CODES

COALITION FOR DIGITAL ENVIRONMENTAL SUSTAINABILITY

Action Plan for a Sustainable Planet in the Digital Age

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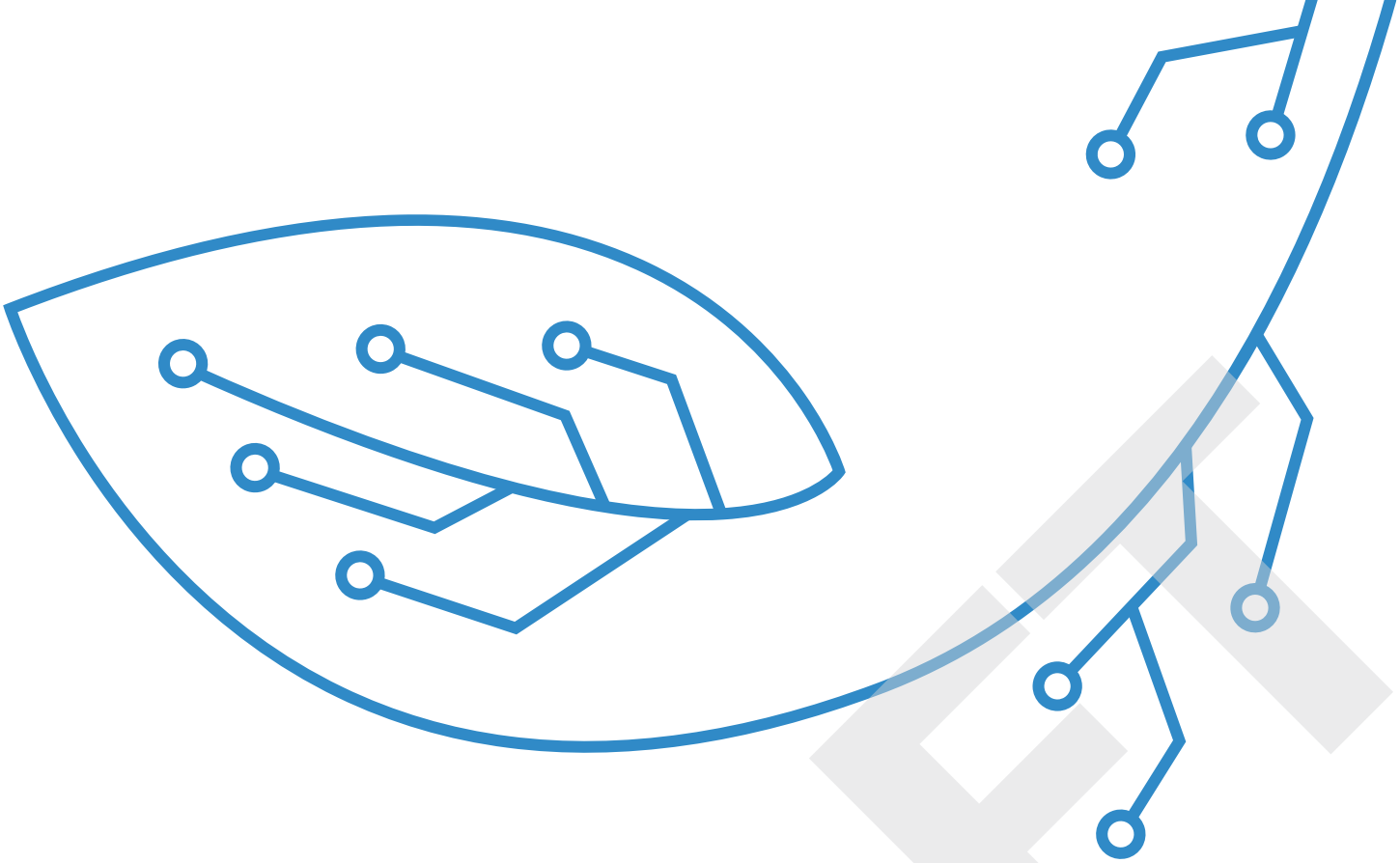

Acknowledgements

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 digitalizing environmental sustainability.

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The digital revolution is one of the most important drivers of economic and social change. It has given rise to powerful general-purpose technologies such as artificial intelligence or cloud computing of revolutionary scale and potential.

Digital technologies are globally pervasive, increase productivity, disrupt pre-existing business models and lead to diverse innovations with profound implications for the human future. Digitalization has enormous potential to support progress towards sustainability however in its current form, it continues to enable and/or encourage unsustainable practices that are degrading natural systems, entrenching inequality, and undermining human wellbeing.

There is an urgent need to reverse these negative trends and to utilize the potential of digitalization as a vital tool in developing globally sustainable economic and social behaviours. We need to move the focus away from the pursuit of short-term, unsustainable gains towards the achievement of long-term values-driven sustainable outcomes. Three fundamental shifts are needed:

- **Shift 1 Enable Alignment:** Create the enabling conditions to align the vision, values and objectives of the digital age with sustainable development.
- **Shift 2 Mitigate Negative Impact:** A commitment to sustainable digitalization that mitigates the negative environmental and social impacts of digital technologies.
- **Shift 3 Accelerate Innovation:** Directing efforts and investments toward digital innovation that accelerates environmental and social sustainability.

Within each shift, this report identifies six strategic priorities that must be addressed during the 2022-2025 timeline. CODES will contribute to these fundamental shifts in four main ways:

- **Convene and connect** a global community of common purpose to advance these 3 shifts.
- **Identify enabling policies and systemic transformations** towards all 18 strategic priorities.
- **Suggest impact initiatives** as actionable items to concurrently progress strategic priorities.
- **Foster and demonstrate political leadership** in advocating for and realizing the impact initiatives.

Executive Summary

The future of humanity and the health of planet Earth depend to a large extent on how we develop and deploy digital technologies. Driving massive economic, social and environmental changes, digital technologies can either be used to exacerbate environmental degradation, inequality and social division or they can be employed to help build a healthier, safer, cleaner and more equitable future.

The transformational capabilities of digitalization are a crucial tool to achieve the UN Sustainable Development Goals (SDGs)[1] by 2030. An assessment in 2020 found that digital technologies will have a high impact across at least 10 of the UN's SDGs. The report estimates that 70 per cent of 169 targets base-lining the world's sustainability goals can be positively influenced using digital technology applications.[2] However, achieving global sustainability is not an inevitable or an obvious outcome of the digital revolution. Indeed, digital technologies , through their energy requirements and newly induced demand, have accelerated the exponential rise of the human impact on the natural environment that now threatens the resilience of our ecological systems, alongside worsening societal inequalities and escalating social injustice.[3] The digital revolution has the potential to help transform society and business models to a more sustainable and equitable world but only if there is a conscious and deliberate effort to steer it in that direction.

The **Coalition for Digital Environmental Sustainability (CODES)**, is an international multi-stakeholder alliance created in March 2021 in response to the UN Secretary General's Roadmap for Digital Cooperation to steer the use of digital technologies toward accelerating environmentally and socially sustainable development. CODES is striving to reorient and prioritize the application of digital technologies to meet the 2030 sustainable development agenda and to achieve the multiple global environmental goals that have been adopted as the outcomes of multilateral processes and years of consensus building across all UN Member States.

The emergence of the CODES Action Plan marks the 50th anniversary of the establishment of the United Nations Environment Programme (UNEP) set-up to promote environmental sustainability. The goal of the Action Plan is to offer a vision and set of priorities and targets that have been co-created by the CODES community. This Action Plan is part of the follow-up to the UN Secretary-General's Digital Cooperation Roadmap and is meant to inform the emerging set of priorities for the Global Digital Compact proposed by the UN Secretary-General's latest report "Our Common Agenda", which calls for a new landscape of digital governance to harness data for the global good. It will also contribute to the Stockholm +50 conference and to on-going deliberations in the UN Environment Assembly and in the UN Human Rights Council linked to digital transformation and the recently recognized human right to a clean, healthy and sustainable environment.[4]

As a result of a consultative process over the past 12 months, this Action Plan describes 3 shifts and 18 strategic priorities across the shifts that are needed to harness digital transformation as a positive and exponential force for progressing environmentally and socially sustainable development.

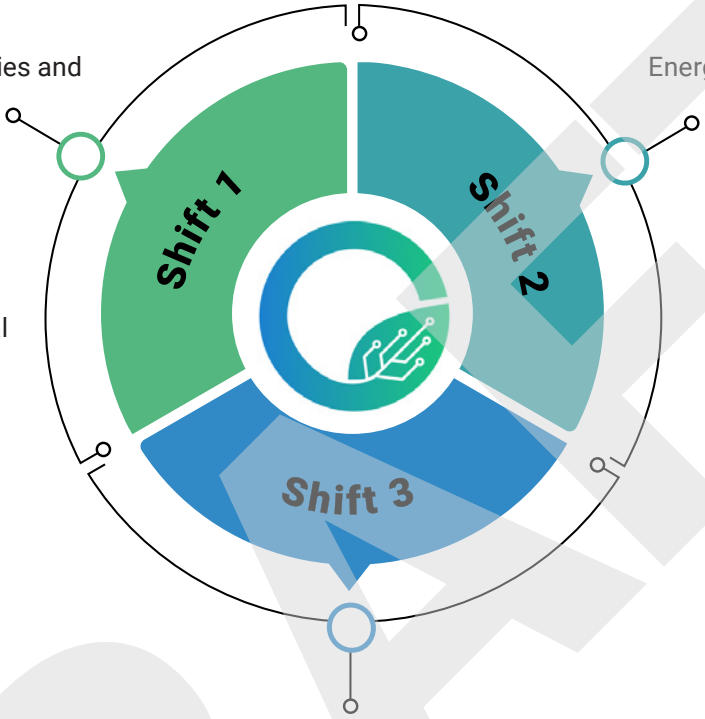
Three Shifts and 18 Strategic Priorities to Achieve a Sustainable Planet in the Digital Age

SIX ENABLERS
Enable Alignment
Align vision, values, objectives

- Connect Communities and Transformations
- Develop Digital Competencies
- Harness Science and Systems Thinking
- Advance Multilateral Action
- Build Pioneering Coalitions
- Adopt Norms and Standards

SIX PROBLEMS
Mitigate Negative Impacts
Sustainable digitalization

- Energy and Emissions
- Material Base
- Consumption
- Misinformation
- Digital Divides
- Rights Violations



SIX INNOVATIONS
Accelerate Innovation
Digital sustainability

- Planetary Digital Twin
- Sustainable Circular Economy
- Sustainable Consumption
- Knowledge Commons
- Governance Breakthroughs
- Access Evolution

The main aim of this Action Plan is to catalyse collective action by the international community and the members of CODES towards the implementation of the 3 shifts and the associated 18 strategic priorities and outcomes during the 2022-2025 time-frame. It also proposes 12 impact initiatives as actionable items that can be undertaken to consolidate and coordinate existing efforts along with addressing key gaps.

The target audience includes national and local governments, policy makers, international organizations, private sector companies, civil society, and the science community. The CODES Action Plan has been drafted in the spirit of the Charter of the United Nations, with its covenant to “promote social progress and better standards” and “to employ international machinery for the promotion of the economic and social advancement of all peoples”. These are reflected in our Action Plan’s comprehensive commitment to the UN SDGs as well as different Multilateral Environmental Agreements (MEAs).

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Overview: A Sustainable Planet in the Digital Age

What's at Stake

In 2015 the international community set itself 17 ambitious Sustainable Development Goals (SDGs), which are to serve as a guideline for all countries until the year 2030. They are intended to promote human dignity, the protection of the planet, peace, and prosperity for all, and to promote global partnerships. However, the SDGs 2020 Progress Report shows that the world is not on track to achieve the goals by 2030.[5] The current trajectory of triple planetary crises of climate change, biodiversity loss and pollution and wastes, threatens to take us beyond the limits of the earth's capacity to sustain human society at near to present levels of social or individual wellbeing.[6] The resulting environmental crises are already being felt across the world. We now have less than ten years to achieve the SDGs, and the reality is that we will not achieve these goals by 2030 without major systems transformation. While we grapple with this understanding, digital technologies and capacities are rapidly accelerating, with the potential to either hinder our ability to achieve the SDGs or facilitate the scale of change needed.

There is a foundational sustainability question about whether humankind is capable of directing digital change for a civilizational shift towards a renewed humanism. Are we able to realize and safeguard the idea of human rights, liberal freedoms, science, rule of law, and democracy against totalitarian temptation, surveillance capitalism and human enhancement? This is an ethical endeavour that needs broad discourse and public response. What are the implications for emerging governance patterns that could challenge our current system of sovereign nation states? Will privacy, trust, deliberation and democratic procedures be undermined or are we heading towards civic empowerment and a transnational 'Earth system consciousness'? These are big questions, but they are imprinted in every little step we take in further developing our digital environment - how we generate and operate data, how we nudge for sustainable lifestyles, how we build transparent supply chains with safeguards, how we share or exclude knowledge, how we provide access to basic services and breakthrough technologies, how carefully we combine democracy with automation-techniques or how we as human beings (re)define ourselves as part of or external to nature. The global community needs to invest in inclusive fora and frameworks to deliberate on, assess and govern these issues. Scientifically driven and socially embedded anticipatory assessment processes should support this endeavour.

The implications of the digital divide sit at the heart of these fundamental questions. There exist deep inequalities in the accessibility and availability of digital rights and services and a wide gap between the digitally connected and unconnected. According to data from the ITU, approximately 4.9 billion people – or 63 per cent of the world's population – used the Internet in 2021.[7] This represents an increase of 17 per cent since 2019, with 782 million people estimated to have come online during that period. Of the 2.9 billion people offline, 96 per cent live in developing countries. Indeed, the WEF Global Risks report for 2021 listed "Digital power concentration" and "digital inequality" as number 6 and 7 on the critical short-term threat list – both representing a clear and

present danger to social and political stability (See Box 1).[8] If digital capacities are to be leveraged for global environmental and social sustainability, the digital divide needs to be closed in a sustainable and equitable manner.

The Challenge and the Opportunity

The UN Secretary Generals' Digital Cooperation Roadmap makes a number of key observations about the challenges and opportunities between digital technology and the evolution of society as captured by the following sentiment:

"DIGITAL TECHNOLOGY IS SHAPING HISTORY. BUT THERE IS ALSO THE SENSE THAT IT IS RUNNING AWAY WITH US. WHERE WILL IT TAKE US? WILL OUR DIGNITY AND RIGHTS BE ENHANCED OR DIMINISHED? WILL OUR SOCIETIES BECOME MORE EQUAL OR LESS EQUAL? WILL WE BECOME MORE, OR LESS, SECURE, AND SAFE? THE ANSWERS TO THESE QUESTIONS DEPEND ON OUR ABILITY TO WORK TOGETHER ACROSS DISCIPLINES AND ACTORS, ACROSS NATIONS AND POLITICAL DIVIDES. WE HAVE A COLLECTIVE RESPONSIBILITY TO GIVE DIRECTION TO THESE TECHNOLOGIES SO THAT WE MAXIMIZE BENEFITS AND CURTAIL UNINTENDED CONSEQUENCES AND MALICIOUS USE."

António Guterres, UN Secretary General
Photo: Eskinder Debebe / UN Photo

We are witnessing fundamental shifts in how sectors define, generate, and distribute value. Digital capabilities are disrupting most economic sectors on which human civilization depends, including agriculture, energy, transport, cities and buildings (see Boxes 2-7). New trans-sectoral and trans-national business models and marketplaces are emerging with often unforeseen or opaque social and environmental consequences.[9] Indeed, digitalization of almost every sector of the global economy and their associated business models is enabled by new dimensions of cost optimizations, operational efficiencies, and extremely fast and cheap expansions of products and services, incentivised by rapid growth and profit while accelerating unsustainable lifestyles and values. An increasing number of people, governments and businesses are both participating in and shaping the emerging digital economy. At least 1.5 billion people consume products and services through e-commerce platforms,[10] and 60 per cent of the global population is anticipated to engage with social media by mid-2022.[11] The transition to a digital economy under the current "business as usual" paradigm will increasingly enable operating models that are not in line with the SDGs.

The digital sector itself is energy and materials-intensive. According to some estimates, the share of the global carbon footprint of our digital gadgets, the internet and the systems supporting them is 2.3 per cent, roughly the same as global air travel.[12,13] As the world prepares for increasingly decentralized internet models like Web 3.0, reliance on energy-intensive technologies like blockchain and AI computing could also increase. In terms of material demands, globally, the world produces as much as 50 million tons of electronic e-waste a year.[14] Only 20 per cent of this e-waste is recycled.[15] In order to meet the high demand for hardware, extraction of rare earth elements and other precious metals like cobalt and lithium is increasing steadily.

Addressing these challenges is more possible than ever before. We can collectively choose to build a future in which digital technologies accelerate and scale environmental and social sustainability, underpin sustainable societies and economies, and empower citizens and local communities. Accelerating sustainability with digital technologies will not happen without deliberate decisions. Indeed, if governed effectively and reflexively, the emerging digital products, services, platforms, and business models can help address and unlock many of the systemic level barriers and perverse incentives that have inhibited sustainable markets, behaviours, and lifestyles.

The Coalition for Digital Environmental Sustainability (CODES) is a multi-stakeholder alliance formed as a follow-up to the UN Secretary General's Digital Cooperation Roadmap. The core goal is to engage our collective intelligence in designing and developing global governance and deployment frameworks that allow for the harnessing of the transformative capabilities of digital technologies to help drive environment and social sustainability, while mitigating their risks and unintended consequences. The CODES Action Plan, generated through a consultative process with the CODES community over the past 12 months, presents 3 shifts and 18 strategic priorities across these shifts along with 12 actionable impact initiatives that can collectively enable the acceleration of environmental and social sustainability through digital technologies. To achieve this, a massive, coordinated effort is essential to ensure the needed shifts in mindsets across digital value chains, services, platforms and most importantly within business models. Thus, redefining the social and economic objectives that are necessary for a sustainable planet in the digital age.

The Action Plan: Seizing the Opportunity

There appears to be emerging political will to address digital ethics, norms and governance as expressed in initiatives including, among others, the UN Secretary General's Digital Cooperation Roadmap,[16] Our Common Agenda,[17] and the planned Global Digital Compact. A clear agenda and set of priorities for advancing environmentally and socially sustainable development within a renewed social contract for the digital age must be reflected in outcomes of such initiatives (See Box 3). Clear entry points for realizing the promise of digital technologies in responding to the triple planetary crises: climate change, degradation of nature and pollution must be included. This will require an embrace of an increased level of agility in the governance and execution of these initiatives that reflects the pace of change of digital advancements and a deeper sense of urgency to consolidate intersecting priorities and solicit collective multilateral stakeholder agreements.

The vision for this Action Plan is therefore to establish a set of priorities, goals, and timeline that will enable environmental and social sustainability to be firmly encoded in the digital revolution. The CODES community has collectively identified 3 major shifts that must be addressed if this vision is to be realized. Strategic priorities to catalyse these three shifts are described in detail in Section 2 of this Action Plan. Important overarching messages and actionable impact initiatives to advance the strategic priorities are summarized in Section 3.

