

Towards a green, competitive and resilient EU economy: How can digitalisation help?

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This paper, prepared for Germany's Presidency of the Council of the European Union, serves to inform EU member states' ministers of environment on the rationale and prospects for aligning the EU's sustainability and digitalisation agendas.

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The project considered the potential linkages between sustainability and digitalisation. It looked more specifically at greening ICT and how digitalisation can enhance sustainable consumption and production (i.e. the circular economy), improve biodiversity, and make agriculture and mobility more sustainable.

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Executive summary

As the EU and its member states prepare their recovery strategies for the social and economic fallout of the COVID-19 pandemic, they should honour their commitment to sustainable growth. This is Europe's opportunity to get on track to achieving a competitive and sustainable climate-neutral economy by 2050. Aligning the EU policy agendas for the green transition and the digital transformation carries enormous possibilities and should become central to these efforts.

The European Commission's Green Deal proposal – supported by, for example, the Industrial Strategy, Circular Economy Action Plan and Digital Strategy – already recognises that the two transitions are closely linked. But the EU should go a step further. It should lead the way and ensure that digitalisation is used to enhance environmental protection and climate action and that the digital sector becomes greener.

For too long, the green transition and digital transformation have been promoted separately, even though their alignment would bring many benefits (see Fig 1). Turning data into knowledge can support policy and investment decisions. Better management of data and the deployment of digitally-enabled solutions can provide the means to make our economy – including our food, mobility and energy systems – more competitive while also contributing to climate action and environmental protection. Connecting governments, people, companies and things will enable the sharing of valuable information and co-creation of needed solutions.

Digital solutions are already behind many novel business models, and they could be utilised even more for greening our economy. They can help improve the design of products and support people's 'right to repair'. They can help us consume fewer materials and less energy, reduce emissions, minimise waste and even support dematerialisation. Moreover, they can enhance governance, including the implementation and enforcement of relevant rules needed to protect our natural capital like biodiversity; enhance the circular economy; and achieve climate neutrality.

However, the EU must also counter the downsides of 'going digital'. The environmental impacts of digitalisation are significant and growing. Digitally-enabled business models can incite even more wasteful consumption, as well as unwanted energy- and transport-related emissions. Moreover, digitalisation can lead to unwanted societal impacts, such as growing inequalities. These downsides must be addressed if the ongoing digital transformation is to become a real contributor to sustainable prosperity.

Although the health and economic repercussions of the pandemic have pushed climate change, biodiversity loss and environmental degradation temporarily out of the spotlight, addressing them remains as urgent as ever. The COVID-19 outbreak has dramatically highlighted that developments in our environment have an enormous impact on our health, well-being and prosperity. For one, environmental degradation

Fig. 1



has likely contributed to the spread of the disease. For another, greening our actions can help us mitigate, respond to and recover from the crisis.

Europe needs recovery strategies that benefit from and contribute to greening the European economy. It is in the EU's interest to start building the conditions for people and businesses to emerge from this crisis stronger, with the capacities to face the next one. This means investing in the skills, sectors, products, services and technologies that can address climate, biodiversity and wider environmental challenges. It is essential to build on Europe's strengths and use all the tools available – including digitalisation – throughout this process. The EU must turn the ongoing digital transition into a catalyst for creating a sustainable economy.

Ensuring long-term sustainable prosperity and a healthy planet and humanity remains the challenge of our lifetime. European leaders are currently rightly focused on addressing and recovering from the COVID-19 crisis. However, in the process, it cannot be forgotten that people's well-being and prospects for businesses will ultimately depend on our ability to live and operate within the planetary boundaries. Our actions today and tomorrow must be aligned with this goal.

The analysis and recommendations in this paper reflect on the framework for aligning the digital and green transitions. This includes the European Green Deal and its spin-off policy initiatives, the existing and planned EU financing programmes, as well as the EU's and member states' COVID-19 response measures as developed until May 2020.

Key policy recommendations for the EU

I. CREATE A EUROPEAN DATA SPACE FOR THE GREEN DEAL AND A RESILIENT ECONOMY

1. **Establish rules to optimise the collection, processing, sharing and analysis of data relevant for climate action, protection of nature and restoration of ecosystems.** Ensuring access to and collecting relevant environment-related data and turning it into actionable knowledge will be key. The aim must be to make better use of the data needed for action across different sectors and government levels, be it to improve the circular economy or energy systems; or enhance biodiversity, farming practices or mobility.
2. **Reduce barriers to the free flow of information across value chains,** which is a key obstacle to developing a sustainable circular economy. The EU should encourage collaboration between businesses; support business-consumer exchange; and establish protocols for the tracking, tracing and mapping

of products and materials. Better coordination and exchange of information in value chains can enhance transparency while creating the basis for smart circular applications, like improved product environmental footprints and digital product passports. The aim should be to provide the different stakeholders in the value chain the information they need for the sustainable development, use, repair, recycling or disposal of products.

II. DEVELOP AND DEPLOY DIGITAL SOLUTIONS FOR GREATER SUSTAINABILITY

3. **Invest in digitally-enabled solutions that support and accelerate the greening of our economy and society.** This entails using digitalisation to enhance climate neutrality, the circular economy, zero pollution efforts and biodiversity, including by improving the implementation of relevant policies. Programmes under the EU's Multiannual Financial Framework should be used to leverage public and private investment for needed solutions. Public funding that is made available as a part of the EU and the member states' COVID-19 recovery efforts should support these efforts, too. The EU and its member states should also use procurement strategically to develop and deploy sustainable digitally-enabled solutions.
4. **The EU should develop provisions and guidelines to ensure that the development and deployment of digitally-enabled solutions actually contribute to the green transition.** This is especially important in areas like agriculture, mobility and energy, as well as in different industrial processes, where digitalisation is already in use but does not necessarily contribute to enhancing the sectors' sustainability.

III. GREEN THE INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT) SECTOR

5. **Introduce new requirements and financial incentives for developing and deploying circular and energy-efficient ICT equipment.** This should include product ecodesign requirements, like possible recycling content quotas, implementing the right to repair for smart devices, as well as the use of market based tools, such as public procurement for greener ICT.
6. **Ensure that the EU's digital infrastructure becomes more sustainable,** leading to fewer emissions and reduced material consumption. Governance and economic instruments should be used to reduce, for example, the climate footprint of data centres by enhancing their energy efficiency and encouraging the use of renewable energy sources.

1. Digitalisation for a sustainable, competitive and resilient economy and society

1.1. A VISION FOR A SMART AND GREEN EU ECONOMY

In its quest for sustainable growth, the EU should align its efforts to advance the green transition and digital transformation (see Fig 2). The EU should make full use of digitalisation to address Europe's biggest societal and environmental challenges and turn this into a source of competitiveness and strength in the ongoing global digital race. By 2030, the EU should be a global leader in using data and digital solutions to protect the environment and support climate action.

Digitalisation should be utilised to accelerate the transition to an environmentally and socially sustainable economic model; one which complies with the Paris Agreement and Sustainable Development Goals (SDGs). It should help bring about a system-wide transformation and create food, mobility and energy systems that operate within the planetary boundaries. Data should be managed, and digital tools deployed to address global warming and environmental challenges, such as pollution and the loss of biodiversity. They should enable greener business models and lifestyles, including more sustainable production and consumption patterns, and ultimately contribute to reversing the trend of growing resource and energy consumption and help achieve climate neutrality by 2050.

While digitalisation can be leveraged to enhance sustainability, the digital transformation itself must also become more sustainable. This requires addressing the climate and environmental footprint of the information and communications technology (ICT) sector, including data centres, other digital infrastructures and devices.

In the process, the EU must aim to address the investment gap and find a balance between adequate protection and sharing of data. The societal dimension, including engagement with citizens, is also essential. Europe needs a just, fair transition that addresses growing social inequalities and supports digital empowerment of people, providing citizens with the needed capacities and skills. Moreover, while it is in the EU's interest to attain a healthy degree of technological sovereignty, including access to needed solutions and skills to deliver on the green transition, it must also continue to engage with its international partners. Turning digitalisation into a real enabler for sustainability requires cooperation between different stakeholders, and across sectors and borders.

