BREAKING FREE FROM MINING

A 2050 BLUEPRINT FOR A WORLD WITHOUT MINING – ON LAND AND IN THE DEEP SEA.

SEAS AT RISK

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SETTING THE SCENE

"WE STAND NOW WHERE TWO ROADS DIVERGE. BUT UNLIKE THE ROADS IN ROBERT FROST'S FAMILIAR POEM, THEY ARE NOT EQUALLY FAIR. THE ROAD WE HAVE LONG BEEN TRAVELLING IS DECEPTIVELY EASY, A SMOOTH SUPERHIGHWAY ON WHICH WE PROGRESS WITH GREAT SPEED, BUT AT ITS END LIES DISASTER. THE OTHER FORK OF THE ROAD — THE ONE LESS TRAVELED BY — OFFERS OUR LAST, OUR ONLY CHANCE TO REACH A DESTINATION THAT ASSURES THE PRESERVATION OF THE EARTH."

– RACHEL CARSON,
SILENT SPRING, 1962

METALS – THE FOSSIL FUELS OF THE 21ST CENTURY

The transition to a carbon-neutral society is heavily focused on technology and innovation fixes, such as the large-scale shift to renewable energy, the replacement of 1.4 billion petrol and diesel cars with electric vehicles, and the digitalisation of our societies and economies. However, the underpinning economic model remains largely unchanged: extract, consume, throw away – a model that privileges continued relentless overconsumption in the Global North and pursues eternal economic growth at nature's expense.

These so-called green technologies and infrastructure fixes come with a substantial – and familiar – catch: they all require vast amounts of metals and minerals. This means opening more and more mines, exacerbating the longstanding environmental and social consequences of extractivism. Metals have become the fossil fuel of the 21st century.

Each year mining moves into new frontiers and encroaches further into nature and communities all over the world. On land, exploration goes deeper underground and eats into our remaining wilderness. For example, rather than serve as a warning, the rapid melting of Arctic ice sheets has encouraged mining, with previously unreachable sites now seen as economically viable.

World-renowned marine biologist Sylvia Earle has called deep-sea mining 'the biggest land-grab in the history of humankind' and indeed the deep sea has become the final frontier for mining on Earth. Already, more than 1.3 million square kilometres of ocean have been set aside for mineral exploration. Despite scientists warning of irreversible, large-scale biodiversity loss, some countries and companies intend to start mining in international waters as soon as 2023.

Several existential questions arise from this relentless push towards extraction. Can humanity really afford to lose large swathes of nature, on land and in the deep sea, to fuel a 'green growth' economy that will benefit a few in the Global North? Do extractive economies still have a place in the 21st century? Can we envisage a society that can counter climate and nature collapse, while simultaneously breaking free from resource extraction?

OBJECTIVE OF THIS PAPER: RETHINKING METALS AND MINING

Recent reports by the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have awakened the world to the damning human impacts on nature and climate. The solution is difficult yet clear: transformative change.

This paper sets out some possible pathways to transformative change. It describes a science and fact-based vision of a world in which terrestrial mining has become obsolete and the deep sea is safeguarded from invasive digging. It offers an alternative to the business-as-usual approach applied by most global scenarios for future metals demand (World Bank[2], International Resource Panel[3], International Energy Agency[4], Organisation for Economic Co-operation and Development (OECD)[5]), which presume continued growth of consumption and production, expressed as Gross Domestic Product (GDP). Typically, these growth scenarios predict at least a doubling or quadrupling in the demand for metals by 2050 or 2060. Breaking away from business-as-usual and envisioning a different future is key to shaping effective policy measures that can prevent the expected mining boom.

* TRANSFORMATIVE CHANGE MEANS DOING THINGS DIFFERENTLY— NOT JUST A LITTLE MORE OR LESS OF SOMETHING WE'RE ALREADY DOING.[1]

1 Chan, K. (2019), "What Is Transformative Change, and How Do We Achieve It?: Think Globally Act Locally," IPBES blog. https://ipbes.net/news/what-transformative-change-how-do-we-achieve-it

2 World Bank (2020), Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition. https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action

3 International Resource Panel, United Nations Environment Programme (2019), Global Resources Outlook 2019: Natural resources for the future we want. https://www.resourcepanel.org/reports/global-resources-outlook

4 International Energy Agency (2021), Role of Critical Minerals in Clean Energy Transitions. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

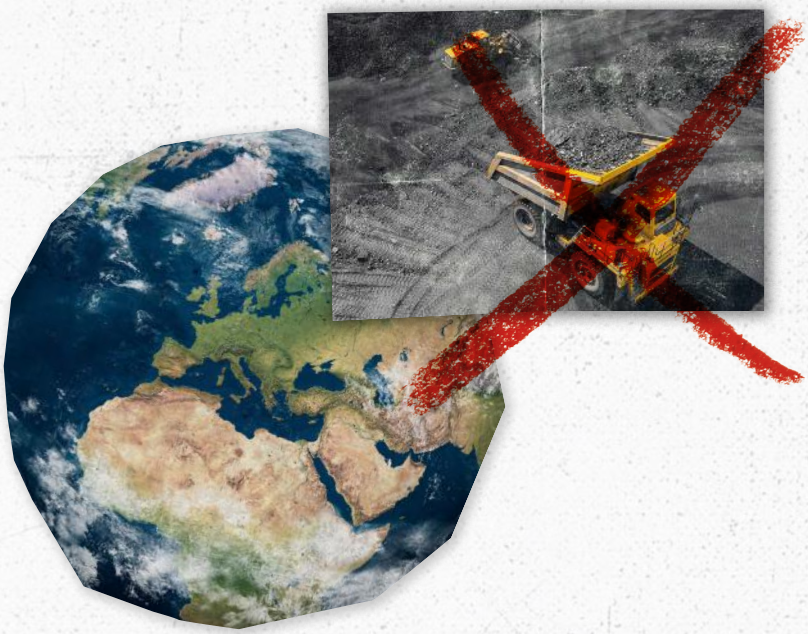
5 Organisation for Economic Co-operation and Development (2019), Global Material Resources Outlook to 2060. https://www.oecd.org/environment/global-material-resources-outlook-to-2060-9789264307452-en.htm

The paper takes 2050 as its viewpoint. This temporal displacement enables reader-participants to grasp the enormous transition to a far less resource-intensive society, a society equipped to deal with the impacts of climate change, reverse the biodiversity loss of the preceding century, and break free from resource extraction.

The paper is structured as follows:

- **2050: a post-mining world** brings us into an alternative vision of the future;
- **2020: the tipping point for mining** explains some of the ongoing trends in 2020, helping readers understand the shift to come;
- **Seeds of change** highlights the many changes and new ways of doing that were already present in 2020 and that allowed the transformation to take place;
- **A compass for the future** provides insights on on the paradigm shift away from mining in the 2020s;
- **Imagining a world without mining workshop** presents a workshop concept to co-envisage the paths to post-mining futures, encouraging readers to adopt their own paths of action.

Let's start by **projecting ourselves to 2050**, a world in which mining has become a thing of the past, and look at how we got here, by visiting the seeds of change already sprouting in 2020.



2 STORY OF A 2050 POST-MINING WORLD

AND HOW WE GOT HERE

"THERE IS NOTHING LIKE A DREAM TO CREATE THE FUTURE."

— VICTOR HUGO, LES MISÉRABLES

WE ARE IN 2050, NOVEMBER 23RD – CHUQUICAMATA, CHILE.

A crowd gathers for the opening of the Global Extractivism Museum (GEM). It is a sober memorial to an era of relentless extractivism and mining that came to an end this year, when Chuquicamata, Chile's biggest copper mine and the last mine on Earth, closed. The massive scar of the mining pit forms a dramatic backdrop to the museum.

Visitors – and the millions of people across the globe who experience the GEM virtually – marvel at the mining machines on display. It is sobering to see how over time the greed for metals created irreparable injustices across the planet. The lives it destroyed, the ecological disasters it led to, the wars it ignited. The most terrifying machines are those designed for deep-sea mining – massive, automated machines designed to dig up the deep seabed, working as far as six kilometres under water. They were used only in a few tests in the 2020s and then, when by deep-sea mining's certain devastation of the place where life originated could no longer be ignored or accepted, put on hold forever.

By then it was already clear that mining was a hopelessly outdated concept: new ventures such as deep-sea mining or moon and asteroid mining were not only untenable – they weren't even needed. In the 2040s mining could no longer compete with the supply of secondary metals and substitute materials that were progressively taking over the market, supported by a circular-economy approach pioneered in the 2020s. The 2030s and 2040s were hard times for the few companies that survived the burst of the mining "bubble" and continued extracting copper, nickel, lithium or cobalt. More successful companies shifted towards urban and landfill mining, recovering metals from e-waste, landfills and other secondary sources.

NEW VENTURES SUCH AS DEEP-SEA MINING OR MOON AND ASTEROID MINING WERE NOT ONLY UNTENABLE – THEY WEREN'T EVEN NEEDED.

It wasn't just changes in materials use that drove mine closures. Growing concern led citizens across the world to challenge extractive economies that threatened life by driving climate change. Accountability to future generations became the compass for strict circular-economy policies that included caps on global resource use and a general shift in consumer behaviour: the Great Transition. The Transition was also about deeper change, with more and more countries letting go of the tired GDP-growth paradigm and replacing it with economies focusing on wellbeing for both planet and people.

2020 – THE TIPPING POINT FOR MINING

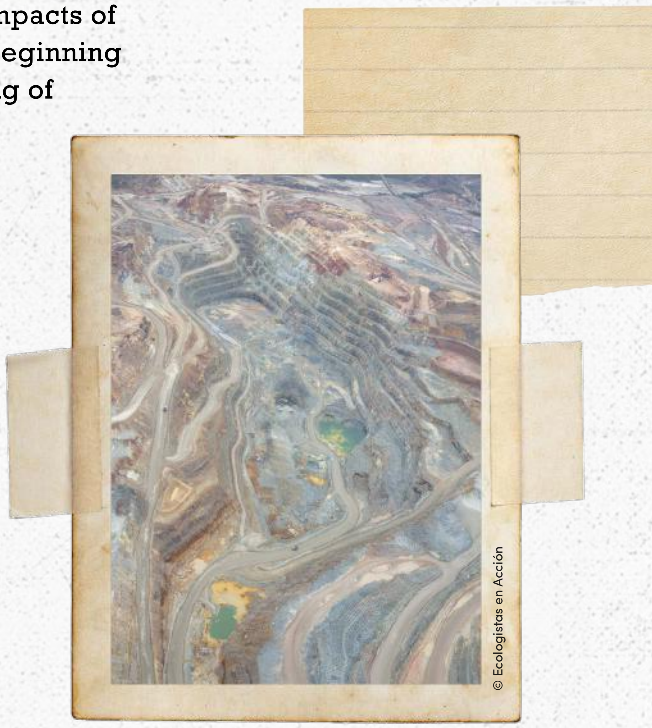
The destructive lifestyles and economies of much of the 20th century and first two decades of the 21st were deeply shaken in the Global North by the 2020 COVID pandemic. Called the "lost year" because of the deep crisis sparked by the pandemic, 2020 was later acknowledged as a positive year of change. Years of climate campaigning together with COVID-related measures such as lockdowns, travel restrictions and a return to public spaces brought on by less car use made society think about its relationship to nature. The evidence that extractivism and other assaults on nature triggered the emergence of new diseases through zoonosis contributed to a growing sense that something was fundamentally wrong with the "old normal".

In the Global North, and particularly in Europe, plans to securitise supply chains of raw materials through insourcing of mining production encouraged communities and civil society to mobilise in opposition to resource exploitation, empowered by similar social movements from the Global South, already well versed in the dangers and effects of the mining industry. Resistance came in the form of declarations, protests, petitions and rising awareness. The environmental crimes and corruption associated with mining were pursued through the courts and in the streets. New narratives such as Ubuntu, Buen Vivir and degrowth challenged traditional modes of development, and were discussed and debated amongst those who viewed "business-as-usual" as a direct threat to societal wellbeing. As people noticed how their lifestyles had been affected by COVID, new narratives of a post-gowth, post-development, post-extractive and post-mining future began to take shape.

The expansion of mining to new frontiers, such as the deep sea, stood in stark contrast to global commitment to reversing biodiversity loss. Under increasing pressure from citizens, civil society organisations and thousands of scientists, decision-makers were forced to turn their backs on extractive lobbies and listen carefully to calls for the transformational change needed to preserve life on the planet – including human life.

While many had already known that several planetary boundaries (the planet's "safe operating space for humanity") had been transgressed, this fact and its consequences were generally ignored – by individuals as much as by governments – despite the growing social and political movements promoting alternatives, despite the overwhelming scientific knowledge about the potential impacts of deep-sea mining and ongoing extraction on land. The increasing gap between the 1% extremely rich and the remaining 99%, between the over-developed and under- or de-developed areas of the world, the social exclusion and growing economic inequality which converted some countries into "sacrifice zones" for mining and other forms of extractivism to benefit others: these were ignored, too.

Looking back, it's hard to imagine how so many people put up with it. Polluted cities caused nine million deaths each year and created generations of asthmatics.[6] Toxic stress caused by working and living conditions led to a massive increase in depression and other mental health illnesses all over the world. Heavy metals at sea forced restrictions in fish consumption. Acid drainage from mining reached the seas and polluted coastal areas. The long-term health impacts of the endocrine disruptors in synthetic chemicals were just beginning to be understood. Ever-increasing extraction and processing of natural resources (metals, minerals, biomass, fossil fuels, water and land) was destroying biodiversity and driving gross human-rights violations.



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6 Le Page, M. (2019). "Does air pollution really kill nearly 9 million people each year?", *New Scientist*, March 12. At: https://www.newscientist.com/article/2196238-does-air-pollution-really-kill-nearly-9-million-people-each-year/

Promises to end child labour and deadly conditions in and around mines were not kept. The exploitation of people and human rights violations by the mining industry grew with each new mine. Mining and processing kept destroying biodiversity, led to increasing water stress impacts, and about 10% of global greenhouse gas emissions.[7] Even the most unenlightened began to see: this could not go on.

Options were very limited anyway. By 2020, even the most fervent proponents of the electric vehicle (EV) transition within a GDP-growth scenario knew global reserves of metals such as copper, lithium or manganese would be depleted before 2050, even with an exponential increase in recycling rates. Predicted lithium consumption for EVs alone would have completely depleted world reserves in just two decades, while increased mining and continuous growth would have actually increased greenhouse emissions in absolute terms, making decarbonisation policies utterly useless.[8]

Deep-sea mining - still promoted by some - threatened to worsen biodiversity loss and climate conditions by reducing the ocean's carbon dioxide absorption capacity and disrupting open-ocean ecosystems on a global scale. The fact that genetic material from threatened deep-sea vents made it possible to develop tests and vaccines for COVID and other diseases[9] lead to strict protection measures under a newly mandated International Seabed Protection Agency following a global ban on deep sea mining.

PROMISES TO END CHILD LABOUR AND DEADLY CONDITIONS IN AND AROUND MINES WERE NOT KEPT. THE EXPLOITATION OF PEOPLE AND HUMAN RIGHTS VIOLATIONS BY THE MINING INDUSTRY GREW WITH EACH NEW MINE.

7 IPBES (2019). *Global Assessment Report on Biodiversity and Ecosystem Services*. Bonn: IPBES. At: https://ipbes.net/global-assessment ; IRP (2019). *Global Resources Outlook* 2019. Nairobi: UNEP. At: https://www.resourcepanel.org/reports/global-resources-outlook ; Azadi, M., et al. (2020). *"Transparency on greenhouse gas emissions from mining to enable climate change mitigation," Nature Geoscience*, 13: 100–104. At: https://www.nature.com/articles/s41561-020-0531-3

8 Blas, Ignacio de, et al. (2020). "The limits of transport decarbonization under the current growth paradigm," *Energy Strategy Reviews*, 32: 100543. At: https://www.sciencedirect.com/science/article/pii/S2211467X20300961

9 UNESCO (2020). "COVID-19: the ocean, an ally against the virus". At: https://en.unesco.org/news/covid-19-ocean-ally-against-virus

THE GREAT TRANSITION: FROM EFFICIENCY TO SUFFICIENCY

Thus 2020 became the beginning of a Great Transition toward the post-mining world of today. Many started to ask themselves what it was that people needed to thrive and have a good life and how these needs could be met within the limits of our planet. Building on early thinkers such as Mahatma Gandhi and J. C. Kumarappa and works such as *The Limits to Growth* (1972)[10] or Small Is Beautiful (1973), the community of degrowth, post-growth and ecological economics advocates brought the message to the mainstream that the paradigm needed to change, the system needed to change. Groundbreaking works like Tim Jackson's 2017 *Prosperity Without Growth*[11] and Kate Raworth's *Doughnut Economy*[12] inspired governments, companies and citizens alike. Millions of youth clamored in the streets for *system change instead of climate change*. While frightening, the 2020 crisis not only made people realise that change was needed, it showed them that it was possible.

At the political level, the notion that societies needed economic growth (i.e., growth in consumption and production, expressed as GDP growth) was starting to crack. The European Environment Agency openly challenged this idea,[13] outlining ideas for "growth without economic growth", joining the voices of indigenous peoples, local communities, social movements and scientists from across the world. In Europe, the first-ever EU binding targets to reduce over-consumption were established with the goal of reducing resource use by 2030, which would bring EU consumption within planetary boundaries by 2050. The stage was set for further developments towards a more sustainable future.

MILLIONS OF YOUTH CLAMORED IN THE STREETS FOR SYSTEM CHANGE INSTEAD OF CLIMATE CHANGE.

10 In fact, the business as usual scenario projected in the 1970s compares very well with real developments 40 years later. See: Turner, G.; Alexander, C. (2014). "Limits to Growth was right. New research shows we're nearing collapse," *The Guardian*, Sep. 2. At: https://www.theguardian.com/commentisfree/2014/sep/02/limits-to-growth-was-right-new-research-shows-were-nearing-collapse

11 Jackson, T. (2017). *Prosperity Without Growth: Foundations for the Economy of Tomorrow*. London: Routledge.

12 Raworth, K. (2018). *Doughnut Economics, Seven Ways to Think Like a 21st-Century Economist.* New York: Random House.

13 Strand, R., et al. (2021). "Growth without economic growth," EEA Briefing no. 28/2020. At: http://doi.org/10.2800/781165

Cities reinvented their mobility plans, banning private cars altogether in many places and revolutionng transport infrastructure, while rational use of work-from-home helped reduce commuting and traffic. In the Global North car sales plummeted and a drastic reduction of privately own cars followed. Reduced work weeks and workdays facilitated a return to the countryside, the return of self- and community-grown foodstuffs, and more available time for social, cultural and political engagement. Social pressure forced governments and international bodies to establish binding commitments and new regulatory frameworks.

This affected everyday patterns of consumption and behaviour: i.e., planned obsolescence of mobile phones, laptops and other electronics was banned and enforced, while strict guidelines for advertisement curbed perceived obsolescence and conspicuous consumption; new regulations ensured long-durability guarantees for all metal-containing devices as well as design and traceability standards that guaranteed reparability, reuse and full recovery of all components. No longer were hundreds of millions of old mobile phones hoarded in drawers, shipped to the Global South or dumped. Most electronic devices became a valuable part of leasing or cooperative schemes where items were fixed during their lifespan and recuperated at end-of-life as part of their producer's expanded responsibility. In the over-developed Global North, the widespread adoption of simple living[14] became a cultural trend, redefining appropriate technologies on the basis of actual needs rather than growth. Reducing overconsumption and superfluous travel was critical for de-carbonising energy and transport systems.