The first shift that is needed is to align the visions, values, and objectives of digital capabilities with those of environmentally and socially sustainable development. Greater commitments to sustainability require shifts in values and norms that drive a transition beyond profit towards positive social and environmental outcomes. The mindset of maximizing shareholder value must evolve to a new set of values focusing on transparency, accountability, and inclusive stakeholder engagement.

A shared set of sustainability values and standards must be encoded into the design, development and deployment of digital products, services, platforms, and business models. Enabling such a shift requires connecting communities, building digital competencies, taking advantage of science and arts, advancing multilateral action, building pioneering coalitions, and adopting norms and standards.

The second shift is to ensure inherently sustainable digitalization. We must confront the paradox that increased reliance on digital technologies for sustainability comes at an environmental cost. Indeed, digitalization without sustainability can run counter to sustainability goals, by encouraging unsustainable consumption, causing environmental impacts across supply chains, directly consuming energy and resources, entrenching social divides, amplifying misinformation, dislocating labour markets, exacerbating inequality within and between societies, or consolidating the power of the few over the many (see Box 1).[18] This shift requires a focus on six problem areas entrenched in digitalization. These are energy and emissions, materials, consumption behaviours, misinformation, digital divides, and rights violations.

The third shift is to direct and incentivize innovations towards digital sustainability. We see the need to actively harness the power and reach of digital technology for exponential improvements in environmental management, governance, green financing, and sustainable production and consumption within a net zero and circular economy, while empowering more people with the knowledge and the agency to adopt sustainable lifestyles and livelihoods. Digital technology and innovation, if directed with intention, can empower government, businesses, communities, and individuals to make decisions and take action that align with their values. To achieve planetary sustainability and equitable human development, the digital transformation process in every sector must be actively guided through conscious choices and values – collective and individual. This shift suggests six areas of innovation that we must intentionally incentivize to support digital sustainability. These include building a digital twin of the planet, enabling a circular economy, supporting sustainable consumption, enabling a knowledge commons, creating networked and agile governance and accessible technologies for the whole of society.

The contents of this Action Plan are based on a series of open dialogues and collective intelligence processes undertaken with over 800 stakeholders that voluntarily participated in CODES. This process involved structured round tables, a global conference, and online consultations. The process captured a diverse range of views, experiences, and priorities from stakeholders in over 100 countries and from across major stakeholder groups. These inputs have been synthesized by the co-champions of CODES, including UNEP, UNDP, the International Science Council, Future Earth, the German Environment Agency, and the Kenyan Environment Ministry. This has been conducted in close collaboration with the Office of the Secretary-General's Envoy on Technology, UN within the framework of the Digital Cooperation Roadmap.

The key goal of this Action Plan is to catalyse collective action by the international community and the members of CODES towards the implementation of the 3 shifts and the 18 strategic priorities during the 2022-2025 timeframe. The aim is to encourage the expansion of existing efforts, intersecting, and coordinating parallel initiatives and catalysing new efforts. This also includes integration of the shifts and strategic priorities in relevant international processes such as the UN Environment Assembly, Stockholm plus 50 and the planned Global Digital Compact (Figure 1). The target audience includes national and local governments, policy makers, international organizations, private sector companies, civil society, academia, and the science community. Actions should be adopted across all age groups in an inclusive and gender balanced way. It forms an important baseline on where we currently stand that will be used for measuring progress going forward.

As the digital age unfolds, it must become the responsibility of governments at all levels to ensure the availability of digital infrastructure and to catalyse and incentivize the use of digital products & services to create social, economic, and ecological benefits. Furthermore, governments must strengthen the standards and open-source communities that provide the technologies which enable those products, services and the digital transformation at large. This must go hand in hand with paying due attention to trust building, transparency, and the protection of human and civil rights as part of the digital governance framework. It is essential that there is some degree of uniformity of intent behind key legislation, regulations and policies given the global reach of digital products, services and platforms and the existence of international businesses operating in multiple geographies. It is also equally clear that action cannot be undertaken by governments acting alone. Success depends on deep collaboration within and between international organizations, the global science community, arts and open technology communities, all levels of government, civil society, the private sector, and digital-native companies.

Figure 1: **Timeline for the CODES Action Plan**

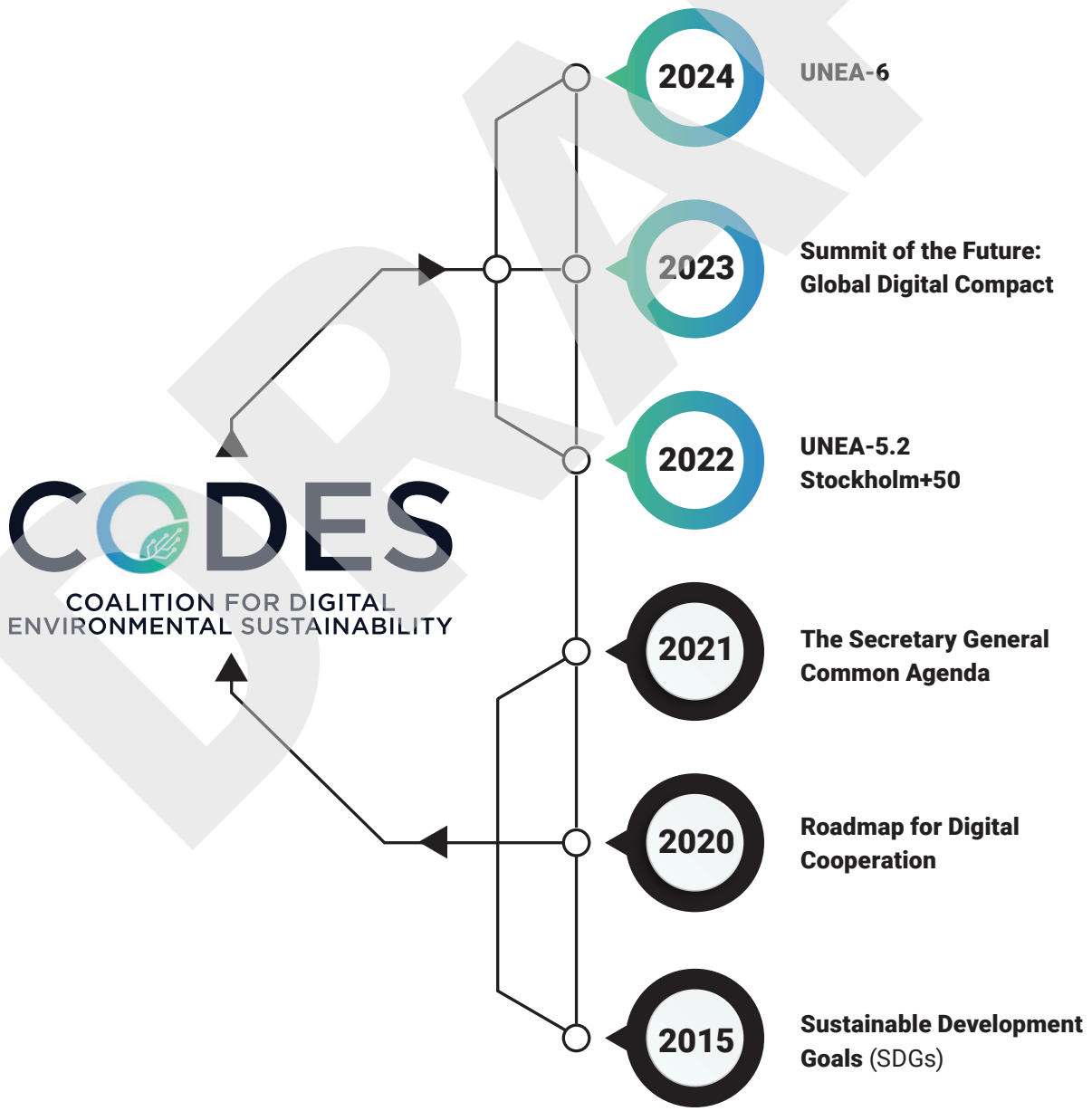


Photo: Envato

BOX 1 Digital power concentrations

Increasing reliance on digital technologies for our purchasing, education and social interactions has led to an increasing shift of economic power to digital companies. According to one estimate by Forbes, less than 20 companies own or control 80 per cent of our essential global digital infrastructure in terms of cloud storage and compute.[19]

In terms of capacity to engage in and benefit from the data-driven digital economy, two countries stand out: the United States and China.

Together, they account for half the world's hyperscale data centres, the highest rates of 5G adoption in the world, 94 per cent of all funding of AI start-ups in the past five years, 70 per cent of the world's top AI researchers, and almost 90 per cent of the market capitalization of the world's largest digital platforms.[20]

The largest such platforms – Apple, Microsoft, Amazon, Alphabet (Google), Meta (Facebook), Tencent and Alibaba – are increasingly investing in all parts of the global data value chain: data collection through the user-facing platform services; data transmissions through submarine cables and satellites; data storage (data centres); and data analysis, processing and use, for instance through AI. These companies have a competitive data advantage resulting from their platform component, but they are no longer just digital platforms. They have become global digital corporations with planetary reach; huge financial, market and technology power; and control over large swathes of data about their users.[21]

The combined value of the seven largest digital "super platforms" is estimated in January 2022 at nearly $10 trillion. This comprises Apple (2.64 trillion), Microsoft (2.23 trillion), Google (1.73 trillion), Amazon (1.47 trillion), Facebook (858.76 billion), Tencent (572.85 billion) and Alibaba (328.52 billion). The US and China host 90 per cent of the market capitalization value of the world's largest digital platforms.[22,23] This means seven companies represent approximately 8 per cent of the $120.4 trillion global equity market capitalization.[24] Digital power concentrations of that extent can pose huge challenges for a whole-of-society approach, e.g. regarding growing private-public capacity divide or growing inequalities within and between societies.

BOX 2 Digital disruption can help tackle the triple planetary crisis

Preliminary estimates suggest that digital technologies can make significant contributions to tackling the triple planetary crisis by 2030 aiming to stabilize the Earth system to stay within the planetary boundaries.[25] While assessment methods are still in their infancy, some early estimates on the positive impact have been calculated:

- **Decarbonization for Climate Action:** For example, in 2015 the Global e-Sustainability Initiative and Accenture Strategy estimated that digital information and communication technologies (ICT) can enable a 20 per cent reduction of global CO_2 emissions when applied to five sectors: mobility, manufacturing, agriculture, energy, and buildings. ICT solutions can help cut nearly 10 times more CO_2e than they emit.[26] A similar assessment was conducted by GSMA, looking at the impact of mobile communications technologies on carbon emission reductions.[27] This study concluded that mobile technologies had a 10:1 enablement ratio compared to the footprint of the industry.
- **Dematerialization to Protect Nature:** The "Rethinking humanity" series estimated that digital technologies and improved design can help reduce natural resources and other materials used in products by 90 per cent[28] - through efficiency, tracking and tracing as well as by turning products into services in a circular economy. This can help reduce the impact of material extraction on nature and the environment.
- **Detoxification to Prevent Pollution:** The "Rethinking humanity" series also estimated that digital technologies can help reduce waste & detoxify supply chains by a factor of 10-100 times through improved design, resource substitution and circularity.[29]

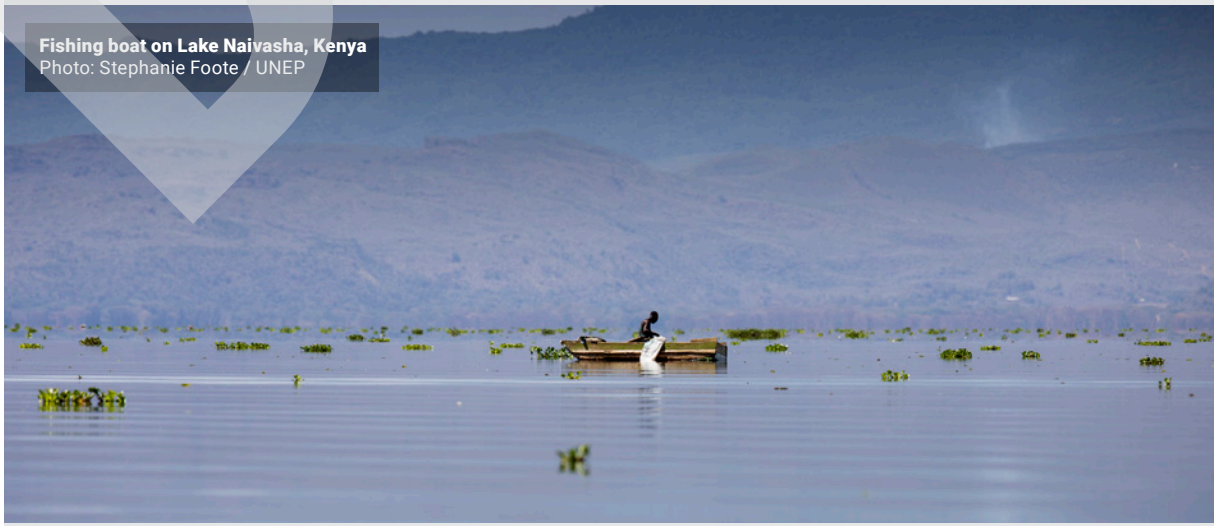
However, these studies and estimates do not fully account for rebound effects. Changes in production and consumption behaviour might limit digital technologies' mitigation effect and entail additional negative environmental effects ("digital rebound effect"). Such counterproductive effects need to be taken into account when designing policy interventions.

Reducing our use of natural resources can minimize our impact on the environment
Photo: UNEP

BOX 3 Digital transformation in the water sector

Despite the fact that about 71 per cent of the earth's surface is covered with water, less than 3 per cent is fresh water and about 1 per cent is readily accessible for human use.[30,31] Population growth, geopolitics, economic development, industrialization and climate change are some of the factors that have intensified the pressure on the already scarce resource. Global water demand is projected to rise by 55 per cent from 2000 to 2050[32] and therefore there is a need to promote and advance the use of technology in the water sector not only to meet future human water demand but also for the attainment of SDG 14.[33] Following are major applications where digital technologies are currently transforming the water sector:

- **Water Management:** Remote sensing services and technologies can facilitate mapping, assessing and monitoring of water resources both fresh, marine and coastal resources. These technologies can also be used to monitor and track illegal, unregulated and unreported wildlife and marine product exploitation; controlling water hyacinth; flood and drought management; surface and ground water monitoring and sustainable wetlands management just to mention but a few of the space-based technology capabilities.[34]
- **Payment for Ecosystem Services:** A new type of financial technology (FinTech) – 'mobile money' – could offer a novel and available solution to Payments for Ecosystem Services (PES) frameworks. Mobile payments have been used successfully in development projects related to micro-credit, micro-insurance, and humanitarian relief. In certain circumstances, benefit distribution via FinTech may lower transaction costs, enable higher frequency payments, and provide new socioeconomic benefits. It could also improve the privacy, transparency, traceability, and security of disbursements, contributing to more efficient and equitable PES schemes.[35]
- **Digital Water Diplomacy:** Developments made in the use of social media – Twitter, facebook, Instagram, blogs, YouTube – have led to a shift of diplomats,[36] Ministries of Foreign Affairs (MFAs) and embassies to these platforms so as to engage the public,[37,38] advance national interests and policies while at the same time enhance strategic communication for transboundary water cooperation. The use of technology in diplomacy fosters water peace and cooperation in hydro-diplomacy[39] through data sharing, minimising misinformation, and enhancing transparency and trust among riparian states.[40]



Fishing boat on Lake Naivasha, Kenya
Photo: Stephanie Foote / UNEP

Photo: Shutterstock

BOX 4 Digital transformation of the energy sector

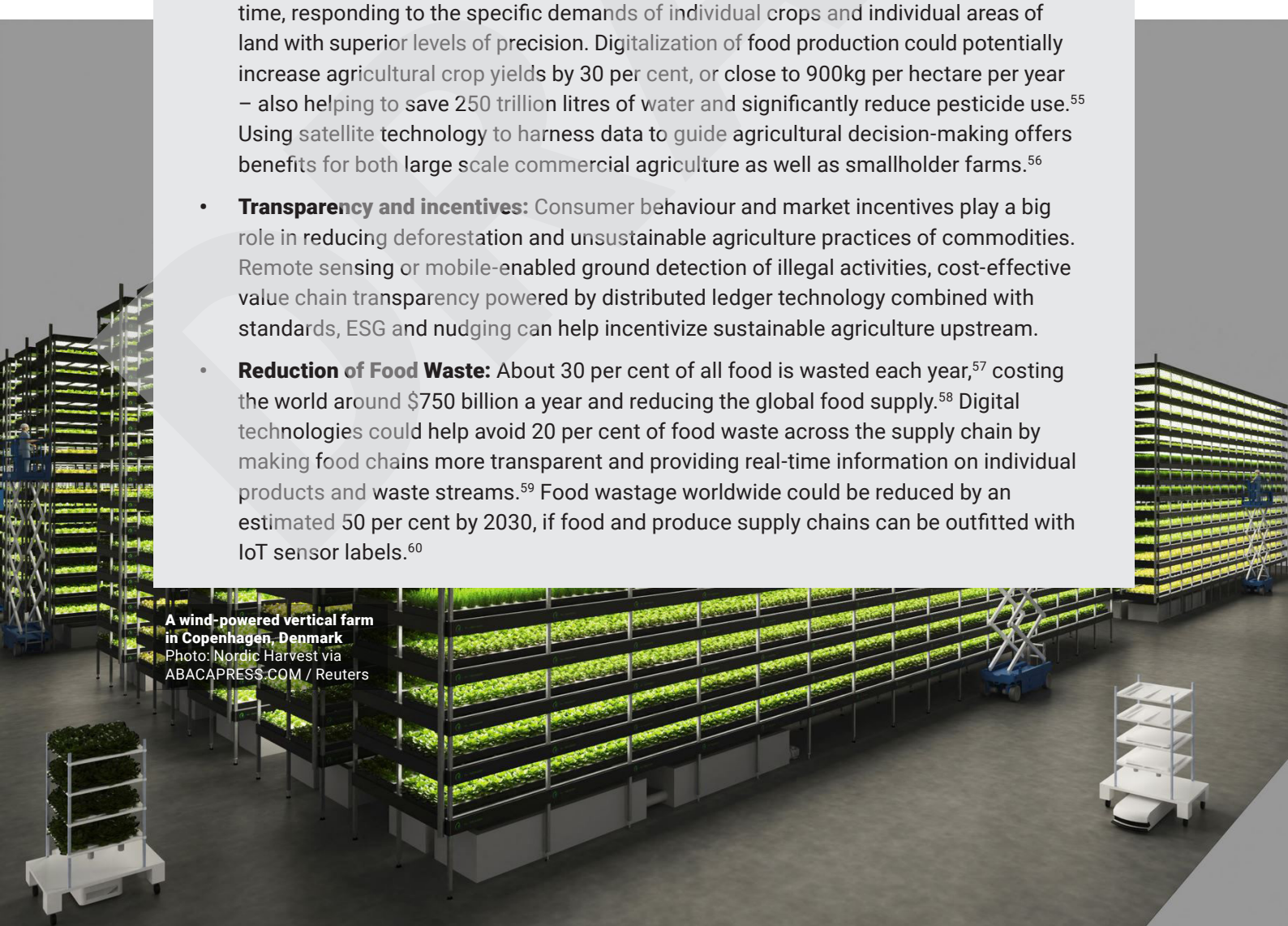
The energy sector today accounts for 40 per cent of carbon emissions worldwide, or 13.6 $GtCO_2e$, and is expected to rise further as the global population grows and demand increases, including from digitalization.[41] Three key renewable energy technologies are critical for realizing a net zero carbon future and powering the digital economy over this century: wind, solar, and energy storage.[42] A range of digital technologies are being used for managing the transition to renewable and low-carbon energy:[43]