The European Commission's proposal for a European Green Deal and its subsequent plans, including for digital, circular economy and industrial agendas, provide an important basis for action. As the work continues in the

Fig. 2



post-COVID-19 world, the EU must aim to maximise the synergies between the green and digital transformations. It needs to enhance a transition to a sustainable, competitive and resilient economy and society.

1.2. SUSTAINABILITY AS THE FOUNDATION FOR LONG-TERM PROSPERITY

Ensuring long-term sustainable prosperity within the limits of our planet is the challenge of our lifetime. While the pandemic has temporarily shifted the world's attention from the climate, biodiversity and wider sustainability crisis to managing its social and economic consequences, it also provides an occasion for serious reflection. It has demonstrated the systemic problems in our present economic model and shed light on what needs to be changed. It provides an unprecedented occasion to accelerate the transition to a more resilient and sustainable economy and society.

Climate action and environmental protection offer enormous possibilities for not only people and the planet, but also industry and economic welfare. Firstly, inaction comes with a cost that could be avoided. It has been calculated that climate change will end up costing the EU between €100 and €200 billion annually if left unaddressed.¹ Air pollution, too, is costing Europeans hundreds of billions annually, not only as direct health costs but also as economic damages, like labour productivity losses.²

There is also another side of the coin. Action can lead to new and even immediate economic and societal benefits. According to the Organisation for Economic Co-operation and Development (OECD), as fine particulate concentration across Europe dropped between 2000 and

2015, this boosted the GDP growth. Around 15% of GDP growth in Europe could be attributable to air quality improvements during the aforementioned period.⁵

Being smarter with existing resources and enhancing a transition to a circular economy would not only help reduce greenhouse gas (GHG) emissions. The Commission suggests that this transition would ensure access to critical materials, lead to a net increase of 700,000 jobs, increase demand for new products and services, raise the EU's GDP by 0.5%, and generate a net economic benefit of €1.8 trillion by 2030.⁴ Transitioning to cleaner energy as well as more sustainable mobility and food systems, and greening our built environment hold great additional prospects for enhancing growth and creating new jobs.⁵

The economic fallout from the COVID-19 pandemic should provide a strong rationale to get the economy on a greener track and capture the related benefits.⁶ The economic troubles must be addressed together with the ongoing sustainability challenges. It is more important than ever to be smart with public spending and recognise the value emerging from environmental protection and climate action. Moreover, the EU must encourage investing in sectors, products and services with higher value and returns; that is, those sustainable solutions and jobs that will be needed increasingly in the future. The European Green Deal must be the driving force behind Europe's COVID-19 recovery plans.

As the EU works to address its sustainability challenges alongside its economic and societal ones, traditional silo thinking simply will not do. Europe must align its efforts across different policy areas with a clear goal in mind: to achieve sustainable prosperity for today, tomorrow and the generations to come.

One of the possible catalysts for a green transition, which has not received enough attention, neither within the EU nor beyond, is digitalisation. As the rapid digital transformation continues, it is in the EU's interest to align it with its efforts to protect natural capital, enhance the circular economy and achieve climate neutrality.

1.3. DIGITALISATION AS A CATALYST

It is widely recognised that climate and environmental challenges, on the one hand, and digital transformation on the other are megatrends changing people's lives and how businesses, societies and economies operate. Managing these megatrends by aligning the relevant agendas can provide a valuable basis for safeguarding Europe's socioeconomic prosperity.

Digitalisation, which builds upon increased connectivity and improved data management, carries great potential to act as an enabler and even accelerator for a sustainable and competitive European economy. Better management, including use, of data across borders, sectors and different levels of governance as well as

data-driven digital solutions can enhance knowledge and information sharing.⁷ They can improve the way we operate, produce and consume, and help to scale-up effective solutions. They can change thinking and even disrupt current practices. They could ultimately help entire systems – be it food, mobility or energy – to operate within planetary boundaries.

Better management of data and digitally-enabled solutions can provide the means to:

1) enhance knowledge and information sharing by:

- improving the collection, processing and analysis of data and sharing of information needed for the protection of the environment and for climate action, while enhancing transparency and collaboration between stakeholders. The knowledge gained can also raise awareness and support policy and investment decisions.
- informing, influencing and empowering citizens and consumers. Greater engagement with people can lead to citizen science, the co-creation of solutions and strengthening their voice in decision-making.

2) make processes and procedures more effective and efficient by:

- enhancing governance, including the monitoring, implementation, enforcement and evaluation of relevant policies and environmental standards.
- improving the use of human and natural resources.

3) create sustainable products, services and business models, and disrupt current practices by:

- improving product design, industrial production and processes, and the end-of-life management of products and materials.
- enabling business models like servitisation⁸ that can lead to even dematerialisation.⁹
- helping improve consumption patterns.
- enabling system-wide transformation, by turning different modes of transport into environmentally-friendly mobility systems; supporting sustainable agricultural and food systems; and enabling the clean energy transition, for example.



INFO BOX. EXAMPLES OF DIGITAL TECHNOLOGIES AND DIGITALLY-ENABLED SOLUTIONS:

Applications or apps for computers, tablets and mobile devices can be used, for example, to inform citizens about the environment around them; incite them to live, travel or consume more sustainably; and encourage them to gather data to support so-called citizen science.

Artificial intelligence (AI) is understood as a machine's capability to perform tasks which would normally require human intelligence. AI enables more efficient collection and processing of (big) data to, for instance, improve biodiversity monitoring and design more circular products and services.

Blockchain is a distributed ledger that records and shares information securely. Blockchain is already proving useful in improving transparency and communication across value chains and can be used to support a circular economy, increase transparency around food production, and manage renewable energy resources, for example.

Cloud computing delivers computing services like storage, databases, networking and analytics via the Internet, and is already used to manage data and enhance knowledge for nature protection and climate action.

Data sharing building on Quick Response (QR) codes, barcodes, watermarks, radio-frequency identification devices (RFID) and blockchain can enable information to travel across value chains of products. These solutions can support development of product environmental footprints and digital product passports.

Digital twins are virtual models or digital replicas of physical objects. They can be used, for example, to predict how a product would operate throughout its life. Building on this knowledge, its design and performance can be improved. Digital twins can optimise production systems and waste management operations, and thus make them more sustainable.

Earth observation, satellite imagery, sensors, cameras, drones or robots can be used to gather data and monitor the environment, including biodiversity. They can support greener practices like precision farming to optimise production, using fewer resources. They can also enhance compliance with existing rules to ensure that, for example, farming practices are aligned with climate and environmental standards.

Internet of things (IoT) and connected devices are everyday physical objects or devices that are connected to the Internet and can 'identify' themselves to other objects. The IoT can, for example, be used to predict when machines require maintenance or upgrades and thus prolong their lifetime, or micromanage their energy usage.

Online platforms host applications or services that can be used for a variety of activities. They can support information exchange, education and therefore decision-making. They provide a place for trade, asset sharing and selling services, and can enable novel business models like products-as-a-service.

3D printing or additive manufacturing are computer processes which join or solidify materials to create a three-dimensional object, often using less material in comparison to traditional manufacturing methods.

A joint green and digital transformations can provide significant business opportunities. A large and growing number of European companies are already building on these possibilities. Digitalisation can facilitate the customisation of products and services and foster industrial modernisation, thus providing an added value to companies and consumers. Digital solutions like 3D printing can support local production and improve resilience when global value chains are affected. Digitalisation provides the basis for servitisation and dematerialisation, which could render the EU industry less dependent on scarce and imported raw materials.

The pandemic has boosted the digital transformation significantly. The physical distancing measures have led to an unprecedented uptake of digital solutions, enabling people to work, operate and communicate despite lockdowns. At the same time, the pandemic has demonstrated the importance of digital infrastructures as an indispensable pillar for a resilient society, showcased the need to steer digitalisation, and reminded us that digitalisation has an environmental and climate footprint that must be addressed.

