FUELLING FAILURE

How coal, oil and gas sabotage all seventeen Sustainable Development Goals

Freddie Daley & Charlie Lawrie, University of Sussex

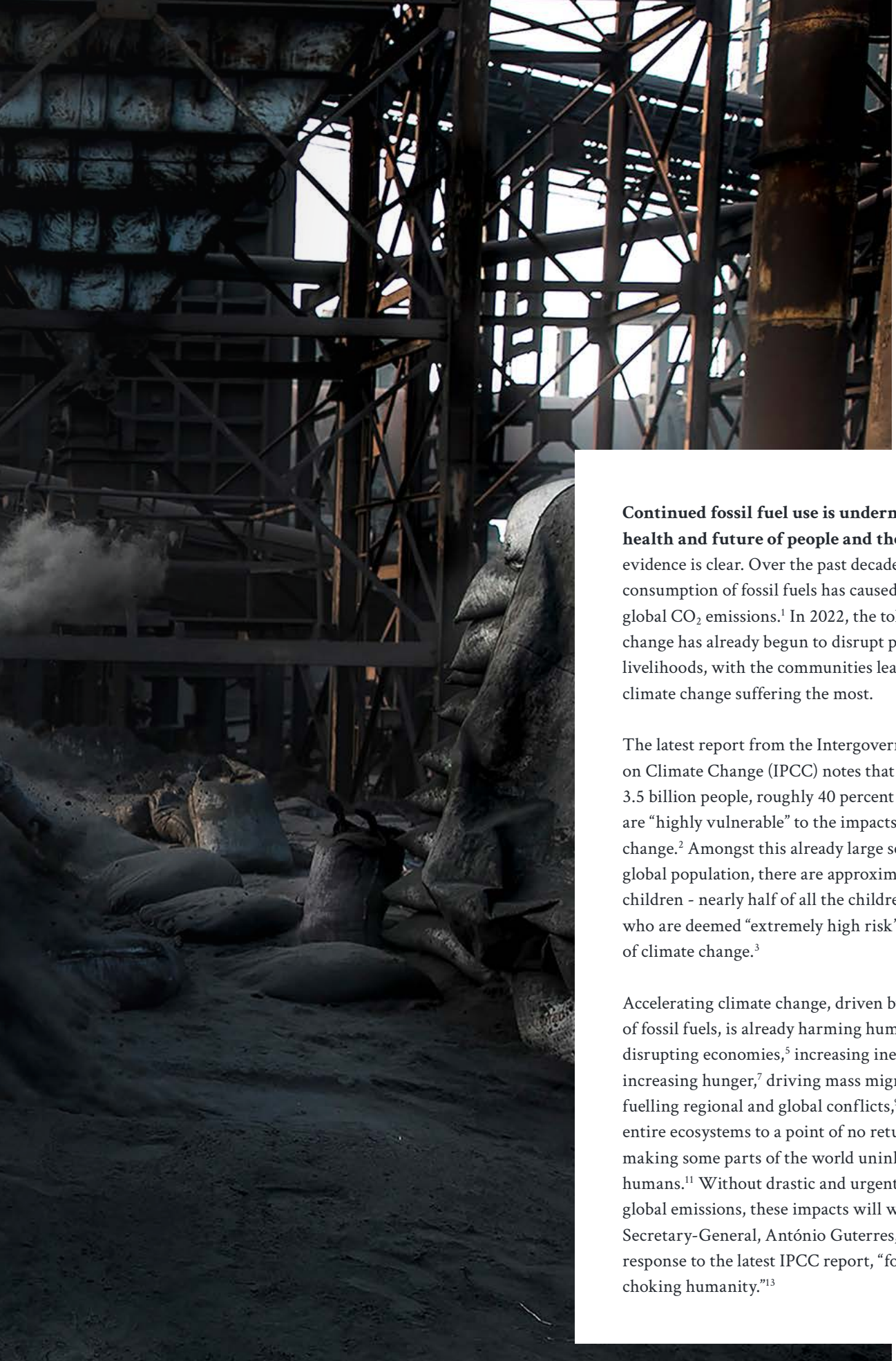
FOSSIL FUEL NON-PROLIFERATION TREATY

FOSSIL FUEL NON-PROLIFERATION TREATY

Acknowledgements: *The authors would like to thank the following for their invaluable comments and suggestions on earlier drafts of this report: Teresa Anderson (ActionAid), David Hillman (Stamp Out Poverty), Josh Karliner, Shweta Narayan and Dr Peter Orris (Health Care Without Harm), Dunja Krause (UN Research Institute on Social Development), Nakul Sharma (CAN-I), Shaye Wolf and Jean Su (Centre for Biological Diversity), and Mariel Vilella (GAIA). Any remaining errors remain the sole responsibility of the authors. Graphic design by Made Visual and Spade & Arrow.*

CONTENTS

Introduction



Continued fossil fuel use is undermining the health and future of people and the planet. The evidence is clear. Over the past decade, humanity's consumption of fossil fuels has caused 86 percent of global CO_2 emissions.[1] In 2022, the toll of climate change has already begun to disrupt peoples' lives and livelihoods, with the communities least responsible for climate change suffering the most.

The latest report from the Intergovernmental Panel on Climate Change (IPCC) notes that a staggering 3.5 billion people, roughly 40 percent of humanity, are "highly vulnerable" to the impacts of climate change.[2] Amongst this already large section of the global population, there are approximately one billion children - nearly half of all the children on Earth - who are deemed "extremely high risk" to the impacts of climate change.[3]

Accelerating climate change, driven by the burning of fossil fuels, is already harming human health,[4] disrupting economies,[5] increasing inequality,[6] increasing hunger,[7] driving mass migrations,[8] fuelling regional and global conflicts,[9] pushing entire ecosystems to a point of no return,[10] and making some parts of the world uninhabitable for humans.[11] Without drastic and urgent action to cut global emissions, these impacts will worsen.[12] As UN Secretary-General, António Guterres, remarked in response to the latest IPCC report, "fossil fuels are choking humanity."[13]

In addition to fossil fuels' dominant role in driving climate change, the infrastructure that enables their exploration, extraction, transportation and combustion are responsible for staggering human and economic costs the world over. In each year between 2012 and 2018, an estimated 8.7 million people died prematurely due to fossil fuel air pollution.[14] However, just focusing on particulate matter may underestimate the true health impacts of fossil fuel pollution, with one study concluding that fossil-fuel-related emissions account for around 65 percent of the excess mortality rate attributable to air pollution.[15] In 2018, fossil fuel pollution was responsible for 1.8 billion days of work missed due to illness, 4 million new cases of asthma amongst children and 2 million preterm births.[16] Phasing out fossil fuels, and curtailing emissions at the rate required to limit temperatures to 1.5°C, could prevent 153 million premature deaths worldwide by the end of the century due to improvements in air quality.[17]

Such disastrous scenarios run counter to humanity's efforts to achieve equitable, sustainable development for all states and nations across the world. These efforts find their most prominent manifestation in the Sustainable Development Goals (SDGs). Unanimously endorsed and adopted by the member states of the United Nations (UN) in September 2015, the SDGs provide a comprehensive sustainable development agenda agreed at the intergovernmental level. The 17 SDGs, whose 169 targets aim to "end poverty, protect the planet, and ensure prosperity for all" by 2030, touch on a diverse range of issues and challenges, such as biodiversity, work, health, inequality and food.

The SDGs apply to all countries, rich and poor, with the aim of ensuring that "no one will be left behind".[18] Moreover, the SDGs provide a framework for international actors to rally around, with the goals and commitments of the 2030 Agenda closely intertwined with other global commitments, such as the Paris Agreement.[19] Actions, initiatives and efforts to address climate change, biodiversity loss and pollution directly interact with many of the SDGs. There are trade-offs that must be carefully navigated, but there are positive synergies too and immense opportunities to improve the lives of billions of people, many of whom are extremely susceptible to the impacts of climate change.

This report is the first to highlight the dangers that the fossil fuel industry poses to the SDGs. It collates evidence of how the exploration, extraction, refining, transportation and combustion of oil, gas and coal is making it impossible for the global community to meet the SDGs, threatening lives and livelihoods, and the ability of the planet to sustain human wellbeing.

The exploration, extraction, refining, transportation and combustion of oil, gas and coal is making it impossible for the global community to meet the SDGs, threatening lives and livelihoods, and the ability of the planet to sustain human wellbeing.

Drawing on more than four hundred academic articles and civil society reports, the report examines each of the individual seventeen SDGs and specifies precisely how the exploration, extraction, transportation and combustion of fossil fuels, as well as the corporate conduct of the fossil fuel industry, are eroding efforts towards achieving them.

The report not only acknowledges the direct and indirect impacts of fossil fuels and supporting infrastructures on the SDGs, but also explores the complex interlinkages between fossil fuels and other areas of the global economy, such as transportation, urban development, and consumption, amongst others.

The conclusion of this report outlines a way forward that aligns ambitious climate action with efforts to revitalise the sustainable development agenda, reverse biodiversity loss and curtail pollution. This approach highlights the need for a new international framework to coordinate a fast, fair and equitable phase out of fossil fuels. Supply side action – stopping fossil fuel extraction in the first place, to complement existing efforts to reduce fossil fuel demand – is vital for stimulating an orderly, but rapid, transition away from fossil fuels, while supporting the most vulnerable communities, who have done the least to create this crisis, to thrive in our warming world.

THE SDGs IN A WARMING WORLD

As global temperatures rise and climate impacts become more frequent and severe, achieving all 17 SDGs by 2030 will become an increasingly daunting task despite the notable progress made in certain areas.[20] Climate change, biodiversity loss and pollution will all make the world a more unstable, unpredictable and less habitable place for humanity. To bring the 2030 target within sight and deliver the economic and social transformations required to achieve each of the SDGs, the international community must pursue a faster, deeper and more ambitious approach to tackling climate change, biodiversity loss and pollution that addresses a root cause of these intertwined crises - fossil fuels.

Despite the most recent climate science stating that emissions need to fall dramatically to limit temperatures to 1.5°C above pre-industrial levels, the bold target envisioned under the Paris Agreement, there is currently enough coal, oil and gas under production today to take global heating well beyond this figure.[21] The most recent UN Production Gap report, which measures the gap between the levels of fossil fuel production and the required emissions cuts, found that governments around the world are expected to produce more than twice the amount of fossil fuels by 2030 than is consistent with keeping warming below 1.5°C.[22] Many of these governments are based in wealthy, industrialised nations that are disproportionately responsible for climate change due to their historical legacy of greenhouse gas (GHG) emissions and the fossil fuel intensity of their economic development.[23] These are the same nations that have a duty and the capacity to be driving progress towards the SDGs.

In 2019, calls were made from the international community for a "decade of action" to deliver sustainable development, mobilise finance, enhance national implementation and strengthen institutions "to achieve the goals by the target date of 2030."[24] But shortly after, the global pandemic took hold which has been a tragic setback for the SDGs. The global rate of extreme poverty increased for the first time in 20 years, with approximately 100 million people pushed back into extreme poverty and hunger.[25] Due to COVID-19, essential health services faced disruption and measures to contain the virus wreaked havoc on the accessibility of education and employment with women suffering a disproportionate share of job losses.[26] COVID-19 has reversed years, or even decades, of progress towards the SDGs.

Yet the global pandemic is just one of several barriers to achieving the SDGs in a warming world. Conflict and war, displacement and migration, the sheer lack of development finance, and the peril of climate change, all threaten the feasibility of achieving the SDGs by 2030. The 2021 update on progress towards the SDGs from the UN highlights how many of these compounding and interrelated factors are impeding progress towards the goals and, in some cases, actually reversing the notable headway made.

For example:

SDG 1:
The global poverty rate is projected to be 7 percent in 2030, which would mean the target on eradicating poverty will be missed;

SDG 2:
22 percent of children under 5 are stunted, 6.7 percent suffer from wasting;

SDG 6:
2 billion people lack safely managed drinking water and 3.6 billion people lack safely managed sanitation;

SDG 13:
In 2020, the global average temperature was at 1.2°C above the pre-industrial baseline; and

SDG 15:
The world has lost 100 million hectares of forest between 2000-2020.[27]

Despite global carbon emissions briefly falling at the onset of the COVID-19 pandemic, emissions surged in 2021 to the second-highest rate in recorded history.[28] This resurgence was partly driven by governments pouring public money into fossil fuels to stimulate an economic recovery. Analysis by Tearfund revealed that between January 2020 and March 2021, G7 nations committed over US$189 billion to support coal, oil and gas while clean and renewable energy received just $147 billion.[29] Despite multiple warnings that this level of support for fossil fuels is inconsistent with both G7 nations' own net-zero pledges and the emissions reductions required to limit warming to 1.5°C, fossil fuels received more than half of the total G7 support given to the energy sector during the pandemic.[30] Even now, more than two years into the pandemic, fossil fuel firms are projected to pump $932 billion into new oil and gas developments over the next nine years.[31]

While the *rate of growth* of greenhouse gas emissions has slowed, emissions are still increasing in absolute terms year on year. The cumulative nature of greenhouse gases means that global heating will continue until emissions are swiftly brought down to zero. Until then, climate impacts will continue to increase in their severity and frequency, causing immense disruption to human and natural systems. In this warmer, more unstable and unpredictable world, the barriers impeding the SDGs are plentiful. As the box out below emphasises, the extent of global climate impacts, its severity, and the number of people affected varies greatly according to the extent of warming experienced. The future humanity faces depends on the choices made today.

Box out 1: Fossil fuelled-climate change will push the SDGs further out of reach

Climate Impact	SDGs	1.5°C	2°C
Sea level rise by 2100	SDG1; SDG6; SDG11	↑ 48cm	↑ 56cm
Ocean acidity by 2050	SDG14; SDG8; SDG9; SDG12;	↑17%	↑29%
Frequency of warm extremes over land	SDG15; SDG3; SDG16; SDG2; SDG10	↑ 129%	↑ 343%
Population facing at least one severe heatwave every 5 years	SDG3; SDG2; SDG10;	14%	37%
Average drought length	SDG2; SDG3; SDG8; SDG9; SDG6; SDG15;	2 months	4 months
Average crop yield change by 2100	SDG1; SDG2;	Maize: ↓ 6% Wheat: ↓ 5%	Maize: ↓ 9% Wheat: ↓ 4%
Suitability of drylands for malaria transmission	SDG3; SDG6;	↑19%	↑27%
Annual flood damage losses from sea level rise	SDG1; SDG3; SDG11	$10.2 trillion	$11.7 trillion
Global per capita GDP in 2100	SDG1	↓8%	↓13%

Source: scientific synthesis from Carbon Brief

While the table above paints a global picture, there are important geographical and regional aspects to climate change that will also impede efforts to achieve the SDGs. According to the Climate Impact Lab, countries in the Global South are expected to suffer the greatest loss of life, property and economic activity due to climate change and its impacts while the basic needs of billions are already not being sufficiently met.[32] The World Bank forecasts that most of the world's poorest citizens are expected to live in sub-Saharan Africa in 2030 based on current economic forecasts.[33] At the same time, sub-Saharan Africa, which is home to 1.1 billion people, will be exposed to more frequent and severe droughts, floods and extreme heat due to climate change that will hamper the production of food, provision of basic services and trigger mass migrations.[34] Despite these extensive impacts, sub-Saharan Africa was responsible for just 1 percent of global fossil fuel emissions in 2020.[35] Climate impacts, under all temperature trajectories, will further hamper progress towards the SDGs, but it is the communities and countries that did the least to drive climate change that will suffer the most as the crisis deepens.

Sub-Saharan Africa, which is home to 1.1 billion people, will be exposed to more frequent and severe droughts, floods and extreme heat due to climate change that will hamper the production of food, provision of basic services and trigger mass migrations. Despite these extensive impacts, sub-Saharan Africa was responsible for just 1 percent of global fossil fuel emissions in 2020.

Box Out 2: Summary of fossil fuel impacts on SDG2

SDG	Fossil fuel impact	SDG	Fossil fuel impact
SDG 1. No Poverty 	Fossil fuels are the primary driver of climate change, which is set to push 122 million more people into extreme poverty by 2030.[36] Globally, governments spend three times more money on fuel subsidies than the annual amount needed to eradicate poverty.[37,38]	**SDG 9.** Industry, Innovation and Infrastructure 	Fossil fuel companies are expected to spend $527 billion on new fossil gas exploration and $405 billion on oil exploration by 2030.[39] This will lock economies into emissions for decades at a time when they need to decrease urgently.
SDG 2. Zero Hunger 	Increases in global temperatures, shifting rainfall patterns, extreme weather events, and elevated surface carbon dioxide concentrations from burning fossil fuels will reduce the yields of key crops and push millions into food insecurity. Fossil fuel production and offset schemes pull vast amounts of land away from agricultural uses.	**SDG 10.** Reduced Inequality 	Fossil fuel pollution disproportionately impacts poorer and more vulnerable communities, while fossil fuel subsidies benefit the richest members of society the most. The risk of stranded assets could further entrench global wealth inequalities.
SDG 3. Good Health and Wellbeing 	Roughly 8.7 million people died prematurely due to fossil fuel pollution every year between 2012 and 2018.[40] The worsening climate crisis, driven by fossil fuels, is linked with increases in disease, infant mortality and displacement, with devastating impacts on health and wellbeing.	**SDG 11.** Sustainable Cities and Communities 	Fossil fuel pollution is making urban life a health hazard, with 98 percent of cities with populations over 100,000 in low- and middle-income countries exceeding WHO guidelines for particulate matter.[41] As the climate crisis accelerates, many cities will suffer due to sea-level rise and extreme heat.
SDG 4. Quality Education 	Children born in 2020 are expected to experience between two and seven times as many extreme weather events as someone born in 1960, disrupting their education and future prospects.[42] Fossil fuel exporting states are vulnerable to fluctuating prices and often underfund the provision of education.[43]	**SDG 12.** Responsible Consumption & Production 	Humanity is not shifting away from fossil fuels quickly enough, with the global "material footprint" increasing by 70 percent between 2000 and 2017.[44] In 2020, global fossil fuel subsidies reached $5.9 trillion–equivalent to $11 million per minute.[45]
SDG 5. Gender Equality 	Climate change exacerbates existing gender inequalities, particularly during natural disasters and extreme weather events. Women disproportionately bear the health and social burdens of fossil fuel processes, such as gas flaring.	**SDG 13.** Climate Action 	Fossil fuel firms are actively undermining climate action through lobbying, donating to politicians and political parties and funding misinformation. Despite all their promises and pledges, fossil fuel firms are not driving the energy transition, they are subverting it.

SDG	Fossil fuel impact	SDG	Fossil fuel impact
SDG 6. Clean Water and Sanitation	Fossil fuel production and the waste it generates are proven to contaminate water supplies, which can lead to increased outbreaks of disease and illness. Broader climate impacts, like rising temperatures and flash flooding, have been shown to increase water insecurity and disease outbreaks.	**SDG 14.** Life Below Water	Fossil fuels are fundamentally altering the chemistry of the oceans, with acidification and extreme heat stress threatening marine life and ecosystems. Fossil fuel production processes are proven to disrupt key feeding and breeding areas, which can have huge implications for global populations of marine species.
SDG 7. Affordable and Clean Energy	770 million people are estimated to remain without access to cheap, reliable electricity, of whom 570 million live in least developed countries (LDCs).[46] While the cost of providing universal energy access would only cost $41 billion annually, total fossil fuel subsidies came to $5.9 trillion in 2021.[47,48]	**SDG 15.** Life on Land	The extraction, transportation and combustion of fossil fuels drives the fragmentation of habitats, contaminates the water and feeding grounds wildlife populations rely on and, when these infrastructures fail, ecosystems can face total annihilation.
SDG 8. Decent Work and Economic Growth	1.2 billion jobs directly rely on a healthy environment, which is being undermined by fossil fuelled-climate change.[49] By 2030, heat stress alone could lead to the loss of over 2% of total working hours worldwide every year.[50] It is estimated that a green economy transition will lead to a net gain of approximately 18 million jobs.[51]	**SDG 16.** Peace, Justice and Strong Institutions	Oil and fossil gas are associated with higher levels of conflict and lower levels of democracy. Despite its invasion of Ukraine, Russia is expected to receive $321 billion from energy sales by the end of 2022.[52]
		SDG 17. Partnerships for the Goals	Fossil fuel firms do not play by the rules, avoiding tax, enjoying tax exemptions and suing governments pursuing ambitious climate action. In 2019-2020, 62 fossil fuel companies paid zero tax in Australia despite receiving revenues of $81.4 billion.[53]

TIME FOR A NEW APPROACH: A FAIR, FAST AND GLOBAL FOSSIL FUEL PHASE OUT

Limiting global temperatures to 1.5°C implies that fossil fuel production must be tightly constrained and ultimately phased out, rapidly and equitably. This, in the words of the IPCC, is "fundamental" to limiting global heating.[54] To do this, vast reserves of fossil fuel must remain in the ground and existing infrastructures must be wound down prematurely, phased out and replaced with low-carbon alternatives. A recent study found that, for a 50 percent probability of staying below 1.5°C, approximately 40 percent of developed reserves must remain safely in the ground.[55] Simply put, humanity cannot tackle climate change, biodiversity loss, pollution or prevent irreparable climate-induced loss and damage around the world without ending the use of fossil fuels.

No longer the preserve of environmentalists and radicals on the fringes of public debate, this view has become increasingly endorsed by some of the largest and most influential institutions in the world. The International Energy Agency (IEA), for instance, has recently called for no new investment into fossil fuel production to 'keep the 1.5°C target alive'.[56] In fact, as the UN Secretary-General António Guterres has succinctly stated "climate activists are sometimes depicted as dangerous radicals. But, the truly dangerous radicals are the countries that are increasing the production of fossil fuels."[57]

A new, joined-up and global approach to tackling climate change, advancing the sustainable development agenda and strengthening the Paris Agreement must begin with an understanding that the fate of Earth's climate and the SDGs are inextricably linked. If humanity fails to tackle climate change and prevent the current crisis from intensifying, the aims and ambitions of all seventeen SDGs will slip further from our grasp, with some goals becoming an impossible endeavour. **This new approach must align efforts and initiatives to achieve all 17 of the SDGs with a fast, fair and equitable fossil fuel phase out.** In order to navigate these challenges and capture the benefits, a global fossil fuel phase out must prioritise the following three principles:

This new approach must align efforts and initiatives to achieve all 17 of the SDGs with a fast, fair and equitable fossil fuel phase out.

1. Fairness

Much like the SDGs, a fossil fuel phase out must ensure it leaves no one behind. The deeply unjust nature of climate change means that fairness must be at the heart of phasing out fossil fuels. The communities feeling the impacts of climate change already, through extreme heat, flooding and harvest-wrecking droughts, are those that have done the least to create the climate crisis. According to Oxfam, the richest ten percent of humanity accounts for over half (52 percent) of emissions added to the atmosphere between 1990 and 2015–a 25 year period in which humanity doubled the amount of carbon dioxide in the atmosphere.[58] To make matters worse, many wealthy nations are planning to expand fossil fuel production, despite the overwhelming evidence of the dangers of doing so.[59]

The extraction and consumption activities of wealthy countries have also disproportionately driven pollution and biodiversity loss,[60] while the global trade system and the continued indebtedness of Global South countries has entrenched historic inequalities, undermined development, and contributed to the fossil fuel lock-in.[61] Embracing the principle of fairness will require wealthy nations taking responsibility for their historical emissions, leading by example in phasing out fossil fuels and support to scale up renewable energy, economic diversification away from fossil fuels and a just transition for workers and communities. For instance, among the wealthiest fossil fuel producing nations like the US, UK and Norway, output of oil and gas needs to be cut by 74 percent by 2030 and completely phased out by 2034 to keep the 1.5°C target alive in an equitable manner.[62] While some of the poorest nations on earth, with the fewest resources available to transition their economies, need to reduce fossil fuel output by 14 percent by 2030, with all production phased out by 2050.[63]

2. Speed

When it comes to curtailing global emissions to fend off the worst impacts of climate change, speed is everything. It is essential to act **quickly** with wealthy nations using their financial resources and technical capacity to move **fast** in phasing out fossil fuels first while helping other nations to follow their example. The latest IPCC report made clear that the time for action is now and that global emissions from all sectors need to be halved by 2030.[64] The UN, World Health Organization (WHO), and other notable organisations have called for a similar level of urgency to address the "unprecedented" level of biodiversity loss[65] and life-threatening levels of pollution.[66] There is also growing concern in the natural sciences over tipping points within the Earth system, which could cause irreversible and abrupt changes to the natural world, with potentially catastrophic impacts. Although there is still significant uncertainty over when these tipping points will be reached, the heightened risk of irreversible climate changes should compel a rapid reduction in global emissions and a fast phase out of fossil fuels, as every 0.1 of a degree matters. The pace at which humanity addresses these three intertwined crises will determine how many human and non-human lives are saved and how much suffering is prevented.

3. Global

The principles of fairness and speed can only be met with adequate **global** coordination. The cumulative nature of greenhouse gas emissions and the fact that fossil fuels are distributed through global markets poses a complex and multilateral challenge that requires international collaboration. A multilateral approach to the phase out process, such as through a Fossil Fuel Non-Proliferation Treaty, could coordinate equitable phase out timelines, reflecting the capacity and resources of each state in order to prevent economic shocks and safeguard workers transitioning out of fossil fuel sectors. It could also include support for economic diversification to entice fossil fuel producing nations to join up to minimise risk by reducing their dependence on fossil fuels.

The opportunity of concerted and targeted action to phase out fossil fuels must not be underestimated. A fast, fair and equitable fossil fuel phase out has the potential to improve the wellbeing and economic opportunities afforded to billions of people around the world through a wholesale shift towards renewable energy sources and infrastructures. From reduced suffering and cleaner air, to happier and healthier children with brighter futures, the transition towards a low-carbon global economy will unlock a myriad of benefits and create opportunities that could help bring all 17 SDGs within reach.

Evidence-based hope for rapid transition: how we can change fairly and faster than the climate - Andrew Simms, Rapid Transition Alliance

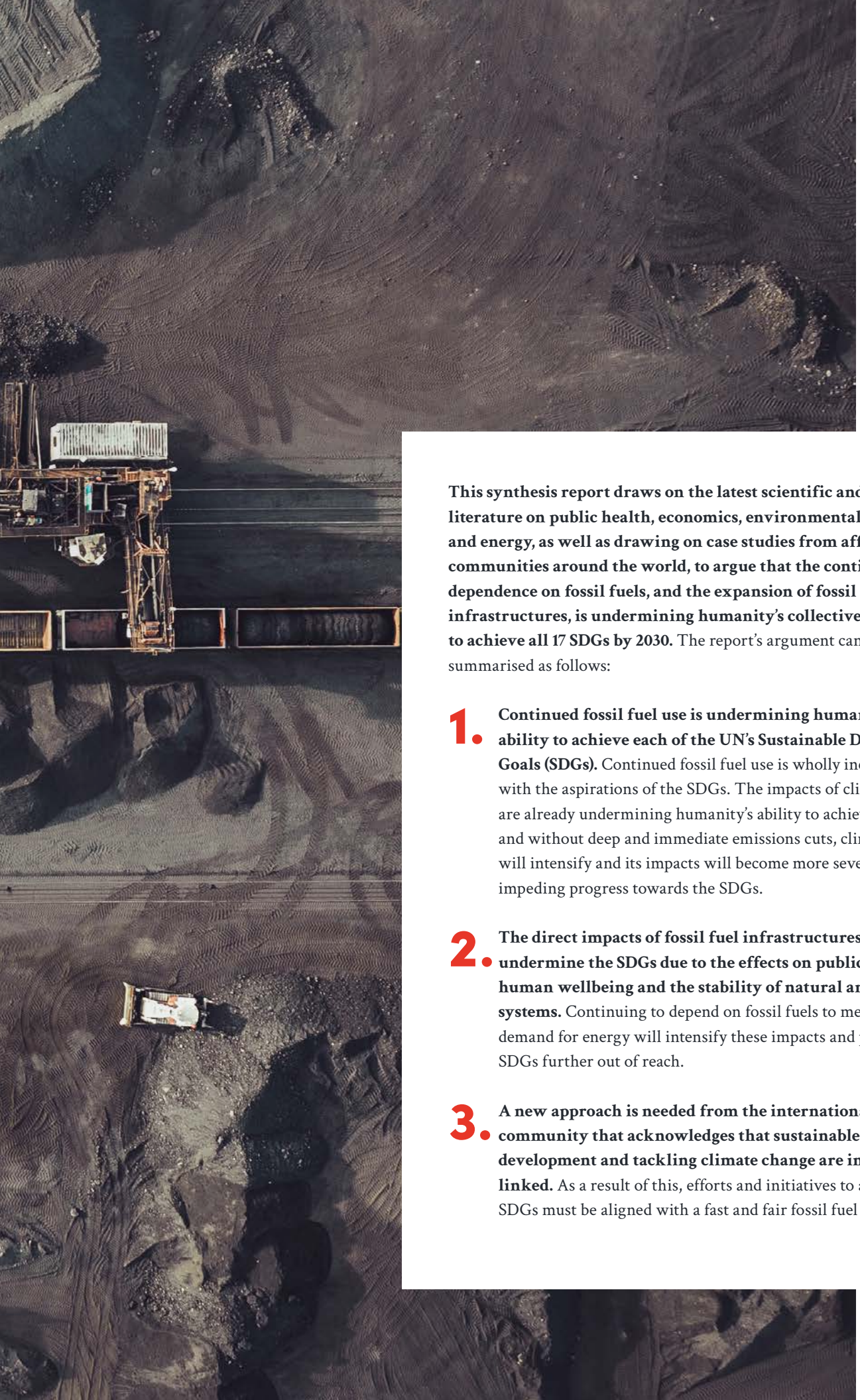
What holds nations back from necessary climate action when there is so much to gain in terms of green jobs, cleaner air, freedom from volatile fossil fuel dependence and the absence of climate catastrophe? Dithering governments, powerful vested interests and enduring infrastructures all play their part - but there is a blind spot about the possibilities and proven practicalities of rapid transition.

Rather than accept at face value claims about the impossibility of achieving fair and rapid change, the Rapid Transition Alliance is collecting and communicating compelling proof that it can be done because it has either been done before, or it is being done right now. This removes political excuses for inaction, and gives us hope that with effective mobilisation, the right support, clear priorities and the re-direction of our economies towards sustainability, we can tackle the climate crisis.

With temperature thresholds set to be crossed imminently and sky-high fossil fuel prices pushing hundreds of millions of people towards destitution, we can't afford ***not*** to transition rapidly away from coal, oil and gas. Prices are driving rates of inflation not seen for decades, and hamstringing the ability of developing nations to invest in public goods such as health and education.

Rapid transition to renewables, better ways of living and low-carbon infrastructures presents an opportunity to re-wire the global economy, bringing it in line with planetary boundaries and the sustainable development goals (SDGs). But with only eight years to achieve the SDGs, and halve global emissions, rapid transition is now the only way forward. The good news is that human history and the present day are bulging with big, transformative and radical changes - in finance, infrastructure, attitude, culture, technology and politics.

Our Approach



This synthesis report draws on the latest scientific and academic literature on public health, economics, environmental science and energy, as well as drawing on case studies from affected communities around the world, to argue that the continued dependence on fossil fuels, and the expansion of fossil fuel infrastructures, is undermining humanity's collective ability to achieve all 17 SDGs by 2030. The report's argument can be summarised as follows:

1. **Continued fossil fuel use is undermining humanity's ability to achieve each of the UN's Sustainable Development Goals (SDGs).** Continued fossil fuel use is wholly incompatible with the aspirations of the SDGs. The impacts of climate change are already undermining humanity's ability to achieve the SDGs, and without deep and immediate emissions cuts, climate change will intensify and its impacts will become more severe, further impeding progress towards the SDGs.

2. **The direct impacts of fossil fuel infrastructures also undermine the SDGs due to the effects on public health, human wellbeing and the stability of natural and human systems.** Continuing to depend on fossil fuels to meet the global demand for energy will intensify these impacts and push the SDGs further out of reach.

3. **A new approach is needed from the international community that acknowledges that sustainable development and tackling climate change are inextricably linked.** As a result of this, efforts and initiatives to achieve all 17 SDGs must be aligned with a fast and fair fossil fuel phase out.

Drawing inspiration from a paper by Lucas and Wilting (2018), this paper clusters the SDGs into four categories which comprise the core chapters of the report: the natural world, food & water, economic empowerment & just transition, and human wellbeing (see graphic below). The clustering of the SDGs reflects the interlinked and interconnected nature of the Goals, which is acknowledged by the UN and others.[67] The order of the clusters within the report, where the natural world and food & drink clusters are analysed first, reflects the role that these play as the building blocks of all life on Earth. Improving the rate of progress towards these is foundational for achieving the other SDGs. But the opposite is also true: undermining one SDG risks undermining others, creating further setbacks for the global sustainable development agenda through cascading risks and tipping points.

This argument is premised on the inherently interlinked challenges of reviving the sustainable development agenda and tackling climate change. Due to this, the report begins with analysing SDG13 - the goal that aspires to urgent climate action to combat climate change and its impacts. SDG13 cuts across and reinforces efforts to achieve many other SDGs, making it a crucial tool to attaining all the Goals by 2030. Yet, if climate action fails to deliver deep and far-reaching emissions reductions and keep fossil fuel reserves safely in the ground, the remaining SDGs will continue to elude humanity and may become an impossible endeavour.

HOW FOSSIL FUELS UNDERMINE THE SDGS

Fossil fuels undermine all 17 SDGs. As the primary driver of climate change and air pollution, and a major contributor to biodiversity loss, fossil fuels have a detrimental impact on all the SDGs. The direct impacts of the exploration, extraction, refining, transportation and combustion of fossil fuels also impact every SDG.

SDG 13. Climate Action: Fossil fuel firms are actively undermining climate action and boosting extraction

Increasing fossil fuel production and extraction undermines pledges to cut global emissions.

Fossil fuel firms ardently suppress climate action through lobbying, political donations and misleading advertising and pledges.

Despite their promises, fossil fuel firms invest a tiny slither of their overall capital expenditure into renewable sources of energy.

Revitalising the sustainable development agenda and tackling climate change are inextricably linked. The integration of a specific climate goal – SDG 13 – into the Goals is testimony to this. Climate change is a global and urgent threat that can impede the realisation of the remaining SDGs.[68] The speed at which humanity ramps up climate action and ambition during the current decade will be decisive for the future habitability of Earth and the feasibility of the 2030 Agenda. The costs of climate inaction are too great and the impacts too harsh for increasing climate action not to be a central pillar of the sustainable development agenda.

The IPCC's latest report has called for a "substantial reduction in fossil fuel use, widespread electrification, improved energy efficiency, and use of alternative fuels."[69] The IPCC report also highlighted the increased risk of stranded fossil fuel assets due to their lengthy lifetimes that will lock humanity into "carbon-intensive lifestyles and practices for many decades."[70] Limiting warming to 1.5°C, which would avert the worst impacts of climate change, requires deep and far-reaching emissions cuts that must begin now. In the latest IPCC scenarios, global greenhouse gas emissions must peak before 2025–at the latest–and be reduced by 43 percent by 2030. Achieving this will be impossible without deep and immediate cuts in fossil fuel production and use.[71] As IPCC Working Group III Co-Chair Jim Skea has stated, "it's now or never."