New institutional arrangements were made to ensure that remaining raw materials were used sensibly for the benefit of the whole of humanity while considering the possible needs of future generations. Individual countries started to ban metal mining altogether and deep-sea mining was banned globally. The International Resource Panel gave way to a new global mechanism for raw-materials governance. Mining ceased to be ruled by market mechanisms and speculative finance and came under the steering capacity of an international body and publicly owned enterprises which supervised the phasing out of new metals mining. Mining for luxury goods such as gold and diamonds was the first to be banned; rising prices led to more targeted use of minerals, extended value retention, less waste and more reuse and recycling.[15] Social needs and planetary boundaries superseded profit-making as a driver for steering enterprises, securing a "justice transition" away from mining.[16]

14 Or, as the 1987 UN World Commission on Environment and Development ("Brundtland") Commission report had stated, that *"those who are more affluent adopt life-styles within the planet's ecological means"*. See: "Report of the World Commission on Environment and Development: Our Common Future". At: http://www.un-documents.net/wced-ocf.htm

15 See: Meynen, N. (2019). *Frontlines: Stories of Global Environmental Justice*. Alresford: Zero Books, p. 142.

16 See: Hitchcock, B. (2019). *A just(ice) transition is a post-extractive transition.* London: War on Want and London Mining Network. At: https://londonminingnetwork.org/wp-content/uploads/2019/09/Post-Extractivist-Transition-report-2MB.pdf

2050, THE SYMBIOCENE

The geological scars of pollution and exploitation left by the Anthropocene – a term proudly adopted by the scientific community in the 2010s based on the new stratum of radiation, soot and plastics on the planet's surface – as well as the social and environmental scars of the Capitalocene – a historical epoch characterised by the apparently endless accumulation of capital – slowly started to heal, moving away from an apparently irreversible path toward self-annihilation and mass extinction. A new geosocial era emerged: the *Symbiocene*.[17]

How did this transition to a global society that walks lightly upon Earth come about? How did we become equipped to deal with the effects of climate change and reverse the biodiversity loss of the previous century? How did mining become obsolete, restoring life to mountains and rivers and safeguarding the seabed from an invasion of digging machines? How could bold visions for the future have empowered people, communities and countries to act? Read on to find out…

17 Albrecht, G. (2019). "After the Anthropocene," *Ecologist*, February, 27. At: https://theecologist.org/2019/feb/27/after-anthropocene

3

2020: THE TIPPING POINT FOR MINING

"THE GLOBAL RESOURCES OUTLOOK SHOWS THAT WE ARE PLOUGHING THROUGH THIS PLANET'S FINITE RESOURCES AS IF THERE IS NO TOMORROW, CAUSING CLIMATE CHANGE AND BIODIVERSITY LOSS ALONG THE WAY. FRANKLY, THERE WILL BE NO TOMORROW FOR MANY PEOPLE UNLESS WE STOP."
— JOYCE MSUYA, ACTING EXECUTIVE DIRECTOR OF UN ENVIRONMENT.

WHAT WAS IT LIKE BACK IN 2020?

Earth was in crisis at the turn of the third decade of the century: climate change, the peak of the Anthropogenic extinction, water scarcity and peak extraction of oil and many metals. These interwoven crises were being approached as unconnected problems despite their common root causes. The main driver of environmental destruction, biodiversity extinction and dramatic climate events was the overconsumption fuelling an extractive throw-away economy in over-developed societies. This was based on a fantasy of perpetual growth imposed by a global minority.

Growing consumption and increasing population numbers living unsustainable lifestyles meant Earth was no longer able to deliver natural resources for an overgrown socioeconomic metabolism nor to absorb its waste, including carbon emissions. The global material footprint, i.e., the total amount of all raw materials – including metals and minerals – extracted to meet consumption demands was more than 90 billion tons in 2017, an increase of 70% from 2000. The UN had predicted that it would grow to 190 billion tons by 2060.[18] Inequalities in per capita resource consumption were extravagant: from 30 tonnes per person in high-income countries to 2 tonnes in low-income countries. In 2020, 1% of the world's population used twice as much energy as the less materially "wealthy" 50%.[19]

THE GLOBAL MATERIAL FOOTPRINT, I.E., THE TOTAL AMOUNT OF ALL RAW MATERIALS — INCLUDING METALS AND MINERALS — EXTRACTED TO MEET CONSUMPTION DEMANDS WAS MORE THAN 90 BILLION TONS IN 2017, AN INCREASE OF 70% FROM 2000. THE UN HAD PREDICTED THAT IT WOULD GROW TO 190 BILLION TONS BY 2060.

18 See: https://unstats.un.org/sdgs/report/2019/goal-12/

19 Gore, T. (2020). *Confronting carbon inequality*. Nairobi: Oxfam. At: https://www.oxfam.org/en/research/confronting-carbon-inequality

In 2020, the UN Secretary-General António Guterres denounced humanity's suicidal "war on nature", warning about the broken state of the planet: "Biodiversity is collapsing. One million species are at risk of extinction. Ecosystems are disappearing before our eyes. Deserts are spreading. Wetlands are being lost. Every year, we lose 10 million hectares of forests."[20] That same year, the Executive Director of UN Environment Inger Andersen and the economist Partha Dasgupta said COVID was an "SOS signal for the human enterprise"[21] and that contemporary economic thinking did not recognise that human wealth depends on nature's health. They stressed how the pandemic was a warning about "the need to live within the planet's 'safe operating space', and the disastrous environmental, health and economic consequences of failing to do so." Correctly, they identified the problem as a mismatch between the artificial "economic grammar" driving policy and business and "nature's syntax", which determines how the real world works.

At the beginning of the Great Transition, big corporations and their lobbies influenced public debate. They worked behind the scenes, stoking the obsession for economic growth[22] and policy-makers' fear of making bold decisions. Despite the clear evidence change was indeed possible, political will proved difficult to mobilise. Many feared the uncertainty, while others gripped firmly to their profits and lifestyles even as everything threatened to collapse around them.

Policy decisions that appeared to be solutions or improvements were in fact only temporary measures, problems postponed in the short term only to deepen them further. It was no longer possible to solve existing problems using the same kind of thinking that created them – but alternatives were often dismissed as utopian or unrealistic.

River at the San Finx mine, Spain

20 See: https://www.un.org/press/en/2020/sgsm20467.doc.htm

21 Carrington, D. (2020). "Coronavirus is an 'SOS signal for the human enterprise'," *The Guardian*, June 5. At: https://www.theguardian.com/world/2020/jun/05/coronavirus-is-an-sos-signal-for-the-human-enterprise

22 Richters, O.; Siemoneit, A. (2019). "Growth imperatives: Substantiating a contested concept," *Structural Change and Economic Dynamics*, 51: 126-137. At: https://doi.org/10.1016/j.strueco.2019.07.012

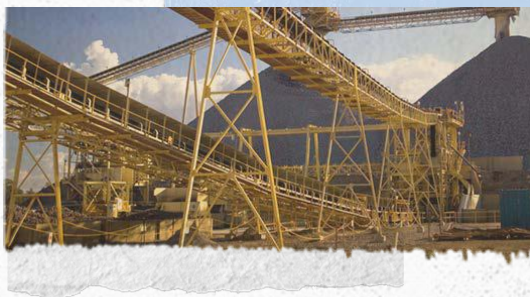
MINING OUR WAY INTO TROUBLE

The pathological focus on economic growth in the decades leading up to the 2020s had set humankind on a course to the abyss. Deep-sea mining was a sign of increasing desperation. Societies in over-developed countries became trapped by the belief that only owning more could make people happy. On the other hand, under- and de-developed areas with easily extractable mineral ores often became trapped by the resource curse (the poverty paradox). A 2020 scientific study published in Nature concluded that, "Based on the current resource consumption rates and best estimate of technological rate growth our study shows that we have very low probability, less than 10% in most optimistic estimate, to survive without facing a catastrophic collapse."[23] The study concluded that there were only "a few decades left before an irreversible collapse of our civilisation."

At the eleventh hour for reducing carbon emissions policy-makers and society finally acknowledged the need to turn away from fossil fuels, but with the delusional idea that all could remain the same, and only energy production would have to use renewable sources, even if these came at a huge cost in minerals, energy and infrastructure.

As over-developed countries tried to *mine their way out* of the problems they had created, most people seemed to ignore how this in fact meant digging humanity deeper into trouble. As a senior geologist at the Geological Survey of Finland put it in 2020, most policy-makers had been led to believe that, through mining, they could simply replace an industrial civilisation built on cheap oil with a green version of the same model.[24]

A 2020 SCIENTIFIC STUDY PUBLISHED IN NATURE CONCLUDED THAT, "BASED ON THE CURRENT RESOURCE CONSUMPTION RATES AND BEST ESTIMATE OF TECHNOLOGICAL RATE GROWTH OUR STUDY SHOWS THAT WE HAVE VERY LOW PROBABILITY, LESS THAN 10% IN MOST OPTIMISTIC ESTIMATE, TO SURVIVE WITHOUT FACING A CATASTROPHIC COLLAPSE." THE STUDY CONCLUDED THAT THERE WERE ONLY "A FEW DECADES LEFT BEFORE AN IRREVERSIBLE COLLAPSE OF OUR CIVILISATION."

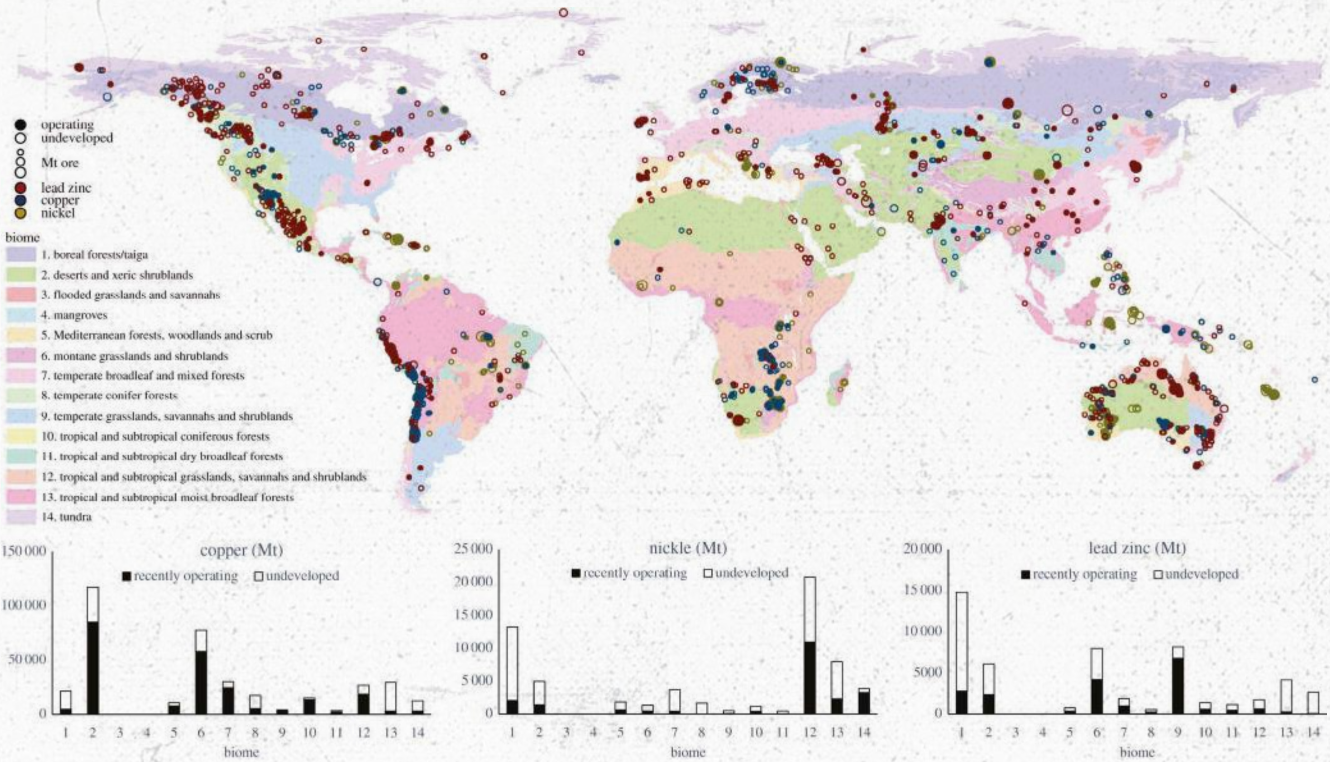


23 Bologna, M.; Aquino, G. (2020). "Deforestation and world population sustainability: a quantitative analysis," *Scientific Reports*, 10: 7631. At: https://www.nature.com/articles/s41598-020-63657-6

24 Michaux, S. (2020). "The Raw Material Challenges Facing the Energy Transition from Oil to Minerals" [presentation]. At: https://www.gtk.fi/en/presentation-the-raw-material-challenges-facing-the-energy-transition-from-oil-to-minerals/

The resulting demand for renewable energy and power storage, EVs, digitisation and urbanisation, as well as an overall rise in resource consumption, pushed the demand for raw materials and mining many times beyond planetary limits, while the drive for increased *low-cost* mining led to larger and more disastrous failures in mine tailings facilities. Mining and processing kept destroying biodiversity, led to increasing water stress impacts, and about 10% of global greenhouse gas emissions.[25] Exponential growth in metal mining meant that even at what was then considered a moderate growth rate of 3%, mining production was to double every 25 years.[26]

Figure 1: Distribution of operating metal mines and prospecting projects among Earth's terrestrial biomes.



Source: Sonter et al. (2018).[27] Note: Mine symbol colour distinguishes between metals (lead/zinc, copper, nickel) and symbol size depicts reserve size (Mt). The three bar graphs represent each metal tonnage per biome and the biome numbers are found in the key.

25 IPBES (2019). *Global Assessment Report on Biodiversity and Ecosystem Services*. Bonn: IPBES. At: https://ipbes.net/global-assessment ; IRP (2019). *Global Resources Outlook 2019*. Nairobi: UNEP. At: https://www.resourcepanel.org/reports/global-resources-outlook ; Azadi, M., et al. (2020). "Transparency on greenhouse gas emissions from mining to enable climate change mitigation," *Nature Geoscience*, 13: 100–104. At: https://www.nature.com/articles/s41561-020-0531-3

26 Exter, Pieter van, et al. (2018). *Metal demand for renewable electricity generation in The Netherlands*. Amsterdam: Metabolic. At: https://www.metabolic.nl/publications/metal-demand-for-renewable-electricity-generation-in-the-netherlands-pdf/

27 Sonter, L.J., et al. (2018). "Mining and biodiversity: key issues and research needs in conservation science," *Proceedings of the Royal Society B*, 285(1892). At: https://royalsocietypublishing.org/doi/10.1098/rspb.2018.1926

Meanwhile, metals were wasted on a large scale – lost in incineration, downcycled, buried in landfills or dumped in the Global South? instead of being reused or recycled. In Europe alone, 160 million mobile phones were discarded every year. Each device, typically weighing less than 150 grams, was packed with valuable resources.[28] The "circular economy" had been a popular policy narrative for years, even supported by industry – arguably because it focused on efficiency while maintaining the economic-growth paradigm. The need for rich countries to tackle the root-cause of planetary crises – i.e., overconsumption and obsession with growth – remained largely unaddressed, even though the science was clear: humanity would not be able to recycle or mine itself out of the mess.

28 See: http://www.ellenmacarthurfoundation.org/news/in-depth-mobile-phones

RENEWABLE ENERGY PRODUCTION AND POWER STORAGE

After a century in which fossil fuels were the life-blood of global economies, the planet had been brought to the brink of climate chaos. Under great social pressure, fossil-fired power plants started to be replaced by energy production from renewables. Further electrification in all sectors would ensure the phase-out of fossil fuel. This heralded a time of techno-optimism, during which over-developed societies tried to hold onto the economic-growth model of the past century under the illusion that efficiency and innovation could turn the tide on global warming and biodiversity collapse. While the transition to renewable energies was an important component to mitigate global warming, the initial business-as-usual approach compromised carbon reduction gains, while mechanical stress and climatological impacts made wind and solar renewable energy infrastructure's lifespan short – i.e., 25 years.[29]

The transition to renewable energy meant phasing out internal combustion vehicles and ships, replacing fossil-fuel power generation and converting industrial energy systems and residential heating systems to electricity. If patterns of consumption had continued, this would have involved quadrupling the non-fossil-fuel power-generation capacity of 2020 – which included nuclear and waste incineration, in addition to metal-intensive renewables.

Under a business-as-usual projection, this would have meant building almost:

900 NEW NUCLEAR POWER STATIONS – still seen as viable by some at the time

more than 13,000 LARGE HYDROELECTRIC DAMS

some 70,000 NEW WIND FARMS and OVER 74,000 SOLAR FARMS GLOBALLY,[30]

in addition to hugely extended and material-intensive power-distribution infrastructure.[31]

29 See: http://www.ewea.org/wind-energy-basics/faq/ (wind); https://news.energysage.com/how-long-do-solar-panels-last/ (solar)

30 Based on Michaux, S. (2020), op cit.

31 Bumby, S. et al. (2010). "Life Cycle Assessment of Overhead and Underground Primary Power Distribution," *Environ. Sci. Technol.*, 44: 5587-5593. At: https://doi.org/10.1021/es9037879

Metals in a 84 MW solar power plant (tonnes)

13650	Iron
1344	Aluminium
184.8	Copper
168	Steel
46.2	Chromium
42	Manganese
38.9	Tin
19.7	Nickel
13.6	Zinc
4.5	Magnesium
4.2	Molybdenum
3.9	Silver
1.7	Lead
0.5	Titanium
0.5	Cadmium
0.4	Tellurium
0.4	Indium
0.04	Vanadium
0.03	Gallium

Massive large-scale solar-energy projects (so-called sun farms) then being built required huge quantities of minerals for solar panels, cabling, motors, inverters, transmission lines and energy-storage facilities, which in turn required extraction.[32] In fact, photovoltaic plants were one of the renewable energies with the highest raw-material demands – only beaten by offshore wind power. In the second decade of the 21st century, large-scale solar-energy projects had caused a surge in demand for certain metals, consuming 18% of the world's silver production every year and leading to aggressive extraction in increasingly marginal deposits. Some projections contemplated more than 8,000 GW of installed photovoltaic energy in 2050, up from 480 GW in 2018.[33]

While onshore wind-power infrastructures were less dependent on scarce minerals than their solar counterparts,[34] the huge scale of projects being built drove a surge in demand, including for rare-earth minerals. Demand for neodymium and dysprosium increased by 700% and 2,600% respectively.[35] The ocean was more and more seen as a vast new energy plant, with the EU alone planning a twenty-five-fold increase of offshore wind farms by 2050 (some 300 GW), which would correspond to about 80,000 wind turbines in European seas alone.[36] Globally, estimates targeted 1,400 GW of offshore facilities by the same year.[37]

32 An average sun farm in the late 2010s demanded for every MW of production capacity 162.5 tonnes of iron, 16 tonnes of aluminium, 2.2 tonnes of copper, 2 tonnes of steel, 0,55 tonnes of chromium, 0,5 tonnes of manganese, 0,46 tonnes of tin, 0,23 tonnes of nickel and 0,16 tonnes of zinc, among a much longer list of minerals. An average 84 MW farm required massive amounts of all these metals plus large quantities of other raw materials, including 4.2 tonnes of molybdenum; 3.92 tonnes of silver; 1.78 tonnes of lead, 530 kg of titanium, 390 kg of tellurium, etc. De Castro, C.; Capellán-Pérez, I. (2020). "Standard, Point of Use, and Extended Energy Return on Energy Invested (EROI) from Comprehensive Material Requirements of Present Global Wind, Solar, and Hydro Power Technologies," *Energies*, 13: 3036. At: https://doi.org/10.3390/en13123036

33 IRENA (2019). *Future of solar photovoltaic*. Abu Dhabi: International Renewable Energy Agency. At: https://www.irena.org/publications/2019/Nov/Future-of-Solar-Photovoltaic

34 Every MW of installed wind power still required 22 tonnes of iron, 2 tonnes of aluminium, 2.7 tonnes of copper, 126 tonnes of steel, 0.1 tonnes of nickel, 0.1 tonnes of neodymium and smaller amounts of dysprosium. Capellán-Péreza, Í.; de Castro, C. (2020), op. cit.