Indeed, greater use of data and digital solutions do not automatically contribute to reduced GHG emissions, nor a smarter use of resources. In fact, digitalisation can very likely cause the opposite if it is not guided and governed well.

Firstly, the ICT sector has a significant environmental footprint. Data centres, digital devices and digital infrastructures often require critical levels of energy and materials. The waste created by the sector is another growing problem to be addressed. Secondly, when data and digital solutions are used to make existing practices more efficient, this does not necessarily lead to greener practices like more sustainable production and consumption. Moreover, the digital transformation can have unwanted implications for privacy; security (i.e. cyberattacks); and personal well-being, health (i.e. radiation, hazardous substances) and even job prospects.

It must be in Europe's interest to become a standard-setter in the development of sustainable digital solutions that help protect the environment and combat climate change. By combining digitalisation with its values of sustainability, privacy, trust and security, the EU can create its own model of digital transformation. The global demand for such solutions is already here and growing. Although the race is on and tough, the EU has valuable human capital and a strong innovation base upon which it can and should build.

It is in Europe's interest to remain a frontrunner in eco-innovation¹⁰ and become the lead market for digital solutions that protect our planet. It is time to start discussing pathways for making digitalisation a real enabler for sustainability.

2. Recommendations

In order to achieve a sustainable, resilient and competitive economy, the green and digital transformations must be aligned. The EU must use its policy framework, economic instruments and convening power to support these efforts. The EU needs an action plan that will help:

- 1) create a European data space for the Green Deal and a resilient economy;
- 2) develop and deploy digital solutions for greater sustainability;
- 3) green the ICT sector.

Below is a set of policy recommendations that could support these efforts. It is worth noting that the European Commission's proposals for the European Green Deal and its spin-off strategies – including for industry, a circular economy, the digital agenda, biodiversity, food systems –, the existing and announced financing programmes, and its COVID-19 recovery plan provide a good basis for an action plan. While the recommendations are mainly aimed for the EU as a whole, the member states will play a key role in aligning the agendas for the green and digital transformations.

The recommendations aim to give a snapshot of the myriad of possibilities for the way forward. The EPC-BMU project 'Digitalisation and Sustainability', as reflected in the recommendations below, focused specifically on *the circular economy, biodiversity, agriculture, mobility and the greening of the ICT sector*. This is due to the related sustainability challenges, prospects for digitalisation to overcome these challenges, and ongoing initiatives in these areas. However, the selection of recommendations does not negate the role digitalisation can play to also improve, for example, energy systems, the built environment, air quality, water management and more. Many of the sectorial recommendations can also be applied in other sectors.

2.1. CREATE A EUROPEAN DATA SPACE FOR THE GREEN DEAL AND A RESILIENT ECONOMY

Achieving the goals of the Green Deal and sowing the seeds for a resilient, competitive and climate-neutral economy by 2050 starts with having the right data for action. This requires identifying the necessary data for protecting the environment and for climate action. Moreover, collecting, facilitating access to, using, sharing and analysing data forms the basis for knowledge and innovation. Better access to and management of data carries enormous value. It could help unleash the

innovative power of the EU's research and business sector to develop needed solutions for transforming our societies and protecting the environment.

Public institutions across the EU, including competent authorities and EU agencies like the European Environment Agency (EEA), collect enormous amounts of environmental data via technologies like satellites and sensors. An increasing amount is collected and owned by the private sector, too. While EEA data is publicly available, much of the other public and private data is inaccessible to stakeholders who could benefit from it and use it to generate solutions for sustainability.

Moreover, when organisations do not share data, they tend to recollect overlapping datasets. This is redundant and highly inefficient and has an economic and environmental cost due to the high energy consumption of data collection and processing, especially if AI learning is applied.

The Commission's European strategy for data, including its proposal to establish a 'Common European Green Deal data space', provides a valuable basis for enhancing the access to and availability of data needed for greater sustainability. While the work on the concept has started, ensuring efficient and effective collection, sharing and analysis of needed data and information requires adequate resources to achieve the set ambition.

Fig. 3



2.1.1. IMPROVE DATA COLLECTION, SHARING AND ANALYSIS

Data collection, sharing and analysis can capture societal needs and the environmental value of the measures taken. Enhanced data management can improve policymaking and the implementation of rules as well as policy evaluations. It can help businesses and citizens become active participants in protecting nature and the climate and enhancing the transition to a circular economy.

Challenges to be addressed include data fragmentation (e.g. data being in multiple data formats and confined to only a handful of public and private stakeholders) and inadequate rules on data standardisation and sharing. Furthermore, existing rules on data protection (e.g. General Data Protection Regulation 2016/679) and intellectual property rights (IPRs) can be applied to restrict the access to, collection and sharing of environment- and climate-relevant data. Moreover, while the EU has traditionally been good in collecting data, creating concrete value of increasing amounts of data requires enhancing capabilities for analysis.

- The EU should **identify the needed data, optimise its collection and analysis, and turn it into actionable knowledge** for the Union's long-term sustainability goals. Collecting relevant data for the Green Deal data space starts with asking the right questions. For example, what data is needed to understand systemic problems? What data do different stakeholders need to improve policymaking and the implementation of rules and enhance practices for greater sustainability? Data collection should be efficient to avoid data graveyards and increasing administrative burden. Moreover, improving analysis via, for instance, AI may require additional financial resources.
 - Data collection and analysis should be structured to support the EU's high-level policy goals, as outlined in the proposed European Green Deal, its derived strategies and the UN's SDGs. Furthermore, it should be used to create actionable knowledge to facilitate better decision-making. The EU should strengthen the EEA's capacity to analyse big data, provide expertise and share best practices with national environment agencies.
 - The Commission should add 'climate and environment' to the Open Data Directive's 2019/1024 (ODD) list of thematic categories of high-value datasets. Thereby, data that is relevant to the objectives of the European Green Deal would be available free of charge and in a machine-readable format.
 - The EU must provide adequate funds, including under the Multiannual Financial Framework (MFF), to develop the Green Deal data space and enhance the subsequent analysis of data.
- The EU must **create framework conditions for the private sector to share data** that is of relevance for the environment or helps improve the protection of the climate and environment. It should start by developing guidelines and building on the economic incentives, and be prepared to adopt mandatory rules later.
 - Policymakers should recognise and build on the tangible benefits that data sharing offers for businesses in their communications and measures. Companies can be encouraged to share data if it supports their business by, for example, enhancing transparency in the supply chains or making eco-friendly products in online shopping platforms more visible.
 - The EU should use its stakeholder platforms to encourage businesses to discuss about their interests in and best practices on data sharing and build on businesses' shared interest to exchange information.
- The EU should **condition financial support** under MFF funds, recovery instrument and other financing tools (e.g. of the European Investment Bank, InvestEU) on beneficiaries making data of public interest (i.e. relevant for the protection of the climate and environment) available to the Green Deal and other relevant data spaces. For example, EU financial support to farmers could be made conditional on their disclosure of data relevant for a 'Common Agriculture data space'.¹¹
- Led by the Commission, the EU should **continue to develop common standards for data collection and sharing** at the EU, member state, subnational and corporate levels.
 - This requires agreeing on rules for minimum data content, format and quality, and on procedures for data and information exchange. The EU should build on the existing data standardisation practices (e.g. INSPIRE Directive 2007/2/EC).
 - The Commission should carry out consultations with relevant stakeholders to ensure buy-in. Public authorities and companies may have different technical, financial and administrative capacities and hesitate to standardise sensitive data (e.g. personal data and data linked to IPRs, national security or potential law infringements). The Commission may need to consider transitional periods, differentiate between mandatory and non-mandatory standardisation, and provide expertise and financial support.
- **Developing and managing the Green Deal data space requires collaboration** across different levels of government and sectors. It is essential that the data space is developed in partnership with relevant stakeholders from the EU institutions and agencies like the EEA, while also considering the input of relevant business and civil society stakeholders.