Momentum behind rapid and far-reaching climate action is growing. The rising tide of concern and fear over the impacts of climate change - what it means for people's lives, livelihoods and the future prospects of their children and grandchildren - is visible around the world. The Peoples' Climate Vote, the biggest-ever global climate survey conducted by the UN last year that surveyed over half of

humanity, showed that for 64 percent of people spread over 50 countries, climate change is a global emergency.[72] What's more, 59 percent said that the world should do everything necessary to address the climate emergency, acting urgently and decisively. While surveys will always fall short of capturing the sentiments of every voice, especially the most vulnerable, the available data shows an appetite for more climate action, not less, and a clear mandate for governments to increase their climate action ambition.[73]

Despite this widespread concern, climate action has not reached the level of ambition necessary to avert the worst impacts of climate change. The world is awash with climate pledges and commitments, as well as bullish rhetoric around net-zero and new technologies, but these pledges are yet to be followed up with concrete action that will bend the global emissions curve. Recent analysis has shown that the net-zero pledges made by nations at COP26 could prevent global temperatures from exceeding 2°C by 2100, but are not sufficient to keep warming below 1.5°C, and are also not backed up by short-term policies that would lead to the steep emissions reductions needed this decade.[74,75] Ahead of COP27 in Egypt, none of the governments of major G20 emitters, which represent around 75 percent of emissions, have revisited and strengthened their 2030 climate targets despite agreeing to the Glasgow Climate Pact at COP26.[76]

If the global expansion of fossil fuel production were to end immediately, the amount of fossil fuels already under production in existing mines and developed wells would take global temperatures beyond 1.5°C if burnt.[77] The most recent estimates are that, for a 50 percent probability of staying below 1.5°C, approximately 40 percent of developed reserves must remain in the ground.[78] But despite this fact, the governments of the world are still planning to push ahead with extracting and burning more fossil fuels. According to 'The Production Gap' report, governments are planning to produce more than double the amount of fossil fuels by 2030 than is consistent with a 1.5°C trajectory.[79] Governments are forecast to produce 240 percent more coal, 57 percent more oil and 71 percent more gas by 2030 than is consistent with halting global temperatures at 1.5°C.[80] Such high levels of planned production undermines climate action, as progress towards bending the global emissions curve is being consistently undermined by expanding fossil fuel production.

Governments are forecast to produce 240 percent more coal, 57 percent more oil and 71 percent more gas by 2030 than is consistent with halting global temperatures at 1.5°C.

Fossil fuel companies' expansion plans have set the timer on 'Carbon Bombs'; humanity must now defuse them - Kjell Kühne, founder of the Leave It In The Ground Initiative (LINGO)

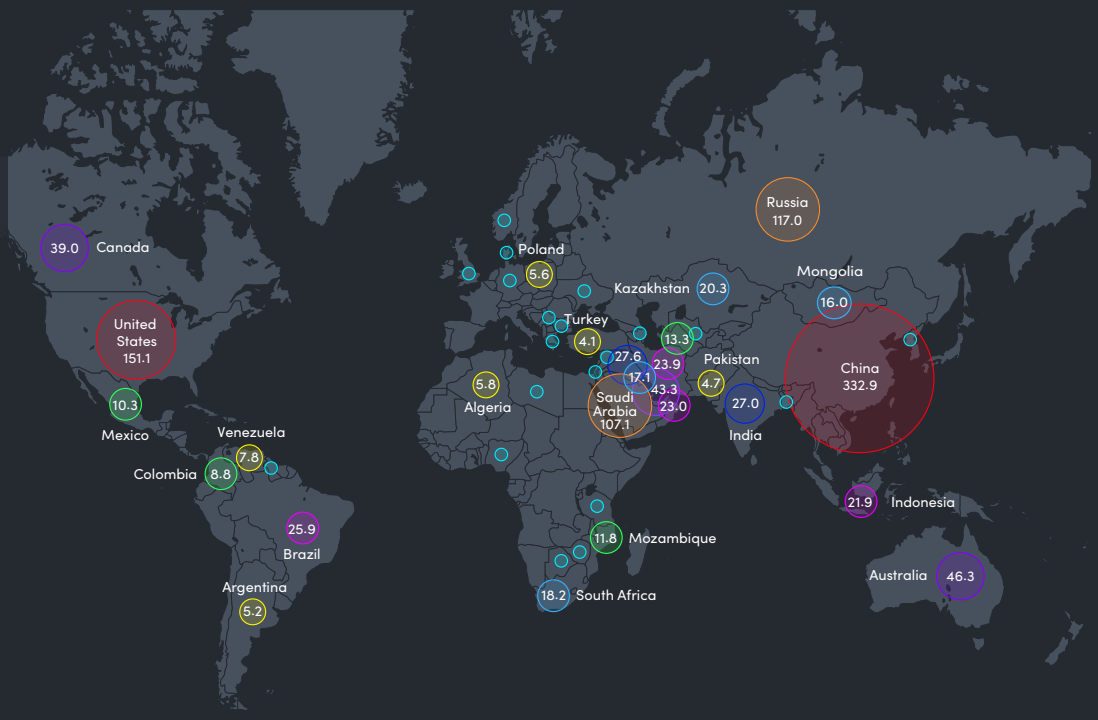
Achieving the goals of the Paris Agreement requires humanity to look at both sides of the energy equation, both the demand and supply of fossil fuels. There is a growing gap between governments' emissions reduction pledges and the level of fossil fuel extraction planned for the coming decades. In fact, there is currently no international roadmap for constraining the production of fossil fuels, despite being the primary driver of climate change. Without closing this gap, humanity is likely to trigger catastrophic climate breakdown.

Within this production gap sit 425 **Carbon Bombs**.[81] These fossil fuel mega projects each contain over one gigatonne of potential CO_2 emissions. If allowed to go ahead, these carbon bombs will release enough emissions into the atmosphere to exceed the 1.5°C temperature goal by a factor of two.[82] While 60 percent of these carbon bombs are already under extraction, with fossil fuel firms cashing in on climate chaos, 40 percent have not begun extraction as of 2020.

Humanity cannot afford to ignore these carbon bombs and defusing them must be at the forefront of climate mitigation policy. From this point onwards there needs to be an international moratorium on future fossil fuel projects due to the long lead-up times of regulatory approvals and breaking even on initial investments. What's more, there needs to be a planned phase out of existing infrastructures that addresses the need for early closures, forgone revenues, stranded assets, clean-up costs and the shocks to global financial markets that may accompany a swift end of the fossil fuel era.

Potential CO_2 Emissions

Country	Potential Emissions
China	332.9
United States	151.1
Russian Federation	117.0
Saudi-Arabia	107.1
Australia	46.3
Qatar	43.3
Canada	39.0
Iraq	27.6
India	27.0
Brazil	25.9
Iran	23.9
United Arab Emirates	23.0
Indonesia	21.9
Kazakhstan	20.3
South Africa	18.2
Kuwait	17.1
Mongolia	16.0
Turkmenistan	13.3
Mozambique	11.8
Mexico	10.3
Colombia	8.8
Venezuela	7.8
Algeria	5.8
Poland	5.6
Argentina	5.2
Pakistan	4.7
Turkey	4.1
North Korea	3.2
Germany	3.0
Norway	2.8
Libya	2.7
Serbia	2.5
Bulgaria	2.5
Uzbekistan	2.4
Denmark	2.2
Botswana	2.2
Greece	2.2
Guyana	2.1
Ukraine	1.7
Azerbaijan	1.7
United Kingdom	1.5
Bahrain	1.4
Bangladesh	1.4
Syria	1.4
Israel	1.1
Nigeria	1.0
Tanzania	1.0
Zimbabwe	1.0



The role of fossil fuel companies in attempting to undermine climate action and policy is well documented. Analysis of ExxonMobil's climate change communications, for instance, shows continuous attempts to downplay the risks and severity of climate change, often favouring the notion that climate action is an individual responsibility rather than a collective and systemic challenge.[83] Fossil fuel companies' involvement in both shaping and blocking climate action at a government level is pervasive. A report from InfluenceMap found that in the three years following the Paris Agreement, the five largest publicly traded fossil fuel corporations, which includes ExxonMobil, Shell, Chevron, BP and Total, invested over one billion dollars in misleading branding and lobbying efforts.[84] Other evidence suggests that fossil fuel companies donating to the electoral campaigns of legislators and politicians also undermines climate action. A US-based study found that the more a given member of Congress votes against climate action and environmental policy, the greater the contributions they receive from fossil fuel firms.[85] Fossil fuel firms donating to politicians and political parties is a pattern repeated in many of the largest fossil fuel producing and consuming nations, such as Australia,[86] Canada,[87] Japan,[88] the UK[89] and member states within the European Union (EU).[90]

This extensive lobbying has undermined efforts to increase climate action and resulted in policy environments that are exceedingly generous to fossil fuel firms' operations. According to the International Monetary Fund (IMF), fossil fuel subsidies reached a value of $5.7 trillion in 2020 which is equivalent to 6.8 percent of global GDP.[91] By 2025, this figure is set to rise to 7.4 percent of global GDP, but given the current fossil fuel price spikes it could well be higher. Fossil fuel subsidies can saddle governments with huge fiscal burdens, reducing the amount of government revenues available for investing in areas that bolster sustainable development, such as education or health.[92] What's more, by artificially lowering the price of fossil fuels, subsidies obscure the true environmental and social costs of their combustion.

Investments into new low carbon energy sources also do not stack up against the rhetoric and branding put forward by the fossil fuel majors.[93] As of 2019, fossil fuel majors had collectively invested less than 1 percent of their total capital expenditure in activities outside their core fossil fuel business operations, with the so-called 'leaders' only investing an average of 5 percent on projects and initiatives outside of fossil fuel production.[94]

Climate action, and the transformative shifts it can bring about, is threatened by the continued expansion of fossil fuel production. By impeding and delaying meaningful climate action, governments and fossil fuel corporations are complicit in failing to prevent the worst impacts of climate change, which will be disproportionately felt by those that contributed the least to global emissions. As the world warms, the cost of climate inaction will inflate and the remaining SDGs will become insurmountable.

01

The Natural World

SDG 15
Life On Land: Fossil Fuels are threatening the fabric of life on Earth

SDG 14
Life Below Water: The threat of fossil fuels extends to the depths of the oceans

The natural world is the support system for all life on this planet but climate change and fossil fuels pose an existential threat to it. According to the International Union for the Conservation of Nature (IUCN) red list, which tracks data on more than 134,400 species, more than a quarter (28 percent) of species (37,400) are currently threatened with extinction worldwide due to human activity.[95] A recent UN report concluded that climate change is responsible for pushing one million animal and plant species towards extinction.[96] Despite global efforts to halt deforestation, humanity continues to cut down ten million hectares of forest every year, an area equivalent to the size of Portugal.[97] While half of this deforestation is offset by regrowing forests, nearly 95 percent of deforestation occurs in the tropics where the vast majority of global biodiversity is located.[98] Our oceans, too, are under severe threat from a variety of sources, including plastic pollution, acidification, eutrophication, ocean heating, overfishing and marine ecosystem collapse.[99] At 2°C of global heating, 99 percent of coral reefs are forecast to enter decline.[100]

SDG 15. Life On Land: Fossil fuels are threatening the fabric of life on Earth

Creating the infrastructures required to extract and transport fossil fuels causes substantial habitat fragmentation and destruction, threatening wildlife populations.

Air pollution from fossil fuels causes acid rain which damages trees, soils and water bodies, with severe knock-on effects for food chains and wildlife populations.

The failure of fossil fuel infrastructures, such as pipeline ruptures and oil spills, cause unparalleled disruption to ecosystems and wildlife populations, with some species never recovering.

Fossil fuel production and the infrastructures that enable its exploration, extraction, transportation and combustion impact life on land both indirectly through climate change and directly through pollution and habitat fragmentation.[101,102]

Even before fossil fuel extraction begins, the initial exploration process can negatively impact habitats and biodiversity. Seismic surveys, for instance, clear land and are considered a significant driver of landscape and habitat fragmentation worldwide.[103] Habitat fragmentation is an area of great concern as scientific inquiry is discovering that it is far more detrimental to wildlife populations than a reduction in the total area of an ecosystem. For instance, it has been found that fragmentation of tropical rainforest habitats has had serious impacts on remaining intact old-growth tropical rainforests, including changes in forest structure, ecosystem dynamics, and ecosystem function.[104] Furthermore, once seismic surveys clear land for machinery and other infrastructures, this increases the accessibility to previously inaccessible areas for other industries and practices, such as logging and hunting, which may cause further habitat fragmentation and harm to life on land.[105]

During the extraction process of fossil fuel production, there are both direct and indirect impacts on life on land. The direct impacts include the conversion, degradation, pollution and disturbance caused at or close to extraction sites. One study conducted over five years by the Wildlife Conservation Society examining the impact of two of the largest fossil gas fields in the U.S. on the pronghorn population found an 82 percent decline in 'high quality' habitats.[106] Due to the development of these gas fields leading to a sharp increase in well pads, roads and other associated infrastructures, the pronghorn is being driven to the periphery of areas historically classified as crucial winter ranges which is very likely to cause substantial population decline.[107]

Fossil fuels such as coal, oil and gas are also responsible for high numbers of avian deaths throughout the production process. One study exploring the impact of coal mining on bird populations found that mountaintop removal and valley fill operations in four U.S. states – Kentucky, Tennessee, Virginia, and West Virginia – destroyed over 387,000 acres of mature deciduous forests, resulting in approximately 191,722 deaths of the global population of Cerulean Warblers.[108] Hazardous by-products of fossil fuel production can cause decreased bird egg weight, embryo malformations, lowered hatchability, neural shrinkage, and increased mortality, further damaging avian populations. Mercury poisoning and contamination, for instance, was responsible for population declines ranging from 1 percent to 11 percent across 14 species of penguins, albatross, ducks, eagles, hawks, terns, gulls and other birds.[109]

The transport, distribution, refinement and combustion of fossil fuels impacts life on land through habitat destruction, habitat fragmentation and pollution. Oil and gas pipelines around the world cover a combined length of 1.18 million kilometres - approximately enough to circle the Earth 30 times - and can cause immense damage to surrounding land.[110] In the Niger Delta, the negative impact of the construction of oil and gas pipelines on forest health and biodiversity has been significant. One study exploring the impacts of constructing two pipelines in the Niger Delta found that approximately 495 hectares of forest was cleared and 9,642,000 trees were killed to bring the pipelines to completion.[111] The authors conclude that the area where the pipelines were constructed "had witnessed colossal loss of biodiversity due to habitat displacement, forest fragmentation and deforestation, and escalated exploitation of species."[112] Fossil fuel infrastructure also fails and breaks, which can have disastrous impacts for life on land. Recently the Oleoducto de Crudos Pesados (OCP) pipeline ruptured in the rainforest of Ecuador, spilling 6,000 barrels of crude oil, destroying habitats, polluting rivers and streams and harming surrounding indigenous communities.[113] These incidents are far from isolated. In the U.S. alone, there have been more than 3,300 incidents of oil and gas pipeline leaks and ruptures since 2010.[114]

> "Making peace with nature is the defining task of the 21st century, it must be the top, top priority for everyone, everywhere."
>
> Antonio Guterres, Secretary General, United Nations

Humans are not the only creatures on Earth negatively impacted by air pollution from fossil fuels. The hazardous air pollutants released during the production and combustion of fossil fuels – sulphur dioxide, nitrogen oxides, particulate matter, carbon monoxide and mercury – all cause harm to the environment and animal health. Pollution from fossil fuels can also cause acid rain that damages trees and causes soils and water bodies to acidify, making the water unsuitable for some fish and impacting the terrestrial wildlife that rely on water-based wildlife for sustenance.[115] In a similar vein, pollution from fossil fuels can drive a process known as eutrophication in which excessive nutrients harm aquatic ecosystems by lowering oxygen levels, causing algae blooms and threatening both habitats and food chains.[116] Acid rain and eutrophication can cause damage to crops and forests, further harming animal and human populations.[117]

Fossil fuel production has been shown to use vast amounts of groundwater, pulling this resource away from ecosystems that rely upon it. A single fracking well can use between 1.5 million to 16 million gallons of water with the wastewater often found to be toxic, containing arsenic, lead, chlorine, and mercury that can poison groundwater and drinking water.[118] One report sponsored by the U.S. government found that between 2005 and 2009, 14 oil and gas companies used 780 million gallons of hydraulic fracturing products containing 750 chemicals and other components.[119] Researchers exploring the 750 chemicals identified could track only 353 chemicals and found that 25 percent of those cause cancer or other mutations and about 50 percent could severely damage neurological, cardiovascular, endocrine and immune systems.[120] The researchers concluded that "many chemicals used during the fracturing and drilling stages of gas operations may have long-term health effects that are not immediately expressed."[121]

SDG 14. Life Below Water: The threat of fossil fuels extends to the depths of the oceans

Between 1994 and 2007, the oceans absorbed 34 billion metric tonnes of carbon from the burning of fossil fuels which has fundamentally altered the chemistry of the oceans.

With 2°C of global heating, 99 percent of tropical coral reefs face elimination.

Fossil fuel production is proven to disrupt key feeding and breeding areas, which can have huge implications for global populations of marine species.

The oceans are under severe threat from both fossil fuels and climate change. Since the beginning of the Industrial Revolution between one-quarter to one-third of all carbon emissions from fossil fuels - approximately 500 billion tonnes - have been absorbed by the oceans.[122] Between 1994 and 2007, the oceans absorbed 34 billion metric tons of carbon from the burning of fossil fuels - a four-fold increase from 2.6 billion metric tonnes per year relative to the period starting from the Industrial Revolution in 1800 to 1994.[123]

The increasing uptake of carbon emissions by the world's oceans, however, comes at a high cost to both human and natural systems. Higher concentrations of carbon are altering the chemistry of the ocean through a process known as ocean acidification, where the acidity of the oceans increases as carbon dioxide is drawn down and dissolves. To date, the ocean's absorption of human-induced carbon dioxide emissions has resulted in an increase of 30 percent in the acidity of ocean surface waters, a rate of change that is faster than anything experienced in the past 300 million years.[124] Ocean acidification reduces the availability of carbonate in the seas, which is a vital component for tens of thousands of marine species to form shells and skeletons, resulting in slower growth rates and weaker shells in nearly all species currently studied.[125] Less carbonate in ocean ecosystems also reduces the strength and size of coral reefs, putting additional strain on the species and habitats that rely on reef systems, which support approximately 830,000 species of marine life at some point in their lifecycle.[126,127]

The oceans are also soaking up plastics in alarming quantities, of which 99 percent are made from fossil fuels.[128] Globally, 400 million tonnes of plastic waste are produced each year[129] with 14 million tonnes ending up in the ocean.[130] Plastics now make up around 80 percent of all marine debris

found from surface waters to deep-sea sediments.[131] The pervasiveness of plastics throughout the world's oceans is no clearer than in the case of microplastics which are complex and varied pieces of miniscule plastic that have been found in the depths of the oceans. Microplastics are ingested by marine wildlife due to their resemblance to plankton and have been found to be toxic to many marine species by reducing food intake, delaying growth, damaging organs, causing abnormal behaviour and impacting reproductive cycles.[132,133] Research thus far has been particularly focused on how microplastics impact fish and small crustaceans, which means the effects on wider marine populations and ecosystems remains underdeveloped.[134]

What is emerging in the scientific literature, however, is that microplastics are complex pollutants that can change over time, shifting in their toxicity and causing significant disturbances to marine ecosystems.[135] The slow degradation of plastic pollution in the oceans has been shown to emit greenhouse gas emissions *indefinitely*, with the most common types of plastics also emitting methane and ethylene.[136] Polyethylene, which accounts for 36 percent of all plastic types, is the most prominent emitter of methane and ethylene out of those plastics tested.[137] Of greater concern is the emerging idea that plastic pollution may be weakening the ocean's ability to act as a carbon sink for anthropogenic greenhouse gas emissions.[138] The fossil fuel industry is also eyeing up vast growth in the production of plastics, with current trends leading to a doubling in production over the next two decades.[139]

> The oceans are also soaking up plastics in alarming quantities, of which 99 percent are made from fossil fuels.

There is a substantial evidence base that fossil fuel infrastructures directly impact life underwater.[140] Seismic surveys in marine areas, conducted as part of fossil fuel exploration, can produce some of the most intense human-made noises in the oceans.[141] The sounds generated by seismic surveys can spread over areas of up to 300,000 km,[142] with sound travelling particularly well in deeper waters.[143] These seismic disruptions have been shown to cause physiological impacts[144] and disrupt marine species' behaviour,[145] despite fossil fuel companies' repeated efforts to play down these findings.[146] Evidence suggests that seismic surveys detrimentally impact on a diverse range of marine species, including mammals,[147] fish,[148] invertebrates, plankton[149] and reptiles.[150] While the behaviour changes are highly species-specific, they can include the avoidance of the area being surveyed, attraction towards the vessels and infrastructures, or a complete cessation of vocalisation, which can affect species' ability to hunt, migrate and reproduce.[151] One study exploring the impacts of seismic surveys on humpback whale populations off the coast of Angola found that seismic surveys negatively impacted humpbacks' singing activity.[152] As a result of seismic surveys, wildlife migration routes can be disrupted and key feeding and breeding areas abandoned, which can have vast implications on local, and even global, populations of marine species.

Seismic surveys, however, only mark the beginning of fossil fuels' impact on life below water. Extracting fossil fuels from marine areas has been shown to have adverse impacts on marine biodiversity, as well as driving climate change. Extracting fossil fuels in marine environments is fraught with risk. Rough seas and strong ocean currents can damage fossil fuel infrastructure and heighten the risk of oil spills or other industrial accidents. In 2014, the French fossil fuel company, Total, abandoned its deep-sea extraction off the eastern coast of South Africa because rough seas damaged the oil platform.[153] Waves that are abnormally large and unpredictable, often known as 'rogue waves', have been implicated in damaging oil and gas platforms around the world including the North Sea's Draupner oil platform.[154]

The 2010 Deepwater Horizon oil spill in the Gulf of Mexico exemplifies the immense risks of extracting fossil fuels in marine environments. The explosion on BP's oil rig 66km off the coast of Louisiana caused the largest ever marine oil spill, releasing 134 million gallons of oil into the ocean over a period of 87 days and polluting over 1,300 miles of coastline.[155] Scientists concluded that the oil spill killed thousands of marine mammals and sea turtles, destroying habitats and causing reproductive failure and organ damage amongst a variety of marine species.[156] The researchers

working in the immediate aftermath of the oil spill concluded that the Deepwater Horizon event was the largest and longest marine mammal unusual mortality event ever recorded in the Gulf of Mexico.[157]

The experience of oil spills like the Deepwater Horizon event show that it is not just in the immediate aftermath that marine wildlife is threatened. Instead, the effects can last for decades and some populations of species and ecosystems struggle to fully recover. It was originally believed that once oil pollution was removed from marine ecosystems, a rapid recovery would ensue.[158] However, the evidence gathered in the wake of Exxon Mobil's Valdez oil spill in 1989 in the pristine waters of Prince William Sound in Alaska suggests that oil spills can have long-term impacts on marine life and ecosystems.[159] Beyond the immediate losses to species, marine mammals and sea ducks were still suffering high rates of mortality many years after the oil spill due to the contamination of their prey.[160] The acute toxic effects of oil ingestion and inhalation, smothering, drowning and hypothermia resulted in the death of 250,000 seabirds, 2800 sea otters, 300 harbour seals, 250 bald eagles, 22 killer whales and billions of salmon and herring eggs.[161] It was only in 2014, 25 years after the Exxon Valdez oil spill, that the number of sea otters living in Alaska's Prince William Sound began to recover after a 40 percent loss in population.[162] Some populations of wildlife are not expected to recover at all, such as the pod of killer whales that used Prince William Sound as a feeding ground.[163] The Exxon Valdez Oil Spill Trustee Council, founded to manage the restoration of ecosystems in Prince William Sound, concluded that the slow recovery of sea otter populations was due to "chronic exposure to hydrocarbons".[164]

The fossil fuels that manage to avoid polluting marine ecosystems are no less guilty for the current hardship facing Earth's oceans. Fossil fuels are the primary driver of climate change, with rising temperatures fundamentally altering the chemistry of the oceans and their ability to support flourishing and abundant ecosystems. The impacts of climate change such as changing ocean circulation, sea ice cover, winds and rising water temperatures are key factors in creating and maintaining marine ecosystems. For example, warmer temperatures have been shown to transfer nutrients from surface waters down into the deeper parts of the ocean, leaving less near the surface to support the growth of plankton.[165] This dearth of nutrients could have huge knock-on effects for wildlife populations through the food chain with some researchers suggesting it could lead to a 20 percent reduction in the global fish catch by 2300, with a reduction of around 60 percent in the North Atlantic.[166] The same research suggests that consistently high levels of greenhouse gases in the atmosphere could suppress levels of biological productivity in the oceans for a millennium.[167]

The planet's oceans have absorbed more than 90 percent of the excess heat caused by climate change.[168] The rate of warming in the oceans is also accelerating, with a 2019 study estimating that the oceans are heating 40 percent faster than scientists had predicted.[169] The most abundant marine ecosystem of all, coral reefs, are particularly vulnerable to warming oceans, which can cause mass coral bleaching events, the breakout of infectious diseases and heat stress within reef systems to occur more frequently.[170] While coral reefs are already suffering due to warmer waters and ocean acidification, their future survival depends on humanity's ability to curtail emissions. According to the IPCC, with 1.5°C of global heating coral reefs could still experience losses of between 70 percent and 90 percent.[171] Under 2°C, this rises to 99 percent of coral reefs facing elimination.[172]

Fossil fuels are the primary driver of climate change, with rising temperatures fundamentally altering the chemistry of the oceans and their ability to support flourishing and abundant ecosystems.

02

Food & Water

SDG 2
Zero Hunger: The global food system is both a victim of and contributor to fossil-fuelled climate change

SDG 6
Clean Water and Sanitation: Fossil fuels and climate change are driving global water insecurity

Food, clean water and access to sanitation are necessities for human health, wellbeing and flourishing. Without improving progress towards these SDGs, the other 15 SDGs are pushed further out of reach. Despite real advances in certain parts of the world, reducing world hunger and improving access to clean water and sanitation are still not on the pathway they need to be to achieve the 2030 target. In 2021, between 720 and 811 million people remained undernourished around the world.[173] Due to the COVID-19 pandemic, an additional 70 to 161 million people are likely to have experienced hunger.[174] Even prior to the pandemic, 22 percent (149.2 million) of children under the age of 5 were classified as stunted and 6.7 percent (45.4 million) of children under 5 suffered from wasting.[175] The UN has estimated that in 2020, 2.37 billion people were without food or unable to access a healthy and balanced diet on a regular basis.[176]

Progress towards improving access to clean water and sanitation has also failed to keep pace with the 2030 target, with the UN estimating that 129 countries are still not on track to have sustainably managed water resources by 2030.[177] In fact, access rates to water and sanitation need to double if humanity is to keep the 2030 target alive.[178] In 2020 roughly 2 billion people, which is just over a quarter of humanity (26 percent), lacked access to safely managed drinking water and 3.6 billion people lacked access to safely managed sanitation.[179] Moreover, 2.3 billion people lacked access to basic hygiene in 2021.[180]

Fossil fuel-induced global heating will make achieving SDG2 and SDG6 an all but impossible task. Global heating will exacerbate water scarcity and drought no matter whether the 1.5°C or 2°C targets are met. If humanity manages to phase out fossil fuel usage fast enough to hold global temperatures at 1.5°C, 271 million people will remain exposed to water scarcity and 132.5 million could be exposed to severe drought.[181] At 2°C of warming, the number of people exposed to water scarcity rises to 388 million and the number of people exposed to severe drought increases to 194.5 million.[182] This will impact both food and water security, as well as migrations and displacements that may put additional strain on food and water sources, which will further undermine access to food, water and sanitation. Crop yields too are forecast to drop because of future warming, creating additional strain on food security. At 1.5°C of warming, maize yields are expected to drop by 6 percent and wheat yields by 5 percent by the end of this century.[183] Under 2°C of warming, maize yields drop by 9 percent by 2100 and wheat yields by 4 percent.[184]

In 2020 roughly 2 billion people lacked access to safely managed drinking water and 3.6 billion people lacked access to safely managed sanitation.

SDG 2. Zero Hunger:

The global food system is both a victim of and contributor to fossil-fuelled climate change

Increases in global temperatures, shifting rainfall patterns, extreme weather events, and elevated surface carbon dioxide concentrations from burning fossil fuels will reduce the yields of key crops.

Higher concentrations of carbon dioxide in the atmosphere, driven by the combustion of fossil fuels, can reduce the amount of nutrients in crops that are critical for human health.

Fossil fuel production, and fossil fuel corporations' carbon offset schemes, are pulling vast amounts of land away from productive uses, such as agriculture.

The global food system is both a victim of and contributor to fossil-fuelled climate change. Its ability to deliver healthy and balanced diets to all of humanity is tightly intertwined with fossil fuels. As a sector, global agriculture is extremely vulnerable to the impacts of climate change.[185] The increases in global temperatures experienced to date are already causing havoc for farmers and food systems around the world as they struggle to cope with unpredictable rainfall patterns, droughts, landslides, floods, shifting growing ranges, cyclones and rising sea levels. All of which are set to worsen under even the most optimistic warming trajectories.[186187]

The entire global food system is highly sensitive to a warming world. While the worst impacts to date have been most viscerally felt by farmers and communities in the Global South, food systems in all corners of the Earth are having to navigate extreme weather, crop losses and erratic seasonal shifts. Rainy seasons are starting earlier in places, late in other locations or not at all. When the rainy seasons do begin, they often bring too little or too much rainfall. Planting and harvesting times must be carefully managed to coincide with or avoid rains, but climate induced seasonal irregularities are making this increasingly difficult. At the same time, rising local temperatures and instances of extreme heat are detrimental to pollination and seed development, can intensify pest attacks on crops, cause heat exhaustion in livestock, increase evaporation of water from soils and dry up water sources. Rising sea levels too can either cover cropland permanently or flood agricultural soils with salt water which renders them infertile. For many people around the world, these situations are exacerbated by competition for scarce water resources including rivers, lakes, reservoirs and underground water.

Recurring droughts through the 'Dry Corridor' of Central America have destroyed multiple maize and bean harvests and were partly responsible for the migration of rural farmers to neighbouring states and the USA.[188] A recent heatwave in Canada saw fruit growers in British Columbia's Fraser Valley reporting that crops were cooking on the vines due to the extreme heat.[189] Earlier this year, the UN World Food Programme warned that 13 million people in the Horn of Africa were facing severe hunger due to three consecutive failed rainy seasons amid relentless drought.[190] Similar concerns have been raised over food insecurity in Western Africa and the Sahel.[191] In the words of the UN, climate change "is no longer a glimpse into the future, but the daily reality for communities around the world."[192] Urgently addressing the climate crisis, through deep and far-reaching emissions reductions and the phasing out of fossil fuel infrastructures, is the only way to protect global food security and ensure that large sections of humanity are not facing hunger and destitution.

The global food system is both a victim of and contributor to fossil-fuelled climate change. Its ability to deliver healthy and balanced diets to all of humanity is tightly intertwined with fossil fuels.

actionaid

SDG2: Climate change-induced drought in the Horn of Africa is pushing communities into starvation and destitution - ActionAid

The Horn of Africa is currently in the grip of a climate change-induced drought which is putting nearly 20 million people at risk of famine according to the UN's World Food Programme.[193] Three consecutive years of below-average rainfall, combined with rising temperatures, are culminating in the longest drought the region has experienced in 40 years.[194] UNICEF's Regional Director for Eastern and Southern Africa, Mohamed Fall, has described the situation as the "perfect storm of horror."[195]

The impacts of the record-breaking drought are being felt across Ethiopia, Kenya and Somaliland. In Ethiopia and Kenya, three million livestock have died while in Somalia, up to 30 percent of households' herds have died since mid-2021.[196] Not only is this impacting communities ability to feed themselves, it is also decimating local economies and increasing the risks of insecurity, violence and conflict. In Ethiopia, the impacts of the drought are being compounded by ongoing conflict, desert locusts and the pandemic.[197]

Since most residents are primarily farmers in the rural areas of the Horn of Africa, they rely on selling their crops such as onions, papaya, peppers and mangoes to sustain their livelihoods. At dusk and even early morning, monkeys sneak onto the farms and steal the food and destroy the land. This is because the monkeys no longer have their main source of food due to the drought. Additionally, because of the lack of rain compounded with the rising price of petrol needed for generators to pump irrigation, farmers are struggling to keep production running.

The local climate was once predictable. The community used to know when it would rain, what types of wind were expected and when there would be dry spells. Now everything is confusing and mostly grey. The sky is grey, the trees are grey and even the earth is grey. The winds come both day and night with incredible force, often creating a volatile environment for humans, livestock and crops.

The drought has forced most communities to migrate to the West in search of pasture for their livestock. Pastoralists who previously lived in Ceel-Giniseed have followed this path. Often the men will leave behind their wives and kids to stay on the farms while they search for a better life. As certain members from this community move even further West, migrant communities from the East have found refuge in the barren land nearby. If the rains come, they will stay, but if the rains do not come they will continue to move in search of food and water.

First-hand reflections from Maryan, a farmer from Ceel-Giniseed in Somaliland, paint a visceral image of the hardship facing the region. *"Throughout my whole life, it has been getting worse day by day. It could be better in terms of the experience gained, but environmentally it has worsened. There was a time when these farms were empty and the small amount that we harvested from the land was sufficient for our families but now even if you plant enough, it will not be enough for you. So, we think this is down to environmental changes and the temperature getting higher here and around cities. The world is global and all humans are connected in some way. This is the worst time in terms of the environment. Whatever impacts the world will impact us as well."*

At the same time, agriculture is the second largest contributor to global GHGs. As the global food system has industrialised, it has become highly dependent on fossil fuel energy and the degradation of the natural world, both of which are accelerating climate change. The global industrialised food system is currently dependent on fossil fuels in the production of synthetic nitrogen fertilisers, herbicides and pesticides, as well as to power irrigation pumps, mechanisation processes for crop production and food processing, and in the transportation of agricultural inputs and outputs.[198] Despite fossil fuels having played a pivotal role in raising global crop yields, researchers have shown that reducing fossil fuel emissions must go hand-in-hand with reducing the environmental impact of global agriculture. Otherwise the goals of the Paris Agreement will slip out of reach.[199]

Nitrogen fertilisers, made using fossil fuels to extract nitrogen from air and convert this into plant-soluble form, have boosted crop yields to feed a growing global population but also play a major role in global heating. While important to acknowledge the invaluable contribution nitrogen fertilisers have made to global food production, it is crucial to recognise their impacts on human and environmental health. In addition to the emissions associated with their production, their application to soils results in the highly potent and long-lived greenhouse gas N_2O.[200] The degradation of stored soil carbon into atmospheric CO_2 and the loss of soil biota that naturally improve soil fertility. Excessive application of nitrogen fertilisers can result in degradation in soil, water and air quality, while also contaminating groundwater and other sources of drinking water.[201] Research published in Nature suggests that human-caused N_2O emissions have increased by as much as 30 percent over the past four decades and continue to rise and threaten the goals of the Paris Agreement.[202]

The need to shift away from industrialised farming practices and the extensive use of synthetic fertilisers have been emphasised by the leading climate scientists and international bodies. The IPCC's Special Report and Land and Climate called for a more widespread use of sustainable land management to enhance food security, aid adaptation and mitigation efforts, reduce land degradation, desertification and poverty, as well as improve public health.[203] Through this new approach to agriculture, the IPCC notes the opportunity to strengthen land rights and tenures to empower women and indigenous peoples and enhance local and community action.[204] What's more, the closely intertwined fate of food and fossil fuels within the global food system mean that current sky-high fossil gas prices could lead to further spikes in global food costs, pushing the goal of zero hunger ever further out of reach unless agroecological alternatives to improve soil fertility and crop yields are promoted and scaled up.[205]

The closely intertwined fate of food and fossil fuels mean that current sky-high fossil gas prices could lead to further spikes in global food costs, pushing the goal of zero hunger ever further out of reach.

