WBGU

German Advisory Council on Global Change

Policy Paper

Digital Momentum for the UN Sustainability Agenda in the 21st Century

10

Contents

Summary

The United Nations' High-Level Political Forum for Sustainable Development is the UN's key platform for coordinating global sustainability policy and an important addressee for issues relating to the potential benefits and risks of digital change for achieving the UN sustainability goals. Digitalization fundamentally changes the range of options available for future civilizational development. At the same time, the implementation of the 2030 Agenda with its 17 Sustainable Development Goals requires a fundamental transformation of the economy and society. These two challenges can only be met by dedicated global thinking and action. So what could be more appropriate than to use the momentum of digitalization to advance the Transformation towards Sustainability and launch decisive stimuli for achieving national and global sustainability targets?

The United Nations' High-level Political Forum on Sustainable Development (HLPF), which is discussing progress with the implementation of the Sustainable Development Goals (SDGs) in New York in 2019, offers a special opportunity to address this issue. In the HLPF, the UN acts as guardian of the SDG process and cooperates with nation states, civil-society actors, businesses and academia. In the WBGU's view, the HLPF should be given more political influence in order to improve the chances of the SDGs really being achieved by 2030.

Just as the 1987 Brundtland Report presented sustainable development as a new perspective for action and objectives, the WBGU report 'Towards Our Common Digital Future' (2019) addresses digital change, its core characteristics and its positive and negative effects on the Transformation towards Sustainability. The aim must be to apply the disruptive power of digitalization to the Transformation towards Sustainability. At the same time, our societies must learn to contain digitalization's unsustainable effects. In this way, digitalized sustainability societies can emerge worldwide.

In the WBGU's view, the digital momentum – in the sense of decisive stimuli for successful change – should be exploited and designed in such a way as to support efforts to achieve the SDGs and the targets of the Paris Agreement. To this end, digitalization itself should also be shaped in a sustainable way, for example to establish resource efficiency and the circular economy worldwide as principles of digital solutions, and to promote the expansion of digital commons and public-service infrastructures of information and communication. Furthermore, the issue of 'sustainability in the Digital Age' should be tackled with priority at the UN – up to 2030 and beyond. The WBGU therefore supports the efforts of the UN's High-level Panel on Digital Cooperation to systematically link digital change with the implementation of the SDGs.

The HLPF 2019 focuses on six SDGs. This policy paper uses these SDGs as examples to analyse how digitalization can be used for human-centred, ecology-centred, economy-centred and governance-centred innovations. Against this background, the WBGU proposes four key stimuli to ensure that digitalization has a productive impact for the HLPF and for the global Transformation towards Sustainability:

1. *Develop global (environmental) awareness and communicate it via future-proof education:* According to a humanistic understanding, science and education systems must be consistently geared to enabling people to become proactive actors of both digital change and the Transformation towards Sustainability. To achieve this, they must have access to the corresponding knowledge resources, and they need the corresponding skills and learning environments as proposed in Education for Sustainable Development (ESD) and under the heading 21st Century Skills. Extensive use should be made of open sustainability data, online mate-

rials and learning environments for virtually experiencing the environment and ecosystems. The WBGU recommends:

- the systematic combination of digital education approaches with those of ESD and Global Citizen Education in an integrated programme for future-proof education and transformative learning;
- the further opening of UN processes to transnationally networked citizen-science projects in order to boost environmental awareness and strengthen the foundations of a global culture of cooperation;
- the creation of an 'International Information Union' that bundles existing data-related UN initiatives, responsibly collects and processes sustainability-related data, and makes this data available via suitable infrastructures.

2. *Establish a digitally supported circular economy worldwide:* The WBGU believes that the rapid transition from linear and resource-intensive value chains to a near-complete circular economy is a key component of the Transformation towards Sustainability. Digital data acquisition and processing offer great potential for resource-saving process optimization and product design. In order to leverage this potential, missing or wrong political frameworks or economic incentives should be corrected, and existing information and control deficits overcome with digital instruments. The WBGU recommends:
   - the worldwide establishment of processes and infrastructures for mapping emission and resource footprints in all sectors of the economy across entire value chains;
   - the strengthening of international efforts to implement the 3Rs Strategy – 'reduce, reuse, recycle' – where waste avoidance takes precedence over reuse and recycling.
3. *Modernize sustainability governance:* Digitally supported governance can be used to achieve greater transparency, participation, global networking and coherence in international and transnational sustainability policy. In addition, the knowledge base and process qualities can be improved in this way to counter the growing pressure faced by many nation states to act and justify themselves. The WBGU recommends:
   - supplement the work and strategy-building processes within the UN with digitalization instruments, and set up a mechanism to ensure cooperation between UN agencies and system-wide coordination ('UN Digitalization');
   - negotiate a 'UN Framework Convention on Digital Sustainability and Sustainable Digitalization' as an international framework for the Transformation towards Sustainability in the Digital Age;
   - the UN should establish a globally coordinated digital SDG indicator system to improve the timeliness, comparability and verifiability of SDG reports, and to improve the monitoring of the HLPF by civil society and academia.
4. *Plan sustainability in the Digital Age beyond 2030:* Many SDGs will remain relevant beyond 2030. The sustainability agenda therefore needs to be rethought and further developed over the long term in the context of digital change. The UN should prepare in good time for these future challenges, aiming at an extensively networked world society based on global solidarity, strengthened democracies and massively reduced inequalities. The WBGU recommends:
   - convene a UN summit on 'Sustainability in the Digital Age' in 2022 – i.e. 30 years after the Rio Earth Summit – in order to set the course for the continuation of the sustainability agenda beyond 2030;
   - adopt at this summit a charter of the international community entitled 'Towards Our Common Digital Future' containing principles and guard rails for the digitalized sustainability society. In terms of content, this initiative can be linked with the recommendation of the UN High-level Panel on Digital Cooperation (2019) to launch a Global Commitment for Digital Cooperation in 2020. The WBGU has developed a draft for such a charter which could serve as a starting point (Box 2).

Introduction: What is the Digital Momentum for the High-level Political Forum?

At present, there is both an opportunity and a need to shape digitalization in such a way that it supports the Transformation towards Sustainability and is interlinked with it. This policy paper quotes in part verbatim from the report 'Towards Our Common Digital Future', in which the WBGU deals intensively with this connection (WBGU, 2019). The WBGU has a broad view of digitalization as the development and application of digital and digitalized technologies that connect with and augment other technologies and methods. It unfolds a growing transformative force and has a disruptive impact on all economic and societal systems. The WBGU has identified five essential characteristics of the Digital Age (WBGU, 2019): (1) the all-embracing *interconnectedness* of things, systems, processes, persons and organizations, (2) the increasing *cognitive capabilities* of digital technology, (3) the growing *autonomy* of digitalized systems such as robots, vehicles and institutional decision-making systems, (4) the spread of *virtual spaces* and virtualized technical services and, as a result of all this, an unprecedented (5) *knowledge explosion* in many scientific areas and disciplines.

None of these five core characteristics is fundamentally new. In combination with the enormous pace of development of digital technology, however, profound qualitative and structural changes are currently taking place in society and the economy. The following analogy on the Industrial Revolution illustrates the fundamental nature of these changes. Transformative innovation breakthroughs often combine both positive and negative effects and must be politically shaped. Industrialization contributed to fundamental changes in economic production processes, the natural environment and societal and interpersonal environments. It led to unprecedented prosperity and the widespread availability of knowledge and material goods in some parts of the world, but also to aggravated inequality, exploitation, damage to health and environmental pollution. It took decades for societies to understand these problems and their drivers and to work effectively to mitigate them. Industrialization has continued to have an impact to this day, and the SDGs also address such problems as climate change that are far from being solved today.

With digitalization, another radical change is now taking place that is comparable with the Industrial Revolution in terms of scale and impact. Again, it is mainly economic forces that are shaping and driving the process. In the Digital Age, the profound effects of the transformation again manifest themselves across all levels of society. However, societies are now in a much better position to understand developments, analyse interrelationships and broadly share knowledge – not least partly thanks to digitalization. The digitally driven changes in production processes, environmental conditions and living environments can thus be directly geared towards the SDGs.

However, appropriate framework conditions must be created in order for the knowledge gained to actually lead to a trend reversal and for digitalization to be placed at the service of sustainability. For up to now digitalization itself has proved to be resource-, energy- and greenhouse-gas-intensive: data centres use enormous amounts of energy, and many digital devices and infrastructures are based on non-renewable resources. Moreover, the often expressed hope that digitalization might contribute significantly to decoupling the development of prosperity from the burden on ecosystems in many parts of the economy and society has not materialized. Instead, the importance of information and communication technologies (ICTs) in the economy has grown rapidly over the past two decades. At the same time, the pressure on local and global ecosystems has continued to rise. In this sense, digitalization seems to function as a kind of 'fire accelerant' for unsustainable, linear economic activity. Up to now, digital innovations and investments have been primarily geared to population groups with a lot of purchasing power, and too little to the needs of poor and vulnerable people. There is a danger of accelerating existing problems and a need for action in order to use the digital momentum as an important stimulus for a successful Transformation towards Sustainability. This means that digitalization is an important formative task for the UN.

