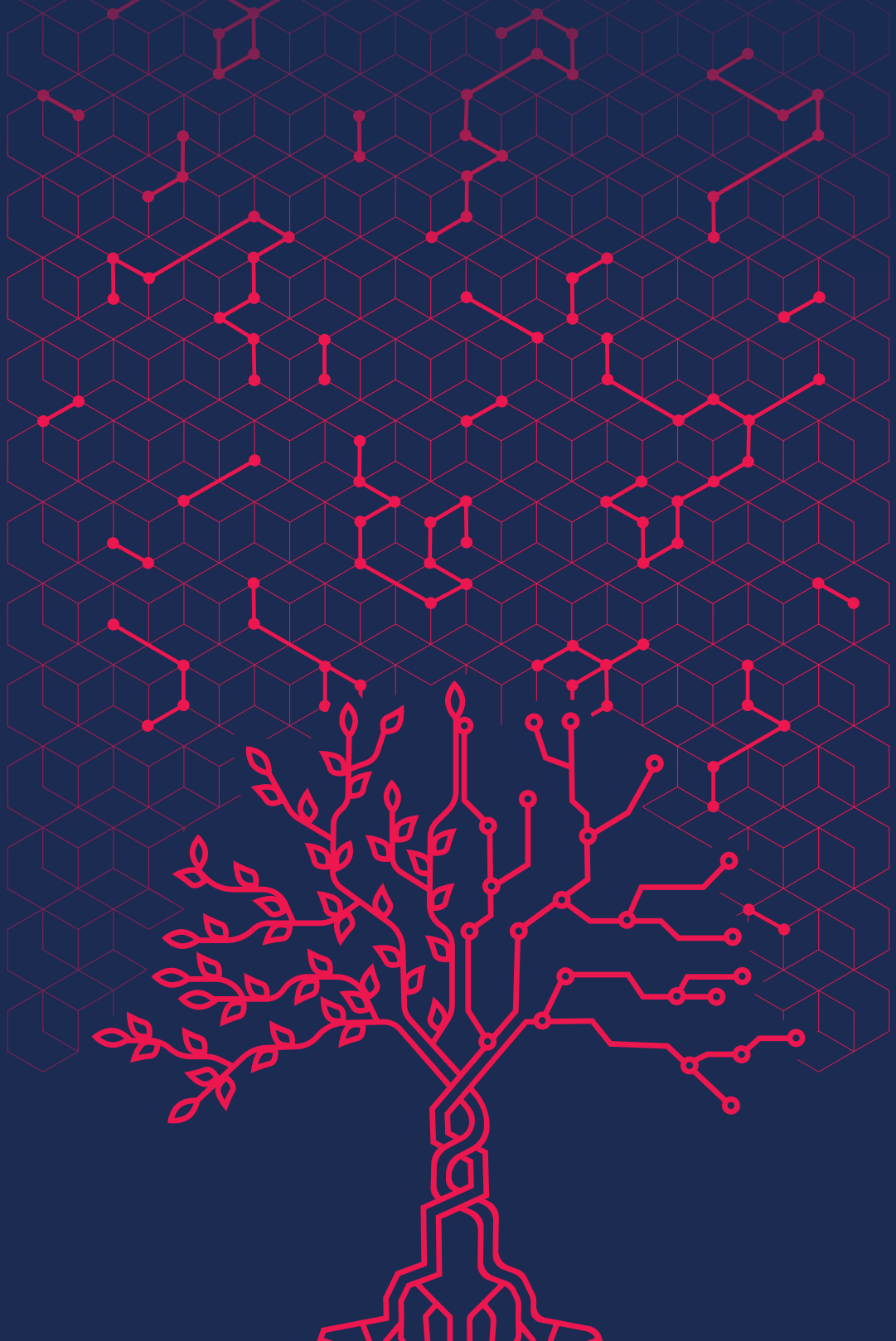# DIGITAL ANATOLIA 3: QUALIFIED DIGITAL TRANSFORMATION GUIDE

TÜRKONFED

CIPE

DIGITAL ANATOLIA 3:
QUALIFIED DIGITAL TRANSFORMATION GUIDE

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Executive Summary

Within the scope of the "Local Development for the Business World:Environmentally Friendly Growth" project implemented in cooperation with the Turkish Enterprise and Business Confederation (TÜRKONFED) and the Center for International Private Enterprise (CIPE), it is aimed to raise awareness about the effects of digitalization on the environment. Thus, it is aimed to raise political awareness about the opportunities and risks posed by technologies that have become widespread through digital transformation for environmental sustainability. Within the scope of the project , workshops drawing attention to the effects of digitalization on the environment were held in Hakkari on 26 April 2023, Giresun on 17 May 2023, Şırnak on 10 June 2023 and Çorum on 14 September 2023. In these workshops, feedback was collected from the participants through both awareness and end-of-event surveys.

"The importance of digitalization" was the topic that participants in all events agreed on. Where; It can be interpreted that there is interest in digitalization, therefore future policies will be supported by the grassroots and adaptation will be easier. It would be useful to see this as the opportunity brought by digitalization. In order to manage the urgent need for digitalization together with its environmental impacts, it is necessary to include environmental opportunities and risks in all policy steps. Digitalization means; While it means more energy and raw materials in the environmental dimension, it also means an excellent tool that can be used for efficiency and reduction. Within the scope of the project, a tool consisting of 130 questions, aiming to measure the level and type of digitalization achieved by businesses in Türkiye, was developed and put into use.

When evaluated in terms of regional development and inequalities, digitalization trends are evaluated on three different aspects: social, economic and environmental. From a social perspective, it is critical to ensure justice and balance in the access of various social segments to digital technologies. This situation, also referred to as the digital divide; It refers to the differences in

access to information and communication technologies between commercial enterprises and individuals who differ in terms of socio-economic conditions in different geographical areas. In our country, as in most countries of the world, there are differences between regions in terms of access to digital technology infrastructure and adoption of technology use, making public intervention necessary in this area.

When evaluated from an economic perspective, the digital economy changes business models as companies adapt prominent technologies such as advanced data analytics, machine learning, internet of things, cloud computing to existing production practices, thereby providing significant productivity increases. On the other hand, as a result of the rapid development of Industry 4.0 applications in terms of the employment market, more and more tasks, professions and business lines are subject to automation.

When evaluated from an environmental perspective, "smart city" applications come to the fore along with digitalization. Today, municipalities and other public services are digitalized with smart city applications that adopt automation, machine learning and internet of things technologies, and decision-making processes are made more rational by processing high-dimensional data. Smart city solutions also bring along consumption practices that reduce negative environmental impacts. In particular, applications such as smart transportation, smart grid, and smart waste management play a critical role in reducing carbon emissions and increasing energy efficiency.

There are three objectives aimed at ensuring policy consistency between sustainability and digitalisation:

1. Reducing the environmental footprint of digital technologies;
2. Identifying opportunities and risks of digital solutions in sustainability policies;
3. Incorporating sustainability goals into digitalization policies.

Introduction

Digitalization gives people access to a large data network. As long as the goals are to create an equitable, ecologically sustainable and healthy society, internet-connected intelligent systems can offer a systematic opportunity to solve long-term sustainability problems. Digital technologies can change the rules of the game at three points: sustainable development goals; socio-economic development and the role of digital technology in environmental sustainability. The technological network has the potential to unite urban and rural lives under a common principle of sustainable development and keep all social elements in the loop. Countries that follow a comprehensive strategy will be able to offer their citizens equitable growth and an effective, sustainable and digital existence.

Informed, self-aware and digitally empowered individuals will be better learners, thinkers, reformers, participants and agents of change and growth on the path to sustainable progress. The advantages of digitalization are being investigated in accelerating the transition to sustainable industrial processes and ensuring people's health and happiness. However, it is very critical to ensure progress by being aware of the possible threats and cyber security vulnerabilities of digital technologies to the planet's resources.

Within the scope of the "Local Development for the Business World:Environmentally Friendly Growth" project implemented in cooperation with the Turkish Enterprise and Business Confederation (TÜRKONFED) and the Center for International Private Enterprise (CIPE), it is aimed to raise awareness about the effects of digitalization on the environment. Thus, it is aimed to raise political awareness about the opportunities and risks posed by technologies that have become widespread through digital transformation for environmental sustainability. Within the scope of the project, a tool was developed that aims to measure the level and type of digitalization achieved by businesses in Tükiye. This report was prepared in the light of the answers collected through four local events and tools organized within the scope of the project.

General Evaluation of Digitalization Policies in the World and in Türkiye in the Environmental Aspect

Digitalization, which expresses the transformation in the economy with the wide-scale adoption of existing and newly prominent technologies on a sectoral, social and state basis, becomes more influential in the economy every day. The concept of digitalization includes a wide range of different technologies such as computers, mobile applications, robotic technologies, internet of things, automation, etc., which will directly affect the economy and social life.