Beyond the use of fossil fuels in agricultural processes, the expansion of the fossil fuel industry around the world is also consuming and polluting land that could be used to bring an end to world hunger. In 2006, the discovery of 10 trillion cubic feet of fossil gas–the largest African reserves ever found[206]–in Cabo Delgado, in the northernmost province of Mozambique, has led to a swathe of transnational companies rushing to exploit the newly found reserves including BP, Shell, Total, Eni and Exxon and the export credit agencies of South Africa, Japan, China, Italy and the Netherlands.[207] Despite 73 percent of Mozambique's population having no access to electricity, the extraction of these vast reserves will do little to improve the energy access and security of the population as the majority of the fossil gas will be exported to Asian and European markets. To build the colossal infrastructure required to exploit the reserves, hundreds of rural families have been forcefully removed from the homes, farmland and fishing grounds that have provided livelihoods and sustenance for generations.[208] The compensatory mechanisms for those removed from their farmland have been the source of significant controversy. Families have been awarded compensatory plots of land on the basis of the number of palm trees on their original plots; as a result of this mechanism, some families who owned 10 hectares before the fossil fuel projects began were compensated with just one hectare, often in areas far from where they had previously lived.[209] Not only are such fossil fuel projects occupying valuable land that could be used to provide food and livelihoods, they are also set to devastate local communities and the surrounding wildlife and biodiversity while increasing global emissions.

Carbon offsetting represents another aspect of fossil fuel production that directly impacts efforts to end world hunger. In a flawed attempt to rectify their pivotal role in driving climate change, fossil fuel companies are buying or forcibly acquiring large amounts of land to grow crops to offset the emissions from the production process and bolster their questionable net zero pledges. Despite these companies' insistence on the viability and credibility of carbon offsetting, research suggests that the use and sale of carbon offsets to regulated polluters has substantially increased global carbon emissions and wasted vital resources.[210] The Italian oil and gas giant Eni recently announced plans to establish carbon offset plantations over 8.1 million hectares of African land by 2030 as part of their 'net zero strategy.'[211] Not only will this pull land away from agriculture and other productive uses on a continent that is set to experience frequent and severe climate impacts, but the offset plantations will likely create monocultures that damage biodiversity, groundwater levels and pollinators which further impede the SDGs. Eni is not alone in this questionable endeavour. Royal Dutch Shell's net-zero plans depend heavily on carbon offsetting that will likely drive land grabs in the Global South. Analysis from ActionAid has found that Royal Dutch Shell's plan to offset 120 million tonnes of CO_2 would require 12 million hectares of land by 2030, an area of land three times the size of the Netherlands.[212] ActionAid's analysis concludes that "climate targets that rely heavily on carbon offsetting are likely to fail, while driving large-scale conflicts over land and food, particularly in the Global South."[213]

While rising CO_2 levels and temperatures are already disrupting food production, particularly in the Global South and in communities that have done little to cause the climate crisis, North of the tropics growing food crops is being made easier by extending the length of growing seasons.[214] Crops tend to grow faster as a result of increased rates of photosynthesis, with higher levels of carbon dioxide in the atmosphere responsible for at least 80 percent of this increased rate.[215] However, this may not be as positive for improving global food security as climate sceptics have continuously claimed[216] given that research suggests that higher concentrations of CO_2 actually reduce the amount of nutrients in crops that are critical for human health. One study examining a wide variety of cereal and legume crops found that rising levels of CO_2 reduce the amount of zinc, iron and protein in these crops with deficiencies of these nutrients posing a variety of health and developmental issues.[217] Another study noted that increases in CO_2 levels could cause 175 million people to become deficient in zinc with an additional 122 million people becoming protein deficient. For iron, it is forecast that 1.4 billion women of child-bearing age and young children will be at high risk for iron deficiency due to higher levels of atmospheric CO_2.[218] It is a cruel reality that as crops grow faster due to higher levels of carbon dioxide, their ability to provide sustenance is curtailed, meaning millions more people will suffer malnutrition.

SDG 6.
Clean Water and Sanitation:
Fossil fuels and climate change are driving global water insecurity

Climate change exacerbates water stress. By 2040, one in four children will live in areas of extremely high water stress.[219]

Fossil fuel production and waste products generated during this process are proven to contaminate water supplies which can lead to increased instances of disease and illness.

Climate impacts, such as flash flooding and storm surges, disrupt water supplies for drinking and sanitation, leading to shortages, large-scale water contamination and causing the outbreak of diseases and illness after these disasters.

Humanity's ability to ensure the availability and sustainable management of water and sanitation for all is closely interlinked with humanity's ability to tackle climate change and phase out fossil fuels. In 2018, approximately 2.3 billion people lived in water-stressed countries.[220] As temperatures rise further, access to clean water and sanitation will become increasingly insecure. Extreme weather events, higher global temperatures and shifts in the water cycle patterns are already making it more difficult to access safe drinking water and sanitation, especially for some of the world's most vulnerable children.[221] According to UNICEF's Children's Climate Risk Index (CCRI), approximately 920 million children are 'highly exposed' to water scarcity. Many of these children live in countries considered 'extremely high-risk' to climate change impacts, despite these 33 countries being collectively responsible for just 9 percent of global carbon emissions.[222]

To meet the 2030 target of achieving sustainably managed water resources for all, the current rate of progress must double.[223] But achieving this against the backdrop of climate change is a tall order - and even more challenging once other drivers such as urbanisation and economic growth are taken into consideration. Rising temperatures and shifting precipitation patterns are undermining the security of water supplies. In certain parts of the world, such as the Andes in South America and High Mountain Asia, glaciers are a source of drinking water, sanitation and irrigation for several hundred million people due to the difficulties of extracting groundwater.[224] As glaciers shrink due to climate change, and snowmelt declines, many millions more will be pushed into water and sanitation insecurity.[225]

Freshwater wetlands, which are vital for replenishing groundwater supplies, are also disappearing at an alarming rate. Between 1970 and 2015 natural wetlands shrank by 35 percent, three times the rate of forest loss during the same period.[226] Shrinking wetlands will have huge knock-on effects on other SDGs as approximately one billion people rely on wetlands for their livelihoods while more than half the world relies on wetland-grown produce such as rice for their staple diet.[227] Rising sea levels, as a result of climate change, are causing freshwater supplies to salinate which also threatens the water security of millions of people.[228]

Alongside the increasingly alarming impacts of climate change on access to clean water and sanitation, the direct impacts of fossil fuel infrastructures are also undermining SDG6. There is an extensive evidence base that shows how coal mining, especially open-cast mining, can cause significant damage to waterways and increase water insecurity.[229] Globally, the burning of coal creates millions of tonnes of solid waste in the form of coal ash and slurry that sits in 'ponds' close to power plants which often contaminates groundwater supplies. Studies have found that coal ash and slurry often contains several toxic heavy metals such as lead, nickel and zinc, as well as other pollutants like arsenic and mercury which pollute groundwater supplies.[230] The pollution of drinking surface water and groundwater with heavy metals increases the chances of developing cancer, lung disease and birth defects, among many other health defects and illnesses.[231,232] These health impacts can often expand beyond the direct consumption of water too, posing risks to human health through the food chain and to marine and terrestrial ecosystems.[233,234]

The production of oil and gas can also have devastating impacts on clean water and sanitation. Following more than five decades of oil and gas extraction in the Niger Delta, Ogoni communities have faced large-scale and continued contamination of water supplies due to fossil fuel production and oil spills. Both Amnesty International and UNEP have heavily criticised Shell's presence in the Niger Delta and the company's manifold failures to clean up the pollutants and toxins that are directly linked to its operations.[235] One particularly shocking example of the extent of pollution caused by fossil fuel production and its devastating impact on surrounding communities' health and access to clean water and sanitation was outlined by UNEP in 2011. The UNEP report found that the community was relying on drinking water wells contaminated with the carcinogen benzene at levels over 900 times the World Health Organization's (WHO) recommended advice.[236]

Gas flaring, a process in which dangerous gases are burnt during oil and gas extraction, is a highly polluting activity that contaminates water supplies and releases large volumes of climate change-accelerating methane and carbon dioxide into the atmosphere. According to the IEA, 142 bcm of fossil gas was flared in 2020, equivalent to the annual gas demand of Central and South America combined.[237] Gas flaring also releases toxic pollutants such as sulphur dioxide into the atmosphere causing acid rain. The Niger Delta has suffered greatly at the expense of gas flaring with the occurrence of acid rain in the region impeding the long-term water security and public health by contaminating rainwater and surface water.[238,239] In particular, nitrate contamination in the water due to gas flaring has long been regarded as a health threat with long-term exposure linked to increased mortality,[240] the incidence of cancers and lesions,[241] as well as increased risk of miscarriage and ectopic pregnancies.[242]

Many of these children live in countries considered 'extremely high-risk' to climate change impacts, despite these 33 countries being collectively responsible for just 9 percent of global carbon emissions.

Consuming nitrate contaminated water can also impact young children, with one study reporting that consuming water containing nitrate can cause delayed reactions to light and sound stimuli.[243]

The impacts of climate change, exacerbated by the continued combustion of fossil fuels, are reducing the availability and security of clean water and sanitation. More immediate climate threats such as flash flooding and storm surges have been shown to disrupt water supplies for drinking and sanitation, leading to shortages, large-scale water contamination and causing the outbreak of diseases and illness after these disasters.[244,245] In the aftermath of flooding, drinking water can become contaminated with bacteria, sewage, heating oil and agricultural and industrial waste - all of which can cause serious illness and impede the recovery of affected communities.[246] In these instances of large-scale water contamination, the proliferation of water-borne illnesses has been associated with poor hygiene, sanitation and insufficient drinking water.[247]

The goal of ensuring access to clean water and sanitation services worldwide is consistently undermined by both fossil fuel production and the impacts of climate change. Due to the foundational role that clean water plays in both human and natural systems, the knock-on effects are as significant as they are detrimental. Contaminated water and poor hygiene can have devastating impacts on human health, food security, child development and the spread of infectious diseases. These compounding impacts undermine humanity's ability to achieve multiple SDGs, not just SDG6.

The impacts of climate change, exacerbated by the continued combustion of fossil fuels, are reducing the availability and security of clean water and sanitation.

03

Human Wellbeing

SDG 1
No Poverty: Fossil fuels are entrenching poverty and stranded assets risk exacerbating poverty

SDG 5
Gender Equality: Climate change and fossil fuel use reinforce existing gender inequalities

SDG 3
Good Health and Wellbeing: Fossil fuels kill people quickly and slowly

SDG 10
Reduced Inequality: Fossil fuels rob from the poor to give to the rich

SDG 4
Quality Education: Fossil fuels are polluting children's school years, especially in the Global South

SDG 16
Peace, Justice and Strong Institutions

At the outset of this section, it must be acknowledged that fossil fuels have played an historical role in the development of industrialised societies and in achieving dramatic increases in the quality of life of billions of people. From agriculture and energy generation, to communication and transport, fossil energy is embedded in virtually every sector of the modern economy. Fossil fuels have, in this sense, been central to the project of modern society, and even to modernity itself.[248]

Yet the continued use of fossil fuels threatens to erode these gains. Fossil fuels are directly impacting the lives of people around the world through the pollution generated by extracting and burning them. Fossil fuel-linked air pollution is causing millions of preventable deaths every year as people inhale carbon dioxide, carbon monoxide, particulate matter and other airborne pollutants. For every year between 2012 and 2018, an estimated 8.7 million people died prematurely as a result of fossil fuel-driven pollution.[249] Children are suffering reduced health and education outcomes as they are exposed to pollutants in school. Among those most affected by the fossil fuel industry are the communities who go about their lives in the direct vicinity of fossil fuel infrastructure, including Indigenous communities who often rely on ecosystems for their livelihoods that are threatened by fossil fuel extraction on their land. As the sections on SD 3 (Good Health and Wellbeing) and SDG 5 (Gender Equality) attest, the process of 'flaring', which involves burning off excess gas from oil extraction, disproportionately impacts the women who live nearby through heightened risk of preterm births,[250] foetal neurodevelopmental defects,[251] spontaneous abortions[252] and sterility.[253]

The indirect effects of fossil fuel use are being felt through two major phenomena: climate change and war. The extreme weather events and mass displacement associated with climate change significantly affect women's economic and social outcomes relative to men, entrenching poverty among some of the world's most vulnerable communities.[254] Children's education outcomes are reduced as extreme weather events disrupt schooling, particularly in the Global South and for children in low-income households in these countries.[255,256] Globally, the impacts of climate change are already exacerbating poverty by harming human health, destroying sources of income and disrupting educational attainment. What is more, climate change increases the prevalence of a host of diseases, including malaria, dengue, chikungunya virus, Lyme disease and encephalitis-bearing insects, with the WHO estimating that climate change could lead to a quarter of a million additional deaths per annum between 2030 and 2050.[257]

The fossil fuel economy has also been connected to conflict and war. Research has pointed to an increased likelihood of conflict due to the presence of fossil fuels in certain countries while fossil fuel companies have long partnered with autocratic regimes around the world. At the time of writing, Russia's ongoing invasion of Ukraine provides a striking example of the ways in which fossil fuel revenues are being used to fund war, with Russia set to receive $321 billion in energy export revenues by the end of 2022.[258]

Climate change increases the prevalence of a host of diseases, including malaria, dengue, chikungunya virus, Lyme disease and encephalitis-bearing insects, with the WHO estimating that climate change could lead to a quarter of a million additional deaths per annum between 2030 and 2050.

SDG 1.
No Poverty:
Fossil fuels are entrenching poverty and stranded assets risk exacerbating poverty

By 2030, climate change could push 122 million more people into extreme poverty worldwide.

Countries dependent on fossil fuel imports are driven further into debt.

Stranded assets pose a huge challenge to economic development.

Poverty, which is caused by a host of social, political, economic and historical factors, remains a difficult term to define, measure and explain. One standard index of poverty provided by the World Bank defines extreme poverty as living on less than $1.90 per day. In turn, Sustainable Development Goal 1 sets out to eradicate extreme poverty by 2030. While the 2010s showed encouraging signs of reaching this target, the 2021 UN Sustainable Development Goal report stated that the global rate of extreme poverty had increased for the first time in twenty years, amounting to one hundred million people pushed back into extreme poverty.[259] Fossil fuel use threatens to push still more people into poverty. As the underlying cause of human-induced global warming, fossil fuels increase the likelihood of natural disasters,[260] overwhelming the aspirations of SDG 1.5 to "build resilience to environmental, economic and social disasters."

In part, the poverty today witnessed in countries with vast amounts of oil wealth may be traced back to the twin legacies of fossil fuel extraction and colonialism. The first projects to exploit the oil resources of the modern states of Iraq, Iran, Kuwait, Qatar, Libya and Nigeria were often conducted in colonial contexts.[261,262,263] These extractive enterprises transferred vast amounts of oil wealth away from their colonial subjects. Even as former colonies declared independence, foreign control of oil resources, particularly in the Persian Gulf, continued into the 1970s.[264] In turn, this extractive model, which allowed local oligarchies to accumulate large oil rents, came to define the patterns of inequality that persist today in oil-exporting countries. Western oil companies continue to operate in countries such as Nigeria, where oil spills have resulted in massive environmental and economic damage, and Uganda, where Total is proposing to drill for oil in a national park.[265,266]

The immensely profitable nature of the fossil fuel economy has led to highly undiversified economies, raising the question of how fossil fuel-exporting countries will fare in the event of an energy transition.[267] The risk of stranded assets poses a challenge to the right to development for countries in the Global South, which may lack the resources to absorb the cost associated with decommissioning them–as well, of course, as the potentially vast revenues lost from declining fossil fuel production. Venezuela, Nigeria and Angola stand out among the countries with substantial fossil fuel reserves yet which also rank among the countries with the lowest GDP per capita rates in the world.[268] The Ecuadorian government derives roughly a third of its public budget from fossil fuel income while Timor-Leste derives as much as eighty-five percent of its government revenue from exports of oil and gas.[269,270] Of course, as the section below on SDG 17 (Partnerships for the Goals) will demonstrate, fossil fuel companies do not even pay taxes on their existing revenues. In countries where fossil fuels do provide substantial revenues, the already high rates of poverty risk being exacerbated unless policies are put in place to replace lost income.

Countries dependent on fossil fuel imports must shoulder substantial debt and endure the inflationary pressures of soaring energy prices currently being witnessed across the world.[271] Indeed, oil imports represent a primary source of debt for some of the poorest countries: in some countries, payments for oil imports exceed total external debt.[272] Rising energy prices due to Russia's ongoing invasion of Ukraine have exacerbated the debts of low income countries, already inflated as a result of the COVID-19 pandemic. This is due to the fact that higher energy prices lead to higher import costs, meaning that countries' currencies are devalued and the relative value of their external debts increases too.[273,274] Partly as a consequence of the Ukraine crisis, Egypt has had to approach the IMF for additional funding beyond the $12 billion that it already owes the Fund in loan programmes.[275]

In the Global South, the COVID-19 pandemic has caused a reversal to the improved energy access experienced during the 2010s. In 2021, an estimated 770 million people lacked access to electricity principally in sub-Saharan African and Asian countries.[276] Although energy access had been increasing at an annual rate of 9 percent between 2015 and 2019, 2020 saw the number of people in sub-Saharan Africa without access to energy increase for the first time since 2013.[277] In addition to the problem of energy access, the affordability of energy has now become a significant challenge for many in the Global South. In 2020, as many as 90 million people with grid connections could no longer afford a basic electricity subscription.[278]

In the United Kingdom, thirty-seven percent of households in the lowest income decile are classified as living in fuel stress; this number is set to increase to eighty percent by the end of 2022.

Even in wealthier countries, fuel poverty continues to cause significant discomfort and an increased risk of mortality among low-income households. Fuel poverty, defined as when households spend more than ten percent of their monthly income on fuel, increases household debt and causes excess winter mortality and winter hospitalisations across the world.[279,280] Decades of research attest to sustained rates of fuel poverty in high-income countries, a situation which recent fuel prices spikes have exacerbated further. In the United Kingdom, thirty-seven percent of households in the lowest income decile are classified as living in fuel stress; this number is set to increase to eighty percent by the end of 2022.[281] National home insulation programmes continue to prove challenging to implement, despite the fact that countries with greater stock of home insulation are known to have fewer excess winter deaths.[282]

In recent years, policymakers in a number of countries have resorted to energy subsidies to alleviate the cost of fossil fuels on households. In part, this has stood to benefit poor communities in society who would otherwise be unable to afford access to electricity, heating oil and transportation. Yet energy subsidies are highly problematic for several reasons. By incentivising the use of fossil fuels, energy subsidies directly contribute to increased greenhouse gas emissions and higher mortality rates associated with higher air pollution. In countries with blanket subsidy programmes and regressive tax regimes, fuel subsidies also represent a net transfer from poorer to richer households which tend to consume greater levels of energy. The UNDP recently highlighted a revealing statistic based on research by the IMF. Globally, governments spend three times more money on fuel subsidies than the annual amount needed to eradicate poverty.[283,284] However, as the section on SDG 10 (Reduced Inequality) strongly emphasises, energy subsidy reform must be undertaken with great care to ensure that it avoids retrenching poverty and pushing households away from adopting clean fuels.

Beyond the poverty that fossil fuel consumption creates directly, the indirect effect of fossil fuels–climate change–is expected to push many into poverty. Chapter 8 of the IPCC's most recent report which explores the impact of climate change on poverty, livelihoods and development, states with high confidence that "[existing] vulnerabilities and inequalities intensify with adverse impacts of climate change."[285] The impacts of flooding, droughts and storms will be felt more strongly in communities that experience higher levels of existing vulnerability. The observed average mortality rate from floods, droughts and storms is fifteen times higher for countries categorised as highly vulnerable such as Mozambique, Somalia, Nigeria, Afghanistan and Haiti compared to countries with low levels of vulnerability such as the UK, Canada and Sweden.[286] The effect of climate change on agricultural yields is likely to push rural farming communities, some of the world's most economically deprived groups, into other forms of work that may require migration to faraway economic centres. The risk of disease and conflict will cause additional social tensions, changes that the IPCC suggests could drive an additional 122 million people into extreme poverty by 2030.[287]

Globally, governments spend three times more money on fuel subsidies than the annual amount needed to eradicate poverty.

SDG 3.
Good Health and Wellbeing:
Fossil fuels kill people quickly and slowly

An estimated 8.7 million people died prematurely due to fossil fuel pollution every year between 2012 and 2018.

Accelerating climate change is associated with increases in a wide range of communicable diseases and negative outcomes for people with existing conditions.

779,000 additional annual deaths due to climate-related health impacts between 2030 and 2050.

Fossil fuel infrastructures cause infant mortality, acid rain and displacement among nearby populations, devastating human health and wellbeing.

Health co-benefits from phasing out fossil fuels in the energy and transport sectors including improved air quality and increased physical activity from walking and cycling.

Fossil fuels have proven to be a public health disaster. In each year between 2012 and 2018, an estimated 8.7 million people died prematurely due to fossil fuel pollution.[288] However, just focusing on particulate matter may underestimate the true health impacts of fossil fuel pollution, with one study concluding that fossil fuel-related emissions account for around 65 percent of the excess mortality rate attributable to air pollution.[289] Fossil fuel pollutants, including fine particles, polycyclic aromatic hydrocarbons (PAHs), sulphur and nitrogen oxides, benzene and mercury have been linked to infant mortality, lower birth weight, deficits in lung function, respiratory symptoms, childhood asthma, developmental disorders, and the risk of infant disease and infant mortality.[290] Multiple studies have demonstrated a causal relationship between particle exposure and infant mortality.[291] Moreover, *in utero* or early childhood exposure to pollutants has been linked to adult disease such as chronic respiratory illness,[292] cardiovascular disease[293] and genetic damage,[294] the latter of which is associated with increased cancer risk.[295]

With the advance of globalisation, the health burdens of the fossil fuel economy have shifted from rich countries to their low and middle-income counterparts.[296] The industrialisation of countries such as India and China has seen their emissions increase substantially.[297] In 2007, China's annual CO_2 emissions exceeded those of the United States.[298] This has been driven in no small part by the desire of Global North countries to reduce their own CO_2 emissions, which they have achieved by outsourcing their emissions to countries in the Global South.[299,300,301] Multinational enterprises, whose total CO_2 emissions accounted for nearly a fifth of the global total in 2017,[302] have contributed to this by importing products from the parts of their supply chains located in the South. This practice, known as 'carbon transfer', has contributed to additional CO_2 emissions in India, China and countries in southeast Asia such as Vietnam, the Philippines, Thailand and Malaysia.[303]

Attention must also be paid to the harmful role of fossil fuel infrastructures. Specifically, how supply chains harm the communities involved in the production, distribution and storage of fossil fuels. The shale boom in the United States has generated a large body of epidemiological literature which has found that communities living in the vicinity of oil and gas infrastructures suffer adverse health and life outcomes as a result. In Pennsylvania, for example, unconventional natural gas production has been associated with premature births,[304] decreases in average birth weight,[305] migraine,[306] fatigue, [307] nasal and sinus symptoms[308] and asthma.[309] In Colorado, meanwhile, an association between maternal exposure to fossil gas developments and infant congenital heart defects.[310] In the United States more broadly, Black, Hispanic, Indigenous and low-income communities are disproportionately harmed by the environmental and health effects of fossil fuels. Black Americans and Hispanic Americans are exposed to 56 and 63 percent more particulate matter than they produce respectively. The predominantly Black and low-income area of Louisiana known as 'Cancer Alley', located near 150 chemical plants and oil refineries, exhibits cancer rates that are nearly 50 times higher than the national average.[311] In the region of the Trans Mountain Pipeline (TMX) in Canada, Indigenous communities face chemical exposures and threats to health via the contamination of their traditional food sources.[312]

The same is true of countries in the Global South, where fossil fuel infrastructure has rarely proven to the advantage of the communities whose homes and livelihoods are located nearby. Oil spills in countries such as Nigeria frequently harm local communities, which may also lack recourse to advocacy support, justice mechanisms and adequate compensation. In Nigeria, regular oil spills along pipelines are statistically correlated with increasing infant mortality by 38.3 deaths per 1000 children, or double the average.[313] Gas flaring in the Niger Delta, which has poisoned the local water supply, is also associated with localised incidents of acid rain[314] and higher rates of mortality due to cancer and other diseases.[315,316] In India, coal mining has had a highly deleterious effect on the lives of 26 million members of the Adivasi community in Chhattisgarh, Jharkhand and Odisha.[317]

In each year between 2012 and 2018, an estimated 8.7 million people died prematurely due to fossil fuel pollution.

Coal mining and combustion in Raigarh, Chhattisgarh, India is poisoning the local community – Health Care Without Harm

Coal mines located in the Tamnar and Gharghoda blocks are part of the Gare Pelma coal block in the Central Indian state of Chhattisgarh. Gare Pelma coal block is the largest of the 80 coal blocks in the Mand-Raigarh coalfields[318] and is spread over an area of 16,649 hectares. The Mand-Raigarh coalfield itself stretches over an area of more than 112,000 hectares in Raigarh district with an estimated 21,117 Mt of coal. Most of these coal mines, located in the Tamnar and Ghargoda blocks, were built on agricultural, forest and pasture lands.

The Raigarh district is a Schedule V area (Scheduled Tribes are 33 percent of the total population) with Gonds and Oraons being the main inhabitants. The primary occupation of the large population was agriculture, livestock rearing and collection of forest produce. Every aspect of the natural resource-based economy has been adversely affected by the spread of industrial and mining activity in the district.

In August 2017, Community Environmental Monitoring, a community support group based in Chennai,, released a report on the environmental quality around the coal mines and thermal power plants in Tamnar and Gharghoda blocks of Raigarh district, Chhattisgarh.[319] According to the report, a total of 12 toxic metals including aluminium, arsenic, antimony, boron, cadmium, chromium, lead, manganese, nickel, selenium, zinc and vanadium were found in the water, soil and sediment in the area. Arsenic and cadmium are known carcinogens and lead and nickel are probable carcinogens.

The report concluded that humans and animals in the area are at risk of amplified harm due to the exposure to multiple toxicants and carcinogens all at once. Many of these toxic chemicals adversely affect the same organ (e.g., lungs, kidneys) or have similar impacts (cancer, skin damage, damage to reproductive system). There is an increased cumulative threat when the exposure is to many toxic chemicals at the same time. What's more, many of the chemicals found are known to accumulate and move up the food chain.

Many of the toxins found cause respiratory disorders, shortness of breath, lung damage, reproductive damage, liver and kidney damage, skin rashes, hair loss, brittle bones, nausea, vomiting, diarrhoea, stomach pains, muscle and joint pain and weakness.

Air samples taken downwind of the power plants not only exceeded the WHO's limits of PM2.5 but also indicated presence of toxic chemicals like manganese, nickel, silica and lead; all in levels at which it would be harmful to human health. Manganese, nickel and lead are known to be neurotoxins affecting brain development.

In 2020, India's premier health agency, the Indian Council of Medical Research, released its own health assessment from the region.[320] The report confirms the claims of the local communities as to the severe adverse health impacts around mines and power plants. According to the report, "nearby mining activities put the tribal population of Raigarh at increased risk of diseases such as acute respiratory infection (ARI), tuberculosis, road traffic accident (RTA), etc. Apart from environmental health hazards, undernutrition increases the risk further for various diseases."

The local residents have appealed to the National Green Tribunal (NGT), the highest green court in India, seeking remediation for the environment and health impacts, as well as action against the polluters. The NGT has appointed an oversight committee[321] to look into the matter, hold polluters to account and provide compensation to affected residents.

The wide-ranging indirect health impacts of fossil fuel consumption as a result of climate change must also be acknowledged. The IPCC has documented the increasing frequency of climate-related illnesses, premature deaths, malnutrition and threats to mental health.[322] Climate-related illnesses include malaria, dengue, chikungunya virus, Lyme disease and encephalitis-bearing insects. In addition, the higher temperatures, heavy rainfall and flooding associated with climate change are causing the spread of cholera, gastro-intestinal infections, foodborne diseases related to salmonella and campylobacter and respiratory tract infections.[323] Conservative estimates by the World Health Organization project that 250,000 additional annual deaths due to climate-related illness would be generated between 2030 and 2050 due to just four climate related health impacts: heat, diarrhoea, malaria and childhood undernutrition.[324] Another projects that a climate change-associated net increase of 529,000 adult deaths worldwide will result from expected reductions in food availability (particularly fruit and vegetables) by 2050, as compared with a reference scenario without climate change.[325] Increased rates of mental illness have been observed in communities that have been affected by climate-driven events such as wildfires, storms and floods.[326] In turn, flooding has also damaged healthcare infrastructures, limiting their ability to provide services.[327]

Estimates suggest that, between 2030 and 2050, climate-related health impacts could cause between 250,000 and 529,000 additional annual deaths across the world.

SDG 4.
Quality Education:
Fossil fuels are polluting children's school years, especially in the Global South

Two billion children are exposed to particulate matter ($PM_{2.5}$) that exceeds WHO guidelines.

Children born in 2020 are expected to experience between two and seven times as many extreme weather events as someone born in 1960.

Fossil fuel economies have failed to invest in education.

Not only has COVID-19 posed major challenges to achieving quality education for children,[328] continued fossil fuel use directly and indirectly affects the health and educational outcomes of children across the world. A 2013 review of studies on air quality in schools[329] found that higher concentrations of indoor CO_2 levels are associated with higher rates of headaches, tiredness, and an inability to concentrate,[330] dry cough and rhinitis,[331] nocturnal breathlessness,[332] reduced academic performance[333] and absenteeism.[334] When it comes to academic performance, a negative relationship has been shown between concentrations of CO_2 and student performance in standardised tests.[335] It has been repeatedly demonstrated that fossil fuels impact children's cognitive and behavioural development.[336] Exposure to particulate matter (PM) has been found to cause respiratory symptoms, asthma and reduced lung function in children.[337] A 2021 index published by UNICEF demonstrated that children across the world are exposed to the effects of air pollution, including two billion children who are exposed to particulate matter ($PM_{2.5}$) that exceeds 10μg/m3.[338] Carbon monoxide (CO) is associated with asthma and eczema.[339] NO2 has been associated with causing asthma and decreased lung capacity.[340,341] $PM_{2.5}$ has been linked to autism spectrum disorder.[342] Schools also demonstrate how the impacts of fossil fuel pollution can be differentially distributed across socioeconomic groups. Higher air pollution in schools is at times related to the schools' proximity to industrial sites. As a result, children who live near industrial sites have been shown to suffer from increased respiratory problems compared to those living in less polluted urban areas, with potential impacts on their school attendance and success.[343]

The climate change brought on by humanity's use of fossil fuels also affects children's educational and economic attainment. UNICEF has highlighted the multi-faceted impacts of climate change on education.[344] Not only does climate change cause damage to educational infrastructure through the increased risk of floods and storms, the impact of climate change on the availability of water, food security and nutrition, parental livelihoods, and migration patterns all have negative consequences for children's educational outcomes.[345] The losses to human capital, defined as the present value of the labour force's future earnings, are particularly significant for girls.[346] A 2018 World Bank study estimated that the economic losses associated with girls not having 12 years of schooling ranges between $15 trillion and $30 trillion.[347]

The impact of climate change on children's education is proving to have especially negative consequences in the Global South. In South-East Asia, higher-than-average temperatures have been shown to result in fewer years of schooling.[348] A longitudinal study by Oxford University that has tracked the lives of 12,000 young people in Ethiopia, India, Peru and Vietnam since 2001 shows that between thirty and fifty-four percent of children in these countries had already experienced at least one extreme weather event by the age of fifteen; children from poorer backgrounds were four times as likely to experience such events as children from wealthier households.[349] Evidence of substantial intergenerational inequity in levels of exposure to the effects of climate change exists across the world: a recent study has demonstrated that a child born in 2020 is expected to experience between two and seven times as many extreme weather events during their lifetime as someone born in 1960.[350]

In turn, the low educational attainment produced by climate change creates a vicious cycle of vulnerability. Children who leave school early are more exposed to environmental shocks and more likely to be displaced and have less access to information on disaster preparedness and school safety, as well as a reduced ability to respond and adapt.[351] The families of poor children are also often dependent on natural systems such as agriculture, hunting and fishing to support themselves, have fewer opportunities to diversify their incomes and fewer savings with which to withstand the negative shocks brought on by natural disasters.[352]

In some countries, transitioning away from fossil fuels is likely to result in the provision of even fewer public services including education. In Timor-Leste, for example, the majority of whose exports are crude oil and natural gas,[353] a drop in demand will have a devastating impact on public spending. This is particularly concerning given that Timorese public infrastructure spending on education, health and water was so low between 2011 and 2018 that a World Bank report rounded them off to zero.[354]

A long-term study by Oxford University tracking the lives of 12,000 young people in Ethiopia, India, Peru and Vietnam shows that between thirty and fifty-four percent of children in these countries had experienced at least one extreme weather event by the age of fifteen.

SDG 5. Gender Equality: Climate change and fossil fuel use reinforce existing gender inequalities

Climate change exacerbates existing gender inequalities, particularly during natural disasters and extreme weather events.

Fossil gas flaring has been shown to disproportionately harm women.

Just transitions must address gender disparities of the past and present to avoid imposing additional work and care duties on women.

SDG 5 aims to achieve gender equality and empower all women and girls.[355] While fossil fuel-driven economies have achieved transformational changes for many women and girls in the Global North, fossil fuel usage in the Global South today threatens to undermine similar progress. Not only has it has been suggested that fossil fuel extraction reinforces patriarchal norms around the world,[356] climate change has been shown to increase existing gender inequalities between men and women.[357] The lack of control over decision-making and resources experienced by women in many contexts limits their ability to respond to the shocks brought on by fossil fuelled climate change.

Climate change-induced natural disasters and extreme weather events have been shown to have more direct and adverse impacts on women.[358,359,360,361] Pre-existing gender-based economic inequalities entail that women are more likely to experience poverty, live in lower-quality housing and experience higher levels of mortality and disease as a consequence of natural disasters. A study that sampled 141 countries between 1981 and 2002 found that women are more likely to die as a result of natural disasters than their male counterparts.[362] Women are frequently denied access to the same educational opportunities as men, meaning that when disasters emerge, they lack access to important disaster response information and coping mechanisms. Women with less education are also more likely to die during climate disasters. Analysis of climatic natural disasters in 56 countries which experienced at least one natural disaster per year found that lower female educational attainment was associated with increased female mortality.[363] Natural disasters also increase the likelihood of sexual exploitation, trafficking and sexual and physical violence against women and girls following displacement.[364,365]

Pre-existing gender-based economic inequalities entail that women are more likely to experience poverty, live in lower-quality housing and experience higher levels of mortality and disease as a consequence of natural disasters.

Fossil gas flaring in the Texan Permian Basin disproportionately harms women
- Women's Earth and Climate Action Network (WECAN)

Refineries and petrochemical facilities "flare" to burn off excess hydrocarbon gas that cannot be reused or recycled.[366] Flares release toxic endocrine disruptors and carcinogens[367] into neighbouring communities. These toxins fundamentally impact the reproductive health of women living near flare sites – increasing the risk of preterm births,[368] foetal neurodevelopmental defects,[369] spontaneous abortions,[370] and sterility.[371]

Flares can occur during the starting-up or shutting-down of refineries and petrochemical plants, as well as during unplanned operational interruptions like power outages. Gas flaring is implicated in most oil extraction processes, and has persisted since oil production began over 160 years ago.[372] The World Bank regards flaring as a "monumental waste", and reports that about 142 billion cubic metres of gas is currently flared - enough gas to power all of sub-Saharan Africa.[373]

A 2021 nationwide University of Southern California study found that flares in the United States were most frequent in the Permian Basin, including West Texas and Southeast New Mexico.[374] Most Texas Permian Basin counties are predominantly Latinx.[375] However, Indigenous and Black communities are also disproportionately impacted by flaring elsewhere in the U.S.[376]

These flares release a variety of toxins, many of which are endocrine disruptors and carcinogens.[377] These toxins include volatile organic compounds, polycyclic aromatic hydrocarbons, carbon monoxide, nitrogen oxides and black carbon.[378]

Endocrine disruptors and carcinogens both have a disproportionate impact on women's health. In addition to non-gendered health impacts of flaring (e.g., respiratory, immune, and cardiovascular deficits), women living near flare sites experience higher rates of preterm births,[379] foetal neurodevelopmental defects,[380] spontaneous abortions[381] and sterility.[382] Downstream, these reproductive defects can result in increased unpaid caretaking labour for women, as community members become ill or disabled as a result of flaring.

