A DIGITAL PLANET FOR SUSTAINABILITY

In support of the UN Secretary General's Roadmap on Digital Cooperation

DRAFT v2

28 June 2021

TABLE OF CONTENTS

I. What's At Stake

For the first time in human history, we face a stark choice in the evolution of our species. Two distinct pathways lie ahead. If we go along with business as usual, digital technology will accelerate the demise of our species. But we can build a future in which digital technologies become a tool to amplify environmental sustainability and help us build the mindset necessary to create a sustainable civilisation.

On our current trajectory, climate change, biodiversity loss, and pollution of the land, air, and oceans threaten to take us beyond the limits of the earth's capacity to sustain human life – with devastating consequences.[1] This degradation of the planet has directly resulted from the idea that human economic activity has no significant impact outside the human sphere. This couldn't be further from reality. Human activity is just one part of a broader planetary exchange system. If we are to transform our future – rather than continue to destabilise the planet – we must broaden our understanding of economics to include more than just monetary profit. We must reorient our conception of value, and rebuild our socio-economic capital to achieve a balance between people and planet. The digital revolution offers us an opportunity to make this change.

The digital revolution has led to technology and digitally-driven transformations that have enabled unprecedented rates of data acquisition, processing, and the capacity to share data, information, and ideas. The power of digitalisation lies in its applicability to most human, societal, and economic purposes. Digitalisation continually transforms itself; it is constantly penetrating new domains, reducing costs, and boosting productivity across all sectors and industries. It is globally pervasive, disrupting pre-existing norms and unleashing an unprecedented new era of innovation that has profound implications, for science, industry and economies, but also for society and for policy at all levels of governance.

But we face a paradox as the world undergoes digital transformation. On the one hand, digital technologies have brought about unprecedented scaling of connectivity, decentralisation, and information sharing. Together, these can accelerate our understanding of the earth's complex dynamic systems, and increase our chances of achieving environmental sustainability at a planetary scale. Digital technologies also affect human wellbeing by enhancing capacities to share, innovate, and participate in our communities. A 2019 expert review conducted by Future Earth identified four digitally empowered capabilities already disrupting our economic, governance, and cognitive systems at a global scale: "unprecedented levels of transparency, intelligent systems, mass collaboration, and mixed reality."[2]

Digitally empowered capabilities can provide a pathway to sustainability – but they don't guarantee it. We are not yet using the available tools to build a sustainable civilisation. In fact, our degradation of the planet is accelerating – as digital technologies are simply amplifying the effects of business as usual.

---

[1] McSweeney, R. 2020. "Explainer: Nine 'tipping points' that could be triggered by climate change."

[2] Sustainability in the Digital Age, "The Digital Disruptions for Sustainability (D^2S) Agenda: Research, Innovation, Action," Future Earth, 2020.

While digital technologies are a vital piece of the planetary sustainability puzzle, we must address the fact that they are often developed, produced, and deployed in ways that are harmful. They fuel consumption, amplify environmental impact, use vast quantities of energy, entrench social divides, dislocate labour markets, and consolidate the power of the few over the many. Moving forward, we must work to ensure that continued digitalisation and efforts to close the digital divide do not unintentionally amplify the drivers of climate change, biodiversity loss, and pollution of the air, soil, and oceans. Realising the positive potential of digital technology needs to go hand in hand with minimising negative impacts.[3]

To achieve planetary sustainability and equitable human development, digitalisation must be actively channeled through conscious choices – collective and individual – as well as deliberate, strategic intent and effective governance. So far, the haphazard way that digitalisation has progressed has proved to be an engine for scaling and amplifying existing global inequalities, including widening income gaps, deepening exclusion and discrimination, and diminishing agency. In many cases, it has also amplified the profit-centered motives and business models that are degrading the health of our planet. Are the values of competition and accumulation, which sustain many digital businesses today, ones we want to amplify and accelerate? Is this the vision for a digital planet that we want?

The COVID-19 pandemic has revealed deep inequalities in the accessibility and availability of digitalisation and the wide gap between the digitally connected and unconnected. While digital technologies supported many during months of lockdown, billions of people lacked the same opportunities to safely work and learn from home.

At the same time, the global cooperation seen in response to COVID-19 demonstrates the potential of Open Science – the unprecedented sharing of ideas and data within and beyond the scientific community and across the public-private interface, accelerated by digital technologies. The scientific community's contribution to the pandemic response – from initial gene sequencing to effective, trusted vaccines in under a year – illustrates the profound capacity of modern science and technology to quickly address major crises when the global commons is urgently prioritised and political will is mobilised.

The lessons we have learned from COVID-19 must inform our path toward environmental sustainability. The parallels hold fast: as we've seen with the pandemic, ignoring evidence, denying science, failing to mobilise a global response, and leaving behind those less fortunate will only lead to catastrophe. It is a crucial responsibility of governments not only to stimulate the use and effectiveness of technology to create social and economic benefit, but also to mitigate the risks. Action cannot be undertaken by governments alone; success depends on deep collaboration, trust, and transparency across academia, civil society, governments, and the private sector. Further, any action must be underpinned by a common and enabling digital infrastructure. Creatively combining bottom-up and top-down approaches, as well as high- and

[3] GeSI & Deloitte, 2019. Digital with Purpose: Delivering a SMARTer2030

low-tech solutions, will be critical to successfully tackling this multifaceted problem and building our resilience to future risks.

Digital infrastructure is increasingly being recognised as a basic human right in our increasingly digitalised society. This is an essential start in eliminating an ever-widening digital inequality that reinforces existing social inequality.

This is one of the lessons we can take as we move beyond the pandemic. But it is crucial that the recovery from COVID-19 does not impede efforts toward sustainability. As we recalibrate in the wake of the pandemic, there is a crucial opportunity to close the digital divide in a manner that can also accelerate pursuit of the Sustainable Development Goals by the global community. It is also necessary to send the clear strategic signals and economic incentives that private and public sector actors need. Only then will they be able to work together to achieve the massive technological, economic, and social transformations required for the world to achieve existing net-zero carbon emissions targets – let alone a net-negative future – in a fair, just, and inclusive manner.

This report offers a vision, a set of values, and clear priorities to achieve these goals in the coming years through a massive multi-stakeholder coalition of the willing who are committed to walking the talk and investing in the changes needed.