During the COVID-19 pandemic, which emerged in the last month of 2019 and spread all over the world, digital technologies allowed governments to communicate with people and provide services online. During this period, in many countries, digital governance took on a central role as a necessary element of communication, leadership and collaboration between policy makers and society. With the call of the United Nations Department of Economic and Social Affairs (UN DESA), with the rapid information program in 2020, governments from around the world shared almost 500 applications regarding COVID-19 in a short time. As the pandemic became more widespread, policymakers mobilized public and private partnerships to design new services and applications as part of the crisis process. Some of these new services and applications has gone beyond sharing information and delivered essential services to those who need them most. They achieved this by optimizing the entire supply chain with digital government services. Increasing expectations for governments during the pandemic continued to increase in the post-pandemic period. Digital technologies are vital to providing accessible, reliable and inclusive services, especially for vulnerable groups. Additionally, digital technologies and solutions have now become available as an implementation tool to achieve the 2030 Agenda for Sustainable Development and improve public services, increase people's participation, increase transparency, accountability and inclusion. The 500 policy implementations brought together by UN DESA are included in detail in the "Compendium of Digital Government Initiatives in response to the COVID-19 Pandemic 2020" report.

Along with the digital technological developments that we briefly mentioned above and which will enable us to achieve the 2030 Sustainable Development Agenda, to our knowledge, there is not yet a comprehensive regulation addressing the opportunities and risks of digital technology in terms of sustainability worldwide. And for this reason, the relationship between digitalization and environmental sustainability still remains unclear. Undoubtedly, potential digital technologies will play an important role in overcoming the climate crisis. However, on the other hand, digital hardware production and data-intensive applications increase the demand for natural resources and energy. For these reasons, digital policies to be developed should include measures that serve environmental goals, and environmental policies should address the risks and opportunities of digital technologies to promote sustainability transformations.

In 2019, according to the GeSI and Deloitte's report titled "Digital with Purpose: Realizing SMARTer2030", it is estimated that global greenhouse gas emissions in industry will be reduced by roughly 9% thanks to digital technologies. In the article "Digital Action Climate Action: 8 ideas to accelerate the twin transition" published on the Digitaleurope website in 2021, it was stated that multinational companies and national trade associations joined forces in key sectors to make digitalization indispensable for sustainability. However, digitalization is not yet sufficiently used to achieve environmental goals, as there is a lack of coordination and cooperation in the policy areas of digitalization and environmental sustainability.

At the global level, the United Nations Secretariat-General created a Roadmap for Digital Cooperation in 2020. The World Trade Organization (WTO) is working on an e-Commerce Agreement. The European Union has implemented several important regulatory initiatives, including the Digital Services Package, the Data Governance Act and the Artificial Intelligence Act. There are numerous policies currently under consideration, such as the proposed Platform Competition and Opportunity Act in the United States; and besides, States such as China, Egypt and South Africa are developing their own national approaches to digital regulation. In many countries, national digital strategies form at least part of politicians' future narratives. However, in all of the mentioned initiatives, there is a serious lack of policy consistency between digital policy initiatives and policies targeting sustainable development. For example, the vast majority of regulatory initiatives in the EU's two main policy packages, the Green Deal and Fit for the Digital Age, do not address the environmental opportunities and risks of digitalisation.

Similarly, the United Nations Digital Cooperation Roadmap neglected environmental issues when it was established in 2020 and has only recently begun to address the issue in its ongoing work. Currently, very few initiatives directly aim to reduce environmental impacts related to digital technology hardware (such as regulation to reduce impacts from e-waste). However, globally there is no comprehensive regulation addressing the indirect environmental impacts resulting from the use of any digital technology. Therefore, much more comprehensive, multi-stakeholder collaboration and governance is needed to nurture the potential of digital technologies to achieve sustainability goals. In this way, it may be possible to decarbonize society or protect scarce resources and fragile ecosystems.

When we look at Türkiye, we see that laws and regulations have been created on the e-commerce side. However, digital tracking of waste is not yet possible. Issues such as waste management and environmental impact assessment are included in the Environmental Law. However, specific regulations do not yet exist. A regulation has been created for medical waste in our country, but no regulation has been enacted for digital waste.

Why Digitalization?

The use of digital technologies, which have the potential to ensure effective and efficient use of resources and enable sustainability, is rapidly increasing on a global scale. Therefore, the fact that digitalization is a global trend brings risks and opportunities. This is exactly why the integration of sustainability and efficiency criteria has become much more important.

According to the digital competitiveness data of the International Management Development Institute (IMD) as of the end of 2022 , Türkiye ranked 55th among the 63 countries examined. According to the Türkiye's Digital Transformation Index , prepared by the Informatics Industrialists Association (TÜBİSAD), its index rate increased by 2.94, 3.06, 3.21 in 2019-2021, and then it decreased by 2.8 percent to 3.12 in 2022. Access to finance, high taxes and difficulties in supplying qualified labor have been factors restricting the development of the information and communication sector.

Some of the results shared in the Digital and Financial Scorecard of SMEs|The Effect of Digitalization and Pandemic on Businesses | Quantitative Analysis Report published in April 2021 by TÜRKONFED, which has prepared many reports on digitalization to date, are as follows: In the digital/technology investments made by the SMEs that responded to the survey in the 2017-2020 period, the website (59.6%), company equipment (59.0%) and technological infrastructure, which we can call the first phase, are at the top. The fact that areas such as ERP

Enterprise Resource Planning (28%) and CRM-Customer Relationship Management (26.4%), which indicate a new phase in digital transformation, are at the bottom of investment decisions, reveals that companies prioritize digital/technological investments mainly for the functioning of the current structure. Effective data use ranks last among the reasons behind digital/technology investments both in the past and in the next three years. The trend of making lower investments in the fields that indicate a new phase in the digital transformation such as ERP and CRM shows that there is a major gap in the levels of awareness and knowledge of the businesses. Only 16.7% of SMEs define their digital maturity level as high. As the financial maturity level of companies increases, the digital maturity level also increases. Moreover, it is seen that the digital maturity level of the companies investing in the digital/technology field is higher (73,1%).

Another report of TÜRKONFED that we would like to mention is Digital Anatolia 2 | Sector Based Digital Transformation Roadmap. The results of the survey prepared for the report show that the automotive/component production sector is the most developed sector according to the digitalization map; It has been shown that this sector is followed by textile-ready-made clothing and greenhouse farming sectors, respectively. In detail, it shows that while the automotive sector is close to the industry 3.0 level, it remains below the 3.0 level in the strategy and smart production dimension. While the textile-ready-made clothing sector is at level 2.0 in the strategy, it approached level 2.5 in technical infrastructure, smart production and people, organization. Greenhouse farming, on the other hand, follows other sectors behind, being below the 2.0 level in strategic terms, close to 2.0 in terms of technical infrastructure, and slightly above 2.0 in smart production and organization.

Digitalization is of great importance for economic, social and environmental sustainability with its transformative power and the opportunities it offers. Among the subheadings of sustainability; Agriculture and Food Production, Clean Water, Energy Efficiency, Clean Energy, Industrial and Social Well-being, and Climate Research should be areas of study.

When digital technologies are evaluated on the basis of the business value chain, it will be seen that they create value at many points of the company value chain, from product development to R&D and innovation, from supply chain management to sales and marketing functions. Resource Utilization, Marketing, Labor Efficiency, Time Management, Quality Management, Asset Utilization, After-Sales Services, Process Management, Supply-Demand Balance and Stock Management are the main topics of the value chain where implementations will be made.

Demand for digital services will drive the production and supply of digital devices, resulting in an increase in energy demand. Providing electricity through polluting fossil fuels and increasing greenhouse gases will increase climate change and therefore negatively affect human health. Digital devices, if manufactured using renewable energy sources and powered by recyclable components such as batteries, will help improve human health by reducing pollution and climate change. With this approach, the demand for sustainable digital services can also be increased.

The European Union Green Deal, adopted to combat Climate Change and lay the foundations for a more sustainable life, has 9 policy areas. These have been determined as:

(i) Sustainable Industry (More sustainable and environmentally friendly production), (ii) Pollution Elimination (Reducing pollution quickly and effectively), (iii) Buildings and Renovation (Correctly guiding the construction sector) (iv) Sustainable Transportation (Supporting sustainable transportation methods), (v) From Field to Fork (Creating a sustainable food system), (vi) Climate Actions (Climate neutrality of the European Union in 2050), (vii) Sustainable Agriculture (Supporting agriculture in the EU with common agricultural policies), (viii) Biodiversity (Measures to protect the fragile ecosystem) and (ix) Clean Energy.