- **Coordination, Balancing and Monitoring:** coordinating localized energy grids involving various distributed and variable renewable power generation sources. This is combined with smart monitoring of supply and demand as well as artificial intelligence to optimize loads for grids to work properly.[44] Moreover, by allowing energy prices to respond to market signals in real-time, smart monitoring has the potential to optimize electricity consumption by not just key sectors but also households and governments.[45,46] Together with other technologies such as high-speed connectivity and IoT, blockchain technologies have been proposed to help address this challenge by managing, in a decentralized way, the distributed energy value chain, from the generation of electricity, to distribution, to final consumption. It can serve as an enabling technology for scaling energy systems powered by distributed energy resources that lack a central grid operator, enabling participation in collective, local energy structures.[47]
- **Energy Access:** 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 per cent of whom reside in rural areas.[48] 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.[49] These have opened up new options to rural and indigenous communities for reaching universal energy access.
- **Modeling and Prediction:** Digital twins – virtual representations of physical assets – will also be an important digital tool to optimize the use of renewable energy and increase predictive accuracy. They have already helped increase the yield of some wind farms by up to 20 per cent.[50]

BOX 5 Digital transformation of the agricultural and food commodities sector

Agriculture currently accounts for around 20-30 per cent of global carbon emissions[51] and 70 per cent of all freshwater withdrawals. By 2030, around 8.3 billion people will require water, food and shelter, placing increasing strains on a finite amount of land, freshwater reserves, and other natural resources.[52] As agriculture becomes more knowledge-intensive, access to accurate and timely data relevant to specific conditions and locations is becoming increasingly critical to improve agriculture efficiency. A range of digital technologies are contributing to the transformation of the agricultural sector:

- **Vertical Farming:** This practice involves producing food in vertically stacked layers commonly integrated into other structures like a skyscraper, shipping container or re-purposed warehouse. This approach uses Controlled Environment Agriculture (CEA) technology to optimize the control of temperature, light, humidity, gas exchange, and nutrition. Vertical farming supports increased crop production from the same square footage of growing area with fewer inputs and can be conducted all year round. For example, vertical farming uses 70 to 97 per cent less water than required for normal cultivation due to high levels of retention and recycling.[53]
- **Precision Agriculture:** This involves the use of real-time data, analysis and automated application technologies to optimize the use of inputs such as fertilizer, pesticides and water enabling farmers to produce more and waste less.[54] It is referred to as "precision" because it is possible to perform the right intervention, in the right place, at the right time, responding to the specific demands of individual crops and individual areas of land with superior levels of precision. Digitalization of food production could potentially increase agricultural crop yields by 30 per cent, or close to 900kg per hectare per year – also helping to save 250 trillion litres of water and significantly reduce pesticide use.[55] Using satellite technology to harness data to guide agricultural decision-making offers benefits for both large scale commercial agriculture as well as smallholder farms.[56]
- **Transparency and incentives:** Consumer behaviour and market incentives play a big role in reducing deforestation and unsustainable agriculture practices of commodities. Remote sensing or mobile-enabled ground detection of illegal activities, cost-effective value chain transparency powered by distributed ledger technology combined with standards, ESG and nudging can help incentivize sustainable agriculture upstream.
- **Reduction of Food Waste:** About 30 per cent of all food is wasted each year,[57] costing the world around $750 billion a year and reducing the global food supply.[58] Digital technologies could help avoid 20 per cent of food waste across the supply chain by making food chains more transparent and providing real-time information on individual products and waste streams.[59] Food wastage worldwide could be reduced by an estimated 50 per cent by 2030, if food and produce supply chains can be outfitted with IoT sensor labels.[60]

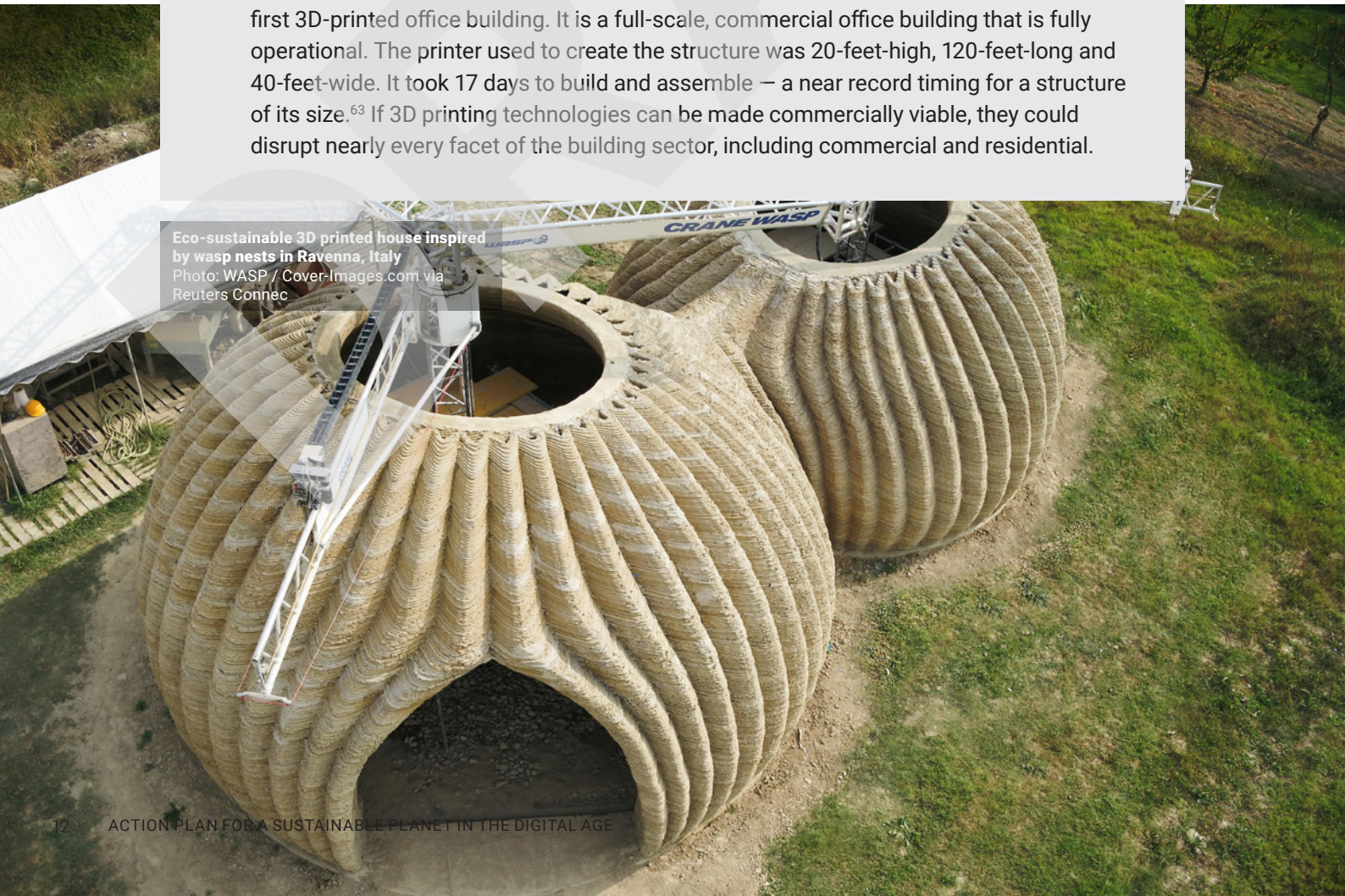


A wind-powered vertical farm in Copenhagen, Denmark
Photo: Nordic Harvest via ABACAPRESS.COM / Reuters

BOX 6 Digital transformation of the buildings sector

The construction and operation of buildings remains highly resource and energy intensive, with buildings accounting for around 40 per cent of global energy consumption.[61] A range of digital technologies are transforming the buildings sector:

- **Smart Buildings:** One of the most important applications of digital technologies is often described as "smart buildings" or "intelligent buildings". This concept refers to any structures that use data collection, integrated processes, smart engineering or creative design to self-regulate and optimize the building's environment and operations. Every sensor, automation and monitor used in smart buildings is integrated into a main building management system which can capture changes within the building and enable the building to self-learn and automatically modify or customize its settings. The global emissions abatement potential from Smart Buildings is approximately 2.0Gt CO_2e or around 3.4 per cent of GHG emissions by 2030. Smart buildings could also save up to 5 billion MWh of energy and 300 billion litres of water.[62]
- **Digital Building Passports:** adopt a range of technologies in order to encourage the production, collection, and maintenance of digitized records for each building. Rather than a single dataset, the digital building passport links multiple different datasets about the building throughout its lifecycle - offering full transparency and accountability. They would also allow city planners to link performance data to planning data, so that they can validate assumptions and better monitor the performance of planning policies.
- **3D Printing of Buildings and Components:** While 3D printing of buildings and their components has not yet reached commercial scale, the technology has achieved a number of important milestones. Dubai recently announced the completion of the world's first 3D-printed office building. It is a full-scale, commercial office building that is fully operational. The printer used to create the structure was 20-feet-high, 120-feet-long and 40-feet-wide. It took 17 days to build and assemble — a near record timing for a structure of its size.[63] If 3D printing technologies can be made commercially viable, they could disrupt nearly every facet of the building sector, including commercial and residential.



Eco-sustainable 3D printed house inspired by wasp nests in Ravenna, Italy
Photo: WASP / Cover-Images.com via Reuters Connec

Smart crossing lights the way for pedestrians in Suzhou, China
Photo: Oriental Image / Reuters

BOX 7 Digital transformation of cities

While cities occupy just 3 per cent of the Earth's land, they account for 60-80 per cent of global energy consumption and 75 per cent of global carbon emissions.[64] Rapid urbanization also imposes challenges to waste management, land use, water and consumption patterns. A range of digital technologies are contributing to improved city management:

- **Smart Urban Management:** Combining IoT, sensors and AI enables "smart" urban management. This involves- including smart traffic lights and street lights, smart waste disposal, smart utilities and smart buildings – all of which optimize energy usage and reduce the environmental impact of cities.
- **Collaborative urban governance:** Cities are a mix of formal and informal economies, dwellings, waste streams and intellectual activities. Urban planning and governance could be improved with the use of augmented reality, mobile-based citizen science or inclusion of the informal economy and tracking of waste and pollution.
- **Smart Sustainable Cities:** Sitting one layer above this is the concept of a Smart Sustainable City, a digitally-enabled amalgamation of all or some of the above digital services, where all relevant data is collected and controlled from a 'digital command centre'.[65] According to the ITU, "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects".[66]
- **Urban Digital Twins:** Urban digital twins are a virtual representation of a city's physical assets, using data, analytics and machine learning to develop simulation models that can be updated and changed (real-time) as their physical equivalents change. This allows the users of the digital twin to manipulate it and see how those changes would be expected to play out in the real world.[67] City digital twins can improve planning activities such as public engagement, scenario planning, and zoning and development. They have the potential to assist planners in reaching local climate resilience, economic development, and housing goals.

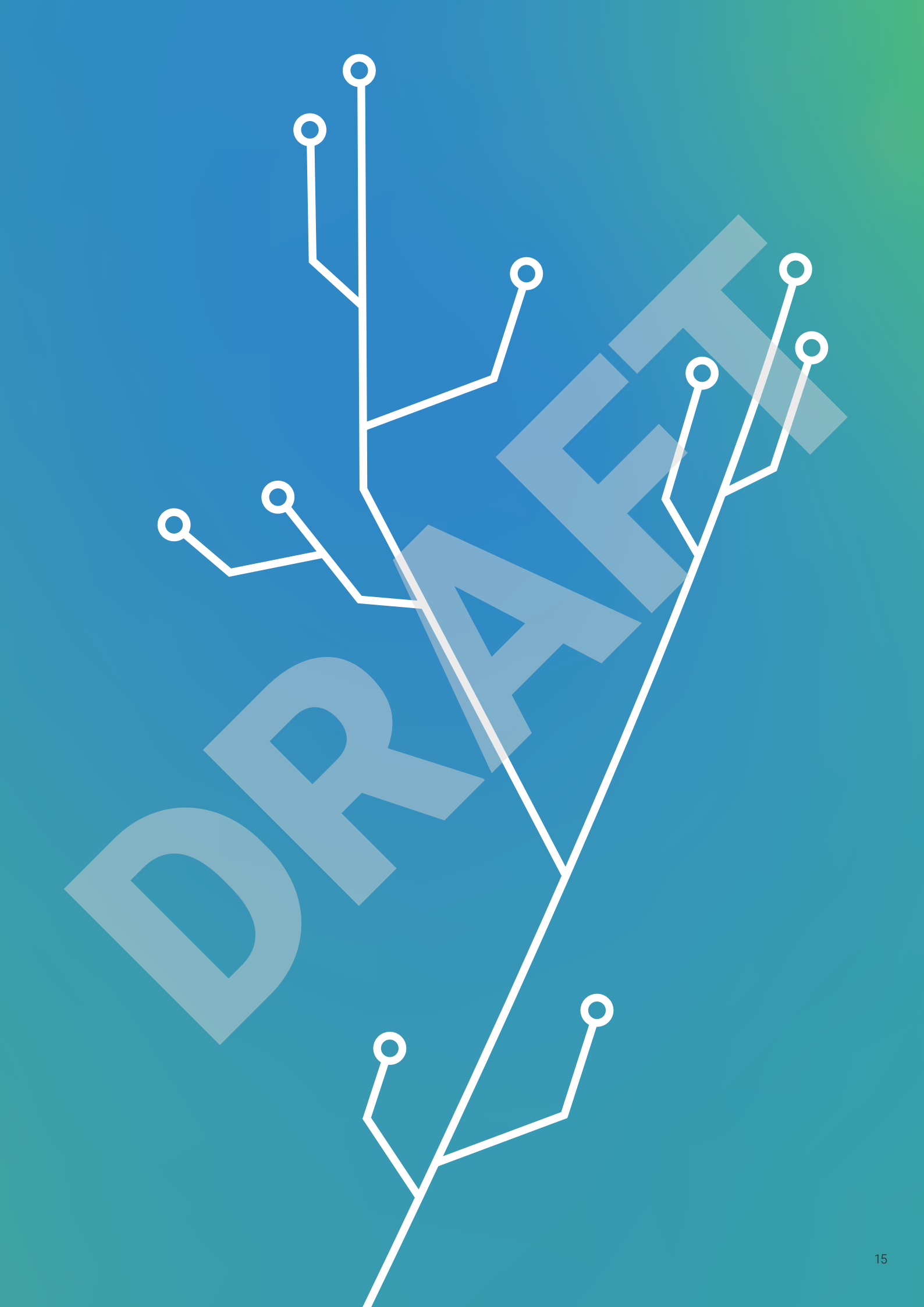
In 2019, Shenzhen's first smart road, opens to public in Shenzhen city, China
Photo: Oriental Image / Reuters

BOX 8 Digital transformation of the transport sector

Across the globe today, there are one billion vehicles on the road. As a result of globalization and of a rapidly rising middle class this number is expected to double by 2035.[68] The transportation sector accounts for nearly 15 per cent of current emissions worldwide.[69] There are three major applications where digital technologies are currently transforming the transport sector:

- **Traffic Control and Optimization:** Digital solutions can significantly support the controlling and optimization of traffic. Connectivity between cars, roads, lights, and control systems allows for the gathering of real-time information on traffic conditions. Traffic control and optimization platforms can use this data to generate insights for drivers, such as the optimal driving speed to avoid congestion and the best route to avoid a traffic jam. They can contribute to safety and convenience through, for example, collision alarms and lane-keeping-systems.
- **Shared Mobility:** connecting people and vehicles that have similar origins or destinations. While not all smart or shared mobility options are sustainable, smartphone enabled bike- and car-sharing, demand-responsive public transport systems or pooling platforms can help create modern mobility systems that maximize convenience while reducing the footprint of individual transport.[70]
- **Smart Logistics and Fleet Management:** connecting vehicles, products, and load units, thereby improving route and load optimization and reducing the amount of waste in the system.

A combination of real-time traffic information, smart logistics and fleet management, and other ICT enabled solutions could abate 3.6Gt CO_2e, or around 6 per cent of GHG emissions by 2030.[71]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Sonika Manandhar, Young Champion of the Earth for Asia and the Pacific, is honing big data to make electric transport in Nepal more efficient and accessible, especially for women. Photo: UNEP

Three Shifts for a Sustainable Planet in the Digital Age

The goal of the consultation and co-design process with the CODES community was to jointly identify the three most important shifts needed to catalyse **a digital transformation of society and economy to enable an environmentally sustainable and equitable future for all**. The following sections identify and describe each strategic shift, including six global-scale strategic priorities for each shift.