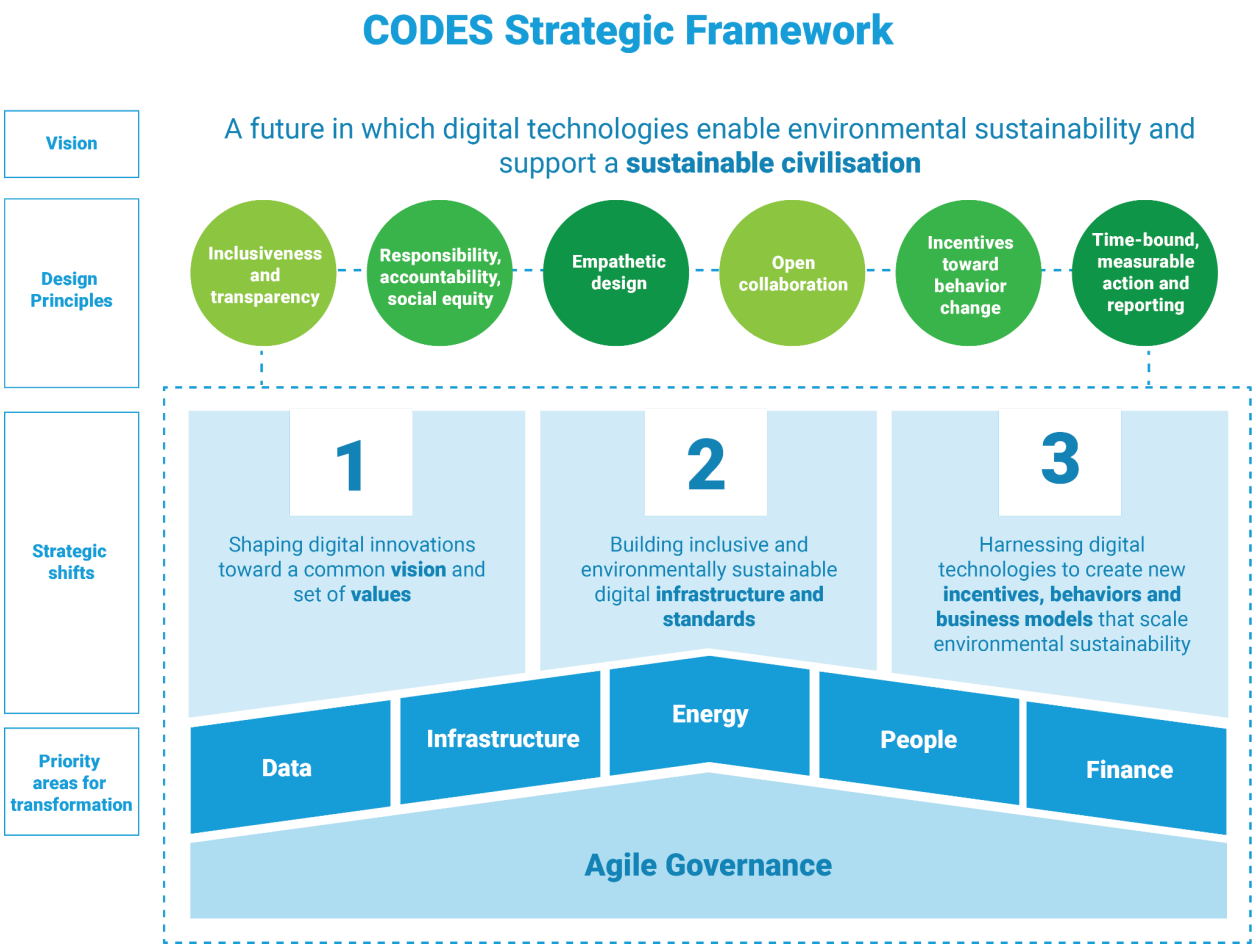
II. CODES's Theory of Change

The United Nations Secretary-General's Roadmap for Digital Cooperation calls on the international community to explore the ethical, legal, and human rights implications of our digitalised society. The Coalition for Digital Environmental Sustainability (CODES) emerged from this process as a means for advancing collective action and our individual obligations to advance environmental sustainability and greening our digital future.

Launched in March 2021, CODES is a global, multi-stakeholder coalition primarily intended to convene and coordinate collaborative action by existing public and private programmes in steering the digital revolution and the power of digitalisation towards global environmental sustainability. CODES involves UN agencies, scientific and research bodies, governmental institutions, DigiTech companies, and other private sector players, and civil society. The coalition of organisations is intended to draw on the best aspects of each sector – the UN to convene and galvanise broad-based support, science and civil society organisations to add legitimacy and foster inclusion, governments to establish the enabling policies and incentives, and private sector companies to take forward CODES' vision and values in their investments and business models. By forming this new type of coalition, we aim to redefine international cooperation on environmental sustainability in this new digital age.

There are two aspects of digitalisation that form the fundamental pillars of the CODES initiative. First, is our digitally enabled scientific understanding that defines environmental sustainability targets and is able to monitor progress towards them. The second aspect involves the digitally

enabled process efficiencies that are compatible with social and human values, as represented by the SDGs. For its inaugural year CODES will develop an Action Plan for digitalising environmental sustainability and greening our digital future, aligned with the Secretary-General's Roadmap for Digital Cooperation. The Action Plan will outline key priorities, actions, and commitments over a three year timeframe. This will provide a specific roadmap for collective action and accountability by the CODES Community of Practice, delineating who will act on which priorities, and with whom. Ultimately, the Action Plan will be aimed at facilitating knowledge sharing, promoting strategic coherence, and catalysing new, collaborative efforts in priority areas.



This report is the first step in support of these goals. It is aimed at establishing the foundation for a new vision of an ideal environmental sustainability and digitalisation interchange as new information and innovation become available. CODES members will be invited to evolve the ideas presented in this report on a rolling basis to signal their commitment to our shared vision and values. It is also intended to provide a framework for the development of the CODES Action Plan.

To ensure CODES operates in an inclusive and bottom-up manner, the co-champions have committed to the following processes:

1. Development and management of community building, consultation, and engagement processes, including a series of online roundtables and a discussion platform designed to foster thoughtful debate and idea exchange on collective action across public and private sectors, academia, and civil society.

2. A global conference – "A Digital Planet for Sustainability" – to be held from 30 June to 1 July 2021. The conference will bring together the CODES Community of Practice to further refine and flesh out the Action Plan, as well as engage key stakeholders in leading implementation activities (see Fig. 1 CODES Strategic Framework).

3. CODES stakeholders will form linkages with existing processes and initiatives in this field, by engaging at key international events including Policy Network on Environment within the Internet Governance Forum, and United Nations General Assembly debates and events on digital cooperation.

Building on previous multi-stakeholder processes and work[4] [5] [6] [7] [8], this report describes three primary, intertwined dynamics of the emerging and accelerating digital age. These intertwined dynamics are to be the focus of the forthcoming Action Plan, to be deliberated and endorsed at the *A Digital Planet for Sustainability* conference. These are:

(1) shaping digital innovations toward a common vision and set of values;
(2) building inclusive and environmentally sustainable digital infrastructure and standards; and
(3) harnessing digital technologies to create new incentives, behaviors, and business models that scale environmental sustainability.

This report offers the rationale for developing an action plan for digitally powered sustainability infrastructure, and for thriving, empowered, and connected livelihoods all over the world. It will offer milestones and a commitment framework to ensure that digital transformation supports, rather than undermines, a sustainable, equitable, and just future. The follow-up process to the report will offer milestones and a commitment framework. The ideas and thought-provoking questions presented in this report are not intended to be prescriptive; rather they are meant to inspire a new approach to the challenges ahead.

We intend for this report to serve as a foundation for the working groups convened at the conference beginning 30 June. Based on the outputs of the conference, the report will be adjusted to better reflect the thinking and goals of this community.