For Sustainable Industry, which is one of the above policy steps, the "Net-Zero Industry Law" proposal was presented by the European Commission on March 16, 2023. Technologies to be supported in this context are explained as; (i) Solar Energy Systems, (ii) Wind Energy Systems, (iii) Battery / Storage Technologies, (iv) Heat Pump and Geothermal Systems, (v) Electrolyzer and Fuel Cells, (vi) Biogas and Biomethane, (vii) Carbon Capture and (viii) Storage and Network Technologies.

The intersection points between the 9 policy areas listed above and digitalization may be listed as follows:

Smart Cities: With the use of digital technologies, urban planning and management can contribute to sustainability goals in areas such as energy efficiency, transportation and waste management.

Digital Agriculture: Sensors, data analytics and other digital technologies used in the agricultural sector can support sustainable farming practices.

Digitalization of Energy: Smart grids can contribute to green energy policies on issues such as energy efficiency and renewable energy integration.

Digitalization of Business Processes: Digitalization solutions can be created that allow companies to make their production and business processes more efficient and sustainable.

Digital Innovation in Transportation and Logistics: Intelligent transportation systems can promote sustainable transportation models.

Data Analytics and Environmental Monitoring: Digital technologies can provide benefits in areas such as monitoring and evaluating environmental impacts and more effective use of natural resources.

Integration of digitalization with green policy areas will contribute to the development of more effective solutions and sustainable practices.

Digital Technologies

Artificial intelligence (AI) means the systems and machines that perform tasks by imitating human intelligence and improve themselves with the information they collect. Thanks to artificial intelligence technologies, many systems, vehicles and machines can operate autonomously without human intervention. The areas where artificial intelligence is most used in the industry are; (i) Industrial progress control, (ii) Quality analyzes in welding, (iii) Product design analyses, (iv) Paper quality estimation, (v) Method and machine recognition, (vi) Part identification, (vii) Machine maintenance analyses, (viii) Project pricing, (ix) Appearance quality control systems, (x) Planning and management.

Cloud technologies are provided through server computers hosted by the service provider, where resources can be increased or decreased instantly, management costs are low, and far from the physical access of the enterprise, instead of the internal information technology hardware of the enterprises. Technologies such as Microsoft one drive, Google drive, Dropbox, Icloud are among the usage examples.

Internet of things (IoT) is the technology in which objects are controlled and managed by connecting to the internet. IoT connects machines equipped with sensors and actuators to the internet, enabling machines to generate, process and transmit data to people or machines in real time. For example: sensors, barcode readers, machinery, energy monitoring systems, fire detection systems and monitoring and control systems.

Cognitive robotics is an autonomous robot that can infer, perceive and learn based on obligatory autonomy and cognitive intelligence. Usage examples are; Environments (radioactive, toxic, extremely hot, etc.) that are not suitable for automatic production and human work.

Big data is the techniques adopted to analyze and derive intelligence from big data. It helps to ensure customer satisfaction, sales increases and correct product development by observing trends. It is also used to predict the interaction and impact of human or natural events, to observe trends and to create sample models.
Virtual reality (VR) is an advanced human-computer interface that simulates a realistic environment and allows participants to interact with it, aiming to establish a relationship between the participant and the created environment. It is used in studies such as occupational safety training, production line and operation process experience.

Augmented reality transforms the real environment into a digital interface by interacting with virtual objects in the real world. It is used in the processes such as (i) Making Research-Development (R&D) and Production-Development (P&D) simulation processes easier and faster, (ii) eliminating prototype costs with 3D virtual models, (iii) optimizing maintenance processes, (iv) instant stock tracking, (v) optimization of packaging processes.

Cyber Physical Systems (CPS) are transformative technologies that provide systems that are seamlessly integrated into their physical assets and computational capabilities. For example: These systems are used in simulation of a factory before its establishment, for carrying out necessary feasibility studies, and in smart factories.

Green Opportunities and Good Examples Brought by Digitalization

It was announced at the World Economic Forum that global emissions could be reduced by 15% thanks to the current applications of digital technologies. With the use of digital technologies in the fields of energy, manufacturing, agriculture and land use, buildings, services, transportation and traffic management, it is estimated that an amount between 15% and one-third of the 2030 target of 50% reduction in global carbon emissions can be met.

International organizations such as the United Nations and the World Bank carry out thematic programs compatible with the Sustainable Development Goals and create funding sources for technologies that will reduce our environmental impacts. Within this context; TÜBİTAK has shared comprehensive and detailed road maps on priority areas that will support the R&D ecosystem. The "TÜBİTAK 2022-2023 Priority R&D and Innovation Topics" study, which deals with current priority issues, focuses on "green" and "digital" technologies.

Digital technologies play a key role in achieving climate neutrality, reducing environmental pollution and restoring biodiversity. With the report prepared by the European Union Commission, an action plan was presented for the following topics: (i) Increasing the climate neutrality of the industry, (ii) Digitalization of energy, (iii) Switching to environmentally friendly transportation, (iv) Making smart and green agriculture, (v) Making buildings greener.

Here are some successful examples of a range of areas where AI can play a role in tackling environmental challenges and streamlining the supply chain, from designing energy-efficient buildings to monitoring deforestation and optimizing the distribution of renewable energy:

Via the "wesr.unep.org" website prepared by the World Environment Situation Room(UNEP), visuals compiling the best available earth observation and sensor data can be accessed to obtain information about near real-time analysis and future predictions about many environmental factors.
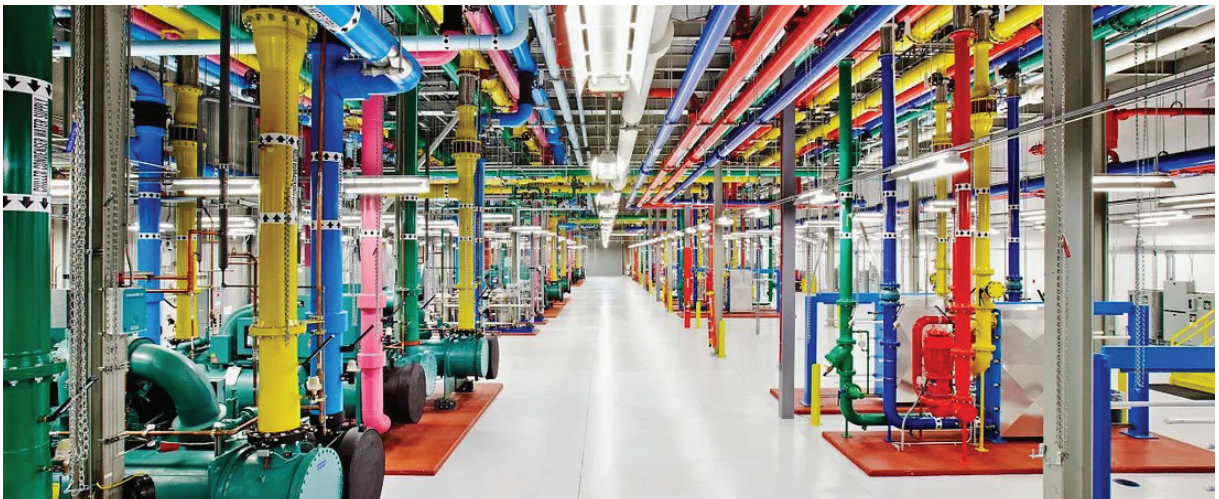

Figure 1: Google Deepmind data center

DeepMind Technologies Limited, operating as "Google DeepMind", is an artificial intelligence research laboratory serving as a subsidiary of Google. A self-learning artificial intelligence technology is used to reduce the energy load of Google DeepMind's highly secure data center, and with this successfully functioning system, energy savings of up to 40% have been achieved.

Offering technology-based, holistic waste management solutions for different waste streams from food to textiles, from packaging to chemicals, "More" provides many services such as "More Market, Smart Weighing System, Better Application and Sustainability Consultancy. Thus, by preventing waste generation at its source, it aims to convert the generated waste into a circular economy with the highest environmental, social and economic benefit. More Market is a commercial shopping platform that enables suppliers to deliver surplus products that they cannot sell through standard sales channels to new buyer groups, preventing waste and obtaining financial gain by making these products ready for use. Smart Weighing System monitors at what stage and in what amount food turns into waste in professional kitchens, enabling the organizations to take actions to reduce waste and increase profitability. Smart Weighing System determines action plans to reduce the purchasing costs and environmental impacts of organizations by measuring the size of wastes that cannot be tracked due to the intensity of kitchen operations, revealing the financial losses and environmental impacts of organizations resulting from waste, with the analysis and reports it automatically prepares in line with the measurements performed. The Better Application allows local businesses such as restaurants, greengrocers, markets and patisseries to bring their excess food, which they cannot turn into sales but is in good condition, to consumers. Businesses that bring their excess food together in surprise boxes under sweet, salty, fruit-vegetable and delicatessen categories offer them for sale on the mobile application with a 50% discount on menu prices, thus increasing food accessibility. Consumers, who purchase the boxes they want in cash, visit the business at the time specified by the business and receive their surprise boxes.

