood. Indeed, China appears to have first identified its own long-term energy and mineral supply chain vulnerability. China's dominant position on minerals today is the fruit of more than a decade of careful planning and expansion: the Belt and Road Initiative (BRI) land, sea and air network connecting present and future markets and primary materials from as far away as sub-Saharan Africa and Latin America.

Beyond China's own natural endowments in REEs and dominance of midstream processing, it has also invested in mines in the DRC, Brazil, Chile, Indonesia, Argentina, Zimbabwe, Ireland, Canada, and Australia (Bazilian and Brew 2022; Castillo and Purdy 2022: 7; IEA 2021: 12). As a result, China is today the most consequential country in the world with respect to energy transition minerals. Downstream, it accounts for three-quarters of the global production capacity of lithium-ion batteries and EV batteries, and the bulk of solar panels (Bazilian and Brew 2022) and leads research and development on sodium batteries.

The United States has, in recent decades, largely lost its market share as a producer of lithium and has little midstream refining or downstream manufacturing capacity. In

response, recent legislation aims to rebuild the United States' capacity to produce and supply key critical minerals to power the renewable energy and mobility transitions. U.S. industry is now incentivised to ramp up domestic production of the minerals and components that go into batteries, EVs and renewable power infrastructure. Multiple new massive lithium-ion batteries factories are in development (Bazilian and Brew 2022). India, whose energy demand is set to grow more than that of any other country, began focusing on critical minerals policy around the same time as China with a 2011 Planning Commission report and subsequent work. Current recommendations include increased domestic exploration, mining research and development and joint trade partnerships with key governments and acquisition of overseas mining rights (Gupta, Biswas and Ganesan 2016: 43–46).

For many Western governments, the onset in 2022 of the Ukraine War was a vulnerability wake-up call and prompted calls for more secure and resilient mineral supply chains (Castillo and Purdy 2022: 9). Europe is moving along a path similar to that of the United States with a broad strategy of investment in new mines and refineries, innovation, recycling, and higher sustainability standards. A draft Critical Raw Materials Act aims at mitigating future shocks (Birol and Canfin 2023). Beyond the EU, India has placed the issue on the G20 agenda under its own chairmanship (Council on Energy *et al.* 2023). And in its 2022 ministerial communiqué, the IEA committed to further work on the availability, security and responsible sourcing of critical minerals and materials. It also launched a voluntary critical minerals security programme to include stockpiling, cooperation, and data sharing (IEA 2022a).

There are important choices ahead for all players, with profound consequences for international cooperation. Castillo and Purdy identify several interesting scenarios. Optimally for the energy transition, China's dominance of critical minerals supply chains would give way to substantial diversification (United States, Europe) of upstream production, midstream refinement and downstream manufacturing. China would improve its due diligence on critical minerals, opening the way to a globally harmonised set of standards. This scenario is optimal for the transition itself, given the accelerating demand for these minerals. Alternatively, a diversified but bifurcated 'cleaner' and 'dirtier' minerals system would evolve. If China maintains its dominance and does not strengthen due diligence, supply chain hiccups and geopolitical tensions could affect the flow of critical minerals and the transition (Castillo and Purdy 2022: 21–28).

Two tiers of competition are therefore likely. First, at the great power level, China, the United States and the European Union (and perhaps India) will vie for overall control or energy independence from each other at the systemic level. Second, 'major producers' like Australia, Chile, Peru, the DRC, and Indonesia will find themselves dealing with both the competing great powers and with a wide range of other countries eager to access a steady supply of the requisite minerals.

