CHAPTER

1

A new uncertainty complex

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Feelings of distress have been on the rise for almost everyone everywhere, even before the Covid-19 pandemic. Yet conventional measures of wellbeing suggest that, on average, life has never been better for our species.

What is going on? Why are people so worried, and what worries them?

This chapter argues that a new uncertainty complex is emerging, driven by three novel sources of uncertainty that interact at a global scale:

- The intertwined planetary pressures and inequalities of the Anthropocene.
- The pursuit of just societal transformations to ease those pressures.
- Widespread, intensifying societal polarization, delaying necessary action for change.

Together, they are painting a picture of uncertain times and unsettled lives.

A world of worry in uncertain times

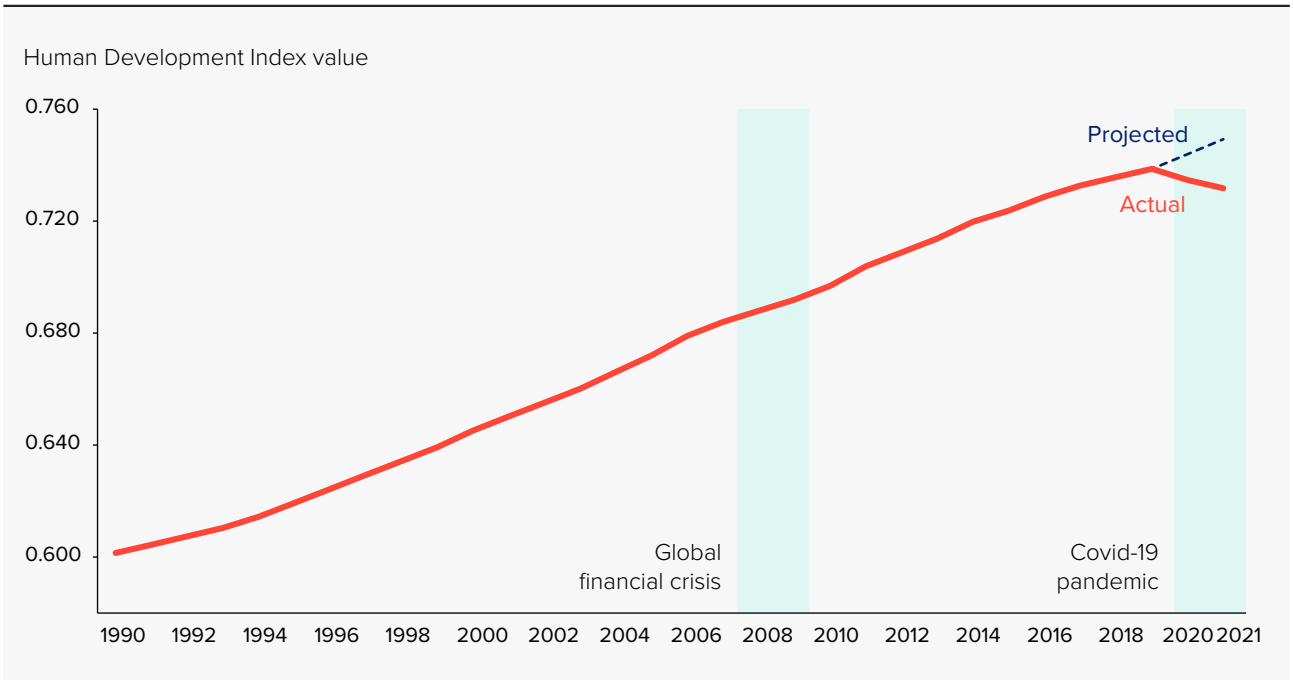
A war between countries in Europe reawakens fear of global nuclear conflagration. A volatile geopolitical context[1] coexists with a pandemic that continues to kill and frighten more than two years since it was declared. Behind the headlines progress in human development has gone into reverse—with worsening trends in poverty, food insecurity, forced displacement and many compounding inequalities.[2] For the first time on record, the global Human Development Index (HDI) has dropped for two years in a row, taking the world back to just after the adoption of the 2030 Agenda for Sustainable Development and the Paris Agreement (figure 1.1). Every year a few countries face declines on the HDI, but over 90 percent of countries saw their HDI value drop in either 2020 or 2021 (figure 1.2). Furthermore, while only a third of very high HDI countries saw a decline in 2021 (compared with over 90 percent in 2020), about 60 percent of low and medium HDI and high HDI countries did (figure 1.3).

There is little doubt that these are uncertain times,[3] as people feel less sure about what the future holds. Even before the Covid-19 pandemic hit, six of seven people in the world reported feeling insecure about many aspects of their lives, with concerns rising the most in very high HDI countries (see chapters 3 and 4 on the links between uncertainty and insecurity).[4]

Life has always been uncertain.[5] The world has faced wars, pandemics and massive natural hazards before. Today's uncertainty is not necessarily any greater than in the past. If anything, given record achievements in average standards of living and incomes, with astonishing technological progress, we could be expected to be more ready than ever to meet uncertain times. Yet, we display high, and often rising, concern about the future. So, what is going on? Why are people so worried, and what worries them? If today's world is not more uncertain than the past's, are today's uncertain times different? If so, how? And how do they relate to human development?

This chapter presents evidence that people are feeling distressed and explores what they may be worrying about. While it cannot be established that there is more uncertainty today than in the past, there is a novel context for uncertainty. The novelty comes from three interacting layers of uncertainty, superimposed on ongoing development challenges. The

Figure 1.1 A drop in global Human Development Index value two years in a row for the first time on record



Note: The period of the global financial crisis is indicative.
Source: Human Development Report Office calculations based on data from Barro and Lee (2018), IMF (2021c, 2022), UNDESA (2022a, 2022b), UNESCO Institute for Statistics (2022), UNSD (2022) and World Bank (2022c).

Figure 1.2 Drops in Human Development Index values were widespread during the Covid-19 pandemic, with over 90 percent of countries suffering a decline in either 2020 or 2021

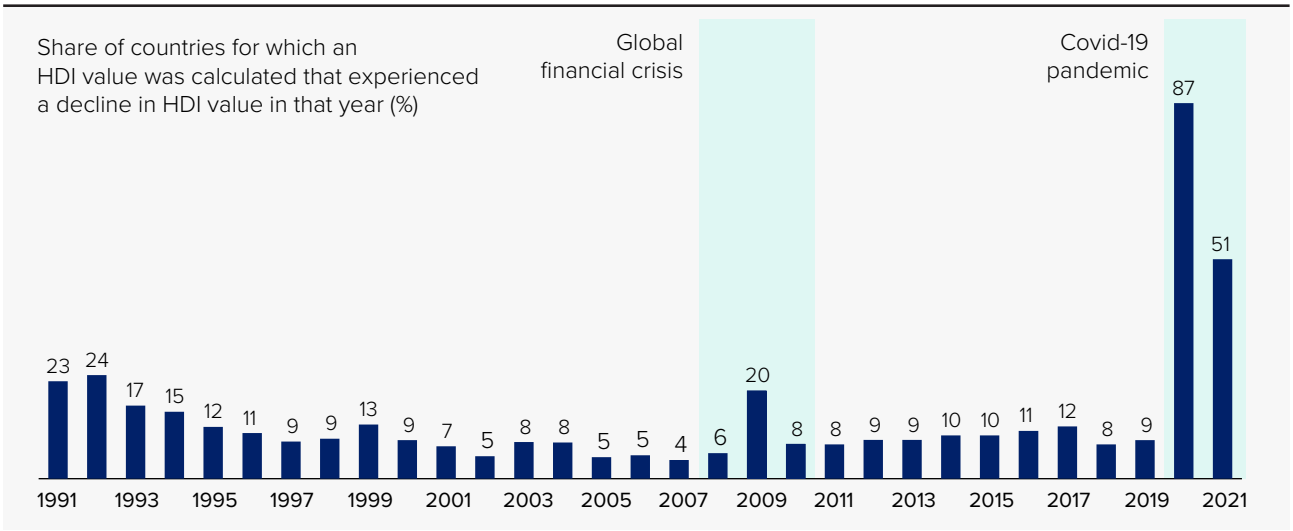


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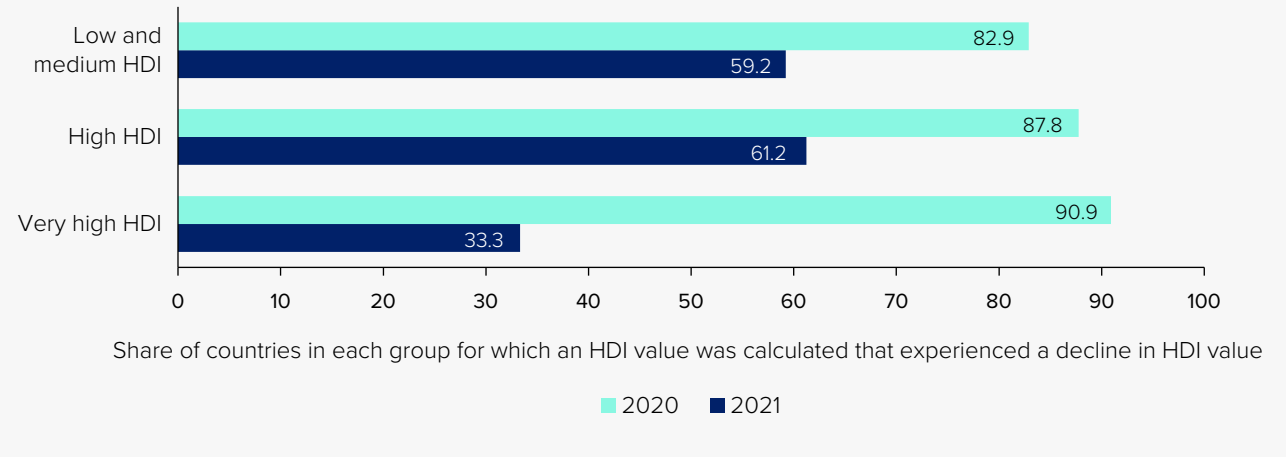
Figure 1.3 While most very high Human Development Index (HDI) countries did not suffer declines on the HDI in 2021, the majority of countries in low and medium HDI and high HDI countries did



Source: Human Development Report Office calculations based on data from Barro and Lee (2018), IMF (2021c, 2022), UNDESA (2022a, 2022b), UNESCO Institute for Statistics (2022), UNSD (2022) and World Bank (2022c).

first is associated with the Anthropocene's dangerous planetary change and its interaction with inequalities. The second is the purposeful efforts and intentions to transition towards new ways of organizing industrial societies—purporting transformations similar to those in the transition from agricultural to industrial societies.[6] The third is the intensification of political and social polarization across and within countries—and of misperceptions about information and across groups of people—facilitated by how new digital technologies are often being used.[7] This new and interacting "uncertainty complex" is unequal and universal; it can exacerbate inequalities, yet like the ongoing pandemic, it touches us all.

The interaction of these three layers of uncertainty implies that threats to people and planet compound, with events rippling through our socially and ecologically connected societies in multiple and unpredictable

ways. Consider how the war in Ukraine is compounding a global food insecurity crisis.[8] Consider how the Covid-19 pandemic, in addition to the health impacts, also devastated economies and reversed progress in gender equality.[9] Many of the threats, in isolation, are not new. But the confluence of pandemics, the invention of vaccines in record time, the digital proliferation of misinformation, the breakdown of supply chains, the strong market concentrations for essential goods, the loss of biodiversity—have all interacted to present a "complex mixture of the precedented and the unprecedented" at a speed and scale never before seen.[10]

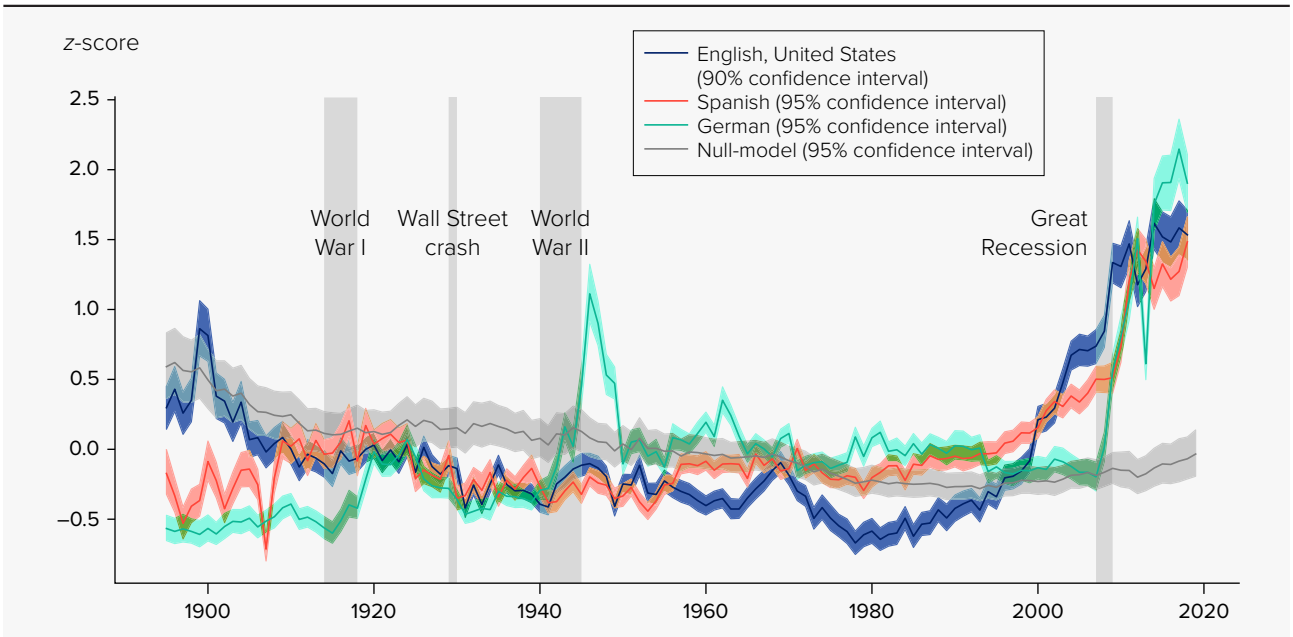
Rising insecurity amid unprecedented material prosperity—for some

Large-scale text analysis identifying language trends in books over the past 125 years reveals a sharp increase in expressions reflecting cognitive distortions associated with depression and other forms of mental distress (see chapter 2).[11] Over the past two decades the language reflecting overly negative perceptions of the world and its future has surged (figure 1.4).[12] Indeed, today's distress levels are unprecedented,[13] exceeding those during the Great Depression and both world wars. The analysis of more than 14 million books in three languages signals cultural, linguistic and psychological shifts beyond changes in word meaning, writing and publishing standards or the books considered. Indeed, literature has been thought of as mirror of our societies, and studies show that text expressions reflect emotional states[14] and sometimes anticipate broader social and political changes.[15]

Other studies—on, for example, online behaviour[16] and analysis of emotional expressions on social media[17]—echo these findings.[18] The Covid-19 pandemic and uncertainty about the impacts and spread of the disease sparked rapid surges in online searches for acute and health- and economic-related anxiety.[19] While reflecting the concerns of only those with internet access, the measures coincide with survey data[20] across geographic locations.[21] Still other studies show that when events are sudden or unexpected, online behaviour can indicate shared sentiments.[22]

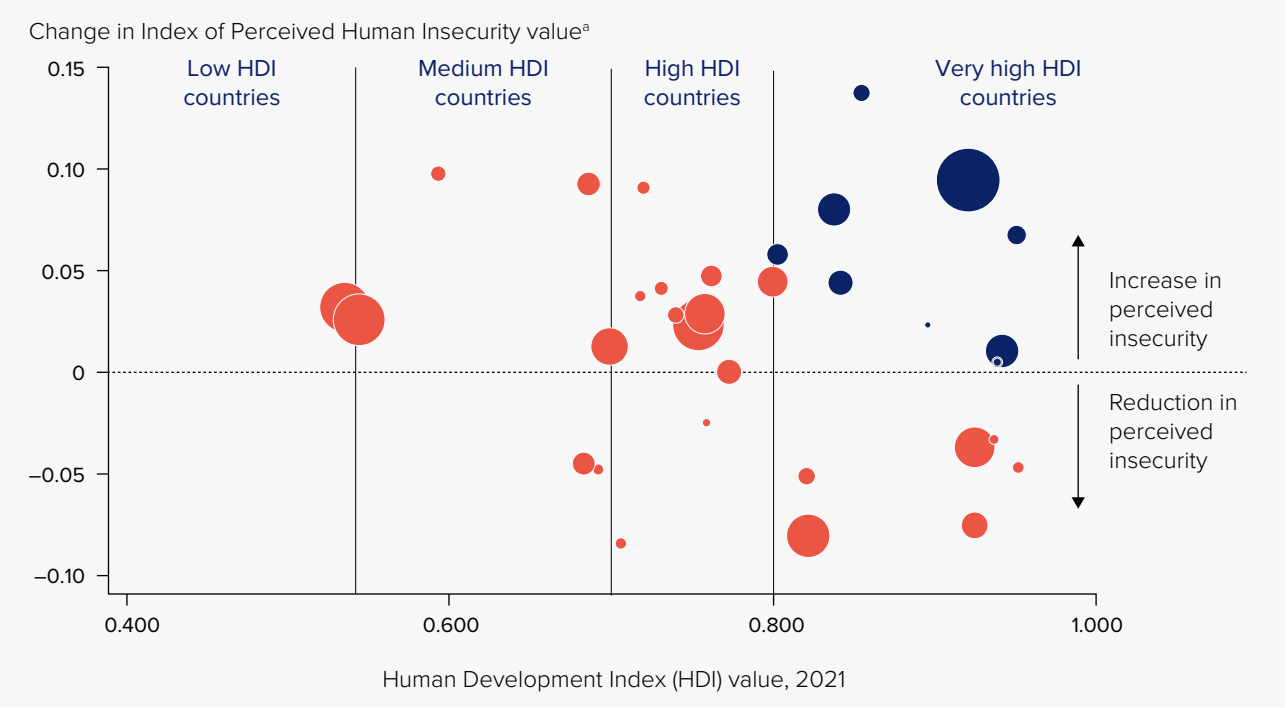
People report feeling more distressed and insecure about their lives and the future. While perceived insecurity is higher in low and medium HDI countries, some of the largest increases in feelings of insecurity are in very high HDI countries (figure 1.5).[23] Insecurity, discontent and pessimism loom large across

Figure 1.4 Negative views about the world and the future have surged to unprecedented highs



Note: Negative views are defined as textual analogues of cognitive distortions in one- to five-word sequences reflecting depression, anxiety and other distortions, published in 14 million books in English, Spanish and German over the past 125 years. The prevalence of these word sequences are converted to *z*-scores for comparability. They are compared with a null-model that accounts for over-time changes in publication volumes and standards.
Source: Bollen and others 2021.

Figure 1.5 Perceived insecurity is on the rise in most countries, even in some very high Human Development Index countries



Note: Bubble size represents the country population.
a. Refers to the change between waves 6 and 7 of the World Values Survey for countries with comparable data.
Source: Human Development Report Office based on World Values Survey data.