"Ecording" is a social enterprise that develops sustainable, innovative and technological solutions against the global climate crisis and has different products. Among these, E coDrones are unmanned aerial vehicles that support afforestation and biodiversity efforts by delivering seeds and seed balls to hard-to-reach areas, which is a priority against the global climate crisis. ecordingAPP is a mobile application where both individual and world needs can be met with the ecoPoints earned while taking action against the global climate crisis by verifying the tasks given for the benefit of the world.

"ForFarming" is an agricultural technology company that develops artificial intelligence-supported and IoT-based applications in vertical and greenhouse farming to increase efficiency, product diversity, energy and water efficiency, that produces practical, turnkey solutions for both agricultural producers and consumption points to provide fresh and healthy food to people. The Farmio product it developed is a remote monitoring application that automatically monitors all environmental parameters and provides the farmer with full visibility in real time. The farmer can thus immediately detect any deviation from the optimum situation, take the necessary precautions and keep his plants in optimum growing conditions at all times. Receiving instant alerts when any of the environmental parameters is outside the desired range or when any of the systems are suspected to be malfunctioning, the farmer is able to diagnose any problems early before they cause damage to his crops. It is possible to realize agricultural automation with Farmio.

"Ecosia" is a search engine founded in Berlin, Germany, that donates 80% or more of its profits to non-profit organizations focused on reforestation .

Figure 2: Ecosia Screen View. As of 18:36 on January 12, 2024, the Ecosia community has planted 190,249,023 trees in the world and the number of trees planted is increasing every second.

Negative Effects of Digitalization on the Environment

There are environmental impacts at every stage of the Life Cycle, starting from the extraction and processing of raw materials for the production of a digital device and ending with its transportation to the factory, production, packaging, distribution, use and disposal.

More than half of all components of devices produced within the scope of digitalization are made from raw or semi-processed materials produced by mining activities. Rare and important reserves such as cobalt, graphite and copper used in digital devices are especially concentrated in sensitive regions where corruption and human rights violations occur. These situations are frequently encountered in industries where sustainability policy is inadequate.

Electronic waste poses both a threat and an opportunity to the environment due to the hazardous substances and precious metals they contain. Approximately 700 thousand tons of electronic waste is generated every year in our country, but only 5 percent of this waste is recycled. Heavy metals such as mercury found in electronic waste damage the groundwater and soil when left exposed. Since this is an irreversible pollution, it causes permanent damage to the environment. Heavy metals pose a serious threat to public health by mixing with groundwater through rain and polluting our water resources. It has been proven that lead, called a heavy metal, has negative consequences on the nervous system, blood circulation and kidneys.

Data centers consume approximately 400-500 TWh of electricity. The devices in these centers produce a lot of heat and a lot of energy is spent to cool these devices. Today, only about 19% of global data centers can reuse this waste heat. There is a great potential here waiting to be benefited from.

Global trends that will further increase energy demand in the future within the scope of digitalization may be listed as; (i) cryptocurrency mining, (ii) cloud use, (iii) virtual and augmented reality, (iv) internet of things, (v) artificial intelligence, (vi) driverless cars and (vii) 5G internet. An unnecessary attached file that we send individually releases approximately 50g of CO_2 into the atmosphere. This is equivalent to harming the environment as much as using 5 plastic bags. If we consider the e-mails we send in a year, we can calculate the extent of the damage we cause to our planet with this activity alone. We use electricity for every email we send. Apart from this, we also use electricity to run computers and servers. Additionally, electricity is also used in the production of the device we use. Even in the environmental impacts resulting from just one e-mail we send, all the parameters we have mentioned should be taken into consideration.

Methodology

The project, which was implemented in cooperation with TÜRKONFED and CIPE within the scope of the "Local Development for the Business World: Environmentally Friendly Growth" project, aimed to raise awareness about the effects of digitalization on the environment. It is aimed to raise political awareness about the risks and opportunities that technologies becoming widespread through digital transformation pose for environmental sustainability. The prepared digital tool and surveys focused on the environmental dimension of sustainability, and the trainings covered all dimensions of sustainability, namely economic, social and environmental aspects.

Within the scope of the "Local Development for the Business World: Environmentally Friendly Growth" project, workshops drawing attention to the effects of digitalization on the environment were held in Hakkari on 26 April 2023, Giresun on 17 May 2023, Şırnak on 10 June 2023 and Çorum on 14 September 2023. As part of the workshops, the event, which proceeded as presentation and question-answer in the first three provinces, evolved into a panel in the last province. You can click here to access the training content, titled "Environmental Risks and Opportunities Brought by Digitalization", consisting of a 45-minute presentation in total and followed by a 15-minute question-answer session.

Awareness and End of Event Surveys

Within the scope of the project, workshops drawing attention to the effects of digitalization on the environment were held in Hakkari on 26 April 2023, Giresun on 17 May 2023, Şırnak on 10 June 2023 and Çorum on 14 September 2023. The event, which proceeded as a presentation and question-answer session in the first three provinces, evolved into a panel in the last province. In these workshops, feedback was collected from the participants through hand-filled surveys both at the beginning and at the end of the event, and it was observed whether the activities increased people's awareness levels. 10 of the 20 propositions in the survey were based on the relationship between digitalization and the environment. Each proposition was expected to be given a score from 1 to 5. 1 point / red corresponds to the answer "I have no idea" and 5 points / blue corresponds to the answer "I know very well". The qpropositions in the survey are as follows:

Hakkari Event

50 participants were included in the survey at the event in Hakkari province. In the awareness survey, the focus is the intensity of red and orange colors.. While the propositions on which the participants had least idea are the propositions "I can comment on how much carbon emissions a search engine query produces" with 52 percent and "I can comment on what percentage of electronic waste is recycled" with 40 percent, the proposition "I have information about why we need to digitalize" was the most well-known proposition with 28.

1. I have information about why we need to digitalize.
2. I can comment on the artificial intelligence opportunities brought by digitalization.
3. I have knowledge of companies that can be given as examples of Green Technologies.
4. I have knowledge about the life cycle of a digital product.
5. I know how the devices produced within the scope of digitalization affect the raw material supply.
6. I can comment on what percentage of electronic waste is recycled.
7. I have knowledge about the damage electronic waste causes to the environment.
8. I can comment on how much carbon emissions a search engine query produces.
9. I am aware of the high energy needs of data centres.
10. I am aware of the global trends that will further increase energy demand in the future within the scope of digitalization.
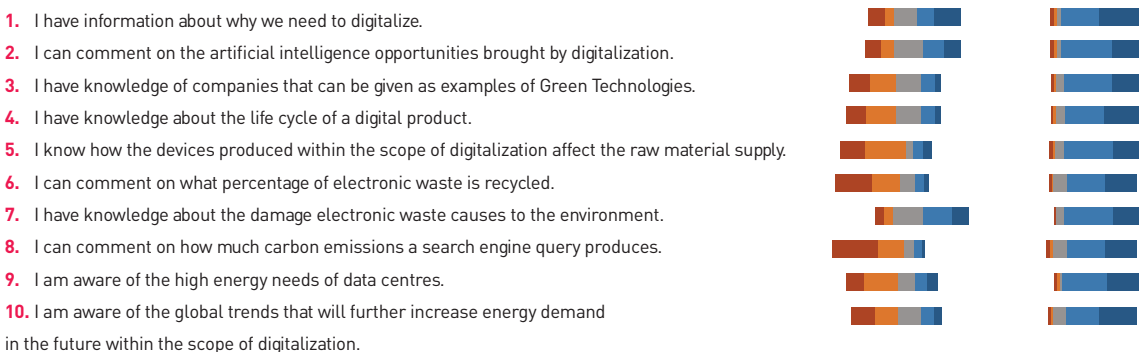

Figure 3: Awareness and End of Event Surveys, April 26, Hakkari (red "I have no idea", -blue "I know very well")

From the answers given in the end-of-event survey , a significant increase in awareness was observed among those who attended the training. The number of people who have no opinion on all propositions is extremely low. While the proposition "I have very good knowledge about why we need to digitalize" ranked first with 48 percent , "I have a good command of the global trends that will further increase energy demand in the future within the scope of digitalization." was the second well-known proposition with 42 percent. Again, at the end of the event, the proposition "I know how the devices produced within the scope of digitalization affect the raw material supply." had the lowest rate in the information section with 32 percent.