There is of course a long historical relationship between fossil fuels, conflict and geopolitics, from the Biafra secession attempt (1967–70) in Nigeria through the 1990–2003 United Nations Security Council Iraq trade embargo and oil-for-food programme or U.S. oil sanctions on Venezuela or Iran. But Russia's invasion of Ukraine provides perhaps the first window into the relationship between great power geopolitics, conflict and the net-zero transition itself in the decades ahead. The Ukraine conflict was not triggered by the net-zero transition nor by a resources dispute. But, as the world largest exporter of fossil fuels, its web of energy relationships was deeply affected, with a profound effect on the pace of the overall energy transition (IEA 2022c: 19). The *Economist* concludes

that the war may have fast-tracked the entire transition by 'an astonishing' five to ten years ('War and Subsidies' 2023). Specifically, Russia's decision to cut natural gas to Europe and European sanctions on Russian oil and coal effectively caused a reorientation of a significant part of the global energy trade to Russia's ultimate disadvantage.

Europe had planned to wean itself off Russian fossil fuels, but only very gradually, given Russia's ability to deliver oil and gas at relatively low cost. The invasion triggered a final rupture that could not have been imagined even a year before the war: Russian fossil fuel exports are expected never to return to 2021 levels (IEA 2022c: 24).

#### *A New Front between the Developing and the Developed Worlds?*

Beyond superpower competition or friction between major minerals producers and consumers, the climate agenda of the last 15 years is polarising developed and developing nations (Yergin 2022: 11–12). The core issues are disagreements over the speed of the transition, how development priorities will be affected, and who will pay for past and current pollution.

Faced with the long tail of COVID-19 and the economic consequences of the war in Ukraine, many developing countries are struggling to meet their social commitments to their own citizens and their debt obligations to international lenders. Many continue to rely on fossil fuels, both production and consumption, to power their economies and develop their countries.

Global finance is the main battlefield of this polarisation. Developed nations and the multilateral banks they control have started to withhold financing on capital projects (powerplants, mines, pipelines, ports) which they judge to be too fossil fuel oriented (Yergin 2022: 12). In parallel, they have yet to meet their earliest green financing pledges in support of the transition. Beyond the fact that the transition cannot succeed if industrialised countries do not provided the required support (Gallagher 2021), the increasing acrimony is a risk to the transition itself.

## Implications for Global Governance

Given what (little) we discern of the transition's requirements and effects, several preliminary observations emerge.

#### *Instability and Conflict Must Be Expected*

##### *An Uncertain Future for the Most Vulnerable States*

There will be great variation within and between regions. Some countries will prosper; others will weather the transition; some may not survive it (see Table 24.1). Africa is the most vulnerable region with a group of nations that combine very high potential losses of oil and gas revenues, a high degree of fiscal dependence on oil and gas, and very low development levels. How will countries like Cameroon, Chad, the Democratic Republic of Congo, South Sudan, and Sudan, each with per capita GDP below $2,000, manage total revenue losses (combining rates of projected oil and gas shortfall and rates of fiscal dependence) of 10 to 56 per cent? How can Nigeria manage the loss of 31 per cent of its income over the next 20 years with a GDP per capita of $2,580?

In the Americas, equally dramatic revenue shortfalls are mitigated by much lower fiscal dependence on oil and gas and higher GDP per capita. Challenging cases include

Bolivia (total revenue shortfall of 14 per cent against a GDP per capita of $3,790), Venezuela (very similar to Bolivia, some data missing), Ecuador (total revenue shortfall of 15 per cent against a GDP per capita of $6,590) and Surinam (total revenue shortfall of 26 per cent against a GDP per capita of $5,040). Even at higher GDP levels, questions remain: how well can countries like Mexico or Trinidad and Tobago manage total revenue shortfalls of 15–25 per cent against a GDP per capita of $10–20,000?

By comparison, the MENA feature the highest levels of fiscal oil and gas dependence. Potential oil and gas revenue shortfalls are significant but lower than Africa and softened by higher GDP per capita. Iraq and Libya face total revenue shortfalls of 26–31 per cent against per capita GDPs of $6,000. By contrast, Bahrain, Oman and Saudi Arabia face higher total revenue shortfalls (30–50 per cent) but against higher per capita GDPs ($20,000–$30,000). While there is no oil revenue data for Yemen, its GDP per capita ($871) makes it acutely vulnerable.