In the following, the conceptual foundations and examples of approaches to the relationship between

digital change and the Transformation towards Sustainability are laid down in two framing sections, initially drawing on the WBGU's 2019 report. First, three 'Dynamics of the Digital Age' are presented to illustrate different, but acute areas where action is needed. Second, transformative change requires different innovations that can be triggered, supported or threatened by digitalization. In this context, Table 1 summarizes the relevant opportunities and risks of digitalization for this year's HLPF's six focus SDGs.

The remaining four sections are devoted to innovative stimuli with which the current digital momentum should be used and actively shaped:

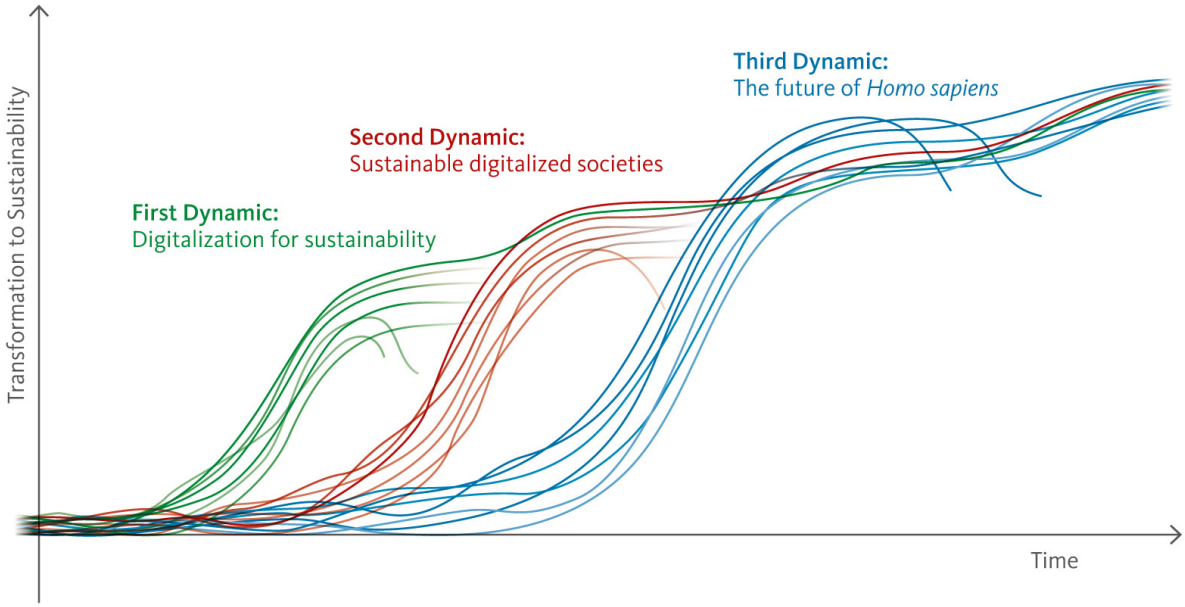
- innovations to strengthen global (environmental) awareness through future-proof education,
- innovations to establish a digitally supported circular economy,
- innovations to modernize global sustainability governance within and beyond the HLPF,
- innovations for the design and further development of the sustainability paradigm beyond the year 2030.

Conceptual Framework: Three Dynamics of the Digital Age

In order to gain a conceptual understanding of the formative task involved, the WBGU proposes three 'Dynamics of the Digital Age' (WBGU, 2019; Figure 1). The First Dynamic is directly related to the 2030 Agenda. Many SDGs – such as 'Affordable and Clean Energy' or 'Quality Education' – can be achieved more efficiently and quickly with digital technology than without; however, digital technology can also continue to fuel trends that run counter to sustainability. The rapidly increasing energy consumption of digital technology and digital and digitalized infrastructures leads to or exacerbates environmental problems. Substantive, economic and political inclusion for all people can be jeopardized by differences in access to and use of information and communication services (digital divide).

Parallel to this, the processes of the Second Dynamic are already underway. Here it is a matter of fundamental societal changes caused by digitalization, because digital change is affecting more and more areas of society and the economy, and having ever more far-reaching effects. Again, positive and negative potential as well as corresponding formative challenges can be identified. In the positive case, there is hope that digitalization will open up new prospects for developing a humanist vision for a networked, sustainable global society of the Digital Age. In this case, the preconditions for human coexistence, human self-determination and dignity can be improved and welfare development decoupled from resource consumption and the destruction of nature. However, digitalization also carries the risk of undermining democracies and empowering autocracies by providing digital support. Furthermore, it can destroy the sustainability achievements that have already been attained, and perpetuate or reinforce massive inequalities, monopolies of power and elite rule, as well as total surveillance and loss of freedom in societies. Corresponding developments are already visible, e.g. the comprehensive use of scoring procedures to support, control and manipulate decisions (e.g. at state level in China), or the discussed fragmentation and trivialization of public digital communication. This can be countered by public-service ICT. In the WBGU's understanding, this includes a public-service section of the internet, including social platforms that make sources of data, information, knowledge, education and citizen services accessible to the public, and are subject to fundamental principles such as net neutrality, inclusiveness and accessibility. Furthermore, worker protection and social security must be redefined and further developed with a view to the future of work in digitally networked labour markets. Last but not least, it is also a matter of setting the course for an economy that appropriately takes the planetary guard rails of the Earth system (WBGU, 2014) into account. Digitalization offers the potential to close material cycles in order to reduce ecological burdens in the long term.

The Third Dynamic has also already begun. It basically deals with the prospects of human development: the future and identity of humans themselves, the future relationship between technical and societal systems, and the relationships between the human species and the Earth system. Core questions are asked which sound futuristic but must already be discussed today: What relationship will humankind develop in the future with an environment that is being fundamentally transformed in the Anthropocene? How will humans change in the Digital Age through interaction with artificial intelligence (AI) or the fusion of the physical with the virtual world? Which artificially intelligent, cognitively powerful machines will emerge, and what scope for action will we assign to them? What characteristics and decision-making skills do we want to concede to machines? How can people, societies, international organizations and networks face these fundamental questions about the future of *Homo sapiens* and consciously shape developments and contain undesirable developments? A holistic view of the interplay between new technological possibilities and existing social systems is needed in order to align digitalization trends to sustainability goals in a meaningful way.



↑ Digitally support sustainability

- Comply with planetary guard rails (climate, nature, soils, oceans)
- Secure social cohesion (against hunger, poverty, inequality; for access to water, health, education, energy)

↓ Ecological and societal disruption

- More emissions and resource use
- More inequality
- Greater concentration of power
- Erosion of civil rights and privacy
- Erosion of the state's governance

↑ New humanism

- Networked world society as a further advancement of Enlightenment and humanism
- Development of global (environmental) awareness
- Culture of cooperation, empathy, global solidarity

↓ Digitally empowered totalitarianism

- Hollowed-out democracies and digitally empowered autocracies
- Massive inequality, domination by elites, total surveillance and loss of freedom
- Environmental destruction and loss of social cohesion

↑ Strengthen *Homo sapiens*' self-confidence

- Preservation of the biological human in its natural environment
- Ethically reflected advancement of humanity
- Design human-machine collaboration

↓ Blurring of borderlines between humans and machines

- Abuse of human-machine relationship
- Superintelligence
- Artificial human evolution

Figure 1
Three Dynamics of the Digital Age.
The chart shows the positive case of the Dynamics being successfully contained through goals and governance. All three Dynamics are already emerging in parallel today, albeit with different levels of intensity, so there is no strict chronological sequence involved. Each Dynamic consists of different subpaths following different trajectories. The name given to each Dynamic reflects the priorities for action required in each case.
The texts beneath the figure give keywords on the potential (↑: upper row) and risks (↓: lower row) of the three Dynamics.
Source: WBGU, 2019; diagram: Wernerwerke, Berlin

Digitalization as a Lever for Innovation in Transformation Processes

On the positive side, digitalization can facilitate transformative change through systemic innovation and systems innovation. This requires an understanding of the problem contexts, a holistic description of the problem and often cooperation across institutional and sectoral boundaries – so that resources, competencies and networks can be re-bundled (Eggers and McMillan, 2013; Abercrombie et al., 2015). Furthermore, it is not enough to only change individual technologies or standards (elements of a system); goals, work sequences and procedures must also be reoriented (architecture of a system; OECD, 2015:6; Geels et al., 2015). Social, cultural, economic, political and technological changes have to be considered together as they mutually reinforce each other (Beddoe et al., 2009; OECD, 2015:7; similar to social innovations: The Young Foundation, 2012:18).