Numerous studies have identified reproductive abnormalities among women living near fossil fuel activity, including flaring. A study in the Permian Basin involving a birth cohort of mothers living within 10km of an active or future extraction site (1996-2009), found higher incidence of maternal hypertension and otherwise rare life-threatening eclampsia cases.[383] Another study in Pennsylvania evaluated 15,451 live births and found a significant association between natural gas activity (i.e., flaring) and decreased birth weight.[384] Yet another study published in the American Journal of Epidemiology, found that the risk of stillbirth increased 13 percent with every three parts per billion sulphur dioxide (present in flares) exposure in the first trimester of pregnancy and 26 percent in the third trimester.[385]

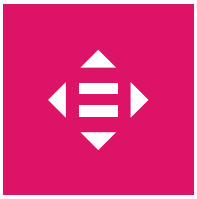
SDG 5 establishes goals of ensuring access to reproductive rights as well as eliminating all forms of gendered violence.[386] The gendered harm of flaring is clear. By living near flare sites, women and their children are subjected to unfair reproductive and fertility damage. Environmental racism and redlining practices exacerbate these gendered impacts to uniquely harm low-income women of colour.

Women are also more likely to be exposed to the negative consequences of energy poverty than their male counterparts. In the European Union, research conducted by the European Parliament has indicated that women are at higher risk of energy poverty than their male counterparts, not least because they tend to live longer than men and are paid less on average.[387]

Greater economic opportunities may exist for women in the renewables sector. Evidence indicates that, on average, female representation is higher in the renewable energy sector than in the fossil fuel sector.[388,389,390] With that said, women are less likely to be employed in senior management in the renewable energy economy than their male counterparts, and are more likely to occupy administrative and non-technical positions.[391] Nevertheless, women have been shown to play a central role in energy provision and governance in remote communities in countries such as Indonesia, Kenya, Nepal, Nigeria, Senegal, Tanzania and Uganda.[392]

However, for energy transitions to be truly just (see SDG 8 Decent Work and Economic Growth for a general discussion of just transitions), the gendered inequities of historical energy transitions and the ongoing gender imbalances of today must be accounted for. Previous energy transitions negatively affected the socio-economic position of women. In the United Kingdom, for example, the closure of coal mines in the 1980s saw women being pushed out of the manufacturing workforce as male miners sought alternative forms of employment.[393,394] A 2021 review of 73 previous energy transitions found that female labour force participation increased following energy transitions but that care-giving duties did not always reduce, presenting women with the double burden of work and care.[395] Moreover, the needs of women involved in every stage of the renewable energy supply chain, from women participating in Chilean extraction of raw materials such as coltan for solar panel manufacture to the women involved in delivering local solar energy services in Indonesia, must be considered.[396] Gender-just transition policies include improving the conditions of sectors in which women work such as care and the service sector, retraining women to work the renewable energy sector and providing psychological support for ex-miners, who are mainly men, to cope with the loss of such identity-forming employment.[397]

A 2021 review of 73 previous energy transitions found that female labour force participation increased following energy transitions but that care-giving duties did not always reduce, presenting women with the double burden of work and care.



SDG 10. Reduced Inequality: Fossil fuels rob from the poor to give to the rich

Fossil fuel subsidy reform is necessary to reduce wealth transfers to the rich, but great care must be exercised to avoid exacerbating poverty.

Fossil fuel infrastructure disproportionately impacts poorer and more vulnerable communities.

In the Global South, the richest twenty percent of the population receive six times more in fuel subsidies than the poorest twenty percent.

Foregone oil revenues risk entrenching global wealth inequalities.

While fossil fuel use has enabled the prosperity brought about by industrialisation in the Global North, it has also produced major socio-economic inequality. In many fossil fuel exporting countries, those that benefit from the income generated by fossil fuels are rarely, if ever, the poorest in society. The unequal distribution of fossil fuel income is reinforced by fossil fuel energy subsidies, which, in addition to costing an exorbitant 6.8 percent of world GDP in 2020, are demonstrably anti-poor.[398] Higher income households are more likely to own cars and consume more fossil fuels, meaning that vehicle fuel subsidies are an effective means for transferring wealth from poor to rich.[399] One estimate suggests that, on average, the richest twenty percent of the population in developing countries receive six times more in fuel subsidies than the poorest twenty percent. When it comes to gasoline, the wealthiest forty percent receive more than 83 percent of the total subsidies provided.[400]

However, exceptional care must be exercised in energy subsidy reform to avoid exacerbating poverty.[401,402,403] Different forms of energy subsidy benefit different sections of society and must therefore be distinguished from one another. Broadly speaking, two forms of energy subsidy exist: production subsidies and consumption subsidies. Production subsidies, which reduce costs for businesses involved in the extraction of fossil fuels, have historically been used to attract fossil fuel companies and represent a major source of public expenditure which is addressed in greater detail in SDG 17 below. Consumption subsidies, which lower domestic energy prices related to international energy prices, alleviate the cost of energy for poor households, who typically spend a higher proportion of their income on energy.[404] Removing consumption subsidies, therefore, risks great harm to low-income households across the world, even if these subsidies benefit the rich the most. In addition, the implementation of energy subsidy reforms is often politically fraught given that

they affect not only the poorest households but also a large contingent of households who live just above the poverty line.[405] Indeed, protests in countries including Nigeria, Bolivia, Cameroon, Venezuela, Yemen and France have forced governments to abandon fossil fuel subsidy removal.

Careful planning has enabled some governments to mitigate the adverse impacts of subsidy reform. In Iran, the government accompanied subsidy removal with a compensatory cash transfer to the bank account of every Iranian. India and Indonesia, on the other hand, used a period of low energy prices to reduce subsidies and raise taxes on petroleum products; Indonesia introduced immediate cash transfers for low-income households.[406, 407] Subsidy reform must also bear in mind whether alternative fuels are available to citizens. In contexts where alternative fuels are absent, subsidy removal can render energy unaffordable for poor households, forcing them into using harmful fuel replacements such as plastic. Nor is the solution a simple matter of improving fossil fuel subsidy design. Policymakers must move beyond the use of fossil fuels by expanding reliable, acceptable, renewables-based energy access to the poor.

Beyond the question of subsidies, low-income and marginalised communities are often those most affected by fossil fuel infrastructures. Indigenous peoples, in particular, have historically been and continue to be exposed to the negative impacts of fossil fuel use. Not only do Indigenous communities often live in areas far from the reach of energy infrastructure, requiring them to import fuel to power diesel generators,[408] they also rely on ecosystems for their livelihoods that may be threatened by fossil fuel extraction on their land. In the USA,[409] Canada,[410] Russia,[411] Bolivia[412] and other nations, the construction of fossil fuel infrastructure– the most prominent being oil pipelines–frequently passes through Indigenous land. Such infrastructure projects have recently been sites of conflict, violence, and Indigenous-led[413] resistance, with fossil fuel companies aided and abetted by the state's recent efforts to criminalise environmental protest in the U.S.A.,[414] Canada,[415] the U.K[416] and Australia.[417] In the U.S.A., for instance, eighteen bills have been passed in seventeen states that impose criminal penalties for a vaguely-defined set of activities such as trespass, 'obstruction', or 'interference' on or near critical infrastructure including fossil gas and oil pipelines.[418]

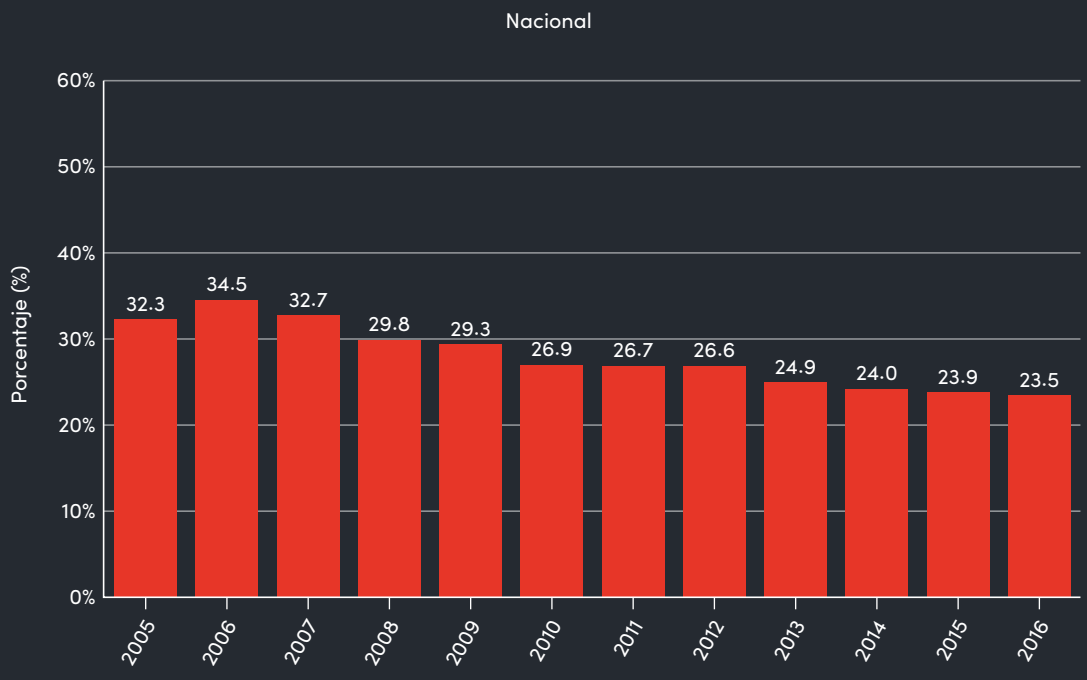
In the U.S.A., seventeen states have criminalised trespass, 'obstruction', or 'interference' on or near critical infrastructure including fossil gas and oil pipelines.

Fossil fuel infrastructures entrench inequalities in Peru
- Movimiento Ciudadano frente al Cambio Climatico (MOCICC)

According to the Peruvian national system to monitor the progress towards the SDGs through its National Institute of Statistics and Informatics (INEI) the country has not only failed to make significant progress towards several Sustainable Development Goals, it has also been moving backwards rapidly in one of the most important Goals for tackling climate change - SDG 7, Affordable and Clean Energy for all.

As can be seen in the graph, coinciding with the beginning of the production of so-called "Camisea Gas" in 2004, fossil gas has displaced hydropower as the country's main source of power, while marginalising the solar, wind or geothermal sources of energy, despite Peru's has great renewable energy potential.

Proporción de la energía renovable en el consumo final total de energía (Porcentaje)



Source: Minister de Energía y Minas

On the other hand, the impact of fossil fuels, and in particular oil extraction in the northern Amazonian territory, is particularly violent. Between 1997 and 2021 more than 566 oil spills have been registered in indigenous ancestral territories, two thirds of these are due to corrosion of pipelines and operational failures. In many of these cases, the negligence of public and private companies to maintain infrastructures and implement technology to prevent these disasters has led to a litany of environmental crimes.

The highest incidence of oil spills is the Peruvian coast, in particular the northern zone around the department of Piura. This is where the Norperuvian oil pipeline ends and where there have been around 404 spills between 1997 and 2021. These spills have decimated both the marine fauna and the livelihoods of tens of thousands of small fishermen, reducing fish stocks and contaminating the ecosystem.

On January 15, 2022, a ship unloading oil for REPSOL spilled approximately 6,000 barrels of crude oil on the coast of Lima, causing the biggest ecological disaster in the history of the capital. The oil spill affected a vast coastal strip of around 28 beaches and the health of thousands of people who live in front of this area of the sea and rely on the ecosystems for their livelihoods.

Peru lacks both state capacity for strong oversight and control to prevent these cases, as well as the mechanisms required to promote and plan the energy transition to leverage the transformative processes of decarbonization and bring all the SDGs within reach.

The fact that fossil fuels must be left in the ground in order to meet the 1.5°C Paris Agreement target raises questions about the lost potential income that fossil fuel exporting countries would face. It has been argued that low-income countries' 'right to development' imposes a moral duty on countries in the Global North to replace these foregone oil revenues with wealth transfers.[419] Such an approach would enable fossil fuel exporters to diversify their economies away from oil and gas production by enabling the development of other productive sectors. An emphasis on the right to development, moreover, would enable poorer countries to benefit from wealth transfers, as opposed to countries that have already benefited significantly from fossil fuel exports.[420] Fortunately, mechanisms already exist to provide such transfers, including the Green Climate Fund (GCF), even if the GCF is yet to be fully funded and lacks the mandate to fund the energy transition beyond conventional mitigation and adaptation development projects. Expanding the mandate and resources of the GCF and of other international financial institutions such as the World Bank, Asian Development Bank and African Development to fund the transition could be combined with 'debt-for-non-extraction' agreements, in which debtor countries agreed to forego the development of fossil fuel extraction in exchange for debt forgiveness.[421]

SDG 16.
Peace, Justice and Strong Institutions

Oil and fossil gas exploitation are associated with higher levels of conflict and lower levels of democracy.

Russia is expected to receive up to $321 billion from energy sales abroad by the end of 2022.

Western fossil fuel companies have collaborated with oppressive regimes in Russia, Azerbaijan, Equatorial Guinea, the Republic of the Congo, and the Gulf States.

SDG 16 aims to reduce violence everywhere, promote the rule of law and ensure access to justice for everyone, reduce corruption and bribery, and strengthen national institutions. Conflict and fossil fuel extraction, however, have an extensive and well-documented mutual history. An extensive literature has documented the relationship between oil and conflict. This literature has found, for example, that the presence of oil resources exacerbates the likelihood of civil war and the emergence of separatist movements in the countries where it is located.[422,423,424] Such conflict, it is suggested, is driven by the opportunity to control oil rents and the symbolic power afforded by control over such resources.[425] Nor are such conflicts strictly limited to the presence of oil. Other studies have suggested that the presence of fossil gas, too, may also drive conflict in contexts where external military intervention is deemed necessary to secure access to gas pipelines.[426] Of course, counterexamples of positive fossil fuel management exist, including Norway and the Gulf States, which have established sovereign wealth funds to steward their fossil fuel wealth and diversify their economies.

Compounding the problem of the 'resource curse', a phrase which encapsulates the poor economic and social outcomes associated with certain countries endowed with large natural resources,[427] fossil fuels strengthen the hand of autocrats around the world. Several decades of scholarship demonstrate a close link between oil wealth and lower levels of democracy in the countries of the Middle East, even if more recent research has sought to contest the definition of democracy used in earlier studies.[428,429] The most prominent contemporary example of fossil fuel-based autocracy is perhaps Russia under President Vladimir Putin, whose state coffers have continued to receive vast energy payments from European energy importers despite the Russian invasion of Ukraine.[430] By the end of 2022, Russia is anticipated to earn as much as $321 billion from total energy exports should they continue unabated.[431] Of course, Russia is not the only example of fossil fuel-powered autocracy: in recent years, Western fossil fuel companies have collaborated with oppressive regimes in Azerbaijan, Equatorial Guinea, the Republic of the Congo, and the Gulf States.[432]

SDG 16. The war in Ukraine and the climate crisis have the same root cause: fossil fuels
- by Svitlana Romanko, Environmental Lawyer, Climate Change, Law, Social Transformation Strategist, Stand With Ukraine.

We cannot hope for sustainable development without peace, stability, human rights and effective governance - all based on the rule of law. Yet our world is becoming increasingly divided. Some regions enjoy peace, security and prosperity, while others fall into seemingly endless cycles of conflict, violence and poverty. This is not inevitable and must be addressed if the goals of SDG16 are to be realised.

Armed violence and insecurity have a destructive impact on a country's development, affecting economic growth, and often resulting in grievances that last for generations. Sexual violence, crime, exploitation and torture are also prevalent where there is conflict, or no rule of law, and countries must take measures to protect those who are most vulnerable to violence and lasting fall out of war. The SDGs aim to significantly reduce all forms of violence and work with governments and communities to end conflict and insecurity. Promoting the rule of law and human rights are key to this process, as is reducing the flow of illicit arms and strengthening the participation of developing countries in the institutions of global governance.

The role of fossil fuels in driving violence and conflict around the world cannot be overlooked - and Russia's invasion of Ukraine has brought this into sharp focus.

What began on February 24th has quickly escalated into seemingly endless cycles of conflict and violence. Make no mistake, this is a fossil fuel-financed war - and while it may be the first to rear its head in Europe, the history of the Middle East is littered with such eruptions of violence. Russia, the largest country in the world by landmass with 60 percent of its economy based on fossil fuels, is using the eye-watering revenues from fossil fuel exports to fund abhorrent violence. The invasion of Ukraine is a war against Ukrainian sovereignty and independence, as well as a grave violation of human rights, international law, and global peace.

The destruction of Ukraine's economy is yet to be fully understood as the war is ongoing, but current estimates vary from 35 percent reduction in GDP to 60 percent. According to joint estimates of the Ministry of Economy and Kyiv School of Economics, during the first two months of the war the total losses of Ukraine's economy due to the war due to direct and indirect losses range from $564 billion to $600 billion.[433] This damage and the prolonged recovery will have huge implications towards implementation of the SDG16, as well as many other SDGs.

The war in Ukraine is not "just another conflict". Besides the dreadful death, destruction, violence, terror and genocide against thousands of Ukrainians killed during shelling, bombing and missile attacks from Russian forces, it has already affected 1.7 billion people in 107 countries who are now facing sky-high prices for food and energy.[434] From Egypt to Sri Lanka, food and energy prices are adding additional layers of strain to already struggling communities, threatening peace and security within these nations.

Faced with strong resistance from the Ukrainian armed forces and suffering heavy losses, Russian invaders are increasingly resorting to terrorist tactics and committing war crimes. Cities like Mariupol, Volnovakha, Chernihiv and Kharkiv are being levelled to the ground. Thousands of civiialians have been brutally murdered, raped and tortured and mass graves have been found in those areas liberated from Russian occupation. All civilians, medics, the wounded and the severely wounded were taken out of the territory of Azovstal. According to the state officials all defenders of Mariupol will be returned home.

Despite these horrors being broadcast around the world, and inviting widespread condemnation from governments, institutions and businesses, many countries continue to import vast amounts of Russian fossil fuels, actively lining the pockets of a regime that is complicit in war crimes. At the end of April 2022, approximately two months into the invasion, €58 billion worth of fossil fuels were exported via shipments and pipelines from Russia, of which 70 percent went to EU member states.[435] The biggest importers of Russian energy range from Germany (€8.3bln) to China (€7.1bln). These financial flows equate to nearly one billion Euros a day making its way into Putin's war chest. The condemnation from allied governments ringa hollow when you see the sheer scale of money going to Russia. Of course, many governments have pledged to cut their dependence on Russian fossil fuel imports in the near-term but these measures will not have an immediate impact on Russia's ability to wage war.

Fossil fuel companies have used the current crisis as an opportunity to bolster their revenues. In the first quarter of 2022, the top 20 U.S based oil and gas companies reported $30.3 billion in profits, a 155 percent increase from the first quarter of 2021.[436] The EU fossil fuel sector received an average of €107 million in additional daily revenues from increased prices in March alone, with €94 million from the sale of diesel and €13 million from petrol.[437] Oil companies such as ExxonMobil have been some of Putin's closest partners, aiding and abetting a rise to power that has culminated in the invasion of Ukraine.

The war in Ukraine and the existential threat of climate chaos have the same root cause - fossil fuels. The sooner economies move away from fossil fuel dependency, the sooner peace and security for all of humanity can be achieved. The technologies and finance exist to drive a rapid phase out of fossil fuels. If we fail to use this moment to rise to the challenge, Ukraine will not be the last fossil fuel war.

04

Economic Empowerment & Just Transition

SDG 7
Affordable and Clean Energy: Fossil fuels make life unaffordable for many

SDG 11
Sustainable Cities and Communities: Cities drive CO_2 emissions but have a major role to play in combating climate change

SDG 8
Decent Work and Economic Growth: Fossil fuels have failed to deliver on jobs and growth

SDG 12
Responsible Consumption and Production: Fossil fuel companies are refusing to disclose climate risk

SDG 9
Industry, Innovation and Infrastructure: Infrastructure projects are soaked in emissions

SDG 17
Partnerships for the Goals: Fossil fuel companies are violating the spirit of partnership through tax havens and tax breaks

Humanity's heavy dependence on fossil fuel-based energy, with all the economic opportunities it has afforded to some countries, is accompanied by several contradictions. Government revenues spent on energy subsidies to shield the poor from global energy price increases end up largely benefiting the rich. 770 million people in the Global South remain without access to cheap, reliable electricity.[438] The fossil fuel companies responsible for extraction make use of tax havens to avoid paying the countries from whose resources they profit, while continuing to refuse to disclose the true extent of the climate risk embedded in their balance sheets (see SDG 17 (Partnerships for the Goals) for greater detail). Such behaviour comes in the context of five years of falling growth in the fossil fuel sector relative to renewable energy projects.[439]

In this context, the prospect of a just transition offers a chance to move beyond the fossil fuel order and achieve economic empowerment for all. Support for such transitions is being increasingly voiced by workers in the fossil fuel sector, while examples of just transitions are emerging from countries across the world.[440] Cities, which account for over seventy percent of CO_2 emissions,[441] can play a major role in decarbonising the economies and societies of tomorrow and urban planners will be able to redesign the urban environment in ways that ensure humanity's physical and mental flourishing. The race to decarbonise will also generate significant employment opportunities, with the ILO suggesting that 6.5 million jobs could be generated globally in the construction sector, 2.5 million jobs in manufacturing and 1.2 in the mining sector during a sustainable transition.[442]

Despite a brief reprieve following the outbreak of COVID-19, 2021 saw the second-largest CO_2 emissions increase in history.

SDG 7. Affordable and Clean Energy: Fossil fuels make life unaffordable for many

A third of the world population lacked access to clean fuels and technologies for cooking in 2019.

Renewables offer electricity generation that is cost-competitive with fossil fuels and opportunities for decentralised energy generation, local energy ownership and greater community participation in energy governance.

770 million people worldwide are estimated to remain without access to cheap, reliable electricity, of whom 570 live in least developed countries (LDCs).

Cost of providing universal residential electrification comes to $41 billion every year, a fraction of the $5.9 trillion spent on fossil fuel subsidies globally in 2021.

Fossil gas presents a major barrier to the introduction of renewable energy.

Sustainable Development Goal 7 envisions a world in which "access to affordable, reliable, sustainable and modern energy for all" is ensured[443]. Yet fossil fuels continue to account for the vast proportion of global energy consumption.[444] Despite a brief reprieve following the outbreak of COVID-19 in 2020, 2021 saw the second-largest increase in CO_2 emissions in history.[445]

While the 2021 Glasgow Climate Pact explicitly calls for inefficient energy subsidy reductions and a coal 'phase-down'–though not their removal altogether–the role of fossil gas remains unchallenged. Fossil gas now presents a barrier to the introduction of renewable energy, with new gas power plants threatening to lock in decades of fossil fuel-based energy production.[446] Fossil gas companies have spent millions of dollars in lobbying government bodies such as the European Union to classify fossil gas as a 'clean' bridging fuel to renewable energy (see SDG 17 (Partnerships for the Goals) for a detailed discussion of fossil fuel lobbying efforts). However, the risk of additional emissions, infrastructural lock-in, and stranded assets–plus the higher-than-previously thought levels of methane emissions from gas, now the second-highest source of GHG emissions[447]–have led many to argue that fossil gas is a 'bridge to nowhere'.[448,449,450]

By contrast to fossil fuels, renewables offer a range of advantages. Not only do they provide electricity generation that is frequently cheaper than fossil fuels,[451] they also offer opportunities for decentralised energy generation, local energy ownership and greater community participation in energy governance. Decentralised solutions also offer an opportunity to avoid the high distribution and transmission costs associated with grid expansion, which may prevent remote communities from being provided with electricity.[452,453] Such opportunities must be considered given that, while substantial progress has been made in expanding

access to electricity for much of the world's population, 770 million people worldwide are estimated to remain without access to cheap, reliable electricity–of whom 570 million live in least developed countries (LDCs).[454,455]

Moreover, many people around the world remain unable to afford energy. Energy poverty, which has been defined as "the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services to support economic and human development" continues to affect millions of people around the world[456,] with a third of the world's population lacking access to clean fuels and technologies for cooking in 2019.[457] Communities across the world continue to be obliged to use charcoal, kerosene and firewood to cook with. As the volume of plastic continues to grow, communities in countries such as Malawi and Indonesia have been reported to use plastic as a cooking fuel, producing carcinogenic dioxins in the process. These dioxins are inhaled by women and children who are typically responsible for cooking and transferred to waterways and crops via airborne dust.[458,459,460]

As the volume of plastic continues to grow, communities in countries such as Malawi and Indonesia have been reported to use plastic as a cooking fuel, producing carcinogenic dioxins in the process.

Investing in renewables will unleash a wave of benefits, from green jobs to cleaner air - Aishwarya Dhar, Strategic Intelligence Project Management at REN21

Energy is the lifeblood of the modern economy and society and is deeply embedded in many of the contemporary global challenges we face today – ranging from security, geopolitics, poverty, environmental degradation, and social justice. It is in this context that renewable energy does so much more than providing clean and affordable energy (SDG7); it is an enabler and an opportunity for accelerating global progress on other SDGs as well. Renewable energy supports local economic development - it helps to reduce air pollution, alleviate poverty, create jobs, allow for energy security, sovereignty, and democracy, and certainly contributes to climate change mitigation and adaptation.

Renewables-based electric power systems and clean cooking solutions play an increasingly important role in improving energy access rates, especially in rural and remote areas where such access remains low. Stand-alone solar systems and renewables-based mini-grids are often the most cost-effective way of electrifying off-grid areas in the least developed and developing world, providing power for households and productive uses. Furthermore, renewable energy options such as improved biomass stoves and fuels, biogas, ethanol, solar cookers, and renewables-based electric cooking help reduce the health and environmental impacts of traditional use of biomass.

However, with less than a decade left before 2030, the total investment in energy access is far below what has been estimated as needed to achieve SDG 7. This is primarily because the energy access finance that is available is not being channelled into countries with the greatest access deficit, and very little of the already small amount of finance is dedicated specifically to renewables-based energy access systems. Furthermore, while the share of renewable energy has advanced considerably in the electricity sector (26%), the share of renewables in total final energy consumption for heating and transport sectors has barely changed from past levels – 11% and 3.3% respectively.

Hence, drastically stepping up investments in renewable energy for universal energy access, especially in least developed and developing countries, is a necessary precondition for ensuring energy justice and delivering on the SDG7 by 2030.

Additionally, decentralised renewable energy generation promotes democratic governance of the local energy system. By locating energy production facilities closer to the site of energy consumption, a decentralised energy system allows for more optimal use of renewable energy as well as combined heat and power, reduces fossil fuel use and increases eco-efficiency. Renewables can not only reduce our energy vulnerability but also drive global and local economic development that is inclusive, fair, and equitable.

Providing clean energy access is financially achievable and substantially less costly than the current subsidisation of fossil fuels. According to the IEA, the cost of providing universal residential electrification would come to around $41 billion every year,[461] a figure that is sharply contrasted with the $5.9 trillion that was provided in fossil fuel subsidies provided in 2021.[462] However, it must be emphasised that any energy subsidy reform must be conducted with great care to avoid reinforcing poverty and forcing households to use alternative fuels such as plastics as substitutes, while access to clean energy must be guaranteed before subsidy programmes are removed.

Energy affordability is closely linked to government policy decisions. To cite a current example, the EU's efforts to reduce its dependency on Russian gas may well increase the cost of electricity to consumers. The EU's new strategy, REPowerEU, sets out to reduce and eliminate the import of Russian gas "well before" 2030.[463] REPowerEU will be achieved through three principal strategies. Demand reduction through the reduction of gas in electricity and heating, diversification of natural gas supply and accelerating the construction of renewable gas infrastructure. Yet these plans have been criticised for the simple reason that the EU's proposals to subsidise the production of biogas and hydrogen–both promoted as forms of renewable gas–may end up increasing the cost of electricity for consumers.[464] Instead, it is argued, the EU should focus on reducing consumer energy demand by supporting the installation of electric heat pumps, which have been shown to be four times more efficient than gas-based heating systems.[465] Technological solutions, however, will not be enough on their own, given that utility scale solar risks concentrating capital and authority in a small group of institutions. Instead, the energy transition must be used to institute justice-centred systems based on principles of energy democracy and around decentralised renewable energy-based systems, including roof-based solar, community-owned solar and other energy democracy systems and mini-grid systems.[466]

According to the IEA, the cost of providing universal residential electrification would come to around $41 billion every year, a figure that is sharply contrasted with the $5.9 trillion that was provided in fossil fuel subsidies provided in 2021.

SDG 8.
Decent Work and Economic Growth:
Fossil fuels have failed to deliver on jobs and growth

Across multiple countries, fossil fuel sector workers support proposals for a just transition.

Between 2011 and 2020, global renewable energy portfolios delivered a total return on investment of 422.7 percent, fossil fuel portfolios just 59.0 percent.

A net 18 million jobs could be generated globally as part of a sustainable energy transition, with 6.5 million jobs to be generated in the construction sector, 2.5 million in manufacturing and 1.2 in the mining sector.

Global heating has been shown to affect both national economic output and the rate of economic output.[467] Given the relative impact of climate change decreases as per capita income rises, economic losses will be felt most strongly among countries that are lower-lying, poorer and hotter.[468] The economies of many low-income countries are based on agriculture and as a result, the impact of rising temperatures and flooding will have a disproportionately greater impact on their yields.

In countries in the Global South, the promises of fossil fuel energy investments have failed to deliver. Fossil fuel revenues have not always been invested in expanding the economies of low-income countries.[469] In energy-exporting countries such as Nigeria, Angola and Mozambique, domestic electricity access increased by an annual average of merely 1.02 percent between 2001-2019.[470] Nor have the revenues from fossil fuel exports translated into better conditions for fossil fuel workers. Instead, income from such energy wealth has been accumulated by small groups of local elites.[471]

At the same time, the causal link between energy use and economic growth[472] means that energy must continue to play a vital role in supporting economic growth. This section on SDG8 looks at work opportunities and economic growth within the energy sector itself, while the next section on SDG 9 (Industry, Innovation and Infrastructure) looks at the energy sector's links to broader economic issues.

Fortunately, economic growth in the energy sector is highly likely to emerge from the widespread deployment of renewable energy technologies. Research has demonstrated that investment in renewable energy technologies will

generate more jobs per dollar spent than equivalent jobs in the fossil fuel sector, and public investment in renewable energy policies generates more jobs than spending on equivalent fossil fuel sector jobs. Heidi Garrett-Peltier at the Massachusetts Institute of Technology (MIT) has shown that in the United States, five additional jobs are generated for every $1 million in spending shifted from fossil fuels to clean energy.[473] In South Africa, an low-carbon transition in the buildings, power and sustainable transport sectors could generate nearly two million jobs by 2030[474] while women across Africa stand poised to benefit from green jobs.[475]
The transition away from fossil fuels will not simply have implications for the renewables sector. The ILO estimates that the transition to a green economy will generate a net 18 million jobs globally, with 6.5 million jobs generated globally in the construction sector, 2.5 million jobs in manufacturing and 1.2 in the mining sector during a sustainable transition.[476]

Analysis of recent historical financial performance suggests that fossil fuel companies have been a poor investment choice. Research by Imperial College London suggests that, between 2011 and 2020, global renewable energy portfolios performed seven times better than fossil fuel investments, with a total return on investment of 422.7 percent by contrast to the 59 percent exhibited by fossil fuel portfolios. Modelling conducted by the IEA and the IMF in 2020 indicated that policies designed to shift energy consumption away from fossil fuels would generate additional global economic growth of 1.1 percent per year and lead to global GDP in 2023 being 3.5 percent higher than it would have been.[477] Moreover, public investment in renewable energy policies generates more jobs than spending on equivalent fossil fuel sector jobs.

The IEA and the IMF have shown that low-energy policies would generate additional global economic growth of 1.1 percent per year and an additional 3.5 percent in 2023.

We need a just transition away from fossil fuels to achieve the SDGs
- UN Research Institute on Social Development

The large-scale shifts and transformations required to move our economies away from fossil fuels will undoubtedly have significant impacts on the world of work. Potential job losses are often used to mobilise opposition and entrench resistance against fossil fuel phase out policies. We have seen this play out in a variety of countries and contexts, time and time again, with fossil fuel companies and complicit politicians claiming that phasing out fossil fuels will "kill jobs" and "destroy the economy". In many cases, these claims are exaggerated and often misleading.

This "jobs vs. environment" narrative ignores two important points: on the one hand, an estimated 1.2 billion jobs directly rely on a healthy environment and that by 2030, heat stress alone could lead to the loss of over 2% of total working hours worldwide every year.[478] On the other hand, it is estimated that a green economy transition will lead to **a net gain of approximately 18 million jobs.**[479] Strong climate policy supported by sufficient investment will create a myriad of new green jobs and remediation roles, will 'green' jobs currently in polluting sectors, and drive innovation and support nascent sectors of the economy. In terms of employment and professional opportunities, many more people and communities stand to benefit from transitioning away from fossil fuels compared to continuing with the fossil fuelled-status quo.

But while a transition away from fossil fuels is inevitable, justice and equity are not. Workers and communities whose livelihoods and local economies will be impacted by the transition away from fossil fuels will require both a seat at decision-making tables, and support and investments to ensure that they can determine the way transitions are implemented and ensure that they, too, can transition into new forms of employment (or early retirement) (see JTRC 2018).[480]

A comprehensive policy approach that promotes green industrial policy and active labour market policies is needed to tackle the regional disparities between areas where jobs are lost compared to those where they are created. If these policies are not prioritised, then the energy transition risks further entrenching social inequalities, hampering communities that are already subject to structural disadvantages and feel left behind by economic tides outside of their control. By not actively engaging affected communities, unions and sectors, governments and businesses risk provoking antagonism against the low-carbon transition, which could ultimately bolster fossil fuel corporations' efforts to slow the transition.

Just transitions are a way to tackle the required transitions proactively and inclusively, and will also bring about co-benefits like improved social protection, more sustainable production and consumption and reduced inequality. Without just transitions, progress towards many other SDGs (including 1, 7, 8, 10) is difficult to achieve and safeguard.

Just transitions are a way to tackle the required transitions proactively and inclusively, but also open up general opportunities to bring about co-benefits of improved social protection, more sustainable production and consumption and reduced inequality. Without just transitions, progress towards many other SDGs (including 1, 7, 8, 10) is difficult to achieve and safeguard.

Naturally, however, such proposed transitions will include winners and losers. Governments will need to implement just transitions that mitigate the negative economic impacts on communities whose livelihoods depend on the fossil fuel sector. These communities include not only those who work in coal mines and on oil rigs but also those involved in the supply of parts, the construction industry and service providers in local areas.[481] Evidence of just transitions is emerging across the world. A 2018 report by the Just Transition Research Collaborative provides a comprehensive mapping of the just transitions unfolding in Brazil, Canada, Germany, Kenya, South Africa and the United States.[482] Depending on whether just transitions are defined narrowly–simply focussing on providing replacement jobs for fossil fuel sector workers–or more broadly as policies that support those affected by fossil fuel extraction but not necessarily by job losses, just transitions can play a role in addressing SDGs including SDG 1 (No Poverty), SDG 3 (Good Health and Wellbeing) and SDG 10 (Reduced Inequality). Broad just transition policies which provide the training required to work in the renewable energy sector find support among workers in the Canadian[483,] South African[484] and UK[485] fossil fuel sectors.