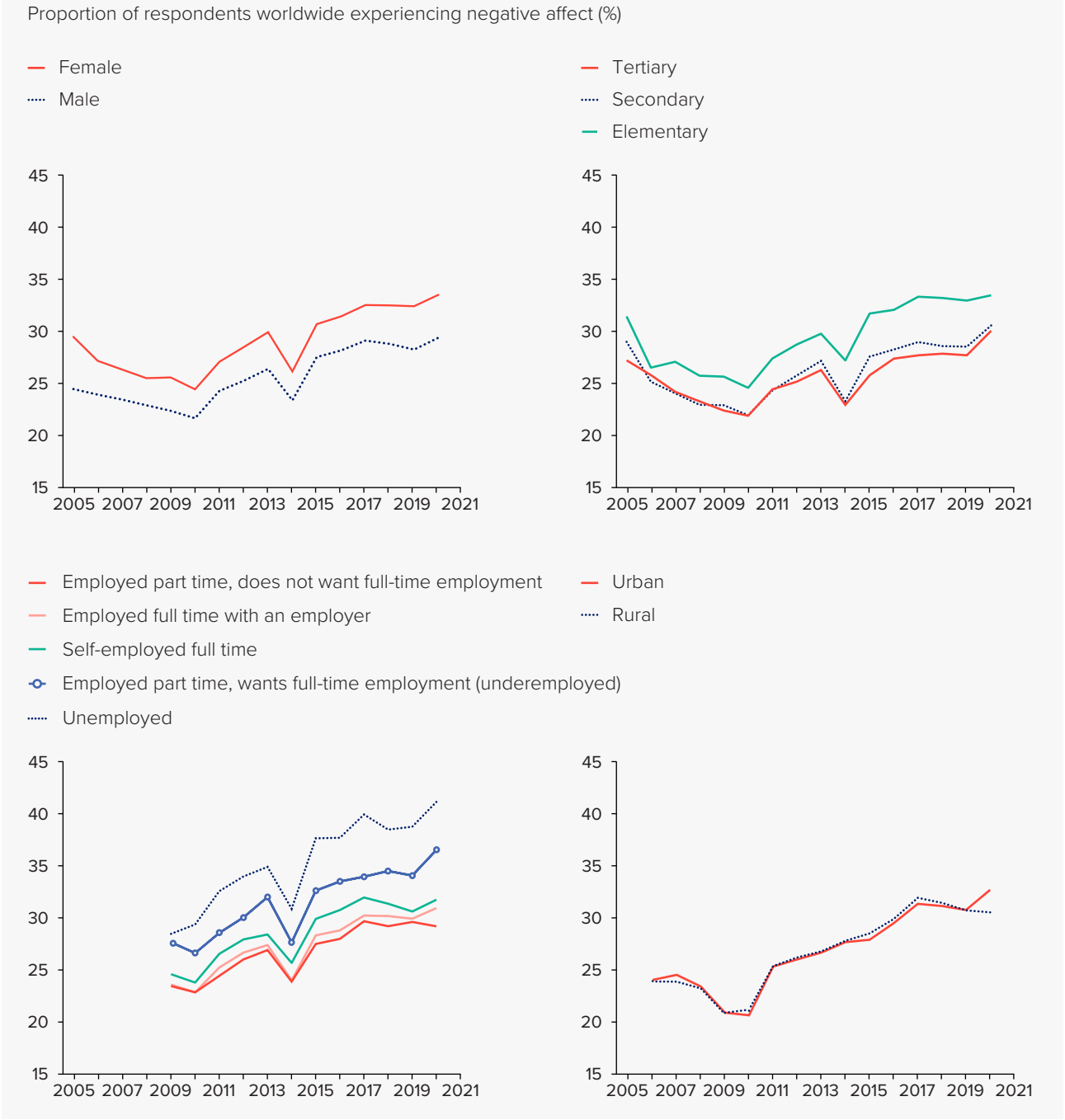
all geographic regions, including countries with the highest incomes, with some surveys finding that younger people tend to have a more positive outlook on the future in some lower-income countries.[24] For instance, while the mentions of threats, such as those from conflict or natural hazards, in US newspapers steadily declined from 1900 to about 2010, they have since shot up, with forecasts of further increases in coming decades.[25]

The numbers of people reporting negative affect—stress, sadness, anger or worry and experiencing physical pain—have been on the rise for the past decade and have hit a record high since the Gallup Global Emotions Report started assessing these experiences in 2006.[26] When excluding physical pain and assessing only feelings, research finds that all groups report experiencing negative affect, with women, people with lower than tertiary education and people who are underemployed or unemployed reporting higher absolute levels (figure 1.6). Indeed, a trend of increased stress is discernible across the world and across socioeconomic groups, despite volatility from year to year (figure 1.7).[27]

These patterns of high or increasing worry parallel improvements in some measures of prosperity, such as the global Human Development Index, which before the Covid-19 pandemic had reached record highs.[28] The human development perspective can shed light on this seeming puzzle. Human development is in part about achievements in wellbeing (in health, education and standards of living), a crucial aspect of people's capabilities: their ability to be and do what they value and have reason to value. But chapter 3 considers other aspects of capabilities that matter beyond wellbeing achievements. Looking beyond averages, horizontal inequalities in capabilities across groups—reflected, say, in gender and racial discrimination or in dimensions important for life in the 21st century, including enhanced capabilities such as higher education and access to broadband[29]—persisted and in many cases widened during the pandemic.

And even progress in basic capabilities has stalled or reversed. The Covid-19 pandemic set back the reduction in global extreme poverty, disrupting the

Figure 1.6 Negative affect is increasing for everyone, with persistent by inequalities between groups

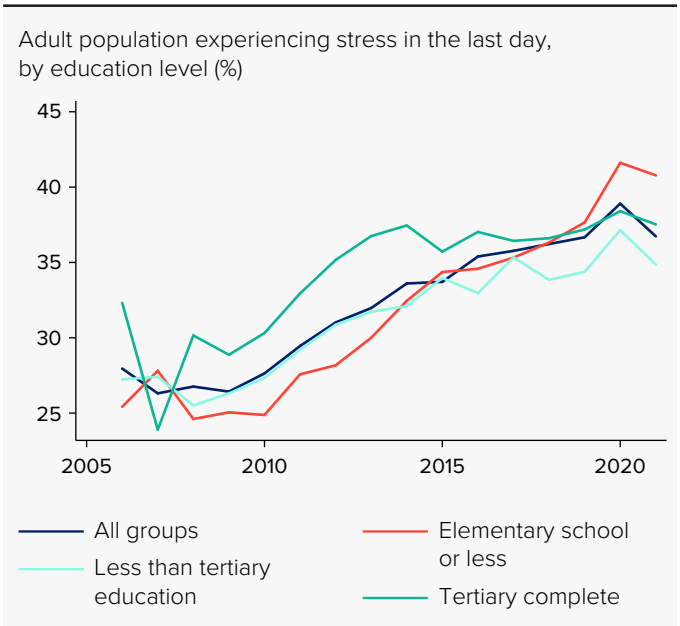


Note: Negative affect is defined as the aggregate of reported feelings of sadness, anguish, worry and anger in the Gallup Emotions Survey and excludes reported feelings of physical pain.
Source: Pinto and others (2022), based on data from Gallup.

steady decline in the number of people living in extreme poverty since 1990. Over the pandemic's first two years an additional 110–150 million people may have been pushed into extreme poverty, adding to the 689 million people worldwide forced to survive on less than $1.90 a day in 2018.[30] Even before the pandemic, the pace of poverty reduction was slowing—from about 1 percentage point a year in 1990–2015 to half a percentage point a year in 2015–2017.

What is more, at least 1.3 billion people live in multidimensional poverty, facing deprivations in dimensions important for human development—including

Figure 1.7 Stress is high and rising, independent of education



Note: Median values are shown due to inconsistencies in the number of observations across countries and years.
Source: Human Development Report Office based on The Gallup Organization (2022).

health, education and material standards of living. Half of them are children.[31] And while child mortality has declined globally since 1990, children born in the world's poorest countries in the world still have a 1 in 10 risk of not surviving to their fifth birthday, whereas almost all children born in some of the richest countries survive beyond their fifth birthday.[32] The long-term effects of the Covid-19 pandemic and the current inflation in consumer goods prices—especially the increased price of food compounded by the war in the Ukraine—threaten to exacerbate the situation for people living in, or on the brink of, poverty across the world.

These deprivations and inequalities in capabilities pose serious challenges on their own but matter even more when people try to navigate uncertain times—and they matter not only to those excluded and left behind. Indeed, the feedback loops between pre-existing development challenges and a novel context of uncertainty "constitute a systemic challenge to social progress."[33] That provides even more reason to explore why so many people—even if they have met their basic needs—perceive themselves as lacking agency (see chapter 3 for a discussion of agency in the human development framework) as they look to the future. Doing so requires understanding what is novel about today's uncertain times—the new planetary reality of the Anthropocene, the unprecedented transition from industrial societies and the new forms of political polarization.

Uncertainty driven by dangerous planetary change in the Anthropocene

Never have so many of the planet's systems been knowingly affected by a single species. We humans are driving climate change[34] and harming the integrity of many of the ecosystems that sustain human lives and other species. Our choices are shaping the evolution of life on Earth through legacies that will unfold over millions of years to come.[35]

Climate change, biodiversity loss and many other environmental challenges—from air pollution to plastics use—are receiving individual attention. But the way these and other planetary pressures are interlinked—and the speed, scale and scope of the unprecedented planetary changes unfolding as a result—has motivated a new framing of this current context as the Anthropocene—the age of humans, where humans' impact on the planet is so stark that it is driving dangerous planetary change—which has been formally proposed as a new geological epoch.[36]

The threats to human lives in the Anthropocene are fundamentally unequal, as they will more quickly and intensely affect people and countries that have contributed less in relative and absolute terms to planetary pressures and benefited less from the changes that drive planetary pressures. As the 2020 Human Development Report argued, large and often growing inequalities and power imbalances are a defining feature of the Anthropocene, underpinning the destabilizing dynamics that divert policy attention and may delay action to ease planetary pressures. But given that the threats emanating from dangerous planetary change are driven mainly by humans, the Anthropocene context is creating a responsibility for humanity to act.[37]

If humans have the power to change the planet in harmful and unequalizing ways, they have the obligation to act towards pursuing a safer and more just world.[38] The responsibility to act falls more heavily on those who account for more of the planetary pressures and have more power to change course. People are not inherently destroyers of nature; they have

also shaped ecosystems in mutually beneficial ways.[39] So the Anthropocene provides us with not only the responsibility but also the opportunity to pursue human development while easing planetary pressures—the central message of the 2020 Report.

A new planetary reality

Uncertainty in the Anthropocene is about much more than climate change. Even with advances in science and computational power,[40] the multiple feedback loops between social and ecological systems may imply that our "knowledge of the world, its ecosystems and people, their behaviour, values and choices will always be partial."[41] One key unknown is whether people will appreciate, and take the responsibility to act on, the power that we have to stop disrupting planetary processes. Thus, the Anthropocene is characterized by far-reaching and complex interactions between social and planetary systems that engender a layer of novel uncertainty.[42]

Beyond warming temperatures,[43] human-induced planetary pressures result in a natural environment profoundly different from what humans have previously experienced (spotlight 1.1). The frequency and intensity of extreme storms, droughts, wildfires and heatwaves have increased since the 1950s.[44] The intensification of urbanization and agricultural production has disrupted forests, wetlands and grasslands—so much that the amount of human-made materials, such as concrete and asphalt, now outweigh the Earth's biomass.[45] More than 1 million species face extinction, threatening the integrity of whole ecosystems.[46]

> "The Anthropocene is characterized by far-reaching and complex interactions between social and planetary systems that engender a layer of novel uncertainty

These phenomena reinforce each other, magnifying the speed and scale of threats to our natural and social systems. For example, the warming and acidification of oceans provoke migration of fish stocks, affecting food supplies and the livelihoods of coastal communities. Food insecurity and eroded livelihoods can then prompt migration, change land uses and exacerbate pollution, further weakening ecosystems.[47] As another example, zoonotic diseases are a latent threat: more than 10,000 virus species have the potential to infect humans.[48] These have so far been contained within wild animal populations, but with accelerated climate change and increased human interference with zoonotic reservoirs, animal to human transmission is expected to increase[49] and heighten the risk of new and more frequent pandemics.[50] For example, the intensified human intervention in animal habitats due to agricultural production is associated with more than half of all zoonotic diseases infecting humans since 1940.[51] And climate change may alter the pattern of disease exposure and infections as warmer temperatures change the range of disease-carrying insects.[52]

More volatility is also expected. Climate change is predicted to increase both average temperatures and temperature variability, with temperature fluctuations projected to increase by 100 percent at lower latitudes.[53] More than 40 percent of the world's population depends on water sources affected by high climate variability. By 2080 an estimated 1 billion additional people are expected to be impacted by high climate variability and climate-related water security threats.[54] High weather variability reduces the "ability of economic agents to plan and function effectively"[55] and may impair health[56] and economic productivity.[57] For example, intraday and interday temperature variability is associated with increased mortality risk.[58] Many lower-income countries are disproportionately exposed to increased temperature fluctuations and lack resources to invest in adaptation, leaving them more vulnerable.[59]

Dangerous planetary changes are shifting the baseline of hazards,[60] but because these changes are driven largely by humans, our choices matter. The uncertainty related to the range of possible evolutions in emissions[61] is driven by both the evolution of the climate system and its interaction with the choices we make. Implementing the Paris Agreement in a timely manner increases the world's chances of keeping global average temperature increases below 2°C (figure 1.8).[62] For example, the difference between a 1.5°C and a 2°C increase in global temperature exposes an extra 1.7 billion people to extreme heatwaves.[63]

The uncertainty about dangerous planetary change does not spell unavoidable doom and societal collapse.[64] A balanced reading of the historical record

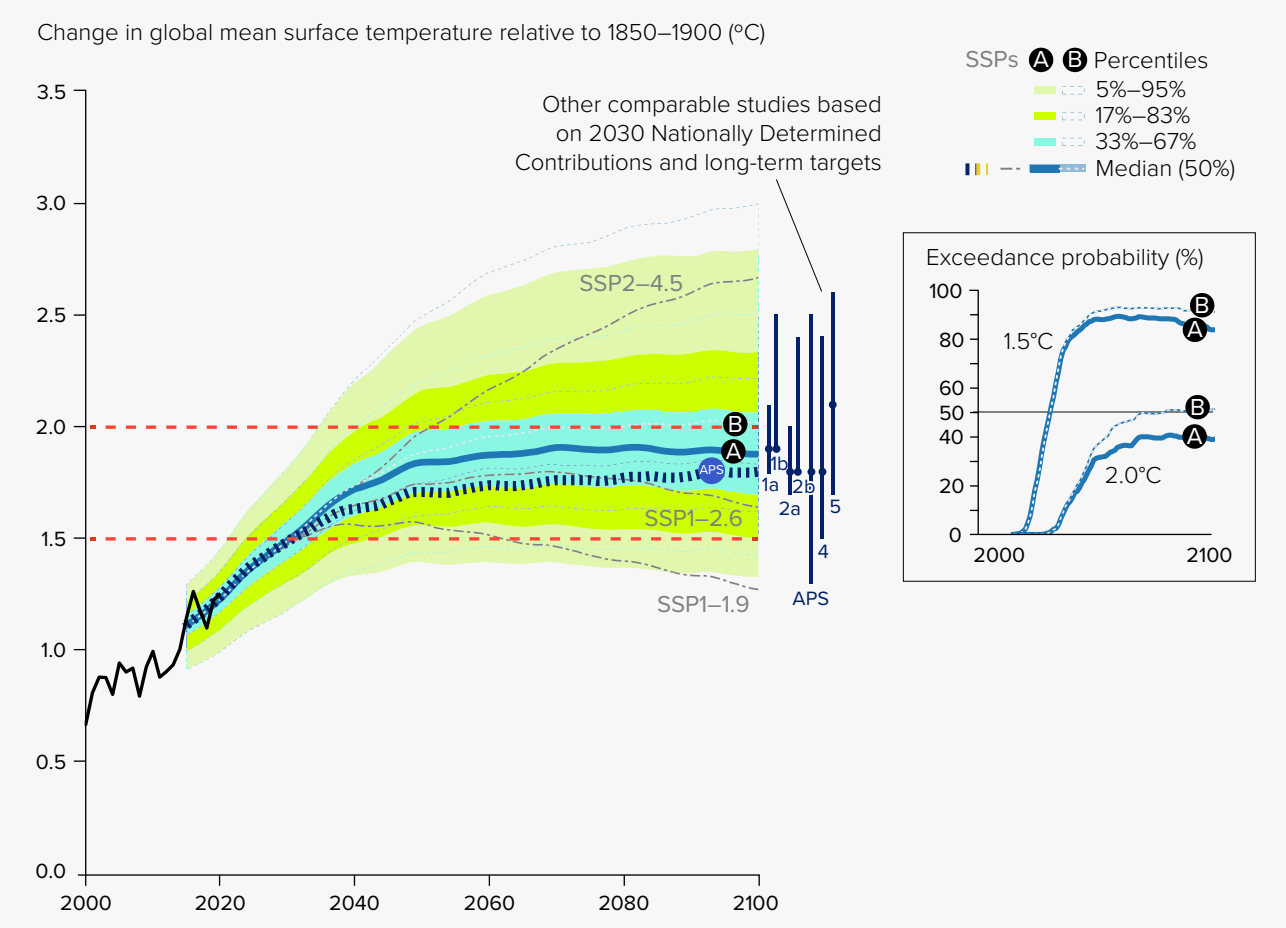
suggests that human societies have, for the most part, been resilient, flexible and able to respond, adapt and thrive when confronting major environmental changes (see spotlight 1.1).[65] Even though the evidence pertains to circumscribed geographic contexts, there is reason to believe that even if not all response options are fully available—for instance, migration when there will be fewer areas with temperatures suitable for human thriving[66]—people retain their ability to adjust and respond, even to a new planetary reality.

Unequal contributions, unequal impacts—planetary pressures and social imbalances reinforcing each other

Countries and groups of people that have contributed less to planetary pressures are projected to bear the largest burdens of dangerous planetary change.[67] For example, mortality and reductions in labour productivity due to warming temperatures will be greater in low- and middle-income countries,[68] leaving them with fewer resources to adapt to planetary pressures and adding layers of vulnerability.