For example, the circular economy and sustainable mobility, a renewable energy supply and regenerative agriculture differ from their unsustainable predecessors both in terms of their objectives and in the basic configuration of the systems. Continuous monitoring and adaptive governance are recommended for these radically oriented but incrementally implemented innovation processes, in order to be able to anticipate and prepare for non-linear, erratic or unexpected changes in increasingly complex societal contexts (Abercrombie et al., 2015).

Digital key technologies – particularly the Internet of Things, Big Data, AI and cybersecurity – offer new possibilities for collecting the data needed to develop a holistic understanding of problems, as well as for good monitoring, evaluation and governance processes. They allow modelling that tests and refines planning, fast and decentralized information transfers, as well as automated feedback loops. Completely new technological solutions for production processes also become possible. Overall, therefore, digital technologies, if their use is organized in a secure and trustworthy manner, offer great opportunities for dealing with long-standing and analysed blockades to achieving sustainability goals.

A systemic understanding of innovation that is appropriate for the Transformation towards Sustainability is needed in order to exploit the potential of digitalization and contain its risks. This requires innovation at three levels:

1. *Human-centred innovations:* A renewed enlightenment comes within reach that can use digitalization to turn educational opportunities and information sources into a widely accessible, culturally differentiated, non-discriminatory global public good (SDG 4 'Quality Education'), and reduce inequalities between regions, cultures, generations and genders (SDG 10 'Reduced Inequalities'). A global (environmental) awareness – i.e. an awareness of actions that preserve the Earth system and the development of a solidarity-based lifestyle – becomes possible.
2. *Ecology- and economy-centred innovations:* As an important lever for sustainable economic activity, a digitally supported circular economy creates new options for resource conservation, product longevity, innovative materials and product design, ease of repair and recycling along the entire product life cycle through digitalized coordination, process control and monitoring, and makes processes transparent (SDG 8 'Decent Work and Economic Growth', SDG 13 'Climate Action').
3. *Governance-centred innovations:* Digital technologies should be used to enable responsibility-based inter- and transnational, national and regional partnerships and institutions to make the objectives and evaluations of their actions and their decision-making systems transparent and non-corruptible (SDG 16 'Peace, Justice and Strong Institutions'), thus strengthening their effectiveness and acceptance (SDG 17 'Partnerships for the Goals'). The HLPF itself can also be modernized with the instruments of digitalization.

The six SDGs that are receiving special attention within the framework of the HLPF 2019 are:

- SDG 4 'Quality Education',
- SDG 8 'Decent Work and Economic Growth',
- SDG 10 'Reduced Inequalities',
- SDG 13 'Climate Action',
- SDG 16 'Peace, Justice and Strong Institutions',

› SDG 17 'Partnerships for the Goals'; this SDG is addressed each year by the HLPF.

For all six SDGs in focus this year, Table 1 shows examples of how digital change and digital technologies can, on the one hand, support or make possible system innovations for the implementation and achievement of objectives, but, on the other hand, can also endanger or even prevent them. To illustrate these points, the assessments of potential benefits and risks are linked to selected concrete 'arenas of digital change', which, in the WBGU's report 'Towards Our Common Digital Future', describe the interplay between digitalization and sustainability and offer detailed references to the SDGs (WBGU, 2019: Chapter 5). These examples not only clarify the prospects and challenges of digitalization for the necessary global Transformation towards Sustainability, but also reveal possibilities for shaping its development in a positive way.

Table 1
Focus SDGs at the HLPF 2019. The 'arenas' relate to the 'arenas of digital change', i.e. sections in the flagship report entitled 'Towards Our Common Digital Future', WBGU (2019).
Source: WBGU

SDG 4
Quality Education

Important options & opportunities through digitalization

- The wider availability and better accessibility of digitalized learning opportunities allows a financially and geographically more independent use of education by learners, also in less developed countries and regions – provided they have access to the necessary digital infrastructures.
- Digital media offer new possibilities for participation in designing learning opportunities and materials as well as better quality assurance. It is also easier to develop targeted opportunities for and with disadvantaged groups.

Important hazards & risks from digitalization

- Potential users frequently still lack the necessary hardware and software, as well as the skills needed to use digital educational opportunities.
- Existing inequalities and discrimination could be exacerbated by unequal access to digitally mediated education.
- Insufficient knowledge about the resilience of digitally transmitted information or the effects of technological developments can lead to misjudgements.

Arena on 'Future-proof Education': Up to now, digitalization has not been systematically incorporated into many educational programmes. Yet digital solutions can make a decisive difference in terms of access to, and thus the availability of, opportunities and new forms of education and lifelong learning. A particular challenge is strengthening 'future-proof education' using digital instruments and solutions. Future-proof education, which teaches skills and knowledge on transformation, sustainability and the environment, on anticipation and digital skills, should enable individuals to actively participate in shaping the Transformation towards Sustainability in the context of the Digital Age. Visualization, interactive animations or simulations of possible futures could, for example, enable people to experience links between societal and natural processes, potential methods of sustainable living and working, and solidarity-based quality of life, and embed welfare-oriented development models for future generations. However, a solid 'analogue basis' and pedagogical support remain key, as does the need to train people in digital literacy (digital resilience).
Source: WBGU, 2019: Section 5.3.4

SDG 8
Decent Work and Economic Growth

Important options & opportunities through digitalization

- New, digitally controlled production technologies, virtualization, monitoring and the provision of information can make economic activity more resource- and energy-efficient, support qualitative growth and – by means of an effectively organized circular economy – help decouple resource use from production and consumption.
- Digital technologies can trigger further (productivity) growth. With the right framework conditions, higher productivity and automation can, in turn, help the spread of decent work environments and create space for new models of sustainable work.
- New forms of access to (labour) markets, goods and services (e.g. financial services, education) are opened up, which expands opportunities for economic inclusion, particularly in developing countries and emerging economies.

Important hazards & risks from digitalization

- The rationalization effects of technical innovations (e.g. substitution of human labour with machines) threaten to decouple economic growth from employment, jeopardizing social cohesion and political stability.
- Risks of increasing inequality or a widening digital divide exist between (1) developing countries and emerging economies on the one hand and industrialized countries on the other, (2) regions within countries, (3) people with different qualifications, (4) people with different work incomes and other forms of income, (5) people of different gender, and (6) of different ages.
- New forms of work (quasi-self-employment) in the digital economy undermine standards in occupational health and safety, and increase the risks of worker exploitation and control.

- More precise monitoring of the development of labour markets and, above all, compliance with minimum social standards becomes possible.
- The rising use of digital devices and increased consumption in the context of rebound effects increase resource consumption, which is difficult to decouple from economic growth.

Arenas on 'Digitally Supported Circular Economy' and 'New Digital Economy': Digitalization enables a fundamental, systemic change both in production and working methods and in consumption in line with the goals of the circular economy. It not only changes the material flows within and between companies (i.e. industrial metabolism), but also creates both environmental risks (e.g. e-waste) and potential for digitally optimized, more resource-efficient manufacturing processes. Novel corporate models or economic systems (e.g. platform cooperatives, 'prosumers', sharing economy), which may reduce the input of resources, can also contribute to this. However, to date there are few cases where this has been done, so that little knowledge exists about how digital technologies can be used in practice in the circular economy or whether they might even have negative effects. Furthermore, the companies established in the circular economy are as yet poorly positioned for digitalization, while some ICT start-ups are discovering the business potential for themselves. Corresponding decisions must therefore be taken to promote the digitally supported circular economy in the sense of the Transformation towards Sustainability. Source: WBGU, 2019: Sections 5.2.2 and 5.2.5

SDG 10
Reduced Inequalities

Important options & opportunities through digitalization

- Technological leaps forward (leapfrogging) offer special potential for making up development deficits, particularly for developing countries. In addition, the amount of catching up needed can be better identified and made transparent.
- Mobile terminals and internet access increase the geographical and temporal flexibility of participation in digital and digitalized services and also create new forms of gainful employment (e.g. via platforms).
- Universal access to digital infrastructures could provide more equal access to important information, e.g. about employment, education and health.

Important hazards & risks from digitalization

- The digital divide could widen, e.g. in terms of increasing gender inequalities and big differences in digital literacy between sections of the population within and between countries.
- Digitalized, automated production of goods could jeopardize low-skilled jobs in particular and thus contribute to growing inequalities.
- Automation can encourage backshoring (the relocation of employment from developing back to industrialized countries) and thus create new geographical inequalities in production and employment.