Asia differs again in that it faces neither the same dramatic oil and gas revenue shortfalls nor fiscal dependence. Timor-Leste (total revenue shortfall of 48 per cent against a GDP per capita of $1,490) is the notable exception. But Asia does include several countries with a different challenge profile: very high exposure, low per capita GDP and acute climate physical risks. These include Bangladesh, China, India, Pakistan, Sri Lanka, and Vietnam.

Finally, the CIS, Central Asia and the Caucasus do not feature the difficult combinations noted earlier to the same degree of severity with the exception of Azerbaijan (total revenue shortfall of 43 per cent against a GDP per capita of $6,870), though data is missing for several important cases (Ukraine, Turkmenistan, Uzbekistan).

Anticipating how the transition will unfold is difficult, and new economic opportunities will certainly mitigate some of the aforementioned difficulties. But at continental and global levels, the picture is clear: a non-negligible number of states face considerable additional fiscal and macroeconomic headwinds beyond their present challenges. Future state paralysis, failure or fragmentation is possible. Crucially, then, the custodial work of global governance institutions like the Security Council, Peacebuilding Council, Human Rights Council, World Bank, and IMF with respect to state fragility and failure looks to continue through the transition.

### *The Growing Gap between Developed and Developing Countries*

The pattern of individual vulnerability suggests that at the group or regional level, the current fault line between developing and developed nations is unlikely to fade away. Developing nations have long harboured suspicions concerning developed nations' good faith with respect to the unfinished developmental agenda. At the same time, climate change is a problem created by the Global North. For developing nations, therefore, the 2015 Paris Agreement fell within a climate-development nexus in which poverty, prosperity, environmental protection, and climate change are linked. Developed nations did not necessarily share this framing. In the rush to a climate change agreement, broad principles were laid down, but climate financing details were not.

In the years immediately after the agreement, developed nations moved far more quickly to the emissions side of implementation than to adaptation and financing. The Western 'vaccine nationalism' of the 2019–2021 COVID-19 pandemic caused an uproar around the meaning of international 'solidarity'. In the run-up to COP26, developing nations essentially asked why they should 'increase the ambition' on climate action if others were not prepared to share vaccines? When developed nations again sought

support against Russia's 2022 invasion of Ukraine, some developing-country leaders dismissed it as 'Europe's problem' despite being keen on the non-aggression principle.

This is the backdrop against which the net-zero transition now accelerates. Financing and technology transfers are increasingly seen as the good faith bar that must be cleared. This rift poses an additional level of difficulty for the management of an already complicated and unpredictable transition.

### *The Next Great Power Contest Is Already Here*

A better understanding of the net-zero transition yields an improved explanatory framework for the 'strategic competitors' lens that now pervades the United States–China relationship. In the net-zero transition, Europe behaves as a 'power' because its policymaking in the industrial, economic and technological spheres is more concentrated than in other areas. Each of these three has started to vie for overall control or energy independence from each other at the systemic level.

Russia's actions in Ukraine have had multiple effects already described in this chapter, but one of them is to push Europe and the United States closer together, even as differences over their respective industrial policies emerge. That, in turn, has probably pushed China and Russia closer together as well. As demonstrated, great power geopolitics and the transition will affect each other in the decades ahead in deeply unpredictable ways. While Europe had a plan to gradually wean itself off Russian fossil fuels in the decade ahead, the invasion accelerated an energy-relationship rupture that could not have been previously imagined (Wagner 2022).

### *Major Players Majorly Affected?*

Because the transition will impact countries in different ways, it will likely affect the multilateral fora within which those countries operate. For example, within the Security Council Russia has a 39 per cent exposure score and will likely lose 47 per cent of its oil and gas revenues over two decades while China carries a 49 per cent exposure to the transition, more than twice the rate of the other three permanent members (16–21 per cent), compounding the current per capita GDP gap between China and Russia ($13,000–$14,000) and the other three ($42,000–$78,000).