Moreover, climate change is an inequality multiplier. Consider the stark inequalities in contributions to and impacts of carbon dioxide emissions. The top 10 percent of the global income distribution is responsible for almost half of global annual emissions, and the bottom 50 percent, only 12 percent of emissions.[69] The inequalities run even deeper at the top. In 2019 the bottom 50 percent accounted for 1.6 tonnes of carbon dioxide emissions per capita, while the top 10 percent accounted for 31 tonnes per capita, the top 0.1 percent 467 tonnes per capita and

Figure 1.8 The wide range of possible future warming depends on our choices



SSP is Shared Socioeconomic Pathway.
Note: The figure shows global warming as a result of officially submitted Nationally Determined Contributions to reduce emissions under the Paris Agreement, as well as the long-term targets at the end of the 2021 United Nations Climate Change Conference (COP 26). It shows a wide range in increased temperature outcomes, depending on whether the base for analysis is Nationally Determined Contributions or only unconditional targets.
Source: Meinshausen and others 2022.

the top 0.01 percent 2,531 tonnes per capita.[70] Since 1990 the top 1 percent have accounted for 21 percent of the increase in emissions.[71] So, within-country inequalities are quickly becoming a defining feature of global carbon dioxide emissions, all while massive between-country inequalities in emissions persist.[72]

> "The channel through which planetary pressures are affected by inequality runs through actual choices as well as through aspirations

Those contributing the least to climate change find themselves at the losing end. Unmitigated climate change may drive up to 132 million people into poverty in the coming decade.[73] Planetary pressures may also exacerbate horizontal inequalities or even open new gaps between groups.[74] For instance, future risks of flooding in the United States are expected to affect mainly low-income Black communities.[75] And barriers to women's participation in decisionmaking work against policies and resource allocations that address women's specific vulnerabilities to environmental change.[76]

As seen above, curbing emissions at the top of the income distribution would have a great impact,[77] but when those responsible for planetary pressures are not equally affected by them and believe they have the resources to shield themselves from the adverse effects, incentives to ease planetary pressures are distorted. The choices of high-income earners are associated with consumption and production patterns that account for a disproportionate share of planetary pressures. These choices are driven by many factors, but social norms among high-earners and peer effects influence the lifestyles they expect.[78] Their social context determines not only choices but also aspirations.[79]

The channel through which planetary pressures are affected by inequality runs through actual choices as well as through aspirations. Aspirations can play an important role as an incentive for effort with positive individual and collective outcomes[80] and in enhancing human development.[81] The reference frames of aspirations for adjacent, but lower, income groups are influenced by the behaviour of higher earners. As reference points change, more and more people may be influenced to behave in ways that add to planetary pressures. Such dynamic "expenditure cascades" show how demand for large housing, large cars and other large goods has increased even where median incomes are stagnant.[82] If access to these positional goods becomes harder and the referent of aspirations is seen to be out of reach, the positive effects of aspiration can instead lead to alienation and frustration.[83] This mismatch between aspiration and realization has implications for people's wellbeing (it can increase depression).[84] But it can also change people's perception of the future from positive to negative and their sense of agency over the future from high to low[85]—leading to more pessimistic views. As a result, there will be less of a concern about how individual behaviour affects future outcomes. And alienation and frustration can, in turn, contribute to polarization, making collective action towards easing planetary pressures more difficult.

No second chances: Existential threats in the Anthropocene

To see how the uncertainties in the Anthropocene are novel, consider existential threats. For the first time in human history, anthropogenic existential threats loom larger than those from natural hazards.[86] This started with the advent of nuclear weapons, with escalating technological power reaching the point where we are able to threaten our own destruction. Nuclear war posed an existential risk:[87] the permanent destruction of humanity's long-term potential. Throughout most of human history, the existential risks to our species emanated exclusively from natural hazards, independent of human action—including large asteroid impacts or massive volcanic events, such as those leading to mass extinction events in the geological timescale.[88] Humans have always had power to inflict much harm on each other and on nature, but only in the Anthropocene have they reached the potential to kill much of the global population and destroy the potential of future societies.[89]

The spectrum of anthropogenic existential threats is large and growing. In addition to the prospect of nuclear war, threats include artificial intelligence (AI), genetic engineering and nanotechnology, as well as the dangers of planetary pressures and their interactions.[90] They may be deliberate, as in the use of nuclear force. Or they may be accidental, such as

the spread of a virus from a lab, or they may emerge from ungovernable technological development.[91] Heightened political polarization and conflict may increase the existential threats, including through nuclear war or biological warfare.[92] The drivers of a possible nuclear conflict may be linked, both in exacerbating the risks and in magnifying the impacts for human lives and the planet (spotlight 1.2).[93]

> "Easing planetary pressures would entail a fundamental transformation in how societies live, work and interact with nature. This transformation engenders its own novel layer of uncertainty, because, like the Anthropocene reality, it is unprecedented and uncharted

While the existential risks of nuclear war might be easily imagined, the existential risks of slow-onset climate change or biodiversity loss may not be as evident. With continued human pressures on the planet, tipping points—beyond return—can inflict irreversible damage to ecosystems and to the benefits humans derive from them. If tipping points interact, they may have catastrophic and cascading consequences.[94] For example, climate change is provoking Arctic sea-ice loss, which contributes to a slowdown of the Atlantic circulation, which could disrupt the West African monsoon and trigger drought in the Sahel, dry up the Amazon and warm the Southern Ocean, further accelerating the melting of Antarctic ice. Amazon forest dieback would distort the stability of the Earth's biosphere, with large-scale consequences, including massive biodiversity loss and unprecedented rises in carbon dioxide concentrations in the atmosphere.[95] While uncertainty remains about the exact "location" of tipping points and the full consequences of crossing one, they are just "too risky to bet against."[96]

Realizing the power that humans have over our entire planet implies the responsibility to act. Recognizing anthropogenic existential threats also provides an obligation to lower, indeed to eliminate, existential risk. In the same way that the Anthropocene provides a unifying framework to understand how human choices drive planetary pressures that result in disequalizing dangerous planetary change, eliminating existential risk—or promoting existential security—is the ultimate nonrenewable resource and demands reflecting on the type of institutions needed to reach existential security (spotlight 1.3).

Uncertainty emerges from complex transitions to ease planetary pressures

Adapting to the uncertainty brought about by the Anthropocene reality just described is a tall order. In addition to adaptation, it is crucial to ease the planetary pressures that are driving dangerous planetary changes. Easing planetary pressures will also mitigate some of the uncertainties.[97]

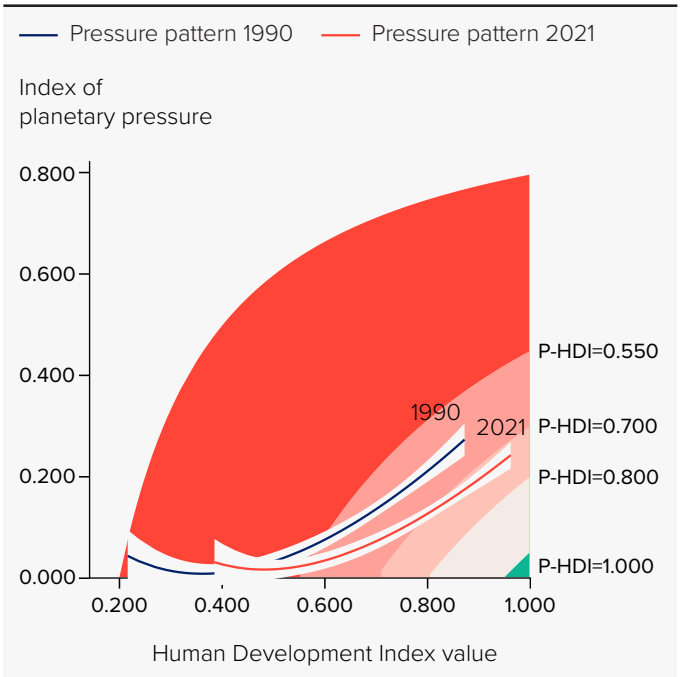
Easing planetary pressures would entail a fundamental transformation in how societies live, work and interact with nature, comparable to the transitions to agricultural societies and from agricultural to industrial societies.[98] That calls for us to work with —not against—nature (spotlight 1.4). This transformation engenders its own novel layer of uncertainty, because, like the Anthropocene reality, it is unprecedented and uncharted. Uncertainty also emanates from the fact that transformations involve multiple social and ecological factors, and their interactions, playing out over the long term of the transitions at stake. Even if many of these transitions have in some ways been charted and modelled (singly or in parts of the world), there is also modelling and analytical uncertainty.

Central in all this is transforming how societies generate energy and use materials.[99] That will involve shifting both production and consumption patterns, underpinned by how human behaviour interacts with institutions. And that interaction shapes, and is shaped by, incentives, social norms and values.

The 2020 Report proposed representing advancing human development while easing planetary pressures as paths taking countries towards the aspirational space of the green triangle in figure 1.9.[100] While the world had moved in that direction over the past 30 years, it has done so far too slowly and in a way that leaves higher human development strongly correlated with greater planetary pressures. The needed scale and speed of this transition should not be oversimplified or minimized, given the ambition of the required shifts[101]—and that, along with complexity of the transition, adds a new layer of uncertainty.[102]

Transitional uncertainty has several dimensions, including those associated with a move towards a

Figure 1.9 Transforming our world to advance human development while easing planetary pressures



Note: Cross-sectional pressure patterns for 1990 and 2021 were calculated using a polynomial regression model. Shaded areas are confidence intervals. The index of planetary pressures is constructed using the per capita levels of carbon dioxide emissions and material footprint in each country (it is 1 minus the adjustment factor for planetary pressures presented in table 7 in the *Statistical Annex*).

Source: Human Development Report Office. See specific sources in tables 2 and 7 in the *Statistical Annex*.

low-carbon economic development path.[103] Beyond the physical uncertainties of climate change are the uncertainties associated with our deliberate policy choices—such as altering carbon taxes, shifting economies away from carbon-intensive industries or adopting new technologies.[104]

Some of the uncertainty is associated with who will win and who will lose as the process unfolds, which will likely differ across regions and groups—recognizing that some are better equipped than others to benefit from new opportunities.[105] One possible manifestation of uncertainty could be economic insecurity (spotlight 1.5). For instance, the green economy could add more than 24 million jobs worldwide by 2030.[106] But these jobs will not necessarily be in the same regions that stand to lose jobs as fossil fuel industries shut down,[107] nor will they require the same set of skills as in a fossil fuel–based economy. The economic gains from phasing out coal could amount to as much as 1.2 percent of global GDP every year until 2100—but the question remains about how these gains would be distributed across countries and across individuals.[108] If distributional effects are perceived as unfair or if people are left without the support to adapt to a new economic reality, transitions may be met with resistance, dissent and dispute.[109]

The outcomes of past transitions have been largely unplanned and unintentional. But the expansion of knowledge and science and our awareness of the Anthropocene reality imply that the transitions to ease planetary pressures are purposeful and deliberate. The goal of the transitions is clear—to move to the aspirational space of high human development and low planetary pressures—even if much uncertainty remains about the pathways that would take us there.[110]

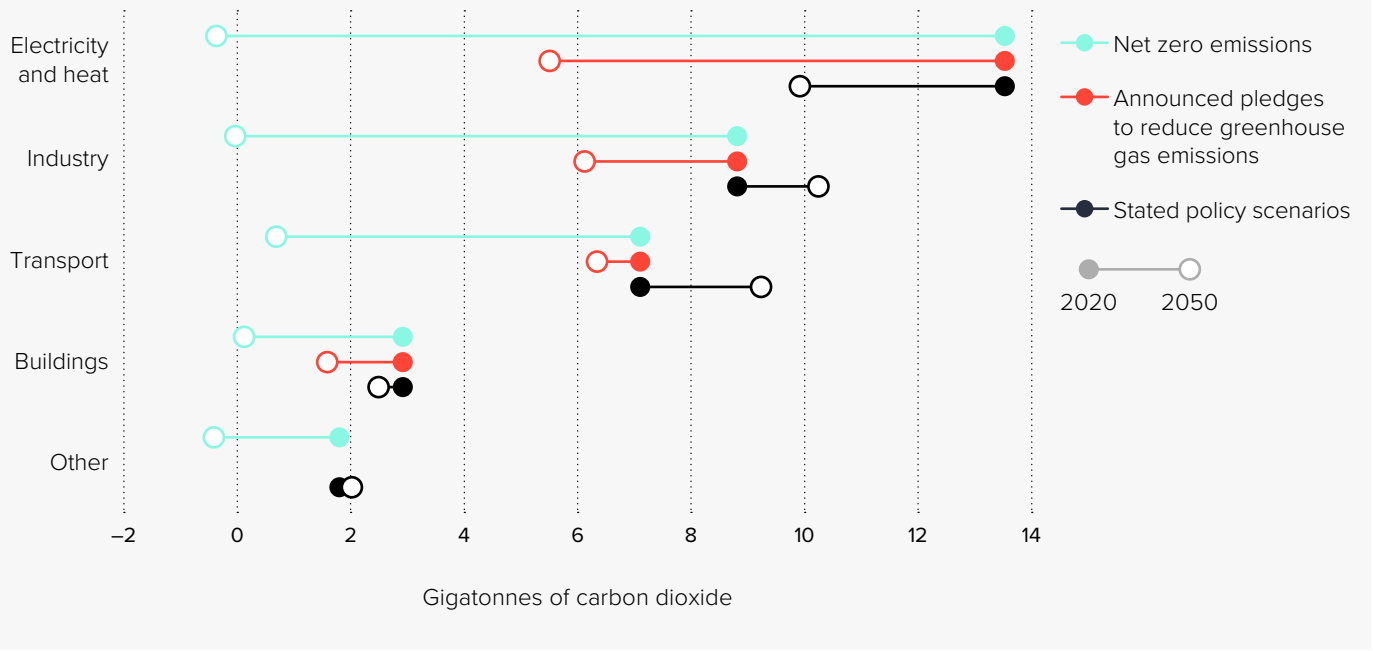
Uncertainties stem not only from the types of policy choices that are adopted but also from how they are designed and implemented. Success depends on their perception—on their social acceptance by different segments of the public and those that hold positions of power. Transitions depend on technology, and the resulting efficiency gains from it and how they are distributed. Explored here are changes required to ease planetary pressures and the layer of uncertainty associated with energy and resource transitions.

Energy transitions: Making their way, but too slowly and amid great uncertainties

Energy transitions from fossil fuels towards renewables are driven by new technologies and lower costs.[111] While fossil fuels such as coal, natural gas and oil still produce two-thirds of global electricity,[112] renewables are expected to become the dominant source of global energy supply by 2040.[113] But this is only one of many possible future outcomes. The outcomes vary widely under three scenarios of the International Energy Agency: net-zero emissions, stated policy scenarios and announced pledges to reduce greenhouse gas emissions (figure 1.10).

Uncertainty can unfold as consequences emerge. Biofuels, originally thought to be an excellent alternative for fossil fuels, also pose a variety of challenges[114] —with implications for land use,[115] carbon footprint,[116] deforestation impacts,[117] biodiversity loss,[118] water competition[119] and poverty impacts,[120] among others.

Figure 1.10 Energy transitions towards renewables can unfold in different ways for different sectors



Source: IRENA 2021.

Uncertainty is also associated with prospects for developing technologies key to the energy transition, which are not yet in place. Consider energy storage, which is critical to addressing the intermittency of supply due to daily and seasonal differences in renewable power. While a handful of technologies are available, much more is needed to enhance technological solutions, lower costs and make transmission more efficient. Even with advances in battery storage, adoption remains limited in most low- and middle-income countries due to policy, financial and regulatory barriers. Options sought beyond short-term energy storage solutions, such as lithium-ion batteries, include sustainable, cost-efficient long-duration energy storage systems, which are a long way off.[121]

Another dimension of uncertainty is how the financial system, which assumes a stable climate, will evolve.[122] A shift away from carbon-intensive assets will expose some investors, who may resist and attempt to slow a move towards a low-carbon path.[123] Governments are now paying more attention to climate-related financial risks. For example, a 2021 executive order by US President Joseph Biden requires clear and accurate disclosure of climate-related financial risks to safeguard physical assets as well as financial markets from climate change–related risks.[124] The objective is to protect communities and families as the United States transitions to the net-zero emissions target by 2050.

Global and regional mechanisms are also working to facilitate a low-carbon transition in the financial sector. The Task Force for Climate-Related Financial Disclosure seeks to provide investors with information on climate change–related risks in their portfolios. With the same inspiration a consortium of central banks and financial supervisors established the Network for Greening the Financial System.[125] The EU Taxonomy, which classifies environmentally sustainable economic activities, supports transitioning to net-zero emissions by 2050 and implementing the European Green Deal; the EU Delegated Act has been formalized to set the screening criteria for the environmental objectives of new economic activities. And European countries are stepping up various mitigation efforts, such as ending the sale of new diesel- and gas-powered cars in 14 years and imposing tariffs on goods imported from countries with lax environmental laws.[126]

The volatility in oil and gas prices during the Covid-19 pandemic and now as the war in Ukraine unfolds is sending shock waves around the world.[127] Oil-exporting countries experienced large fiscal deficits

when oil prices dropped.[128] But a range of factors, including the conflict in Ukraine and economic recovery as Covid-19 concerns have eased, have led to a rapid increase in oil prices, a boon to oil-exporting countries but also a driver of inflation almost everywhere.[129]

The uncertainty associated with energy transitions has unsettled people who perceive it as unjust. French villages and small towns saw protests against rising petrol prices again in 2021, reminiscent of the "yellow vest" movements of 2018, Spain saw demonstrations against energy bills and Greece faced social unrest with the closure of coal mines.[130] This even as a large numbers of jobs are being created in the renewable energy sector.[131] Yet while it is anticipated that more jobs will be created than lost in energy transitions, whether the transitions will be just will depend on how they are managed.[132]

Current global pledges to reduce greenhouse gas emissions cannot safeguard against dangerous climate change.[133] Carbon prices remain far too low to effectively curb emissions. Only 22 percent of global carbon emissions are under a carbon pricing scheme.[134] And implementation remains a challenge even for commitments made to phase out fossil fuel subsidies —no date has been set to achieve the target globally, and 2021 saw the highest increase in fossil fuel subsidies since 2010.[135] Uncertainty associated with the transition can be heightened by the realization that more ambition is needed, along with the resistance to change from powerful lobby groups or public concerns with loss of employment in specific sectors.[136] And the transitions can be drawn out: phasing out coal in Germany, initiated in the 1980s, is still years from completion, with concerns about stranded assets and the insecurity of affected workers and communities.[137]

"Deliberate energy transitions are happening now, backed by policies and supported by social movements