---

[4] WBGU. 2019. "Towards Our Common Digital Future".
[5] IIASA, 2019. TWI2050 Report: "The Digital Revolution and Sustainable Development: Opportunities and Challenges"
[6] Sustainability in the Digital Age, "The Digital Disruptions for Sustainability (D^2S) Agenda: Research, Innovation, Action," Future Earth, 2020.
[7] UNEP Science Policy Business Forum. 2019. The Case for A Digital Ecosystem for the Environment.
[8] Royal Society. 2020. Digital Technology and the Planet.

III. Three Strategic Shifts

Now that we understand what's at stake and the CODES mandate, in this section we discuss the three dynamics toward which we must shift our collective efforts and attention in order to build a digital planet for sustainability. Enabling these shifts will require a combination of data and universal standards, technological infrastructure, new investment incentives, and social capital (people), supported by values-based strategies, design principles and agile governance frameworks that position environmental sustainability and human wellbeing at the heart of digital solutions.

As the CODES initiative progresses, we will reflect on and refine these three strategic shifts. Later in this report, we isolate the design principles that should govern any action taken to enable these shifts, and the areas of transformation that should be prioritised.

We introduce the three dynamics here, and discuss them in detail later on in this section.

1. **Shaping digital innovations toward a common vision and set of values:** Digital innovations are not only tools to help solve sustainability challenges. If they are based on shared values of knowledge, responsibility, sustainability, resilience, solidarity, and humility, they can act as drivers of fundamental systemic changes.

2. **Building sustainable digital infrastructure:** Digital infrastructure is foundational to ensure digitalisation benefits the whole of society. Infrastructure must be built in a way that ensures universal access and participation. And infrastructure must be designed so that its construction, operation, and disposal is sustainable, energy efficient, non-toxic, and climate-safe.

3. **Reimagining the core incentives underlying models for business and leadership:** We must take action to shift leadership and business models and guide our technologies – digital and otherwise – with the values we want to reflect. A better understanding of our systems as a whole is critical to identifying drivers and incentives for change that can both influence and be influenced by digital channels.

These three dynamics will form the basic structure for the remaining sections of this report. But as we take these global opportunities forward, we must also consider how to mitigate the risks of digital technologies and uncontrolled digital transformation.

(1) Shaping digital innovations toward a common vision and set of values

Key message: Digital innovations are not only instruments to solve sustainability challenges; they also hold the potential to act as drivers of fundamental, deep systemic changes if they are based on universal values like inclusivity, responsibility, resilience, sustainability, solidarity, and dignity.

Realigning our digital innovation efforts to promote a universal set of values geared toward sustainability will benefit both humanity and the planet. In this section we set out specific ways in which systems, supply chains, and ways of working can be realigned using digital technologies to correspond to values that will better serve humans and the planet: sustainability, transparency, and the connected values of equity, justice, and dignity.

Sustainability is a critical value toward which we must align everything we do. Digital technologies can directly address sustainability challenges. Smart manufacturing can contribute to the rollout and longevity of circular business models by allowing products and components to be tagged, tracked, and traced throughout their life cycles. In a circular model, products are returned to the factory at end-of-life to be remanufactured, repaired, or refurbished, creating significant resource savings. By reducing the amount of materials used, increasing their lifespans, or tracking and tracing them, costs can be decreased and emissions reduced.[9] A more circular economy could also cut emissions from heavy industry by 56% in the EU by 2050, and 45% of cumulative emissions from steel, cement, plastic, and aluminum production globally.[10]

Digital technologies also have incredible potential to align energy production and use toward the value of sustainability. The energy sector today accounts for 40% of carbon emissions worldwide, and this is expected to rise as the global population grows and demand increases, including from digitalisation.[11] The proliferation of renewable energy, as we move away from fossil fuel, will be crucial to achieving – and maintaining – targets for net-zero carbon emissions, or pursuing a net-negative future.[12] With adequate support, including governance, many cities could achieve an electrical grid mix of 50-70% renewables (mostly solar and wind with some other zero-emission generation sources) by 2030. This would be a significant shift: cities occupy just three percent of the Earth's land, but they account for up to 80% of global energy consumption and 75% of global carbon emissions.[13] An additional 2.5 billion people are projected to be living in cities by 2050 – bringing the total urban population to nearly seven billion.[14]

Three key renewable energy technologies are critical for realising a net-zero carbon future over this century: wind, solar, and energy storage.[15] Solar PV and onshore wind are already the cheapest ways of adding new electricity-generating plants in most countries today.[16] Smart grids, a 'digitalisation' of the previous analogue grids, have been the key enablers of decentralised electricity generation and new business models such as feed-in tariffs, which have unlocked a huge change in consumer behaviour. A concerted effort of technology innovation, policies and regulation, investments, and financial incentives have resulted in a drastic increase of renewable energy sources.

---

[9] Exponential Roadmap 1.5, 2019. Exponential Roadmap Scaling 36 Solutions to Halve Emissions by 2030.
[10] PA. Enkvist, P. Klevnas, The Circular Economy–A Powerful Force for Climate Mitigation: Transformative Innovation for Prosperous and Low-Carbon Industry. Material Economics Sverige AB: Stockholm, Sweden (2018).
[11] World Bank, 2020. Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition
[12] Nature, 2021. Net-zero emissions targets are vague: three ways to fix
[13] Cities – United Nations Sustainable Development, https://www.un.org/sustainabledevelopment/cities/
[14] UN DESA https://population.un.org/wpp/
[15] World Bank, 2017. The Growing Role of Minerals and Metals for a Low Carbon Future
[16] IEA, 2020. Renewables 2020 Analysis and forecast to 2025.

In some cases, digital technologies can align challenges toward more than one value. Digital technologies applied to global food systems in particular can promote greater sustainability as well as **equity, justice, and dignity**. Digital technologies can contribute to the development and longevity of products that prioritise human, social, and natural capital, rather than financial. By valuing the positive and negative externalities along value chains, regenerative production systems that contribute to societal and planetary wellbeing can be incentivised.

The human food system is one of the largest pressures on the planet. Producing food for the global population accounts for 23% of annual greenhouse gas emissions. Nearly half of these – primarily livestock production and rotting food waste – are directly related to food choices we make as individuals.[17] One third of the 1.3 billion tons of food produced each year is lost or wasted.[18] These inefficiencies are unevenly distributed throughout the globe; higher-income countries waste almost as much food annually as the entire net food production of sub-Saharan Africa.[19] On the other hand, nearly 820 million people lack sufficient food.[20] Many millions more are part of a global trend in which traditional diets are being replaced by diets higher in foods from animal sources and high-input agriculture with low-nutrient value. If this trend continues, emissions from food consumption and production will nearly double by 2050.[21]

Digital technologies can play a key role in estimating and monitoring carbon sequestration, and stand to hugely benefit the field of agriculture, in particular in regards to water efficiency and reducing the use of pesticides and chemical fertilisers. These include precision input delivery, satellite monitoring, simulated agricultural trials, and more.[22] [23] [24] [25]