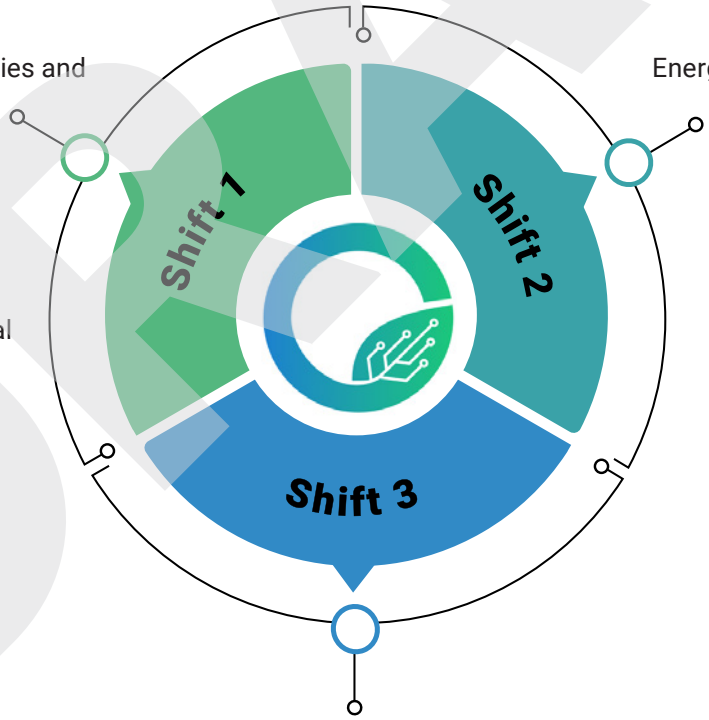
Figure 2: **Three Shifts and 18 strategic priorities to achieve a sustainable planet in the digital age**

SIX ENABLERS
Enable Alignment
Align vision, values, objectives

- Connect Communities and Transformations
- Develop Digital Competencies
- Harness Science and Systems Thinking
- Advance Multilateral Action
- Build Pioneering Coalitions
- Adopt Norms and Standards

SIX PROBLEMS
Mitigate Negative Impacts
Sustainable digitalization

- Energy and Emissions
- Material Base
- Consumption
- Misinformation
- Digital Divides
- Rights Violations



SIX INNOVATIONS
Accelerate Innovation
Digital sustainability

- Planetary Digital Twin
- Sustainable Circular Economy
- Sustainable Consumption
- Knowledge Commons
- Governance Breakthroughs
- Access Evolution

Shift 1: Enable Alignment
Aligning vision, values, and objectives of the digital age with sustainable development

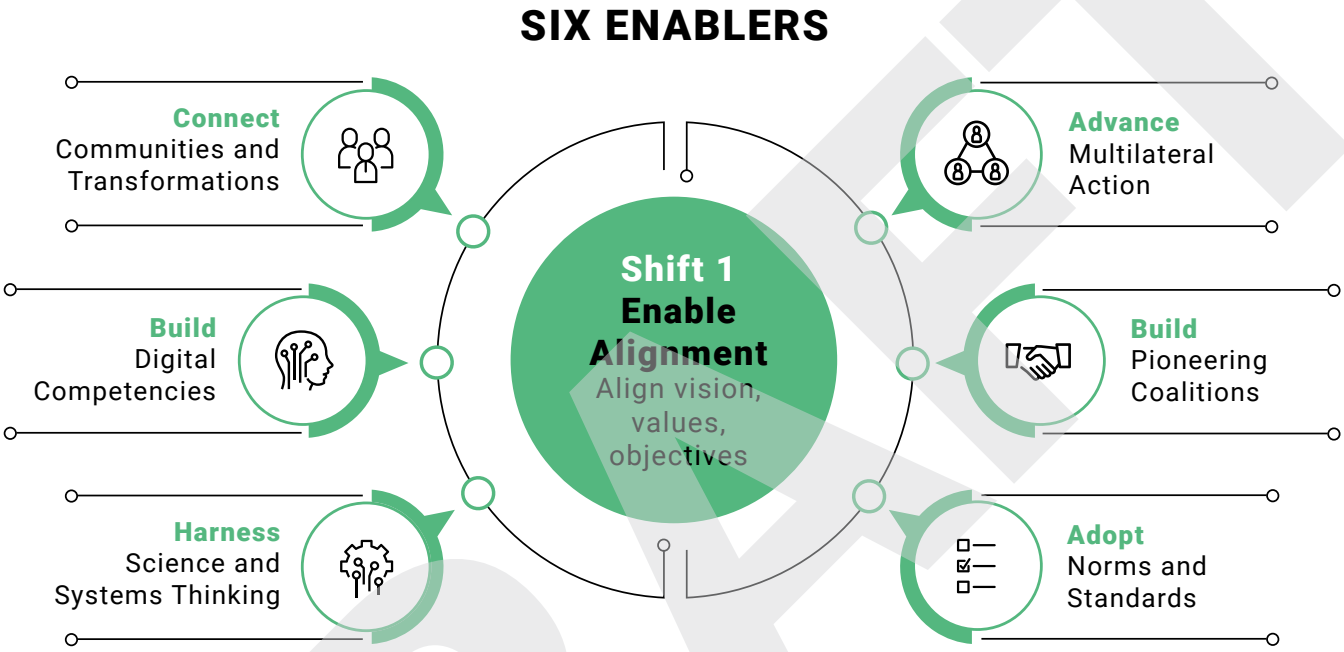


Figure 3 **Shift 1: Enable Alignment** - Aligning vision, values, and objectives of the digital age with sustainable development

The first shift concerns changing our approach to digital transformation and sustainability transformation. It is key to reorient the purpose of digital change, develop common visions, values, and renewed objectives for sustainable development in the Digital Age. The application of digital innovations needs to focus on achieving the implementation of the 2030 Agenda with its 17 Sustainable Development Goals and to progress the different global environmental commitments adopted through multilateral environmental agreements (MEAs).

The SDGs and MEA global frameworks hold a measure of legitimacy as our "north star" for environmentally sustainable human development as they represent the outcomes of multilateral processes and years of consensus building across all UN Member States. They reflect our collective effort towards a shared paradigm of global collective action and shared objectives. Digital technologies and related infrastructure and standards must be designed, developed, and applied as useful and powerful means towards accelerating the achievement of these goals.

To implement this first shift systemically in all sectors, strong coalitions of citizens, governments, scientists, and private sector actors must proactively shape the digital age towards sustainable futures. Connecting communities, building adequate competencies, and understanding systemic complexity are important preconditions that empower agile frontrunner coalitions, new culture and mechanisms of global collective action and joint principles and standards.

CODES stakeholders identify 6 strategic priorities that are globally applicable to achieve the kind of systems-level change needed for this first shift. Examples of initiatives that are already addressing this shift are contained in Table 1.

Enabler 1 **Connect Communities and Transformations:** Mutually connect digital and sustainability communities to catalyze the twin transformation.

All actors should prioritize systematically intersecting the digital with the sustainability transformation by maximizing opportunities for promoting environmental sustainability through existing and emerging digital technologies, innovations, and governance frameworks (Box 9). Similarly, sustainability commitments and agreements must consistently consider how they can be enabled through digital transformation. Should the strategic dialogue and mutual learning between the digital and sustainability communities materialize, it will unite policy makers, scientists, engineers, entrepreneurs, organizational leaders, and activists under a shared vision and mindset. Digital transformation must be used as an opportunity to solve systemic barriers to environmental and social sustainability, or it will continue to accelerate perverse and unsustainable incentives of capitalism and business as usual. This integrated approach should be consequently implemented in, and incentivized by, national and international policy agendas and organizations, research and education programs, technology development and civil society action alike. Silo-thinking must end in order to systematically address digitization and sustainability as closely interlinked cross-cutting tasks.

Enabler 2 **Develop Digital Competencies:** Build interdisciplinary digital sustainability skill sets.

Many of the key actors with the ability to influence the trajectory of digital transformation for environmental sustainability lack a number of essential digital competencies and skills needed to catalyse this shift. On the one hand, public sector and policy makers need to understand both the environmental opportunities and risks from digital transformation. They must build up their own digital capacities to understand what they want to regulate, enable, and incentivize. On the other hand, entrepreneurs, computer scientists as well as hardware and software engineers also need to understand how their products and services generate different sustainability incentives and impacts in the real world in order to take these into account in the design process. They must enhance their understanding of today's sustainability challenges, especially on decarbonization, dematerialization, detoxification, and circularity. This must be centered on a renewed humanism mindset that emphasizes empathy, ethics, and traditional indigenous wisdom. Academic curricula, vocational training, professional associations all need upskilling to reflect digital sustainability needs and outcomes. Moreover, to overcome the digital divide, digital and sustainability literacy has to be an integrated effort.

Enabler 3 **Harness Science and Systems Thinking:** Mobilize science to understand how the sustainability of complex systems can be enhanced through digital transformation.

Understanding the inherent complexity of achieving planetary sustainability is one of the biggest challenges facing modern science. It is essential to use the best available science to monitor our current trajectory and change it in the direction of sustainability by intentionally transforming key

economic, social, and environmental systems simultaneously (see Box 10). A "systems thinking" holistic approach will be needed that focuses on the way that a system's constituent parts interrelate and how systems work overtime and within the context of larger systems. This entails the earth system as such, including its large variety of complex and interlinked dynamics, the economic system, and the societal realm, but also many applied research fields such as mobility or energy systems. The question of how different feedback loops operate to either reinforce or shift system behaviours is also key. A science-based understanding of how digital technologies are changing key economic, social, and environmental systems and how they can be aligned towards sustainability outcomes is needed as part of the new social contract.

Enabler 4 **Advance Multilateral Action:** Develop new multilateralism for digital sustainability and a culture of multi-stakeholder collaboration.

The digital ecosystems of data, analytics and applications are not confined to national boundaries, nor yet handled by the international community effectively. Instead, a handful of companies now have the ability to influence human attitudes and behaviours at a planetary scale with more money, power and reach than most national governments. These kinds of global systemic challenges can only be effectively tackled through systemic solutions and effective collective action. To safeguard traditional indigenous knowledge systems and our modern knowledge commons as an influencing tool for driving global sustainability, a new kind of digital translateralism and multilateralism is needed. Collaborative policy making of international organizations, national governments, civil society, and the private sector should define, implement, and apply global standards and safeguards towards a global, inclusive, and sustainable digital ecosystem of data, analytics and applications. It should be strictly premised on accelerating sustainability outcomes for the planet and its people while being respectful of the sovereignty of the countries on their national data. For strong digital innovation ecosystems, we need to promote a culture of open collaboration and co-creation between governments, the private sector and civil society. This should be founded on the development and use of inter-operable digital public goods based on a set of 'sustainability by design' principles. We need to avoid the mentality of 'one platform to rule them all' and allow multiple solutions to flourish and interconnect. We must promote good data governance and stewardship that ensures the availability of relevant data in a timely and user-friendly, accessible-for-all-abilities, portable, machine-readable, and actionable format.

Enabler 5 **Build Pioneering Coalitions:** Foster innovation eco-systems and solutions that support agile and collaborative governance.

While new forms of multilateralism are needed, this alone is not enough to effectively govern and steer the pace and direction of digital technologies. Inclusive and mission-oriented coalitions between governments, academia, private sector actors and civil society organizations will be needed to catalyse transformational investments in digital innovation ecosystems, infrastructure and emerging standards that are premised on planetary sustainability. Committed communities with a shared sense of common purpose and practice can build trust and conduct experiments that serve as testing grounds for better standards and governance solutions. Agile approaches to define and test reflexive and iterative governance frameworks for digital technologies must be explored. This must be based on adaptive, forward looking and innovation-friendly regulation together with tiered and principle-based approaches to collective governance.[72]

Enabler 6 **Adopt Norms and Standards:** Adopt joint principles, normative frameworks and global standards for digital sustainability.

While the pace of digital innovation is dynamic, and although several international standards are emerging[73], there are only a few nascent normative and ethical frameworks in place to guide its direction. The majority of these frameworks lack clear principles and norms linked to environmental and social sustainability or climate action. In this context, it is critical to develop a global set of standards and guidelines for the sustainable production, use and adoption of digital technologies[74] based on specific, measurable, achievable, and time-bound indicators. Additionally, it is critical to set a global standard methodology for assessing and measuring the net impact of digital technologies on sustainability and climate change. It is noted that standardization in this domain has been ongoing for a decade or more, so any effort in this direction should start from existing standards and integrate with ongoing standardization processes (See Boxes 11 and 12). Efforts in this direction will also need to cover the governance of data that is being used to fuel digital transformation and has become one of the new factors of production, alongside land, labour, and capital.

Table 1: **Mapping of key Stakeholders and Initiatives Addressing Shift 1**

Type of actor / Initiative	Title	Strategic Priorities
Digital Innovation and Acceleration Initiatives or Funding	• Climate Technology Centre and Network (CTCN) • UNDP Accelerator Labs • OECD Mission Oriented Innovation Lab • Digital4Development Hub • United 4 Smart Sustainable Cities (U4SSC) • BMZ Digital Transformation Centers	• 4 • 4 • 4 • 4 • 4 • 4
Agenda Setting and Stakeholder Dialogue	• Secretary General's Digital Cooperation Roadmap • Coalition for Digital Environmental Sustainability (CODES) • The Dialogue on Global Digital Finance Governance	• 1, 4 • 1, 4, 6 • 4, 6
Data, Analytics and Tools	• Secretary General's Data Strategy • Global Partnership for Sustainable Development Data • UN Global Pulse • Digital Public Goods Alliance	• 6 • 6 • 4 • 5, 6
Policies, Norms and Standards	• The UN Environmental Assembly (UNEA) • The International Telecommunications Union (ITU), Standardization Sector (ITU-T) • UN Environmental Management Group (EMG) • The Internet Governance Forum (IGF): Policy Network on the Environment • The Global Partnership on AI (GPAI)	• 1, 6 • 1, 6 • 1 • 1, 6 • 4, 6

	• OECD AI Policy Observatory • European Council Conclusions on Digitalization for the Benefit of the Environment • Principles for Digital Development • Corporate Digital Responsibility • The International Sustainability Standards Board (ISSB) • Global Agreement on the Ethics of Artificial Intelligence • Open Collaboration for Next Generation Digital Solutions for MRV • Certified B-Corporation • Science-based Targets Initiative	• 4 • 4 • 6 • 6 • 6 • 6 • 5, 6 • 6 • 6
Advocacy	• Digital Goes Green	• 3, 5
Training	• Atingi Digital4Sustainability Learning Programme • Principles for Digital Development Training Programme • IEEE's Course on Digital Transformation: Moving Toward a Digital Society • Open SAP: Sustainability Through Digital Transformation • ITU and UNDP's digital capacity database	• 2 • 2 • 2 • 2 • 2
Research and Knowledge	• Future Earth | Sustainability in the Digital Age • Digitalization for Sustainability – Science in Dialogue (D4S) • International Society for Digital Earth • Research Group on Digitalization and Sustainability Transformations, IASS Potsdam • UNEP's Global Environmental Outlook	• 3 • 3 • 3 • 3 • 3
Collective Action Networks and Coalitions	• Digital With Purpose Movement • Every Actions Counts Coalition • Green Digital Finance Alliance • Global Enabling Sustainability Initiative • Digital Future Society • Greentech Alliance • The Future Society • UN Innovation Network	• 5, 6 • 5 • 5 • 5 • 5 • 5 • 5 • 5

BOX 9 European Green Digital Coalitions and Political Declarations

The European Union's (EU) Green Deal is the EU's main new growth strategy to transition the EU economy to a sustainable economic model. It is the first regional strategy that is aiming to unify the twin transformations of digitalization and sustainability.

Presented in December 2019, the overarching objective of the EU Green Deal is for the EU to become the first climate neutral continent by 2050, resulting in a cleaner environment, more affordable energy, smarter transport, new jobs and an overall better quality of life. There are a number of funding mechanisms in place to facilitate the EU Green Deal, totalling over €1 trillion. This investment will fund the delivery of the policy reform needed for the EU's economic growth and climate neutrality. Two political declarations have recently been adopted to further the goals of the EU Green Deal.

European Green Digital Coalition: In March 2021, 26 CEOs of companies have joined a Green Digital Coalition committing on behalf of their companies to significantly reduce their carbon footprint by 2030, and to become climate neutral by 2040. Solutions include investing in the development of more energy and material efficient digital technologies, working with relevant NGOs and expert organizations to measure and monitor the net environmental impact of green digital solutions and many more. Finally, they commit to co-create deployment guidelines of green digital solutions together with other industry leaders, in order to accelerate the transition to sustainability of sectors such as energy, transport, building and agriculture.

Declaration on *A Green and Digital Transformation of the EU*: Twenty-seven EU countries plus 2 additional member states signed an EU declaration committing them to leading the green digital transformation. Member States will work together to speed up the deployment and development of advanced digital technologies, such as 5G and 6G, fibre optics, high-performance computing and Internet of Things, as key solutions to achieve climate neutrality and drive the green and digital transitions in priority sectors, such as energy, transport, manufacturing, agri-food and construction. Other areas of action include the promotion of green cloud, Artificial Intelligence (AI) and blockchain technologies, as well as sustainable hardware, green public procurement, support for green tech start-ups and SMEs.

Workers laying fiber optic cables in Schulenburg, Germany
Photo: Moritz Frankenberg / Reuters

Technosreda Festival of Science and Technology in Moscow
Photo: Artyom Geodakyan / TASS via Reuters Connect

BOX 10 Digitalization for Sustainability – Science in Dialogue (D4S)

The European research network 'Digitalization for Sustainability – Science in Dialogue' (D4S) is dedicated to developing a progressive vision for a digitalization that fosters environmental and social sustainability using systems thinking.

The project aims at enhancing the science-policy discourse by delivering a comprehensive analysis of opportunities, risks and governance options regarding digitalization and sustainability. It will also develop guidelines, design principles, policies, and new institutions to shape digitalization towards deep sustainability transformations outlining an inter- and trans-disciplinary research agenda.

At the very core of the research network stands a group of 15 renowned experts, consisting of European researchers as well as practitioners representing a variety of institutions and schools of thought. The Expert Panel consisting of researchers from European academia, think tanks, and civil society organizations includes different scientific disciplines and reflects diverse thematic and national backgrounds.

The dialogue aims at integrating various topics regarding digitalization/ICT (e.g., data governance, platform economics, surveillance/privacy, AI) with topics regarding sustainability transformations (inter- and intra-national justice, sectoral transitions in energy, mobility and agriculture, sustainable production and consumption) in order to synthesize these into an integrated, comprehensive analysis of prospects, risks, governance options and policy solutions for a sustainable digitalization.

BOX 11 Sustainable digitalization standards by the ITU

ITU-T Study Group 5 (**Environment, climate change and circular economy**) developed the standard Recommendation ITU-T L.1470, which provides operators of mobile networks, fixed networks and data centres with guidance to set science-based targets (SBTs), approved by the science-based target initiative (SBTi), to reduce GHG emissions at a rate that is in line with climate targets set in the 1.5°C scenario of the Paris Agreement and the subsequent standard ITU-T L.1471 giving guidelines for setting and reporting net zero targets. Recommendation ITU-T L.1050 provides a guide to different network architectures, while ITU L.1410 provides guidance for assessing the environmental impacts of goods, networks, and services while L.1420 focus on organizational footprints. In addition, ITU-T L.1023 provides an assessment method for circular scoring, which allows ICT designers to determine the multiple facets of circularity such as durability, reparability, ability to refurbish, recycle material or critical raw material content by using a single scoring method. Together, these ITU standards are providing authoritative guidance to put the ICT sector on a decarbonization pathway towards net zero emissions based on circular economy principles, ensuring environmental sustainability in digital transformation.

New standards are also targeting methodologies for estimating GHG emissions of induced effects and virtual meetings, for estimating biodiversity related impacts, and for best practices to achieve net-zero using ICTs, energy efficiency and smart energy solutions, among other related topics.

Looking ahead, ITU will continue to support the ICT sector's circular economy transition. For example, the ITU-T Study Group 5 is developing a new standard that will define the requirements of a global digital sustainable product passport for a circular economy. The concept of a digital product passport has recently generated significant attention, particularly at the European level. ITU will also be organizing a series of global dialogues to promote a sustainable digital transformation, in addition to supporting key initiatives that focus on connecting digital technologies with environmental sustainability.