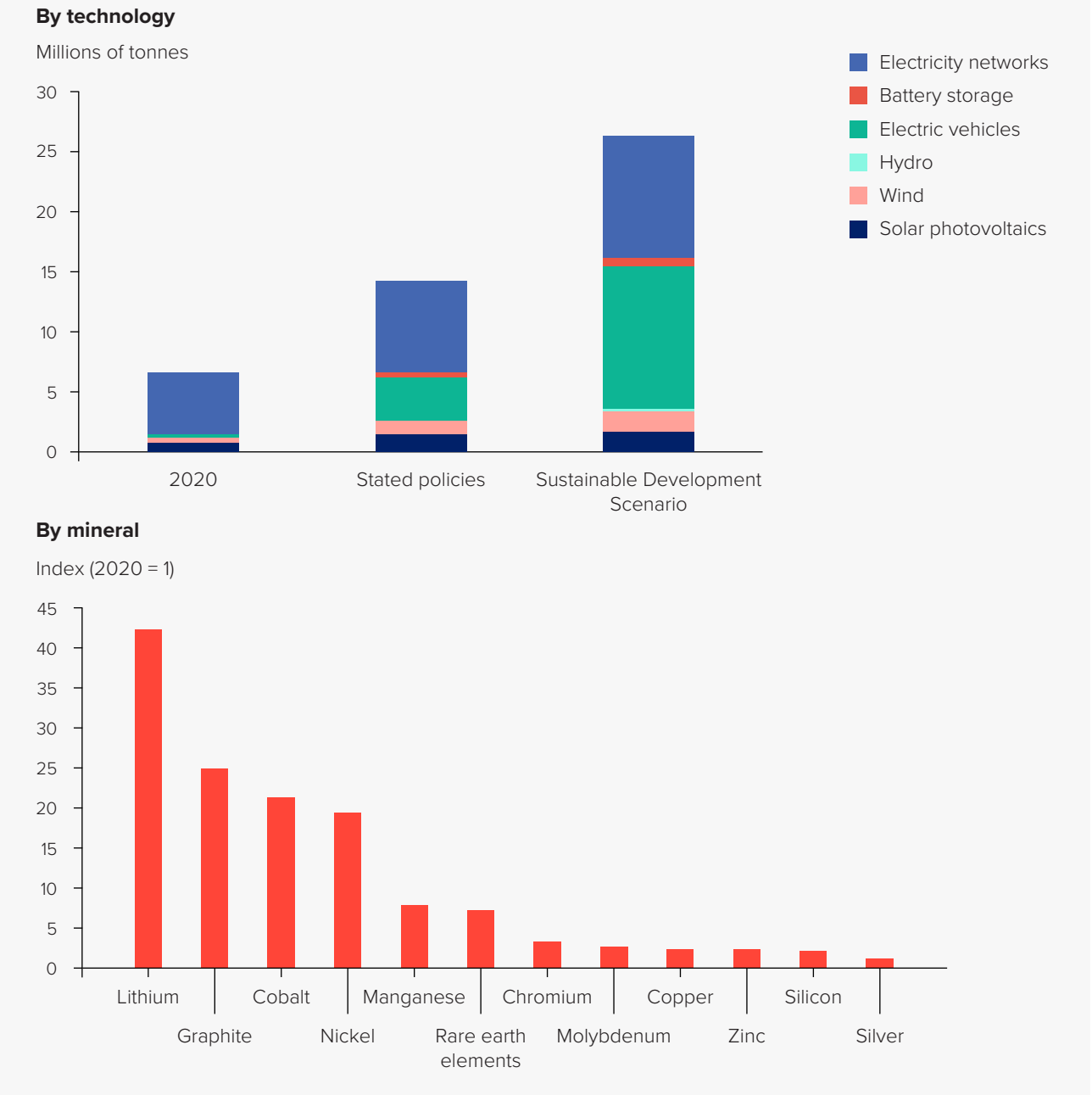
Even so, energy transitions are possible.[138] A move in France to increase nuclear capacity boosted its share of power from 4 percent in 1970 to 40 percent in 1982.[139] The Netherlands went from having coal supply 55 percent of its power and crude oil 43 percent in 1959 to having natural gas supply 50 percent by 1971.[140] Deliberate energy transitions are happening now, backed by policies and supported by social movements.[141]

Uncertainty associated with managing material use to ease planetary pressures

The shift to low-carbon economies will depend in part on extracting minerals and using materials that are key to technologies such as electric cars and solar panels. The same extraction implies land-use change and emissions that not only add to planetary pressures but have also been linked with serious human rights violations.[142] For example, rare earth elements can be located in sensitive ecosystems with high biodiversity, crucial carbon sinks and water resources, which if exploited could irreversibly damage natural resources. Of the 50 million square kilometres of the Earth's land currently being mined, about 8 percent overlaps with protected areas, 7 percent with key biodiversity areas and 16 percent with the remaining areas free of industrial activities and other human pressures.[143] The next wave of renewable energy growth could affect 30 percent of protected areas and key biodiversity areas and compromise 60 percent of the remaining areas free of industrial activities and other human pressures.[144] Ongoing conflict diverts resources and attention from protecting sensitive ecosystems and vulnerable populations. With energy demand projections based on existing policies and policy announcements, mineral demand is expected to double. And under a sustainable development scenario, where energy policies are consistent with the Paris Agreement goals, mineral demand is expected to quadruple (figure 1.11).[145]

Another dimension of uncertainty is related to the future of seabed and space mining. Growing demand for renewables is driving mining companies and start-ups to invest in opportunities under the ocean.[146] Scientists warn that disturbing an otherwise quiet and dark seabed that provides a unique ecosystem for marine life will have ramifications not only locally but also thousands of kilometres away. The first experiment in seabed mining in 1989, DISCOL,[147] demonstrated that species did not recolonize after more than 30 years. With technology ahead of the curve and regulations catching up, the commercial exploitation of seabed mining could be devastating for marine life.

Figure 1.11 The energy transition demands minerals and materials that add to planetary pressures



Note: The demand for minerals will depend on the types of renewable energy. For example, copper and silicon are important for solar panels and transmitting power, and lithium, manganese and zinc are important for wind energy (IEA 2021b).
Source: Human Development Report Office compilations based on data from IEA (2021b).

And as technology races ahead to make space mining a near possibility, questions are being raised about regulations.[148] There is no legal agreement among nations to prohibit mining celestial bodies; the two treaties in place allow for free exploration and use of space resources, leaving choices to miners. Moreover, strong pressures to look for answers beyond our own planet may divert attention from ourselves.[149]

The demand for materials goes beyond that for the energy transition. It is adding to planetary pressures with implications that will span deep into the future. A plastic water bottle can remain in nature for approximately 450 years.[150] And since the 1950s we have produced more than 8 billion tonnes of plastic.[151] In 2020 the world's consumption of materials exceeded 100 billion tonnes a year,[152] twice the amount

in 1995.[153] By 2060 it is expected to be at least three times that in 1995.[154] Only about 8.6 percent of everything produced is recycled.[155] Human-produced goods are changing the face of the Earth. To give a sense of the scale, for the first time in human history, anthropogenic mass exceeded world's living biomass (figure 1.12).[156]

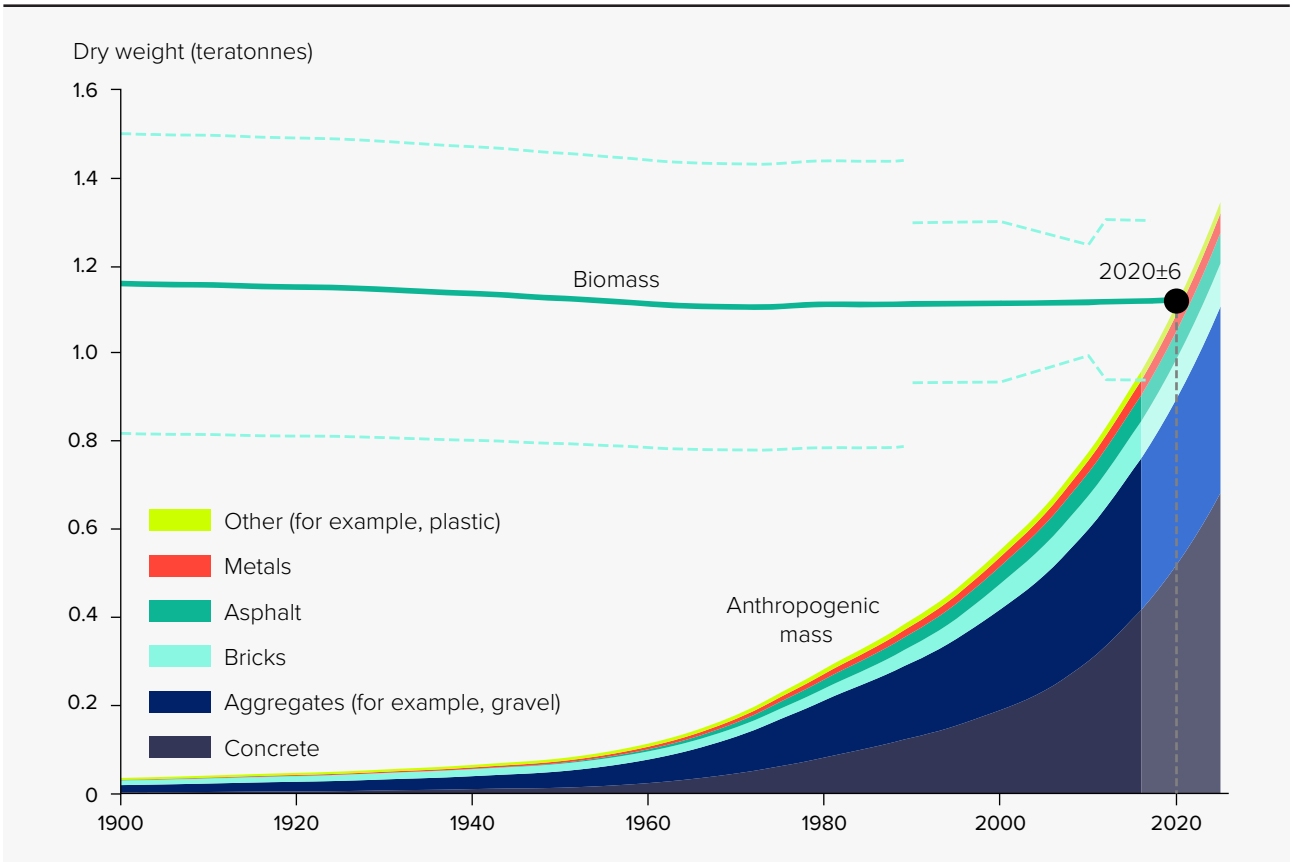
The challenges with nuclear waste disposal also point to the need to consider material use in a comprehensive way. Nuclear resources that are used to produce clean energy and industrial goods and for military applications also generate radioactive waste, which needs to be stored for more than half a million years—transmitting responsibilities and challenges to distant generations.[157] Much of the waste is temporarily stored underground in tanks, which through wear and tear may leak radioactive material into our soils and water. About 95 percent of the world's nuclear power reactors have produced an estimated 265,000 metric tonnes of spent heavy-metal fuel and 38 million cubic metres of solid nuclear waste.[158]

Anthropogenic activities are also disrupting biogeochemical cycles. Carbon levels are 36 times higher than preindustrial levels, phosphorous levels 13 times higher and nitrogen levels 9 times higher.[159] The nitrogen in fertilizers accumulating in nature pollutes water (excessive nitrates in drinking water), reduces air quality, depletes the ozone layer and accelerates global warming and biodiversity loss.[160] The excessive runoff of nitrogen into rivers and oceans increases algae blooms, which are depleting ocean oxygen and killing aquatic flora and fauna. Satellite images suggest that about 1.15 million square kilometres of the ocean surface may be eutrophic zones,[161] with a large part of them dead zones.[162]

Rapid technological change: A shifting ground beneath our feet

Rapid technological shifts are bringing new ways for humans to interact with technology, and with each

Figure 1.12 Anthropogenic mass now exceeds the world's total living biomass



Source: Elhacham and others 2020.

other, creating more novel uncertainties.[163] The potential gains are massive, but what about the distribution of benefits and the differentiated impacts on people? The eventual emergence of general-purpose AI could multiply global GDP per person by a factor of 10—something that historically took the world 190 years to accomplish, from 1820 to 2010.[164] But these massive potential aggregate gains may be concentrated among a few, leaving many behind. One possibility is falling into a Turing trap, where technological and economic power is concentrated and translated into political power, "trapping a powerless majority into an unhappy equilibrium."[165] The backlash against free trade in some high-income countries offers a cautionary tale, given that the aggregate income gains of globalization through comparative advantage and specialization were not distributed to compensate disadvantaged occupations, sectors or regions. The economic winners gained power and lost interest in ensuring the equitable distribution of benefits.[166]

"Recent technological changes outpace our ability to understand their societal implications. Often disruptive, artificial intelligence, social media and other new technologies are changing our lives in fundamental ways

Recent technological changes outpace our ability to understand their societal implications. Often disruptive, AI, social media and other new technologies are changing our lives in fundamental ways.

To illustrate the novel dimensions of uncertainty, the following sections briefly consider the digital age, AI and genetic editing; see chapters 4 and 5 for further analysis of the implications of technological change.

The digital world—transforming human-to-human interaction

Less than 1 percent of the world's technologically stored information was in a digital format in the late 1980s compared with more than 99 percent by 2012.[167] Whether the way we connect to our work, how we communicate with friends and family or what we do in our free time, digital technology has become an indispensable part of many people's lives. In 2010 the number of machines connected to the internet exceeded the number of people connected to it for the first time.[168] Unlike any previous generation, many children born after 2008 have extensive exposure to digital devices early in life.

Tempering the initial optimism about the opportunities of new technologies are downsides or unintended consequences. Mobile phones trace our movements. AI, reducing human effort in sophisticated tasks, can also replicate and amplify stereotypes. Social media, originally meant to connect us, are contributing to divisiveness. These illustrate how new technologies bring along unintended consequences, engendering uncertainty.[169]

Firms are bringing in new technologies at an accelerated pace to automate production and reduce costs. Some jobs are being lost, as in accounting, administration and translation, just as others are created in big data, digital security and robotics engineering. The World Economic Forum projects that by 2025, 97 million new jobs will be created and 85 million jobs will be lost across 15 industries in 26 economies.[170] Industries not keeping pace with the trend towards automation stand to lose competitive edge, as will labourers who do not acquire new skills to keep pace with the changing labour market. This may also have implications for low- and middle-income countries, which may see a reshoring of jobs.[171]

Digitalization is changing human-to-technology and human-to-human interactions, sometimes radically. Online dating is one example of digitalization-altered human interaction.[172]

Human interaction with algorithms has also turned detrimental in many ways.[173] Mobile telephones and social media lift the voices of marginalized and oppressed groups but are also tools for those wishing to do harm.[174] Through these platforms groups with extremist and violent ideologies can expand their followings.[175]

The constant connectedness to social media can have harmful cognitive and emotional effects.[176] Neuroscientists suggest that internet use has altered the way the brain functions, affecting attention and memory and making us less sociable and empathetic.[177] For example, adding a single moral-emotional word to a tweet increases its retweet rate by 19 percent.[178] A post that includes indignant disagreement

obtains twice as many likes and three times as many comments.[179] And the high demand for attention, as through the overuse of social media, reduces the time young people have for constructive reflection, shrinking the space for future imagining or reflecting on personal memories.[180]

Artificial intelligence—making choices for us

As our lives become more dependent on AI—from weather forecasts to financial market transactions to analysing DNA—we are delegating human choices. AI is choosing the news and information we are exposed to and suggesting what we should buy.

The use of algorithms in social media results in people's decreased exposure to counterattitudinal news, facilitating the polarization of views.[181] Among millennials in many parts of the world, social media outlets are often the dominant source of news about politics and governments.[182] By recommending automated videos and news, manipulative content now easily reaches viewers, amplifying the spread of disinformation.[183] Social media can also fuel populist, nationalist and xenophobic waves across societies.[184]

AI is getting better at creating counterfeit information and fuelling the spread of disinformation. Consider how generative adversarial networks create counterfeit audios and videos.[185] These technologies can now be easily used through apps to create deepfakes. By 2016 more than 50 percent of internet traffic was generated by bots.[186] Indeed, false information tends to spread more broadly than true information.[187] Social networks can reduce critical assessment and facilitate the diffusion of conspiracy theories.

> "As our lives become more dependent on artificial intelligence—from weather forecasts to financial market transactions to analysing DNA—we are delegating human choices

In a similar vein, who is responsible for mistaken AI decisions? Credit applications are rejected, and social media posts are deleted based on AI decisions, while mechanisms to contest these decisions are not fully developed. Many algorithms are opaque, unregulated and difficult to contest.[188] Pattern-recognition algorithms could be applied to target certain people[189] or produce disproportional and biased collateral damages due to imperfections in the code or in training data.[190] The use of AI in the military to deploy autonomous weapons or killer robots raises many questions.[191]

Machine learning is also providing firms with market information that they have never had before, creating new avenues for advertising while potentially encroaching on consumer privacy. When consumers purchase online, they reveal their preferences, and perhaps information about their friends and families, that companies can use to expand market outreach. Such data, often provided inadvertently by consumers, may transfer information to companies without constraints on how it may be used.[192]

Genomic editing—redefining the realm of possibilities

Genomic editing has revolutionized the life sciences and medicine through the possibility of changing the characteristics of living organisms by altering DNA. CRISPR can support the treatment of a range of health conditions with relative ease and efficacy.[193] For the first time it is possible to increase the longevity of children with progeria, a genetic disorder that promotes early aging and to reverse blindness.[194] CRISPR is also being explored for neurodegenerative diseases such as muscular dystrophy, Huntington's disease and Alzheimer's disease.[195]

Genomic editing also raises questions. Somatic cell editing can change the genes of a particular patient, while germline editing of egg and sperm cells can carry the treatment to future generations. Progress in this field has been so rapid that issues around ethics, regulations and societal implications have countries scrambling to catch up. Recently, a researcher alarmed the world by confirming that he had edited the genes of twin babies.[196] There are also many safety concerns. For example, in an embryo a nuclease may not necessarily cut both copies of the target genes or may start dividing before the corrections are complete.[197] Gene editing in rats, cattle, sheep and pigs also shows that it is possible to delete or disable genes in an embryo. Bioethicists argue that it is impossible to obtain consent on germline editing from an embryo or from future generations.[198]

Gene editing in the food industry can enhance productivity and make products resilient to weather and disease.[199] Japan recently authorized a genetically edited tomato variant rich in amino acids (GABA) that can induce relaxation and lower blood pressure.[200] Drought-resistant crops are being developed to keep yields high in times of reduced water supply, and research is under way on whether genetically edited rice could be resistant to flooding.[201]

> "The conjunction of uncertainty and polarization may be paralyzing—delaying action to curb human pressures on the planet

How should genetically edited food be regulated and how should consumers be informed? And what about the labelling of genetically edited food? Several biotech companies, agribusinesses and food retailers are behind an antilabelling drive, while others advocate otherwise—but until these questions are answered, uncertainty is likely to persist.[202]

Uncertainty propelled by polarization: Delaying action, adding conflict

Uncertainty opens space for dispersing beliefs[203] and disagreeing on best courses of action.[204] This is not necessarily a problem. Indeed, when facing unpredictability, societies tend to leverage aggregate collective knowledge and narratives to mobilize resilience.[205] But uncertainty can also spur political polarization, especially among those averse to uncertainty.[206] For example, research finds that in the uncertain aftermath of a shock, such as a financial crisis, support for political extremes increases.[207] Political polarization reduces generalized trust and divides society into "us" and "them." It entrenches opinions, undermines public deliberation and may even reach toxic levels, with detrimental effects for democratic freedoms and human rights.[208]