Over the last 20 years, China and Russia, while remaining within existing institutions, have engaged in counter-institutionalisation by creating parallel 'friendlier' ones like the Shanghai Cooperation Organization or the Collective Security Treaty Organization (Zurn 2018: 254–55). This pattern will likely continue or accelerate under the transition.

Second, nations which are major producers or which control world market share of specific minerals—such as Australia, Chile, Peru, the DRC, and Indonesia—will find themselves orbiting the competing great powers, even as they manage a wide range of others eager to access a steady supply of the requisite minerals.

## ***Finance as Both Transition Backbone and Battleground***

'Money, money, money, money', replied U.S. Climate Envoy John Kerry when asked what he needed at Davos in January 2023. 'We need it for the developing world. We need it for the right choices to be made [and] to leapfrog the mistakes' (Mufson 2023). Two months later, at the first meeting of the U.S. Financial Risk Advisory Committee,

U.S. Treasury Secretary Janet Yellen warned that 'as climate change intensifies, natural disasters and warming temperatures can lead to declines in asset values that could cascade through the financial system. … A delayed and disorderly transition to a net-zero economy can lead to shocks to the financial system as well' (Yellen 2023).

Kerry and Yellen's comments (and global itineraries) underscore a unique aspect of the net-zero transition: the importance and primacy of global finance, economics and political economy perspectives. The hundreds of billions of dollars of climate finance lift needed now, the two hundred plus trillion dollars of new capital infrastructure needed by 2070, the 'shocks to the financial system' that a 'delayed or disorderly transition' would entail, the astronomical cost of climate disaster: all return financial actors—the Bretton Woods international financial institutions (IFIs) and multilateral development banks (MDBs)—to a prominence unseen since the World War II reconstruction years, except that the scope this time is truly global.

### *Innovating Financial Partnerships*

Because it is both battleground and backbone, finance is a space for reform, renewal and innovation. At COP26 (United Nations 2021), the first 'Just Energy Transition Partnership' (JETP) was established as a financing cooperation mechanism to support developing economies make the transition from a heavy dependence on coal. South Africa was the pilot country with a $8.5 billion package from France, Germany, the United Kingdom, the United States, and the European Union.

In 2022, India, Indonesia, Vietnam and Senegal were announced as the next cohort. The donor coordination group has now been extended to MDBs, national development banks and development finance agencies. Indonesia's package will reportedly give it $20 billion, half of it from the private sector. There is continuing discussion about whether JETPs should be limited to countries transitioning from coal to gas (sometimes considered a bridging fuel) or extended more widely (Kramer 2022). Similarly, within Europe, the European Commission has created a Just Transition Mechanism (JTM) to mobilise €55 billion over the period 2021–27 to assist its most affected (coal-producing) regions (European Commission n.d.).

### *Reforming Existing Financial Institutions*

There are growing calls for fundamental reform of the World Bank and IMF. On behalf of the Bank's largest shareholder, Yellen called in late 2022 for 'a World Bank evolution roadmap' to better tackle global challenges without eroding poverty reduction and sustainable development. She called for better incentivisation of investments that address global challenges, for changes to the banks' operational models, and for financial innovation to responsibly extend lending (Yellen 2022).

Prime Minister Mia Mottley of Barbados and German Minister for Economic Cooperation Svenja Schulze have similarly called for the scientific consensus on climate change to be translated into 'a new economic paradigm' at the IFIs. The Bridgetown Initiative wants sustainability and resilience elevated to core institutional goals: analysis and lending to better address new transboundary challenges, MDBs' financing capacity vastly expanded, and their lending used to catalyse private investment in low-carbon energy, transportation and agriculture in developing countries. Finally, natural disaster and pandemic clauses must be accepted in financing instruments (Mottley and Schulze 2023).

The proposed changes to the IFIs would mark the most significant reform of these global institutions in their entire history. Beyond lending, proposals centred on a sustainability imperative (Esty 2022) increasingly question existing economic frameworks.