Giresun Event

30 participants were included in the survey at the event in Giresun province . In the awareness survey, the focus is the intensity of red and orange colors. While the propositions on which the participants had least idea are the propositions "I can comment on what percentage of electronic waste is recycled" and "I can comment on how much carbon emissions a search engine query produces" with 43.3 percent and 36.7 percent, respectively, the proposition "I have information about why we need to digitalize" proposition was the most well- known proposition with 36.7 percent.
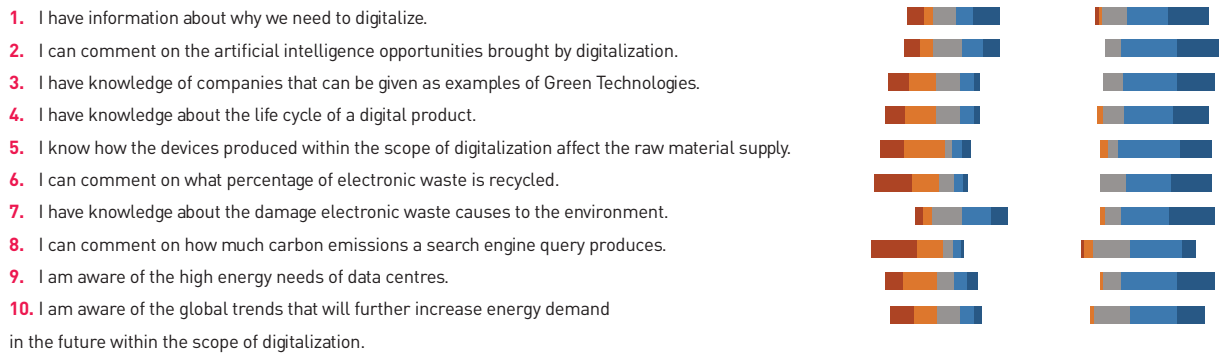
1. I have information about why we need to digitalize.
2. I can comment on the artificial intelligence opportunities brought by digitalization.
3. I have knowledge of companies that can be given as examples of Green Technologies.
4. I have knowledge about the life cycle of a digital product.
5. I know how the devices produced within the scope of digitalization affect the raw material supply.
6. I can comment on what percentage of electronic waste is recycled.
7. I have knowledge about the damage electronic waste causes to the environment.
8. I can comment on how much carbon emissions a search engine query produces.
9. I am aware of the high energy needs of data centres.
10. I am aware of the global trends that will further increase energy demand in the future within the scope of digitalization.

Figure 4: Awareness and End of Event Surveys, 17 May Giresun (red "I have no idea" - blue "I know very well")

From the answers given in the end-of-event survey , a significant increase in awareness was observed among those who attended the training. The number of people who have no opinion on all propositions is extremely low. The propositions with the highest awareness are " I have information about the damage electronic waste causes to the environment." with 40 percent and "I have information about why we need to digitalize.", "I can comment on the artificial intelligence opportunities brought by digitalization.", "I can comment on what percentage of electronic waste is recycled." with 36.7 percent. Among all the propositions, the only proposition in which those who still do not know the subject is " I can comment on how much carbon emissions a search engine query produces" with 10 percent.

Şırnak Event

52 participants were included in the survey at the event in Şırnak province . In the awareness survey, the focus is the intensity of red and orange colors.. While the propositions on which the participants had least idea are the propositions "I can comment on what percentage of electronic waste is recycled" and "I can comment on how much carbon emissions a search engine query produces" with 57.7 percent and 53.8 percent, respectively, the proposition "I have information about why we need to digitalize" proposition was the proposition with the highest awareness as 7.7 percent of the participants stated to know very well.

1. I have information about why we need to digitalize.
2. I can comment on the artificial intelligence opportunities brought by digitalization.
3. I have knowledge of companies that can be given as examples of Green Technologies.
4. I have knowledge about the life cycle of a digital product.
5. I know how the devices produced within the scope of digitalization affect the raw material supply.
6. I can comment on what percentage of electronic waste is recycled.
7. I have knowledge about the damage electronic waste causes to the environment.
8. I can comment on how much carbon emissions a search engine query produces.
9. I am aware of the high energy needs of data centres.
10. I am aware of the global trends that will further increase energy demand in the future within the scope of digitalization.
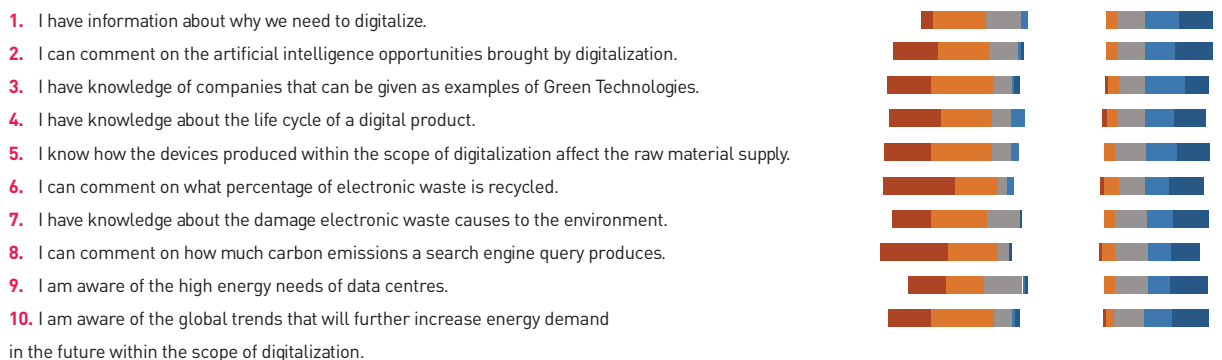

Figure 5: Awareness and End of Event Surveys, June 10, Şırnak (red "I have no idea" - blue "I know very well")

From the answers given in the end-of-event survey , a significant increase in awareness was observed among those who attended the training. The number of people who have no opinion on all propositions is extremely low. At the end of the training, the topics with the highest awareness were ¨ I can comment on the artificial intelligence opportunities brought by digitalization.¨, ¨I have information about the damage electronic waste causes to the environment.¨ ʽand ¨I am aware of the high energy needs of data centres.¨ with 36.5 percent. The answer of¨I have knowledge of companies that can be given as examples of Green Technologies.¨ had the lowest rate with 25 percent .

Çorum Event

69 participants were included in the survey at the event in Çorum province . In the awareness survey, the focus is the intensity of red and orange colors. ¨ I have an understanding of how devices produced within the scope of digitalization affect the raw material supply ¨ and ¨ I can comment on the artificial intelligence opportunities brought by digitalization . ¨ ¨ propositions were the propositions with the least awareness with 31.9 percent . ¨I have information about why we need to digitalize.¨ topic was the proposition with the highest awareness with 24.6 percent
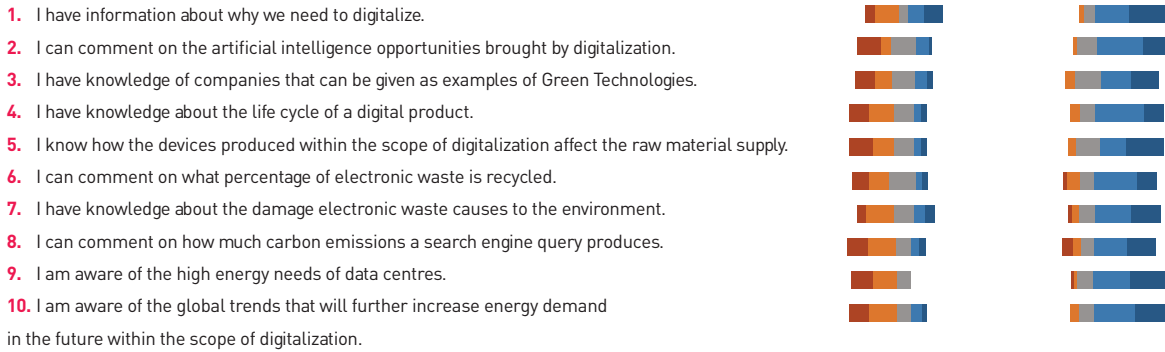
1. I have information about why we need to digitalize.
2. I can comment on the artificial intelligence opportunities brought by digitalization.
3. I have knowledge of companies that can be given as examples of Green Technologies.
4. I have knowledge about the life cycle of a digital product.
5. I know how the devices produced within the scope of digitalization affect the raw material supply.
6. I can comment on what percentage of electronic waste is recycled.
7. I have knowledge about the damage electronic waste causes to the environment.
8. I can comment on how much carbon emissions a search engine query produces.
9. I am aware of the high energy needs of data centres.
10. I am aware of the global trends that will further increase energy demand
in the future within the scope of digitalization.

Figure 6: Awareness and End of Event Surveys, 14 September Çorum (red ¨I have no idea¨ - blue ¨I know very well¨)

In the End of Event Survey, the propositions "I have knowledge about why we need to digitalize" and " I am aware of how the devices produced within the scope of digitalization affect the raw material supply." were the propositions with the highest awareness with 47.8 percent and 39.1 percent, respectively. From the answers given in the end-of-event survey , a significant increase in awareness was observed among those who attended the training. The number of people who have no opinion on all propositions is extremely low. At the end of the training , the propositions "I have information about the life cycle of a digital product." and " I can comment on what percentage of electronic waste is recycled." had the least awareness as 21.7 percent of the participants stated to have least idea.