35 Alonso, E. et al. (2012). "Evaluating Rare Earth Element Availability: A Case with Revolutionary Demand from Clean Technologies," *Environ. Sci. Technol.*, 46(6):3406-3414. At: https://pubs.acs.org/doi/10.1021/es203518d

36 OREAC (2020). *The Power of our Ocean*. Brussels: Global Wind Energy Council.

37 COM(2020) 741 final. At: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:741:FIN

The shift to renewables also involved developing immense power-storage capacity to manage intermittent supply fluctuations. Some projections envisioned the installation of approximately 6 million 100MW storage stations that would require 48.7 million tonnes of lithium-ion batteries just to secure a 4-week period of limited wind and solar availability during winter.

BY 2020, THE LARGEST OF SUCH STATIONS WAS THE HORNSDALE POWER RESERVE IN AUSTRALIA, INTENDED TO SERVE AS A MODEL FOR REPLICATION ACROSS THE WORLD. SUCH BATTERY STORAGE CAPACITY, HOWEVER, WOULD HAVE REQUIRED EXTRACTING 8 MILLION TONNES OF COPPER, 4 MILLION TONNES OF ALUMINIUM, 7.4 MILLION TONNES OF NICKEL, 1.3 MILLION TONNES OF COBALT, 1 MILLION TONNES OF LITHIUM AND 10.7 MILLION TONNES OF GRAPHITE.[38]

Almost no one seemed to care back in 2020 that this disaster was built on a system of wasted energy. Energy losses in transmission and distribution grids were an average 10% (up to 50% in some countries).[39] Another 10% of the total annual household electricity consumption was due to standby losses (those little red lights) causing 1% of global carbon emissions.[40] Air conditioning accounted for another 10% of all global electricity consumption in 2018.[41] AC to DC conversion losses were around 20% for computers, rechargeable electronics and lighting. How could massive mineral extraction be justified in the context of massive waste?

38 Michaux, S. (2020), op. cit.

39 Jordaan, S.M.; Surana, K. (2019). "We calculated emissions due to electricity loss on the power grid – globally, it's a lot," *The Conversation*. At: https://theconversation.com/we-calculated-emissions-due-to-electricity-loss-on-the-power-grid-globally-its-a-lot-128296

40 See: https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/selina_consumer_guide_en.pdf

41 IEA (2018). *The Future of Cooling*. Paris: International Energy Agency. At: https://www.iea.org/futureofcooling/

ELECTRIC VEHICLES

In 2009 Fatih Birol, Chief Economist of the International Energy Agency, warned "we have to leave oil before oil leaves us".[42] Even as oil was eventually left behind, the environmental consequences of burning fossil fuels did not leave us. As global warming threatened humanity, bringing a sense of urgency to move away from oil, the early choice in the 2020s was to phase out internal-combustion vehicles and replace them with EVs. For cars and trucks alone, this meant replacing 1.4 billion vehicles.

Shifting these 1.4 billion vehicles to electric motors would have required 339 million tonnes of lithium-ion batteries while electrifying maritime shipping – some 100,000 vessels – would have required another 451 million tonnes of Li-ion batteries. In Europe alone, substituting over 260 million internal-combustion vehicles with EVs would have required over 65 million tonnes of Li-ion batteries.[43] Despite a lack of alternatives to fossil-fuel-based aviation in the 2010s, passenger numbers doubled between 2009 and 2019 (partially thanks to heavy subsidies) before finally collapsing in 2020 in the context of the COVID pandemic.

The projected amount of batteries required – 790 MILLION TONNES OF LI-ION BATTERIES – for cars, trucks and marine vessels alone (excluding trains and aeroplanes, as well as power storage) would require 134.3 MILLION TONNES OF COPPER, 63.2 MILLION TONNES OF ALUMINIUM, 120 MILLION TONNES OF NICKEL, 22 MILLION TONNES OF COBALT, 17.1 MILLION TONNES OF LITHIUM and 173.8 MILLION TONNES OF GRAPHITE.[44]

These impossible figures refer exclusively to first-use EV batteries themselves, excluding the minerals necessary to build the vehicles or vessels, the minerals required to build the renewable-energy installations, the power-storage facilities to charge the batteries,[45] the subsequent battery replacements – as battery life is usually shorter than vehicle life – and all other lithium-ion batteries used for other electrical devices.

42 Connor, S. (2009). "Warning: Oil supplies are running out fast," *Independent*, August 3. At: https://www.independent.co.uk/news/science/warning-oil-supplies-are-running-out-fast-1766585.html

43 Michaux, S. (2020), op. cit.

44 Michaux, S. (2020), op- cit.

45 Lucas, A.; Silva, C.; Neto, R. (2012). "Life cycle analysis of energy supply infrastructure for conventional and electric vehicles," *Energy Policy*, 41: 537-547. At: https://doi.org/10.1016/j.enpol.2011.11.015

By 2020, on-surface copper stock (copper that had already been mined) was 50% of all known ore reserves. Projections contemplated mining in the remaining 50% over the following 30 years – i.e., mining more copper in three decades than during the previous 7,000 years.[46] In the case of other metals, such as silver and gold, the on-surface stock was 70%.[47] Although the projected mineral demand for batteries to be used in EVs alone by far exceeded known global reserves of nickel (90 million tonnes of reserves vs 120 million tonnes required) and cobalt (3.6 million tonnes vs 22 million tonnes) and would fully deplete known global lithium reserves, the assumption was that reserves would continue to expand through more exploration – particularly in the deep seas – and that mining could simply continue indefinitely.

The old English proverb says, "there are none so blind as those who will not see." Changing mobility without changing our habits was not going to solve our environmental problems, but rather aggravate them.[48] Like previous internal-combustion vehicles, proposed EVs still wasted most of their power to carry around 1 or 2 tonnes of materials that made up the vehicle itself, a hugely energy-inefficient manner to transport one or two people.[49] While it took time to admit that transport could never again be what it had become in the over-developed world at the turn of the 21st century, EVs momentarily became a revolutionary creed for those who wished for everything to remain the same. But soon it became clear that it was the whole mobility system that needed overhauling. Like other private cars, EVs spent 95% of the time parked, representing a huge waste of materials. The introduction of the EV car did not change the fact that the road transport system was coming to a grinding halt: the economic cost of traffic congestion was between 2% and 5% of GDP every year[50] and people often spent hours in motorway stand-stills.

46 Pitron, G.; Pérez, J.-L. (2019). *Le vert n'est pas vert!* [film]. Paris: Arte France.

47 Galos, K.; Szamałek, K. (2016). "Metals in Spent Mobile Phones (SMP) – a new challenge for mineral resources management," *Mineral Resources Management*, 32(4):45-48. At: http://journals.pan.pl/dlibra/publication/121561/edition/105936/

48 Pulido-Sánchez, D., et al. (2021). "Analysis of the material requirements of global electrical mobility," *Dyna*, 96(2). At: https://doi.org/10.6036/9893

49 Marqués, R. (2016). "The future of electric mobility (I) Electro-gas stations or electrostables?" At: http://active-mobility.blogspot.com.es/2016/11/

50 See: https://www.adb.org/sectors/transport/key-priorities/urban-transport (Asia); https://ec.europa.eu/transport/themes/urban/urban_mobility_en (Europe)

DIGITALISATION

The beginning of the 21st century came with a frenzy of semiconductor-rich devices, particularly portable electronics such as phones, laptops or tablets and a variety of previously unseen (and mostly rather useless) home appliances and gadgets. In 2020, there were about 15 billion phones, more than double the world's population at the time, in addition to some 2 billion computers. It was estimated that e-waste production would reach 120 million tonnes per year by 2050, while in 2017 global annual production of electronic and electrical waste was already at 44 million tons – the equivalent of 4,500 Eiffel Towers.[51]

An average smartphone included 50 different metals, including almost every existent rare-earth element. In the mid-2010s approximately 5% of global gold, silver and copper production and 20% of cobalt and palladium production went to mobile phones alone, while if adding up all other electric and electronic equipment, these devices hoarded over 40% of the global mining production of copper, tin, antimony, indium, ruthenium and rare-earth elements.[52]

Metal contents of an average smartphone

(Source: University of Plymouth[53])

Iron	33 G	**Molybdenum**	0.07 G
Chrome	7 G	**Gold**	0.036 G
Copper	6 G	**Praseodymium**	0.03 G
Nickel	2.7 G	**Tantalum**	0.02 G
Aluminium	2.5 G	**Niobium**	0.01 G
Tungsten	0.9 G	**Antimony**	0.007 G
Tin	0.7 G	**Gadolinium**	0.005 G
Neodymium	0.16 G	**Germanium**	0.002 G
Silver	0.09 G	**Dysprosium**	0.002 G
Cobalt	0.07 G	**Indium**	0.002 G

51 WEF (2019). *A New Circular Vision for Electronics*. Geneva: World Economic Forum.
At: http://www3.weforum.org/docs/WEF_A_New_Circular_Vision_for_Electronics.pdf

52 Hagelüken, C. (2013). "Recycling of technology metals from electronics".
At: http://www.p-plus.nl/resources/articlefiles/ClosingtheLoopNL2013-10Hagelueken.pdf

53 Williams, A. (2019). "Scientists use a blender to reveal what's in our smartphones".
At: https://www.plymouth.ac.uk/news/scientists-use-a-blender-to-reveal-whats-in-our-smartphones%20
Also see: https://youtu.be/bhuWmcDT05Q

Although concentration-wise a mobile phone had 100 times more gold and 10 times more tungsten than a high-grade mineral deposit,[54] nine out of ten discarded phones – with an average lifespan of little more than two years in 2020 – were incinerated or buried in landfills[55] when over 80% of their total metal value could be recycled with the technology then available.[56] Poor product design made recycling costly and ineffective, while neither producers nor consumers were made liable for recovery. In fact, many people kept stacks of fully operative but out-of-fashion phones in their drawers for no apparent reason.[57] In the EU alone, there were more than 500 million shelved phones in 2020, worth 1.3 billion euros of recoverable gold, silver, platinum, palladium and copper.[58] As a society, we were mining in the wrong places: we should have been mining our drawers and landfills.

The IoT, which involved flooding our homes, towns, cities, workplaces and almost every aspect of life with sensors, apps and other digital technologies, further increased metal demand as sensors needed tin, tungsten, tantalum and platinum; radio frequency identification-tags – such as those used at the time to avoid people stealing items in shops – used silver, copper and aluminium stolen from poor countries around the world; touchscreens relied on indium, silver and copper; and microchips required gallium.[59] The IoT also involved extensive and overlapping wireless networks – as analogue technology led to 2G, 3G, 4G and 5G. Increasing frequency spectrum meant expanding the number of base stations and orbital satellites to support massive volumes of data, with the growing demand for minerals for infrastructure.

* 1.3 BILLION EUROS OF RECOVERABLE GOLD, SILVER, PLATINUM, PALLADIUM AND COPPER

54 Galos, K.; Szamałek, K. (2016). See previous reference.

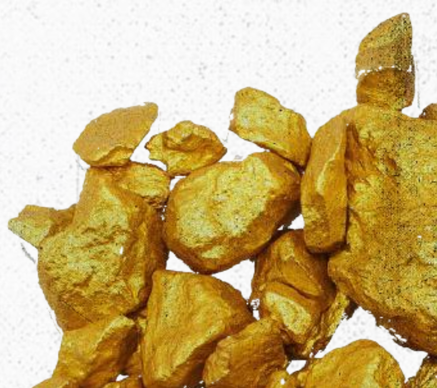
55 Gornall, J. (2016). "Here's the fix: planned obsolescence and the rise of a global repair movement," *The National*, October 10. At: https://www.thenationalnews.com/arts-culture/here-s-the-fix-planned-obsolescence-and-the-rise-of-a-global-repair-movement-1.161013

56 Bookhagenab, B., et al. (2020). "Metallic resources in smartphones," *Resources Policy*, 68: 101750. At: https://doi.org/10.1016/j.resourpol.2020.101750

57 Unwin, T. (2020). "Digital Technologies Are Part of the Climate Change Problem," *ICTworks*, February 20. At: https://www.ictworks.org/digital-technologies-climate-change-problem/

58 reBuy (2020). 2020 Mobile Phone E-Waste Index. At: https://www.rebuy.de/s/mobile-ewaste-index-en

59 Pilgrim, H. (2017). *The Dark Side of Digitalization*. Berlin: PowerShift. At: http://ak-rohstoffe.de/wp-content/uploads/2020/07/PS_FS_Digitalization.pdf



ICT networks used up 10% of the world's electrical production in 2020, while some estimates calculated up to 50% use of world electric production by 2030.[60] In 2020, the digital sector was responsible for almost 4% of global greenhouse emissions (double those from aviation) while 80% of data traffic was video (mostly entertainment).[61] Instead of using the potentials of digital technologies wisely for solving already existing problems – like mobility issues – it was used to "create" new needs and generate massive data flows and technologies to meet them.

COVID accelerated digitalisation trends like never before, leading to an exponential increase in online education, online shopping and online working and meeting. It made some ICT companies dream about making this the norm for the future. In a stark warning, also reminiscent of *The Machine Stops*, Naomi Klein wrote:

This is a future in which, for the privileged, almost everything is home delivered, either virtually via streaming and cloud technology, or physically via driverless vehicle or drone, then screen "shared" on a mediated platform. It's a future that employs far fewer teachers, doctors and drivers. It accepts no cash or credit cards (under guise of virus control), and has skeletal mass transit and far less live art. It's a future that claims to be run on "artificial intelligence", but is actually held together by tens of millions of anonymous workers tucked away in warehouses, data centres, content-moderation mills, electronic sweatshops, lithium mines, industrial farms, meat-processing plants and prisons, where they are left unprotected from disease and hyper-exploitation. It's a future in which our every move, our every word, our every relationship is trackable, traceable and data-mineable by unprecedented collaborations between government and tech giants.[62]

* COVID ACCELERATED DIGITALISATION TRENDS LIKE NEVER BEFORE

60 See: https://ictfootprint.eu/en/news/decreasing-ict-energy-consumption-%E2%80%93-power-data-centres-and-people%E2%80%99s-will-ictfootprinteu-webinar

61 Efoui-Hess, M. (2019). *Climate crisis: The unsustainable use of online video*. Paris: The Shift Project. At: https://theshiftproject.org/en/article/unsustainable-use-online-video/

62 Klein, N. (2020). "How big tech plans to profit from the pandemic," *The Guardian*, May 13. At: https://www.theguardian.com/news/2020/may/13/naomi-klein-how-big-tech-plans-to-profit-from-coronavirus-pandemic

URBANISATION – CITIES GOBBLING UP MATERIALS

At the end of the 2010s, more than half of the world population lived in cities; some projections estimated that by 2050 the urban population would represent 90% of humanity. In 2020, the UN still claimed that "Urbanisation will continue to be the driving force for global growth".[63] If the infrastructure technology of the 2010s was going to be maintained, material consumption would probably need to rise from 40 billion tonnes in 2010 to approximately 90 billion tonnes in 2050.[64] As a 2018 report by the UN International Resource Panel acknowledged, the material requirements, including huge quantities of metals such as copper, iron, titanium or steel, was "more than the planet can sustainably provide".

As an example of this trend, in just three years (2011–2013) China used more cement – 6.6 gigatonnes – than the United States had used during the whole previous century (1901–2000).[65] Growing urban infrastructure inevitably meant more mining in increasingly depopulated rural areas, while smart cities required greater quantities of rarer metals. Self-indulgent efficient and eco-cities seemed to ignore where and how the resources needed for so-called green urbanisation were extracted and at what colossal environmental costs. A vast and increasingly depopulated global hinterland – often due to forced displacement and evictions – continued to feed urban growth and build up waste, including construction residues.

63 UN-Habitat (2020). *World Cities Report 2020: The Value of Sustainable Urbanization*. Nairobi: UN-Habitat. At: https://unhabitat.org/World%20Cities%20Report%202020

64 IRP (2018). *The Weight of Cities*. Nairobi: UNEP. At: https://www.resourcepanel.org/reports/weight-cities

65 Smil, Vaclav (2013). Making the modern world: materials and dematerialization. Chichester: Wiley.

THE GEOPOLITICS OF DYSTOPIA: "WHERE" OR "WHETHER" TO MINE?

These accelerating trends had all the ingredients for an extractivist dystopia. Extractivism not only drained natural resources out of life-sustaining ecosystems, converting them into commodities and waste, but also drained society: it extracted cheap labour from workers without fair pay; it extracted the added value (profit) created by workers for shareholders; it extracted public money for private corporations (subsidies) to maximise profits and redeem their environmental liabilities; it extracted resources from the Global South and peripheral areas to be consumed in the Global North and wealthier cities, leaving huge environmental and social burdens behind; and it extracted data, curtailing privacy and autonomy. Globally, 150 mining companies controlled almost 90% of raw-material extraction in the world.[66]

These different forms of extraction combined into a powerful global phenomenon: extractivism, a profoundly un-ecological and anti-social economic model fuelled by the unsustainable exploitation of nature – from minerals, metals and fossil fuels to land, water and humans. This kind of economy, built upon earlier forms of colonialism, was enabled by the ideological assumption that the Earth, future generations and other, less powerful people were resources to be exploited without limit or consequence for the benefit of a global minority.