#### *New Treaties and Funds*

But the urgency and scale of need is yielding even bigger and entirely new multilateral proposals. Old debates on the responsibility for historical emissions are slowly ceding the stage to new debates about sharing and using the gains of the energy transition and global green economy. New initiatives like the campaign for a Fossil Fuel Non-Proliferation treaty include proposals like a Global Transition Fund in which global carbon taxes and fossil fuel subsidy cuts would be pooled to support fossil fuel-dependent developing countries ('Fossil Fuel Non-Proliferation Treaty' n.d.; Newell, van Asselt and Daley 2022).

### *Second-Order Implications for Global Governance*

Beyond increased state vulnerability, exacerbated interstate competition and the risks and opportunities of climate finance, we can begin to discern a range of second-order implications for global governance more widely.

#### *Security, Peacebuilding and Human Rights*

As noted earlier, the transition will stress test the world's most vulnerable countries to the point of breakage. On that basis, sadly, the global and regional governance architecture currently focused on state fragility, fragmentation and failure will likely continue to be needed. Actors from the UN Security Council, Peacebuilding Commission, and peacekeeping and special political missions to regional/subregional actors like the African Union's Peace and Security Council and ECOWAS in West Africa, will be needed to manage a range of these situations.

Similarly, in the related area of human rights, oil and gas and mining have long given rise to human rights violations. Indigenous communities have often borne the brunt of extractive economies and poor governance. As exemplified with cobalt in the Congo, a range of such concerns exist today on every continent (Zuckerman 2023). Given the expected 400-to-600 per cent growth in demand for transition minerals in the decades ahead, an increase in this category of human rights concerns can be expected.

In addition, large infrastructure projects, as a category of their own, whether related to the BRI or 'green' infrastructure plans, can foster similar human rights concerns. Here again, parts of the existing human rights architecture will see their case load evolve as a result of the net-zero transition. This includes, at UN level, the Human Rights Council itself as well as 'thematic mandates' like the Special Rapporteurs on (a) the rights of indigenous peoples, (b) the human rights of migrants or (c) minority issues, as well as the Working Group on transnational corporations and other business enterprises (to mention only a few).

#### *Institutional Innovation and Proliferation*

A number of older entities like the 1974 IEA, the 1990 Alliance of Small Island States (AOSIS) or the 1991 Global Environmental Facility (GEF) have found their work and mandate transformed by the net-zero transition. But the last 20 years have witnessed an explosion of new institutions, partnerships and initiatives. New formal, informal,

technical, scientific, political or financial entities have emerged and multiplied, composed of national governments, sub-national entities and civil society. To cite a few examples: the International Solar Alliance (ISA; 2015); the Coalition of Finance Ministers for Climate Action (2019); the International Renewable Energy Agency (IRENA; 2009); the Coalition for Disaster Resilient Infrastructure (CDRI; 2019), and its Infrastructure Resilience Accelerator Fund (IRAF; 2022); the Global Green Growth Institute (GGGI; 2012); the Global Centre on Adaptation (GCA; 2018); the Climate Ambition Alliance (2020), and its Race to Zero; Leadership Group for Industry Transition (Lead It; 2019); and the NDC Partnership (2016), to name only a few.

Interestingly, mineral-producing countries are considering new kinds of cartel-like organisations, including Indonesia for nickel or Chile, Argentina and Bolivia for lithium (Dempsey 2022). As demand begins to shift from fossil fuels to transition minerals, the Organization of Petroleum Exporting Countries (OPEC) might give way to a range of Organizations of Mineral Exporting Countries (OMECs). More widely, as the transition progresses and as new technologies emerge, the mandates of a wider set of older institutions will change. As new aircraft fuels and wing designs are commercialised, the International Civil Aviation Organization (ICAO) will evolve its standards and regulatory processes, as will the International Maritime Organization (IMO), the World Tourism Organization (UNTWO) or the International Labour Organization (ILO).