Arena on 'International Division of Labour': The ongoing digitalization-driven transformation of the patterns of international division of labour will lead to a readjustment of the role of developing countries and emerging economies. Only limited conclusions can be drawn at present on the effects of digitalization on the international organization of value chains. On the one hand, job losses – due to digitally supported automation and the relocation of production from developing countries back to industrialized countries – might potentially be high; on the other hand, new ways of accessing markets can arise, above all through digital platforms. Source: WBGU, 2019: Section 5.3.8

SDG 13
Climate Action

Important options & opportunities through digitalization

- Digital applications offer potential to contribute to emission reductions in many sectors by improving efficiency (e.g. energy, agriculture, industry, buildings, transport).
- Networked early-warning systems can increase resilience to natural disasters and improve climate-risk management and weather forecasting.
- Digital applications can play a central role in obtaining and publishing information on future climate change and form the basis for decisions on climate-change-mitigation and adaptation measures (climate services).

Important hazards & risks from digitalization

- The increasing production and use of digital devices goes hand in hand with rising greenhouse-gas emissions if fossil energy sources continue to be used.
- Digital technologies support or facilitate the exploration, extraction and use of fossil fuels.
- New digital multi-purpose technologies can lead to an increase in economic activity and thus to a higher demand for energy, which has a negative impact on emissions and climate-change mitigation.
- The increasing dependence on ICT can reduce the resilience of infrastructures to climate-related disasters and extreme events.

Arena on 'Digitalization for Climate-change Mitigation and the Energy Transformation': Digital solutions support the integration of fluctuating renewable energies into energy systems and can ease access to modern energy in off-grid regions. However, increases in energy demand triggered directly and indirectly by digitalization can be problematic. The security of increasingly complex energy systems (and other digitalized critical infrastructures), data protection and data security should be taken into account from the outset. Source: WBGU, 2019: Section 5.2.6

SDG 16
Peace, Justice and Strong Institutions

Important options & opportunities through digitalization

- By improving the exchange and comparison of information between states, not only tax evasion and money laundering but also environmental offences can be better detected and punished, enabling fairer participation in the financing of public expenditure. In combination with data analyses, illegal financial flows and arms trafficking, for example, are easier to track down.
- In general, digitalization can contribute to the detection of environmental and other offences in the fight against crime, and to justice, e.g. by means of monitoring and tracking. This supports the enforcement of environmental law.
- Digitalization makes it possible to strengthen institutions and boost political inclusion. Approaches such as open government, for example, promote the verifiability of official decisions by society, and create more citizen participation and control. Data collection and processing support policy coherence and good governance. Furthermore, digital monitoring of target achievement makes institutions more accountable.
- Digital networking and virtual reality applications can awaken and strengthen empathy in interpersonal interactions.

Important hazards & risks from digitalization

- Risks to peace are growing because robotics and AI can be used to develop autonomous weapon systems.
- Cyberattacks in the sense of sabotage or espionage can be used militarily (cyberwar), which is especially problematic with regard to attacks on critical infrastructures.
- Digital technologies can also be misused in the areas of crime prevention and justice. For example, states can use them deliberately for total surveillance or controlling citizens' behaviour, violating their personal or human rights (e.g. using scoring procedures).
- Digital applications create extended possibilities for manipulation by media (fake news) and for influencing democratic legitimation procedures (e.g. elections), as well as environmental crime organized via digital communication channels.

Arena on 'Public-service ICT': Information and communication technologies have become more important in society and increasingly influence citizens' lives. Public-service ICTs are an important prerequisite for equal inclusion in societal life and for the provision of and access to digital commons; they are also a locational factor for innovation, competition, employment and sustainable economic growth. The public sector has a responsibility for the operation and content of public-service ICT, a responsibility that is not sufficiently respected in many countries. The WBGU therefore recommends the implementation of a public-service ICT system. According to the WBGU's understanding, these ICT infrastructures include a public-service section of the internet, including social platforms that make sources of data, information, knowledge, education and citizen services accessible to the public, and are subject to fundamental principles such as the – increasingly threatened – net neutrality, inclusiveness and accessibility. Guaranteeing these principles and the consideration of sustainability aspects – in particular environmental aspects in the development and expansion of public-service ICT – are among the key challenges. Source: WBGU, 2019: Section 5.3.5

SDG 17
Partnerships for the Goals

Important options & opportunities through digitalization

- The transfer of knowledge and technology is improved by digitalization, and this comprehensively supports the implementation of all SDGs, e.g. with regard to broadband and information access, global exchange and low-cost access to digitized collections of writings. Technology transfer increasingly includes the unlimited passing on of software and methodological competence.
- Capacities for data evaluation and monitoring, and the concrete elaboration of national implementation plans, can be continuously expanded.
- Digitalization makes effective systemic networking possible, leading to improved transparency and coordination, also in the areas of financing, debt management and rule-based world trade.

Important hazards & risks from digitalization

- Individual or cumulative consequences of digitalization can have disruptive effects on world trade, macroeconomic stability and generally the achievement of systemic SDG issues.
- Collaborations on technology transfer, data collection and statistics, or the dissemination of ICT applications, can lead to (new) dependencies and privacy conflicts.

Arena on 'Digital Commons': According to the WBGU's understanding – and following the idea of commons in general – digital commons are digitalized goods in the fields of data, information and knowledge which, as non-rival resources, are made as broadly, i.e. publicly, accessible as possible in the common interest. Examples include open education, free knowledge and open data, or digitalized natural and cultural heritage. Technically they should be provided via public-service ICT and must therefore be protected from exclusion, privatization and under-use. To achieve this, fundamental organizational, regulatory and financial decisions, e.g. obligations to provide information, are necessary to develop a public-welfare orientation via digital commons. Source: WBGU, 2019: Section 5.3.10

Strengthen Global (Environmental) Awareness: Demonstrate Inter-relationships and Communicate them with Future-proof Education

Human well-being depends to a large extent on their knowledge, creativity, autonomy and ability to cooperate. "Since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed," according to the constitution of the United Nations Educational, Scientific and Cultural Organization of 1945 (UNESCO, 1945). In order to be able to shape the future in a peaceful, participatory and sustainable way, people need trustworthy information and educational opportunities that are relevant to the challenges facing societies (WBGU, 2019: Section 5.3.4).

Sustainable development, for example, requires a reflective understanding of the feedbacks between ecological, societal, economic and socio-technical systems. The discrepancies between environmental awareness and environmental action in everyday practice must also be better understood in order to make transformative action possible. Although the requirements for Education for Sustainable Development (ESD) and Global Citizenship Education have been developed in the context of the UN sustainability agenda and systematically recorded in the meantime (UNESCO, 2014), their implementation is still inadequate (World Future Council, 2019). At the same time, calls for digital competence and social skills are becoming louder – often from the business world and with reference to the challenges of future working environments (Ananiadou and Claro, 2009; WEF, 2016; World Bank, 2019). These already largely match the competencies and capabilities called for at UNESCO and in ESD research. Recommendations on technical knowledge and the role of mathematics and digital resilience are now slowly finding their way into ESD (e.g. in UNESCO's document 'Education for Sustainable Development Beyond 2019'; UNESCO, 2019). Yet environmental knowledge and an understanding of ecosystems are generally still lacking in the studies on digital learning from the business sector and on the world of work. In the WBGU's view, the combination of ESD and digital education is an important basis for enabling people to implement the SDGs.

The Transformation towards Sustainability in the Digital Age requires holistic knowledge for all key challenges, not just reskilling for changing careers. Rather, what is required is a broad discourse on the practical structuring of jobs, companies and political framework conditions in the *future*. This requires responsible action, individual and collective creativity and innovativity (WBGU, 2016:425), as well as personality development, cooperation skills and the courage to act (UNESCO, 2014; Brundiers and Wiek, 2017; Rasfeld and Breidenbach, 2014). Because of the OECD's role in setting standards in educational contexts, the Future of Education and Skills 2030 Initiative, for example, is relevant here. It is explicitly oriented towards Target 4.7 of the 2030 Agenda, and its contents could also be adapted and used for educational opportunities for adults.

A corresponding awareness of the problems can also be developed outside educational institutions, and concrete knowledge can be made available locally in everyday activities. Information on supply chains, the environmental costs of products and services, or banks' investment flows can be made available to consumers online or using QR codes, thus raising their awareness of ecologically and socially sustainable production and financing. Digital applications, e.g. interactivity, gaming, virtual experiences of nature or transnationally networked citizen-science projects, offer new opportunities for raising environmental awareness and understanding global interrelationships (WBGU, 2019: Section 5.3.1). In the long term, this can lead to a greater readiness for global cooperation and a strong global (environmental) awareness.