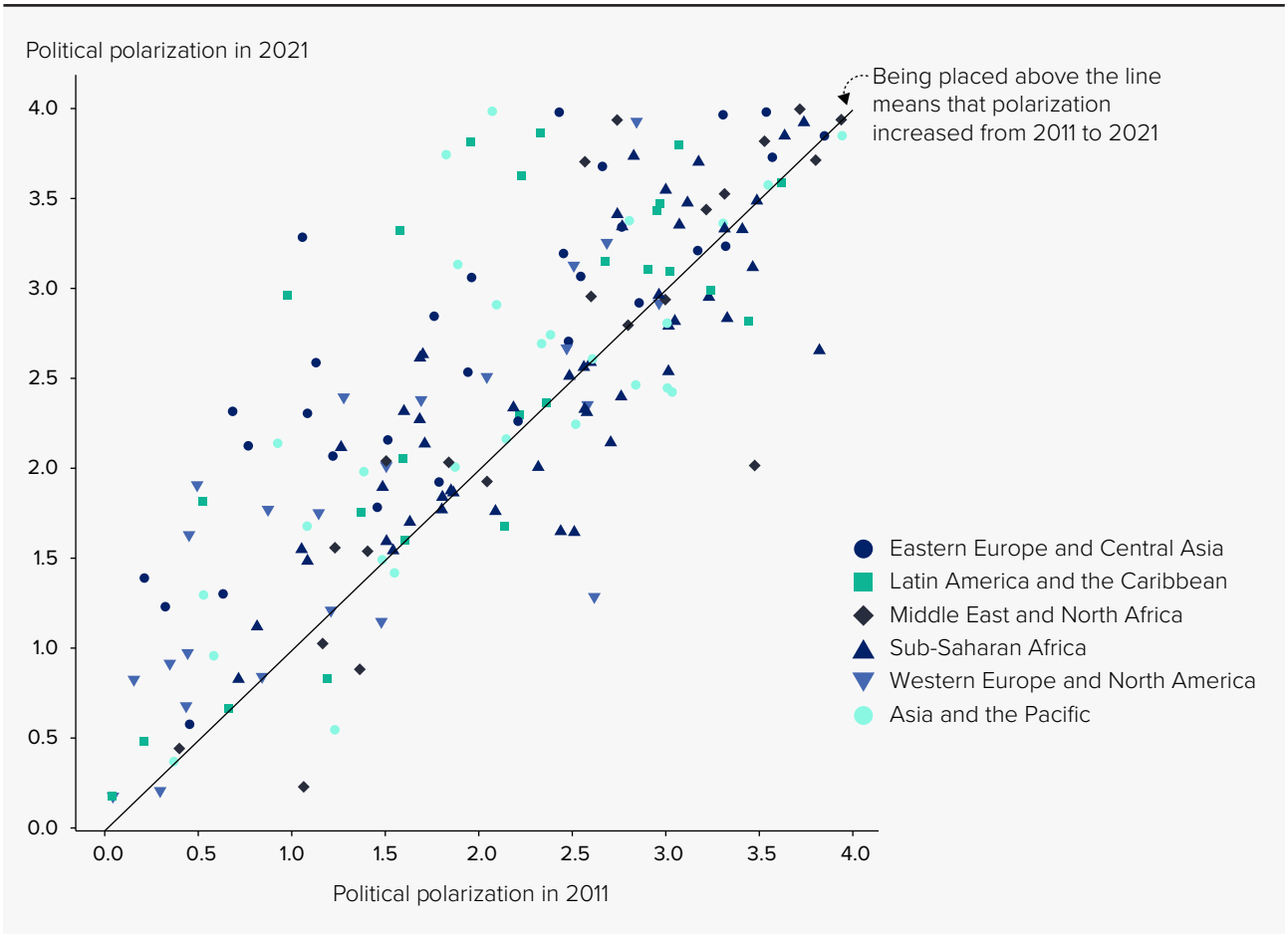
The last decade has seen rapid democratic backsliding and increased political polarization in many societies (see chapter 4).[209] Trust and belief in democracy have been declining in parallel with increasing authoritarianism.[210] Political polarization has been increasing across a diverse set of countries (figure 1.13).

The conjunction of uncertainty and polarization may be paralyzing—delaying action to curb human pressures on the planet. The real paradox of our time may be our inability to act, despite mounting evidence of the distress that human planetary pressures are causing our ecological and social systems. But when perspectives of the future are uncertain, people may draw different conclusions from the same data,[211] and scientific uncertainty can be a basis for political manipulation.[212] Indeed, the spread of disinformation has been found to contribute to deteriorating social attitudes and polarization.[213]

In today's uncertain times cooperation and dialogue have often taken a backseat, as armed conflicts and military spending peak.[214] Wars and violent conflicts pose direct threats to lives and livelihoods and compounding pre-existing vulnerabilities. They add huge layers of uncertainty to people's lives and impede both individual and collective investments in human development.[215] The number of people living in areas affected by violent conflict was reaching record levels even before the war in Ukraine. In 2020 about 1.2 billion people lived within 50 kilometres of a conflict event, almost half of them (560 million) in places outside so-called fragile contexts.[216] Furthermore, a large share of the increase in the number of people living close to conflict events has occurred in settings where conflict is present but results in fewer than 10 fatalities, indicating a shift towards insecurity and uncertainty that go beyond the most violent and deadly conflicts.[217]

Conflict diverts policy attention and resources from sustainable development and can hamper climate change mitigation and adaptation efforts.[218] Studies point to the twin crisis of conflict and planetary disruption (spotlight 1.6). Warming temperatures heighten conflict risks,[219] as documented in history,[220] with temperature surges linked to higher crime and interpersonal violence, even outside armed conflict settings.[221] Nature and natural resources are also becoming a source of contestation.[222] But the links between climate and conflict are not straightforward—they span socioeconomic, political and ecological spheres.[223] Today, some of the places most exposed to climate change coincide with fragile and conflict-ridden contexts, where resources and the capacity for resilience are already low (see spotlight 1.6). Conflict hinders access to much-needed climate financing in fragile and violent conflict contexts.[224] The low-carbon transitions under way can add insecurity by

Figure 1.13 Political polarization is on the rise across the world



Source: Adapted from Boese and others (2022).

opening new areas of contestation—especially when coupled with unequal power dynamics and uncertainties about land ownership (spotlight 1.7).

And now for something completely different: Novel and layered drivers of uncertainty

Uncertainties are stacking up and interacting. The novelty of humans' stark impact on the planet, the intentional efforts to transform, the fast pace of technological innovation and human development's embeddedness in nature invite us to take a step back and consider the feedback loops and interlinkages between our social and ecological systems.[225] With close interlinkages threats can easily spill over and multiply—leading to systemic failure.[226] The interaction of different layers of uncertainty makes the current context one of systemwide turbulence.[227] Extreme weather and climate events interact in ever more complex ways, shaped both by physical drivers and by societal contexts.[228] Institutions and behaviours create nonphysical interconnections, with implications for the impact of natural hazards and the severity of future extreme events in a series of complex feedback loops (table 1.1).

These interactions between physical and societal drivers have always been present at the local level. But over the 21st century the world will confront a continuously changing baseline, along with more extreme wet and dry precipitation events that will present adaptation challenges far beyond anything already experienced.[229] In fact, the changing "normal" will be so substantial that, if traditional measures to identify extreme events are based on what has been considered "normal," the entire late 21st century would be a single large extreme event.[230] In other words the interaction of physical drivers and societal

Table 1.1 Climate hazards driven by compounded physical drivers and societal context

Hazard	Climatic drivers	Societal drivers
Drought	Precipitation, evapotranspiration, antecedent soil moisture, temperature	Water management, land-use change
Physiological heat stress	Temperature, atmospheric humidity, diurnal cycle	Urbanization, irrigation
Fire risk	Temperature, precipitation, relative humidity, wind, lightning	Urbanization, deforestation
Coastal flooding	River flow, precipitation, coastal water level, surge, wind speed	Hard infrastructure, removal of natural coastal barriers
Flooding at river confluences	Precipitation, river water levels, large-scale atmospheric circulation	Water management, urbanization
Concurrent heat and drought	Temperature, precipitation, evapotranspiration, atmospheric humidity	Water management, soil management, land-use change
Concurrent wind and precipitation extremes	Wind speed, precipitation, orography, large-scale atmospheric circulation	Few or none
Concurrent heat and air pollution	Temperature, solar radiation, sulphur dioxide, nitrogen oxides, ozone, particulate matter	Urbanization, agricultural and industrial activities

Note: The table provides examples of how compounding climatic drivers and societal drivers interact to produce connected climate extremes. The societal drivers listed are nonexhaustive and include only those that contribute directly to the hazard rather than those that contribute to the impact. Long-term anthropogenic climate change plays into many of these hazards but is omitted here for simplicity.
Source: Adapted from Raymond and others (2020).

forces[231] is fundamentally shifting both the baseline of hazards and their increased variance.[232] In the past, institutions and behaviours evolved over time to manage the impact of uncertainty and reduce the vulnerabilities to threats. In the future, patterns of local adaption will be so disrupted as a result of climate change[233] that we may be ill-equipped to handle nationally and even globally the simultaneous materialization of multiple threats interacting with one another in compounding and novel ways (see box S1.6.1 in spotlight 1.6 for one example of a compounding crisis at the national level).

Droughts have rarely, if ever, affected all the major food producing regions at the same time, providing opportunities for "global insurance" through trade. The decline in food supplies in a drought-affected region could be compensated for by the supply from other regions free of drought. Now, the risk of global crop failure will emerge from more frequent spatially concurrent heatwaves and droughts affecting major breadbaskets for wheat, maize and soybean.[234] Today, there is almost zero probability of the four countries that account for the vast majority of global maize exports suffering simultaneous crop harvest losses greater than 10 percent. But this probability could increase to almost 90 percent under global warming of 4°C.[235] The global impact runs not only through temperature and changes in hydrological patterns but also through the large changes in global ecosystem productivity set in motion by the rise in carbon dioxide levels.[236]

These risks are compounded by strong pressures to increase efficiency through powerful economies of scale in food production, concentrating global food production in only a few breadbaskets. The homogenization of food consumption habits leaves the world reliant for nourishment on a limited number of crops from a limited number of places.[237] So, behavioural and social choices—diet choices and economic incentives to concentrate production—make us increasingly vulnerable to synchronized crop failures.[238] Furthermore, the loss of crop diversity could destabilize entire ecosystems and have adverse economic and social impacts.[239]

Conflict weaves in additional layers of uncertainty to the increasingly concentrated and homogenous global food production. Consider the war in Ukraine, one of the world's largest wheat producers and exporters. The Russian Federation controls much of the global market share of fertilizer—a key input in agricultural production. The conflict has disrupted grain and fertilizer exports, contributing to a commodity price shock, especially among people living in poverty.[240] Beyond the battle-related deaths and displacements, energy insecurity is looming, a food insecurity

crisis is under way and geopolitical instability is on the rise.[241] Indeed, war may be a "trigger of triggers," with global ripple effects.

The Covid-19 pandemic brought together zoonotic disease, inequalities and global socioecological connectivity. Unequal labour market conditions implied that some workers could quickly transition to remote working arrangements, safeguarding health and economic livelihoods, but others had to continue interacting with people or leave their jobs. And while social protection may have determined whether a person had the possibility of forgoing work to follow public health recommendations, political polarization, misinformation and deteriorating trust in science and institutions were also at play, influencing whether people were willing to follow the recommendations of public health authorities.[242]

What the future may hold due to pandemics is a major source of distress,[243] and the Covid-19 pandemic may leave deep scars. Inequality in access to digital technologies may have widened education disparities, setting back children in lower-income countries.[244] While higher-income countries could mobilize massive resources for recovery spending, often by borrowing at record-low interest rates, lower-income countries faced tight fiscal conditions and had to service debt rather than support people in dealing with the pandemic's socioeconomic impacts. Going forward, the differences in recovery spending between developed and developing economies may exacerbate differences in growth trajectories.[245]

Zoonotic diseases and pandemics may be in the limelight, but health threats from anthropogenic impacts on the planet expand beyond that. Accelerated biodiversity loss is a threat to food security, since much of our agricultural production depends on pollinators.[246] Food security is a looming global crisis, with 2.4 billion people facing moderate to severe food insecurity in 2020. The loss of pollinators also affects the diversity and availability of different nutrients.[247] The loss of biodiversity reduces the potential for new medical discoveries and poses a direct threat to local and traditional medicinal practices.[248] Pollution is becoming a major health threat, causing approximately 9 million premature deaths globally in 2015, 92 percent of them in low- and middle-income countries.[249] Exposure to air pollution has also been linked to higher Covid-19 mortality.[250]

A mismatch between interacting uncertainties and resilience strategies

The interaction of uncertainties casts doubt on the effectiveness of some of the resilience strategies that have historically been pursued (see spotlight 1.1). Leveraging trade to cope with local climate extremes affecting food production, building temperature-independent energy systems or migrating may be difficult amid layered and interacting uncertainties. Where do we migrate if the entire world is affected by simultaneous natural hazards—or when inequalities and political polarization set up barriers to people's movement? Can we diversify food supplies through imports in a world where increasing temperatures heighten the risk of simultaneous failures of wheat, maize and soybean harvests[251] or where pandemic-induced labour shortages, war and geopolitical tensions weaken global supply chains?[252]

"The interaction of uncertainties casts doubt on the effectiveness of some of the resilience strategies that have historically been pursued. Where do we migrate if the entire world is affected by natural hazards—or when inequalities and political polarization set up barriers to people's movement?

Our common aspirations, as codified in the 2030 Agenda for Sustainable Development and the Universal Declaration of Human Rights, are indivisible. Today, many people are losing faith in our collective ability to meet them.[253] Indeed, democratic practices have been weakening,[254] and the inability of countries to come together quickly enough during the Covid-19 crisis to provide equitable vaccine access, another illustration.[255] UN Secretary-General António Guterres has warned repeatedly of a fraying global world order[256] and has called on nations to rebuild global solidarity and multilateral cooperation in the face of systemic and interconnected threats.[257]

To meet the "confluence of calamities"[258] in the world today, we need more international cooperation, not less, and more solidarity across people, across generations and with the planet. A main challenge to overcome is that action to ease planetary pressures is needed now, but some of the benefits will not materialize until well in the future. Insights from

indigenous philosophies bridge these intergenerational gaps and may contribute to foster change. In many of these philosophies, past, present and future generations share "interwoven histories that shape [...] collective lives and the world" and intergenerational responsibilities of "socioenvironmental guardianship" are implied.[259] Restoring our connection with the planet and with ourselves, including across generations, and acting in ways that enhance our shared, intergenerational, collective lives then become central objectives. Yet these perspectives are often marginalized in mainstream policy debates, making the empowerment of indigenous and other marginalized communities not only a matter of justice but also a matter of gaining insights and ideas that could benefit humanity as a whole (spotlight 1.8).[260]

Where we go from here is up to us: will we act in time to avoid the worst consequences, or will polarization drive disagreement and hinder change? Will we address the power imbalances and inequalities that drive planetary pressures and obstruct people's agency? Will the actions taken be enough, and will they benefit everyone, or will they exacerbate inequalities, adding strain to already weakened social contracts and global cooperation? The uncertainty complex we face may seem daunting, but history provides ample evidence of individual and societal resilience. Inaction in the face of deep uncertainty and compounding threats to human development is not an option. Going forward, we need to be courageous enough to challenge the status quo and to look into new places, new people and a diverse set of knowledge traditions for inspiration and solutions.[261] Indeed, human agency can be a major driver of large-scale societal change (see chapter 3).

SPOTLIGHT 1.1

Beyond crisis and collapse: Climate change in human history

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Today's climate crisis has no precedent in Earth's history, owing to the combination of its speed, eventual magnitude, global scale and human cause. Yet regional and even global climates have changed profoundly and often abruptly over the roughly 300,000-year history of humanity.[1] Anthropologists, archaeologists, economists, geneticists, geographers, historians, linguists and paleo scientists have long attempted to identify how these changes influenced communities and societies. Scholars in this field—recently termed the history of climate and society (HCS)—typically identify relationships between climatic and human histories not only to improve understandings of the past but also to inform forecasts of the hotter future.[2]

For over a century the most influential studies in HCS argued that temperature and precipitation trends and anomalies caused human populations to either collapse or undergo subsistence crises. While HCS scholars have not settled on a common, cross-disciplinary definition of collapse, to them the concept usually involves a disintegration of socioeconomic complexity, leading to depopulation, new political structures and new settlement patterns. HCS scholars have used statistical and qualitative methods to link drought and cooling to the collapse of, for example:

- The Akkadian Empire in the 3rd millennium BCE.
- The societies of the Bronze Age Mediterranean in the 2nd millennium BCE.
- The Western Roman Empire in the 5th and 6th centuries CE.
- The cities of the Classical Maya in the 10th century CE.
- Angkor, capital of the Khmer Empire, in the 15th century CE.
- The Norse settlements of western Greenland in the 15th century CE.[3]

When examining well-documented and often comparatively recent periods and places, HCS scholars usually concentrate on subsistence crises that culminated in political transformation but not collapse. In such studies crises typically afflicted only one state—for example, during dynastic transitions in ancient Egypt or Imperial China—but occasionally also entire continents, in western Eurasia during the 14th or 17th century, for instance. In this scholarship the worst-affected civilizations were those with subsistence strategies, hydraulic infrastructure, military and demographic pressures, or inefficient and unpopular governments that left them vulnerable to environmental disruption.[4]

HCS studies of collapse and crisis inform common fears that present-day civilizations cannot survive continued global warming.[5] Today's climate change will indeed reduce agricultural productivity; limit the availability of freshwater; increase the severity of droughts, heat waves and tropical cyclones; and reshape coastal environments on a speed and scale that could provoke destabilizing societal responses.[6] Yet the disproportionate emphasis on collapse and crisis in HCS scholarship partly reflects systematic biases in how studies in the field are designed, rather than the most common historical responses to climate change.[7]

HCS scholars are increasingly exploring the resilience of past populations to climatic changes and anomalies. Definitions of resilience in climate-related fields long privileged "bouncing back" in the wake of disaster and were eventually criticized for assuming that social change is inherently undesirable. Critics argued moreover that the concept distracted from the more urgent priority of mitigating human greenhouse gas emissions. They claimed that focusing on resilience encouraged the assumption that disasters are inevitable—naturalizing sources of vulnerability in marginalized populations—and that it displaced responsibility for avoiding disaster from governments to individuals.[8]

Yet people of the past plainly found ways to cope with climate changes, and there is no term as accessible as resilience to describe their achievements. Nor

is there any doubt that governments must foster resilience to the human-caused warming that is already baked into the current climate crisis. Today, the Intergovernmental Panel on Climate Change (IPCC) uses the term resilience to mean the ability of coupled human and natural systems "to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure."[9] It therefore encompasses adaptation, which the IPCC defines as the "process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities."[10] Neither adaptation nor resilience is automatically a positive quality. Both may preserve unjust systems and come at the expense of vulnerable populations. In particular, the resilience of a society, government, institution or culture across decades or centuries may belie the vulnerability of ordinary people to extreme weather.[11]

Scholars in different disciplines have attempted to identify historical examples of resilience in diverse ways. Archaeologists, for example, have perhaps overstressed "adaptionist" understandings of past responses to climate change. Many have defined resilience using resilience theory, a method based on the adaptive cycle model, in which social-ecological systems gradually lose resilience as they grow in size and complexity, then regain it after they collapse. Yet today there is widespread disagreement over how—and whether—to use resilience theory. Interdisciplinary collaborations therefore typically use broad conceptualizations of resilience, most of which roughly align with the IPCC's definition.[12]