In the events held respectively in Hakkari, Giresun, Şırnak and Çorum provinces, a total of 201 participants were directly reached through the surveys performed. According to survey data , in the awareness surveys, the proposition with the highest awareness is; ' **I have knowledge about why we need to digitalise** ' , while the proposition with the least awareness is; **"I can comment on how much carbon emissions a search engine query produces."** In addition to this topic; The topics **"I can comment on what percentage of electronic waste is recycled"** and " **I have knowledge of how the devices produced within the scope of digitalization affect the raw material supply "** emerged as the propositions with the least awareness.

In the end-of-event surveys ; the topics with the highest awareness were **" I have very good knowledge about why we need to go digital "**, **" I have knowledge about the damage electronic waste causes to the environment. "**, **" I am aware of the global trends that will further increase energy demand in the future within the scope of digitalization. "** and **"I can comment on the artificial intelligence opportunities brought by digitalization. "** . According to the same surveys, awareness was lower in the propositions of **"I know how the devices produced within the scope of digitalization affect the raw material supply." ʼ, ¨ I can comment on how much carbon emissions a search engine query produces. ¨, "I have knowledge of companies that can be given as examples of Green Technologies. ", " I have knowledge about the life cycle of a digital product ." and " I can comment on what percentage of electronic waste is recycled. "** compared to other topics. However, the percentage of negative responses to these propositions is much lower than before the event.

"The importance of digitalization" is the title that participants agree on. Where; It can be interpreted that there is interest in digitalization, therefore future policies will be supported by the grassroots and adaptation will be easier. It would be useful to see this as **the opportunity** brought by digitalization. In order to manage the urgent need for digitalization together with its environmental impacts, it is necessary to include environmental opportunities and risks in all policy steps. Digitalization means; While it means more energy and raw materials in the environmental dimension, it also means an excellent tool that can be used for efficiency and reduction. For example, while carbon emissions, product life cycle and raw material supply topics, where awareness of environmental impacts is low, appear as **risks** , software that calculates the carbon footprint in a digitally organized way and provides guidance on reduction, networks that analyze the product life cycle by including the supply chain, digital infrastructures that perform risk dimension assessment are indicators that every risk topic is an opportunity for development.

Making business plans from a sustainability perspective has become even more important. Among the United Nations Sustainable Development Goals, Article 9 - Industry, Innovation and Infrastructure, which was determined to establish durable infrastructures, support inclusive and sustainable industrialization and strengthen innovation, is an important goal in this sense. Türkiye's indicator data on this subject can be monitored from the "sdg.tuik.gov.tr" portal prepared by the Turkish Statistical Institute.

As a result, while digitalization is spreading globally at a speed that cannot be ignored, it is inevitable for the planet to look at it from a window that will benefit economically, socially and environmentally. But, it is required to develop policies where the environmental risks and opportunities are reviewed at every step.

Digital Tool

Within the scope of the project, a tool was developed that aims to measure the level and type of digitalization achieved by businesses in Türkiye. This tool consists of a total of 130 questions and is located on the website https://yerelkalkinmaprojesi.org/ with the title "Digitalization and Sustainability Survey" at the top right. When you click on the title, you can access the survey.

Figure 7: yerelkalkinmaprojesi.org website

Until the date of preparation of the report, the tool was answered by a total of 101 SME representatives. 6 of these SME representatives are in Istanbul, 22 in Şanlıurfa, 9 in Ankara, 6 in Gaziantep, 6 in Hatay, 4 in Bursa, 3 in Sakarya. 2 of them live in Sinop, 1 in Konya and 1 in Tekirdağ. Among the responding SME representatives, 17 works in the transportation sector, 11 in food, 11 in consultancy, 9 in media, 9 in software, 7 in packaging, 6 in textile, 5 in informatics, 4 in glass, 3 in education, 2 in service, 2 in construction, 2 in marketing, 2 in sports, 1 in electronics, 1 in health, and 1 in production sector. The number of employees of the SMEs where 27 of the respondents work is between 1-50, SMEs where 21 of them work have between 51-100, SMEs where 33 of them work have 101-500, SMEs where 7 of them work have 501-6000 and SMEs where 2 of them work have 100000 employees.
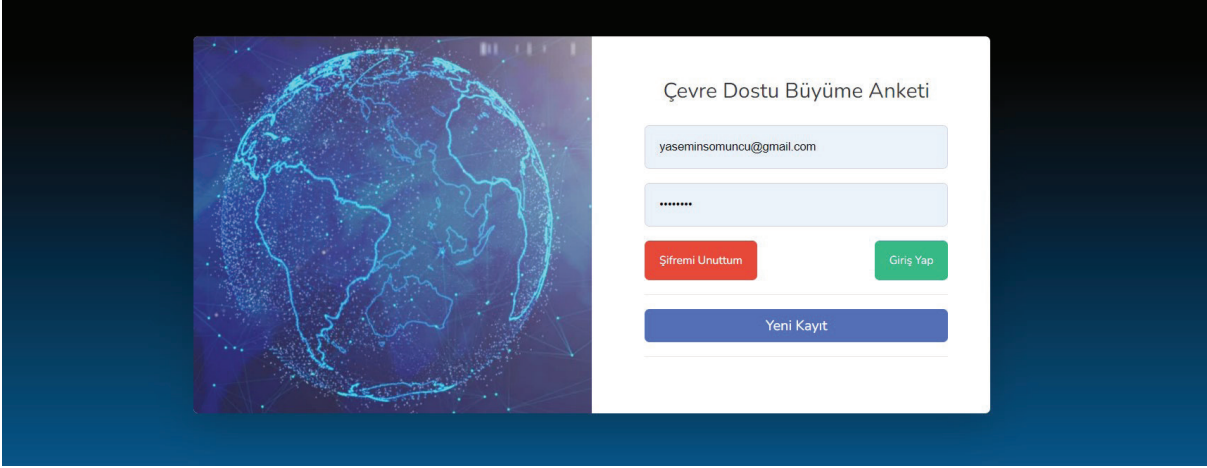
Based on the answers given in these surveys, guidance was given to SMEs. The guidance given based on the answers given under the sustainability subheading is as follows:

1.Does your company have an investment or plan to increase sustainability? You have reported that your company has an investment or plan to increase sustainability. Have you set sustainability goals?

You stated that you have not set sustainability targets. You can look at the United Nations Sustainable Development Goals. We recommend that you look at the targets in the sub-breakdowns to achieve the goals that are suitable for you among the 17 Sustainable Development Goals. It would also be useful to look at the action plans and projects prepared by Türkiye to achieve the Sustainable Development Goals, as well as the current situation analysis report.

You stated that your company does not have any investments or plans to increase sustainability. You can examine the United Nations Sustainable Development Goals and the reports developed by Türkiye on this subject, global and local trends, and sectoral sustainability reports, develop a policy specific to your organization, then set goals with your team and move on to the implementation phase.

2. Are you renewing your fixtures (server, computer, etc.)?

You stated that you renewed your fixtures. By inclusion of consideration to the average lifespan of products in the purchasing process, you can ensure that those with longer lifetime are preferred Afterwards, you can prepare a document regarding the maintenance frequency of the products. Thus, you can contribute to the long life of the fixtures. After all this, you can fulfill the requirements of the waste management policy in case the product turns into waste.

You stated that you did not renew your fixtures. We remind you to fulfill the requirements of the waste management policy in case the inventory whose shelf life has expired turns into waste .

3.Do you have a regulation and process for the disposal of the fixtures you renew?

You stated that you have a regulation and process for the disposal of the fixtures you renew.
We recommend that you ensure that you follow the updates in the legislation effectively and make the necessary updates in your process management.

You stated that you do not have a regulation or process for the disposal of the fixtures you have renewed.
Depending on the type of fixture waste, a waste code determined in accordance with Annex-1 Waste Code Determination Hierarchy and Waste Code Explanations of the Waste Management Regulation should be given, and these wastes should be managed in accordance with the issues specified in the same regulation. In addition to the Waste Management Regulation, you can prepare a waste management procedure by taking into account the issues specified in the Zero Waste Regulation and the Regulation on the Management of Waste Electrical and Electronic Equipment.

4.Do you benefit from renewable energy sources?

We have determined that your company "does not benefit at all / benefits very little" from renewable energy resources. You can supply renewable energy resources either at the location of your buildings/campus, or from a nearby location. Among the renewable energy sources, we can count solar energy, wind energy, hydraulic energy, biomass energy and heat pump.