By contrast, a lack of access to good education is seen as a key challenge on the sustainability agenda for reducing social inequality and ensuring equal rights for girls and women. Furthermore, education has a lowering

Box 1

Concentration of data-related UN initiatives in an 'International Information Union'

Information and data, their acquisition, processing, provision, availability and analysis, are key for all areas of life and work in the Digital Age. At all levels of governance, they are an essential instrument for determining, tracking and optimizing paths for achieving the SDGs. The UN has identified the possible roles of data and information in its report 'Data Revolution for Sustainable Development' (UN IEAG, 2014). Five years after this report, the WBGU recommends going one step further and establishing an 'International Information Union' as a joint initiative of UNDP and UNEP. This would provide the international community with SDG-relevant open data relating to different regions, at different levels of aggregation and over several years. The type of data would go far beyond the SDG indicators databases of UNSD and UNdata, since the 'International Information Union' would simultaneously establish and coordinate the necessary processes and interoperable standards. Particular emphasis should be placed on environmental, social-policy and governance-relevant data.

impact on population growth. The relevance of educational content made available via smartphones to refugees is also increasingly being discussed. Educational materials that are available online, multimedia learning formats and direct worldwide communication offer new opportunities for knowledge transfer, especially in poorer countries and rural areas, often even despite a weak educational infrastructure and a lack of qualified teaching staff. The possibilities of virtual learning spaces also open up new perspectives for understanding ecosystems and global interrelationships.

Digital commons are essential to ensure inclusive, equitable and high-quality education (SDG 4) as an element for the Transformation towards Sustainability. They are digitalized data, information and knowledge goods that are made publicly accessible as non-rival resources in the common interest (e.g. open environmental data). In addition, local and cultural knowledge must be protected and systematically converted into digital learning content, so that the global dissemination of knowledge does not foster uniformity but protects diversity and promotes *Eigenart* (Amsler and Facer, 2017; WBGU, 2019: Section 2.2.4).

Establish a Digitally Supported Circular Economy Worldwide: New Prospects for Sustainable Economic Activity

In various places, the 2030 Agenda highlights the circular economy as a central approach for the Transformation towards Sustainability, including SDG 8 'Decent Work and Economic Growth', SDG 11 'Sustainable Cities and Municipalities' and SDG 12 'Responsible Consumption and Production'. The WBGU strongly supports this approach and believes that the rapid transition from linear value chains to a near-complete circular economy is a key component of the Transformation towards Sustainability (WBGU, 2016: 21). The '3Rs Strategy' (reduce, reuse, recycle) called for by the UN, among others, is seen as one of the guiding principles here. In its report entitled 'Towards Our Common Digital Future', the WBGU refers to the circular economy in various 'arenas of digital change' (WBGU, 2019: Sections 5.2.1, 5.2.2, 5.2.5).

In this transition, the expedient use of digital data acquisition and processing should be examined as part of a systemic approach to resource-efficient process optimization and product design. The circular economy has so far been inadequately implemented due to information deficits and a lack of – or ill-conceived – political frameworks and economic incentives (WBGU, 2019: Section 5.2.5). Adequate political support for the circular economy should take greater account of digitalization's potential for improving information flows. Digitalization can significantly support the circular economy by providing (in real-time) the necessary – and hitherto often unavailable – data on the location, condition, availability and material composition of products (EMF, 2016; Wilts and Berg, 2017). Digital instruments can help identify and network ecologically relevant parameters and relationships (e.g. footprints, material cycles). In this way, they create the information basis for reliably tracing resource consumption and environmental pollution. Digitalization thus offers the technical prerequisites for a form of regulation that can firmly assign responsibilities for such pollution and consumption.

Digital tools can also improve product design and thus significantly facilitate the circular economy (e.g. EMF, 2016:37ff.). For example, AI can be used to improve our understanding of material cycles, production processes, supply chains, usage contexts and consumption patterns, including their international interrelationships. This makes it possible to identify essential drivers and patterns and to implement potential for optimizing – or improving the efficiency of – resource use.

Some user data already flow back into design processes today, so that in future the targeted expansion of a public information base – which appropriately takes data- and privacy-protection concerns into account – can help to bring more products into line with user interests and conditions of use at an early stage. The prerequisite for this is that the corresponding aims and principles of design are first defined and then made binding. Digitalization also facilitates the accurate matching of supply and demand; it can thus increase re-use rates and provide data for product tracking, as well as exchange, distribution and usage processes. In waste management and in the context of reverse logistics (i.e. the transport of goods from users back to the manufacturer or disposal company), digital solutions can improve process tracking, which is already standard practice in other areas of logistics (WBGU, 2019: Section 5.2.5). In waste management and recycling, digitally controlled, adaptive sensor technology makes ever-more-precise sorting possible; satellite and mobile communications enable the (real-time) route optimization of waste collection, and intelligent waste containers provide incentives for better waste separation by citizens. Digital technologies can thus contribute in many ways to better identifying, coordinating and controlling options for the circular economy and closing process gaps (WBGU, 2019: Section 5.2.5).

The national policy approaches proposed via the HLPF process and aimed at achieving the SDGs should pursue a systemic and transformative strategy in the field of the circular economy. The whole life cycle of products

and services should be brought into the equation and digital technologies used as tools wherever appropriate and compatible with data-protection requirements. The EU's existing political approaches to the circular economy are ground-breaking in this respect, but they should be reviewed and further developed more decisively with regard to the appropriate use of digitalization in creating standards on a broader international basis. In addition, companies can be given incentives to increase their efforts on their own initiative, e.g. via certificates promoting the digitalized circular economy (modelled on EMAS, the EU Eco-Management and Audit Scheme) or via preferences in public procurement procedures. Digital technologies should be used to globally establish processes and infrastructures that make it possible to map the emissions and resource consumptions of both traditional industries and the digital economy across the entire value chain.

At the international level (UN, WTO), extended producer responsibility for the circular economy should be enshrined in law. Manufacturers of electronic equipment should be committed to sustainable product design that includes energy consumption, longevity, reparability, proper take-back systems and recycling. This also includes the publication of data and information (e.g. manuals, construction plans, functionality, components, constituents), as well as the long-term supply of spare parts and tools for repair and recycling. Software should be designed in a modular and flexibly adjustable way during the development phase, conceived to be resource- and energy-efficient and decoupled as far as possible from hardware, in order to be compatible with both old and new devices for a longer period of time (WBGU, 2019: Section 5.2.5).

Numerous measures can thus use the digital momentum to set a clear future course in the direction of as complete a circular economy as possible. Transnational initiatives and international agreements resulting from the HLPF process are effective stimuli to support these decisions for the future.

Modernize Sustainability Governance: Unleash Innovation Dynamics

Digitalization also offers opportunities for national and international environmental and sustainability governance that go far beyond mere increases in efficiency (Wangler und Botthof, 2019). Strong public institutions are themselves one of the goals for sustainable development (SDG 16) that are at the focus of the HLPF 2019. Open-government approaches have identified many opportunities worldwide for Target 16.7 of ensuring responsive, inclusive, participatory and representative decision-making processes (OGP, 2019). For example, digitalization can simplify cooperation, information flows and interaction opportunities – and thus also improve national and international policy for the Transformation towards Sustainability. In the course of digitalization, there is an opportunity for a cultural change in institutions towards more transparency, participation and global networking – also within the UN and the HLPF.

In addition, reliable data help us to better understand the various change processes of the Transformation towards Sustainability and to shape them – for example with appropriate incentive systems. They are also of key importance for the emergence of a global (environmental) awareness. Data on air and water quality, soil and sea pollution or the condition of forests support evidence-based policy decisions and can make the effects of administrative action transparent. The UN Data Revolution Report has highlighted the potential of digitalization in this context – this must now be realized (UN IEAG, 2014). The digital availability and evaluation of data make it possible to analyse and assess the consequences of political objectives and the resulting programmes and laws more efficiently and precisely. Political reviews and revisions of programmes or laws can be set in motion in this way. Last but not least, data and their scientific analysis are an important basis for evidence-based scientific advisory services for policy-makers, e.g. at the IPCC or IPBES, who, in turn, inform and sensitize the public and put pressure on policy-makers to take action and justify it.

These effects can also unfold beyond the concrete object of the published data. Making political decision-making processes more visible and accessible by means of digital instruments and applications would, on the one hand, directly contribute to increasing the transparency of institutions (Target 16.6). Through social media and other channels, institutional transparency can increase confidence in state institutions (Song and Lee, 2016; Janssen et al., 2017) from the outset and thus counteract currently perceived legitimacy crises. On the other hand, the quality of political processes can also improve if transparency is created through the publication of data, as evaluation research has shown (Stockmann and Meyer, 2016).

The nation states should, in the context of the UN, develop a globally coordinated and interoperable system of digitally supported SDG indicators to improve the topicality, comparability and verifiability of digitalized national and international SDG reports. This could make it easier for civil society and academia to follow and monitor the actions of states and political institutions like the HLPF. Regional, digitally supported citizen dialogues or land planning processes have already produced many innovative solutions in this context (Fürst et al., 2010). The WBGU therefore proposes establishing an 'International Information Union' at the UN (Box 1).