2.1.2. CAPITALISE ON PUBLIC DATA

Improving accessibility to public data would help public and private stakeholders to capitalise on it. Public-to-public data sharing across sectors and governance levels would improve the interoperability of public databases and facilitate the implementation and enforcement of EU environmental legislation. Better access to and transparency with environmental data can also enhance people's engagement and trust in environmental policymaking.¹²

However, in many EU member states, publicly collected environmental data is only available and shared to limited audiences, despite it being publicly funded. It may even be unavailable in digital format. Reasons include different data management standards, and the sensitive nature of certain data (e.g. IPRs, personal data, potential evidence for EU law infringement cases).

- As envisaged by the European strategy for data, **the Directive on public access to environmental information 2003/4/EC should be reviewed** to improve access to and sharing of information relevant to achieving a European Green Deal. This would result in minimal exceptions to accessible data (based on e.g. public security, confidentiality) and facilitate access to standardised information.
- Under the revised ODD,¹³ the EU and its member states should **determine which public statistics would enhance greater sustainability and should thus be provided free of charge.**
- **When collecting data, EU member states and the relevant authorities should coordinate** and thus help reduce economic and environmental costs resulting from duplicating data collection. The Commission should provide specific guidance on how to apply the 'once-only principle',¹⁴ as outlined in the European eGovernment Action Plan 2016-2020, for the collection of environment-related data. The aim should be to share and reuse data that is already collected whenever possible.
- The EU should **ensure the interoperability of the Green Deal data space and sectoral common data spaces** (e.g. for industry, mobility, agriculture) envisaged under the European strategy for data. There needs to be cross-referencing of content between the data spaces to form a coherent and consistent EU information system.

2.1.3. OPTIMISE DATA MANAGEMENT TO ENHANCE BIODIVERSITY

Over the past decades, digital solutions have supported the monitoring of biodiversity, awareness-raising and implementation of agreed measures. As part of the Copernicus programme, Earth observation satellites gather great quantities of data that allow public authorities to monitor protected areas and even enforce legislation. The EEA is using different kinds of databases

– such as the Biodiversity Information System for Europe (BISE), European University Information Systems (EUNIS), EU-wide monitoring methods and systems of surveillance for species and habitats of Community interest and the CORINE Land Cover – to provide data and map services. It is worth noting that optimising data management for biodiversity is also an opportunity to enhance other goals, like climate resilience.

The EEA and European Space Agency are considering using AI and machine learning to improve the efficiency of biodiversity data collection and processing. Another important recent initiative is the development of a digital twin of planet Earth, as proposed by the Commission under the European Green Deal and new Digital Agenda for Europe.

The Commission, with the contribution of the EEA, is also working to establish a 'Biodiversity Knowledge Centre' in 2020 that will: (i) track and assess progress in implementing biodiversity-related international instruments; (ii) foster cooperation and partnership, including between climate and biodiversity scientists; and (iii) underpin policy development.¹⁵ If the Centre benefits from the latest digital developments with biodiversity monitoring, this could ensure more unified data management and help improve relevant decision-making. Member state-level efforts to systematise data collection and processing, like the BMU's projected 'Biodiversity Monitoring Centre', can provide valuable lessons and input for EU-level efforts.

While the EU is well established in monitoring and collecting data on biodiversity, its true value remains unexploited as it lies fragmented across different institutions and databases, and it is not properly analysed. The European Biodiversity Strategy for 2030 envisages a new European biodiversity governance framework, including a monitoring and review mechanism with a clear set of agreed indicators.¹⁶ These developments could optimise the collection, processing and analysis of data. The Strategy recognises the importance of data, especially in strengthening law enforcement, but otherwise, references to digitalisation as an enabler for addressing biodiversity loss are limited.

- **The EU's biodiversity policy must be brought into the digital age.** Building on the new governance framework (as envisaged in the post-2020 Biodiversity strategy), the EU should aim to optimise data management and the use of digitally-enabled solutions, like AI and robotics, for the benefit of ecosystem restoration and nature protection.
- The EU should fully **support establishment of a 'European Biodiversity Knowledge Centre'** that streamlines the collection, monitoring and analysis of data needed to enhance biodiversity. More knowledge on the state of and trends for biodiversity in Europe (including soil and marine environments) and the drivers of biodiversity loss and ecosystem collapse is needed.

- ▶ This Centre should help increase the interoperability of existing biodiversity databases at the EU, member state and sub-national levels. It should build on existing tools like the EUNIS and aim to improve and optimise data management and analysis further at the EU level.
- ▶ The EU should speed up the uptake of new digital technologies, such as AI, to improve data collection, processing and analytics.
- ▶ Data collection and its analysis must help meet the EU's long-term priorities of biodiversity protection. Data must be turned into actionable knowledge that can support better decision-making and improve the implementation and enforcement of policies outlined in the Biodiversity Strategy and relevant legislation.

2.1.4. ENHANCE INFORMATION SHARING FOR A CIRCULAR ECONOMY

Changing what and how we produce and consume would not only address the environmental and climate challenges but also allow Europeans to control materials better, create more value from their use and become less dependent on major raw material exporters. A circular economy would reduce EU emissions significantly, and is key to ensuring a transition to more sustainable energy, mobility and food systems.¹⁷ Digitalisation carries many opportunities to improve existing production and consumption patterns, including by enabling information transfer across value chains.¹⁸

Under the Circular Economy Action Plan, the Commission highlights the importance of consumer empowerment, which could be supported via digital solutions. It envisages that at the point of sale, consumers should receive trustworthy and relevant information on products, including on their lifespan and repair services, spare parts and repair manuals. The Commission proposes that companies should substantiate their environmental claims by using Product and Organisation Environmental Footprint (PEF, OEF) methods. It also suggests that the EU Ecolabel should better integrate the PEF and OEF methods and considerations on durability, recyclability and recycled content.

The Commission also proposes establishing a common European data space for smart circular applications, which would include data on value chains and product information. This is a highly needed initiative. If governments, producers, traders, consumers and waste operators had access to the necessary information on products and materials (e.g. the presence of hazardous chemicals in products or recycling instructions), the design, use, reuse, recycling and disposal of products could be significantly improved. Moreover, it is worth noting that digital solutions for tracking environmental sustainability can also help increase transparency on social considerations, including whether workers' human rights are respected.

The Commission rightly recognises the potential of digitally-enabled solutions, like tagging and digital product passports, to improve the transfer of product information. While QR codes, barcodes, watermarks and RFID are already used to tag and trace information, for example, blockchain-enabled solutions carry interesting possibilities to enable information to travel securely and efficiently. However, some challenges to be addressed include access to relevant, reliable and standardised data; ensuring trust between stakeholders across the value chains; and achieving a fair balance between sharing and protecting information between stakeholders in a value chain.

- The EU should **create a data space for the circular economy that incentivises and enables the fair access to and sharing of data and information**. It should help create the conditions for sharing information about products, materials and substances between producers, traders, waste operators and consumers while recognising the different needs of all the stakeholders in the value chain. The data space does not need to be a 'single place' where data is collected; a decentralised system and the secure exchange of information via technologies like blockchain could be more attractive for many businesses.
- The EU should start by **developing general guidelines – a protocol – for the tracking and mapping** of products, materials and substances across value chains. They should be feasible, with a set of minimum criteria for sharing data (including on toxic substances), while enabling companies to safeguard commercial and strategic information (i.e. IPRs, know-how). The aim should be to provide, for example, consumers with the information necessary to use, repair and recycle a product. It is worth building on the experiences and lessons of those companies that are already transparent about their due diligence, and products' environmental footprint, and material and substance composition.
- The EU should pave the way for **the development of digital product passports** to systematise the tracking and tracing of products. The aim should be to provide governments, producers, traders, retailers, consumers, repair shops and waste operators the information they need for the sustainable development, production, use, recycling and disposal of the products.
 - ▶ The development of the digital product passport architecture should build on information in existing databases, such as the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) and EPREL (European Product Database for Energy Labelling). It should also benefit of experiences with tracking and tracing, for example, chemicals under the REACH process.
 - ▶ The Commission should use existing stakeholder platforms to encourage alliances and the exchange of practices between businesses and

other concerned stakeholders in using digitally-enabled solutions to share information and value across the value chains.¹⁹ It should encourage exchange on the technical and economic feasibility of different options for tracking and tracing in the value chains to ensure buy-in. The actors should be encouraged to define the needed elements for an information-sharing system that would provide each of the stakeholders in the value chain with the information they need.