One recent approach is to identify common pathways followed by populations that were broadly resilient in the face of past climate changes—meaning that they avoided serious or sustained demographic loss. This approach can emphasize both the diversity of resilient responses to past climate changes and the existence of shared strategies that may inform present-day climate policy.[13] There are at least five of these pathways (figure S1.1.1):

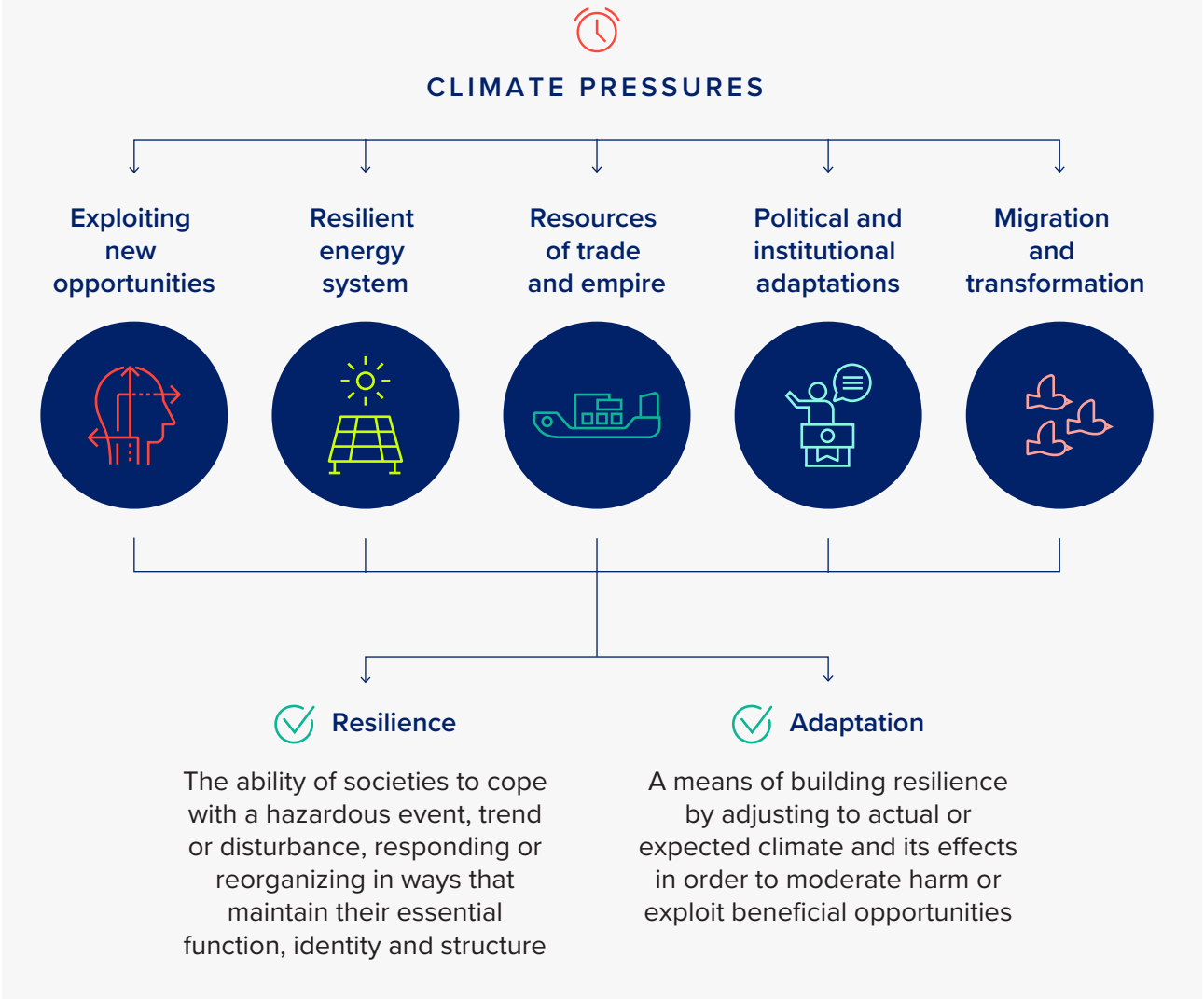
- Identifying new opportunities in local and regional environments.
- Maintaining or developing resilient energy systems.
- Exploiting diverse resources through trade.
- Adapting institutions to new climatic risks.
- Migrating to new environments.

Populations that followed the first pathway exploited regional or local environments that responded to global or hemispheric climate changes in ways that benefitted how these populations had organized their societies. The most striking examples date back to the Pleistocene, the geological epoch in which cycles in Earth's orbit and rotation repeatedly altered greenhouse gas concentrations enough to trigger alternating glacial and interglacial periods. In glacial periods advancing ice sheets trapped water previously in the oceans, lowering sea levels and creating land bridges that humans exploited to migrate across the Earth. The same forces responsible for glacial and interglacial periods also strengthened monsoon systems, periodically "greening" the Sahara and helping pastoralists migrate through and thrive in what is now the world's largest desert. Pastoralists, in turn, may have delayed the redesertification of parts of the Sahara by sustaining healthy grassland ecosystems.[14]

Well into the Holocene, the recent geological epoch characterized by a relatively stable interglacial climate, similar dynamics played out across smaller scales in time and space. In the Eastern Mediterranean precipitation increased during winter, the region's wet season, during the 6th century CE. Pastoral and agricultural communities benefitted from higher rainfall because the taxation system of the Eastern Mediterranean allowed them to easily transport agricultural commodities to population centres. Rising productivity encouraged elites to invest in market-oriented agriculture; new dams, channels, pools and other infrastructure then allowed farmers to manage water more effectively.[15]

The second pathway involved developing or exploiting energy systems for transportation, industry and human subsistence that did not respond directly to shifts in temperature or precipitation. As European temperatures declined in the 6th century, communities in Frisia (in today's northern Netherlands) thrived by consuming dairy and meat from livestock, supplemented by fish, shellfish and waterfowl. This subsistence strategy was less sensitive to cooling than others in Europe, many of which depended on cultivating grains that were sensitive to variations in temperature.[16] In the same century subsistence strategies across much of Finland and in northern Sweden and Norway did not depend on crop cultivation and in

Figure S1.1.1 The five pathways to resilience



Note: The definition of resilience and adaptation are based on IPCC (2022a).
Source: Created by Hans Sell, Michelle O'Reilly and Dagomar Degroot.

fact primarily exploited wild food resources such as birds, freshwater fish, seals and terrestrial mammals. Changes in temperature affected the availability and accessibility of these resources in diverse ways.[17]

In Kraków, Poland, firewood prices rose as winter temperatures declined in the 17th, 18th and 19th centuries. Because the city occupied an increasingly peripheral position within larger polities, state authorities did not act to relieve high fuel prices. The city's inhabitants therefore shifted decisively from wood to coal for heating. Coal was more reliable and less expensive than firewood—and therefore beneficial for household budgets.[18]

To follow the third pathway, populations exploited the benefits of trade—including trade within imperial borders—to cope with climate change. Weather rarely affected far-flung regions simultaneously or equally. Trade therefore allowed populations to thrive despite climatic anomalies by importing commodities that were less available locally, owing in part to extreme weather. The integration of European and then global grain markets in the 2nd millennium CE eventually buffered populations at the centre of trading networks from increases in food prices that were influenced by precipitation or temperature anomalies.[19] At the same time these networks could render populations on

their periphery more vulnerable to extreme weather. In the late 19th century millions died when economic and political priorities led British governments to demand grain exports from colonized India, despite local droughts.[20]

Some populations coped with climatic variability and change by inventing technologies and exploiting commodities that opened new possibilities for trade. When droughts and periods of high precipitation alternated in southeastern California in the 15th century, Mojava settlements developed new ceramic technologies and basket-making techniques to establish trade networks centred on maize, beans and squash produced by nearby Kwatsáan communities.[21] These networks fostered the expansion of a dynamic "dream culture" that further elevated Mojave long-distance trading. Dreams that successfully directed Mojaves towards prosperity or military victory rewarded leaders with political power, while dreams that resulted in failure undermined the individual leaders who shared them. The result was a more mobile, seasonally oriented and interregional economy that could better cope with climatic variability.[22]

The fourth pathway involved deliberate political and institutional adaptations that fostered resilience to weather extremes. Italian city-states responded to agricultural disruptions worsened by 13th century cooling by securing new food imports, setting restrictions on grain prices, providing grain subsidies and banning grain exports. Cooling across Europe in the final decades of the 17th century reduced grain yields and tax revenues across France just as grain supplies were already strained by military provisions. French administrators struggled to respond effectively, and harvest failures in 1693 and 1694 led to catastrophic famines.[23] When similar conditions returned in 1709, however, administrators negotiated emergency grain imports from Algeria that effectively eased food shortages.[24]

Finally, populations took the fifth pathway by migrating to either escape or exploit the impacts of climate change in local environments. Climate refugees migrating to escape the desertification of the eastern Sahara likely helped establish Pharaonic Egypt.[25] Across Eurasia, pastoral societies later threatened agrarian empires when precipitation changes either allowed them to rear more horses or threatened grasslands that otherwise sustained them. Some migrations by pastoralists responded to subsistence crises—and thus political and military vulnerability—within agrarian empires. Jurchen raids, for instance, exploited destabilizing droughts in 17th century China to establish the Qing Dynasty.[26]

Populations often pursued multiple pathways at the same time, and different communities in societies could follow distinct pathways. Populations may also have benefitted from additional pathways to endure or exploit climate changes. For example, resilient populations may have enjoyed low socioeconomic inequality or effective means of providing life's necessities for their poorest members. A robust culture of civic charity in Dutch coastal cities helped insulate the 16th and 17th century Dutch Republic from famines that affected primarily poor people in other parts of Europe.[27] Similarly, the population of Tokugawa Japan soared during periods of severe 17th century cooling partly because wealthy farmers were expected to provide for poor people.[28] Additional pathways may have been adaptive for some communities but maladaptive for others. Capital-intensive hydraulic infrastructure likely increased the vulnerability to drought of polities in South America, Egypt, Mesopotamia and Cambodia, all of which depended on canals for irrigation, but provided drainage and transportation opportunities in coastal areas of the present-day Netherlands and thereby stimulated the development of greater wealth and military potential.[29]

What, then, can policymakers learn from the diverse experiences of climate change in the past to build resilience to today's human-caused warming? One lesson may be that the impacts of climate change on populations were and are determined as much by human socioeconomic, cultural and political arrangements as the magnitude of environmental transformations. Communities, therefore, are rarely doomed to a particular fate; under all but the most extreme emissions scenarios, substantial scope remains for human adaptation and prosperity.

More specifically, the past reveals that adaptations to build resilience may involve identifying and exploiting what rare opportunities warming may provide, developing energy systems that both mitigate emissions and are resilient to extreme weather, diversifying sources of energy and commodities, restoring or maintaining flexible political and legal systems

that prioritize redundancies over efficiencies and normalizing climate migration. The past may also reveal that tackling inequality and poverty—in particular, through policies that further environmental justice for historically marginalized populations—will foster resilience to global warming. And it may indicate that capital-intensive interventions to adapt to climate change have the potential to become sources of vulnerability. More HCS scholarship will further clarify the lessons of the past, lessons that may offer compelling reasons for hope and suggest strategies for sustainable human development in the decades to come.

NOTES

1 Osman and others 2021; Tierney and others 2020.
2 Degroot and others 2021.
3 See, for example, Brooke (2015) and Weiss (2017).
4 See, for instance, Campbell (2016) and Parker (2013).
5 See, for example, Begley (2021).
6 IPCC 2021.
7 Degroot and others 2021.
8 Soens 2020.
9 IPCC 2022a.
10 IPCC 2022a.
11 Izdebski, Mordechai and White 2018; Soens 2018; Van Bavel and others 2020.
12 Bradtmöller, Grimm and Riel-Salvatore 2017; Riede 2008.
13 Degroot and others 2021.
14 Brierley, Manning and Maslin 2018; Claussen, Dallmeyer and Bader 2017; Timmermann and Friedrich 2016.
15 Decker 2009; Izdebski and others 2016.
16 Devroey 2003; Knol and Ijssennagger 2017; Vos 2015.
17 Oinonen and others 2020; Tvauri 2014.
18 Miodunka 2020.
19 Epstein 2006.
20 Davis 2002.
21 Anderson 2005.
22 Zappia 2014.
23 Berger 1976; Lachvier 1991; Campbell and others 2017; Guillet and others 2017; Lavigne and others 2013.
24 Goubert 1982.
25 Lieberman and Gordon 2018.
26 Brook 2010; Cui and others 2019.
27 Curtis and Dijkman 2019.
28 Parker 2013.
29 Buckley and others 2010; Degroot 2018; de Souza and others 2019; Gill 2000; Manning and others 2017.

SPOTLIGHT 1.2

The nuclear–environment nexus and human development in the Anthropocene

Rens van Munster, *Danish Institute for International Studies,* and **Casper Sylvest,** *University of Southern Denmark, Department of History*

When Paul Crutzen and Eugene Stoermer coined the term Anthropocene in 2000 to denote an epoch characterized by the geological impact of the human species on planet Earth, these effects were already evident.[1] Since then, geologists and other scientists have debated the starting point of the Anthropocene. Among the contenders is the dispersion of radioactive isotopes from widespread nuclear testing during the 1950s—an indicator also singled out by the Anthropocene Working Group under the International Commission on Stratigraphy.[2] Meanwhile, the Anthropocene has become both a ubiquitous scientific concept and a potent political symbol that extends to the Earth's climate and ecosystems. As a result, questions of extinction and survival loom large in political debates about human development in this new epoch. Such debates echo those around the Cold War nuclear arms race, and there are good reasons for scrutinizing the intellectual and political links between the nuclear age and the current predicament. Indeed, a closer examination of the nuclear–environment nexus offers a prescient perspective on the persistent links between militarization and anthropogenic reconfigurations of the planet.

Historically, the connections between nuclear weapons and the environment are both multiple and deep. That nature could be controlled and manipulated was an integral part of the notion of security during the Cold War. The postwar development of such scientific disciplines as meteorology, glaciology and oceanography took place in a close relationship with the preparations for nuclear war, since adequate understanding of the effects of these weapons—vital for strategy and defence—depended on ecological knowledge. Over time these branches of science produced a new understanding of the Earth and its interacting systems, which in turn fostered conceptions of security as common and tied to the natural environment.

Nuclear testing and uncertainties about the effects of radioactive fallout gave rise to scientific measurements and environmental concerns, entanglements that persist to this day in climate modelling.[3] Anti-nuclear activists and movements unrelentingly criticized the arms race and the attendant risks of nuclear deterrence while exploiting scientific uncertainty and disagreement to expand political responsibility in time and space. Temporally, the effects of nuclear weapons revolved around future generations. And spatially, the effects transgressed any ground zero and came to include concern for both humanity and the planet, later symbolized in iconic photos of a living yet fragile Earth taken from space. The nuclear arms race paradoxically sparked a more ecocentric conception of the environment.[4]

The 1980s, when détente had given way to the second Cold War, witnessed an intensification and emerging synthesis of such links, especially striking in the work of Jonathan Schell, author of the best-selling *The Fate of the Earth* (1982).[5] The book, which compels people to imagine the extinction of the human species as a way of cultivating a global ecological awareness that included the fate of future generations, played a central role in the "nuclear freeze" movement and primed the public for debates about nuclear winter. Drawing on the latest insights from Earth system science, Schell concluded that the environmental effects of nuclear war would most likely leave Earth uninhabitable for humans. The political lesson taught by science was clear: the survival of the human species depended on functioning Earth systems and had to be seen in a broader ecological framework. To Schell, nuclear weapons symbolized not only modernity's inability to recognize its own self-destructiveness but also a hubris in humans' belief that the threat to complex, fragile and highly interdependent ecosystems could be rationally managed and contained.[6]

After the turn of the millennium, Schell's understanding of the entanglements between nuclear weapons and climate issues led him to recognize the value of the Anthropocene as an idea that explicitly foregrounds the connections between Western modernity and human technological prowess on the one hand and climate change, species extinction and biodiversity loss on the other. To Schell the Anthropocene called for reflecting more deeply on human–Earth relations and expanding the conventional horizons of space, time, community and agency. Yet, valuing ourselves as humans in relation to nature and other forms of life involves a heavy ethical and political responsibility, and Schell clearly feared that humans were not up to the task at a time when their technological power forcefully set the species apart from the rest of creation. Ultimately, however, Schell insisted on the role of human beings as "chief valuer" and maintained that a true embrace of this responsibility would decentre the human, whether by installing sober lessons about humility, prudence and the limits of a narrow technological rationality or by promoting more ecocentric valuations of the world, as expressed in ideas about interspecies entanglements, companionship and "nature-based" solutions to climate change.[7]

Schell's work is a reminder of the deep relationship between nuclear weapons and the environment in the Anthropocene. Nuclear weapons are detrimental to human development and risk jeopardizing the ecological systems on which it depends. The vast economic resources required for the production, maintenance and stockpiling of nuclear weapons divert funds away from human development and achieving the Sustainable Development Goals. Nuclear war would also have grave humanitarian consequences, including large-scale displacements, long-term harm to human health, restricted access to food and catastrophic damage to the environment. Some scientists predict that even a limited nuclear war could set off a global nuclear winter.[8] In a nuclear-armed world survivability and sustainability are tightly entwined.

Source: This spotlight also builds on Bilgrami (2020), Steffen and others (2011) and UNODA (2018).

NOTES

1 Crutzen and Stoermer 2000.

2 See Working Group on the Anthropocene 2019.

3 For example, Doel (2003), Edwards (2012) and Masco (2010).

4 Worster 1985.

5 Schell 1982.

6 van Munster and Sylvest 2021.

7 See Schell's late essays on "Nature and Value" and "The Human Shadow," posthumously published in Bilgrami (2020).

8 Witze 2020.

SPOTLIGHT 1.3

What kind of institution is needed for existential security?

Toby Ord, *Senior Research Fellow, The Future of Humanity Institute, University of Oxford, United Kingdom*

Humanity has faced many natural existential risks over the 3,000 centuries we have survived so far—such as risks from asteroid impacts or supervolcanic eruptions. But the anthropogenic risks we now face appear much greater in probability and continue to rise as our power over the world grows ever greater.[1] It is unclear whether we can survive another three centuries, let alone three thousand.

To survive, we need to achieve two things. We must first bring the current level of existential risk down—putting out the fires we already face from the threat of nuclear war and climate change. But we cannot always be fighting fires. A defining feature of existential risk is that there are no second chances—a single existential catastrophe would be our permanent undoing. So we must also create the equivalent of fire brigades and fire-safety codes—making institutional changes to ensure that existential risk (including that from new technologies and developments) stays low forever.