At the same time, these countries benefit from economic diversity, relatively low government revenues from fossil fuel exports and limited numbers of workers in the fossil fuel sector. In Australia, for example, more people are employed by McDonald's than by the fossil fuel sector, contrary to fossil fuel companies' emphasis on job generation.[486] Countries that are more heavily dependent on fossil fuel income must be supported to diversify their economies (see SDG 10). Greg Muttit and Sivan Kartha have suggested five broad principles for achieving an equitable energy transition: phasing out global extraction at pace consistent with limiting warming to 1.5°C, enabling a just transition for workers and communities, curbing extraction consistent with environmental justice, reducing extraction fastest where doing so will have the least social costs and sharing transition costs fairly, according to ability to bear those costs.[487] Of course, this implies that some countries, including those in the Global South, will be obliged to accept significant foregone revenues from their natural resource sectors. As has been discussed above, however, approaches such as debt-for-climate swaps would enable such countries to benefit from aid provided to support the transition from fossil fuels and facilitate economic growth and prosperity through alternative economic sectors.

Broad just transition policies which provide the training required to work in the renewable energy sector find support among workers in the Canadian, South African and UK fossil fuel sectors.

SDG 9.
Industry, Innovation and Infrastructure: Infrastructure projects are soaked in emissions

In 2021, industrial emissions represented nearly 40 percent of global total emissions, while transport emissions accounted for 37 percent.

Fossil fuel companies are expected to spend $527 billion on new fossil gas exploration and $405 billion on oil exploration by 2030.

Globally, diesel generators are twice as costly to run as grid-based electricity.

Global South energy policy can avoid the infrastructure lock-in pathway of the Global North.

Each of the sectors involved in SDG 9–which calls for sustainable industrialization, increased innovation and improved access to transport, irrigation, energy and information and communication technology–depends heavily on fossil fuels at present.[488] In 2021, industrial emissions represented nearly 40 percent of global total emissions, while transport emissions accounted for 37 percent.[489] The industrial sector generated 12.3 Gt of CO_2 in 2019 in processes such as steel, iron and cement production.[490] The cement and steel industries have been the sectors most responsible for driving GHG emissions during the past 20 years, while other industries have decreased with this trend most evident in China.[491] The IPCC has called for efficiency increases and reduction in overall production and consumption of cement and for its production to utilise renewable energy and recycle energy generated.[492] With that said, the industrial sector is poised to benefit from substantial green investment. Decarbonising this sector will require around $200 billion to be invested by 2030 to meet the IEA's target of a 'Net Zero by 2050' scenario.[493] Half of this would be spent on improving energy efficiency and electrification, with the rest allocated to renewable energy generation, carbon capture and storage and hydrogen generation.[494]

When it comes to innovation, both governments and corporations have continued to spend billions of dollars on new extractive technologies. Between 2009 and 2018, nearly 21 percent of United States federal funding for energy R&D, or just under $10 billion, was spent on fossil fuel technology development.[495] Spending by fossil fuel companies between 2010 and 2019 increased from $17.3 billion at the start of the decade to $18.9 billion by its end, or exactly three times the $6.3 billion spent by corporations on renewable energy R&D in 2019.[496] In addition, fossil fuel companies are expected to spend $527 billion by 2030 on new fossil gas exploration

and $405 billion on oil exploration by 2030 despite issuing statements in support of the 2015 Paris Agreement.[497] Rystad Energy, an energy research company, estimated that by 2030, BP will have spent between 25 and 37.5 percent more on fossil fuel exploration than on renewable capital expenditure. For Total, the figure is 40 to 50 percent.[498] At the end of April 2022, Chevron announced plans to invest still more in fossil gas production.[499]

The transport sector, meanwhile, generated 8.5 Gt of CO_2 in 2019.[500] Yet recent increases in the sale of electric vehicles have failed to make a dent in the vast majority of vehicles that remain powered by fossil fuels. Moreover, demand for vehicles in the Global South is set to increase over the next decade. As the International Energy Agency highlights, many countries in the Global South lack the electrical infrastructure needed to guarantee electric vehicle adoption, which means that emissions from the road vehicle sector are set to increase substantially with dire consequences for levels of air pollution.[501]

Rystad Energy, an energy research company, estimated that by 2030, BP will have spent between 25 and 37.5 percent more on fossil fuel exploration than on renewable capital expenditure. For Total, the figure is 40 to 50 percent.

POWER SHIFT AFRICA

EACOP, Uganda and Tanzania: a threat to development and communities

- Amos Wemanya, Power Shift Africa

The Ugandan and Tanzanian governments have signed an accord with the French fossil fuel company, Total, and the Chinese energy company, CNOOC, to build the East African Crude Oil Pipeline (EACOP.)[502] A 1,445-kilometre pipeline that will transport oil from Hoima, Uganda to the port of Tanga in Tanzania.

The fossil fuel industry and those that finance it continue to frame ongoing and new fossil fuel extraction as an important driver of development. However, investments in fossil fuel infrastructure hold significant economic, social and environmental risks to the communities surrounding these infrastructural projects.

The argument for supporting the development of the East African Crude Oil Pipeline is that it will ignite development in the region. However, investments in fossil fuels and its infrastructure are a dead-end. Developing this oil pipeline will not only support the extraction of environmentally-harmful oil but also lead to social and environmental challenges such as land appropriation, threats to land and marine ecosystems, biodiversity loss and air and water pollution, all of which cause serious harm to the health of Tanzanians and Ugandans.

A report by Bank Track indicates that the current plan for the pipeline will lead to the displacement of an estimated 14,000 households across Uganda and Tanzania.[503] As a result of this, hundreds of families will need to be resettled and thousands more will be affected by the associated oil development projects leading to loss of livelihoods.[504]

In the case of EACOP and oil extraction in Uganda, there are serious risks of degrading the ninth most biodiverse region in the world.[505] Oil extraction will degrade the rich ecosystems in the Albertine Graben region, which is home to half of all African bird species. The EACOP will cause destruction and loss of cultural sites and value and lead to habitat disturbance to nearly 2000 kilometres of protected wildlife habitat.[506]

The lack of reliable electricity infrastructure around the world has led to the proliferation of diesel and petrol-powered generators, with significant negative health and economic consequences. Not only is it expensive to operate such generators, with generator users typically spending between $0.20 and $0.60/kWh compared to the $0.10-$0.30 kWh on grid-based energy, they also contribute to local air pollution.[507] In one estimate by the World Bank, generators in sub-Saharan Africa account for the vast proportion of nitric oxide (NOx) and fine particulate matter (PM2.5) from the power sector.[508] Integrating solar and battery into local energy systems has been shown to reduce electricity costs and air pollution.[509,510] By investing in renewable energy infrastructure, countries in the Global South also have the opportunity to avoid the infrastructure 'lock-in' faced by countries in the North, leap-frogging straight to low carbon technologies and avoiding stranded assets (see the discussion of stranded assets in SDG 1 (No Poverty)).

Exponential growth in information and communication technology (ICT) infrastructure threatens to increase energy demand and risk additional fossil fuel use. In 2020, ICT GHG emissions were estimated at between 1.8 percent and 2.8 percent of total global emissions.[511] The energy demand of data centres and communication networks is expected to grow exponentially in the coming decade. One widely-cited study suggests that communication technology could account for up to 51 percent of global electricity consumption and 23 percent of global emissions by 2030.[512] Other estimates of future ICT energy demand are more sanguine: in 2017, the IEA suggested that data centre energy demand would only increase by 3 percent between 2014 and 2020 due to efficiency gains.[513] However, the myriad opportunities afforded by ICT in healthcare, education, financial inclusion, and gender equity mean that ICT access must remain central to development. Expanding ICT access must therefore be accompanied by policies that limit or offset additional energy demand, such as device energy efficiency standards, product eco-labels and incentives for energy-efficient industrial processes and renewable energy, incentives to improve the efficiency of data centres, and network device energy efficiency standards.[514] Encouraging initiatives have emerged such as the RE100, a coalition of companies that have committed to source 100 percent of their energy from renewable sources, although companies must ensure they use appropriate carbon accounting measures to ensure that carbon emissions are actually being reduced.[515,516]

One widely-cited study suggests that communication technology could account for up to 51 percent of global electricity consumption and 23 percent of global emissions by 2030.

SDG 11. Sustainable Cities and Communities: Cities drive CO_2 emissions but have a major role to play in combating climate change

Areas in South Asia have already experienced surface temperatures of 60°C, with business-as-usual scenarios indicating South-West Asian cities to see annual maximum temperatures exceed 60°C by end of 21st century.

98 percent of cities with populations over 100,000 in low- and middle-income countries exceed WHO guidelines for particulate matter.

In East Asia and the Pacific, urban sprawl has been shown to have a strongly positive effect on CO_2 emissions.

Cities form the locus of most global fossil fuel consumption today yet are also poised to play a leading role in addressing climate change. Urban centres account for around two-thirds of total energy consumption and over seventy percent of CO_2 emissions.[517] By 2030, the UN expects that there will be 30 megacities in the world with more than ten million inhabitants with major implications for additional energy consumption.[518] That most of these megacities are located in the Global South adds to the challenge, given that the Global South will be disproportionately exposed to the effects of climate change and enjoys fewer resources with which to address them than their counterparts in the Global North.

Heat, flooding and other climate-inducted extreme weather events will have a significant impact on cities.[519] Because cities are often built on coasts, they are at greater risk of flooding and storms. In turn, urban heat islands mean that city populations are both more exposed to heat and more likely to rely on cooling technologies during the summer months.[520] Flooding and storms impact urban infrastructure, causing damage to energy and water infrastructure. Cities in the Middle East and North Africa provide a stark illustration of these impacts. In Kuwait City, the annual maximum temperature is expected to reach 60°C by the end of the century–a temperature reached in northern India in May 2022, illustrating that excessive temperatures are already a reality for some communities.[521,522] Flooding is expected to affect Tangier, Tunis, Alexandria and Muscat while coastal populations in the cities of the Gulf will be at greater exposure to storms. One study has suggested that storm intensification would lead to $12.7 annual storm-related damages in Morocco, the United Arab Emirates, Kuwait and Yemen.[523]

Unmanaged or improperly managed waste is a major cause of flooding, especially in areas with little or poorly maintained drainage systems. In addition to geographical and meteorological characteristics, the vulnerability to flooding increases as a result of waste clogging up drainage systems in urban areas. The rise of discarded personal protective equipment in times of COVID-19 has also contributed to the blockage in drains and waterways. Examples of waste-induced flooding may be found in Senegal, Nigeria and Ghana.[524,525,526] Many governments have long recognised the role of plastics in causing floods and have imposed plastic bag bans.[527]

In Kuwait City, the annual maximum temperature is expected to reach 60°C by the end of the century–a temperature reached in northern India in May 2022, illustrating that excessive temperatures are already a reality for some communities.

Cities are not only the victims of the climate change brought on by greenhouse gas emissions, they are one of their primary sources of demand.[528] Such demand is concentrated in a small number of sectors. Up to half of emissions in cities, for example, are generated by the need to cool and heat buildings.[529] Air conditioning is hugely energy-intensive and rising global temperatures mean that cities are growing increasingly dependent on cooling technology to render urban conditions habitable, which is often highly energy inefficient. This is due to the absence of effective building regulations, which ensure that both residential and commercial buildings are often built without proper insulation and with the use of inexpensive building materials such as concrete, whose production is also highly carbon-intensive. Appropriate regulations for building design would decrease energy use while increasing comfort and health for inhabitants.

Transport, which drives a significant proportion of urban emissions, is responsible for the high levels of particulate matter found in cities. A lack of access to affordable, low-carbon public transport and safe and appealing infrastructure for active mobility as well as urban planning to make access by public and active transport feasible, ensures that urban populations are forced to rely on fossil fuel-powered automobiles or buses. As a consequence, urban fossil fuel use drives extremely high levels of air pollution. The World Health Organization (WHO) estimates that 98 percent of cities with populations over 100,000 in low- and middle-income countries exceed WHO guidelines for particulate matter (PM2.5 and PM10).[530] The solutions including electrified public transport systems, the adoption of personal electric vehicles (EVs) and cities re-designed to be walkable and cyclable, requires substantial capital investment in charging infrastructure, bus and train fleets and private sector incentives, as well as public awareness campaigns.[531]

The provision of goods and services also constitutes a source of emissions, including those emitted throughout the life cycle of products. Waste management, which often consumes substantial amounts of urban administration budgets, represents the sector with the second-highest level of emissions produced by cities.[532] Decarbonisation of the waste sector would require urban policymakers to apply a zero-waste strategy at the city level to reduce waste such as returning compost to the farms that supply food to cities, reducing methane emissions from landfill by separating waste at source, rejecting waste-to-energy approaches that burn refuse in incinerators and by developing waste collection programmes with citizens and formally integrating waste pickers, whose work is often located in the informal sector, into waste management strategies.[533]

These drivers of high energy consumption in cities are being reinforced by energy-intensive urbanisation. Such urbanisation is often occurring in the form of urban sprawl, which typically involves often unplanned development at the urban periphery with low density housing, a lack of public transport, high use of automobiles and segregated land use for residential and non-residential building.[534,535] In East Asia and the Pacific, the region that currently exhibits the highest rates of urbanisation across the world, urban sprawl has been shown to strongly increase CO_2 emissions.[536] As a consequence of heavy fossil fuel use, cities are also highly exposed to the impacts of climate change. In an urban context, these include increased mean and extreme temperatures and air pollution due to air circulation

stagnation, greater risk of disease, reduced availability of fresh water and food, higher likelihood of wildfires, increased demand for building cooling, more exposure to heat-related illness such as heat stroke and heat exhaustion and population displacement.[537] Such things, however, would offer substantial health benefits from cleaner air, reduced injuries from car accidents and greater daily physical activity.

In attempting to reduce their reliance on fossil fuels, urban policymakers are faced with multiple structural challenges. First, urban policymakers may have little control over energy planning in their cities. Energy policy is often dictated by governance structures and policy directives at the state or regional level, limiting the ability of city governments to influence energy policy decisions.[538] Second, policymakers are faced with opposition from local interest groups who may resist plans to decarbonise such as the impact of congestion charges or traffic reduction plans on consumer spending in the area, although evidence suggests that removing cars can boost local economies. Third, decarbonising urban infrastructure is capital-intensive and cities often lack the skills in fiscal management, capital investment planning and project preparation to obtain the credit ratings necessary to access debt markets.[539]

It must be emphasised, of course, that cities have a chance to play a transformational role in addressing the challenges of climate change. Careful urban planning and building design play major roles in addressing climate change and in improving the physical health, mental health, and economic and social well-being of urban inhabitants. Increasing evidence suggests that cities are attempting to move beyond the use of fossil fuels.[540,541] Cape Town, for example, has conducted substantial retrofitting programmes in low-income areas which provided thousands of temporary jobs and improved the health outcomes of local residents, while reducing their energy bills in the process.[542] The city has also designed a Small-Scale Embedded Generation programme, which enables local residents and businesses to generate electricity using rooftop solar photovoltaic systems and small wind turbines, as well as sell this electricity back onto the grid.[543] Combining rooftop solar and battery storage, meanwhile, can significantly increase climate resilience.[544]

SDG 12. Responsible Consumption and Production: Fossil fuel companies are refusing to disclose climate risk

Ongoing fracking has been estimated to affect areas in the anthroposphere, atmosphere, biosphere, hydrosphere, and lithosphere.

None of the world's largest greenhouse gas emitters included implications of using 1.5 degree-consistent estimates in their 2020 financial statements.

2020 saw global fossil fuel subsidies amount to 6.8 percent of GDP or $5.9 trillion–equivalent to $11 million per minute.

Pricing fossil fuels at their true cost would raise public revenue by 3.8 percent and decrease CO_2 emissions by 36 percent.

SDG 12 aims to ensure sustainable patterns of consumption and production through, among other things, the sustainable use of natural resources, encouraging companies to adopt sustainability practices such as sustainability disclosures, and removing market distortions that encourage wasteful consumption. In this context, the fossil fuel industry stands in clear violation of sustainable natural resource use. In particular, the contemporary practice of unconventional oil and gas production known as fracking threatens air and water quality and human health problems in the proximity of wells. Fracking, initially conducted by the USA and followed by countries including the UK, China, South Africa, Poland and Argentina has been justified on the grounds that the natural gas it produces represents a greener form of fossil fuel than coal.[545] Fracking, however, has been estimated to affect areas in the anthroposphere, atmosphere, biosphere, hydrosphere and lithosphere.[546]

The petrochemicals sector is also responsible for driving unsustainable production and consumption through the plastics industry (see SDG 14 Life Below Water for analysis of how plastics have flooded the oceans). Each year, 400 million tonnes of plastic are produced globally, with over half of all plastic products manufactured since 2000.[547] Fossil fuel companies bear significant responsibility for the increased production of plastic, which in recent years has been driven not so much by demand as by the supply of cheap raw ingredients generated by the U.S. fracking boom.[548] The shale gas produced during fracking is separated to produce ethane, which in turn is used to make ethylene, a key ingredient in hard-to-recycle plastics such as packing film, sachets and bottles.[549] Faced with declining demand for gasoline as car users switch to electric vehicles, fossil fuel companies have expanded into shale gas extraction for plastics production, which is now expected to account

for 45 percent of the growth for fossil fuel extraction from 2018 to 2040.[550] Petrochemical production is predicted to increase significantly in the next thirty years, with the International Energy Agency suggesting it could grow by 70 percent between 2017 and 2050.[551,552] As plastics production increases, emissions from the plastics manufacturing sector could reach 56 gigatons by 2050 or 10-13 percent of the remaining carbon budget.[553] The incineration of plastic waste, a vastly more carbon-intensive form of plastic waste management than recycling or landfill, also contributes to emissions. Plastic incineration generated 16 million Mt of GHGs in 2015 and only addressed 25 percent of global plastic waste generated that year.[554] The boom in petrochemical production comes alongside an increasing body of research on the toxicity of petrochemicals such as per- and polyfluoroalkyl substances (PFAS). These substances are used in single-use plastics such as food packaging, storage containers and plastic tableware, many of which have been found to be carcinogens and endocrine disruptors.[555,556] In 2020, thirty-three scientists issued a consensus statement calling attention to the harmful impact of food contact chemicals on human health and emphasising that other harmful effects remain unknown.[557]

When it comes to sustainability practices, the world's largest fossil fuel companies have been shown to selectively disclose their climate risks to investors. As recently as March 2022, an analysis of corporate disclosures conducted by Carbon Tracker revealed that none of the members of the Climate Action 100+, a consortium of the world's largest greenhouse gas emitters[558] had included the implications of using 1.5°C-consistent estimates and assumptions in their 2020 financial statements.[559] Carbon Tracker also found fault with the Climate Action 100+ companies' approved capital allocation plans, two-thirds of which have endorsed oil and gas exploration that is inconsistent under the 1.5°C climate scenario.[560] More troubling still are the unsanctioned projects (projects that are yet to be formally approved) which amount to $750 billion worth of oil and gas exploration between 2021 and 2030. Additionally, less than forty percent of the companies analysed have disclosed the commodity price assumptions that they use for testing the future value of their fossil fuel extraction projects.[561]

Beyond the unsustainable corporate strategies of the world's largest private emitters, government fossil fuel subsidies present a challenge to Sustainable Development Goal 12. SDG 12 makes explicit mention of decreasing the fossil fuel intensity of economic activity, defined as the amount of fossil fuel subsidies per unit of GDP. The use of fossil fuel subsidies, already discussed under SDG 10 Reduced Inequality above, directly incentivises fossil fuel consumption with the support of taxpayers' funds. Despite this, 2020 saw global fossil fuel subsidies amount to 6.8 percent of GDP or $5.9 trillion–equivalent to $11 million per minute.[562] These subsidies are expected to rise to 7.4 percent of global GDP in 2025.[563] Large fossil fuel subsidies can undermine the ability of governments to pursue other sustainable development goals, such as reducing poverty, improving the provision of health services or providing access to energy. According to the IMF, pricing fossil fuels at their true market cost would raise public revenue worth 3.8 percent of global GDP, prevent around one million air pollution-related deaths and reduce global carbon dioxide emissions by thirty-six percent below baseline levels. A reduction consistent with keeping global warming to 1.5°C above industrial levels.[564] However, as the section on SDG 10 has already emphasised, energy subsidy reform must be carefully designed to avoid reinforcing poverty or preventing households from adopting clean fuels.

As plastics production increases, emissions from the plastics manufacturing sector could reach 56 gigatons by 2050 or 10-13 percent of the remaining carbon budget.

SDG 17. Partnerships for the Goals: Fossil fuel companies are violating the spirit of partnership through tax havens and tax breaks

Fossil fuel companies avoid tax, enjoy tax exemptions and sue and lobby pro-climate governments.

Fossil fuel companies use 'captive insurer' subsidiaries to reduce their tax liabilities.

In 2019-2020, 62 fossil fuel companies paid zero tax in Australia despite receiving revenues of $81.4 billion.

SDG17 calls for partnerships to be forged between governments, the private sector and civil society. This framing emphasises the importance of public revenue mobilisation and development assistance, as well as investing at scale in the Global South.[565] Yet recent history demonstrates that fossil fuel companies are hardly behaving in the spirit of partnership. Fossil fuel corporations are engaging in tax avoidance, extracting domestic tax breaks for their production, suing governments and lobbying to undermine legislation that would reduce plastic production, consumption and waste. The victims are the communities in the extraction regions, the societies and environments that must endure plastic pollution and the taxpayers who have to foot the bill.

In recent years, fossil fuel companies have deployed an arsenal of tax avoidance schemes to forego paying billions of dollars. A recent investigation by Reuters shows that in 2018 and 2019, Shell used the legal but morally eyebrow-raising practice of corporate tax avoidance to earn $2.7 billion in tax-free revenue. The company did so by booking these profits in the tax havens of Bermuda and the Bahamas, enabling it to avoid paying $700 million in taxes that it would otherwise have had to have paid in the Netherlands.[566] More egregiously, Shell avoided paying taxes in the countries where it extracted the oil in the first place, depriving countries such as Nigeria of much-needed fiscal revenue.

Opaque accounting practices by Chevron were the focus of a 2006 Nigerian parliamentary enquiry, which alleged that Chevron had avoided up to $10.8 billion in avoided tax liabilities.[567] In 2019, the Nigerian government has issued orders for companies including Royal Dutch Shell, Chevron,

Exxon Mobil, Eni, Total and Equinor to each pay between $2.5 billion and $5 billion in outstanding tax obligations.[568] BP Plc, Chevron and Total also utilise well-known tax havens such as the Bahamas, Switzerland, Bermuda, the UK Channel Islands and Ireland to structure their global corporate profits. Such practices enabled BP, for example, to use its insurance subsidiary, Jupiter Insurance Ltd which is registered in the tax haven Guernsey, to retain $6.5 billion in cash in 2018. These remarkable profits are significant because as a 'captive insurer', Jupiter only provides services to BP affiliates and is registered as having no employees. Other oil majors use identical tactics. Chevron uses a Bermuda-based captive insurer, Total one in Switzerland and Eni one in Ireland. Australia represents perhaps one of the most prominent examples of tax minimisation by fossil fuel companies. Between 2013 and 2020, Chevron's Australian subsidiaries earned $59.1 billion between 2013 and 2020 but paid none of this in tax. In the financial year 2019-2020 alone, 62 fossil fuel companies paid zero tax in Australia, yet collectively received revenues of AUD 114 billion ($81.4 billion).[569]

Fossil fuel companies' tax avoidance practices are rendered still more problematic once considered alongside the generous tax relief measures that they also receive. To draw once again on the Australian case, fossil fuel companies receive an annual average of AUD 12 billion ($8.59 billion) in public subsidies, including fuel tax credit schemes, statutory effective life caps, concessionary aviation fuel rates and at least thirteen other favourable tax benefits.[570] Since this figure does not include state-level subsidies, direct government grants to fossil fuel projects, or public financing of international projects through export credit agencies or international financial institutions, it is likely underestimated.[571] Outside Australia, fossil fuel companies find similarly high levels of government support. In the UK, fossil fuel companies have received nearly £14 billion in subsidies–£9.9 billion for new exploration and production and £3.7 billion in decommissioning costs–since the signing of the Paris Agreement in 2016.[572] In the United States, oil and gas companies receive state support in the form of tax credits, exemptions and deferments, which have been shown, in some cases, to drive greater extraction efforts.[573,574]

BP used a tax haven-registered insurance subsidiary, Jupiter Insurance Ltd, to retain $6.5 billion in cash in 2018. Jupiter only provides services to BP affiliates and is registered as having no employees.

In the UK, fossil fuel companies have received nearly £14 billion in subsidies–£9.9 billion for new exploration and production and £3.7 billion in decommissioning costs–since the signing of the Paris Agreement in 2016.

Fossil fuel companies have also engaged in extensive lobbying to protect their business interests. In 2016, fossil fuel companies spent €100 million in 2016 to promote the narrative among EU officials that fossil gas is a 'clean' fuel to partner renewables.[575] A lobby representing major oil and chemical companies has sought to prevent the inclusion of the plastic additive UV-328 in the Stockholm Convention, the UN treaty which regulates chemicals which do not decompose in nature, known as persistent organic pollutants (POPs).[576] In Australia, more than 180 individuals moved between positions in the fossil fuel and mining sector and senior positions in government between 2007 and 2017, allowing these companies to influence the formation of tax and regulatory policy.[577] In Canada, fossil fuel representatives were found to have had official contact 11,452 times with government officials between 2011 and 2018, or six contacts per working day.[578] In the USA, Shell Polymers, LyondellBasell, Exxon Mobil, Chevron Phillips, DowDuPont, and Novolex are all members of a lobby group, the American Progressive Bag Alliance, which is backing a state bill that would make it illegal for local governments to ban or restrict bags and other single-use plastic products, one of the few measures that actually reduce plastic waste (see SDG 14 Life Below Water and SDG 12 Responsible Consumption and Production for a greater discussion of the plastics industry).[579] In the UK, the British Plastics Federation lobbied the UK government in 2019 to reduce plastic bag taxation. International climate conferences have also become the target of fossil fuel lobbying. 503 fossil fuel representatives attended COP26, meaning that if they had been a country, they would have had the largest delegation.[580]

In another violation of the SDG principle of partnership for the goals, fossil fuel companies are quick to initiate legal action when they perceive risk to their future profits. In 2021, Global Justice Now estimated that fossil fuel companies are suing governments around the world for $18 billion, a figure that is equivalent to net annual climate funding provided to the Global South.[581] European companies are using a mechanism known as investor-state dispute settlements–which gained notoriety during earlier debates over international trade agreements such as the Transatlantic Trade and Investment Partnership (TTIP)–to demand payment for potentially diminished profits. German energy companies RWE and Uniper are suing the Netherlands over plans to phase out coal, while the British company

503 fossil fuel representatives attended COP26, outnumbering the delegates of the largest country delegation.

Rockhopper is suing the Italian government for bans on offshore drilling. Another British company, Ascent Resources, has taken the Slovenian government to court for insisting on environmental assessment prior to fracking, while the Canadian company TC Energy is suing the U.S. government over the cancellation of the Keystone oil pipeline.[582]

Of course, positive partnerships that seek to address the fossil fuel-induced crisis also exist. The 2021 Glasgow Climate Change Conference (COP26), which agreed to phase out foreign investment in fossil fuels, demonstrates the opportunities that exist for international, consensus-based approaches to addressing the fossil fuel system. The Beyond Oil and Gas Alliance, established by the Costa Rican and Danish governments at COP26, seeks to align oil and gas production with the Paris Agreement.[583] The Powering Past Coal Alliance (PPCA), founded in 2017, is a group of 165 countries, cities, regions and businesses that aim to secure public and private sector commitments to phase out existing unabated coal power and impose moratoria on new unabated coal-fired power plants.[584]

While these initiatives represent steps in the right direction, however, they do not go far enough in addressing the systemic power of the incumbent fossil fuel industry and its efforts to resist the energy transition. In the next and final section, we call for a fair phase out that would require countries to regulate the fossil fuel industry so that it can no longer employ these tactics and instead be compelled to transition if companies wish to remain financially viable.

In 2021, Global Justice Now estimated that fossil fuel companies are suing governments around the world for $18 billion, a figure that is equivalent to net annual climate funding provided to the Global South.

Where next?

Aligning the SDGs with a fossil fuel phase out

As the evidence collated in this report makes clear, humanity's continued dependence on fossil fuels is incompatible with achieving the SDGs. The burning of fossil fuels is accelerating the climate crisis, with rising temperatures and recurrent climate impacts disrupting the fabric of life for billions of people. As this crisis worsens, progress towards the SDGs will become increasingly difficult. Combined with this are the direct impacts of fossil fuel production, extraction, transportation and combustion, which cause substantial disruption to human and natural systems the world over. Without rapidly and equitably phasing out fossil fuels, failure is being fuelled and all 17 SDGs will remain beyond reach.

Global efforts to achieve the goals and galvanise the sustainable development agenda, therefore, must be aligned with measures to control and eventually phase out fossil fuel production and use. Unlike the current international climate agreements that primarily focus on emissions reductions, this would require binding policies and commitments that constrain fossil fuel production globally.

Such an international framework would sit alongside agreements like the Paris Agreement and complement existing pledges to cut emissions, reverse biodiversity loss and curtail pollution. It would also provide the strategic oversight needed to wind-down and phase out fossil fuels equitably, ensuring that wealthier nations deliver on their duty to phase out fossil fuels first and protecting developing nations from the heightened economic and social risk associated with stranded assets.

The international framework required to align efforts to achieve the SDGs with ending the era of fossil fuels could take the form of a Fossil Fuel Non-Proliferation Treaty, which has already made head-way in cities around the world and amongst leading scientists, academics and faith leaders. The Fossil Fuel Treaty would take a three-pronged approach to the root cause of the climate crisis:

1. **Non-proliferation.** End new exploration and production by issuing a worldwide moratorium on the extraction of new fossil fuel reserves.

2. **Equitable Phase Down.** Commit countries to phase down production in existing projects, in line with equity and the 1.5°C global temperature goal.

3. **Accelerate a Fair Transition.** Provide finance and technological assistance to aid those most dependent on fossil fuel production to climate change to diversify their economies and move away from fossil fuels, scale up access to renewable energy and ensure a just transition for all.significant financial and technological assistance to poorer and more fossil fuel dependent nations.

Adopting this supply side approach delivers a diverse number of co-benefits that ultimately support the realisation of the SDGs. Tackling fossil fuel production will remove the main driver of global emissions, preventing some of the worst impacts of climate change. What's more, phasing out fossil fuels will prevent the industry's infrastructure causing permanent damage to natural and human systems, while significantly reducing lethal levels of pollution. There are also huge opportunities in scaling up clean, cheap and accessible energy. A rapid deployment of renewable sources of energy will stimulate economies, create inclusive jobs for all, boost energy access, free up government revenues for the provision of public goods and improve the health and wellbeing of human and non-human communities.

It is time we acknowledged reality: fossil fuels are completely incompatible with the SDGs. If humanity is to achieve these goals and improve the lives of billions, the era of fossil fuels must be brought to an end.

If humanity is to achieve the SDGs and improve billions of lives, the era of fossil fuels must be brought to an end.

ENDNOTES

1 IPCC, 'Sixth Assessment Report', (2022), https://www.ipcc.ch/assessmentreport/ar6/

2 IPCC, 'Sixth Assessment Report: Working Group III: Climate Change 2022: Mitigation of Climate Change', (2022) https://www.ipcc.ch/report/ar6/wg3/

3 UNICEF, 'The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index', (2021), https://www.unicef.org/reports/climate-crisis-child-rights-crisis

4 McMichael et al., 'Climate change and human health: present and future risks', *The Lancet*, (2006), https://doi.org/10.1016/S0140-6736(06)68079-3

5 Stern, 'The Economics of Climate Change: The Stern Review', Cambridge University Press, (2006).

6 King & Harrington, 'The Inequality of Climate Change From 1.5 to 2°C of Global Warming', *Geophysical Research Letters*, (2018), https://doi.org/10.1029/2018GL078430

7 Janssens et al., 'Global hunger and climate change adaptation through international trade', *Nature Climate Change*, (2020), https://doi.org/10.1038/s41558-020-0847-4

8 Podesta, 'The climate crisis, migration, and refugees', (2020), https://www.brookings.edu/research/the-climate-crisis-migration-and-refugees

9 San-Akca et al., 'Does natural gas fuel civil war? Rethinking energy security, international relations, and fossil-fuel conflict', *Energy Research & Social Science*, (2020), https://doi.org/10.1016/j.erss.2020.101690

10 Soultan et al., 'Risk of biodiversity collapse under climate change in the Afro-Arabian region', *Scientific Reports*, (2019), https://doi.org/10.1038/s41598-018-37851-6

11 Salimi & Al-Ghamdi, 'Climate change impacts on critical urban infrastructure and urban resiliency strategies for the Middle East', *Sustainable Cities and Society*, (2020), https://doi.org/10.1016/j.scs.2019.101948

12 IPCC, 'Sixth Assessment Report: Working Group III: Climate Change 2022: Mitigation of Climate Change', (2022), https://www.ipcc.ch/report/ar6/wg3/

13 UN, 'Secretary-General's video message to the Press Conference Launch of IPCC Report', (2022), https://www.un.org/sg/en/content/sg/statement/2022-02-28/secretary-generals-video-message-the-press-conference-launch-of-ipcc-report-scroll-down-for-languages

14 Karn Vohra et al., 'Global Mortality from Outdoor Fine Particle Pollution Generated by Fossil Fuel Combustion: Results from GEOS-Chem', *Environmental Research* 195 (April 2021): 110754, https://doi.org/10.1016/j.envres.2021.110754.