Photo: Shutterstock

Planting mangroves to help restore the ecosystem. Port Royal, Jamaica.
Photo: Kadir van Lohuizen / NOOR

BOX 12 EU Taxonomy for Sustainable Activities

In order to meet the EU's climate and energy targets for 2030 and reach the objectives of the European Green Deal, it is vital that investments are directed towards sustainable projects and activities. To achieve this, a common language and a clear definition of what is 'sustainable' is needed. This is why the EU's Action Plan on Financing Sustainable Growth[75] called for the creation of a common classification system for sustainable economic activities, or an 'EU taxonomy'.

The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities. It could play an important role helping the EU scale up sustainable investment and implement the European Green Deal, including various digital transformation objectives. The EU taxonomy is built to provide companies, investors, and policymakers with appropriate definitions for which economic activities can be considered environmentally sustainable. In this way, it aims to create security for investors, protect private investors from greenwashing, help companies to become more climate-friendly, mitigate market fragmentation and help shift investments where they are most needed.

The EU Taxonomy Regulation establishes six environmental objectives:

1. Climate change mitigation
2. Climate change adaptation
3. The sustainable use and protection of water and marine resources
4. The transition to a circular economy
5. Pollution prevention and control
6. The protection and restoration of biodiversity and ecosystems

Different means can be required for an activity to make a substantial contribution to each objective. Under the Taxonomy Regulation, the Commission had to come up with the actual list of environmentally sustainable activities by defining technical screening criteria for each environmental objective through delegated acts.

The Taxonomy will play an important role in standardizing a common classification system that can then be deployed by different digital platforms and algorithms.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Shift 2: Mitigate Negative Impacts
Ensure sustainable digitalization to mitigate negative environmental and social impacts

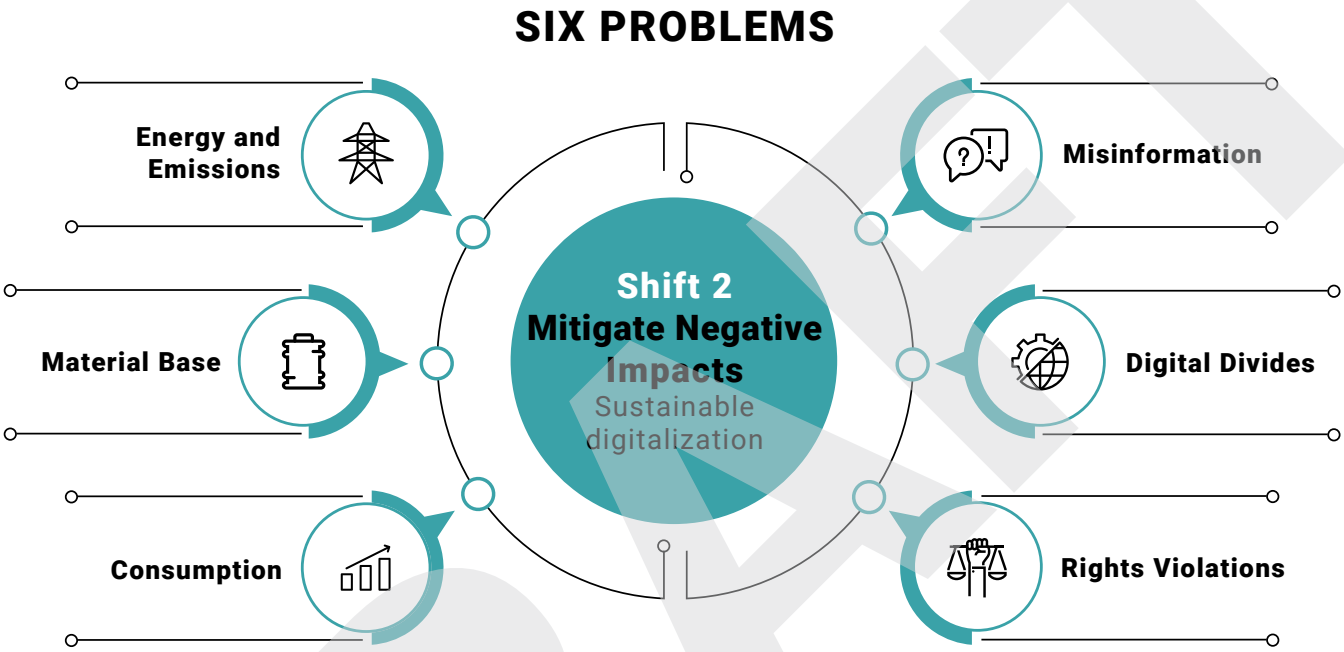

Figure 4 **Shift 2: Mitigate Negative Impacts** - Ensure sustainable digitalization to mitigate negative environmental and social impacts

Digital technologies exact a significant ecological impact linked to energy and material consumption as well as a social impact from problems linked to unsustainable consumption patterns, unequal access to digital technologies, discrimination in the provisioning of digital skills and capabilities, or targeted human rights violations.

CODES stakeholders identified 6 strategic priorities that must be addressed to ensure the sustainability, inclusiveness, and scalability of our underlying digital backbone. Examples of initiatives addressing this shift are contained in Table 2:

Problem 1 **Energy and Emissions:** Reduce energy consumption and CO_2 emissions from energy production.

One of the biggest challenges to address are the energy requirements needed to power the digital society and economy. According to the ITU, ICT's share of global electricity consumption was projected to reach 3.2 per cent in 2020.[76] Depending on scope and method of calculation, some estimates suggest that the ICT sector could be up to 7 per cent of the total global electricity use in 2020.[77] Peer-reviewed studies estimate ICT's current share of global greenhouse gas (GHG) emissions ranging from

1.8–3.9 per cent depending on the calculation method.[78] The explosion of digital cryptocurrencies is also accelerating energy consumption. With 37 million tons of carbon dioxide emissions, Bitcoin would rank between New Zealand and Ireland.[79] This necessitates investments in sustainable decentralized renewable energy infrastructure and green data centers (See Box 12). This will require common standards to ensure the energy consumption and carbon emissions of digital platforms be transparently aggregated and calculated to support the calculation of Scope 1, 2 and 3 emissions for carbon accounting. Enabling policies and incentivization mechanisms such as sustainable public procurement can thus ensure compliance with such global standards.

Problem 2 **Material Base:** Address material use and waste linked to digitalization.

The fast-evolving digital economy demands an increasing number of elements for ICT devices such as computers, data centers, mobile phones, batteries, and networks. To meet the growing demand for green technologies associated with the energy transitions, the extraction of minerals, such as graphite, lithium and cobalt, could increase by 500 per cent by 2050.[80] While the materials footprint in the volume of ICT is quite small, looking at its effect from the perspective of some specific and often rare materials, resource depletion and toxicity, the sector has a substantial impact. There are at least twenty-four elements that are considered important for the digital future, including a range of rare earth elements (REEs).[81] Each of these generate different environmental, social and political impacts during their extraction, transformation and disposal, often depending on the level of national governance capacity to monitor and mitigate those impacts. In 2019 a record 53.6 million metric tons of e-waste was produced globally.[82] The equivalent weight of 125,000 Boeing 747 jumbo jets – more than all of the commercial aircraft ever created.[83] This makes e-waste the fastest-growing domestic waste stream. Only 17.4 per cent of e-waste was documented as formally collected and recycled. Only 78 countries have e-waste legislation.[84] This means digitalization must go hand in hand with a circular economy so that metals and minerals used for digital products can be tracked, traced, recovered and recirculated. ICT producers must be held accountable (e.g. through the extended producer responsibility approach) for the environmental impact associated with their products and services and legislation should enforce stricter sustainability requirements. Minimum standards for the procurement of green digital infrastructure, digital services and ICT products would also support a circular economy.

Problem 3 **Consumption:** Restrain persuasive technologies and practices that accelerate consumption.

Despite an opportunity to drive sustainable behaviours and lifestyles through “prosumption” - the sharing and reselling of used goods on digital platforms - digitalization is inducing new demand and accelerating consumption. Current marketplace and social media business models often permit a one-way flow of user data and preferences to the digital platform companies in an opaque manner. This information is then mined, transformed into targeted advertisements, and used to accelerate the consumption of products and services through persuasive digital technologies such as: (1) product customization; (2) influencer endorsements; (3) personalized advertising; (4) digital nudging; (5) and 24/7 opportunities for purchasing (See Box 13). Additionally, digital technologies are optimizing supply chains and enabling efficiency gains by reducing the time, transaction costs or human capital needed for various tasks. This is lowering the costs of production and distribution of goods and as a consequence, creating “rebound effects”,[85,86] by placing a downward pressure on the prices of goods and services, thereby enabling increased production and consumption. All of these catalysing factors, from persuasive technologies, efficiency gains, and associated rebound effects, need to be

considered in any policy actions and economic accounting frameworks that promote sustainability through digital transformation. Measures at the system level such as carbon prices and trading schemes can represent the necessary tools to contain these factors and address indirect rebound effects. This must also include specific ethical frameworks combined with algorithmic transparency to govern digital nudging.

Problem 4 **Misinformation:** Prevent the amplification of misinformation and disinformation about sustainability and related themes.

As the digital revolution spreads around the world, we are conducting an unprecedented social experiment in which 4.5 billion people are now connected and exchanging ideas through social media, gaming (over 2.5 billion people),[87] and chat apps. This offers both powerful opportunities for accelerating social change as well as risks from the spread of misinformation of a magnitude different from anything we have experienced in human history. An MIT study found that false news stories are 70 percent more likely to be retweeted than true news stories are. It also takes true stories about six times as long to reach 1,500 people as it does for false stories to reach the same number of people.[88] The spread of misinformation about planetary sustainability topics such as climate change, biodiversity loss or pollution has real world consequences. It can undermine collective action and trust in institutions as well as magnify polarization and mistrust between divided groups. We have become less likely to find common ground on existential threats such as climate change[89] or COVID-19[90] as we cannot agree on a basic set of scientific facts. The amplification of misinformation about sustainability themes such as climate change, nature protection and pollution is a major problem that must be addressed by social media platforms. Trusted sources of information must be more systematically identified and articles containing misinformation flagged or taken down (See Box 14).

Problem 5 **Digital Divide:** Close the digital divide in an environmentally and socially sustainable manner.

The digital divide is the product of systemic inequities and power imbalances that must be addressed, amongst other measures, through agile governance frameworks and public investment in digital infrastructure together with digital literacy building. It goes also beyond inequalities in access to the internet, and includes differential access to the tools, information, technologies, skills, capacities, and agency in driving the directions of digitalization.[91] There are also important facets embedded within this divide that include gender, age, income, language and culture that must be considered. As such, efforts to close the digital divide must include a number of parallel investments. First, addressing pervasive biases in STEM that have ripple effects throughout the digital ecosystem (i.e. algorithmic bias). Second, shifting resources, finance incentives and talent funnels towards Equity, Diversity, and Inclusivity (EDI). Third, directing investments towards increasing availability and affordability of digital infrastructure where access is currently limited. A whole of society approach is necessary in order to leave no one behind.

Problem 6 **Rights Violations:** Protect human, civil and environmental rights.

In a digitally connected world, the question of how to respect, protect and implement human rights is becoming paramount. As ever more human beings, organizational systems and technical devices transition online, realizing human rights in online settings is becoming an essential consideration

in the emerging governance framework. Human rights such as freedom of expression, privacy, free assembly, child rights, indigenous land rights, or the right to a fair trial, are all heavily impacted by new digital technologies. Three important domains in the digital space need specific attention linked to environmental and social sustainability. *First*, human rights abuses linked to land use conflicts in mining minerals needed to power a green digital future, including cobalt, graphite, copper, and rare earths, particularly in lands inhabited by and/or managed by Indigenous Peoples and local communities.[92] *Second*, human rights violations in the form of digital surveillance and digital reprisals against environmental and human rights defenders, whistle blowers, journalists, and political dissidents. *Third*, violations of online data privacy by independent actors, private organizations, and state governments. Human rights need to be safeguarded in the development, implementation, law, and governance of digital technologies. They need to be accounted for and realized at every step of the value-chain of digital technologies.[93] Priority needs to be made for a new generation of rights protection mechanisms in the digital age, as enabled by digital technology solutions such as secure multi-party computation as well as personal data control. Children under 18 make up one-third of all internet users,[94] and youth (here, 15–24-year-olds) are the leading internet usage cohort[95] (globally, 71 per cent use the internet, compared with 57 per cent of the other age groups). Considering both human and child rights, as enshrined in the Convention on the Rights of the Child, is thus essential to creating an inclusive and right-based digital environment for all. Special consideration must also be given to application of CARE principles and Indigenous data sovereignty principles-- where regulations around data are not just limited to usage but considered to include (but not limited to) environmental, social, economic, historical, cultural, and resource data. Such principles should center the rights and protection of non-human entities and require engaging Indigenous experts to inform policies and standards.

Table 2: **Mapping of Key Stakeholders and Initiatives Addressing Shift 2**

Type of actor / Initiative	Title	Strategic Priorities
Digital Innovation and Acceleration Initiatives or Funding	• ITU's International Centre of Digital Innovation (I-CoDI) • ITU Partner Connect Digital Coalition	• 5 • 5
Agenda Setting and Stakeholder Dialogue	• ITU-T Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies • UN E-waste coalition • Roundtable on Global Connectivity within the Secretary General's Digital Cooperation Roadmap • Roundtable on Ensuring the Protection of Human Rights in the Digital Era within the Secretary General's Digital Cooperation Roadmap	• 1 • 2 • 5 • 6
Data, Analytics and Tools	• CodeCarbon • Carbon Mark • Global E-waste Statistics Partnership	• 1 • 1 • 2

Policies, Norms and Standards	• ITU-T SG5: Environment Climate Change and Circular Economy, standards on:
	  • ITU-T L.1000-series: E-waste and circular economy
	  • ITU-T L.1200 series: Power feeding and energy storage
	  • ITU-T L.1300-series Energy efficiency, smart energy and green data centers
	  • ITU-T L.1400-series: Assessment methodologies of ICTs and CO2 trajectories (for goods, networks, services, organizations, cities and sector levels)
	  • ITU-T L.1500 series: Adaptation to climate change
	  • ITU-T L.1700 series: Low cost sustainable infrastructure standards
	• ITU-D E-waste Policy Development
	• Digital Nations - Sustainable Government Information Technology
	• One Planet Programme on Sustainable Public Procurement (SPP)
	• EU Green Public Procurement guidebook
	• OECD green ICT assessments
	• OECD.AI Policy Observatory (Task Force on AI Compute & Environment)
	• OECD Recommendations on Information and Communication Technologies (ICTs) and the Environment
	• Principles for Green Software Engineering
	• European Committee for Standardization (CEN) Materials efficiency
	• European Committee for Electrotechnical Standardization (CENELEC) Materials efficiency
	• European Telecommunications Standardization Institute (ETSI) Materials Efficiency and Life Cycle Assessment
	• Internet Engineering Task Force (IETF)
	• Institute of Electrical and Electronics Engineers Standard Association (IEEE SA)
	• Sustainable IT Pledge by the Canadian CIO Strategy Council
	• Basel Convention on controlling transboundary movements of hazardous wastes and their disposal
	• EU Ethics Guidelines for Trustworthy AI
	• Guidelines for sustainability information on e-commerce platforms
	• Global Agreement on the Ethics of Artificial Intelligence
		
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		• 3
		• 3, 4

	• World Wide Web Foundation REACT policy framework on Digital Inclusion • Principles for Digital Development • UN Declaration on the Rights of Indigenous Peoples (UNDRIP) • Audit AI • UNICEF Policy Guidance on AI for Children • Responsible Data for Children • OHCHR's work on privacy in the digital age • GESI Good Practice Guide on Remedy Human Right Impacts • UN Guiding Principles on Business and Human Rights • Children's Rights and Business Principles • UNICEF: The Case for Better Governance of Children's Data: A Manifesto	• 5 • • 5 • 6 • 6 • 6 • 6 • 6 • 6 • 6 • 6 • 6
Advocacy	• Center for Humane Technology • International Campaign for Responsible Technology • Center for Countering Digital Hate • Alliance for Affordable Internet • Amnesty International • Global Witness	• 3, 4, 6 • 3, 4, 6 • 4 • 5 • 6 • 6
Training	• Open SAP: Clean-IT: Towards Sustainable Digital Technologies • Open SAP: Sustainable Software Engineering • Principles for Digital Development	• 1, 2 • 1 • 4
Research and Knowledge	• UNFCCC Climate Action Pathways - ICT & Mobile • Digital Goes Green • ICT4S Research Community • Digitalization for Sustainability – Science in Dialogue (D4S) • Network for Digital Economy and Environment (nDEE) • C-SERVES • EFUTURES - Electronics for Sustainable Societies • PARIS DE • Global E-waste Statistics Partnership | Global E-waste Monitors | Regional E-waste Monitors • FacProSUM Urban Mine Platformebook Climate Science Center • Facebook Climate Science Center • Google initiative on verified climate science • Twitter initiative on authoritative climate info • ITU-T Joint Coordination Activity on Accessibility and Human Factors (JCA-AHF)	• 1 • 1, 2, 3 • 1, 2, 3 • 1, 2, 3 • 1, 2, 3 • 1, 2 • 1, 2 • 1 • 2 • 2 • 4 • 4 • 4 • 5, 6

Collective Action Networks and Coalitions	• UNFCCC Race to Zero Climate Champions team • Exponential Roadmap Initiative • WBCSD Carbon Transparency Partnership • United 4 Smart Sustainable Cities (U4SSC) • Sustainable Digital Infrastructure Alliance • Playing for the Planet Alliance • Digital With Purpose Movement • Green Software Foundation • Global Enabling Sustainability Initiative • Green 500 • Greentech Alliance • ICT Pact • Icebreaker One • Carbon Call • RE100 • GSMA • Internet Governance Forum - Policy Network on Environment • Science-based Targets Network (SBTN) • E-waste Coalition • Circular Electronics Partnership • WEEE Forum • International POPS Elimination Network (IPEN) • Partner Connect Digital Coalition • Digital Poverty Alliance • ITU / UNESCO Broadband Commission • Alliance for Affordable Internet • Responsible Business Alliance • Global Electronics Council	• 1 • 1, 2 • 1 • 1 • 1, 2 • 1, 2, 3 • 1, 2, 3 • 1, 2, 3 • 1, 2, 3 • 1, 2 • 1, 2 • 1, 2 • 1 • 1 • 1 • 1, 2, 5 • 1, 2, 3 • 1, 2 • 2 • 2 • 2 • 2 • 5 • 5 • 5 • 5 • 6 • 1, 2

BOX 13 The Roadmap to Sustainable Digital Infrastructure by 2030

The Sustainable Digital Infrastructure Alliance is a network of stakeholders committed to sustainability working across the entire digital infrastructure value chain. The goal is to participate in key activities toward sustainable digital infrastructure and set the direction for the development of the sector. This is embodied in the Roadmap to Sustainable Digital Infrastructure by 2030 that has been adopted by the alliance. The roadmap includes a number of key targets on emissions, energy consumption, e-waste, resource consumption, pollution, and the cost of digital power.