- ▶ The Commission should focus on and consider initiating pilot projects for information exchange in those product value chains it has already identified as a priority: textiles, electronics, construction, packaging, batteries and electric vehicles. In addition, more must be done to improve information exchange and the subsequent reuse and recycling of materials in renewable technologies, like wind turbines and solar panels, as there cannot be a clean energy transition without smarter use of resources across the relevant value chains.
- ▶ Building on consultations with relevant stakeholders and possibly the support of a High-Level Expert Group, the Commission should – in collaboration with, for instance, CEN-CENELEC, consider further action. This could entail regulatory intervention, such as introducing mandatory technical requirements under the Ecodesign framework. Alternatively the Commission could propose non-mandatory technical requirements for information sharing if the former poses, for example, a serious threat to the competitiveness of the EU's industry.
- The EU's **Ecolabel scheme should be updated** for the digital age. Digitally-enabled solutions (e.g. QR codes, apps, online platforms) should be used to clarify and communicate the relevant information to stakeholders in the value chain. They could also help consumers make sustainable choices. The EU should learn from and build on the ongoing efforts to use digital tags with energy labels, which enables access to an underlying database with relevant information.
- In the next years, **online platforms should be encouraged to provide information on products with an EU ecolabel**, as well as official national ecolabels, and enable consumers to filter more sustainable products.

2.1.5. ENHANCE GLOBAL COLLABORATION

As the world aims to recover from the COVID-19, it is more important than ever to enhance collaboration to address the nature-related causes for pandemics, and use the recovery efforts to transition towards a global economy that respects the SDGs. Climate change, biodiversity loss and environmental degradation are global problems that can only be solved via joint effort.

Digitalisation is already an important driver and could do even more to support these efforts.

Global data management is key to understanding these problems and designing needed measures. International efforts to keep track of global GHG emissions (for example, by the Intergovernmental Panel on Climate Change) and biodiversity loss (for example, by the Global Biodiversity Information Facility) are examples of ongoing collaboration. Challenges remain, however, like the reliability of and access to data.

Moreover, digital tools are often not used to their full capacity. For example, digital tools like eCITES have been developed to automatise the electronic exchange of information between customs and other stakeholders, and thus the improve enforcement of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). However, the uptake of this tool by governments around the world has been negligible.²⁰

Much more needs to be done in other areas, too. Modern value chains are global. Products on the European market comprise components and materials from across the world. This implies that the Union must engage and collaborate with its global partners if it is to ensure optimal data management, transparency and information exchange to make supply chains and products more sustainable. Existing global databases like the Global Material Flows Database (GMFD) provide a good basis on which to work. Moreover, organisations like the World Trade Organization (WTO) and OECD can play an important role in enhancing shared understanding and collaboration on needed information exchange.

- The EU and its member states should **enhance the global collaboration of sharing data and information** relevant for the protection of the climate and environment. The aim should be to encourage the global development of open, interoperable data for greater sustainability.
 - ▶ As signatories of CITES, the EU and its member states should adopt eCITES and use diplomacy and financial support, if needed, to encourage its uptake across the globe. This would help combat the illegal trade of endangered species and thus prevent biodiversity loss.
 - ▶ The EU should encourage the development of global guidelines for the sharing of data and information across value chains (within e.g. the WTO, OECD). It should promote international collaboration between governments and industries to develop a common set of standards on data sharing, which could also support digital product passports. The EU should ensure that the information on products and materials collected outside of the EU is reliable, compatible and of use in the EU. This should build on existing work, such as EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport) and EDIFICE (Global Network for B2B Integration in

High Tech Industries) standards, global initiatives on blockchain (e.g. International Association of Trusted Blockchain Applications) and AI (e.g. Institute of Electrical and Electronics Engineers), and the GMFD and Global Resources Outlook.

2.2. DEVELOPING AND DEPLOYING DIGITAL SOLUTIONS FOR GREATER SUSTAINABILITY

The EU risks falling behind in the overall digital race – think 5G, IoT and AI – vis-à-vis China and the US. This could have significant negative implications on the EU’s competitiveness, security and prosperity. However, the game is not lost. European businesses are successfully developing digital, innovative solutions for the benefit of the planet and people. Europe is, for example, a global leader in industrial IoT, which can enable predictive maintenance. It also has a strong basis in industrial AI and blockchain development. If the EU successfully integrates its values of sustainability, privacy, trust and security in the digital transformation, it could create a pioneering model for a green and human-centred digital transformation.

Digitalisation, if managed well, could transform our business models and consumption patterns; help address inefficiencies, waste and pollution in the existing economic systems; and ensure sustainable prosperity for future generations. It can also provide valuable tools (via for example platforms and apps) for engaging with and empowering citizens and relevant stakeholders in the transition to a greener economy. It is in the EU’s interest to continue building on the aforementioned opportunities and address the existing challenges, starting with investment gaps regarding the development and deployment of sustainable digital solutions.

At the same time, it should be noted that digitalisation does not automatically lead to greater sustainability. If unguided, it risks leading to unwanted rebound effects, like an overdrive of an unsustainable linear, take-make-dispose economy (e.g. people using e-commerce platforms to consume more), or make agricultural or transport systems more efficient but not more sustainable.

The Commission’s proposals for an industrial strategy and digital agenda provide a starting point for European industry’s path to becoming a global leader in developing and utilising sustainable digital solutions for the protection of climate and environment. Moreover, financial tools like the MFF, or the new recovery instrument Next Generation EU, as proposed by the Commission, could provide public support and leverage private funding for these efforts.

2.2.1. FINANCE THE TRANSITION

Under its new proposal for the 2021-27 MFF,²¹ the Commission suggests allocating around 13% (i.e.

Fig. 4



Credit: macrovector/StockAdobe.com

€140.656 billion) to the Single Market, innovation and digitalisation. The Digital Europe Programme (DEP) is expected to play a key role in the deployment and uptake of digital technologies, and promotion of supercomputers, AI, cybersecurity and digital skills. Taking the scale of investment needed in these areas, its share in the proposed budget appears very small (around €8 billion).

However, in addition to the DEP, funds from Horizon Europe, InvestEU and Connecting Europe Facility (CEF) should be used to enhance digital transformation. Moreover, the Commission stresses the need to support green and digital transitions under its recovery plan, which include additional funding for a Recovery and Resilience Facility under cohesion policy (i.e. €560 billion), InvestEU (i.e. €30.3 billion) and Horizon Europe (i.e. €13.5 billion).

There is a great risk that the importance given to digitalisation rhetorically will not be translated into concrete investments that are urgently needed. Even Europe’s basic digital infrastructure for connectivity, including Internet coverage (i.e. high-speed broadband, 5G, fibre networks) and cybersecurity, remains underdeveloped. This has been further highlighted by the pandemic, which has demonstrated the need for an improved ICT infrastructure to ensure fast, reliable and high-quality connections.

This infrastructure forms the basis for a functioning society and resilient and competitive economy. Moreover, digitalisation comes with the risk of a digital divide, where only the wealthy and skilled can access and utilise available technologies. If the EU fails to invest in the needed infrastructure and skills, it will not reap the full benefits of the solutions that digitalisation offers.