If we can achieve both these things, we will have reached existential security: a return to comparative safety, where we have ended the era of heightened risk to humanity.[2] This would be no utopia. Existential security would not guarantee universal human development or freedom—or health and prosperity. But it would be necessary to achieve any of those things—a foundation on which they rest.

One way to look at our current position is that humanity faces a high and unsustainable level of risk. Indeed, we can see this as one of the most fundamental kinds of sustainability. Think of the probability that humanity will continue to survive and flourish over a time span comparable with the 3,000 centuries we have lived so far. Each year that our time of heightened risk goes on, this probability of a successful future drops. And nothing we ever do could restore that chance. The probability of humanity surviving to live out its potential is the ultimate nonrenewable resource: something we depend on completely—with no possible substitutes—but are frittering away. Existential security means stabilizing humanity's survival curve—greatly reducing the risk and ensuring that it stays low. Only by doing so can we keep the probability of long-term survival high (figure S1.3.1).

What would be required to stem this loss—to reach existential security?

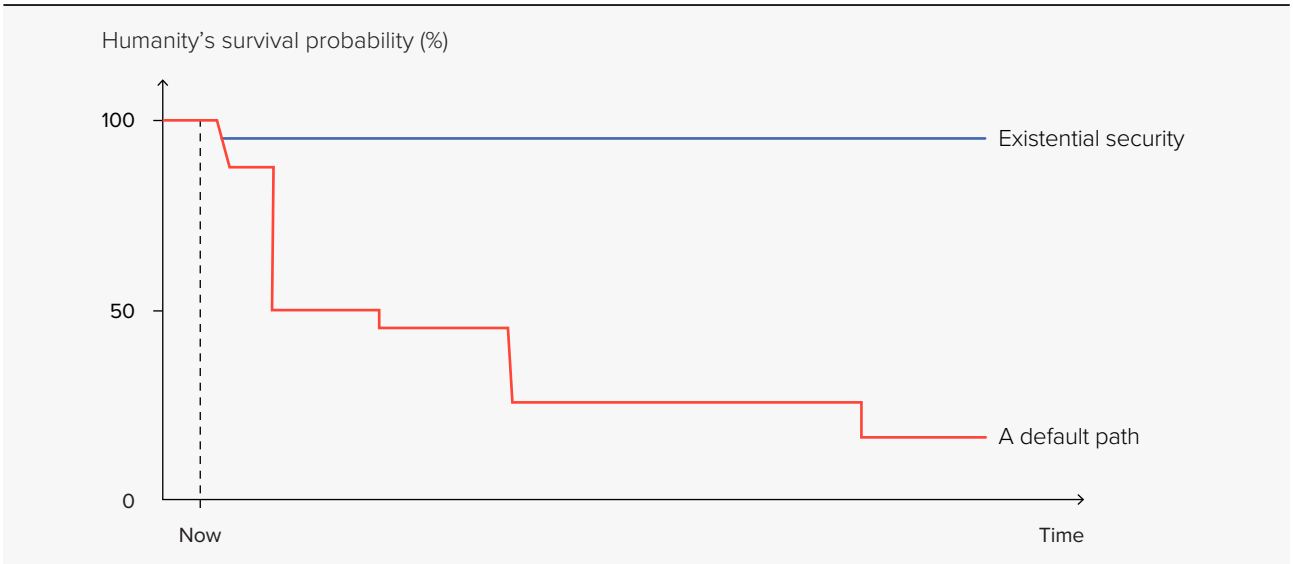
A large part of the answer has to come from international institutions. Existential security is inherently international: the risks that could destroy us transcend national boundaries, and finding ways forward that never once succumb to an existential catastrophe will require international coordination. Meeting this challenge would be an extremely difficult but necessary task. Here are some broad outlines of what it would require.

As Carl Sagan wrote: "The world-altering powers that technology has delivered into our hands now require a degree of consideration and foresight that has never before been asked of us."[3] We need the foresight to see the risks while they are still on the horizon, providing time to steer around them or, if that is impossible, to prepare to meet them. This involves knowing how to ask the right questions about future dangers. And while being able to accurately answer such questions is impossible, great progress is being made in systematically assigning well-calibrated and accurate probabilities to them.[4] An institution aimed at existential security would need to harness this progress and be at the forefront of forecasting expertise.

It would also require extremely high trust: from both the public and the elites across many different nation states. Perhaps it could learn from the Intergovernmental Panel on Climate Change, with its attempts to neutrally establish the current state of scientific consensus on climate change in a transparent manner, with input from all nations.

An institution for existential security would need extremely strong coordinating ability. Because existential risk threatens a common foundation on which

Figure S1.3.1 Humanity's survival curve can drop down during periods of risk but can never climb back up



Source: Author's creation.

all of our varied hopes and futures are built, it is in every nation's interest to avoid it. But because different strategies and tactics for avoiding risk will have burdens that fall unevenly upon the nations, there are still great challenges for coordinating a path forward that everyone can accept.

Finally, such an institution would require a great deal of buy-in. This would have to be both strong and lasting.

Strong buy-in would be required before the idea of an institution to govern existential risks could even get off the ground, as nations will not lightly make the sacrifices in sovereignty that would be required. While there is not sufficient buy-in at the moment, this may change over years or decades as people slowly face up to the gravity of the threats facing humanity. And just as the United Nations was formed in the wake of the crisis and catastrophe of the Second World War, in the wake of new global crises and threats, the idea of new institutions with the power to achieve existential security may move quickly from unthinkable to inevitable.

Our resolve would have to be lasting. National constitutions provide proof that building institutional constraints that last hundreds of years is possible. Designing a constitution means setting in place the parameters for our descendants to operate across generations—as well as the means to adjust those parameters if circumstances change in unforeseen ways. Building institutions to reach existential security would have much in common with formulating a constitution—not just for a nation, but for humanity, and with a focus on ensuring that each generation cooperates to give succeeding generations the chance the exist and flourish in their turn.

Source: This spotlight also builds on Bostrom (2013), Leslie (1996), Ord (2020), Parfit (1984), Sagan (1983) and Schell (1982).

NOTES

1 Snyder-Beattie, Ord and Bonsall 2019.

2 Ord 2020.

3 Sagan 1994, p. 316–317.

4 Tetlock and Gardner 2015.

SPOTLIGHT 1.4

People–planet relationships in an uncertain, unsettled world

Belinda Reyers, *University of Pretoria and Beijer Institute of Ecological Economics of the Royal Swedish Academy of Sciences*

People–planet interactions underpin many of the diverse capacities required to embrace uncertainty, to navigate and respond to the complex dynamics of the Anthropocene. The diversity of life on Earth and all the myriad functions, connections and interactions we have with it provides short-term and long-term capacity for life (including human life) to persist under and adapt to sudden and gradual changes of the Anthropocene. As dominant models of development—with their emphasis on industrialization, resource exploitation and urbanization—continue to erode biodiversity and human interactions with it, we lose options and opportunities, reducing flexibility and adaptive capacity. Worryingly, these declines further push other planetary pressures such as climate change and pollution ever closer to dangerous thresholds.[1]

A focus on human–nature relationships and transformative capacities moves away from the risk reduction approaches that have become dominant as ways to manage uncertainty but that often fail to address the complex causes of planetary pressures and inequality.[2] Instead, by foregrounding on relationships, policy can overcome problematic divisions between nature and development to focus on the quality of relationships connecting people and planet and on reconfiguring relationships to enhance capacities to navigate uncertain futures.[3] For example, new indicators emerging from indigenous community monitoring systems feature relationships connecting people and nature, such as indicators of the condition of the human–biodiversity relationship[4] and indicators that monitor relationships and feedbacks between the social and ecological components of a place.[5] Such monitoring systems do not treat the social and ecological parts as separable. They focus instead on what connects them and could prove a valuable way forward for more integrated approaches to assessing human development progress.

Recognizing people–planet relationships widens the focus of policy from the local level to take into account the globally intertwined social-ecological systems of the Anthropocene. An increase in planetary pressures in one part of the world ripples across regions, with material and other less tangible impacts on distant places and groups, as the Covid-19 pandemic has so graphically highlighted. The Anthropocene is a heightened state of interconnectedness where social-ecological teleconnections and power asymmetries in global systems require new forms of solidarity for the interdependencies and realities of the Anthropocene.[6] Transitions in one country from nonrenewable energy sources (fossil fuels) towards renewable energy (solar)—done in solidarity with groups and places where the mineral resources (cobalt or lithium) for these technologies reside—will likely have very different outcomes for human development from local transitions that do not account for such distant impacts and dynamics.[7]

Inclusion and participation, so central to the human development journey, can also have blind spots. Focusing on people–planet relationships highlights additional barriers and potentially new dimensions of inclusiveness. It opens avenues to explore moral or ethical questions around including nonhuman entities and the risks and impacts imposed on those entities through various policy choices. This expansion of care and concern in human development is a lively topic receiving increasing attention as the interconnection and impact of our relationship with the natural world becomes more apparent.[8] It is strengthened as development policy engages more deeply with multiple knowledge and value systems that reject the separation of human and nonhuman or of nature and people.

Biocultural approaches, for example, portray human livelihoods, landscapes and ecosystems as having coevolved over long periods of time.

Biocultural diversity is the "diversity of life in all its manifestations—biological, cultural, and linguistic—which are interrelated within a complex socio-ecological adaptive system."[9]

Taking into account the dynamics of the Anthropocene, where complex social-ecological interactions result in lag effects and where today's choices are committing the planet to global-scale changes that will span thousands of years,[10] it becomes apparent that inclusion and participation have an important temporal dimension and that policy must innovate to include young people and consider future generations whose realities are being shaped for the long term by actions and choices taken today.

Innovation and human development have long gone hand in hand. In the context of the Anthropocene, there is, however, a risk that many of the innovative policies, practices and interventions that exist and are emerging will all stay small, localized and short term—tinkering at the edges without fundamentally rewiring development models and approaches to truly contend with the Anthropocene, the scale of its planetary pressures and the economic and political systems and asymmetries on which it is based.[11] Innovations that do not consider what needs to be built up and broken down, what needs protection and how to manage power asymmetries and participation can end up increasing vulnerability and eroding sustainability and resilience.[12]

Substituting one innovation (such as fossil fuel) with another (such as renewable energy) without addressing justice and sustainability of the transition will reduce emissions but will also likely defer many other impacts and risks to another place, group and time, without necessarily improving energy access and democracy.[13] As the 2020 Human Development Report made clear: "We must reorient our approach from solving discrete siloed problems to navigating multidimensional, interconnected and increasingly universal predicaments."[14] By anchoring innovation in deliberate considerations of people–planet relationships, the interconnections and interdependencies become clear and offer novel opportunities for human development in an uncertain future.[15] These interdependencies are not only material flows of energy, resources and waste; they are also intangible but essential in how they shape identities, cultures, relationships, minds, mental and physical wellbeing, and ultimately freedoms and choices in ways we often realize only when lost.[16]

Without acknowledging these relationships in the human development journey, dangerous feedbacks and negative people–planet relationships will undermine human development gains.[17] Previous innovations that have ignored these relationships to the detriment of the environment, vulnerable groups, local adaptive capacities and cultural practices are legion.[18] On the other hand, research exploring persistent poverty traps that considers social-ecological interactions highlights not only important causes of these traps but also novel pathways out of poverty.[19] As Michele-Lee Moore and colleagues point out, it is "the capacity to see, interrogate, and reimagine" these people–planet relationships that will create the disruptive and radical changes needed for transformations to sustainability.[20]

NOTES

1 Mace and others 2014; Steffen and others 2015.
2 Reyers and others 2022.
3 Haider and others 2021.
4 Lyver and others 2017.
5 Thompson and others 2020.
6 Rocha, Peterson and Biggs 2015.
7 Lèbre and others 2020.
8 Díaz and others 2019; Lee 2020.
9 Maffi 2005, p. 602.
10 Keys and others 2019.
11 Eriksen and others 2021; Hooli 2016.
12 Olsson and others 2017.
13 Lèbre and others 2020.
14 UNDP 2020b, p 5.
15 Moore and others 2014.
16 Njwambe, Cocks and Vetter 2019.
17 Olsson and others 2017
18 Haider and others 2021.
19 Lade and others 2017.
20 Moore and others 2018, p. 38.

SPOTLIGHT 1.5

On economic insecurity

Jonathan Perry, Marta Roig *and* **Maren Jiménez,** *United Nations Department of Economic and Social Affairs*

Economic security is a cornerstone of wellbeing. Economic stability and some degree of predictability enable people to plan and invest in their future and that of their children. They encourage innovation, reinforce social connections and build trust in others and in institutions.[1] Worry and anxiety about the future have negative health outcomes, ranging from mental health problems to heart disease and increased risk of obesity, including among children.[2] Pervasive economic insecurity generates popular discontent and imperils political stability.

Even before the Covid-19 pandemic, many people found themselves and their families on shaky economic ground. Growing employment instability and work that is increasingly precarious and poorly paid, together with persistent joblessness, are root causes of rising economic insecurity in high-income countries. In low- and middle-income countries high informal employment continues to affect income stability. People can no longer rely on stable, decent work to provide economic stability throughout their lives—a trend compounded by the Covid-19 pandemic and an emerging climate crisis.

Increased awareness of climate change and its many implications has injected growing uncertainty about the future and raised people's concerns about their wellbeing in the long run. Even though the effects are shaping anxieties worldwide, the impacts will be uneven. People in the poorest countries, particularly children and young people, stand to lose the most.

Indeed, people in poverty are more exposed to adverse events, from ill health to the growing impacts of systemic shocks such as climate change and pandemics, and have fewer resources to cope with and recover from their consequences. However, many people who are not poor by national or international standards are or feel economically insecure as well. In fact, while economic security and confidence in the future have traditionally been defining features of the middle class, this group is feeling increasingly insecure.[3] Workers in the informal economy and the growing number of people under nonstandard contractual arrangements are highly insecure, as are people with lower education levels, women, younger adults, members of racial and ethnic minorities and heads of single-parent households.[4]

Despite its significance, growing economic insecurity has stayed under the policy radar in many countries. Experts find fault in the fact that it is not adequately reflected in standard national statistics.[5] Indeed, many measurement issues related to insecurity are still unresolved, and empirical research on developing countries is scarce.

Whatever the method used to assess economic risks, the implications of these risks depend crucially on the buffers available. Catastrophic expenses and large debts drive falls into poverty when social protection systems do not help guard against risks or cover their effects. Even in developed countries with comprehensive social protection systems, comparative cross-country data suggest that public transfers protect only about 40 percent of adults against large drops in disposable income (drops of 25 percent of disposable income or above).[6]

Not only are risks growing, but policies are also not keeping up with current trends. Public institutions, policies and governance systems are struggling to adapt to rapidly changing needs across countries. Social protection coverage is often contingent on a traditional formal employer–employee relationship, and many schemes are not portable across jobs. Labour market institutions and regulations are also challenged by the growing diversification of working arrangements.

There are, however, policy innovations in both developed and developing countries that demonstrate the capacity of social protection systems, labour market institutions and public services to adapt to changing circumstances. These include new forms

of social protection that adequately cover informal workers, migrant workers or those with nonstandard contracts.[7] There are also agile programmes that automatically scale up in response to systemic shocks, such as pandemics or climate-related emergencies. Some groups of informal workers have pursued new models of collective representation to protect their interests, namely through cooperatives, self-help groups and associations. Some of these new organizations have helped workers connect and undertake collective action, but many lack the legal capacity to negotiate working conditions. A key challenge for these organizations is that many informal workers are not considered workers under the law and therefore do not have bargaining rights. In some countries—Canada, Germany and Sweden, for instance—collective bargaining rights have been extended to some categories of self-employed workers.[8]

Providing economic security remains a key role of the state and its institutions and is a foundation of the social contract between government and citizens. Many governments spend a substantial share of GDP to safeguard against hardship-causing losses, through social protection systems, healthcare and other public services. This is a crucial moment to reflect on how to adapt past policies and institutions to a new socioeconomic reality.

Large-scale crises heighten risk and insecurity and have, at times, opened a path to renew the social contract. The unprecedented income support and health measures put in place by many governments as a response to the Covid-19 pandemic attest to the primary role that the state continues to play in confronting economic risk and insecurity. Policy responses to the crisis have ranged from direct payroll support to employers to covering income losses in informal employment to rent payments and eviction moratoriums, not to mention expanding healthcare coverage in traditionally underserved areas.[9]

However, many of these measures are temporary. Most of them leave beneficiaries just as vulnerable to future shocks once they are removed. Comprehensive, universal social protection systems, when in place, play a much more durable role in protecting workers and in reducing the prevalence of poverty than short-term, ad hoc measures, since they act as automatic stabilizers. They provide basic income security at all times and therefore enhance people's capacity to manage and overcome shocks.

Countries with social protection systems already in place were able to scale them up quickly during the Covid-19 pandemic. Investments in building and expanding social protection systems in some Latin American countries over the past decades have cushioned the fallout from the crisis, at least in the short term.[10] Many other low- and middle-income countries entered the crisis on weak financial footing, however. Their ability to expand social protection has been constrained by lack of fiscal space as well as by a lack of existing mechanisms on which to build. Overall, the financial support to individuals and families has varied dramatically across countries, as has access to vaccines and thus the speed of economic recovery. Without urgent corrective action from the international community, the current crisis is likely to widen disparities both within and between countries.[11]

Focusing on the challenges people face today—from increasingly precarious employment to inadequate healthcare and difficulty accessing social protection, housing and other public services—can narrow social, economic and political divides and guard against the next global crisis.

NOTES

1 For a broad assessment of economic insecurity and its measurement, see Stiglitz, Fitoussi and Durand (2018).

2 See Rohde and others (2017) and Watson and Osberg (2017).

3 Hacker 2018b.

4 Hacker 2018a.

5 Durand, Fitoussi and Stiglitz 2018; Stiglitz, Fitoussi and Durand 2018.

6 On average, although the percentage varies widely across countries. See Hacker (2018a).

7 See, for instance, ADB 2016.

8 For details of specific programmes in these countries, see OECD (2019b).

9 ILO 2020a.

10 Blofield, Giambruno and Pribble 2021; Lustig and others 2019.

11 Ferreira 2021.

SPOTLIGHT 1.6

Building an environment of peace in a new era of risk

Environment of Peace Initiative, *Stockholm International Peace Research Institute*

Humanity has entered a new era of risk created by the confluence of twin crises—one rooted in the darkening global security horizon, the other stemming from ongoing environmental destruction. The risks are complex and often unpredictable. While failing to address either crisis adequately, governments are not paying enough attention to the crossover points where the most dangerous situations are emerging.

There are more hungry and displaced people than a decade ago,[1] twice as many state-based conflicts and twice as many deaths in those conflicts.[2] Governments are spending more on their military forces.[3] Even before the war in Ukraine, nuclear states were increasing the number of warheads being held in readiness for use.[4] Meanwhile, the impacts of climate change are worsening,[5] plastic pollution and resource depletion continue almost unabated and the health of ecosystems declines.