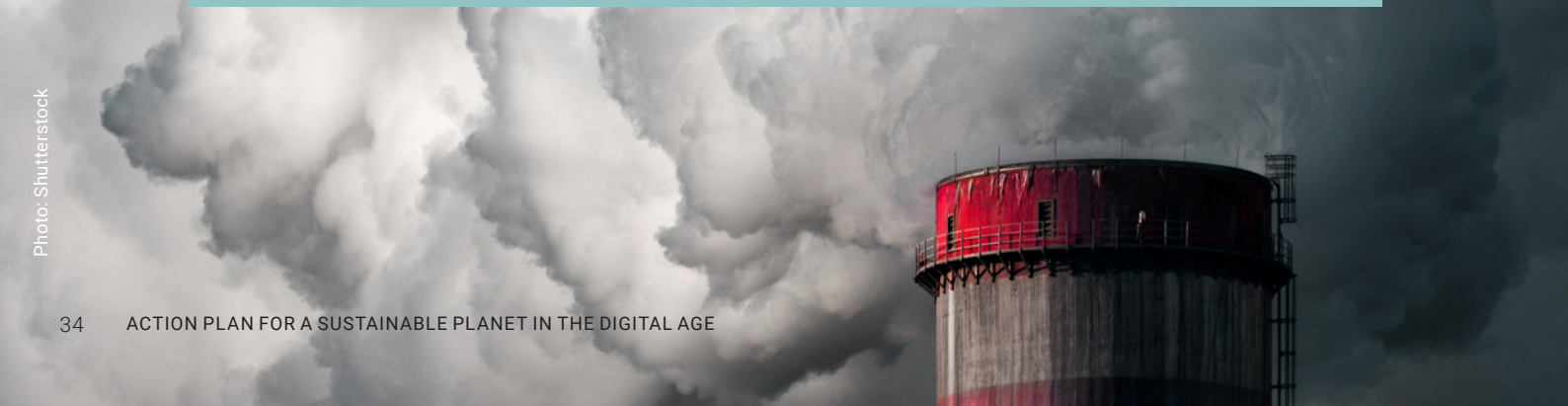

Photo: Shutterstock

BOX 14 The risks of digital nudging powered by AI

Nudge Theory, as popularized by the Nobel Memorial Prize laureates Richard Thaler and Cass Sunstein, is a concept involving indirect suggestions and positive reinforcement as means to influence decision-making behaviours. Today, this theory finds application in digital spheres where, through algorithmic nudging, organizations can collect, parse, and crunch their stakeholders' data on a large scale, and use this data to train their algorithms and target users through personalized nudges, such as push-notifications and rewards. With advances in AI and machine learning, such algorithms can be adjusted in real-time based on user feedback and have proven to be very effective in triggering behavioural change.

A survey by Deloitte of 500 companies found that among all of the retailers that have adopted AI to personalize the consumer experience, 40 per cent of them used AI with the specific purpose of tailoring pricing and promotions in real time based on digital intelligence of user preferences and predictive analytics.[96]

This incredible opportunity for micro-targeting can potentially be harnessed to foster sustainable consumption and more climate-friendly lifestyles and behaviours. Conversely, this unprecedented access to user data also carries the risk of manipulating consumers to options that may not be the most beneficial or interfere with human privacy and individual agency.

Therefore, it is essential that such algorithmic nudges be designed ethically taking into account regulatory provisions such as the EU's General Data Protection Regulation (GDPR) and various AI regulations, such as the EU AI Act. Creators need to ensure they create a win-win situation and empower users to decide how they want to engage with sustainability nudges. Furthermore, creators should share information about data collection and storage and explain the algorithms' logic and optimization goals.


Photo: Shutterstock

Photo: Shutterstock

BOX 15 Verified sources of climate information

Some social media companies and digital platforms are exploring how to address mis-information linked to climate change.

Facebook has launched the Climate Science Center[97] to help users find validated information on climate change from authoritative sources including UNEP, WMO and IPCC. This service is available to all Facebook users to help mitigate the spread of misinformation about climate science.

Google is also teaming up with the UN[98] to offer verified climate information. When users search for "climate change," they will be able to find authoritative information from the United Nations. In addition to organic search results, Google will surface short and easy-to-understand text blurbs and visuals on the causes and effects of climate change as well as individual actions that people can take to help tackle the climate crisis.

Google and YouTube also announced a new policy that prohibits climate deniers from being able to monetize their content on its platforms via ads or creator payments.[99]

Twitter rolled out a new program designed to "pre-bunk" climate misinformation or get ahead of false narratives about climate by exposing people to more accurate information about the crisis on its platform.[100] Twitter users will be directed to online hubs containing credible, authoritative information. These guides will appear in users "Explore" tabs, their Twitter search portals, and relevant trends lists.

Despite these efforts, misinformation in general and on climate change in particular, remains a pervasive problem on social media. A recent study by the Center for Countering Digital Hate (CCDH) found that of 7,000 misleading Facebook posts describing climate change as "hysteria", "alarmism", a "scam", or other related terms, only 8 per cent were marked as misinformation.[101] Highly shared articles made false assertions that climate change was not confirmed by science or claimed to debunk it with data. Of these, 69 per cent could be traced back to just 10 "super-polluter" publishers - dubbed the "toxic ten" - the campaign group found.

Shift 3: Accelerate Innovation
Directing innovation efforts toward digital sustainability

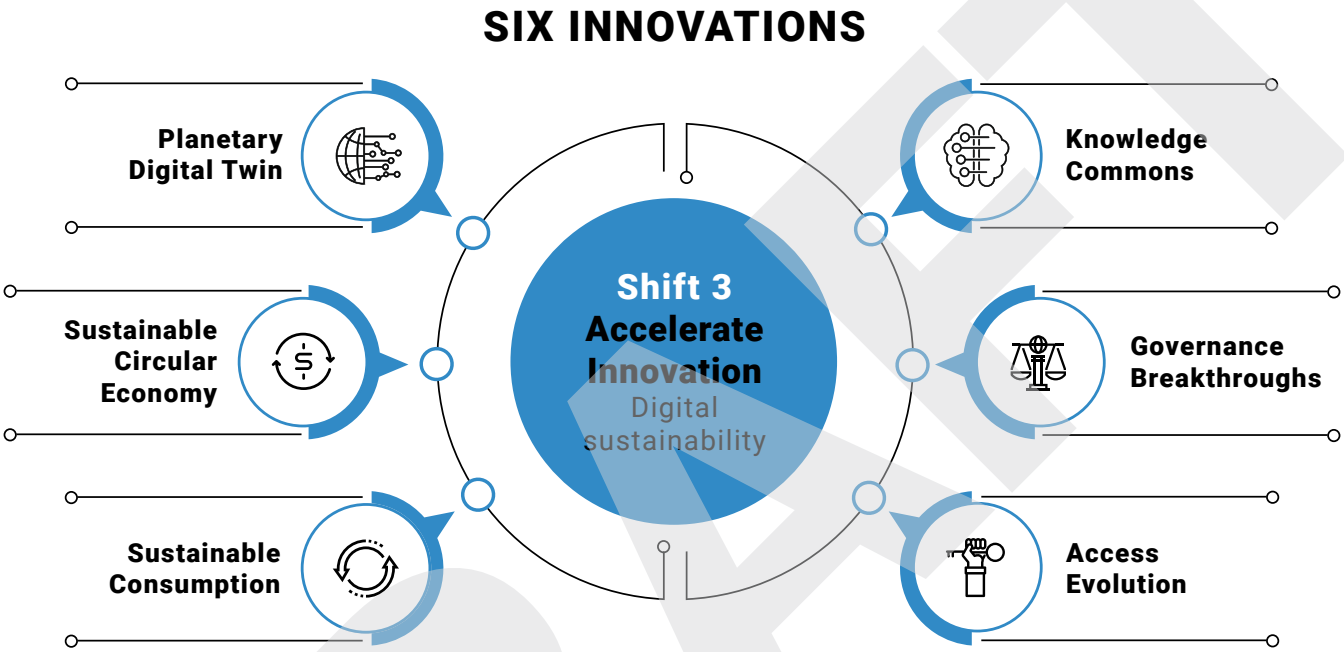

Figure 5 **Shift 3: Accelerate Innovation** - Transform systems, incentives, and business models through digital innovations for sustainability

The third shift calls the digital innovation community, including governments, development partners, private sector, informal economy actors, local communities, and academia, to channel large investments, capacity development and collective efforts toward digital sustainability with intention.

This translates into the commitment to advance a decade of innovation for digital sustainability. The very process of digital transformation holds great promise in addressing some of the key environmental challenges and systemic barriers to planetary-scale sustainability that we face today. It provides new opportunities and useful means to change the ways in which we interact with and understand the natural environment, and organize, produce, and consume. Redirecting the innovative powers of digital technologies towards achieving our sustainability agenda in time and scale is absolutely key. Shifting the collective effort towards harnessing the potential of digitalization for systems level transformation is an important strategic priority for positive change towards a sustainable planet.

CODES stakeholders identified 6strategic priorities where innovation can be proactively used to implement, accelerate, and scale sustainability globally: building planetary digital twins and a sustainable circular economy, ensuring sustainable consumption and global knowledge commons, striving for governance breakthroughs and an access revolution. Examples of initiatives that are working on this shift are shared in table 3.

Innovation 1 **Planetary Digital Twin:** Prioritize innovations to measure, monitor and model the health of the planet's biosphere and interactions with economic and social systems.

Digitally driven advances in science, predictive data analytics, artificial intelligence and collective intelligence methods are already proving to be drivers for promoting sustainability transparency, accountability and reporting, and knowledge production. However, many efforts continue to be fragmented and unable to connect in order to monitor planetary health in real time. Major investments are needed to build digital twins of the earth and its various subsystems that can allow us to monitor and model complex relationships among environmental, social, governance, and economic systems using the best science and data available as well as robust data-protection rules. These systems could conduct automated monitoring of risks and threats to key natural or cultural areas under global protection frameworks, e.g., related to key biodiversity areas (KBAs)[102], ecosystem services or protected species, and allow for the integration of geographic/geospatial information in temporal views which can enable enhanced analysis of impact over certain time periods. They can also assist in understanding options and trade offs for achieving different SDGs and MEAs. This can benefit not just the national governments, but also for private sector companies, research institutions, non-profit organizations, and local communities, with consideration to leave no one behind (See Box 16). Accomplishing this goal will require a number of investments. First, investments to improve the sensing, connectivity and compute requirements required to collect and process the vast volumes of data, especially for real-time data processing scenarios. Second, adoption of transparency principles, data standards and safeguards, open APIs and communication protocols that enable safety, privacy, interoperability, transferability, and quality control of key data across disparate systems. Third, ways to support, and integrate validated citizen science contributions and observations as well as other open-source tools and algorithms into the digital twin ecosystems. Finally, development of applications that enable real-time ingestion and processing of data from the digital twin ecosystem into governments, science, civil society, and private sector ecosystems and vice-versa to inform meaningful forms of analysis and decision support systems.

Innovation 2 **Sustainable Circular Economy:** Prioritize innovations towards an inclusive, net zero, sustainable circular economy.

Digital transformation is an opportunity to rethink how private sector business models can contribute to a sustainable circular economy and how companies can achieve full environmental transparency and accountability across their entire value chain. To achieve circular business models, innovations are needed on multiple fronts. First, the digital transformation process itself should be used as an opportunity for companies to identify concrete pathways to advance decarbonization, dematerialization, detoxification, and circularity goals across their value chains. This should also include a transitioning away from the provision of products to offering services. Second, digital standards and infrastructure are needed for digital product passports to hold data and relevant sustainability information on their lifecycle. This includes a product's origin, composition, environmental and carbon performance, repair, and dismantling possibilities as well as end of life handling. Third, increased use of eco-labels and provision of information to consumers to inform their own decision making. Finally, aligning business models, financial and institutional procurement practices with sustainability goals, with the view to transitioning away from unsustainable products and services towards products and services that are fully ESG compliant. Ultimately, one of the outcomes of digital transformation is that it should help identify opportunities to adopt a "beyond growth" paradigm where the application of digital technologies, in addition to profits, is baselined on social and environmental accountability with the goal of accelerating planetary sustainability and respecting planetary boundaries in the context of a circular economy (see Boxes 17 and 18).

Innovation 3 **Sustainable Consumption:** Empower sustainable lifestyles, behaviors, and collaboration.

Digital tools can empower consumers to make and demand sustainable consumption choices which can collectively drive businesses to adopt sustainable practices. For example, digital applications embedded in e-commerce platforms such as product comparability, ethical nudging, gamification, footprint calculations and green activations can support a shift in awareness and enable people to choose more environmentally sustainable products and services (see Box 19). Social media, gaming platforms and fintech can also help amplify proof of environmentally sustainable lifestyles, enabling people to receive social recognition from their choices thereby reinforcing green behaviours (See Box 20). A range of digital marketplaces can also support the collaborative economy that enables giving, reselling, swapping, sharing, and renting products and services directly between individuals. While strong privacy protection must be obligatory everywhere, digital innovations must be flexible enough to be adapted to the specific local, socio-economic, and geographic contexts on the basis of human-centered design, respectful of the planet's ecological ecosystems. Digitalization also enables mass collaboration and mobilization of citizens through platforms enabling crowdfunding. Opportunities to use digital technologies to empower sustainable lifestyles, behaviours and collaboration should be designed into digital platforms by default. They must become essential channels to influence sustainable consumption drivers at a planetary scale.

Innovation 4 **Knowledge Commons:** Prioritize innovations towards a broadly accessible knowledge commons.

Digital change continuously expands options to co-produce, process, and share knowledge. Digital tools - from data collection and analysis, model building, knowledge aggregation, visualization to virtuality - can expand scientific methods in all disciplines, facilitate inclusive and cooperative forms of co-production of knowledge (e.g., citizen and open science) and enable knowledge sharing across the globe for all kinds of educational, scientific, or practical purposes (see Box 21). However, this valuable global public good needs to be actively built, managed, and protected to serve as a strong lever for sustainability. It is yet too often challenged by a lack of understanding, infrastructure, and supportive framework conditions or by large public-private-imbalances towards well-resourced private innovation hubs (especially in tech-research and platform solutions). Innovations, political and financial investments are needed: operationalized FAIR principles for data (findability, accessibility, interoperability, reusability), public money and public data for public research and knowledge, open science standards, broad investments in digital literacy, education, and digital knowledge access around the globe. Creating a global knowledge commons has vast potentials for sustainable development, the empowerment of marginalized groups, the creation of a global (environmental) awareness and empathy as well as breakthroughs in sustainability solutions.

Innovation 5 **Governance Breakthroughs:** Prioritize innovations towards a revolution in networked, agile, and collaborative governance.

Presently, many national laws, regulations and associated governance frameworks that implement global SDG and MEA commitments are not yet being designed to directly benefit from digital technologies, platforms, applications, and SMART systems. Many national legal frameworks are still using traditional approaches for regulating the physical world while neglecting opportunities to harness digital tools to achieve sustainability outcomes and regulatory compliance. As "whole of government" approaches to digitalization and e-governance are taken forward, a range of innovations

are needed to catalyse a series of sustainability governance and rule of law breakthroughs. First, improving the ability of governance systems and regulations to dynamically adapt to changing sustainability risks and opportunities using real-time information feedback loops and AI in an agile and iterative manner (See Box 22). Second, increased automation of Systems of National Accounts (SNAs)[103] used to measure national economic activity with sustainability criteria included (See Box 23). Third, transparent monitoring, reporting and verification (MRV) of legal compliance and progress towards national sustainability goals as part of new accountability frameworks. Fourth, decentralized and distributed governance solutions to trigger and incentivize collective sustainability actions and behaviours at scale through digital channels. Finally, new digital mechanisms to support public participation in decision-making to crowdsource governance priorities and solutions from citizens. All of these governance innovations must also prioritize the inclusion and ownership/agency of marginalized groups, support subsidiarity and self-governance in an increasingly polycentric setting and help overcome the harsh global-local divide e.g., by building inclusive fora connecting local interests with global decision-making. Sustainability policies, laws and regulations increasingly need to be written in digitally relevant and machine-readable formats that can interact with and inform algorithmic decision making, SMART systems and digital twins.

Innovation 6 **Access Evolution:** Prioritize actions to make digital innovations for the Whole of Society, broadly accessible for the many.

Several digital innovations pose systemic challenges to existing individual, economic and societal development models with the potential to exacerbate power imbalances, monopolistic competition, exclusion, and societal conflict. More basically, still half of the world's population suffer from the digital divide including lack of access to basic connectivity, opportunities, and skills. As important as the technology coverage is the accessibility for all and digital literacy. Addressing these trends requires an active, global, and radical vision along the 2030 Agenda. The global community should actively and comprehensively promote access to a broad scope of digital innovations for the whole of society, while empowering local digital ecosystems. This 'access evolution' must entail multiple domains to develop new sustainable development perspectives, support green jobs, unlock alternative green financing mechanisms or sustainable market incentives and sustainable livelihoods. Some illustrative priority domains for innovations in access include: the development of digital infrastructure and digital public goods to support low cost renewable mini and off grids, support for sustainable small-scale agriculture, support to access micro-finance, access to open education as well as local business models for green digital jobs, self-employment, products, and services. Promoting digital inclusion through prosperous and dignified work must be a top investment priority for companies and governments alike, and international actors can play a role to safeguard technology innovation and foster healthy digital ecosystems. Crowding in investments and public funding to foster local digital ecosystems, establishing multi-faceted partnerships that support open technology and adopting frameworks for a whole-of society approach are needed.