Achieving universal electrical connectivity is a goal that aligns with the values of equity and justice as well. Digital technologies enable exciting new ways of connecting to the electrical grid in rural areas. At present one billion people still lack access to electricity, 85% of whom reside in rural areas.[26] In areas distant from the main grid, innovative new technology and processes have increased the potential for previously unfeasible off-grid electrification projects and investments. These include mobile phone-enabled payment options, fintech solutions like end-user credit assessments, and new business models like pay-as-you-go.[27] These have opened up new options to countries for reaching universal access. Nigeria, for example, has implemented the largest minigrid programme in Africa, aiming to extend electrical services to

[17] All facts in this paragraph from IPCC. Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. (2019).
[18] Food and Agriculture Organization of the United Nations, 2019. Key facts on food loss and waste you should know!
[19] W. Willett et al., Food in the Anthropocene: the EAT Lancet Commission on healthy diets from sustainable food systems. Lancet 2019; 393: 447–92. (2019).
[20] Food and Agriculture Organization of the UN. International Fund for Agricultural Development, UNICEF, World Food Programme, WHO. The state of food security and nutrition in the world. Rome: Food and Agriculture Organization of the UN (2018).
[21] W. Willett et al., Food in the Anthropocene: the EAT Lancet Commission on healthy diets from sustainable food systems. Lancet 2019; 393: 447–92. (2019).
[22] https://doi.org/10.1016/j.njas.2019.100315
[23] https://doi.org/10.1162/glep_a_00566
[24] https://doi.org/10.17261/Pressacademia.2017.448
[25] NJAS-Wageningen Journal of Life Sciences, 90, p.100315
[26] World Bank 2020. Tracking SDG 7 - The Energy Progress Report 2020
[27] UNDP, 2018. Derisking Renewable Energy Investment: Off-Grid Electrification

300,000 households and 30,000 enterprises in rural areas by 2023. By 2025, Nigeria aims to have 850 minigrids up and running.[28]

Gender equity remains a serious global problem, one which is exacerbated by global crises such as COVID-19. Digital technologies offer opportunities to enhance gender equity by allowing the potential for increased access to education and information for women and girls, particularly in rural settings. Social media and online networks allow women to more easily connect, build coalitions, draw attention, and demand accountability. However, a digital gender divide still persists within technologies themselves. As digital tools are designed primarily by men, race, gender, age, and other biases are often transferred into their code, algorithms, and design. This has resulted in, for example, facial recognition systems that disproportionately misidentify women and people of color, in screening algorithms that disadvantage female applicants, and more.

To address these asymmetries and bridge the digital gender divide, we need funding mechanisms and tools supported by public and private sectors that ensure equity in gender access and representation at all levels of power. We also need to develop safe, confidence-building environments where girls and women can safely acquire skills. But beyond this, we need to include members of marginalised communities not just as consumers, but as producers of digital technologies. Promoting women's leadership requires policies that build on gender analysis and ensure safe environments for learning and growth throughout education and career paths.

Finally, in making data available to us in new ways, digital technologies allow us to support realignment toward the value of **transparency**. By supporting a transition from machine dominant manufacturing toward digital manufacturing,[29] data can eliminate current confusion and complexity around the pursuit of sustainability by allowing for seamless automation of product life cycles, taking into account their environmental and social footprints. In terms of urban planning, the availability of good quality data has made digital visualisations far more relevant and informative, allowing for better flow of traffic, urban infrastructure resilience, and solving problems of sprawl and heat islands. Finally, data can support parallel advancements in net-negative technology, such as carbon capture and re-use.

Increased understanding of the power of data from a wide variety of sources has also enabled the rise of citizen science, giving people all over the world the power to participate in scientific discovery. It has also presented opportunities for solving prominent problems in the last mile.

Business systems centered around sustainability, development programmes organised around equity and justice, citizen empowerment, and a seamless flow of data can aid societies to make deliberate choices. However this will not happen organically. A change in governance is necessary, toward more participatory forms. Participatory forms of governance across all governance levels, where nations, industry leaders in digital innovation, and other stakeholders

[28] World Bank, 2019. Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers
[29] https://doi.org/10.1007/s10845-018-1433-8

(like multilateral organisations and human rights institutions) can be brought into a dialogue to shape the direction of digital innovation, manage efforts to enhance diverse and mission-led innovation in various economies and geographic locations, and to ensure equality in access to digitalisation. Technology innovation, entrepreneurship, policies and regulation, consumer awareness, investment, and financial incentives need to move hand in hand toward a common vision.

(2) Building inclusive and sustainable digital infrastructure

Key message: Green, resilient, and adaptive digital infrastructure is foundational for ensuring digitalisation is benefiting the whole of society. Infrastructure must be collaboratively created in a way that ensures universal access, interoperability, and participation, and that can be powered in a sustainable and climate-safe way.

Digitalisation is happening rapidly but unequally. Around 60% of the world's population is now online. But 90% of those live in developed countries. In those developed countries, 80% of people are online, compared to only 20% in less developed countries.[30] Further, digitalisation is contributing to a widening inequality, knowledge, and education gap between developed and less developed countries, and within countries too.[31] In OECD countries between 2001 and 2013, labour productivity among frontier firms – more likely to be digitally literate – rose by around 35%. Among non-frontier firms, that increase was only around 5%.[32]

Least developed countries have the greatest digital divide, with an average 32.9% inequality gap related to internet access. Jobs everywhere increasingly require some level of digital access, which leaves a large number of people greatly disadvantaged.[33] At the same time, half the women on the planet today have no digital access.[34] In order to ensure sustainable livelihoods for all, bridging this digital divide is vital.

There has been progress toward this goal. In India and sub-Saharan Africa, investments in digital identification systems using biometric data are helping bridge the gender gap by reducing barriers for women and members of marginalised groups to access financial and public services and join the formal economy. Without more efforts like this, a quarter of the world's population will find themselves unable to contribute to digital environmental sustainability as producers or even consumers. Women and girls from early childhood to adulthood must have affordable, equal access to digital literacy education, content, and infrastructure to support their becoming not just consumers, but producers of technological innovations.

Research shows that small businesses in poorer nations suffered more during COVID-19 lockdown than their wholly digital counterparts.[35] This has spurred momentum to recognise

[30] United Nations, 2019. Digital Economy Report, 2019
[31] Qureshi, 2020. Inequality in the Digital Era
[32] OECD 2016. The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy
[33] Plan International. Bridging the Digital Divide
[34] ITU, 2020. Measuring digital development: Facts and figures 2020
[35] UNCTAD, 2020. New survey shows COVID-19's impact on e-commerce in poorer nations

digital infrastructure as a basic human right. And critically, access to a quality, affordable, and secure internet connectivity should be governed as a digital public good.

Unfortunately, the processes by which our digital infrastructure is currently developed, produced, powered, and disposed of are exacerbating our acceleration toward the threshold of the other planetary boundaries. According to the European Framework Initiative for Energy & Environmental Efficiency in the ICT Sector, almost 10% of all energy used and 4% of carbon emissions in the environment come from ICT alone.[36] As the world continues to digitise, the ICT sector will only grow. The tools and processes many associate with digitalisation take up an inordinate amount of energy, stealthily increasing their usage in ways that too often go unnoticed.