- **The EU must invest more in basic digital infrastructure and people’s capacities to benefit from digitalisation.**
 - ▶ The EU must support infrastructural investments in connectivity (e.g. 5G, fibre networks) and cybersecurity since these are the basic conditions for digital transformation. In doing so, greater alignment with sustainability objectives must be ensured (e.g. energy and material efficiency of infrastructure).
 - ▶ The EU must ensure that citizens, workers and small and medium-sized enterprises have the necessary skills to use and benefit from sustainable, digitally-enabled solutions. This requires guidance and investment, especially in digital skills, and should build on existing initiatives like the New Skills Agenda for Europe.
- **The EU must invest in digital solutions** (e.g. AI, robotics, digital twins, blockchain, 3D printing), and ensure that these investments contribute towards its sustainability goals. The EU should aim to make the ICT sector more sustainable. It should encourage the development and deployment of greener digital solutions, and use the solutions to accelerate change towards a sustainable economy. To enhance recovery from the COVID-19 crisis, the EU should explore how investing in digital solutions can serve the different economy-, society-, security- and sustainability-related priorities efficiently.
 - ▶ Improving data analysis, including through AI, must become a higher priority. In line with the White Paper on Artificial Intelligence and with support from the DEP and Horizon Europe, the EU should provide financial support when needed to research centres across Europe that are improving analytics with AI, and encourage collaboration between them.
 - ▶ EU funds provided under the DEP and Recovery and Resilience Facility, for example, should be spent on projects that support the European Green Deal objectives. For example, investments in 3D printing can achieve several goals if they help reduce the environmental and climate footprint of production processes and also increase local business opportunities and business resilience in the face of disruptions to supply chains. As another example, using digital solutions to design, construct and deconstruct buildings, and investing in smart and green built environment can benefit the climate, environment and people in the form of better living and new jobs.
 - ▶ Under Horizon Europe, the European Institute of Innovation and Technology should be funded to research and develop sustainable digital technologies and business models, and innovative solutions like smart energy grids.
- ▶ European Investment Bank financing and the InvestEU programme should leverage public and private funding in order to support the scaling up and commercialisation of digitally-enabled solutions for greater sustainability. For example, a green tech investment initiative, as recently proposed by the Commission,²² should use InvestEU funding on the scaling up of innovative business solutions like greener product-as-service business models.
- ▶ The EU and member states’ COVID-19 recovery efforts must be aligned with the Green Deal goals and SDGs, and contribute to the joint green and digital transformations. This applies not only to the Commission’s proposal for Next Generation EU. It is also the case for the ECB’s Pandemic Emergency Purchase Programme (worth €750 billion), and member states’ use of public money, including state aid, credits, loans and stimulus packages.

2.2.2. ENHANCE NEW SUSTAINABLE BUSINESS MODELS

Business models are increasingly shifting from producing goods to delivering services, and digitalisation plays a major role in this development. Servitisation can improve the use of resources and facilitate the transition toward greater circularity. In its simplest form, existing products can be combined with value-added services to enhance their durability. A ‘product-as-a-service’ business model allows consumers to purchase the desired result rather than equipment, resulting in resources being used more smartly. Examples include selling printing services rather than printers, or healthy plants rather than pesticides and fertilisers.

Numerous examples of digitalisation enabling new business models already exist. Online platforms, apps or IoT can be used to connect service providers, users and assets. These practices can encourage product longevity, reusability and sharing; reduce demand for materials and negative externalities (e.g. pollution or waste); and ultimately even support dematerialisation. Simultaneously, shifting to servitisation can help businesses benefit from stronger customer relations and thus generate more stable revenue streams. But while prospects for new business models are promising; only case-by-case analysis can help ensure that they deliver greater social and environmental benefits than traditional business models.

The public sector can be an important player in creating demand for new sustainable business models. The Public Procurement Directive 2014/24/EU and other derivative rules, such as the green public procurement (GPP) criteria, can play a central role in these efforts.

- Member states should **utilise the full potential of public procurement to drive the green transition and favour solutions with a smaller**

environmental footprint. Should servitisation be more sustainable than buying products, this should be recognised in procurement criteria and decisions. The EU should support this by updating the GPP criteria to include a stronger emphasis on procuring services.

- The Commission should **promote strategic public procurement and public procurement for innovative solutions** to enhance the development and uptake of new sustainable business models. It should develop concrete guidelines while also building on specific procedures and initiatives like innovation partnerships, the Big Buyers and Networks Initiative, procure2innovate (European network of competence centres for innovation procurement) and European Assistance for Innovation Procurement.
- The EU should **develop monitoring mechanisms to assess the transition toward sustainable digitally-enabled business models.** The EU's Digital Economy and Social Index (DESI) should be expanded to include indicators on environmental and climate performance of companies.

2.2.3. DEVELOP SUSTAINABLE AND SMART MOBILITY

The mobility sector is currently undergoing a fundamental transformation – partly driven by digitalisation – which is changing the way we move in cities, rural areas and even between different countries. A whole range of digital technologies (i.e. IoT, sensory equipment, AI, platforms, apps) is being deployed and tested to make mobility more efficient, giving rise to new concepts such as intermodal, connected, automated and service-based mobility.

Although these new mobility solutions can help reduce the environmental impact of the transport sector, this is not a given. There is even a risk that they will result in more cars, or other potentially polluting and/or wasteful individual modes of transport on the street. However, bearing in mind the potential of digitalisation to disrupt and transform existing systems, if it is well guided, it could help tackle mobility and especially road transport-related environmental challenges (i.e. GHG emissions, congestion, air pollution, consumption of natural resources, waste).

Ensuring the shift to sustainable mobility is especially pressing in the context of the pandemic, which will continue to have great impacts on how people move. The Strategy for sustainable and smart mobility – envisaged to be adopted by the Commission in late 2020 – is very much needed to provide a holistic policy framework which ensures that digitalisation contributes to making the mobility system cleaner and climate-neutral.

- The EU must develop a '**Charter for Sustainable Mobility in a Digital Age**' – a vision of sustainable mobility in the digital age that is shared and supported by relevant stakeholders. The Charter should contain reflections on the future of mobility and transport alternatives, and recognise how the paradigm shift resulting from the pandemic can increase teleworking and demands on mobility. The Commission should convene relevant stakeholders to develop the Charter together, creating a shared vision, a common understanding of principles and a commitment to a holistic policy approach. An ad hoc stakeholder platform consisting of public authorities, industry, consumer associations, non-governmental organisations (NGOs) may need to be founded for this purpose. The Charter should be suggested in the upcoming Strategy for sustainable and smart mobility and developed by mid-2021.
- The EU should encourage the development of apps or application programming interfaces to offer citizens **end-to-end and comparative 'green and clean' travel options** across Europe. Such solutions could enable easy-to-use, one-stop shops for booking travels using several modes of transport across the continent. The required data about the emissions of different transport modes should be provided by a 'Common European mobility data space'.

2.2.4. DEVELOP SUSTAINABLE AND SMART AGRICULTURE

Digitalisation offers many possibilities for addressing the significant environmental and climate footprint of European agricultural sector. Digital technologies like big data analytics and AI can help manage data in the agriculture sector. Meanwhile, satellite imagery, sensors, IoT, automation, drones and robots can support precision farming, the sharing of information, better monitoring and surveillance of agricultural practices, including impacts on ecosystems and biodiversity, and even compliance with environmental rules.

The prospects of digitalisation enhancing the EU's agriculture is recognised in the Commission's proposal for a post-2020 Common Agricultural Policy (CAP). The Farm to Fork strategy recognises even more clearly the link between digitalisation and achieving climate and environmental goals. As such, it serves as a good basis for aligning the digital and green transitions within the agricultural sector.

However, it is worth noting that there is a great risk that if not steered adequately, increased emphasis on digitalisation within agriculture could just lead to a boost in efficiency gains, more intensive farming and the optimisation of unsustainable farming practices. Moreover, as long as there is no standardised data on, for example, pesticide use, the monitoring of progress will be hampered.