Table 3: **Mapping of Key Stakeholders and Initiatives Addressing Shift 3**

Type of actor / Initiative	Title	Strategic Priorities
Digital Innovation and Acceleration Initiatives or Funding	• UNDP's Digital Transformation Initiative • UNEP's Digital Transformation Programme • GIZ's Innovation Challenge • Ellen Macarthur Foundation • Digital Public Goods Alliance • United for Smart Sustainable Cities (U4SSC) • UNFCCC Global Innovation Hub • SITRA Sustainable Lifestyles	• 1, 4, 5, 6 • 1, 2, 3, 5 • 2, 3, 5, 6 • 2, 3, 5 • 2, 5, 6 • 2, 3, 5, 6 • 2, 3, 5, 6 • 3, 5
Agenda Setting and Stakeholder Dialogue	• Global Partnership on Artificial Intelligence (GPAI) • Coalition for Digital Environmental Sustainability (CODES)	• 1, 2, 3 • 2, 3, 5
Data, Analytics and Tools	• Destination Earth - Digital Twin of the Planet • System for Earth Observation, Data Access, Processing and Analysis (SEPAL) • Big Earth Data Science Engineering Program (CASEarth) • UNEP's World Environment Situation Room • Various applications of open data cube technology including Digital Earth Africa, Digital Earth Pacific • Group on Earth Observations (GEO) work on Digital Earth • Computational Sustainability • International Society for Digital Earth • Sustainability in the Digital Age • Joint Centre for Excellence in Environmental Intelligence • Alan Turing Institute Environment and Sustainability Interest Group • UNDP Data Futures Platform, Green Recovery Data Hub • UN Secretary General's Future Labs • Global Initiative on AI and Data Commons • Artificial Intelligence for Environment & Sustainability (ARIES) to support the System of Environmental Economic Accounting (SEEA) • Microsoft Planetary Computer • Google Earth Engine • Nvidia Omniverse platform for digital twinning and 3D simulations • Amazon Sustainability Data Initiative	• 1 • 1 • 1 • 1 • 1 • 1 • 1, 2, 3 • 1 • 4, 5, 6 • 1, 4, 5 • 1, 2, 3 • 1 • 1, 2, 3, 5 • 1, 5 • 1, 2, 4 • 1, 2, 4 • 1, 2, 4 • 1, 2

	• Salesforce Sustainability Cloud • Global Open Science Cloud Initiative • Future of Sustainable Data Alliance (FoSDA) • Global Data Access Framework (GDAF) • United Nations Satellite Centre UNOSAT • Copernicus Open Access Hub • Trase Earth **On Climate Change** • Camda Data 2.0 working group • Climate TRACE • Climate Chain Coalition • Climate Change AI • Centre for AI & Climate • Climate Informatics • Icebreaker One • Data Driven Lab • Digital Public Goods Alliance - Climate Change Adaptation Community of Practice **On Nature and Biodiversity** • Framework on Ecosystem Restoration (FERM) • UN Biodiversity Lab • IPBES • Restor • The Life Map • e-shape • Coordinadora de las Organizaciones Indígenas de la Cuenca Amazonica (COICA) • Indigenia Mundus **On Chemicals and Pollution** • Global Partnership on Marine Litter (GPML)	• 1, 2 • 1, 2 • 1 • 1 • 1 • 1 • 2, 3 • 1 • 1 • 1 • 1, 3, 4 • 1, 3, 4 • 1 • 1, 2, 3 • 1 • 1, 4, 5 • 1 • 1, 4 • 1, 4 • 1 • 1 • 1 • 4, 6 • 4, 6 • 1, 5
Policies, Norms and Standards	• Global Partnership for Sustainable Development Data • Global Environmental Data Strategy requested by UNEA 4/23 • FAIR Principles for Scientific Data • CARE Principles for Indigenous Data Governance • First Nations Principles of Ownership, Control, Access, and Possession (OCAP) • ISC-CODATA's Decadal Programme 'Data for the Planet: making data work for cross-domain grand challenges' • International Open Data Charter • Data Interoperability Collaborative • GS1 Digital Link	• 1, 2 • 1, 2, 5 • 1, 2, 5 • 1, 2, 5, 6 • 1, 2, 5, 6 • 1, 2 • 1 • 1 • 2, 3, 5

	• ITU-T Study Group 5: Environment, Climate Change and Circular Economy	
	• ITU-T L.1000-L.1199 standards: set of standards that can form the basis for circular economy	• 2
	• ITU-T L.1470 series to achieve net zero in the ICT sector	• 2
	• ITU Sustainability passport for digital products	• 2, 3
	• ITU standards and guidelines on Green Procurement	• 2
	• ITU-T Study Group 20: Internet of things (IoT) and smart cities and communities (SC&C)	
	• ITU-T Y.4900 series: Evaluation and assessment of smart cities	• 2, 3
	• ITU-T Y.4903: Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals	• 2, 3
	• ITU-T Y.4904: Smart Sustainable cities maturity model	• 2, 3
	• Focus Group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture (FG-AI4A)	• 3, 6
	• Green Fintech Taxonomy	• 2, 3
	• Planet Mark	• 3
	• Guidelines for Sustainability Information on E-commerce Platforms	• 3
	• Consumers International - Digital Trust	• 3
	• EU Digital Services Act	• 2, 3, 5
	• EU Digital Markets Act	• 2, 3, 5
	• UNEP Finance Initiative	• 2, 3, 5
	• Responsible AI Strategy for the Environment (RAISE)	• 2, 3, 5
	• EU Corporate Sustainability Reporting - Directive 2014/95/EU Non-Financial Reporting	• 2, 3, 5
	• EU Proposal for a Corporate Sustainability Reporting Directive (CSRD)	• 2, 3, 5
	• UNESCO Recommendations on Open Science	• 4
	• Open Science guidelines	• 4
	• European Financial Reporting Advisory Group (EFRAG)/ Sustainability Reporting Board	• 5
	• Digital Nations - Leading Digital Governments	• 5
	• The GovLab	• 4, 5
	• Open Government Partnership: workstream on digital governance	• 5
	• Open North	• 4, 5
	• Principles and Recommendations to align BigFintech governance with the SDGs	• 3.5

	• ITU and Digital Impact Alliance GovStack • ITU GreenGovStack • Digital Investment Toolkit	• 5, 6 • 5 • 6
Advocacy	• Digital Goes Green	• 2, 3, 5
Training	• EO4GEO Alliance • Open SAP: Helping Business Thrive in a Circular Economy • ICLEI Europe: AI4 Cities • ITU Centres of Excellence programme	• 1 • 2 • 2 • 4, 6
Research and Knowledge	• ICT4S Research Community • UNESCO International Research Centre in Artificial Intelligence • Digitalization for Sustainability – Science in Dialogue (D4S) • International Resource Panel's workstream on "Sustainable Trade in Resources: Global Material Flows, Circularity and Trade" • Stockholm Environment Institute (SEI) • Alan Turing Institute Environment and Sustainability Interest Group • ITU E-agriculture • Climate Change AI • ITU-T Study Group 5: Environment, Climate Change and Circular Economy • International Resource Panel's workstream on "Sustainable Trade in Resources: Global Material Flows, Circularity and Trade" • Green Digital Finance Alliance • EU's Regulations on Sustainable Finance • OECD International Programme for Action on Climate (IPAC) • UNFCCC Resilience Frontiers • UK Center for Greening Finance and Investment • ITU and UNDP's Digital Capacity Database • AI Commons • World Benchmarking Alliance • EU Blockchain Observatory and Forum • Ubuntoo - Environmental Solutions Platform • The GovLab • Focus Group on AI for Natural Disaster Management (FG-AI4NDM) • Focus Group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture (FG-AI4A)	• 1, 2, 3 • 4, 6 • 1, 2, 3 • 3.2 • 2, 3, 4 • 2, 4, 6 • 3, 4, 6 • 2, 3, 4, 5 • 2, 4, 6 • 2, 5 • 2, 5 • 2, 5 • 2, 5 • 2, 5 • 2, 5 • 2, 5 • 2, 4, 5, 6 • 5, 6 • 2, 5 • 4, 6 • 4, 6 • 2, 5 • 3, 5, 6 • 3, 5, 6

Collective Action Networks and Coalitions	• Working towards a Digital Twin on Earth • Greentech Alliance • European Green Digital Coalition • WEF 2030 Vision • Platform for Accelerating a Circular Economy (PACE) • Circular Electronics Partnership (CEP) • Digital With Purpose • Icebreaker One • Playing for the Planet Alliance • Google Sustainability Choices - Green Apps • Amazon Climate Pledge Friendly Products • Every Action Counts Coalition • United 4 Smart Sustainable Cities (U4SSC) • ITU and UNICEF Giga Connectivity • Science-based Targets Initiative • Climate Chain Coalition • United Citizens Organization for Action for Climate Empowerment • High-Speed Access for All: Canada's Connectivity Strategy • Digital Connectivity and Cybersecurity Partnership (DCCP) • Technology for Development • Digital Impact Alliance • Digital Poverty Alliance	• 1 • 2, 3, 4, 6 • 2, 3, 5 • 2, 5, 6 • 2 • 2 • 2, 3, 5 • 2, 3, 5 • 2, 3 • 3 • 3 • 2, 3 • 2, 3, 5 • 4, 6 • 2, 3, 5 • 2, 3 • 5 • 6 • 6 • 6 • 6 • 6

BOX 16 Destination Earth - a Digital Twin of the Planet

Destination Earth aims to develop a high precision digital model of the Earth to model, monitor and simulate natural phenomena and related human activities. As part of the European Commission's Green Deal and the Digital Strategy, Destination Earth (DestinE) will contribute to achieving the objectives of the twin transition, green and digital.

DestinE will unlock the potential of digital modeling of the Earth system. It will focus on the effects of climate change, water and marine environments, polar areas, cryosphere, biodiversity or extreme weather events, together with possible adaptation and mitigation strategies. It will help to predict major environmental degradation and disasters with unprecedented fidelity and reliability.

By opening up access to public datasets across Europe, DestinE represents also a key component of the European strategy for data. At the heart of DestinE will be a user-friendly and secure digital modeling and simulation platform. This platform will provide access to data, advanced computing infrastructure, software, AI applications and analytics.

Photo: iStockphotos

BOX 17 Digital With Purpose Movement

The Digital With Purpose Movement (DWP) is establishing a series of metrics and a certification scheme that will help companies communicate how their digital products, services and business practices are contributing positively to SDGs and improving the sustainability of society as a whole. Member companies represent billions in market capitalization.

The DwP framework has three main components:

- **Purpose:** Principles and associated metrics to inform a company on becoming a purpose-led business, i.e., connecting core business models to address sustainable development goals, maximizing positive contributions, and minimizing negative effects.
- **Digitally Enabled Solutions:** Principles and associated metrics that reflect how a company contributes innovative digital solutions through its products, services, and core business practices in a way that improves the sustainability of society overall.
- **Responsible Business:** Principles and metrics covering how a responsible company operates with respect to climate change, digital trust and responsibility, the circular economy, digital inclusion, and supply chain. This covers the design, delivery and end-of-life management of products and services, as well as interactions with stakeholders, monitoring performance, and setting targets for improvement.

Equivalent weighting is given to the solution generation component and the component associated with more traditional ESG metrics covering responsible business practices.

Members of the Movement are required to make a public commitment to the "Digital With Purpose Movement" – to pledge to adhere to the four universal commitments that make up the 'Digital with Purpose Framework' (the Framework provides a rigorous and robust process for corporates to articulate their ambitions for SDG impact and to track their progress through impact measurement).

The four universal commitments are:

1 We commit to supporting the UN SDGs and establishing practical and incremental steps to become a purpose-led business.

2 We take and report concrete action on climate change.

3 We embrace the principles of impact transparency and report accordingly every year.

4 We develop and deploy digital technology with positive societal impact.

BOX 18 Green Fintech Taxonomy

The Green Digital Finance Alliance (GDFA) and the Swiss Green Fintech network launched the world's first green fintech taxonomy. Through the report entitled: *A Green Fintech Taxonomy and Data Landscaping*,[104] the taxonomy seeks to develop and stimulate the green fintech market by enabling a harmonized approach for policy makers, investors, and market actors to assess green fintechs. The report categorizes green fintech through the following lenses:

1. Green digital payment and account solutions
2. Green digital investment solutions
3. Digital ESG-data and -analytics solutions
4. Green digital crowdfunding and syndication platforms
5. Green digital risk analysis and insure-tech
6. Green digital deposit and lending solutions
7. Green digital asset solutions

A key value add of the report is the mapping of the main databases leveraged by each category of green fintech, and providing an overview of the datasets which, if made accessible, can catalyse an increased supply of green fintech innovation.

Innovations in fintech solutions that seek to better align behaviours of the financial system with green objectives, are critical to achieving sustainable outcomes and taxonomies like the GDFA's are an essential catalyst for this wave of innovation.

Level39 FinTech hub based in the One Canada Square tower, London
Photo: Jemima Kelly / Reuters

Customers pay for having trees planted around the world using Treedom, Italy's new e-commerce platform, Cameroon.
Photo: Riccardo Grando Treedom Press Office/Handout via Reuters

BOX 19 E-commerce platforms are offering green filters and procuring with purpose options

Three of the largest digital platforms in the e-commerce space are aiming to support greener consumption and lifestyles using digital channels. Amazon has adopted the Climate Pledge Friendly initiative to help at least 100 million Americans find climate-friendly products that carry at least one of 32 different environmental certifications.

Google is now highlighting green products and services such as flights and transport routes within search results and navigation tools. These could help influence the behaviours of the billions of people who use Google services.

SAP's Ariba platform is the largest digital business-to-business network on the planet. It has also fully embraced the idea of "procuring with purpose" offering a detailed look at corporate supply chains so potential partners can better assess the social, economic and environmental impact of transactions.

BOX 20 The Green Digital Finance Alliance and the Every Action Counts Coalition

The Green Digital Finance Alliance (GDFA), launched by Ant Group and the United Nations Environment Programme (UNEP), seeks to address the potential for digital finance, and fintech to reshape financial incentives in ways that better align it with the needs of green production and consumption aims to enhance financing for sustainable development. Recently, the GDFA launched the Every Action Counts Coalition, a global network of digital, financial, retail investment, e-commerce, and consumer goods and services companies that have a shared interest in using digital platforms to accelerate green finance and consumption.

It identifies and shares best practices in encouraging individuals to take positive actions in daily life to create planet-friendly outcomes through digital channels. The Coalition has collectively set an ambitious target. The EAC Coalition will creatively leverage technology and partnerships to enhance green awareness and action of 1 billion people around the globe by making greener choices and taking action for the planet by 2025.

For example, financial services providers such as GDFA member Mastercard in collaboration with the Swedish fintech financial technology company Doconomy are enabling their users to buy lower carbon products by providing shoppers with a personalized carbon footprint tracker and insights to help inform their spending decisions.

Mobile apps like Ant Forest, by Ant Group, are also using a combination of incentives, digital engagement and social engagement models to help 600 million make more sustainable choices. Users are rewarded for low-carbon choices through green energy points that they can use to plant real trees. So far, the Ant Forest app has resulted in 122 million trees being planted, reducing carbon emissions by over 6 million tons.

Trees waiting to be remplanted ito help reforestation in Malaysia
Photo: Mokhamad Edliadi / CIFOR

Machine learning can help predict the climate and protect nature
Photo: iStockphotos

BOX 21 Public-private research collaboration in the use of artificial intelligence for climate action

In 2019, a major academic collaboration was conducted between a range of academic and private sector experts on potential applications for tackling climate change with machine learning.[105] The collaboration was unprecedented in terms of bringing together some of the biggest names in AI research from 12 universities (University of Pennsylvania, Carnegie Mellon University, ETH Zurich, University of Colorado Boulder, Mila, Universite de Montreal, Ecole Polytechnique de Montreal, Harvard University, Mercator Research Institute on Global Commons and Climate Change, Technische Universität Berlin, Massachusetts Institute of Technology, Cornell University, and Stanford University) together with senior experts from DeepMind, Google AI, Microsoft Research and Element AI.

The collaborative endeavour covers possible machine-learning interventions in 13 domains, from electricity systems to farms and forests to climate prediction. Within each domain, it breaks out the contributions for various sub-disciplines within machine learning, including computer vision, natural-language processing, and reinforcement learning. This resulting study represents a model of best practice in terms of working across disciplines and between public and private sectors. It should be replicated in other domains such as nature protection and pollution prevention.

BOX 22 Modern digital administration – the German AI Application Lab for Sustainability Solutions

Digitization enables us to think about issues in the context of socio-ecological sustainability in a completely new and different way. In order to take advantage of the emerging transformational momentum through digitization, environmental governance needs new structures, processes and competencies to effectively design in multicomplex and interdisciplinary subject areas. But administration can only shape what it also understands.

The aim of the German Environmental Agency's AI Application Lab for Sustainability Solutions is to develop and consolidate AI methods as a standard tool in the sustainability transformation toolbox of the German administration and to research and demonstrate the sustainable use of the technology.

The AI Application Lab will analyze environmental data using AI to better identify complex relationships, or even to do so for the first time. It will address pressing issues with an eye toward sustainability research; and ultimately to better derive measures to protect people and the environment.

BOX 23 ARIES for SEEA Explorer: The first AI tool for rapid natural capital accounting

Artificial Intelligence for Environment & Sustainability (ARIES), developed by researchers at the Basque Centre for Climate Change (BC3), is an integrated, open-source modeling platform for environmental sustainability, where researchers from across the globe can add their own data and models to web-based repositories.

Thanks to the use of artificial intelligence (AI) – specifically semantics and machine reasoning – ARIES automates data and model integration. A core component of ARIES is the use of a set of consistent, shared semantics, which comprise uniform and unambiguous definitions for the data and models involved, and the relationships between them. These semantics are constructed using an intuitive language readable by both people and computers. The ARIES technology automates model selection based on a user's specific request (e.g., an ecosystem service assessment or condition account for a given country and year), matching the requested concepts to the most suitable models and data for the context of interest. The "most appropriate" models and data for the location, time span and spatiotemporal resolution specified are chosen among those provided by contributors to a communally curated, distributed network of participating institutions, and assembled to produce the best-in-class computation that answers the user's query.

ARIES, UN DESA and UNEP recently produced a joint **interoperability strategy document** and launched an easy-to-use application to harness data and AI tools for Ecosystem Accounting within the System of Environmental-Economic Accounting (SEEA) framework. This ground-breaking tool enables ecosystem account production anywhere on Earth, making it easier for countries to measure the contributions of nature to their economic prosperity and wellbeing.

BOX 24 United for Smart Sustainable Cities (U4SSC) initiative

The **United for Smart Sustainable Cities** (U4SSC) is a UN initiative coordinated by ITU, UNECE and UN-Habitat, and supported by CBD, ECLAC, FAO, UNDP, UNECA, UNESCO, UNEP, UNEP-FI, UNFCCC, UNIDO, UNOP, UNU-EGOV, UN-Women and WMO to achieve Sustainable Development Goal 11: *Make cities and human settlements inclusive, safe, resilient and sustainable.*

U4SSC is working on the following Thematic Groups:

- City Platforms
- Lessons learned from building urban economic resilience at city level during and after COVID-19
- Compendium of Practices on Innovative Financing for Smart Sustainable Cities Projects
- Guiding principles for artificial intelligence in cities
- Procurement Guidelines for Smart Sustainable Cities
- Digital Transformation for People-Oriented Cities:
  - WG1: Setting the Context: Digital Transformation for People-oriented Cities
  - WG2: Policy Benchmarks for Digital Transformation for People-oriented Cities
  - WG3: Digital Transformation Assessment for People-oriented Cities
  - WG4: Guidelines for Unlocking Net Zero in Cities Through Sustainable Digital Transformation
  - WG5: Methodology for Measurement of GHG Emissions in Smart Sustainable Cities

The U4SSC developed a set of **international key performance indicators (KPIs) for Smart Sustainable Cities (SSC)** to establish the criteria to evaluate ICT´s contributions in making cities smarter and more sustainable, and to provide cities with the means for self-assessments in order to achieve the sustainable development goals (SDGs). Over 150 cities worldwide are already implementing these KPIs.