Bitcoin, heralded as the currency of the future, uses a form of blockchain based on extremely energy inefficient 'Proof-of-Works' algorithms. As a result, it consumed an estimated 50-70 terawatt hours of electricity in 2019 alone – about equivalent to the consumption of Switzerland.[37] The backlash against Bitcoin has already begun: in May 2021, Elon Musk tweeted that Tesla would no longer accept the cryptocurrency over climate concerns. By June 2021, Bitcoin had dropped 50% from its all-time high in April.[38] Further, new studies show that typical machine learning processes can emit nearly 300,000 kilograms of carbon dioxide equivalent. That's about five times the lifetime emissions of the average American car, including the manufacturing process.[39]

An Open Science approach – which emphasises shared information and common metrics – has the potential to improve the social impact, effectiveness, and carbon footprint of digital systems while avoiding duplication costs and resource waste. For example, OpenAI's GPT-3 model, which uses deep learning to produce human-like language ranging from computer code to poetry, is estimated to have cost $5 million USD and 86 tonnes of CO2 emissions. It's a best-in-class tool with a great deal of potential in both public and private sectors. But after all this cost and effort, the code has been kept private. This has created vast wealth for the company's shareholders, but has also stymied the potential of the tool for maximum good.

Open source initiatives have succeeded in reproducing universally accessible, albeit less powerful, versions of the model, but their efforts have been duplications of existing work, creating more emissions and expending human labor reinventing a wheel. An Open Science framework could enable more research from the same data, and increase opportunities for participation in research at local, national, and global scales. Open Science practices and infrastructure enable greater innovation and partnerships, which not only provide economic benefits and returns, but also steer digital transformations to be inclusive and more environmentally sustainable.

---

[36] https://www.ictfootprint.eu/en/about/ict-carbon-footprint/ict-carbon-footprint
[37] IEA, 2020. Data Centres and Data Transmission Networks
[38] https://www.cnbc.com/2021/06/08/whats-really-behind-the-bitcoin-decline-and-why-it-could-take-the-cryptocurrency-as-low-as-20000.html
[39] Hao, Karen, 2019. MIT Technology Review. 'Training a Single AI Model Can Emit as Much Carbon as Five Cars in Their Lifetimes.'

In 2019 alone, a record-breaking 53.6 million metric tons of e-waste was produced. That's the equivalent weight of 125,000 Boeing 747 jumbo jets – more than all of the commercial aircraft ever manufactured. This incredible volume makes e-waste the world's fastest-growing domestic waste stream, fuelled primarily by higher consumption rates of electric and electronic equipment, short life cycles, and few options for repair.[40] Less developed countries in particular struggle with managing e-waste, as nascent or non-existent e-waste management infrastructure fails to keep up with fast growing use of digital devices.

As we shift away from fossil fuel dependence, our demand will increase for other sources of green energy or renewable energy. Green technologies are more mineral intensive in their composition than traditional fossil fuel-based energy supply systems.[41] At least 23 key minerals are critical to the development and deployment of solar panels, wind turbines, electric vehicles, and energy storage technologies. To meet the growing demand for green energy technologies, the production of some minerals could increase by nearly 500% by 2050.[42] Substantial reserves of 18 key minerals are found in states with a high rank on the 2017 corruption perceptions index. Increased demand for minerals from these areas could amplify existing drivers of instability and cause significant environmental risks in mining locations.[43] Ultimately, this could stymie human development and potentially trigger a global backlash that undermines the growth of green energy and digital technologies.[44]

To ensure the increasing demand for minerals does not exacerbate existing inequalities and fragilities – or cause new ones – we must devote careful attention to ICT supply chains. Concerns have been raised about all stages of the supply chain – from mining in conflict zones to the long, transcontinental journeys that most rare earth minerals take from the ground into electronics.

(3) Reimagining the core incentives underlying governance, business models, and leadership

Key message: Leverage digital technologies to influence a shift in governance and leadership, and reimagine core incentives underlying key business models.

Scientists and environmentalists have warned of the consequences of the destruction of non-renewable and renewable natural capital since Rachel Carson's *Silent Spring* was published in 1962. Yet how much have the business models that drive the global economy actually shifted to reflect the overwhelming evidence presented by the scientific community? Of the $97 trillion USD in global financial capital, less than 2% is currently aligned to environment, social, and governance (ESG) principles.[45] How can we achieve planetary sustainability when

[40] GEM, 2020. The Global E-waste Monitor 2020. Quantities, flows, and the circular economy potential
[41] World Bank Group, 2017. The Growing Role of Minerals and Metals for a Low Carbon Future
[42] World Bank, 2020. Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition
[43] IISD, 2018. Green Conflict Minerals: The fuels of conflict in the transition to a low-carbon economy
[44] World Bank, 2017. The Growing Role of Minerals and Metals for a Low Carbon Future
45 Global Infrastructure Hub, 2019 https://www.gihub.org /

more than 98% of our financial capital is focused exclusively on maximising profit, without regard for our planet? It's critical for us to acknowledge that outdated economic growth models are leading to increased inequality and accelerated degradation of the natural environment, in addition to other risks. As we repair and build forward, we must reorient our economic incentives toward a scientifically informed understanding of earth systems, taking a whole-of-society approach with a clear intent to restore nature and reduce our footprint.

As we emerge from the pandemic, this is the moment to shift incentives and investments away from unsustainable production and consumption patterns – business as usual – toward more nature-positive, low emissions, and low polluting economic activities: decarbonisation, dematerialisation, and detoxification. This requires placing nature and climate concerns at the heart of all socio-economic recovery efforts, and bringing justice and equity at the forefront. Efforts to shape a new digital society should work toward closing the digital divide while simultaneously enabling shifts in sustainable production and consumption practices.

Business models and consumption patterns driven and, at present, served by the infinite growth paradigm draw limited distinction between price and inherent value. This mindset is pushing us beyond the planet's carrying capacity. Ubiquitous features of online platforms, search engines, news feeds, targeted advertisements, suggested sites, and connections have become "hyper-nudge" mechanisms that increasingly determine what people read, what questions they are encouraged to ask, and what opinions and candidates they support.

As our global economy undergoes digital transformation, there are opportunities to 'hard code' environmental sustainability as a foundational feature. In doing so, we can fundamentally shift incentive structures – and use digital technologies to optimise for sustainability outcomes rather than ones that are solely profit-oriented.

We are seeing nascent efforts to embed environmentally minded values, goals, and metrics into existing digital technologies. Blockchain is increasingly being used for supply chain tracking, offering transparent and traceable information exchange on environmental metrics.[46] Google has also adjusted its maps algorithm to show 'greener' options for transportation.[47] Microsoft's so-called moonshot carbon initiative promises that the company will be carbon-negative by 2030, and by 2050 it will have removed all the carbon it has emitted since founding in 1975.[48] Even Amazon is responding to climate-based criticisms by beginning to highlight climate pledge-friendly products on its platform to nudge consumers toward better sustainability choices. These efforts should be noted, but Big Tech companies struggle with reconciling sustainability goals with traditional profit-making practices.[49] Despite their climate pledges, Microsoft and Google continue to support the oil and gas sector, offering cloud computing technology to expand oil production and increase profitability.[50]

---

[46] UNDP - Climate Change Adaptation More than just cryptocurrencies - using blockchain for climate action in agriculture

[47] Google, 2021 Redefining what a map can be with new information and AI

[48] https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/

[49] https://www.greenpeace.org/usa/reports/oil-in-the-cloud/

[50] https://www.vice.com/en/article/xgqypn/while-microsoft-was-making-its-climate-pledge-it-was-sponsoring-an-oil-conference

But rebuilding a compassionate, ecologically minded economic system without addressing inequality in all its forms would be self-defeating. Digital transformation is not simply a channel to speed up economic activities, nor one that by itself ensures long-term environmental health. It must also optimise social equality and collaboration, facilitate the creation of decent, green jobs, and promote greater inclusivity and diversity.