- The Commission should set up a ‘**Stakeholder Platform on Sustainable Agriculture in a Digital Age**’, comprising public authorities (including spatial planning authorities), farmers, digital experts and industry, academia, civil society (including environmental NGOs) and consumer associations. It should develop a joint vision and criteria for sustainable agriculture in the digital age. Building on the Commission’s Farm to Fork strategy, the platform should potentially be scaled up to address the entire food system, and explore how it could be made more sustainable with the help of data and digitally-enabled solutions.
- **The post-2020 CAP should ensure that the uptake of digitally-enabled solutions supports environmental and climate objectives**, as suggested in the Farm to Fork strategy. Member states’ strategic plans must reflect the links between digitalisation and sustainability, so that the uptake of digital technologies under the CAP contributes to more sustainable farming practices and avoids rebound effects, like intensive farming.

2.3. GREEN THE INFORMATION AND COMMUNICATIONS TECHNOLOGY SECTOR

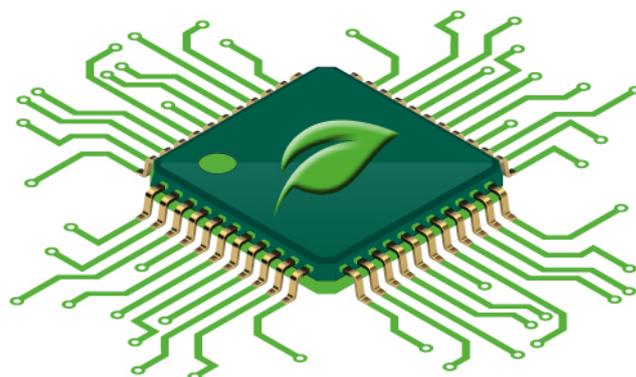
While the information and communications technology (ICT) sector plays a vital role as an enabler for a more sustainable economy and society, the negative side-effects of accelerated digitalisation merit attention. Be it the data centres, electronics or computing, the ICT sector has a significant climate and environmental footprint.

The sector currently accounts for around 2% of global GHG emissions, which is comparable to the aviation sector.²³ What is even more alarming are the estimations that the ICT’s share in global GHG emissions could increase to over 14% by 2040.²⁴

Moreover, the sector’s resource use and waste are a problem. A significant consumer of critical and virgin materials, the sector’s resource extraction contributes to biodiversity loss and water stress. Computers, smartphones and other electronic devices eventually become e-waste, which is currently one of the fastest-growing waste streams. Multiple device ownership, the growth of cloud computing services and short replacement cycles are paving the way towards a growing e-waste generation.

The need to improve the energy and material efficiency of ICT is recognised in the EU’s Digital Strategy as well as Circular Economy Action Plan. The Ecodesign policy framework provides particularly interesting prospects for tackling energy and material inefficiency in electronics.

Fig. 5



2.3.1. ENHANCE THE SUSTAINABILITY OF DATA CENTRES AND CLOUD COMPUTING

Data centres have significant energy and thus climate as well as material footprints. Data centres’ energy demand is increasing drastically. This is due to the increasing demand for computing power for applications and technologies like streaming, machine learning, IoT, quantum computing and blockchain technology. Although cloud technology can reduce the amount of hardware used, the amount of data stored and exchanged is growing explosively, which risks offsetting gains made.

Besides energy efficiency, a decarbonised energy supply for the data centres would form the basis for a green digital transformation. Thus, the scope and speed of the EU’s energy transition have direct implications on the sustainability of the digital transition.

- **The environmental footprint of data centres should be evaluated** by the Commission while bearing in mind both energy and material efficiency and building on existing initiatives (e.g. German Key Performance Indicators for Data Centre Efficiency).²⁶
 - The Commission should establish an inventory of data centres at the EU level, to be collected by Eurostat.
 - The indicators for the environmental footprint of data centres should go beyond energy efficiency and include the entire lifecycle of data centres (e.g. construction materials, water consumption for cooling hardware).
 - The Commission should develop standards to monitor and compare the energy consumption of data centres.

- **The Commission should develop energy and resource efficiency criteria for data centres** within the Ecodesign policy framework.

- When developing the criteria, frontrunners' performance should provide guidance and form the basis for minimum criteria.
- The new Ecodesign criteria could be established as mandatory requirements under the new regulation. When developing mandatory requirements, the EU must be mindful of their potential impact on the competitiveness of the EU's ICT industry in the global arena. Close collaboration between the Commission and the ICT sector is, therefore, of paramount importance.

- The EU should take the necessary measures to **make European data centres climate-neutral by 2030**, as proposed by the Commission,²⁷ which could entail purchasing or producing, and thus using 100% renewable energy.

- The Commission should set targets and mandatory monitoring mechanisms to track progress. When developing targets and monitoring mechanisms, it should consult and collaborate with a wide range of stakeholders (i.e. member states, digital industries, energy companies, academia, NGOs).
- As a starting point, prior to regulatory intervention, the EU should initiate a pledging campaign with the ICT industry to increase the share of renewable energy supply.
- The EU should consider introducing a new directive which stipulates general requirements on renewable energy for data centres. Member states should establish their own concrete action plans for making their data centres' energy supply completely renewable by 2030 and monitor performance.
- The Commission must consider the European digital industry's potential concerns on the stability and costs of renewable energy supply in comparison to the business-as-usual scenario. The EU and member states should devise technical solutions to ensure the stability of the grid as envisaged by the European Green Deal. This entails developing the energy storage capacities further and investing in digitally-enabled smart grids, to better match the renewable energy supply with the energy demand. The EU should also consider implementing different financial measures that can facilitate the progress while ensuring the competitiveness of the EU's ICT sector (by e.g. cutting subsidies to fossil fuels and, if needed, providing subsidies for renewable energy).

- The EU should **develop indicators for greening ICT**. The EU's DESI could be expanded to include indicators on the climate and environmental performance (i.e. energy and resource efficiency) of data centres, as well as the entire ICT infrastructure needed for connectivity like 5G and fibre networks.

- The EU should provide guidance, and possibly indicators, for **energy- and resource-efficient use of AI and blockchain technologies**. For example, as suggested in the White Paper on Artificial Intelligence, the Commission should explore with the member states how they can promote sustainable AI solutions, which are trained not just to make choices that are positive for the environment but also critically examine their resource usage and energy consumption.

2.3.2. MAKE HARDWARE MORE SUSTAINABLE AND EXTEND ITS LIFETIME

ICT equipment requires significant amount of often critical and virgin materials. As suggested in section 2.1.4., increasing information sharing across value chains for sectors like electronics is central to enhancing smarter use of resources.

Moreover, the short lifecycles of new electronic devices are a significant problem. ICT equipment often loses its function due to software changes or a lack of reparability, spare parts or support including software updates. The Commission has already taken first steps with its Circular Electronics Initiative – envisaged under the Circular Economy Action Plan – to promote longer product lifetimes. Building on this initiative, more concrete policy measures should follow. A major instrument for defining product standards in the EU is the Ecodesign Directive 2009/125/EC.

- Building on the Circular Economy Action Plan, the EU should **develop ecodesign requirements and corresponding labels for ICT equipment, including mobile phones, printers, tablets and laptops**. This should cover aspects related to energy and material efficiency (i.e. durability, reparability, modularity, upgradability, remanufacturing, maintenance, reuse, recycling), as well as the presence of hazardous substances.
 - New ecodesign requirements should make the provision of updates, repair instructions and spare parts mandatory. Such requirements would prolong the durability of products and ensure the implementation of a 'right to repair', as envisaged in the Circular Economy Action Plan.
 - Ecodesign requirements should entail prolonging software support for older hardware to avoid hardware obsolescence. The Commission and ICT producers should collaborate, for example, via stakeholder platforms, on increasing

compatibility between software and repaired and remanufactured equipment.