With the "Regulation on Amendments to the Energy Performance Regulation in Buildings" prepared by the Ministry of Environment, Urbanization and Climate Change and published in the Official Gazette on February 19, 2022, the transition to the concept of "Nearly Zero Energy Buildings" that are more energy efficient than normal buildings and procure a certain part of the energy they use from renewable energy sources has been made mandatory gradually. Accordingly, as of January 1, 2023, all buildings with a total construction area of more than 5 thousand square meters on a parcel will be constructed with an energy performance class of at least 'B'. In addition, at least 5 percent of the energy used by these buildings will be required to come from renewable energy sources such as solar energy panels, wind energy and heat pumps. As of January 1, 2025, all buildings larger than 2 thousand square meters will be constructed with an energy performance class of at least 'B'. In addition, at least 10 percent of the energy used by these buildings will be required to come from renewable energy sources such as solar energy panels, wind energy and heat pumps.

Thanks to renewable energy sources, your dependence on the grid and external sources is reduced. Your energy bills will decrease so you can use your equity to grow your business. If you are a company working with the EU within the scope of Green Transformation, your CO 2 emission reduction efforts will increase your chances of competition.

We have determined that your company "benefits very little" from renewable energy sources. You can increase or diversify the use of your renewable energy sources. By considering the possibility of energy storage, you can minimize the problems that may arise from seasonal fluctuations. Among the renewable energy sources, we can count solar energy, wind energy, hydraulic energy, biomass energy and heat pump.

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Thanks to renewable energy sources, your dependence on the grid and external sources is reduced. Your energy bills will decrease so you can use your equity to grow your business. If you are a company working with the EU within the scope of Green Transformation, your CO_2 emission reduction efforts will increase your chances of competition.

5. Do you monitor energy? If your answer is "Yes", what is the communication infrastructure system you use for this?

You reported that your company does not monitor energy efficiency. Energy monitoring is a web-based system designed to monitor the energy consumption of businesses and is developing day by day. This system, which provides not only the monitoring process but also remote management of the devices used, is very important in terms of efficient use of energy and reduces your costs by saving energy. With energy monitoring, you can also prevent system-related imbalances such as malfunctions, new loads, load imbalances and material wear.

You stated that you use GPRS in your company's energy monitoring. / You stated that you use Ethernet in your company's energy monitoring. You can obtain documents specific to your company with detailed reporting software. You can include advanced analyzers in the monitoring process (such as harmonics; cos fi; voltage fluctuations; drawn currents). With advanced studies, you can create systems where you can monitor the energy consumption in your company remotely, access your energy-consuming devices from anywhere you want and manage the system easily.

6. When the costs in your company are examined, what is the extent of the energy cost?

You stated that the energy costs constitute a large part of your company's costs. You can save energy consumption by collecting data. It will also be difficult to have detailed data about a machine's consumption at specific times if you are manually monitoring your consumption. Most facilities use an energy management system to map energy flows and receive detailed, real-time information about consumption. Thus, you can easily compare the consumption of your machines and optimize their energy efficiency.

You have stated that energy costs constitute half of the costs, while the other costs represent the other half in your company. If you are using an energy management system, you may want to consider renewing/upgrading it. You can further reduce your energy costs by using more user-friendly interfaces to collect real-time data.

7. Are any strategies being followed to increase energy efficiency?

You stated that you are following a strategy to increase your energy efficiency. This strategy will enable your company to better manage the risks and opportunities of the issue compared to other SMEs.

You stated that you do not follow any strategy to increase your energy efficiency. In order to contribute to sustainable development, to be competitive and to fulfill the duties and responsibilities imposed on your company by current legal regulations, your company needs to develop an energy efficiency strategy. With the energy efficiency strategy, you create a comprehensive plan to achieve the goals and objectives you set.

Energy efficiency is the most important component of sustainable development and competitiveness, and the most important legal regulation governing your company is the Energy Efficiency Law No. 5627. This law aims at increasing efficiency in the use of energy resources and energy in order to use energy effectively, to prevent energy waste, to alleviate the burden of energy costs on the economy and to protect the environment at every stage from production to consumption. In addition to this law, the Regulation on Amending the Regulation on Increasing Efficiency in the Use of Energy Resources and Energy, the Energy Performance Regulation in Buildings and the Energy Efficiency Strategy Document should be taken into consideration. If you are a company working with the EU, you can take a look at the energy efficiency focus of the Green Deal.

8. If so, what is being done in line with this strategy?
Or is it planned to prepare such a strategy?

You stated that you have a strategy to increase your energy efficiency and what you do in line with this strategy. In line with this strategy, we recommend that you make sure that you create the appropriate organizational structure, organize the budget, operation plan and motivation system necessary to achieve the goals and objectives, check whether the determined strategy serves the goals and objectives of your company, and update your strategy if necessary.

You stated that you do not have any strategy to increase your energy efficiency, but you plan to prepare it. To develop an energy efficiency improvement strategy, we recommend that you first review the philosophy and mission of your organization, then set out the goals to achieve this mission, and finally create a strategy with comprehensive planning to achieve these goals.

9. Does your company have a climate change policy?

You stated that your company has a climate change policy. Have you been able to review the latest report of the Intergovernmental Panel on Climate Change (IPCC)? It would be beneficial to make preparations within the scope of the EU Green Deal and also to follow the Climate Law that will be on the agenda in the coming days. It is also important to keep on the agenda the reports prepared by universities (Istanbul Policy Center, IklimBu etc.) and civil society on climate change.

You stated that your company does not have a climate change policy. It will be very useful for you to review the current development reports prepared by the Intergovernmental Panel on Climate Change (IPCC). It would also be useful for you to examine Türkiye's Climate Change Adaptation Strategy and Action Plan. You can also put the Carbon Footprint issue on the agenda within the scope of preparations against the sanctions that await ithe organizations exporting to Europe, determined within the scope of the EU Green Deal. You can also review local action plans prepared for adaptation.

10. Has the issue of preparing a life cycle analysis of your products been brought to the agenda in your company?

You stated that the issue of preparing a life cycle analysis of your products has been brought to the agenda in your company. You can prioritize your products for which you can have life cycle analysis done. Thanks to the Life Cycle Assessment, which includes the stages of raw material, production, transportation, use and waste disposal, you can both increase the value of your products and contribute to your sustainability policy.

You stated that the issue of preparing a life cycle analysis of your products has not been brought to the agenda in your company. We recommend that relevant persons and managers receive a short awareness training on Life Cycle Analysis. Life cycle analysis is a technical subject and this subject is calculated and analyzed by experts. However, it is very important to understand the value you will add to your products, your company and the nature with the training that managers/relevant persons will receive on this subject.

11. Has your company's carbon footprint been calculated?

You reported that your company's carbon footprint was calculated. We recommend that as a company, you check that the work on calculating the equivalents in carbon dioxide of greenhouse gases in your production are performed by covering all your activities such as transportation, heating and electricity consumption. Check that your report is prepared in accordance with the ISO 14064 standard. We recommend that your report include Category 1, Category 2, Category 3, Category 4, Category 5 and Category 6 coverage.

You reported that your company's carbon footprint was not calculated. We recommend that the persons in charge of this subject receive training on Carbon Footprint. With this calculation, you can understand the environmental impacts of activities at different stages of production and at the same time increase the energy efficiency of your company. In this way, while negative environmental impacts are reduced, you can also save on expenses resulting from inefficient use of energy resources.

12. Has your company's water footprint been calculated?

You stated that your company's water footprint was calculated. We recommend that as a company, you make sure that you calculate the total amount of clean water you have used in production and consumption activities and the pollution rate. You can determine methods to reduce the environmental impacts of water consumption by measuring the amount of fresh water used in production (including evaporation) within the entire supply chain and evaluating the entire process from the processing of raw materials to direct operations and the consumer's use of the product according to the ISO 14046 Standard. You can then work to put them into practice.

You stated that your company's water footprint was not calculated. ISO 14046 is an international standard that defines principles, requirements and guidelines for assessing and reporting water footprints. It is applied to products, methods and organizations based on life cycle assessments. You can use ISO 14046 to calculate and report the water footprint as an individual assessment, or as part of a more comprehensive assessment, or you can first receive awareness training.

13. Does your company have a waste management policy?

You stated that your company has a waste management policy. In this context, we recommend that you detail the strategies related to your waste management plan , the responsible persons, and issues of which wastes will be collected separately, stored, and sent for recycling. In addition, we recommend that you also bring to the agenda the goals of developing sustainable environmental awareness within the company and raising awareness by organizing events on this subject.

You stated that your company does not have a waste management policy. In this context, we recommend that you first conduct a preliminary study in which all processes will be reviewed and evaluated. We recommend that you work with a consultancy firm on the subject to determine strategies to minimize waste within the business, to establish waste collection points suitable for the goal of separate collection at the source, to identify licensed companies suitable for waste, and to ensure coordination in shipments.

Digitalization Trends
Assessment

When evaluated in terms of regional development and inequalities, digitalization trends are evaluated on three different aspects: social, economic and environmental.