III. Toward an Action Plan

Our collective response to (1) climate change and environmental degradation and (2) the use and governance of digital technology will shape the future of humanity. Our work now is to connect these two challenges and leverage digital technologies to recalibrate values, shift incentives, catalyse sustainable behaviours, and co-create the jobs of the future. How we tackle the challenge will determine whether we move toward a future where human development can progress in a way that is harmonious with the planet, or whether we carry on with business as usual amidst an environment of increasingly devastating crises and consequences.

Through multilateral cooperation we can harness the power of digital technology to create a path forward that both eases the pressure on the planet and allows us to advance human development by closing the digital divide. It's important to remember that digital technologies are not ends in themselves – rather, they are only means for us to address existential threats like zoonotic diseases, climate change, pollution, and biodiversity loss. We can only successfully address these issues if we build infrastructure, standards, algorithms, and laws with an eye toward ensuring positive environmental outcomes that are inclusive, equitable, and sustainable.

There has been recent progress on the policy front. In May 2021, a Dutch court ruled that Shell, one of the world's largest oil companies, must cut its emission by 45% by 2030 relative to 2019 levels.[51] There have been similar, earlier precedents in France, Germany and other countries, where companies were found guilty of denying basic rights to future citizens. The landmark Hague decision shows that corporations can now be ordered to comply with the goals of the Paris agreement. They also can be made responsible for the basic rights of future citizens, a new application of the duty of care principle. The corporate world has struck back against this type of ruling, however the fact that the battle is being waged demonstrates marked progress.

Deep collaboration between public and private sectors will be necessary in the development of digital public goods and in the sustainability transformation. New partnerships need safeguards and new business models to ensure they are conducted in the public interest with maximum transparency. The twinned projects of achieving net-zero and closing the digital divide must be data-led. The ability to track the environmental footprint of increased use of digital technologies, as well as the progress we make in closing the digital divide, is critical to transparent and agile workflows. Systematic changes and new incentives are needed to link digital transformation to environmental sustainability and human development. In the next three years, we believe that these changes can be catalysed by organising our collective response around six main design

[51] https://www.theguardian.com/business/2021/may/26/court-orders-royal-dutch-shell-to-cut-carbon-emissions-by-45-by-2030

principles and seven strategic priorities for transformation. Each of these challenges is necessary to address as part of an action plan for building a digital planet for sustainability.

The CODES stakeholders hosted a design thinking workshop on 7 May 2021, during which a total of 118 collaborators brainstormed common values that should be adopted in order to achieve equitable environmental sustainability. The resulting levers can be interpreted as 'design principles'. CODES advocates that they be applied across any kind of governance structure (at meso, international, national, corporate, and local) and design of action plans as well as each on-the-ground initiative.

Design principles:

- Inclusiveness and transparency
- Responsibility, accountability, social equity
- Empathetic design
- Open collaboration
- Incentives toward behavior change
- Time-bound, measurable action and reporting

Priorities for transformation

This section presents sustainability challenges and opportunities in seven priority areas, as well as proposed goals that we hope to refine during the upcoming conference. The CODES community has isolated the areas as the ones in which digital technologies can make the greatest impact and where public-private partnerships are essential. Strategies for transformation must be developed with the six above design principles in mind. Digitalising environmental sustainability is a system-wide effort, requiring collaboration across all industries and stakeholders that contribute to the digitalisation of the economy. CODES can offer both a commitment framework and "docking station" for active pledges to the framework on the part of companies, governments, civil society actors, research organisations, and others during 2022-2024.

1) Data: *Building a universal digital planetary database with trusted environmental data, standards, and governance frameworks*

Fifty-eight percent of environmental SDG indicators cannot be measured globally due to a lack of data. Similarly, many of the performance indicators for the Paris Agreement, the Convention on Biodiversity, the Chemicals Conventions, and other Multilateral Environmental Agreements (MEAs) cannot be universally measured on a global basis due to a lack of universal, standardised reporting standards and data taxonomies. UNEP's 2021 Measuring Progress Report finds gaps not only in the underlying data, but also in the tools and analytical methods for understanding interactions among and between the environmental dimensions of the SDGs, and the social and economic dimensions of sustainable development. In order to close these gaps, we can leverage open data, interoperability of Earth Observations, and universal standards, among other tools and strategies. Advancing a new generation of agile tools, data and information systems, and data strategies can also assist nations and other

actors in fulfilling their environmental pledges and stimulate new mechanisms to hold stakeholders to account.

For example, private sector actors need access to high quality digital public good data to advance their net-zero goals, SDG targets, and Environment, Social, and Governance (ESG) commitments across their business operations and supply chains. This goes hand in hand with transparently disclosing information on their own environmental and climate performance to investors, governments, and individuals.

> **Goal I:** Identify a set of high-value datasets that are needed to underpin ESG, SDG, and MEA actions by public and private sector actors together with a business model to finance digital public goods.
>
> **Goal II:** Establish global digital disclosure standards for ESG and net-zero data from sub-state and non-state actors and test digital integration frameworks in national reporting.
>
> **Goal III:** Establish a set of global standards for “Earth APIs” that discover, harmonise, share, and integrate environmental data across digital platforms and cloud services.
>
> **Goal IV:** Assess the data needs, interoperability standards, and digital infrastructures that are needed to support and automate Life-Cycle Assessment (LCA), Product Environmental Footprinting (PEF), and Digital Product Passports needed for a circular economy.
>
> **Goal V:** Aggregate environmental information at a planetary scale and use that information to understand the earth as one interconnected social-biophysical system, assessing, and predicting implications of changes for people and nature.

2) Infrastructure: *Greening the digital technology supply chain and advancing circularity*

Greening the digital infrastructure that underpins the digitalisation of the economy is an essential priority. While many public and private sector actors have migrated large portions of their ICT infrastructure to the cloud, there is often a lack of transparency and comparability in terms of the environmental and carbon performance of different cloud providers. There are no standard metrics for measuring and benchmarking digital footprints across the digital infrastructure value chain or for procuring ICT infrastructure in a manner that minimises environmental impact, e-waste, and energy demand.

We also need to ensure that the global digital infrastructure is fit for purpose for the kinds of applications that will be needed to conduct carbon, biodiversity, and pollution accounting at a global scale in near real time. This will require building digital ecosystems of infrastructure and platforms that can seamlessly share information about their environmental and carbon

performance to enable the calculation of emissions across scopes 1, 2 and 3 (see footnote).[52] This will go hand in hand with building the required infrastructure for digital twins, smart applications, and digital product passports in an interoperable manner for global integration and connectivity.