66 Ericsson, M. (2012). "Mining industry corporate actors analysis". At: https://goxi.org/sites/default/files/2019-06/Mining%20industry%20corporate%20actors%20analysis.pdf

Paradoxically, human rights violations and absence of environmental "best practices", together with international economic rivalries, were used as an excuse to justify mining pristine areas on land and the destruction of the deep seabed. The fact that certain countries prohibited foreign investors from extracting metals in their territory together with international concerns regarding security of supply was a perfect excuse to encourage mining where (and how) no one had mined before. These actions threatened to exacerbate the environmental and social consequences that extractivism had caused for centuries. At the same time, used batteries and other discarded devices bearing such "critical metals" were being shipped from the EU and US all the way to China for recycling and later repurchase.[67]

Mining was one of the world's most polluting, destructive and deadly[68] industries and a main contributor to climate change and the destruction of nature.[69] The production of seven metals (iron, aluminium, copper, zinc, lead, nickel and manganese) was responsible for 7% of total greenhouse gas emissions.[70] Growing opposition to mining was confronted in many countries with brutality and murder.[71] In 2012, 34 miners on strike were shot dead by police in South Africa.[72] In 2019, more than 200 environmental defenders were killed, mostly in conflicts involving mining.[73] In places where the assassination of opponents was not acceptable, soft counter-insurgency tactics were used to undermine or ridicule those who denounced its impacts and associated corruption.[74]

* IN 2012, 34 MINERS ON STRIKE WERE SHOT DEAD BY POLICE IN SOUTH AFRICA.[72]

67 Melin, H. (2019). *State-of-the-art in reuse and recycling of lithium-ion batteries– A research review*. Stockholm: The Swedish Energy Agency. At: http://www.energimyndigheten.se/globalassets/forskning--innovation/overgripande/state-of-the-art-in-reuse-and-recycling-of-lithium-ion-batteries-2019.pdf

68 MacDonald, A. et al. (2019). "The Hidden Deaths of Mining," *The Wall Street Journal*, December 21. At: https://www.wsj.com/articles/the-hidden-deaths-of-mining-11577825555

69 Nag, O.S. (2020). "The World's Most Polluting Industries", *World Atlas*, October 21. At: https://www.worldatlas.com/articles/the-top-10-polluting-industries-in-the-world.html

70 OECD (2018). *Global Material Resources Outlook to 2060*. Paris: OECD. At: https://doi.org/10.1787/9789264307452-en

71 See: https://www.ilo.org/ipec/areas/Miningandquarrying/lang--en/index.htm

72 See: https://marikana.mg.co.za/

73 Global Witness (2020). *Defending tomorrow*. London: Global Witness. At: https://www.globalwitness.org/en/campaigns/environmental-activists/defending-tomorrow/

74 Dunlap, A. (2020). "Wind, coal, and copper: the politics of land grabbing, counterinsurgency, and the social engineering of extraction," *Globalizations*, 17:4, 661-682. At: https://doi.org/10.1080/14747731.2019.1682789 ; Martinez Alier, J. (2020). "MIREU Backfires," *Environmental Justice*. At: http://www.envjustice.org/2020/09/mireu-backfires/

As part of what was called the Great Acceleration, mining not only continued to be critical for the armaments industry[75] but directly fuelled and prolonged wars, instigated political instability, increased the vulnerability of countries to war and undermined the quality of governance, all in order to get hold of the last minerals across the world, further expanding the consequences of what came to be called the resource curse.[76] Tensions and rivalry between states were also used as an excuse to further ease environmental regulations and silence communities in the sacrifice zones. Indigenous peoples were displaced and whole communities forcibly evicted. In India alone, mining brought about the displacement of 2.55 million people between 1950 and 1990.[77] Labour and health conditions in many mines and smelting factories were inhumane, while more than a million children were working as miners in the early 2020s. As anthropologist Stuart Kirsch put it, mining was an industry where profits were predicated on harm.[78] People had enough of it.

75 Selwyn, D. (2020). *Martial Mining*. London: London Mining Network. At: https://londonminingnetwork.org/wp-content/uploads/2020/04/Martial-Mining.pdf

76 Ross, M.L. (2004). "What Do We Know about Natural Resources and Civil War?" *Journal of Peace Research*, 41(3): 337-356. At: https://doi.org/10.1177/0022343304043773 ; Norman, C. S. (2008). "Rule of Law and the Resource Curse," *Environmental and Resource Economics*, 43 (2): 183-207. At: https://link.springer.com/article/10.1007/s10640-008-9231-y

77 Terminski, B. (2012). "Mining-Induced Displacement and Resettlement: Social Problem and Human Rights Issue," *SSRN*. At: https://www.ssrn.com/abstract=2028490

78 Kirsch, Stuart (2014). *Mining Capitalism*. Oakland: University of California Press. p. 13.

MORE EXTRACTION MEANT MORE DESTRUCTION

As the UN International Resource Panel co-chair Janez Potočnik warned, it was not resource exhaustion that was becoming the core limiting factor of development but rather the "environmental and health consequences caused by this excessive and irresponsible use of resources".[79] A 2020 tailings guidelines warned that mine tailings dams were "failing with increasing frequency and severity".[80] The surge of mining of the early 21st century meant many more and far larger tailings dams,[81] increasing chances of ever greater mining disasters. As the guidelines acknowledged, "the safest tailings facility is the one that is not built."

In 2019 the critical failure of a mine tailings dam in Brumadinho, Brazil, killed over 250 people, destroyed a whole city and released 12 million cubic meters of tailings, polluting 300 km of river ecosystems. In 2015, another tailings dam in the same region caused the Mariana disaster, which released 43.7 million cubic meters of tailings, killing 19 people and polluting 650 km of rivers with heavy metals such as arsenic, lead and mercury before reaching the Atlantic. A year before, in 2014, the tailings dam of the Mount Polley gold and copper mine in Canada failed, causing the spill of 21 million cubic meters into nearby lakes and rivers. One of the reasons for this series of disasters was the decline of ore grades since the 1980s and a subscequent "doubling the volume of mine waste tailings generated for each unit of mineral produced".

THE SURGE OF MINING OF THE EARLY 21ST CENTURY MEANT MANY MORE AND FAR LARGER TAILINGS DAMS, INCREASING CHANCES OF EVER GREATER MINING

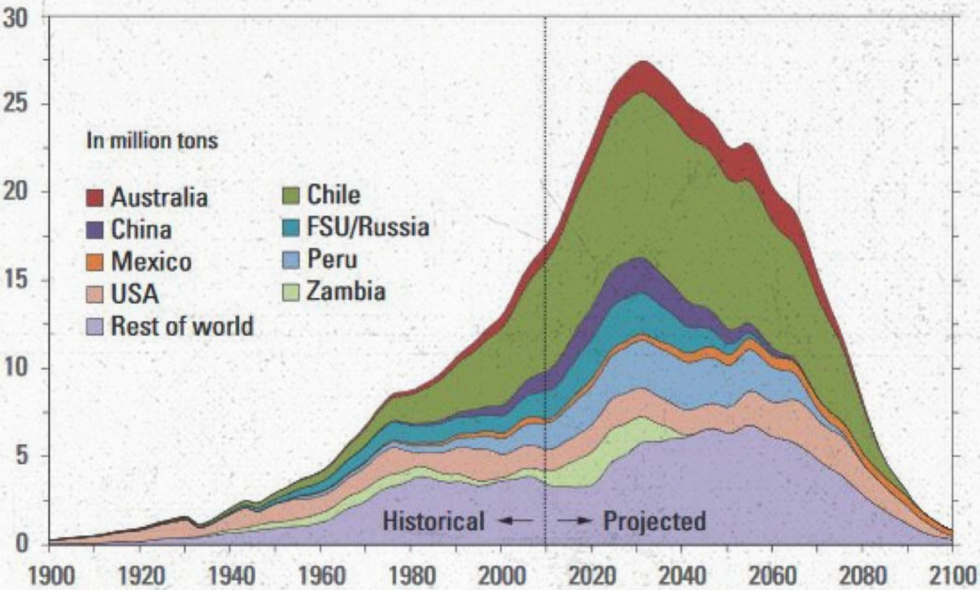
79 See: https://europa.eu/capacity4dev/file/83457/download?token=V5Ht7VEH

80 Morrill, J., et al. (2020). *Safety First: Guidelines for Responsible Mine Tailings Management.* Washington: Earthworks. At: https://www.earthworks.org/publications/safety-first-guidelines-for-responsible-mine-tailings-management/

81 Gold mines – like Mount Polley – generated about 20% of mine tailings in the world. Mudd, G.M. (2019). "Mining & Its Growing Environmental Impacts". At: https://miningwatch.ca/sites/default/files/muddpresentationmining-v-mine-waste.pdf

Grades were reduced by half for many minerals. The average concentration of copper went from 1.8% in 1930 to 0.5% in the 2010s.[82] Lower concentration of ores required mining higher volumes of materials with no commercial value to get the same amount of metals, usually in bulk operations. These demanded higher energy intake, created larger environmental impacts and long-term liabilities and were more likely to involve bigger waste facilities built under minimum low-cost safety standards. Lower ore grades and increasing metal demand was also leading to a rise in greenhouse gas emissions from mining and metal production, which already amounted to 10% of global energy-related greenhouse gas emissions in 2018. Decreasing grades in copper deposits in Chile from 2001 to 2017 led to a 130% increase in fuel consumption and a 32% increase of electricity consumption per unit of mined copper.[83] Projections estimated that by 2050 the exploitation of the last major copper deposits would drain 2.4% of global energy consumption, compared to 0.3% in 2012.[84]

Figure 2: Historical and projected copper production (in million tons).



Soure: Kerr (2014).[85]

82 Arnsperger, C.; Bourg, D. (2017). *Écologie intégrale. Pour une société permacirculaire*. Paris: Presses Universitaires de France, p. 87

83 Azadi, M. et al. (2020). "Transparency on greenhouse gas emissions from mining to enable climate change mitigation," *Nature Geoscience*, 13:100-104. At: https://www.nature.com/articles/s41561-020-0531-3

84 Elshkaki, A. et al. (2016). "Copper demand, supply, and associated energy use to 2050," *Global Environmental Change*, 39: 305-315. At: https://doi.org/10.1016/j.gloenvcha.2016.06.006

85 Kerr, R. (2014). "The coming copper peak," Science, 343: 722-724. At: https://science.sciencemag.org/content/343/6172/722

In 2011, a UN report had already acknowledged that "Today, depending on the metal concerned, about three times as much material needs to be moved for the same ore extraction as a century ago, with concomitant increases in land disruption, groundwater implications and energy use".[86] Together with increased demand this led to a vicious cycle that policymakers, pressured by mining lobbies, seemed unwilling to break:[87] "more energy [was] necessary to extract more minerals which [were] needed to build more energy infrastructure, part of which [was] needed to provide the additional energy required to extract more minerals and so on and so on."[88]

While in the early 2020s most people were roughly aware of what climate change was, very few had had any clue about acid mine drainage, although the UN had acknowledged it as the second biggest global issue after global warming.[89] A 2006 review of environmental impact statements for mining operations concluded that "nearly all the mines that developed acid drainage either underestimated or ignored the potential for acid drainage in their EISs" as well as impacts to groundwater, seeps, and surface water.[90]

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86 IRP (2011). *Decoupling natural resource use and environmental impacts from economic growth*. Nairobi: UNEP. At: https://www.ourenergypolicy.org/wp-content/uploads/2014/07/decoupling.pdf

87 See, for example, the EU's 2020 "Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability". At: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0474

88 Parrique, T. et al. (2019). *Decoupling debunked: Evidence and arguments against green growth as a sole strategy for sustainability*. Brussels: European Environmental Bureau. At: https://eeb.org/library/decoupling-debunked/

89 Marchildon, J. (2017). "The UN Has Called This The Second Biggest Environmental Problem Facing Our World," *Global Citizen*, September 14. At: https://www.globalcitizen.org/en/content/acid-drainage/

90 Kuipers, J.R. et al. (2006). *Comparison of Predicted and Actual Water Quality at Hardrock Mines*. Washington: Earthworks. At: https://www.earthworks.org/publications/comparison_of_predicted_and_actual_water_quality_at_hardrock_mines/

Heavy metals were poisoning soils, rivers, underground water and the oceans. In Cerro de Pasco, Peru, 90% of all children had high levels of lead, mercury, arsenic, tungsten, and other heavy metals in their bodies.[91] Children in the Sierra Minera of Cartagena, in Spain, were suffering a similar fate.[92] The small Tinto and Odiel rivers in Spain transported 37% of the zinc and 15% of the copper contributed by all of the world's rivers to the seas and oceans.[93] This was a consequence of continued mining activity in their basin and lack of environmental control and restoration efforts, leading high heavy metal concentrations in many types of commercially important fish species and forcing restrictions among at-risk groups, particularly children.[94]

Not only were the social and ecological impacts of terrestrial mining worsening, but the drive for mining pushed destruction into previously untouched and pristine environments.[95] A 2020 article in Nature had revealed how mines targeting "materials needed for renewable energy production" had a greater overlap with protected areas and remaining wilderness than mines targeting other materials.[96]

91 See: https://pulitzercenter.org/projects/pasco-region-residents-peru-plead-poisoned-kids

92 Kuner, D. (2019). "Heavy metals are school health risk in Murcia," *EuroWeekly*, October 30. At: https://www.euroweeklynews.com/2019/10/30/heavy-metals-are-school-health-risk-in-murcia/

93 Nieto, J.M., et al. (2007). "Acid mine drainage pollution in the Tinto and Odiel rivers (Iberian Pyrite Belt, SW Spain) and bioavailability of the transported metals to the Huelva Estuary," *Environment International*, 33(4):445-455. At: https://doi.org/10.1016/j.envint.2006.11.010

94 Damiano, S. et al. (2011). "Accumulation of heavy metals to assess the health status of swordfish in a comparative analysis of Mediterranean and Atlantic areas," *Marine Pollution Bulletin*, 62(8):1920-1925. At: https://doi.org/10.1016/j.marpolbul.2011.04.028

95 Marin, D. (2021). "Greenland: Global Warming Hotspot and Environmental Frontline," META, Feb. 11. At: https://meta.eeb.org/2021/02/11/greenland-global-warming-hotspot-and-environmental-frontline/

96 Sonter, L., et al. (2020). "Renewable energy production will exacerbate mining threats to biodiversity," *Nature Communications*, 11:4174. At: https://www.nature.com/articles/s41467-020-17928-5

DEEP SEA MINING: THE BIGGEST LAND-GRAB IN HUMAN HISTORY

With advances in mining technologies, an old dream was revived: all eyes turned to the vast and largely unexplored half of the planet – the deep sea. The metals on the deep seabed, already briefly explored in the 1970s, again became the centre of attention. Driven by a technology optimism to "boldly go where no man has gone before", the push to mine the deep sea seemed unstoppable, and threatened the planet with unprecedented destruction.

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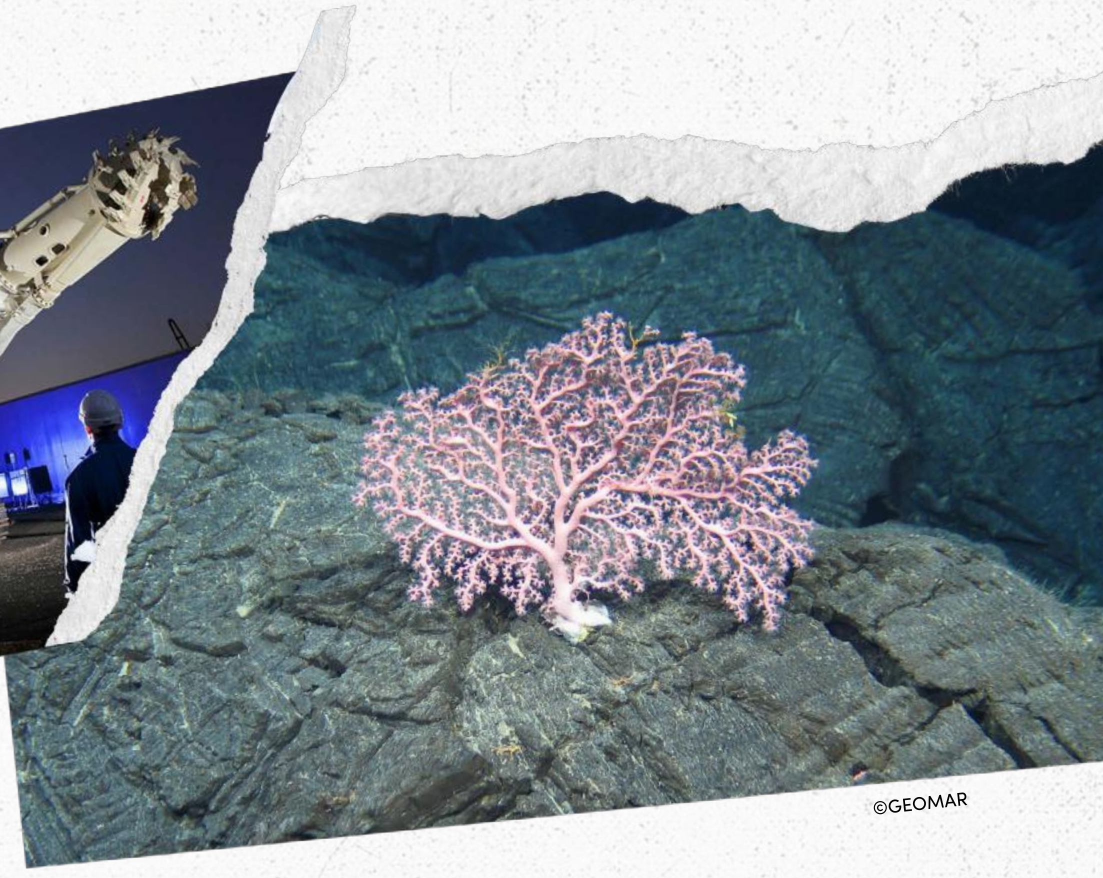

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THE DEEP SEA

The deep sea is the entire ocean below 200 meters in depth. It makes up 95% of Earth's living space. Only in recent decades have scientists been able to explore it and understand its importance.

Scientists believe that as many as 10 million species may inhabit the deep sea – a biodiversity that may be as rich as tropical rainforests. The majority of species are yet to be discovered.

All life on Earth – including human life – depends on the deep sea because it keeps the planet's systems functioning. It drives the global currents that keep temperatures and weather regulated. It regenerates nutrients. And it absorbs and stores the carbon dioxide emitted into the air by human activity.

Humans benefit from the deep sea in other ways. Deep-sea coral and sponge communities are largely untapped sources of natural products which can be used in medicines, cosmetics and other commercial products. A test being used to diagnose COVID-19 was developed using an enzyme isolated from a microbe found in deep-sea hydrothermal vents.

The deep sea is the most difficult area on Earth to access: so far, fewer humans have explored its deepest regions than have walked on the moon. But it is also extremely vulnerable.

Most deep-sea species are slow to grow and reproduce, and highly adapted to a largely unchanging environment. This makes them extremely vulnerable to overfishing and other human disturbance. This was recognised by the United Nations General Assembly, which committed nations to protect the deep sea from harmful fishing activities "recognising the immense importance and value of deep-sea ecosystems and the biodiversity they contain".