From a social perspective, it is critical to ensure justice and balance in the access of various social segments to digital technologies. This situation, also referred to as the digital divide; It refers to the differences in access to information and communication technologies between commercial enterprises and individuals who differ in terms of socio-economic conditions in different geographical areas. In our country, as in most countries of the world, there are differences between regions in terms of access to digital technology infrastructure and adoption of technology use, making public intervention necessary in this area. These interventions include eliminating infrastructure deficiencies and increasing the capacity and capabilities of segments of society that cannot interact with digital technology due to age, demographic and socio-economic reasons.

When evaluated from an economic perspective, the digital economy changes business models as companies adapt prominent technologies such as advanced data analytics, machine learning, internet of things, cloud computing to existing production practices, thereby providing significant productivity increases. On the other hand, as a result of the rapid development of Industry 4.0 applications in terms of the employment market, more and more tasks, professions and business lines are subject to automation. This trend manifests itself with robotization, especially in areas where physical processes are involved, such as the manufacturing industry and agriculture, while it manifests itself with software interfaces in the service sector. These developments can sometimes be seen as a threat to a segment of society in terms of the technological unemployment they cause. In the next 10 years, it is expected that there will be significant employment losses due to the digitalization of the economy both in Türkiye and in the world, and many new job areas will emerge related to newly developed technologies.

When evaluated from an environmental perspective, "smart city" applications come to the fore along with digitalization. Today, municipalities and other public services are digitalized with smart city applications that adopt automation, machine learning and internet of things technologies, and decision-making processes are made more rational by processing high-dimensional data. Smart city solutions also bring along consumption practices that reduce negative environmental impacts. In particular, applications such as smart transportation, smart grid, and smart waste management play a critical role in reducing carbon emissions and increasing energy efficiency. On the other hand, the smart city concept can also manifest itself in rural areas with "smart village" applications. Digital technologies and related innovations have significant potential in terms of increasing the quality of life in rural areas, improving public service delivery, resource efficiency and creating new opportunities in the rural value chain. While there is a risk that many existing professions will disappear with the digital transformation process, it is also possible that new job areas will emerge. It is predicted that occupations with a high risk of extinction will be those that rely on routine work and are suitable for computerized automation.

It is important for development agencies to guide their regions towards employment areas in line with the requirements of the digital economy in the coming years and to engage in activities to improve the technical capacities of public institutions and private sector organizations. They are expected to analyze the labor markets of their regions for business areas suitable for the professions of the future and develop programs to improve professional skills in these areas. In this context, development agencies' working in harmony with public institutions, municipalities, business world and civil society, which are the other driving forces in local development, will enable the desired goals to be achieved more easily.

General Recommendations for Ensuring Policy Consistency Between Sustainability and Digitalization
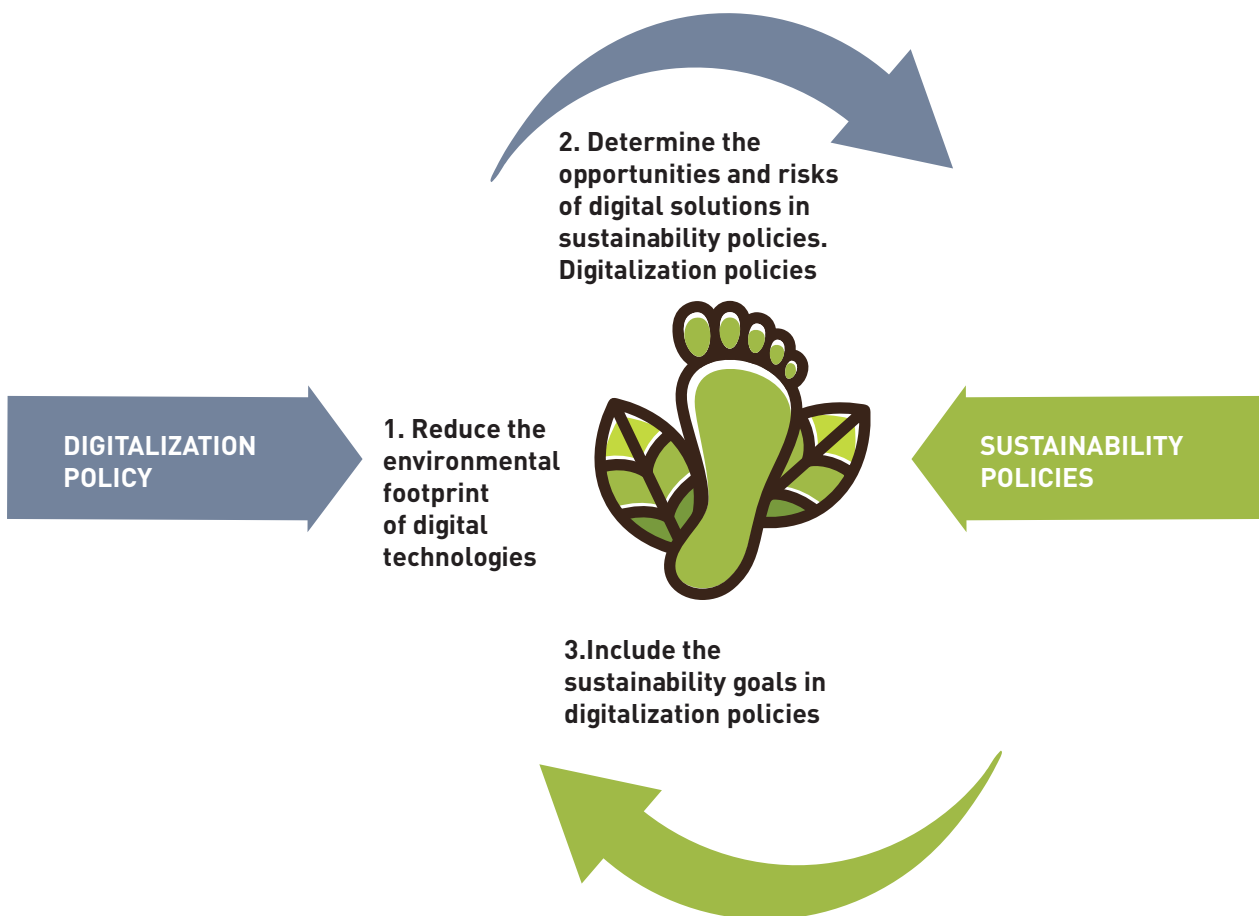
DIGITALIZATION POLICY

1. Reduce the environmental footprint of digital technologies

2. Determine the opportunities and risks of digital solutions in sustainability policies. Digitalization policies

3.Include the sustainability goals in digitalization policies

SUSTAINABILITY POLICIES

Figure 9: Three objectives aim to ensure policy consistency between sustainability and digitalization (Digitalization and Sustainability: A Call for a Digital Green Deal, https://doi.org/10.1016/j.envsci.2023.04.020)

Policies should first reduce the environmental footprint resulting from the life cycle impacts of digital technologies. For example, design directives may establish environmental standards for hardware production, require manufacturers to increase the share of recycled materials and reused parts, and require devices to be designed to be modular and repairable. Moreover, hardware companies may be encouraged to change their business model from selling to renting (device as a service). To reduce in-use impacts, policies should set clear and ambitious energy standards for devices and data centers and ensure that these standards are continually improved over time.

Second, sustainability policies should encourage the development and implementation of digital solutions aimed at minimizing the use of environmentally inefficient digital innovations, while promoting real transformations in supply and distribution systems. Digital opportunities and risks should be addressed in a cross-cutting way, for example in circular economy legislation, governance of value chains and corporate accountability requirements. Opportunities and risks should also be addressed in sectoral policies, so that social issues should not be left behind while advancing sustainable transformations in energy, transportation, agriculture, building/housing, industry and supply chains. For example, transport policy making should not leave the management of vehicle automation solely to ethics commissions or data governance initiatives, but should also proactively develop initiatives to support social or private mobility providers (e.g. transport associations) in the packing of vehicle automation and car sharing. In general, governance should ensure that a digitalized solution provides added value compared to a non-digital solution. Additionally, risks of digital failure caused by unforeseen environmental events or malicious actors (e.g., cybersecurity attacks) should also be assessed and countermeasures should be configured.

Third, digital policies should include elements that serve sustainability goals. For example, most platform markets do not have 'production standards': There are no energy standards for either video broadcasts or social media platforms; or services on rental/sharing platforms are not required to contribute to low-energy housing or reducing greenhouse gas emissions in transport. Future legislation that includes environmental and social standards for the provision of services in platform markets is needed, since even relatively strong platform legislation such as the European Union's Digital Services Package has not filled this gap. Similarly, policies regarding data management, artificial intelligence, e-commerce, digital finance, cryptocurrencies and others should include legislation that advances sustainability goals.

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