> **Goal I:** Develop and adopt green public procurement standards and policies, laws, and regulations to reduce and mitigate the adverse impact of e-waste regulations for ICT with adoption by at least 100 countries as part of closing the digital divide.
>
> **Goal II:** Develop and adopt energy efficiency standards for digital infrastructure, Artificial Intelligence, and associated software.
>
> **Goal III:** Develop tracking and tracing standards and digital product passports for ICT components that are needed to support e-waste management and circular design.
>
> **Goal IV:** ICT companies measure, validate, and disclose ESG and SDG performance in easy to understand consumer labels.
>
> **Goal V:** Adopt a common set of metrics and standards that enables every industrial actor to measure and benchmark their digital footprint within the digital infrastructure value chain.
>
> **Goal VI:** Assess the digital infrastructures needed to underpin the global adoption and interoperability of digital twins, smart cities, and digital product passports.

3) Energy: *Digital technologies must both power and benefit from the green energy revolution*

As new energy-intensive technologies like AI, blockchain, digital twins, and high-performance computing come online, greener energy sources will be critical to fulfilling massive new demands. The energy sector today accounts for 40% of carbon emissions worldwide, or 13.6 gigatons, and is expected to rise further as the global population grows and demand increases, including from digitalisation.[53] The penetration of renewable energy in the energy sector will be crucial to achieve a net-zero carbon future and to powering the digitalisation of the economy.

Green energy technologies provide a smaller overall greenhouse gas footprint than hydrocarbons. Three key green technologies are critical for realising a net-zero carbon future over this century based on renewable energy: wind, solar, and energy storage. If these technologies can be scaled, we can potentially achieve a halving of energy-related emissions by 2030.

---

[52] A widely-used international accounting tool for GHG emissions: Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. Scope 3 includes all other indirect emissions that occur in a company's value chain.

[53] http://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf

Digital technologies are also essential for the SMART management of distributed green energy systems as well as for tracking and tracing ICT components as part of a circular economy strategy for the sector.

> **Goal I:** Data centers of all major cloud providers, social media platforms, and e-commerce platforms adopt 100% renewable energy targets; targets for renewables should apply to all new connectivity investments (e.g. mobile towers).
>
> **Goal II:** Embed energy efficiency and green energy protocols within stack and end-user software to help optimise and reduce energy demand.
>
> **Goal III:** Develop a global framework for the digitalisation of financial mechanisms such as carbon credit and distributed renewable energy credits (D-RECs) to incentivise investments in developing countries and to monetise the value of distributed renewable energy installations on a global basis.
>
> **Goal IV:** Identify consensus mechanisms and related energy efficiency gains for blockchain applications and cryptocurrencies that both minimise energy requirements and automatically prioritise green energy supplies.

4) Finance: *Aligning finance, investments, and public procurement to environmental sustainability goals and net-zero carbon commitments*

Of the $95 trillion USD invested in global stock markets, only $2 trillion USD is aligned to ESG principles. We must close this gap through the adoption of disclosure standards and new incentives that work to align finance with SDG goals. By requiring companies to disclose specific information, they enable stakeholders to better understand the concentrations of carbon-related assets in the financial sector and the financial system's exposures to climate-related risks. The more investors can understand climate risk as financial risk, the more it affects stock valuation and pricing on the market.

The growing world of fintech also provides a major opportunity to embed environmental sustainability data, goals, and metrics directly into the financial services offered by these platforms. However, issues of data privacy and security as well as algorithm bias, can negatively impact individual consumers. Many fintechs have been allowed to grow to massive scale through data models that monetise customer data in non-transparent ways and that actively promote unsustainable consumption.

Sustainable procurement policies can also have a major influence on market demand dynamics. Public procurement by governments drives 15-20% of global GDP. Governments are uniquely positioned to demand transparency to the upstream and downstream impacts of goods and services. Digital tools can help automate this process and help matchmake companies and suppliers that are aligned with procurement objectives.

Goal I: Adopt digital standards and verification mechanisms to calculate and disclose ESG and SDG performance and climate-related risks including through the use of emerging technologies that support spatial finance.

Goal II: Fintech applications systematically embed environmental sustainability data, values, and goals into their service offerings and simplify sustainable investing processes for end users and retail investors.

Goal III: At least 100 governments digitalise their sustainable procurement policies and adopt measurable procurement targets.

Goal IV: Business to business (B2B) platforms and Enterprise Resource Planning (ERP) services offer full environmental and climate transparency on supply chain providers and help companies procure with purpose through digital filtering and automation.

Goal V: Development of disclosure standards for business models and algorithms that optimise for environmental sustainability to ensure transparency and sharing of best practice.

5) People: *Bridging the digital divide and influencing sustainable livelihoods, lifestyles, and behaviors*

Advancing human-well being including sustainable livelihoods, lifestyles, and behaviors must be one of the overarching outcomes from the digitalisation of the economy. This has two main dimensions.

A major focus is needed on promoting sustainable consumption at the individual level using digital tools such as product comparability, nudging, and gamification. Sixty-five percent of people in a recent survey say they want to buy purpose-driven brands that advocate sustainability, yet only about 26% actually do so.[54] [55] We must use digital technologies to close this attitude-behavior gap. Sustainability must be automated, simple, and seamless. Two-thirds of climate emissions are based on household-level decision making, so this individual level is a critical first step.

Presently, there is only a nascent movement on e-commerce platforms to include sustainability nudging, gamification, or filters to actively influence and drive the adoption of sustainable product, services, behaviors, and lifestyles. This needs to be amplified and standards are needed to ensure comparability and quality control. Efforts are also needed to battle fake news about the environment and climate change and to amplify positive stories of environmental change on social media platforms.

[54] https://hbr.org/2019/07/the-elusive-green-consumer
[55] https://www.accenture.com/_acnmedia/Thought-Leadership-Assets/PDF/Accenture-CompetitiveAgility-GCPR-POV.pdf#zoom=50

At the same time, we must close the digital divide and ensure people are not left behind as the economy continues to digitalise. Indeed, digital technologies also offer massive opportunities to support sustainable livelihoods in rural settings and in marginalised populations through the provision of information, training, and sharing lessons on best practices.

Development programmes using digital transformation approaches must actively engage and empower vulnerable and marginalised people (rural farmers, people with low income, people working in the informal economy, people with disabilities, displaced people, women) to utilise the wealth of data and digital technologies to improve sustainable livelihoods, promote the sound management of natural resources and identify environment and climate risks.

> **Goal I:** Increase the number of algorithms on consumer platforms that help to optimise for sustainability criteria in recommendation engines.
>
> **Goal II:** Social media algorithms help minimise the proliferation of environment and climate disinformation while promoting positive stories about impact.
>
> **Goal III:** Ensure that apps designed to support sustainable livelihoods are built using human-centered design principles that consider rural needs and digital literacy.
>
> **Goal IV:** Ensure digital inclusion policies, programmes, and tools include specific provisions on sustainable ICT infrastructure, green energy, and on engagement with vulnerable and marginalised people.