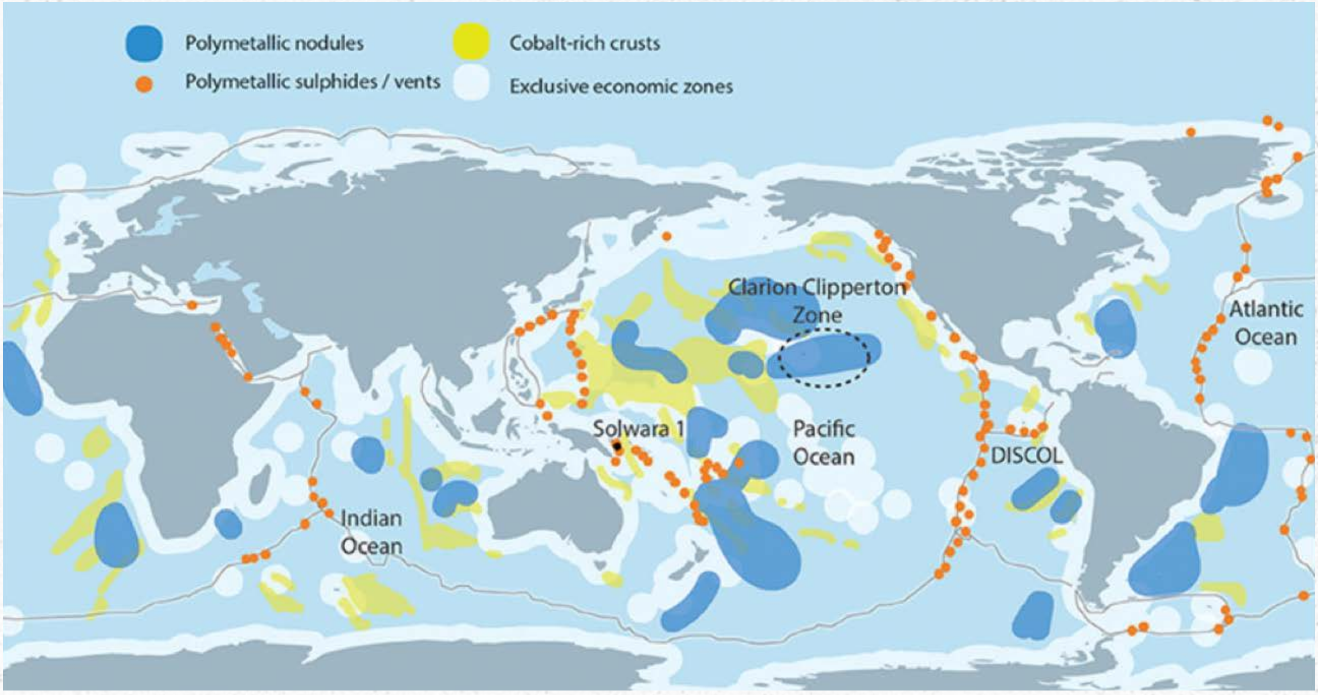
The deep sea is home to remarkably rich coral systems. Corals were once thought to inhabit only the warm waters of tropical and subtropical regions, but they have actually been thriving in deep, dark and cold waters throughout the world for millions of years. In fact, over half of all known coral species are found in the deep sea. Cold-water reefs are bustling with life, providing essential sanctuaries and nursing grounds for countless other species.

Adapted from: http://www.savethehighseas.org/about-the-deep-sea/

* ALL LIFE ON EARTH – INCLUDING HUMAN LIFE – DEPENDS ON THE DEEP SEA

In 2020, more than 1.3 million km^2 of the deep ocean was already set aside for deep-sea mining exploration, with permits overseen by the International Seabed Authority. Scientists warned of irreversible large-scale biodiversity loss, and for sediment plumes with high concentrations of heavy metals that could travel hundreds of thousands of kilometres, affecting the entire food chain through bioaccumulation and biomagnification processes.[97] Hundreds of thousands of square kilometres would be physically destroyed, including especially vulnerable areas such as seamounts that serve as a habitat and pantry for millions of species.[98] Vast areas of the seabed would be dredged for manganese nodules, rock concretions that took millions of years to grow and provided habitats for many species, which also would mean removing the top layer of the seabed in which all microbial life resides.

Figure 3: Location of the three main marine mineral deposits: polymetallic nodules (blue); polymetallic or seafloor massive sulfides (orange); and cobalt-rich ferromanganese crusts (yellow).



Source: Miller et al. (2018).

97 Hauton, C. et al. (2017). "Identifying Toxic Impacts of Metals Potentially Released during Deep-Sea Mining—A Synthesis of the Challenges to Quantifying Risk," *Front. Mar. Sci.*, 4: 368. At: https://doi.org/10.3389/fmars.2017.00368

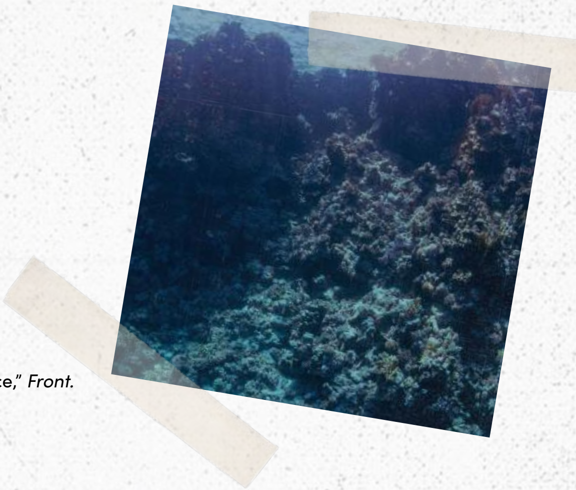
98 Miller, K.A. et al. (2018). "An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps," *Front. Mar. Sci.*, 4: 418. At: https://doi.org/10.3389/fmars.2017.00418; Watling, L.; Auster P.J. (2017). "Seamounts on the High Seas Should Be Managed as Vulnerable Marine Ecosystems," *Front. Mar. Sci.*, 4: 14. At: https://doi.org/10.3389/fmars.2017.00014

The disruption of the planet's main carbon sink, oceans, which captured a quarter of the CO_2 emitted by human activity,[99] would imply the release of greenhouse gases sequestered for millions of years, suppressing the capacity of carbon-fixing organisms.[100] Deep-sea mining risked the destruction or extinction of species that allowed for the discovery of new medicines, associated with life forms present only in the deep ocean, like the COVID test, developed using an enzyme isolated from a microbe found in deep-water hydrothermal vents.[101]

Calls for moratoriums or bans were issued by, among others, the United Nations Environmental Programme, the European Parliament, the European Commission, the British Parliament, the International Union for Conservation of Nature, the EU's fisheries advisory councils, Seas At Risk, WWF, Greenpeace, Fauna & Flora International and Deep Sea Conservation Coalition.[102] They went largely unheeded by the International Seabed Authority, the UN-sponsored body – with 167 countries and the EU among its members – mandated in 1994 to manage deep-sea resources for the "protection and preservation of the marine environment". In practice, the ISA mostly acted as a promotor of deep sea-mining.

In a compelling video message, world-renowned marine biologist Sylvia Earle called deep-sea mining the biggest land-grab in the history of humankind and warned it could vastly disrupt deep-sea ecosystems that provided oxygen to all life on earth and had a climate-regulating function.[103]

Legally designated as "Common Heritage of Mankind", the deep sea was being divided like a cake for the financial gains of a few countries and companies. And more and more the fundamental question was being posed: could it be that we – humankind – stood to lose far more than we would gain if the member nations of the ISA permitted deep-sea mining?[104]



99 See: https://www.earth.columbia.edu/articles/view/2586

100 Levin, L.A. et al. (2016). "Hydrothermal Vents and Methane Seeps: Rethinking the Sphere of Influence," *Front. Mar. Sci.*, 3: 72. At: https://doi.org/10.3389/fmars.2016.00072

101 See: https://en.unesco.org/news/covid-19-ocean-ally-against-virus-0

102 See: http://www.savethehighseas.org/wp-content/uploads/2020/06/DSCC_FactSheet3_DSM_moratorium_4pp_web.pdf

103 Earle, S. (2021. "Oceanographer Sylvia Earle on the Dangers of Deep-Sea Mining," *Now This News*, March 4. At: https://nowthisnews.com/videos/earth/oceanographer-sylvia-earle-on-the-dangers-of-deep-sea-mining

104 See: http://www.savethehighseas.org/wp-content/uploads/2020/07/DSCC_FactSheet6_DSM_WhoBenefits_4pp_web.pdf

4

SEEDS OF CHANGE

"TO GET OUT OF A HOLE, THE FIRST STEP IS TO STOP DIGGING."

— ENGLISH PROVERB

If we look back at 2020 and the preceding decades through today's post-extractive lens, many seeds of change that were to become pivotal in the transformational decade ahead become evident. While an increasing sense of urgency calling for the development, escalation and spread of emerging alternatives existed at the time, most were disregarded by mainstream policy-makers as utopian or unpractical exercises of wishful thinking.

Changes related to the circular economy, technology, efficiency and innovation were an important step in the right direction. But deeper social and economic change was critical. The biggest challenge and opportunity was to move away from a linear, throw-away economy focussed on consumption and GDP growth to a circular economy focussed on sufficiency, wellbeing and fair and equitable distribution.

THINKING ENERGY DIFFERENTLY

Energy consumption reduction was not only about behaviours and design – like keeping those irritating standby lights off – and upscaling simple and efficient appropriate technologies. It was first and foremost part of an overall transition to a much less energy-intensive economy. Calls were being made to end wasteful practices and energy-hoarding by electro-intensive industries while personal and family energy budget schemes such as the UK's TEQs[105] were followed by binding mechanisms for resource capping and schemes conditioning trade to mandatory metal recovery and substitution.

Wasteful use of electricity for heating and cooling was minimised through age-old ground-coupled heat exchangers – Provençal or Canadian wells – solar chimneys, circulating fans as well as solar thermal collectors and water-brake windmills. The extended use of pot skirts, pressure cookers, fireless cookers and solar cookers[106] led to huge energy savings in everyday cooking, while shared open WiFi, a movement started in 2012,[107] made 5G unnecessary and significantly cut IT energy use.

Direct hydro- and wind-power were other age-old technologies that made their comeback, not only for industrial applications[108] but even for water-powered household devices.[109] So did compressed-air energy-storage systems, which were already being deployed in the 2010s and, together with hydraulic accumulators, gravity batteries and thermal energy-storage systems, made stationary lithium-ion storage stations unnecessary. Ironically, the end of mining brought new uses for abandoned mineshafts, with the design of gravity-storage installations using 2000-tonne weights suspended from winches.[110]

105 See: https://flemingpolicycentre.org.uk/teqs/

106 De Decker, K. (2014). "If We Insulate Our Houses, Why Not Our Cooking Pots?," *Low-tech magazine*, Jul. 1. At: https://www.lowtechmagazine.com/2014/07/cooking-pot-insulation-key-to-sustainable-cooking.html

107 See: https://www.eff.org/pages/openwirelessorg

108 De Decker, K. (2013). "Back to Basics: Direct Hydropower," *Low-tech magazine*, Aug. 11. At: https://www.lowtechmagazine.com/2013/08/direct-hydropower.html

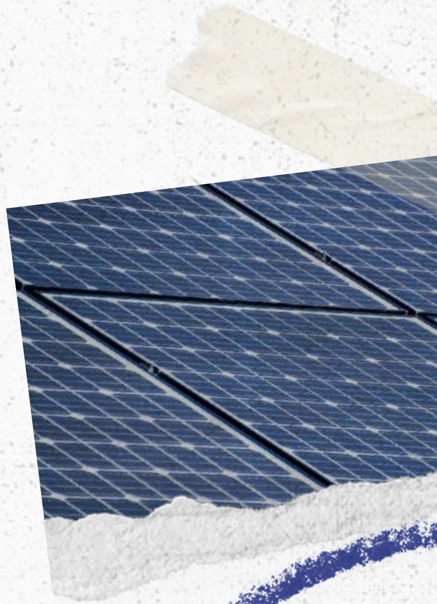
109 De Decker, K. (2013). "Power from the Tap: Water Motors," *Low-tech magazine*, Sept. 9. At: https://www.lowtechmagazine.com/2013/09/power-from-the-tap-water-motors.html

110 O'Neill, N. (2018). "Is gravity and old mineshafts the next breakthrough in energy storage?," *Imperial College London*, Apr. 23. At: https://www.imperial.ac.uk/news/185896/are-gravity-mineshafts-next-breakthrough-energy/

Losses in long-distance transport systems led to rethinking the grid as large-scale, mineral-intensive power plants became unviable. The 2020s became a decade of transition back to distributed generation, once the norm, with small, interconnected, distributed energy resources that massively reduced energy losses in transmission.[111] Decentralised models and protest grid defections[112] to counter initial resistance by electric power lobbies helped democratise energy supply beyond existing oligopolies.[113]

In 2010 the US state of Colorado passed a law requiring that by 2020 at least 3% of electricity generation came from distributed grids, while EU Directive 2019/944 acknowledged citizen energy communities,[114] helping renewable energy cooperatives and their distributed grids to thrive. Home, community and district biodigesters became a common way to address energy needs while coping with waste.[115]

Massive losses in AC to DC conversion – DC already accounted for about 50% of the energy used in buildings in 2020 – were avoided by shifting to parallel AC/DC installations at homes and offices,[116] leading to 25% energy savings.[117] Distributed energy and DC household systems allowed homes to use the power they produced through solar, wind or pico- or micro-hydro directly in low-power devices without incurring conversion losses, meaning fewer solar panels (or other technologies) for the same amount of energy. The mainstreaming of direct-DC electric appliances and efficient house design to minimise cable losses further reduced consumption and made electric products simpler, cheaper, more reliable and longer-life, extending product value over time.[118]



111 O'Neil, C. (2019). "From the Bottom Up: Designing a Decentralized Power System," *NREL*. At: https://www.nrel.gov/news/features/2019/from-the-bottom-up-designing-a-decentralized-power-system.html

112 Rocky Mountain Institute (2014). *The economics of grid defection*. Boulder: Rocky Mountain Instituite. At: https://www.homerenergy.com/pdf/RMI_Grid_Defection_Report.pdf Miniature solar panels on windows and balconies became a common sight at first, powering low-voltage direct current (DC) distribution networks for laptops, LED lighting and other small appliances.

113 Kunze, C.; Becker, S. (2015). "Collective ownership in renewable energy and opportunities for sustainable degrowth," *Sustain Sci*, 1-13. At: https://doi.org/10.1007/s11625-015-0301-0 ; European Union (2018). *Models of Local Energy Ownership and the Role of Local Energy Communities in Energy Transition in Europe*. At: https://cor.europa.eu/en/engage/studies/Documents/local-energy-ownership.pdf

114 See: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/energy-communities-overview-energy-and-social-innovation

115 See: https://mossy.earth/guides/energy/home-biodigester

116 Glasgo, B.; Lima Azevedo, I.; Hendrickson, C. (2016). "How much electricity can we save by using direct current circuits in homes?" *Applied Energy*, 180: 66-75. At: https://www.sciencedirect.com/science/article/pii/S0306261916309771#b0060

117 Savage, P.; Nordhaus, R. R.; Jamieson, S. P. (2010). "DC Microgrids:Benefits and Barriers," *Yale School of Forestry and Environmental Studies*, March. At: https://www.academia.edu/8050676/DC_Microgrids_Benefits_and_Barriers

118 De Decker, K. (2016). "Slow Electricity: The Return of DC Power?," *Low-tech magazine*, Apr. 27. At: https://www.lowtechmagazine.com/2016/04/slow-electricity-the-return-of-low-voltage-dc-power.html

RETHINKING MOBILITY SYSTEMS

While predictions had estimated 2 billion international travellers in 2020 (mostly using planes), travel actually collapsed, falling by 70%. While the COVID pandemic took the blame, in reality, passenger numbers had already been dropping significantly in European short-haul routes because of *flygskam* (flight shaming) instigated by climate activists[119] and preference for rail. Even in over-developed countries like the UK, at least half of the population took no flights at all in a given year, with 70% of flights taken by less than 15% of the population.[120] Commuting and other work-related travel also dropped dramatically as work-from-home schemes grew. Transport methods also changed. Earlier ongoing trends explain how this collapse became the "new normal".

Shifts in individual transportation modes and needs had increasingly made private car ownership obsolete.[121] Cities were again starting to become living spaces, often decentralised, where people could walk or cycle to and from work, meeting spaces and markets. It took almost two decades for cities like Ghent,[122] in Belgium, to become pedestrianised and car-free, but the trend expanded rapidly in the 2020s. The cycling boom intensified[123] so much that even by the 2010s, some countries had already started to remove motorways instead of building more.[124]

119 Asquith, J. (2020). "The Spread Of Flight Shame In Europe—Is Greta Thunberg The Reason Why?" *Forbes*, January 13. At: https://www.forbes.com/sites/jamesasquith/2020/01/13/the-spread-of-flight-shame-in-europe-is-greta-thunberg-the-reason-why/

120 Hopkinson, L., et al. (2019). "Radical Transport Policy Two-Pagers," *Transport for Quality of Life*. At: http://www.transportforqualityoflife.com/radicaltransportpolicytwopagers/

121 Nieuwenhuijsen, M.J.; Khreisd, H. (2016). "Car free cities: Pathway to healthy urban living," *Environment International*, 94: 251-262. At: https://www.sciencedirect.com/science/article/pii/S0160412016302161

122 Rutter, T. (2016). "Car-free Belgium: why can't Brussels match Ghent's pedestrianised vision?" *The Guardian*, November 28. At: https://www.theguardian.com/cities/2016/nov/28/car-free-belgium-why-cant-brussels-match-ghents-pedestrianised-vision

123 See: https://ecf.com/news-and-events/news/get-ready-cycling-boom-experts-predict-30-million-bicycle-sales-2030

124 See: https://bicycledutch.wordpress.com/2016/01/05/motorway-removed-to-bring-back-original-water/

COVID was a wake-up call to rethink urban mobility systems in particular. Following long standing traditions in place such as Amsterdam, Copenhagen and Bogotá,[125] voices were raised for enhanced public transport, putting in place car-sharing systems and walking and cycling infrastructures in cities. Milan – the epicentre of Italy's COVID outbreak – announced it would transform 35 km of its streets for cycling.[126] In Berlin, a campaign started to oust the car.[127] Parisian Mayor Anne Hidalgo announced that returning to a city dominated by cars post-pandemic was "out of the question"[128] and declared Paris would become a "15 minute city" (were residents can meet most of their needs within a short walk or bicycle ride from their homes). And more people started asking what needed to be asked: can we let go of car ownership?

Costs associated with car ownership and maintenance (pay-as-you-drive pricing policies, advertising bans, taxation, highway charges, parking fees, etc.) and the redesign of transport infrastructure paved the way for plain walking or a combination of public transport with the use of bikes, skates, unicycles, velomobiles and kick scooters becoming the norm. Bikes, pedelecs and scooters became part of urban infrastructure through public sharing systems and were rarely individually owned. Even as micro e-mobility developed, the types of batteries that micro e-mobility needed were less energy-intensive and required significantly less material than EV batteries, further reducing the demand for increased extraction. Alternative technologies, including metal-free protein batteries, made mining for batteries increasingly redundant.

In the 2010s bicycles were already replacing vans for cargo deliveries in many cities.[129] Even in regions where car-like vehicles could not be easily replaced – such as rural areas – private ownership dwindled with the emergence of sharing systems and capillary public transportation coverage through on-demand services, drastically reducing car numbers, raising mean passenger occupation and cutting carbon emissions.