15 Lelieveld et al., 2019, 'Effects of fossil fuel and total anthropogenic emission removal on public health and climate', *Earth, Atmosphere and Planetary Sciences*, https://doi.org/10.1073/pnas.1819989116

16 CREA, 'Quantifying the Economic Costs of Air Pollution from Fossil Fuels', (2020), https://energyandcleanair.org/wp/wp-content/uploads/2020/02/Cost-of-fossil-fuels-briefing.pdf

17 Shindell et al., 'Quantified, localized health benefits of accelerated carbon dioxide emissions reductions', *Nature Climate Change*, (2019), https://www.nature.com/articles/s41558-018-0108-y

18 UN, '2030 Agenda, Preamble', https://sdgs.un.org/2030agenda

19 Nerini et al., 'Connecting climate action with other sustainable development goals', *Nature Sustainability*, (2019), https://doi.org/10.1038/s41893-019-0334-y

20 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf;

21 Welsby et al., 'Unextractable fossil fuels in a 1.5 °C world', *Nature*, (2021), https://www.nature.com/articles/s41586-021-03821-8

22 SEI, IISD, ODI, E3G and UNEP, 'The Production Gap Report 2021', (2021), http://productiongap.org/2021report

23 Daley, 'The *Fossil Fuelled 5*: Comparing rhetoric with reality on fossil fuels and climate change', (2021), https://fossilfueltreaty.org/fossil-fuel-5

24 UN, 'The Sustainable Development Agenda', https://www.un.org/sustainabledevelopment/development-agenda/

25 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

26 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf;

27 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf;

28 IEA, 'Global Energy Review 2021', (2021), https://www.iea.org/reports/global-energy-review-2021

29 Tearfund Report, 'Cleaning up their act? G7 fossil fuel investments in a time of green recovery', (2021), https://learn.tearfund.org/-/media/learn/resources/reports/2021-tearfund-consortium-cleaning-up-their-act-g7.pdf

30 Tearfund Report, 'Cleaning up their act? G7 fossil fuel investments in a time of green recovery', (2021), https://learn.tearfund.org/-/media/learn/resources/reports/2021-tearfund-consortium-cleaning-up-their-act-g7.pdf

31 Global Witness, 'IPCC clarion call puts spotlight on fossil fuel industry's hypocrisy', (2022), https://www.globalwitness.org/en/campaigns/fossil-gas/ipcc-clarion-call-puts-spotlight-on-fossil-fuel-industrys-hypocrisy/

32 Climate Impact Map, Impact Map, https://impactlab.org/map/#usmeas=change-from-hist&usyear=2020-2039&gmeas=change-from-hist&gyear=2040-2059&usvar=mortality&tab=global&gvar=tasmax-over-95F&grcp=rcp45; Roser & Ortiz-Ospina, 'Global Extreme Poverty', *Our World In Data*, (2019), https://ourworldindata.org/extreme-poverty

33 Yonzan et al., 'Projecting global extreme poverty up to 2030: How close are we to World Bank's 3% goal?', *World Bank*, (2020), https://blogs.worldbank.org/opendata/projecting-global-extreme-poverty-2030-how-close-are-we-world-banks-3-goal

34 Serdeczny et al., 'Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions', *Regional Environmental Change*, (2017), https://doi.org/10.1007/s10113-015-0910-2

35 Global Carbon Atlas, 'Fossil Fuel Emissions', (2020), http://www.globalcarbonatlas.org/en/CO_2-emissions

36 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change' (Cambridge University Press, In Press).

37 'UNDP: More Spent on Fossil Fuel Subsidies than Fighting Poverty', Africa Renewal, 29 October 2021, https://www.un.org/africarenewal/magazine/november-2021/undp-more-spent-fossil-fuel-subsidies-fighting-poverty.

38 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 September 2021), https://papers.ssrn.com/abstract=4026438.

39 'IPCC Clarion Call Puts Spotlight on Fossil Fuel Industry's Hypocrisy', Global Witness, accessed 19 April 2022, https:///en/campaigns/fossil-gas/ipcc-clarion-call-puts-spotlight-on-fossil-fuel-industrys-hypocrisy/.

40 Vohra et al., 'Global Mortality from Outdoor Fine Particle Pollution Generated by Fossil Fuel Combustion: Results from GEOS-Chem', *Environmental Research* 195 (April 2021): 110754, https://doi.org/10.1016/j.envres.2021.110754.

41 WHO, 'Air Pollution Levels Rising in Many of the World's Poorest Cities', 2016, https://www.who.int/news/item/12-05-2016-air-pollution-levels-rising-in-many-of-the-world-s-poorest-cities.

42 Thiery et al., 'Intergenerational Inequities in Exposure to Climate Extremes', Science 374, no. 6564 (8 October 2021): 158–60, https://doi.org/10.1126/science.abi7339.

43 Timor-Leste Economic Survey: The End of Petroleum Income', *Asia & the Pacific Policy Studies* 8, no. 2 (2021): 253–79, https://doi.org/10.1002/app5.333.

44 International Energy Agency, 'The Future of Petrochemicals: Towards More Sustainable Plastics and Fertilisers', 2018, https://iea.blob.core.windows.net/assets/bee4ef3a-8876-4566-98cf-7a130c013805/The_Future_of_Petrochemicals.pdf.

45 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 September 2021), https://papers.ssrn.com/abstract=4026438.

46 International Energy Agency, 'World Energy Outlook 2021', 2021.

47 International Bank for Reconstruction and Development, 'Tracking SDG7: The Energy Progress Report 2021', 2021, https://trackingsdg7.esmap.org/data/files/download-documents/2021_tracking_sdg7_report.pdf.

48 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 September 2021), https://papers.ssrn.com/abstract=4026438.

49 ILO, 2019, 'Working on a warmer planet: The effect of heat stress on productivity and decent work', https://www.ilo.org/global/publications/books/WCMS_711919/lang--en/index.htm.

50 ILO, 2019, 'Working on a warmer planet: The effect of heat stress on productivity and decent work', https://www.ilo.org/global/publications/books/WCMS_711919/lang--en/index.htm.

51 ILO, 2018, 'World Employment and Social Outlook 2018: Greening with jobs', https://www.ilo.org/global/publications/books/WCMS_628654/lang--en/index.htm

52 Bloomberg News, 'Putin May Collect $321 Billion Windfall If Oil and Gas Keep Flowing', *Bloomberg.Com*, 1 April 2022, https://www.bloomberg.com/news/articles/2022-04-01/putin-may-collect-321-billion-windfall-if-oil-gas-keep-flowing.

53 Market Forces, 'Do You Pay More Tax than the Big Fossil Fuel Companies?', Market Forces, accessed 4 May 2022, https://www.marketforces.org.au/campaigns/subsidies/taxes/taxavoidance/.

54 IPCC, 'Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', (2022), https://doi.org/10.1017/9781009157926.

55 Trout et al., 'Existing fossil fuel extraction would warm the world beyond 1.5 °C', *Environmental Research Letters*, (2022), https://doi.org/10.1088/1748-9326/ac6228.

56 IEA, 'Net Zero by 2050', *IEA*, (2021), https://www.iea.org/reports/net-zero-by-2050.

57 UN, 'Secretary-General Warns of Climate Emergency, Calling Intergovernmental Panel's Report 'a File of Shame', While Saying Leaders 'Are Lying', Fuelling Flames', (2022), https://www.un.org/press/en/2022/sgsm21228.doc.htm.

58 Oxfam, 'Confronting Carbon Inequality', (2020), https://www.oxfam.org/en/research/confronting-carbon-inequality

59 Daley, 'The *Fossil Fuelled 5*: Comparing rhetoric with reality on fossil fuels and climate change', (2021), https://fossilfueltreaty.org/fossil-fuel-5

60 Hickel et al., 'National responsibility for ecological breakdown: a fair-shares assessment of resource use, 1970–2017', *The Lancet Planetary Health*, (2022), https://doi.org/10.1016/S2542-5196(22)00044-4

61 Stoddard et al., 'Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?', *Annual Review of Environment and Resources*, (2021), https://doi.org/10.1146/annurev-environ-012220-011104

62 Calverley, D., & Anderson, K, 'Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets', *Tyndall Centre for Climate Change Research*, (2022), https://www.research.manchester.ac.uk/portal/files/213256008/Tyndall_Production_Phaseout_Report_final_text_3_.pdf

63 Calverley, D., & Anderson, K, 'Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets', *Tyndall Centre for Climate Change Research*, (2022), https://www.research.manchester.ac.uk/portal/files/213256008/Tyndall_Production_Phaseout_Report_final_text_3_.pdf

64 IPCC, 'Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', (2022), doi:10.1017/9781009157926

65 IPBES, 'Summary for policymakers of the global assessment report on biodiversity and ecosystem services', *Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*, (2019), https://doi.org/10.5281/zenodo.3553579

66 WHO, Air Pollution, https://www.who.int/health-topics/air-pollution#tab=tab_1

67 UN, 'The Sustainable Development Goals Report', (2018), https://unstats.un.org/sdgs/report/2018/interlinkages/

68 Calzadilla, 'The Sustainable Development Goals, climate crisis and sustained Injustices', *Oñati Socio-Legal Series*, (2021), https://doi.org/10.35295/osls.iisl/0000-0000-0000-1158

69 IPCC, 'Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', (2022), doi:10.1017/9781009157926

70 IPCC, 'Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', (2022), doi:10.1017/9781009157926

71 Calverley, D., & Anderson, K, 'Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets', *Tyndall Centre for Climate Change Research*, (2022), https://www.research.manchester.ac.uk/portal/files/213256008/Tyndall_Production_Phaseout_Report_final_text_3_.pdf

72 UNDP, 'The People's Climate Vote', (2021), https://www.undp.org/library/peoples-climate-vote

73 UNDP, 'The People's Climate Vote', (2021), https://www.undp.org/library/peoples-climate-vote

74 Meinshausen et al., 'Realization of Paris Agreement pledges may limit warming just below 2 °C', *Nature*, (2022), https://doi.org/10.1038/s41586-022-04553-z

75 Hausfather & Moore, 'Net-zero commitments could limit warming to below 2 °C', *Nature*, (2022), https://doi.org/10.1038/d41586-022-00874-1

76 E3G, 'Keeping 1.5 alive', (2022), https://www.e3g.org/news/keeping-1-5-alive/

77 Teske, 'Fossil Fuel Exit Strategy: A global just transition that delivers renewable energy to all', (2021), https://fossilfueltreaty.org/exit-strategy

78 Trout et al., 'Existing fossil fuel extraction would warm the world beyond 1.5 °C', *Environmental Research Letters*, (2022), https://doi.org/10.1088/1748-9326/ac6228

79 SEI, IISD, ODI, E3G and UNEP, 'The Production Gap Report 2021', (2021), http://productiongap.org/2021report

80 SEI, IISD, ODI, E3G and UNEP, 'The Production Gap Report 2021', (2021), http://productiongap.org/2021report

81 Kühne et al., '"Carbon Bombs" - Mapping key fossil fuel projects', *Energy Policy*, (2022), https://doi.org/10.1016/j.enpol.2022.112950

82 Kühne et al., '"Carbon Bombs" - Mapping key fossil fuel projects', *Energy Policy*, (2022), https://doi.org/10.1016/j.enpol.2022.112950

83 Supran &Oreskes, 'Rhetoric and frame analysis of ExxonMobil's climate change communications', *One Earth*, (2021), https://doi.org/10.1016/j.oneear.2021.04.014

84 InfluenceMap, 'Big Oil's Real Agenda on Climate Change', *InfluenceMap*, (2019), https://influencemap.org/report/How-Big-Oil-Continues-to-Oppose-the-Paris-Agreement-38212275958aa21196dae3b76220bddc

85 Goldberg et al., 'Oil and gas companies invest in legislators that vote against the environment', *Environmental Sciences*, (2020), https://doi.org/10.1073/pnas.1922175117

86 Market Forces, 'Dirty money – political donations from the fossil fuel industry', (2021), https://www.marketforces.org.au/politicaldonations2021/

87 Graham et al., 'Big Oil's Political Reach: Mapping fossil fuel lobbying from Harper to Trudeau', *Canadian Centre for Policy Alternatives*, (2019), https://policyalternatives.ca/publications/reports/big-oil%e2%80%99s-political-reach

88 InfluenceMap, 'Japanese Industry Groups and Climate Policy', (2020), https://influencemap.org/presentation/Japanese-Industry-Groups-and-Climate-Policy-899704d005cb96359cc5b5e2a9b18a84

89 Duncan et al., 'Tories received £1.3m from fossil fuel interests and climate sceptics since 2019', *The Guardian*, (2021), https://www.theguardian.com/politics/2021/oct/25/tories-received-13m-from-fossil-fuel-interests-and-climate-sceptics-since-2019

90 Corporate Europe Observatory et al., 'Big Oil and Gas buying influence in Brussels', (2019), https://corporateeurope.org/sites/default/files/2019-10/FFP%20Briefing%20-%20Big%20Oil%20and%20Gas%20buying%20influence%20in%20Brussels%20-%20Oct%202019.pdf

91 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', *IMF*, (2021), https://www.imf.org/en/Publications/WP/Issues/2021/09/23/Still-Not-Getting-Energy-Prices-Right-A-Global-and-Country-Update-of-Fossil-Fuel-Subsidies-466004

92 Scheiner, 'Timor-Leste economic survey: The end of petroleum income', *Asia & The Pacific Policy Studies*, (2021), https://doi.org/10.1002/app5.333

93 REN21, 'Renewables 2021 Global Status Report', *REN21*, (2021), https://www.ren21.net/wp-content/uploads/2019/05/GSR2021_Full_Report.pdf

94 REN21, 2021, 'Renewables 2021 Global Status Report', *REN21*, (2021), https://www.ren21.net/wp-content/uploads/2019/05/GSR2021_Full_Report.pdf

95 IUCN, 'IUCN Red List: 2017-2020 Report', https://nc.iucnredlist.org/redlist/resources/files/1630480997-IUCN_RED_LIST_QUADRENNIAL_REPORT_2017-2020.pdf

96 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 'Global Assessment Report', (2019), https://ipbes.net/news/Media-Release-Global-Assessment.

97 UN Food and Agriculture Organization (FAO), 'Forest Resources Assessment', (2020), https://www.fao.org/documents/card/en/c/ca9825en

98 Ritcher & Roser, 'Deforestation and Forest Loss', *Our World In Data*, (2020), https://ourworldindata.org/deforestation#:~:text=Globally%20we%20deforest%20around%20ten,deforestation%20occurs%20in%20the%20tropics.

99 IPCC, 'Sixth Assessment Report', *IPCC*, (2021), https://www.ipcc.ch/assessmentreport/ar6/

100 IPCC, 'Global Warming of 1.5°C', *IPCC*, (2018), https://www.ipcc.ch/sr15/

101 Harfoot et al., 'Present and future biodiversity risks from fossil fuel exploitation', *Conservation Letters*, (2018), https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/conl.12448

102 Allred et al., 'Ecosystem services lost to oil and gas in North America', *Science*, (2015), DOI: 10.1126/science.aaa4785

103 Parish et al., 'Comparing scales of environmental effects from gasoline and ethanol production', *Environmental Management*, (2013), DOI:10.1007/s00267-012-9983-6

104 Lewis, 'Tropical Forests and the Changing Earth System', *Philosophical Transactions of The Royal Society Biological Sciences*, (2006), http://dx.doi.org/10.1098/rstb.2005.1711

105 Finer & Orta-Martínez, 'A second hydrocarbon boom threatens the Peruvian Amazon: trends, projections, and policy implications', *Environmental Research*, (2010), https://iopscience.iop.org/article/10.1088/1748-9326/5/1/014012

106 Beckmann et al., 'Human-mediated shifts in animal habitat use: Sequential changes in pronghorn use of a natural gas field in Greater Yellowstone', *Biological Conservation*, (2012), 10.1016/j.biocon.2012.01.003

107 Beckmann et al., 'Human-mediated shifts in animal habitat use: Sequential changes in pronghorn use of a natural gas field in Greater Yellowstone', *Biological Conservation*, (2012), 10.1016/j.biocon.2012.01.003

108 Winegrad, 'Wind turbines and birds. In: Schwartz S, editor. Proceedings of the Wind Energy and Birds/Bats Workshop: understanding and resolving bird and bat impacts', (2004), https://tethys.pnnl.gov/sites/default/files/publications/Wind_Energy_Birds-Bats_Workshop_2004.pdf

109 Sovacool, 'The avian and wildlife costs of fossil fuels and nuclear power', *Journal of Integrative Environmental Sciences*, (2012), https://doi.org/10.1080/1943815X.2012.746993

110 Global Energy Monitor, 'Global Fossil Infrastructure Tracker', https://globalenergymonitor.org/projects/global-fossil-infrastructure-tracker/tracker-map/

111 Agbagwa & Ndukwu, 'Oil and Gas Pipeline Construction-Induced Forest Fragmentation and Biodiversity Loss in the Niger Delta, Nigeria', *Natural Resources*, (2014), DOI:10.4236/nr.2014.512061

112 Agbagwa & Ndukwu, 'Oil and Gas Pipeline Construction-Induced Forest Fragmentation and Biodiversity Loss in the Niger Delta, Nigeria', *Natural Resources*, (2014), DOI:10.4236/nr.2014.512061

113 Rainforest Rescue, 'Ecuador: Pipeline rupture causes oil spill in rainforest', (2022), https://www.rainforest-rescue.org/updates/10653/ecuador-pipeline-rupture-causes-oil-spill-in-rainforest

114 U.S. Department of Transport, Pipeline and Hazardous Materials Safety Administration, 'Pipeline Incident 20 year trends', https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends

115 Macaulay et al., 'Chapter 3: Acid Rain: A Growing Global Concern', *Handbook of Environment & Waste Management*, (2020), https://doi.org/10.1142/9789811207136_0003

116 Nazari-Sharabian et al., 'Climate Change and Eutrophication: A Short Review', *Engineering, Technology and Applied Science Research*, (2018), https://digitalscholarship.unlv.edu/fac_articles/562

117 Department of Environmental Protection, US, https://www.mass.gov/doc/health-environmental-effects-of-air-pollution/download

118 Elliot et al., 'A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity', *Journal of Exposure Science & Environmental Epidemiology*, (2016), https://www.nature.com/articles/jes201581

119 U.S. House of Representatives, Committee on Energy and Commerce, Minority Staff, 2011, 'Chemicals used in hydraulic fracturing', (2011), https://hero.epa.gov/hero/index.cfm/reference/details/reference_id/2079174

120 Colborn et al., 'Natural Gas Operations from a Public Health Perspective', *Human and Ecological Risk*, (2010), https://doi.org/10.1080/10807039.2011.605662

121 Colborn et al., 'Natural Gas Operations from a Public Health Perspective', *Human and Ecological Risk*, (2010), https://doi.org/10.1080/10807039.2011.605662

122 NRDC, 'Ocean Acidification: The Other CO_2 Problem', (2009), https://www.nrdc.org/sites/default/files/NRDC-OceanAcidFSWeb.pdf

123 Gruber et al., 'The oceanic sink for anthropogenic CO_2 from 1994 to 2007', *Science*, (2019) DOI: 10.1126/science.aau5153

124 U.S. Global Change Research Program, 'Climate Science Special Report: Fourth National Climate Assessment, Vol. I', (2017), https://science2017.globalchange.gov/ at 372, 374.

125 Bindoff, N.L. et al., 'Changing Ocean, Marine Ecosystems, and Dependent Communities', *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, (2019) pp. 447–588.

126 Hoegh-Guldberg et al., 'Coral Reefs Under Rapid Climate Change and Ocean Acidification', *Science*, (2007), https://www.science.org/doi/abs/10.1126/science.1152509

127 Fisher et al., 'Species Richness on Coral Reefs and the Pursuit of Convergent Global Estimates', *Current Biology*, (2015), https://doi.org/10.1016/j.cub.2014.12.022

128 CIEL, 'Plastic & Climate: The Hidden Costs of a Plastic Planet', (2019), https://www.ciel.org/wp-content/uploads/2019/05/Plastic-and-Climate-FINAL-2019.pdf

129 Lili Fuhr and Matthew Franklin, eds., *Plastic Atlas 2019: Facts and Figures about the World of Synthetic Polymers* (Berlin: Heinrich Böll Stiftung, 2019).

130 IUCN, Marine Plastic Pollution, https://www.iucn.org/resources/issues-briefs/marine-plastic-pollution

131 IUCN, Marine Plastic Pollution, https://www.iucn.org/resources/issues-briefs/marine-plastic-pollution

132 Susanti et al., 'Microplastics and the Impact of Plastic on Wildlife: A Literature Review', *IOP Conference Series: Earth and Environmental Science*, (2020), https://iopscience.iop.org/article/10.1088/1755-1315/528/1/012013/meta

133 Li et al., 'Research on the Influence of Microplastics on Marine Life', *OP Conference Series: Earth and Environmental Science*, (2021) https://iopscience.iop.org/article/10.1088/1755-1315/631/1/012006

134 Carlos de Sá et al., 'Studies of the effects of microplastics on aquatic organisms: What do we know and where should we focus our efforts in the future?', *Science of the Total Environment*, (2018), https://doi.org/10.1016/j.scitotenv.2018.07.207

135 Rebelein et al., 'Microplastic fibers — Underestimated threat to aquatic organisms?', *Science of The Total Environment*, (2021), https://doi.org/10.1016/j.scitotenv.2021.146045

136 Royer et al., 'Production of methane and ethylene from plastic in the environment', *PLOS One*, (2018), https://doi.org/10.1371/journal.pone.0200574.

137 Ford et al., 'The fundamental links between climate change and marine plastic pollution', *Science of The Total Environment*, (2022), https://doi.org/10.1016/j.scitotenv.2021.150392.

138 ClientEarth, 'Is plastic affecting the ocean as a carbon sink? We ask Tatiana Luján', (2021), https://www.clientearth.org/latest/latest-updates/opinions/is-plastic-affecting-the-ocean-as-a-carbon-sink-we-ask-tatiana-lujan/.

139 Ellen MacArthur Foundation, 'The New Plastics Economy: Rethinking The Future of Plastics and Catalysing Action', (2017), https://www.ellenmacarthurfoundation.org/assets/downloads/publications/NPEC-Hybrid_English_22-11-17_Digital.pdf.

140 Venegas-Li, Rubén et al., 'Global assessment of marine biodiversity potentially threatened by offshore hydrocarbon activities', *Global Change Biology*, (2019), https://doi.org/10.1111/gcb.14616.

141 Gordon et al., 'A review of the effects of seismic surveys on marine mammals', *Applied Health Sciences*, (2001), https://abdn.pure.elsevier.com/en/publications/a-review-of-the-effects-of-seismic-surveys-on-marine-mammals/fingerprints/

142 Weilgart, 'A review of the impacts of seismic airgun surveys on marine life', Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, (2013), http://www.cbd.int/doc/?meeting=MCBEM-2014-01

143 Popper & Hawkins, 'The Effects of Noise on Aquatic Life II', (2016), https://tethys.pnnl.gov/publications/effects-noise-aquatic-life-ii

144 Jepson et al., 'Acute and chronic gas bubble lesions in cetaceans stranded in the United Kingdom', *Veterinary Pathology*, (2005), DOI:10.1354/vp.42-3-291

145 Di Iorio & Clark, 'Exposure to seismic survey alters blue whale acoustic communication', *Biology Letters*, (2010), https://doi.org/10.1098/rsbl.2009.0651

146 Case No: 3865/2021 in the High Court of South Africa Eastern Cape Division, Grahamstown. Third to Fifth Respondents' Heads of Argument; 2021. Available from: https://cer.org.za/wp-content/uploads/2021/12/shell.headsof-argument.1-December-2021.pdf

147 Gordan et al., 'A Review of The Effects of Seismic Surveys on Marine Mammals', *Marine Technology Society Journal*, (2003), DOI:10.4031/002533203787536998

148 Weilgart, 'A review of the impacts of seismic airgun surveys on marine life', Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, (2013), http://www.cbd.int/doc/?meeting=MCBEM-2014-01

149 Nieukirk & Mellinger, 'Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009', *The Journal of the Acoustical Society of America*, (2012), https://doi.org/10.1121/1.3672648

150 Carroll et al., 'A critical review of the potential impacts of marine seismic surveys on fish & invertebrates', *Marine Pollution Bulletin*, (2017), DOI:10.1016/j.marpolbul.2016.11.038

151 Singh et al., 'Marine seismic surveys for hydrocarbon exploration: What's at stake?', *South African Journal of Science*, (2022), https://doi.org/10.17159/sajs.2022/13420

152 Cerchio et al., 'Seismic Surveys Negatively Affect Humpback Whale Singing Activity off Northern Angola', *PLoS ONE*, (2014), https://doi.org/10.1371/journal.pone.0086464

153 Singh et al., 'Marine seismic surveys for hydrocarbon exploration: What's at stake?', *South African Journal of Science*, (2022), https://doi.org/10.17159/sajs.2022/13420

154 Hansteen et al., 'Observed platform response to a 'monster' wave', In: Myrvoll F, editor. *Field measurements in geomechanics: Proceedings of the Sixth International Symposium on Field Measurements in Geomechanics*, CRC Press; (2003).

155 National Ocean Service, U.S. Department of Commerce, 'Deepwater Horizon Oil Spill: Longterm Effects on Marine Mammals, Sea Turtles', https://oceanservice.noaa.gov/news/apr17/dwh-protected-species.html

156 National Ocean Service, U.S. Department of Commerce, 'Deepwater Horizon Oil Spill: Longterm Effects on Marine Mammals, Sea Turtles', https://oceanservice.noaa.gov/news/apr17/dwh-protected-species.html

157 National Ocean Service, U.S. Department of Commerce, 'Deepwater Horizon Oil Spill: Longterm Effects on Marine Mammals, Sea Turtles', https://oceanservice.noaa.gov/news/apr17/dwh-protected-species.html

158 Moore, 'Long term ecological impacts of marine oil spills', *Interspill Conference Paper*, (2006), https://www.interspill.org/wp-content/uploads/2021/11/marine_ecological_doc.pdf

159 Peterson et al., 'Long-Term Ecosystem Response to the Exxon Valdez Oil Spill', *Science*, (2003), doi:10.1126/science.1084282

160 Peterson et al., 'Long-Term Ecosystem Response to the Exxon Valdez Oil Spill', *Science*, (2003), doi:10.1126/science.1084282

161 Barron et al., 'Long-Term Ecological Impacts from Oil Spills: Comparison of Exxon Valdez, Hebei Spirit, and Deepwater Horizon', *Environmental Science & Technology*, (2020), https://doi.org/10.1021/acs.est.9b05020

162 Platt, '25 Years after Exxon Valdez Spill, Sea Otters Recovered in Alaska's Prince William Sound', *Scientific American*, (2014), https://blogs.scientificamerican.com/extinction-countdown/25-years-after-exxon-valdez-spill-sea-otters-recovered-in-alaskae28099s-prince-william-sound

163 Matkin et al., 'Ongoing population-level impacts on killer whales Orcinus orca following the 'Exxon Valdez' oil spill in Prince William Sound, Alaska', *Marine Ecology Progress Series*, (2008), https://doi.org/10.3354/meps07273

164 Platt, '25 Years after Exxon Valdez Spill, Sea Otters Recovered in Alaska's Prince William Sound', *Scientific American*, (2014), https://blogs.scientificamerican.com/extinction-countdown/25-years-after-exxon-valdez-spill-sea-otters-recovered-in-alaskae28099s-prince-william-sound

165 Moore, 'Sustained climate warming drives declining marine biological productivity', *Science*, (2018), DOI: 10.1126/science.aao6379

166 Moore, 'Sustained climate warming drives declining marine biological productivity', *Science*, (2018), DOI: 10.1126/science.aao6379

167 Moore, 'Sustained climate warming drives declining marine biological productivity', *Science*, (2018), DOI: 10.1126/science.aao6379

168 IPCC, 'Summary for Policymakers In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', (2021), https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/

169 Cheng et al., 'How fast are the oceans warming?', *Science*, (2019), DOI: 10.1126/science.aav7619.

170 NOAA, 'How does climate change affect coral reefs?', https://oceanservice.noaa.gov/facts/coralreef-climate.html

171 IPCC, 'Special Report: Global Warming of 1.5°C: Impacts of 1.5°C global warming on natural and human systems', (2018), https://www.ipcc.ch/sr15/chapter/chapter-3/

172 Dixon et al., 'Future loss of local-scale thermal refugia in coral reef ecosystems', *PLOS Climate*, (2022), https://doi.org/10.1371/journal.pclm.0000004

173 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

174 Ibid.

175 Ibid.

176 Ibid.

177 Ibid.

178 Ibid.

179 Ibid.

180 Ibid.

181 Carbon Brief, 'The impacts of climate change at 1.5C, 2C and beyond', https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/?utm_source=web&utm_campaign=Redirect

182 Carbon Brief, 'The impacts of climate change at 1.5C, 2C and beyond', (2019), https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/?utm_source=web&utm_campaign=Redirect

183 Carbon Brief, 'The impacts of climate change at 1.5C, 2C and beyond', (2019), https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/?utm_source=web&utm_campaign=Redirect

184 Carbon Brief, 'The impacts of climate change at 1.5C, 2C and beyond', (2019), https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/?utm_source=web&utm_campaign=Redirect

185 Lancet, 'Addressing the vulnerability of the global food system', (2017), https://doi.org/10.1016/S0140-6736(17)31803-2

186 Jägermeyr et al., 'Climate impacts on global agriculture emerge earlier in new generation of climate and crop models', *Nature Food*, (2021), https://doi.org/10.1038/s43016-021-00400-y

187 ActionAid, 'Principles for a Just Transition in Agriculture', (2019), https://actionaid.org/publications/2019/principles-just-transition-agriculture#downloads

188 UN World Food Programme, 'Is climate a "risk multiplier" in the Central American dry corridor?', *WFP*, (2021), https://www.wfp.org/publications/climate-risk-multiplier-central-american-dry-corridor

189 Koberle et al., 'Climate Change and the Future of FoodPart 1 – Risks to the Agricultural Sector', *Imperial College Business School*, (2021), https://imperialcollegelondon.app.box.com/s/z55v1vp6notsyxvogimsktigxa682hh7

190 UN World Food Programme, '13 million people facing severe hunger as drought grips the Horn of Africa', (2022). https://www.wfp.org/news/13-million-people-facing-severe-hunger-drought-grips-horn-africa

191 UN News, 'Food insecurity soaring across 20 hunger hotspots', (2022), https://news.un.org/en/story/2022/01/1110742

192 UN News, 'Food insecurity soaring across 20 hunger hotspots', (2022), https://news.un.org/en/story/2022/01/1110742

193 UN, 'Worsening drought in Horn of Africa puts up to 20 million at risk: WFP', (2022), https://news.un.org/en/story/2022/04/1116442

194 Mulvaney, 'Historic drought looms for 20 million living in Horn of Africa', *National Geographic*, (2022), https://www.nationalgeographic.com/environment/article/historic-drought-looms-for-20-million-living-in-horn-of-africa

195 UN, "Perfect storm of horror' facing Horn of Africa: UNICEF director', (2022), https://news.un.org/en/audio/2022/04/1116122

196 UN, 'Worsening drought in Horn of Africa puts up to 20 million at risk: WFP', (2022), https://news.un.org/en/story/2022/04/1116442

197 ActionAid, 'Climate crisis fuels drought and severe hunger across the Horn of Africa', (2022), https://actionaid.org/news/2022/climate-crisis-fuels-drought-and-severe-hunger-across-horn-africa

198 Arizpe et al., 'Food Security and Fossil Energy Dependence: An International Comparison of the Use of Fossil Energy in Agriculture (1991-2003)', *Critical Reviews in Plant Sciences*, (2011), https://doi.org/10.1080/07352689.2011.554352

199 Clark et al., 'Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets', *Science*, (2020), DOI: 10.1126/science.aba7357

200 EPA, Overview of Greenhouse Gases, https://www.epa.gov/ghgemissions/overview-greenhouse-gases

201 Sainju et al., 'Nitrogen Fertilization I: Impact on Crop, Soil, and Environment', (2018), DOI:10.5772/intechopen.86028

202 Tian et al., 'A comprehensive quantification of global nitrous oxide sources and sinks', *Nature*, (2020), https://doi.org/10.1038/s41586-020-2780-0

203 IPCC, 'Special Report on Climate and Land: Summary for Policymakers', (2019), https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/

204 IPCC, 'Special Report on Climate and Land: Summary for Policymakers', (2019), https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/

205 Singh & Tan, 'High natural gas prices could lead to spike in food costs through fertilizer link', *S&P Global Commodity Insights*, (2022), https://www.spglobal.com/commodityinsights/en/market-insights/blogs/agriculture/011922-fertilizer-costs-natural-gas-prices

206 JA! & FoE Mozambique, 'The Impacts of the LNG industry in Cabo Delgado, Mozambique' *Banktrack*, (2020), https://www.banktrack.org/download/the_impacts_of_the_lng_industry_in_cabo_delgado_mozambique/impacts_of_lng_in_mozambique_by_ja.pdf

207 Ibid.

208 Ibid.

209 Ibid.

210 Calel et al., 'Do Carbon Offsets Offset Carbon?', *CESifo Working Paper*, (2021), https://www.cesifo.org/DocDL/cesifo1_wp9368.pdf

211 REDD Monitor, 'NGOs oppose the oil industry's Natural Climate Solutions and demand that Eni and Shell keep fossil fuels in the ground', (2019), https://redd-monitor.org/2019/05/14/ngos-oppose-the-oil-industrys-natural-climate-solutions-and-demand-that-eni-and-shell-keep-fossil-fuels-in-the-ground/#more-46002

212 ActionAid, 'Not-their-lands: The land impact of Royal Dutch Shell's net zero climate target', *ActionAid*, (2021), https://actionaid.org/publications/2021/not-their-lands-land-impact-royal-dutch-shells-net-zero-climate-target

213 ActionAid, 'Not-their-lands: The land impact of Royal Dutch Shell's net zero climate target', *ActionAid*, (2021), https://actionaid.org/publications/2021/not-their-lands-land-impact-royal-dutch-shells-net-zero-climate-target

214 Gonsamo & Chen, 'Circumpolar vegetation dynamics product for global change study', *Remote Sensing of Environment*, (2016), https://doi.org/10.1016/j.rse.2016.04.022

215 Cernusak et al., 'Robust Response of Terrestrial Plants to Rising CO_2', *Trends in Plant Science*, (2019), https://doi.org/10.1016/j.tplants.2019.04.003

216 Rep. Lamar Smith, 'Don't Believe the Hysteria Over Carbon Dioxide', *The Daily Signal*, (2017), https://www.dailysignal.com/2017/07/24/dont-believe-hysteria-carbon-dioxide/?wpisrc=nl_energy202&wpmm=1

217 Myers et al., 'Increasing CO_2 threatens human nutrition', *Nature*, (2014), https://doi.org/10.1038/nature13179

218 Smith & Myers, 'Impact of anthropogenic CO_2 emissions on global human nutrition', *Nature Climate Change*, (2018), https://doi.org/10.1038/s41558-018-0253-3

219 UNICEF, 'Water and the global climate crisis: 10 things you should know', (2022), https://www.unicef.org/stories/water-and-climate-change-10-things-you-should-know

220 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

221 UNICEF, 'Water and the global climate crisis: 10 things you should know', (2022), https://www.unicef.org/stories/water-and-climate-change-10-things-you-should-know

222 UNICEF, 'The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index', *UNICEF*, (2021), https://www.unicef.org/reports/climate-crisis-child-rights-crisis

223 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

224 Buytaert, 'Glacier melt and water security', *Imperial College London*, https://www.imperial.ac.uk/grantham/research/resources-and-pollution/water-security-and-flood-risk/glacier-melt-and-water-security/

225 Howard et al., 'Climate Change and Water and Sanitation: Likely Impacts and Emerging Trends for Action', *The Annual Review of Environment and Resources*, (2016), https://www.annualreviews.org/doi/pdf/10.1146/annurev-environ-110615-085856

226 UN, 'The Sustainable Development Goals Report 2021', (2021), https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

227 WWT, 'Why wetlands?', https://www.wwt.org.uk/our-work/why-wetlands/

228 Li et al., 'Water diversion and sea-level rise: Potential threats to freshwater supplies in the Changjiang River estuary', *Estuarine, Coastal and Shelf Science*, (2015), https://doi.org/10.1016/j.ecss.2014.07.007

229 Griffith et al., 'The effects of mountaintop mines and valley fills on the physicochemical quality of stream ecosystems in the central Appalachians: a review', *Science Total Environment*, (2012), DOI:10.1016/j.scitotenv.2011.12.042

230 Verma et al., 'Heavy metal contamination of groundwater due to fly ash disposal of coal-fired thermal power plant, Parichha, Jhansi, India', *Cogent Engineering*, (2016), http://dx.doi.org/10.1080/23311916.2016.1179243

231 Mandour, Human health impacts of drinking water (surface and ground) pollution Dakahlyia Governorate, Egypt', *Applied Water Science*, (2012), https://doi.org/10.1007/s13201-012-0041-6

232 Salem et al., 'Heavy Metals in Drinking Water and Their Environmental Impact on Human Health', Proceedings of the International Conference for Environmental Hazards Mitigation, Giza, 9-12 (September 2000), 542-556.