Beyond the provision of information, digital technology also simplifies active participation in political decision-making processes and can thus increase the long-postulated input legitimacy of political decisions (Scharpf, 1999). Experience in this respect has been gained particularly in the municipal context (Certomà et al., 2015). This participation can be made possible, for example, within the formal framework of participatory budgeting (WBGU, 2016: 109). Civil-society initiatives such as the Fridays for Future movement can also achieve greater mobilization and impact with digital support. Together, all these transparency effects improve the chances of policy coherence in the field of sustainability, i.e. the successful interaction of policy measures in a wide variety of fields to achieve the SDGs. However, all the potential for digitally supported sustainability governance highlighted here requires appropriate competencies for implementation. Without the necessary knowledge and equipment – both among public institutions and individuals – the use of digital instruments

for sustainability governance cannot unfold its potential, and can even exacerbate existing problems such as inequality (SDG 10) (Bertot et al., 2010; Zhang and Kim, 2016). For example, digitally enabled participatory budgeting can only be fair if poorer population groups also have access to the necessary technology.

This digital potential can also be used for the HLPF itself. According to the 2030 Agenda, the responsibility for implementing the SDGs at the regional, national and global level lies primarily, but not exclusively, with national governments. The aim is to support and ensure accountability to citizens through systematic follow-up and monitoring at many levels. The HLPF assumes the central role of monitoring and verifying the achievement of objectives, especially at the global level. The voluntary national reviews within the framework of the annual HLPF are an important building block in the architecture of the 2030 Agenda, but up to now they have been carried out very much on a case-by-case basis and have been difficult to compare. For example, for political reasons, the national reviews and discussions in the HLPF frequently focus on best practices, but not on those SDGs and indicators that have not yet been adequately implemented in the national context or where there are target conflicts between them (Beisheim, 2018). In the WBGU's view, the sustainability agenda clearly requires a comprehensive approach and an associated transparent form of reporting that is as uniform as possible. The processes and formats of the HLPF are not only being officially discussed in 2019, but will also continue to develop dynamically from various practices and examples, setting new standards and, in the medium term, permanently improving and reforming sustainability governance (Beisheim, 2018). With regard to the HLPF's 2020–2023 cycle, the following three points need to be improved:

1. the *knowledge basis* (through open sustainability data for SDG implementation),
2. the *process quality* before, during and after the annual HLPF (through standardized, digitally supported processes with compatible evaluation and analysis steps), and
3. multiple *pressures to justify actions or inaction* (through analysis and references to shadow and parallel reports from civil society and academia).

Thus, there is an important window of opportunity for the use of digitalization. Digitalization, digital instruments and applications can make important contributions in each of these fields. For example, the initiatives in the Multi-Stakeholder Forum on Science, Technology and Innovation for the SDGs (UN, 2019; STI Forum 4 SDGs, 2019) are a positive first step, but not yet oriented towards a comprehensive understanding of sustainability. A global scientific conference on digitally supported sustainability transformation should draw up concrete proposals for the further modernization of the HLPF in the run-up to the major UN summit on 'Sustainability in the Digital Age' recommended by the WBGU for 2022 (see the following section). Pioneering alliances for participatory digital reporting and monitoring could be formed in this context.

Sustainability Policy Beyond 2030: Charter and World Summit on Sustainable Development in the Digital Age

The 2030 Agenda and the Paris Agreement on Climate Change must remain a priority for the international community. Failure to implement them would result in environmental, inequality, economic and security crises. At the same time, the upheavals facing societies in the course of digitalization (Figure 1) are creating new challenges that are already becoming apparent. In addition to efforts to use digital change directly to implement the 2030 Agenda, the UN should already think beyond 2030 and begin a process to outline longer-term transitions to a sustainable Digital Age. Such a process could follow on from the UN Secretary-General's High-level Panel on Digital Cooperation and emerging initiatives launched by UNDP, UN-Habitat and UNEP, such as the Digital Financing Task Force of the SDGs or the UNDP's Digital Strategy.

The WBGU proposes that in 2022 – 30 years after the Earth Summit in Rio de Janeiro – a UN summit on 'Sustainability in the Digital Age' be held to look at the future of human development and the planet in the 21st century. It is important to make the topic of digitalization and sustainability more established across the board in the institutions of the UN system. In order to embed the issue of digitalization in strategy-building and work processes, consideration could be given to a UN mechanism for system-wide coordination ('UN Digitalization', analogous to UN Energy). The most complex option from a negotiating standpoint, but potentially the most enforceable, would be a 'UN Framework Convention on Digital Sustainability and Sustainable Digitalization'. In addition, the state of scientific knowledge

Box 2

'Our Common Digital Future' – a draft charter for a sustainable Digital Age

Preamble

Conscious of the responsibility of all societies for our common digital future,

conscious of the urgent need for decisive action to limit anthropogenic climate change and sustain the natural life-support systems, and conscious of the responsibility of humankind in the new geological epoch of the Anthropocene,

endeavouring to work towards a humanistic vision for a networked global society of the Digital Age in which civilizational and human potential can fully unfold,

recognizing the Universal Declaration of Human Rights, the report of the World Commission on Environment and Development, the United Nations Conference on Environment and Development, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the United Nations-sponsored World Summit on the Information Society, the United Nations 2030 Agenda with its Sustainable Development Goals, the Paris Agreement and similar processes launched by informal initiatives,

the undersigned acknowledge and commit to the implementation of the following goals, principles, freedoms, rights and obligations.

Goals and principles

1. Human *dignity* shall also be inviolable in digital space. Everyone shall have the right to digital identity, sovereignty, data protection and privacy. This shall also include the right to evade digitalization in the private sphere and the right to be informed if an interaction partner is not a human being but a technical system.
2. The development of digital technologies and digitalized infrastructures shall always be geared towards sustaining the *natural life-support systems*. The planetary guard rails must be observed, global and local environmental problems must be avoided. The polluter-pays, cooperation, integration and precautionary principles must be observed as guiding principles.
3. The development of digitalized infrastructures shall always be oriented in such a way that it is *accessible to all* and offers equal opportunities for societal participation and realization. For the underlying technologies such as microelectronics, tele- and data-communication networks, data processing and artificial intelligence, information on the basic functions should be accessible to all worldwide.
4. The rights of the individual to the *protection of individual freedom of development* in the digital space shall be guaranteed. These rights shall include informational self-determination, the protection of freedom of expression and digital identity, the protection of minorities and protection against discrimination. All people shall have the fun-

damental right to inspect and correct data stored about them, to determine their use and to have them deleted. These rights shall be legally enforceable.

Digitalization at the service of sustainability goals

5. The potential of digitalization should be used worldwide to achieve the *goals of sustainable development* (2030 Agenda and beyond). Solutions based on digital technology should be considered in societal decisions involving the goals of sustainable development.
6. The development of digital technologies and digitalized infrastructures shall always take the environmental and social impacts into account. The *planetary guard rails* must be observed.
7. Digitalization shall be used specifically to monitor the *UN's sustainability goals* and thus to safeguard social and ecological standards.
8. All countries shall contribute to the development of *digital commons*, to the cultural and natural heritage and to the global state of knowledge, and shall ensure their protection and universal accessibility across generations.

Avoid systemic risks

9. All states and companies shall actively work to minimize *risks to critical infrastructures*. They shall be obliged to inform each other about errors and vulnerabilities and to ensure that these are remedied. Responsibility for damage shall always be clearly defined.
10. The use of digital technology involves obligations. Its use should at the same time serve the *common good*. Digital solutions may not be used to oppress people, to monitor them without cause, or to exercise social control.
11. All states shall have a duty to provide appropriate support for people affected to adapt to the *changes in the world of work* caused by digitalization according to the principles defined above.
12. Human *decision-making sovereignty* in the use of artificial intelligence and algorithm-based automatic systems in societal decision-making processes shall be guaranteed. Human beings shall retain the right to make the final decision. Automated decision-making and decision-making support must always be traceable, and shall take place only within a clearly defined framework and with the option of making corrections. The responsibility for automated decision-making and decision-making support shall always be clearly defined.
13. All states shall have a duty to preserve the *right of the individual to Eigenart and imperfection*. Societal pressure to optimize the human body through technology shall be countered. All states shall agree on binding rules and ethical guidelines at the multilateral level.
14. *Cyberattacks* shall be subject to the Geneva Conventions on Armed Conflict and their additional protocols, which must be supplemented to include attacks on critical infrastructures. The use of fully automated *autonomous weapon systems* shall be prohibited. The protection of the civilian population shall have the highest priority.