125 Sisson, P. (2020). "Ban cars: Why cities are embracing the call for car-free streets," *City Monitor*, September 21. At: https://citymonitor.ai/transport/ban-cars-why-cities-are-embracing-the-call-for-car-free-streets

126 Perry, F. (2020). "How cities are clamping down on cars," *BBC Future Planet*, April 30. At: https://www.bbc.com/future/article/20200429-are-we-witnessing-the-death-of-the-car

127 Posaner, J. (2021). "Berlin campaigners look to oust the car," *Politico*, February 26. At: https://www.politico.eu/article/berlin-looks-to-the-post-car-city/

128 Frost, R. (2020). "Will cars be banned in Paris after lockdown?" *Euronews*, May 5. At: https://www.euronews.com/living/2020/05/15/will-cars-be-banned-in-paris-after-lockdown

129 De Decker, K. (2012). "Cargo cyclists replace truck drivers on European city streets," *Low-tech Magazine*, September 24. At: https://www.lowtechmagazine.com/2012/09/jobs-of-the-future-cargo-cyclist.html

Where needed for individual transport, car-equivalents became smaller and lighter, replaced by light electric and compressed-air (battery-free) quadricycles, velomobiles and rickshaws. Metal frames gave way to organic and light recycled materials, such as bamboo and other natural fibres, which were becoming popular not only for bikes[130] but also cars.[131] Strict battery standards on durability and reusability, as well as recycled-content requirements and supply-chain due diligence – such as the EU's 2021 Batteries regulation – helped end wasteful practices associated with non-catenary or grid-connected vehicles and appliances.

By 1999 it was already known that around 70% of households owning a car – some 700 million – would economically benefit from shifting to car sharing, with 95% of cars being idle during most of the day[132] while most driving was for short distances that could be walked or cycled.[133] Eventually, car-sharing schemes became mainstream through Transport as a Service and peer-to-peer systems, and also due to the lower costs of renting instead of owning.[134] By 2020, Moscow had a fleet of over 30,000 shared cars making some 50 million trips per year.[135]

Eventually, cars started to become a rarity in many towns and cities, as well as on the previously jammed roads connecting them. Catenary-based grid-connected systems – train, light rail, commuter rail, metro, trams, trolleybuses, guideway and elevated transport systems – became the standard land transport for both passengers and freight[136] – following insistent policy recommendations such as those by the Intergovernmental Panel on Climate Change.[137] These highly efficient, battery-free systems already moved much of the world in 2020, more than doubling the number of passenger-kilometres moving on electric trains from 1995 to 2016,[138] and reaching 3 trillion by 2020. In reality, grid-connected electric transport had already been the norm in the beginnings of mass transport systems, when "The electric streetcar [had been] the dominant mass transit vehicle".[139]

130 See: http://www.bamboobike.org/

131 Scharping, N. (2017). "A New Take on the Biodegradable Car," *Discover*, August 8. At: https://www.discovermagazine.com/technology/a-new-take-on-the-biodegradable-car

132 Prettenhaler, F.E.; Steininger, K.W. (1999). "From ownership to service use lifestyle: The potential of car sharing," *Ecol. Econ.*, 28:443-53. At: https://doi.org/10.1016/S0921-8009(98)00109-8; García-Olivares, A., et al. (2018). "Transportation in a 100% renewable energy system," *Energy Conversion and Management*, 158:266-285. At: https://doi.org/10.1016/j.enconman.2017.12.053

133 See: https://www.energy.gov/eere/vehicles/articles/fotw-1042-august-13-2018-2017-nearly-60-all-vehicle-trips-were-less-six-miles

134 Transport & Environment (2019) *Less (cars) is more: how to go from new to sustainable mobility*. Brussels: European Federation for Transport and Environment. At: https://www.transportenvironment.org/publications/less-cars-more-how-go-new-sustainable-mobility

135 Khrennikov, I. (2019). "Why do automakers fear car-sharing? Take a look at Moscow," *Chicago Tribune*, Feb. 11. At: https://www.chicagotribune.com/business/ct-biz-uber-lyft-automakers-russia-20190211-story.html

136 Wong, M. (2018). "Freight trams of Europe," *Euro Gunzel*. At: https://www.eurogunzel.com/2018/09/freight-trams-of-europe/

137 IPCC (2015). *Climate Change 2014*. Geneva: IPCC. At: https://www.ipcc.ch/report/ar5/syr/

138 IEA (2019). *The Future of Rail*. Paris: International Energy Agency. At: https://www.iea.org/reports/the-future-of-rail

139 Young, Jay (2015). "Infrastructure: Mass Transit in 19th- and 20th-Century Urban America," *Oxford Research Encyclopedia of American History*. At: https://doi.org/10.1093/acrefore/9780199329175.013.28

Wind also made its comeback in marine shipping in the 2020s. Rotor sails, wing sails and kite rigs started to be incorporated in modified conventional cargo vessels in the 2010s,[140] in conjunction with hydrogen fuel cells[141] and compressed air that used energy production peaks at ports to recharge. The first 32,000-tonne wind-powered freighter came into service in 2024[142] while a variety of smaller sailing ships started to serve trading routes transporting high-value, low-weight items.[143] Inland, grid-connected electric barges and riverboats (trolley boats and trolley ferries) thrived after catenary overhead systems were reintroduced to rivers and canals,[144] further removing hundreds of thousands of trucks from the roads.[145]

Shifting patterns of consumption, increased localised production,[146] taxation schemes based on transport externalities and emissions, carbon footprint labels on foodstuffs[147] and other measures also initiated changes in the transportation of goods, encouraging local production and rational use of long-distance freight. Changes in product design and usage behaviours and shifts away from pathological consumption made so-called just-in-time delivery unnecessary, allowing for slower but more rational, resilient, assured and energy-efficient logistics and goods storage, particularly for critical items.

Air travel declined sharply from 2020 onwards mainly due to *flygskam*, with leisure, business and cargo flights being increasingly limited with the prioritisation of other uses of high-energy dense fuels during the descent from Peak Oil. Urgent indispensable air transport was covered with lighter and more efficient models, maximising jet-stream travel. Jet streams also allowed for the reintroduction of heavy-load cargo airships circumnavigating the world from west to east wherever shipping and rail were unavailable.[148]

140 Bryce, E. (2018). "Cheap oil killed sailing ships. Now they're back and totally tubular," *Wired*, May 29. At: https://www.wired.co.uk/article/norsepower-flettner-rotor-sail-modern-ship-finland

141 Radowitz, B. (2020). "World's first liquid hydrogen fuel cell cruise ship planned for Norway's fjords," *Recharge*, Feb. 5. At: https://www.rechargenews.com/transition/world-s-first-liquid-hydrogen-fuel-cell-cruise-ship-planned-for-norway-s-fjords/2-1-749070

142 Prisco, J. (2020). "Sweden's new car carrier is the world's largest wind-powered vessel," *CNN*, Nov. 13. At: https://edition.cnn.com/travel/article/oceanbird-wind-powered-car-carrier-spc-intl/index.html

143 See: https://www.towt.eu/

144 De Decker, K. (2009). "Trolley canal boats," *Low-tech magazine*, Dec. 15. At: https://www.lowtechmagazine.com/2009/12/trolley-canal-boats.html

145 See: https://www.electricvehiclesresearch.com/articles/16009/electric-container-barges-to-set-sail

146 Dombroski, S. (2019). "How Locally Grown Products are Disrupting F&B Manufacturing," *QAD blog*, Dec. 3. At: https://www.qad.com/blog/2019/12/how-locally-grown-products-are-disrupting-fb-manufacturing

147 Tatum, M. (2020). "Will Carbon Labels on Our Food Turn us Into Climatarians?," *Discover*, Nov. 4. At: https://www.discovermagazine.com/environment/will-carbon-labels-on-our-food-turn-us-into-climatarians

148 Hunt, J. D. et al. (2019). "Using the jet stream for sustainable airship and balloon transportation of cargo and hydrogen," *Energy Conversion and Management*, X (3). At: https://www.sciencedirect.com/science/article/pii/S2590174519300145

MAKING OBSOLESCENCE OBSOLETE

The shift away from the throw-away take-make-waste consumer society involved adding Rs to the earlier Reduce-Reuse-Recycle triad, boosting Repair, Remanufacture and Recovery. The end of wasteful practices implied drastically curving obsolescence – technological, psychological and planned – guaranteeing reparability, long-life product cycles and built-in raw-material-recovery design.[149]

A number of pioneering public policies were already making steady progress in the 2010s. In 2015 France made planned obsolescence a punishable offence and by 2021 products had lifetime-index stickers based on build quality, reparability and durability.[150] Others followed after a 2020 European Parliament report calling for a "clamp down" on planned obsolescence.[151] Long-life guarantees were made compulsory while producer liability for repair, remanufacture and recovery encouraged companies to re-engineer designs into compliance. In the US, Massachusetts passed the first Right to Repair Act in 2012, requiring car manufacturers to provide the information necessary to allow anyone to repair their vehicles.[152]

149 Bachér, J. et al. (2020). *Electronic products and obsolescence in a circular economy*. Boeretang: European Topic Centre on Waste and Materials. At: https://www.eionet.europa.eu/etcs/etc-wmge/products/electronics-and-obsolescence-in-a-circular-economy

150 See: https://www.thelocal.fr/20180216/france-muses-whether-to-expose-the-true-lifespan-of-goods-and-appliances

151 See: https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2020/2021(INI)

152 Wiens, K. (2014). "You Gotta Fight For Your Right to Repair Your Car," *The Atlantic*, Feb. 13. At: https://www.theatlantic.com/technology/archive/2014/02/you-gotta-fight-for-your-right-to-repair-your-car/283791/

Laws were not only passed but also rolled out and enforced, as illustrated by French and Italian legal actions in 2018 against Apple and Samsung for planned obsolescence.[153] In 2017 Sweden lowered VAT for repair services – from bikes to shoes and phones to washing machines – and new laws allowed citizens to claim part of the labour cost of appliance repair on their taxes.[154] Many were already proposing that tax on labour for repairs should be zero. Crucially, the 2020s saw generalised suppression of advertisements in public spaces and prohibition of advertising unsustainable products, following earlier bans of tobacco and alcohol advertising and a clamp-down on misleading claims to sustainability.[155]

Most of these policies had already been recommended in a 2017 UN report,[156] including minimum durability criteria and extended guarantees, planned obsolescence and right-to-repair legislation, product lifetime labelling and individual producer responsibility. EU ecodesign regulations passed on October 2019 and a previous July 2017 European Parliament resolution for "A longer lifetime for products" paved the way for upscaling such policies, ensuring the availability of replacement parts, establishing an independent system to test and detect built-in obsolescence in products, and changing design norms to force manufacturers to use easily replaceable materials and techniques that allow for repairs – for example, using screws rather than welding parts together.[157]

153 Kayali, L. (2020). "Apple fined €25M in France for misleading consumers about slowed-down iPhones," *Politico*, Feb. 7. At: https://www.politico.eu/article/apple-fined-e25m-in-france-for-misleading-consumers-about-slowed-down-iphones/ ; BBC (2018). "Apple and Samsung fined by Italian authorities over slow phones," *BBC*, Oct. 24. At: https://www.bbc.com/news/technology-45963943

154 Venard, L. (2017). "Get Paid To Fix Your Broken Things — New Swedish Tax Breaks Support Repair," *Medium*, Mar. 1. At: https://medium.com/@greenxeurope/getting-paid-to-fix-your-broken-things-new-swedish-tax-breaks-support-repair-ff67c016c211

155 Dean, B. (2020). "The five: ads banned for greenwashing," *The Guardian*, Feb. 9. At: https://www.theguardian.com/technology/2020/feb/09/the-five-ads-banned-for-greenwashing

156 Bakker, C. A.; Schuit, C. S. C. (2017). *The Long View: Exploring Product Lifetime Extension*. Nairobi: UNEP. At: https://www.oneplanetnetwork.org/resource/long-view-exploring-product-lifetime-extension

157 See: https://www.europarl.europa.eu/news/en/headlines/economy/20170629STO78621/meps-call-for-measures-to-ensure-products-last-longer

As in other instances, social action preceded public policies and forced states and corporations to act. A culture of repairing grew out from the maker and right-to-repair movements, not only producing self-organising manuals, workshops and repair cafés, but also challenging large companies like Apple, John Deere and AT&T to break restrictions preventing farmers,[158] health professionals[159] and IT users from repairing their own devices. The first repair café, a meeting space where people got together to repair household electrical and mechanical devices, computers, bicycles, clothing and other items, opened in 2009 and, a decade later, there were over 2,000 in 35 countries.[160] The iFixit right-to-repair platform grew from 1.3 million users in 2016 to more than 4.1 million by 2018.[161]

Changes also included new patterns of shared or collective ownership, as in transport and other areas. Washing machines are one example: while reparability regulations banned sealed drum designs that hindered repairability by making it uneconomical to replace certain parts,[162] there was a shift towards communal laundry facilities – like Swedish *tvättstuga* that had been common for decades – with robust long-life and easily repairable machines. Ownership shifted to usership, with producers' long-term liability encouraging long-life, robust, and reparable devices. The sharing economy went beyond cars and washing machines to include all sorts of items that became part of "Libraries of Things" and peer-to-peer lending that included tools, kitchen equipment, electronics, toys, clothes, etc.[163]

In the 2020s, maker culture and the open-source movement took a step further by adopting raw-material recovery and urban mining that allowed not only repairing and refurbishing but also locally self-built items using 3D printing from recovered materials. Microfactories started to produce plastic filaments for 3D printing extracted from e-waste,[164] bringing about the resurgence of people- and planet-centred technology, as theorised long before in Schumacher's *Small Is Beautiful.*[165]

158 Fitzpatrick, A. (2017). "Hand Me That Wrench: Farmers and Apple Fight Over the Toolbox," *Time*, Jun. 22. At: https://time.com/4828099/farmers-and-apple-fight-over-the-toolbox/

159 Condon, S. (2020). "Lawmakers call for 'right to repair' medical equipment during COVID-19 pandemic," *ZDNet*, Aug. 6. https://www.zdnet.com/article/lawmakers-call-for-right-to-repair-medical-equipment-during-covid-19-pandemic/

160 See: https://repaircafe.org/en/visit/

161 Lepawsky, J. (2019). "Planet of fixers? Mapping the middle grounds of independent and do-it-yourself information and communication technology maintenance and repair," *Geo*, Dec. 11. At: https://rgs-ibg.onlinelibrary.wiley.com/doi/full/10.1002/geo2.86

162 Porter, A. (2015). "Are washing machines built to fail?" *Which?*, Jun. 17. At: https://www.which.co.uk/news/2015/06/are-washing-machines-built-to-fail-406177/

163 Benedictus, L. (2019). "The library of things: could borrowing everything from drills to disco balls cut waste and save money?," *The Guardian*, Apr. 24. At: https://www.theguardian.com/society/2019/apr/24/library-of-things-borrowing-scheme-conquer-world

164 Mehta, A. (2019). "Australian university pioneers urban mining 'microfactories'," *Reuters Events*, Apr. 29. At: https://www.reutersevents.com/sustainability/australian-university-pioneers-urban-mining-microfactories

165 Schumacher, E. F. (1973). *Small Is Beautiful: A Study of Economics As If People Mattered*. London: Blond & Briggs.

CIRCULARITY AND INNOVATION – A FIRST STEP IN THE RIGHT DIRECTION

Circular economy policies in the 2010s emphasised recycling in a time where actual recycling rates for many metals were trivial while reuse, repair, remanufacture and lifetime extension were being mostly ignored. Policy and legal changes as well as public pressure reframed the "problem" of e-waste into a growing opportunity for urban mining so that effective metal upcycling and reuse of products not only became mandatory (with defined thresholds), but actually thrived, particularly when required recycled-content targets in manufacture were set and enforced.[166] In the 2010s China had already established that new products were required to contain a minimum of 20% recycled materials by 2025.[167]

Effective product and process design involved not only reparability and remanufacture, but also simpler, economical separation of components for recycling. The rise of available secondary metals through the reverse supply chain and the increasingly higher requirements for recycled metal use reduced demand for primary metal even further.

New buy-back and electronics-as-service schemes helped suppress e-waste hoarding, leading to increased metal recovery.[168] Extracting metals such as copper or gold from e-waste was actually 13 times cheaper than extracting them from conventional mines,[169] and even more so when compared to hypothetical deep-sea operations. In the late 2010s, a single recycling company in China was producing more cobalt annually than all the country's mines together.[170] Landfill mining – recovering materials from landfill deposits – promised soon to become fully operational and profitable.

166 Söderholm, P. (2020). "Metal markets and recycling policies: impacts and challenges," *Mineral Economics*, 33:257-272. At: https://link.springer.com/article/10.1007/s13563-019-00184-5

167 See: http://www.responsabilitas.com/blog/china-epr-regulation/

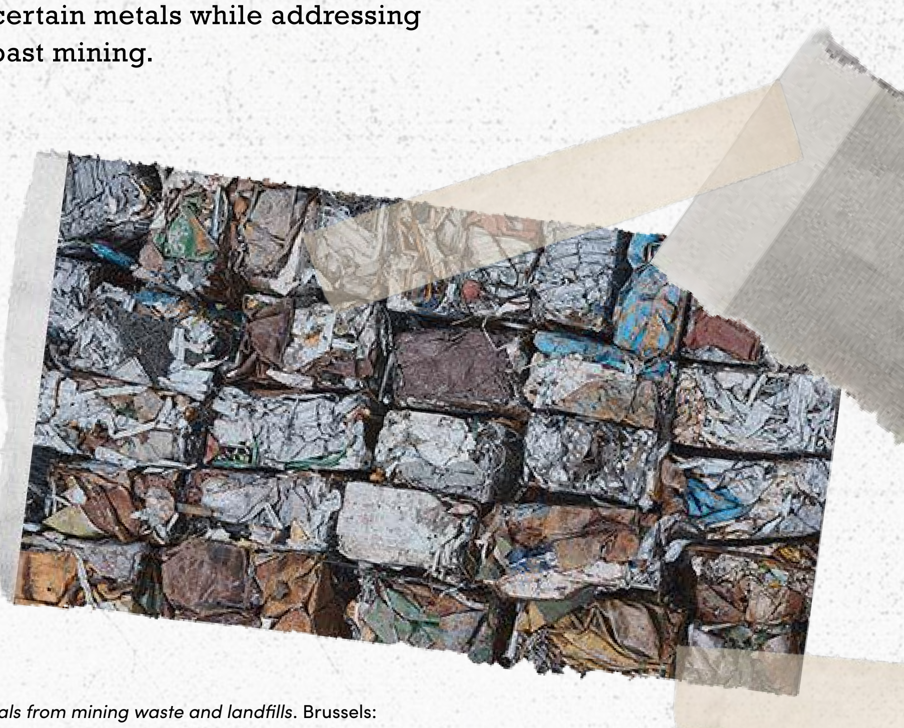
168 Johnson, R. (2018). "Fairphone-as-a-service," *Project Breakthrough*, July 26. At: http://breakthrough.unglobalcompact.org/briefs/fairphone-as-a-service/

169 Zeng, X. et al. (2018). "Urban Mining of E-Waste is Becoming More Cost-Effective Than Virgin Mining," *Environ. Sci. Technol.*, 52(8): 4835-4841. At: https://doi.org/10.1021/acs.est.7b04909

170 WEF (2019). *A New Circular Vision for Electronics*. Geneva: World Economic Forum. At: http://www3.weforum.org/docs/WEF_A_New_Circular_Vision_for_Electronics.pdf

The reframing of waste policies, strategies and management solutions not only affected metal-bearing trash, but waste from mining itself: the toxic left-overs of metal mining and processing that had been dangerously building up in tailings dams, mine dumps and acid-mine drainage runoff into rivers and oceans. While addressing the unsolved environmental problems related to critical tailings infrastructure became an urgent matter, ironically, the decrease of ore-grades also made these left-behinds more attractive in terms of the prospects for recovering valuable metals. Mine tailings included relatively high recoverable concentrations of iron, copper, nickel and zinc and often smaller concentrations of gold, silver, rare-earth elements and other metals.[171]

New techniques such as phytomining or metal bioharvesting – extraction of metals in polluted soils through hyperaccumulator plants and fungi – and heavy-metal removal from polluted water started to gain traction in the 2020s. Farmers by Lake Ohrid, Albania, were selling alyssum weeds harvested in the proximities of a former nickel mine due to their high values of that metal,[172] while trials with *Pycnandra acuminate* trees showed they could produce 200kg of nickel per hectare every year for centuries (their sap contains up to 25% nickel content).[173] Research showed many other local native plant species around the world – such as *Erica andevalensis* in Iberia – could be used for decontamination and metal recovery. While some of these techniques were still energy-intensive, their wise use within post-growth societies allowed for a steady supply of certain metals while addressing continuing environmental impacts from past mining.