DRAFT

Impact Initiatives for a Sustainable Planet in the Digital Age

The preceding two sections of this Action Plan provided a guiding vision and a set of priorities and targets for a sustainable planet in the digital age. This section articulates critical impact initiatives as actionable commitments that key stakeholders throughout the digitization and sustainable development communities need to make to achieve the stated goals.

Key messages

1 Scalable Action Now

2 Strong Movement with Common Commitment

3 Diverse Leadership for Political Opportunity Window

4 Showcases and Bold Impact Initiatives

Humanity's response to the two mega-trends of digital and sustainability transformation will shape our collective future. The way in which we connect these two trends and leverage digital applications to shift values, behaviours and related incentive structures to drive sustainability will play a critical role in determining what kind of future emerges. We are standing at a pivotal moment in human history. Decisions we take today to address environmental change, sustainable futures and the governance of digital technology will set off a chain reaction that will determine the future trajectory of human evolution and life on this planet.

This CODES Action Plan is an initial step forward to address these collective challenges. It has identified 3 Shifts of Change as essential to accelerating environmentally and socially sustainable development in the Digital Age: 1) Enabling Alignment: Aligning the digital age with sustainable development, 2) Mitigating Negative Impacts: Ensuring sustainable digitalization to mitigate negative environmental and social impacts, and 3) Accelerating Innovation: Directing innovation efforts toward digital sustainability.

Based on our collaborative work on this Action Plan, the CODES community stresses some emerging overarching messages that are important to move into action together:

- **Scalable Action Now:** We now urgently need to turn the tide, strongly develop all three shifts in parallel and scale our efforts on our path towards a sustainable planet in the digital age. The world needs heavy intellectual, financial, political, and practical involvement as soon and as boldly as possible to provide the foundations for a sustainable digital age.
- **Strong Movement with Common Commitment:** We need awareness, convergence and cooperation of existing initiatives and networks of actors already undertaking ambitious sustainable digitization and digital transformation initiatives in different sectors. This network is already growing fast, but we need to support, connect, and strengthen these aims, ambitions and achievements together.
- **Diverse Leadership to Harness the Political Window of Opportunity:** We need to harness the political leadership of governments, academia, the private sector, and civil society to ensure that digitization is used to promote a sustainable planet. Digitalization is not a sector, and shaping it sustainably is a task for all. We face a unique political window of opportunity on the global level: the vision outlined in this action plan must be systematically integrated into the Stockholm+50 process in 2022, the Summit of the Future in 2023 and the processes leading to the important Global Digital Compact in 2024. Other global fora and governance frameworks for digital transformation, sustainability, and environmental management should also engage with the tasks laid out in this Action Plan, e.g., the Rio Conventions or the IGF.
- **Showcases and Bold Impact Initiatives:** We need to invest in a diverse series of digital sustainability impact initiatives at all policy levels and scales - all around the world. Exploring and showcasing such 'innovations with purpose' on-site is essential to catalyse the three shifts and take forward various strategic priorities in a stepwise and applied manner. These impact initiatives should be designed to further inspire and elevate existing work, improve strategic coordination and collaboration, and get into a new mode of productive creation. In the following we sketch nine exemplary impact initiatives for that purpose to ramp global action towards achieving a sustainable planet in the digital age together.

Digital Sustainability Impact Initiatives

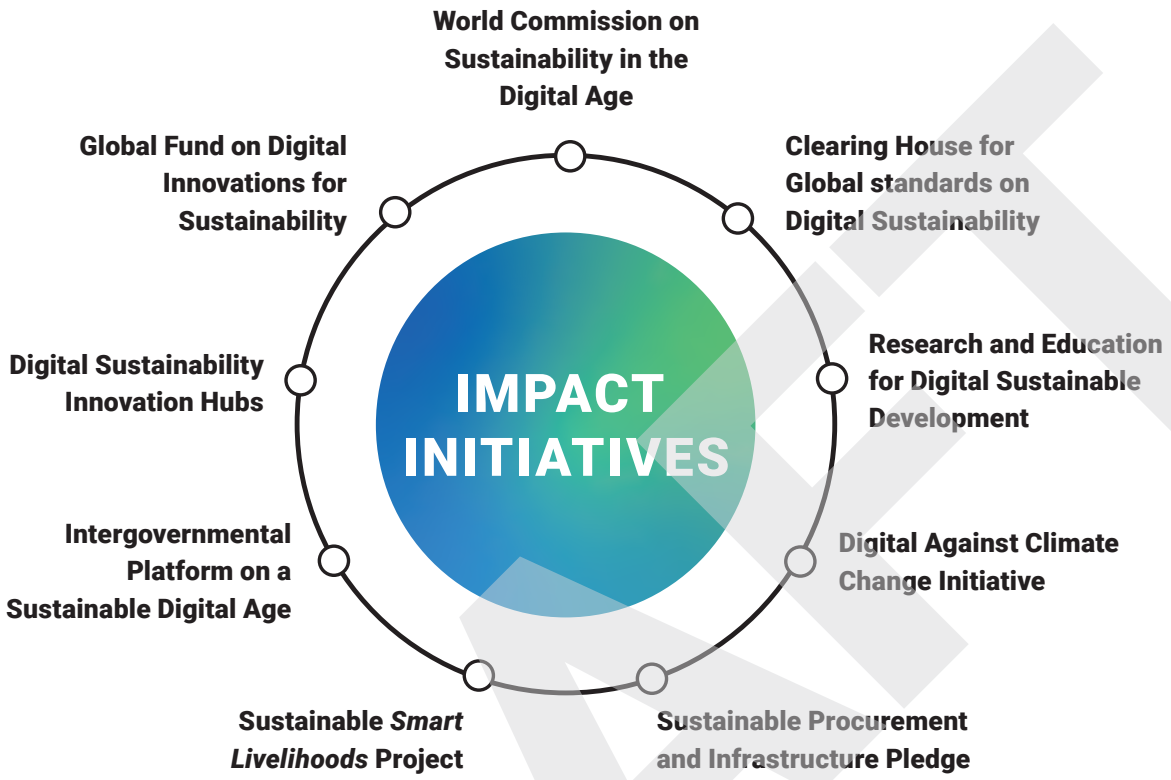

Figure 6 **Impact Initiatives needed to catalyze the 3 shifts and progress the 18 strategic priorities**

The CODES community has collectively identified 9 exemplary impact initiatives that are needed to catalyse the 3 shifts and progress the 18 strategic priorities. All these initiatives are catalytic in that they lever transformational change in one or more shifts. All are meant to be global in that they stimulate change across the globe and in different geographical and socio-political contexts. And all are multi-stakeholder based in that they rely on broad actor coalitions to effectively implement change.

These 9 impact initiatives are developed to inspire and to provoke thoughts and further action. Neither the CODES co-champions nor the whole CODES network could drive and implement these initiatives alone. We now need an even bigger coalition, we need new partners, agile pioneers as well as capable established organizations; we need broader collaboration and truly global collective action.

CODES will further promote this Action Plan and stand in for a sustainable planet in the digital age. And we will contribute to catalysing its key messages and impact initiatives in four main ways:

- Convene and connect a global community of common purpose to advance these 3 shifts.
- Identify enabling policies and systemic transformations towards all 18 strategic priorities.
- Suggest impact initiatives as actionable items to concurrently progress strategic priorities.
- Foster and demonstrate political leadership in advocating for, and realizing the impact initiatives.

Shift 1: Enable Alignment

Create the enabling conditions to align the vision, values, and objectives of the digital age with sustainable development.

Impact Initiative	Potential Timeline	Relevant Actor
1. **World Commission on Sustainability in the Digital Age:** Under the aegis of the United Nations, consider convening a high-level multistakeholder global Commission on Sustainability in the Digital Age. Core principles leading up to the Commission , including the call for its establishment, could feed into the process towards the Global Digital Compact or a UNEA Declaration. The commission, once established, would explore the key enabling policies, standards, infrastructure and governance frameworks needed to harness digital innovations to safeguard and accelerate sustainability, including the possibility of a new international convention. The Commission would also be able to promote the nexus among member states, UN entities, up to the opportunities on subsidiary, local policy levels.	**2022** Awareness and Alliance-building to establish multistakeholder support for Commission **2023** Global Digital Compact or UN/UNEA Declaration **2024** Follow-up to Global Digital Compact: Establishing World Commission	CODES Office of the Secretary-General's Envoy on Technology, UN ITU
2. **Clearing House for Global Standards on Digital Sustainability:** An orchestrating "clearing house" entity is needed to collect, aggregate, coordinate and co-define key standards, APIs and data sets for sustainable digitalization and digital sustainability. This entity should create an authoritative overview on existing standards and organize a coordinated process to address the needs for effective implementation - especially regarding interoperable environmental and climate data, digital public goods and infrastructures as well as other means to support e.g., environmental monitoring, environmental risks management, digital product passports, open science or systems modeling. This process should include inputs by and coordination among a large set of public, private, scientific and civil actors to address gaps or blockade early on and to improve capacity for feedback mechanisms to evolve standards.	**2022** Clearing house platform for existing standards **2023** Consolidate standards and procedural capacity to enable implementation in specific sustainability area (e.g., circular economy) **2024** Widening to include other sustainability areas; incl. Capacity building programmes in partnership with stakeholders	ITU IEEE ISO IETF OECD UNEP High-level advisory body on digital public goods

3. **Research and Education for Digital Sustainable Development:** A new international programme is needed to enhance research on digital sustainability along with fostering new skill sets that intersect sustainability and digitalization. Fostering global research agendas to advance digital sustainability is essential not only for stimulating new perspectives and methods in fields of sustainability and digitalization, but also to create intersecting knowledge and applications for urgent tasks, including decarbonization, dematerialization, detoxification, misinformation, and digital divides. Developing localized and contextualized curricula that build skill sets to advance sustainability through digitalization is important for mainstreaming and awareness building regarding sustainable development in the digital age (building on UNESCO's important Education for Sustainable Development). The initial target audience should include public sector actors, science and education, civil society, and entrepreneurs. Innovative partnerships are needed to educate, facilitate, and empower in a whole-of-society approach.	**2022** Adoption of curriculum outline **2023** Development of open-source modules & research incubator **2024** Integration across relevant training and research programmes	UNESCO Future Earth ISC CODATA UNEP GAIA ITU EO4GEO Alliance

Shift 2: Mitigate Negative Impact

A commitment to sustainable digitalization that mitigates the negative environmental and social impacts of digital technologies.

Impact Initiative	Potential Timeline	Relevant Actor
4. Digital against Climate Change Initiative: Member states, academia, companies, civil society along with international organizations should rally behind the urgent task to transform production, distribution and consumption into a climate neutral global economy. Innovations and practices for GHG reduction and climate neutrality are needed that are effective, scalable and easy to implement around the globe. This ranges from (decentralized, small- and large-scale) renewable energy production, the sustainable use of the fourth industrial revolution (incl. MRV of scope 1, 2 and 3 emissions across supply chains), sectoral innovations towards climate neutrality, up to empowered consumer choices e.g. via green product transparency or educated choices on e-commerce or social media platforms. Importantly, these changes with a clear directionality towards climate change mitigation need to move rapidly beyond niches and take center stage in the mainstream around the globe.	**2022** Setup funding, programme and partners **2023** Co-create focused products and processes with clear directionality on CC mitigation across all sectors **2024** Expansion and implementation	UNEP UBA GPAI / Climate Change AI Digital With Purpose ITU Green Digital Finance Alliance UNFCCC Climate Champions and Global Innovation Lab
5. Sustainable Procurement and Infrastructure Pledge: A key need is the broad commitment to sustainable public procurement of digital services and ICT and to transforming (existing and new) digital infrastructures into sustainable infrastructure. As a first step, all governments, civil society organizations, and large private sector companies should adopt sustainable procurement pledges and enabling- policies to buy and deploy digital services as well as ICT. Governments and digital infrastructure companies should also adopt and implement sustainable digital infrastructure targets and policies to decarbonize, dematerialize and detoxify the digital backbone, including net-zero data centers and ICT supply chains.	**2022** Development of sustainable procurement principles **2023** Sustainable procurement operational framework & infrastructure framework **2024** Sustainable procurement and infrastructures compliance and reporting framework	Digital Nations EU OECD UNEP Sustainable Digital Infrastructure Alliance Global Electronics Council

6. **Sustainable "Smart Livelihoods" Project:** International organizations, national, regional and local governments, scientists, civil society and private actors should implement real-world laboratories for developing practical concepts for inclusive and sustainable urban and rural "smart livelihoods" that favors a whole-of-society approach (transcending elitist smart city approaches). Applied regional solutions should be developed, using available digital means for the best specific sustainable development purpose on the ground, e.g. for construction and smart housing, regionally embedded circular economy, infrastructures for digitally supported mobility, transport and energy supply, as well as other access areas that close digital divides.	**2022** Project co-creation **2023** Implementation of regional hub(s), research and working programme **2024** Transfer and global knowledge network	ITU World Bank UNDP Accelerator Labs CGIAR Research Centers New Bauhaus

Shift 3: Accelerate Innovation

Directing efforts and investments toward digital innovation that accelerates environmental and social sustainability.

Impact Initiative	Potential Timeline	Relevant Actor
7. **Intergovernmental Platform on a Sustainable Digital Age:** Inclusive scientifically driven transnational assessment process that: i) provides transparency on the ecological and social footprint of digital services and goods across the value chain; ii) implements forward-looking impact assessment on environmental, societal, economic and human impact of digital change; iii) establishes a science-policy-society and governance framework based on lessons learned from similar initiatives such as IPBES and the IPCC. In this regard, the platform should explicitly provide science-based policy recommendations, inclusive formats for stakeholder engagement, the option for focused regional assessment streams as well as a designated commitment to include ethical perspectives and perspectives on safeguarding just transitions.	**2022** Formation of Platform and TOR **2023** Development of assessment methodology **2024** Publication of first flagship report	GPAI OECD International Resource Panel ITU Rio Conventions

8. Digital Sustainability Innovation Hubs and Accelerators: Based on a Global Horizon Scanning Process, a regional network of Innovation Hubs would identify and help accelerate digital sustainability innovations in a co-creative manner. It would include entrepreneurs, engineers, scientists, policy makers and practitioners offering real-world laboratories and scaling opportunities for digital sustainability solutions on the ground.	**2022** Network of Innovation Hubs and Accelerators created **2023** Per cent of Innovation proposals brought to market **2024** Per cent of innovation proposals successful scaled	UNDP UNEP UNICEF World Bank D4D Hubs ITU I-CoDI GIZ USAID UNIN
9. Global and National Funds and Acceleration Programs on Digital Innovations for Sustainability: Provide public finance and incentives to stimulate green digital solutions and transformation innovations that accelerate decarbonisation, dematerialization and detoxification of key economic sectors. Initial focus should be on using smart energy access and networks, food commodity transparency and precision farming, smart transport and buildings which contribute to green job creation.	**2022** At least 1 trillion dollars of public innovation funds for digital sustainability made available **2023** Breakthrough innovation initiatives launches **2024** Exponential impact identified	World Bank EU GEF GCF BMZ/GIZ USAID

Annexures

Action Plan for a Sustainable Planet in the Digital Age

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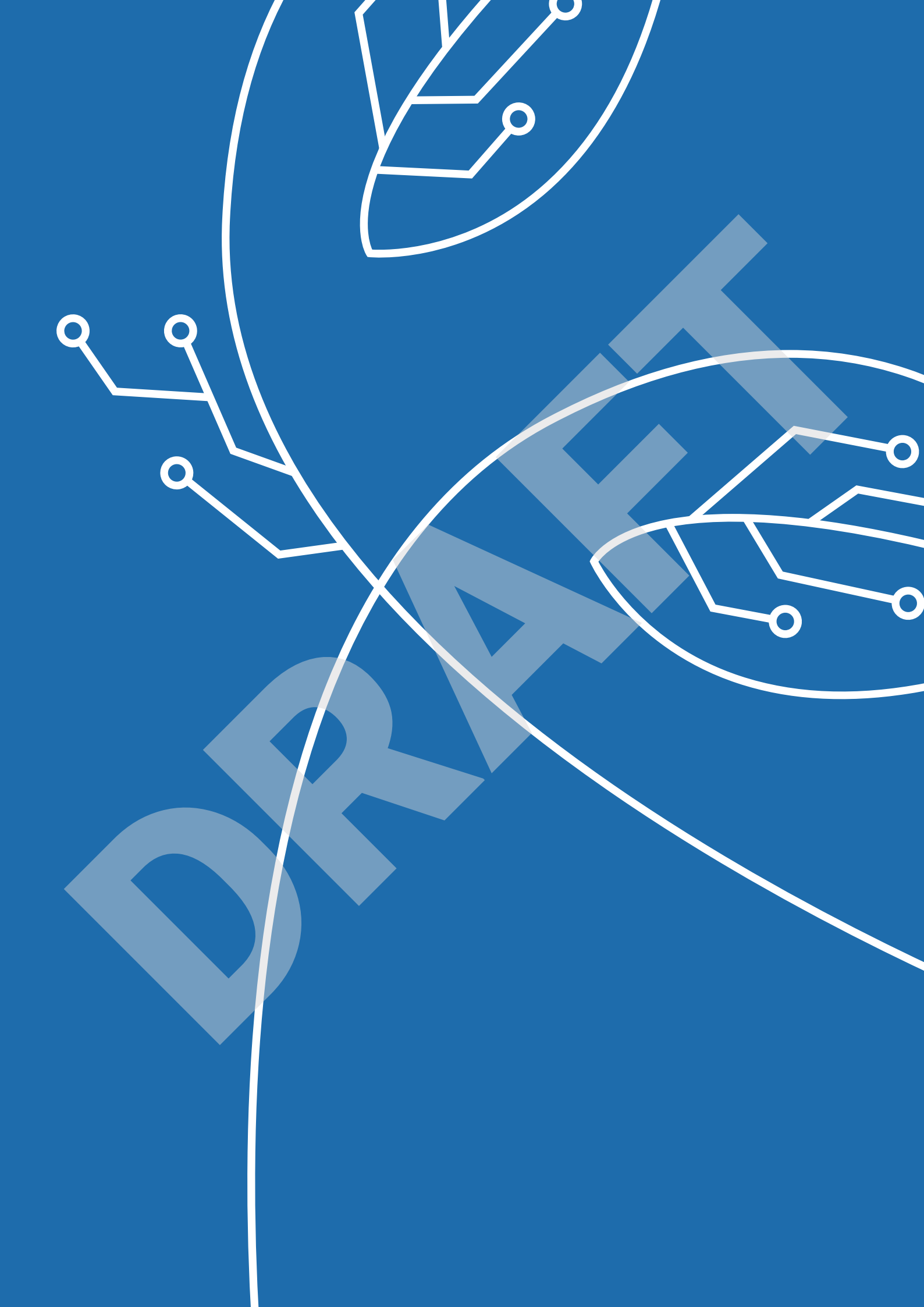
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