Half a century ago, at the United Nations Conference on the Human Environment in Stockholm, governments formally recognized that ecological integrity is essential to human development.[6] Now, the consequences of declining ecological integrity are clear. The countries facing the greatest ecological threat are statistically likely to be among the least peaceful. They also tend to be marked by fragility and low capacity for resilience.[7] Half of ongoing UN peace operations are in the countries with the highest exposure to climate change impacts.[8]

A climate change impact or the disappearance of an important food resource does not axiomatically cause insecurity and conflict, but it does increase the risk.[9] The risk will be heightened if the society in question is already tense, fragile or insecure and will be lower if it is well-governed and well-resourced (box S1.6.1). Additionally, insecurity can lead to people taking decisions that damage environmental integrity.

To succeed, transitions must be just and peaceful

Turning back the tide of environmental decline is necessary in order to reduce the risks and secure an environment of peace. It will entail major transitions in such sectors as energy, industry and land use.[10] Transitions need to occur quickly and successfully. However, interventions aiming to tackle an environmental problem can exacerbate insecurity or cause a different form of environmental damage.

In the 2000s the rush to biofuels led to landgrabs in the Global South as producers looked to meet demand stimulated by policy choices in the Global North. This contributed to soaring food prices and resultant unrest in countries such as Burkina Faso, Egypt and Haiti.[11]

Building hydropower dams has altogether displaced an estimated 80 million people on every inhabited continent.[12] In Myanmar dam building has forced displaced people into areas populated by other ethnic groups, leading to clashes.[13] Once in place, dams restrict water availability for downstream use, disrupt biodiversity and fish stocks important for food, flood farmland and divide communities.

Meeting the Paris Agreement 1.5°C target could entail a 10-fold expansion of hydropower in Africa.[14] Governments and companies such as airlines propose increased biofuel production.[15] Unless a different approach is taken, conflict and displacement could result again.

With the sixth mass extinction of species in Earth's history possibly under way, attempts to protect nature and biodiversity are at a crunch point. More than 90 governments now support the goal of protecting 30 percent of the Earth's surface through conservation by 2030, the so-called 30×30 initiative,[16] which is up for negotiation at the 2022 UN Convention on Biological Diversity summit.[17] However, with 300 million people living in key biodiversity areas, 30×30 has

Box S1.6.1 Haiti's systemic shock

Environment of Peace Initiative, Stockholm International Peace Research Institute

Haiti, the lowest income country in the Americas, has been beset by decades of political instability, natural hazards (including a massive earthquake in the Southern Peninsula of the country in 2010) and removal of tree cover, in turn leaving communities exposed to storms and landslides.[1] In January 2020 the Haitian Parliament dissolved after elections were postponed, with President Jovenel Moïse attempting to rule by decree against a backdrop of continuing public unrest.[2] Two months later Haiti reported its first cases of Covid-19. The government declared a health emergency, with a familiar mix of school and business closures, limitations on transport and gatherings, and a night-time curfew.[3]

With three-fifths of the population already below the poverty line and antigovernment sentiment running high,[4] people refused to abide by the regulations, boosting the infection rate.[5] Agricultural production fell, and food prices rose by more than 25 percent.[6] In August tropical storm Laura came to Haiti, ruining 50–80 percent of certain crops in the southeast.[7] Unusually dry months followed, depressing harvests by up to 80 percent. Entering 2021, food prices were running 40 percent above normal.[8]

In May 2021, with Covid-19 cases soaring, the government redeclared a state of emergency.[9] In July tropical storm Elsa hit the same southeast regions devastated by Laura the previous year.[10] Four days later, for reasons that remain unclear, gunmen assassinated President Moïse, unleashing a further period of political turmoil.[11] Soon afterward, the United Nations Food and Agriculture Organization declared that nearly half the Haitian population was in acute food insecurity.[12]

Perhaps a country with stable politics could have coped with the two storms in quick succession. Perhaps without the restrictions around Covid-19, political order could have been restored. But the combination of the previous decades of environmental destruction and political turmoil, unrest in the streets, Covid-19 and two major storms dealt Haiti a systemic blow. Millions have been left without sufficient food or prospects, the only certainty being that more insecurity lies ahead.

Notes
1. USAID 2020. **2.** Freedom House 2021. **3.** Díaz-Bonilla and others 2021. **4.** Freedom House 2021; USAID 2020. **5.** Fujita and Sabogal 2021. **6.** Díaz-Bonilla and others 2021. **7.** UN OCHA 2020. **8.** FEWS NET 2021a. **9.** FEWS NET 2021b. **10.** FAO 2021. **11.** BBC News 2021. **12.** FAO 2021.

provoked concern over land rights, indigenous peoples' rights and food security.[18] Two UN Special Rapporteurs have warned of "fortress conservation."[19]

Wind and solar power, set to become the main energy sources in a rapidly decarbonizing world, have historically generated very little conflict. However, there are potential issues at both ends of the product lifecycle, as there are with batteries for energy storage and electric vehicles. At the source end, concerns focus on the human rights abuses connected with some mining operations for minerals such as lithium, cobalt and rare earth elements.[20] At the disposal end, wind turbines, solar panels and batteries need to be made fully recyclable, to avoid the creation of potentially huge waste streams.[21]

The urgency of the crisis in nature and climate change is so acute that rapid and profound transitions are needed to halt and reverse it. Failure to do so will inevitably lead to further security risks associated with continuously rising impacts. However, failure to enact transitions in a fair and peaceful manner will be a sure-fire recipe for both creating further insecurity and conflict risks and compromising the prospects of success.

Beginnings of a new security

Despite the gravity of the global situation, there are hopeful signs from community projects up to the supranational institution level.

Recognition within the United Nations of the relationship between environmental degradation and security dates back to at least January 1992, when the Security Council declared that "non-military sources of instability in the economic, social, humanitarian and ecological fields have become threats to peace and security."[22] The link has since been acknowledged in many other declarations and initiatives, including the Sustainable Development Goals and the

Sustaining Peace initiative.[23] Nevertheless, security and environmental agendas have largely progressed along separate tracks. The creation of the Climate Security Mechanism in 2018 has built a bridge, but the serial vetoing of resolutions on climate change and security within the Security Council is one bar to fuller coordination.

Several regional blocs also acknowledge the links between environmental degradation and security, including the African Union, the European Union, the Organisation for Security and Co-operation in Europe and the Association of Southeast Asian Nations. The African Union recognizes that addressing human impacts on the planet, such as climate change, will reduce the risk of conflict and commits to tackling them as a route to securing development.[24]

At the operational level, the UN Assistance Mission in Somalia represents an important step forward. It is the first mission to include a dedicated environmental and climate security adviser.[25] The United Nations is deploying similar advisers elsewhere.

Civil society organizations and international agencies have launched many initiatives that build peace and address environmental degradation simultaneously in historically conflict-prone areas. In the Sahel, where climate change impacts and overuse of water have exacerbated tension between pastoralists and farmers, multiple projects are improving resource management and animal health, facilitating access to markets, helping pastoralists diversify sources of income and managing conflict.[26] Across the borders of Israel, Jordan and the State of Palestine, the nongovernmental organization EcoPeace builds mutual understanding among communities whose security is impacted by shortfalls in water and energy access relating to environmental decline.[27] In Uganda the Strengthening Resilience and Inclusive Governance project aims to defuse tensions between refugees and host communities who would otherwise be competing for the same charcoal resources and in the process would use it unsustainably.[28] All these examples can be learned from and scaled up.

Towards an environment of peace

There are, broadly, two areas in which governments and other decisionmaking institutions need to take action to mitigate the growing threat to peace posed by the twin crises.

One is to link up responses to insecurity and environmental degradation, at every level from policymaking down to projects, so that manifestations of the crises are tackled holistically. This cannot be only about responses to emerging situations—it must also be anticipatory, involving horizon scanning, forecasting, knowledge sharing and resilience building.

The second is to get on with solving the underlying environmental threats. Security risks will keep growing until society rebuilds the natural resource base, restores biodiversity, aggressively limits pollution and reduces greenhouse gas emissions to net-zero. Moves to do this must be undertaken in a just and peaceful way—but they must be undertaken.

The Stockholm International Peace Research Institute report *Environment of Peace,*[29] launched in May 2022, concludes with six recommendations for action and five principles to guide them. The principles include approaching the crises cooperatively, because a nationalistic approach to threats faced in common is clearly illogical and inefficient. Governments need to combine far-sighted vision and strategy with urgent action and to adapt strategies as they go along because the manifestations of the twin crises will evolve. All the transitions needed to halt and reverse environmental degradation, including climate change, must be enacted justly and peacefully—which also implies enacting them inclusively, ensuring that affected people are involved in decisionmaking and share in the benefits.

The recommendations themselves include some that will build resilience. For example:

- All governments should carry out a risk assessment on the security risks posed by environmental decline.
- All transboundary resources such as river basins should be covered by resource-sharing agreements, and those agreements should be made fit for purpose in an era of climate change.
- Early warning systems for conflict should include indicators of environmental change.

Others address root causes. For example:

- Governments should, as far and fast as possible, stop funding conflict risk through building up weaponry and subsidising fossil fuels and instead fund environmental restoration and peace.

- The public and private sectors should proactively identify and reduce conflict risks in the clean technology supply chain.
- Indigenous peoples and other marginalized groups should routinely be involved in making decisions that concern them.

All the recommendations can be implemented within the next few years. And all should be. Governments agreed, in approving the Working Group 2 report from the Intergovernmental Panel on Climate Change in February 2022, that there is "a brief and rapidly closing window to secure a liveable and sustainable future for all."[30] The context of its words was climate change; but they are equally applicable across the entire risk landscape of the twin security and environmental crises. With the escalating risks having been identified, it is clearly in every government's self-interest to act.

NOTES

1 UNHCR 2021; von Grebmer and others 2021.
2 Pettersson and others 2021.
3 Lopes da Silva, Tian and Marksteiner 2021.
4 Kristensen and Korda 2021.
5 IPCC 2022b.
6 UN 1972.
7 IEP 2021, p. 4.
8 Krampe 2021.
9 Mobjörk, Krampe and Tarif 2021.
10 IPCC 2019, p. 15; Lebling and others 2020, p. 8.
11 Headey and Fan 2010; Zoellick 2008.
12 Walicki, Ioannides and Tilt 2017.
13 International Rivers Network 2011.
14 IEA 2021a.
15 European Commission 2021; ICAO 2019.
16 High Ambition Coalition for Nature and People 2022.
17 The Open-ended Working Group on the Post-2020 Global Biodiversity Framework 2022.
18 Rights and Resources Initiative 2020.
19 Boyd and Keene 2021; Tauli-Corpuz, Alcorn and Molnar 2018.
20 Searcey, Lipton and Gilbertson 2021.
21 Harper and others 2019; Månberger and Stenqvist 2018; Morse 2021; Pavel and others 2017.
22 United Nations Security Council 1992.
23 UN 2020b.
24 African Union 2015.
25 Hodder 2021.
26 World Bank 2017a, 2022a, 2022b.
27 EcoPeace Middle East n.d.
28 CARE 2019.
29 Black and others 2022.
30 See note 6 in IPCC (2022b).

SPOTLIGHT 1.7

Low-carbon transformations: A green resource curse?

New low-carbon technologies such as electric vehicles and renewable energy generation will require much larger inputs of nonrenewable minerals than are needed for high-carbon energy sources, such as petroleum-powered cars.[1] In many instances these minerals are found in a very limited number of locations, often low- and middle-income countries.[2]

Africa hosts some of the largest reserves of many of the minerals used to produce low-carbon technologies at scale.[3] And by 2040 renewable energy is projected to account for 75 percent of Africa's new power generation and 40 percent of its total power generation.[4] These two trends could boost economic growth and improve living standards. But many resource-rich countries have suffered from a "resource curse," with resource wealth fuelling violent conflict, heightened poverty and social inequality.[5] The shift to low-carbon technologies and renewable energy raises concerns about potential "green resource curses."

There are multiple channels for low-carbon transitions to lead to conflict and dispossession. A recent mapping of renewable energy projects and conflict sites across five African countries revealed a substantial correlation. Proximity to a renewable energy site was strongly associated with higher conflict risk across green activities, ranging from establishing renewable energy projects to green mineral mining to producing renewable energy.[6]

Establishing and operating renewable energy projects are frequently fraught with tension over land acquisition, employment opportunities and benefit sharing—often compounded by a lack of consultation with existing landowners and users, especially where customary land users may lack written documentation of their claims. Grievances were compounded by concerns about local employment opportunities and the lack of a mechanism for reinvesting project revenues in the local community.[7] Moreover, many residents in the communities closest to the project sites were not afforded access to the national electric grid, despite ceding their historical lands for project development.

Tensions often persist after projects become operational. Key reasons include limited employment opportunities and a perceived lack of benefit sharing among the communities most impacted by such projects. When the benefits and value produced from such projects are seen as benefitting far-away elites or a rival status group, the potential for conflict is high. This risk can be reduced by including local communities and indigenous and marginalized groups in project planning.

Green mineral mining is also a classic example of a potential resource curse. From cobalt and coltan in the Democratic Republic of the Congo to lithium in Zambia and Zimbabwe to copper across much of southern Africa, the region holds enough mineral wealth to support the mass production of low-carbon technologies.[8] Yet, resource curse dynamics are a threat where economic diversification is limited, institutions are weak and potential for resource capture is high.

Even where conflict is less prevalent, many such projects are plagued by unsafe conditions, environmental degradation and benefits that fail to accrue to the local communities.[9] Voluntary governance initiatives, such as limiting the sale of conflict diamonds, can help prevent green resource curse dynamics but require coordination across the supply chain of mineral producers, processers and consumers.

The adverse impacts associated with renewable energy production have yet to reach the conflicts sparked by fossil fuel production. But given the projected growth of renewable energy, active policy interventions will be needed to reduce conflict risks associated with low-carbon transitions.[10]

Source: This spotlight builds on Aas Rustad and others (2022).

NOTES

1 Leonard and others 2022; Aas Rustad and others 2022.

2 See, for example, IEA (2021b).

3 Aas Rustad and others 2022; IEA 2021b.

4 IEA 2014, 2019.

5 Aas Rustad and others 2022; Leonard and others 2022.

6 Aas Rustad and others 2022.

7 Aas Rustad and others 2022; Schilling, Locham and Scheffran 2018.

8 Aas Rustad and others 2022; IEA 2021b; Leonard and others 2022.

9 Aas Rustad and others 2022; Frankel, Mucha and Sadof 2018; Ochab 2020.

10 Leonard and others 2022; Schilling, Locham and Scheffran 2018.

SPOTLIGHT 1.8

The new uncertainty complex and intergenerational justice

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Pursuing socioenvironmental justice now and leaving a thriving planet for the generations that follow require both knowledge and imagination. Not only do we need to know how to pursue and realize such things as social justice and ecosystem health, but we also need to be able to imagine relationships and responsibilities far beyond our own temporally and spatially bound lives. For instance, to "[meet] the needs of the present without compromising the ability of future generations to meet their own needs,"[1] we must both know what meeting needs requires now and be able to imagine what the lives of future generations might be like in a range of different and distant futures.

Philosophers have developed several theories of intergenerational justice that animate the normative underpinnings of our responsibilities to future generations.[2] Some theories take the view that justice requires that we imagine ourselves choosing principles to govern intergenerational responsibilities. To enforce fairness, the choice procedure removes knowledge of exactly which generation we (the decisionmakers) will belong to.[3] Other theories contend that justice requires that we imagine having to justify any courses of action we take now directly to our descendants who will inherit the consequences of those actions.[4] For other theories justice requires that we imagine ourselves situated such that we must justify our actions now directly to our ancestors given their values, aspirations and expectations.[5] Similarly, other theories start out from the contention that justice requires we imagine ourselves as part of connected and overlapping intergenerational communities extending backwards and forwards in time.[6] In line with this view Indigenous philosophies situate each generation as part of a "series of never-ending beginnings"[7] —each born in the imaginations of generations past, with the responsibility to set the course for the journeys that follow.[8]

Our cultural values, narratives and practices have a vital role in protecting and enabling intergenerational links—connecting past, present and future generations.[9] Polynesian ocean-voyaging narratives, for example, trace descent lines across the expanses of the Pacific Ocean, the largest body of water on Earth, in some cases all the way to the Southern Ocean and Antarctica.[10] Land-based narratives story ancestral migrations that weave networks of communities into the land and waterways—embedding connections and responsibilities through and across multiple generations.[11] Socioenvironmental practices enact values that preserve relationships and knowledge transmission.[12] Together, these theories, cultural values and practices provide critical conceptual and cognitive tools that bridge distant people and places in ways that situate the current generation as having responsibilities as part of a far-reaching intergenerational community.[13]

Our theories, values and practices are grounded in the aspiration to leave behind a thriving planet. This aspiration is reflected in the way we live our individual and collective lives hopeful that what we value, create and pursue will endure. It is similarly reflected in the way we make policies based in part on the legacies that those policies will chart and enable in the long run. There tends to be, in other words, "a conceptual connection between valuing something and wanting it to be sustained."[14] Indeed, what we leave behind for future generations shapes not just how meaningful their lives will be but how meaningful our lives can be said to have been as well.

The uncertainty complex outlined in this year's Report, while reinforcing this aspiration, highlights a more fundamental aspiration and challenge as well: namely, that there will be a future of some sort at all. While previous generations have largely been able to take a stable planetary system for granted, our generation faces the challenge of ensuring the planet's long-term survival. Such a predicament reinforces the urgent need for pathways through which different ideas, fresh perspectives and appropriate socioenvironmental practices can be enabled and enacted

now. More specifically, our collective challenge provides an opportunity to adopt the kind of long-term intergenerational thinking that grounds Indigenous (and many other) philosophies—which Tim Mulgan refers to as "multigenerationalism."[15] According to this view, the best way to find meaning in the world today is to embark on projects spanning several generations that come to fruition only long after the present generation is gone.

To do multigenerationalism well, or even at all, however, we must remember what we truly need to flourish,[16] and we must be courageous enough to remake our local and global systems in ways that will truly enable and sustain that flourishing.[17] What is more, we have to find the courage to radically change our values and narratives so that our descendants might still be here to pursue planetary wellbeing and justice long after we are gone.[18] Perhaps most important, we must have "radical hope"[19]—we must hope for a world that we know may never materialize in the future and yet still find the courage to hold the course towards that future anyway.

NOTES

1 WCED 1987, p. 37.

2 See, for instance, Gardiner (forthcoming) and Mulgan and others (2021).

3 Rawls 1971.

4 Darwall 2009; Mulgan 2018.

5 Watene 2022.

6 De-Shalit 1995.

7 Jackson 2020, p. 99.

8 Kelbessa 2022; Watene 2022, forthcoming; Whyte 2013.

9 Epeli Hao'ofa 2008; IPBES 2019b; Kimmerer 2013; Mutu and McCully 2003.

10 Wehi and others 2021a, 2021b.

11 See, for instance, Watene (forthcoming).

12 Grix and Watene 2022.

13 Watene 2022.

14 Scheffler 2013, p. 60.

15 Mulgan forthcoming.

16 Grix and McKibbin 2015, p. 292–306.

17 Táíwò 2022; Watene 2022.

18 Bendik-Keymer 2016; Táíwò 2022.

19 Lear 2006. See also van der Lugt (2022) and Whyte (2017).