171 Blengini, G. (2019). *Recovery of critical and other raw materials from mining waste and landfills*. Brussels: European Union. At: https://ec.europa.eu/jrc/en/publication/recovery-critical-and-other-raw-materials-mining-waste-and-landfills

172 Schmidt, F. (2017). "When plants work as miners and cleaners," *DW*, May 18. At: https://www.dw.com/en/when-plants-work-as-miners-and-cleaners/a-38882153

173 van der Ent, A. (2019). "Heavy Metal Farming," *Australasian Science*, July-August. At: http://www.australasianscience.com.au/article/issue-may-2015/heavy-metal-farming.html

SPACE, HOUSING AND CITIES

Almost 90 years ago, in 1961's *The Death and Life of Great American Cities*,[174] Jane Jacobs had questioned the increasingly bizarre logics of urban planning and discussed the need for walkable spaces. Early adopters of pedestrianisation paved the way to *doughnut* cities and *slow* cities that rose after the 2020 COVID pandemic.[175] The localisation of neighbourhood economies and the transport revolution made cities walkable again – inaugurating the new "15-minute city" concept[176] – while the urban landscape was redesigned to accommodate urban horticulture and farming (including beekeeping), foodscaping in parks, vertical gardens and rooftop farming, community composting and biowaste-management initiatives.

From "Incredible Edible" Totnes[177] in the UK to Rosario in Argentina,[178] urban landscapes changed while rural areas flourished once again. The increasing localisation of and involvement in food production led to more diversified and resilient agricultural systems throughout the world, minimizing inequalities associated with crop monocultures, helping reduce global shipping needs, and curbing the need for chemical fertilisers – especially potash – by restoring soil productivity.

174 Jacobs, J. (1961). *The Death and Life of Great American Cities*. New York: Random House.

175 Boffey, D. (2020). "Amsterdam to embrace 'doughnut' model to mend post-coronavirus economy," *The Guardian*, Apr. 8. At: https://www.theguardian.com/world/2020/apr/08/amsterdam-doughnut-model-mend-post-coronavirus-economy

176 Sisson, P. (2020). "What is a 15-minute city?" *City Monitor*, Sept. 21. At: https://citymonitor.ai/environment/what-is-a-15-minute-city

177 See: https://www.transitiontowntotnes.org/incredible-edible/

178 See: http://www.fao.org/ag/agp/greenercities/en/ggclac/rosario.html

Ecological architecture and design in both new and updated buildings centred on maximum efficiency and reduction of raw materials through reuse (such as reclaiming lumber). From insulation schemes and passive solar building design that benefited single units in terms of daylighting, urban planning was modified to create solar envelopes in solar-oriented cities and towns.[179] The 2030 Challenge[180] was one of many initiatives that helped empower architects, planners, builders and society at large to shift their understanding of the built environment. Behavioural change included more shared housing and co-working spaces, while tax policies discouraged unused buildings and incentivised rehabilitation. Some early examples include Vancouver's "Empty Home Tax", launched in 2016,[181] or Italy's 2020 Ecobonus for renovation works targeting energy efficiency.[182]

In 1900, 85% of the world's population lived the countryside, with access to land to obtain food and dispose of waste directly. In the 2010s more than half of the world's population lived in cities, which not only demanded unprecedented levels of extraction in certain parts of the world to provide food, energy and goods, but also involved returning unprecedented levels of waste to rural areas and the seas. Separation from nature and the means of subsistence made most urban populations oblivious to the real impacts of extractivism and fostered the belief that cities could continue to grow indefinitely.[183] The Transition Movement, initiated in 2006, involved thousands of local initiatives in more than 50 countries by 2020, focussing on issues such as degrowth, energy descent, local food production and permaculture design, inspiring many other commoning communities and ecovillages that helped to make the Global North more aware of the alternatives to over-development.

179 De Decker, K. (2012). "The solar envelope: how to heat and cool cities without fossil fuels," *Low-Tech Magazine*, March. At: https://www.lowtechmagazine.com/2012/03/solar-oriented-cities-1-the-solar-envelope.html

180 See: https://architecture2030.org/2030_challenges/2030-challenge/

181 CBC (2019). "Vancouver raising empty homes tax by 25%," *CBC*, Nov. 28. At: https://www.cbc.ca/news/canada/british-columbia/vancouver-empty-homes-tax-increase-1.5376581

182 Lovells, H. (2020). "Implementing rules for Superbonus 110% have finally been issued," *JDSupra*, Aug 11. At: https://www.jdsupra.com/legalnews/implementing-rules-for-superbonus-110-40883/

183 Bradford, J. (2019). *The Future is Rural: Food System Adaptations to the Great Simplification*. Corvallis: Post Carbon Institute. At: https://www.postcarbon.org/publications/the-future-is-rural/

TIME IS…LIFE: THE TIME-USE REVOLUTION

Changes in mobility, production and transport of goods and usership were facilitated, together with many other social and economic changes – such as localised food production, increased social and political engagement, etc.– by shifts in work environments and patterns. Home working increased exponentially during COVID lockdowns, and was continued, generally on a part-time basis, when the pandemic was tamed. Working from home allowed greater flexibility, reduced commuting and allowed an inversion of urbanisation trends and rural reflourishing.

Four-day working weeks and six-hour workdays became the norm in the 2020s, building from early adoption experiences such as that of the Gambia in 2013[184] to extended calls a few years later, particularly during and after the COVID pandemic, in places such as Scotland[185] or Finland.[186] Strong evidence for shorter working days and weeks had been put forward by time-use researchers and led to adoption of time-use policies that promoted healthy life habits (including mental health and the physical benefits of non-motorised transport), sustainable transition towards new labour models and work-life balance between paid work, non-paid work and leisure in order to reduce inequalities.

Combined with forms of guaranteed livelihoods – such as universal basic income[187] – this allowed more time for caring, creativity, social and environmental activism and learning. Many people were increasingly able to spend more time with their families and communities and to follow their passions, which had an impact on how people viewed their environment. This slowing down of life opened up new spaces for reflection and resistance, generating more imaginative ways of recreating society through sustainable types of living.[188]

184 Williams, J. (2013). "Gambia's four day week," *Earthbound*, Feb. 7. At: https://earthbound.report/2013/02/07/gambias-four-day-week/

185 Cooney, A.F. (2020). "Scotland is ahead of the curve with four-day working week," *The National*, Jul. 23. At: https://www.thenational.scot/news/18600678.scotland-ahead-curve-four-day-working-week/

186 Claesson, A. (2020). "Finland Is Rallying Around a Six-Hour Workday — And So Should We," *Jacobin*, Sept. At: https://jacobinmag.com/2020/09/finland-six-hour-workday-working-hours-covid

187 Patel, S. B. (2021). "Universal basic income and covid-19 pandemic," *British Medical Journal*, 372: 193. At: https://doi.org/10.1136/bmj.n193

188 Jordan, J. (2017). "Artivism: Injecting Imagination into Degrowth," *Degrowth*. At: www.degrowth.info/en/catalogue-entry/blog-artivism-injecting-imagination-into-degrowth

As the New Economics Foundation had pointed out, much of our earlier resource-intensive consumption was triggered by busy-ness[189] and what sociologist Hartmut Rosa called our obsession with "increasing the volume [of activity] per unit of time":[190] traveling by plane or car rather than by public transport, bike, or on foot; throwing away items instead of trying to repair them; heating-up processed foods from afar in energy-intensive devices instead of slow-cooking locally produced or home-grown ingredients; using faster information media instead of taking time to examine issues in depth; spending free time consuming advertising and other audio-visuals instead of engaging in meaningful social, political and environmental activities. The widespread adoption of many alternatives that had been around for decades was facilitated by the social shifts stemming from time-use change and the deceleration of living.

Money systems were also reinvented, moving away from the debt-based economy of the past. Innovation in monetary, mutual- and community-credit and local-exchange trading systems included municipal and grass-root initiatives, which flourished after legal bans were lifted; in France, the Social and Solidarity Economy Law had granted legal recognition to complementary local currencies in 2013. The growth of alternative finance models – crowdfunding, peer-to-peer lending, community shares, etc. – and the crisis of traditional banking and the speculative economy allowed for greater economic resilience and a shift away from extractivist speculation, the lifeblood of mining.

189 See: https://www.foeeurope.org/eco-sufficiency-focus-on-enough-301117

190 Harmut, R. (2013). *Social Acceleration: A New Theory of Modernity*. New York: Columbia University Press.

BANS, MORATORIA AND RAW-MATERIALS GOVERNANCE

By the 2010s people had enough of mining. In 2017 El Salvador had become the first country to ban metal mining altogether, with the support of all political parties.[191] In 2010, Costa Rica's Assembly banned open-cast mining,[192] sparkling similar moves in Colombia,[193] Argentina,[194] Ecuador[195] and the Philippines.[196] In 2019 Kyrgyzstan passed a law banning mining of radioactive materials,[197] as did Spain a year later.[198] Other countries and regions passed moratoria, such as Malaysia with bauxite between 2014 and 2019, the US state of Wisconsin with its 1997 Mining Moratorium Law that was in effect for a full decade,[199] or the Uttarakhand 2017 temporary ban in India. The 1998 Protocol on Environmental Protection to the Antarctic Treaty strictly prohibiting "any activity relating to mineral resources"[200] showcased how countries could agree to put an end to the environmental damage caused by mining.

191 Mardirossian, N. (2017). "Does El Salvador's Metal Mining Ban Suggest a Global Trend?," *State of the Planet*, May 2. At: https://blogs.ei.columbia.edu/2017/05/02/does-el-salvadors-metal-mining-ban-suggest-a-global-trend/

192 Evans, M. (2013). "Costa Rica Upholds Ban On Open-Pit Mining," *The Costa Rica Star*, February 8. At: https://news.co.cr/costa-rica-upholds-ban-on-open-pit-mining/21901/

193 See: https://aida-americas.org/es/node/2081

194 Laje, D. (2019). "Argentine court upholds law banning mines," *Al Jazeera*, June 12. At: https://www.aljazeera.com/economy/2019/6/12/argentine-court-upholds-law-banning-mines

195 Jamasmie, C. (2021). "Southern Ecuador's Cuenca bans large-scale mining," *The Northern Miner*, February 19. At: https://www.mining.com/southern-ecuador-bans-large-scale-mining/

196 Sarmiento, B.S. (2020). "Philippine court upholds open-pit mining ban in Mindanao," *Mongabay*, October 19. At: https://news.mongabay.com/2020/10/philippine-court-upholds-open-pit-mining-ban-in-mindanao/

197 Fergana (2019). "Kyrgyz President signs law banning mining of uranium and thorium," *Fergana*, December 16. At: https://en.fergana.news/news/113444/

198 Hall, L. (2020). "Moves to ban uranium mining in Spain," *EuroWeekly*, October 19. At: https://www.euroweeklynews.com/2020/10/19/moves-to-ban-uranium-mining-in-spain/

199 Barrows, M. (2017). "Wisconsin Legislature Repeals Moratorium on Sulfide Mining," *Freshwater Future*, November 8. At: https://freshwaterfuture.org/watchdog/wisconsin-legislature-repeals-moratorium-on-sulfide-mining/

200 Potočnik, J. (2019). "Are we really ready to risk our own future?" Bled Strategic Forum, September 3. At: https://medium.com/bled-strategic-forum/are-we-really-ready-to-risk-our-own-future-5450c375a8fe

Mining bans worldwide.

	Country/Territory	*Year*	*Types of mining*
	**Antarctica**	1998	All mining
	**Costa Rica**	2010	Open-cast mining
	**El Salvador**	2017	All metal mining
	**Kyrgyzstan**	2019	Radioactive minerals
	**Spain**	2021	Radioactive minerals
	**Northern Territory (Australia)**	2021	Deep-sea mining
	**Cuenca (Ecuador)**	2021	All metal mining

Governments also started to turn away from the trap of investor-state dispute-settlement systems.[201] Community charters[202] and local or regional popular consultations[203] were instrumental in banning mining from the bottom up. Calls began for a global ban of the unnecessary mining of certain metals such as gold, since by 2020 there was enough gold in vaults and national reserves to meet global demand in perpetuity without extracting another ounce from the ground. More than 90% of gold was mined exclusively for luxury and financial markets, whereas less than 10% went toward industry and technology applications.[204]

201 Public Citizen (2014). Exiting the Unnecessary, Damaging Investor-State Dispute Settlement System. At: http://worldinvestmentforum.unctad.org/wp-content/uploads/2015/05/Public-Citizen-Draft.pdf

202 Rahman, M. (2018). "Community Charters," *The Conscious Lawyer*. At: https://www.theconsciouslawyer.co.uk/community-charters/

203 Dietz, K. (2018). "Referendums on mining in Colombia: the conditions in which they are held and their political meanings. The case of La Colosa," *Colombia Internacional*, 93: 93-117. At: http://dx.doi.org/10.7440/colombiaint93.2018.04

204 See: https://miningwatch.ca/blog/2019/2/5/behind-glitter-gold-facts

Concerns over the potential environmental and social impacts of deep-sea mining also led to increasing calls for a ban or a moratorium on deep-sea mining – at least untill the knowledge gaps could be closed and alternatives (like sustainable consumption and production) had been fully explored. Hundreds of NGOs and environmental and social organisations, scientists and renowned figures such as Sir David Attanborough and Sylvia Earle rallied to stop the assault on the deep sea.[205] In 2012 Australia's Northern Territory Government passed such a moratorium, extending it in 2015 and 2018 before establishing an indefinite ban in 2021.[206] In 2018 the European Parliament passed a resolution by an overwhelming majority that called for an international moratorium on deep seabed mining,[207] a move partly endorsed by the European Commission in its Biodiversity Strategy for 2030. In 2019 the Prime Ministers of Fiji, Vanuatu and Papua New Guinea made a similar call for a moratorium at least until the end of the UN Decade of Ocean Science in 2030.[208]

The UN International Resource Panel had already noted the existing governance gap in its 2020 *Mineral Resource Governance for the 21st century* report; the UN Environmental Assembly called for a new global mechanisms to oversee the use and supply of mineral resources.[209] Early UN resolutions and decisions had stressed the need for oversight. The first UN Conference on the Environment, held in Stockholm in 1972, issued an Action Plan that included recommendations for establishing a mining and mineral information system that "would indicate where certain kinds of mining should be limited, where reclamation costs would be particularly high, or where other problems would arise."[210]

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205 See: http://www.savethehighseas.org/wp-content/uploads/2020/06/DSCC_FactSheet3_DSM_moratorium_4pp_web.pdf

206 See: https://newsroom.nt.gov.au/mediaRelease/34139

207 Woody, T. (2018). "European Parliament Calls for a Moratorium on Deep-Sea Mining," *News Deeply*, February 1. At: https://deeply.thenewhumanitarian.org/oceans/articles/2018/02/01/european-parliament-calls-for-a-moratorium-on-deep-sea-mining

208 Doherty, B. (2019). "Collapse of PNG deep-sea mining venture sparks calls for moratorium," *The Guardian*, September 15. At: https://www.theguardian.com/world/2019/sep/16/collapse-of-png-deep-sea-mining-venture-sparks-calls-for-moratorium

209 IRP (2020). *Mineral Resource Governance in the 21st Century*. Nairobi: UNEP. At: https://www.resourcepanel.org/reports/mineral-resource-governance-21st-century; UNEA resolution on Mineral resource governance, 9 March 2019, UNEP/EA.4/L.23. See: https://www.ecologic.eu/sites/files/publication/2020/2599-international-governance-raw-materials-ingoro.pdf

210 See: http://undocs.org/en/A/CONF.48/14/Rev.1

The 5th principle of the Stockholm Declaration affirmed the common conviction that: "The non-renewable resources of the earth must be employed in such a way as to guard against the danger of their future exhaustion and to ensure that benefits from such employment are shared by all mankind." Ten years later, in 1982, the UN General Assembly approved the "World Charter for Nature",[211] again establishing that "non-renewable resources which are consumed as they are used shall be exploited with restraint, taking into account their abundance, the rational possibilities of converting them for consumption, and the compatibility of their exploitation with the functioning of natural systems."

Such principles were enshrined with binding legal force in the 2021 Global Pact for the Environment,[212] an international legal framework for environmental rights, including the rights of nature and future generations, and they were consolidated after 2025, when a new set of global goals and targets to end extractivism were drawn up as a *Blueprint for 2050* without mining to succeed the 2015 UN Sustainable Development Goals in 2030.

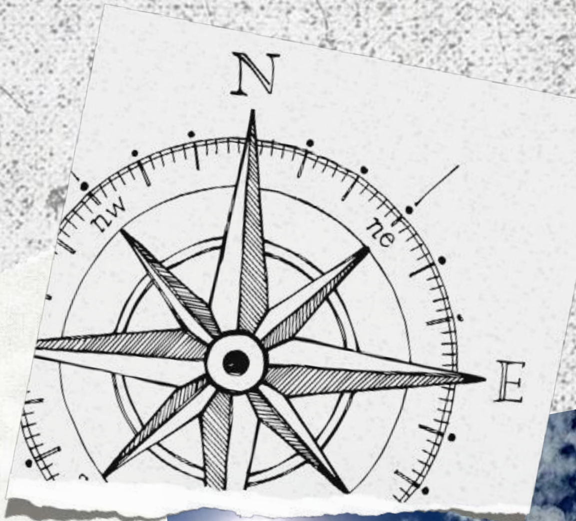
* THE NON-RENEWABLE RESOURCES OF THE EARTH MUST BE EMPLOYED IN SUCH A WAY AS TO GUARD AGAINST THE DANGER OF THEIR FUTURE EXHAUSTION

211 See: https://digitallibrary.un.org/record/39295

212 See: https://globalpactenvironment.org/en/

5

A COMPASS FOR THE FUTURE



"YOU NEVER CHANGE THINGS BY FIGHTING THE EXISTING REALITY.

TO CHANGE SOMETHING, BUILD A NEW MODEL THAT MAKES THE EXISTING MODEL OBSOLETE."

— BUCKMINSTER FULLER

While many argued humans were destroying the Earth, it was in fact a specific social and economic system and the ideology of growth and extractivism that was driving the planet to collapse. The way many people lived, worked, produced and consumed, particularly in the Global North, was dependent on concrete decisions and on how societies were organised.

In many ways, the 2020 pandemic helped to further expose the systemically unjust and destructive nature of such systems: response packages – such as the EU's Next Generation plan – bailed out polluting corporations and stimulated the mining and energy sectors instead of supporting those who had been harder hit; local trade and production suffered strict lockdown measures while multinational online retailers made billions; streaming platforms took over the spaces for conviviality, creativity and learning.