Prepare for procedural challenges

15. All states and companies shall develop *ethical guidelines* on the conception, development and application of digital technologies and solutions with regard to human dignity and sustainability goals and shall create the necessary legal and organizational frameworks for their implementation.
16. All states shall create *institutions* that give advice on the use of digital technologies when they impinge directly on human dignity, the natural life-support systems, the inclusion of all human beings, or the individual's *Eigenart*. All states shall create the conditions for *civil society* to participate in these processes at an early stage.
17. Through *technology-oriented future-proof education*, all states shall enable their citizens to participate in the use of digital technology, to develop an awareness of global responsibility and a holistic understanding of their options for action in the Digital Age, and to actively participate in shaping future developments of digital technologies and digital infrastructures. This shall include in particular education for sustainable development.
18. All states shall *cooperate* at a multilateral level in accordance with the objectives and obligations agreed in this Charter.

Source: WBGU, 2019: Chapter 9

on all sustainability-relevant aspects of the digital transformation should be reviewed in regular assessment reports. A body similar to the IPCC or IPBES should be set up for this purpose.

The institutional framework for global sustainable development in the Digital Age also needs a normative reference point, which should be agreed at the UN Summit in 2022 in the form of an international charter for a sustainable Digital Age. The WBGU has submitted a draft for such a charter outlining the starting points for such a world summit. It ties in with the 2030 Agenda and the Declaration of Human Rights and, at the same time, goes beyond them (Box 2; WBGU, 2019: Chapter 9). The charter is intended to serve as a system of principles, objectives and standards for the international community and to link digital change with the necessary global sustainability perspective. It formulates objectives and principles for the protection of human dignity, natural life-support systems, inclusion in and access to digital and digitalized infrastructures and technologies, as well as individual and collective freedom of development in the Digital Age. On this basis, the charter sets out concrete guidelines for action to be drawn up by the international community with a view to the challenges of the Digital Age.

For this purpose, the charter contains three core elements (Box 2): First, digitalization should be designed in line with the 2030 Agenda, and digital technology should be used to achieve the SDGs. Second, beyond the 2030 Agenda, systemic risks (Box 3) should be avoided, in particular by protecting civil and human rights, promoting the common good and ensuring decision-making sovereignty. Third, societies must prepare themselves procedurally for future challenges by agreeing, among

Box 3

Avoiding systemic risks in the Digital Age

In order to be able to exploit the potential of digitalization, we must be aware of the possible systemic risks in the Digital Age. Digital systemic risks include conceivable, large-scale changes in our societies, each of which could in itself trigger destabilization in those societies. Knock-on and cumulative amplifying effects would multiply accordingly and have a broad-based impact.

While some of these threats are undisputed (e.g. labour-market disruptions), the magnitude of the changes is uncertain. The probability of other systemic risks occurring is significant (e.g. breaching planetary guard rails, digital authoritarianism, further power gains by major digital corporations), while the likelihood of other risks occurring is relatively low from today's perspective (e.g. acceptance of human enhancement to create an optimized *Homo sapiens*). However, even the latter systemic risks must not be neglected because, in a worst-case scenario, they would have a major impact on the future of civilization. The WBGU identifies the following systemic risks in the Digital Age:

- the breaching of planetary guard rails as a result of digitally driven, resource- and emissions-intensive growth patterns,
- the disempowerment of the individual, threats to privacy and an undermining of the digitalized public sphere through digitally empowered authoritarianism and totalitarianism,
- an undermining of democracy and deliberation by normatively and institutionally non-embedded, automated decision-making or decision-making support,
- dominance by companies that can elude government control, driven by further data-based power concentration,
- disruption of labour markets by the comprehensive automation of data-driven activities and the danger that human labour will become increasingly irrelevant to the economy,
- a deeper division of global society as a result of limited access to, and use of, digital potential, mainly by wealthy minorities in the global society,
- abuse of the mechanization of humanity on the basis of human-enhancement philosophies and methods.

It is also important to bear in mind that the digital upheavals are being experienced by societies that are already unsettled by globalization, the rise of new powers, refugee flows and forms of authoritarian populism. The bow-waves of digitalization are colliding with the current crisis in Europe and the West, as well as with frontal attacks on a multilateral world order based on cooperation and rules. The systemic risks of the Digital Age could overlap with and reinforce the centrifugal forces that already exist in many societies.

Source: WBGU, 2019: Chapter 9

other things, ethical guidelines and ensuring future-oriented research and education.

The WBGU will present a draft for this charter on the occasion of the SDG summit in September 2019 and, at the same time, provide opportunities to comment on it (the draft of the charter is available at www.wbgu.de/charter). The aim is to stimulate a worldwide discussion on the Transformation towards Sustainability in the Digital Age.

Epilogue

The digital momentum can make a significant contribution to the Transformation towards Sustainability and greatly support the achievement of the SDGs. Digital solutions can make it easier to supply the world's population with food and renewable energies in an environmentally friendly and sustainable way. The intelligent design, longevity, reparability and recyclability of products in a digitally supported circular economy can reduce the demand for resources. Individuals can further their education using digital commons and develop an awareness of responsibility for overarching sustainability and humanity issues. Polycentric networks based on a culture of global cooperation and as a foundation for global governance can increasingly use sustainability-oriented social platforms. International sustainability politics could follow principles of open government and improve democratic participation.

However, leveraging this potential will not happen automatically. Taking into account the opportunities and risks of digitalization in selected fields, the WBGU's policy paper offers four stimuli for using the digital momentum to (1) develop a global (environmental) awareness, (2) establish a globally networked, digitally supported circular economy, (3) modernize sustainability governance, and (4) continue sustainability policy in the Digital Age beyond 2030.

The implementation of these proposals can provide essential impetus for global sustainability politics: it is a question of the further development of our civilization on a finite planet in the digital Anthropocene. In this way, the WBGU wishes to generate impetus for inter- and transnational initiatives that urgently need to be taken. At the latest, the UN Summit proposed by the WBGU for 2022 should agree on key steps for a sustainable Digital Age – 30 years after the Earth Summit in Rio de Janeiro.

References

Abercrombie, R., Harris, E. and Wharton, R. (2015): Systems Change. A Guide to What it is and How to Do It. London: New Philanthropy Capital (NPC).

Amsler, S. and Facer, K. (2017): Contesting anticipatory regimes in education: exploring alternative educational orientations to the future. Futures 94, 6–14.

Ananiadou, K. and Claro, M. (2009): 21st Century Skills & Competences for New Millennium Learners. Paris: OECD.

Beddoe, R., Costanza, R., Farley, J., Garza, E., Kent, J., Kubiszewski, I., Martinez, L., McCowen, T., Murphy, K., Myers, N., Ogden, Z., Stapleton, K. and Woodward, J. (2009): Overcoming systemic roadblocks to sustainability: The evolutionary redesign of worldviews, institutions, and technologies. PNAS 106 (8), 2483–2489.

Beisheim, M. (2018): UN-Reformen für die 2030-Agenda. Sind die Arbeitsmethoden und Praktiken des HLPF „fit for purpose"? Berlin: Stiftung Wissenschaft und Politik (SWP), Deutsches Institut für Internationale Politik und Sicherheit.

Bertot, J., Jaeger, P. and Grimes, J. (2010): Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. Government Information Quarterly 27 (3), 264–271.

Brundiers, K. and Wiek, A. (2017): Beyond interpersonal competence: teaching and learning professional skills in sustainability. Specialist Studies In Education 7 (1), 39ff.

Certomà, C., Corsini, F. and Rizzi, F. (2015): Crowdsourcing urban sustainability. Data, people and technologies in participatory governance. Futures 74, 93–106.

Eggers, W. and McMillan, P. (2013): The Solution Revolution. How Business, Government, and Social Enterprises are Teaming up to Solve Society's Toughest Probems. Boston: Harvard Business Review Press.

EMF – Ellen MacArthur Foundation (2016): Intelligent Assets: Unlocking the Circular Economy Potential. Cowes: The Ellen MacArthur Foundation.

Fürst, C., König, H., Pietzsch, K., Ende, H. P. and Makeschin, F. (2010): Pimp your landscape – a generic approach for integrating regional stakeholder needs into land use planning. Ecology and Society 15 (3), 1–34.

Geels, F. W., McMeekin, A., Mylan, J. and Southerton, D. (2015): A critical appraisal of Sustainable Consumption and Production research: The reformist, revolutionary and reconfiguration positions. Global Environmental Change 34, 1–12.

Janssen, M., Matheus, R., Longo, J. and Weerakkody, V. (2017): Transparency-by-design as a foundation for open government. Transforming Government: People, Process and Policy 11 (1), 2–8.

OECD – Organisation for Economic Co-operation and Development (2015): System Innovation: Synthesis Report. Paris: OECD Publishing.

OGP – Open Government Partnership (2019): About Open Government Partnership. Internet: https://www.opengovpartnership.org/about/. Washington, DC: OGP.