- ▶ The Commission should develop mandatory requirements, like possible recycling content quotas, to encourage the intake of recycled materials in new electronics.
- ▶ Further development of ecodesign requirements for hardware should be supported by instruments like PEF and lifecycle assessments (LCAs), which provide useful methodologies to assess the environmental footprint of products.
- ▶ New ecodesign requirements should be turned into new regulations, or integrated into existing ones under the Ecodesign Directive.
- The Commission should speed up the development of **ecodesign requirements for fast-evolving consumer electronics, such as smartphones**.
 - ▶ A fast-track procedure for the development of ecodesign requirements for mobile phones, laptops and tablets should be devised. This requires the Commission and expert bodies like CEN-CENELEC to intensify their collaboration.
 - ▶ Horizon Europe and DEP programmes and funds should be used to speed up the development of standards for fast-moving consumer electronics. Investing in big data analysis to support these efforts is particularly important, given that the development of standards is too slow to keep up with the pace of technological developments in this sector.
 - ▶ Rules (e.g. regulations) for frontrunners should be developed, where the highest performing product in terms of resource and energy efficiency can set the minimum standard for similar products on the market. When developing these rules, the Commission should consider current market conditions and consult with the European ICT industry to ensure its competitiveness. It should also consider similar practices in other countries (e.g. Japan's Top Runner programme).

2.3.3. DEVELOP PUBLIC PROCUREMENT FOR A GREEN ICT

GPP is a powerful instrument that can create a market demand for more sustainable products. However, the potential of GPP to incentivise the development and deployment of greener ICT (including the uptake of refurbished and remanufactured equipment) has not been utilised to their maximum by public authorities, maybe due to more complex procedures and higher costs. Also, good practices are hard to identify because of the absence of mandatory reporting on GPP. The need to strengthen GPP is recognised in the Circular Economy

Action Plan, which outlines a vision to create minimum mandatory GPP criteria.

- Building on the current Commission's proposal, the EU should **amend the Public Procurement Directives** to introduce i) mandatory GPP for electrical and electronic equipment; ii) mandatory GPP criteria to assess progress at the EU level and compare GPP performance between member states; and iii) mandatory reporting on GPP by member states to the Commission.
- **The EU should develop mandatory GPP criteria for ICT:**
 - ▶ The Commission should start by assessing whether the existing non-mandatory GPP criteria can be turned into mandatory criteria. Moreover, it should consider introducing criteria for products like laptops, mobile phones, tablets, for which GPP criteria does not yet exist. Mandatory GPP criteria could be introduced via specific regulations.
 - ▶ The establishment of mandatory GPP criteria could build on already existent labelling schemes at the EU and member state levels. For example, the German Blue Angel ecolabel can serve as a model for developing criteria on sustainable data centres and software.
 - ▶ In the process of developing mandatory GPP, the Commission must conduct consultations with industry, civil society, and national and subnational administrations that may show hesitation due to new responsibilities and a lack of expertise. The Commission must make efforts to understand their potential difficulties and find ways to facilitate the process (e.g. provide guidelines on GPP, transitional periods and training, share best practices, encourage alliances between different public procurement authorities).
 - ▶ The Commission should plan and prepare guidelines and projects that would support national and subnational authorities (e.g. via training and exchanging good practices). Together with member states, the Commission should consider economic incentives for the procurement of greener ICT (e.g. lower VAT for electronics containing recycled materials).
- **The Green Deal data space should support new GPP rules.** The Green Deal data space could contain a common repository of different GPP practices at the member state level, and common electronics forms could be established at the EU level to facilitate public procurement procedures. Thereby, public authorities would be able to compare their practices more easily, identify the best solutions and make better public procurement decisions that incentivise the development and deployment of greener ICT.

3. The time to act is now

The COVID-19 pandemic and consequent economic recession require the undivided attention of European leaders. At the same time, the recovery from this crisis provides an opening to address the systemic problems in our current economy. This is an opportunity to build a more sustainable, resilient and competitive European economy. This is the occasion to strengthen and prepare Europe for the multiple challenges it faces.

Global warming, pollution, environmental degradation, biodiversity loss, a lack of competitiveness, the lag in the digital race, competition over resources and social woes... The list of challenges is long, and the EU must tackle all of these if it is to ensure long-term sustainable prosperity for all Europeans.

Europe cannot afford to wait for the sustainability crisis to accelerate. It must continue to address the systemic and sectoral problems proactively, prioritise climate action and the protection of nature, and capture the related benefits for the economy and society. The cost of inaction would be incalculable. The benefits of action would be numerous.

To recover from the pandemic, Europe needs sustainable growth and jobs. It is now more urgent than ever for the EU and its member states to create the conditions for European industry to become a leader in providing solutions for greater sustainability. The EU has valuable human capital and a strong innovation base upon which it can build. Moreover, the market for sustainable, innovative products and services that help solve global sustainability challenges is growing fast in Europe and beyond.

What the EU needs now is more comprehensive efforts to align the green transition with the digital transformation. If the EU creates the right conditions for the development, deployment and scale-up of digitally-enabled solutions for a more sustainable economy, the rewards will be massive and also benefit generations to come.

As this paper has argued, digitalisation can be a powerful enabler for the green transformation. Managing data and deploying digitally-enabled solutions can improve the monitoring, evaluation and implementation of existing environmental policies. Digital solutions can turn data into usable knowledge, enhance the connectivity and exchange of information, and make existing operations and practices more

sustainable. Be it consumption and production, agriculture or mobility – if guided well, digitalisation can support system-wide transformations.

As the EU looks for a new entry point into the digital race, it should recognise that digitalisation itself is not the end goal: Europe needs digital solutions that can help it meet its goals. Digital transformation will be a real contributor to greening our economy only if the ICT sector itself becomes more sustainable. The EU needs a digital transformation that helps it solve climate and environmental challenges, enhance social cohesion and improve competitiveness – all at the same time.

The Commission's proposal for a European Green Deal provides the direction. The follow-up initiatives, be it on the digital agenda, circular economy, industry, biodiversity, food systems or mobility, provide the working ground for interlinking the sustainability and digital agendas. The EU and its member states should use these as a basis to further develop a policy framework and action plan that harness the power of data and digital technologies in achieving sustainable prosperity. They must use the available financial tools, including the MFF and Next Generation EU recovery instrument, to provide public support and leverage private funding to create sustainable, competitive and resilient Europe. It is time to turn digitalisation into a catalyst for creating a better world; an enabler that helps people and businesses operate within the planetary boundaries.



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- 7 The authors recognise that digital technologies are increasingly integrated in different innovations and enable a wide range of solutions. Thus when they refer to digital solutions and digitally-enabled solutions, this refers to technologies like artificial intelligence, blockchain and the Internet of things, but also to solutions enabled by them like digital product passports.
- 8 *Servitisation* refers to the shift to business models that are based on the provision of services rather than products. This can reduce material consumption and waste generation.
- 9 *Dematerialisation* is the reduction of materials to achieve greater prosperity. Virtualisation and servitisation can help achieve dematerialisation.
- 10 The European Commission defines *eco-innovation* as "[a]ny form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development. This can be achieved either by reducing the environmental impact or achieving a more efficient and responsible use of resources." *European Commission*, "[Eco-innovation > FAQ > What is Eco-Innovation?](#)" (accessed 2 May 2020).
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- 17 See e.g. Material Economics (2018), "[The Circular Economy: A powerful force for climate mitigation](#)", Stockholm.
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The Sustainable Prosperity for Europe (SPfE) programme explores the foundations and drivers for achieving an environmentally sustainable and competitive European economy. While the climate crisis is a complex challenge to be addressed, non-action is not an option. Prospering within the planetary boundaries requires rethinking the existing take-make-dispose economic model, reducing pollution and being smarter with the resources we have.

The Paris Agreement and the Sustainable Development Agenda provide a direction for travel, and SPfE engages in a debate on the needed measures to achieve a fair transition to an environmentally sustainable economy and society. It focuses on areas where working together across the European Union can bring significant benefits to the member states, citizens and businesses, and ensure sustainable prosperity within the limits of this planet.

The ‘Digitalisation and Sustainability’ project was commissioned by the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) and was carried out between 2019 and 2020. It explored the potential links between sustainability and digitalisation, and specifically considered how digitalisation could enhance sustainable consumption and production, improve biodiversity, make agriculture and mobility more sustainable, and green ICT.

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