Many among the priviledged had hoped the majority would have stood still, letting business-as-usual continue to destroy lives and the planet under pretences of sustainability and with the "miracle mining solution" of jobs for all amid the post-COVID crisis. But many decided to stand up. Faced with increasing proposals for mining projects around the world, communities mobilised to protect their lands and the deep sea. Mining companies found it more difficult to start operations due to a lack of consent from potentially affected communities. In many cases governments attempted to violently repress these resistance movements, but they were unable to convince the public at large that mining projects were an environmentally viable activity.[213]

The roots of the Great Transition can be traced back to the struggles of a myriad of frontline local and indigenous communities fighting extractivism across the world. The growing numbers of people and increased engagement could not be ignored. Earlier experiences such as Iceland's Kitchenware Revolution (2009–2011), the *Indignados* of Spain (2011), Occupy (2011–2016), the Idle No More protests in Canada (2012–), Extinction Rebellion and Fridays for Future (2018–), the *Estallido social* in Chile (2019-2020), the Climate Assemblies movement (2019–) led to new waves of global protests in the 2020s calling for a politics focused on the common good.

213 Earthworks et al. (2020). *Voices from the Ground: How the Global Mining Industry is Profiting from the COVID-19 Pandemic*. At: https://miningwatch.ca/publications/2020/6/2/voices-ground-how-global-mining-industry-profiting-covid-19-pandemic

Early examples include the acknowledgement of the Rights of Nature by the Convention on Biological Diversity (CBD) in 2021[214] and the European Economic and Social Committee's proposal for a EU Charter of the Fundamental Rights of Nature,[215] which moved away from the flawed idea of nature as a resource to be owned, used and degraded. The 2008 constitutional amendments in Ecuador, the 2010 Bolivian Law of the Rights of Mother Earth or the attribution of legal personhood through treaties to rivers, mountains or forests in New Zealand in the 2010s were obvious precedents. After Vanuatu's 2020 proposal, the Rome Statute was amended to bring the crime of ecocide under the jurisdiction of the International Criminal Court, matching previously defined crimes like genocide, crimes against humanity or war crimes.[216] The principle of "common heritage of humanity", applied in international law since the 1970s to the seabed, was extended in the 1997 *UNESCO Declaration on the Responsibilities of the Present Generations Towards Future Generations*, establishing that "Each generation inheriting the Earth temporarily should take care to use natural resources reasonably and ensure that life is not prejudiced by harmful modifications of the ecosystems."[217]

Social pressure at last transformed such declarations into binding commitments as environmental rights were further empowered through mechanisms such as the Escazú Agreement in Latin America and the Caribbean and the Aarhus Convention in Europe, Central Asia and the Caucasus. Increased public participation allowed communities and environmental defenders to more effectively resist proposed mining projects. In areas where mining projects were already present and resulting in damaged livelihoods and environments, affected people were able to hold authorities and companies to account.

The deep sea's status as common heritage of humankind – established by the 1982 United Nations Convention on the Law of the Sea – was re-evaluated in light of the 2050 Blueprint that followed the 2030 Sustainable Development Goals. Marine scientists and ocean defenders exposed the environmental and social risks of deep-sea mining. Expanding knowledge about the deep sea and efforts to improve society's ocean literacy made it clear to citizens and politicians that the life-generating role of the ocean – as provider of half of the atmosphere's oxygen, as climate regulator, as source of cultures and wellbeing – was worth more than its minerals.

* EACH GENERATION INHERITING THE EARTH TEMPORARILY SHOULD TAKE CARE TO USE NATURAL RESOURCES REASONABLY

214 See: https://www.earthlawcenter.org/elc-in-the-news/2020/9/convention-on-biodiversity-advances-the-rights-of-nature-in-proposed-post-2020-global-biodiversity-framework

215 Carducci, M., et al. (2020). *Towards an EU Charter of the Fundamental Rights of Nature*. Brussels: European Economic and Social Committee. At: https://www.eesc.europa.eu/en/our-work/publications-other-work/publications/towards-eu-charter-fundamental-rights-nature

216 Yeo, S. (2020). "Ecocide: Should killing nature be a crime?" *Future Planet*, Nov. 6. At: https://www.bbc.com/future/article/20201105-what-is-ecocide

217 See: http://portal.unesco.org/en/ev.php-URL_ID=13178&URL_DO=DO_TOPIC&URL_SECTION=201.html

The 167 member countries of the International Seabed Authority finally realised that public participation, transparency and consideration of the social and cultural impacts of activities were necessary to ensure that due regard was given to the interests of civil society, in particular in developing countries, and of future generations. The ISA's mandate to protect the deep sea eventually overcame its earlier role as "extractivism" manager.

UNCLOS AND THE COMMON HERITAGE OF HUMANKIND

The 1982 United Nations Convention on the Law of the Sea (UNCLOS) declared the Area (i.e. the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction) and its resources the common heritage of mankind (CHM) and vested all rights therein in "mankind as a whole". However, a consensus on the practical application of this principle had not yet been achieved in the early 2020s.

The principle of the common heritage of mankind is based on notions of stewardship and trusteeship and was created to realise a vision of solidarity and distributive justice. Critical elements of the common heritage regime outlined in UNCLOS included the preservation of the deep seabed for exclusively peaceful purposes; the principle of non-appropriation; the reservation of mineable areas for developing states in the Area; the equitable sharing of any financial or other economic benefits as well as knowledge generated through mining activities; and the protection and preservation of the marine environment.

Maltese Ambassador Arvid Pardo, one of the founders of the common heritage of humanity concept under international law, claimed that it challenged the "structural relationship between rich and poor countries" and amounted to a "revolution not merely in the law of the sea, but also in international relations". One of the main architects of the principle under international space law claimed that it is "the most important legal principle achieved by man throughout thousands of years during which law has existed as the regulating element of social exchange". This praise relates to the fact that international law in the common heritage of humanity principle sought to protect, respect and fulfil the interests of human beings independently of any politically motivated sovereign state; the concept covering all humans wherever they were living, as well as future generations.

Adapted from: The International Seabed – the Common Heritage of Mankind, IASS Policy Brief 2/2018 and https://en.wikipedia.org/wiki/Common_heritage_of_mankind

BREAKING FREE FROM THE GROWTH PARADIGM

Eighty-four years ago, in 1966, Kenneth Boulding's landmark essay, "The Economics of the Coming Spaceship Earth",[218] defined extractivism as the "cowboy economy", "the cowboy being symbolic of the illimitable plains and also associated with reckless, exploitative, romantic, and violent behaviour". In contrast, Boulding called for a new "spaceman economy", considering Earth as "a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system".

Back in 2020, as the initial COVID disruption brought back images from the Great Depression of the 1930s, a shrinking economy initially triggered fear furthering growth-seeking responses. But many realised that the path ahead – post-growth and degrowth[219] – was very different from the unmanaged processes of economic contraction – recession, depression or collapse – that were around the corner if the over-developed world continued with business-as-usual.

The 2020 COVID pandemic and the political discussions it caused brought degrowth narratives into the spotlight,[220] facilitating a combined effort to develop many of the emergent alternatives that had been around for years or decades. Buen Vivir (good living, a concept adopted from the *Quechua Sumac Kawsay* and introduced to the Constitutions of Bolivia and Ecuador in the late 2000s) inspired new ways to achieve social and environmental justice within Spaceship Earth as a global goal, replacing GDP and a never-ending spiral of increasing commodified materials and energy use.

218 Boulding, Kenneth E. (1966). "The Economics of the Coming Spaceship Earth," In H. Jarrett (ed.) *Environmental Quality in a Growing Economy*. Baltimore: Resources for the Future/Johns Hopkins University Press, pp. 3-14.

219 Hickel, J. (2020). "What does degrowth mean? A few points of clarification," *Globalizations*. At: https://www.tandfonline.com/doi/full/10.1080/14747731.2020.1812222

220 Rathi, A (2020). "How 'Degrowth' Pushes Climate and Well-Being Over GDP," *Bloomberg Green*, September 18. At: https://www.bloomberg.com/news/articles/2020-09-18/how-degrowth-pushes-climate-and-well-being-over-gdp-quicktake

Serge Latouche summarised this shift through the "8 Rs" of the virtual circle of degrowth:[221]

- **Reassess** what matters;
- **Reframe** key notions such as wealth, poverty, value, scarcity and abundance;
- **Restructure** the productive apparatus and social relations to fit these new values;
- **Redistribute** wealth and access to natural resources between North and South and between classes, generations and individuals;
- **Relocalise** savings, financing, production and consumption;
- **Reduce** production and consumption, especially for goods and services with little use value but high environmental impact;
- **Repair** and Re-use products; and
- **Recycle** waste.

In 2013 the EU adopted its 7th Environment Action programme with the title "Living well, within the limits of our planet", a vision for 2050 that should "help guide action up to and beyond 2020", and was also reiterated in the 8th Environment Action programme:

In 2050, we live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society.[222]

Green growth was based on a belief in decoupling – which held that techno-efficiency would make increasing goods and services available with negligible environmental impacts[223] – which proved to be a myth. Following the early warning of Herman Daly in his 1977 *Steady-State Economics*,[224] the profound dilemma faced by humanity at the beginning of the 2020s was clear: people could continue to dream that mounting social and environmental problems would simply solve themselves through more economic growth; or admit that the dominant social and economic system was causing irreversible environmental impacts that threatened the biosphere and human existence. Change required, first of all, a deep paradigm shift: what really needed to be decoupled were prosperity and good living from economic growth. As Daly had called for, "enough is best".

221 Latouche, S. (2010). *Farewell to Growth*. London: Polity Press,

222 See: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1493802707367&uri=CELEX:32013D1386

223 Parrique, T. et al. (2019). *Decoupling debunked: Evidence and arguments against green growth as a sole strategy for sustainability*. Brussels: European Environmental Bureau. At:https://eeb.org/library/decoupling-debunked/ ; Vadén, T. et al. (2020). "Raising the bar: on the type, size and timeline of a 'successful' decoupling," *Environmental Politics*. At: https://doi.org/10.1080/09644016.2020.1783951

224 Daly, H. E. (1977). *Steady-state economics*. San Francisco: Freeman.

SYSTEM CHANGE COMPASS

While in the 2010s many were still grappling with the unsolvable riddle of how to continually increase production and consumption without destroying the planet, in the 2020s efficiency finally gained a new (common-)sense and was paired with sufficiency.

The need to downscale economic consumption was finally addressed, the priority shifted from destructive growth to meeting people's needs without overshooting Earth's ecological ceiling, as set out in works such as Kate Raworth's Doughnut Economics.[225] A 2018 special report by the IPCC[226] warned the only viable way ahead was for rich countries to decisively cut their rates of material production and consumption. In 2020 the Club of Rome published its "System Change Compass" [227] calling for system-level change mirroring "naturally regenerative ecological systems, rather than resource-depleting systems."

"System Change Compass" (Club of Rome, 2020).

225 See: https://doughnuteconomics.org

226 IPCC (2018). *Global Warming of 1.5 ºC*. Geneva: IPCC. At: https://www.ipcc.ch/sr15/

227 Club of Rome (2020). *A System Change Compass: Implementing the European Green Deal in a time of recovery*. Winterthur: Club of Rome. At: https://clubofrome.org/publication/a-system-change-compass-implementing-the-european-green-deal-in-a-time-of-recovery/

Tim Jackson's 2017 *Prosperity Without Growth*[228] articulated many of the guiding principles for a post-growth social and economic paradigm. Focus shifted from GDP to well-being indices such as the Happy Planet Index and ideas such as Gross National Happiness and Maximum of Ecological Footprint; from smart cities to Transition Towns; and from increasing inequalities to mission-driven social enterprises and cooperatives. The "polluter pays" principle widely adopted in the first decades of the 21st century evolved into more effective Pigovian ecotaxes, higher severance taxes and "polluter restores" guarantees, particularly addressing mining.

Bold visions for the future were already being broadcast in the early 2020s. Examples included "A Societal Transformation Scenario for Staying Below 1.5°C" for countries in the Global North.[229] It suggested by 2050 there should be a 37% drop in transport demand; 81% reduction of the share of car transport in urban areas; 81% reduction of flights per person; halving of appliances per person; or a 24% reduction of calories per person (mainly through the reduction of food waste). This showed how a massive reduction in consumption was possible "by reshaping key infrastructures of societies and by regulative frameworks, economic principles and incentive structures guiding behaviour within society."

228 Jackson, T. (2017). *Prosperity Without Growth: Foundations for the Economy of Tomorrow*. London: Routledge.

229 Kuhnhenn, K. et al. (2020). *A Societal Transformation Scenario for Staying Below 1.5°C*. Berlin: Heinrich-Böll-Stiftung. At: https://eu.boell.org/en/2020/12/09/societal-transformation-scenario-staying-below-15degc

In 2021, 101 Nobel Laureates from peace, literature, medicine, physics, chemistry and economic sciences signed the "Our Planet, Our Future: An Urgent Call for Action"[230] statement, urging the adoption of "principles of recirculation and regeneration of materials" and concluding that:

Global sustainability offers the only viable path to human safety, equity, health, and progress. Humanity is waking up late to the challenges and opportunities of active planetary stewardship. But we are waking up. Long-term, scientifically based decision-making is always at a disadvantage in the contest with the needs of the present. Politicians and scientists must work together to bridge the divide between expert evidence, short-term politics, and the survival of all life on this planet in the Anthropocene epoch. The long-term potential of humanity depends upon our ability today to value our common future. Ultimately, this means valuing the resilience of societies and the resilience of Earth's biosphere.

Few of them would have imaged that global energy use in 2050 would have been reduced back to 1960 levels and that sufficiency is far more materially generous than many opponents of degrowth often assumed in the early 2020s.The social and technological solutions to bring about an end to mining and the ecological challenges of the early 21st century were already in existence; they required only an act of will to be mobilised under a common vision for the future.

And it all started when people got together to **imagine a world without mining.**

* GLOBAL SUSTAINABILITY OFFERS THE ONLY VIABLE PATH TO HUMAN SAFETY, EQUITY, HEALTH, AND PROGRESS.

230 US National Academy of Sciences (2021). "Our Planet, Our Future. An Urgent Call for Action," *National Academies*, April 29. At: https://www.nationalacademies.org/news/2021/04/nobel-prize-laureates-and-other-experts-issue-urgent-call-for-action-after-our-planet-our-future-summit

6

“IMAGINING A WORLD WITHOUT MINING” WORKSHOP

“NEVER DOUBT THAT A SMALL GROUP OF THOUGHTFUL, COMMITTED CITIZENS CAN CHANGE THE WORLD. INDEED, IT IS THE ONLY THING THAT EVER HAS.”

— MARGARET MEAD

The previous pages presented an evidence-based literary exercise to help bring about system change at the beginning of the third decade of the 21st century. Readers are invited to join the make-believe exercise by considering it a *gift from the future.*

This activity is based on an original workshop conceived in the 1980s by Elise Boulding (1920–2010) to imagine a nonviolent world. Boulding, a sociologist and peace activist, realised how many peace activists were unable to imagine a world without wars or armies, and asked, “How could we work to bring about something we cannot even see in our imaginations?”[231] Similarly, in 2021 ordinary citizens, activists in many fields and policy makers often find it hard break out of the mindset which holds that only solutions based on mining and the previously existing growth ideology could bring about change.

The workshop incorporates the views of futurist Fred Polak, who argued that positive images of the future are instrumental if movements and citizens are to guide their actions in the present toward preferred futures. This tool is of particular importance for those striving for complex social or political change, often hampered by dystopian and pessimistic views of the future.

The methodology of the workshop is detailed in the Warren Ziegler’s workbook “A Mindbook for imagining/inventing a world without weapons” (1987).[232] Several adaptations of this workshop have been developed addressing a number of themes.[233] This is the first to address a world without mining. Participants may find many other existent methodologies useful to develop their action plans, such as Donella Meadows’s Leverage Points[234] or *Schöne Neue Welt* by Forum Umwelt & Entwicklung.[235]

LENGTH AND SETTING: This workshop should ideally be developed at some length, preferably over a weekend and with at least two sessions of several hours each. It can be condensed to a shorter format of approximately four hours, although this is not the best option. Ideally, participants *should have read* the previous report in advance. It is highly recommended that the workshop be conducted in person and in an outdoor setting, or combine outdoors and indoors for different steps of the process.

A facilitator or group of facilitators should have prepared the workshop format in advance to guide participants through its seven steps (as described in the following box).

231 Boulding, E. (2002). “A Journey into the Future: Imagining a Nonviolent World,” *Peace and Conflict Studies*, 9(1): 4. At: https://nsuworks.nova.edu/pcs/vol9/iss1/4

232 Zeigler, W. (1982). *A Mindbook of Exercises for Futures/Invention*. Denver: Futures-Invention Associates.

233 For example: http://www.globalepe.org/article_print.php?aid=43

234 See: http://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

235 See: https://www.snw2048.de/

WORKSHOP STEPS

1 **Introduction to the activity with a brief introduction to the importance of views of the future** (Fred Polak, Elise Boulding, Futures, etc.). Participants are asked to express their own personal hopes (three or four) they have for a future society 30 years from the present (in 2050) where resource consumption has been greatly reduced. These must be positive hopes.

2 **Exercising imagination through memories of the past.** Participants are asked to "flex their imaging muscles" by closing their eyes and, in silence, remembering a positive, personal memory from the past, one they enjoy reliving. Focus is on details such as sights, sounds, smells. These are then shared with the group. Remembering images of the past brings participants into the "imagining mode" needed to move into the future.

3 **Leap into the future, 30 years ahead (2050),** where/when a *world without mining* is a reality. The facilitator helps participants leap the barrier separating present-present from future-present (for example, asking them to close their eyes and drift to the future). This is an exploratory trip (20-30 minute) where participants are expected to record their observations, interview (imaginary) inhabitants, and take notes, as ethnographers or sociologists is a field study.

4 **Sharing visions of the future.** Participants are expected to share their observations with the group that may ask questions and seek clarification. *Present tense must be used*, as we are still 30 years into the future!

5

Consequence mapping. In small groups, participants are expected to construct a more analytical description of the society/world they have observed (i.e., institutional/social arrangements, economy, material culture, time-use, technology, etc.), negotiating contrasting or conflicting imagery that may emerge among participants. Participants are invited to draw pictures, diagrams or other representations to prepare such a description before sharing it with the larger group (materials should be prepared in advance). The group may again ask questions and seek clarifications.

6

Remembering history. Standing in the future-present society, where a post-mining world thrives, participants are asked to *remember* in the same small groups what had happened over the previous years and decades, leading to successful change. A *ladder* or Gantt chart can be used, starting from the most recent events from the *future-present* stand point to the moment the workshop was carried out 30 years ago. Participants should note key events, stepping stones, with particular focus on the use of raw materials, consumption patterns and overarching policies shifted in time. The history of change will be presented to the larger group, always using past tense to explain what “happened”, and will be open to questions and debate.

7

Development of an action plan in the present. Back in the workshop’s 2020 present, each individual participant (or alternatively, if the setting allows, small groups) will prepare a short-term action plan to catalyse change toward the experienced future reality based on the pictured future and remembered history. The plan should be realistic in what the individual/small group is actually ready to commit to do to bring about a world without mining. It should include concrete actions with description of how they are to be implemented, with what allies, expected results, etc. As a closing, participants should be strongly encouraged to actively engage in making such action plans reality, either individually or in collaborations.

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