A full examination of this issue is beyond the scope of this survey. But this institutional growth has been explosive and falls within a wider trend of accelerating institutional pluralism (Johnstone and Lincoln 2022). As one analysis notes, '[T]here is a need to "launch less and implement more"' (Roesch and Nobre 2021: 22). Indeed, this institutional proliferation calls for consolidation and streamlining for greater effectiveness.

## Final Thoughts

UN Secretary-General Guterres described the 2022 Working Group II report of the IPCC Sixth Assessment simply as an 'atlas of human suffering' but also 'a damning indictment of failed climate leadership', a blunt reference to increasing frustration over Paris Agreement implementation and the risk of COP summits descending into pageantry. Questions around the pace and impact of the net-zero transition are, therefore, sure to multiply with the first Global Stocktake in 2023 (COP28) and the next iteration of 2025 climate commitments or NDCs.

Previous energy transitions were the result of some combination of technological change and economic motive. In this case, scientific conclusion sparked policy that, in turn, drives economic, industrial and societal change. No previous energy transition has occurred as swiftly as this one, nor ever attempted the total transformation of the global economy in the course of 35 years.

Though happily ignored in good times, government's importance rises in crisis. The policy challenge is acute. Overlapping crises—an epidemic, a frozen development agenda, accelerating climate change, macroeconomic woes, and a land war in Europe—have strained traditional stovepipe policymaking. Economic and broader energy policy analyses are no exception (Wagner 2022). Pisani-Ferry and Mahfouz (2022) see a lack of credible climate policymaking:

> Many governments have pledged to reach carbon neutrality by mid-century, but their actions do not yet align with this objective. In the absence of stronger carrots or sticks, energy producers, unlike carmakers, can and still do hedge their bets. The result … is that overall energy investment is critically insufficient to meet future demand. Taken

> together, these developments threaten to create a stagflationary environment where brown energy is scarce and green energy is still in short supply. Coping with such imbalances will be an ongoing challenge for governments and central banks. Policymakers can no longer afford to overlook these issues, nor can they rely on fairy tales about what the energy transition entails.

This policymaking challenge is tied to two related phenomena: the widespread loss of trust in government and a slow 'constrained breakdown' in multilateral affairs (Homer-Dixon 2006: 23). And yet, 'constrained breakdown' has the advantage (relative to sudden collapse) of enabling 'processes of restructuring, renewal, and long-term adaptation … which may well prove to be the defining story of this century' (Kreienkamp and Pegram 2021: 800).

Climate science has delivered on its first responsibility: it has answered over decades big and difficult questions about the earth, its temperature, what warms and cools it, different gases, the oceans, forests and carbon sinks, and the repercussions of human activity. It has also succeeded in delivering that consensus into the public arena. Still ahead is a deeper melding of climate science and other fields of knowledge, including other domains of physical science, but especially the social sciences and humanities (Meyer 2023). Over the horizon then is the allure of an overarching post-climate science grounded in a strengthened planetary framework.

A newly emergent, planet-centred frame of reference has triggered an urgent transition to low-carbon economies and societies. To achieve that transition, a new economic paradigm is being called for. The only certainty is that this transition will be onerous. But it holds one further possibility. Can disaster-motivated better care for the planet and its biodiversity crack the door to a reappraised care ethic that includes humans as well as the planet?

## Notes

1 Carbon Tracker's 2021 study compares a country's current fiscal dependence on oil and gas revenues (as a percentage of overall revenues) and the likely shortfall of future oil and gas government revenue (against industry expectations).
2 McKinsey (2022) analyses the economic first-order effects for 69 countries on demand, capital allocation, costs, and jobs through 2050 across energy and land-use systems. The transition will require $275 trillion of capital spending through 2050, much of it front-loaded in the next ten years and will have uneven effects on specific sectors, geographies, and communities (McKinsey 2022: viii). Specific country scores provided on request care of McKinsey's Global Institute.
3 Rare earth elements (REEs) include 17 metallic elements, four of which—neodymium, dysprosium, praseodymium, and terbium—are of particular relevance to clean energy technologies. Demand for these four elements is expected to rise dramatically (Castillo and Purdy 2022: 8).

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