233 Amado-Filho et al., 'Heavy metals in benthic organisms from Todos os Santos Bay, Brazil', *Brazilian Journal of Biology*, (2008), DOI:10.1590/s1519-69842008000100013

234 Health Energy Initiative & Community Environmental Monitoring, 'Coal Ash in India: A Compendium of Disasters, Environmental and Health Risks', (2020).

235 Amnesty International, 'No Clean-up, No Justice: An evaluation of the implementation of UNEP's environmental assessment of Ogoniland, nine years on', (2020), https://www.amnesty.org/en/documents/afr44/2514/2020/en/

236 UNEP, 'Environmental Assessment of Ogoniland', (2011), https://www.unep.org/explore-topics/disasters-conflicts/where-we-work/nigeria/environmental-assessment-ogoniland-report

237 IEA, 'Flaring Emissions', (2021), https://www.iea.org/reports/flaring-emissions

238 Nduka et al., 'Impact of Oil and Gas Activities on Acidity of Rain and Surface Water of Niger Delta, Nigeria: An Environmental and Public Health Review', (2016), DOI:10.4236/jep.2016.74051

239 Amadi, 'Impact of Gas-Flaring on the Quality of Rain Water, Groundwater and Surface Water in Parts of Eastern Niger Delta, Nigeria', *Journal of Geosciences and Geomatics*, (2014), DOI:10.12691/jgg-2-3-6

240 Cantor, 'Drinking Water and Cancer. Cancer Causes & Control', (1997), http://dx.doi.org/10.1023/A:1018444902486

241 Gulis et al., 'An Ecologic Study of Nitrate in Municipal Drinking Water and Cancer Incidence in Trnava District, Slovakia', *Environmental Research*, (2002), http://dx.doi.org/10.1006/enrs.2002.4331

242 Gharoro & Igbafe, 'Ectopic Pregnancy Revisited in Benin City, Nigeria: Analysis of 152 Cases', *Acta Obstetricia et Gynecologica Scandinavica*, (2002), http://dx.doi.org/10.1034/j.1600-0412.2002.811207.x

243 Robillard et al., 'Nitrates in Drinking Water', *Pennsylvania State University*, Agricultural and Biological Engineering, (2003).

244 Michelozzi & Donato, 'Climate changes, floods, and health consequences', *Recenti Progressi in Medicina*, (2014), DOI:10.1701/1417.15695

245 Sun et al., 'Impacts of a flash flood on drinking water quality: case study of areas most affected by the 2012 Beijing flood', *Heliyon*, (2016), https://doi.org/10.1016/j.heliyon.2016.e00071

246 Murshed et al., 'Changes in the quality of river water before, during and after a major flood event associated with a La Niña cycle and treatment for drinking purposes', *Journal of Environmental Sciences*, (2014), https://doi.org/10.1016/j.jes.2014.08.001

247 Baig et al., 'Microbial water quality risks to public health: Potable water assessment for a flood-affected town in northern Pakistan', *Rural and Remote Health*, (2012), https://search.informit.org/doi/abs/10.3316/informit.626310081528329

248 Daggett, *The Birth of Energy: Fossil Fuels, Thermodynamics, and the Politics of Work*, Elements (Durham: Duke University Press, 2019).

249 Vohra et al., 'Global Mortality from Outdoor Fine Particle Pollution Generated by Fossil Fuel Combustion: Results from GEOS-Chem', *Environmental Research* 195 (April 2021): 110754, https://doi.org/10.1016/j.envres.2021.110754.

250 CDC, 'Reproductive Health: Preterm Birth', https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pretermbirth.html

251 Bergman et al., 2013, 'State of the Science of Endocrine Disrupting Chemicals 2012', *WHO*, https://apps.who.int/iris/bitstream/handle/10665/78102/WHO_HSE_PHE_IHE_2013.1_eng.pdf;jsessionid=B5628E6A8D2F3BAFB6E5056ECBF814C1?sequence=1

252 Forsey and Bessonova, '5 Ways Reducing Pollution Can Improve Equality for Women', *SEI* (blog), 6 March 2020, https://www.sei.org/featured/5-ways-reducing-pollution-can-improve-equality-for-women/.

253 Ibid.

254 Owren, 'Understanding and Addressing Gender-Based Violence as Part of the Climate Emergency' (UN Women, September 2021), https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/CSW/66/EGM/Expert%20Papers/Cate%20OWREN_CSW66%20Expert%20Paper.pdf.

255 UNICEF, 'It Is Getting Hot: Call for Education Systems to Respond to the Climate Crisis', 2019, https://www.unicef.org/eap/media/4596/file/It%20is%20getting%20hot:%20Call%20for%20education%20systems%20to%20respond%20to%20the%20climate%20crisis.pdf.

256 Porter, 'Education Is under Threat from Climate Change - Especially for Women and Girls', *Education Is under Threat from Climate Change - Especially for Women and Girls* (blog), 8 November 2021, https://www.ox.ac.uk/news/features/education-under-threat-climate-change-especially-women-and-girls.

257 World Health Organization, *Quantitative Risk Assessment of the Effects of Climate Change on Selected Causes of Death, 2030s and 2050s* (Geneva: World Health Organization, 2014), https://apps.who.int/iris/handle/10665/134014.

258 Bloomberg News, 'Putin May Collect $321 Billion Windfall If Oil and Gas Keep Flowing', *Bloomberg.Com*, 1 April 2022, https://www.bloomberg.com/news/articles/2022-04-01/putin-may-collect-321-billion-windfall-if-oil-gas-keep-flowing.

259 United Nations, 'The Sustainable Development Goals Report 2021', accessed 22 April 2022, https://www.un.org/en/file/115921/download?token=d3Op77Tr.

260 Banholzer et al., 2014, 'The Impact of Climate Change on Natural Disasters', Reducing Disaster: Early Warning Systems For Climate Change. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-8598-3_2

261 Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (Verso Books, 2013).

262 Askari, *Collaborative Colonialism* (New York: Palgrave Macmillan US, 2013), https://doi.org/10.1057/9781137353771.

263 Steyn, 'Oil Exploration in Colonial Nigeria, c. 1903–58', *The Journal of Imperial and Commonwealth History* 37, no. 2 (1 June 2009): 249–74, https://doi.org/10.1080/03086530903010376.

264 Askari, *Collaborative Colonialism*.

265 'Nigerians Could See Justice over Shell Oil Spills after Six Decades', *The Guardian*, 29 September 2021, sec. World news, https://www.theguardian.com/world/2021/sep/29/nigerians-could-see-justice-over-shell-oil-spills-after-six-decades.

266 Dorothée Moisan, 'Uganda Oil Project Casts Shadow over Total's Eco-Friendly Image', *The Guardian*, 19 April 2022, sec. Environment, https://www.theguardian.com/environment/2022/apr/19/uganda-oil-project-casts-shadow-over-totals-eco-friendly-image.

267 Armstrong, 'Decarbonisation and World Poverty: A Just Transition for Fossil Fuel Exporting Countries?', *Political Studies* 68, no. 3 (1 August 2020): 671–88, https://doi.org/10.1177/0032321719868214.

268 Based on World Bank 2020 estimates for Nigeria and Angola and IMF estimates for Venezuela. World Bank, 'Poverty Headcount Ratio at $1.90 a Day (2011 PPP) (% of Population) | Data', accessed 21 April 2022, https://data.worldbank.org/indicator/SI.POV.DDAY; https://www.imf.org/en/Publications/WEO/weo-database/2021/April/weo-report?c=299,&s=NGDP_RPCH,NGDPD,PPPGDP,NGDPRPPPPC,NGDPDPC,PPPPC,PCPIPCH,LUR,LP,&sy=2018&ey=2023&ssm=0&scsm=1&scc=0&ssd=1&ssc=0&sic=0&sort=country&ds=.&br=1

269 Sovacool and Scarpaci, 'Energy Justice and the Contested Petroleum Politics of Stranded Assets: Policy Insights from the Yasuní-ITT Initiative in Ecuador', *Energy Policy* 95 (1 August 2016): 158–71, https://doi.org/10.1016/j.enpol.2016.04.045.

270 Scheiner, 'Timor-Leste Economic Survey: The End of Petroleum Income', *Asia & the Pacific Policy Studies* 8, no. 2 (2021): 253–79, https://doi.org/10.1002/app5.333.

271 Huang, 'Consumers Are Hurting as "global Energy Shock" Gets Underway, Says World Energy Council', CNBC, 20 May 2022, https://www.cnbc.com/2022/05/20/global-oil-crisis-and-inflation-hurt-consumers-world-energy-council.html.

272 Kaygusuz, 'Energy for Sustainable Development: Key Issues and Challenges', *Energy Sources, Part B: Economics, Planning, and Policy* 2, no. 1 (1 April 2007): 73–83, https://doi.org/10.1080/15567240500402560.

273 Yuka Hayashi, Jason Douglas and Chao Deng, 'Ukraine War Deepens Debt Woes Across Developing World', *Wall Street Journal*, 17 April 2022, sec. Economy, https://www.wsj.com/articles/ukraine-war-deepens-debt-woes-across-developing-world-11650187803.

274 Benjamin Parkin and Mahendra Ratnaweera, 'Sri Lankan Businesses Struggle to Remain Open as Fuel Prices Surge', *Financial Times*, 24 April 2022, https://www.ft.com/content/413a7878-17e9-4d8c-ae2c-193f55048d40.

275 Mirette Magdy and Eric Martin, 'Egypt Turns to IMF Seeking Help for Economy Amid Ukraine Shock', Bloomberg, 2022, https://www.bloomberg.com/news/articles/2022-03-23/imf-says-egypt-seeking-help-for-economic-shock-from-ukraine-war.

276 International Energy Agency, 'World Energy Outlook 2021', 2021.

277 International Energy Agency.

278 International Energy Agency.

279 Howden-Chapman et al., 'Tackling Cold Housing and Fuel Poverty in New Zealand: A Review of Policies, Research, and Health Impacts', *Energy Policy*, Special Section: Fuel Poverty Comes of Age: Commemorating 21 Years of Research and Policy, 49 (1 October 2012): 134–42, https://doi.org/10.1016/j.enpol.2011.09.044

280 Teller-Elsberg et al., 'Fuel Poverty, Excess Winter Deaths, and Energy Costs in Vermont: Burdensome for Whom?', *Energy Policy* 90 (1 March 2016): 81–91, https://doi.org/10.1016/j.enpol.2015.12.009.

281 Adam Corlett and Jonathan Marshall, 'Stressed Out' (Resolution Foundation, 1 April 2022), https://www.resolutionfoundation.org/publications/stressed-out/.

282 Marmot et al., *The Health Impacts of Cold Homes and Fuel Poverty* (London: Friends of the Earth & the Marmot Review Team, 2011), http://www.instituteofhealthequity.org/projects/the-health-impacts-of-cold-homes-and-fuel-poverty.

283 'UNDP: More Spent on Fossil Fuel Subsidies than Fighting Poverty', Africa Renewal, 29 October 2021, https://www.un.org/africarenewal/magazine/november-2021/undp-more-spent-fossil-fuel-subsidies-fighting-poverty.

284 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 September 2021), https://papers.ssrn.com/abstract=4026438.

285 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change' (Cambridge University Press, In Press), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FinalDraft_FullReport.pdf.

286 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'.

287 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'.

288 Vohra et al., 'Global Mortality from Outdoor Fine Particle Pollution Generated by Fossil Fuel Combustion: Results from GEOS-Chem', *Environmental Research* 195 (April 2021): 110754, https://doi.org/10.1016/j.envres.2021.110754.

289 Lelieveld et al., 2019, 'Effects of fossil fuel and total anthropogenic emission removal on public health and climate', *Earth, Atmosphere and Planetary Sciences*, https://doi.org/10.1073/pnas.1819989116

290 Perera, 'Children Are Likely to Suffer Most from Our Fossil Fuel Addiction', *Environmental Health Perspectives* 116, no. 8 (August 2008): 987–90, https://doi.org/10.1289/ehp.11173.

291 Grigg, 'The Health Effects of Fossil Fuel Derived Particles', *Archives of Disease in Childhood* 86, no. 2 (1 February 2002): 79–83, https://doi.org/10.1136/adc.86.2.79.

292 Gauderman et al., 'Association between Air Pollution and Lung Function Growth in Southern California Children', *American Journal of Respiratory and Critical Care Medicine* 162, no. 4 (October 2000): 1383–90, https://doi.org/10.1164/ajrccm.162.4.9909096.

293 Carl H. Backes et al., 'Early Life Exposure to Air Pollution: How Bad Is It?', *Toxicology Letters* 216, no. 1 (10 January 2013): 47–53, https://doi.org/10.1016/j.toxlet.2012.11.007.

294 Bocskay et al., 'Chromosomal Aberrations in Cord Blood Are Associated with Prenatal Exposure to Carcinogenic Polycyclic Aromatic Hydrocarbons', *Cancer Epidemiology, Biomarkers & Prevention* 14, no. 2 (25 February 2005): 506–11, https://doi.org/10.1158/1055-9965.EPI-04-0566.

295 Tang et al., 'Polymorphisms in the DNA Repair Enzyme XPD Are Associated with Increased Levels of PAH–DNA Adducts in a Case-Control Study of Breast Cancer', *Breast Cancer Research and Treatment* 75, no. 2 (1 September 2002): 159–66, https://doi.org/10.1023/A:1019693504183.

296 Baker, 'Of Embodied Emissions and Inequality: Rethinking Energy Consumption', *Energy Research & Social Science*, Spatial Adventures in Energy Studies:, 36 (1 February 2018): 52–60, https://doi.org/10.1016/j.erss.2017.09.027.

297 Sadorsky, 'The Effect of Urbanization and Industrialization on Energy Use in Emerging Economies: Implications for Sustainable Development', *The American Journal of Economics and Sociology* 73, no. 2 (2014): 392–409, https://doi.org/10.1111/ajes.12072.

298 PBL Netherlands Environmental Assessment Agency, 'China Now No. 1 in CO_2 Emissions: USA in Second Position', Text, PBL Netherlands Environmental Assessment Agency, 22 June 2007, https://www.pbl.nl/en/Chinanowno1inCO_2emissionsUSAinsecondposition.

299 Davis and Caldeira, 'Consumption-Based Accounting of CO_2 Emissions', *Proceedings of the National Academy of Sciences* 107, no. 12 (2010): 5687–92.

300 Davis et al., 'The Supply Chain of CO_2 Emissions', *Proceedings of the National Academy of Sciences of the United States of America* 108, no. 45 (8 November 2011): 18554–59, https://doi.org/10.1073/pnas.1107409108.

301 Kanemoto et al., 'Mapping the Carbon Footprint of Nations', *Environmental Science & Technology* 50, no. 19 (4 October 2016): 10512–17, https://doi.org/10.1021/acs.est.6b03227.

302 Zhang et al., 'Embodied Carbon Emissions in the Supply Chains of Multinational Enterprises', *Nature Climate Change* 10, no. 12 (December 2020): 1096–1101, https://doi.org/10.1038/s41558-020-0895-9.

303 Zhang et al.

304 Casey et al., 'Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA', *Epidemiology (Cambridge, Mass.)* 27, no. 2 (March 2016): 163–72, https://doi.org/10.1097/EDE.0000000000000387.

305 Currie et al., 'Hydraulic Fracturing and Infant Health: New Evidence from Pennsylvania', Science Advances 3, no. 12 (December 2017): e1603021, https://doi.org/10.1126/sciadv.1603021.

306 Tustin et al., 'Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania', Environmental Health Perspectives 125, no. 2 (February 2017): 189–97, https://doi.org/10.1289/EHP281.

307 Tustin et al., 'Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania', Environmental Health Perspectives 125, no. 2 (February 2017): 189–97, https://doi.org/10.1289/EHP281.

308 Tustin et al., 'Associations between Unconventional Natural Gas Development and Nasal and Sinus, Migraine Headache, and Fatigue Symptoms in Pennsylvania', Environmental Health Perspectives 125, no. 2 (February 2017): 189–97, https://doi.org/10.1289/EHP281.

309 Casey et al., 'Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA', Epidemiology (Cambridge, Mass.) 27, no. 2 (March 2016): 163–72, https://doi.org/10.1097/EDE.0000000000000387.

310 McKenzie et al., 'Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado', *Environmental Health Perspectives* 122, no. 4 (April 2014): 412–17, https://doi.org/10.1289/ehp.1306722.

311 Bertrand, 'Fact Sheet | Climate, Environmental, and Health Impacts of Fossil Fuels (2021) | White Papers | EESI' (Environmental and Energy Study Institute, 17 December 2021), https://www.eesi.org/papers/view/fact-sheet-climate-environmental-and-health-impacts-of-fossil-fuels-2021.

312 Jonasson et al., 'Oil Pipelines and Food Sovereignty: Threat to Health Equity for Indigenous Communities', *Journal of Public Health Policy* 40, no. 4 (1 December 2019): 504–17, https://doi.org/10.1057/s41271-019-00186-1.

313 Bruederle and Hodler, 'Effect of Oil Spills on Infant Mortality in Nigeria', *Proceedings of the National Academy of Sciences* 116, no. 12 (19 March 2019): 5467–71, https://doi.org/10.1073/pnas.1818303116.

314 Nduka et al., 2016, 'Impact of Oil and Gas Activities on Acidity of Rain and Surface Water of Niger Delta, Nigeria: An Environmental and Public Health Review', https://doi.org/10.4236/jep.2016.74051.

315 Amnesty International, 2018, 'Niger Delta Negligence', https://www.amnesty.org/en/latest/news/2018/03/niger-delta-oil-spills-decoders/#:~:text=Swimming%20in%20oil,reality%20may%20be%20even%20worse.

316 Cantor, 1997, 'Drinking Water and Cancer. Cancer Causes & Control', http://dx.doi.org/10.1023/A:1018444902486

317 Amnesty International India, '"When Land Is Lost, Do We Eat Coal?": Coal Mining And Violations Of Adivasi Rights In India', 2016, https://www.amnesty.org/en/wp-content/uploads/2021/05/ASA2043912016ENGLISH.pdf.

318 Global Energy Monitor, https://www.gem.wiki/Mand-Raigarh_coal_mines.

319 Community Environmental Monitoring, 2017, 'Posioned: Report on the Environmental Sampling around the Coal Mines, Thermal Power Plants and Ash Ponds in Tamnar & Gharghoda Blocks of Raigarh, Chhattisgarh, https://sipcotcuddalore.com/wp-content/uploads/Poisoned_English_Version_Aug2017.pdf.

320 Shrivastava and Chakma, 2020, 'Health Assessment of Villagers Tanmar Block, District Raigarh', https://imgs.mongabay.com/wp-content/uploads/sites/30/2020/12/14091427/TAMNAR-PROJECT-REPORT-ICMR-NIRTH-1.pdf.

321 Ramanathan, 2021, 'Industrial pollution in rural Raigarh: NGT appoints new head to oversight committee', https://www.downtoearth.org.in/news/pollution/industrial-pollution-in-rural-raigarh-ngt-appoints-new-head-to-oversight-committee-77715.

322 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'.

323 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'.

324 World Health Organization, *Quantitative Risk Assessment of the Effects of Climate Change on Selected Causes of Death, 2030s and 2050s* (Geneva: World Health Organization, 2014), https://apps.who.int/iris/handle/10665/134014.

325 Marco Springmann et al., 'Global and Regional Health Effects of Future Food Production under Climate Change: A Modelling Study', The Lancet 387, no. 10031 (7 May 2016): 1937–46, https://doi.org/10.1016/S0140-6736(15)01156-3.

326 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'.

327 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'.

328 Kath Ford and Richard Freund, 'Two Years of COVID-19 Threatening Progress Towards the Sustainable Development Goals', 2022, 12.

329 Annesi-Maesano et al., 'Indoor Air Quality and Sources in Schools and Related Health Effects', *Journal of Toxicology and Environmental Health, Part B* 16, no. 8 (17 November 2013): 491–550, https://doi.org/10.1080/10937404.2013.853609.

330 Annesi-Maesano et al.

331 Simoni et al., 'School Air Quality Related to Dry Cough, Rhinitis and Nasal Patency in Children', *European Respiratory Journal* 35, no. 4 (1 April 2010): 742–49, https://doi.org/10.1183/09031936.00016309.

332 Zhao et al., 'Asthmatic Symptoms among Pupils in Relation to Microbial Dust Exposure in Schools in Taiyuan, China', *Pediatric Allergy and Immunology* 19, no. 5 (2008): 455–65, https://doi.org/10.1111/j.1399-3038.2007.00664.x.

333 Mendell and Heath, 'Do Indoor Pollutants and Thermal Conditions in Schools Influence Student Performance? A Critical Review of the Literature', *Indoor Air* 15, no. 1 (January 2005): 27–52, https://doi.org/10.1111/j.1600-0668.2004.00320.x.

334 Shendell et al., 'Associations between Classroom CO_2 Concentrations and Student Attendance in Washington and Idaho', *Indoor Air* 14, no. 5 (October 2004): 333–41, https://doi.org/10.1111/j.1600-0668.2004.00251.x.

335 Johnson et al., 'Indoor Air Quality in Classrooms: Environmental Measures and Effective Ventilation Rate Modeling in Urban Elementary Schools', *Building and Environment* 136 (15 May 2018): 185–97, https://doi.org/10.1016/j.buildenv.2018.03.040.

336 Perera, 'Pollution from Fossil-Fuel Combustion Is the Leading Environmental Threat to Global Pediatric Health and Equity: Solutions Exist', *International Journal of Environmental Research and Public Health* 15, no. 1 (23 December 2017): 16, https://doi.org/10.3390/ijerph15010016.

337 Kim et al., 'A Review on the Human Health Impact of Airborne Particulate Matter', *Environment International* 74 (1 January 2015): 136–43, https://doi.org/10.1016/j.envint.2014.10.005.

338 'The Climate Crisis Is a Child Rights Crisis', accessed 22 April 2022, https://www.unicef.org/reports/climate-crisis-child-rights-crisis.

339 Pénard-Morand et al., 'Long-Term Exposure to Close-Proximity Air Pollution and Asthma and Allergies in Urban Children', *European Respiratory Journal* 36, no. 1 (1 July 2010): 33–40, https://doi.org/10.1183/09031936.00116109.

340 Albuquerque de Castro et al., 'Efeitos Da Poluição Do Ar Na Função Respiratória de Escolares, Rio de Janeiro, RJ', *Revista de Saúde Pública* 43, no. 1 (February 2009): 26–34, https://doi.org/10.1590/S0034-89102009000100004.

341 Mi et al., 'Current Asthma and Respiratory Symptoms among Pupils in Shanghai, China: Influence of Building Ventilation, Nitrogen Dioxide, Ozone, and Formaldehyde in Classrooms', *Indoor Air* 16, no. 6 (December 2006): 454–64, https://doi.org/10.1111/j.1600-0668.2006.00439.x.

342 Perera, 'Pollution from Fossil-Fuel Combustion Is the Leading Environmental Threat to Global Pediatric Health and Equity: Solutions Exist', *International Journal of Environmental Research and Public Health* 15, no. 1 (23 December 2017): 16, https://doi.org/10.3390/ijerph15010016.

343 Gül et al., 'Respiratory Health Symptoms among Students Exposed to Different Levels of Air Pollution in a Turkish City', *International Journal of Environmental Research and Public Health* 8, no. 4 (April 2011): 1110–25, https://doi.org/10.3390/ijerph8041110.

344 UNICEF, 'It Is Getting Hot: Call for Education Systems to Respond to the Climate Crisis', 2019, https://www.unicef.org/eap/media/4596/file/It%20is%20getting%20hot:%20Call%20for%20education%20systems%20to%20respond%20to%20the%20climate%20crisis.pdf.

345 UNICEF.

346 Wodon et al., 'Missed Opportunities: The High Cost Of Not Educating Girls', 2018, https://openknowledge.worldbank.org/bitstream/handle/10986/29956/HighCostOfNotEducatingGirls.pdf?sequence=6&isAllowed=y.

347 Wodon et al.

348 Randell and Gray, 'Climate Change and Educational Attainment in the Global Tropics', *Proceedings of the National Academy of Sciences* 116, no. 18 (30 April 2019): 8840–45, https://doi.org/10.1073/pnas.1817480116.

349 Porter, 'Education Is under Threat from Climate Change - Especially for Women and Girls', *Education Is under Threat from Climate Change - Especially for Women and Girls* (blog), 8 November 2021, https://www.ox.ac.uk/news/features/education-under-threat-climate-change-especially-women-and-girls.

350 Thiery et al., 'Intergenerational Inequities in Exposure to Climate Extremes', *Science* 374, no. 6564 (8 October 2021): 158–60, https://doi.org/10.1126/science.abi7339.

351 Nicholas Rees and United Nations Children's Fund (UNICEF), *The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index* (UNICEF, 2021), https://www.unicef.org/media/105376/file/UNICEF-climate-crisis-child-rights-crisis.pdf.

352 Rees and United Nations Children's Fund (UNICEF).

353 OEC - The Observatory of Economic Complexity, 'Timor-Leste (TLS) Exports, Imports, and Trade Partners', accessed 26 May 2022, https://oec.world/en/profile/country/tls/.

354 This point is made by Scheiner, 'Timor-Leste Economic Survey: The End of Petroleum Income', *Asia & the Pacific Policy Studies* 8, no. 2 (2021): 253–79, https://doi.org/10.1002/app5.333. Scheiner cites data from World Bank, 'Timor-Leste Economic Report, October 2020: Towards a Sustained Recovery' (Washington, DC: World Bank, 31 October 2020), https://doi.org/10.1596/34748.

355 'Goal 5: Gender Equality - SDG Tracker', Our World in Data, accessed 13 April 2022, https://sdg-tracker.org/gender-equality.

356 Daggett, 'Petro-Masculinity: Fossil Fuels and Authoritarian Desire', *Millennium* 47, no. 1 (1 September 2018): 25–44, https://doi.org/10.1177/0305829818775817.

357 Owren, 'Understanding and Addressing Gender-Based Violence as Part of the Climate Emergency' (UN Women, September 2021), https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/CSW/66/EGM/Expert%20Papers/Cate%20OWREN_CSW66%20Expert%20Paper.pdf.

358 Neumayer and Plümper, 'The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981–2002', *Annals of the Association of American Geographers* 97, no. 3 (1 September 2007): 551–66, https://doi.org/10.1111/j.1467-8306.2007.00563.x.

359 Pichler and Striessnig, 'Differential Vulnerability to Hurricanes in Cuba, Haiti, and the Dominican Republic: The Contribution of Education', *Ecology and Society* 18, no. 3 (2013): 31, https://doi.org/10.5751/ES-05774-180331.

360 UN Commission on the Status of Women, 'Gender Equality and the Empowerment of Women in Natural Disasters', 9 March 2012, https://www.gender.go.jp/english_contents/international/un/pdf/56th_resolution_en.pdf.

361 Committee on the Elimination of Discrimination and against Women, 'General Recommendation No. 37 on Gender-Related Dimensions of Disaster Risk Reduction in the Context of Climate Change', 7 February 2018, https://web.archive.org/web/20220401142424/https://tbinternet.ohchr.org/Treaties/CEDAW/Shared%20Documents/1_Global/CEDAW_C_GC_37_8642_E.pdf.

362 Neumayer and Plümper, 'The Gendered Nature of Natural Disasters'.

363 Pichler and Striessnig, 'Differential Vulnerability to Hurricanes in Cuba, Haiti, and the Dominican Republic'.

364 Owren, 'Understanding and Addressing Gender-Based Violence as Part of the Climate Emergency'.

365 UN Women, 'Tackling Violence Against Women And Girls In The Context Of Climate Change', 2022, https://www.unwomen.org/sites/default/files/2022-03/Tackling-violence-against-women-and-girls-in-the-context-of-climate-change-en.pdf.

366 ExxonMobil, 2019, 'Understanding Flares', https://www.exxonmobil.com.sg/Company/Overview/Who-we-are/Understanding-flares

367 Macfarlane et al., 2020, 'Fractures in the Bridge: Unconventional (Fracked) Natural Gas, Climate Change and Human Health', *Canadian Association of Physicians for the Environment (CAPE)*, http://www.hpaf.co.uk/wp-content/uploads/2020/02/CAPE-Fracking-5b.indd_.pdf

368 CDC, 'Reproductive Health: Preterm Birth', https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pretermbirth.html

369 Bergman et al., 2013, 'State of the Science of Endocrine Disrupting Chemicals 2012', *WHO*, https://apps.who.int/iris/bitstream/handle/10665/78102/WHO_HSE_PHE_IHE_2013.1_eng.pdf;jsessionid=B5628E6A8D2F3BAFB6E5056ECBF814C1?sequence=1

370 Forsey & Bessonova, 2020, '5 ways reducing pollution can improve equality for women', *Stockholm Environment Institute*, https://www.sei.org/featured/5-ways-reducing-pollution-can-improve-equality-for-women/.

371 Forsey & Bessonova, 2020, '5 ways reducing pollution can improve equality for women', *Stockholm Environment Institute*, https://www.sei.org/featured/5-ways-reducing-pollution-can-improve-equality-for-women/.

372 World Bank Group, 2022, 'Global Gas Flaring Reduction Partnership (GGFR)', https://www.worldbank.org/en/programs/gasflaringreduction/gas-flaring-explained

373 World Bank Group, 2022, 'Global Gas Flaring Reduction Partnership (GGFR)', https://www.worldbank.org/en/programs/gasflaringreduction/gas-flaring-explained

374 Cushing et al., 'Up in Smoke: Characterizing the Population Exposed to Flaring from Unconventional Oil and Gas Development in the Contiguous US', *Environmental Research Letters* 16, no. 3 (1 March 2021): 034032, https://doi.org/10.1088/1748-9326/abd3d4.

375 U.S. Census Bureau, (2021, July 1). Quick Facts: Ward County, Texas; Loving County, Texas; Howard County, Texas; Crane County, Texas; Ector County, Texas; Midland County, Texas, https://www.census.gov/quickfacts/fact/table/wardcountytexas,lovingcountytexas,howardcountytexas,cranecountytexas,ectorcountytexas,midlandcountytexas/PST120221.

376 Women's Earth & Climate Action Network (2021). *Gendered and Racial Impacts of the Fossil Fuel Industry in North America and Complicit Financial Institutions: A Call to Action for the Health of our Communities and Nature in the Climate Crisis*, https://www.wecaninternational.org/_files/ugd/d99d2e_918b1e133b2548549b686e4b6eac4cc3.pdf.

377 Macfarlane et. al. 2020.

378 Hopper 2021.

379 CDC. Reproductive Health: Preterm Birth.

380 Bergman et al. 2013.

381 Forsey and Bessonova 2020.

382 Ibid.

383 Willis M.D., et. al, (2021, December 13). Associations between residential proximity to oil and gas extraction and hypertensive conditions during pregnancy: a difference-in-differences analysis in Texas, 1996–2009. *International Journal of Epidemiology,* https://pubmed.ncbi.nlm.nih.gov/34897479/.

384 Stacy et. al. Perinatal outcomes and unconventional natural gas operations in Southwest Pennsylvania. *PLoS One*, 10(6). 2015. https://doi.org/10.1371/journal.pone.0126425.

385 Faiz, A.S., Et al. (2012, August 15). Ambient Air Pollution and the Risk of Stillbirth. *American Journal of Epidemiology,* 176(4), 308-316. https://doi.org/10.1093/aje/kws029.

386 United Nations. Goal 5: Gender Equality. *Sustainable Development Goals*, https://www.undp.org/sustainable-development-goals?c_src=CENTRAL&c_src2=GSR#gender-equality.

387 Clancy et al., 'Gender Perspective on Access to Energy in the EU', 2017, https://www.europarl.europa.eu/RegData/etudes/STUD/2017/596816/IPOL_STU(2017)596816_EN.pdf.

388 Pilgrim et al., 'Women in Senior Management Roles at Energy Firms Remains Stubbornly Low, but Efforts to Improve Gender Diversity Are Moving Apace – Analysis', IEA, 2021, accessed 12 April 2022, https://www.iea.org/commentaries/women-in-senior-management-roles-at-energy-firms-remains-stubbornly-low-but-efforts-to-improve-gender-diversity-are-moving-apace.

389 Piggot et al., 'Realizing a Just and Equitable Transition Away from Fossil Fuels', 2019, https://cdn.sei.org/wp-content/uploads/2019/01/realizing-a-just-and-equitable-transition-away-from-fossil-fuels.pdf.

390 Pilgrim et al. 2021.

391 Carley and Konisky, 'The Justice and Equity Implications of the Clean Energy Transition', *Nature Energy* 5, no. 8 (August 2020): 569–77, https://doi.org/10.1038/s41560-020-0641-6.

392 Dutta, 'Supporting Last-Mile Women Energy Entrepreneurs: What Works and What Does Not' (ENERGIA, 2019), https://www.energia.org/assets/2019/01/Supporting-Last-Mile-Women-Entrepreneurs.pdf.

393 Bennett, 'Women and Economy: Complex Inequality in a Post-Industrial Landscape', *Gender, Place & Culture* 22, no. 9 (21 October 2015): 1287–1304, https://doi.org/10.1080/0966369X.2014.958066.

394 Aragón et al., 'Resource Shocks, Employment, and Gender: Evidence from the Collapse of the UK Coal Industry', *Labour Economics* 52 (1 June 2018): 54–67, https://doi.org/10.1016/j.labeco.2018.03.007.

395 Walk et al., 'Strengthening Gender Justice in a Just Transition: A Research Agenda Based on a Systematic Map of Gender in Coal Transitions', *Energies* 14, no. 18 (21 September 2021): 5985, https://doi.org/10.3390/en14185985.

396 Mang-Benza, 'Many Shades of Pink in the Energy Transition: Seeing Women in Energy Extraction, Production, Distribution, and Consumption', *Energy Research & Social Science* 73 (1 March 2021): 101901, https://doi.org/10.1016/j.erss.2020.101901.

397 Walk and Braunger, 'Guest Post: Why Gender Justice Matters in the Transition Away from Coal', *Carbon Brief* (blog), 3 March 2022, https://www.carbonbrief.org/guest-post-why-gender-justice-matters-in-the-transition-away-from-coal/.

398 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 September 2021), https://papers.ssrn.com/abstract=4026438.

399 Arze del Granado et al., 'The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries', *World Development* 40, no. 11 (1 November 2012): 2234–48, https://doi.org/10.1016/j.worlddev.2012.05.005.

400 Coady et al., 'The Unequal Benefits of Fuel Subsidies Revisited: Evidence for Developing Countries', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 November 2015), https://papers.ssrn.com/abstract=2727215.

401 Inchauste and Victor, *The Political Economy of Energy Subsidy Reform* (Washington, DC: World Bank, 2017), https://doi.org/10.1596/978-1-4648-1007-7.

402 Lockwood, 'Fossil Fuel Subsidy Reform, Rent Management and Political Fragmentation in Developing Countries', *New Political Economy* 20, no. 4 (4 July 2015): 475–94, https://doi.org/10.1080/13563467.2014.923826.

403 Birdsall and Diofasi, 'Reducing Energy Subsidies without Hurting the Poor?', *Center for Global Development* (blog), 2015, https://www.cgdev.org/blog/reducing-energy-subsidies-without-hurting-poor.

404 Birdsall and Diofasi.

405 Lockwood.

406 Beaton and Lintoh, 'Lessons Learned from Indonesia's Attempts to Reform Fossil-Fuel Subsidies', 2010, https://doi.org/10.4135/9781412963893.n343.

407 Birdsall and Diofasi.

408 Riva et al., 'Energy Poverty in Canada: Prevalence, Social and Spatial Distribution, and Implications for Research and Policy', *Energy Research & Social Science* 81 (1 November 2021): 102237, https://doi.org/10.1016/j.erss.2021.102237.

409 Estes, *Our History Is the Future: Standing Rock Versus the Dakota Access Pipeline, and the Long Tradition of Indigenous Resistance* (Verso Books, 2019).