Rasfeld, M. and Breidenbach, S. (2014): Schulen im Aufbruch – Eine Anstiftung. Munich: Koesel.

Scharpf, F. (1999): Governing in Europe: Effective and Democratic? Oxford, New York: Oxford University Press.

Song, C. and Lee, J. (2016): Citizens' use of social media in government, perceived transparency, and trust in government. Public Performance & Management Review 39 (2), 430–453.

STI Forum 4 SDGs (2019): About STI Forum. Internet: https://stiforum4sdgs.globalinnovationexchange.org/about. o.O.: STI Forum.

Stockmann, R. and Meyer, W. (2017): Evaluation in Deutschland. Woher sie kommt, wo sie steht, wohin sie geht. Zeitschrift für Evaluation 16 (2), 57–110.

The Young Foundation (2012): Social Innovation Overview: A Deliverable of the Project 'The Theoretical, Empirical and Policy Foundations for Building Social Innovation in Europe (TEPSIE)'. European Commission – 7th Framework Programme. Brussels: European Commission, DG Research.

UN – United Nations (2019): STI Forum 2019. 4th annual Multi-stakeholder Forum on Science, Technology and Innovation for the Sustainable Development Goals. Internet: https://sustainabledevelopment.un.org/TFM/STIForum2019. New York: UN.

UNESCO – United Nations Educational, Scientific and Cultural Organization (1945): Constitution of the United Nations Educational, Scientific and Cultural Organization. Paris: UNESCO.

UNESCO – United Nations Educational, Scientific and Cultural Organization (2014): Roadmap for Implementing the Global Action Programme on Sustainable Development Education. Paris: UNESCO.

UNESCO – United Nations Educational Scientific and Cultural Organization (2019): Education for Sustainable Development Beyond 2019. Paris: UNESCO.

UN High-level Panel on Digital Cooperation (2019): The Age of Digital Interdependence. Report of the UN Secretary-General's High-level Panel on Digital Cooperation. New York: UN.

UN IEAG – Independent Expert Advisory Group on a Data Revolution for Sustainable Development (2014): A World That Counts. Mobilising the Data Revolution for Sustainable Development. New York: UN.

Wangler, L. and Botthof, A. (2019): E-Governance: Digitalisierung und KI in der öffentlichen Verwaltung. In: Wittpahl, V. (Hrsg.): Künstliche Intelligenz. Heidelberg, Berlin: Springer, 122–141.

WBGU – German Advisory Council on Global Change (2014): Human Progress within Planetary Guard Rails. Policy Paper 8. Berlin: WBGU.

WBGU – German Advisory Council on Global Change (2016): Humanity on the Move: Unlocking the Transformative Power of Cities. Flagship Report. Berlin: WBGU.

WBGU – German Advisory Council on Global Change (2019): Towards Our Common Digital Future. Flagship Report. Berlin: WBGU.

WEF – World Economic Forum (2016): The Future of Jobs. Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution. Global Challenge Insight Report. Geneva: WEF.

Wilts, H. and Berg, H. (2017): Digitale Kreislaufwirtschaft: Die Digitale Transformation als Wegbereiter ressourcenschonender Stoffkreisläufe. Wuppertal: Wuppertal Institut für Klima, Umwelt, Energie.

World Bank (2019): World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank.

World Future Council (2019): Advancing Education for Sustainable Development: Key Success Factors for Policy and Practice. Hamburg: World Future Council.

Zhang, J. and Kim, Y. (2016): Citizens' perceptions of the impact of information technology use on transparency, efficiency and corruption in local governments. Information Polity 21 (3), 321–334.

German Advisory Council on Global Change (WBGU)

The WBGU is an independent, scientific advisory body to the German Federal Government, set up in 1992 in the run-up to the Rio Earth Summit. The Council has nine members appointed for a term of four years by the Federal Cabinet. The WBGU is jointly managed by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry of Education and Research. It is monitored and supported by an interministerial committee of the Federal Government in which the Federal Chancellery and all the ministries are represented. The WBGU's remit is to:

- analyse global environmental and development problems and report on them,
- review and evaluate national and international research in the field of global change,
- issue early warnings to draw attention to new problem areas,
- identify gaps in research and initiate new research,
- monitor and assess national and international policies for achieving sustainable development,
- elaborate recommendations for action and research, and
- raise public awareness and heighten the media profile of global change issues.

Authors

Lead authors: Martina Fromhold-Eisebith, Ulrike Grote, Ellen Matthies, Dirk Messner, Karen Pittel, Hans Joachim Schellnhuber, Ina Schieferdecker, Sabine Schlacke, Uwe Schneidewind

Co-authors: Robyn Blake-Rath, Marcel J. Dorsch, Marian Feist, Juliana Gärtner, Maja Göpel, Hans Haake, Ulrike Jürschik, Karen Krause, Carsten Loose, Reinhard Messerschmidt, Johannes Pfeiffer, Benno Pilardeaux, Astrid Schulz, Jan Siegmeier, Paul Szabo-Müller, Nora Wegener

Recommended Citation

WBGU – German Advisory Council on Global Change (2019): Digital Momentum for the UN Sustainability Agenda in the 21st Century. Policy Paper 10. Berlin: WBGU.

Acknowledgments

The Advisory Council would like to thank all those who have contributed valuable suggestions on the policy paper through conversations, comments and advice.

Dr Hannah Janetschek (German Development Institute – DIE, Bonn), Dr Lutz Möller (German Commission for UNESCO, Bonn).

Research Analysts

Prof Maja Göpel (Secretary-General), Dr Carsten Loose (Deputy Secretary-General), Robyn Blake-Rath, MA (Leibniz University of Hannover), Marcel J. Dorsch, Magister Dipl.-Päd. (Univ.) (WBGU Secretariat, Berlin), Dr Marian Feist (United Nations University, Bonn), Juliana Gärtner, MPhil (Potsdam Institute for Climate Impact Research – PIK), Dipl.-Oec. Hans Haake (Wuppertal Institute for Climate, Environment and Energy), Ulrike Jürschik, Dipl.-Jur. (Institute for Environmental Law and Planning Law – IUP, Münster), Karen Krause, MSc (Otto-von-Guericke-University Magdeburg), Dr Reinhard Messerschmidt (WBGU Secretariat, Berlin), Dr Johannes Pfeiffer (ifo Center for Energy, Climate and Resources, Munich), Dr Benno Pilardeaux (WBGU Secretariat, Berlin), Dr Astrid Schulz (WBGU Secretariat, Berlin), Dr Jan Siegmeier (WBGU Secretariat, Berlin), Paul Szabo-Müller, MA (Department of Geography at RWTH Aachen University), Nora Wegener, MA (Fraunhofer Institute for Open Communication Systems – FOKUS, Berlin).

The R&D project that generated this report was conducted on behalf of the German Federal Ministry of Education and Research and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety under grant number 01RIO708A4. Responsibility for the content of this publication rests with the author.

The Council Members

Prof Dirk Messner (Chair)
Director of the United Nations University – Institute for Environment and Human Security (UNU-EHS), Bonn and Co-Director of the Center for Advanced Studies on Global Cooperation Research, University of Duisburg-Essen

Prof Sabine Schlacke (Chair)
Professor of public law, executive director of the Institute for Environmental Law and Planning Law, University of Münster

Prof Martina Fromhold-Eisebith
Chair of Economic Geography, Department of Geography at RWTH Aachen University

Prof Ulrike Grote
Director of the Institute for Environmental Economics and World Trade at Leibniz University of Hannover and Senior Fellow at Center for Development Research (ZEF), Bonn

Prof Ellen Matthies
Professor for Environmental Psychology, Otto-von-Guericke-University Magdeburg

Prof Karen Pittel
Director of the ifo Center for Energy, Climate and Resources and Professor of Economics, esp. Energy, Climate and Exhaustible Natural Resources, Faculty of Economics, University of Munich

Prof Hans Joachim Schellnhuber CBE
Director Emeritus of the Potsdam Institute for Climate Impact Research (PIK)

Prof Ina Schieferdecker
Director of Fraunhofer Institute for Open Communication Systems (FOKUS) in Berlin, Professor for Quality Engineering of Open Distributed Systems at TU Berlin and Director of Weizenbaum Institute for the Networked Society

Prof Uwe Schneidewind
President and Chief Research Executive of the Wuppertal Institute for Climate, Environment and Energy; Professor for Sustainable Transition Management at the University of Wuppertal

German Advisory Council on Global Change

WBGU Secretariat
Luisenstraße 46
D-10117 Berlin

Phone: +49 30 26 39 48-0
Email: wbgu@wbgu.de
Internet: www.wbgu.de
@WBGU_Council

Copy deadline 21.06.2019
This policy paper is available online in German and English.
Translation: Bob Culverhouse, Berlin
2019, WBGU ISBN 978-3-946830-23-8