6) Governance: *Supporting the migration of power and decision-making from traditional governance systems toward more nuanced, decentralised structures.*

As we continue to move into the digital age, the realm of governance and decision making is being influenced by forces outside of traditional structures of governance. Governance systems at all levels have become more complex, multifaceted, and decentralised. The traditional boundaries between sectors have blurred, with a less intuitive role for national governments, and a wider role for civil society and powerful non-state actors, including the private sector, where a handful of large technology firms have emerged as geopolitical actors that transcend national boundaries. While digital technology holds tremendous promise, a new era of international cooperation, attention to science, and agile governance across decision-making levels is required if we are to resolve problems like the climate crises and the ongoing pandemic.

New roles and responsibilities for civil society, private enterprise, and other non-state actors, together with a shared set of values, can help harness the contributions of science, technology, and innovation.

> **Goal I**: Implement a cooperative, iterative, values-based design approach into norms, institutional principles, and governance standards.

Goal II: Overcome silos and increase the horizontal and vertical interplay between various agents and agendas.

Goal III: Expand traditional environmental governance regimes and policy-making processes to include more dynamic, agile governance models.

Goal IV: Define what is needed for further institutional modernisation to organise processes for digital sustainability.

Goal V: Establish new models of public-private collaborative governance to encourage transparency, accountability, and trust in technology innovation.

7) Science: *Facilitating the integration of scientific data into the digitalisation of sustainability*

As the digital revolution continues to accelerate, scientific advances, predictive analytics, and collective intelligence will play a vital role in achieving environmental sustainability. Over the last two decades, the creation of a Digital Earth has been important in creating a scientific definition of and making progress toward environmental sustainability. This work currently focuses on the creation of digital twins, whereby the sustainability state and evolution of the elements of the earth system, its hydrosphere, atmosphere, biosphere, geosphere and, crucially, its anthroposphere are digitally represented.

Goal I: Continual improvement of assessments of sustainability targets, pathways to environmental sustainability and monitoring procedures that evaluate progress. Assessment model improvements will indicate the need for further data series.

Goal II: Support the international science community in embedding Open Science practices within national science systems, working with UNESCO in monitoring their development, and focusing on bridging the digital divide in infrastructure and capacity in low-to-middle-income countries.

Goal III: Support the international science community in establishing data standards that enable the data interoperability that is crucial if science is to address the complexity that is at the heart of sustainability challenges.

Goal IV: Prioritise the federation of globally distributed databases and digital knowledge platforms that operate under FAIR and CARE principles; facilitate cross-domain interoperability; interact with the research community in developing new sustainability functionalities; facilitate democratic access to data resources; act to combat the privatisation of knowledge.

IV. Seizing the opportunity

The lesson from the COVID-19 crisis holds true for the environmental sustainability crisis we face. With international trade, globalised travel, and cross border migration, no nation will make it on their own. No one is safe unless we are all safe.

The tools of digital transformation have the potential to make our predictive models and visualisations more visceral and engaging. This will allow us to understand the crises we face in a context of compassion rather than quantification. The task is now to manage the change together so that marginalised voices are considered, engaged, empowered, and employed – rather than excluded – from the future we envision in this paper. We must use digital tools to compile better data sets than the ones we've used until now, and rectify the policies and programmes we've built on this unsteady foundation.

The content available through these technologies must be accurate, open, and universally accessible to ensure the technology itself does not become a source of inequality. We should be aware that the internet – now fundamental as the conduit of dialogue, exchange, and information – has fundamentally changed since its inception. Pioneered by its founders as open, free, and with universal infrastructure and standards, it has now become fragmented by computer protocols that increasingly differ by company and by country. The priorities advocated in this report would best be served by a reversion to the internet's original democratic designs.

Markets are essential to progress because they can identify, deliver, and distribute solutions to society's problems as well as supply products in general. But the market is not an end in itself. Markets are tools for society; platforms or arenas where transactions happen. For markets to serve our best interests, they need rules based on common values about how the transactions work and how the market operates. When a market's rules enable particular interest groups to maximise their benefits, and for the market itself to self-perpetuate, the market is exploiting the society that sponsors them.

When, instead, markets are based on values – responsibility, resilience, fairness, and sustainability – they can become open exchange platforms for a society rather than predatory gambling dens. The actualisation of these values, as well as solidarity, dynamism, and humility, would make markets work to strengthen the integrity of the society that supports them. It would also inspire confidence in the people and institutions that participate in them.

As all economic transactions are increasingly digitalised, we can harness this opportunity to fundamentally encode environmental sustainability values, goals, and metrics within the algorithms, platforms, and applications of the digital economy. We can use digital technologies to optimise for sustainability outcomes and we can finally make sustainability simple, seamless, and automated.

When we say our response to environmental crises and the adoption of digital technology will determine the future of humanity, the choice is obvious about what future that should be – a

better one than we have today. In our action plan, the six challenges mould the digitalisation goals to address environmental complexities with place-based, appropriate solutions that tackle societal inequities.

So this is how we design our digitalised future: in a manner so that the process, the means, and the ends promote those objectives we already agree on. These are social justice, human rights, economic equity, gender equality, resource conservation, biological integrity, environmentally sound technological advances, and opportunities that allow communities and individuals to follow their own aspirations. Ultimately, digital technologies are simply means to give people more freedom to make informed choices about how they live their lives. The challenge is to drive digitalisation in a way that lets them do so while also contributing to a healthy planet and sustainable civilisation.

This working paper has been prepared by a collective of core authors on behalf of the Coalition for Digital Environmental Sustainability (CODES) which emerged from the Secretary-General's Roadmap for Digital Cooperation. The working paper supports the roadmap in specifically seeking to advance collective action on digitalising environmental sustainability.

Coordinating Lead Authors
Stephanie d'Arc Taylor, United Nations Development Programme
Jason Jabbour, United Nations Environment Programme

Lead Authors
Geoffrey Boulton, International Science Council and University of Edinburgh
David Jensen, United Nations Environment Programme
Dirk Messner, Umweltbundesamt/German Environment Agency (UBA)
Robert Opp, United Nations Development Programme
Reina Otsuka, United Nations Development Programme
Philip Thigo, Executive Office of the Deputy President, Kenya
Éliane Ubalijoro, Future Earth & Sustainability in the Digital Age

Contributing Authors
Heide Hackmann, International Science Council
Ben Larroquette, United Nations Development Programme
Christian Löwe, Umweltbundesamt/German Environment Agency (UBA)
Catherine P. McMullen, independent expert
Dirk Osiek, Umweltbundesamt/German Environment Agency (UBA)
Hélène Osterman, United Nations Environment Programme
Nilufar Sabet-Kassouf, Future Earth & Sustainability in the Digital Age
Megha Sud, International Science Council

Reviewers
Pierre Boileau, United Nations Environment Programme
Andrea Hinwood, United Nations Environment Programme
Hannah Kromminga, GIFTD, Greentech Alliance; SILFIR
Dave Thau, WWF
Ashbindu Singh, Environmental Pulse Institute
Michael J. Oghia, Sustainable Digital Infrastructure
Edward Darling, The Life Map; Redlist Revival
Simon Gardner, Natural Environment Research Council