410 Nuttall, *Pipeline Dreams: People, Environment, and the Arctic Energy Frontier*, IWGIA Document 126 (Copenhagen: International Work Group for Indigenous Affairs, 2010).

411 Yakovleva, 'Oil Pipeline Construction in Eastern Siberia: Implications for Indigenous People', *Geoforum* 42, no. 6 (1 November 2011): 708–19, https://doi.org/10.1016/j.geoforum.2011.05.005.

412 Painter and Castillo, 'The Impacts of Large-Scale Energy Development: Indigenous People and the Bolivia-Brazil Gas Pipeline', *Human Organization* 73, no. 2 (21 May 2014): 116–27, https://doi.org/10.17730/humo.73.2.9h502275372j30jm.

413 Spiegel, 'Climate Injustice, Criminalisation of Land Protection and Anti-Colonial Solidarity: Courtroom Ethnography in an Age of Fossil Fuel Violence', *Political Geography* 84 (1 January 2021): 102298, https://doi.org/10.1016/j.polgeo.2020.102298.

414 Colchete and Sen, 'Muzzling Dissent: How Corporate Influence over Politics Has Fueled Anti-Protest Laws' (Institute for Policy Studies, October 2020), https://web.archive.org/web/20201203184239/https://ips-dc.org/wp-content/uploads/2020/10/Muzzling-Dissent-Anti-Protest-Laws-Report.pdf.

415 Spiegel 2020.

416 Brock, '"Frack off": Towards an Anarchist Political Ecology Critique of Corporate and State Responses to Anti-Fracking Resistance in the UK', *Political Geography* 82 (1 October 2020): 102246, https://doi.org/10.1016/j.polgeo.2020.102246.

417 Irwin et al., 'Making Green Extreme: Defending Fossil Fuel Hegemony through Citizen Exclusion', *Citizenship Studies* 26, no. 1 (2 January 2022): 73–89, https://doi.org/10.1080/13621025.2021.2011145.

418 'US Protest Law Tracker', International Centre for Non-Profit Law, accessed 26 May 2022, https://www.icnl.org/usprotestlawtracker/?location=&status=enacted&issue=6&date=&type=.

419 Armstrong, 'Decarbonisation and World Poverty'.

420 Armstrong, 'Decarbonisation and World Poverty'.

421 Armstrong, 'Decarbonisation and World Poverty'.

422 Ross, 'What Do We Know about Natural Resources and Civil War?', *Journal of Peace Research* 41, no. 3 (May 2004): 337–56, https://doi.org/10.1177/0022343304043773.

423 Lujala, 'The Spoils of Nature: Armed Civil Conflict and Rebel Access to Natural Resources', *Journal of Peace Research* 47, no. 1 (1 January 2010): 15–28, https://doi.org/10.1177/0022343309350015.

424 Paul Collier and Anke Hoeffler, 'The Political Economy of Secession', 2002.

425 Paul Collier and Anke Hoeffler, 'The Political Economy of Secession', 2002.

426 San-Akca et al., 'Does Natural Gas Fuel Civil War? Rethinking Energy Security, International Relations, and Fossil-Fuel Conflict', *Energy Research & Social Science* 70 (1 December 2020): 101690, https://doi.org/10.1016/j.erss.2020.101690.

427 Ross, 'The Political Economy of the Resource Curse', *World Politics* 51, no. 2 (January 1999): 297–322, https://doi.org/10.1017/S0043887100008200.

428 See, for example, Ross, 'Does Oil Hinder Democracy?', *World Politics* 53, no. 3 (April 2001): 325–61, https://doi.org/10.1353/wp.2001.0011.

429 Oskarsson and Ottosen, 'Does Oil Still Hinder Democracy?', *The Journal of Development Studies* 46, no. 6 (1 July 2010): 1067–83, https://doi.org/10.1080/00220380903151058.

430 Bill McKibben, 'Putin's War Shows Autocracies and Fossil Fuels Go Hand in Hand. Here's How to Tackle Both', *The Guardian*, 11 April 2022, sec. Environment, https://www.theguardian.com/environment/2022/apr/11/putin-autocracies-fossil-fuels-climate-action.

431 Bloomberg News, 'Putin May Collect $321 Billion Windfall If Oil and Gas Keep Flowing', *Bloomberg.Com*, 1 April 2022, https://www.bloomberg.com/news/articles/2022-04-01/putin-may-collect-321-billion-windfall-if-oil-gas-keep-flowing.

432 Alexandra Gillies, 'How to Stop Oil Companies From Propping Up Kleptocrats', *Foreign Policy* (blog), 2022, https://foreignpolicy.com/2022/03/04/russia-oil-energy-bp-shell-exxonmobil-prop-up-corruption-kleptocrats/.

433 The Page, 2022, 'The total losses of Ukraine's economy due to the war reach $ 600 billion - KSE', https://thepage.ua/ua/news/skilki-vtratila-ekonomika-ukrayini-za-10-tizhniv-vijni

434 UN, 2022, 'Global Impact of war in Ukraine on food, energy and finance systems', https://news.un.org/pages/wp-content/uploads/2022/04/UN-GCRG-Brief-1.pdf

435 CREA, 2022, 'Financing Putin's war on Europe: Fossil fuel imports from Russia in the first two months of the invasion', https://energyandcleanair.org/wp/wp-content/uploads/2022/04/Fossil-fuel-imports-from-Russia-first-two-months-of-invasion.pdf

436 Bailout Watch, 2022, 'Big Oil's Wartime Bonus: An Update On How It Turns Profits Into Wealth', https://bailoutwatch.org/analysis/big-oils-wartime-bonus-update

437 Greenpeace, 2022, 'The Crisis Profiteers: How the oil industry has raked in record profits at the petrol pump since Russia's invasion of Ukraine', https://greenpeace.at/assets/uploads/pdf/presse/Media_briefing_Greenpeace_the_Crisis_Profiteers_analysis.pdf

438 'Access to Electricity – SDG7: Data and Projections – Analysis', IEA, accessed 4 May 2022, https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity.

439 Centre for Climate Finance and Investment and International Energy Agency, 'Energy Investing Exploring Risk and Return in the Capital Markets', accessed 19 April 2022, https://imperialcollegelondon.app.box.com/s/f1r832z4apqypw0fakk1k4ya5w30961g.

440 Just Transition Research Collaborative and United Nations Research Institute for Social Development, *Mapping Just Transition(s) to a Low-Carbon World*, 2018, https://cdn.unrisd.org/assets/library/books/pdf-files/report-jtrc-2018.pdf.

441 International Energy Agency, 'World Energy Outlook 2021'.

442 International Labour Organisation, 'World Employment and Social Outlook 2018 – Greening with Jobs' (Geneva, ILO: International Labour Office, 2018).

443 'Goal 5: Gender Equality - SDG Tracker', Our World in Data, 7, accessed 13 April 2022, https://sdg-tracker.org/gender-equality.

444 BP, 'Statistical Review of World Energy 2021', 2021, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf.

445 International Energy Agency, 'World Energy Outlook 2021', World Energy Outlook, 2021.

446 Brad Plumer, 'As Coal Fades in the U.S., Natural Gas Becomes the Climate Battleground', *The New York Times*, 26 June 2019, sec. Climate, https://www.nytimes.com/2019/06/26/climate/natural-gas-renewables-fight.html.

447 IEA (2021), *Methane Emissions from Oil and Gas*, IEA, Paris. https://www.iea.org/reports/methane-emissions-from-oil-and-gas

448 Paul Hockenos, 'Natural Gas Is a Bridge to Nowhere', Energy Transition, 7 January 2021, https://energytransition.org/2021/01/23585/.

449 Howarth, 'A Bridge to Nowhere: Methane Emissions and the Greenhouse Gas Footprint of Natural Gas', *Energy Science & Engineering* 2, no. 2 (2014): 47–60, https://doi.org/10.1002/ese3.35.

450 McGlade et al., 'The Future Role of Natural Gas in the UK: A Bridge to Nowhere?', *Energy Policy* 113 (1 February 2018): 454–65, https://doi.org/10.1016/j.enpol.2017.11.022.

451 International Energy Agency, 'Projected Costs of Generating Electricity 2020' (Paris: IEA, 2020), https://iea.blob.core.windows.net/assets/ae17da3d-e8a5-4163-a3ec-2e6fb0b5677d/Projected-Costs-of-Generating-Electricity-2020.pdf.

452 Hiremath et al., 'Decentralised Renewable Energy: Scope, Relevance and Applications in the Indian Context', *Energy for Sustainable Development* 13, no. 1 (1 March 2009): 4–10, https://doi.org/10.1016/j.esd.2008.12.001.

453 Nguyen, 'Alternatives to Grid Extension for Rural Electrification: Decentralized Renewable Energy Technologies in Vietnam', *Energy Policy* 35, no. 4 (1 April 2007): 2579–89, https://doi.org/10.1016/j.enpol.2006.10.004.

454 'Access to Electricity – SDG7: Data and Projections – Analysis', IEA, accessed 4 May 2022, https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity.

455 'Over Half of the People in Least Developed Countries Lack Access to Electricity | UNCTAD', accessed 4 May 2022, https://unctad.org/topic/least-developed-countries/chart-july-2021.

456 Reddy et al., 'Energy and Social Issues', *World Energy Assessment*, 2000, 39–60.

457 Authors' calculations based on World Bank data.

458 The Beam, 'Burning Issues about Plastic Pollution', *TheBeamMagazine* (blog), 22 January 2019, https://medium.com/thebeammagazine/burning-issues-about-plastic-pollution-a4f4d1264f3d.

459 Paddock, 'To Make This Tofu, Start by Burning Toxic Plastic', *The New York Times*, 14 November 2019, sec. World, https://www.nytimes.com/2019/11/14/world/asia/indonesia-tofu-dioxin-plastic.html.

460 United Nations Environment Programme, *Single-Use Plastics, a Roadmap for Sustainability.*, 2018.

461 International Bank for Reconstruction and Development, 'Tracking SDG7: The Energy Progress Report 2021', 2021, https://trackingsdg7.esmap.org/data/files/download-documents/2021_tracking_sdg7_report.pdf.

462 Parry et al., 'Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies', SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, 1 September 2021), https://papers.ssrn.com/abstract=4026438.

463 'Joint European Action for More Affordable, Secure Energy', Text, European Commission - European Commission, accessed 13 April 2022, https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511.

464 David Toke, 'In a Rush to Replace Russian Gas, the EU Has Damaged Its Own Climate Change Strategy', The Conversation, accessed 13 April 2022, http://theconversation.com/in-a-rush-to-replace-russian-gas-the-eu-has-damaged-its-own-climate-change-strategy-178688.

465 Cassarino and Barrett, 'Meeting UK Heat Demands in Zero Emission Renewable Energy Systems Using Storage and Interconnectors', *Applied Energy* 306 (15 January 2022): 118051, https://doi.org/10.1016/j.apenergy.2021.118051.

466 'Letter from 520+ Organisations Urging End to Fossil Fuel Era, Transition to Renewable Energy', 2021, https://www.biologicaldiversity.org/programs/energy-justice/pdfs/2022-4-27_Letter-to-Pres-Biden-re-End-Fossil-Fuel-Era-Accelerate-Transtion-to-Renewable-Energy.pdf.

467 Dell et al., 'Temperature Shocks and Economic Growth: Evidence from the Last Half Century', *American Economic Journal: Macroeconomics* 4, no. 3 (2012): 66–95.

468 'Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change' (Cambridge University Press, In Press), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FinalDraft_FullReport.pdf.

469 Nnimmo Bassey and Anabela Lemos, 'Africa's Fossil-Fuel Trap', 24 February 2022, https://www.foreignaffairs.com/articles/africa/2022-02-17/africas-fossil-fuel-trap.

470 Authors' calculations based on World Bank, 'Access to Electricity (% of Population) - Angola, Nigeria, Mozambique | Data', accessed 19 April 2022, https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=AO-NG-MZ.

471 Bassey and Lemos, 'Africa's Fossil-Fuel Trap'.

472 Nicholas Apergis and Chor Foon Tang, 'Is the Energy-Led Growth Hypothesis Valid? New Evidence from a Sample of 85 Countries', *Energy Economics* 38 (1 July 2013): 24–31, https://doi.org/10.1016/j.eneco.2013.02.007.

473 Garrett-Peltier, 'Green versus Brown: Comparing the Employment Impacts of Energy Efficiency, Renewable Energy, and Fossil Fuels Using an Input-Output Model', *Economic Modelling* 61 (1 February 2017): 439–47, https://doi.org/10.1016/j.econmod.2016.11.012.

474 'C40 Cities Launches Research on South Africa Green Jobs', C40 Cities, accessed 26 May 2022, https://www.c40.org/news/c40-research-south-africa-green-jobs/.

475 UNECA, 'Green Jobs for Women in Africa Key Outcomes', 28 February 2022, https://www.uneca.org/sites/default/files/TCND/ARFSD2022/Sideevent-presentation/Green%20Jobs%20for%20Women%20in%20Africa%20Key%20Outcomes.pdf.

476 International Labour Organisation, 'World Employment and Social Outlook 2018 – Greening with Jobs' (Geneva, ILO: International Labour Office, 2018).

477 International Energy Agency, *Sustainable Recovery: World Energy Outlook Special Report* (OECD, 2020), https://doi.org/10.1787/3f36f587-en.

478 ILO, 2019, 'Working on a warmer planet: The effect of heat stress on productivity and decent work', https://www.ilo.org/global/publications/books/WCMS_711919/lang--en/index.htm

479 ILO, 2018, 'World Employment and Social Outlook 2018: Greening with jobs', https://www.ilo.org/global/publications/books/WCMS_628654/lang--en/index.htm

480 UNRISD, 2018, 'Mapping Just Transition(s) to a Low-Carbon World', https://www.unrisd.org/en/library/publications/mapping-just-transitions-to-a-low-carbon-world

481 Muttitt and Kartha, 'Equity, Climate Justice and Fossil Fuel Extraction: Principles for a Managed Phase Out', *Climate Policy* 20, no. 8 (13 September 2020): 1024–42, https://doi.org/10.1080/14693062.2020.1763900.

482 Just Transition Research Collaborative and United Nations Research Institute for Social Development, *Mapping Just Transition(s) to a Low-Carbon World*, 2018, https://cdn.unrisd.org/assets/library/books/pdf-files/report-jtrc-2018.pdf.

483 Abacus Data, 'Climate Emergency Polling & Transition To Renewable Sources With Oil & Gas Sector Workers', May 2021, https://d3n8a8pro7vhmx.cloudfront.net/ironandearth/pages/1702/attachments/original/1635867551/Abacus_-_Iron___Earth_poll_July_13_.pdf?1635867551.

484 Karl Cloete, 'Op-Ed: Numsa Supports a Transition from Dirty Energy to Clean Renewable Energy', Daily Maverick, 15 March 2018, https://www.dailymaverick.co.za/article/2018-03-15-op-ed-numsa-supports-a-transition-from-dirty-energy-to-clean-renewable-energy/.

485 Gabrielle Jeliazkov, Ryan Morrison, and Mel Evans, 'OFFSHORE: Oil and Gas Workers' Views on Industry Conditions and the Energy Transition' (Platform, Friends of the Earth Scotland and Greenpeace), accessed 19 April 2022, https://platformlondon.org/wp-content/uploads/2020/09/Oil-Gas-Workers-Report.pdf.

486 Muttitt and Kartha, 'Equity, Climate Justice and Fossil Fuel Extraction: Principles for a Managed Phase Out', *Climate Policy* 20, no. 8 (13 September 2020): 1024–42, https://doi.org/10.1080/14693062.2020.1763900.

487 Muttitt and Kartha, 'Equity, Climate Justice and Fossil Fuel Extraction'.

488 'Goal 9: Industry, Innovation and Infrastructure - SDG Tracker', Our World in Data, 9, accessed 19 April 2022, https://sdg-tracker.org/infrastructure-industrialization.

489 International Energy Agency, 'World Energy Outlook 2021'.

490 'Emissions by Sector – Greenhouse Gas Emissions from Energy: Overview – Analysis', IEA, accessed 19 April 2022, https://www.iea.org/reports/greenhouse-gas-emissions-from-energy-overview/emissions-by-sector.

491 IPCC, 'Climate Change 2022: Mitigation of Climate Change (Working Group III Contribution To The IPCC Sixth Assessment Report (AR6)', 2022, https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter11.pdf.

492 IPCC.

493 This scenario would include the use of carbon capture and storage (CCUS) and other carbon removal technologies.

494 International Energy Agency, 'World Energy Outlook 2021'.

495 Corrie E Clark, 'Renewable Energy R&D Funding History: A Comparison with Funding for Nuclear Energy, Fossil Energy, Energy Efficiency, and Electric Systems R&D', 2018, 10.

496 International Energy Agency, 'Global Reported Corporate Energy R&D Spending in Selected Sectors, 2010-2019 – Charts – Data & Statistics', IEA, accessed 19 April 2022, https://www.iea.org/data-and-statistics/charts/global-reported-corporate-energy-r-and-d-spending-in-selected-sectors-2010-2019.

497 'IPCC Clarion Call Puts Spotlight on Fossil Fuel Industry's Hypocrisy', Global Witness, accessed 19 April 2022, https:///en/campaigns/fossil-gas/ipcc-clarion-call-puts-spotlight-on-fossil-fuel-industrys-hypocrisy/.

498 Andreas Exarheas, 'The Renewables vs Oil Spend of Majors', 19 May 2021, https://www.rigzone.com/news/the_renewables_vs_oil_spend_of_majors-19-may-2021-165463-article/.

499 Sabrina Valle, 'Chevron's Profit Nearly Quadruples, Vows More Natural Gas Investment', *Reuters*, 29 April 2022, sec. Energy, https://www.reuters.com/business/energy/chevron-profit-nearly-quadruples-oil-prices-surge-2022-04-29/.

500 'Emissions by Sector – Greenhouse Gas Emissions from Energy'.

501 'Emissions by Sector – Greenhouse Gas Emissions from Energy'.

502 The Standard, 'Uganda, Tanzania, oil firms sign accords to build Sh371.7b pipeline', 2021, https://www.standardmedia.co.ke/business/business-news/article/2001409298/uganda-tanzania-oil-firms-sign-accords-to-build-35-billion-pipeline?_ga=2.264194895.2108840479.1652435760-1263012914.1628439589

503 Bank Track, 'Crude Risk: Risks to banks and investors from the East African Crude Oil Pipeline', 2020, https://www.banktrack.org/download/crude_risk/cruderisk_eacop_briefing_nov2020_1.pdf.

504 Bank Track, 'Crude Risk: Risks to banks and investors from the East African Crude Oil Pipeline', 2020, https://www.banktrack.org/download/crude_risk/cruderisk_eacop_briefing_nov2020_1.pdf.

505 Republic of Uganda, 'National Biodiversity Strategy and Action Plan', 2002, https://www.cbd.int/doc/world/ug/ug-nbsap-01-en.pdf.

506 Republic of Uganda, 'National Biodiversity Strategy and Action Plan', 2002, https://www.cbd.int/doc/world/ug/ug-nbsap-01-en.pdf.

507 IFC, 'The Dirty Footprint of the Broken Grid: The Impacts of Fossil Fuel Back-up Generators in Developing Countries', 2019, https://www.ifc.org/wps/wcm/connect/2cd3d83d-4f00-4d42-9bdc-4afdc2f5dbc7/20190919-Full-Report-The-Dirty-Footprint-of-the-Broken-Grid.pdf?MOD=AJPERES&CVID=mR9UpXC.

508 IFC.

509 Dekker et al., 'Economic Analysis of PV/Diesel Hybrid Power Systems in Different Climatic Zones of South Africa', *International Journal of Electrical Power & Energy Systems* 40, no. 1 (1 September 2012): 104–12, https://doi.org/10.1016/j.ijepes.2012.02.010.

510 Cader et al., 'Global Cost Advantages of Autonomous Solar–Battery–Diesel Systems Compared to Diesel-Only Systems', *Energy for Sustainable Development* 31 (1 April 2016): 14–23, https://doi.org/10.1016/j.esd.2015.12.007.

511 Freitag et al., 'The Real Climate and Transformative Impact of ICT: A Critique of Estimates, Trends, and Regulations', *Patterns* 2, no. 9 (10 September 2021): 100340, https://doi.org/10.1016/j.patter.2021.100340.

512 Andrae and Edler, 'On Global Electricity Usage of Communication Technology: Trends to 2030', *Challenges* 6, no. 1 (30 April 2015): 117–57, https://doi.org/10.3390/challe6010117.

513 International Energy Agency, 'Digitalization and Energy', 2017.

514 International Energy Agency.

515 'RE100', accessed 20 May 2022, https://www.there100.org/.

516 de Chalendar and Benson, 'Why 100% Renewable Energy Is Not Enough', *Joule* 3, no. 6 (June 2019): 1389–93, https://doi.org/10.1016/j.joule.2019.05.002.

517 International Energy Agency, 'World Energy Outlook 2021'.

518 '68% of the World Population Projected to Live in Urban Areas by 2050, Says UN | UN DESA | United Nations Department of Economic and Social Affairs', accessed 20 April 2022, https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.

519 The effects are summarised in Hunt and Watkiss, 'Climate Change Impacts and Adaptation in Cities: A Review of the Literature', *Climatic Change* 104, no. 1 (January 2011): 13–49, https://doi.org/10.1007/s10584-010-9975-6.

520 Hunt and Watkiss.

521 Salimi and Al-Ghamdi, 'Climate Change Impacts on Critical Urban Infrastructure and Urban Resiliency Strategies for the Middle East', *Sustainable Cities and Society* 54 (1 March 2020): 101948, https://doi.org/10.1016/j.scs.2019.101948.

522 'Surface Temperature Tops 60°C in Parts of North India, Satellite Images Show', Hindustan Times, 30 April 2022, https://www.hindustantimes.com/india-news/surface-temp-tops-60-c-satellite-images-show-101651343166998.html.

523 Dasgupta et al., 'Exposure of Developing Countries to Sea-Level Rise and Storm Surges', *Climatic Change* 106, no. 4 (1 June 2011): 567–79, https://doi.org/10.1007/s10584-010-9959-6.

524 Xanthos and Walker, 'International Policies to Reduce Plastic Marine Pollution from Single-Use Plastics (Plastic Bags and Microbeads): A Review', *Marine Pollution Bulletin* 118, no. 1–2 (15 May 2017): 17–26, https://doi.org/10.1016/j.marpolbul.2017.02.048.

525 Ojolowo and Wahab, 'Municipal Solid Waste and Flooding in Lagos Metropolis, Nigeria: Deconstructing the Evil Nexus', *Journal of Geography and Regional Planning* 10, no. 7 (31 July 2017): 174–85, https://doi.org/10.5897/JGRP2016.0614.

526 Drew Hinshaw, 'Ghana's Growth Spurs Uncontrollable Trash', WSJ, accessed 20 May 2022, http://www.wsj.com/articles/ghanas-growth-spurs-uncontrollable-trash-1434928945.

527 Xanthos and Walker, 'International Policies to Reduce Plastic Marine Pollution from Single-Use Plastics (Plastic Bags and Microbeads): A Review', *Marine Pollution Bulletin* 118, no. 1–2 (15 May 2017): 17–26, https://doi.org/10.1016/j.marpolbul.2017.02.048.

528 Bulkeley, *Cities and Climate Change* (London: Routledge, 2012), https://doi.org/10.4324/9780203077207.

529 Waite et al., 'Global Trends in Urban Electricity Demands for Cooling and Heating', *Energy* 127 (May 2017): 786–802, https://doi.org/10.1016/j.energy.2017.03.095.

530 WHO, 'Air Pollution Levels Rising in Many of the World's Poorest Cities', 2016, https://www.who.int/news/item/12-05-2016-air-pollution-levels-rising-in-many-of-the-world-s-poorest-cities.

531 Haddadian et al., 'Accelerating the Global Adoption of Electric Vehicles: Barriers and Drivers', *The Electricity Journal* 28, no. 10 (1 December 2015): 53–68, https://doi.org/10.1016/j.tej.2015.11.011.

532 Shukla et al., 'Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change', 2022, https://doi.org/10.1017/9781009157926.001.

533 Mariel Vilella, 'IPCC's Mitigation Report: 5 Takeaways for Zero Waste Cities', *GAIA* (blog), 4 April 2022, https://www.no-burn.org/ipcc-takeaways-zw/.

534 Johnson, 'Environmental Impacts of Urban Sprawl: A Survey of the Literature and Proposed Research Agenda', *Environment and Planning A: Economy and Space* 33, no. 4 (April 2001): 717–35, https://doi.org/10.1068/a3327.

535 Bhatta, 'Causes and Consequences of Urban Growth and Sprawl', in *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, ed. Basudeb Bhatta, Advances in Geographic Information Science (Berlin, Heidelberg: Springer, 2010), 17–36, https://doi.org/10.1007/978-3-642-05299-6_2.

536 Hanif, 'Impact of Fossil Fuels Energy Consumption, Energy Policies, and Urban Sprawl on Carbon Emissions in East Asia and the Pacific: A Panel Investigation', *Energy Strategy Reviews* 21 (1 August 2018): 16–24, https://doi.org/10.1016/j.esr.2018.04.006.

537 Balbus et al., 'Ch. 1: Introduction: Climate Change and Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment' (U.S. Global Change Research Program, 2016), https://doi.org/10.7930/J0VX0DFW.

538 United Nations Environment Programme and United Nations Human Settlements Programme (UN-Habitat), *Global Environment for Cities-GEO for Cities: Towards Green and Just Cities* (Nairobi: UNEP, 2021).

539 Bigger and Webber, 'Green Structural Adjustment in the World Bank's Resilient City', *Annals of the American Association of Geographers* 111, no. 1 (2 January 2021): 36–51, https://doi.org/10.1080/24694452.2020.1749023.

540 McKinsey Sustainability and C40 Cities, 'Focused Adaptation: A Strategic Approach to Climate Adaptation in Cities', 2021, https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/how%20cities%20can%20adapt%20to%20climate%20change/focused-adaptation-a-strategic-approach-to-climate-adaptation-in-cities-vf.pdf.

541 C40, 'Inclusive Climate Action in Practice', accessed 20 April 2022, https://cdn.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5c4204754722d40016c4eda6/files/C40_Inclusive_Climate_Action_in_Practice.pdf?1547830389.

542 Waite et al., 'Global Trends in Urban Electricity Demands for Cooling and Heating'.

543 C40 Knowledge Hub, 'Cities100: Cape Town Is Spearheading South Africa's Shift towards a Decentralised, Renewable Energy Supply', accessed 20 April 2022, https://www.c40knowledgehub.org/s/article/Cities100-Cape-Town-is-spearheading-South-Africa-s-shift-towards-a-decentralised-renewable-energy-supply?language=en_US.

544 Sherry Stout et al., 'Distributed Energy Planning for Climate Resilience', 2018, https://www.nrel.gov/docs/fy18osti/71310.pdf.

545 Shanti Gamper-Rabindran, *The Shale Dilemma: A Global Perspective on Fracking and Shale Development* (University of Pittsburgh Press, 2017).

546 Meng, 'The Impacts of Fracking on the Environment: A Total Environmental Study Paradigm', *Science of The Total Environment* 580 (15 February 2017): 953–57, https://doi.org/10.1016/j.scitotenv.2016.12.045.

547 Fuhr and Franklin, eds., *Plastic Atlas 2019: Facts and Figures about the World of Synthetic Polymers* (Berlin: Heinrich Böll Stiftung, 2019).

548 Mariel Vilella, 'New Business Models Cutting Back on Single-Use Plastic' (Manchester: Sustainable Consumption Institute, 2020), https://zerowasteeurope.eu/wp-content/uploads/2021/08/New-Business-Models-Cutting-Back-on-Plastic_-FINAL.pdf.

549 Lisa Anne Hamilton et al., 'Plastic & Climate: The Hidden Costs of a Plastic Planet' (Center for International Environmental Law (CIEL), May 2019), https://www.ciel.org/wp-content/uploads/2019/05/Plastic-and-Climate-FINAL-2019.pdf.

550 International Energy Agency, 'The Future of Petrochemicals: Towards More Sustainable Plastics and Fertilisers', 2018, https://iea.blob.core.windows.net/assets/bee4ef3a-8876-4566-98cf-7a130c013805/The_Future_of_Petrochemicals.pdf.

551 Vilella.

552 International Energy Agency, 'The Future of Petrochemicals: Towards More Sustainable Plastics and Fertilisers', 2018, https://iea.blob.core.windows.net/assets/bee4ef3a-8876-4566-98cf-7a130c013805/The_Future_of_Petrochemicals.pdf.

553 Hamilton et al.

554 Hamilton et al.

555 Cingotti and Howard, 'Turning the Plastic Tide: The Chemicals in Plastic That Put Our Health at Risk' (Health and Enviromental Alliance (HEAL), 2020), https://www.env-health.org/wp-content/uploads/2022/03/HEAL_Plastics_report_v5.pdf.

556 Straková et al., 'Throwaway Packaging, Forever Chemicals: European-Wide Survey of PFAS in Disposable Food Packaging and Tableware', 2021, https://www.envhealth.org/wp-content/uploads/2021/05/FINAL_pfas_fcm_study_web.pdf.

557 Muncke et al., 'Impacts of Food Contact Chemicals on Human Health: A Consensus Statement', *Environmental Health* 19, no. 1 (December 2020): 25, s12940-020-0572–75, https://doi.org/10.1186/s12940-020-0572-5.

558 Climate Action 100+, 'About Climate Action 100+', Climate Action 100+, accessed 20 April 2022, https://www.climateaction100.org/about/.

559 Henrik Jeppesen, 'CA100+ a Long Way from Destination', Carbon Tracker Initiative, 28 March 2022, https://carbontracker.org/ca100-a-long-way-from-destination/.

560 Jeppesen.

561 This is a form of accounting analysis known as 'asset impairment testing'.

562 Damian Carrington, 'Fossil Fuel Industry Gets Subsidies of $11m a Minute, IMF Finds', *The Guardian*, 6 October 2021, sec. Environment, https://www.theguardian.com/environment/2021/oct/06/fossil-fuel-industry-subsidies-of-11m-dollars-a-minute-imf-finds.

563 Parry et al., 'Still Not Getting Energy Prices Right'.

564 Parry et al.

565 'Goal 17: Partnerships for the Goals - SDG Tracker', Our World in Data, accessed 27 April 2022, https://sdg-tracker.org/global-partnerships.

566 Tom Bergin and Ron Bousso, 'Special Report: How Oil Majors Shift Billions in Profits to Island Tax Havens', *Reuters*, 9 December 2020, sec. Commodities, https://www.reuters.com/article/global-oil-tax-havens-idUSKBN28J1IK.

567 Tom Bergin and Ron Bousso.

568 Ron Bousso, 'Exclusive: Nigeria Hits Oil Majors with Billions in Back Taxes', *Reuters*, 21 February 2019, sec. News, https://www.reuters.com/article/uk-nigeria-oil-debt-exclusive-idUKKCN1QA1EN.

569 Market Forces, 'Do You Pay More Tax than the Big Fossil Fuel Companies?', Market Forces, accessed 4 May 2022, https://www.marketforces.org.au/campaigns/subsidies/taxes/taxavoidance/.

570 Market Forces, 'How Your Tax Dollars Subsidise Fossil Fuels', Market Forces, accessed 4 May 2022, https://www.marketforces.org.au/campaigns/ffs/tax-based-subsidies/.

571 Market Forces.

572 Paid to Pollute, 'Press Release: UK Has given £14bn in Subsidies to Oil & Gas Industry', 25 November 2021, https://paidtopollute.org.uk/news/14-billion-in-subsidies/.

573 Barclay Palmer, 'How Oil Companies Pay Such Low Taxes', Investopedia, 21 February 2022, https://www.investopedia.com/articles/investing/011216/understanding-how-oil-companies-pay-taxes.asp.

574 Erickson et al., 2020, 'Why fossil fuel producer subsidies matter', *Nature*, https://doi.org/10.1038/s41586-019-1920-x

575 Belén Balanyá et al., 'The Great Gas Lock-in Industry Lobbying behind the EU Push for New Gas Infrastructure', 2017, https://corporateeurope.org/sites/default/files/the_great_gas_lock_in_english_.pdf.

576 Emma Howard, 'The Oil and Chemical Industry Is Lobbying against Global Regulation of Microplastic Chemicals', Unearthed, 28 June 2021, https://unearthed.greenpeace.org/2021/06/28/microplastics-chemicals-lobbying-oil-industry-stockholm-convention/.

577 Adam Robert Lucas, 'Revealed: The Extent of Job-Swapping between Public Servants and Fossil Fuel Lobbyists', *The Conversation*, 2018.

578 Nicolas Graham, William K Carroll, and David Chen, 'Carbon Capital's Political Reach: A Network Analysis Of Federal Lobbying By The Fossil Fuel Industry From Harper To Trudeau', *Canadian Political Science Review* 14, no. 1 (2020): 1-31, https://ojs-test.unbc.ca/index.php/cpsr/article/download/1743/1359.

579 Sharon Lerner, 'How the Plastics Industry Is Fighting to Keep Polluting the World', *The Intercept*, 20 July 2019, https://theintercept.com/2019/07/20/plastics-industry-plastic-recycling/.

580 'Hundreds of Fossil Fuel Lobbyists Flooding COP26 Climate Talks', Global Witness, 8 November 2021, https:///en/press-releases/hundreds-fossil-fuel-lobbyists-flooding-cop26-climate-talks/.

581 Global Justice Now, 'Corporate Courts vs the Climate: How the Fossil Fuel Industry Is Deterring Climate Action through Secret Tribunals', September 2021, https://www.globaljustice.org.uk/wp-content/uploads/2021/09/GJN_CorporateCourtsVsClimateBriefing_Sept2021.pdf.

582 Global Justice Now.

583 'Beyond Oil & Gas Alliance', Beyond Oil & Gas Alliance, accessed 21 May 2022, https://beyondoilandgasalliance.com/.

584 'Powering Past Coal Alliance (PPCA)', accessed 21 May 2022, https://www.poweringpastcoal.org/.

IMAGE CREDITS

Cover: Image by Brook Mitchell from Getty
Image by Анатолий Стафичук from Pixabay
Image by PublicDomainPictures from Pixabay
Image by kevin-harris from Unsplash
Image by Naja Bertolt Jensen from Unsplash
Image by Marcelo Perez del Carpio from Climate Visuals Countdown

Inside cover: Image by JuergenPM from Pixabay

Page 1: Image by Rajesh Kumar Singh from Climate Visuals Countdown

Page 4: Image by Maxim Tolchinskiy from Unsplash

Page 15: Image by Mark Agnor from Shutterstock

Page 24: Image by Marcelo Perez del Carpio from Climate Visuals Countdown

Page 28: Image by Naja Bertolt Jensen from Unsplash

Page 32: Image by Mahelder Haileselassie/ActionAid

Page 35: Image by Daniel Jukes/ActionAid

Page 41: Image by Daniel Jukes/ActionAid

Page 44: Image by Brook Mitchell from Getty

Page 59: Image by Kunal Gupta from Climate Visuals Countdown

Page 62: Image by Amirtharaj Stephens from Healthy Energy Initiative India

Page 65: Image by Beyond Coal & Gas from Flickr (CC BY 2.0)

Page 70: Image by Amirtharaj Stephens from Healthy Energy Initiative India

Page 80: Image by Ahden from Climate Visuals Countdown

Page 82: Image by Ralf Vetterle from Pixabay

Page 87: Image by Ralf Vetterle from Pixabay

Page 90: Image by Rebecca Bliklen on Unsplash

Page 95: Photo by Li-An Lim on Unsplash

FOSSIL FUEL NON-PROLIFERATION TREATY

fossilfueltreaty.org